Steam Drum Water Holding Time

Water held in a steam drum between two levels and the time it lasts at the steaming rate if feedwater is lost, from the drum size and pressure.

Method: Geometry of a horizontal cylinder; IAPWS R7-97(2012) IF97 (saturated water density)

Input parameters

Unit system: SI

Parameter	Value	Unit
Drum inside diameter	1,500.0	mm
Drum straight length	8.0000	m
Lower level above the drum bottom (e.g. low-low trip)	600.00	mm
Upper level above the drum bottom (e.g. normal water level, at most D)	750.00	mm
Drum pressure (absolute)	70.000	bar
Steaming rate	50,000	kg/h

Calculated results

Parameter	Value	Unit
Holding time between the levels	95.225	s
Water between the levels	1,322.6	kg
Volume between the levels	1.7879	m³
Density of saturated water	739.72	kg/m³

Formula and method

$$A(h) = R^2 \cos^{-1}\left(\frac{R-h}{R}\right) - (R-h)\sqrt{2Rh-h^2} \qquad R = \frac{D}{2}$$

$$V = L\,[A(h_2) - A(h_1)] \qquad m = \rho V \qquad t_h = \frac{m}{\dot{m}_s}$$

Variables

D	drum inside diameter	m
L	drum straight length	m
h_1	lower level above the drum bottom	m
h_2	upper level above the drum bottom	m
p	drum pressure, absolute	Pa
$\dot{m}_s$	steaming rate	kg/s
t_h	holding time between the levels	s
m	water between the levels	kg
V	volume between the levels	m³
ρ	density of saturated water	kg/m³
$A(h)$	area of the circular segment up to level h	m²

Method and standards

Volume of a horizontal cylinder between two liquid levels (circular segments) times the density of saturated water from FireCAD's IAPWS-IF97.

Assumptions and limits

- Dished ends and drum internals are ignored (ends add a little, internals take a little).
- Steady steaming rate with no feedwater and no blowdown.
- Steam bubbles below the surface (swell) reduce the real water content.

References

• Geometry of a horizontal cylinder
• IAPWS R7-97(2012) IF97 (saturated water density)

Report details

Report reference	FCC-90CB-P0A4 (the same inputs always give the same reference)
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Software release	FireCAD Calc, release of 17 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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-holding-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.