ENGINEERING
TOMORROW

Connectivity: The Current & Future State of HVAC/R

Agenda

- Danfoss Background
- Advanced HVAC Equipment: Chillers
- Advanced HVAC Connectivity: Supermarkets
- Challenges to Advanced HVAC Connectivity
- Potential Solutions

Danfoss at a **Glance**

Employees	24,000
Worldwide sales	more than 100 countries
Factories	63 in 19 countries
Top three markets	USA, Germany and China
Ownership	Privately held
Headquarters	Nordborg, Denmark

Danfoss' **History**

- Founded in 1933 by Mads Clausen in Nordborg, Denmark
- Grown from a solo enterprise into a world-leader
- Made possible by clear focus on innovative engineering and early entry on emerging markets

Cooling

First product was an expansion valve for refrigeration systems (1933)

Later the hermetic compressor for refrigerators and freezers followed (1952)

Heating

Danfoss invented one of the first radiator thermostats in the world (1943)

Power Solutions

Entered hydraulics business with orbit motor for agricultural and construction machines (1964)

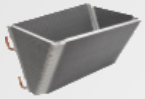
Drives

First company to mass-produce variable speed drives for controlling motors (1968)

Today, we are one of the world's leading producers of these and many other products

Next Generation Solutions: **Efficiency**

Chiller plate heat exchanger (MPHE)



Microchannel heat exchanger (V-coil MCHE)

Inverter drives

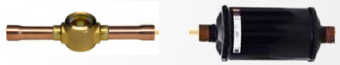
Electronic controls

Pressure control and regulation

High efficiency inverter & fixed speed scrolls with IDV

Pressure independent balancing valves

Solenoid valves



Line components

EXVs & TXVs

Oil-free, variable speed centrifugal compressors

Energy Use & Connectivity in **Buildings**

- "Plug-and-Play" Components
- Predictive Analytics
- Preventative Maintenance
- Advanced Diagnostics

Next Generation Solutions: **Connectivity**

- Monitoring, control, optimization, autonomy
- 5,000 Danfoss smart stores in operation
- Improve food safety, efficiency; drive decision-making, maintenance, demand response

Next Generation Solutions: **Connectivity**

Next Generation Solutions: **Challenges**

- New Regulations – particularly in the European Union
- Available Technology vs. User Behavior
- Multiple Data Platforms
- Unknown Value to OEMs & End Users

Next Generation Solutions: **Solutions**

- Simple & Effective Technology Deployment
- New & Innovative Business Models
- Continued Utility Support of Efficiency Incentives and M&V 2.0
- Building Guidelines such as ASHRAE 90.1 & DOE Regulations

Questions?

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