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CONNECTING EXPERTS.

Low charge R717 Refrigeration

Javier Cano

CHILLVENTA

International Exhibition
Refrigeration | AC & Ventilation | Heat Pumps

Nuremberg 11–13.10.2022

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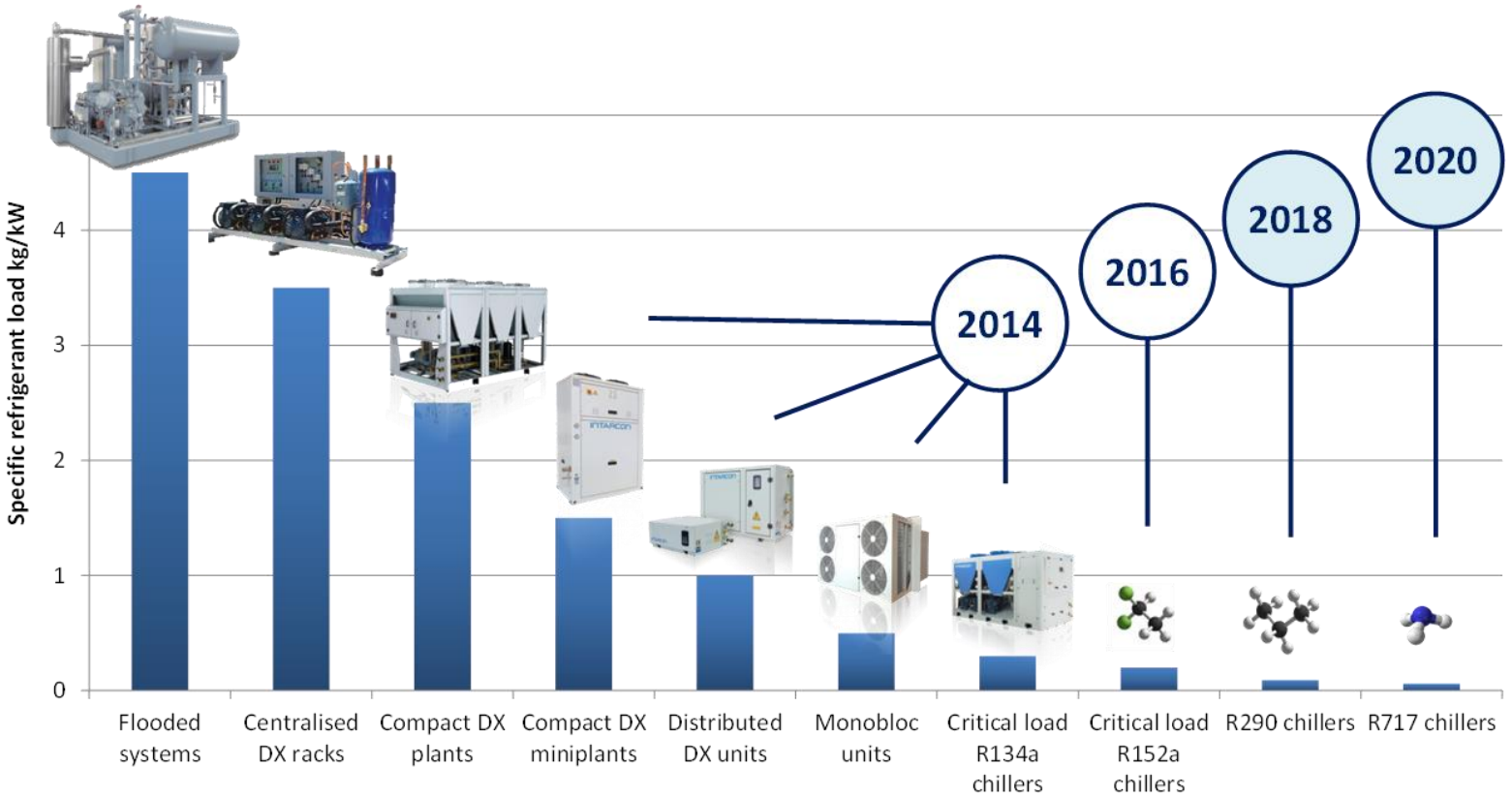
NÜRNBERG MESSE

Contents

- Low-charge concept
- Low charge technology in Ammolite units
- Key issues
- Packaged chillers
- Packaged DX systems
- Life cycle cost
- Conclusions

How much is low-charge?



