Eicen

Bold in Innovation Stable & reliable

Energy-saving & Environmental Friendly

EPM SERIES MAGNETIC PUMP

DURABLE MAGNETIC PUMP NEW BENCHMARKS

Company Profile

Our company is specialized in the directional R&D, design, manufacturing, sales and Services of industrial pumping. Relying on deep technical reserves, integrating the advantages of international famous brands, selecting high-quality raw materials, our company can continue to provide customers with efficient, energy-saving, stable, reliable and complete products.

Our pumps and systems are widely used in photovoltaic solar energy, semiconductor, Chemical industry, surface treatment, continuous electroplating, capacitance coating, chemical energy storage, water treatment and other industries.

Advantages and Characteristics

1. Use imported suppliers for the core components, such as magnetic drive, shaft sleeve, etc;
2. Use high-end raw materials for the castings , mainly imported and self-developed to eliminate material problems;
3. Make the magnetic pump zero leakage to ensure the operations safe and reliable;
4. Self-design the pump channel with efficient operation, energy conservation and environmental friendly;
5. Design the pump uniquely, which can operate stably at both high and low temperatures;
6. Have a strong R&D team and can be customized according to customer needs.

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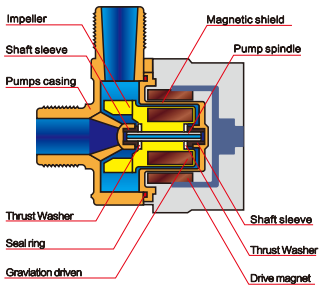
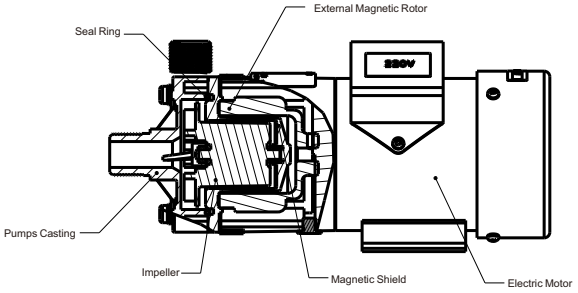
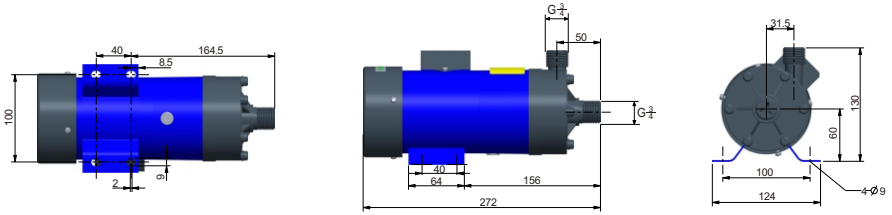
Magnetic Pump EPM0.5 >>>

>> Principle diagram





>> Envelop dimensions figure

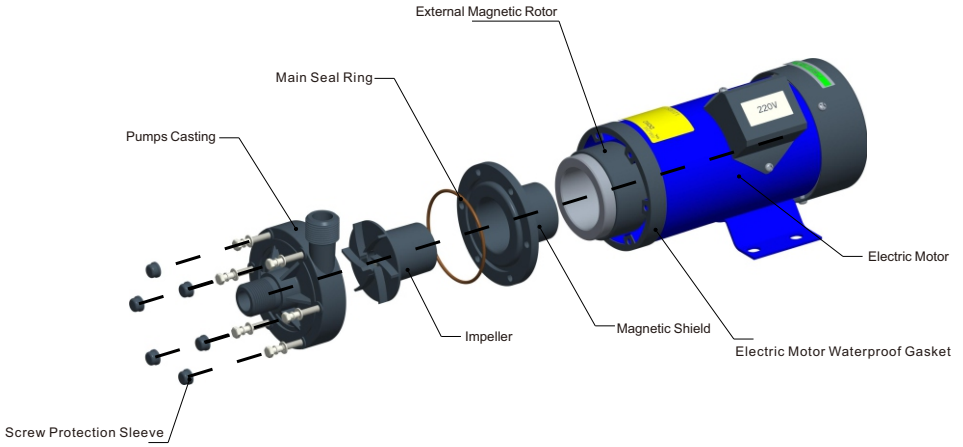


>> Optional Materials & Temperature Range of Overcurrent Components

Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
PVDF	-20℃~100℃	VITON	-25℃~80℃	High Purity Silicon Oxide	-60℃~150℃
PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

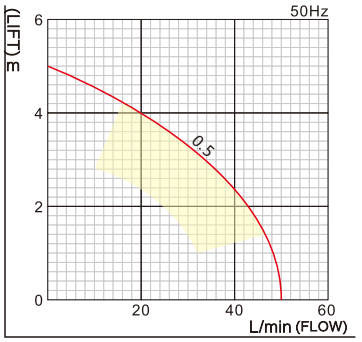
Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

>> series decomposition figure

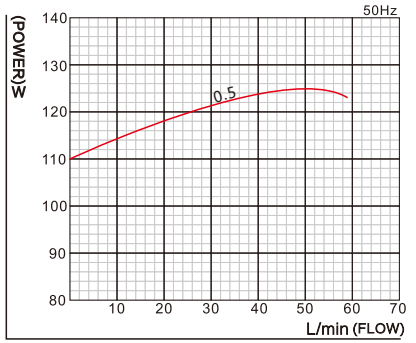


>> 50Hz Performance Curve

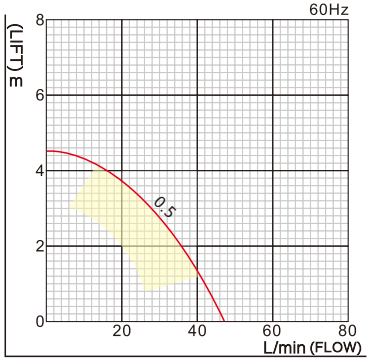
Lift – flow curve

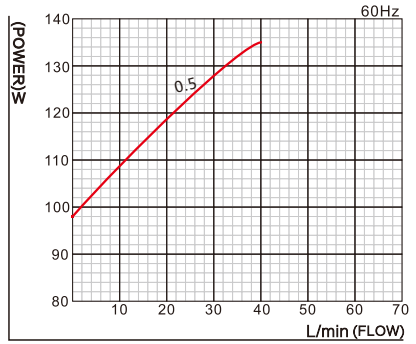


Power – flow curve



>> 60Hz Performance Curve





Note: The above is the standard electric motor curve.

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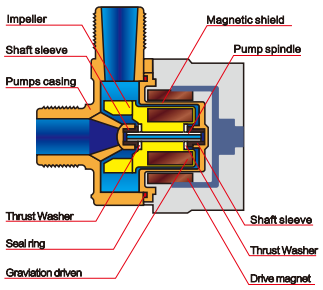
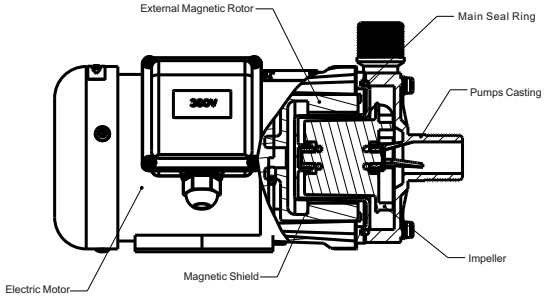
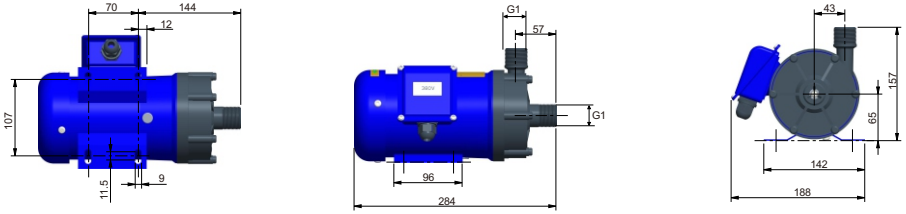
Magnetic Pump EPM1 >>>

>> Principle diagram





>> Envelop dimensions figure



>> Optional Materials & Temperature Range of Overcurrent Components

Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
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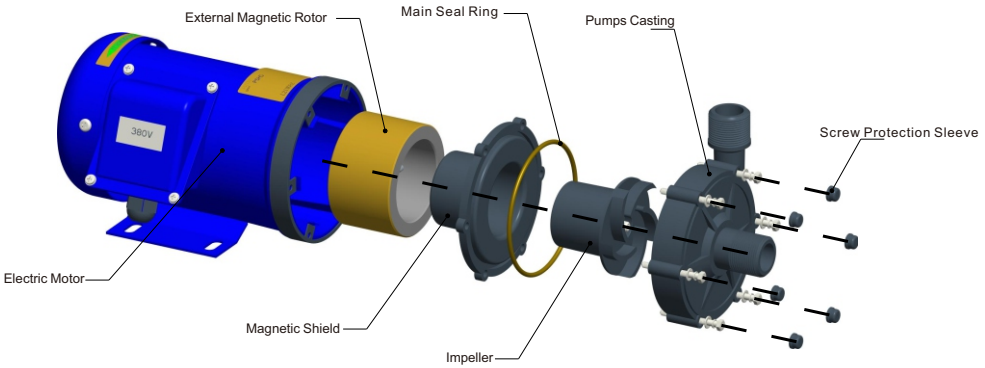
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

