SMC

Expertise – Passion – Automation

SMC chillers for additive manufacturing

Additive manufacturing

Additive manufacturing, often referred to as 3D printing, has grown exponentially over the last few years. While these technologies bring great advantages in terms of efficiency, quality, cost and delivery times, they also raise unique challenges in terms of protecting equipment from heat. Heat build-up can degrade parts of machines, reducing their service life and increasing cost. These technologies require cooling solutions that are reliable and capable of keeping the cooling temperature stable in a precise way.

The use of an SMC chiller will give you not only reliability and precision, but also confidence. We have been manufacturing chillers since 1978. Our evolution since then has been considerable, together with the progression in our customers' demands. At present, we have a portfolio of 9 different families of cooling solutions, including standard, rack mount, dual channel and high-level chillers.

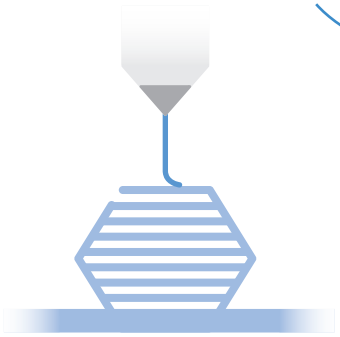
Index

What are SMC chillers used for?

Material extrusion

Fused Deposition Modeling (FDM) & Fused Granular Fabrication (FGF)

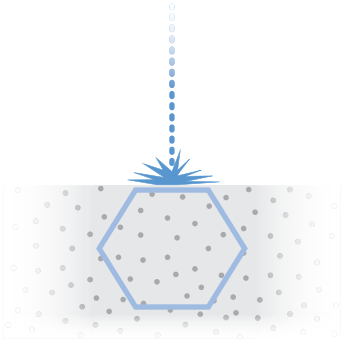
FDM & FGF involves extruding a plastic filament or granules through **a nozzle at high temperature**.



Powder bed fusion

Selective Laser Sintering (SLS)

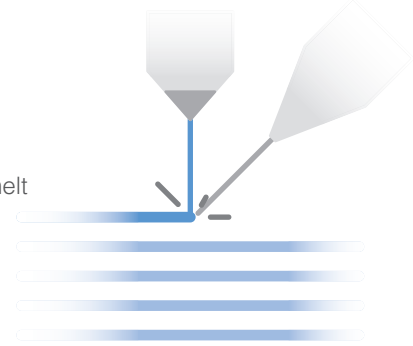
SLS is characterised by sintering or melting a bed of powder (thermoplastics). To create the part, **a laser** is applied to the powder surface of the material.



Direct energy deposition

Laser metal deposition (LMD)

LMD uses **a laser beam** to form a pool of melted metal (a melt pool) on the surface of a metallic substrate into which metal powder is injected using a gas stream.

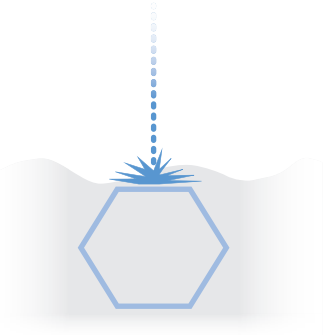


...to cool a heat source

Vat photopolymerization

Stereolithography (SLA)

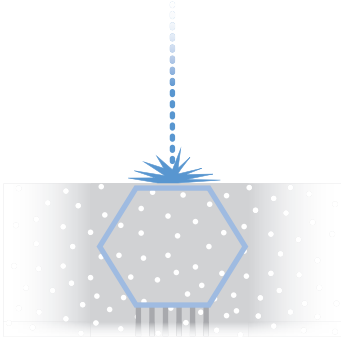
SLA works by focusing **an ultraviolet (UV) laser** on to a vat of photopolymer resin.



