Enclosure Climate Control — Anti-Condensation Heaters, Filter Fans and When Each Applies

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Why panels drown from the inside (condensation physics in two sentences), sizing anti-condensation heaters and where thermostats versus hygrostats belong, filter-fan cooling with its IP cost and filter-mat discipline, and the decision table from a damp coastal cabinet to a drive panel that needs real cooling.

The enemy is the dew point, not the cold

A cabinet breathes with every temperature swing; when its internal surfaces fall below the dew point of the air inside, water films every terminal — which is how outdoor, coastal and washdown panels corrode shut with their doors never opened. The cure is not sealing (IP68 cabinets still breathe through glands) but keeping the internal air a few degrees above ambient so relative humidity stays low. That is the entire job of the anti-condensation heater — stocked across the formats: nVent HOFFMAN 250 W / 230 V and 115 V touch-safe units, and the TEF 9208 300 W heater for heavier marine-grade cabinets.

Heater practice

Sizing is modest: tens of watts per enclosure-surface square metre to hold a 5 K lift — a 250–300 W unit covers a substantial outdoor cabinet; the maker's chart per volume beats guessing.

Control by hygrostat (on above ~60 % RH) where moisture is the enemy, thermostat where freezing instruments are — both together on exposed sites. A heater running uncontrolled cooks the top-row components in summer.

Mount low, convect up, keep clearances — PTC touch-safe designs (the stocked pattern) self-limit and shrug off a blocked airflow where wire-element heaters scorch.

When the problem is heat, not damp

Internal load | Answer | Notes |

Up to ~50 K·m² of passive surface | Natural convection, dark paint, shade | Free, often forgotten |

Moderate (drives, PSUs) | Filter fans + outlet filters | Cheap, but the enclosure drops to ~IP54 and inherits a filter-mat schedule — stocked spares: Rittal pleated mats, fan spare filters, Fibox mats among 200+ rows |

High, or hot/dirty room air | Air-to-air heat exchangers, cooling units | Keeps the cabinet sealed; sized from heat load, not habit |

Filter-fan arithmetic is honest: required airflow "H heat load ÷ (allowed internal rise × 0.33 Wh/m³K equivalent) — then the mat clogs, flow halves, and the drive trips on a hot Friday. Put the mats on the maintenance list the day the fan is fitted. Dust-heavy rooms argue for over-pressure (fan blows in through the filter) so unfiltered air never enters at the louvre.

Selection pairs with the enclosure finder and IP decoder; VFD heat loads per the drive guide. Around 150 heater and 210 filter-fan rows are stocked — quoted within 24 hours against enclosure size, ambient, internal load and site conditions.

Frequently asked questions
How big a heater does my outdoor cabinet need?Enough for a few degrees of lift over ambient — makers chart it per enclosure surface; a 250–300 W touch-safe unit covers a generous outdoor cabinet. Oversizing wastes little if a hygrostat controls it; running uncontrolled is the real error.Hygrostat or thermostat for the enclosure heater?Hygrostat where condensation is the enemy (switch on above roughly 60 % RH); thermostat where low temperature itself hurts (instruments, batteries). Exposed sites often wire both in parallel.Does fitting a filter fan ruin the enclosure's IP rating?It redefines it — typically down to IP54 with the filter mats in place, less without. If the room holds washdown or conductive dust, keep the cabinet sealed and move heat with an air-to-air exchanger or cooler instead.Why did the drive start tripping on over-temperature months after install?Walk to the cabinet and look at the filter mat — clogged mats halve airflow silently. Replace mats on schedule (stocked as consumables) and check the fan still turns; thermal trips in late summer are a maintenance calendar, not a drive fault.Should the filter fan blow in or suck out?Blow in through the filter (slight over-pressure) in dusty rooms, so every leak path leaks outward and only filtered air enters. Exhaust arrangements suit clean rooms where heat removal at the top is the only concern.

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