Formula & Conversion Sheet

For drinking water treatment and distribution exam math. Print on one letter-size page. November 2026.

> Educational study aid only. Never use these results to dose chemicals or operate a live water treatment or distribution facility. Follow your facility's SOPs, your ORC, and your state primacy agency.

Independent study resource. This sheet is published by Altitude Water LLC. It is **not affiliated with, endorsed by, or sponsored by** the Water and Wastewater Facility Operators Certification Board or Colorado Certified Water Professionals (CWP / CCWP / WWFOCB), the Operator Certification Program Office (OCPO), the Colorado Department of Public Health and Environment (CDPHE), the U.S. Environmental Protection Agency (EPA), Water Professionals International (WPI, formerly ABC), the American Water Works Association (AWWA), or Sacramento State Office of Water Programs (OWP). It restates standard water-operator engineering formulas and conversion factors in original language for study use. It does **not** reproduce any copyrighted WPI/ABC Formula/Conversion Table, exam item, or third-party workbook text. Passing a certification exam is not guaranteed. Always confirm the formula sheet handed out at your exam with your certifying board.

Standard constants and conversions

Relationship	Standard value
Cubic feet to gallons	1 ft^3 = 7.48 gal
Weight of water	1 gal = 8.34 lb (at standard exam conditions)
Pressure and head	1 psi = 2.31 ft of water · 1 ft of water = 0.433 psi
Time	1 day = 1,440 min = 24 h
Million gallons per day	1 MGD = 1,000,000 gal/day = 694.4 gpm (exactly 1,000,000 ÷ 1,440)
Cubic feet per second	1 cfs = 448.8 gpm (7.48 gal/ft^3 × 60 s/min)
Concentration	1 mg/L = 1 ppm in dilute aqueous solutions
Acre-foot	1 ac·ft = 43,560 ft^3 = 325,829 gal
Circle factors (exam convention)	π ≈ 3.14 · area factor 0.785 (= 3.14 ÷ 4)

Area and volume

- Rectangle (or square) area = length × width
- Circle area = **$0.785 \times D^2$** = $3.14 \times r^2$ (D and r in the same units; convert inches to feet first)
- Cylinder or tank volume = area × depth (or height)
- Volume in gallons = volume in ft^3 × **7.48**
- Pipe volume uses the same cylinder formula, with diameter converted to feet

Flow and velocity

- Continuity: **Q = A × V** (cfs = ft^2 × ft/s)
- Flow in gpm = flow in cfs × **448.8**
- Flow in MGD = flow in gpm × 1,440 ÷ 1,000,000

Detention time and fill time

- **t = Volume ÷ Flow** (units must match)
- Minutes = gallons ÷ gpm
- Hours = gallons ÷ (gpm × 60), or (volume in MG ÷ flow in MGD) × 24
- Fill or drain time uses the same relationship

Chemical dose — the pounds formula

- **lb/day = Flow (MGD) × Dose (mg/L) × 8.34**
- If the product is not 100% active: **lb/day of product = (MGD × mg/L × 8.34) ÷ (purity as a decimal)**
- Dose (mg/L) = (lb/day) ÷ (MGD × 8.34)
- Applied dose = demand + desired residual

Solutions and chemical feed

- Pounds of active chemical in a liquid = gallons × 8.34 lb/gal × (percent as a decimal) × specific gravity (use SG = 1.00 unless a problem gives another value)
- Gallons of solution per day = (lb/day of solution) ÷ (8.34 × SG)
- Dilution / two-normal mixing: $\mathbf{C_1V_1 = C_2V_2}$ (concentrations in the same units; volumes in the same units)

Filtration and backwash

- Surface loading (or filtration) rate, gpm/ft² = filter flow (gpm) ÷ filter area (ft²)
- Backwash rate, gpm/ft² = backwash flow (gpm) ÷ filter area (ft²)
- Backwash rise rate, in/min = **(backwash rate, gpm/ft² × 12 in/ft) ÷ 7.48 gal/ft³**
- Backwash volume, gal = backwash flow (gpm) × backwash duration (min)

Pressure, head, and horsepower

- Head (ft) = pressure (psi) × **2.31**
- Pressure (psi) = head (ft) × **0.433**
- Water horsepower: **WHP = (Q, gpm × H, ft) ÷ 3,960**
- Brake horsepower: **BHP = WHP ÷ pump efficiency** (efficiency as a decimal)
- Motor horsepower: **MHP = WHP ÷ (pump efficiency × motor efficiency)**

Distribution disinfection, flushing, and CT

- Pounds of chlorine to dose a main or tank = **(volume, gal × dose, mg/L × 8.34) ÷ 1,000,000**
- Flushing flow still follows Q = A × V (pipe length is not used to find instantaneous flow)
- **CT = C × T** (C = disinfectant residual, mg/L; T = contact time, minutes; result in mg·min/L). Required CT values come from EPA and state rules — this sheet only defines the calculated CT.

