Better chillers – from the inside out

Strict regulations, a competitive marketplace, and the need to optimize system costs compel you to update your chiller designs. Building chillers with Danfoss products and solutions enables you to optimize energy efficiency, reduce development time, and obtain reliable performance for multiple chiller platform types and uses.

Smart technology in up to 70% of the chiller value reduces development costs
Climate change regulations, new demands for energy efficiency, higher expectation of comfort levels, and pressure to reduce overall cost of ownership drive current development in a competitive HVAC marketplace. With Danfoss, you have a business partner who understands the complexity of your business and supports you with the most in-depth expertise of solutions for chiller systems.

**Combat Climate Change**

Synthetic refrigerants like HFCFs and HFCs have a high global warming potential (GWP).

By using climate-friendly Danfoss components that utilize the ultra-low GWP refrigerant 1234ze, you contribute to global efforts to make our planet cleaner.

**Maximize Energy Efficiency**

The building sector represents about 40% of global energy use in regions like Europe and the USA and heating and comfort cooling a large part of it. To reduce the global warming impact and lower operating costs, you need new technologies that can maximize energy efficiency. Our technologies for chillers help you meet new regulations and achieve the best energy efficiency with your products.

**Promote Dependable Infrastructure**

As the global population continues to grow, energy use is expected to rise by one third by 2035. The introduction of variable speed technology in air conditioning and heat pump systems presents an opportunity for significant reduction of inrush current and can smartly modulate the electric load to the exact need to limit peaks of demand.

**Help Meet Increasing Global Food Demand**

An estimated global population of 10 billion people in 2035 means that food needs to be delivered more safely and efficiently. Process chillers provide the support farmers and industries need to grow a greater variety of fruit and vegetables in larger quantities, and help them adapt to the different stages of farming to increase quality and turnover.

**GWP<7**

with chillers featuring Danfoss technologies using R1234ze

**Up to 40% lower energy consumption in chillers**

**70% lower start current with Danfoss variable speed technology enhances grid reliability**

**+/- 0.3°C temperature and humidity setting guarantees a safe growing and storage process**

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**A global overview of regulations impacting HVAC markets**

**USA**
- Legislation: ASHRAE 60.1 for rooftops and chillers / DOE for rooftops
- Building codes: ENERGY STAR, Energy Conservation Building Index, Net Zero Building, ENERGY 2019

**Europe**
- Legislation: Regulation 517/2014 (F-Gas) Regulation 813/2013 (Ecodesign ENER Lot 1 and 21)
- Building codes: ASHRAE 90.1 for rooftops / DOE for Renewables

**Central & South America**
- Legislation: Building, ENERGY 2030
- Building Index, Net Zero Building, LEED
- Legislation: ASHRAE 90.1 for rooftops / DOE for Renewables

**Middle East**
- Energy Labelling and Minimum Energy Performance Requirements for Air Conditioner

**Asia & Oceania**
- Legislation: China
- Legislation: ASHRAE 90.1 for rooftops

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**A revolution in the A/C market**

Driven by the global need to reduce CO₂ emissions, new legislation around the world is requiring air conditioning systems with higher energy performance as well as non ODP (Ozone Depletion Potential) and lower GWP (Global Warming Potential) refrigerants.

In addition to conforming to strict new standards, next-generation systems need to meet the challenges of complex applications, increased energy efficiency, and varied climates, while also providing flexibility and a high level of comfort and reliability.

Increasing population, rising expectations of comfort, and a high penetration of IT technologies are putting pressure on electric grids, and driving up overall energy consumption and utility peak loads. In parallel, as building designs and functionalities evolve, chiller systems must adapt to meet these new demands. Examples include modern office architecture with large windows, as well as new development or renovation of hospitals, hotels, museums or data centers, where air conditioning is critical.

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**60-80% of current air conditioning systems will not comply with the new standards and need to be redesigned**

As it stands, 60-80% of current air conditioning systems will not comply with the new standards, and need to be redesigned. Original Equipment Manufacturers are increasingly being challenged to provide integrated solutions with superior reliability and efficiency that are easy to install and maintain. Danfoss innovations and technical expertise support you to build better chillers from the inside out and take up the challenge of improving part-load efficiency and maintaining lifecycle performance while keeping development time and resulting costs at competitive levels.