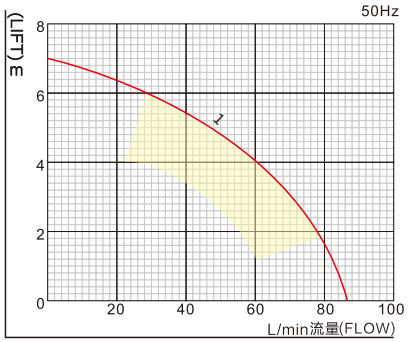
Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

>> series decomposition figure

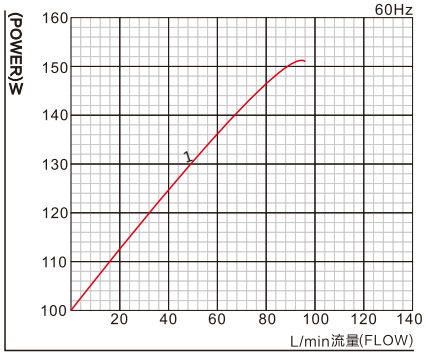


>> 50Hz Performance Curve

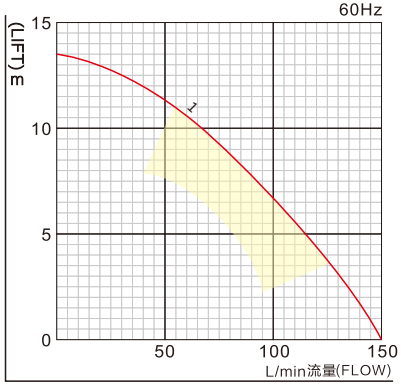
Lift – flow curve

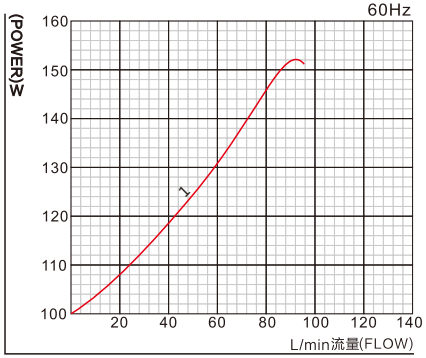


Power – flow curve



>> 60Hz Performance Curve





Note: The above is the standard electric motor curve.

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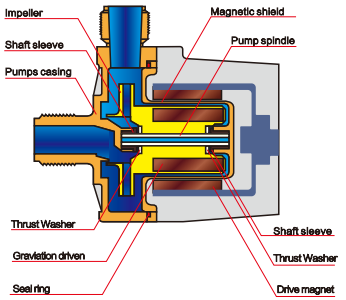
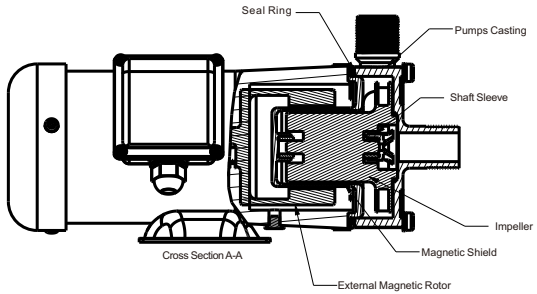
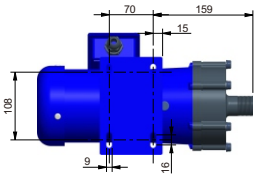
Magnetic Pump EPM2 >>>

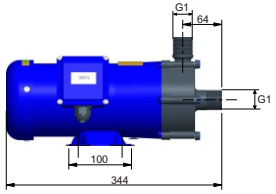
>> Principle diagram

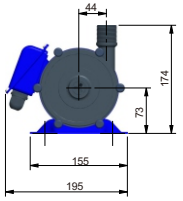




>> Envelop dimensions figure







>> Optional Materials & Temperature Range of Overcurrent Components

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GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
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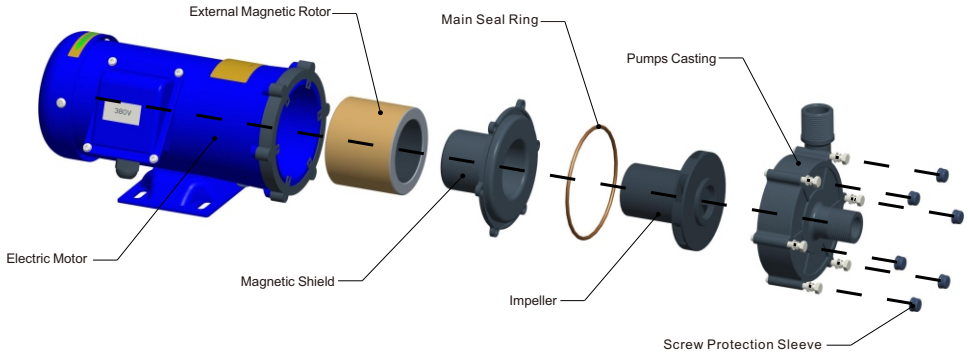
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

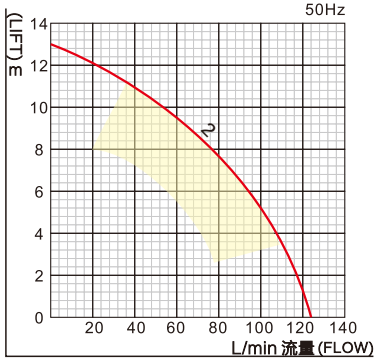
Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

>> series decomposition figure

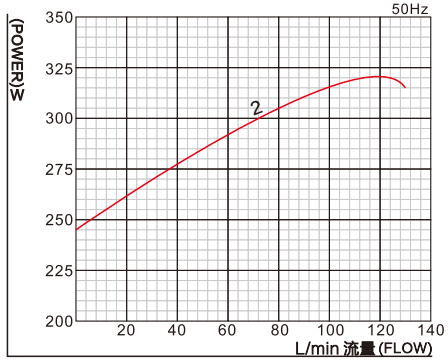


>> 50Hz Performance Curve

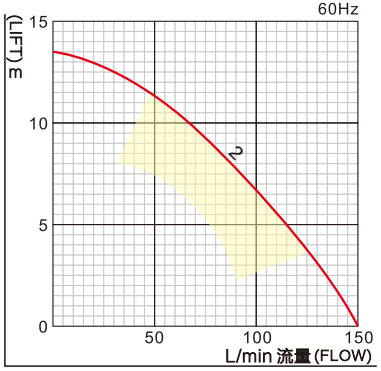
Lift – flow curve

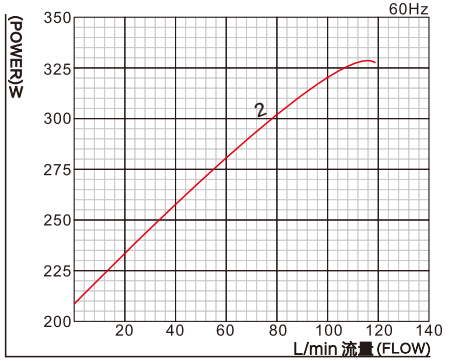


Power – flow curve



>> 60Hz Performance Curve





Note: The above is the standard electric motor curve.