What is a low charge system?

Specific load

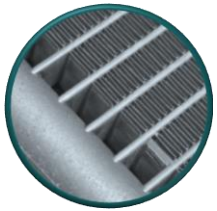
Type of R717 system	Specific R717 Load
Conventional pumped systems.	~ 2.5 - 4 kg/kW
Low-overfeed pumped systems	~1.5 kg/kW
Centralised R717 DX systems	~1 kg/kW
Cascade R717 Systems	~0.6 kg/kW
Distributed DX Systems	~0.3 kg/kW
Secondary systems	~0.07 kg/kW

Total load

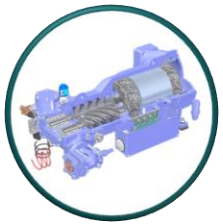
Safety requirement	R717 Load
EN 378 – Access cat. C, loc.1	< 4.5kg per system
EN 378 – Access cat. C, loc. 2	< 25kg per system
EN 378 – Additional safety req.	> 50kg
Transport by road cat.1 (ADR)	< 50kg total charge
USA EPA (release reporting)	> 100 lbs (45 kg)
France (hazard declaration, arrêté 19/11/2009)	> 150 kg total charge
USA EPA (hazard declaration)	> 500 lbs (225 kg) total charge.
EN 378 – Further requirements	> 500kg …

Low-charge technology in Ammolite DX

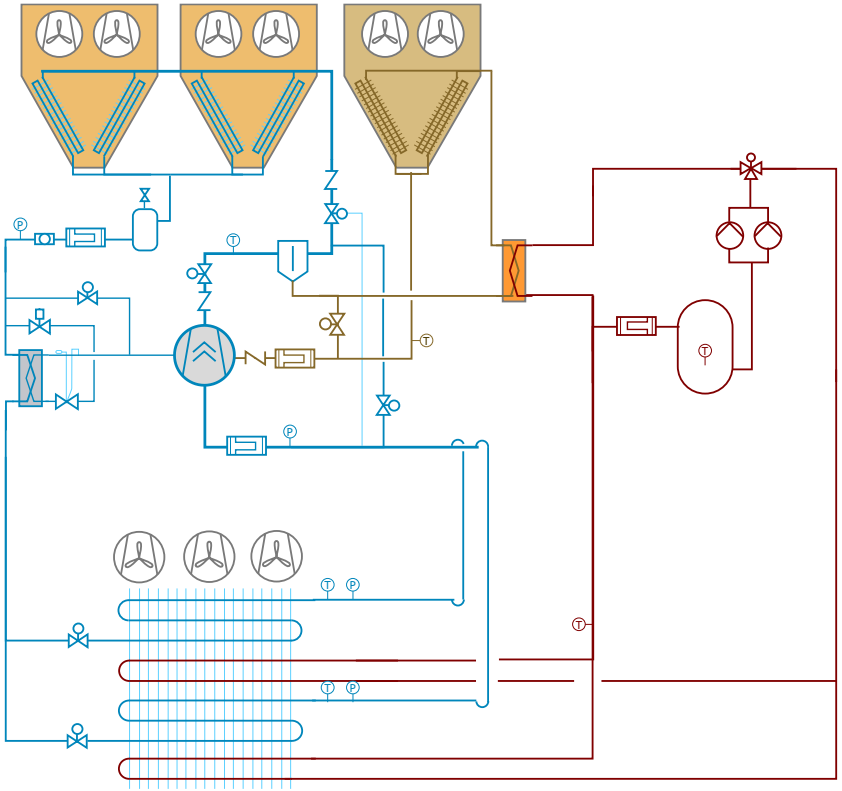
Microchannel condenser

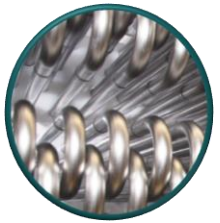


Semihermetic screw compressor with permanent magnet motor.