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(3) Source: Danfoss – Simulation based on Eurovent database and European draft for Ecodesign ENTR LOT 21 Tier 2 level
A chiller for every situation

Energy consumption is a key driver for building owners when it comes to chillers. Depending on the building size, type, and use, as well as the surrounding climate, you need different options for your chiller designs to provide the most value to your customers and differentiate yourselves in the market. We have solutions for chiller needs in a multitude of contexts, from mid-size office buildings that are in operation 10 hours per day, 5 days a week, to data centers and large hospitals that operate 24 hours per day, all year long.

Regardless of the building your chiller system is designed to fit, Danfoss has the widest portfolio of products and technology options to help it perform reliably and efficiently.

Our solutions match the needs of the building owners

3 key drivers for chillers:
- Building Size
- Energy Intensity and number of operating hours over the year
- Energy Cost

Looking for:
Initial cost ($/Ton)
Meet minimum energy efficiency at the lowest cost.

Looking for:
Return On Investment ($ Savings/Year) =
Maximize energy efficiency at the best cost.

Next-generation technology for your next generation of chillers

Danfoss technology helps you keep up with shifting global regulations and stay competitive with low lifecycle costs. Here’s how:

Redesign at minimal cost

By using Danfoss scroll compressors with IDV technology, either fixed-capacity or inverter-driven, in combination with our innovative electric expansion valves and heat exchangers, you will be able to offer a chiller system meeting the latest energy requirements with minimal redesign costs.

Go oil-free for maximum efficiency

Oil-free turbo chillers have been proven to deliver the best efficiencies in demanding applications. They also deliver additional benefits for both building owners and end users, which include low maintenance costs, a space-efficient design, and minimal noise levels. After pioneering the oil-free technology with our Turbocor® compressor, Danfoss now offers a wide portfolio of components that have been tested and approved for use in oil-free systems and strengthens reliability of oil-free chillers.

Extensive portfolio of products tested and qualified for oil-free systems
Building a higher standard for energy efficiency

Chillers and low-GWP Refrigerants

One of the most important changes currently facing the HVACR industry is how to lower GWP values while also increasing energy efficiency of chiller systems.

Regulation changes require equipment and component manufacturers to rethink traditional design options and find the right balance between affordability, safety and environment. Danfoss is actively working on solutions for alternative refrigerants with a pragmatic approach keeping system applied and running costs in mind.

Chiller designers will need to focus on using products and technologies that allow for the lowest charge and deliver the best cost and performance for each given refrigerant.

Generally speaking when it comes to refrigerants, chillers are divided into two categories: low/medium (L/M) and medium/high (M/H) pressure. L/M pressure chillers can benefit from the use of pure HFOs (R1233zd, R1234yf and R1234ze), resulting in a GWP close to zero. The flammability penalty is very low and manageable, especially for systems installed outdoors or in machine rooms. We can expect that for the short-to-medium term, this type of system will adopt ultra-low GWP refrigerants. The upper GWP limit, for large L/M chillers, will be governed by local phasedown implementation and informally by GWP level impact on fluid costs. Depending on these, they could reach 630, which corresponds to the GWP of HFO blend R513A, listed by the EPA-SNAP regulation of July 2015 while R134a will be delisted starting in 2024.

For M/H pressure chillers, the medium GWP alternatives are in the 125-750 GWP range but users must be willing to accept an A2L flammability classification. This, again, should be acceptable for systems installed outdoors or in machine rooms. The market will likely move to GWP alternatives which offer the best trade-off between system costs and performance. We foresee that the high density/ pressure refrigerant choice will fall to those with a GWP around 500-750.

Part-load Efficiency

Inverter drives optimize condensing temperatures for maximum part-load efficiency.

Electronic Controls

Electronic controls match varying needs of automation and can deliver energy savings of up to 50%.

