



PIERRE-ETIENNE DEHON,
CHAIRMAN OF THE DEHON GROUP

At the end of November, Paris will host the climate change conference, COP21, which aims to reach a worldwide agreement to keep global warming increases below 2°C.

As refrigeration professionals, we are well aware of this problem, which has been a great challenge for a number of years. From CFCs to HCFCs, we are now looking at replacing HFCs. The case studies contained in this issue testify to the implementation of reliable, efficient and sustainable alternatives: HFOs.

Today, Climalife pursues its commitment to tackling climate change by launching a global CO₂ offer, a very low-global warming potential refrigerant that allows specific applications to reduce their impact on the environment.

Climalife is always keen to make work easier for engineers. It has therefore innovated and invested in Mooviz®, a new, light and mobile composite container for this high-pressure gas.

Our actions in favour of the environment are not limited to innovations and replacement solutions, despite their importance.

Following action initiated by Climalife in 1989 and thanks to the enterprising and proactive nature of our profession, an agreement to systematically recover and recycle fluorinated gases was signed in 1993 in France, before any regulations on this matter were introduced. Research carried out by CITEPA testifies to the agreement's achievements and effectiveness.

We can all be proud of our actions to fight climate change.

Keeping one step ahead is the best guarantee of future success!

Happy reading!

Focus on the environment and anticipate regulatory changes: 9.2 MT CO₂ equivalent avoided.

In 1989, aware of the environmental risk posed by the inability to manage greenhouse gases, Climalife decided to focus on the environment by introducing a recovery system that would analyse, recycle and regenerate refrigerants. This voluntary approach, adopted by all industry players has, not only allowed us to reduce the impact of our products on the environment but also given rise to one of the first virtuous cycles of the circular economy.

A recent study by CITEPA (Interprofessional Technical Centre for Studies on Air Pollution) has revealed that the efforts made by companies on behalf of climate change, over a period of more than 20 years, will have avoided the emission of 9.2 Million Tonnes CO₂ equivalent (or 1.3 million cars a year).

Today, we continue to develop our environmental actions with the shared aim of managing and reducing the impact of our products and services on human health and the environment:

- by replacing hazardous substances in our formulated products,
- by reducing and recovering waste,
- by managing and reducing greenhouse gas emissions on our sites and on those of our clients.

The coming years will bring new projects, which will allow users to monitor the quantity of used greenhouse gases more closely.



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Lubricant innovation for CO₂ compressors

Industrial and commercial facilities using carbon dioxide (CO₂, R-744) are experiencing strong growth in Europe. The main benefits of using this "natural" fluid are the strong better cooling capacity for relatively low installed compressor power, an Ozone Depletion Potential (ODP) of 0, and a Global Warming Potential (GWP) of 1. The low ODP and GWP values can make this an "ideal" fluid for many users. However, R-744 presents technological challenges in its implementation and maintenance and cannot be used for all applications. Let us review this technology with Jean-Yves Clairé, a Lubrication Engineer at ExxonMobil.

Mr Clairé, could you explain the challenges related to the lubrication of CO₂ compressors?

J-Y. C.: Facilities operating with R-744 present three significant technological challenges: the pressures involved in facilities using subcritical and transcritical CO₂ systems, the high solubility of CO₂ in the lubricants can potentially lead to an excessive drop in viscosity and the solvent effect of CO₂ can reduce the thickness of the lubricating film on moving parts. In so-called "miscible" facilities (those designed on the principle of perfect miscibility between the refrigerant and the lubricant), certain standard polyolester oils (POE) show their limitations in CO₂ operating conditions.

What solutions has ExxonMobil developed to overcome these constraints?

J-Y. C.: In order to fully meet user requirements, ExxonMobil has developed, for miscible CO₂ systems, a polyolester oil with innovative and advanced technology providing increased lubrication performance.

The features and benefits of the new polyolester technology are, firstly, the excellent low temperature fluidity of the lubricant and its potential to improve evaporator efficiency. Secondly, the lubricant provides excellent control of in-service viscosity for optimal mechanical protection of compressors, extended compressor life and possible increase in maintenance intervals.

How did you go about validating the new product?

J-Y. C.: The validation of the new POE technology developed by ExxonMobil was carried out in a large pig abattoir in Brittany. Its refrigeration system is composed of a CO₂/ammonia loop: the ammonia circuit consists of two screw compressors and the CO₂ circuit is made up of four reciprocating compressors.

After having faced two successive breakages of the same compressor that required a new replacement each time due to a lack of lubrication with the oil used previously, and one maintenance intervention to replace the pistons and

cylinders in a 2nd compressor, the four reciprocating compressors used were switched to "Mobil SHC Gargoyles 80 POE" starting in December 2013.

The compressor producing hot CO₂ gas for the daily defrosting of evaporators located in the freezing tunnels was the first to be lubricated with Mobil oil. The operating, and so lubrication, conditions of this compressor are the most severe with higher pressures and temperatures. It was in this compressor, essential to the working of the refrigeration system in the abattoir, that the compressor breakages were reported.

What were the results of these tests?

J-Y. C.: The trial period using "Mobil SHC Gargoyles 80 POE" ended with the inspection of all lubricated parts in the compressor producing hot gas during its periodic servicing at 5,600 operating hours. The inspection was carried out in the presence of the compressor manufacturer, the company specialised in the maintenance and operation of industrial refrigeration facilities, the client, and ExxonMobil field technical services and manufacturer relations.

All participants in the servicing of the compressor noted the excellent general condition of the compressor and of all of its lubricated mechanical parts and, in particular, the very good condition of the parts related to piston no.1, the piston subjected to the highest temperature and pressure conditions in this type of machine. All the parts were still coated in a film of lubricant with a good appearance in contrast to the presence of significant wear marks and dry appearance when the previous oil was used and this with the same operating conditions.

As an example of the strong lubrication performance in this reciprocating compressor lubricated with "Mobil SHC Gargoyles 80 POE", the content of wear metals in iron and aluminium were 13mg/kg (ppm) and 3mg/kg (ppm) respectively after 5,600 operating hours. The very low levels of wear metals were particularly remarkable for reciprocating compressors.

From an economic point of view, what are the benefits of the lubricant for the operator of the facilities?

J-Y. C.: Due to the excellent mechanical stability of the lubricated parts, the use of Mobil SHC Gargoyl 80 POE has allowed periodic servicing to be moved to 6,000 hours with a target of 8,000 hours. With the previous oil, the manufacturer had recommended bringing servicing down to every 4,500 hours. The increased operation time between periodic servicing will allow the abattoir to reduce maintenance costs by €2,640 per compressor and per year with a total reduction of €10,560 per year for its fleet of reciprocating compressors using CO₂ on the basis of periodic inspections every 6,000 hours.

