



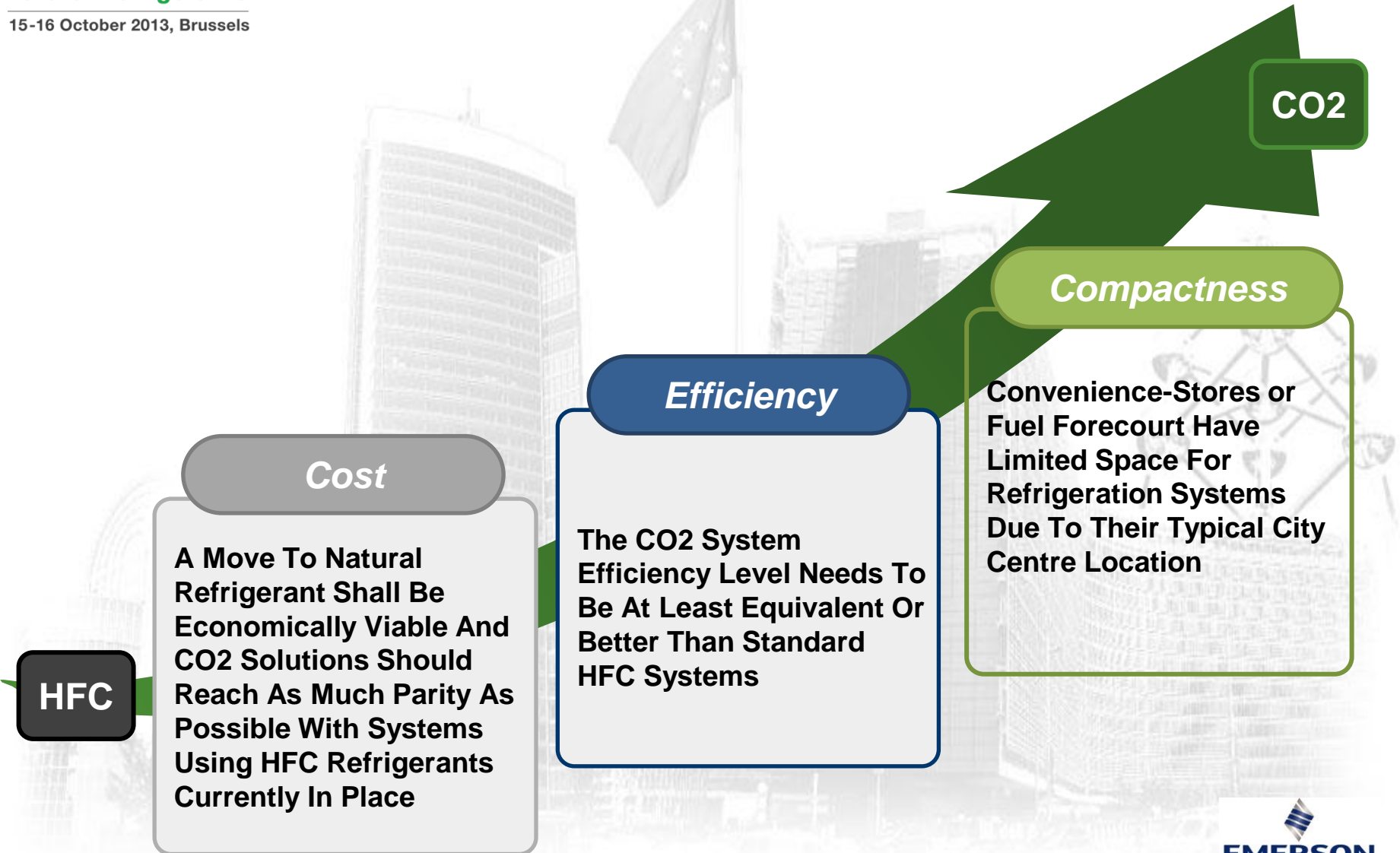
CO₂ Booster System For Convenience Stores Using Mixed Scroll/Piston Compressor Technology

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What Drives Retailers In Choosing The Right Booster CO2 Pack For Their Convenience Store

