

TOPAIRE

R134a

TCCWG - † Series

TOPAIRE WATER COOLED MAGNETIC CENTRIFUGAL
CHILLERS Cooling Capacity: 170 to 420 TR



50Hz

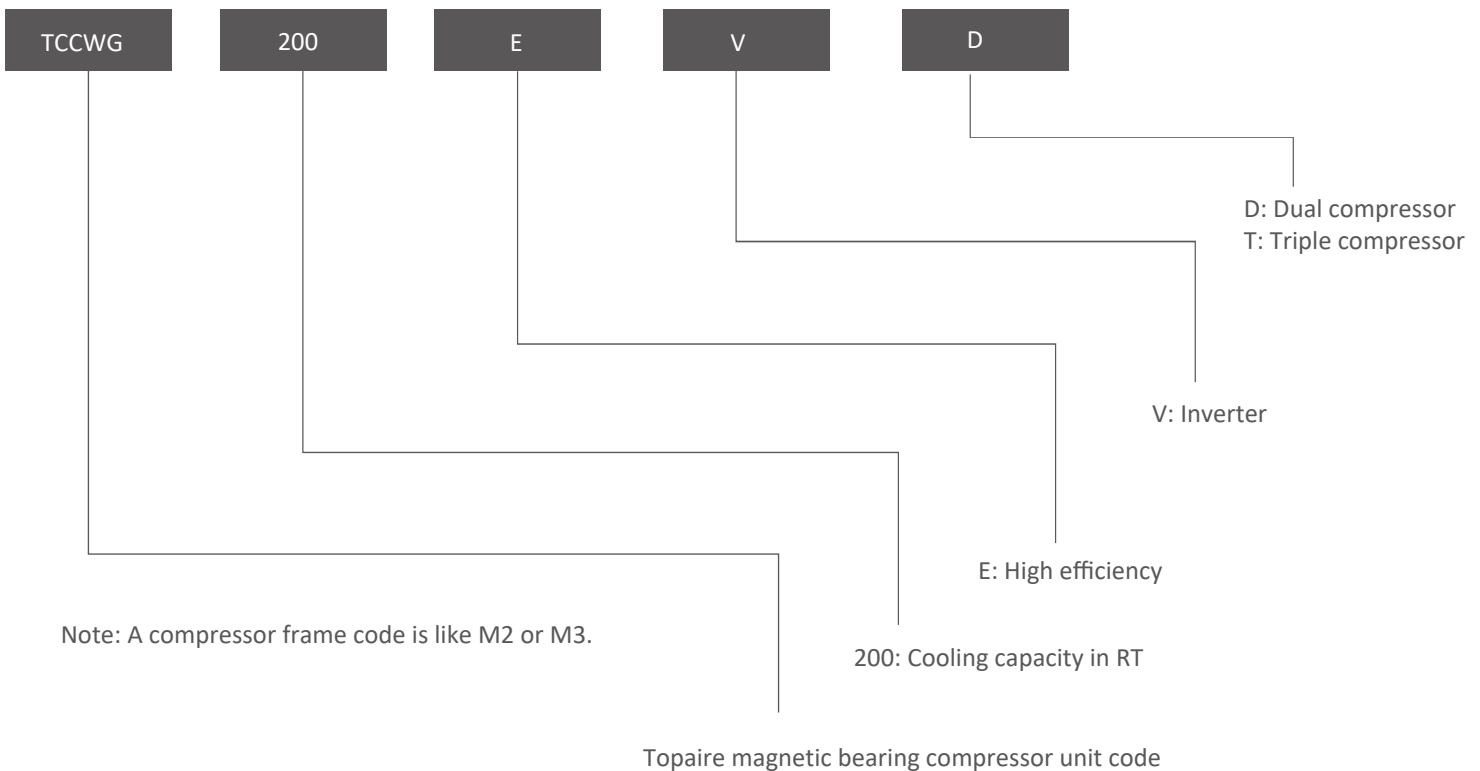
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 Innovation Beyond Comfort

• Overview

The new-generation magnetic bearing centrifugal compressors adopt the magnetic bearing compressor technology, high-efficiency oil-free magnetic bearing, cutting-edge aerodynamic design in the industry, horizontally back-to-back impeller, and magnetic bearing parts with small power consumption. The direct-drive structure ensures efficient and reliable rotation. With micro-channel refrigerant-cooled VFD, it reduces the operating costs, and the operating range is comprehensively improved compared to traditional centrifugal chillers.

◆ Nomenclature



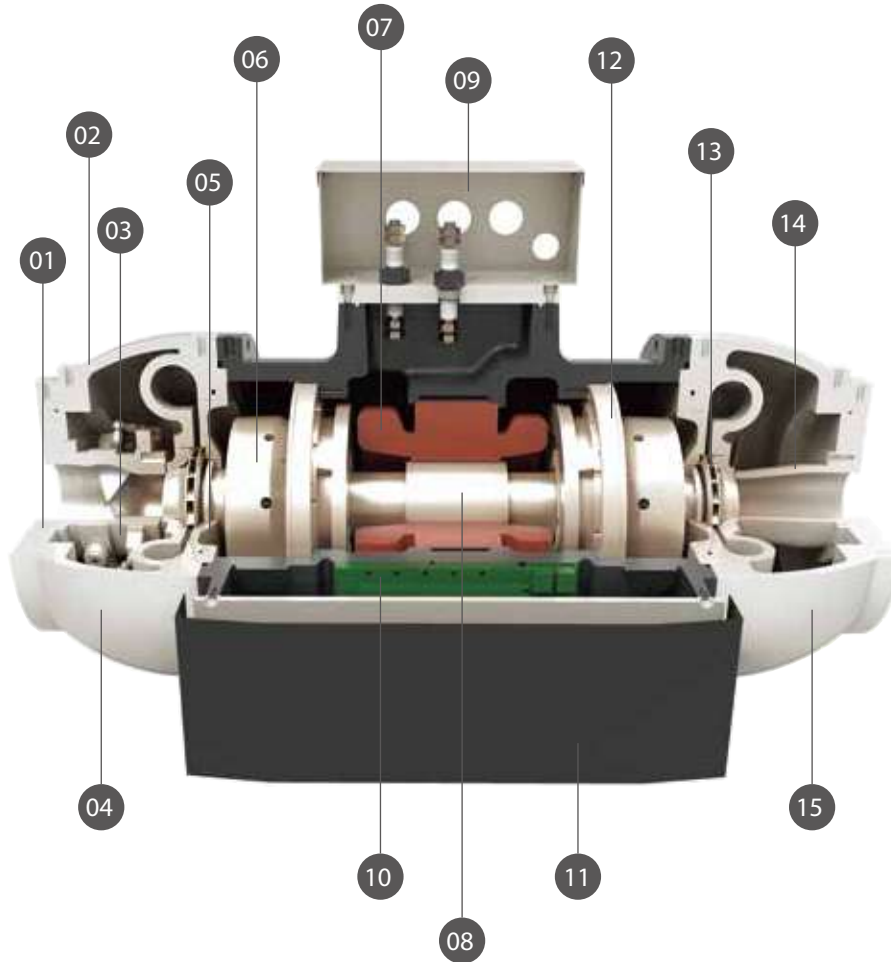
◆ Supply scope of magnetic bearing compressor

