TECHNICAL WHITE PAPER

Eliminating Point-of-Use Bacteria in DI Water Lab Faucets

The Series LG Recirculating Lab Faucet (LG-DDR): recirculation carried to the point of use

Marquest Scientific, Inc. | Non-Metallic Point-of-Use DI Water Lab Faucets | Document MS.LG-DDR.WP | 2026

Executive summary

Laboratories and cleanrooms that distribute deionized (DI) and ultrapure water (UPW) frequently trace persistent bacterial contamination back to the faucet itself. Even when the distribution loop is well designed — recirculated, UV-treated, and 0.2 µm filtered — the branch feeding each point-of-use (POU) faucet is usually a **dead leg**: water stagnates there between draws, biofilm establishes on the wetted surfaces, and bacteria shed into every dispense. A 0.2 µm capsule filter at the outlet treats the symptom, not the cause — it restricts flow, adds a maintenance and validation burden, and leaves the stagnant volume and biofilm in place upstream. The Marquest Series LG Recirculating Lab Faucet (LG-DDR) removes the dead leg by carrying recirculating flow all the way to the point-of-use control valve, keeping DI water in continuous, turbulent motion through the entire faucet — right up to the dispense point.

1. Why point-of-use faucets grow bacteria

High-purity water is not sterile water

DI and UPW are oligotrophic (nutrient-poor), but that condition simply selects for hardy, low-nutrient organisms — Pseudomonas, Ralstonia, Sphingomonas and similar gram-negative bacteria — that colonize wetted surfaces and build biofilm from trace organics. Biofilm is the reservoir that matters: it resists rinsing, periodically sloughs, and produces the colony-count spikes seen at the tap, along with elevated total organic carbon (TOC) and endotoxin.

Stagnation is the driver; movement is the control

The most effective microbial control in high-purity water systems is to keep the water moving in turbulent flow and to eliminate dead legs. Two long-standing rules of thumb frame good practice. First, keep dead legs short: the U.S. FDA's 1993 **Guide to Inspections of High Purity Water Systems** popularized the "six-diameter" (6D) rule, and modern standards are tighter still — ASME BPE limits an unflushed branch to L/D ≤ 2, and WHO guidance recommends roughly 1.5–3 diameters. Second, keep flow turbulent: a Reynolds number above about 4,000 (10,000 to be conservative) — roughly 1.2 m/s, or about 4 ft/s, and faster — so organisms cannot settle and adhere to pipe walls.

The point of use is the weak point

A recirculating loop only recirculates the loop. At each faucet, a branch tees off the loop and rises through the bench to the POU valve. In a conventional (non-recirculating) faucet, that riser — plus the faucet body and gooseneck — sees no through-flow between uses. It is a textbook dead leg, commonly 12 to 24 inches of small-diameter run, i.e., tens of pipe diameters, far beyond any dead-leg

rule. Critically, the loop's UV and filtration sit upstream of this branch and cannot reach the water stagnating within it.

