

Basic Principles Thermo-Chillers Training



Contents

Cooling and Heating Methods

SMC Chillers

Main Applications

Main Parameters

Model Selection

Contents

Cooling and Heating Methods

SMC Chillers

Main Applications

Main Parameters

Model Selection

Basic Principles

A Chiller is a device to control the temperature of a customer's tool or machine.



SMC.

Cooling and Heating Methods

Basic Principles

Q. How can a chiller set the temperature of the circulating fluid at the required value?





A. By exchanging heat (giving/taking) with the circulating fluid.



Cooling and Heating Methods

Basic principles of heat exchange

SMC's chillers are divided in 3 families according to their operating principle

- 1. Water-cooled
- 2. Refrigerated
- 3. Peltier

Basic Principles

Cooling and Heating Methods

Water-cooled Chillers



In principle, this kind of chiller consist of a **heat exchanger** only.

What is a heat exchanger?

A heat exchanger is a device used to passively transfer heat from one material to another.

Heat exchangers are basically two chambers separated by a single wall. Most heat exchangers are simply two passageways of pipe that snake back and forth, turning in on themselves.



The circulating fluid temperature cannot be set lower than the facility water temperature.

The circulating fluid temperature can be set higher than the facility water temperature by means of an <u>electric</u> <u>heater</u>.

SMC.



Cooling and Heating Methods

Chillers Exchanger

Heat is exchanged between circulating fluid and facility water by means of an heat exchanger.





Flow schematic of a brazed plate heat exchanger



Operation and assembly principle of a brazed plate heat exchanger

Basic Principles

Cooling and Heating Methods

Refrigerated chillers

In principle, this kind of chillers consist of:

- ✓ Compressor
- ✓ Condenser
- ✓ Evaporator
- ✓ Expansion valve





Cooling and Heating Methods

Refrigerated chillers



Basic Principles

Cooling and Heating Methods

Peltier chillers



Electrons in the n-type element (moving in the opposite direction of the current) and "holes" in the p-type element (moving in the same direction of the current) transfer heat and charge from one side of the device to the other.

Contents

Cooling and Heating Methods

SMC Chillers

Main Applications

Main Parameters

Model Selection

Temperature Control Equipment High performance chiller



Series HRZ

Applicable for Various

Operating Conditions

Wide SP Temp. range: $-20 \sim 90C$ Wide cooling capacity: $1 \sim 15$ kW Temp. stability: $\pm 0.1C$ Available for various fluids

Running Cost Reduction

Low power consumption Leak-proof with low evaporation Low facility water consumption

-20 to 40°C

Thermo-chiller

SMC

Temperature Control Equipment High performance chiller



HRZ Thermo-chiller: Construction

SMC

SMC.

Basic Principles



Thermo-chiller

Temperature Control Equipment High performance chiller



Applicable for Various Operating Conditions Wide SP Temp. range 20 ~ 90C Wide cooling capacity 2 ~ 30 kW Available for various fluids

Reduced Fab Facility Requirements

Smaller power utility box required Less air-conditioning required Less space required

Running Cost Reduction

Low power consumption Leak-proof with low evaporation Low facility water consumption

Temperature Control Equipment High performance chiller



HRW Thermo-chiller: Construction

SMC.

Temperature Control Equipment Basic Type Chiller





Applicable for Various Operating Conditions

Wide SP Temp. range 5 ~ 30C Wide cooling capacity 1.0 ~ 2.2 kW Available for various fluids



Triple Control

Compressor, fan, electronic control valve can be controlled depending on heat-load Power consumption reduced by 33%



Low-noise Design 55dB(A)

Temperature Control Equipment



SMC.

Temperature Control Equipment Compact chiller





Applicable for Various Operating Conditions

Wide SP Temp. range 5 ~ 40C Wide cooling capacity 1.1 ~ 5 kW Available for various fluids





Communication function

 Equipped with serial communication (RS232C, RS485) and contact I/Os (2 inputs and 3 outputs) as standard.

Thermo-chiller

SMC.

SMC.

Temperature Control Equipment

Basic Principles



HRS012/018/024 Thermo-chiller: Construction

Temperature Control Equipment



HRS050 Air Cooled Thermo-chiller: Construction

SMC.

Temperature Control Equipment



HRS050 Water Cooled Thermo-chiller: Construction

SMC.

SMC

Temperature Control Equipment Energy saving chiller





Energy saving

Triple inverts (Compressor, fan, pump) Power consumption reduced by 34%

Short Start-up and "Down" Times

Fast temperature response Easy maintenance Alarm indication



Operating Conditions Wide SP Temp. range 5 ~ 40C Wide cooling capacity 10 ~ 25 kW Temp. stability: ±0.1C Available for various fluids



Thermo-chiller

Basic Principles

Temperature Control Equipment



HRSH series Thermo-chiller: Construction

Temperature Control Equipment High Precision chiller





Precise temperature control

Circulating fluid by using a Peltier device



Environmentally friendly



Applicable for Various Operating Conditions Cooling capacity: 140 ~ 1200 W

Temp. stability: ± 0.01 to 0.03C Available for various fluids

SMC

SMC.

Temperature Control Equipment





Flow switch (option)

HEC Air Cooled Thermo-con: Construction

SMC.

Temperature Control Equipment



HEC Water Cooled Thermo-con: Construction

Temperature Control Equipment High Precision Rack Mounted Chiller





Applicable for Various Operating Conditions Cooling capacity: 200 ~ 1000 W Temp. stability: ±0.01 to 0.03C Available for various fluids



Series HRCR



Circulating fluid by using a Peltier device



19 inch Rack Mounted (can be operated without being mounted to a rack)

SMC.

Contents

Cooling and Heating Methods

SMC Chillers

Main Applications

Main Parameters

Applications



La Co

Laser beam machine/Laser welding machine

Cooling of the laser oscillation part and power source



Printing machine Temperature control of the ink roller



Cleaning machine

Temperature control of cleaning solution

Arc welding machine



Cooling of the power source

Resistance welding machine (Spot welding)

Cooling of the welding head electrodes, transformers and transistors (thyristors)



High frequency induction heating equipment

Cooling of the heating coils, high frequency power source and around inverters

High frequency inverter



Contents

Cooling and Heating Methods

SMC Chillers

Main Applications

Main Parameters

Model Selection

Basic Principles

Main Parameters

How does a Chiller operate and what are its main components?

A Chiller operates by:

1. Controlling the temperature of a fluid



---- circulation

2. Circulating this fluid through the customer's tool

This requires:

- ✓ Pump
 - Tank

Main Parameters

Main specifications of a Chiller

Characteristics that define whether the Chiller is suitable or not for a specific application



Main Parameters

1 – Fluid type

What type of circulating fluids to use?

