Document No.: ME_PU_EMT2200MK/3300MK-B_STD(CN)_R0

Instruction Manual

Magnetically Suspended Compound Molecular Pump with Integrated Control Unit EMT2200M-B series EMT3300M/3400M-B series

It is mandatory to read and understand all the ”Important warning” and ”Important caution” in this manual before using the product.

Keep this manual close at hand in order to read it at any time.

EBARA Corporation

Introduction

The ”EMT-K” series pump is the magnetically suspended compound molecular pump with integrated control unit, regarding as industrial machinery.

The magnetically suspended compound molecular pump transports gas molecules from the inlet port to the outlet port by the high speed rotation of the rotor in the pump. This rotor is suspended by five-axis active control magnetic bearing with no contact.

Hereinafter, this magnetically Suspended Compound Molecular Pump is referred to as the ”pump”, integrated control unit is referred to as the ”ICU”.

This instruction manual (hereinafter, ‘this manual’) provides safety notes, operation procedures, and maintenance and inspection procedures for the pump.

Before operation of the pump, be sure to read and understand the contents of this manual.

Keep this manual readily available for reference and troubleshooting.

The pump conforms to the following directives and standards.

Pump model (*)	The conformity directives and standards.
EMT220xMyWz-B EMT330xMyWz-B EMT340xMyWz-B	UL61010-1:2012 SEMI S2-0712a CE marking (**) RoHS Directive (2002/95/EC)

* Refer to "13.2 Model Code" about the pump model.

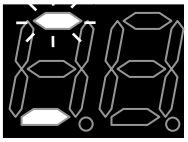
** EC directive applied to the pump is as follows.
(Refer to the “CE declaration of conformity” attached this manual, too.)

- Machinery Directive (2006/42/EC)
- Electromagnetic Compatibility Directive (2004/108/EC)

*** Please refer to us for the conformity of the other models.
(e.g. The special specification pump followed by two digits in the end of the model code.)

Notation and definitions

The following symbols and notations are used in this manual.

Symbol / Notation	Meaning
ATTENTION	Indicates the items that require attention on using the pump.
INFO	Indicates the useful information on using the pump.
IMPORTANT	Indicates the important items on using the pump.
○, ◕, ◑, ◔, ●	Indicates the status of LED. ○ ··· lighted, ● ··· not lighted ◕ ··· blink (cycle: ○ ● ● ● ● ● / 1 sec.) ◑ ··· blink (cycle: ○ ● ○ ● ● ● / 1 sec.) ◔ ··· blink (cycle: ○ ● ○ ● ○ ● / 1 sec.)
	Indicates the status of segments in the INDICATOR.  ··· segment is lighted  ··· segment is not lighted  ··· segment is blinked
[START/STOP]button [POWER]switch	Indicates buttons switch, or connector on the front panel of the ICU.
“ ***** ”	Indicates the references. (E.g. the other item in this manual, other relevant instruction manual, other attached document, others.)

Safety

- The following ”Important warning” and ”Important caution” provide safety information. Be sure to read them before using the pump. In addition, be sure to follow ”Important warning” and ”Important caution”.
- Note that all ”Important warning” and ”Important caution” in this manual are limited to the range of our expectation. For your safety, follow all general rules (laws and regulations) in addition to the instructions provided in this manual.
- EBARA Corporation holds the right to modify the product specifications without prior notice for to maintain and to improve the quality of the product. For this reason, the contents of this manual may not match exactly with the actual product.

Symbols and Definitions

The following symbols and definitions are used for ”Important warning” and ”Important caution” in this manual.

Symbol	Definition
WARNING	Important warning This is important information for preventing serious injuries. Failure to follow instructions labeled with this symbol may result in death, serious injury, and/or property damage.
CAUTION	Important caution This is important information for the safe use. Failure to follow instructions labeled with this symbol may result in injury and/or property damage.

Symbol	Definition
	Fire or explosion hazard.
	Inhalation hazard.
	Electric hazard.
	Hot surface.
	Requires grounding.
	Do not disassemble.

Symbol	Definition
	Do not touch.
	Prohibited.
	Mandatory.

WARNING

■ General warning

Only the ”Eligible Workers” shall perform the job assignment in each chapter.

Failure to follow this instruction may result in serious accidents, causing death, a serious injury and/or the property damage.

■ 2.2 Carriage

When moving the pump, use a crane to lift the pump by the eyenut on the inlet flange.

The pump is about 60-70 kg in weight. If the pump is carried by hand, the pump may fall, causing an injury and/or the property damage.

When moving the pump, use a dolly or a lift.

The pump is about 60-70 kg in weight. If the pump carried by hand, the pump may fall, causing an injury and/or the property damage.

■ 3.1 Pumping Media

Before using gases, read the SDS (Safety Data Sheet) provided by the gas supplier, and take appropriate protective measures to ensure safety.

Failure to take protection measures may result in serious accidents. And it may cause death, a serious injury, and/or the property damage.

- When gases including explosive gas or flammable gas are used, be careful to prevent an explosion or a fire.
- When gases including toxic or reactive gas are used, be careful to prevent leakage.

If you should take (breathe) in toxic gas, or reactive gas, take appropriate measures immediately, and see a doctor.

■ 3.2 Usage Environment

Do not use the pump in the following environment.

- An area exposed to reactive, corrosive and/or toxic gas
- An area exposed to explosive and/or flammable gas
- An area exposed to radiation

The use in such location may result in serious accidents, causing death, a serious injury, and/or the property damage.

At the following location, do not install the pump, do not connect the cable and do not use the pump.

- An area exposed to high temperature and/or high humidity
- An area exposed to strong magnetic field and/or strong electric field
- An area with a lot of vibration
- An area exposed to direct sunlight
- An area exposed to sea breeze
- An area in which condensation may occur.
- An area where water may drop
- An area with a lot of dust
- In the environment that does not satisfy IP54

The use in such location may damage the pump.

■ 3.5 Labels

Follow the instructions on the warning labels at all times.

Failure to follow instructions may result in serious accidents, causing death, a serious injury, and/or the property damage.

■ 4.1 Preparations before Installation

For mounting the pump, design the device, frame, mount, floor, and others (Hereinafter these are referred to as the "equipment") so that the pump can be fixed securely pursuant to the Fixture Method indicated in this manual.

Failure to follow instructions may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.

Design the equipment so that it can withstand the rapid shutdown torque generated when the rotor burst. (Refer to Table4).

If the rotor is clashed during the pump operation, a large torque is generated by rotor breakage, and the whole pump is going to spin by this torque.

The insufficient strength of the equipment may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.

Be sure to prepare the bolts of the strength conforming to our designation for the pump fixing. (Refer to Table5 and Table6.)

Applying incorrect bolts may result in serious accidents such as a drop or a fall of the pump caused due to insufficient fixing. And it may cause death, a serious injury, and/or the property damage.

If the fixing bolts conforming to our designation can't be prepared, consult us prior to mount the pump. For our contact information, refer to the end of this manual.

Do not install the pump at the place that is easily touched to the pump, for avoiding hot surface of the pump.

Touching the surface may result in a burn.

If you cannot help installing the pump where it is easily touched, it is necessary to guard from the hot surface.

■ 4.2 Mounting Method and Procedure

Do not hang the pump above a walkway.

The pump is about 60-70 kg in weight. Failure to follow this instruction may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.

When installing or fixing the pump, use a lifter or crane to lift the pump by the eyenut on the inlet flange.

The pump is about 60-70 kg in weight. Failure to follow this instruction may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.

Fix the pump to the equipment securely.

Defective fixing of the pump may result in serious accidents such as a drop or a fall of the pump, during operating the pump, connecting the cable, checking, or maintenance. And it may cause death, a serious injury, and/or the property damage.

When mounting the pump, be careful that the equipment does not fall.

If the equipment is unstable, it may result in serious accidents such as a drop or a fall of the pump, during connecting the cable, checking, or maintenance. And it may result in damage of the pump, or an injury.

Connect the inlet flange and inlet piping securely.

Defective connection of the piping may result in suffocation by the handling gas or the purge gas leak. And it may cause death, a serious injury, and/or the property damage.

■ 4.8 Connecting the cooling water piping

Connect the cooling water piping securely so as not to leak the water.

If water leakage occurs, it may result in an electric shock.

■ 5.1 Preparations before Installation

Be sure to confirm that the pump is mounted securely before connecting the cables.

Unstable mounting of the pump may result its drop or tipping over while connecting the cables. And it may cause death, a serious injury, and/or the property damage.

Before connecting the cables, ensure that the [POWER] switch of the pump is turned off.

Connecting a cable while the [POWER] switch of the pump is turned on may result in an electric shock.

Before opening the cover of each connecter, ensure that water does not leak.

If water leakage occurs, it may result in an electric shock**.**

Take note of the minimum bending radius of all cables, and avoid over-bending.

Over-bending of the cable may result in cable damage. In particular, over-bending of the power supply cable may result in an electric shock and/or a fire.

■ 5.2 Power supply cable

Do not connect the power supply cable to an improper power supply.

Failure to follow the instruction may result in a damage of the pump, an electric shock and/or fires. The supply voltage for the pump is AC200 to 240V, 50 / 60Hz.

Be sure to connect the earth line of the [INPUT] connector to EARTH / GROUND.

Otherwise, an electrical leakage may occur, resulting in an electric shock and/or fires.

Make sure to implement a disconnecting device and an over current protection device for the host equipment.

Otherwise, it may result in serious accidents, causing death, a bodily injury and/or the property damage.

- Cut off the power supply with the disconnecting device and the overcurrent protection device.
- The disconnecting device and the overcurrent protection device should have an ampere interruption capacity of 10000 A or greater.
- The disconnecting device and the overcurrent protection device must be equipped with a lockout device which enables to keep their switch at off position.
- The disconnecting device and the overcurrent protection device, both for indoor use, should be installed in close proximity to the host equipment and within easy reach of the operators so that they shall not be exposed to any danger all the while in their operation.

■ 5.3 REMOTE Communication Cable

Do not connect the hazard voltage circuit to the SELV (Safety Extra Low Voltage) circuit.

Otherwise, it may result in serious accidents, causing death, a serious injury, and/or the property damage.

■ 6.1 Pre-Operation Notes

Ensure that the pump is mounted securely.

Unstable mounting of the pump may result in serious accidents such as crashed pump, due to an earthquake, external vibration, vibration of pump itself, others. And it may cause death, a serious injury, and/or the property damage.

Before operating the pump, ensure safety around the pump and operation place.

Do not turn on the power supply when the worker is installing, maintaining, or doing something the pump. Otherwise, it may result in serious accidents causing death, a serious injury, and/or the property damage.

■ 6.2 Notice during operation

During the operation, do not send a large amount of gas/air into the pump.

Failure to follow this instruction may result in damage of the pump.

In case of touchdown during the pump operation, do not touch or get close to the pump until the pump completely stops.

In case of touchdown, the rotor is supported by Touchdown bearing while the rotor slows down and stops. Large noise and vibration occur from the pump all the while.

The time required from rated rotation to a stop in a vacuum.

- With brake : about 10-12 min.

Do not touch the connector during operation.

[INPUT] connector is locally carrying dangerous voltage. Touching the connector with hand or any other body part may result in an electric shock.

Do not move the pump and the equipment during operation.

Moving them during operation, may result in serious accidents. And it may cause death, a serious injury, and/or the property damage.

■ 7.3 Bake-out

Do not touch the pump surface during and just after bake-out.

During and just after bake-out, the pump surface becomes hot. Contact to the pump surface may result in a burn.

You should install the safety guard and display warning so as not to touch the pump surface by mistake during bake-out.

■ 8 Emergency OFF (EMO) system

Design the EMO system so that its activation does not cause sudden pressurization in the pump.

Sudden pressurization will cause the pump touchdown, and the pump will be prevented from stopping safety.

■ 9.1 Protective function

If the some error occurs, the ICU may not indicate that the rotor is still rotating. Do not touch the pump or perform recovery work until the pump has stopped completely.

In order to stop the pump completely, raise pressure inside the pump.

In case of touchdown during the pump operation, do not touch or get close to the pump until the pump completely stops.

In case of touchdown, the rotor is supported by Touchdown bearing while the rotor slows down and stops. Large noise and vibration occur from the pump all the while.

Do not cut off power supply during rotating in case of freerun

In case of freerun, the regenerative energy of the motor cannot work.

Therefore, if the power supply is cut off, the pump cannot maintain the operation of the magnetic bearing, and then the rotor will touchdown. In that case, the regenerative brake does not work, and so an excessive load is applied to the touchdown bearing.

When the rotation speed at such the touchdown is 75 rps or more, the pump detects “Change Safety Bearing” (error code: 94).

The time required from rated rotation to a stop

- In a vacuum : roughly 10 hours
- With vent gas : roughly 10-15 min
  (In the case of passing 500 sccm of the vent gas when the inlet port and the outlet port are sealed)

■ 9.4 Main power supply fault / Power failure

If the main power supply fault / power failure occurs when the pump is running at warning condition or low-speed condition, the INDICATOR may not give any indication that the rotor is still running.

Check the rotation state by turning the power on or hearing the rotation sound.

■ 10 Check / Maintenance

Before Check / Maintenance, firstly confirm that the pump completely stops, secondly turn off the [POWER] switch, lastly disconnect the power supply cable.

Otherwise, it may cause an injury, and/or the property damage.

■ 10.1 Daily check

Do not check the pump other than the maintenance worker.

Otherwise, it may result in accidents, causing an injury, and/or the property damage.

Ensure that the pump is mounted securely.

Unstable mounting of the pump may result in serious accidents such as crashed pump, due to an earthquake, vibration from the outside, vibration of pump itself.

It may result in causing death, a serious injury, and/or the property damage because the pump falls from the equipment and the damaged parts scatters from Inlet vigorously.

Do not fall the tools, the bolts, and/or others, in the pump.

Protective mesh screen is not sufficient to prevent the entrance of all foreign matters.

Do not use the pump when some kind of objects passed through the Protective mesh screen and fell in the pump. If you force the pump to operate, serious trouble happens.

