Discharge from a Tank Through an Orifice at Constant Head

Flow from an orifice or nozzle in a tank under a constant head (Torricelli with a discharge coefficient), the jet velocity and the horizontal throw of the jet.

Method: Torricelli's theorem with discharge and velocity coefficients (Textbook fluid mechanics (White, Fluid Mechanics))

Input parameters

Unit system: SI

Parameter	Value	Unit
Head above the orifice centre	2.5000	m
Orifice diameter	30.000	mm
Discharge coefficient About 0.61 for a sharp-edged orifice, 0.8 for a short tube, 0.95–0.98 for a rounded nozzle.	0.61000	
Velocity coefficient	0.97000	
Height of the orifice above the floor (for the throw)	1.0000	m
Extra gas pressure above the liquid (gauge)	0	kPa
Liquid density	998.00	kg/m³

Calculated results

Parameter	Value	Unit
Effective head H + p_g/(ρ g)	2.5000	m
Jet velocity C_v √(2 g H_e)	6.7923	m/s
Flow C_d A √(2 g H_e)	10.870	m³/h
Horizontal throw to the floor 2 C_v √(H_e y)	3.0674	m

Formula and method

$$Q = C_d A\sqrt{2gH_e}, \quad v = C_v\sqrt{2gH_e}, \quad x = 2C_v\sqrt{H_e\,y}$$

Variables

H	Head above the orifice centre	m
d	Orifice diameter	m
C_d	Discharge coefficient	-
C_v	Velocity coefficient	-
y	Height of the orifice above the floor (for the throw)	m
p_g	Extra gas pressure above the liquid (gauge)	Pa
ρ	Liquid density	kg/m³
H_e	Effective head H + p_g/(ρ g)	m
v	Jet velocity C_v √(2 g H_e)	m/s
Q	Flow C_d A √(2 g H_e)	m³/s
x	Horizontal throw to the floor 2 C_v √(H_e y)	m

Method and standards

Torricelli's theorem.

Assumptions and limits

- Constant head.
- C_d = C_c C_v, so C_d should not exceed C_v (a warning is given).

References

• Torricelli's theorem with discharge and velocity coefficients (Textbook fluid mechanics (White, Fluid Mechanics))

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/fluid-mechanics/orifice-tank-discharge

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Reopens the calculator with the inputs of this report.