High-Efficiency Heat Pump Technology

DALRADA
Climate Technology

GENERAL UNIT BROCHURE - One Series - Hot Water | Chilled Water

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TECHNOLOGY GROUP

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Introduction

Dalrada Climate Technology provides end-to-end comprehensive energy service solutions in a robust commercial capacity to businesses of all sizes and industries. This helps organizations meet environmental, social, and governance (ESG) goals and standards while mitigating adverse environmental impacts and increasing the efficiency and profitability of operations.

Through its global group of climate focused tech companies, Dalrada Climate Technology provides businesses and government institutions with customized, comprehensive energy saving solutions such as energy audits, process management, and procurement. DCT offers a suite of climate tech and services, including installations of required equipment or installation improvements.

Dalrada Climate Technology provides companies with the tools and equipment to achieve maximum energy efficiency and cost savings while minimizing their carbon footprint.

Driven by the combined expertise and commitment of its subsidiaries and strategic partners worldwide, Dalrada Climate Technology is committed to revolutionizing the global clean energy industry by developing innovative products and services. This includes new and retrofit installations of renewable energy equipment and infrastructure for large facilities based on established science for the use of energy equipment, resources, processes, and materials that are both cost-effective and sustainable.

- DCT One and Two Series heat pumps and Cryo chillers
- Lighting (LED enhancements and more)
- HVAC upgrades (high-efficiency systems)
- Enhanced, modern lighting
- Water conservation efforts
- Battery storage and capacitor banks
- Window replacement and upgrade
- Solar power
- Real-time energy monitoring
- Building envelope/ building management
- Tax credits, carbon credits, rebates, and more

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Hot-Cold Coupling

Process Cooling to 0°C(32°F)

Process Heating to 85°C (185°F)

Energy Recovery

150kW heating, 105kW cooling

Natural Refrigerant CO_2

DCT
One Series

Dalrada Climate Technology heat pumps answers perhaps the biggest challenge that the US and the rest of the world face when it comes to meeting our obligations under the Paris Climate Change Agreement: how can you decarbonize the industrial heating and cooling sector that depends so heavily on fossil fuels?

Heat is the single biggest reason we use energy in our society. Believe it or not, we use more energy for heating than for transport or the generation of electricity. In the UK for instance, $40 billion is spent on heat alone. Today, the majority of that heat is unfortunately produced by burning fossil fuels (around 70% from gas alone), and thus heat is responsible for around a third of the UK's greenhouse gas emissions. This is simply unsustainable.

Combustion of the planet's reserves of fossil fuel is becoming increasingly socially unacceptable as pollution levels grow and the long-term

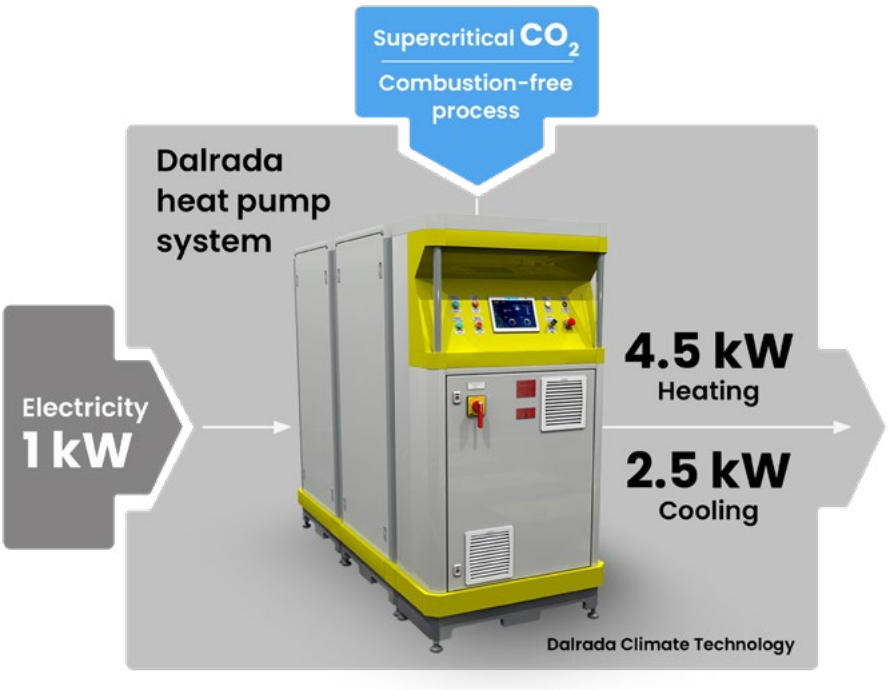
effects become more apparent. Heating or cooling of products and intermediates in the most efficient and least environmentally damaging way is critical to both the environment and business profits. Combustion emissions, from burning fuel for the production of low and high-grade heat, drying/separation, space heating and electricity generation for own use accounted for 85% of manufacturing emissions.