In relation to the energy efficiency of the system, does the new product provide any improvement?

J-Y. C.: Indeed, other than the increase in maintenance intervals, a reduction in electrical power of 2 to 3 kW from an average of 100 kW con-

sumed in similar running and load conditions were seen by the key "hot gas" compressor at the Breton facility. The savings can be valued at €599 per year and per compressor. The explanation rests in the reduction of the traction coefficient (which characterises the internal friction of oil molecules during the flow of lubricant under high pressures) of "Mobil SHC Gargoyl 80 POE" in relation to the oil used previously.

These energy savings are in direct relation to the reduction of the traction coefficient of the innovative POE technology molecules: reduction of internal energy loss due to friction within the lubricant and increase in mechanical work at an identical electrical consumption

What conclusions can be drawn from the large-scale trial?

J-Y. C.: To summarise¹, Mobil SHC Gargoyl 80 POE allows a reduction in maintenance costs thanks to an increase in time between periodic compressor visits and an improvement in pro-

ductivity due to a reduction in energy costs. In terms of security, operator interventions are minimised thanks to an increase in time between periodic compressor inspections. In relation to the environment, a reduction in waste can be observed thanks to a reduction in the number of oil changes by increasing the life of lubricant loads in service.

Finally, at the level of productivity, there is a gain of €10,560 per year on the basis of periodic inspections every 6,000 hours and a reduction in the power consumption of each compressor, at a load equivalent to 2 to 3% of the electrical power consumed.



INDUSTRIAL REFRIGERATION - WAREHOUSE

HFO Blend R-448A replaces R-22

The above-zero refrigeration production unit of a crop storage warehouse that had been running on R-22 for more than 15 years was recently retrofitted with the new refrigerant, N40, from Honeywell's Solstice® range.

Holland is a country that prides its quality of potatoes; a speciality that has a long tradition and benefits from a high level of research. Around eight million tonnes are grown each year.

The family business, MTS CLEVERING, based in Den Handel, in the north of the country, has specialised in the cultivation of seed potatoes since 1906. These potatoes are harvested at

functions correctly. In light of regulations that forbid the use of HCFC (even recycled) in Europe, which came into force on 1 January 2015, it was necessary to find an alternative to R-22, according to the installer, Peter Wierenga, to ensure the system's long-term survival and to avoid any malfunction. After having considered several possible options, the new refrigerant, Solstice® N40, developed by Honeywell and distributed by Climalife, was chosen.



the installation and the superheat settings were adjusted. The installer also took this opportunity to isolate the pipes in order to avoid any condensation.

With a GWP of 1387, Solstice® N40 is a suitable and lasting solution in light of F-Gas regulations. All those involved were satisfied with their choice.

Company: Koeltechniek Noord
Business: Industrial refrigeration for agriculture and the shipping industry
Location: Uithuizen, Holland
Date established: 2007
Employees: 3



the end of the summer and then stored at a controlled temperature before being prepared for shipment around the world through specialist cooperatives from November to June.

A controlled temperature is essential for high-quality products

Rubertus Clevering pays careful attention to his seed potatoes during the storage period. He checks climate conditions to make sure that the potatoes remain dormant for as long as necessary or possible. A high level of moisture can shorten the dormancy period and temperature fluctuations favour the growth of germs. This Dutch grower uses the firm, Koeltechniek Noord, which specialises in industrial refrigeration for market gardeners, to ensure that his warehouse

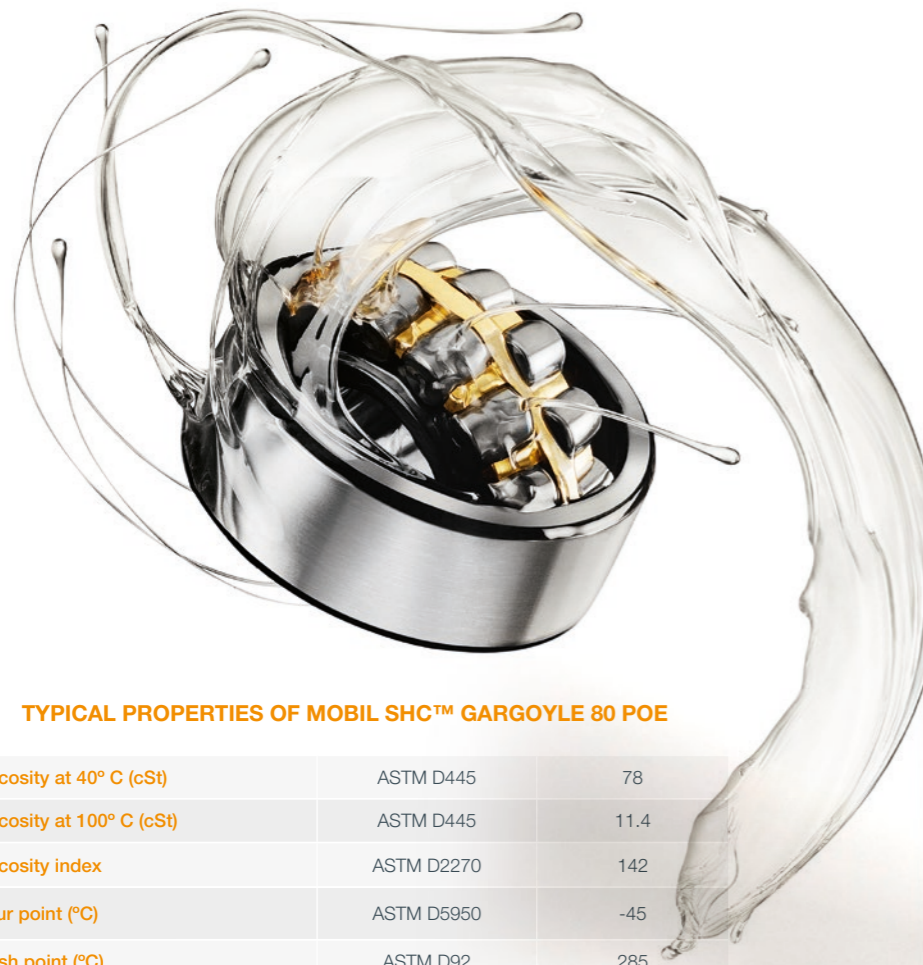
The installation is fitted with an above-zero rack with one Bitzer 6HE35Y compressor, two Helpman Thor evaporators and a Condor condenser, and cools a 1000m² warehouse at a controlled temperature of +3°C / +5°C.

