The wraps came off the world’s first and only natural-refrigerant-based container refrigeration system at Intermodal Europe 2011 in Hamburg, as the new NaturaLINE™ product design made its debut, exactly one year after Carrier Transicold announced the technology development.

“Advancing Carrier’s natural leadership in environmental technologies for the marine container refrigeration market, the NaturaLINE design provides the global shipping industry with the most environmentally sound alternative for refrigerated transport,” said David Appel, president, Carrier Transicold. “Carbon dioxide has a global warming potential of only one, and when compared to today’s container refrigeration units, NaturaLINE stands apart as the only one to offer a natural refrigerant-based solution.”

Incorporating breakthrough technologies, the NaturaLINE unit has been engineered to deliver efficiencies currently only achieved by Carrier’s best-in-class performer, the popular PrimeLINE® unit. Both units significantly reduce on-board power generation requirements, helping shipping lines save fuel used in generation of electricity. This, in turn, helps hold down operating costs and reduce emissions related to power generation.

“NaturaLINE demonstrates how technological innovation can reduce the impact on climate change, continuing Carrier’s long-standing commitment of providing sustainable solutions,” Appel said.

Through the use of the natural refrigerant CO₂, the NaturaLINE design will improve upon the PrimeLINE unit’s ability to reduce carbon emissions 28 percent compared to previous units.

**The Advantages of One**

The natural refrigerant CO₂, also known as R-744, is non-ozone depleting. Its GWP of one compares very favorably to conventional container system refrigerants R-134a and R-404A, which have GWPs of 1,300 and 3,260, respectively. The GWP of CO₂ is also lower than other natural refrigerants, such as propane and ammonia. So even in the event of a leak, the use of CO₂ adds no new environmental risk.

The introduction of natural refrigerant technology comes at a time when shipping lines are under increasing pressure to reduce their carbon footprint. Even though HFC refrigerants are considered to be minor contributors to global warming, their use continues to draw the focus of governments and the environmental community because of their higher GWP.

While presently there are no HFC bans for the shipping industry, the F-gas regulation in Europe has phased out automotive air conditioning systems using refrigerants with GWPs greater than 150 in new cars, and incentives are being offered in several EU ports for ships that produce low emissions and report their energy efficiency.

Although transport refrigeration (marine, truck and trailer, vans) is not presently covered by the European Union F-Gas
NaturaLINE technology shines in shipping innovation awards. Story on p. 12

Regulation, developments point to a potential inclusion in upcoming new F-Gas regulations. Carrier is committed to offering solutions to our shipping customers, even before these potential regulations take effect.

One-Upping

In developing the NaturaLINE system for best-in-class environmental performance, engineers drew from Carrier’s considerable experience with CO₂ in other applications, such as the CO₂OLtec™ system used in retail refrigeration applications throughout northern Europe. With nearly 300 installations at press time, CO₂OLtec systems continue to grow in popularity while reducing the impact from potential greenhouse gas emissions.

(continued on next page)

Refrigerants – Environmental Impact

<table>
<thead>
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<th>Refrigerant</th>
<th>GWP</th>
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<td>CFC-12</td>
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<tr>
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<tr>
<td>CO₂</td>
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GWP = Heat trapped per lb. of greenhouse gas

Heat trapped per lb. of CO₂

Source: IPCC SAR WG I, 2010
Although it bears some resemblance to other refrigeration units in the Carrier Transicold family, closer inspection of the NaturaLINE™ design reveals some critical distinctions or, in deference to our container refrigeration engineers, we’ll call them “transcritical” distinctions.

“Transcritical refers to a refrigeration cycle that is unique to CO\textsubscript{2} compared to conventional refrigerants,” explained Program Manager Mike Griffin, who led the engineering and development of NaturaLINE technology.

Addressing the transcritical cycle and the special thermodynamic properties of CO\textsubscript{2} necessitated the development of an innovative refrigerant management system, including a new purpose-built multi-stage compressor, a “gas cooler” with a wrap-around coil design and a flash tank.

