Damper Leakage, Heat Loss and Sealing Efficiency

Gas leakage through a closed damper from duct area, sealing efficiency and pressure difference (Ganapathy), its heat loss and cost, and flow-basis efficiency.

Method: Ganapathy; Steam Plant Calculations Manual; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Duct cross-section	1.8241	m²
Sealing efficiency on an area basis	99.500	%
Differential pressure across the closed damper	177.80	mmWC
Gas temperature	282.22	°C
Normal gas flow (for the flow-basis efficiency)	104,326	kg/h
Gas specific heat	1.0886	kJ/(kg·K)
Ambient temperature	26.670	°C
Fuel cost per GJ (currency)	2.8430	

Calculated results

Parameter	Value	Unit
Leakage	925.60	kg/h
Heat lost with the leakage	71.526	kW
Cost per hour (currency)	0.73206	
Sealing efficiency on a flow basis	99.113	%

Notes for this case

- The flow-basis efficiency falls as the gas flow drops while the leakage, set by the pressure difference, stays the same.

Formula and method

$$W_L = 2484\,A\,(100-E)\sqrt{\frac{\Delta p}{460+t}} \quad (\mathrm{lb/h;\ ft^2,\ in\,WC,\ °F})$$

$$Q_L = W_L c_p (t - t_a), \quad E_f = 1 - \frac{W_L}{W_g}$$

Variables

A	Duct cross-section	m²
E	Sealing efficiency on an area basis	-
Δp	Differential pressure across the closed damper	Pa
t	Gas temperature	K
W_g	Normal gas flow (for the flow-basis efficiency)	kg/s
c_p	Gas specific heat	J/(kg·K)
t_a	Ambient temperature	K
c_f	Fuel cost per GJ (currency)	-
W_L	Leakage	kg/s
Q_L	Heat lost with the leakage	W
C_L	Cost per hour (currency)	-

E_f	Sealing efficiency on a flow basis	-

Method and standards

Ganapathy's orifice-flow expression for damper leakage (C_d = 0.61, gas density 40/(460 + t)).

Assumptions and limits

- Gas density 40/(460 + t) lb/ft³ (flue gas of molar mass about 29 near 1 atm); other gases or pressures are not adjustable.
- The cost is the heat lost times the price per GJ entered: enter the cost per GJ of heat (fuel price divided by boiler efficiency) for the fuel cost.
- The flow-basis efficiency is not shown when the gas flow is zero.

References

- Ganapathy
- Steam Plant Calculations Manual
- 2nd ed. (Marcel Dekker, 1993)
- Q1.20 (gas leakage across dampers; orifice flow with C_d = 0.61)

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/damper-leakage-sealing-efficiency

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Reopens the calculator with the inputs of this report.