Do not bend Protective mesh screen.

Because Protective mesh screen is not solid, it can be deformed with pressure.

Deformed Protective mesh screen may result in pump crashing because it contacts to the rotating rotor.

■ 10.4 Removal of pump

Before removal of the pump, be sure to confirm the type of the using gas and obtain its SDS from the gas supplier. Take necessary protection measures according to the characteristic of the gas in order to secure the safety of the workers.

Failure to take protection measures may result in serious accidents such as cause death, a serious injury, and/or the property damage.

Wear the suitable ‘personal protective equipment’, such as suits, goggles, gloves, to prevent exposure to the hazardous gas.

If you should be exposed to toxic gas or reactive gas, take appropriate measures immediately, and see a doctor.

Do not pressurize pump more than 0.2 MPa.

If the pressure rises excessively, it may result in serious accidents accompanied with the pump burst or scattering of connection parts. And it may cause death, a serious injury, and/or the property damage.

	**Keep the pump away from flame when removing the pump. And before removal of the pump, be sure to purge the used pump of explosive gas and flammable gas by introducing inert gas such as nitrogen.** Otherwise, it may result in serious accidents such as an explosion or a fire. And it may cause death, a serious injury, and/or the property damage.
	**If the pump has been used to intake (exhaust) of toxic or reactive gas, be sure to purge the pump of these gases by introducing gas such as nitrogen before removal of the pump.** Otherwise, it may result in exposure of the hazardous gas, such as toxic gas or reactive gas. And it may cause a serious injury or death. If you should be exposed to toxic gas or reactive gas, take appropriate measures immediately, and see a doctor.
	**Before transporting the pump, be sure to fill the pump with nitrogen or dry air, and completely seal up the Inlet Port, the Outlet Port and the Purge Port.** Failure in this procedure may result in leak of hazardous gas during transportation. And it may cause death, a serious injury, and/or the property damage.
	**Use a crane or a lift with eyenut when you remove the pump.** The pump is about 60-70 kg in weight. If the pump carried by hand, the pump may fall, causing an injury and/or the property damage.
■ 10.5 Request of overhaul / Maintenance	
	**Do not disassemble or modify the pump.** Contact us on the occasion of overhaul and/or repair. When it was found out the pump disassembled or modified, we decline repair and overhaul of the pump.
	**If you request overhaul of the pump, regardless of the kind of handling gas, be sure to specify the kind of handling gas and safety notes on 'inspection order form' as well as on 'the face of the package'.** Otherwise, our employee may be exposed the hazardous gas, such as toxic gas, reactive gas, or the compounds of these gases which remains in the pump. And it may cause our employee's death, serious injury.
	**If you request overhaul, be sure to purge the pump of hazardous gases, such as toxic gas, corrosive gas, explosive gas, flammable gas, reactive gas.** Otherwise, our employee may be exposed the hazardous gas which remains in the pump. And it may cause our employee's death, serious injury..
	**Do not pressurize pump more than 0.2 MPa.** If the pressure rises excessively, it may result in serious accidents accompanied with the pump burst or scattering of connection parts. And it may cause death, a serious injury, and/or the property damage.
	**Use the packing materials with enough strength if you send the pump.** Insufficient strength of packing materials may result in serious accidents, such as a drop or a fall of the pump, due to damage of packing materials during the transportation. And it may cause serious injury, and/or property damage. Use the original packaging or the packaging of equivalent quality, so as not to have the pump be damaged by external force.

■ 11.1 Storage
 **Before storage of the pump, be sure to purge the pump of hazardous gases, such as toxic gas, corrosive gas, explosive gas, flammable gas, reactive gas.** Remains of such hazardous gas inside of the pump may result in gas leak during storage. And it may cause death, a serious injury, and/or the property damage.
 **Do not expose the inside of the pump to air.** Exposure to air will accelerate the growth of reaction products in the pump, causing pump damage or failure.
 **Be sure to store the pump upright on a flat floor.** The pump weighs about 60-70 kg per unit. Storage of the pump at high or unstable place may result in serious accidents, such as a drop or a fall of the pump, due to vibration or an earthquake. And it may cause death, a serious injury, and/or the property damage.
■ 11.2 Disposal
 **Before disposing the pump, take proper measures to discharge any gas remaining in the pump, such as hazardous gas or reaction products.** Remains of hazardous gas or reaction products in the pump may result in serious accidents. And it may cause death, a serious injury, and/or the property damage.

 CAUTION
■ 3.5 Labels
 **If a warning label on the pump becomes illegible or the label peels off, obtain replacement from EBARA Corporation and attach it to the same position.** Illegible labels may lead to an accident. For our contact information, refer to the end of this manual.
■ 4.2 Mounting Method and Procedure
 **When mounting the pump, be careful that your hands is not trapped by the equipment.** Failure to follow this instruction may result in minor injury.
 **Do not put your hands into the pump.** If putting hands into the pump, the hands may be caught in the rotor. It may result in minor injury.
■ 4.8 Connecting the cooling water piping
 **Do not exceed upper limit of the cooling water supply pressure.** An excess of the upper limit of the supply pressure of the cooling water may result in burst at the cooling water piping or the connecting part. And it may cause property damage, and/or an injury.

■ 5.2 Power supply cable
 **Assemble the power supply cable properly.** Otherwise, protection rating IP54 may be not applied.
■ 6.2 Notice during operation
 **Do not cut off power supply during pump operation, except for emergency stop.** Cutting off power supply during operation may result in damage of the pump.
 **Do not apply an excessive vibration or shock to the pump.** An excessive shock or vibration may cause pump failure.
■ 8 Emergency OFF (EMO) system
 **After activating the EMO system, do not perform recovery work until the pump has stopped completely.** Power supply is shut off when the EMO system is activated, but the pump will continue to rotate until it is stopped by the protective function. If power is not restored after that shut off, it will take about 30 min until the pump stops completely. Completely stop of the pump can be confirmed with display indication after power is restored.
■ 10.4 Removal of pump
 **Before removing the fixation parts of the pump, be sure to remove the cables.** If the fixation parts are removed with cables connected, the cables may be pulled by mistake. So it may result in accidents such as a cable break.
 **Do not put your hands in the pump.** Doing so may result in injury.

Warranty and Liability

EBARA Corporation guarantees the quality of its pumps and their accessories as described in the included "Standard Warranty Certificate". Note, however, that using the pump in manners not described in this manual will void all warranty.

Use of the pumps under atypical conditions without prior consent from EBARA Corporation may also void the warranty.

Copyright and Responsibilities

This manual is provided solely for the purpose of providing support for the use of the pump, and must not be used for any other purpose.

It is strictly prohibited to quote, reproduce, falsify, and translate the entire or partial contents of this manual.

The original language of this manual is the English. (Other languages are translated based on this manual.)

Any information contained in this manual is subject to change without notice.

Definition of Eligible Workers

While this manual has been prepared for all the people handling the pump, for the purpose of improved safety, its intended readers are categorized as follows.

Each workers should equip the PPE(Personal Protective Equipment).

■ Handling worker

Handling worker is a worker performing the receipt of goods of the pump, unpacking, transportation, packing and shipment.

Handling worker must read this manual thoroughly and fully understand relevant job assignment and safety well before starting work.

■ Installation worker

Installation worker is a worker performing work related to the installation of the pump, such as installation, connecting the cable and connecting the peripheral device. Installation worker needs knowledge and experience referring to the installation of the pump.

Installation worker must read this manual thoroughly and fully understand relevant job assignment and safety well before starting work.

■ Operator

Operator is a worker operating the pump via the controller.

Operator must read this manual thoroughly and fully understand relevant job assignment and safety well before starting work.

■ Maintenance worker

Maintenance worker is a worker performing check, maintenance, disassembly, storage, the disposal of pump. Maintenance worker needs electrical and mechanical technical knowledge.

Maintenance worker must read this manual thoroughly and fully understand relevant job assignment and safety well before starting work.

Eligible Workers for Each Chapter

⚠ WARNING

Only the ”Eligible Workers” shall perform the job assignment in each chapter.
Failure to follow this instruction may result in serious accidents, causing death, a serious injury and/or the property damage.

”Eligible Workers” of each chapter of this manual and example of the each workers PPE is as follows.

Chapter	Handling worker	Installation worker	Operator	Maintenance worker
Introduction	✓	✓	✓	✓
1 Workflow	✓	✓	✓	
2 Unpacking and Carriage	✓	✓		
3 Technical Data		✓	✓	✓
4 Pump Installation		✓		✓
5 Connecting the Cables		✓		✓
6 Operation			✓	
7 Various Operation			✓	
8 Emergency OFF system		✓	✓	✓
9 Troubleshooting			✓	✓
10 Check / Maintenance				✓
11 Storage and Disposal	✓			✓
12 Spare	✓	✓		✓
13 Specification	✓	✓	✓	✓
PPE; Gloves	✓	✓	✓	✓
Safety shoes	✓	✓		✓
Helmet	✓	✓		✓
Goggle				✓
Mask				✓

Contents

1 Workflow: Unpacking, Installation and Operation

The workflow from unpacking of pump to operation is as follows.

Unpacking	●Checking contents of the package
Carriage	●Notice of carriage
Preparations before Installation	●Pumping media ●Usage environment ●Pump dimensions ●Labels
Installation	●Mounting method and procedure ●Selecting the backing pump ●Connecting the exhaust piping ●Connecting the purge gas piping ●Connecting the cooling water piping
Connecting the Cables	●Assembly cable ●Connecting cable
Operation	●Pre-operation notes ●Notice during operation ●Local operation ●Remote operation

2 Unpacking and Carriage

2.1 Unpacking

■ Checking contents of the package

The standard package is shown below. Should any item be missing, contact EBARA Corporation Note that some components may differ depending on the specifications of your pump.

Should any of the package contents be missing, damaged, defective, contact us. For our contact information, refer to the end of this manual.

Name	Quantity
Pump	1 set
Inlet flange for shipping and its peripheral parts (attached to Inlet Port)	
Temporary blank Flange	1 set
for VG250: O-ring (V275) x 1, Bolts (SUS304 M12x40) x 4, Nuts (SUS304 M12) x 2, and Eye-nuts (SUS304 M12) x 2	1 set
for ISO-B250: Center ring (for ISO-B250) x 1, Bolts (SUS304 M10x35) x 2, Stud bolts (SUS304 M10x50) x 2, Nuts (SUS304 M10) x 4, and Eye-nuts (SUS304 M10) x 2	1 set
for VG300: O-ring (V325) x 1, Bolts (SUS304 M12x40) x 4, Nuts (SUS304 M12) x 2, and Eye-nuts (SUS304 M12) x 2	1 set
for ISO-B320: Center ring (for ISO-B320) x 1, Bolts (SUS304 M12x40) x 4, Nuts (SUS304 M12) x 4, and Eye-nuts (SUS304 M12) x 2	1 set
for VG350: O-ring (V380) x 1, Bolts (SUS304 M12x40) x 4, Nuts (SUS304 M12) x 2, and Eye-nuts (SUS304 M12) x 2	1 set
Protective mesh screen (attached to Inlet Port)	1 sheet
Outlet flange for shipping and its peripheral parts (attached to Outlet Port) Blank flange, center ring, and clamp	1 set
Water Valve (attached to cooling water inlet)	1 set
Purge gas plug for the Pump and its O-ring (attached to purge port for the Pump)	1 set
Vent gas plug for the Pump and its O-ring (attached to vent port for the Pump)	1 set
Purge gas plug for the ICU and its O-ring (attached to purge port for the ICU)	1 set
Connector protective cover ”COM. SLOT”,”WATER VALVE”,”VENT VALVE”,”SERVICE PORT”, ”INPUT”	1 set
Power supply plug	1 set
Connector hood for [COM.SLOT]	1 set

Instruction manual (this manual)	1 copy
Instruction manual for REMOTE communication	1 copy
Inspection Certificate	1 copy
Standard Warranty Conditions	1 copy
Inspection Order Form	1 copy

2.2 Carriage

WARNING
When moving the pump, use a crane to lift the pump by the eyenut on the inlet flange. The pump is about 60-70 kg in weight. If the pump is carried by hand, the pump may fall, causing an injury and/or the property damage.
When moving the pump, use a dolly or a lift. The pump is about 60-70 kg in weight. If the pump carried by hand, the pump may fall, causing an injury and/or the property damage.

ATTENTION

Do not apply excessive vibration or shock onto the pump.
The pump may become damaged.

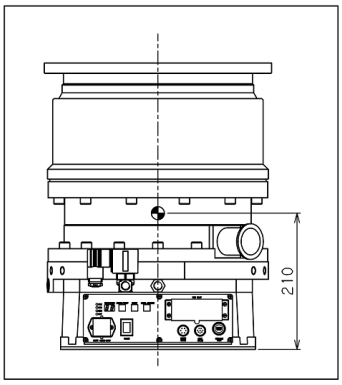


Fig. 1-1 center of gravity of EMT2200M-B

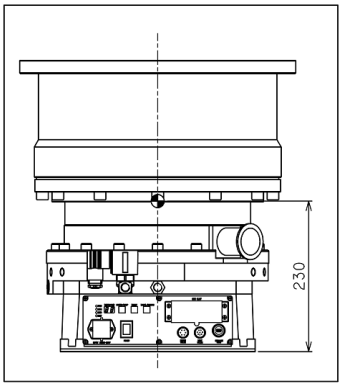


Fig. 1-2 center of gravity of EMT3300M/3400M-B

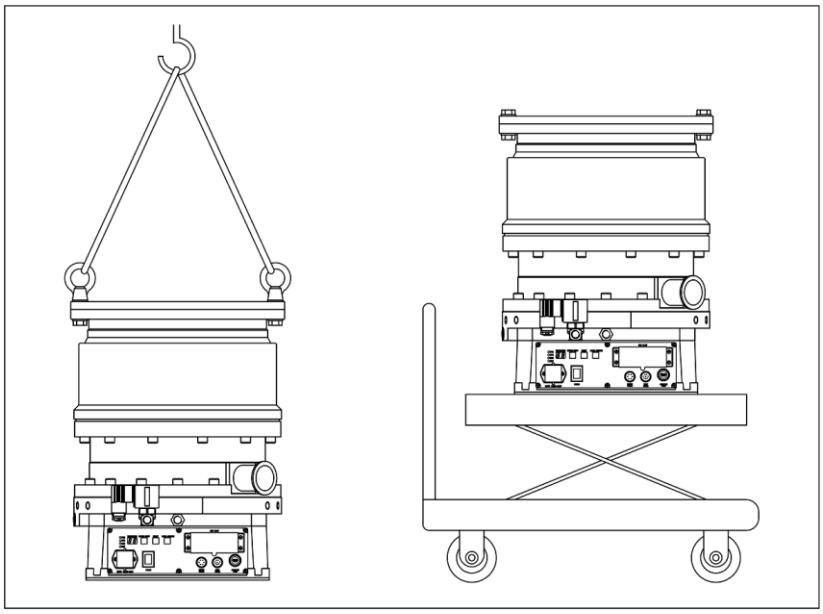


Fig. 2 example of carriage

3 Technical Data

3.1 Pumping Media

WARNING

Before using gases, read the SDS (Safety Data Sheet) provided by the gas supplier, and take appropriate protective measures to ensure safety.