DX evaporator





Air-cooled oil circuit

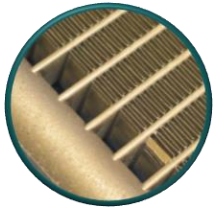
Heat reclaim for hot glycol desfrot

Miscible oil One-stage separator

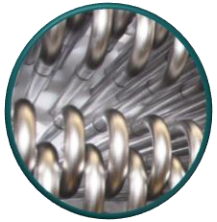
Low-charge technology in Ammolite chillers

Critical load cooling circuit

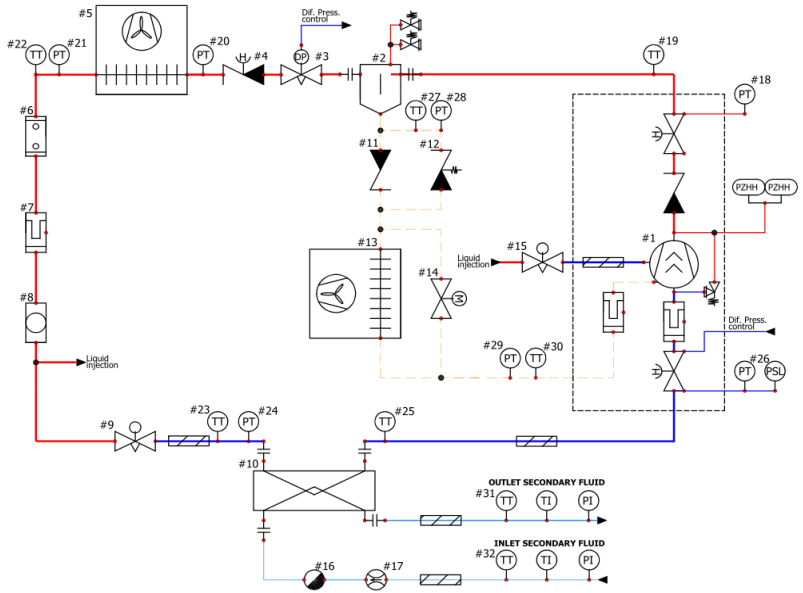
Microchannel condenser



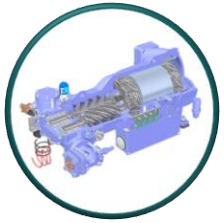
Air-cooled oil circuit



Direct expansión VEE



Miscible oil
One-stage separator

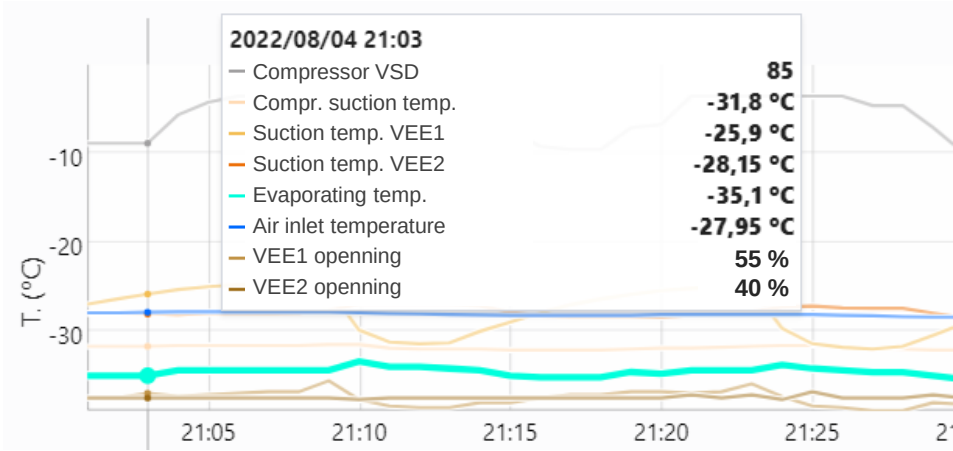


Semihermetic screw compressor with permanent magnet motor.

Full stainless steel plate evaporator

Key issues in DX R717 systems

- Direct Expansion evaporators
  - Refrigerant distribution
  - Enhanced exchange surface for complete wetting
  - Oil fouling on exchange surface
  - Precise injection control
  - Floodback prevention, smooth operation
- Compressor
  - Gas-cooled semihermetic compressor
  - High efficiency motor (permanent magnet rotor)
- Liquid subcooling
  - Economiser subcooler
- Water content in ammonia
  - Water significantly increases the boiling point of ammonia
  - Ammonia-water solution at a concentration of 20% water will return from DX evaporators