The installer, before retrofitting with Solstice® N40, checked that the condenser and the evaporators were of a sufficient size. The operation took place without incident this summer during a slack period for the warehouse. After draining the system, the 60 kg of R-22 was recovered and the mineral oil replaced with Emkarate 32 POE oil.

Once the filters had been cleaned and the seals changed, R-448A refrigerant was charged into



JEAN-YVES CLAIRÉ,
LUBRICANT ENGINEER -
EXXONMOBIL



TYPICAL PROPERTIES OF MOBIL SHC™ GARGOYLE 80 POE

Viscosity at 40° C (cSt)	ASTM D445	78
Viscosity at 100° C (cSt)	ASTM D445	11.4
Viscosity index	ASTM D2270	142
Pour point (°C)	ASTM D5950	-45
Flash point (°C)	ASTM D92	285
Density at 15°C	ASTM D4052	1.02
Brookfield Viscosity at -30°C	ASTM D2983	23600

¹ This summary was established based on the field trial carried out with "Mobil SHC Gargoyl 80 POE" at an abattoir operating four reciprocating compressors using CO₂ between December 2013 and April 2015. Current results are subject to variations according to the type of equipment in service, its maintenance condition, operating conditions, the environment and the lubricants used previously. In case of doubt, consult the maintenance manual provided by the manufacturer.

The validation work was recognised and validated by management at the industrial site and was the subject of a Proof of Performance report available on the website www.mobilindustrial.com. Esso SAF, a public limited company with a capital of €98,337,521.70, RCS Nanterre 542 010 053, 5/6 place de l'Iris 92400 Courbevoie, markets the Mobil brand in France - a registered trademark owned by Exxon Mobil Corporation or by one of its subsidiaries, including Esso SAF, whose legal independence is not here called into question, each being independent.



COMMERCIAL REFRIGERATION - GMS

Solstice® N40, retail Solution: Improving Energy Efficiency and Reducing Environmental Impact

“Our targets of reducing energy consumption and CO₂ emissions were perfectly reflected in Ebrofrío’s proposal for the Simply Plaza store – through their spirit of innovation they developed a solution for the store’s refrigeration needs, while at the same time ensuring that both system GWP and energy usage are much lower.”

ELÍAS MANTECÓN, INASIC INGENIERÍA

Summary: Contributing to an end-to-end energy efficiency strategy

“Simply” is redefining the franchise business model in the retail environment, through a formula that creates opportunities for entrepreneurs to buy into four store sizes:

– Simply Market, Simply City, HiperSimply (developed by supermarket giant Group Auchan) and, most recently, Simply Basic. Simply is not only creating new retail centres (currently 132 super- and hyper- markets and 15 gas stations in nine different regions across Spain), it is also pushing the boundaries of energy efficiency and environmental impact, thanks to an ethos founded on sustainable growth.

Needless-to-say, retail businesses rely heavily upon effective refrigeration systems. In this sector, regulation is driving the adoption of more environmentally-friendly refrigerants – and Honeywell is responding by offering system designers, OEMs and end users a new generation of ultra-low GWP and more energy efficient refrigerants, based on new Hydro-Fluoro-Olefins (HFO) technology. In the case of Solstice® N40 (R-448A), it is a drop-in replacement for R-404A. Solstice® N40 has been incorporated into the latest Simply store near Zaragoza by system designers Ebrofrío, a company renowned for its forward-thinking and innovative approach.

Background: Placing innovation and sustainability at the heart of retail

Ebrofrío is a family-run company, employing 30 people, specialising in the design, installation and maintenance of commercial and industrial refrigeration systems. It is a business that thrives on innovation and which offers advice to engineers on the impact of regulatory change in the refrigeration sector. The company delivers customised installations and high performance maintenance contracts, offering system architecture that take advantage of the latest advances in materials technology, such as Solstice® N40.

In the case of the new 3,500 m² Simply store in Zaragoza, which opened in December 2014, Ebrofrío designed both the Low Temperature (LT) and Medium Temperature (MT) systems, with Solstice® N40 selected for the LT and R-134a used for the MT (Ebrofrío would likely use Honeywell’s recently commercialised low GWP replacement for R-134a – Solstice® N13 (R-450A) – for future MT applications).

The underlying environmental benefits of the refrigeration system proposed by Ebrofrío aligned perfectly to the value proposition of Simply, which is founded on an end-to-end approach to sustainable business and incorporates goals covering energy efficiency and lower CO₂ emissions. Indeed, more than 20 Simply stores already have LED lights on the sales floor as well as refrigeration system heat recovery for winter heating. The stores also target a 20% reduction in water consumption.

Implementation: Contributing to a cleaner, lower carbon future

The Ebrofrío design took account of the entire system architecture – digital compressors, EC fans, doors, and, of course, refrigerant technology – in order to meet refrigeration performance standards while reducing both energy consumption and CO₂ emissions.

System design:

- The Low Temperature (LT) “with doors” design enables the system to work comfortably at -30°C evaporation temperature (or even higher). This, together with the low discharge temperature of Solstice® N40 when compared to other R-404A alternatives, leads Ebrofrío to predict problem-free operation in summer conditions.

- The central pack consists of four compressors in the Solstice® N40 LT system.

- Eilwell controls nowadays incorporate R-448A. At the time of conversion, settings of R-404A were used, proving the suitability of R-404A for direct retrofitting.

During a regular site check four months after opening, the condensing temperature mid-point showed a 1-2°C difference vs the R-404A setting in the control, so very similar to R-404A.

- Charge: 135 kg of Solstice® N40 (R-448A).

- The problem-free retrofit of Solstice® N40 as part of the design architecture ensures ease of working for maintenance technicians.

Ebrofrío is currently recording key performance data on system-critical parameters through the Coresense diagnostics tool from Copeland, including tracking energy consumption, in line with their determination to offer optimal solutions to their customers.



HEADLINE RESULTS

- Solstice® N40 is shown to offer better refrigeration performance than R-404A.
- Monitored energy consumption shows a reduction in line with preliminary estimations.
- Solstice® N40 possesses a GWP 66% lower than R-404A, delivering lower emissions and also lower cost of maintenance due to preferential taxes.
- Retrofitting of Solstice® N40 was problem-free thanks to its direct replacement capability for R-404A, making it safe, easy and time-efficient for the technicians to perform the work.

Sector Perspective: Serving up Sustainable Refrigeration

Each year, the world uses more than 90 million tonnes of refrigerant, enough to keep food fresh in 240,000 supermarkets and to cool more than 300,000 commercial buildings.

Honeywell is committed to continuing to invest in the development and introduction of new products, to make it easier for commercial and industrial sectors to adopt and use alternatives to higher global warming potential refrigerants.