Powder bed fusion

Selective Laser Melting (SLM), Direct Metal Printing (DMP) & Direct Metal Laser Sintering (DMLS)

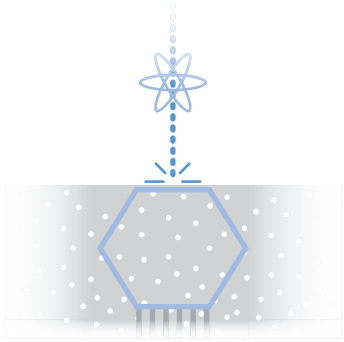
SLM, DMP and DMLS are characterised by sintering or melting a bed of powder (metallic materials). To create the part, **a laser** is applied to the powder surface of the material.



Powder bed fusion

Electron Beam Melting (EBM)

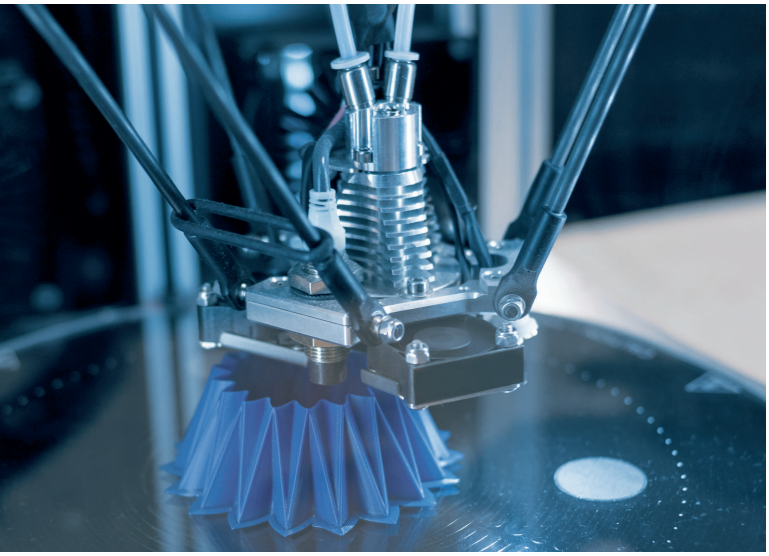
EBM is characterised by sintering or melting a bed of powder (metallic materials). To create the part, **a beam of electrons** is applied to the powder surface of the material.

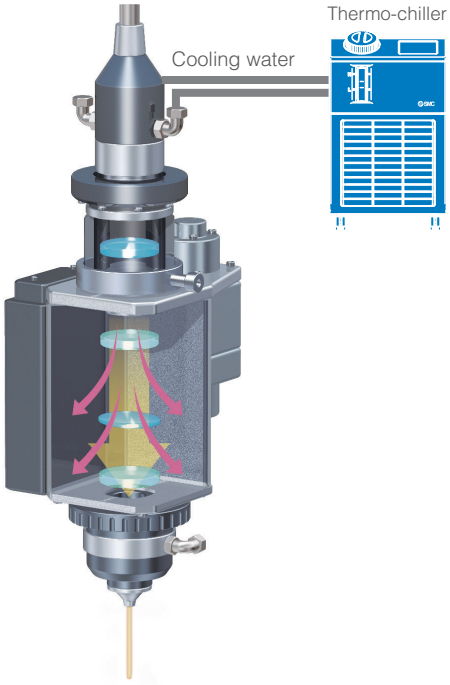


Consequences & benefits of temperature control

Consequences of inadequate temperature control

Inadequate temperature control can significantly shorten component life or even cause the machine failure. Specifically in the case of additive manufacturing, the parts of the machine that can be damaged are the laser and electron beam optics as well as the power supplies among others.





Another zone that can be damaged is the printhead nozzle. If the printhead nozzle gets too hot, it will melt and print too much material, which will affect the quality of the part. Excess material can also block or clog the nozzle as it cools. A printhead nozzle that is not hot enough will not print correctly either, this can also clog the nozzle during printing.

Benefits of proper temperature control

Proper temperature control guarantees a longer life of your machine's components and higher performance in properly melting printing materials, as well as ensuring the precise amount of material to be melted while maintaining the proper viscosity of the material.
These benefits have a major impact on the final quality of your parts.