- Compressor body (including the main motor) and compressor control
- VFD, and control of the VFD and bearing
- Temperature sensors and pressure sensors of the compressor

◆ Optional accessories of magnetic bearing compressor

- Inter-stage reflux device of the compressor
- Electric control assembly of the entire unit
- Temperature sensors and pressure sensors in the system except the compressor
- Matching flanges, gaskets, and connecting bolts at the inlet and outlet flanges of the compressor
- Compressor air discharge check valve
- Compressor gas supplement solenoid valve

◆ Compressor profile



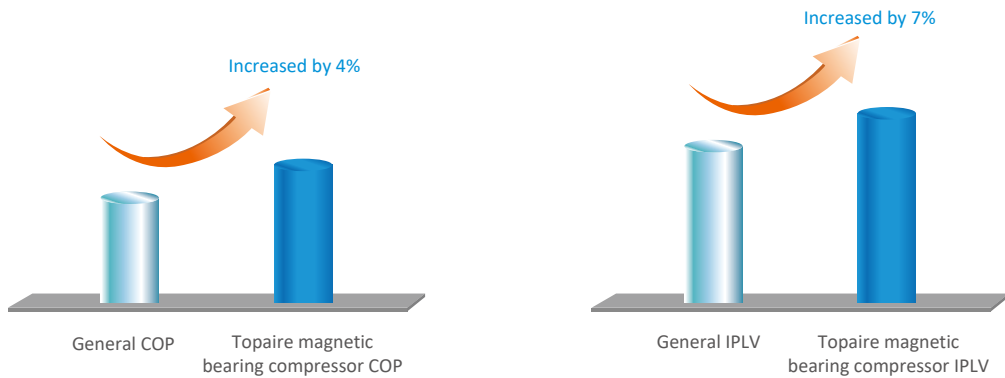
Compressor parts

NO.	Part Name	NO.	Part Name	NO.	Part Name
01	First-stage suction port	06	Magnetic bearing set	11	Casing
02	Electric actuator	07	Stator	12	Magnetic bearing set
03	IGV	08	Rotor	13	Second-stage impeller
04	First-stage Volute	09	Motor junction box	14	Second-stage Volute
05	First-stage impeller	10	MBC board	15	Second-stage suction port

• Features

Oil-free and High Efficiency

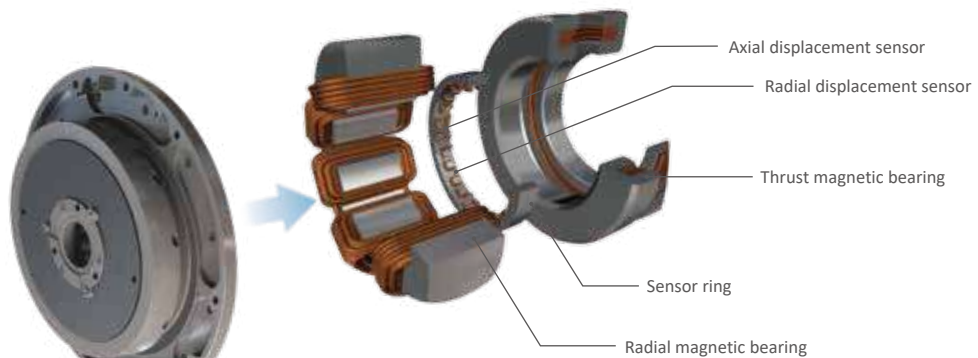
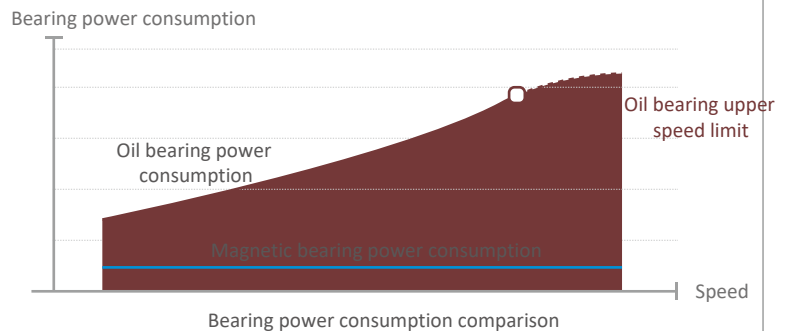
Inverter magnetic bearing compressor boasts magnetic bearing technology, aerodynamic technology, a permanent magnet synchronous motor and full falling film evaporation technology. It combines unique back-to-back two-stage compression structure with higher energy efficiency as compared with the traditional magnetic bearing centrifugal chiller, improving the full-load energy efficiency by **4%*** and improving the part-load energy efficiency by **7%***.



*The above data comes from the average energy efficiency comparison of Topaire's new and old magnetic chillers.

◆ Magnetic bearing technology

- Industrial-level magnetic bearing assembly including the radial magnetic bearing, thrust magnetic bearing and position sensor, featuring low power consumption, high bearing capacity and high reliability.
- Power consumption less than **0.4kW**, only **2% to 10%** of that of conventional oil bearings.
- Breaks through the upper speed limits of conventional oil bearings, significantly reducing power consumption of the bearing at high speed: the higher the speed, the more energy efficient the magnetic bearing is compared to the oil bearing.