Tap water		De-ionized water	
Advantages * Easy handling * Low price * High specific heat * Non-toxic	Disadvantages * Low electrical resistance * Freezes below 0° C * Needs periodical replacement (high running cost)	Advantages * Easy handling * Low price * High specific heat * High electrical resista	<u>Disadvantages</u> * Corrodes metals * Freezes below 0° C * Needs DI filter and resistivity ince control device (high initial cost) * Needs periodical replacement of water and DI filter

- * Low freezing point
- * Good specific heat
- * No corroding metals
- <u>Disadvantages</u>
- * Low electrical resistance
- * Flammable (concentrations > 80%)
- * EG concentration needs to be kept constant (high running cost)
 * Toxic

Galden (Solvay Solexis), Fluorinert (3M) Advantages Disadvantages * Low freezing point * Very expensive (high initial cost) * Doesn't corrode metals * Toxic * Very high electric resistance * Toxic

Main Parameters

2 – Set temperature

What should be the temperature of the circulating fluid supplied by the Chiller?

What is the maximum fluctuation allowed? (→ Temperature Stability)

Example: T1 = -20 \pm 0.1° C



3 – Flow rate

What should be the flow rate of the circulating fluid supplied by the Chiller to the customer's tool?

Example: $q_v = 10$ L/min

4 – Return temperature (\rightarrow Cooling / Heating capacity)

What is the temperature of the circulating fluid returning to the Chiller from the customer's tool?

Example: $T2 = 22^{\circ}$ C


What is the cooling capacity provided by the Chiller?



The cooling capacity provided by the Chiller depends on the set temperature.

Example: 5 kW @ 50° C

The <u>Cooling / Heating capacity</u> provided by the Chiller is defined completely only when the heat flow (removed or given to the circulating fluid) is specified at a certain set temperature.

5 – Discharge pressure

What should be the pressure of the circulating fluid supplied by the Chiller? *

* It is assumed that the tank is at ambient pressure.

HRZ004-H/008-H HRZ002-W/008-W



The <u>pump capacity</u> is defined properly only when the pressure rise at a certain flow rate is specified.

Example: 0.1 MPa (gauge) @ 10 l/min

6 – Cooling method

How can the Chiller be cooled down?



Water-cooled and Air-cooled versions of the same Chiller model.

SMC

SMC.

Main Parameters

7 – Power supply type

What is the available electric power supply?



8 – Communication type

What is the type of communication required to exchange information between customer's tool and Chiller?

What information have to be exchanged between customer's tool and Chiller?

Available type of communication:

- contact input/output
- Serial



Operation in "Local mode" doesn't require any communication

Basic Principles

Main Parameters

Communication type: Contact Input / Output

What information can be exchanged:

- ➤ remote START / STOP input signal (customer's tool → Chiller)
- ➢ output signal in case of ABNORMAL STOP (Chiller → customer's tool)
- ➢ output signal in case of NORMAL OPERATION (Chiller → customer's tool)
- > output signal in case of WARNING (Chiller → customer's tool)





Chiller

Customer's tool

Communication type: Serial

What information can be exchanged:

- ➤ circulating fluid set temperature input signal (customer's tool → Chiller) - writing
- > circulating fluid present temperature output signal (Chiller → customer's tool) - reading
- > circulating fluid electrical resistivity output signal (Chiller → customer's tool) – reading
- remote START / STOP input signal (customer's tool → Chiller) - writing
- > circulating fluid flow output signal (Chiller → customer's tool) - reading

0-

 > circulating fluid discharge pressure output signal (Chiller → customer's tool) – reading

input signal

output signal

> other signals depending on the specific Chiller

RS-232C: standard for serial **one-to-one communication**. Additional hardware specifications and software protocol are required to define it completely.

RS-485: standard for serial **communication between several devices**. Additional hardware specifications and software protocol are required to define it completely.

DeviceNet_m

CanOpen, Ethernet, ...



customer's tool

Chiller

20°

С

0

Contents

Cooling and Heating Methods

SMC Chillers

Main Applications

Main Parameters

Model Selection

SMC.



Performance



Situation 1

"THE CUSTOMER KNOWS

THE COOLING CAPACITY."