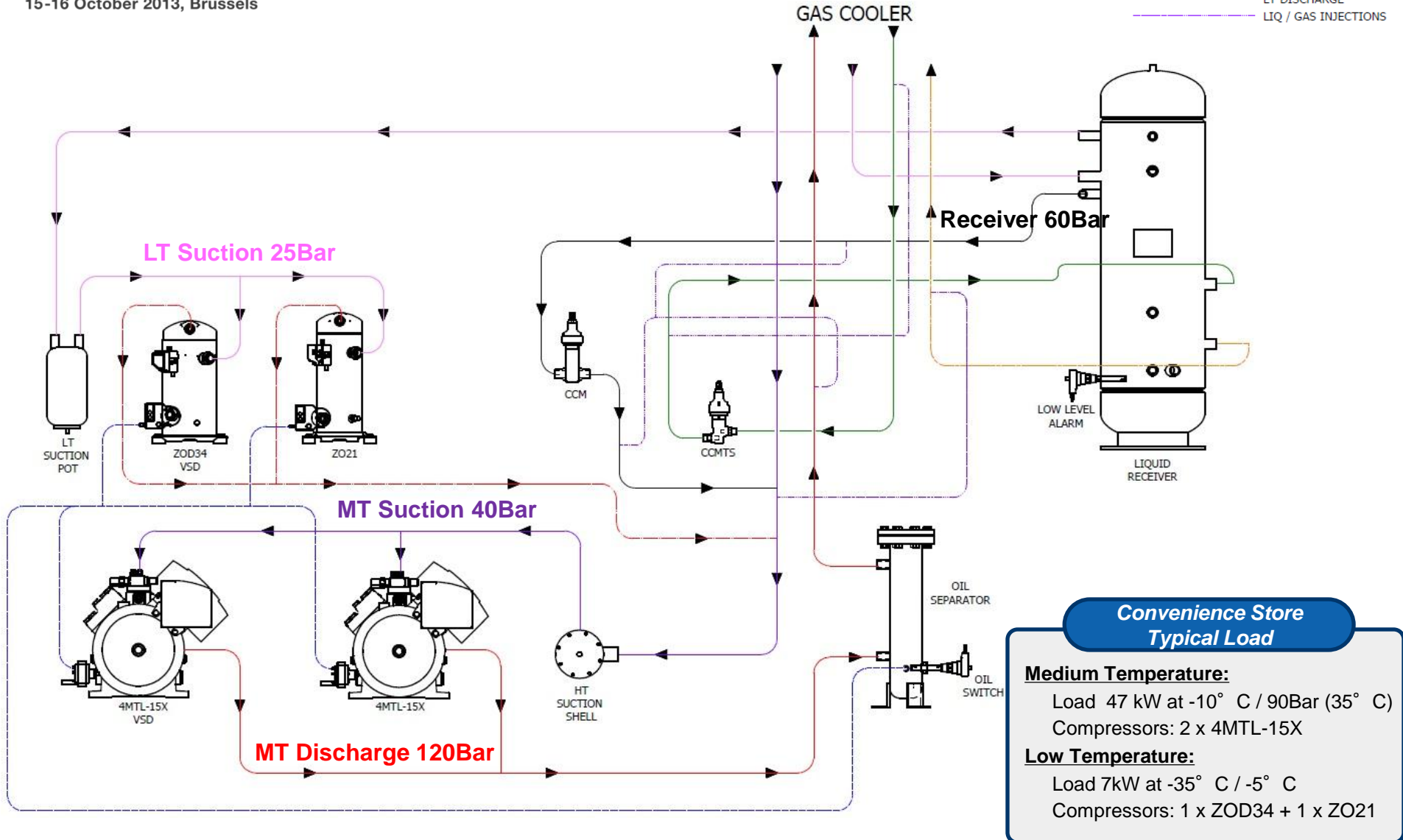


Overview

Compact Booster Pack

PIPE-WORK KEY

- OIL LINE
- HT SUCTION
- LT SUCTION
- GAS RETURN K65
- LIQUID FEED K65
- DISCHARGE K65
- RECEIVER PRESSURE
- - - LT DISCHARGE
- - - LIQ / GAS INJECTIONS



