



The natural leader



High-efficiency
heat exchangers for CO₂



THE NATURAL REFRIGERANTS



In the refrigeration industry, the utilization of CO₂ fluid is becoming more and more popular as a radical solution to eliminate the greenhouse effect caused by halogenated hydrocarbons in the HFC category.

The GWP (Global Warming Potential) of CO₂ is in fact very low compared to HFCs (1 against several thousands); also, CO₂ does not present any problems of toxicity, flammability nor of impact on the ozone layer. CO₂ is significantly different from all the traditional HFCs (R404A, R507, ...) and it poses particular problems for heat exchanger designers; in addition, the appropriate choice of heat exchanger technology is fundamentally important in the realization of high efficiency CO₂ plants. The real challenge is to design plant with an efficiency level equal to or higher than current HFC plants.

There is a serious risk that the use of CO₂ may not be entirely good, regarding greenhouse effect mitigation. Even though the direct contribution is practically zero, the indirect effect would be increased if the CO₂ refrigeration cycles were less efficient than traditional ones, due to larger electricity consumption bringing about larger emissions of CO₂ and of other pollutants from



power stations, consuming more fossil fuels. For this reason, it is always worth bearing in mind that the technical solutions used to improve the environmental aspects cannot disregard the achievement of elevated thermodynamic efficiency.

The appropriate choice of heat exchanger technology is a fundamental condition for obtaining COP values from CO₂ cycles allowing for a real reduction of the greenhouse effect.

For these reasons, a specific project between LU-VE, Politecnico di Milano (Polytechnic University of Milan) and some important customers was carried out in order to define the ideal product configuration to get the best out of the specific characteristics of this refrigerant and to obtain interesting benefits from it.

Over time, LU-VE has in fact developed a line of products specifically for CO₂ unit coolers and, in an even more daring project, for sophisticated gas coolers which in transcritical CO₂ plants substitute traditional condensers in HFC installations.



Today LU-VE can state that it has the highest technical level and greatest experience in this particular field. Numerous unit coolers and gas coolers have been installed in different countries in recent years.

CO₂, the preferred solution. WHAT CAN LU-VE OFFER?



- High performance heat exchangers
- Reliable performance and know-how (laboratory testing plant)
- Experience in trans-critical: installations running for more than **10 YEARS**



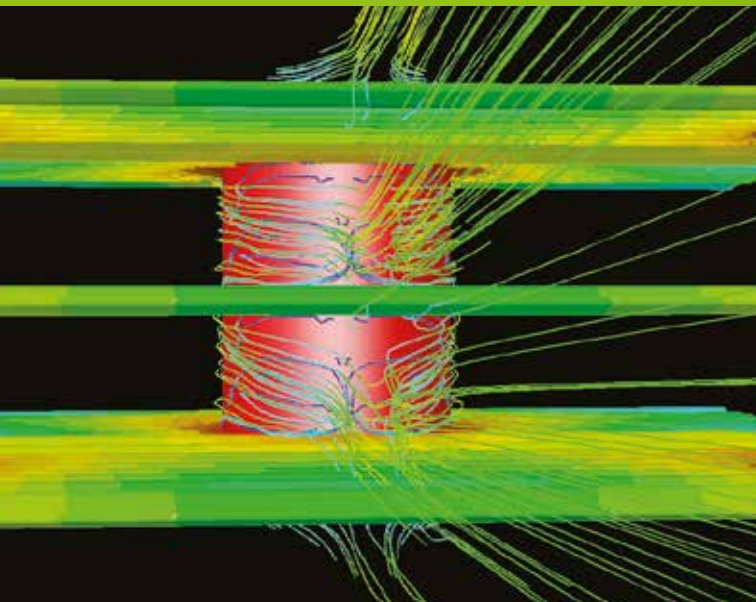
RESEARCH & DEVELOPMENT ACTIVITY

The basis of the industrial philosophy of the LU-VE Group is the principle that: **"IT'S THE GREY MATTER THAT MATTERS MOST!"**

R&D: LU-VE has one of the largest private laboratories in Europe, and works in close cooperation with Politecnico di Milano (Polytechnic University of Milan) and over 21 other universities all over the world.