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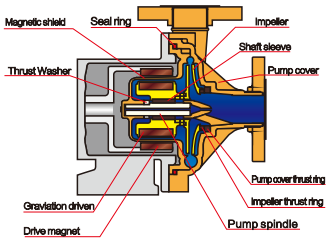
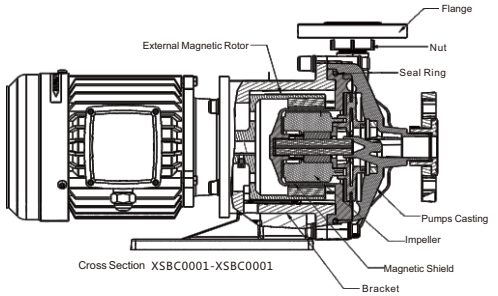
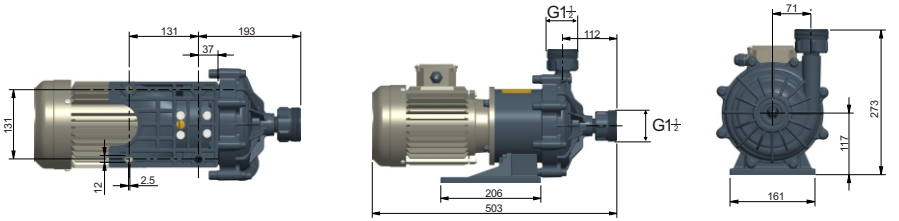
Magnetic Pump EPM2H >>>

>> Principle diagram





>> Envelop dimensions figure



Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
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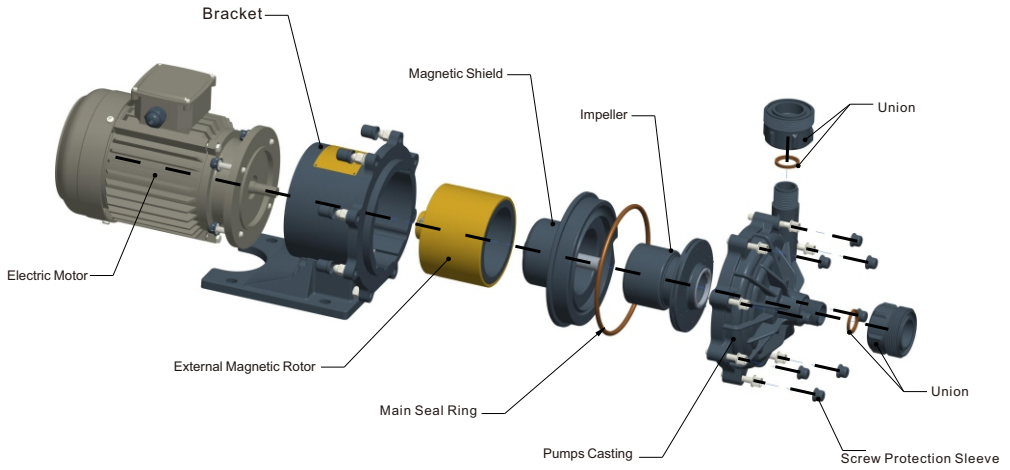
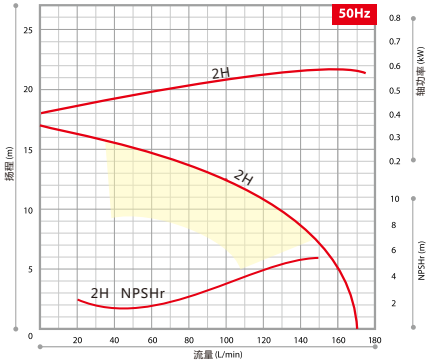
PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

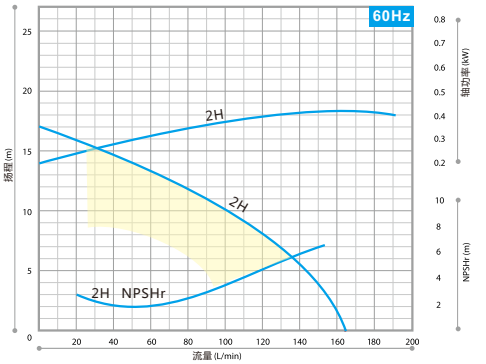
>> series decomposition figure



>> 50Hz Performance Curve



>> 60Hz Performance Curve



Note: The above is the standard electric motor curve.

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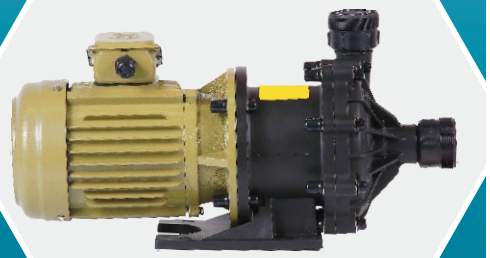
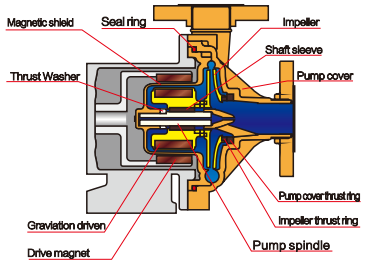
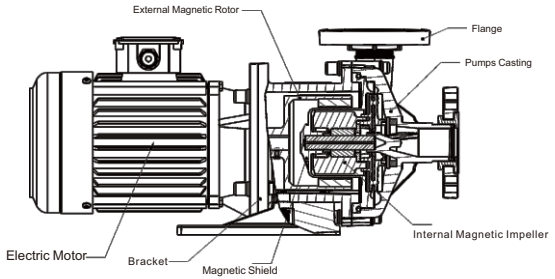
Magnetic Pump EPM3 >>>

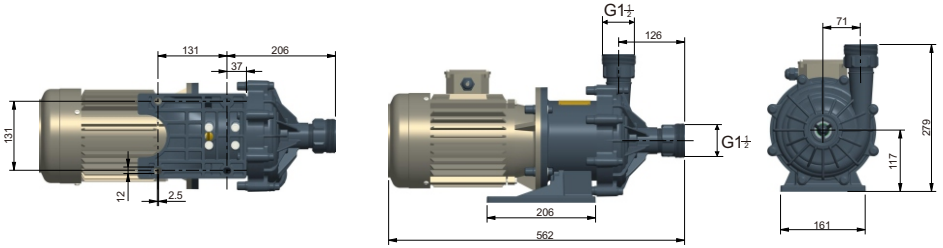


>> Principle diagram





>> Envelop dimensions figure



Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

Pump Body		Sealing Element		Wear Parts	
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Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

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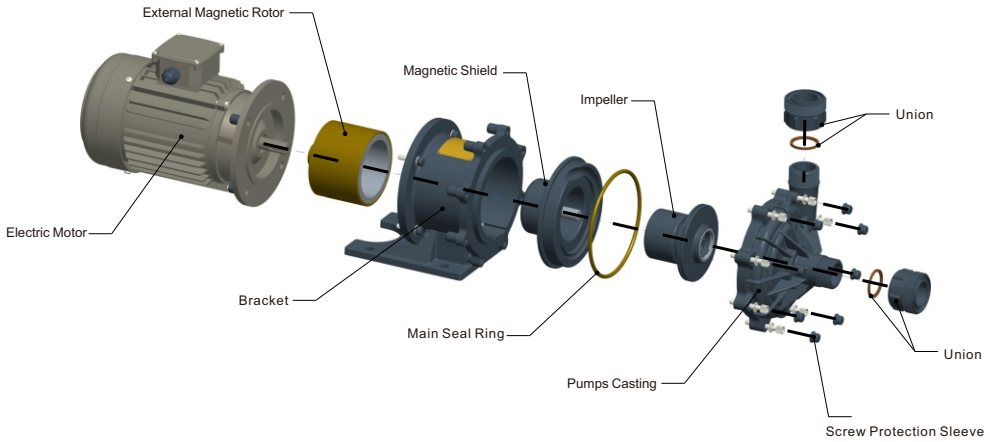
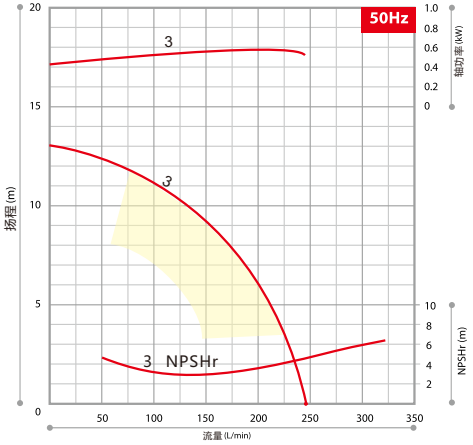
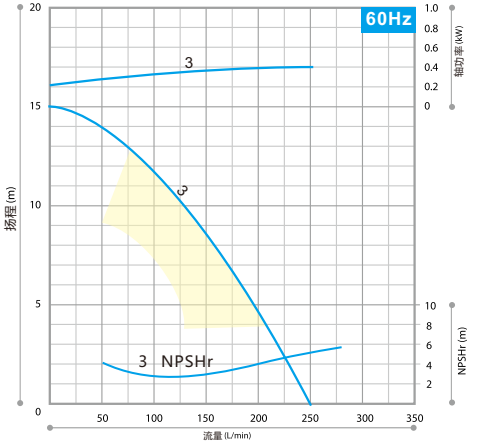


>> 50Hz Performance Curve



>> 60Hz Performance Curve



Note: The above is the standard electric motor curve.