The Expert's experience:

Mr Gary Haynes
Business Development Manager, SMC UK

Additive Manufacturing is not constrained by traditional design rules, increased design freedom allows for complex builds across a wide range of industry applications where durability, customised parts and precision are key. In applications such as Additive manufacturing where laser equipment is used, it is necessary to use precision temperature control equipment to guarantee a stable temperature of the fluid to improve the machine's performance & reliability. SMC is a leading expert in the field of temperature control equipment; whatever your cooling needs, we're confident we'll have a solution for you. SMC's global presence allows us to be close to our customers, understanding your needs and developing products and solutions to adapt to the challenges you face whilst considering the very latest industry trends.

Why SMC?

The Expert's experience:

Ms. Linnet Villanueva
Heat Exchangers
Product Manager,
SMC Spain

With more than 4 decades of experience manufacturing chillers, we in SMC don't act just as chiller's provider, we are partners of our customers. We collaborate with our clients, from the start to the end of the process, firstly making calculations and suggesting the right chiller for their needs among our wide portfolio of solutions, then advising them with any problem they may have during the installation and, finally, giving quick solutions in case of any after-sales issue. Thanks to the self-diagnosis function we have in our chillers, in case of an after-sales issue we focus on the origin of the problem quicker than other chiller designs on the market. We are delighted to say that we have the biggest worldwide network that a chiller manufacturer has, with direct presence in more than 80 countries. Our goal is to satisfy all the needs of our customers in any part of the process and being a trustable solution and partner.

Manufacturers

We have been manufacturing chillers for more than **40** years, with an evolution that has been, and continues to be, constant as well as the needs of our customers in additive manufacturing. Despite our extensive experience we consider it essential to continue working closely with our customers to continue improving our chillers and to help them find the solution that meets their needs and solves their temperature problems.

Worldwide support

SMC's technical support is something recognized by our customers that goes beyond troubleshooting. We have trained our team to solve problems more efficiently and offer assistance in the installation and configuration of our equipment. To ensure worldwide support we have sales offices in **82** countries.

Energy saving

Our HRSH series includes a **triple inverter**. This technology adapts the refrigeration level to demand in real time, avoiding any energy surplus. The inverter controls the number of motor rotations of the compressor, fan and pump depending on the heat load and flow needs from the user's equipment.

Low noise & vibration

We understand the need for cooling systems that provide quieter operation, emitting less noise and vibration. Noisy and vibrating machines can create an unpleasant and dangerous working environment. Our cooling units help you to keep your working environment quieter due to the **low noise and low vibration** of our equipment.

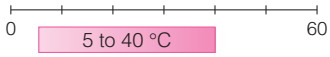
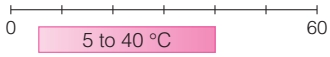
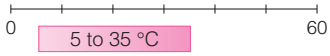
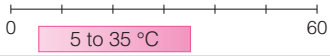
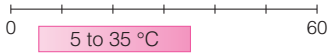
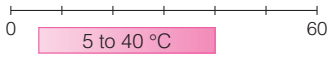
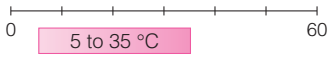
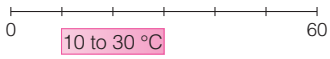
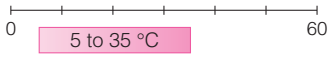
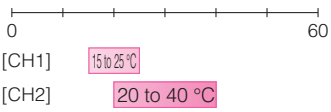
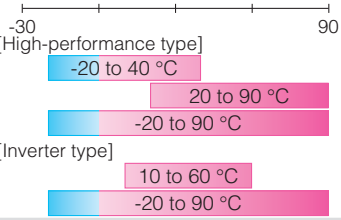
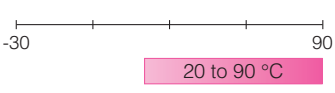
Precise temperature stability

Accurate temperature stability is essential in additive manufacturing to ensure longer life and optimum machine performance. Overheating degrades reliability and service life. Our chillers' **precise temperature stability** will help you avoid these problems.

