Gas–Liquid Separator Sizing by Souders–Brown

Allowable gas velocity and minimum diameter of a vertical gas–liquid separator from the Souders–Brown K factor, and the liquid hold-up volume for a retention time.

Method: Mokhatab; Poe and Speight; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas flow (standard)	50.000	MMscfd
Operating pressure (absolute)	1,000.00	psi
Operating temperature	26.667	°C
Compressibility factor	0.88000	
Gas specific gravity	0.65000	
Liquid density	800.00	kg/m³
Service	General separator with mist pad	
Liquid flow	10.000	m³/h
Liquid retention time	3.0000	min

Calculated results

Parameter	Value	Unit
Gas density at operating conditions	59.174	kg/m³
Souders–Brown coefficient	0.079696	m/s
Allowable gas velocity	0.28199	m/s
Actual gas flow	792.29	m³/h
Minimum separator inside diameter	996.85	mm
Liquid hold-up volume	0.50000	m³

Notes for this case

- K is the GPSA mist-pad fit given by Mokhatab, with his service reductions; it is meant for pressures above about 100 psig. The diameter is the gas-capacity minimum: add nozzles, inlet device and mist-pad clearances, and check the liquid section.

Formula and method

$$V_{max} = K_{SB}\sqrt{\frac{\rho_L - \rho_G}{\rho_G}}, \quad K_{SB} = 0.35 - 0.0001(P_{psig} - 100)\ \text{ft/s}, \quad D = \sqrt{\frac{4Q_a}{\pi V_{max}}}$$

Variables

Q_g	Gas flow (standard)	Nm³/s
P	Operating pressure (absolute)	Pa
T	Operating temperature	K
Z	Compressibility factor	-
SG	Gas specific gravity	-
ρ_L	Liquid density	kg/m³
$\mathrm{service}$	Service	-
Q_L	Liquid flow	m³/s

t_r	Liquid retention time	s
ρ_G	Gas density at operating conditions	kg/m³
K_{SB}	Souders–Brown coefficient	m/s
V_{max}	Allowable gas velocity	m/s
Q_a	Actual gas flow	m³/s
D	Minimum separator inside diameter	m
V_L	Liquid hold-up volume	m³

Method and standards

Souders–Brown with the GPSA K fit.

Assumptions and limits

- Vertical vessel with mist pad; gas capacity only.

References

- Mokhatab
- Poe and Speight
- Handbook of Natural Gas Transmission and Processing (Gulf Professional Publishing, 2006)
- ch. 5
- eqs. 5-6 to 5-8 (Souders and Brown; GPSA K factor fit)

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

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