SMC

Temperature Control Map

HRSH HRSE

٠

٠ ٠

٠

•

• ٠

٠

٠

٠

•

٠

♦/★

 \star

• •

HRZ HRZD HRW

• • •

• • •

• •

• • ٠

• •

٠

•

٠

٠

*

*

*

٠

*

* *

• •

• • •

• • •

• • •

• • • • •

•

٠

٠

×

*

٠ * * * * *

★ ×
 ★
 ★
 ★
 ★

 P.124
 P.160
 P.182
 P.216
 P.218

• * * **♦/★**

* *

*

*

٠

٠ ٠

٠ ٠ • •

> • • • • •

• • • ٠ ٠

11						r											
ă	Ser	ies	Features	Temperature range setting	Cooling	Cooling method	Temperature stability	Pump capacity		Pump	Power supply	Circulating fluid				20	0
rincink	Thermo-chillier Standard type Series HRS	P18	 With this chiller, cooling water can be obtained anywhere it is necessary because of easy installation and easy operation. For a wide range of applications such as laser machine tool, analytical equipment, LCD manufacturing equipment, Moint temperature control, etc. Compact: W 377 x1 615 x D 500 mm, do kg (HRS012/018/024) 	5 to 40°C	1.3 kW 1.9 kW 2.4 kW 3.2 kW 5.1 kW 5.9 kW (60 HH)	Air- cooled Water- cooled	3 ±0.1°C	42 L/min 5	>	Magnet pump (Nectanical seal pump for high pressure pump mounted type)	Single-phase 100 VAC (50/80 Hz) Single-phase 115 VAC (80 Hz) single-phase 200 to 200 VAC (50/90 Hz)	Tap water Delonized water Ethylene glycol aqueous solution (15%)	-	Heating function Fan Inverter Compressor Inverter Pump Inverter	• HRS	 HRS100' 	• • •
	Thermo-chiller Standard type Series HRS100'150	P64	 tank, Power failure auto-restart, Anti- trezing operation function, etc. Self diagnosis function No heater required, circulating fluid is heated using heat exhausted by refrigerating circuit. Daw-noise design: 70 dB(A) (HRS100/150) Outdoor Installation: IPXA (HRS100/150) 	5 to 35°C	9.5 kW 14.5 kW (60 Hz)	Air- cooled Water- cooled	±1.0°C	68 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 Delonized water Ethylene glycol aqueous solution (15%)		PID control ON/OFF control Error diagnostic function Flow sensor/switch RS-232C RS-465	•	• • • • • • • • • • • • • • • • • • • •	•
л Д	Thermo-chiller Inverter type Series HRSH090	P96	Power consumption reduced by 53% Outstanding energy saving effect with the triple inverteri Max, ambient temperature: W 377 x H 1060 x D 970 mm Low-noise design: Max.66 dB Max, ambient temperature: 45°C	5 to 40°C	9.5 KW	Air- cooled Water- cooled	±0.1°C	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 Delonized water Ethylene glycol aqueous solution (15%)		Analog I/O (Contact input/output) Analog communication DeviceNet Communication With earth leakage breaker With earth leakage breaker with handle	•/* *	•	•
	Thermo-chiller Inverter type Series HRSH	P124	Outstanding energy saving effect with the triple inverter! Outdoor installation: IPX4 Outdoor installation: IPX4 Max, ambient temperature: 45°C Space-saving, Lightweight 280 kg (25 kW type)	5 to 35°C	10 kW 15 kW 20 kW 25 kW 28 kW	Air- cooled Water- cooled	±0.1°C	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%)		With heater With external switch iniet With water leakage sensor Drain pan set (With water leakage sensor) With automatic water fill function	•	•	•
	Thermo-chiller Basic type Series HRSE	E160 Simple function and performance Thermo-chiller of the basic type. Large energy saving by triple contr Power consumption 33% energy savin Compact/Lightweight 32 kg (100 VAC Maintenance tree: Magnet pump Low-noise design: 55 dB (A)	10 to 30°C	1.2 KW 1.6 KW 2.2 KW (60 Hz)	Air- cooled	±2.0°C	25 L/min		Magnet pump	Single-phase 100 VAC (50/60 Hz) Single-phase 200 VAC (50/60 Hz) Single-phase 230 VAC (50/60 Hz)	Tap water Ethylene glycol aqueous solution (15%)		With fluid fill port Applicable to delonized water piping High pressure pump mounted High temperature environment specification With caster adjuster-foot	• • •	◆ ◆	•	
	Department (1)	P182	Sultable for semiconductor processing equipment with a wide variety of features such as high temperature stability wide temperature range, tailure diagnosis, external communication, etc. © Can respond to change of process conditions fiexibly, which is suitable for	-20 to 40°C -30 20 to 90°C 9 -30 -20 to 90°C 9 -30 -20 to 90°C 9	0 1 KW 2 KW 4 KW 8 KW	Water- cooled	±0.1°C	40 L/min		Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 208 VAC (60 Hz)	Fluorinated fluid Tap water Delonized water Ethylene glycol aqueous solution (60%)		Circulating Fluid Automatic Recovery DI control M/Electrical resistance control set Electrical resistance sensor set Electric conductivity control set DI filter set Investment for DI filter	* * *	*	*
	Thermo-chiller High-performance type Series HRZ ((SI) (SEII)	P.182	semiconductor equipment with a short innovation cycle. Ocnotrming to various sately standards Inverter type is selectable. Energy saving is achieved through use of a DC inverter compressor.	-20 to 90°C	о 10 кw	Water- cooled	±0.1°C	40 L/min		Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 208 VAC (60 Hz)	Fluorinated fluid Tap water Delonized water Ethylene glycol aqueous solution (60%)		Anti-quake bracket Piping conversion fitting (NPT thread or G thread) NPT fitting Bypass piping set	* •/*	∳/≯ ★	• •/*
	Thermo-chiller High-performance Inverter type Sories HRZD	P218	 Temperature for two systems can be controlled separately by one chiller. Double inverter: More effective energy- saving is achieved through use of a DC inverter compressor and an inverter pump. Space-saving: Footprint 25% reduction eadued withs piping and labor: Single power cable, single catify werk rolation system 	-30 to 90°C	9.5 KW x 2	Water- cooled	±0.1°C	40 L/min		Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 208 VAC (60 Hz)	Fluorinated fluid Ethylene glycol aqueous solution (60%)		Power supply cable Particle filter set Contaminant filter Connector cover Replacement type dustproof filter set	* * *	*	*
	Water-cooled thermo-chille High-performance type Sories HFW C (R) CCC Water-cooled thermo-chiller High-performance inverter typ Sories HFW C (R) CCC	218 2218 2218 2218 2218	 Direct heat exchanger for in-plant circulating fluid Can control the temperature over a wide range since a compressor is not required. Suitable for semiconductor processing equipment with a wide variety of features such as high temperature stability, wide temperature stability, wide temperature range, tailure diagnosis, external communication, etc. 	20 to 90°C	2 kW 8 kW 15 kW 30 kW	Water- cooled (Without compressor)	±0.3°C	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%)		Separately Installed power transformer Relief valve set Snow protection hood 4-port manifold 60% ethylene glycol aqueous solution Ethlene glycol aqueous solution consentation meter	* * P.18	* * * P.64	* P.96

Basic Principles

Check the Cooling Capacity



DON'T FORGET - Introduce a safety margin of 20% Cooling Capacity = Customer's Request x 1.2

Check the Pump Capacity HRZ001-L/002-L/004-L



Flow Rate @ Discharge (customers request) MUST be lower than actual pump performance.



Now we have a Solution!!

We should now confirm the other features the customer may require.

- Power Supply? Communication?
 - Certification? Size?
 - Price?



Situation 2

"THE CUSTOMER DOESN'T KNOW THE COOLING CAPACITY - AND WE NEED TO CALCULATE."

OR

"THE CUSTOMER WANTS TO COOL DOWN AN OBJECT TO A CERTAIN TEMPERATURE IN A PERIOD OF TIME"

Basic Principles





Basic Principles





Basic Principles How to Calculate the Cooling Capacity - 2 $Q = \frac{\rho \times V \times C \times \Delta T}{\Delta t}$ Where: = Calculated heat load [kW] ()= Bath fluid density [kg/dm³] ρ V = Total volume of bath [dm³] or [Litre] С = Bath fluid specific heat at set temperature [kJ/kg.K] = $T_t - T_0$ = Cooling temp. difference [° C] or [K] ΔT = Cooling time [s] Δt Thermo-chiller $Q_{Calc} = \frac{1 \times 20 \times 4.18 \times 10^3 \times 12}{1114} = 1114W$ Q x ∆t: Heat capacity [kJ] Water bath 20°C 900 Considering a 20% Safety Factor After 15 minutes, cool 32°C down to 20°C. $Q_{T_{otal}} = 1114 \times 1.2 = 1336W$

Example 1

- Fluid:
- Set temperature :
- Cooling capacity:
- Flow rate:
- Cooling method:
- Special Requirements:

Water 20°C 6kW 40 litre/min @ 3bar Air-Cooled Low Cost, Compact size

Consider The Possible Solutions

SMC.

