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## **Coolant Dosing Tool for Sealed Liquid Cooling Loops**

### **ABSTRACT**

This disclosure describes a coolant dosing tool for the addition (replenishment) of coolant and/or other liquids to sealed liquid cooling loops used in modern computing devices, e.g., to cool processors and associated circuitry. Sealed cooling loops are modified with a suitable port to receive additional coolant via the coolant dosing tool. Replenishment of coolant can be performed in-situ throughout the lifecycle of the sealed liquid cooling loop, without removal of the loop and/or the associated processor tray from service. The coolant dosing tool includes a refillable reservoir attached to a quick disconnect from the corresponding quick disconnect port provided on the sealed cooling loop. The quick disconnects enable a drip-less connection to be made while the processor tray is in operation. The coolant dosing tool can be utilized for addition of other liquids such as anti-corrosion agents, biocides, etc.

### **KEYWORDS**

- Processor tray
- Heat transfer
- Processor cooling
- Coolant injection
- Closed-loop liquid cooling
- Water cooling loop
- Non-spill coupling
- All in one (AIO) liquid cooler

## BACKGROUND

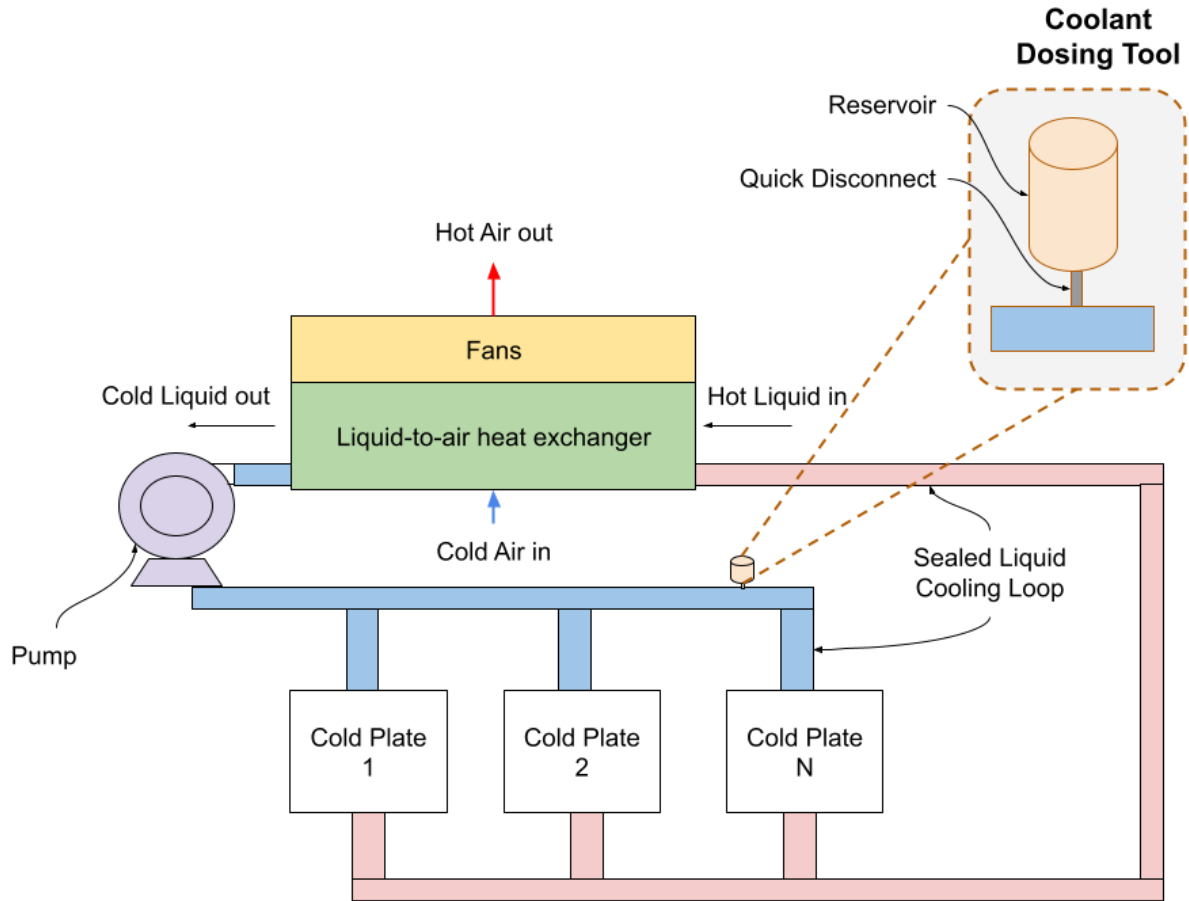
Modern computers with advanced processors and processor systems commonly utilize sealed liquid cooling loops for thermal management. Sealed liquid cooling loops are utilized in data center computing devices as well as in personal computing devices. A typical sealed liquid cooling loop system includes one or more cold plates that pull heat away from the processor(s), a sealed piping (hose) system that connects the cold plate(s) to a radiator, and a pump for continuously recirculating the coolant liquid.

