

## Why proper design and sensor technology is the link to optimize performance

*A recent service visit to a cold store in Europe highlighted how Vapor Quality Sensors can optimize refrigeration system performance. However, the system design limited the sensors' full potential, pointing to room for improvement.*

Refrigeration systems are often designed to operate at full capacity but typically function under partial load conditions. Without active circulation rate control, the partial load leads to an increasing circulation ratio, resulting in higher pressure losses, especially in the riser pipe, and requiring lower suction pressure to maintain freezing capacity. This inefficiency leads to higher energy consumption and reduced overall system performance.



During the review at the cold store, a 44 kW evaporator designed to operate at  $-40^{\circ}\text{C}$  with a circulation ratio of 3 was selected for detailed testing paired with our Vapor Quality Sensor. The evaporator's outlet pipe had a diameter of DN50, which was connected to a DN65 Vapor Quality Sensor. The piping configuration included a reduction back to DN50 and a riser pipe also sized at DN50.

The tests demonstrated that the sensor accurately measured changes in Vapor Quality (dryness) when the liquid valve was adjusted. Also, the fan speed changes were detectable and measurable, indicating the potential for energy savings. However, the regulation window for optimal control was found to be very narrow, limiting the system's ability to fully cover the benefits of the Vapor Quality sensors.

A closer analysis revealed that the narrow regulation window was due to the riser pipe configuration. The pipe size remained at DN50 instead of being reduced to DN40, which would have ensured sufficiently high gas velocity to maintain liquid transport upwards, particularly at lower evaporator loads.

While the sensors demonstrated their effectiveness in monitoring and controlling key parameters, the system's design constrained their full optimization potential. Modifying the riser pipe to DN40 would increase the gas velocity, enabling better liquid transport and a broader regulation window, allowing for more stable and optimum control.

While Vapor Quality Sensors are highly effective sensors for monitoring and optimizing a refrigeration system, they cannot compensate for unsuitable system designs. For maximum efficiency and energy savings, aligning system design with advanced sensor technology from the beginning is crucial.

If you want to know more, we are happy to send a technical report with different calculations. Please send an e-mail to [info@hbproducts.dk](mailto:info@hbproducts.dk).

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