Solstice® N40 is technology proven to deliver outstanding results across key metrics linked to energy efficiency, temperature, cost of operation and overall Coefficient of Performance (COP).

Solstice® N40 is 100% non-ozone depleting, possesses low toxicity (ASHRAE class A) and is non-flammable at ambient temperature (ASHRAE class 1), which makes it significantly safer in use than alternatives such as hydrocarbons and ammonia.

Ebrofrío learned about Solstice® N40 last year during a Honeywell and Friogas (Climalife) presentation.

For any new similar installations, the company would also consider Solstice® N13 (R-450A) from the Solstice® range of HFO refrigerants for Medium Temperature (MT) applications.

	MT PACK	LT Pack
Compressors (Copeland)	1 x 4MUD-25X and 2 x 6MM-30X AWM	4 x 4ML-15X AWM (R-448A)
T evap °C	-8°C	-32°C
T cond °C	+45°C	+45°C
Cooling capacity	118kW	42kW
Refrigerant	R-134a	Solstice® N40 (R-448A)
Charge	220 kg	135 kg

“The store system was commissioned and is running problem-free. Ebrofrío is providing a very good and responsive service and so far there have been no issues at all with the refrigeration system, no downtime.”

JOSE ANTONIO GRACIA BOROBIA, SIMPLY ZARAGOZA PLAZA MANAGER

“During recent machine room monitoring session, only one compressor was at 100% load, with -28°C evaporating temperature and a discharge temperature of 85°C. Performance in terms of capacity and efficiency is fulfilling both ours and our customer’s expectations from the preliminary calculations we have made and presented to Simply.”

ANTONIO ALÓS, EBROFRÍO TECHNICAL MANAGER

“Our vision – ‘A different way to understand franchises’ – expresses a model that retains all our standards and values while offering entrepreneurs a profitable and sustainable business. Our targets of reducing energy consumption and CO₂ emissions were perfectly reflected in Ebrofrío’s proposal for the Simply Plaza store – through their spirit of innovation they developed a solution for the store’s refrigeration needs, while at the same time ensuring that both system GWP and energy usage are much lower.”

LUIS CANOVAI, SIMPLY TECHNICAL MANAGER

“We first listened to our customer to understand their needs and constraints. Their position as the first promoter to run a franchise meant meeting the expectations of the store manager, company and retail chain. In our search to identify the best solution, we considered that Solstice® N40 (R-448A) was the best proposal. Results so far have proved it.”

CARLOS ALÓS, EBROFRÍO COMMERCIAL MANAGER

REFRIGERATION FOR THE FOOD STORAGE SECTOR

Solstice® ze: the long-term alternative to R-134a

In response to the ban on R-22 refrigerant, Quercy Réfrigération offers R-1234ze as an innovative replacement for two industrial cold rooms used for storing apples in a controlled atmosphere.

Specialising in industrial refrigeration and, more specifically, the food storage sector since it was founded in 2007, Quercy Réfrigération works very closely with its customers and is keen to offer them eco-friendly solutions for the future. For Benoît Duparc, the company's director, this approach is of paramount importance when changes are being made to regulations on refrigerants.

Many of his customers are producers and exporters of fruit and vegetables, and more recently include Planavergne, a family-run business based in Escazals in the Lot region of France. Founded in 1937 and focusing largely on apple production, this company yields 3,500 tonnes of the fruit from September to June every year and exports throughout the world.

The apples are stored for between four and 12 months in cold rooms in a controlled atmosphere: nitrogen is injected to lower the oxygen level and the CO₂ content is regulated to prevent asphyxiation and to delay the ripening process.

The storage facility has more than 12 cold rooms, most of which are cooled by units operating on R-404A refrigerant gas. However, two of these rooms were still relying on R-22 units, urging Mr Planavergne to issue an invitation to tender for replacements, in view of the ban on HCFCs in Europe.

Various solutions considered with fierce competition

When negotiations started, the costing process was based on a unit with three direct expansion-type compressors and two cubic evaporators for supplying two 1,400 m³ cold rooms, each storing around 300 tonnes of apples at +1°C.

Company: Quercy Réfrigération
Activity: Refrigeration for the food storage sector
Location: Moissac, France
Founded: 2007
Employees: Six
Turnover: €1.2 million



Quercy Réfrigération studied the CO₂ solution but found it unsuitable for fruit storage. Firstly, the evaporating temperatures would be quite high, varying from +4°C to +8°C and exceeding the operating range for currently available compressors. Secondly, the most intense operating period would be during the summer and autumn, when the CO₂ output would be at its lowest and, finally, the investment cost would be very high.

An initial costing was subsequently drawn up for R-134a versus R-407F, but Planavergne considered these solutions to be too temporary and inconsistent with their investment plan. The aim was to find a long-term solution to avoid the need for 'repeated retrofits'.

In response to this, Quercy Réfrigération found the innovative solution of using R-1234ze with a suitable control system. "Rivalling the choices offered by our competitors, we proved to our customer that this solution would also save energy, by incorporating our own specially designed and patented hygrometry control system for fruit storage rooms. So changing the refrigerant wouldn't be the only way to reduce electricity consumption," said the installation engineer. Planavergne was immediately convinced.

Solstice® ze: the long-term alternative

With a GWP of less than 1, this pure HFO molecule provides a long-term eco-friendly alternative. Solstice® ze, which is not subject to F-Gas



FACILITY DATA

- Pecomark CMI-3-41 unit
- 3 Bitzer 6FE40Y semi-hermetic compressors
- 40 litres of BSE32 oil
- 218 kilos of HFO 1234ze refrigerant
- 1 Guntner GVH090 2C/3 N D.E 200 KW air condenser
- 16 metres of stainless steel piping, diam. 60
- Quercy Réfrigération control system
- Custom-made evaporators based on Quercy Réfrigération's specifications

regulations or the annual declaration applicable to traditional refrigerants, reduces direct CO₂ emissions by 99.6% and helps equipment comply with directives on eco-design. With an ASHRAE A2L classification, this refrigerant is mildly flammable but can be handled as easily as traditional fluids. According to Duparc, however, this particular benefit had no influence over the choice of solution. "These days, we're used to working with toxic products such as NH₃ or high-pressure fluids like CO₂. Our engineers have the experience, so it's simply a matter of working calmly and safely."

A new eco-friendly facility

Work began last June, once a new, Pecomark stainless steel unit with a frame had been selected. The unit has three Bitzer semi-hermetic compressors and a speed regulator, which is connected to one of the compressors and to the condenser fans.

The two evaporators, manufactured according to very precise specifications and incorporating the control system developed by Quercy Réfrigération, are supplied with Carel's electronic stepping regulators for R-1234ze refrigerant.