During operation of the sealed liquid cooling loop, loss of coolant occurs which diminishes thermal performance of the sealed cooling loop. Opening the sealed liquid cooling loop for coolant addition poses the risk of leaks and can be a potential hazard to the electronics if the electronics are exposed to the coolant. Additionally, disassembling the loop can introduce air bubbles to the system, which can be entrapped in the cold plate or the radiator causing degraded thermal performance and reduced longevity of the sealed liquid cooling loop system.

Sealed cooling loops typically include a reservoir of coolant to allow for loss of coolant over time. However, it can be difficult to accurately estimate coolant loss and once depleted, the reservoir cannot be replenished easily.

## DESCRIPTION

This disclosure describes a coolant dosing tool for the addition (replenishment) of coolant and/or other liquids to sealed liquid cooling loops. The coolant dosing tool can be used in single-use or in multi-use mode. It can be utilized to replenish coolant in sealed cooling loops that are provided with a suitable port to receive additional coolant. The replenishment of coolant can be performed in-situ throughout the lifecycle of the sealed liquid cooling loop and without removal of the loop and/or associated processor tray from service.



**Fig. 1: A coolant dosing tool enables coolant addition to a sealed cooling system**

Fig. 1 depicts an example sealed liquid cooling loop and use of a coolant dosing tool, per techniques of this disclosure. As depicted in Fig. 1, the sealed cooling loop includes a set of cold plates attached to the processor(s) for conductive heat transfer of heat away from the processors. A sealed piping system, powered by a pump, conveys coolant between the cold plates and a liquid-to-air heat exchanger (radiator) which expels heat to the environment.

Fig. 1 depicts a coolant dosing tool connected to the cooling loop. As seen in the enlarged view of Fig. 1, the coolant dosing tool includes a refillable reservoir attached to a quick disconnect, a specialized pipe fitting that is utilized for leakage free connections. A corresponding quick disconnect port is provided on the sealed cooling loop that enables coupling

of the dosing tool and the cooling loop. The quick disconnect port on the sealing loop can be provided at an elevated location on the cooling loop to enable coolant to enter the cooling loop via gravity. The quick disconnects enable a drip-less connection to be made while the processor tray can remain in operation. The coolant dosing tool can be utilized for addition of other liquids such as anti-corrosion agents, biocides, etc.

The tool can be designed to be permanently attached or to be removable from the sealed liquid cooling loop subsequent to coolant transfer. Optionally, both ends of the dosing tool can include a quick disconnect for subsequent addition of tools. Further, the tool can be designed to evacuate air from the system before coolant replenishment which can increase the lifespan of the sealed liquid cooling system as well as mitigate system performance degradation due to air bubbles that may get introduced into the system.

## CONCLUSION

This disclosure describes a coolant dosing tool for the addition (replenishment) of coolant and/or other liquids to sealed liquid cooling loops used in modern computing devices, e.g., to cool processors and associated circuitry. Sealed cooling loops are modified with a suitable port to receive additional coolant via the coolant dosing tool. Replenishment of coolant can be performed in-situ throughout the lifecycle of the sealed liquid cooling loop, without removal of the loop and/or the associated processor tray from service. The coolant dosing tool includes a refillable reservoir attached to a quick disconnect from the corresponding quick disconnect port provided on the sealed cooling loop. The quick disconnects enable a drip-less connection to be made while the processor tray is in operation. The coolant dosing tool can be utilized for addition of other liquids such as anti-corrosion agents, biocides, etc.