Thermo-chillers portfolio

Series	Cooling method	Temperature stability	Cooling capacity [kW]														
			1.0	1.2	1.8	2.4	3	4	5	6	9	10	15	20	25	28	30
Thermo-chiller Standard type HRS Series 	Air-cooled/ Water-cooled refrigeration	±0.1 °C		●	●	●	●	●	●	●							
Thermo-chiller Standard type Environmentally resistant type HRS-R Series 	Air-cooled refrigeration	±0.1 °C			●		●		●								
Thermo-chiller Standard type HRS090 Series 	Air-cooled/ Water-cooled refrigeration	±0.5 °C									●						
Thermo-chiller Standard type HRS100/150 Series 		±1.0 °C										●	●				
Thermo-chiller Standard type HRS200 Series 	Air-cooled refrigeration	±1.0 °C												● 20.5 kW			
Thermo-chiller Inverter type HRSH090 Series 	Air-cooled/ Water-cooled refrigeration	±0.1 °C									●						
Thermo-chiller Inverter type HRSH Series 	Air-cooled/ Water-cooled refrigeration	±0.1 °C										●	●	●	●	●	
Thermo-chiller Basic type HRSE Series 	Air-cooled refrigeration	±2.0 °C		● 1.2 kW	● 1.6 kW	● 2.2 kW											
Thermo-chiller Rack mount type HRR Series 	Air-cooled/ Water-cooled refrigeration	±0.1 °C	●	●	●	●	●		●								
Dual Channel Refrigerated Thermo-chiller for Lasers HRL Series 	Air-cooled refrigeration	CH1 ±0.1 °C									●			● 19 kW		● 26 kW	
		CH2 ±0.5 °C	●														
Thermo-chiller High-performance type HRZ Series **Thermo-chiller High-performance inverter type** HRZ Series 	Water-cooled refrigeration	±0.1 °C			● 2 kW			●			● 8 kW	●					
Water-cooled Thermo-chiller High-performance type HRW Series **Water-cooled Thermo-chiller High-performance inverter type** HRW Series 	Water-cooled type	±0.3 °C			● 2 kW						● 8 kW		●				●

For dimensions and other details refer to general catalogue of each series at www.smc.eu

Set temperature range [°C]	Pump capacity	Pump type	Power supply	Circulating fluid	Environment
	42 l/min	Magnet pump (Mechanical seal pump for high-pressure pump mounted type)	Single-phase 100 VAC (50 Hz) Single-phase 100 to 115 VAC (60 Hz) Single-phase 200 to 230 VAC (50/60 Hz)	Tap water Deionized water Ethylene glycol aqueous solution (15 %)	Indoor use
	40 l/min		Single-phase 200 to 230 VAC (50/60 Hz)	Tap water Ethylene glycol aqueous solution (15 %)	Indoor use Electrical box: IP54
	68 l/min	Mechanical seal pump	3-phase 380 to 415 VAC (50/60 Hz)	Tap water Deionized water Ethylene glycol aqueous solution (15 %)	Indoor use
	68 l/min				Outdoor installation IPX4
	130 l/min	Immersion pump	3-phase 380 to 415 VAC (50 Hz) 3-phase 460 to 480 VAC (60 Hz)		Outdoor installation IPX4
	60 l/min	Mechanical seal pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz) 3-phase 380 to 415 VAC (50/60 Hz)	Tap water Deionized water Ethylene glycol aqueous solution (15 %)	Indoor use
	180 l/min	Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz) 3-phase 380 to 415 VAC (50/60 Hz)	Tap water Deionized water Ethylene glycol aqueous solution (15 %)	Outdoor installation IPX4
	25 l/min	Magnet pump	Single-phase 230 VAC (50/60 Hz)	Tap water Ethylene glycol aqueous solution (15 %)	Indoor use
	34 l/min	Magnet pump (Mechanical seal pump for high-pressure pump mounted type)	Single-phase 100 VAC (50/60 Hz) Single-phase 115 VAC (60 Hz) Single-phase 200 to 230 VAC (50/60 Hz)	Tap water Ethylene glycol aqueous solution (15 %)	Indoor use
	CH1: 180 l/min	Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz) 3-phase 380 to 415 VAC (50/60 Hz) 3-phase 460 to 480 VAC (60 Hz)	CH1: Tap water	Indoor use
	CH2: 16 l/min	Canned pump		CH2: Tap water Deionized water	
	40 l/min	Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 208 VAC (60 Hz)	Fluorinated fluid Tap water Deionized water Ethylene glycol aqueous solution (60 %)	Indoor use
	50 l/min	Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 208 VAC (60 Hz)	Fluorinated fluid Tap water Deionized water Ethylene glycol aqueous solution (60 %)	Indoor use