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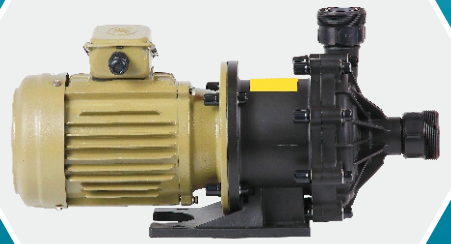
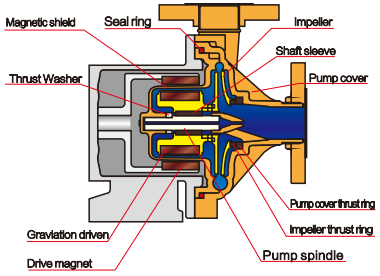
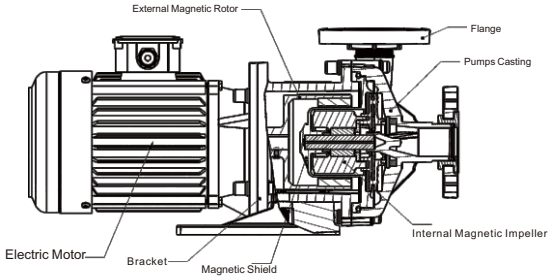
Magnetic Pump EPM4 >>>

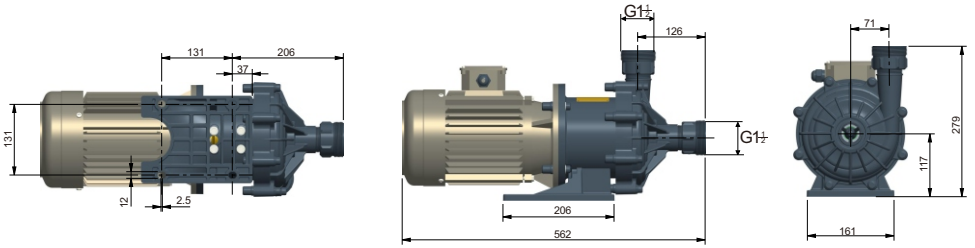


>> Principle diagram





>> Envelop dimensions figure



Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

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PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
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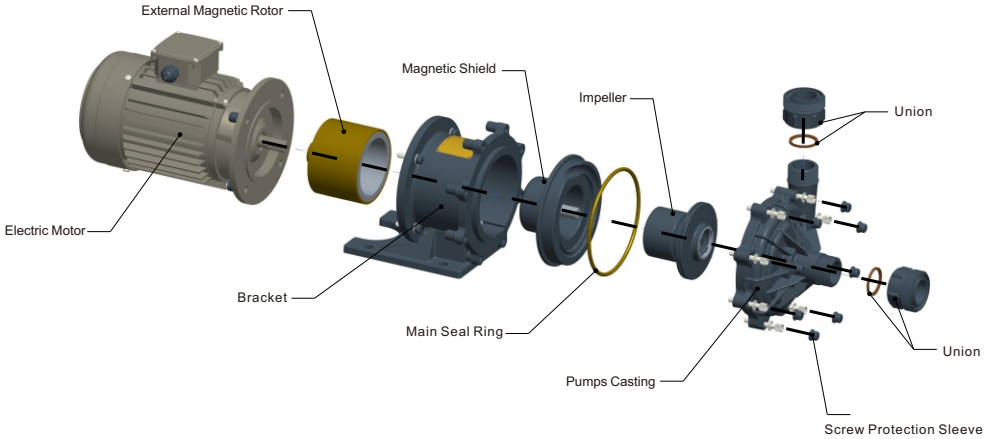
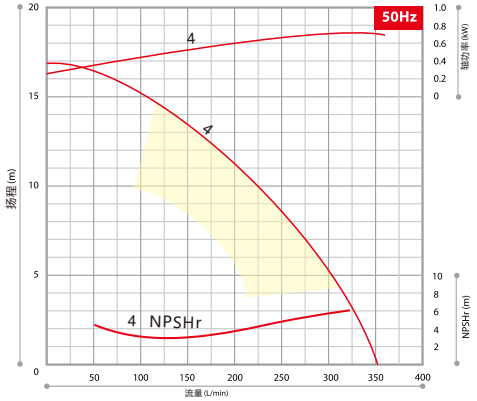
Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

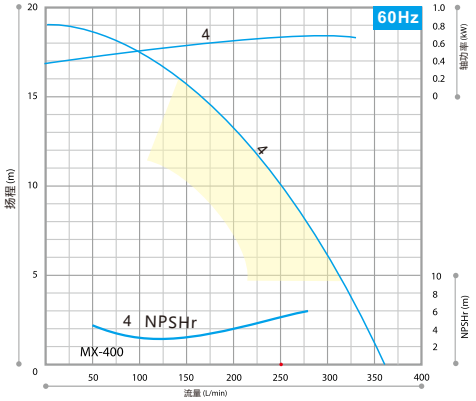
>> series decomposition figure



>> 50Hz Performance Curve



>> 60Hz Performance Curve



Note: The above is the standard electric motor curve.

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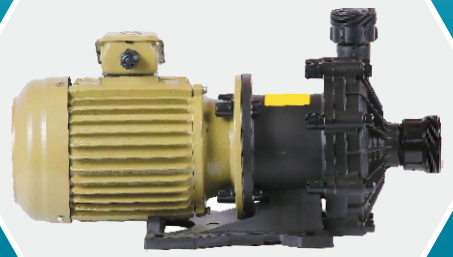
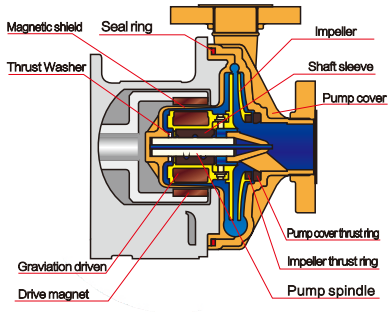
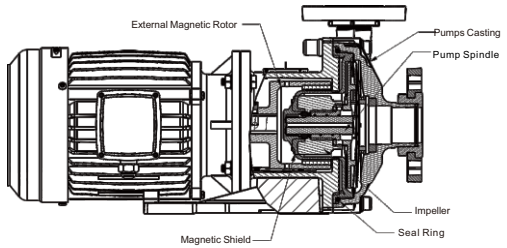
Magnetic Pump EPM5 >>>

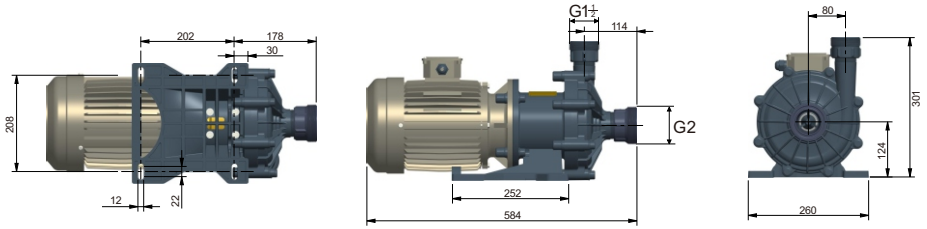


>> Principle diagram





>> Envelop dimensions figure



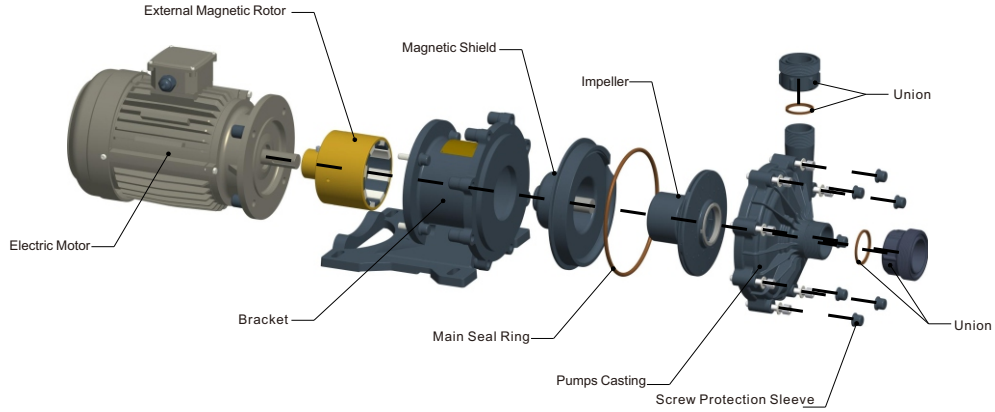
Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

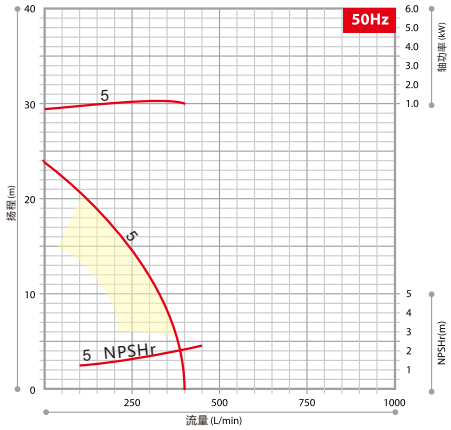
Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
PVDF	-20℃~100℃	VITON	-25℃~80℃	High Purity Silicon Oxide	-60℃~150℃
PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

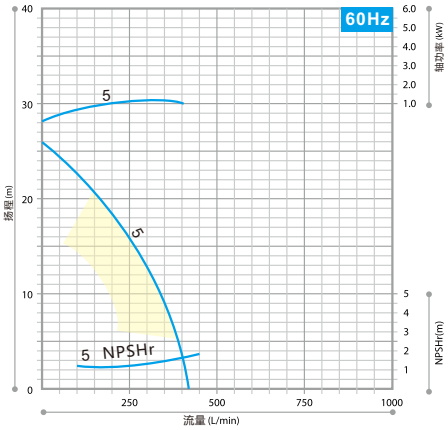
>> series decomposition figure



>> 50Hz Performance Curve



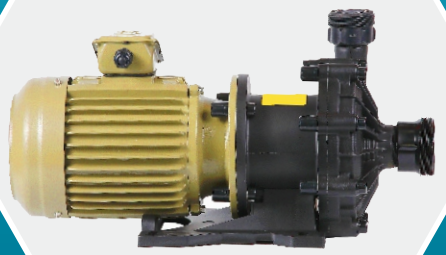
>> 60Hz Performance Curve



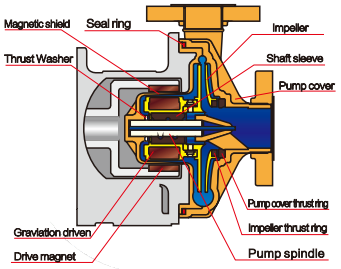
Note: The above is the standard electric motor curve.