Monitoring of a fin & tube DX evaporator in a blast freezer

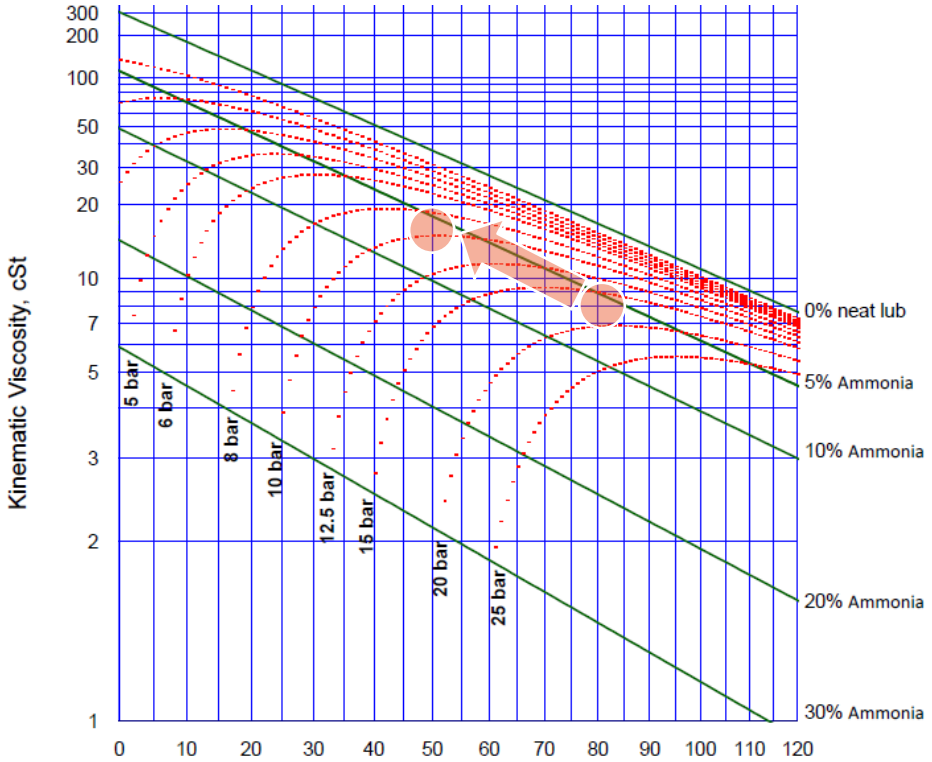
DT1: ~7K

SC: ~3K

Key issues in DX R717 systems

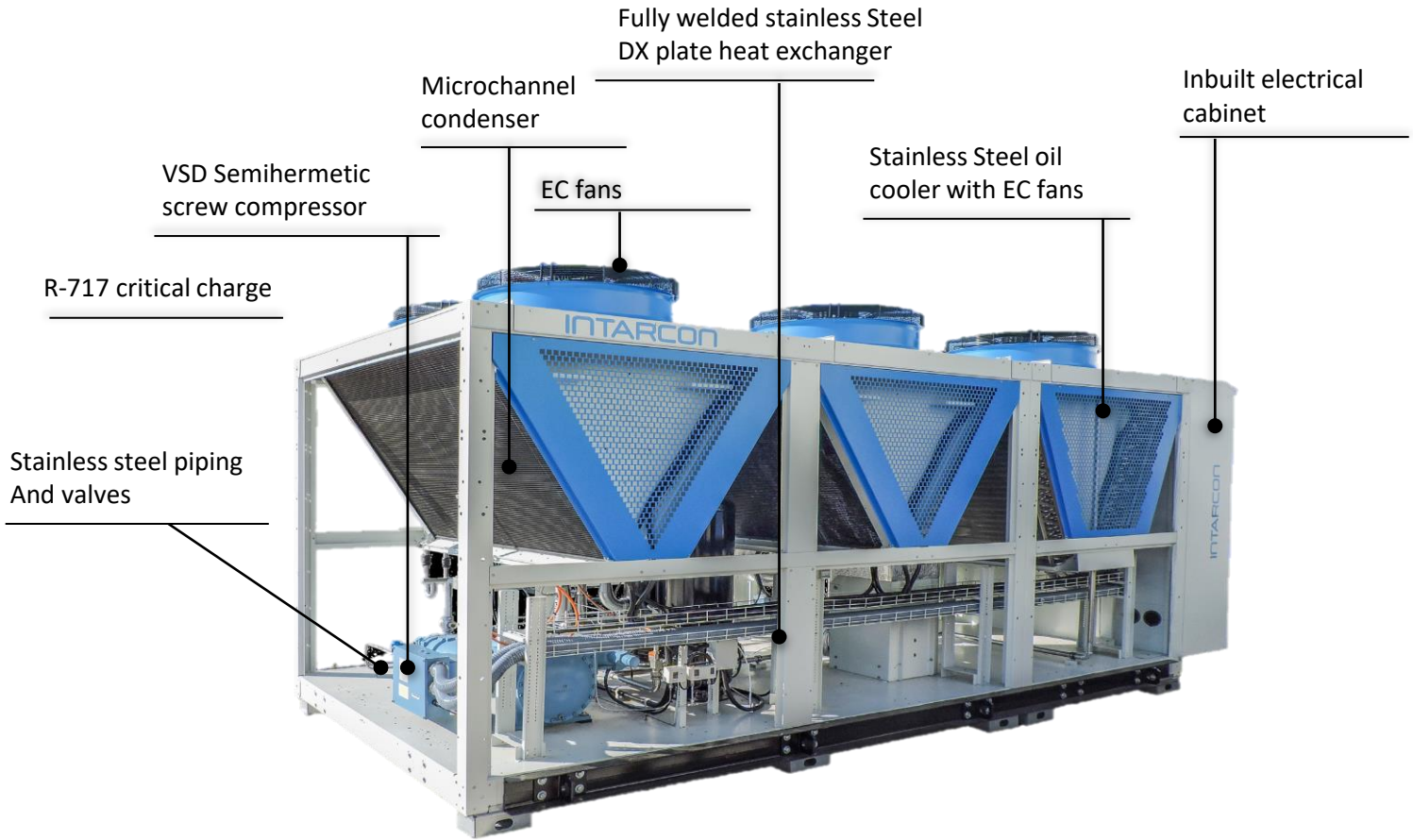
- Oil management
  - Oil migrates to the evaporator and need to be returned to the compressor
  - Miscible oil solution
    - Oil is miscible through the entire operating envelope.
    - One-stage oil separation is enough.
    - Oil traps needed in suction risers
  - Direct air-cooling
    - Direct air cooling is preferred to thermosiphon oil coolers.
    - Increased efficiency.
    - No extra charge of R717 needed
  - Solubility of ammonia in oil
    - Oil must be kept warm to reduce ammonia solubility during stand-by.
  - PAG oil traps moisture into the PAG polymer chain.

R717/PAG PVT chart



Source: Muñoz, M. 2018

Ammolite packaged chillers



Ammolite chiller

Meat processing industry, Mataró, Spain

Cooling capacity: 720 kW (MPG35% @ -8ºC)