In spite of the differences, much of the NaturaLINE design remains the same as other Carrier units. The basic frame, the evaporator and evaporator fans, and the controller and control box are virtually identical to existing Carrier models. The control interface is the same, although there will be new alarm and function codes. Also, serviceability will be similar to existing Carrier products, and will be supported by a new comprehensive training program offered by Carrier.

NaturaLINE technology achieves goals for best-in-class efficiency, performance and serviceability, all within a compact design envelope. The adjacent illustration shows some of the new core components that distinguish a NaturaLINE refrigeration unit from anything that has come before.

**Multi-Stage Compressor**

The NaturaLINE design makes use of an exclusive new multi-stage compressor that maximizes capacity and minimizes power consumption. “Purpose built” for the NaturaLINE application, the patented reciprocating compressor was developed by Carrier’s world-class Carlyle Compressor design center.

New to container refrigeration are the NaturaLINE system’s two stages of compression, which improve the overall efficiency of the unit.

The compressor also features a unique cylinder unloading capability. If the compressor needs to shed capacity for light-load conditions, it can save energy by turning off one of its two cylinders, similar to how certain automobiles do to save fuel.

**Variable-Speed Drive**

A first for a Carrier container refrigeration unit, the electric motor that powers the compressor now runs at variable speeds. A custom-designed variable-speed drive electronically adjusts the compressor’s speed, to provide the precise amount of cooling capacity to meet demand.

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**THE NATURAL ONE**

For container shipping, CO\textsubscript{2} is the only refrigerant that meets all of the following criteria:

- GWP of 1;
- Zero ozone depletion potential (ODP);
- Excellent heat transfer / heat reclaim properties;
- Non-flammable;
- Cost effective, available worldwide and requires no special disposal;
- Protected against phase-outs, taxes, and European F-gas regulations.

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**NaturaLINE™ is The One**

(continued from page 3)

As a result of Carrier’s multi-year development initiative, the NaturaLINE design includes a number of “firsts” for container refrigeration applications, some of which are patented. Among them are:

- A purpose-built, multi-stage compressor with variable-speed drive;
- A new gas cooler in place of the traditional condenser;
- A flash tank;
- Multi-speed fans; and,
- An advanced software control system.

All work together as one to efficiently optimize fan speeds and compressor capacity to match cooling loads and temperature control.

Although natural refrigerant technology differs distinctly from Carrier’s other container refrigeration systems, one point of commonality is the Micro-Link\textsuperscript{®} 3 Control, which assures that NaturaLINE units will be as familiar to operate as any other Carrier container refrigeration unit.

Serviceability will also be very similar to standard practices on today’s refrigeration units, and will be supported by Carrier’s complete service training program and global service center network. The way that technicians interact with, troubleshoot and repair NaturaLINE units will be very similar to how it is done with today’s units.

At the Intermodal Europe 2011 event, Carrier executives said that NaturaLINE units have completed extensive life-testing and are readying for sea trials, following successful trans-critical demonstrations with Hapag-Lloyd in 2010 and 2008.
This saves considerable energy compared to conventional units in which a compressor has only one speed – maximum – and refrigeration capacity is controlled via mechanical means.

**Gas Cooler**

NaturalLINE technology replaces the condenser assembly found in conventional refrigeration units with a new heat exchanger called the gas cooler. The gas cooler’s coil wraps around its fan, maximizing heat-transfer surface area for greater efficiency in a design that is both compact and lightweight.

The gas cooler makes the overall refrigeration system more versatile in responding to CO\(_2\)’s thermodynamic properties. It’s really two heat exchangers in one to allow gas cooling after each compression stage. This results in better unit efficiencies.

**Flash Tank**

An entirely new component in a container refrigeration system is the flash tank, which manages the flow and phase change of the refrigerant after leaving the gas cooler. For efficient cooling performance, the exclusive Carrier design enables final separation of CO\(_2\) from its gas phase to the liquid state before entering the evaporator.