Energy Savings

Variable frequency drives can deliver up to 30% energy savings.

Electronic Controls

All-QM™ pressure independent control valves have a 3-year payback on complete building installation.

Energy Savings

Micro Plate Heat Exchangers deliver a hold-up volume of 35% less.

Water Pumping Energy

Pressure independent balancing valves save water pumping energy and improve chiller part-load conditions.

GWP versus Density (pressure) of main refrigerant groups

GWP level per Chiller size and market development

- Smart technology in up to 70% of the chiller configuration to maximize efficiency
- Energy Savings
- Part-load Efficiency
- Electronic Controls
- Water Pumping Energy

The best trade-off between system costs and performance. We foresee that the high density/ pressure refrigerant choice will fall to those with a GWP around 500-750.
Electronics and sensors

Danfoss has an extensive range of electronic controls and sensors developed to monitor and optimize the operation of your chiller systems. Solutions range from a basic valve driver to a complete system controller capable of monitoring and controlling fans, pumps, valves, and compressors as needed. Danfoss electronic systems put the power of our components directly in your hands.

Use the Danfoss MCX programmable controller for maximum flexibility and the Danfoss EKE superheat controller with temperature and pressure sensors to fine tune any chiller’s output to your desired specifications.

System Protectors

When your customers purchase one of your chillers, they want to know that their investment is secure. Our line of driers, check valves, ball valves, and other system protectors are designed to perform under the most strenuous operating conditions and protect your equipment from potential failures.

Danfoss system protectors have been thoroughly tested in our labs and in the field in order to guarantee trouble-free operation during your system’s lifetime.

Compressors

Danfoss compressor technologies and models are designed to fit a large selection of chiller systems and cooling capacities. You can choose among Danfoss scroll compressors with or without IDVs, Danfoss inverter scrolls, or Danfoss TurboTec® compressors – each one helps you maximize the efficiency of your designs and gives you flexibility to redesign and upgrade as you see fit.

Danfoss compressors range from 3 to 350TR and offer the widest technology options to address new regulations.

Heat Exchangers

Maximizing the heat transfer in your condenser or evaporator is critical to achieving the highest efficiency possible within your chiller system. We are continuously expanding the range of our heat exchangers and also offer economizers with built-in controls to increase the capacity and energy efficiency of your chillers.

The technology in our Micro Channel and Micro Plate Heat Exchangers helps to make a difference in terms of energy consumption and refrigerant charge.

Valves

Choosing the right valve for your system ensures you get the optimal superheat flow just right, meaning your chiller will ensure the desired comfort and cool it’s supposed to. Danfoss has a wide assortment of valves, giving you the ability to choose the right one for your system’s need.

From our TGE valve to the ETS Colibri line, Danfoss has extensive experience in thermostatic and electric valves with proven track records of performance, quality, and durability.

Your source for chiller solutions

With up to 70% of products for chillers in our portfolio, we offer a powerful combination of expertise and product options that will enhance your chiller designs, and increase your bottom line.
### Conditions:

**Cooling capacities in Tons @ ARI 60Hz, in kW @ EN12900**

<table>
<thead>
<tr>
<th>Compressors</th>
<th>Refrigerant</th>
<th>Min</th>
<th>Max</th>
<th>Manifold (on TR / circuit)</th>
<th>Min</th>
<th>Max</th>
<th>Manifold (on kW / circuit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrolls</td>
<td>R410A</td>
<td>2.4</td>
<td>40</td>
<td>120</td>
<td>6.3</td>
<td>103.4</td>
<td>303</td>
</tr>
<tr>
<td>Scrolls with IDVs</td>
<td>R410A</td>
<td>7.5</td>
<td>40</td>
<td>120</td>
<td>20</td>
<td>103.4</td>
<td>303</td>
</tr>
<tr>
<td>Inverter Scrolls (All Speed / Min-speed)</td>
<td>R410A</td>
<td>4</td>
<td>1.2</td>
<td>26</td>
<td>50</td>
<td>13</td>
<td>4.2</td>
</tr>
<tr>
<td>Turbocor oil-free Compressors</td>
<td>R134a*</td>
<td>60</td>
<td>350</td>
<td>1000+</td>
<td>200</td>
<td>1</td>
<td>200</td>
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</table>