The unit went into operation without any setbacks after more than 200 kg of R-1234ze had been loaded into the facility. As the piping was made of stainless steel, this would minimise any leaks over the long term.

"When we commissioned the unit, it was just like loading any other refrigerant into a direct expansion-type system.

There was really no difference, apart from the fact that the operating pressures were very low, but it was also quite pleasant to work under those conditions," said Benoît Duparc.

Current measurements were taken on startup, and were compared with values from the other three units operating on R-404A in the machine room.

"The results spoke for themselves, as it was clear that a lot less energy was being consumed. We can certainly recommend R-1234ze refrigerant as a future solution for above-zero refrigeration. It meets the needs of our customers in this sector, but only requires a small investment," concluded the installation engineer.





COMMERCIAL REFRIGERATION - SUPERMARKETS

MEGA IMAGE tests Solstice® N40 for the conversion of its R-404A facilities

As Bogdan Mascas Radu, co-owner of Frigotehnics, explains: "Climalife gave us the technical support we needed to undergo this conversion, enabling us choose the most appropriate solution for our system".

Founded in 1995, Mega Image is Romania's leading supermarket chain, with a network of 410 local stores across the country, bearing the trade names of Mega Image, Shop & Go and AB COOL FOOD.

Mega Image is part of the Delhaize Group, an international food distributor established in Belgium in 1867, which now has a presence in three continents.

Currently expanding across Romania, with the aim of becoming "the customer's number one choice for fresh, high-quality products, offering a unique and varied range in a pleasant environment", Mega Image decided to refurbish its stores and to take this opportunity to optimise their energy efficiency.

Choosing the most effective solution

Due to the high GWP of refrigerants in the majority of existing installations, Mega Image needed to consider possible solutions for the future. As a result, its Technical Manager, Mr Casian, contacted Climalife to develop a range of thermodynamic models to compare R-404A with various other refrigerants on the market with a lower GWP – namely R-407F, R-448A and R-449A – all in different types of configurations.

Company: Frigotehnics
Activity: Commercial refrigeration and air conditioning
Location: Bucharest, Romania

The company's aim was clearly defined: to find a fluid with a lower GWP, reduce electricity consumption and optimise the efficiency of its equipment

Bogdan Toma, Climalife's Development Manager in Romania, worked alongside Mega Image to aid its initiative, and called upon Climalife's Technical Support to deliver the most appropriate solution. Solstice® N40 (R-448A) was subsequently chosen as the best option for systems operating at a low temperature. Within the operating range covered using R-404A, and compared to the alternatives, the discharge temperature measured with R-448A proved to be lower for low-temperature applications, thus reducing operating costs and the amount of energy consumed.

Mega Image was happy with this theoretical feedback and, for its first conversion, called upon Frigotehnics, a growing company offering comprehensive solutions for the commercial refrigeration and air conditioning market. From design to implementation, servicing and maintenance, Frigotehnics' specialists have experience in dealing with a vast spectrum of situations.

A simple and effective conversion

For this initial conversion, a small supermarket with an area of 200 m² was selected in Obor, close to the centre of Bucharest.

The R-404A refrigeration unit was mainly supplying the frozen food cabinets in the store and the frozen storage facility in the back room. To avoid disrupting the company's sales activity, the conversion was performed one evening after the shop had closed. The frozen products were placed in refrigerated cabinets before the work began on a mild June evening. For food safety reasons, the team had to work very quickly.

The first step involved removing the 45 kg of R-404A from the system. The filters and used oil were then replaced and the Solstice® N40 (R-448A) was loaded without any practical constraints.



The quantity of R-448A required was smaller than the amount of R-404A originally in the system, as a surplus had been injected initially. The entire conversion was completed in four hours and the supermarket was able to open its doors again at the usual time the next day.

In conclusion, Solstice® N40 provides a better performance coefficient than R-404A for this type of installation. "The advantage of R-448A is that it can be used directly as a drop-in replacement for R-404A, without changing any equipment. R-448A has similar pressure requirements to those of R-404A (equivalent LP and slightly higher HP (+1b)), but its cooling capacity is 10% higher on average, and its coefficient of performance is 6% better in comparison," said Pierre-Emmanuel Danet, Technical Support Manager at Climalife.

It is the ideal solution for reducing the total greenhouse gas emissions from installations currently



COMMERCIAL COOLING

R-448A, a solution chosen for soft ice cream machines

Bart Schipperen, manager of the company, Europa Ice, based in Druten, in the Netherlands, specialises in the maintenance of Italian Carpigiani machines for the production of soft, creamy and tasty ice cream. With more than 20 years' experience in commercial cooling, the perfect texture of soft ice cream no longer holds any secrets for him, whether in terms of its structure, flavour or smoothness.

Most machines are installed in convenience stores, fast-food outlets, discos, etc. or used by mobile businesses. They are easy to move, take up little space and adapt perfectly to different business structures. A small share of the Soft Ice and ice cream preparation machine range is charged with 1.7 kg of R-404A refrigerant.



Before the new F-Gas regulations came into force, these machines were not subject to leak-detection testing as the refrigerant load did not exceed the 3kg threshold. The installer, keen to comply with legislation, has faced a real problem since 1 January 2015: 1.7 kg of R-404A is 6.67 tonnes CO₂ equivalent, which calls for leak-detection testing every 12 months.

But how can this regulatory requirement be applied to machines that are, in many cases, difficult to locate and not covered by a maintenance contract?

The installer, on the lookout for an alternative to replace the R-404A, tested a new refrigerant, Solstice® N40, which has a GWP of 1387.

The comparative values measured hardly differ from one another and the conversion solution, R-448A, lets the owner comply with the regulations in force.

"I cannot notice any difference with regards to the quality of the ice cream. The machine works perfectly well and it did not require a lot of adjustments or investment."

It is a sustainable solution that is suitable for the future and lets me deal with regulatory changes when I repair these machines.

With this solution, we can put an end to some of our clients' concerns," concludes Mr Schipperen.