**Convenience Store
Typical Load**

Medium Temperature:
Load 47 kW at -10° C / 90Bar (35° C)
Compressors: 2 x 4MTL-15X

Low Temperature:
Load 7kW at -35° C / -5° C
Compressors: 1 x ZOD34 + 1 x ZO21

A Move To Natural Refrigerant Shall Be Economically Viable And CO2 Solutions Should Reach As Much Parity As Possible With Current Systems Using HFC Refrigerants



Use Of Copper Tubes Instead Of Steel

- Pre-bending Tubing To Reduce By 60 The Number Of Joints
- Soldering Copper Joint 5 Min Vs Welding Steel Joints 30min

Versus Steel
10% Savings
Reduced Build Time: 6 Days



Use Of Scroll Technology In Low Temperature

- Smaller Pack / Frame Size
- 20kg Compressors Vs 50kg Semi
- Frame Easier To Build, Compressors Easier To Handle & Connect

Versus Semi
2 % Savings
Reduced Build Time: 2 Hours



Use Of Digital Scroll Technology For Stepless Modulation

- Match Capacity To Load 10...100% (Versatile, Flexible)
- No Need For Inverter & Associated Components

Versus Semi/Inverter
5% Savings
Reduced Build Time: 4 Hours



Compressor On-boards Electronics (Protection/Diagnostics)

- Integrated Protection Devices - No Longer Needed In Pack
- Predictive Maintenance For Longer Life Cycle
- Run And Fault History, Power Monitoring & Remote Diagnostics

**End
User
Benefit**

Vs Individual Components
2 % Savings
Reduced Build Time: 2 Hours



High Pressure Compressor Oil Regulator (130bar)

- No Need For Oil Reservoir, Oil Fill Solenoid,
- No Need For Dual PRV, Transducer, Hoses

Vs System w/ Oil Reservoir
2% Savings
Reduced Build Time: 4 Hours

Pack Cost Down to To Approx. 50% > HFC
Total Installation 35% > HFC
Cost Reduction Initiatives Continue As Volume Increases

**Total Versus
Conventional CO2 Pack**
21% Cost Savings
9 Days Less

CO2 System Efficiency Needs To Be At Least Equivalent/Better Than Standard HFC Systems

	Conventional HFC Scroll Pack (R404A)	Mixed Technology Scroll/Semi Booster	Delta
COP MT	4,29	3,86	
COP LT	1,65	4,38	
COP Total (1)	3,69	3,93	6%
Energy MT (kWh)	43.412	48.162	
Energy LT (kWh)	9.809	3.704	
Total (kWh) (2)	53.221	51.867	
Yearly Savings (kWh)	Base	1354	3%

(1) Based On UK Average condensing 25 ° C

(2) Based On Actual Running Hours (Bristol)

Efficiency Optimised:
Inverters in MT
Scroll & Digital In LT

**Integrating Heat Reclaim Offers An Opportunity
To Provide 11% Yearly Savings For Full Store**

Convenience-Stores Have Limited Space For Refrigeration Systems Due To Their Typical City Centre Location

1



R&D Test Frame - Prototype

26% Footprint Reduction Through Iterative Design

- Vertical Scroll & Experience w/ Technology
- Pre-bent Pipe Assemblies w/ Minimal Fittings
- One Inverter Less (Digital Scroll)
- Compact Control Panel
- Years Of Experience in Packaged Units Building
- Be Flexible & Listen To The End User
- 3D Simulations

2



Pre-Production Frame
 1900 W x 800 L x 1940 H (mm)