Failure to take protection measures may result in serious accidents. And it may cause death, a serious injury, and/or the property damage.

- When gases including explosive gas or flammable gas are used, be careful to prevent an explosion or a fire.
- When gases including toxic or reactive gas are used, be careful to prevent leakage.

If you should take (breathe) in toxic gas, or reactive gas, take appropriate measures immediately, and see a doctor.

The gas that can be used according to the model of the pump is different.

For the basic (not chemical) type pump, do not use the following gas.

- corrosive gas which corrodes the aluminum alloy. (e.g. chlorine(Cl), gallium(Ga), mercury(Hg))
- reactive gas which forms reaction products inside pump.

In case of using corrosive gases (not including Ga, Hg), use the corrosion resistant type pump.

For model code information, Refer to ”13.2 Model Code”.

ATTENTION

Do not use the gas including Ga, Hg.

Doing so may result in pump failure. If it is absolutely necessary to use the gas including Ga, Hg, consult us. For our contact information, refer to the end of this manual.

3.2 Usage Environment

WARNING

Do not use the pump in the following environment.

- An area exposed to reactive, corrosive and/or toxic gas
- An area exposed to explosive and/or flammable gas
- An area exposed to radiation

The use in such location may result in serious accidents, causing death, a serious injury, and/or the property damage.

At the following location, do not install the pump, do not connect the cable and do not use the pump.

- An area exposed to high temperature and/or high humidity
- An area exposed to strong magnetic field and/or strong electric field
- An area with a lot of vibration
- An area exposed to direct sunlight
- An area exposed to sea breeze
- An area in which condensation may occur.
- An area where water may drop
- An area with a lot of dust
- In the environment that does not satisfy IP54

The use in such location may damage the pump.

Usage Environment	Contents
Location	Permissible location is Indoor.
Ambient temperature	Permissible range is 10 to 40 °C (50 to 104 °F).
Ambient humidity	Permissible range is 5 to 80 %. (with no condensation)
Altitude	Permissible level is 2000 m or below.
Magnetic field	Permissible magnetic field level is 2 mT (20 Gauss) or below.

ATTENTION

If ambient temperature exceeds the permission range, the maximum throughput will decrease. If you keep putting much gas at the environment exceeding the permissible ambient temperature, the pump becomes hot and may result in failure.

ATTENTION

If the altitude exceeds 2000 m, the isolation performance of the pump and controller will no longer be guaranteed, and the pump may result in failure.

ATTENTION

Operation within magnetic field may raise the rotor temperature, and may cause damage of the rotor. And the pump may result in damage.

If the magnetic field level is expected to exceed permissible value, use magnetic shielding. And consult us prior to use. For our contact information, refer to the end of this manual.

ATTENTION

If the pump suffers excessive vibration or shock during the operation, the pump may result in stop by activation of protective functions.

ATTENTION

If the pump operates at the place with radiation, the interior components of the pump may become deteriorated, and the pump may result in failure or damage.

3.3 Pump Dimensions

The external view and the dimensions of the pump are illustrated below.