Model Selection

S	Series	Features	Temperature range setting	Cooling capacity	Cooling 1 method	enperature i stability ca	Pump apacity		Pump	Power supply	Circulating fluid				8	0			Т	
He	Thermo-chiller P.18 Standard type Series HRS	 With this chiller, cooling water can be obtained anywhere it is necessary because of easy installation and easy accention 	(2)	4 1.3 KW	7	3)		type					HRS	RS100/1	HRSH09	HSH	HRSE	HRZ	HRZD HRW
.Ħ		 For a wide range of applications such as laser machine tool, analytical equipment. LCD manufacturing 	5 to 40°C	1.9 KW 2.4 KW 3.2 KW	Air- cooled	±0.1°C	42 J/min		Magnet pump (Mechanical seal pump for	Single-phase 100 VAC (50/60 Hz) Single-phase 115 VAC	Tap water Delonized water		Heating function	•	Ĩ	•	•		•	• •
X		equipment, moid temperature control, etc.	0 60	5.9 KW	cooled				high pressure	(60 HZ)	aqueous solution		Fan Inverter			٠	•			
Ч		 Compact: W 377 x H 615 x D 500 mm, 40 kg 		(60 H>			5)		pump mouned type)	(50/60 Hz)	(15%)		Compressor Inverter		\square	٠	•		•	•
·		(HRS012/018/024)			6]								Pump Inverter			٠	•		•	• •
	Thermo-chiller P64	tank, Power fallure auto-restart, Anti-											PID control	•	•	٠	•		•	• •
Ш	Standard type	freezing operation function, etc.		9.5 kW	Air-					3-phase 200 VAC	Tap water		ON/OFF control		\square			•	_	_
	Series HHS 100 150	No heater required, circulating fluid is	5 10 35°C	14.5	cooled	±1.0°C	68		Mechanical	(50 Hz) 3-phase 200 to 230 VAC	Delonized water		Error diagnostic function	•	•	•	•	•	•	• •
		refrigerating circuit.	0 60	(60 Hz)	Water- cooled	1	_/min		seal pump	(60 Hz)	Ethylene glycol aqueous solution		Flow sensor/switch		\square		_	•	•	• •
· 7		 Low-noise design: 70 dB(A) (HRS100/150) Outdoor installation: IDX4 (HRS100/150) 								3-phase 380 to 415 VAC (50/60 Hz)	(15%)		RS-232C	•	•	•	•		-	_
- (J)	Thermo-chiller P96	Culdoor Installation: IPX4 (HHS100/150)						-		(,			RS-485	•	•	•	•	_	•	• •
	Inverter type	Outstanding energy saving effect with			Air-					3-phase 200 VAC	Tap water		Analog I/O (Contact Input/output)	•/★	-	•	•		•	• •
	Series HRSH090	the triple inverter! Max, ambiant temperature: W 377 x H	5 to 40°C	9.5 KW	cooled	+0.190	60		Mechanical	(50 HZ) 3-phase 200 to 230 VAC	Delonized water		Analog communication	*	\vdash		_		•	• •
Ω		1080 x D 970 mm	0 60	5.5 KW	Water-		_/min		seal pump	(60 Hz)	Ethylene glycol		DeviceNet Communication				-		•	-
	(E 🗊 🧮	Low-noise design: Max.66 dB Max. ambient temperature: 45°C		ľ	cooled					3-phase 380 to 415 VAC (50/80 Hz)	(15%)	(15%)	With earth leakage breaker	•	 	٠	•		_	_
6								-		(00000112)			With earth leakage breaker with handle		\vdash		•		-	• •
	Inverter type	Outstanding energy saving effect with		10 KW	Ale					3-phase 200 VAC	Tap water		With neater				-		-	•••
	Series HRSH	the triple inverter! Outdoor Installation: IPX4	5 to 35°C	15 kW	cooled		180		Immersion	(DU FIZ) S-phase 200 to 230 VAC	Delonized water		with external switch Inlet	•	-	•	•		_	
		Max. ambient temperature: 45°C Space sources labburget: 280 kg	0 60	20 KW 25 KW	Water-	±0.1°C	L/min		pump	(60 Hz)	Ethylene glycol		With water leakage sensor		\vdash		_		•	•••
	CE (m).	 Space-saving, Lightweight 250 kg (25 kW type) 		28 KW	cooled					3-phase 380 to 415 VAC	(15%)	Julion	Drain pan set (With water leakage sensor)	*			_		-+-	_
-	(201 Value spine) (and spine)									(50/60/12)			with automatic water fill function	•					_	
	Thermo-chiller P160	 Simple function and performance. Thermo children of the basis here. 								Single-phase 100 VAC			Applicable to deterined water claims		-		•	•	-	
	Series HRSE	 Large energy saving by triple control! 	10 to 30°C	1.2 KW	Alre		25		Magnat	(50/60 Hz) Single-phase 200 VAC (50/60 Hz)	Tap water		Applicable to deforized water piping	•	\vdash	•	_		-+-	
		 Power consumption 33% energy saving Compact/Lightweight 32 kg (100 VAC) 		2.2 KW	cooled	±2.0°C	_/min		pump		aqueous solution	solution	High pressure pump mounted	•	\vdash		_	•	-+-	
	CE 📕	Maintenance free: Magnet pump		(60 HZ)						Single-phase 230 VAC	(15%)		With cester eduster-foot	•	A 14		• / •			-
1	Crey 200 VAC (yp)	Low-hoise design: 55 dB (A)	00 to 4000							(50/60 Hz)			Circulating Fluid Automatic Recovery		• •		• • ×		-	
	Thermo-chiller P182	Suitable for semiconductor processing	-2010 40 C								Fluorinated fluid		Di control kt/Electrical resistance control set	+	\vdash		-			
	Series HRZ	equipment with a wide variety of	-30 20 to 90°C 90	1 KW						3-phase 200 VAC	Tap water		Electrical resistance sensor set	÷	\vdash		-		-	—
	•	stability, wide temperature range, failure		2 kW 4 kW	Water-	±0.1°C	40 /min		immersion pump	(50 HZ) 3-phase 200 to 208 VA (60 HZ)	Delonized water Ethylene glycol		Electric conductivity control set	<u>^</u>	+	+	+		-+	
		 diagnosis, external communication, etc. Can respond to change of process 	-30 -20 to 90°C 90	8 kW							aqueous solution	solution	DI fliter set	+	Ê	^	^		+	+
	((🔊 🚥	conditions flexibly, which is suitable for	-30 90								(60%)		Insulating material for DI filter	<u> </u>	\vdash				÷	- î
	Thermo-chiller 9 📬 P182	innovation cycle.	-20 to 90°C							S share 200 VAC	Fluorinated fluid		Anti-quake bracket	*	\square	•	•	*	÷.	*
	High-performance type	 Conforming to various safety standards Inverter type is selectable. Energy 	-30 90		Water-	10.405	40		Immersion	(50 Hz)	Tap water Delonized water		Piping conversion fitting (NPT thread or G thread)	♦/★	◆/★	♦/★	♦/★	-	-	
	Survey FITL	saving is achieved through use of a	10 to 60°C	10 KW	cooled	10.1°C	_/min	I	pump	3-phase 200 to 208 VAC	Ethylene glycol		NPT fitting						•	•
	((🔊 (💷 🔍	DC Inverter compressor.	-30 90							(00 HZ)	aqueous solution (60%)		Bypass piping set	*	*	*	*	*	*	* *
	Thermo-chiller P216	Temperature for two systems can be											Power supply cable	*	\square				1	
	High-performance	 Double Inverter: More effective energy- 	-30 to 90°C					I		3-phase 200 VAC	Fluorinated fluid		Particle filter set	*	\star	*	*	*		
	Series HRZD	saving is achieved through use of a DC		9.5 KW	Water-	±0.1°C	40 /min		pump	(50 H2) 3-phase 200 to 208 VAC	Ethylene glycol aqueous solution		Contaminant filter		\square					*
		Space-saving: Footprint 23% reduction	-30 90	**	cooled					(60 Hz)	(60%)		Connector cover	*	\square					
	(🖓 💷 🐛 🔤	 Reduced wiring, piping and labor: Single power cable, single facility water piping system 											Replacement type dustproof filter set	*				*		
	Water-cooled thermo-chiller	Direct heat exchanger for in-plant						1					Separately Installed power transformer	*						
	High-performance type	 Can control the temperature over a 									Fluorinated fluid		Relief valve set		\star					
		wide range since a compressor is not	20 to 90°C	2 KW	Water-			I		3-phase 200 VAC	Tap water		Snow protection hood		\star		*			
ŀ		 Suitable for semiconductor processing 		8 kW	cooled	±0.3∘C	50 /min		pump	3-phase 200 to 208 VAC	Deionized water Ethylene gluppi		4-port manifold						*	*
	Water-cooled thermo-chiller High-performance inverter type	equipment with a wide variety of features such as high temperature	-30 90	30 KW 0	(without compressor)	'				(60 Hz)	aqueous solution		60% ethylene glycol aqueous solution						*	*
	Series HRW	stability, wide temperature range, fallure			1						(60%)		Ethylene glycol aqueous solution concentration meter	*	\star	*	\star	*	*	* *
	((🔊 💷 🛛	 inverter type is selectable. 												P.18	P.64	P.96	P.124	P.160 P	2182 F	216 P.218