Our best solutions for your industry

Standard type

Air/water cooled refrigeration
HRS Series

Improve the performance & reliability of your machine

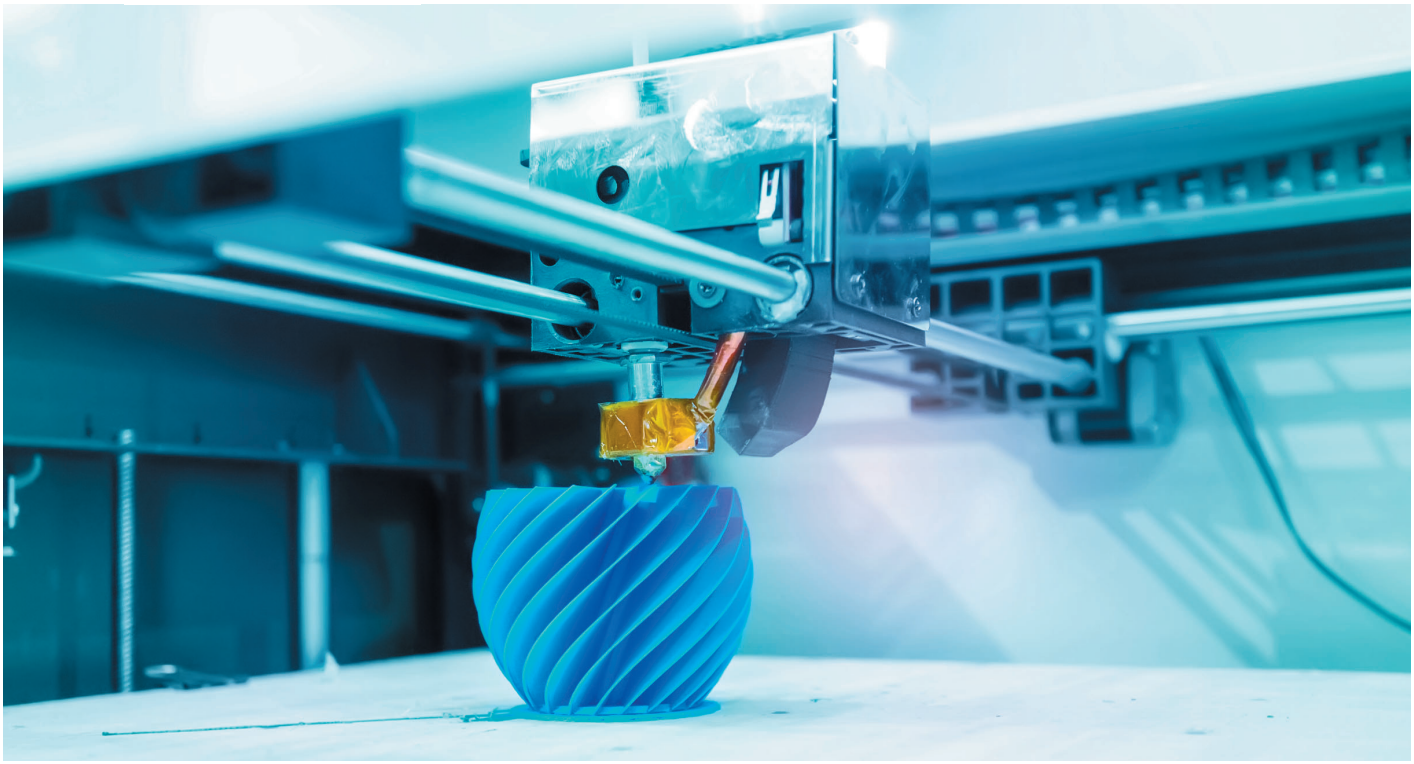
- Cooling capacity: From 1.1 to 17.5 kW (50 Hz)
- Temperature stability: ±0.1 °C to ±1 °C
- Set temperature range: 5-40 °C (HRS012 to HRS060); 5-35 °C (HRS090 to HRS200)
- Compact and lightweight
- With heating function and self-diagnosis.