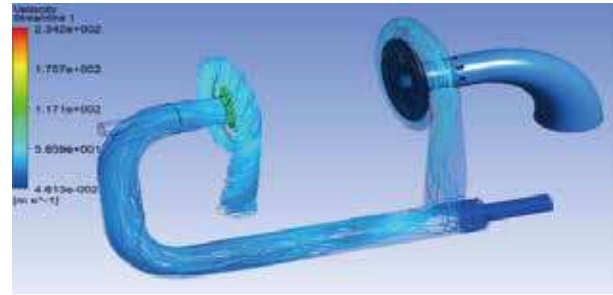
Magnetic bearing component

◆ Aerodynamic technology

- Aerodynamic design optimizes the overall flow field efficiency and improves the compressor's isentropic efficiency.
- Pipe-type reflux device features smoother flow, evener gas supplement, and smaller pressure loss.
- Enclosed impeller design, reduced leakage and improved efficiency.
- Back-to-back two-stage compression structure balances the thrust forces for longer life span and improves efficiency.
- 6% higher efficiency than single-stage compression.



Two-stage compression principle



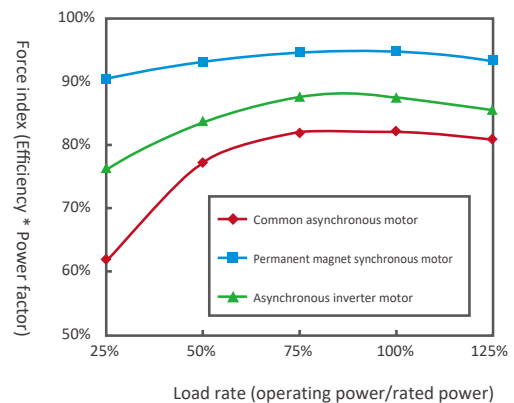
Back-to-back two-stage compression flow field analysis

◆ Permanent magnet synchronous motor technology

- Motor efficiency exceeds 96% in the full operating range, with the highest efficiency of up to 97%.
- The space vector pulse width modulation (SVPWM) technology is used for speed regulation and driving. Accurate and efficient operation is achieved according to changes in the operating conditions. The startup current is small, the operating current is low, the operating electricity charge and distribution cost of the whole life cycle are low.
- The real-time monitoring system of stator temperature and rotor shaft elongation achieve precise, highly-reliable cooling of the motor.



Permanent magnet motor



*The above test data was provided by a third-party organization.

Stable and Reliable

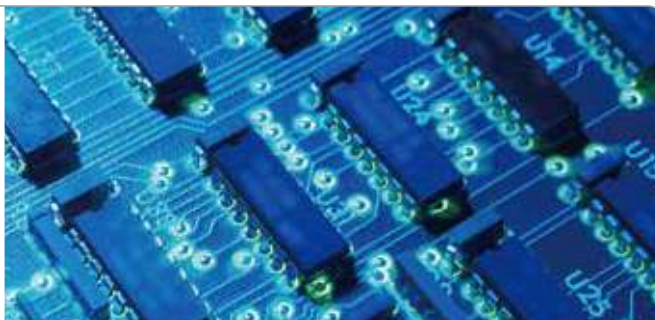
Inverter magnetic bearing centrifugal compressor features oil-free, friction-free, low noise, and low power consumption. This gives more attention to the security and reliability of equipment during use.

Inverter magnetic bearing centrifugal compressor is equipped with a self-generating mode after power failure and features a long-life spare bearing, which can achieve accurate and safe control of the magnetic bearing and ensure the safety of the magnetic bearing to guarantee high efficiency.

How to ensure accurate position control of the magnetic bearing?

Accuracy:

20 kHz high frequency position monitoring, real-time correction output and position control precision at the μm level ensures accuracy of the shaft suspension position.



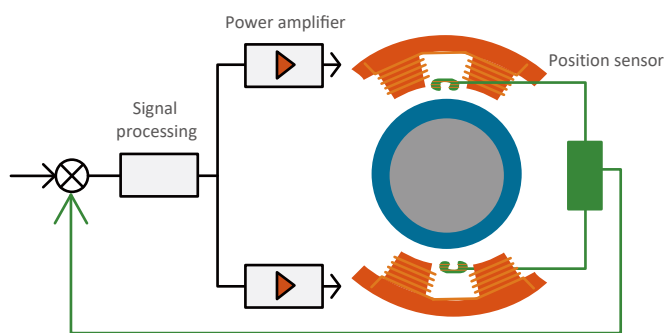
How is the safety of the bearing without lubricating oil after an unexpected power failure?

Safety:

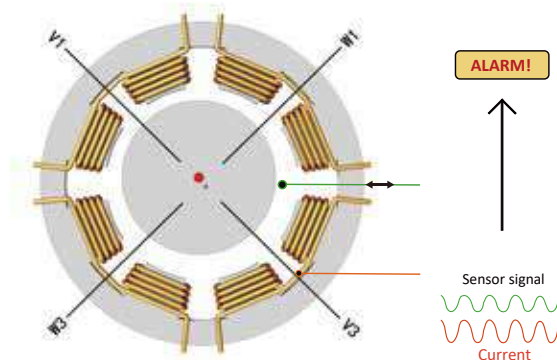
With dual protection of the self-generating mode and long-life spare bearing, a safe landing rate of spare bearing that is **10 times** greater can be achieved when the compressor operates at max. speed; when the speed drops below 10%, normal landing is achieved.

◆ Bearing control technology

- The bearing control system adopts prospective vibration compensation technology, which detects and controls the position at a high frequency to effectively reduce the impact of vibration on the rotating shaft by the amount of imbalance.
- 20 kHz dynamic position scanning and adjustment and position control precision at the μm level ensure the accuracy of the shaft levitation position.