Example 1

- Fluid:
- Set temperature :
- Cooling capacity:
- Flow rate:
- Cooling method:
- Special Requirements:

Water 20°C 6kW 40 litre/min @ 3bar Air-Cooled Compact size, Low cost





Basic Principles

Model Selection Check cooling capacity HRS100-A-40 Check 6kW + 20% = 7.2kWCooling capacity [kW] HRSH090-A-40 Ambient temperature: 32 °C Cooling capacity [kW] Ambient temperature: 43 °C Circulating fluid temperature [°C] Ambient temperature: 45 °C 50Hz Circulating fluid temperature [°C]

Both HRS100-A and HRSH090-A are suitable



Check pump capacity HRS100-A-40 Check Circulating fluid Circulating fluid outlet port(60Hz) outlet port(50Hz) 40 L/min @ 3 bar 0.5 50 0.4 40 Usable range (50Hz) -ifting head [m] Pressure [MPa] 0.3 30 Usable range HRSH090-A-40 0.2 20 (60Hz) 0.1 10 0.6 60 0 0 ۰ irculating fluid pressure [MPa] 0 10 20 30 50 70 0.5 40 60 50 Circulating fluid Circulating fluid flow [L/min] return port 0.4 40 Usable flow rate range Outlet 0.3 30 Usable flow rate range 0.2 20 Return port 0.1 10 Looks like both HRS100-A-40 anc 0 0 HRSH090-A-40 are suitable 20 70 0 10 30 40 50 60 Circulating fluid flow [L/min]

SMC.

Pump head [m]



Model Selection Check Small Size Basic Principles The HRSH090-A is much compact than the HRS100-A-40 HRS100-A-40 HRSH090-A-40 616mm(24.3in) 954mm(37.6in) 0 377mm (14.8in) 970mm (38.2in) 1434mm(56.5in) 1

1080mm (42.5in)

6

Ā

Ĩ

a ∎¶a In case of HRS150-A-20

SMC

The solution

HRSH090-A-40 is our solution!

We should now confirm the other features the customer may require:

- High performance temp. stability: ±0.1° C
- Power Supply: 380 to 415 VAC
- Communications: RS-485, RS-232 & Analog
- Advanced Controller: 44 Alarm Indications
- CE & UL Certification



Example 2

- Fluid:
- Set temperature :
- Temperature stability:
- Cooling Capacity :
- Flow Rate:
- Cooling Method:
- Special Requirements:

Water 18 ° C \pm 0.05° C 450W 5 L/min @ 0.6 bar Air Cooled (none)

Consider The Possible Solutions

SMC.