High-level type

Air/water cooled refrigeration
HRSH Series

Triple savings at the right temperature

- Cooling capacity: From 9.5 to 28 kW
- Temperature stability: ±0.1 °C
- Set temperature range: 5-35 °C ; 5-40 °C (HRSH090)
- Triple inverter control
- With heating function and self-diagnosis.

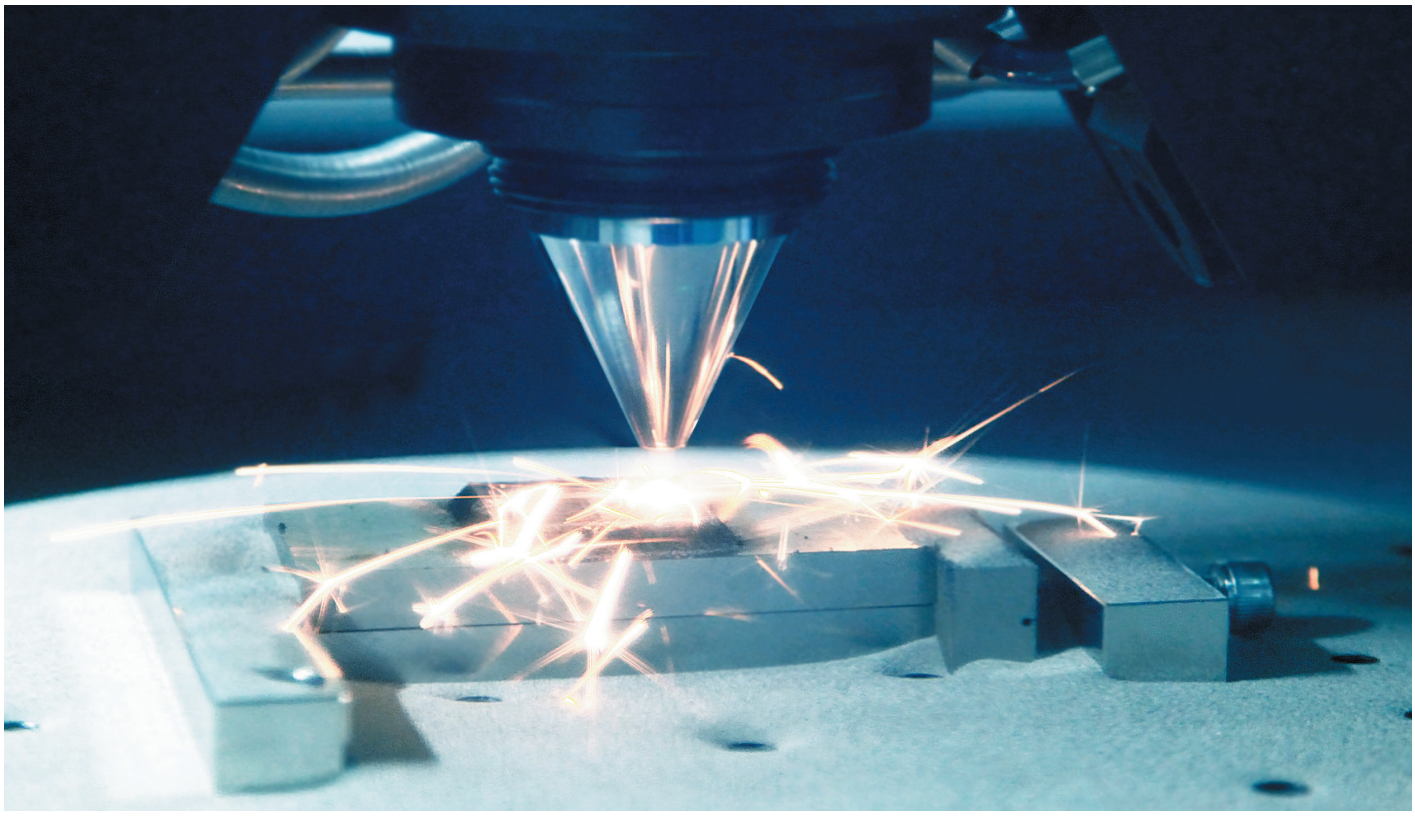


Rack mount type

Air/water cooled refrigeration
HRR Series

Simplify your temperature control

- Cooling capacity: 0.95/1.0/1.6/2.0/2.5/5 kW (50 Hz)
- Temperature stability: ±0.1 °C