**Two-Speed Fans**

The NaturalLINE unit’s evaporator and gas cooler use two-speed fans, offering greater versatility and energy-saving performance. The evaporator fans are the same as the ones used on the PrimeLINE\(^\circ\) unit, and other Carrier models. The new gas cooler fan has an aerospace-inspired design that is larger than the traditional condenser fan, with blades tuned to provide greater airflow and efficiency.

**Advanced Operating Software**

The operating software has been reengineered to manage the unique NaturalLINE mechanical system while still providing an easy to use control interface that works virtually the same as every other contemporary Carrier container refrigeration unit.
An unwavering commitment to the environment led Turkish shipping line Arkas Shipping and Transport S.A. to acquire 1,800 40-foot containers equipped with the Carrier Transicold’s PrimeLINE® refrigeration system, which leads the industry in energy efficiency.

A business unit of Arkas Holding Company, Arkas Shipping and Transport’s environmental commitment is so strong that it would consider nothing less than the PrimeLINE unit with its recent acquisition, which doubled the size of its refrigerated container fleet, according to Friksos S. Rothman, assistant manager – Reefer Container Technical Services, Arkas Holding’s Ardep Customs and Warehousing S.A.

“Arkas contributes to the protection of the environment by making well-directed choices. From that perspective, Carrier’s PrimeLINE was our only choice – a better-performing unit that results in lower emissions related to shipboard power generation,” Rothman said.

Not only was the PrimeLINE unit well suited to Arkas environmentally, but the unit’s exceptional efficiency – thanks in part to its efficient digital scroll compressor – also enables Arkas to fit more reefer containers onto fleet vessels and in terminals without requiring infrastructure upgrades, according to Rothman.

“We are pleased that Arkas has been able to further enhance its environmental profile through the acquisition of these PrimeLINE units, which are expected to save enough energy over their operating lifetime to eliminate more than 62,000 tons of carbon emissions relative to industry average,” said David Appel, president, Carrier Transicold. “That’s equivalent to removing nearly 900 cars from the road over the same period.”

Performance and Commitment

Encompassing 52 companies and over 5,645 employees, Arkas Holding, based in Izmir, Turkey, offers a wide range of services from land, air and sea, including international container shipping and port operations. Arkas today has 33 offices in 15 countries.

Arkas Shipping and Transport constitutes the core of the group of businesses, providing transport services in the Black Sea, Mediterranean and beyond. Its Arkas Line unit offers regular container shipping between ports in the Black Sea and the Mediterranean with a fleet of 27 container vessels. Arkas strives to exceed shippers’ expectations from the vantage of time, safety and cost, renewing itself in response to ever-changing conditions.

While the environmental and operational benefits of reduced power consumption were the primary reasons behind Arkas’ selection, the PrimeLINE unit’s exceptional pulldown and ability to dehumidify down to 50 percent were key decision drivers, Rothman said.

The PrimeLINE unit offers best-in-class pulldown among all container refrigeration units, as well as best deep-frozen capability among refrigeration units using non-ozone depleting R-134a, the refrigerant most widely used by the container industry. No other container refrigeration unit provides dehumidification capability lower than the PrimeLINE unit, and none can achieve 50 percent relative humidity as efficiently.

As Carrier’s Appel noted, “The PrimeLINE unit represents a continuation of Carrier’s decades-long commitment to incorporating sustainability into its product portfolio, giving customers such as Arkas opportunities to increase quality while lowering carbon emissions and operating costs.”
At a time when the total global refrigerated container fleet is estimated to be about a million units and the total number of dry and reefer containers is about 18 times that, a mere 420 containers may seem like a drop in the ocean. But when those 40-foot containers are filled with replacement parts, electronic components, consumables and refrigeration accessories from Carrier, they actually serve as a vital link in the global cold chain.

The 420 containers represent the annual shipments dispatched by Carrier’s Performance Parts Group from Syracuse, N.Y., Rotterdam and Singapore to bolster inventories of Carrier’s other strategically located parts depots throughout the world, which in turn support Carrier-authorized service centers and shipping line customers.