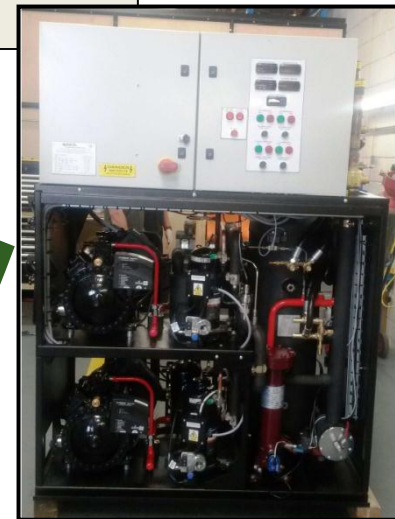


Start



Finish

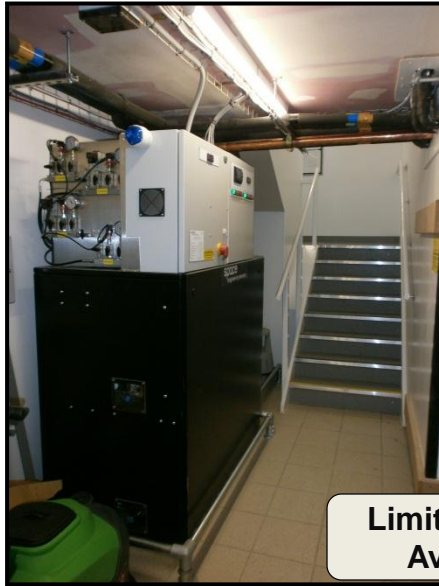
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Production Frame
 1400W x 800L x 1940H (mm)

Experience

Mixed Scroll / Semi-Hermetic Booster Pack



Limited Space Available



- **Trialled From Nov 2012 To July 2013 in Pucklechurch, UK**
- **Several Design Iterations & Improvements**
- **Production Launched Since Aug 2013**
- **Several Packs Already Running In Stores In Different Locations**
- **Roll-out Program Until Feb 2014**

Summary

Helping Retailers To Transition To CO2 For Their Convenience Stores

CO2

 = New Technologies

Cost

50% > HFC (Pack)
35% > HFC (Installation)

1. Copper K65
2. Scroll Technology
3. Digital Modulation
4. HP Oil Management
5. On-Board Compressor Electronics

Efficiency

3...6% > HFC

1. Inverter (Medium Temperature Only)
2. Scroll Technology
3. Digital Modulation (Low Temperature)

Compactness
26% Reduction To 1,4m

1. Scroll 
2. Pre-Bent Pipes
3. 3D Simulations
4. Design Expertise
5. Manufacturing Experience

HFC


EMERSON
Climate Technologies
Emerson
Contributing
Products



OM5 Oil Management
(130Bar)



Scroll / Scroll Digital ZO(D)
CO2 Low Temperature



Stream With CoreSense Diagnostics
CO2 Medium Temperature



Continuous Improvements Ongoing:

- Continue Simplifying Oil Circuit
- Optimise Piping Sizing
- Optimise Component Sizing
- Smaller Capacities
- Air Conditioning
- Heat Reclaim

Lessons Learned

- **Close Collaboration Between Compressor Manufacturer And Equipment Manufacturer Is Essential**
- **There Are No Special Engineering Requirements When Mixing Scroll And Semi-hermetic Technologies In The Same Pack**
- **New Technologies Often Prove To Support Solving End-user Challenges, And Also Open Up New Opportunities**
- **New CO2 Scroll And Digital Scroll Technologies Help Make Systems More Cost Competitive**
- **Natural Refrigerants Will Be Used Not Only In Medium To Large Retail Formats But Also In Smaller Formats, And Now The Technology Is Readily Available**
- **Convenience Store Operators Can Afford To Make The Transition Now. CO2 Refrigeration Equipment Design Will Continue To Improve And Will Be More Competitive In The Future**



solutions for europe

natural refrigerants

15-16 October 2013, Brussels

Thank you very much!