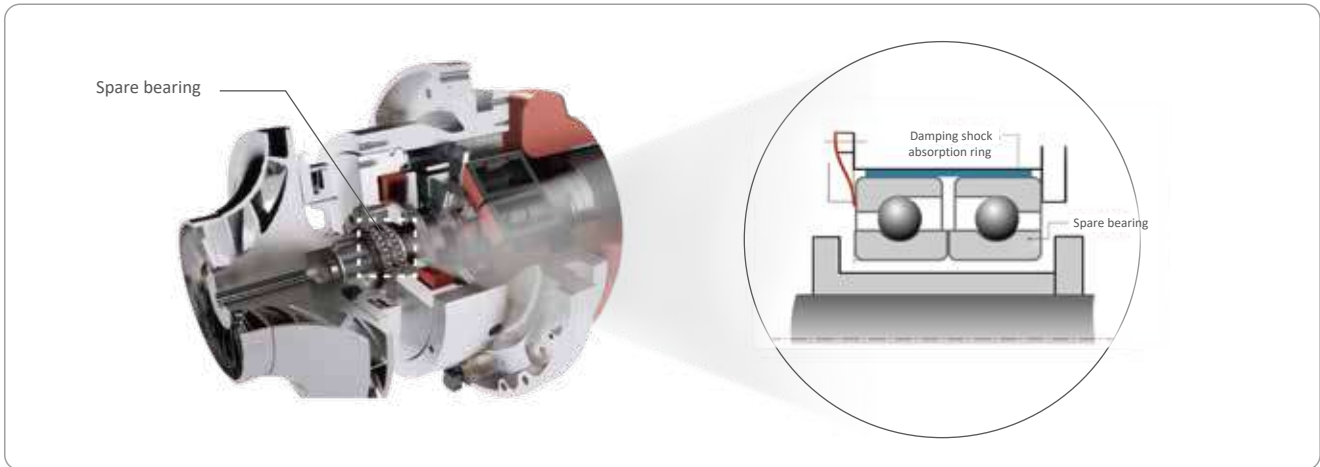
Prospective bearing control principle



Bearing control diagram

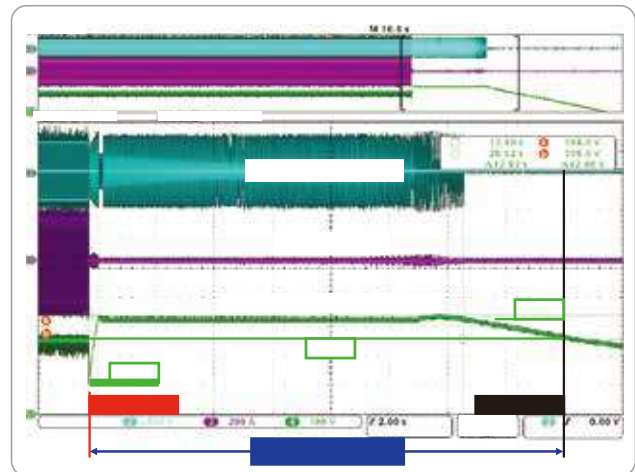
◆ Long-life spare bearing

- The spare bearing employs a set of high-strength rolling bearings and a damping shock absorption ring to effectively stop the rotor shaft during high-speed rotation if a magnetic bearing controller failure occurs, avoiding wear between the magnetic bearing, sensor and rotor and resulting in damage to the compressor.



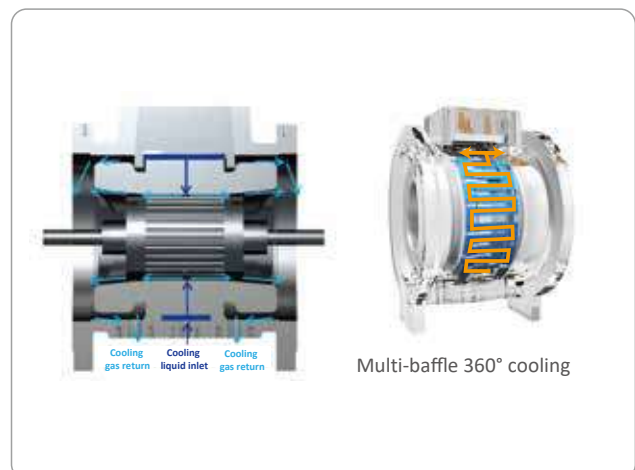
◆ Self-generation control technology

- VFD control + permanent magnet motor technology can automatically switch the motor to the generator mode in the event of unexpected power failure to ensure the stability of the bus voltage and the 40-750 V wide voltage adaptability of the bearing is combined to ensure the power supply safety of the magnetic bearing.
- The self-generating mode guarantees continuous power supply of above 15 Hz to the unit's magnetic bearing, ensuring the bearing remains levitating.



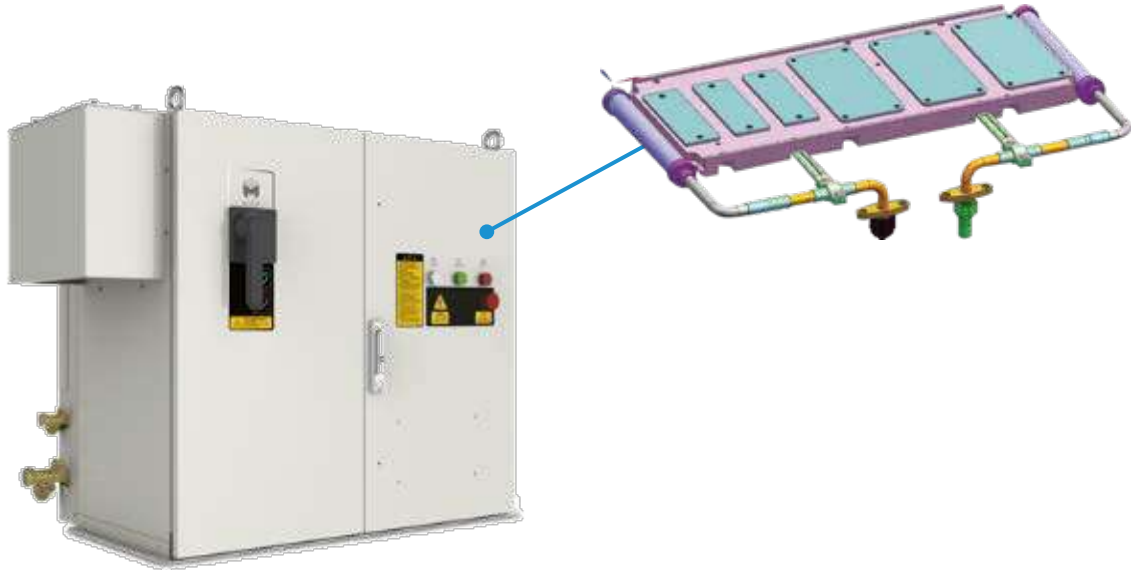
◆ High reliability motor cooling design and monitoring

- The whole flow field analysis and optimum design of the motor cooling channel is adopted to carry out real-time monitoring of the stator temperature and rotor elongation and to ensure operation reliability of the motor.
- There is an annular cooling channel in the motor shell, and the stator core is uniformly cooled.
- Gas returns at the motor bottom. There is no liquid accumulated in the motor cavity, and the rotor has no risk of liquid vibration excitation.
- The motor features class-F insulation (155°C), with three pre-embedded PT100 winding temperature sensors, and three-stage temperature protection.