- Set temperature range: 5 to 35 °C; 15 to 35 °C (HRR010)
- Mountable in a 19-inch rack or free standing
- With heating function and self-diagnosis.



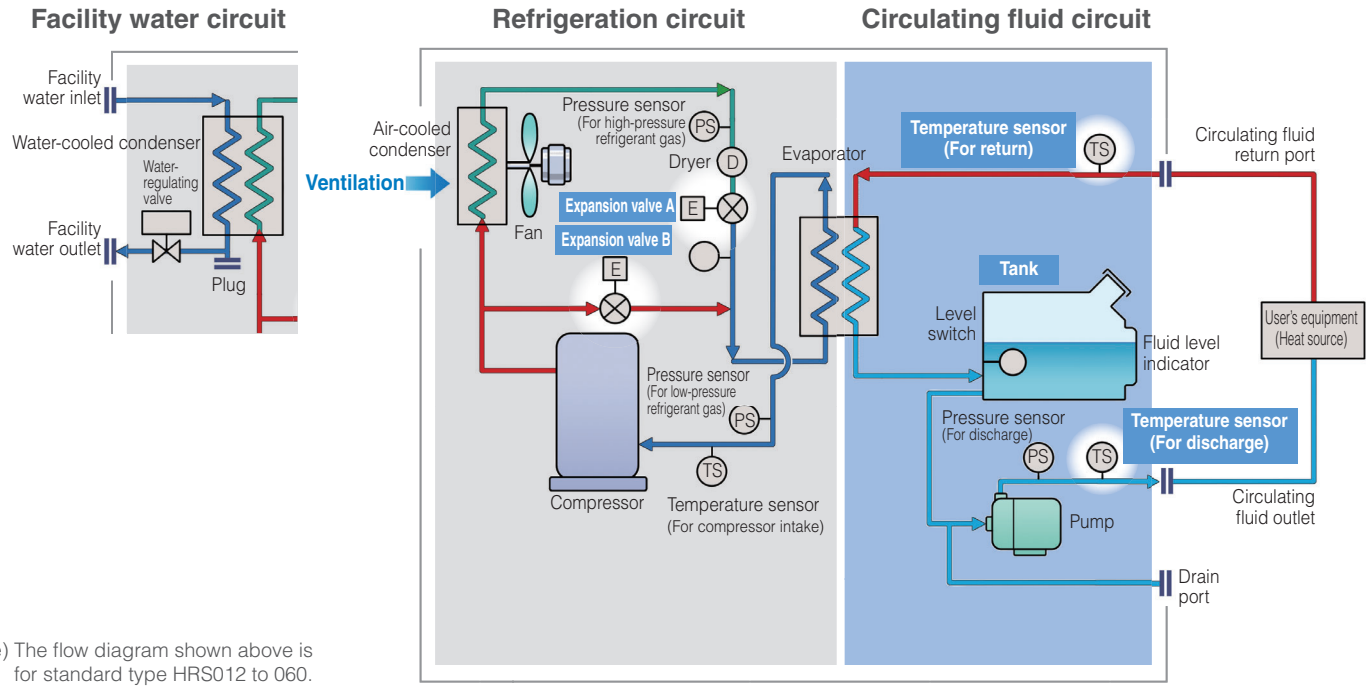
Dual channel type

Air cooled refrigeration
HRL Series

1 instead of 2

- Cooling capacity: CH1: 9 kW to 26 kW; CH2: 1 kW
- Temperature stability: CH1: ±0.1 °C; CH2: ±0.5 °C
- Set temperature range: CH1: 5 to 35 °C; CH2: 10 to 40 °C
- Triple inverter control
- Touch panel
- With heating function and self-diagnosis.