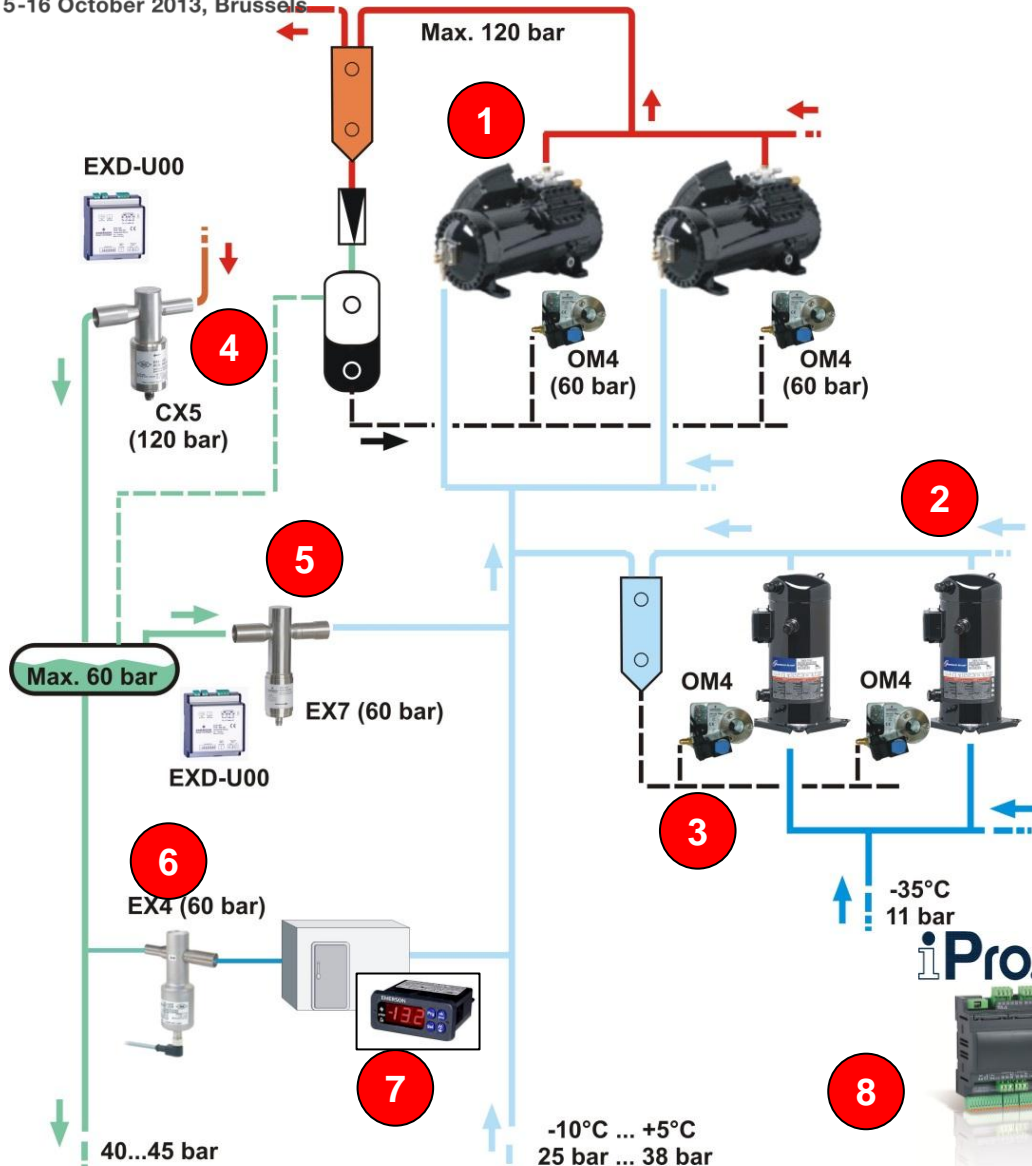
CO₂VENIENCE by space. Refrigeration System Description

engineering services

- **Dual Temperature Configuration**
- **Compact Layout With Minimal Foot Print**
- **Integrated Control Panel**
- **Designed For Easy Installation In Plant Room/
Storage Room**
- **Fitted With Coalescing Oil Separator And
Electronic Level Sensors**
- **Suitable For Convenience And Small
Supermarket Applications**
- **Light Weight Construction And Standard
Insulated Compressor Enclosure And Ventilation
Connection**
- **Pre Piped PRV's To Common Header**
- **K65 Connections**



