PG25 Loop Commissioning and Fluid-Care Checklist

For PG25 technology cooling system (TCS) loops in direct-to-chip liquid cooling · v1, October 2026 · K&K Data Service Inc.

Adapted from the Open Compute Project *Guidelines for Using Propylene Glycol-Based Heat Transfer Fluids in Liquid Cooled Racks*, Revision 2.0, Version 1.0.0 (15 September 2026, CC BY-SA 4.0); [p. NN] gives the page in that document. Items marked [K&K] come from the published K&K GB300-class reference design and its PG25 property table at www.kkdatasvc.com/lab/pg25-coolant-properties/. A field and review aid: the fluid supplier's limits and the project's commissioning specification govern, and OCP presents its own values as examples.

1. Design and procurement — before anything is wetted

- ☐ Working fluid named in every capacity statement: CDU and cold-plate ratings stated on PG25 or the purchased formulation, not on water. A water-calibrated rating can deliver about 0.80–0.85 of nameplate on PG25. [K&K, modeled]
- ☐ Pumps and piping sized on PG25 properties at the coldest expected fluid temperature. Against water at 20 °C, PG25 needs about 1.04× the flow, 1.37× the pipe pressure drop and 1.43× the pump power. [K&K property table]
- ☐ Supplier property table (density, specific heat, viscosity, thermal conductivity versus temperature) and certificate of analysis obtained for the exact formulation, replacing generic correlations.
- ☐ Wetted materials checked against OCP Tables 3–4 or supplier evidence at the maximum operating temperature: brass <15 % zinc (or dezincification-resistant per ISO 6509); peroxide-cured EPDM preferred, sulfur-cured EPDM with caution; stainless quick connects, nickel- or chrome-plated ones avoided until proven; no carbon steel. [p. 19–22, 55]
- ☐ Operating range inside 17–66 °C, or elastomers and plastics re-reviewed for the higher temperature. [p. 25]
- ☐ Leak response designed for a conductive fluid — isolation valves and a bounded response. PG25 is not a dielectric. [K&K; p. 82]
- ☐ Sidestream filtration of 5–15 % of circulating flow provided for loops above 250 gal (inline CDU strainers are typically 25–50 µm and work alongside it). [p. 25–26]
- ☐ Supplier-approved concentrate (e.g. PG55) and qualified dilution water on hand for concentration adjustment during commissioning. [p. 58, 76]
- ☐ Equipment built, tested and cleaned on the same fluid; anything shipped wet with another fluid (water, a different PG25) is flushed and filled with the operating fluid before connection. [p. 62]

2. Records opened [p. 17–18, 46, 62]

- ☐ Fluid type and supplier, batch numbers, delivery dates and certificates of analysis.
- ☐ Total system volume — needed for every concentration or inhibitor calculation.
- ☐ Upstream cleaning and passivation records from the ODM, OEM or fabricator: method, chemicals, concentrations, exposure time, results.
- ☐ Adjustment and treatment log (date, additive, amount, reason) and component replacement history.
- ☐ As-received sample retained from every bulk delivery and lot: HDPE bottle labelled with delivery date and batch number, kept at least 6 months.

3. Cleaning and flushing [p. 45–58]

- ☐ Flush fluid chosen: a cleaning solution for heavy contamination or after construction; PG25 for the final-stage flush; uninhibited water only for early flushing, if at all.
- ☐ Flush water meets the table below. Softened water usually does not.
- ☐ Surfactants and biocides kept out of the final flush; silicates avoided in cleaning solutions.
- ☐ Uninhibited water never left in the loop more than 24 hours; constant flow while it is in.
- ☐ Turbulent flow with staged coarse-to-fine filtration, continued until filter pressure drop is stable, particulate generation has fallen, and conductivity, pH and turbidity agree across sampling points.
- ☐ All low points drained, lines blown through with clean compressed air, accessible filters replaced with elements of the operating rating.
- ☐ Loop filled within 24 hours of the final flush; otherwise purged with nitrogen and sealed (loops of only stainless steel, elastomers and plastics tolerate air up to 72 hours).