Combustion itself is simply not sustainable. However, the solution is rather simple: non-combustion heating and cooling. The future will rely heavily on machines that feature combustion-free performance. Replacing these obsolete systems will require modernization, and most likely, electrification will be the preferred power method for increased efficiency, environmental compliance, and cost savings.

DCT One Series is the world's first high-temperature process heating and cooling system, designed specifically for use in an industrial process environment. Operating in a combined heating and cooling mode, the system aims to reset the world's expectations for industrial heating and cooling systems by using a non-toxic, non-flammable, environmentally friendly, inert, CFC/HFC free "natural refrigerant" to safely provide per unit for your project **150kW$_{th}$** of high-grade heating plus **105kW$_{th}$** of low temperature cooling for an input electrical power of **43 kW$_{e}$**

The ability of DCT technology to be used to generate heat, low pressure and clean steam, cooling and low temperature refrigeration between 0°C — 85°C (32°F — 185°F) means potential application areas are enormous. The systems use $CO_{2,}$ a natural, low-cost working fluid which overcomes the CFC/HFC issue and enables higher discharge temperatures.

In many manufacturing processes, significant amounts of heat are often wasted, while a simultaneous demand for thermal energy exists on site. By taking this waste heat and boosting the temperature to a useful level, DCT technology can be a highly effective way of optimizing the efficiency of site processes.



Advantages of DCT Heat Pumps

+

Is a genuinely modular solution that scales horizontally rather than vertically.

+

Energy savings between 60-80% for heating and cooling applications in a process plant.

+

Delivers a wide temperature range 0°C – +85°C (+32°F – +185°F) even in high ambient conditions.

+

Provides heating and cooling without the need for chillers, cooling towers, or boilers.

+

Enables the active recovery of thermal waste streams: air, water, or cooling towers.

+

Classed as a renewable energy source when using air, water, or geothermal sources.

+

Low capital costs and is simple to install across heat networks, enabling “PINCH”.

+

Near-zero thermal losses through innovative cooled enclosure.

+

Reduces operational cost and carbon emissions by 60 to 80%.

Carbon Dioxide

Many people perceive high pressure Carbon Dioxide [CO_2 or R744] as a working fluid in refrigeration systems as new technology, this perception is incorrect. CO_2 was a widely-used refrigerant in the late 19th century until the advent of low-pressure Freon working fluids were patented & introduced in the early 20th century.

What's new is the fact that few people are familiar with the benefits, safety aspects, usage & application design requirements of CO_2 refrigeration plant. Fewer still are aware of the potential of a CO_2 based heat pump like DCT One Series to produce high temperature heat energy to replace hot water heaters, electric heaters and steam boilers.

Refrigeration accounts for 50% of the energy consumption in a supermarket. As such, it's often the focus of energy efficiency initiatives. Since 2013, most of the refrigeration systems currently being installed in large UK supermarkets such as Sainsbury's, with 160 stores retrofitted (the largest in the UK), Tesco, and Marks & Spencer, which operate with CO2 in its subcritical phase where the pressure of the CO2 is maintained well below its critical pressure of 73 Bar. In fact, the operating pressures for subcritical systems are slightly higher than those in conventional direct-expansion systems but are similar to those seen in air-conditioning applications using R-410A.

Supercritical fluids in general possess unique transport properties compared to liquids or gases. Supercritical fluids can have liquid-like densities, gas-like diffusivities, and compressibility that deviate greatly from ideal gas behavior.