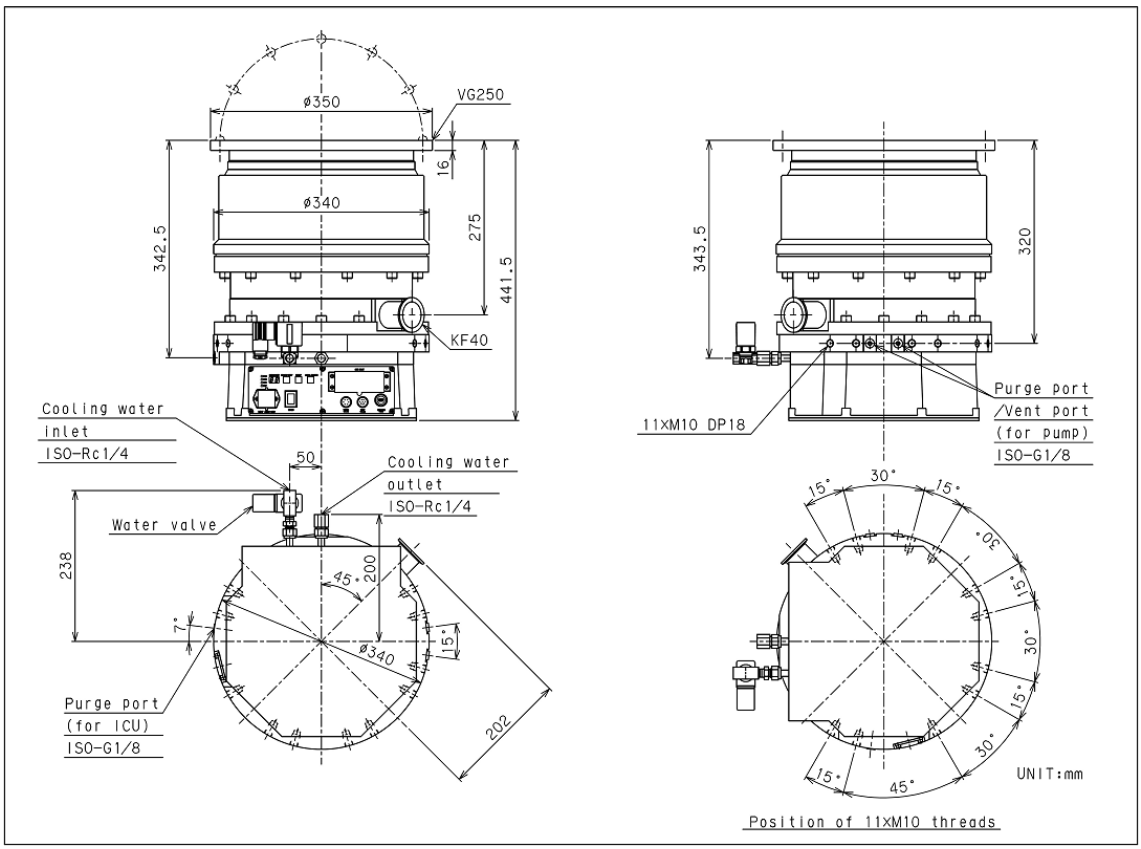


Fig.3 EMT2200MK-B VG250 inlet flange type

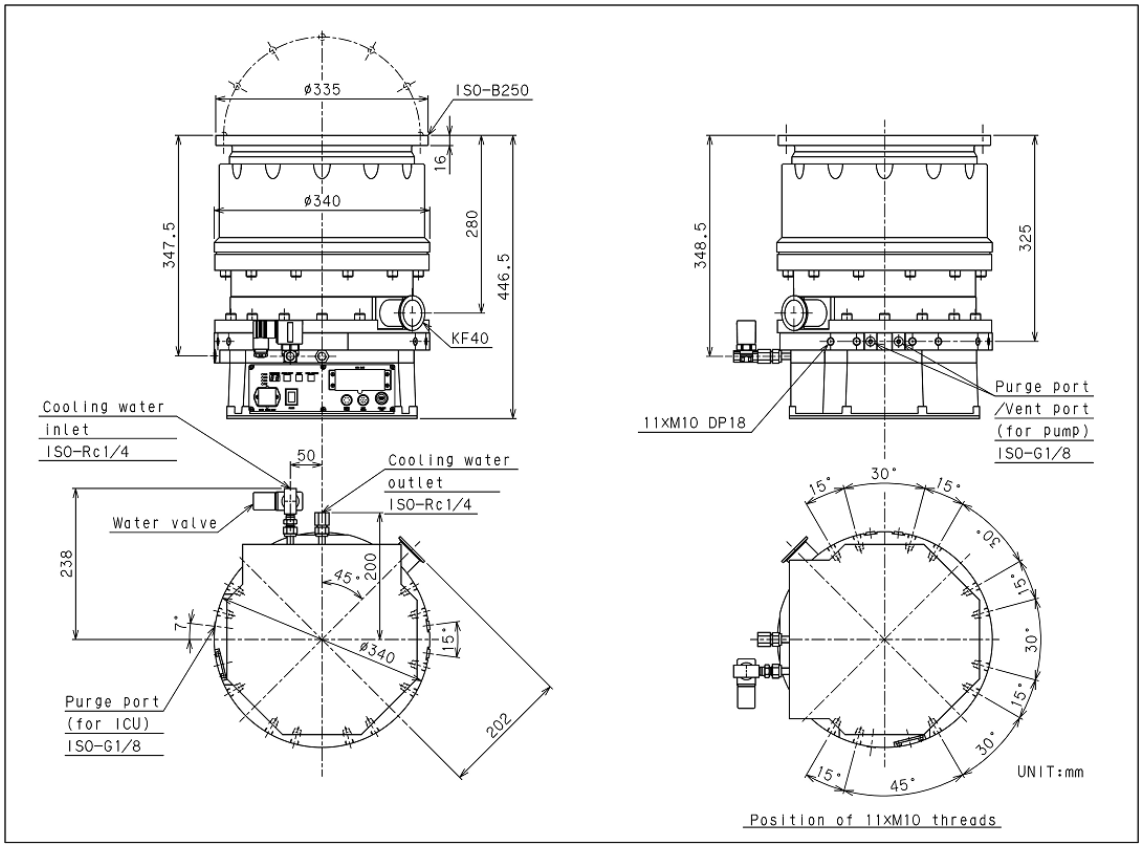


Fig.4 EMT2200MK-B ISO-B250 inlet flange type

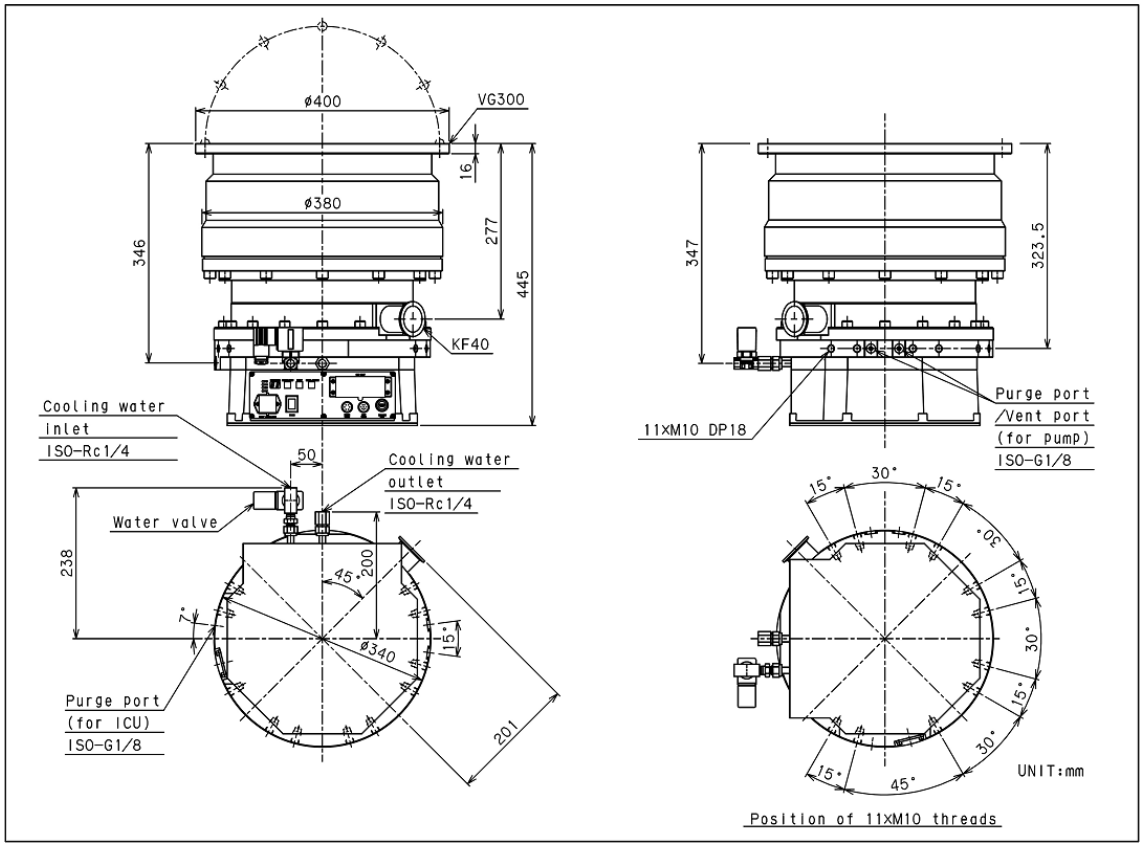


Fig.5 EMT3300MK-B VG300 inlet flange type

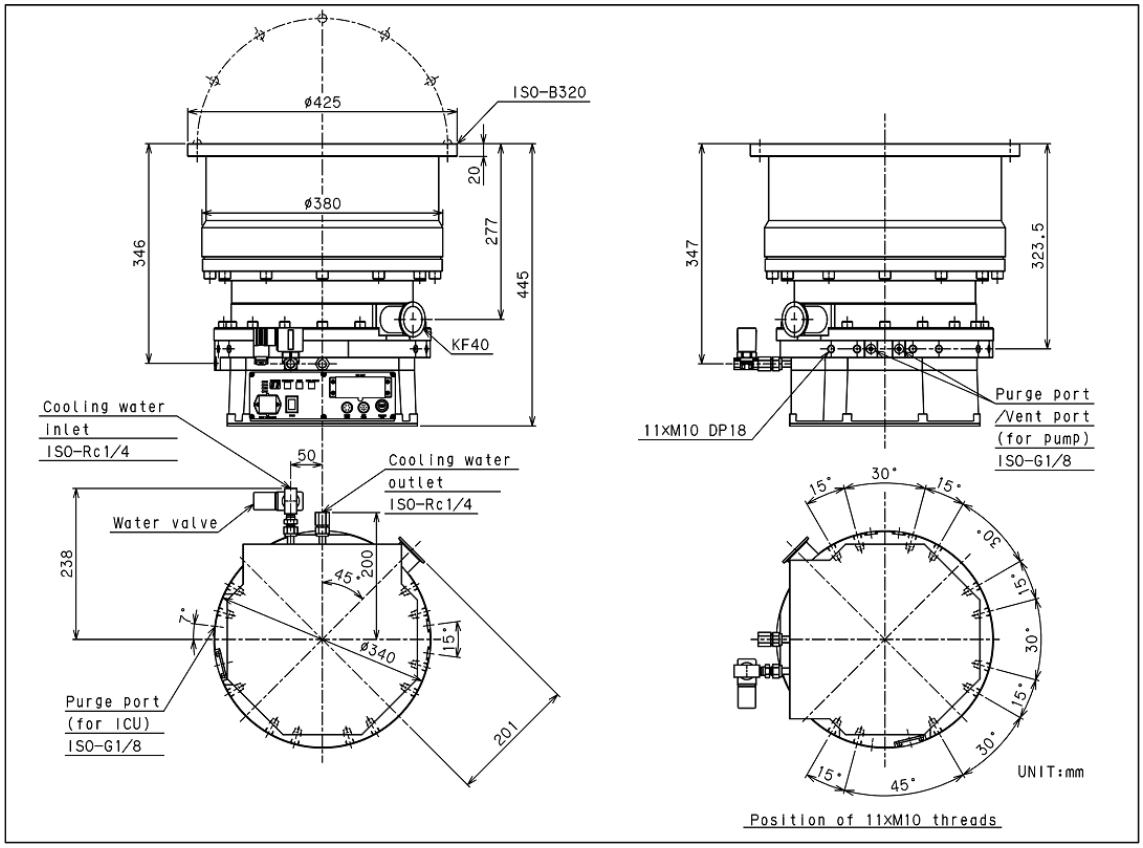


Fig.6 EMT3300MK-B ISO-B320 inlet flange type

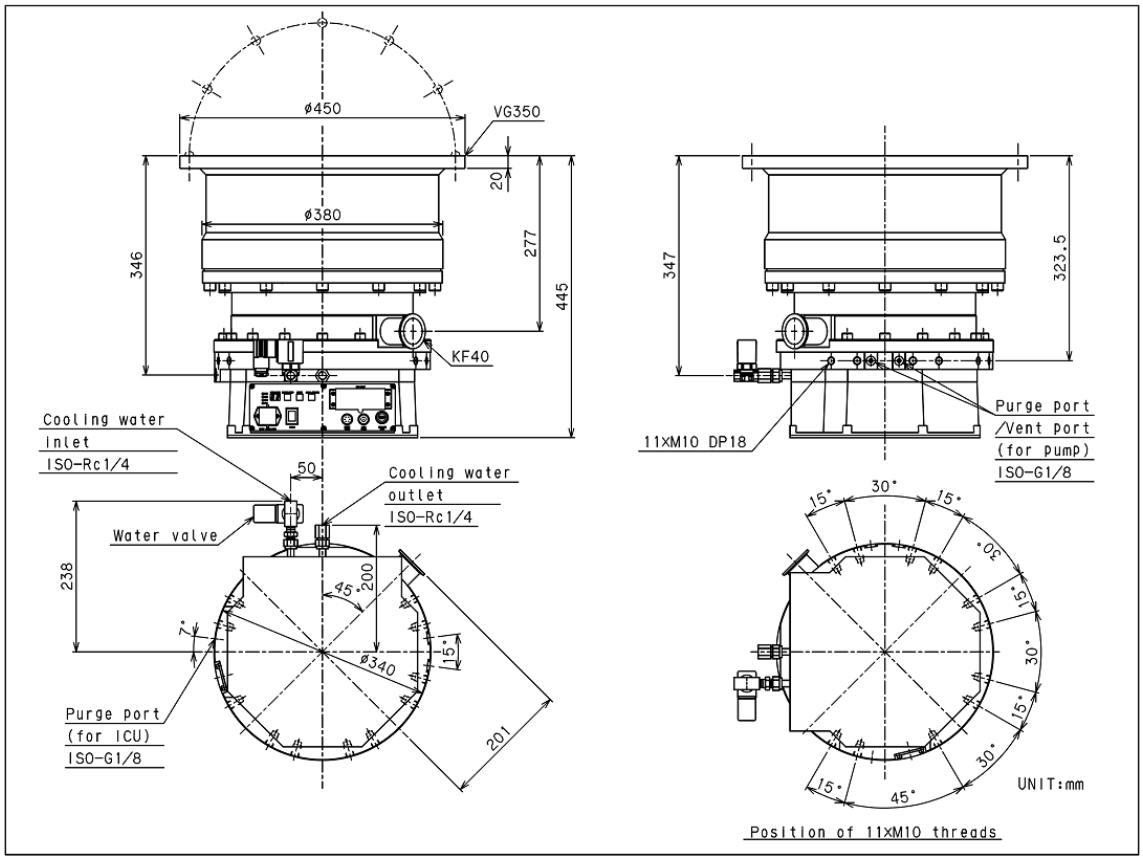


Fig.7 EMT3400MK-B VG350 inlet flange type

3.4 Part Names

The pump parts are named as below.

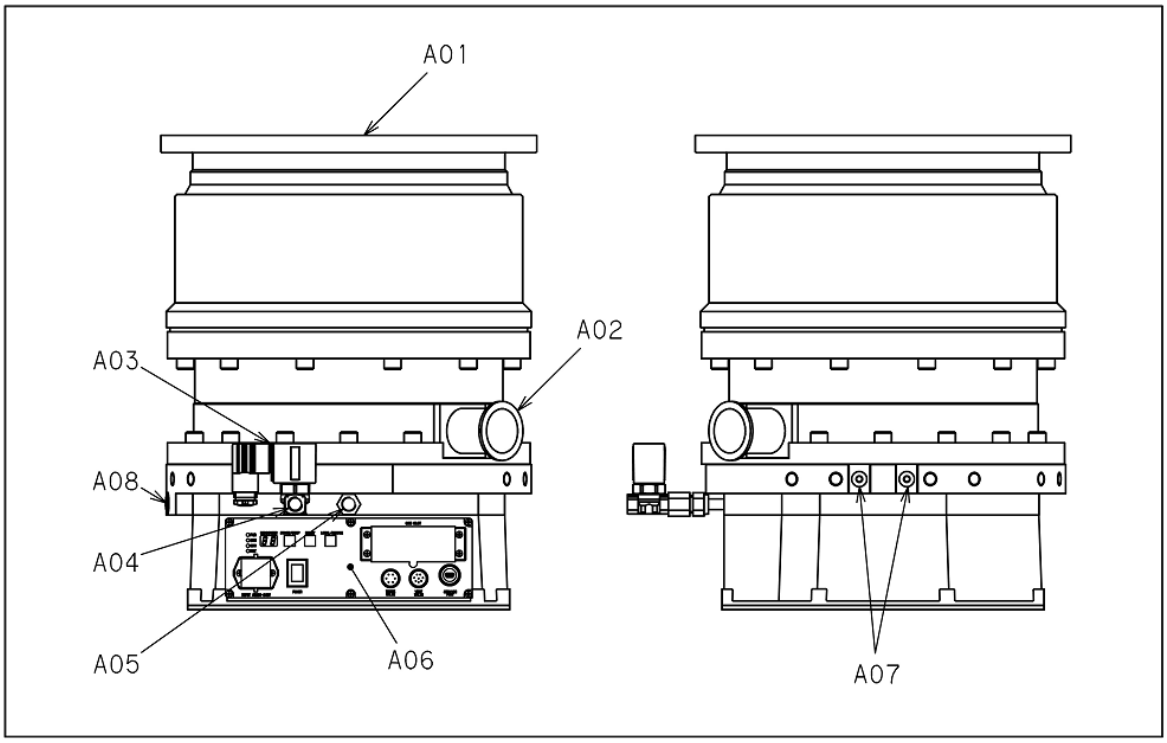


Fig.8 Layout of pump parts

Table1 Functions of pump parts

No.	Name	Function
A01	Inlet port	Connects to the piping in vacuum side.
A02	Outlet port	Connects to backing pump.
A03	Water valve	Controls cooling water supply.
A04	Inlet port of cooling water	Connects to water cooling pipe.
A05	Outlet port of cooling water	Connects to water cooling pipe.
A06	Front panel	Indicating function and cable slot. (Refer to the next page.)
A07	Purge / Vent gas port for the pump	Connects to purge or vent gas pipe for the pump.
A08	Purge gas port for the ICU	Connects to purge gas pipe for the ICU.

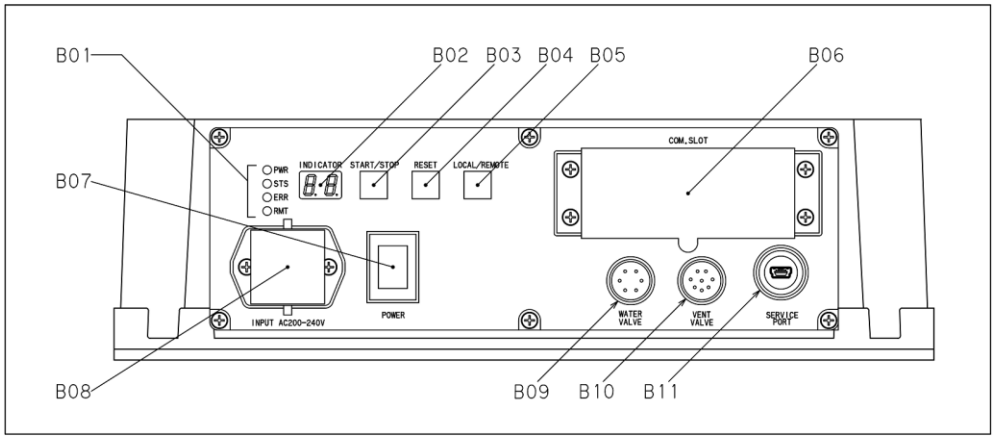


Fig.9 Layout of front panel parts

Table2 Functions of front panel parts

No.	Name		Function
B01	LED	[PWR]	GREEN Becomes lighted, when the power is supplied. (Its light goes out in power failure.)
		[STS]	GREEN Indicates the operation status of the pump. Normal lighted ○ Accelerating blink ◕ Brake blink ◑ Freerun blink ◔ Standby not lighted ●
		[ERR]	RED Becomes lighted when failure is detected.
		[RMT]	GREEN Becomes lighted during REMOTE operation.
B02	7seg. LED x 2	[INDICATOR]	Indicates operating condition and failure details.
B03	Push button	[START/STOP]	Start or stop the pump during local operation.
B04		[RESET]	Reset failure messages / Acknowledge alarm messages.
B05		[LOCAL/REMOTE]	Selects between local operation and remote operation.
B06	Extended slot	[COM.SLOT]	Connect the REMOTE communication cable. It is printed according to the communication method as follows. [RS232], [RS485/422], [Profibus], [PIO-V2] (There is no mark in “Parallel I/O Ver.1”.)
B07	Switch	[POWER]	Supplies and shuts off input power to the pump.
B08	Connector	[INPUT]	Connect the power supply cable.
B09		[WATER VALVE]	Connect the water valve cable.
B10		[VENT VALVE]	Connect the vent valve cable
B11		[SERVICE PORT]	Dedicated for after sales support.

3.5 Labels

WARNING

Follow the instructions on the warning labels at all times.

Failure to follow instructions may result in serious accidents, causing death, a serious injury, and/or the property damage.

CAUTION

If a warning label on the pump becomes illegible or the label peels off, obtain replacement from EBARA Corporation and attach it to the same position.

Illegible labels may lead to an accident.

For our contact information, refer to the end of this manual.

Warning/caution labels are provided to ensure safety during installation, operation, and maintenance of the pump. The positions and contents of these labels and the name plate are detailed below.

