Steam Drum Steam-Space Loading (Souders–Brown)

Allowable and actual steam velocity in a drum's steam space from the steam flow, drum pressure (IF97 densities), the Souders–Brown coefficient and the free area.

Method: Souders and Brown (1934) v = K √((ρ_l − ρ_v)/ρ_v); saturated densities from IAPWS-IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam flow	60.000	t/h
Drum pressure (absolute)	46.000	bar
Steam-space free area The plan area through which the steam rises: for a horizontal drum, the drum length times the width of the water surface at the normal level.	1.6000	m²
Souders–Brown coefficient 0.06 m/s is a FireCAD starting value for a plain steam space, not a sourced figure; with separators use the maker's figure.	0.060000	m/s

Calculated results

Parameter	Value	Unit
Water density	785.52	kg/m³
Steam density	23.224	kg/m³
Allowable steam velocity	0.34376	m/s
Actual steam velocity	0.44854	m/s
Loading	130.48	%

Notes for this case

- Loading above 100 %: risk of carry-over and poor steam purity; check separators and water level.

Formula and method

$$v_{allow} = K\sqrt{\frac{\rho_l - \rho_v}{\rho_v}}, \quad v = \frac{\dot{m}_s}{\rho_v A}$$

Variables

$\dot{m}_s$	Steam flow	kg/s
p_d	Drum pressure (absolute)	Pa
A	Steam-space free area	m²
K	Souders–Brown coefficient	m/s
ρ_l	Water density	kg/m³
ρ_v	Steam density	kg/m³
v_{allow}	Allowable steam velocity	m/s
v	Actual steam velocity	m/s
v/v_{allow}	Loading	-

Method and standards

Souders–Brown: the allowable upward steam velocity is K times the square root of the density difference over the steam density (IAPWS-IF97 saturated densities); the actual velocity is the steam volume flow over the free area. The loading is their ratio.

Assumptions and limits

- Saturated conditions.
- The free area is the plan area of the water surface the steam rises through (for a horizontal drum, length times the surface width

at the normal water level).

- The coefficient K carries the result linearly; the default 0.06 m/s is a FireCAD starting value for a plain steam space, not a sourced figure. Use the drum or separator maker's value.

References

- Souders and Brown (1934) v = K √((ρ_l − ρ_v)/ρ_v); saturated densities from IAPWS-IF97

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/boilers-power-plant/boiler-pressure-parts/steam-drum-separator-loading

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.