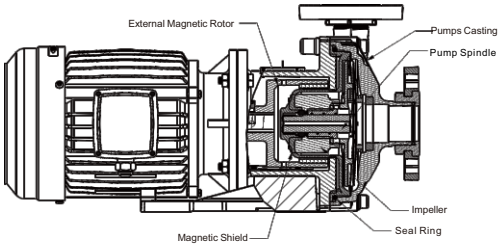
Eicen

Magnetic Pump EPM6 >>>

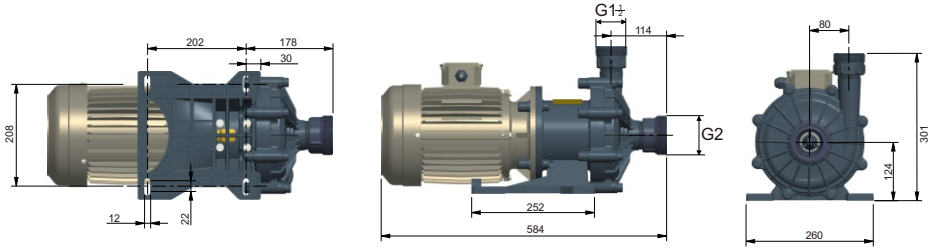


>> Principle diagram





>> Envelop dimensions figure



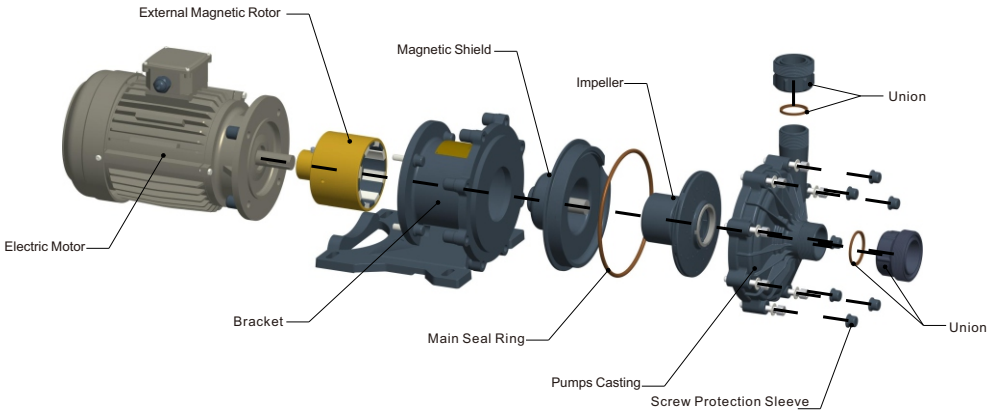
Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

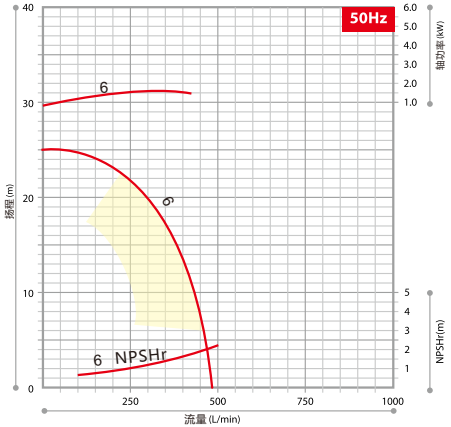
Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
PVDF	-20℃~100℃	VITON	-25℃~80℃	High Purity Silicon Oxide	-60℃~150℃
PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

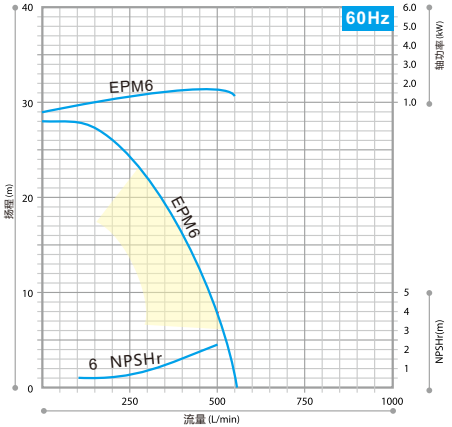
>> series decomposition figure



>> 50Hz Performance Curve



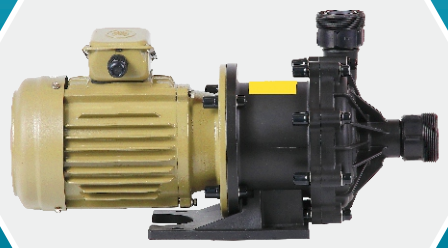
>> 60Hz Performance Curve



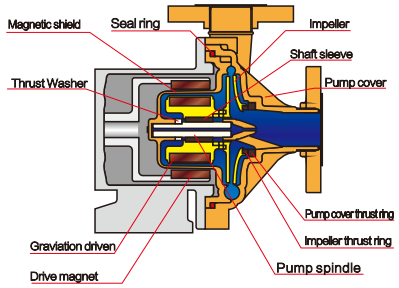
Note: The above is the standard electric motor curve.

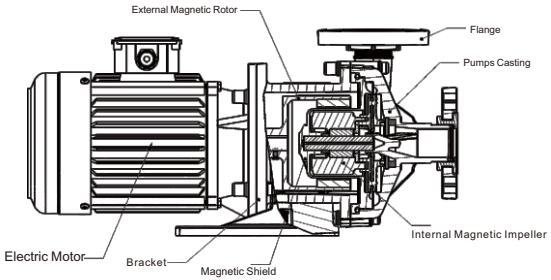
Eicen

Magnetic pump - High head EPMH3 >>>

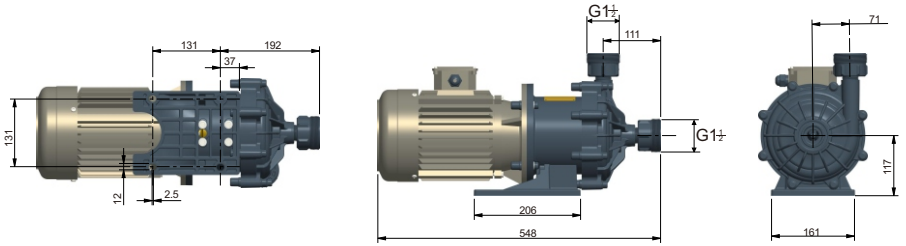


>> Principle diagram





>> Envelop dimensions figure



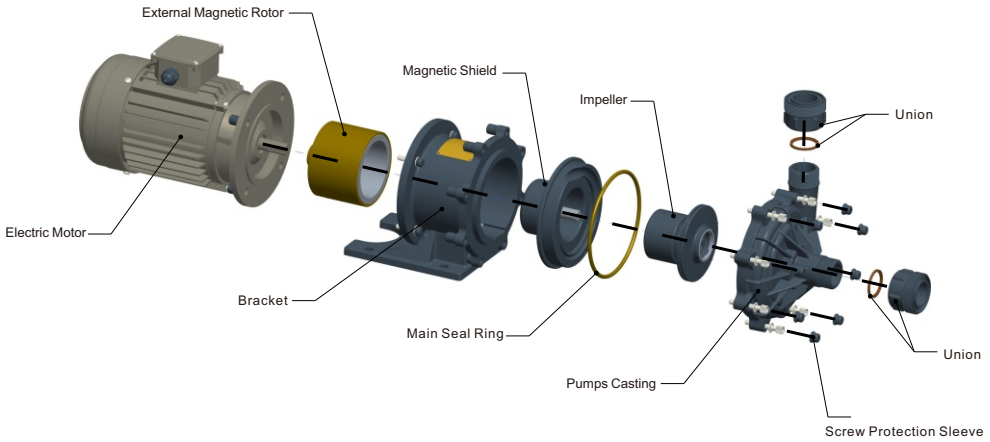
Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