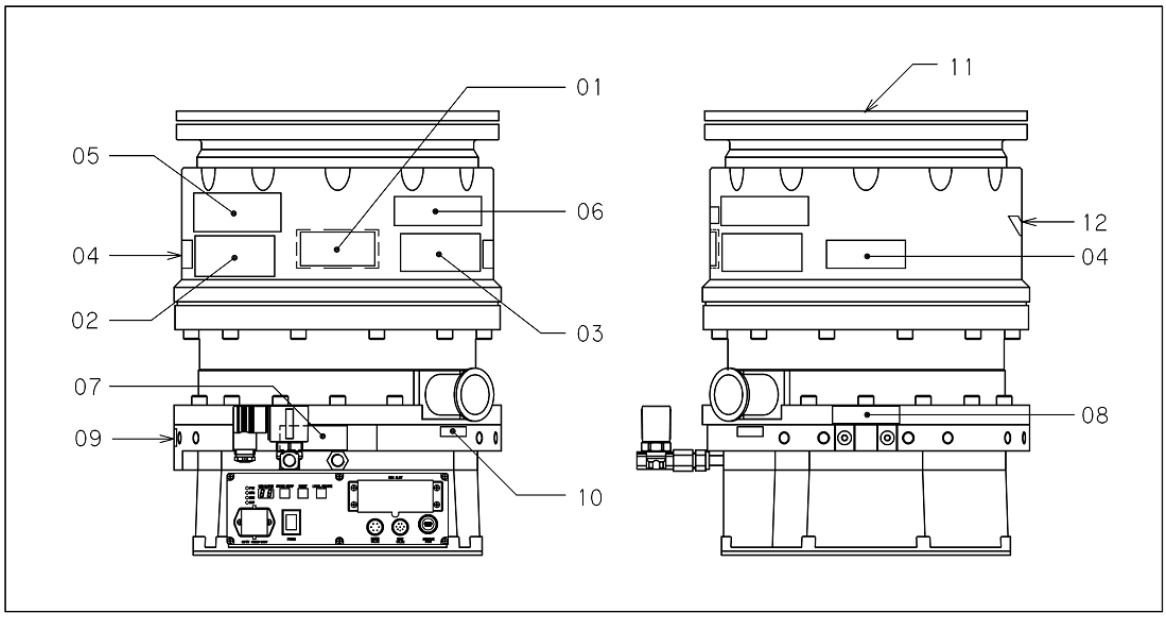


Fig.10-1 Warning Labels and Name Plates EMT2200MK-B

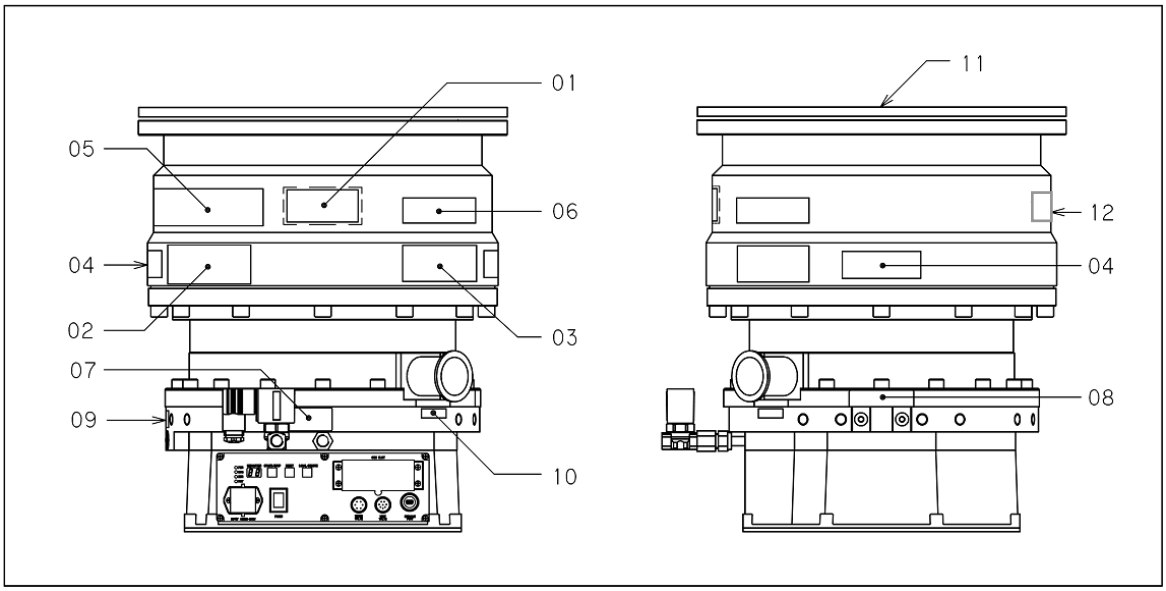
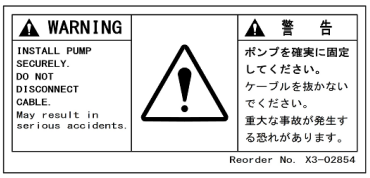
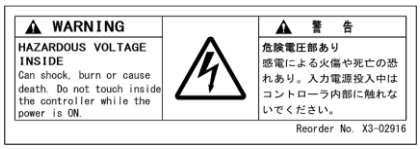
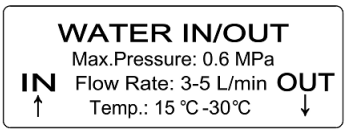
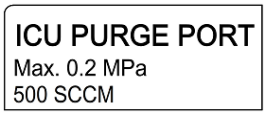
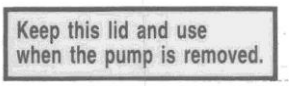


Fig.10-2 Warning Labels and Name Plates EMT3300MK/3400MK-B

Table3 Warning Labels and Name Plates

Number	Label	Content
(01) Name plate	Magnetically Suspended Compound Molecular Pump with Integrated Control Unit Model : EMT3304MKBWB-B Serial No. : 0101 Date : 05-2011 Rot. Speed : 27000 min⁻¹ Direction : ← Input : ~200-240V -15%+10%, 50/60Hz, max. 5.3A SCCR : 5kA Main Doc. : X3-02934 EBARA Corporation Fujisawa Plant 4-2-1 Hon-Fujisawa, Fujisawa 251-8502, Japan MADE IN JAPAN	The items mentioned are as follows; Product type Model: model name Serial No.: serial number Date: the year and month of manufacture Rotation Speed: Maximum Rotational Speed Rotation direction: (clock wise in view of the inlet port) Input: voltage, frequency, maximum current SCCR: short-circuit current rating Main Doc: circuit diagram number Manufacturer and Address
(02) Warning label	⚠ WARNING READ THE INSTRUCTION MANUAL PRIOR TO USE. May result in serious accidents, causing death, serious injury, and/or property damage. ⚠ 警 告 運転前に必ず取扱説明書を読んでください。 重大な事故が発生し人が死亡または重症を負ったり、物的損害を与える恐れがあります。 Reorder No. X3-02907	**Read the instruction manual prior to use.** May result in serious accidents, causing death, serious injury, and/or property damage.

Number	Label	Content
(03) Warning label		**Install pump securely.** **Do not disconnect cable.** If pump isn't secure, or cable is disconnected, it may result in serious accidents.
(04) Warning label		**HOT SURFACE.** Contact may result in severe burns. Do not touch pump surface.
(05) Warning label		**HAZARDOUS VOLTAGE INSIDE** Can shock, burn or cause death. Do not touch inside the controller while the power is ON.
(06) Warning label		**HEAVY OBJECT** The weight of each model is listed.
(07) Caution label		The label indicates the location of water inlet/outlet port. Connect to the cooling water piping.
(08) Caution label		The label indicates the location of purge port/vent port for the pump. Connect to the purge gas piping and/or vent valve/piping for the pump.
(09) Caution label		The label indicates the location of purge port for the ICU. Connect to the purge gas piping for the ICU.
(10) Notice label		The label indicates the location of outlet port. Connect to the exhaust piping and the backing pump.
(11) Notice label		This label is attached on the temporary blank flange for inlet. Keep this flange, and reuse it when the pump is removed from equipments. (E.g. for transportation or storage.)
(12) Trade mark label		EBARA Corporation trademark

4 Pump Installation

4.1 Preparations before Installation

WARNING
For mounting the pump, design the device, frame, mount, floor, and others (Hereinafter these are referred to as the "equipment") so that the pump can be fixed securely pursuant to the Fixture Method indicated in this manual. Failure to follow instructions may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.
Design the equipment so that it can withstand the rapid shutdown torque generated when the rotor burst. (Refer to Table4). If the rotor is clashed during the pump operation, a large torque is generated by rotor breakage, and the whole pump is going to spin by this torque. The insufficient strength of the equipment may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.
Be sure to prepare the bolts of the strength conforming to our designation for the pump fixing. (Refer to Table5 and Table6.) Applying incorrect bolts may result in serious accidents such as a drop or a fall of the pump caused due to insufficient fixing. And it may cause death, a serious injury, and/or the property damage. If the fixing bolts conforming to our designation can't be prepared, consult us prior to mount the pump. For our contact information, refer to the end of this manual.
Do not install the pump at the place that is easily touched to the pump, for avoiding hot surface of the pump. Touching the surface may result in a burn. If you cannot help installing the pump where it is easily touched, it is necessary to guard from the hot surface.

■ Design of the vacuum piping, chamber, and others (vacuum exhaust devices)

Be careful with the following matters for a design of the device which is made a vacuum exhaust.

- For the piping, use the materials with little outgas, such as stainless steel, aluminum alloy, others.
- When designing the piping, take conductance (ease of gas flow) into consideration.
- Minimize the leakage from the piping, the exhaust device, the connecting parts, and others.
- In order to minimize the outgas, degrease and clean the internal surface of the piping and the exhaust device such a chamber.
- For strength of the piping and the exhaust device, consider the rapid shutdown torque generated when rotor burst. (Refer to the next clause “Strength of the installation site (durability to torque and the load)”.)

■ Strength of the installation site (durability to torque and the load)

When designing the equipment (device, frame, mount, floor, others), ensure that it can withstand the rapid shutdown torque generated when the rotor burst. (see Table4.)

In addition, the equipment should be designed so that they can withstand the weight of the pump and secure it firmly.

Table4 Rapid shutdown torque generated when the rotor burst

Pump Model	Rotational Torque [N·m]
EMT2200MK-B	54000
EMT3300MK/3400MK-B	59000

■ Fixing Bolts

When fixing the pump, use bolts that satisfy or exceed the specifications shown in Table5 and Table6. And you should tighten all the bolts securely and evenly.

Table5 Specifications of Fixing Bolts for Inlet Flange

Model	Bolt Quantity x Size	PCD	Bolt Material / Strength Class	Tightening Torque (JIS B 1083)
EMT2200MKB (ISO-B250 flange)	12×M10	310	SCM435 * / Strength class :12.9 (ISO898-1/JIS B 1051)	29 to 38 N·m
EMT2200MKV (VG250 flange)	12×M12	320		46 to 58 N·m
EMT3300MKV (VG300 flange)		370		
EMT3300MKB (ISO-B320 flange)		395		
EMT3400MKV (VG350 flange)		420		

* Chromium molybdenum steel (JIS G 4053)

Table6 Specifications of Fixing Bolts for pump body

Model	Bolt Quantity x Size	PCD	Bolt Material / Strength Class	Tightening Torque (JIS B 1083)
EMT2200MK-B EMT3300MK /3400MK-B	11×M10	340	SCM435 * / Strength class :12.9 (ISO898-1/JIS B 1051)	29 to 38 N·m

* Chromium molybdenum steel (JIS G 4053)

4.2 Mounting Method and Procedure

WARNING	
	**Do not hang the pump above a walkway.** The pump is about 60-70 kg in weight. Failure to follow this instruction may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.
	**When installing or fixing the pump, use a lifter or crane to lift the pump by the eyenut on the inlet flange.** The pump is about 60-70 kg in weight. Failure to follow this instruction may result in serious accidents such as a drop or a fall of the pump. And it may cause death, a serious injury, and/or the property damage.
	**Fix the pump to the equipment securely.** Defective fixing of the pump may result in serious accidents such as a drop or a fall of the pump, during operating the pump, connecting the cable, checking, or maintenance. And it may cause death, a serious injury, and/or the property damage.
	**When mounting the pump, be careful that the equipment does not fall.** If the equipment is unstable, it may result in serious accidents such as a drop or a fall of the pump, during connecting the cable, checking, or maintenance. And it may result in damage of the pump, or an injury.
	**Connect the inlet flange and inlet piping securely.** Defective connection of the piping may result in suffocation by the handling gas or the purge gas leak. And it may cause death, a serious injury, and/or the property damage.

CAUTION	
	**When mounting the pump, be careful that your hands is not trapped by the equipment.** Failure to follow this instruction may result in minor injury.
	**Do not put your hands into the pump.** If putting hands into the pump, the hands may be caught in the rotor. It may result in minor injury.

Do not pollute or damage the sealed surface of the inlet flange, the outlet flange and the other side of each connection. And, do not touch the inside of the pump.

The pump may not perform at its best performance by leak and pollution.

The pump can be mounted in any orientation: upright, inverted, horizontal, or tilted.

Check the Fixing Method in Table7, and fix the pump securely with one of Mounting position (1) to (4).

Table7 Fixing Methods

Model	Inlet flange of the pump connects to	Mounting Position
EMT2200MK-B EMT3300MK /3400MK-B	The equipment or the fitting which can withstand the Rotational Torque in Table4 and the weight of the pump.	(1) Fix at the inlet flange and the body (2) Fix at the inlet flange only
	The equipment or the fitting which cannot withstand the Rotational Torque in Table4 and the weight of the pump.	(3) Fix at the pump body only (4) Fix at the inlet flange and the body

(1) Fix at the inlet flange and the body (Recommended)

The inlet flange is fixed to the equipment, or via a fitting capable of withstanding the rotational torque in Table4.

1. Fix the inlet flange securely to the equipment or the fitting.
2. Fix the pump body securely to the mount.
3. Fix the mount to a solid floor or the equipment identified as rigid structure.