Parameter	Flush water [Table 12, p. 55]	Dilution / make-up water [Appendix 1, p. 94]
pH	5–8	5–8
Chloride / sulfate	<25 / <25 ppm	<10 / <10 ppm
Total hardness (as CaCO3)	<25 ppm	<15 ppm (calcium <2, magnesium <2 ppm)
Electrical conductivity	<25 µS/cm	<25 µS/cm at 20 °C
Bacteria	<100 CFU/mL	<100 CFU/mL
Turbidity / iron	<1 NTU / <2 ppm	— / <2 ppm

Filter any water entering the loop at 25 µm high-efficiency or finer. [p. 94]

4. Fill and start-up [p. 59–60, 81, 83]

- ☐ Ready-to-use fluid from unopened or properly resealed containers, filtered on the way in (e.g. 5–10 µm absolute).
- ☐ Glycol concentration verified at several points with a refractometer read against the supplier's own table: 24.5–27.5 vol % for new PG25. [p. 14]
- ☐ Air bled and the loop circulated for at least 30 minutes with a leak check.
- ☐ Fluid level watched and topped up through the first hours.
- ☐ Representative sample from each loop within 1–3 days of operation, sent for baseline (time-zero) analysis, and retained for the life of the fluid with a sample of the fresh fluid.
- ☐ In-line sensors calibrated with certified solutions before commissioning; baselines recorded at first fill.

5. Sampling plan [p. 61–65, 95]

Loop situation	Laboratory analysis	Between lab tests
Low risk: in-line pH and refractive index, materials accepted, team familiar with the fluid	At commissioning, then annually (optional extra at 6 months in year 1)	On-site tests optional
Medium risk: no in-line monitoring, materials accepted, fluid new to the team	At commissioning, then every 6 months for 18 months; annual after that if stable	On-site tests every 6 months, offset by 3 months
High risk: no in-line monitoring, materials mostly accepted, fluid new to the team	At commissioning, then quarterly for 18 months; every 6 months after that if stable	—

- ☐ Every loop goes to a qualified laboratory at least once a year, in-line monitoring or not. Report covers glycol %, pH, reserve alkalinity, appearance, inhibitor concentration(s), chloride, sulfate, total hardness, degradation acids and dissolved metals. [p. 61–62, 84]
- ☐ Loops under 100 gal: glycol % (or refractive index) and pH checked on every rack at start-up, then a rotating, statistically significant subset every 6 months. [p. 63]
- ☐ Samples from well-mixed circulating fluid — not expansion tanks, reservoirs, low-point drains or dead legs; port flushed first; 4–6 oz in a clean, unused HDPE bottle; consistent labels (date, site, system ID, work order). [p. 62, 65–66]

6. In-use limits and first actions [Table 14, p. 67–70; Table 16, p. 75–76]

Parameter	In-use target	When outside
Glycol, vol %	24–29 (freeze point about −13 to −9 °C)	<24: add supplier-approved concentrate. >29: dilute with Appendix 1 water. System volume must be known.
Appearance	Clear, particulate-free	Laboratory sample; sidestream filtration; replace if contamination is severe.
pH	8.0–10.5 (conventional / IAT); 6.5–9.5 (OAT / hybrid)	Check probe calibration; consult the supplier. Additives only under supplier guidance.
Reserve alkalinity	>4 mL (conventional); report only for OAT	Consult the supplier.
Copper, iron	<3 ppm each	>5 ppm: test more often and consult the supplier.
Total hardness	<50 ppm	>50 ppm: consult the supplier and find the water source.
Chloride	<25 ppm	25–50: monitor and look for corrosion (metals by ICP). >50: supplier.
Sulfate	<25 ppm	25–100: monitor (check for sulfur-cured elastomers). >100: supplier.

- ☐ Any out-of-spec on-site result followed by a laboratory sample within one week. [p. 75]

☐ Inhibitors restored only with additives approved by the original fluid supplier. [p. 16]

7. In-line monitoring — example limits [Table 18, p. 81–82]

Sensor	Example operating limit	Trigger to validate (handheld meter or laboratory)
pH	As section 6	Outside the supplier's limits
Refractive index, 20 °C	1.362–1.368 (24–29 vol % glycol)	Outside range: confirm with a handheld ATC refractometer, then adjust
Electrical conductivity	1,000–10,000 µS/cm (formulation and temperature dependent)	Change of ±20 % from baseline, or a sudden shift
Turbidity	<10 NTU	Change of more than 5 NTU from baseline

☐ Sensors re-baselined after any fluid change; limits reviewed annually or after major system changes; in-line readings compared with laboratory results. [p. 82–84]

8. Storage, replacement and disposal [p. 84–85]

☐ Fluid stored dry, out of direct sunlight, in closed compatible containers — not galvanized steel.

☐ Fluid replaced at the supplier's end of life or when it no longer meets the supplier's specification.

☐ No new or used fluid to sewer, ground or water; used fluid sent to a glycol recycler where possible.

Fluid sample log

One row per sample. Keep with the laboratory reports and the treatment log.

Date	Loop / location	Sample ID	Glycol vol % or RI	pH	Cond. µS/cm	Appearance	Sent to lab?	Action / initials