Solutions For The Needs Of CO2 Refrigeration Systems



Emerson Offering

1. Compressors For MT Semi-Technology
2. Compressors For LT Semi (High Standstill 90bar) & Scroll Technology
3. Compressor Oil Management
4. Gas Cooler Pressure Control Valve
5. Receiver Pressure Control Valve
6. Display Case Expansion valve
7. Display Case Controller
8. Rack Controllers

iPro.RACK



Compressors CO2 Systems Stream CO2 With CoreSense Diagnostics

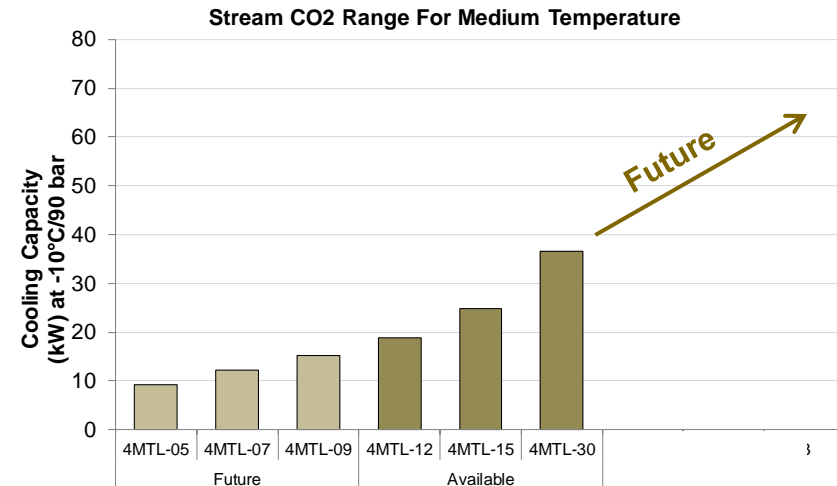
Description:

- CO2 MT & LT Compressors For Booster Systems
- From 9kW to 36kW (MT) & 8kW to 32kW (LT) Cooling Capacity
- Systems Requiring High Standstill Pressure (Up To 90bar)
- Integrated CoreSense Electronics For Protection/Diagnostics