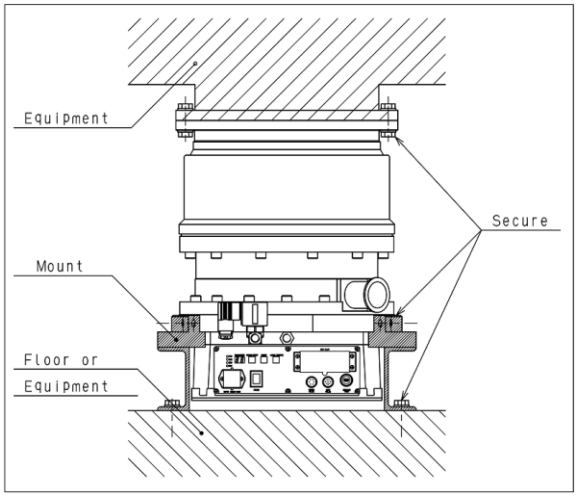


Fig.11 Fixing method (e.g. A)

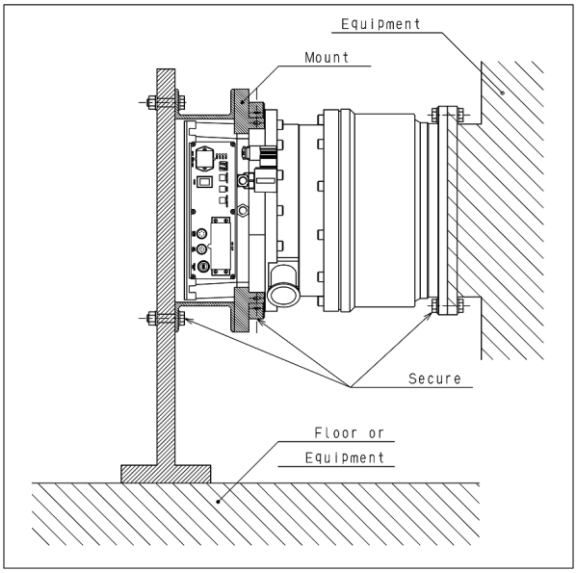


Fig.12 Fixing method (e.g. B)

(2) Fix at the inlet flange only

The inlet flange is fixed directly to the equipment, or via piping capable of withstanding the rotational torque in Table4.

Still, we recommend the additional security measures indicated as follows.

The mount is supported by an adjuster or equivalent, so as to prevent the pump from falling.

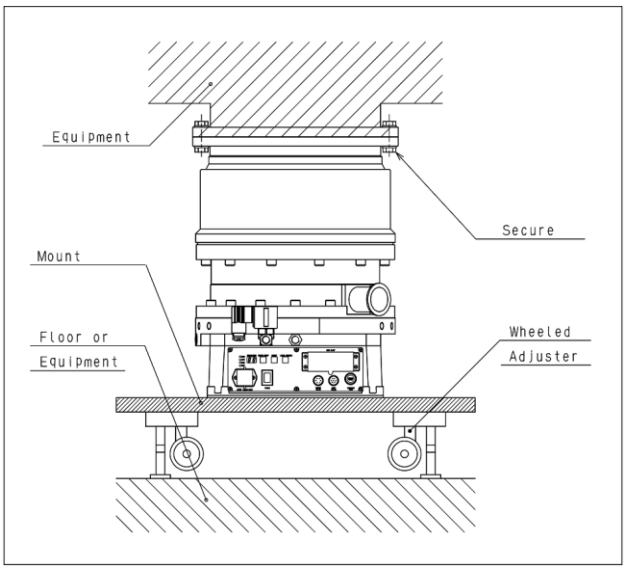


Fig.13 Fixing method (e.g. C)

ATTENTION Secure the enough strength of the Mounts for the inlet flange of the pump so that they will withstand the maximum rotational torque in Table4.

(3) Fix at the pump body only

The inlet flange is secured to the equipment via a connector that cannot independently withstand the rotational torque in Table4. (i.e. bellows, damper, APC)

1. Fix the inlet flange to the equipment or piping.
2. Fix the pump body to the mount.
3. Fix the mount to the floor or the equipment identified as rigid structure.

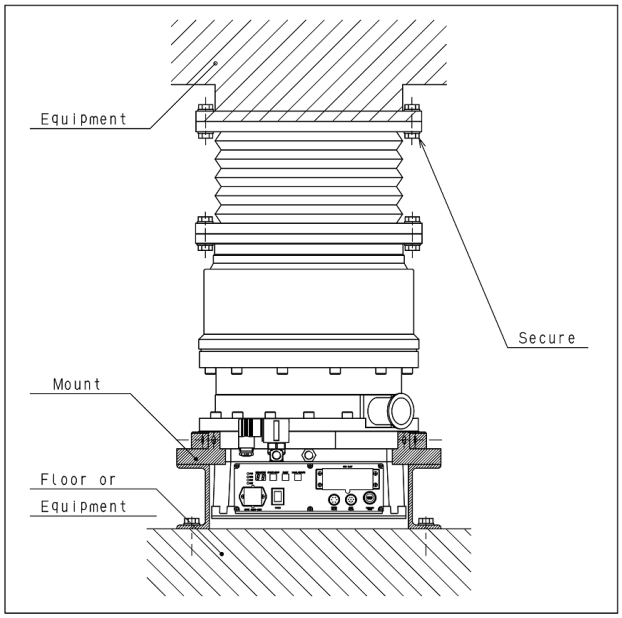


Fig.14 Fixing method (e.g. D)

ATTENTION Secure the enough strength of the Mounts for the body of the pump so that they will withstand the maximum rotational torque in Table4.

(4) Fix at the inlet flange and the body (recommended)

The inlet flange is secured to the equipment via a connector that cannot independently withstand the rotational torque in Table4.

1. Provide two mounts; one is for inlet flange and the other is for pump body.
2. Support the pump with these mounts at two positions respectively.
3. Fix these two mounts securely to the floor or the equipment identified as rigid structure.

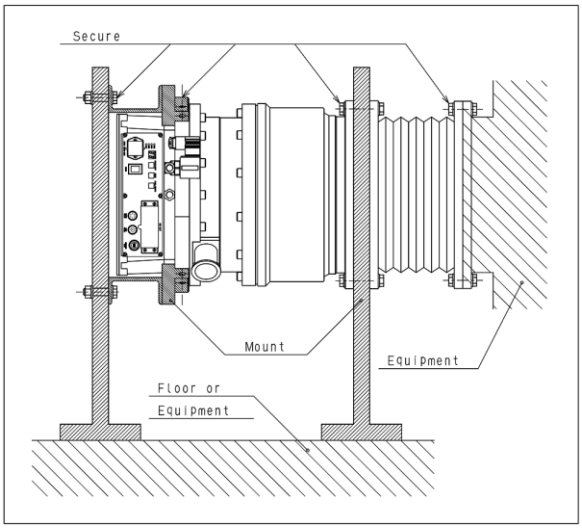


Fig.15 Fixing method (e.g. E)

ATTENTION Secure enough strength of the Mounts at the inlet flange and the body of the pump so that they will withstand the maximum rotational torque in Table4.

4.3 Connecting the Inlet port

Ensure a tight seal between the connections with O-ring or Center ring.

The inlet port of each pump has a groove that keeps the ring in place. Use the suitable O-ring.

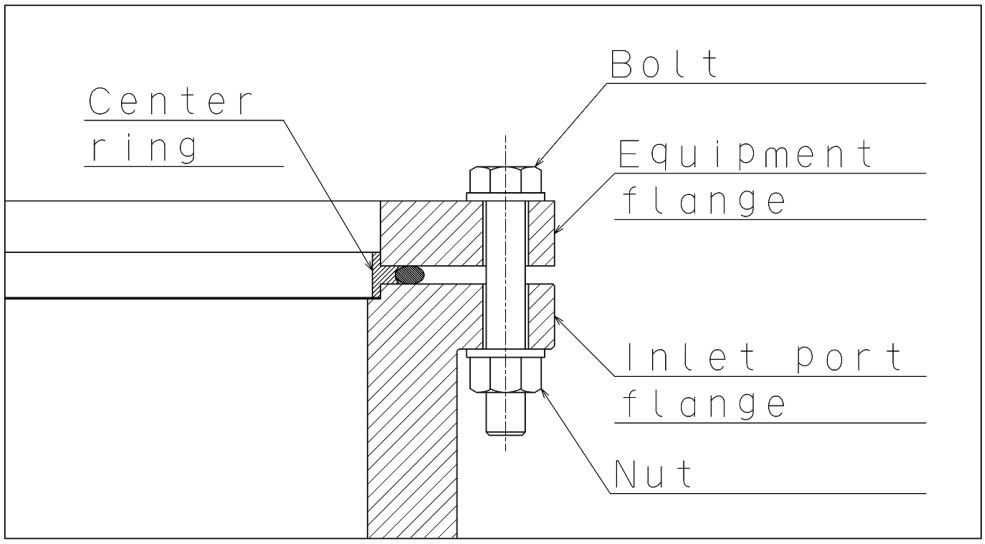


Fig. 16 Connecting Inlet port of ISO-B flange

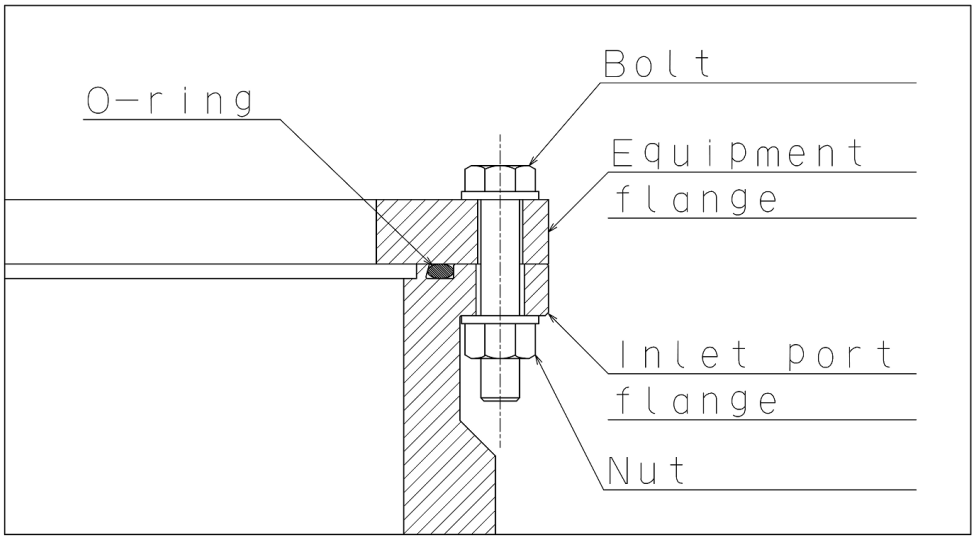


Fig. 17 Connecting Inlet port of VG flange

4.4 Connecting the Exhaust Piping and Backing Pump

■ Backing pump selection

The performance of the pump is affected by the capacity of the backing pump. When selecting the backing pump, refer to Table8, and select a pump that meets the capacity recommendation.

Table8 Recommended backing pump

Model	Recommended backing pump
EMT2200MK-B EMT3300MK/3400MK-B	≥ 2000 L/min

ATTENTION

Use a backing pump with a volume flow rate greater than or equal to the recommended volume flow rate.

If the performance of the backing pump is low or becomes degraded, the pump may not perform at its best.

ATTENTION

Use a trap or other measures to prevent the backstream of oil vapor into the backing pump.

If the pump becomes contaminated by oil vapor, it may not perform at its best.

■ Connecting the Exhaust Piping

- Use the pipe made from stainless steel, aluminum alloy, or the flexible tube.
- The performance of the pump is affected by the conductance of the piping. Minimize the effect of conductance, the piping should be as short as possible, and as large in diameter as possible.
- To prevent the pump from being affected by the vibration of the backing pump, use a flexible tube or bellows.
  Install the pump and the backing pump separately. Or, if installing them on the same mount, take anti-vibration measures.

ATTENTION

Prevent the pump from being affected by the vibration of the backing pump.

If the vibration of the backing pump is strong, it may have bad effects on the magnetic bearing control.

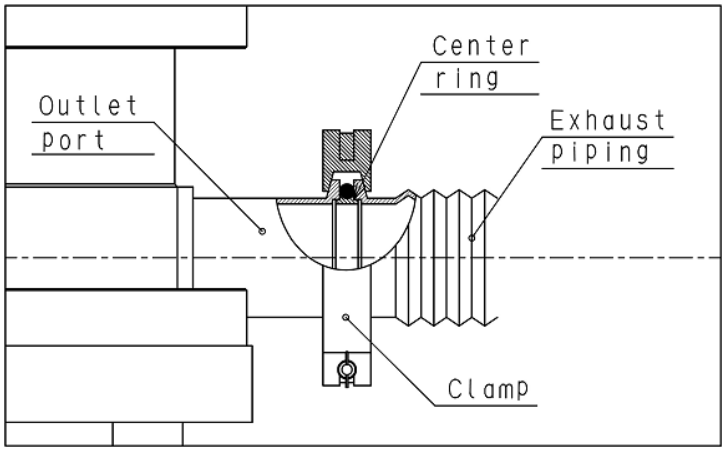


Fig. 18 Connecting the exhaust piping

4.5 Connecting the Vent Gas Piping for the Pump

When the shorter shutdown time is required, be sure to enter the vent gas from the vent port to the inside of the pump.

An example of the vent gas piping is illustrated Fig.19. Vent Gas piping components are optional.

Use inert gases such as nitrogen for the vent gas. Set the vent gas flow rate according to Table9.

When entering the vent gas, check that the pump is braking.