7°C	Amp.	Watt	LP	HP
R-404A	3.05	1270	1.11	16.31
R-448A	3.1	1350	1.15	16.45

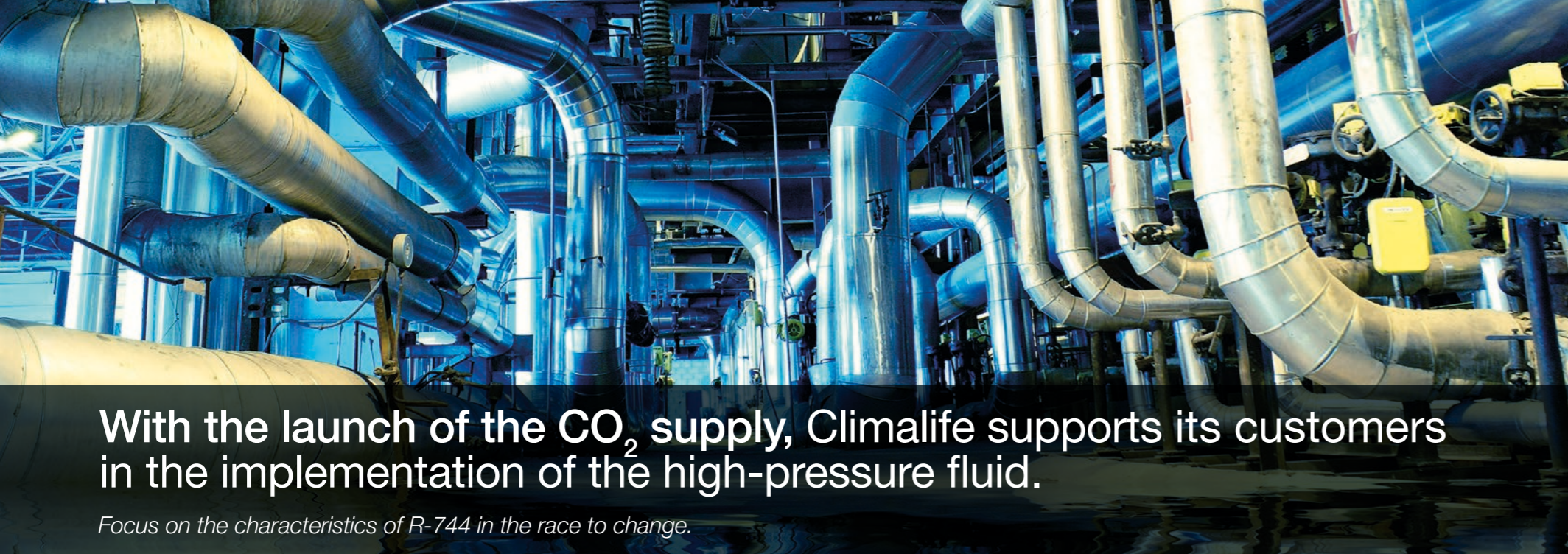


	Before conversion	After conversion
Cooling capacity	6.5 kW	8.78 kW
Condensing power	16.26 kW	16.26 kW
Compressor type	Bitzer—3x4EES—4Y	Bitzer—3x4EES—4Y
Number of compressors	3	3
Refrigerant	R-404A	Solstice® N40 (R-448A)
Load	45 kg	30 kg
Oil type and quantity	BSE 32 - 10 L	BSE 32 - 10 L
Evaporating temperature	-38°C	-38°C
Condensing temperature	+45°C	+45°C
Relative evaporating pressure	0.5 bar	0.25 bar
Relative condensing pressure	19 bars	17 bar
Mass flow	246 kg/hr	138 kg/hr
Instant power input	7.48 kW	5.52 kW

operating with R-404A. Simply switching to a refrigerant with a lower GWP (1,387 in the case of R-448A) means that we can continue to operate R-404A equipment and still comply with F-Gas requirements prohibiting solutions with a GWP greater than 2,500 and reduce global energy consumption to lessen the impact on global warming.

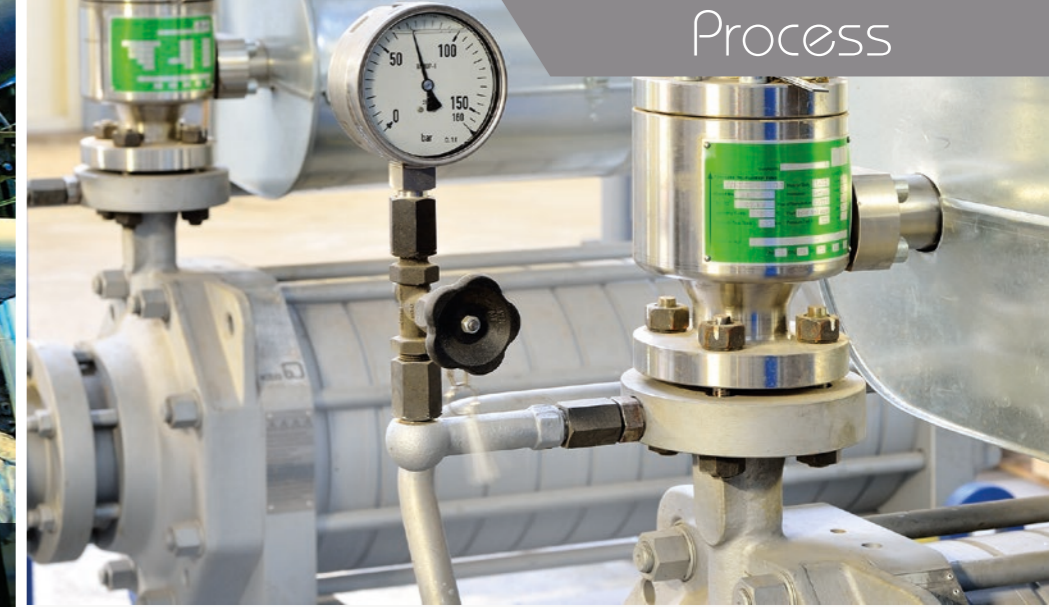
For Petre David Iulian, Maintenance Manager at Frigotehnics, "working with Climalife provided an excellent opportunity to learn more about innovative solutions in the refrigeration sector".

This conversion was the start of a whole series, and Mega Image is fully convinced that real solutions can be found to meet its long-term objectives.



With the launch of the CO₂ supply, Climalife supports its customers in the implementation of the high-pressure fluid.

Focus on the characteristics of R-744 in the race to change.



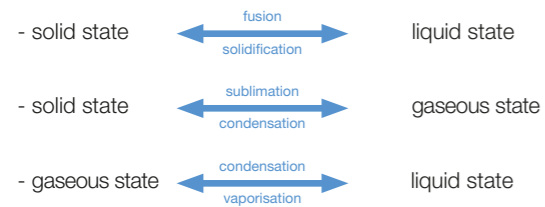
Process

Specific features of carbon dioxide for refrigeration

1 Pressure

- Very high pressure = 57.3 bar at 20°C.
- Critical temperature = +31°C (73.8 bar at 31.1°C).
- Triple point = 5.2 bar -56.6°C.

At the triple point, it can change directly from:



The danger of CO₂ is that of ending up with dry ice in the pipes (problem during the loading operation, for example).