S)	Series		Features	Temperature	Cooling	Cooling	Temperature	Pump		_	Pump						0		_		_	_	_	
				• With this chiller, cooling water can be	range setting	capacity	method	SEDUTY	capacity			type	Power supply	Circulating fluid				1150	06	T	ш.				
	Standard type		218	obtained anywhere it is necessary	\bigcirc	4	11	3						(1)			HHS	100	SH	IRSI	ILS I			ŝ.	
	Series HRS	The state of the s		operation.		1.3 KW		5				Magnet	Single-phase 100 VAC					IRS	۳	-	-			1	
	•	1.		 For a wide range of applications such 	5 to 40°C	2.4 KW	Air- cooled		42			pump	(50/60 Hz)	Tap water				-		_			_	_	
C)			equipment, LCD manufacturing		3.2 KW	Water-	±0.1°C	L/min			(Mechanical seal pump for	Single-phase 115 VAC	Ethylene glycol		Heating function	•	•	•	•		•		4	
A	•			equipment, moid temperature control, etc. • Compact: W 377 x H 615 x D 500 mm		5.9 KW	cooled		-			high pressure	(60 HZ) Sindle-chase 200 to 230 VAC	aqueous solution		Fan Inverter			•	•			_	_	
4	(()			40 kg		(60 H7)	~		5)		type)	(50/60 Hz)	(15%)		Compressor Inverter			•	•		•	-	_	
	(Cely 40 Hz)			(HRS012/018/024) • Timer operation function, Low level in			6)								Pump Inverter			•	•		•	•	-	
	Thermo-chiller	-	P.64	tank, Power fallure auto-restart, Anti-												PID control	•	•	•	•		•	<u> </u>	4	
	Standard type	1 10	_	freezing operation function, etc. Self diagnosis function	E to SEVO	9.5 KW	Air-						3-phase 200 VAC	Tap water		ON/OFF control				_	•	_	_		
	Senes HHS TOUR ISC			No heater required, circulating fluid is	51035-C	14.5	cooled	±1.0°C	68			Mechanical	3-phase 200 to 230 VAC	Delonized water		Error diagnostic function	•	•	•	•	• •	•	•	•	
\mathbf{C}				refrigerating circuit.	0	0 (60 Hz)	cooled		L/min			seal pump	(60 Hz)	Ethylene glycol aqueous solution		Flow sensor/switch				_	• •	•		4	
4	C E			 Low-noise design: 70 dB(A) (HRS100/150) Outdoor installation: IDX4 (HRS100/150) 									3-phase 380 to 415 VAC (50/60 Hz)	(15%)		RS-232C	•	•	•	•			_	_	
M	Thermo-chiller		P96	Dever concurrentian radiused by E39/									()			RS-485	•	•	•	•				4	
	Inverter type	1	1.50	 Power consumption reduced by 53% Outstanding energy saving effect with 			Air-						3-phase 200 VAC	Tap water		Analog I/O (Contact Input/output)	●/★	•	•	•		•	-	-	
(y	Series HRSH090	'		the triple inverter! Max emblant temperature: W 377 x H	5 to 40°C	0.5 KW	cooled	+0.190	60			Mechanical	(50 Hz) 3-phase 200 to 230 VAC	Delonized water		Analog communication	*			_		•		<u>></u>	
\mathbf{n}				1080 x D 970 mm	0 6	0	Water-	10.10	L/min			seal pump	(60 Hz)	Ethylene glycol		DeviceNet Communication				_		•		▶	
	(E 🗊	-		Low-noise design: Max.66 dB Max. ambient temperature: 45°C			cooleu						3-phase 380 to 415 VAC	(15%)	5%)	With earth leakage breaker	•	٠	٠	•				_	
-	Crig 400 VAC (gst)			- max another temperature. To o									(00/00/12)	 		With earth leakage breaker with handle				•		•	•	<u> </u>	
	Thermo-chiller Inverter type	1	P124	 Outstanding energy saving effect with 		10 KW							3-phase 200 VAC	Tap water		With heater				_		•		4	
	Series HRSH			the triple inverter! Outdoor installation: IPX4	5 to 35°C	15 KW	Alr- cooled		180			Immediate	(50 Hz)	Delonized water		With external switch Inlet	•	•	•	•				_	
				Max. ambient temperature: 45°C		20 KW 0 25 KW	Water-	±0.1°C	L/min			pump	(60 Hz)	Ethylene glycol		With water leakage sensor				_		•	-	<u> </u>	
	<u>(</u> E. 🗐.,	(E 🗐.		 Space-saving, Lightweight 280 kg (25 kW type) 	-	28 KW	cooled						3-phase 380 to 415 VAC	aqueous solution (15%)		Drain pan set (With water leakage sensor)	*			_		-	—	_	
	(200 V so an option) (Crig 200 V (an an option)	100				_							(50/60 HZ)			With automatic water fill function	•	•		•		_		_	
	Thermo-chiller Basic type		P160	 Simple function and performance. 									Single-phase 100 VAC (50/60 Hz)			With fluid fill port	•	٠	•	٠	• •	•	•	<u> </u>	
	Series HRSE	Sories HRSE		 Thermo-chiller of the basic type. Large energy saving by triple control! 	10 to 30°C	1.2 KW								Tap water		Applicable to delonized water piping	•		٠	_		_		2	
				Power consumption 33% energy saving • Compact/Lightweight 32 kg (100 VAC) • Maintenance free: Magnet pump	Power consumption 33% energy saving		2.2 KW	Alr- cooled	±2.0°C	25 L/min			Magnet pump	Single-phase 200 VAC (50/60 Hz)	Ethylene glycol aqueous solution		High pressure pump mounted	•			_	•	_	_	_
	66				0 1	(60 Hz)						1	Single-phase 230 VAC	(15%)		High temperature environment specification	•			_			_		
	(Dely 200 VeC lype)			Low-noise design: 55 dB (Å)									(50/60 Hz)			With caster adjuster-foot		◆ ′★		◆ ′★		•	<u> </u>	-	
	Thermo-chiller		P.182	 Suitable for semiconductor processing 	-20 to 40°C	90 1 kW 2 kW							3-phase 200 VAC (50 Hz)	Eluginated fluid	rinated fluid water nized water lene głycol sous solution 6)	Circulating Fluid Automatic Recovery				_		•		<u>></u>	
	High-performance Series HRZ	e type		equipment with a wide variety of features such as high temperature stability, wide temperature range, failure diagnosis, external communication, etc.	³⁰ 20 to 90°C									Tap water		Di control ktl/Electrical resistance control set	*			_		•		▶	
		67 - C					Water-	±0.1°C	40			Immersion		Delonized water		Electrical resistance sensor set	*			_		_		_	
					-30 -20 to 90°C	90 4 KW	cooled		L/min			pump	3-phase 200 to 208 VAC (60 Hz)	Ethylene glycol aqueous solution		Electric conductivity control set		*	*	*		_	+	_	
	(6 98	And		 Can respond to change of process conditions flexibly, which is suitable for 										(60%)		Di filter set	*				,	*		*	
ł			0100	semiconductor equipment with a short.	-30 -20 to 90°C	90										Insulating material for DI filter				_	7	*		<u>*</u>	
	High-performance	e type	P102	Conforming to various safety standards									3-phase 200 VAC	Huorinated fluid Tap water		Annu-quake pracket	*		•	•	* 1	*	-11	<u><</u>	
	Series HRZ	0		 Inverter type is selectable. Energy saving is achieved through use of a 	-30 10 to 60°C	⁹⁰ 10 kW	Water- cooled	±0.1°C	40 L/min			pump	3-phase 200 to 208 VAC	Delonized water		Piping conversion itting (NPT thread or G thread)	●/★	♥/★	* /*	♥/★	_	-	+-	_	
	(6 9 1			DC Inverter compressor.									(60 Hz)	aqueous solution (60%)		NPT fitting							-	4	
ŀ		-	2018	 Temperature for two systems can be 	-30	90										Bypass piping set	*	*	*	*	* 1	* 7	<u> </u>	<u><</u>	
	High-performance	. 188	P210	controlled separately by one chiller.									3-phase 200 VAC	Eluorinated fluid		Power supply cable	*					-	—	_	
	Inverter type			 Double Inverter: More effective energy- saving is achieved through use of a DC 	-30 to 90°C	9.5 KW	Water-		40			Immersion	(50 Hz)	Ethylene glycol		Particle filter set	*	×	*	*	*	-	+	_	
	Series HKZD			Inverter compressor and an Inverter pump.	-30	x 2	cooled	±0.1°C	L/min			pump	3-phase 200 to 208 VAC	aqueous solution		Contaminant filter				-		+	7	<u><</u>	
	((BY (Space-saving: Footprint 23% reduction Reduced wiring, piping and labor: Single power 									(60 112)	(00%)		Connector cover	*					+	—	_	
	((11)			cable, single facility water piping system												Heplacement type dustproof filter set	*			_	*	+	+	_	
	Water-cooled thermo	-chiller	P218	 Direct neat exchanger for in-plant circulating fluid 												separately installed power transformer	*					+	+	_	
	Series HRW			 Can control the temperature over a 									O abase ODOVAC	Fluorinated fluid		Heller valve set		*				+	+	_	
	(6 9%	10055		wide range since a compressor is not required.	20 to 90°C	2 kW	Water-		50			Immersion	5-pnase 200 VAC (50 Hz)	Tap water Delonized water		snow protection hood		*		*		_	+	_	
ŀ	Water-cooled thermo.c	hiller	0210	 Suitable for semiconductor processing equipment with a wide workers of 	-20	15 kW	(Without	±0.3°C	L/min			pump	3-phase 200 to 208 VAC	Ethylene glycol		4-port manifold				_	1	*	*	<u>×</u>	
	High-performance inve	rter type	2210	features such as high temperature	-30	30 KW	compressor)						(60 Hz)	aqueous solution		60% ethylene glycol aqueous solution				_	, 1	*	1	<u>*</u>	
	Series HRW			stability, wide temperature range, failure										(60%)	Euryrene grycol aqueous solution concentration meter	*	*	*	*	* 1	* 7	* 1	<u>*</u>		
	((🔊 💷	lense		Inverter type is selectable.													P.18	P.64	N96	P.124	E160 P	162 P3	.16 P.2	38	