R717 charge: 2x 25kg

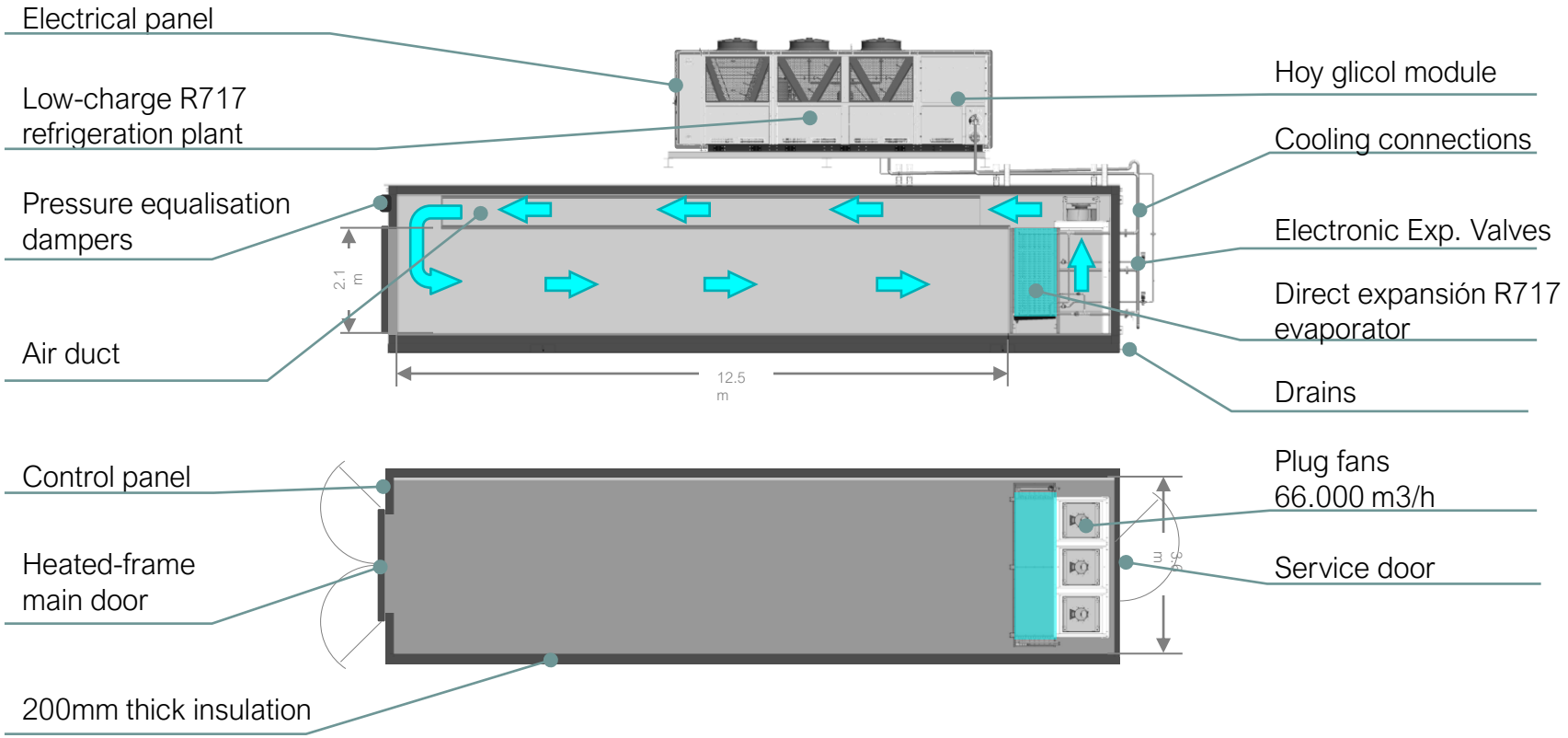
Túrbofreezer Ammolite DX

Meat processing industry, Tarancón, Spain.