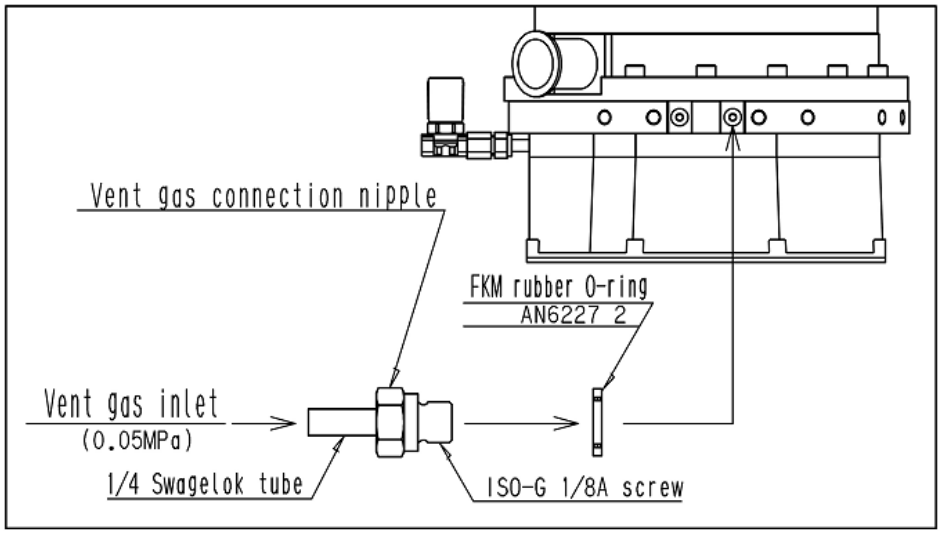


Fig.19 Vent Gas Piping for the pump (Example)

Table9 Permissible vent gas flow rate

Model	Pressure rise rate
EMT2200MK-B EMT3300MK/3400MK-B	$\frac{dp}{dt} \leq 300 \quad Pa/s$

Table10-1 Shutdown time of EMT2200MK-B (Example)

Pump volume	Equipment volume	Total volume	Vent gas flow rate	Pressure rise rate	Shutdown time *
10 L	---	10 L	100 sccm	20 Pa/s	3 min 50 sec
			500 sccm	90 Pa/s	2 min 30 sec
			1000 sccm	180 Pa/s	2 min
10 L	20 L	30 L	1000 sccm	60 Pa/s	2 min 50 sec
			2000 sccm	120 Pa/s	2 min 20 sec
			3000 sccm	180 Pa/s	2 min

Table10-2 Shutdown time of EMT3300MK/3400MK-B (Example)

Pump volume	Equipment volume	Total volume	Vent gas flow rate	Pressure rise rate	Shutdown time *
14 L	---	14 L	100 sccm	10 Pa/s	4 min
			500 sccm	70 Pa/s	2 min 30 sec
			1000 sccm	130 Pa/s	2 min
14 L	40 L	54 L	1000 sccm	30 Pa/s	3 min
			2000 sccm	70 Pa/s	2 min 30 sec
			4000 sccm	130 Pa/s	2 min

* Shutdown time with entering the vent gas (nitrogen) after shifting to brake-operation from rated rotation.

The maximum pressurization into the pump is 0.2 MPa.
If the pressure exceeds 0.2 MPa, it may cause a pump failure.

Do not connect the ICU purge gas piping to the vent port.

4.6 Connecting the Purge gas Piping for the Pump

In case of using gases including reactive gas, corrosive gas, or dust, be sure to enter the purge gas from the purge port to the inside of the pump.

An example of the pas purge piping is illustrated Fig.20. Gas purge piping components are optional. (Primary pressure is 0.05 MPa)

Use inert gases such as nitrogen for the purge gas. Set the purge gas flow rate according to Table11. The gas feed pressure of primary side of the flow rate adjuster (e.g. valve) will follow these specifications. In addition, be careful not to pressurize the pump.

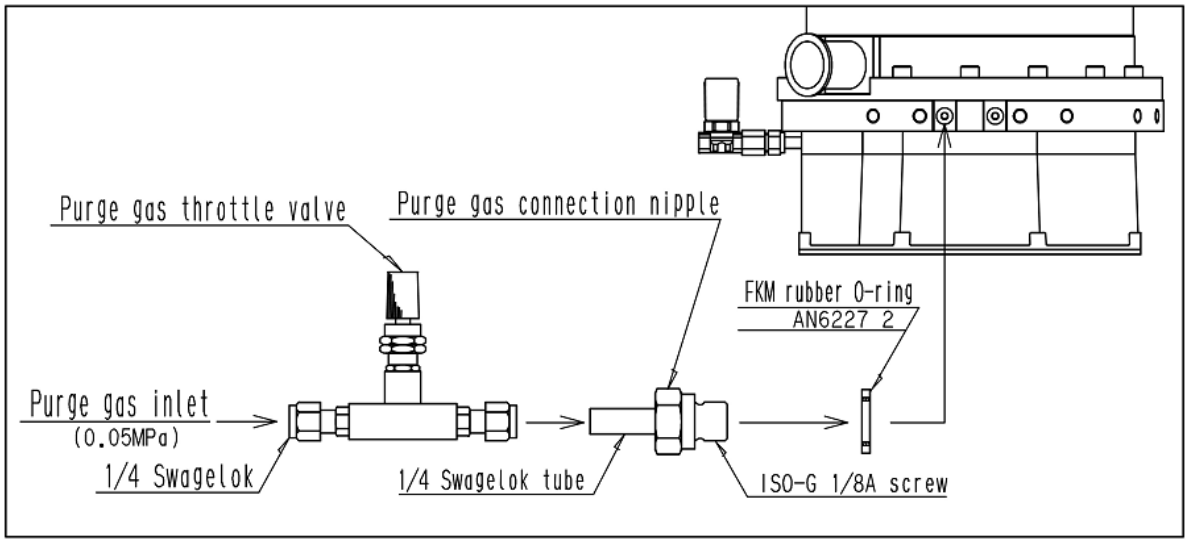


Fig.20 Gas Purge Piping for the pump (Example)

Table11 Specification of purge gas flow rate for the pump

Model	Purge gas flow rate
EMT2200MK-B EMT3300MK/3400MK-B	73.6 Pa·L/sec (40 sccm)

ATTENTION If the flow rate of the purge gas is too small, it will cause pump failure by corrosive gas, reactive gas, or dust.

If the flow rate of the purge gas is too large, it will cause the performance of the pump to become degraded and/or cause pump failure.

ATTENTION If the pump exhausts reactive gas, corrosive gas and dust without the purge gas, it will result in damage of the pump.

ATTENTION The maximum pressurization into the pump is 0.2 MPa.

If the pressure exceeds 0.2 MPa, it may cause a pump failure.

ATTENTION Do not connect the ICU purge gas piping to the purge port for the pump.

4.7 Connecting the Purge Gas Piping for the ICU

The humidity inside the ICU may become high according to the storage environment, or the usage environment. In order to prevent dew condensation, the pump closes the water valve automatically when the internal humidity reaches a limit level.

When the internal humidity rises, even if the water valve is closed, the pump detects the “Condensation Fault” (error code: 50) and stops by the protective function. In that case, be sure to enter the purge gas from the purge port for the ICU.

An example of the gas purge piping is illustrated Fig.21

Set the purge gas flow rate according to Table12.

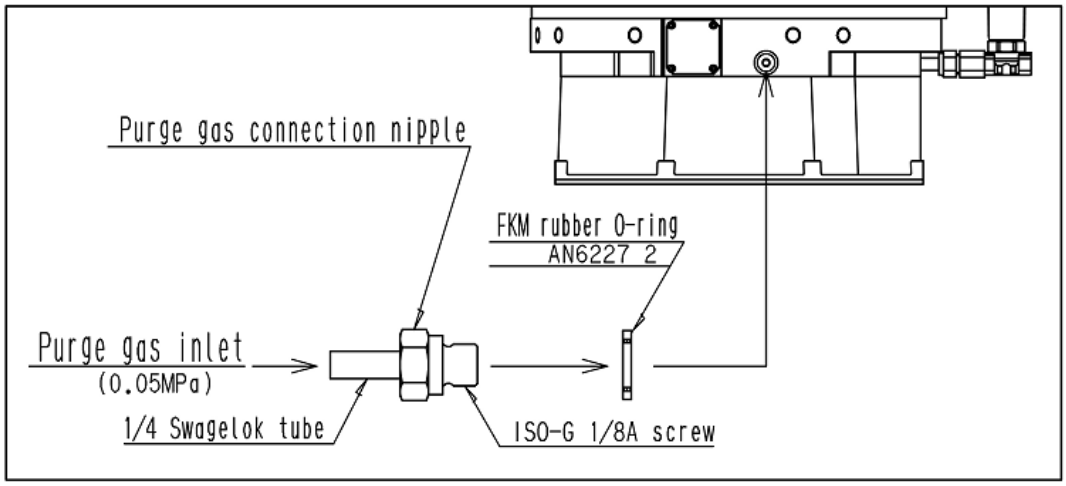


Fig.21 Gas Purge Piping for the ICU (Example)

Table12 Specification of purge gas for the ICU

Model	Purge gas flow rate
EMT2200MK-B EMT3300MK/3400MK-B	920 Pa L/sec (500 sccm)

ATTENTION The maximum pressurization into the ICU is 0.2 MPa.
If the pressure exceeds 0.2 MPa, it may cause a pump failure.

ATTENTION Do not connect the purge or vent gas piping to the ICU purge port.

INFO The purged gas flows out through the gap between ICU, and is emitted to the atmosphere.
The purge gas for the ICU does not have any influence on the pressure in the pump.

INFO Depending on the temperature situation, it may take several hours until the effect of the purge appears.

INFO If Condensation fault recurs, repeat ICU purge.

■ Relations of Water valve controls and pump ambient temperature, humidity, and cooling water temperature, at the standby state

Fig.22 indicates the state of Water valve that will change depending on conditions.

- On the left side of the pump ambient humidity line, the LED of Water valve is on and the cooling water flows through the cooling pipe, because Condensation Fault (Error Code: 50) is not detected usually.
- On the right side of the pump ambient humidity line, the LED of Water valve is off and the cooling water is stopped in order to prevent condensation, because Condensation Fault (Error code: 50) is likely to be detected.

In the case that the ambient of the pump is 30ºC - 80%RH, when the cooling water temperature is 25 ºC or higher, the given zone is on the left side of the line, so the LED of Water valve is on. However, when the cooling water temperature lower than 25 ºC, the given zone is on the right side of the line, so the ICU controls switching of the cooling water flow by Water valve.

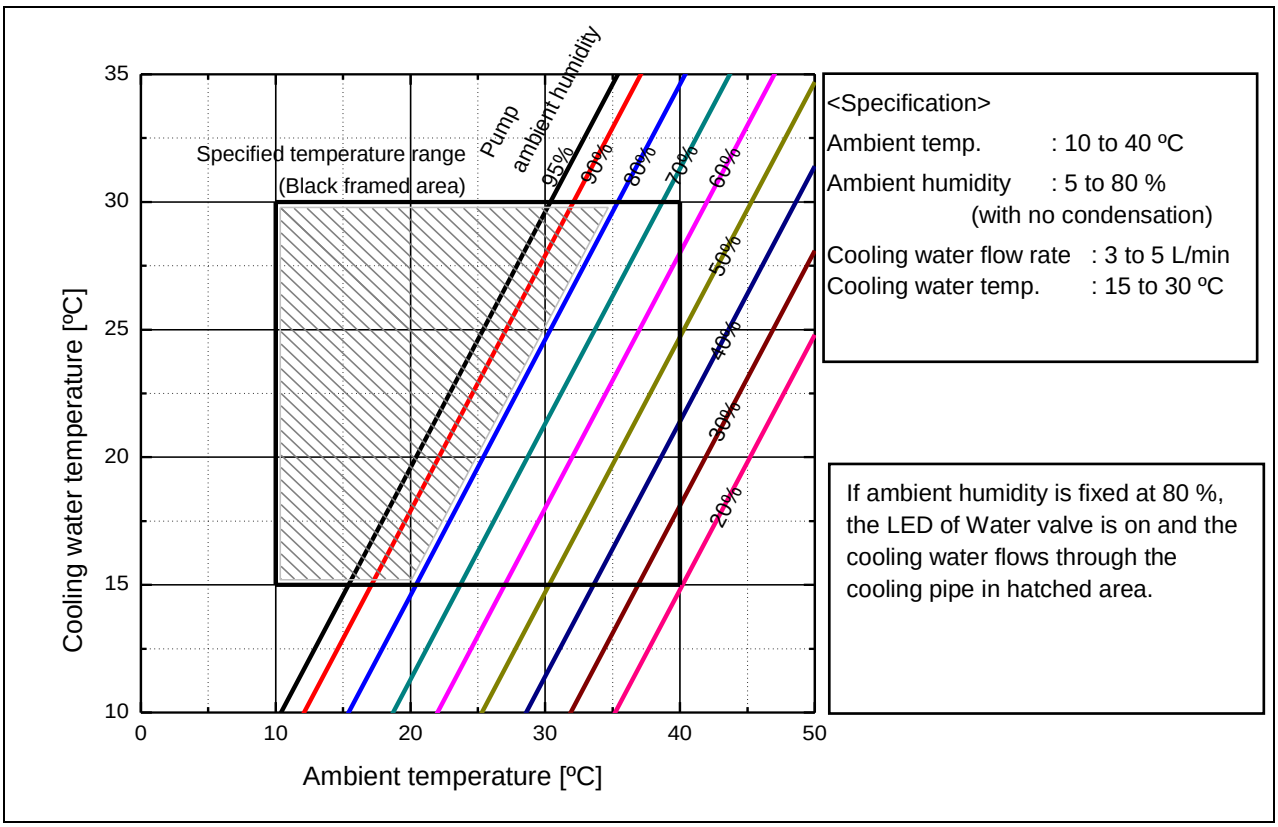


Fig.22 Temperatures and ambient humidity

INFO

When the circuit board temperature in the ICU became higher than specified temperature, the ICU gives priority to the cooling of the circuit board and the cooling water flows through the lower cooling pipe.

In this case, the humidity in the ICU becomes easy to rise, the pump (ICU) may detect the Condensation Fault (Error code: 50).

INFO

Fig.22 is provided under the condition that the dew points inside and outside the ICU are the same.
If the inside dew point is lower than outside dew point, each line will move rightward.
If the inside dew point is higher than outside dew point, each line will move leftward.

4.8 Connecting the Cooling Water Piping

WARNING

Connect the cooling water piping securely so as not to leak the water.
If water leakage occurs, it may result in an electric shock.

CAUTION

Do not exceed upper limit of the cooling water supply pressure.
An excess of the upper limit of the supply pressure of the cooling water may result in burst at the cooling water piping or the connecting part. And it may cause property damage, and/or an injury.

The pump must be cooled during operation.

You have to connect cooling water piping to the pump, and have to flow the cooling water into the piping during operation.

Be sure to follow the requirement of cooling water shown in Table13. Apply the cleanest water available.

Table13 Specification of cooling water

Model	Flow rate	Temperature	Feed pressure
EMT2200MK-B EMT3300MK/3400MK-B	3.0 to 5.0 L/min	15 to 30 ºC (59 to 86 ºF)	≤ 0.6 MPa

ATTENTION

If the cooling function is insufficient, the pump and/or ICU will be damaged due to overheating.