- **C.F.D. METHOD (Computational Fluid Dynamics)**
The use of C.F.D. to increase the understanding of the thermo fluid-dynamic phenomena
- **5 CALORIMETER ROOM TESTS**
The results of the C.F.D. analyses have consistently been confirmed in experimental tests
- **FIN PERFORMANCE TUNNEL**
To study optimized specialized surfaces

- **TUBE PERFORMANCE DEVICE**
To study and optimize grooved tube technology
- **2 FAN PERFORMANCE TUNNELS**
To study fan motors performances
- **CO₂ TEST PLANT FOR UNIT COOLERS AND GAS COOLERS**
To study in detail the behaviour of CO₂ in the heat exchanger
- **SOUND LEVEL TEST ROOM**
To test the sound level of all the products
- **DRY COOLERS, CONDENSERS AND ADIABATIC TEST PLANT**
To test condensers and dry coolers also in wet conditions
- **CORROSION AND DIRTY TEST ANALISYS**
- **CONTROLLERS AND ELECTRONIC TEST R&D AREA**



UNIT COOLERS SERIES FOR CO₂

MAXIMUM WORKING PRESSURE: 40 (bar) - 60 (bar) - 85 (bar)



COMMERCIAL UNIT COOLERS		• FHC <i>Vantage</i>	• FHD <i>Vantage</i>	• BMA-SMA <i>Vantage</i>	• FHA <i>Vantage</i>
Range	Cubic unit coolers - dual discharge - angled unit coolers				
Defrost	Air, electrical				
Casing Materials	Epoxy-polyster powder coated galvanized steel				
Fin Materials	Aluminum, Alupaint (Coated aluminum fins)				
Pressure limits	MWP 60-85 bar				
Accessories	EC fan motor, fan shroud heaters, airstreamers, insulated drain train, shut-up, sock adapters, wired isolator switches				
N° Models	169				
Fin spacing	4.5 mm - 6 mm - 7 mm - 7.5 mm - 9 mm - 10 mm				
Fans	From 1 to 4 fans, Ø 275 mm - 300 mm - 350 mm - 450 mm - 500 mm - 630 mm - 710 mm				
INDUSTRIAL UNIT COOLERS		• FHC <i>Vantage</i>	• CHS • LHS <i>Value Defender</i>	• CDH <i>Value Defender</i>	
Range	CHS/LHS cubic unit coolers, CDH dual discharge, FF - other special coolers available for specific applications				
Coil geometry	Compact (CHS) or large surface (LHS)				
Defrost	Air, electrical, hot gas, hot glycol, water defrost, optional				
Casing Materials	Stainless steel, Epoxy-Polyster powder coated galvanized steel				
Fin Materials	Aluminum, Alupaint (Coated aluminum fins), copper, Blygold protective treatment, Heresite copper or stainless steel				
Tube Materials	Copper or stainless steel				
Pressure limits	MWP 40-60 bar				
Accessories	EC fan motors, fan shroud heaters, motorized dampers, airstreamers, insulated drain train, shut-up, sock adapters, wired isolator switches, hinged fan shrouds, special fans for high pressure and air quantity, air deflectors and more				
N° Models	159				
Fin spacing	4.5 mm - 6 mm - 7.5 mm - 10 mm - 12 mm				
Fans	Ø 450 mm - 500 mm - 630 mm - 450 mm - 710 mm - 800 mm - larger diameters and more powerful fans available				
		• FF <i>Fast Freezer</i>	• PDF • LS • CS		
					
			SPECIAL INDUSTRIAL UNIT COOLERS		

A specific configuration with copper tubes of small diameter and specialized fin geometry has been developed. The use of copper tubes allows high product efficiency and low CO₂ content. Particular circuiting for CO₂ has been designed for each model,

taking into account the thermophysical properties of CO₂, favourable to obtain elevated heat transfer performance and low internal pressure drop. The capacity of CO₂ unit cooler is in the region of +8% of the corresponding model working with R404A (Tevap -8 °C) and about +12% of the corresponding model working with R404A (Tevap -30 °C).

GAS COOLERS AND DESUPERHEATERS FOR CO₂

MAXIMUM WORKING PRESSURE: 120 (bar)



AIR COOLED CONDENSERS		• LMC <i>Nano Giants</i>	• SHV <i>Progress</i>	• SAV • EAV • XAV • EHV <i>Progress</i>
Range	Complete range for trans-critical and subcritical, commercial and industrial			
Accessories	AC and EC fan motors, Modbus, epoxy-coated fins, coil protection grids, anti-vibration pads, isolator switches and more	• XDHV <i>Small Giants</i>	• EHVD <i>Giants</i>	• RAD <i>Propeller</i>
Fans	From 1 to 22 fans, Ø 300 mm - 350 mm - 500 mm - 630 mm - 710 mm - 800 mm - 910 mm - 1000 mm			
ON REQUEST	<p>Whisperer Plus: Compact sillerer designed and developed by LU-VE. Combined with EC fan motor, provides drastic reduction of sound level by up to 6 dB(A) and up to 19% reduction of electricity consumption.</p> <p>Adiabatic System: different solutions to increase capacity with water are available. From Water Spray to the new Emeritus range.</p>			

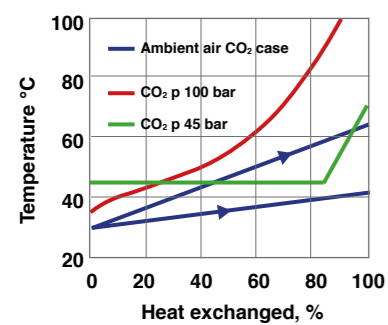


Fig. 1

Gas cooler design is rather complex and it differs from the design of a traditional condenser. The maximum operating pressure is 120 bar and the maximum operating temperature is 150 °C. The temperature profiles of a CO₂ gas cooler and a condenser for R404A are compared in Fig. 1. As a consequence of the high average temperature during the CO₂ cooling process, it is possible to bring the air up to much higher temperatures, as shown in Fig. 1, with notable advantages in terms of reducing the frontal area of the fin pack, reducing the electric power required for ventilation and reducing noise level.