Carrier maintains thousands of active container part numbers supporting various generations of ThinLINE®, EliteLINE® and PrimeLINE® units, PowerLINE® generator sets, and also common replacement components for competitive equipment. Replacement parts are available in both the high-tier Performance Parts™ line and the Select Line™ tier, both of which are manufactured to original-equipment specifications, and supported by Carrier’s global warranty program, but vary in terms of warranty length and cost.

Additionally, the Performance Parts Group is now making preparations so that a ready supply of parts will be available to support the new NaturaLINE™ unit.

“The depth of our product offerings is just one of the key differences between Carrier and our competition,” said Ralph Bott, general manager of Carrier’s Performance Parts Group.

“Knowing what to stock where and in what quantities is fundamental,” he said. “A Carrier advantage is that we have our depots in the right places and the systems in place to assure that they are always well-stocked.

“Built through a nearly four-decades-long investment, our global network of parts depots is as extensive as it is because we’ve listened to our customers,” Bott continued. “We understood where they needed us to be, and in supporting their businesses, we’ve grown along with them.”

The scale and scope of the network itself will remain dynamic, according to Bott. “Based on customer feedback we are always looking for opportunities to support them wherever needed with quality parts and accessories, and unmatched global warranty support.

“Our commitment doesn’t end with the sale. We’re here to support our customers throughout the life of their Carrier investment.”

**PERFORMANCE PARTS DEPOTS 2011**

**AMERICAS**
Oakland, California
Syracuse, New York
Panama Free Trade Zone
Santos, Brazil
San Antonio, Chile

**EUROPE/AFRICA**
Rotterdam, The Netherlands
Cape Town, South Africa

**ASIA/PACIFIC**
Hong Kong
Yokohama, Japan
Yangsan City, South Korea
Singapore
Sydney, Australia
Auckland, New Zealand

“We’re here to support our customers throughout the life of their Carrier investment,” says Ralph Bott, general manager, Performance Parts Group.
New Zealand’s Specialised Refrigeration Services Ltd. (SRS) was named Carrier Transicold’s 2011 Top Performer for the Oceania region during the Container Products Group regional service center meeting in Queenstown, New Zealand.

Established 15 years ago, SRS is part of the Specialised Container Services Group of Pinnacle Corp. Ltd., and has operations in eight New Zealand port cities, including its headquarters in Wellington.

“SRS excelled in all categories considered for the Top Performer program,” said Paul Gray, Carrier Transicold field service manager, Oceania. “As part of their exceptional initiatives, they have in-house video conferencing to communicate to their entire work force in all locations. The owners also take a hands-on approach to shaping their reefer work force on a day-to-day basis to meet their customers’ needs.”

This is the second Top Performer award for SRS, including recognition by Carrier four times since 2001 for its training and employee development programs.

“SRS appreciates the recognition and support provided by Carrier since our company commenced trading,” said Grant Tregurtha, SRS managing director. “The areas of expertise recognized over the years reinforce our commitment to our industry and to Carrier, which remains at the forefront of reefer machinery design and manufacture globally.”

At the Oceania Service Center meeting, accolades also went to Sydney, Australia’s Reefer Management Services Pty. Ltd. and IPC Reefer Services for customer satisfaction and replacement components, respectively. Sturrock & Greenwood Ltd. of Nelson, New Zealand, received special recognition for employee development.

The 2011 Service Center Meeting was a two-day event attended by 40 representatives from 10 service centers as well as Carrier representatives from the Asia-Pacific Operations region, Oceania and Performance Parts Group operations in Australia and New Zealand. Presentations included a review of the current container refrigeration market and updates about service, warranties, field programs, replacement components and container refrigeration technologies.
Dennis Hogendoorn already had a decade of accounting and finance behind him when he joined Carrier Transicold’s Netherlands operation as a finance manager in 2006. Perhaps it was his “spirit of adventure” that lured him to the operations side of the business two years later when he became assistant branch manager in Rotterdam.