**Combinations**

<table>
<thead>
<tr>
<th>Condenser</th>
<th>Refrigerant</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCHE</td>
<td>R410A/R134a</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>MPHE Condenser**</td>
<td>R410A</td>
<td>1</td>
<td>170</td>
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**Evaporator**

<table>
<thead>
<tr>
<th>Level Sensor AKS</th>
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<tbody>
<tr>
<td>Available upon request</td>
</tr>
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**Expansion devices**

<table>
<thead>
<tr>
<th>Thermostatic Expansion Valve TGE</th>
<th>Refrigerant</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Expansion Valve ETS C (Colibri)</td>
<td>R410A</td>
<td>13</td>
<td>91</td>
</tr>
</tbody>
</table>

**Discharge Line**

| Check Valves NR/NR/HV | Refrigerant | 0.5 | 54.6 |
| Check Valves NR/NR/CR | R134a | 1.16 | 121 |

**Ball Valves GBC**

Kv: 1.74–529 m³/h - Cv: 2.01–611 gal/min

**High Pressure Switch (Safety) ACR**

High and low pressure versions

**Pressure sensor AKS**

Max. measuring range: 0–600 bar - Medium Temp: -40 to 85°C (185 °F)

**TemperatureSensor AKS**

Temperature ranges up to 180°C (356 °F)

**Liquid Line**

| Sight Glass SGF | Refrigerant | 0.9 | 106 |
| Solenoid Valve EVR | R134a | 0.85 | 100 |

**Suction Line**

| Ball Valve GRC | Refrigerant | 0.7 | 63.4 |
| Low Pressure Switch ACR | R410A | 7 | 370 |

**Pressure sensor AKS 12R**

Max. measuring range: 0–600 bar - Medium Temp: -40 to 85°C (185 °F)

**TemperatureSensor AKS 11**

Temperature ranges up to 180°C (356 °F)

**Control Panel**

<table>
<thead>
<tr>
<th>System Controller MCX</th>
<th>Models of Programmable Controllers - Inputs/Outputs (AI/DI/AO/DO): from 4/6/2 to 16/22/6/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>EKE 1 Superheat Controller</td>
<td>Drives all Danfoss stepper valves. MS5, LoadApp, fixed superheat control. Models with Modbus, CANbus. Wide sensor selection. Driver function with bus or analog-in input.</td>
</tr>
</tbody>
</table>

**Power supply AE-P5**

Power Supply 24V/DC 0.75 / 1.5 / 2.5 Amps

**VLT HVAC & VLT Refrigeration Drive**

Supply Voltage Range: 200–600V, Power Range: 1–11420kW

**CDS Drive for VZH**

Supply Voltage Range: 200–600V, Power Range: 0.5–2000kW

**VACON NXC Low Harmonic AFE Drive**

Supply Voltage Range: 380–690V, Power Range: 0.55–2000kW

**VACON 3000 Medium Voltage Drive**

Supply Voltage Range: 3300V 2400–7030kVA/4100V 2450–7020kVA

* Danfoss ADCs are today located in:
  China – Haiyan and Wuqing, Denmark – Nordborg, India – Oragadam, USA – Baltimore and Tallahassee

** Range overview**

For Air and Water-Cooled chillers

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For more information about refrigerant and product selection, please contact Danfoss and refer to Coolselector.
Let’s talk
At Danfoss, we believe that long-term business relationships start with a conversation.

• To understand your situation
• To learn how we can meet your needs
• To give you confidence in our solutions

So contact your local Danfoss representative – and let’s talk.

Access our online services 24/7
You can find many helpful resources on our website, including product catalogues, educational and training programs, downloadable manuals and apps, and troubleshooting tools.

Danfoss online self-services
• Chillers: Chillers.danfoss.com
• Product selection: Coolselector.danfoss.com
• Learning platform: Learning.danfoss.com

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