Cooling capacity per unit: 125kW @ -35ºC

R717 charge per system: 50kg

Turbofreezer Ammolite DX



Kiconex - Plataforma de supervisi

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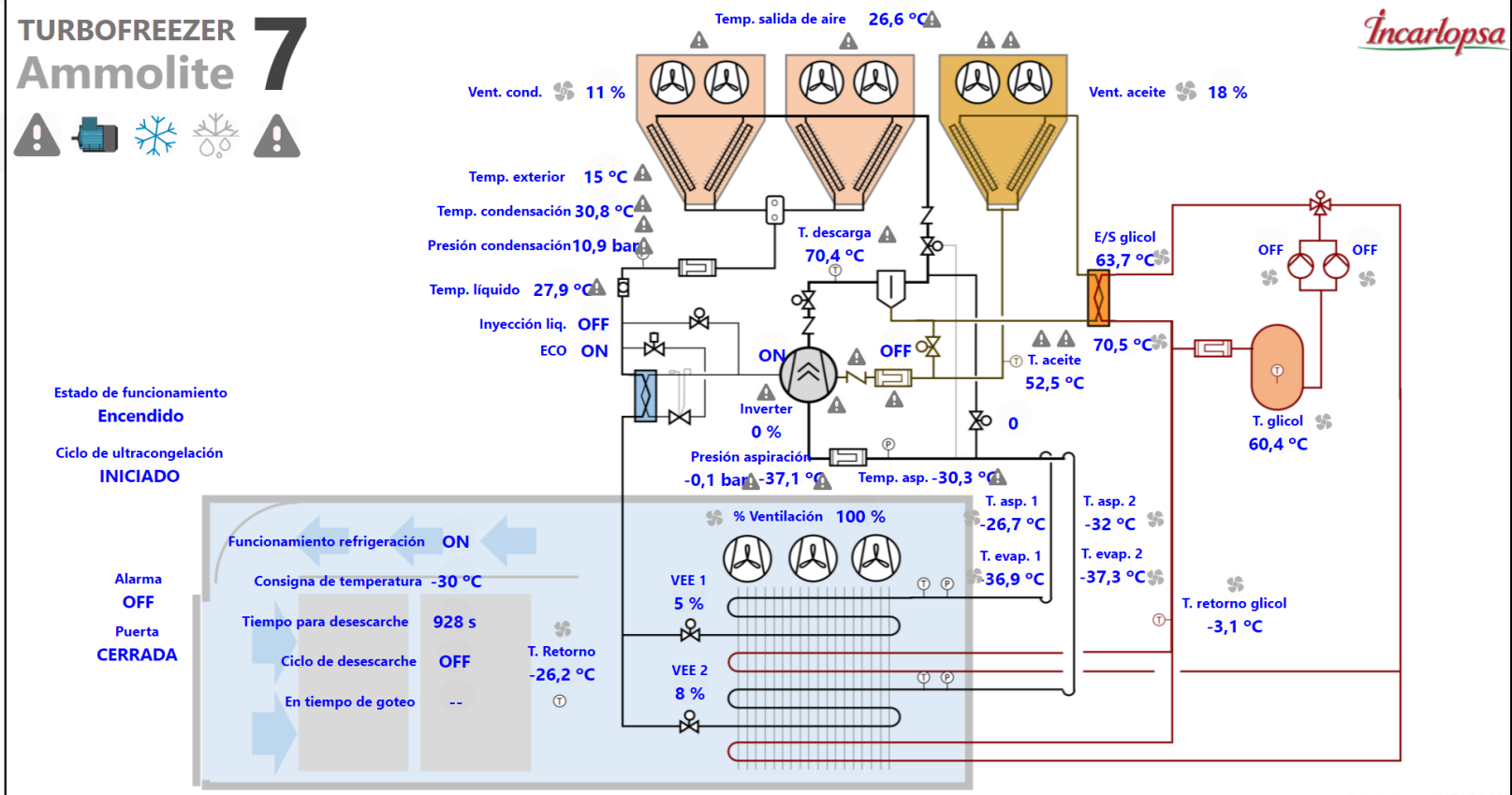
kiconex

Javier Cano

- Vista general
- Alarmas
- Instalaciones
- Gráficas
- Diagramas
- Documentación
- Librerías
- Configuración

TURBOFREEZER 7 Ammolite

Incarlopsa



Diseñado por INTARCON

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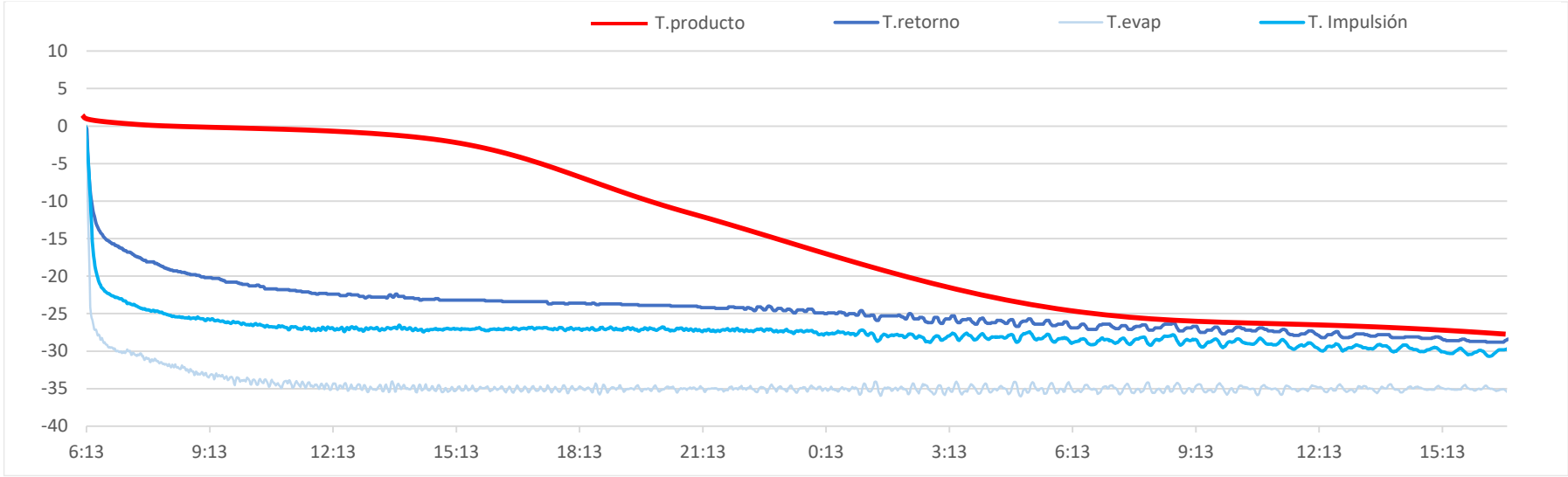
kiconex