Micro-channel Refrigerant-cooled VFD Technology

◆ Micro-channel refrigerant-cooled VFD



Ultra-low thermal resistance micro-channel heat dissipation structure



70+ patented technologies



Technical achievement certificate

- Micro-channel phase change refrigerant cooling: super heat dissipation capability, low temperature rise, uniform heat dissipation, small pressure drop, small size, no noise, and maintenance-free
- Self-adaptive anti-condensing control: ambient temperature self-adaptive anti-condensing control algorithm + insulation cotton protection, which can realize condensation free with an ambient temperature 12°C higher than the cooling water temperature
- Comprehensive protection functions: protection of over-voltage, under-voltage, over-current, overload, over-temperature, output short-circuit, phase loss, and contactor open-circuit fault
- Wide ambient temperature operation: The compressor can operate at a maximum of 45°C without derating, with the maximum derating temperature up to 55°C.
- Dynamic input phase loss detection: Input phase loss is dynamically detected in real time, which is not affected by capacitive devices. High temperature resistant and long-life capacitor: 105°C resistant, with 10-year life guaranteed

◆ Joint regulation of multiple technologies

- Inverter magnetic bearing centrifugal compressor adopts the inverter and Inlet Guide Vane (IGV) to jointly regulate the cooling capacity. In extreme operating conditions, the guide vane opening starts to be reduced when the load becomes 50%.
- When the load is above 15% under normal operating conditions, the load is regulated solely by changing the speed, thus avoiding the additional flow loss caused by reduced opening of the IGV.



Inlet guide vane (IGV)

Eco-friendly

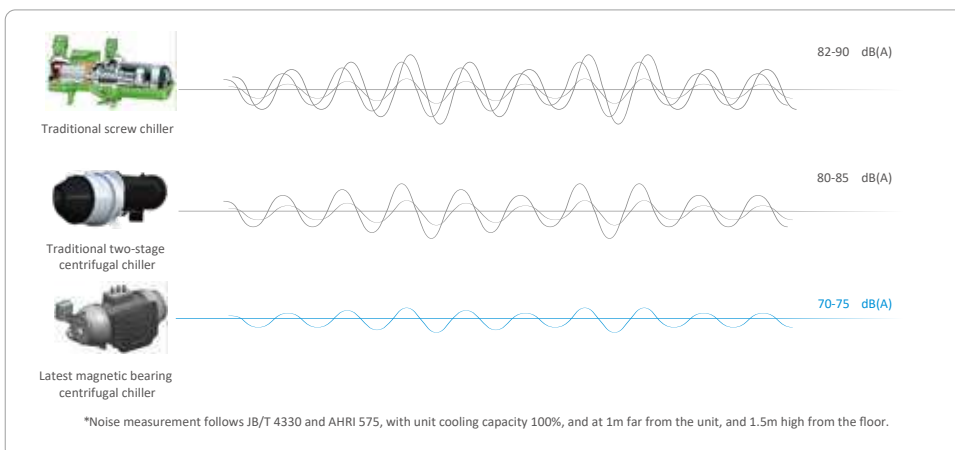
The operating noise of this new-generation inverter magnetic bearing centrifugal chiller can be as low as 70 dB(A).

No physical contact between moving metal parts, very quiet and low vibration levels.

The back-to-back impeller + external pipe-type reflux device structure of the compressor reduces the pneumatic noise of refrigerant while flowing. The smart vibration compensation technology greatly reduces the compressor vibration and noise.

The specially-designed compressor body structure uses the solid-gas-solid interface to dissipate high-frequency noise and achieve ideal sound insulation and noise reduction effects.

The full series of compressors feature R134a eco-friendly refrigerant to achieve optimal cooling efficiency without damaging the ozone layer.

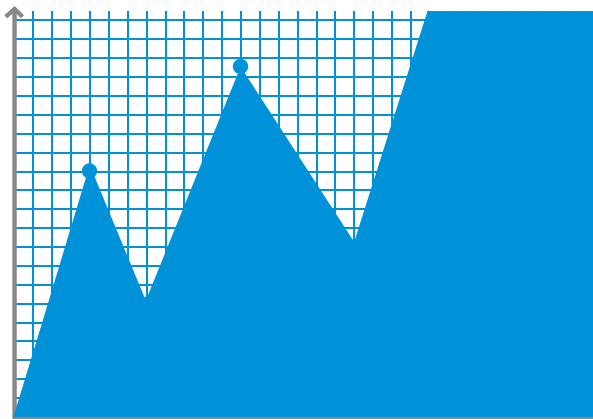
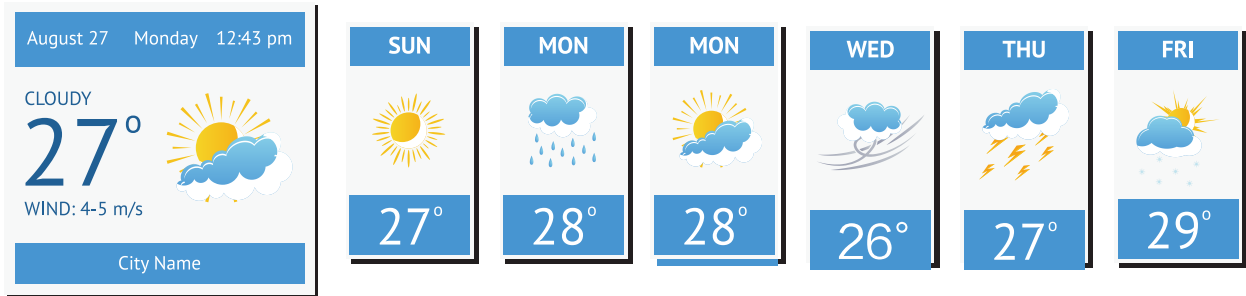


Intelligent Control

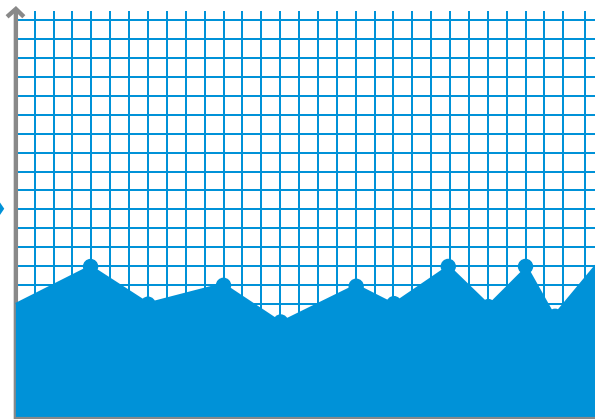
New microcomputer control system enables magnetic bearing compressor control, and provides a full range of control over the cooling system based on user requirements with lower costs. It provides users with a new experience of man-machine interaction.