That spirit runs deep for Hogendoorn. An outdoor recreation and fitness enthusiast who enjoys cycling and snowboarding, Hogendoorn’s venturesome inclinations also led him to the peak of Mount Kilimanjaro in Tanzania in 2008. He followed that in 2009 living temporarily on a tropical-jungle island in Malaysia as a participant on “Expeditie Robinson,” the Dutch version of the American reality television show “Survivor.” Selected from a field of 5,000 applicants, he was a top-five finalist out of 21 competitors.

“I am always looking for new challenges,” he said.

So to step out of finance and into a more commercial and operational role “seemed like an excellent opportunity.”

Earlier this year, he started wearing two hats as both the Rotterdam branch manager and as the Performance Parts Group’s regional manager for Europe, Middle East and Africa (EMEA). That, once again, led him on an adventure, but this time the destination was customers.

“My first goal was introducing myself to as many customers as possible and getting to know them,” he said.

“I travelled to customer locations in the Middle East and also within Europe to understand their businesses. We try to keep the communication very open to be able to anticipate and respond to customer needs.”

Back in Rotterdam, Hogendoorn today applies financial skills honed during prior positions at PricewaterhouseCoopers and a business sense developed at Exel Group Holdings in the Netherlands to achieve results for Carrier. “In any function, you can benefit a lot from a finance background,” he said.

In addition to focusing on meeting the needs of Carrier’s customers in the region, Hogendoorn is responsible for the financial, operational, logistical and commercial aspects of the Performance Parts business in EMEA, and the electronics repair and rebuild operation based in Rotterdam.

As to the success the Rotterdam operation has enjoyed this year, Hogendoorn credits improved efficiencies, programs such as the PartsNet web-based ordering system and an exceptional team.

“We have a good group of people with the right mentality,” he said. “Customer focus is important. I am very proud of them and their accomplishments.

“My biggest challenge at Carrier is, of course, realizing the goals that are set for the Performance Parts Group EMEA business and looking for opportunities to expand the business. Achieving this in an environment in which our customers are happy and all employees feel valued, honored and challenged is very important.”
Natural Refrigerants Captivate Industry Groups

Natural refrigerant technology for the marine shipping industry has been a topic of considerable interest this year among both cold chain and environmental audiences, with Carrier representatives speaking at a number of industry events.

Notably out front at several conferences was Kartik Kumar, Carrier Director of Marketing and Strategic Planning, Global Container Refrigeration, who spoke about the development of NaturaLINE technology on panels at the Cold Chain Logistics Conference and CARBON EXPO, both in Barcelona, Spain, and also at Cool Logistics Global 2011 in Antwerp, Belgium.

Discussing natural refrigerant technology in the context of European environmental standards development, Mike Griffin, Carrier Transicold program manager, addressed the International Congress of Refrigeration in Prague, Czech Republic and the ATMOsphere Europe conference in Brussels, Belgium, an event itself dedicated to the promulgation of policies related to adoption and use of natural refrigerants.

“With the increased focus on environmental sustainability, the idea of natural refrigerants has resonated well with the shipping industry,” said Kumar. “Audiences recognize this as a step in the right direction and have told us that natural refrigerants represent the final step in the transition to the most environmentally sound refrigerant.

“While we are encouraged by the response, we consider it a privilege and are proud to be in a position to help define the industry direction,” Kumar said. “We are truly excited about the promise this technology holds for the container refrigeration industry.”

Griffin’s address at the ATMOsphere Conference clearly stated Carrier’s position on natural refrigerants, calling for the inclusion of transport refrigeration in the European F-Gas Regulation.

“Carrier has the right refrigerant solution for every application, but not every application will use the same refrigerant,” Griffin said. “We have an ongoing commitment to apply refrigeration alternatives that minimize environmental impact while serving customer needs.