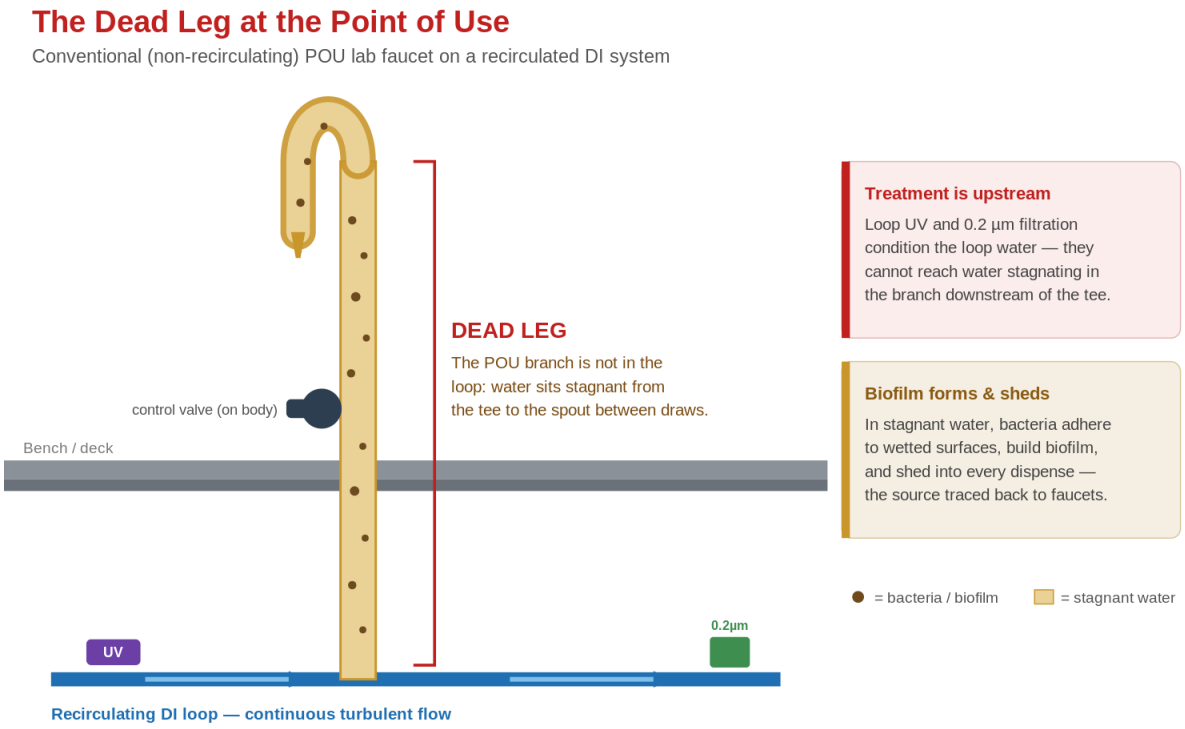


Figure 1. In a conventional POU faucet, the branch from the recirculating loop to the dispense point is a dead leg. Loop UV and 0.2 µm filtration are upstream and cannot reach the stagnant water where biofilm forms and sheds.

Why this matters for clinical and analytical labs

For hospital and clinical laboratories, reagent-water quality is defined by **CLSI GP40 (Clinical Laboratory Reagent Water, CLRW)**, which sets a bacterial limit of fewer than 10 CFU/mL alongside resistivity, TOC, and particulate limits. Point-of-use biofilm is a direct threat to meeting CLRW at the tap — and the tap is the point that matters, because that is where water is drawn for reagents and assays.

2. Why a point-of-use 0.2 µm filter is only a band-aid

A 0.2 µm PES capsule filter at the faucet outlet can reduce the bacteria count in the dispensed stream, and there are applications where a final-barrier filter is appropriate. But as the primary control it treats the symptom and leaves the cause in place:

- **It does not remove the dead leg.** The stagnant branch, faucet body, and gooseneck upstream of the filter keep stagnating and growing biofilm. The filter screens only the last inch of the flow path.
- **It restricts flow.** A 0.2 µm capsule imposes a meaningful pressure drop, so dispensing slows — often unacceptable when filling vessels for reagent preparation. This is exactly the trade-off users report after installing one.
- **It is a consumable and a validation burden.** Capsules must be flushed, replaced, and integrity-verified on a schedule; a neglected filter becomes a liability rather than a safeguard.

- **Bacteria can grow through it.** Challenge studies have documented penetration of integral 0.2/0.22 µm sterilizing-grade filters over sustained (18–24 h) wetted contact — precisely the low- or no-flow condition a POU filter sits in between draws.
- **It does not remove endotoxin.** Pyrogenic fragments from gram-negative cell walls are far smaller than the pore rating (well below 0.01 µm) and pass a 0.2 µm membrane. Trapping bacteria upstream does not stop endotoxin from reaching the tap.

In short: a POU filter manages the last inch while the dead leg that created the problem remains. The durable fix is to remove the dead leg.

3. The Marquest solution: recirculation to the point of use

The Series LG Recirculating Lab Faucet (LG-DDR) is engineered so that the point of use is part of the recirculation loop. A dedicated recirculating tube (0.125 in. ID FEP) carries supply water from the base, up through the gooseneck, to the **Duraline control valve located at the very tip of the spout** — the point of use — and the water returns through the recirculating module to a return line. The result is continuous motion of DI water through the entire faucet, right up to the dispense point, during all phases of operation.