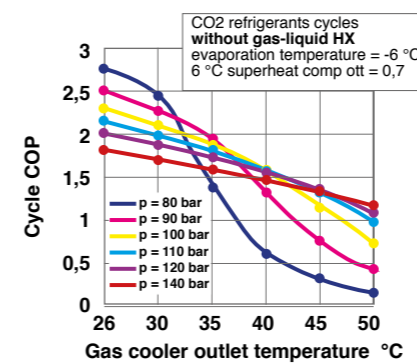


Fig. 2

Another key problem of a CO₂ plant is the heavy influence of the gas cooler outlet temperature on plant efficiency (COP), as indicated in Fig 2. In order to have low gas cooler outlet temperatures also in summer, LU-VE has developed a suitable coil design and in addition made it possible to couple the product with a water spray system. A specific configuration with small diameter copper tubes and specialized fin geometry has been developed. The use of K65 copper alloy tubes makes it possible to obtain high product efficiency and low CO₂ content. Special circuiting and coil configuration have been introduced in order to offer a product which can reach high levels of performance. A specific procedure for testing the coil has been defined.

LEADERSHIP WITH PASSION

LEADERSHIP IN ACTION



LU-VE Group is an international enterprise with its headquarters in Uboldo, Varese, Italy, along with its main offices and principle production facility. The strength of the Group lies in its 10 production plants located in 7 different countries: Italy, China, Czech Republic, India, Poland, Russia, and Sweden. The companies which make up the Group are:

- AIA** / **AIA/LU-VE Sweden (Asarum, Sweden):**
heat exchangers for refrigeration, air conditioning and industrial applications;
- HTS** / **HTS Heat Transfer Systems (Novsedly, Czech Republic):**
coils for air conditioning, refrigeration and for special applications (trains and means of transport in particular);
- LU-VE DIGITAL** / **LU-VE Digital (Uboldo, VA, Italy):**
information technology, development and implementation of calculation softwares;
- LU-VE exchangers** / **LU-VE Exchangers (Uboldo, VA, Italy):**
heat exchangers for refrigeration, air conditioning and industrial applications;
- LU-VE Changshu** / **LU-VE Heat Exchangers (Changshu, China):**
heat exchangers for refrigeration and air conditioning, destined for the Chinese and Asian markets;
- SEST** / **SEST (Limana, BL, Italy), SEST LU-VE Polska (Gliwice, Poland), "OOO" SEST LU-VE (Lipetsk, Russia) & SEST LU-VE China (Changshu, China):**
heat exchangers and condensers for refrigerated cabinets and finned heat exchanger coils for commercial refrigeration and air conditioning;
- SPIROTECH** / **SPIROTECH Heat Exchangers (Bhiwadi, Rajasthan, India):**
heat exchangers for domestic appliances, air conditioning and refrigeration;
- TECNAIR LV** / **TECNAIR LV (Uboldo, VA, Italy):**
close control air conditioning for applications in surgical rooms, white rooms, data centres and telephone exchangers;
- TGD** / **TGD - Thermo Glass Door (Travacò Siccomario, PV, Italy):**
glass doors and closing systems for professional, domestic and industrial refrigeration equipment.

Heat exchangers for industrial and commercial refrigeration, air conditioning and industrial applications.

LU-VE S.p.A. is the holding company of LU-VE Group. In 1985 LU-VE S.p.A. acquired Contardo S.p.A., established in 1928. Production began in 1986.

LU-VE quickly made its mark thanks to high standards of quality, new solutions designed in its own laboratories and to the care taken with the appearance of its products. (Beautiful outside - Revolutionary inside).

It was the first company in the world to apply avant-garde solutions to commercial and industrial refrigeration:

- grooved tube technology;
- specialized heat exchange surfaces;
- certified performance levels;
- innovative materials and colours;
- advanced design.

The success of LU-VE in the international market stems from its research and development policy, its great respect for the environment and its rigorous ethical and commercial principles.

In 2000, LU-VE was the first company in Europe to attain the prestigious Eurovent "Certify-All" certification for the entire range of its products: unit coolers, condensers and dry coolers.

LU-VE and the Group have introduced new ways of conceiving and constructing products for refrigeration, air conditioning and industrial applications, creating new technologies which have then gone on to become the benchmark for the entire industry.