2 Physical and chemical data

- A1 safety group fluid and practical limit of 0.1kg/m³ according to EN378.
- L1 for ERP.
- Low toxicity.
- Chemical reaction with water - very high oxidation and therefore internal destruction of pipes and irreversible corrosion.
- Carbon dioxide has low water solubility: dehydration of circuits is necessary before introducing fluid.

i As a comparison:
R-134a = 5.7 bar at 20°C,
R-404A = 11 bar at 20°C.

Risk identification

1 Risk of freeze burn

Dry ice (-78°C) can cause burns to the skin or eyes in the event of contact.

The correct treatment → In the event of freeze burn, hold under cold water for 15 min.

Preventing/Anticipating the risk → Safety goggles, clothing, overalls and cryo gloves.



2 Risk in the event of ingestion

Ingestion must always be avoided due to the danger represented by the cold and the pressure resulting from evaporation.

The correct treatment → Call for a doctor.

3 Risk of asphyxiation

- **High concentrations** may lead to asphyxiation.

Potential symptoms: loss of consciousness or mobility. The person may not be immediately aware of asphyxiation.

- **Low concentrations** (in the case of vaporisation) cause rapid respiratory failure.

Potential symptoms: headache, nausea and vomiting that may lead to loss of consciousness.

4 Risk of poisoning

Carbon dioxide is naturally present in air at a level of approximately 380 ppm (0.038%). If the concentration increases, pulmonary gas exchange is compromised.

In simple terms, as its concentration in the ambient air increases, smaller quantities of carbon dioxide leave the blood and/or the alveoli have less space for oxygen.

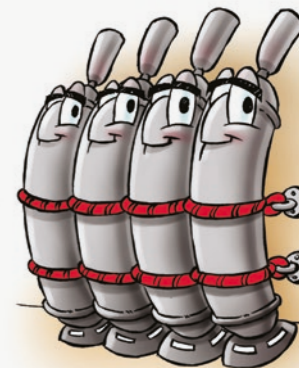
A carbon dioxide concentration of more than 9.5% in the air runs the risk of a very dangerous situation.

Source: IS 08-11-EIGA

Risk prevention

Precautions for the handling of high pressure cylinders:

- Never remove the protection from the valve (cover).
- Never change the gauges on the frames.
- Bleed the cylinders in all circumstances or stow the frames especially during transport.
- Wear suitable personal protective equipment (e.g. cryo gloves, CO₂ detector, etc.).



- Specific high pressure training is recommended as well as specific CO₂ training.

- Ensure that the room is well ventilated especially near floor level.

- Ensure correct operation of the CO₂ detector.

Compliance with the regulations that apply

- DESPT (Directive for high pressure equipment)
- ADR
- Health and Safety at work laws

Equipment used

- Use specific equipment:**
- High pressure hoses with anti-whip cable.
 - Portable and permanent leak detector.
 - CO₂ detector.



i **The correct treatment** → Move the victim into a non-contaminated area, using individual breathing apparatus. Keep the victim warm and resting. Call for a doctor. Practice artificial respiration if the victim is not breathing.



This information is covered in the brochure "Best practice for handling high pressure cylinders". Ask your Climalife sales representative for a copy .

INNOVATION IN THE USE OF CO₂ : Mooviz[®], the first high pressure mobile cylinder

The high-pressure R-744 requires high-pressure packaging which is heavy and difficult to handle. To help professionals overcome these constraints, Climalife has introduced the first innovative mobile cylinder specifically for CO₂: Mooviz[®].

Equipped with an ergonomic handle and wheels to make transporting and handling easier, Mooviz[®] is also light due to its design and high-tech composite materials.

With a tare weight of just 14 kg for a 10 kg load of CO₂, it offers refrigeration and air conditioning installers real added value.



- +** **lighter:** high-tech composite materials to reduce the tare weight
- +** **safer:** designed to handle the pressure constraints of CO₂
- +** **easier to handle:** wheels and ergonomic handle to facilitate transport and use

Charge	10 Kg
Tare	14 Kg
Dimensions	diam. 320 x ht. 780 mm
Test pressure	250 bar
Working pressure	166 bar
Valve	Dual phase 1 outlet, connector type C, bursting disc 250 bar

Make using CO₂ easier with Climalife!

The range also includes lubricants, specially designed for compressors used with the R-744, fixed and portable leak detection solutions and high pressure hoses and manifolds.

MOBIL SHC GARGOYLE™ 80 POE: a refrigeration oil designed specifically for the lubrication of compressors using CO₂ refrigerant for miscible applications

Formulated using an innovative Polyol Ester technology (POE) to provide outstanding lubricity, wear protection, chemical and thermal stability.

Its miscibility with CO₂ refrigerant and viscosity/temperature/pressure relationships ensure an appropriate film thickness even at high operating pressures and temperatures observed in piston compressors using this refrigerant technology.

With its naturally high shear stable viscosity index and low temperature fluidity, it can provide additional performance benefits in severe service conditions, including reduced shaft leakage and potential for improved evaporator efficiency.

- Excellent wear protection contributes to potential extended compressor life.
- High Viscosity Index and excellent low temperature fluidity help improve evaporator efficiency.
- Low traction coefficient provides potential for improved system efficiency and reduced power consumption.

Applications:

- Large industrial reciprocating refrigeration compressors used in the food industry for food preparation and freezing.
- Industrial applications such as food freezing and cold storage plants.
- Marine refrigeration applications;

Typical Properties Mobil SHC™ Gargoyle 80 POE see file p.3



Dates for your diary!

United Kingdom

The ACR Show will be held from 16 to 18 February 2016 at the Birmingham NEC. This national trade show is dedicated to the refrigeration, air conditioning, ventilation, heating, and heat pump sectors. The Climalife team will attend the show to display its new solutions, to share its technical expertise and to provide advice on matters such as energy efficiency and the implications of F-Gas II. Come and visit us: **Hall 9, stand G22.**



For more information on the trade show, go to: www.acrshow.com

Switzerland

Swiss Cooling Expo
The next Swiss Cooling Expo will take place in Forum Fribourg on 25 November 2015. This Swiss trade show is aimed at all stakeholders in the refrigeration, air conditioning, heat pump and ventilation sector. The entire Climalife team will welcome you on **Stand N°19.**



France

In the autumn of 2015, Climalife opened Energy Efficiency Days in Lyon. This unprecedented event presented the various challenges raised by current regulatory, technical and economic developments through a series of interviews with experts led by a professional journalist and broadcast live on TV. This new approach let the entire sector come together and discuss matters interactively. **Discover all of the information and the videos on our dedicated website:** www.journees-efficacite-energetique.com

Hungary

Climalife-Hungary will hold its annual conference on **10 March 2016** at the Holiday Inn hotel in Budaörs. Energy efficiency and innovation in compliance with local regulations and F-Gas II will be at the top of the agenda.