Working principle



Note) The flow diagram shown above is for standard type HRS012 to 060.

Refrigeration circuit

- The compressor compresses the refrigerant gas and discharges high-temperature, high-pressure refrigerant gas.
- In the case of air-cooled refrigeration, the high-temperature, high-pressure refrigerant gas is cooled down by fan ventilation in the air-cooled condenser, where it is then liquefied. In the case of water-cooled refrigeration, the refrigerant gas is cooled by the facility water in the facility water circuit in the water-cooled condenser, where it is then liquefied.
- The liquefied high-pressure refrigerant gas expands and its temperature lowers when it passes through expansion valve A, where it vaporizes after receiving heat from the circulating fluid in the evaporator.
- The vaporized refrigerant gas is sucked into the compressor and compressed again.
- When heating the circulating fluid, the high-pressure, high-temperature refrigerant gas is bypassed into the evaporator by expansion valve B to heat the circulating fluid.

Point The combination of the precise control of **expansion valve A** for cooling and **expansion valve B** for heating allows for high temperature stability.

Circulating fluid circuit

- After the circulating fluid discharged from the pump is heated or cooled by the user's equipment, it returns to the thermo-chiller.
- The circulating fluid is controlled to remain at a set temperature by the refrigeration circuit. It will then be discharged to the user's equipment side again by the thermo-chiller.

Point Since the refrigeration circuit is controlled by the signals from **2 temperature sensors (for return and discharge)**, precise temperature control of the circulating fluid can be achieved. Therefore, there is no need for a tank with a large capacity to absorb the circulating fluid temperature difference, as high temperature stability can be achieved even with a **small-size tank**. This also contributes to space saving.

Facility water circuit

For water-cooled refrigeration

- The water-regulating valve opens and closes to keep the refrigerant gas pressure consistent. The facility water flow rate is controlled by the water-regulating valve.

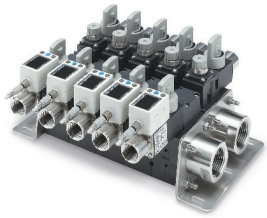
For dimensions and other details refer to general catalogue of each series at www.smc.eu

Related products

Sensors

Digital flow switch for water
PF3W Series

Digital flow switch manifold for water
PF3W Series



Digital flow switch for air
PFMB Series

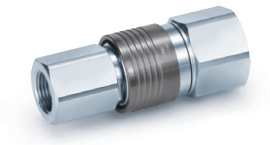
3-screen display high-precision digital pressure switch
ISE20 Series

Multi channel pressure sensor monitor
PSE200A Series

Small pneumatic pressure sensor
PSE540 Series

Fittings & tubing

S coupler, stainless steel 304
KKA Series



Metal one-touch fittings
KQB2 Series

Stainless steel 316 one-touch fittings
KQG2 Series

Nylon tubing – T Series
Polyurethane tubing – TU Series
FEP tubing – TH Series
Modified PTFE tubing – TD Series
PFA tubing – TLM Series
Super PFA tubing – TL Series

Airline equipment

Regulator
AR Series

Filter regulator
AW Series

Combination units
AC Series

Pressure relief 3-port valve
VHS Series

Air filter
AF Series

Mist separator
AFM Series

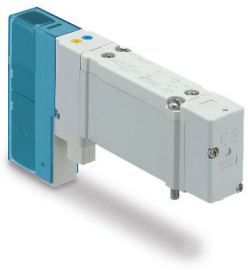
Micro mist separator
AFD Series

Membrane air dryer
IDG Series

Electro-pneumatic regulator
ITV Series

Valves

5-port solenoid valve
SY Series



3-port pilot operated poppet
VP Series

High vacuum angle valve
XLS Series

For dimensions and other details refer to general catalogue of each series at www.smc.eu

Expertise – Passion – Automation

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