

CRYOGIAM ADOPTS R-455A FOR CONDENSING UNITS

Case Study

THE OPPORTUNITY

Cryogiam, a Sicily-based manufacturer of condensing units, compressor racks and split monoblock systems for the refrigeration industry, wanted to adopt a long-term refrigerant in their production of condensing units, using a safe, simple, efficient and cost-effective technology.

THE SOLUTION

Honeywell's Solstice® L40X (R-455A) was the right answer for their requirements.

Solstice L40X, with its ultra-low GWP of only 146, makes it an F-Gas-ready solution. In addition to the refrigerant, Honeywell and their distribution partner GeneralGas S.r.l., also supplied technical support for flammability, glide, and performance management.

Cryogiam partnered with TECA, an external consultant based in Northern Italy, to perform a risk assessment and certify the safety and suitability of Solstice L40X in these applications, complying with the relevant regulations and standards. TECA supports companies who face market challenges, by integrating safety in the construction of machines and installations, with an approach that finds the balance between regulatory requirements and production performance.

Cryogiam undertook this analysis to give their customers peace of mind about the possible flammability-related risks from the use of an A2L refrigerant blend.

Based on the sources of risk and their actual extent in practice, TECA drove Cryogiam through the design

"Uncertainty about the refrigerants of the future is forcing refrigeration operators to look around for new options. Among the various solutions, the A2Ls seem to be the most suitable to meet Cryogiam customer needs."

– MARCO GIAMMUSO, CEO, CRYOGIAM

and production process of two series of units with a maximum refrigerant load of 6 and 14 kg, representing most of the market demand.

Cryogiam ran a full set of tests in its own facilities. All components were carefully selected for the required cooling capacities and working conditions. Bitzer contributed to the success of this project by supporting Cryogiam in the selection of the compressors for Solstice L40X.

THE RISK ASSESSMENT PROCESS

Cryogiam needed to classify the flammability and explosion risks for the A2L refrigerant, and analyze the installation conditions, with the aim of identifying the technical and engineering solutions.

"Our customers ask us for solutions that are "definitive" or that guarantee them a certain continuity over time. Beyond the regulatory compliance, it is important that we ensure the highest safety standards for the handling and operation of our products."

– MARCO GIAMMUSO

To establish which standard should be followed at the design and production stage to ensure equipment

safety, the following aspects of use of the finished product (condensing unit) have been checked:

- **Place of use:** industrial area with reserved and/or authorized access, or a retail store with public access
- **Type of application:** e.g., low-temperature, medium-temperature
- **Charge of refrigerant:** based on specifically required cooling capacity, piping length, and working conditions (evaporating and condensing temperatures)

THE NEEDS

- Comply with the European F-Gas regulation by adopting a refrigerant with GWP below 150, which is the upper limit allowed from 1st Jan 2022.
- Meet the European standard EN378.
- Ensure safety in use and maintenance. A2L gases are safer than hydrocarbons and other industrial gases, due to their low pressures and very low flammability.
- Comply with the EcoDesign directive and achieve minimum targets in the EER (Energy Efficiency Ratio), therefore minimizing the TEWI (Total Equivalent Warming Impact) throughout the lifetime of the system.
- Propose cost-effective systems in terms of investment (CAPEX) and operation (OPEX).
- Scale from very low-to-high cooling capacity.
- Extend to multipack units for large installations.

Honeywell

CRITICAL ASPECTS	ANALYSIS RESULTS
Identification of leak sources	Based on the manufacturing, control and maintenance plan of the machines, some potential leakage areas were considered negligible as they do not generate a risk factor; flanged and threaded joints were considered as leakage areas. For controlling the hazardous areas generated by the emission sources, specific measures have been taken with regard to ventilation and installation conditions. A pictogram indicating the presence of potentially flammable fluid and specific warnings in the instruction has been provided to protect the user.
Ventilation analysis	Deemed sufficient to prevent the formation of a potentially flammable mixture (based on the flammability parameters of the refrigerant). The necessary ventilation flow was calculated and the minimum requirement was met with no decisive impact on costs.
Place of installation	The assessments were based on national fire regulations and with the objective of contributing to the technical documentation indicating potential limitations on the place and method of installation. The result is non-binding for the type and place of use of the machines examined.

Based on these factors the finished unit is not covered by existing product standards, which led to the decision to follow the standard EN378.

All the necessary information for the risk assessment was collected:

- LFL (Lower Flammability Limit)
- ATEL (relative to toxicity)
- ODL (Oxygen Deprivation Limit)
- Flammability field (range between Lower and Upper Flammability Limits)
- Minimum ignition energy
- Heat of Combustion
- Burning Velocity

GLIDE MANAGEMENT

Solstice L40X (R-455A) theoretically shows a temperature glide of up to 10K. Cryogiam had to take this into account for system design and, in particular, the heat exchangers.

The results of Cryogiam's tests show a real glide significantly lower than the theoretical one:

"At the entrance of the evaporator, the refrigerant has, for our applications, a vapor quality of about 0.35, so the glide is less than 7K in practice. Therefore, the refrigerant glide is not a problem; you just need to be aware of it and learn how to manage it both for the design and for the commissioning of the system," said Giammusso.

SAFE, COST-EFFECTIVE TECHNOLOGY

"Cryogiam has invested heavily in CO₂ (R-744) technology in the past,"



says Alessandro Carrubba, R&D Chief Technical Officer, Cryogiam. "However, the problem that emerged immediately was the efficiency at our usual operating temperatures. In the meantime, there are several comparative studies that demonstrate how the use of A2L refrigerants in commercial refrigeration leads to greater operating efficiency. Also, CO₂ technology involves complex installation management, which is, without doubt, expensive in the life span of the system."

"As is common with innovative technology, the analysis path on A2L has not been clearly outlined from the beginning," continued Carrubba. "However, thanks to the shared efforts of our technical team, working side by side with our external partners, we have been able to focus on the critical challenges and minimize the costs and efforts to make our units suitable for safe operation with A2L refrigerants."

Cryogiam's analysis process has made it possible to

identify easily applicable solutions to avoid redesigning the circuit and without installing ATEX-proof components, while safely using a refrigerant that meets the long-term requirements of the F-Gas regulation.

"We are satisfied with the results and will offer the A2L solution with tenacity and conviction as an alternative to CO₂" confirmed Giammusso.

THE SOLSTICE L40X ADVANTAGE

Solstice L40X (R-455A) is a zeotropic blend refrigerant designed for low-, medium- and high-temperature applications in new systems. It also provides a close capacity match to R-404A and, compared to propane (R-290), extends the capacity by 20 %, improves energy efficiency, and offers a similar COP (Coefficient of Performance). As an A2L refrigerant, Solstice L40X presents a lower flammability risk than R-290 (A3). It is approved for use by major compressor manufacturers. Solstice L40X delivers excellent cooling performance in low-temperature applications and can be used across many segments of the HVACR industry. These include plug-in type cabinets, condensing units, waterloop systems, and monoblocks for cold rooms and freezer rooms, heat pumps, and chillers.

Solstice L40X represents a long-term choice, offering both environmental and cost benefits, as well as easy implementation.



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