

# Technical Investigation Report: ASHP Operational Instability

**Date of Analysis:** 19 March 2026

**Subject:** Operational Transition and "Delta T Collapse"

**Case Ref:** 19032026-ST-0750

## 1. Executive Summary

Based on high-resolution sensor data and the state transition log (19032026 status.csv), the investigation confirms that the compressor shutdown at 07:50:36 was the **Primary Cause**, which subsequently triggered a "Delta T Collapse" as a mechanical **Effect**. The system failed to recover efficient operation due to a flow-rate logic error following the restart.

## 2. Event Timeline (07:45 – 08:00)

Time (UTC)	Status Code	Event Description	Flow Rate	Comp. Freq
07:45:01	2 (Normal)	Steady state heating.	12.7 L/min	28 Hz
07:50:36	0 (Standby)	Unit enters Standby mode.	13.3 L/min	0 Hz
07:51:03	0 (Standby)	Pump spikes to 100% duty cycle.	26.9 L/min	0 Hz
07:54:37	1 (Safety)	Unit enters safety/pre-start phase.	26.9 L/min	0 Hz
07:58:38	2 (Normal)	Compressor resumes operation.	26.9 L/min	29 Hz

## 3. Findings & Evidence

### 3.1 The Shutdown Trigger (The "Cause")

At **07:50:36**, the unit transitioned from **Status 2 (Normal)** to **Status 0 (Standby)**.

- Evidence:** The Outdoor Air Temperature (OAT) rose from 5.8Deg C to 6.2Deg C just prior to this shift.
- Analysis:** Under the active Weather Compensation curve, this OAT increase lowered the Leaving Water Temperature (LWT) target. As the actual LWT was 40.6Deg C at the time, the unit determined it had exceeded the new target and

initiated a standard cycle-off (Standby). The compressor dropping to zero was the intended result of this state change.

## 3.2 The Delta T Collapse (The "Effect")

The collapse of the Delta T was the immediate physical consequence of the compressor stopping while the pump remained active.

- **Mechanical Anomaly:** At 07:51:03, while in Standby, the system logic increased the pump speed to **26.9 L/min**.
- **Consequence:** Moving water at maximum velocity with zero heat input flushed the heat exchanger of all thermal energy instantly. LWT and Return Water Temperature (RWT) converged, resulting in a Delta T of approximately  $0^{\circ}\text{C}$ .

## 3.3 Recovery Failure (The "Nightmare" Phase)

The system entered a "Nightmare" state at **07:58:38** upon restarting.

- **Logic Error:** When the compressor resumed (29 Hz), the pump **failed to throttle back** to the efficient 12-13 L/min range.
- **Thermal Impact:** Because the water was moving twice as fast as required, the radiators could not dissipate heat effectively. The system observed a persistent, narrow Delta T  $1.8^{\circ}\text{C}$  and responded by ramping compressor power to compensate, creating a high-consumption, low-efficiency loop.

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## 4. Conclusion

The analysis refutes the possibility of a Defrost Cycle (Status 5) being the culprit. Instead, the instability was born from a **Normal Standby** event triggered by a minor OAT shift. The failure is localized to the pump's Post-Standby logic, where it remains "latched" at 100% flow, preventing the system from re-establishing a healthy Delta T.

**Recommendation:** Bug report to Samsung for firmware revision and investigation. Investigate potential for Manual capping of Pump PWM or flow rate via external control (RS485) to override the internal logic failure during the transition from Status 0 back to Status 2.