

Level Measurement Formulas



Quick reference for instrumentation and control engineers

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Hydrostatic level

Pressure	$P = \rho \times g \times h$
Level	$h = P \div (\rho \times g)$
Water	1 m = 98.07 mbar
Density change	Hydrostatic level reads wrong if density changes; correct or use radar

DP transmitter: open tank or dry leg

LRV	$\rho_p \times g \times h_{\min}$ (+ head below the HP tap)
URV	$\rho_p \times g \times h_{\max}$ (+ same head)
Transmitter below the tap	positive LRV = zero suppression

DP transmitter: wet leg (closed tank)

LRV	$\rho_p g h_{\min} - \rho_s g H_s$
URV	$\rho_p g h_{\max} - \rho_s g H_s$
Result	negative LRV = zero elevation
Symbols	ρ_s seal fluid density, H_s wet leg height between taps

Remote seals (capillary)

Both seals	LRV and URV include $\rho_{\text{fill}} g \times$ (seal height difference)
Tip	Mount the transmitter at or below the lower seal

Radar and ultrasonic

Distance	$d = c \times t \div 2$ (time of flight)
Level	$L =$ reference height $- d$
Speed of sound in air	$c \approx 331.3 + 0.606 \times T$ ($^{\circ}\text{C}$) m/s, 343 m/s at 20°C
Radar	unaffected by temperature, pressure and vapour in most cases

Interface level (DP)

Total DP	$\Delta P = g \times (\rho_1 h_1 + \rho_2 h_2)$
Requirement	both taps always covered by liquid

Tank volumes

Vertical cylinder	$V = \pi r^2 h$
Horizontal cylinder (flat ends)	$V = L \times [r^2 \arccos((r - h) \div r) - (r - h) \sqrt{2 r h - h^2}]$
Sphere	$V = \pi h^2 (3 r - h) \div 3$
Cone (point down)	$V = \pi r^2 h \div 3$ with r at height h

Technology quick guide

Method	Best for
DP / hydrostatic	Liquids with known density
Guided wave radar	Interfaces, foam, small tanks
Non contact radar	Most liquids and solids, vapour
Ultrasonic	Water and simple open tanks
Displacer	Interface, high pressure
Vibrating fork	Point level, high and low alarms