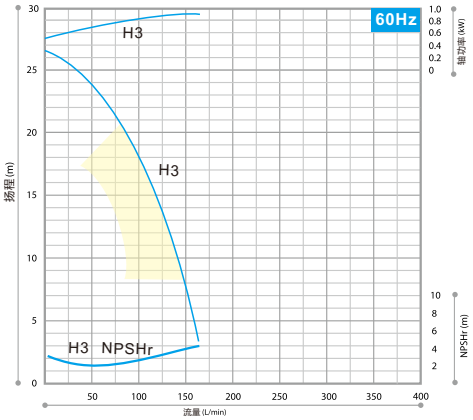
Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
PVDF	-20℃~100℃	VITON	-25℃~80℃	High Purity Silicon Oxide	-60℃~150℃
PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

>> series decomposition figure



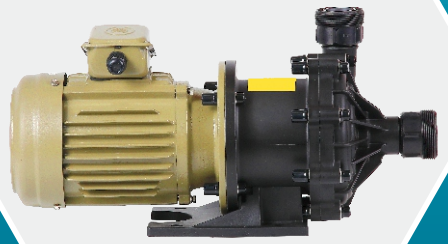
>> 60Hz Performance Curve



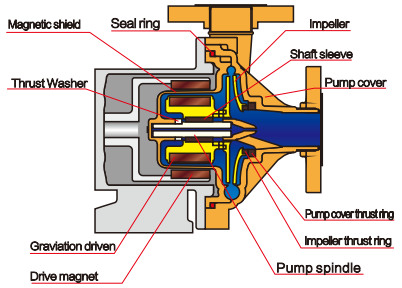
Note: The above is the standard electric motor curve.

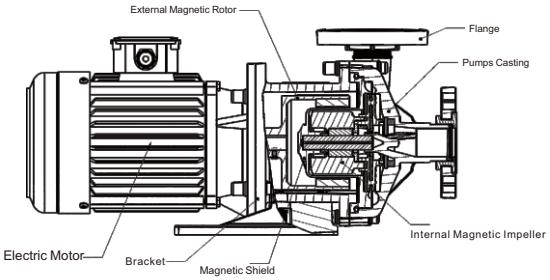
Eicen

Magnetic pump - High head EPMH4 >>>

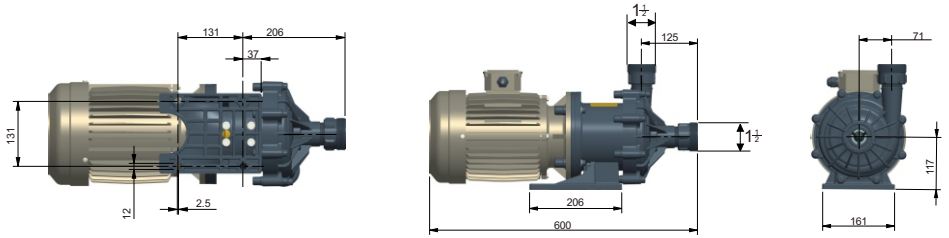


>> Principle diagram





>> Envelop dimensions figure



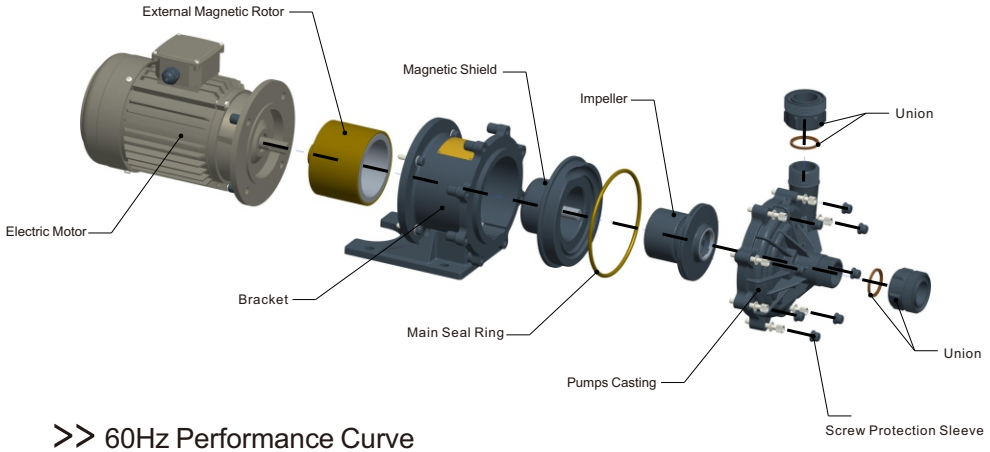
Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

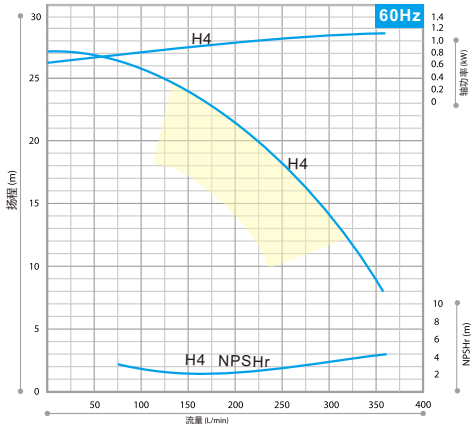
Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
PVDF	-20℃~100℃	VITON	-25℃~80℃	High Purity Silicon Oxide	-60℃~150℃
PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

>> series decomposition figure



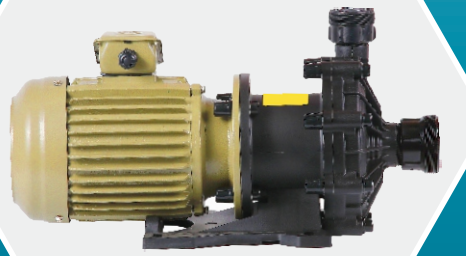
>> 60Hz Performance Curve



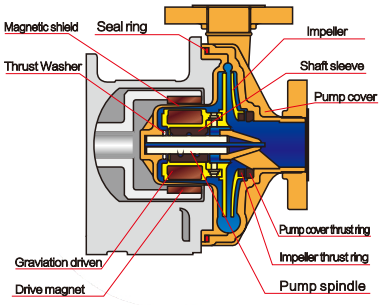
Note: The above is the standard electric motor curve.

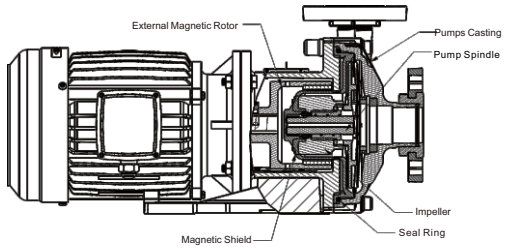
Eicen

Magnetic pump - High head EPMH5 >>>

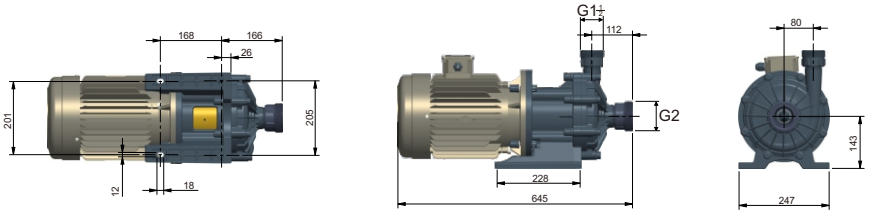


>> Principle diagram





>> Envelop dimensions figure



Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
PVDF	-20℃~100℃	VITON	-25℃~80℃	High Purity Silicon Oxide	-60℃~150℃
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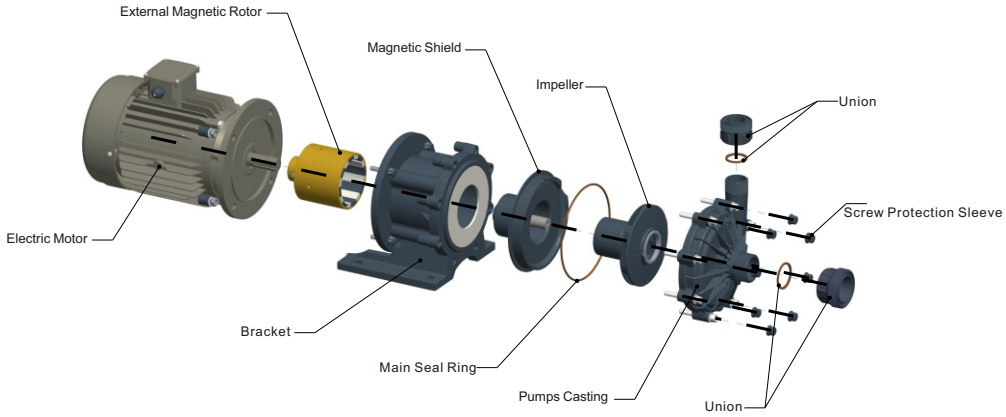
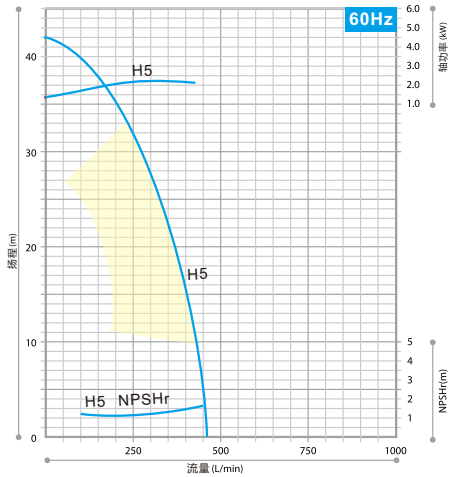
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