Design Standards

DCT One Series is equipped with all necessary safety equipment in accordance with DIN EN 378 In case of exceeding allowable limits automatic shutdown occurs. Protection against exceeding max. permissible operating pressure is guaranteed by:

- Electronic safety pressure limiter
- Safety valves

Further safety devices include:

- Suction pressure sensor (freeze protection)
- Safety temperature limiter (gas cooler side, heating flow temperature)
- Temperature sensor for max. allowable temperature of pressurized gas
- Motor protection

System Design

- **EN 378** Refrigerating systems and heat pumps – Safety and environmental requirements

Pressure Equipment

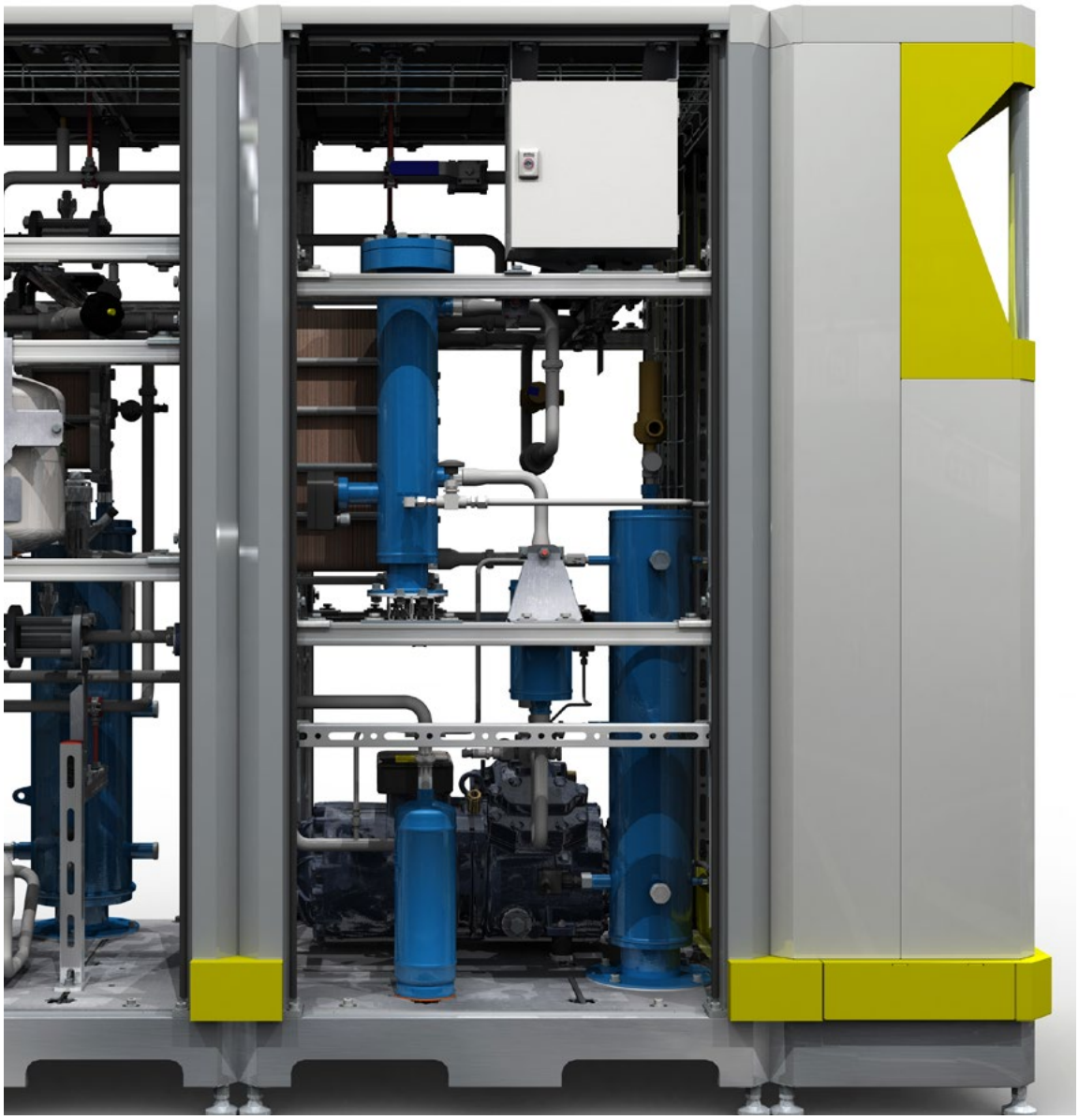
- **PED 2014/68/EU**
  Accordance with Module B
- **PED**
  Regulations of the working group for pressure vessels