Example 2

- Fluid:
- Set temperature :
- Temperature stability:
- Cooling Capacity :
- Flow Rate:
- Cooling Method:
- Special Requirements:

Water 18 °C ± 0.05 °C 450W 5 L/min @ 0.6 bar Air Cooled (none)

HRS HRGC HRZ HRW HEC HED HEBC

Consider The Possible Solutions



Check pump capacity

HEC006

Circulating fluid: Tap water



SMC.

SMC

The solution

HEC006-A5 is our solution!

We should now confirm the other features the customer may require:

- Power Supply 100 to 240 VAC
- Communications RS-485 or RS-232
- CE & UL Certification
- Small Size
- Quiet Operation & Low Vibration



Example 3

- Fluid:
- Set temperature :
- Return temperature:
- Temperature stability:
- Flow Rate:
- Cooling Method:
- Special Requirements:

Fluorinated Fluid -10°C -3.5°C ±0.25°C 20 L/min @ 2 bar Water Cooled (none)

Consider The Possible Solutions

SMC.

Basic Principles

Model Selection

Series	Features	Temperature range setting	Cooling Capacity	Cooling method	Tenperature stability	Pump capacity		Pump type	Power supply	Circulating fluid	
Thermo-chiller Standard type Series HRS	 With this chiller, cooling waler can be obtained anywhere it is necessary because of easy installation and easy operation. For a wide range of applications such as laser machine tool, analytical equipment, LCD manufacturing equipment, moid temperature control, etc. Compact: W 377 x H 615 x D 500 mm, 40 kg (HRS012/018/024) Timer operation function, Low level in 		1.3 kW 1.9 kW 2.4 kW 3.2 kW 5.1 kW 5.9 kW (60 H)	Air- cooled Water- cooled	3 ±0.1°C	42 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 200 VAC (50/60 Hz)	Tap watar Deionized water Ethylene glycol aqueous solution (15%)	H 1 2 3 8
Thermo-chiller Standard type Series HRS 100'150	 tank, Fower failure auto-testart, Anti- treezing operation nucliciton, etc. Self diagnosis function No heater required, circulating fluid is heated using heat exhausted by refrigerating circuit. Low-noise design: 70 dB(A) (HRS100/150) Outdoor installation: IPX4 (HRS100/150) 	5 to 35°C 0 60	9.5 kW 14.5 kW (60 Hz)	Air- cooled Water- cooled	±1.0°C	68 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 Delonized water Ethylene glycol aqueous solution (15%)	6 8 8 8
Thermo-chiller Inverter type Series HRSH090	 Power consumption reduced by 53% Outstanding energy saving effect with the tripte invertert Max, ambient temperature: W 377 x H 1060 x D 970 mm Low-noise design: Max.68 dB Max, ambient temperature: 45°C 	5 to 40°C	9.5 KW	Air- cooled Water- cooled	±0.1°C	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 Delonized water Ethylene glycol aqueous solution (15%)	/ / / /
Thermo-chiller Inverter type Sories HRSH	Outstanding energy saving effect with the triple inverter! Outdoor installation: IPX4 Vax: ambient temperature: 45°C Space-saving, Lightweight 280 kg (25 kW type)	5 to 35°C 0 60	10 KW 15 KW 20 KW 25 KW 28 KW	Air- cooled Water- cooled	±0.1°C	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%)	
Thermo-chiller Basic type Series HRSE	 Simple function and performance. Thermo-chiller of the basic type. Large energy saving by triple controll Power consumption 35% energy saving compactLightweight 32 kg (100 VAC) • Maintenne free: Magnet pump • Low-noise design: 55 dB (A) 	10 to 30°C	1.2 kW 1.6 kW 2.2 kW (60 Hz)	Air- cooled	±2.0°C	25 L/min		Magnet pump	Single-phase 100 VAC (50/60 Hz) Single-phase 200 VAC (50/60 Hz) Single-phase 230 VAC (50/60 Hz)	Tap water Ethylene glycol aqueous solution (15%)	1
Thermo-chiller High-performance type Series HRZ	Sultable for semiconductor processing equipment with a wide variety of features such as high temperature stability wide temperature range, failure diagnosis, external communication, etc. - Can respond to change of process conditions flexibility, which is suitable for semicorductor and mean with a short with	-20 to 40°C -30 20 to 90°C 90 -30 -20 to 90°C 90 -30 -20 to 90°C 90 -30 90 90	1 kW 2 kW 4 kW 8 kW	Water- cooled	±0.1°C	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%)	0 6 6 1
Thermo-chiller High-performance type Series HRZ ((RL (ETT)	 Contorning to various safety standards innovation cycle. Contorning to various safety standards inverter type is selectable. Energy saving is achieved through use of a DC inverter compressor. 	-20 to 90°C -30 10 to 60°C -30 90 000000000000000000000000000000000	10 KW	Water- cooled	±0.1°C	40 L/min		immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 208 VAC (60 Hz)	Fluorinated fluid Tap water Delonized water Ethylene glycol aqueous solution (60%)	/ 1 1
Thermo-chiller High-performance Inverter type Series HRZD	 Temperature for two systems can be ontrolled separately by one offiler. Double inverter: More effective energy saving is achieved through use of a DC inverter compressor and an inverter pump. Space-saving: Footprint 23% reduction Reduced witing, piping and labor: Shige power cable, single softly water boting valent 	-30 to 90°C	9.5 KW x 2	Water- cooled	±0.1°C	40 L/min		Immersion pump	3-phase 200 VAC (50 Hz) 3-phase 200 to 208 VAC (60 Hz)	Fluorinated fluid Ethylene glycol aqueous solution (60%)	8 ((
Wate-cooled thermo-chiller High-performance type Series HFW Image: Cooled thermo-chiller High-performance inverter type Series HFW Image: Cooled thermo-chiller Image: Cooled th	Direct heat exchanger to in-plant circulating fluid Can control the temperature over a wide range since a compressor is not required. Suitable for semiconductor processing equipment with a wide variety of features such as high temperature stability. wide temperature range, failure diagnosis, external communication, etc. Inverter type is selectable.	20 to 90°C	2 kW 8 kW 15 kW 30 kW	Water- cooled (Without compressor)	±0.3°C	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%)	2 5 4 6 8