>> series decomposition figure



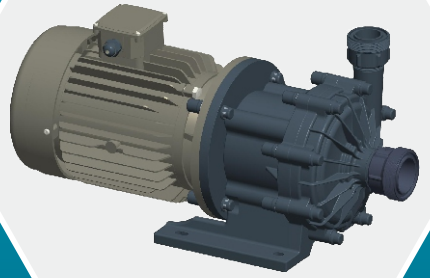
>> 60Hz Performance Curve



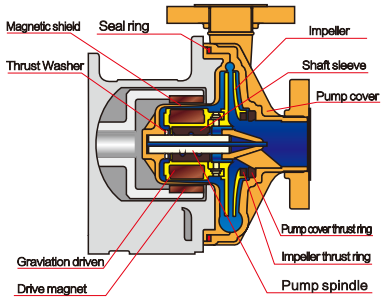
Note: The above is the standard electric motor curve.

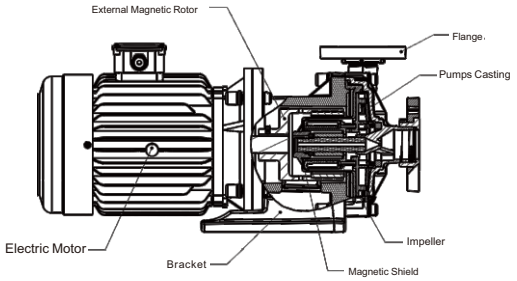
Eicen

Magnetic pump - High head EPMH6 >>>

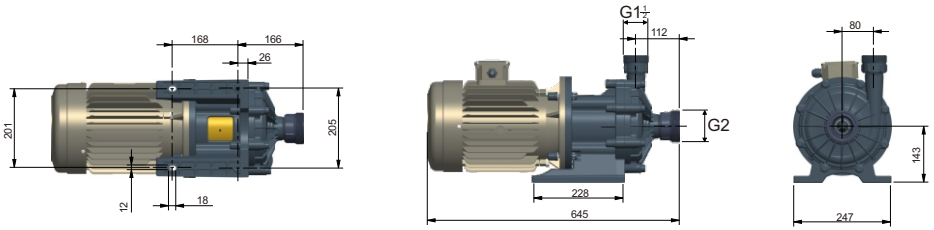


>> Principle diagram





>> Envelop dimensions figure



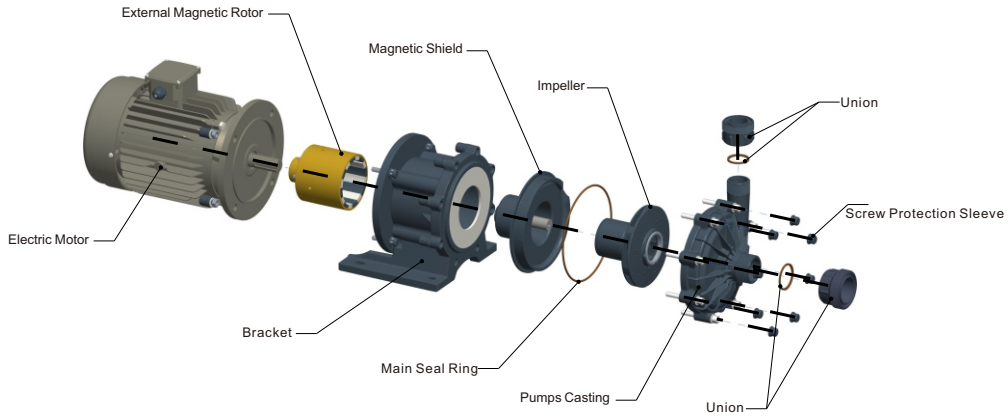
Note:This diagram is a common interface. Other interface modes are optional. If you need other interface modes, you can provide them separately.

>> Optional Materials & Temperature Range of Overcurrent Components

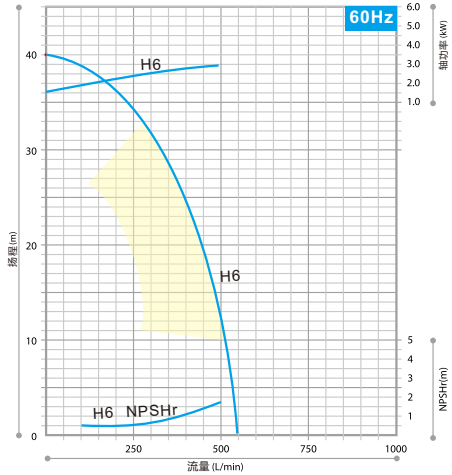
Pump Body		Sealing Element		Wear Parts	
GF+PP	0℃~90℃	EPDM	0℃~60℃	Carbon Graphite	-10℃~80℃
PVDF	-20℃~100℃	VITON	-25℃~80℃	High Purity Silicon Oxide	-60℃~150℃
PPS	-60℃~120℃	FKM	-70℃~120℃	Engineering Compound Silicon Carbide	-80℃~280℃
ETFE	-85℃~120℃	PTFE	-180℃~250℃		℃~℃

Note: The above temperature is for different materials' tolerance. The product operating temperature depends on the medium and environment. Please consult our engineer for more information.

>> series decomposition figure



>> 60Hz Performance Curve



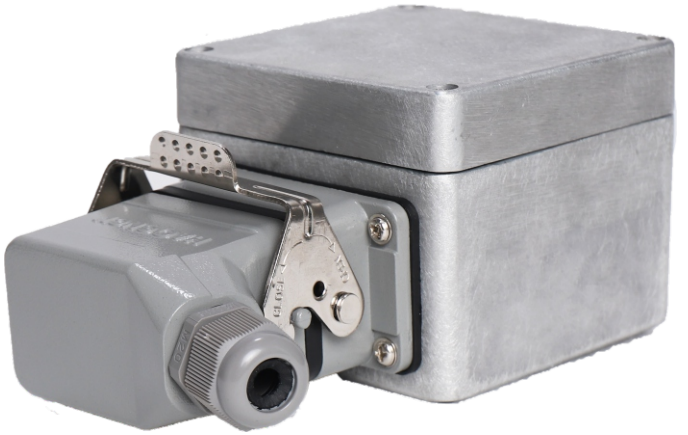
Note: The above is the standard electric motor curve.

PARAMETER SUMMARY

MODEL	THREAD/FLANGE INLET/OUTLET	MAXIMUM FLOW (L/min)		MAXIMUM LIFT (m)		MINIMUM FLOW (L/min)	MOTOR		
		50Hz	60Hz	50Hz	60Hz		POWER	PHASE	FREQUENCY
EPM0.5	G3/4×G3/4	43	47	4.6	5	0.8	0.065	1-220V· 3-380V	50/60
EPM1	G1×G1	85	90	6.7	7.2	1	0.15	1-220V· 3-380V	50/60
EPM2	G1×G1	120	130	9.2	9.5	1.2	0.37	1-220V· 3-380V	50/60
EPM2H	G1¼×G1¼(DN25×DN25)	160	165	15	17	10	0.55	3-220V· 3-380V	50/60
EPM3	G1½×G1½(DN40×DN40)	240	250	15	15	10	0.75	3-220V· 3-380V	50/60
EPM4	G1½×G1½(DN40×DN40)	350	365	17	19	12	1.1	3-220V· 3-380V	50/60
EPM5	G2×G1½(DN50×DN40)	400	420	23	25	20	1.5	3-220V· 3-380V	50/60
EPM6	G2×G1½(DN50×DN40)	500	560	25	28	20	2.2	3-220V· 3-380V	50/60
EPMH2H	G1¼×G1¼(DN25×DN25)		175		26.5	30	1.1	3-220V· 3-380V	60
EPMH4	G1½×G1½(DN40×DN40)		380		27	30	1.5	3-220V· 3-380V	60
EPMH5	G2×G1½(DN50×DN40)		450		42		3	3-220V· 3-380V	60
EPMH6	G2×G1½(DN50×DN40)		580		40		4	3-220V· 3-380V	60

Notes: The pump performance parameters are not marked for non-standard motors with 4-pole motors. If needed, please contact the factory for details.