The control system integrates various functions including intelligent operations, safety protection and interlocking control to achieve reliable start, efficient operations and intelligent control of the compressor and system.

◆ Prospective control logic technology



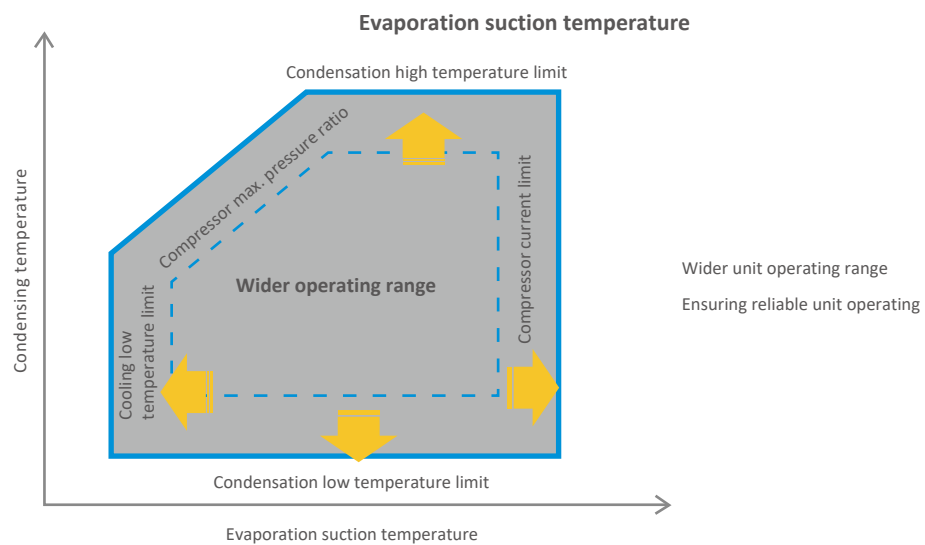
Temperature change in conventional controls



Temperature change in prospective controls

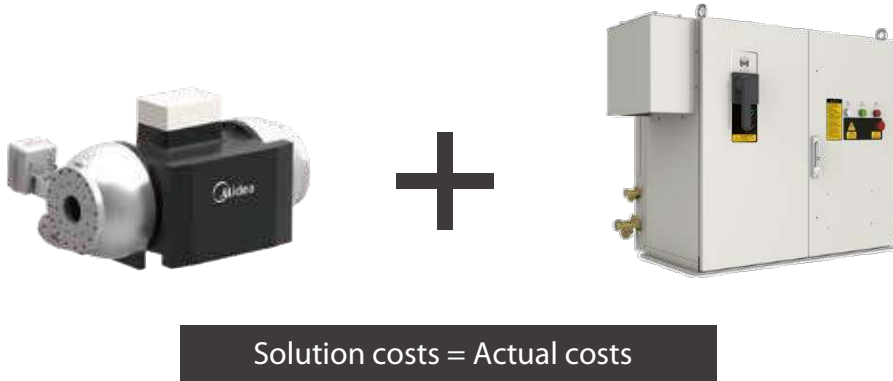
Trend prediction, self-diagnosis and active adjustment to avoid frequent fluctuation and even unit failure

◆ Wider operating range



Cost Saving

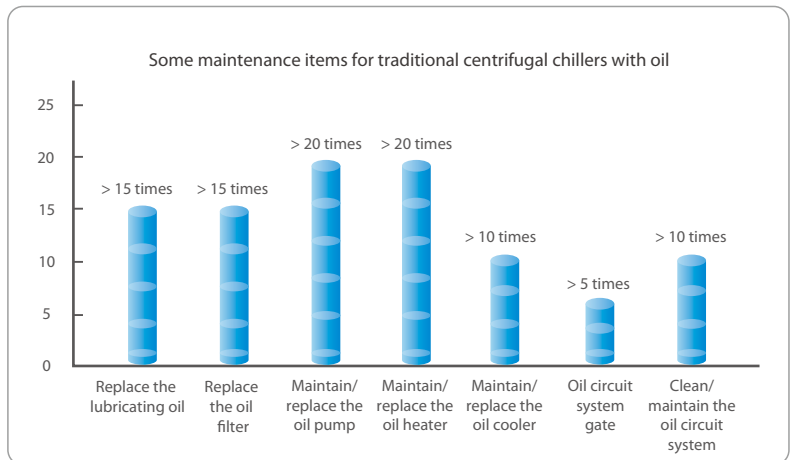
◆ Overall solution



- The latest VFD panel integrates all required electric control components.
- With full-function VFD panel, users do not need to configure the cable inlet reactor panel.

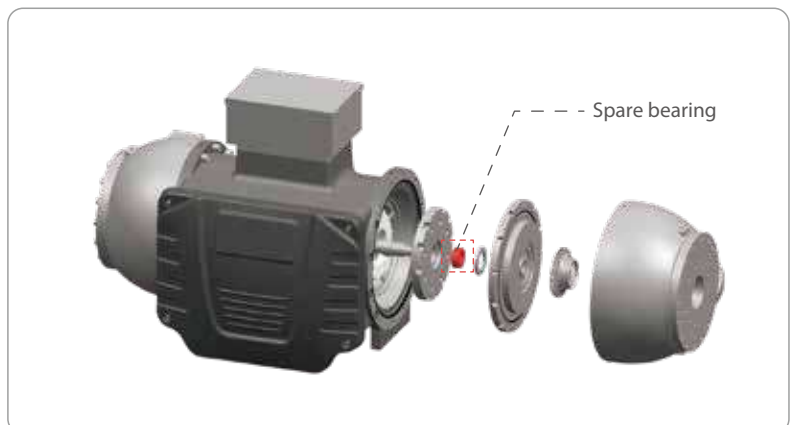
◆ Magnetic bearing compressor maintenance

- With the bearing health self-check function, the magnetic bearing compressor can realize non-attendance operation with no need for routine maintenance.
- Compared to traditional oil bearing chillers, the compressor can save maintenance costs in oil quality detection, lubricating oil replacement, oil filter replacement, oil system cleaning, and bearing wearing check.
- After being used for years, the heat exchanger of a traditional oil-bearing chiller will contain oil, thereby affecting the unit energy efficiency and increasing the energy consumption. A magnetic bearing centrifugal chiller can always keep the heat exchanger new and the unit efficient, and are especially applicable to long-term cooling applications, such as industrial projects and data centers.