Javier Cano

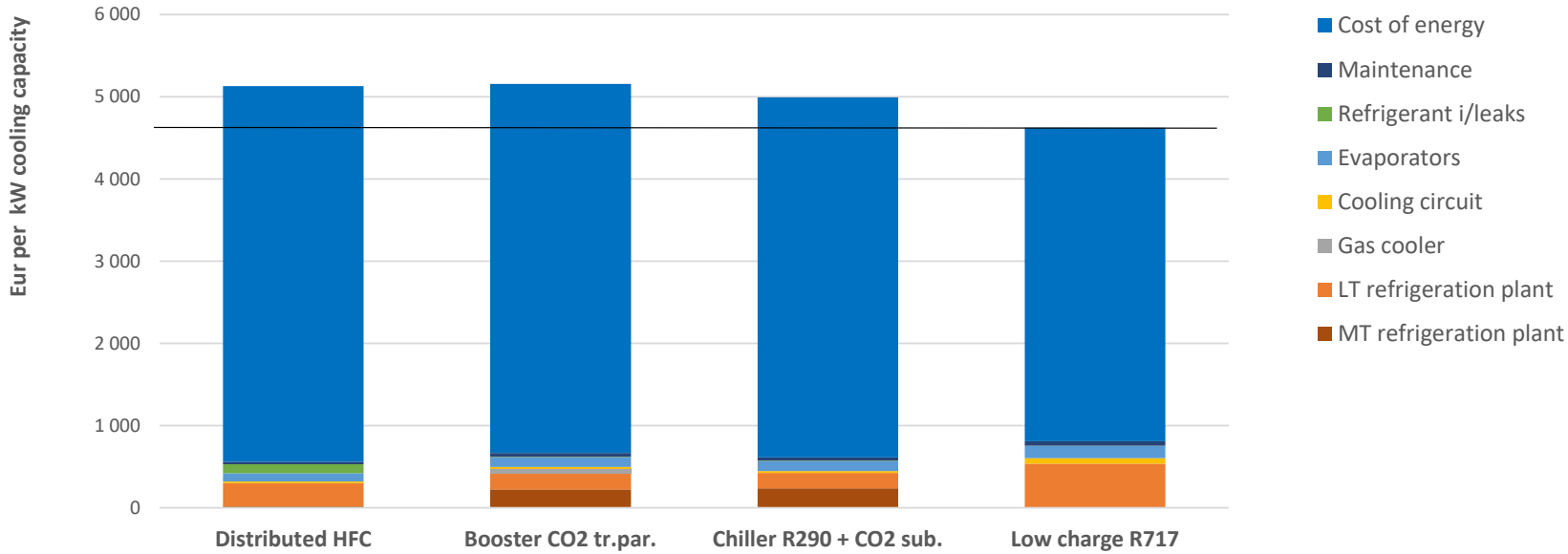
Gráfica

2022-02-24 07:15:00 - 2022-02-25 19:15:00



Life Cycle Cost for a LT cold room

250 kW cooling capacity
20.000 sqm
Life span: 15 years



Cost of energy: 0.15 Eur/kWh,
Seasonal energy performance according to Ecodesign regulation (UE) 2015/1095,
Isentropic efficiency of compressors = 60%, DT1 in condenser = 10K, Evaporating temperature: -30ºC

Low charge R717 technology - conclusions

R717

ECOfriendly solution
Minimal TEWI factor

Safe and reliable
Minimal H&S hazard (< 70gr per kW)

Quick and easy installation
Plug & Play

4.0 Industry
Cloud based monitoring.

Quick pay-back vs HFC systems
Optimal Life Cycle Cost.

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