“Although transport refrigeration is not currently covered by the current EU F-Gas Regulation, Carrier supports its inclusion in a revised F-Gas Regulation that would advocate the use of natural refrigerants by 2025,” said Griffin. “Technological progress has been made with natural refrigerant solutions that can be expected to meet ambitious F-Gas goals by 2025 for transport refrigeration. In this context we believe that any potential intermediate, non-natural refrigerant solution will be damaging to the environment, costly to develop and unnecessary.”
Remembering

Chris McHugh

*This issue of ContainerLINE is dedicated to the memory of our friend and colleague, Global Service Manager Chris McHugh, who had a profound and positive impact on each of us, as well as our business, during his 23-year career with Carrier.*

It is with sadness that we report the loss of an important member of the Carrier family, Global Service Manager Chris McHugh, who was well known by customers and fellow employees throughout the world. A husband, father of two daughters, and friend to many, he passed away on Sept. 5.

Chris served Carrier with dedication for his entire 23-year career, starting in the Container Service Engineering Group after receiving his electronics engineering degree from the State University of New York – Binghamton. Over the years he held a variety of responsibilities, ranging from engineering to product management to customer service, and along the way he also earned a masters degree in engineering management from Syracuse University.

After a stint with Carrier Electronics beginning in 2006, Chris returned in 2010 as regional service manager for the Americas, a position he held until his most recent promotion in June. He is fondly remembered by his colleagues at Carrier, especially for his leadership, sense of humor, love of sports, and devotion to his family.

Personnel Updates

**Regional Service Manager, Americas**

Zvonko Asprovski has been named regional service manager for the Americas. In his new role, he will lead the field service engineering team members in North, South and Latin America and will provide aftermarket support for customers and the service center network in the region.

Asprovski brings nearly 15 years of container refrigeration unit design, application and service experience to his position. He joined the Product Support Group in 1998 as a service engineer, taking on a key role in the development of Carrier’s EliteLINE® scroll platform. He has also supported the Container Products Group’s telephone hotline, which provides 24/7 technical and troubleshooting assistance for customers around the world. Most recently he participated on the container engineering design team developing NaturaLINE™ natural refrigerant technology.

**Program Manager**

David Smith has rejoined the Container Products Group as a program manager. His initial assignments include the Tier 4 engine project for generator sets, which is an emissions enhancement related to U.S. Environmental Protection Agency requirements, and the development of new options for container refrigeration units.

Smith returns to Carrier from JADAK Technologies in Syracuse, N.Y., where he served as a business program manager since March 2010. His original experience with Carrier dates back to 1999, when he joined the Container Products Group as a senior engineer, later growing into product management responsibilities within the Commercial HVAC group.

**Technical Writer**

Tim Kernan has joined Carrier Transicold as technical writer for container products and generator sets. In his new position, he is responsible for creating parts and operations manuals and service guides for container refrigeration units and generator sets, applying his extensive experience in the development of interactive technical documentation to enhance their functionality.

Previously, Kernan served as technical publications manager for BioSpherix Ltd. and as documentation and graphics editor for Lockheed Martin Training & Technical Services.

**Tim Kernan**

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1965 - 2011
Carrier Transicold’s NaturaLINE™ technology was named a finalist in two prestigious shipping industry award events recently.

It was judged “Highly Commended” for the category Innovation Technology of the Year in Containerisation International’s 2011 Awards program. NaturaLINE technology was also among six finalists for Innovation Award, New Products, in the IFW Awards competition.

No other container refrigeration manufacturer’s technology was recognized as a finalist in either program.

“Carrier Transicold was Highly Commended by the judges, as the NaturaLINE CO₂ solution was viewed as representing a tremendous breakthrough from the technological perspective, while allowing for the more sustainable movement of perishable products in an era when companies’ carbon footprints are becoming more important,” said John Fossey, editorial director of Containerisation International.

“Innovation and environmental commitment are key business drivers at Carrier, so we are proud and honored to have been recognized for our NaturaLINE technology in these two internationally recognized programs,” said Kartik Kumar, Carrier Transicold Global Container Refrigeration’s director of Marketing and Strategic Planning. “This recognition reaffirms our drive to develop technologies that can shape the future of the shipping industry by helping it achieve its environmental sustainability goals.”

Winners of the IFW program, now in its 15th year, were to be announced after this issue of ContainerLINE went to press. The monthly trade magazine Containerisation International and media website IFW are both owned by Informa Plc.