Colorado exam edition note (November 2026)

Colorado uses standardized WPI (formerly ABC) Water Treatment and Water Distribution examinations for certificate classes, except custom Class S and Class T exams. In Aqua Talk (May 6, 2026), the Water and Wastewater Facility Operators Certification Board advised operators **not to use WPI's 2025 Need-to-Know Criteria yet**, because those criteria are not aligned with the exams Colorado currently administers. This product is written to that pre-2025 WPI/ABC exam edition and to the standard formulas consistent with WPI's publicly posted Water Treatment, Distribution, and Water Laboratory Formula/Conversion Table (the table itself is copyrighted and is not reprinted here). Colorado Water Treatment Classes D, C, B, and A correspond to WPI Class I–IV; Water Distribution Classes 1, 2, 3, and 4 correspond to WPI Class I–IV. Confirm the edition in effect on your exam date with CCWP / the Board.

This is an independent study resource published by Altitude Water LLC. It is not affiliated with, endorsed by, or sponsored by the Colorado Certified Water Professionals office (CWP/CCWP), the Operator Certification Program Office (OCPO), the Water and Wastewater Facility Operators Certification Board (WWFOCB), the Colorado Department of Public Health and Environment (CDPHE), the U.S. Environmental Protection Agency (U.S. EPA), Water Professionals International (WPI, formerly ABC), the American Water Works Association (AWWA), or Sacramento State Office of Water Programs (OWP). Practice questions and calculators are 100% original educational material and are not actual certification exam items. Passing is not guaranteed. Operators still need operating experience, the official Need-to-Know Criteria for the edition their board is administering, and their state's current rules.

Written for the exam edition Colorado is administering as of November 2026. Colorado uses standardized WPI (formerly ABC) Water Treatment and Water Distribution examinations for certificate classes, except custom Class S and Class T exams (administered through Colorado CWP/CCWP and the WWFOCB Board). In Aqua Talk (May 6, 2026), the Water and Wastewater Facility Operators Certification Board advised operators not to use WPI's 2025 Need-to-Know Criteria yet, because those criteria are not aligned with the exams Colorado currently administers. Confirm the edition in effect on your exam date with CCWP / the Board.

Developed in conjunction with a Colorado-certified Class A Water Treatment Operator & ORC — Altitude Water LLC.

© 2026 Altitude Water LLC. Original educational material. Passing a certification exam is not guaranteed. Always confirm the formula sheet handed out at your exam.

Official Sources · Verified as of November 2026. Public pages only, cited for reference; confirm current details at the official source.

Source: Water Professionals International (WPI), *Standardized Water Treatment Operator Exams — Need-to-Know Criteria and Formula/Conversion Table* (as of November 2026). https://gowpi.org/services/abc-testing/standardized-exams/standardized-water-treatment-operator-exams/

Source: Water Professionals International (WPI), *Formula/Conversion Table — Water Treatment, Distribution & Water Laboratory Exams* (2024 edition, as of November 2026). https://gowpi.org/services/abc-testing/formula-conversion-tables/

Source: Water Professionals International (WPI), *Historical Need-to-Know Criteria (2019 standardized water treatment and distribution exams)* (as of November 2026). https://gowpi.org/services/abc-testing/need-to-know-criteria/

Source: Colorado CCWP Office, *CCWP – Need to know criteria and study resources* (as of November 2026). https://cdphe.colorado.gov/ccwp-need-to-know-criteria-and-study-resources

Independence. Water Operator Desk is an independent educational study resource. Official sources are linked for reference only. Water Operator Desk is not affiliated with, endorsed by, or sponsored by Water Professionals International (WPI, formerly ABC), the American Water Works Association (AWWA), the U.S. Environmental Protection Agency (EPA), the Colorado Department of Public Health and Environment (CDPHE), or the Colorado Water and Wastewater Facility Operators Certification Board. Always confirm current requirements, fees, and exam editions at the official source. Passing a certification exam is not guaranteed.

Publisher. Altitude Water LLC (d/b/a Water Operator Desk · Water Operator Math) · support@wateroperatorcert.com · wateroperatorcert.com