USA



Galco will attend AHR EXPO 2016 as an exhibitor. This international trade show will bring together companies operating in the sector. Orange County Convention Center in Orlando, Florida will host more than 2,000 exhibitors from **25 to 28 January 2016.** The Climalife Galco team looks forward to meeting you at **stand 2959.**

China



The 27th China Refrigeration trade show will take place from **7 to 9 April 2016** at the New China International Exhibition Center in Beijing. Climalife Galco will be at **stand E3F58.** Request your invitation now.

International

COP21
Paris will host the 21st Conference of Parties (COP21) from **30 November to 11 December.** This conference aims to obtain major international agreement on measures to be taken on climate change to help keep global warming increases below 2°C.

Europe

The F-Gas Solutions app takes two awards!
Launched in October 2014, the smartphone application, F-Gas Solutions, continues to gain popularity in Europe with almost 10,000 users.

Aside from the increasing number of professionals who use the app every day, F-Gas Solutions recently received awards both in the United Kingdom and France.

On 23 September in London, at the RAC Cooling Awards, F-Gas Solutions won the product of the year prize in the Refrigeration category (Components and Accessories). The Jury believed that, 'every engineer should have it'.



On 28 September in Paris, F-Gas Solutions was awarded the 'Environmental quality' Special Mention by the Grand Jury in the innovation competition organised by Mondial du Bâtiment 2015.



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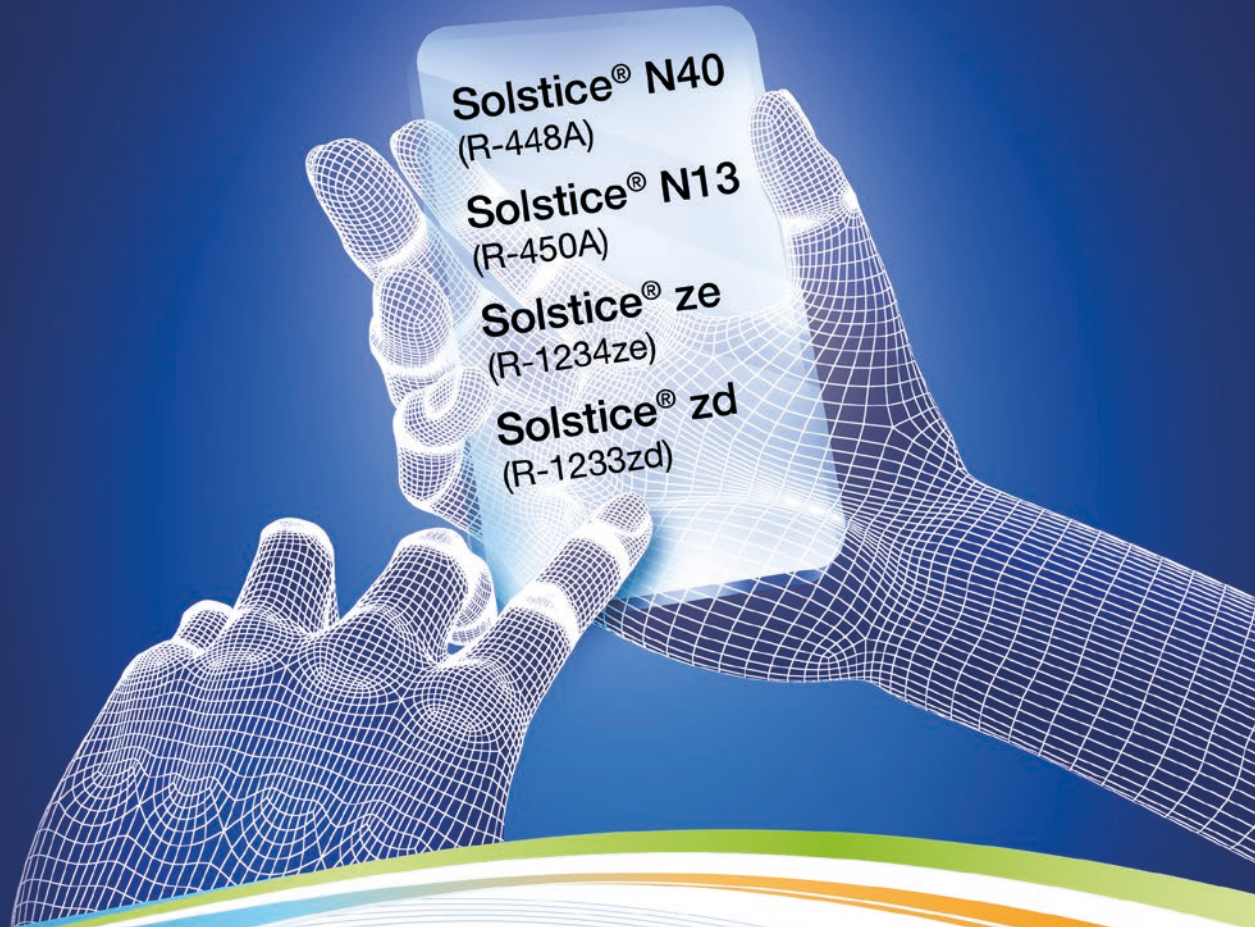
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Solstice[®] range: low GWP HFO refrigerants are here!



Solstice[®] product

Traditional refrigerant replacement

Applications

Benefit



Solstice[®] N40 (R-448A)
GWP* = 1387

R-404A



Medium and low temperature applications
Condensing units
Self contained unit
Refrigerated transport

- ODP = 0
- GWP is 65% lower than R-404A
- Reduced energy consumption by 5 to 16%
- Non-flammable (ASHRAE A1)



Solstice[®] N13 (R-450A)
GWP = 605

R-134a



Medium temperature refrigeration
CO₂ cascade

- ODP = 0
- GWP is 58% lower than R-134a
- Non-flammable (ASHRAE A1)



Solstice[®] ze (R-1234ze)
GWP < 1

R-134a



Heat pumps
Medium and high pressure chillers
Refrigeration equipment

- ODP = 0
- GWP is 99.9% lower than R-134a
- Low flammability (ASHRAE A2L)



Solstice[®] zd (R-1233zd)
GWP = 1

R-123



Low pressure chillers
High temperature heat pumps

- ODP = 0
- Non-flammable (ASHRAE A1)

R-245fa

Organic Rankine cycle

*GWP values are those stated according to the 4th IPCC assessment as per F-Gas regulation except for Solstice[®] yi/zd/ze (IPCC revision 5)