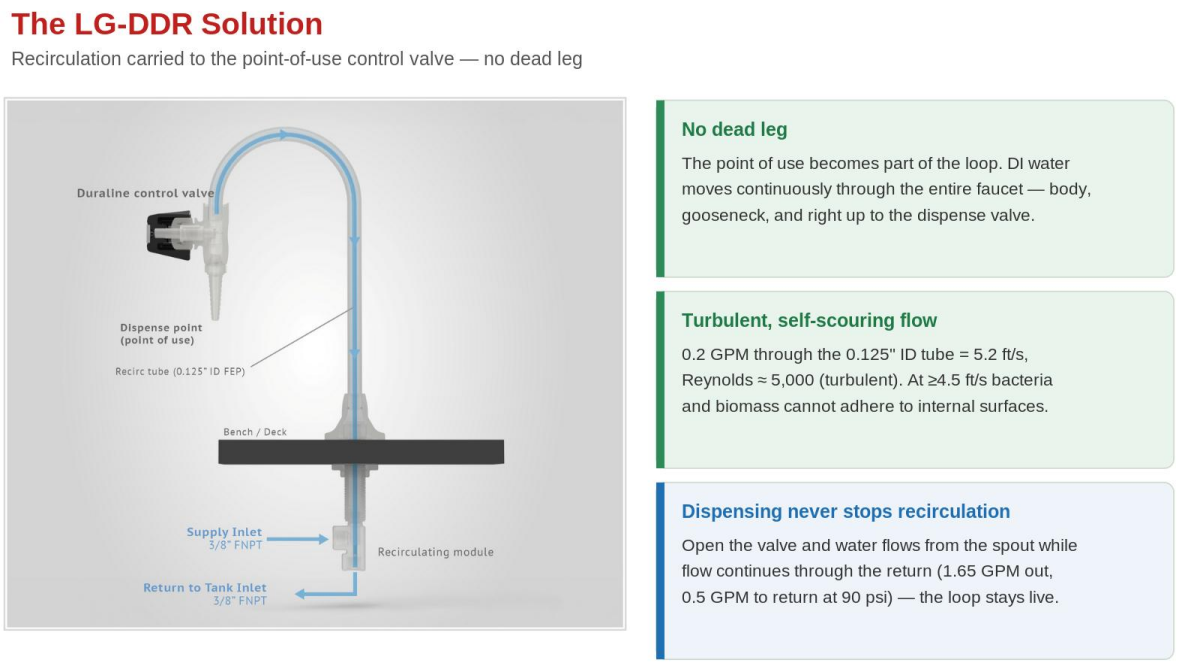


Figure 2. The LG-DDR carries recirculating flow up to the Duraline control valve at the point of use and back — no stagnant volume, no dead leg.

Designed for turbulent, self-scouring flow

The design target is a recirculating velocity of 4.5 ft/s or greater. With the 0.125 in. ID tube, a modest 0.2 GPM produces 5.2 ft/s — a Reynolds number of roughly 5,000, i.e., fully turbulent flow. At these velocities, bacteria and biomass cannot adhere to the internal surfaces, and there is no stagnant volume in which biofilm can establish. Lower rates still help versus a stagnant system, but 4.5 ft/s or greater is the objective.

Dispensing does not interrupt recirculation

Opening the Duraline valve delivers water from the spout while flow continues through the return. Representative flow data at 90 psi: full-open dispense is 1.65 GPM at the spout; the recirculating return carries 1.4 GPM with the valve closed and 0.5 GPM with the valve open. The loop stays live whether or not anyone is drawing water.

Materials and configuration

Wetted parts are molded from high-purity thermoplastics — natural polypropylene (PP, code 2) or PVDF (code 3) — with a PVDF gooseneck, a Duraline globe control valve, an FEP recirculating tube, and PTFE seals. No metal contacts the water. The faucet is deck-mounted through a single 1 in. hole, with handle orientation available left, right, or front. Standard supply-inlet and recirculating-return connections are 3/8 in. female NPT; the LG-DDR-F2 variant provides 3/8 in. male NPT × 1/2 in. OD tube-compression inlet and outlet. A removable barb tip leaves a 1/4 in. female NPT connection for accessories.

4. System integration and installation

The LG-DDR is designed for a recirculating system built around a **non-pressurized (atmospheric, vented) storage tank or reservoir**. The tank is the key: it provides the pressure drop (ΔP) that drives the recirculating return, and because the water returns to the tank it is not consumed.