OPTIONAL MOTOR JUNCTION BOX INTERFACE



Model Identification Code Instruction

EPM 3 / P0 / 111 / FF
(1) (2) (3) (4)

1、Series Model
0.5，1，2，2H，3.....
2、Material Code
General:P0,K0,S0,E0
Option:PF,KF,SF,EF
（P：PP+GF玻纤增强聚丙烯，K：PVDF，S：PPS，E：ETFE、0：常规、F：选配）
3、Motor Code

Code	Voltage
1	Single phase 220V
2	Three phase 220V
3	Three phase 380V
4	Three phase 415V
5	Three phase 380V
X	Customers' Request

Code	Frequency
1	50Hz
2	60Hz
X	Customers' Request

Code	Number of Poles
1	4 -Pole
2	2-Pole
X	Customers' Request

4、 Interface Types
F: Flange H: Union L: Thread Q: Others
Notes: Letter H is added to the end of the model with high cleanliness level requirements.

CHOOSE MODEL DATA TABLES

In order to help you choose the proper pump，please help provide the following data as much detail as possible.

OPERATING CONDITIONS：

REQUIRED FLOW (NORMAL)	L/min	
REQUIRED FLOW (MAXIMUM)	L/min	
TOTAL HEAD	m	
SPIT OUT THE HEAD	m	
INHALED HEAD	m	
NPSHa	m	
INSTALLATION POSITION	☐ INDOOR	☐ OUTDOOR
OPERATION STATE	☐ CONTINUOUS	☐ INTERMITTENT
ENVIRONMENT TEMPERATURE	DESIGN ℃	WINTER ℃
		SUMMER ℃

MEDIA PROPERTIES：

MEDIUM NAME		TEMPERATURE	℃
CONCENTRATION	%	VISCOSITY	CP
SATURATED STEAM PRESSURE	MPa	PROPORTION	
SOLID CONTENT (CONTAIN)	μ %	HARDNESS	HB

MOTOR：

POWER	
SPEED	
PROTECTION GRADE (IP)	
INSULATION CLASS	
EXPLOSIVE-PROOF GRADE	V 相(PHASE) Hz

Precautions

1、The performance curve provided by DATTO is the performance of transporting clean water at room temperature.

2、Select the appropriate impeller according to the specific transport proportion. When selecting, add 5~10% allowance to the motor output power, namely:
POWER (SP) × MEDIUM PROPORTION × ALLOWANCE RATE (1.05 ~ 1.1)≤ MOTOR OUTPUT POWER
Note: The power (SP) increases in proportion to the specific proportion of the medium. If the viscosity increases, not only the power increases, but also the lift and flow will change. Therefore, the power required for pump performance will change, and correction calculation must be carried out. For details, please contact us.

3、For magnetic drive pump, continuous operation is not allowed when the discharge port is closed, and the minimum flow shall be maintained. For the required minimum flow of various pumps, please refer to the performanceparameter table and performance curve.

4、To avoid cavitation in the pump body, the following formula must be met:

$$NPSHa \geq NPSHr + 0.5$$

NPSHa calculation method

$$NPSHa = \frac{10^6(Pa - Pv)}{\rho g} \pm hs - hf$$

Pa：Pressure acting on the surface of transmission medium
ρ：Medium density（kg/m³）
g：Gravity acceleration（m/s）

NPSHa：Available cavitation residue(m)
NPSHr：The necessary cavitation residue(m)
Note：according to performance curve choice NPSHr
Pv：(MPa) vapour pressure of the medium (Mpa)
hs：Suck up height(m)
hf：Suction pipe resistance(m)

INSTRUCTIONS AND PRECAUTIONS

Selection, installation, adjusting, operation and fault

1、 General rules of specifications

Scientific technical specifications should be followed in the process of design, construction and maintenance in order to ensure the safe operation of the pump within its life cycle. During the design, the specific type selection shall be determined according to the flow, lift, specific proportion, pipeline length, medium composition, medium concentration, temperature, solid content, liquid viscosity and other parameters. The model, power, interface size and pipe diameter of the pump shall be determined according to the flow, lift, specific proportion and pipe length of the working point. Determine whether the materials of the flow passage parts of the pump are resistant to medium corrosion according to the medium composition, medium concentration and temperature.If there is solid content, the allowable range, particle diameter, hardness and other special requirements shall be determined with the supplier. If the liquid viscosity is too large, specific parameters shall be provided to the supplier for determination. During the construction, the pipeline works' technical and safety requirements shall be strictly followed. The pipe diameter should be consistent with the nominal diameter of the pump. The pipe diameter can be increased, but not reduced. The inlet and outlet pipes of the pump should be kept at a straight distance. Do not immediately install elbows at the inlet and outlet. As the pump is a rotating equipment, the base should be fixed firmly. Daily maintenance shall pay attention to regular cleaning, regular monitoring of vibration values, proficiency in the normally open and close settings of pipeline valves, and practice the startup and shutdown procedures.

2、Precautions for Installation

1. The length of the inlet pipeline of the pump shall be less than 2 meters, and the number of 90 degree elbows shall be less than 3. The inlet and outlet pipelines shall keep a straight line, and the length shall be 5 times of the flange diameter of the pump. If the inlet pipeline really needs to be more than 2 meters, and there are too many elbows, please increase the pipeline diameter as appropriate.

2. The diameter of the inlet and outlet pipes should be consistent with the requirements of the pump, which can be increased, but not reduced. If the diameter of the inlet pipe is too small, cavitation will occur, and the impeller will generate a lot of air, causing vibration. The inlet should not be installed in an inverted U shape, which will store gas.

3. If filter protection is required for the inlet pipeline, the bottom valve with screen shall be installed consistent with the pipeline model, and regular cleaning shall be specified. If Y-type filter is selected, it shall be increased to 1.5-2 times of the pipeline diameter.

4. When the pump is at full flow, the liquid level at the liquid inlet shall be free of vortex. During installation and adjusting, the liquid level height shall be determined, and it is better to have a low liquid level limit switch for protection. It is recommended that the liquid level of 1-inch (DN25) interface pump should not be lower than 20CM, the liquid level of 1.5-inch (DN40) interface pump should not be lower than 25CM, the liquid level of 2-inch (DN50) interface pump should not be lower than 30CM, and the liquid level of 2.5-inch interface pump should not be lower than 35CM. The standard is that the maximum flow of liquid on site will not produce vortex, because the density, temperature and tension of each liquid will be different.

5. The base of the pump shall be firmly installed. Since the pump is a rotating equipment, the base must be firmly installed to prevent resonance and flexible vibration.

6. Check if the liquid tank is sealed. If it is too tight, there will be negative pressure at the inlet. If there is, an air vent should be added.

3、 Adjusting

1. Clean all overflow pipes before adjusting.
2. Open all pipe valves.
3. Add the required amount of liquid.
4. Discharge the gas in the inlet pipeline and check whether the pipeline is smooth.
5. Check whether the power connection is suitable, turn on the motor power, jog for 3 times to determine the running direction.
6. Start up and operate, observe the change of liquid level and whether there is bubble at the outlet.

4、 Operation Monitoring

1. It is strictly forbidden to run without liquid, and stop the machine for inspection immediately in case of abnormal noise and abnormal rise of motor surface temperature.
2. The vibration value directly above the bearing position of the front end cover of the motor shall be regularly monitored every week and shall be less than 4.5mm/S. If it exceeds the standard, the machine shall be stopped for inspection.
3. Check that the liquid at the inlet nozzle does not contain bubbles, and that the dissolved bubbles in the liquid do not enter the pump. It is necessary to separate the bubbles from the liquid surface.
4. Before starting the machine every day, check the height from the inlet of the inlet pipe (at the opening of the tank) to the liquid level, and no vortex will be generated during operation.

5、 Shutdown protection

First adjust the outlet valve to the minimum flow of the pump, and then close the power to prevent the pump body from being damaged by the impact of returned liquid. Then close the inlet valve and outlet valve.

6、 Maintenance

1. After disassembling the pump, first observe whether the external magnetic rotor (active magnetic rotor) is oxidized, and no liquid can touch the magnet part. Spray quick drying paint to protect the external magnetic rotor when disassembling for maintenance.
2. Handle with care to protect the ceramic parts. Make the assembly angle of the pump cover and the spacer sleeve correct, and ensure the parts clean.

7、 Fault Diagnosis

1. Liquid shortage operation is a general term for phenomena, including dry operation with complete liquid shortage, wet operation with half liquid shortage, and operation with insufficient liquid intake. Completely dry running without liquid will immediately crack the ceramic parts; The liquid will not flow normally when it is half starved of liquid for wet operation, and the plastic around the ceramic parts will be hot melted when the temperature rises; If the liquid inlet is not fully operated, the pump will produce cavitation, increase the vibration and loosen the shaft sleeve.
2. Overflow parts will corrode, decompose and crack if exceeding the scope of use and tolerance of the materials.