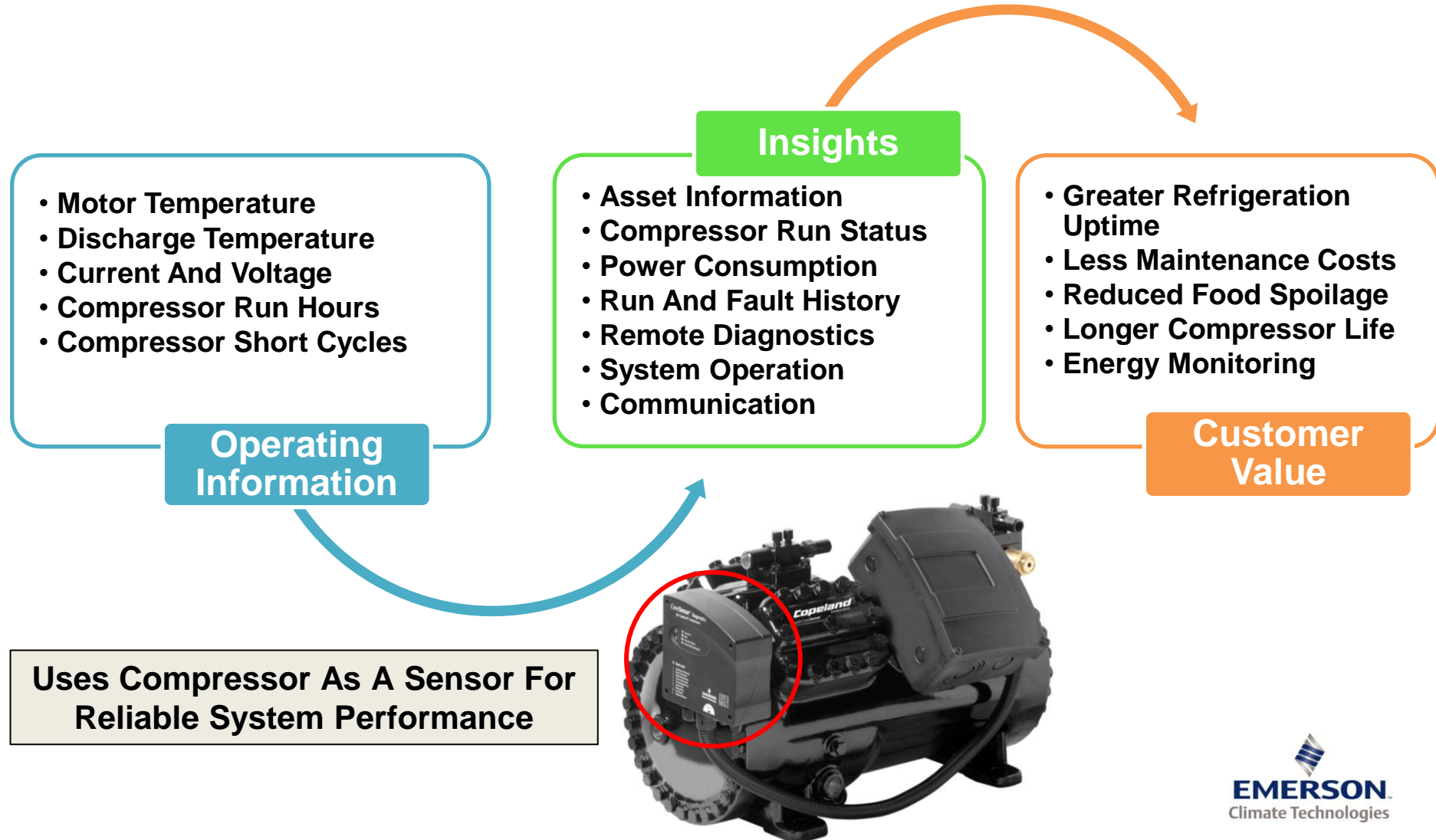
Main Benefits/Characteritics

- Operating 120bar Design 90/135bar
- Inverter Release 25-70hz
- Individual Compressor Power Monitoring
- Coresense Diagnostics On All Models



Using Transcritical Compressors In MT Side & LT Sides Ensures That In Case Of Power Outage, The System Features Full Resilience & No Operation Disruption

CoreSense™ Technology Compressor On-boards Electronics (Protection/Diagnostics)



CoreSense™ Technology Communication – Local & Remote Access

1) Status LED On CoreSense



1. Multi-color Status LEDs
2. Indicate Nature Of Failure
3. Enables Quick Troubleshooting

Local Troubleshooting

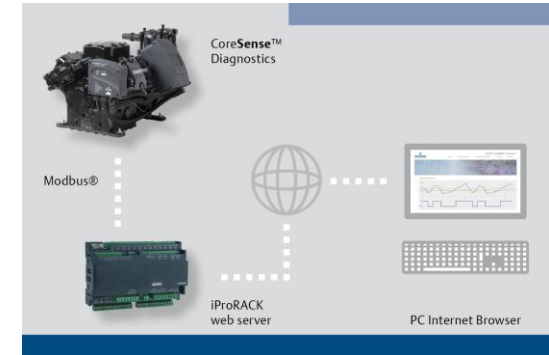
2) Connect To Computer



1. Modify User Adjustable Features
2. Download Compressor Fault History
3. Use As Data Logger

Service Engineer On Site

3) Connect to Pack Controller



1. Modify Adjustable Features
2. Download Fault History
3. Use As Data Logger

Modbus Protocol

**Coresense Guarantees Extended Compressor Life And Sustainable System
Protects The Compressor And Detect Problems Before They Become Fatal
Provide Troubleshooting Assistance To Service Technicians**

Scroll ZO Range Suited For Booster & Cascade CO2 Applications

Description:

- CO2 Scroll Compressors For LT Cascade & Booster Systems
- From 5kW to 23kW Cooling Capacity In Low Temperature

Main Benefits/Characteristics

- Compact, Half The Weight Of Equivalent Semi-hermetic
- Digital Modulation From 10...100% - Alternative to Inverters Drives
- Optional Sound Shell (-12dBA) For Noise Sensitive Supermarket
- Pressure Ratings 30/45Bar
- ZOD34 modulates From 0,7kW to 7kW
- Opportunity To Contain Cost Impact Of Hybrid Systems Using R134a in MT And CO2 in LT