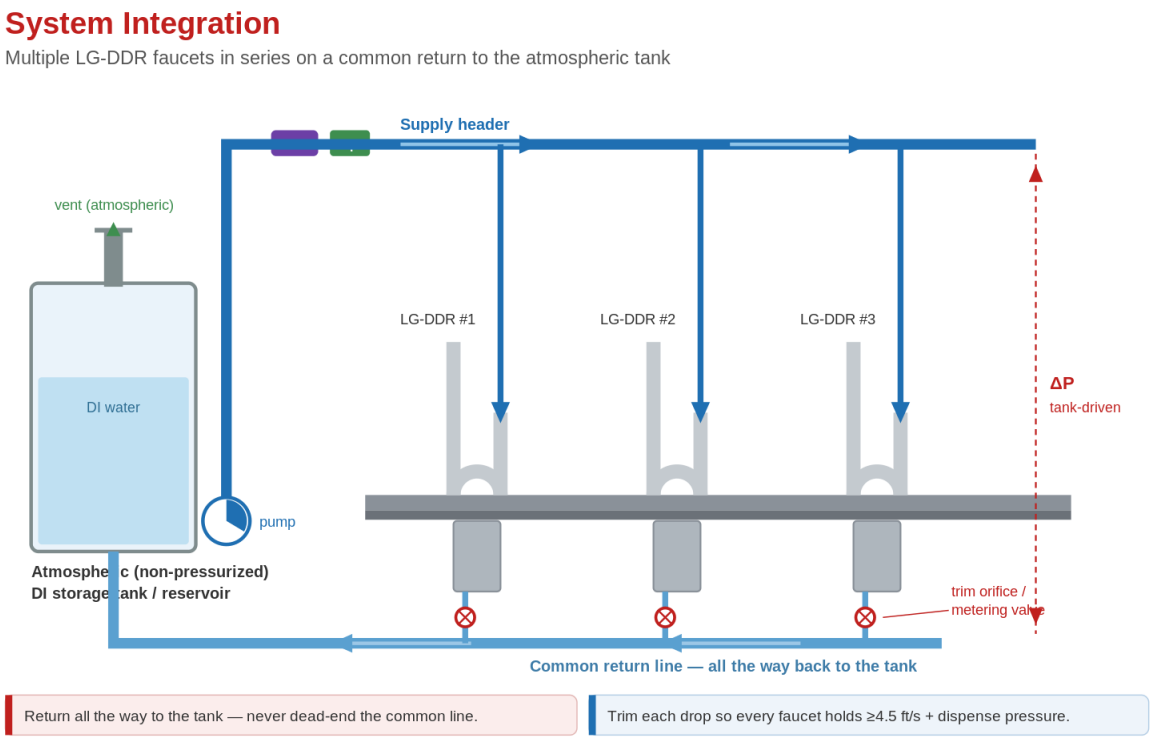


Figure 3. Series LG-DDR faucets on a common return to an atmospheric (vented) DI tank. The tank provides the ΔP that drives return flow; a small trim drop at each faucet balances the loop.

Core requirements

- **Atmospheric return destination.** The recirculating return must terminate at a vented, non-pressurized DI tank or reservoir; this ΔP sustains return flow.

- **Return line routed back to the tank.** Plan the return path early — routing it back to the tank is often the most demanding part of a retrofit. Do not tie the return into a pressurized line or dead-end it.
- **Target velocity.** Size and balance each faucet's recirculating leg for 4.5 ft/s or greater (about 0.2 GPM through the 0.125 in. ID tube).

Faucets in series on a common return

Multiple LG-DDR faucets can share a common return line, with each faucet's recirculating tube feeding the common return. Two cautions govern the design:

- **Cumulative pressure loss.** Each faucet in series adds pressure drop. If the common return is undersized — or is not carried all the way back to the atmospheric tank — downstream faucets can be starved, losing both recirculation velocity and dispensing pressure.
- **Balance with a small trim drop.** A small pressure drop (a trim orifice or metering valve) downstream of each faucet assures positive flow through that faucet's recirculating leg and preserves adequate main dispensing pressure. Always run the common return all the way back to the tank.

Installation sequence

1. Remove the recirculating module and tube from the through-deck nipple (shipped temporarily assembled).
2. Mount the faucet through a 1 in. hole and tighten to the deck with the supplied ring nut.
3. Insert the recirculating tube through the through-deck nipple until its 3/8 in. male NPT mates with the inlet connection; tighten by hand plus 1/4 wrench turn.
4. Connect the supply line to the 3/8 in. female NPT inlet connection.
5. Connect the recirculating return line to the 3/8 in. female NPT outlet connection.
6. Pressure-test all connections. High-density PTFE tape is the recommended thread sealant.

5. Vacuum-breaker considerations — specify carefully

An atmospheric vacuum breaker (AVB) must be installed downstream of the last control valve and above the fixture's flood-level rim, with no valve downstream of it. On the LG-DDR, the control valve sits at the gooseneck tip so that recirculation reaches the point of use; consequently there is no downstream location to fit an AVB, and the fully recirculating configuration cannot accommodate one. If a project's plumbing code or specification calls for an AVB at the outlet, confirm it early:

- If the AVB requirement can be satisfied by system design or upstream backflow protection, the fully recirculating LG-DDR remains the preferred, root-cause solution.
- If an AVB at the outlet is mandatory, the fully recirculating option is precluded; the fallback is a conventional faucet with a POU 0.2 µm PES capsule as a final barrier — recognizing, per Section 2, that this manages the symptom and leaves the dead leg in place.

Bottom line

Persistent point-of-use bacteria in DI water faucets are a stagnation problem, not a filtration problem. The Series LG Recirculating Lab Faucet removes the point-of-use dead leg by carrying turbulent recirculating flow to the dispense valve itself, so biofilm cannot establish where the water is actually drawn. Where an outlet AVB is mandated, a POU filter can serve as a final barrier — but it is a supplement, not a substitute, for eliminating the dead leg.

Talk to Marquest

For system review, configuration, or installation support, contact Marquest Scientific. We manufacture and assemble every faucet in Costa Mesa, California.

Marquest Scientific, Inc. 3184-C Airway Avenue, Costa Mesa, CA 92626 | Toll Free (866) 452-2349 | sales@marquestscientific.com | www.DiWaterFaucets.com | www.marquestscientific.com