◆ Rapid maintenance

- The spare bearing can be rapidly disassembled and replaced on site, and maintenance can be completed within one to two days.
- No cumbersome procedure is required, and there is no need to apply to users for material entry and exit.
- The offline time after a unit failure, and various costs of after-sales services are minimized.



Specifications

Cooling capacity		RT	170	200	230	250	270
		kW	597.7	703.2	808.7	879.0	949.3
Compressor frame code reference		-	M250	M250	M250	M270	M270
Compressor	Type	-	Horizontally back-to-back				
	Refrigerant	-	R134a				
	Stages	-	2				
	Pressure ratio	Pa/Pa	2.58				
	Surge margin	-	>1.05				
	Gas suction flow	kg/s	3.428	4.03	4.638	5.039	5.442
	Gas supplement flow	kg/s	0.386	0.454	0.522	0.567	0.613
	Gas suction volume flow	m ³ /h	708.8	833.2	958.8	1042	1152
	Gas supplement volume flow	m ³ /h	49.9	58.65	67.5	73.34	79.2
	Rated speed	rpm	16140	16560	17040	16440	16740
	Capacity control	%	10 ~ 100				
Transmission	Type	-	Direct-drive				
	Bearing	-	Magnetic bearing				
Motor	Type	-	Permanent magnet synchronous				
	Power supply	-	380V-3Ph-50Hz				
	Configuration power	kW	150				
	Startup mode	-	VFD				
	Cooling mode	-	Refrigerant-cooled				
	Ingress protection	-	IP54				
VFD	Model		MINV-R160/Y2DA				
	Rated input voltage		Three-phase AC: 380V-415V				
	Maximum allowable input voltage range		Three-phase AC: 323V-456V				
	Input frequency		50/60Hz				
	Output voltage range		Three-phase AC: 0V-340V				
	Output frequency		0-383Hz				
	Rated output current		330A				
Compressor dimensions	Length	mm	1150				
	Width	mm	809				
	High	mm	742				
Compressor net weight		kg	755				
VFD dimensions	Length	mm	1050				
	Width	mm	620				
	High	mm	1000				
VFD net weight		kg	220				

Note:

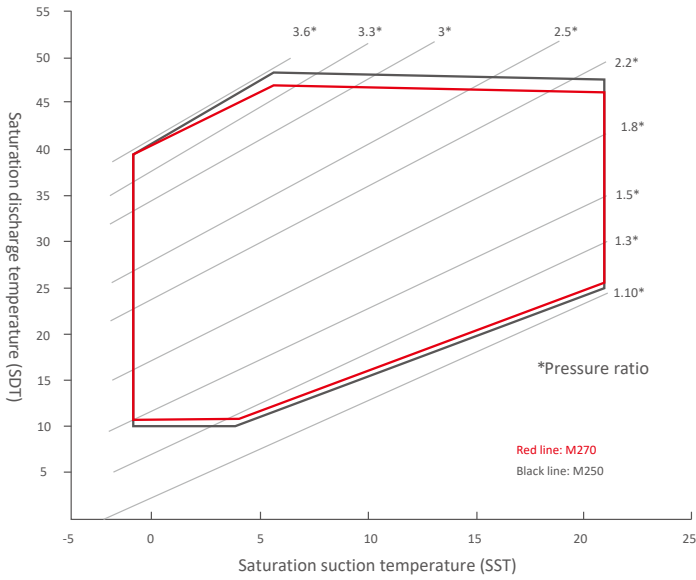
1. The compressor specifications are based on evaporation temperature 6°C, condensation temperature 36°C, suction superheat degree 0.3°C, and refrigerant supercooling degree 3°C, with ash economizer.
2. 380~460V-3Ph-50/60Hz product solutions can also be provided.

Cooling capacity		RT	300	350	380	400	420
		kW	1055	1231	1336	1406	1477
Compressor frame code reference		-	M380	M380	M420	M420	M420
Compressor	Type	-	Horizontally back-to-back				
	Refrigerant	-	R134a				
	Stages	-	2				
	Pressure ratio	Pa/Pa	2.58				
	Surge margin	-	>1.05				
	Gas suction flow	kg/s	6.048	7.057	7.659	8.06	8.467
	Gas supplement flow	kg/s	0.681	0.795	0.863	0.908	0.954
	Gas suction volume flow	m ³ /h	1250	1459	1583	1666	1750
	Gas supplement volume flow	m ³ /h	88.02	102.7	111.5	117.3	123.2
	Rated speed	rpm	14400	14940	13320	13470	13620
	Capacity control	%	10 ~ 100				
Transmission	Type	-	Direct-drive				
	Bearing	-	Magnetic bearing				
Motor	Type	-	Permanent magnet synchronous				
	Power supply	-	380V-3Ph-50Hz				
	Configuration power	kW	280				
	Startup mode	-	VFD				
	Cooling mode	-	Refrigerant-cooled				
	Ingress protection	-	IP54				
VFD	Model		MINV-R315/Y2DA				
	Rated input voltage		Three-phase AC: 380V-460V				
	Maximum allowable input voltage range		Three-phase AC: 380V-506V				
	Input frequency		50/60Hz				
	Output voltage range		Three-phase AC: 0V-380V				
	Output frequency		0-600Hz				
	Rated output current		586A				
Compressor dimensions	Length	mm	1285				
	Width	mm	859				
	High	mm	662				
Compressor net weight		kg	850				
VFD dimensions	Length	mm	1136				
	Width	mm	637				
	High	mm	909				
VFD net weight		kg	260				

Note:

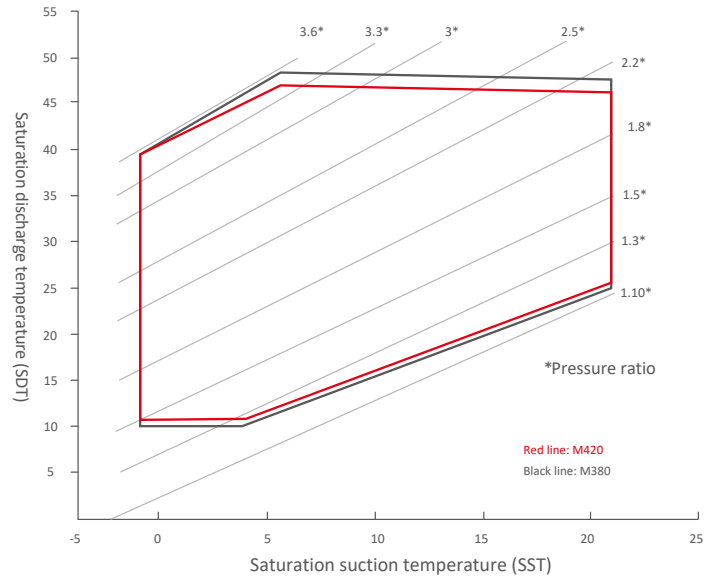
1. The compressor specifications are based on evaporation temperature 6°C, condensation temperature 36°C, suction superheat degree 0.3°C, and refrigerant supercooling degree 3°C, with ash economizer.
2. 380~460V-3Ph-50/60Hz product solutions can also be provided.

Compressor Operating Range



M250 & M270 Compressor Operating Range

- The maximum pressure ratio can be as high as 3.6, applicable to general heat recovery and heat pump operating conditions.
- The minimum pressure ratio can be as low as 1.35, requiring no auxiliary cooling. The evaporation temperature is up to 21°C, applicable to data centers and other scenarios with high outlet water temperature requirements.



M380 & M420 Compressor Operating Range

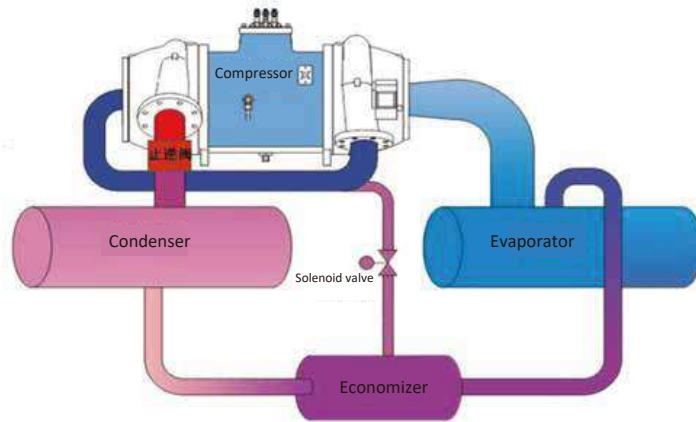
- The maximum pressure ratio can be as high as 3.6, applicable to general heat recovery and heat pump operating conditions.
- The minimum pressure ratio can be as low as 1.35, requiring no auxiliary cooling.
- The evaporation temperature is up to 21°C, applicable to data centers and other scenarios with high outlet water temperature requirements.

Cable Specifications

Unit Cooling Capacity	Maximum Current (A)	Screw Hole of the Phase Line	Bolt of the Phase Line	Bolt of the Grounding Cable	Recommended BVR Cable
170RT	182	1*Φ11	M10x40	M10x40	3×BVR70+BVR35
200RT	208	1*Φ11	M10x40	M10x40	3×BVR95+BVR50
230RT	240	1*Φ11	M10x40	M10x40	3×BVR120+BVR70
250RT	262	1*Φ11	M10x40	M10x40	3×BVR150+BVR95
270RT	279	1*Φ11	M10x40	M10x40	3×BVR150+BVR95
300RT	311	1*Φ11	M10x35	M10x35	3×BVR150+BVR95
350RT	364	1*Φ11	M10x35	M10x35	3×BVR185+BVR95
380RT	393	1*Φ11	M10x35	M10x35	3×(2×BVR120)+BVR120
400RT	416	1*Φ11	M10x35	M10x35	3×(2×BVR120)+BVR120
420RT	437	1*Φ11	M10x35	M10x35	3×(2×BVR120)+BVR120

Recommended Refrigeration System

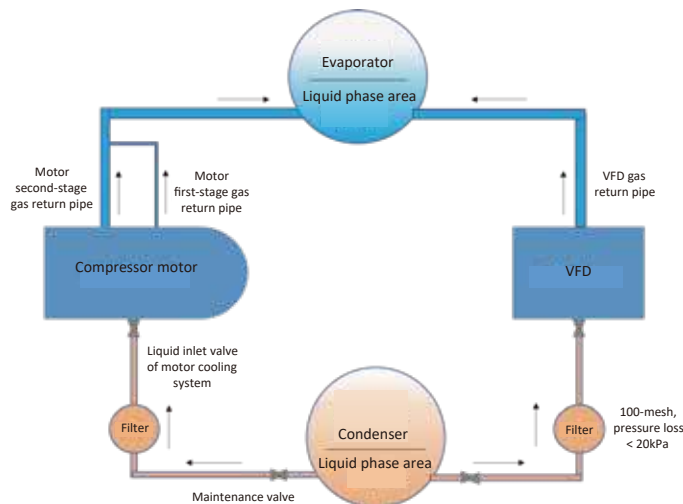
The centrifugal compressor forms a complete refrigeration system together with the evaporator, condenser, economizer, throttling part, controller, and starter panel.



- The compressor gas discharge must have a check valve to prevent surge and reverse operation of the compressor upon shutdown. The air flows from the compressor to the condenser. The check valve pressure loss is generally about 10kPa. Too large pressure loss will affect the unit efficiency.
- The compressor gas supplement pipeline must have a solenoid valve to prevent reverse operation upon shutdown. The air flows from the economizer to the compressor. The solenoid valve should be normally closed and can immediately close upon power failure.
- Liquid is not allowed during compressor first-stage suction and economizer gas supplement. A small amount and short-term liquid will increase the compressor current and decrease the efficiency. A large amount or long-term liquid will damage the compressor. The compressor discharge overheat degree is generally 5–8°C, and not lower than 3°C in all operating conditions.

Recommended Cooling system

The magnetic bearing, motor, and VFD adopt refrigerant for cooling. The figure below shows the recommended cooling process for the bearing, motor, and VFD.



- The compressor gas supplement pipeline must have a solenoid valve to prevent reverse operation upon shutdown. The air flows from the economizer to the compressor. The solenoid valve should be normally closed and can immediately close upon power failure.
- For ideal motor cooling effect, the refrigerant pressure difference of the cooling motor needs to be greater than or equal to 220kPa, and the motor cavity pressure should be close to the evaporation pressure.

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AIR CONDITIONER

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