Electrotechnology

- **2014/35/EU**
  Low Voltage Directive
- **EN 60204-1**
  Safety of machinery – Electrical equipment of machines
- **EN 61439**
  Low voltage switchgear and control gear assemblies

EMC

- **2014/30/EU**
  Electromagnetic compatibility
- **EN 61000-6-2**
  Electromagnetic compatibility (EMC) – Generic standards – Immunity for industrial environments



Features

Controls and Information

- 10” HMI with full diagnostic information & system overview
- Ethernet (LAN/WAN)
- Real-time energy monitoring and metering of performance
- Full interface with customer’s DCS / SCADA / PCS System
- Start / Stop and emergency stop buttons.
- VSD for compressor motors
- Built-in energy optimization functionality
- Advanced building management platform integration

Standard Features

- 304L stainless steel based frame
- Powder-coated GIS panelling system
- Reciprocating piston compressors with full VSD drives
- Temperature, pressure and flow metering sensors
- High integrity and 316L hygienic pipework system orbitally welded
- Emergency stop buttons
- Laser cut construction. Stainless steel fixings
- Temperature-controlled internal cabinet and control panel
- PN16 or ANSI #300 RF connection flanges
- CE-compliant safety system EEU
- Built to pharmaceutical standards, validations, and protocols (GAMP, DGL, IGL, OGL, etc.)

IoT Enabled

DCT One Series Specifications

DCT One Series units are designed and constructed in a modular format with high quality, proven components to EN 378 to 4: 2016, and the EU Machinery Directive (2006/42/EC) and EN ISO 12100 Safety of machinery.

DCT ONE SERIES TECHNICAL SPECIFICATIONS

Unit Name	Unit Type	Net Cooling Capacity (ton)	Net Heating Capacity (MBH)	Power Supply Volts-Ph-Hz	Refrigerant Type
DCT-1	M2002	29	511	480-3-60	R744

Cooling Circuit			Heating Circuit			CO_2 Circuit	
	Min	Max		Min	Max		
Return Temp (°F)	32	72	Return Temp (°F)	40	100	Mass of Gas (kg)	16-22
Flow Temp (°F)	32	50	Flow Temp (°F)	109	185	Mass Flow Rate (kg/s)	2252
Typical ΔTemp (°F)	10-18		Typical ΔTemp (°F)	80-110		Max discharge Temp (°F)	284
Design Flow (gpm)	26	63	Design Flow (gpm)	2	34	Max Op. Pressure (psi)	1450
Supply Press. (psi)	21	72	Supply Press. (psi)	14	72		
Fluid	Water/Glycol		Fluid	Water			

Oil Circuit	
Type	PAG 68
Volume (US Gallon)	2

Electrical Data	
Nominal Absorb Power (kW)	46
Max Apparent Power (kVA)	51
Rated Current (A)	60
Short Circuit Current Rating (kA)	10

Physical Data	
H (in)	79 ”
D (in)	99 ”
W (in)	40 ”
Weight (lbs)	3285
IP Rating	54

Connection	Description	Standard	Type	Sizes
N1	Hot Water Flow	ANSI B16.5	Class 300	1”
N2	Hot Water Return	ANSI B16.5	Class 300	1”
N3	Cold Water Return	ANSI B16.5	Class 300	1,1/2”
N4	Cold Water Flow	ANSI B16.5	Class 300	1,1/2”

DCT ONE SERIES PERFORMANCE DATA

Hot Water Inlet: Outlet(ºF)	Cold Water Inlet: Outlet(ºF)*	Specifications	Hot Water Circuit	Cold Water Circuit
68/140	54/45	Thermal power (Btu/hr)	440,170	307,090
		Combined COP	5.78	
		Flow rate (GPM)	12.4	64.4
		Absorbed power (kW)	37.87	
68/140	63/54	Thermal power (Btu/hr)	474,290	337,800
		Combined COP	6.18	
		Flow rate (GPM)	10.4	64.1
		Absorbed power (kW)	38.4	
68/158	54/45	Thermal power (Btu/hr)	433,340	303,680
		Combined COP	5.17	
		Flow rate (GPM)	9.1	64
		Absorbed power (kW)	42.04	

***All tests performed with the absence of glycol. The data contained in this informational brochure may be subject to updates or modifications based upon any product improvements or revisions.**

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