	HRS	HRS100/150	HRSH090	HRSH	HRSE	HRZ	HRZD	
Heating function	•	•	•	•	_	•	•	ľ
Fan Inverter			•	•				t
Compressor Inverter			•	•		•	•	ł
Pump Inverter			•	•		•	•	ł
PID control	•	•	•	•		•	•	ł
ON/OFF control	-	-	-	-	•	-	-	ł
Error diagnostic function	•	•	•	•	•	•	•	ł
Flow sensor/switch	-	-	-	-				ł
88-2320	•	•	•	•	-	-	-	ł
RS-485	-	-		-		•		ł
Analog I/O (Contect Input/output)	0/+			-				ł
Analog communication		-	-	-		-	-	┝
	*						-	┝
With earth leakage bracker	•		•	•		•		┝
with earth leakage breaker	•	•	•	•				Ļ
with earth leakage breaker with handle				•		-	-	Ļ
with neater						•	•	Ļ
With external switch Inlet	•	•	•	•			_	Ļ
With water leakage sensor						•	•	ļ
Drain pan set (With water leakage sensor)	*							ļ
With automatic water fill function	٠	•		•				ļ
With fluid fill port	•	٠	•	٠	•	•	•	ļ
Applicable to delonized water piping	٠		٠					ļ
High pressure pump mounted	٠				٠			ļ
High temperature environment specification	٠							L
With caster adjuster-foot		◆/★		♦/★		٠	٠	L
Circulating Fluid Automatic Recovery						٠		
DI control ktl/Electrical resistance control set	*					٠		
Electrical resistance sensor set	*							
Electric conductivity control set		*	*	*				
DI fliter set	*					*		Γ
Insulating material for DI filter						*		Γ
Anti-quake bracket	*		٠	٠	*	*		Γ
Piping conversion fitting (NPT thread or G thread)	♦/★	◆/★	◆/★	♦/★				Γ
NPT fitting						٠		Γ
Bypass piping set	*	*	*	*	*	*	*	ſ
Power supply cable	*							ľ
Particle fliter set	*	*	*	*	*			ľ
Contaminant filter								ľ
Connector cover	*							t
Replacement type dustproof filter set	*				*			t
Separately installed power transformer	*							t
Relief valve set		*						t
Snow protection hood		*		*				t
4-port manifold						*		t
60% ethylene alvcol aqueous solution					-	+		t
Ethylene glycol aqueous solution concentration meter	+	+	+	+	+	÷	+	t
, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	P18	P.64	P.96	P.124	P160	P182	P216	ł
	1.10	1.004	1.00	10.000	1.100	2.105	1.2.10	L

Example 3

- Fluid:
- Set temperature :
- Return temperature:
- Temperature stability:
- Flow Rate:
- Cooling Method:
- Special Requirements:

Fluorinated Fluid -10 $^{\circ}$ C -3.5 $^{\circ}$ C \pm 0.25 $^{\circ}$ C 20 L/min @ 2 bar Water Cooled (none)



Consider The Possible Solutions

Example 3

Set temperature : -10 $^{\circ}$ C (T₁)

Return temperature : -3.5° C (T₂)

Fluid: Fluorinated Fluid

Fluorinated Fluid features: (see Cat.E43E page 192) ρ = 1870 grams/litre C = 870 J/kg.K Δ T = T₂-T₁ = 6.5° C

 $Q_{Calc} = \frac{1870 \times 20 \times 870 \times 6.5}{60 \times 1000} = 3.52 \text{kW}$

with a safety margin of 20%: $Q_{Total} = 3.52 \times 1.2 = 4.23 \text{kW}$

<u>4.23kW @ -10° C</u>




Model Selection



Model Selection

Check pump capacity



SMC

Model Selection

The solution

HRZ008-L is our solution!

We should now confirm the other features the customer may require:

- Power Supply: 3 Phase, 200 to 208 VAC
- Communications: RS-485, DeviceNet, Analog
- CE, UL, SEMI & SEMATECH Certification
- Automatic Fluid Recovery System (option: Z)



Construction of main parts (Compressor)



The rotary type refrigerator changes the rotary motion of the motor to compression motion.

The reciprocating type used in the past had a construction whereby the rotary motion of the motor was changed to up-and-down motion of the piston by a crank shaft and a connecting rod. With this method, the valve construction etc. becomes complicated, and at the same time there is up-and-down motion so it tends to be accompanied by vibration and noise. The rotary type refrigerator cuts out the "waste" of the two-step system of changing rotary motion to reciprocating motion.

The accumulator is a buffer tank for separation of liquid and gas when fluorocarbon gas that has not completely turned to gas returns temporarily in a liquid state.