Mine Airway Resistance and Pressure Drop (Atkinson)

Resistance and pressure drop of a mine airway or duct by Atkinson's square law from friction factor, perimeter, length and area, with shock loss and orifice.

Method: Peele (ed.); Mining Engineers' Handbook; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Atkinson friction factor at 1.2 kg/m³ K (kg/m³) = 1.855 × 10⁶ × Peele's k (lb·min²/ft⁴)	0.006865	kg/m³
Perimeter of the airway	9.3878	m
Length of the airway	1,000.0	m
Cross-sectional area	5.2992	m²
Sum of shock-loss factors (bends, obstructions)	0	
Air flow	20.000	m³/s
Air density	1.2000	kg/m³

Calculated results

Parameter	Value	Unit
Friction resistance (N·s²/m⁸)	0.43308	
Air velocity	3.7742	m/s
Friction pressure drop	173.23	Pa
Shock pressure drop	0	Pa
Total pressure drop	173.23	Pa
Air power	3.4646	kW
Equivalent orifice	1.8833	m²
Total resistance including shock (N·s²/m⁸)	0.43308	

Notes for this case

• Peele's friction factors: about 37 × 10⁻¹⁰ for a straight coal-mine heading (K 0.0069), 15 for sheet-metal and 20–25 for canvas ducts; add about 60 % allowance for leakage in real airways. For constant flow, pressure varies with the fifth power of a linear dimension.

Formula and method

$$p = \frac{KOL}{A^3}\frac{\rho}{1.2}Q^2 + X\frac{\rho V^2}{2}, \quad R = \frac{p}{Q^2}, \quad A_{eq} = \frac{Q}{0.625\sqrt{2p/\rho}}$$

Variables

K	Atkinson friction factor at 1.2 kg/m³	kg/m³
O	Perimeter of the airway	m
L	Length of the airway	m
A	Cross-sectional area	m²
X	Sum of shock-loss factors (bends, obstructions)	-
Q	Air flow	m³/s
ρ	Air density	kg/m³
R	Friction resistance (N·s²/m⁸)	-

V	Air velocity	m/s
p_f	Friction pressure drop	Pa
p_x	Shock pressure drop	Pa
p	Total pressure drop	Pa
pQ	Air power	W
A_{eq}	Equivalent orifice	m²
R_t	Total resistance including shock (N·s²/m⁸)	-

Method and standards

Atkinson's square law.

Assumptions and limits

- Fully turbulent flow; constant density.

References

- Peele (ed.)
- Mining Engineers' Handbook
- 3rd ed. (Wiley, 1941)
- sec. 14
- Mine Ventilation
- arts. 10-13 (friction formula, shock losses, equivalent orifice, resistance factor)

Report details

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This calculator online

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Reopens the calculator with the inputs of this report.