If the cooling function cools off excessively, the pump and/or ICU condenses dew and may short-circuit.

ATTENTION

Do not connect cooling water piping of the pump with any other devices or pumps in series. When the condensation protective function becomes activated, the water valve is closed and the flow of water is stopped.

If necessary, install a bypass pipe loop for connecting other devices.

INFO

While the LED of Water valve is on, the cooling water flows through the cooling pipe.

5 Connecting the Cables

5.1 Preparations before Installation

WARNING	
	**Be sure to confirm that the pump is mounted securely before connecting the cables.** Unstable mounting of the pump may result its drop or tipping over while connecting the cables. And it may cause death, a serious injury, and/or the property damage.
	**Before connecting the cables, ensure that the [POWER] switch of the pump is turned off.** Connecting a cable while the [POWER] switch of the pump is turned on may result in an electric shock.
	**Before opening the cover of each connecter, ensure that water does not leak.** If water leakage occurs, it may result in an electric shock**.**
	**Take note of the minimum bending radius of all cables, and avoid over-bending.** Over-bending of the cable may result in cable damage. In particular, over-bending of the power supply cable may result in an electric shock and/or a fire.

Cable connections for the pump are illustrated in Fig.23.

Following Table14 shows the cable parts required.

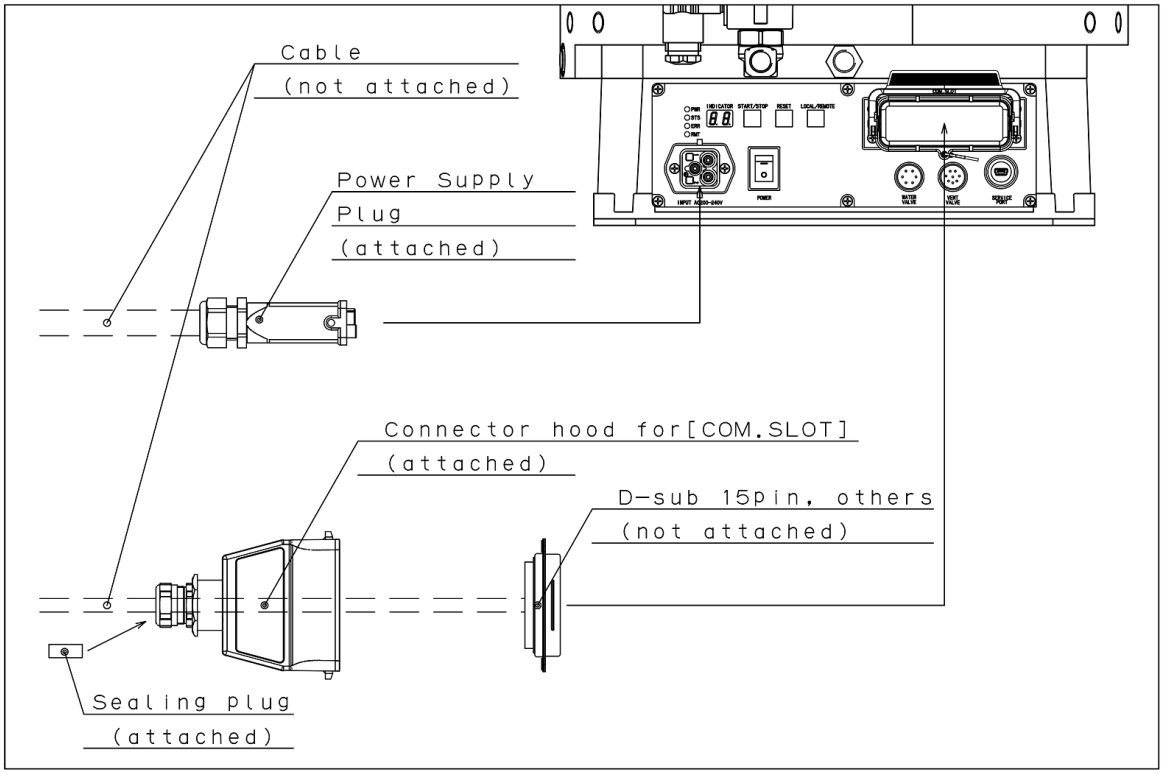


Fig.23 Cable Connections for Pump

Table14 Attached connectors lists

No.	Name	Connector type of the pump side
(1)	power supply plug	HARTING Terminal: 09 12 002 2753 Hood: 19 20 003 0420 Cable entry: 19 00 000 5184
(2)	connector hood for [COM.SLOT]	HARTING Hood: 09 20 016 0441 Reducer: 09 00 000 5066 PFLISCH Single-hole cable entry*: 153d8 HARTING Double-hole cable entry**: HTG153M2X8 Sealing plug: 72BO8.0X20

* Module type: Parallel I/O Ver.1, Parallel I/O Ver.2, RS232C
** Module type: RS485, Profibus

5.2 Power Supply Cable

WARNING

Do not connect the power supply cable to an improper power supply.

Failure to follow the instruction may result in a damage of the pump, an electric shock and/or fires. The supply voltage for the pump is AC200 to 240V, 50 / 60Hz.

Be sure to connect the earth line of the [INPUT] connector to EARTH / GROUND.

Otherwise, an electrical leakage may occur, resulting in an electric shock and/or fires.

Make sure to implement a disconnecting device and an over current protection device for the host equipment.

Otherwise, it may result in serious accidents, causing death, a bodily injury and/or the property damage.

- Cut off the power supply with the disconnecting device and the overcurrent protection device.
- The disconnecting device and the overcurrent protection device should have an ampere interruption capacity of 10000 A or greater.
- The disconnecting device and the overcurrent protection device must be equipped with a lockout device which enables to keep their switch at off position.
- The disconnecting device and the overcurrent protection device, both for indoor use, should be installed in close proximity to the host equipment and within easy reach of the operators so that they shall not be exposed to any danger all the while in their operation.

CAUTION

Assemble the power supply cable properly.

Otherwise, protection rating IP54 may be not applied.

ATTENTION

Use the power supply with small ripple, noise, surges and voltage fluctuation.

ICU does not function normally with unstable power supply.

INFO

Disconnecting device denotes components that are used to cut off a power supply such as circuit breakers, switches, and plugs that comply with the necessary standards.

Overcurrent protection device denotes components that are used to cut off short-circuit and ground-fault currents generated within the host equipment, such as circuit breakers and fuses that comply with the necessary standards.

Some components, such as a circuit breaker with a protection device, offer both functionalities.

INFO

The maximum permissible current rating of the fuse in ICU is 15A.

■ Assembly of power supply cable

Power supply cable is not attached. Please assemble power supply plug of the attachment into the power supply cable.

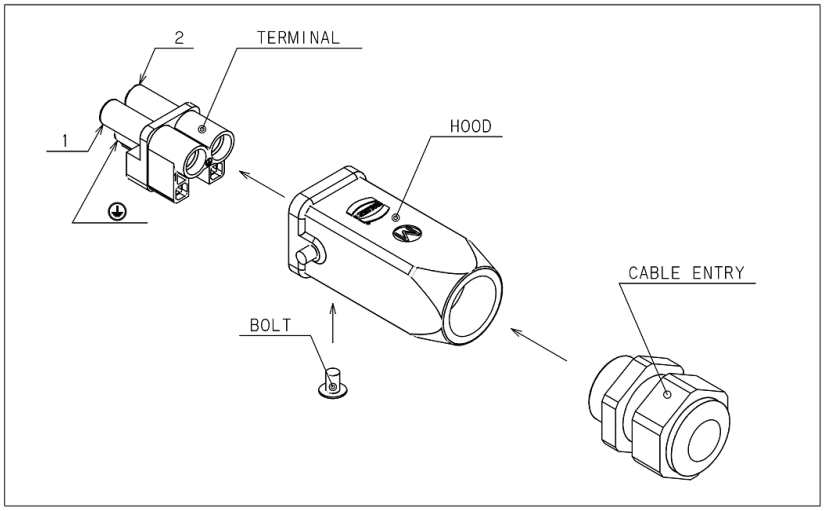


Fig.24 power supply plug assembly

Table15 pin assignment of power supply plug

Terminal Pin	Power supply
1	Single phase AC200 to 240V -15% +10% 50/60Hz, max. 5.9 A
2	
⏚	Ground (Protective Earth)

(1) Selecting cable

Select the power supply cable that complies with required standard.

Recommended specifications are as follows.

- Lead wire type: stranded
- Number of lead wire: 3 (one is for grounding)
- Section area of lead wire(AWG): 2.5 to 6 mm^2 (#14 to 10)
- Outer diameter of sheath: Φ 10 to 14
- Insulation temperature rating: 60 °C (Suitable cable should be selected based on the usage environment)

(2) Connecting wires to the power input plug

(a) Strip back 8 mm of insulation from the end of the wires.

(b) Insert the stripped end into the proper slot of the Terminal. (Refer to the description in Table15 .)

(c) Insert a hexagon wrench (across-flats: 2 mm) from the opposite side of the terminal, and screw it up with the tightening torque of 1.8 Nm so that the wire would be connected firmly to the barrel of the Terminal.

(d) Insert the Terminal and the cable into the Hood, and bolt them firmly together.

(e) Fasten the Cable Entry to the Hood tightly.

■ Connecting power supply cable to the ICU

Connect the power supply plug into the [INPUT] connector of the ICU, and lock the lever on the hood securely.

■ Connecting power supply cable to power supply equipment

Make sure to connect the power supply cable to the power supply via disconnecting device and over current protection device.

5.3 REMOTE Communication Cable

WARNING

Do not connect the hazard voltage circuit to the SELV (Safety Extra Low Voltage) circuit.

Otherwise, it may result in serious accidents, causing death, a serious injury, and/or the property damage.

To operate the pump via parallel or serial communication, connect remote communication cable to the connector of the communication module in [COM.SLOT].

Suitable cable size for cable entry is as follows.

- Outer diameter of sheath for single-hole cable entry: Φ5 to 8
- Outer diameter of sheath for double-hole cable entry: Φ7 to 8

If conformity with IP54 is required, use the Hood, the Reducer and the Cable entry of the attachments.

When using the double-hole cable entry as a single-hole cable entry, stop up the unused hole with the attached sealing plug.

For details of the Remote communication, refer to the "Remote Control Instruction Manual".

ATTENTION

When [COM.SLOT] is not occupied, be sure to attach the Protective cover, and lock the lever on the housing securely.

6 Operation

6.1 Pre-Operation Notes

WARNING	
	**Ensure that the pump is mounted securely.** Unstable mounting of the pump may result in serious accidents such as crashed pump, due to an earthquake, external vibration, vibration of pump itself, others. And it may cause death, a serious injury, and/or the property damage.
	**Before operating the pump, ensure safety around the pump and operation place.** Do not turn on the power supply when the worker is installing, maintaining, or doing something the pump. Otherwise, it may result in serious accidents causing death, a serious injury, and/or the property damage.

There are the following methods for the pump Start-up / Stop.

- Local operation : Operate with [START/STOP] button on the front panel.
- Remote operation : Operate with serial signals or parallel I/O signals through the [COM.SLOT] connector on the front panel.

The operation can perform simply by [START/STOP] button or Start/Stop commands.

Press [LOCAL/REMOTE] button on the front panel to switch the operating mode. Factory setting is Local mode.

When the power supply is turned on, the pump automatically starts the magnetic levitation. Check the following points before operation in order to ensure safety of the pump.

- Ensure that ambient environment of the pump does not have abnormality.
- Ensure that the pump is mounted securely.
- Ensure that all cables are connected securely.
- Ensure that the supply voltage is proper.

If ambient environment of the pump is out of requirement, the pump may be damaged.

If the connection between connector and cable is not tight enough, the pump may not work normally, or it may be damaged.

6.2 Notice during operation

WARNING	
	**During the operation, do not send a large amount of gas/air into the pump.** Failure to follow this instruction may result in damage of the pump.
	**In case of touchdown during the pump operation, do not touch or get close to the pump until the pump completely stops.** In case of touchdown, the rotor is supported by Touchdown bearing while the rotor slows down and stops. Large noise and vibration occur from the pump all the while. The time required from rated rotation to a stop in a vacuum. ● With brake : about 10-12 min.
	**Do not touch the connector during operation.** [INPUT] connector is locally carrying dangerous voltage. Touching the connector with hand or any other body part may result in an electric shock.
	**Do not move the pump and the equipment during operation.** Moving them during operation, may result in serious accidents. And it may cause death, a serious injury, and/or the property damage.

CAUTION	
	**Do not cut off power supply during pump operation, except for emergency stop.** Cutting off power supply during operation may result in damage of the pump.
	**Do not apply an excessive vibration or shock to the pump.** An excessive shock or vibration may cause pump failure.

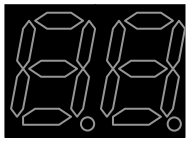
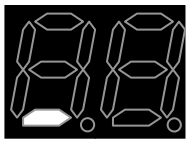
In case that protective function is activated, refer to “9 Troubleshooting”, and solve the problem.

6.3 Local operation

■ Power ON

To turn on the power for the pump, switch on the [POWER] switch on the front panel.

INFO Check that [RMT] LED goes out.

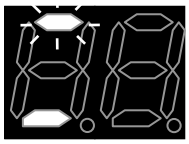
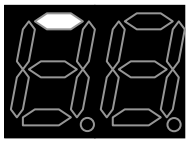
Status	LED	INDICATOR	Description
Power ON	○ **PWR** ● **STS** ● **ERR** ● **RMT**		Self check during approx. 20 seconds.
Standby	○ **PWR** ● **STS** ● **ERR** ● **RMT**		Lift up the rotor. Start to control the water supply with open/close. The pump is ready for operation.

■ Start-up

To start the operation of the pump, press the [START/STOP] button on the front panel.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Start-up	 1 sec.		

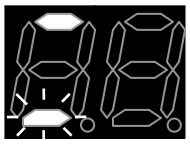
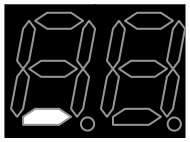
INFO For the preventive measures of miss-operation, the pump does not start-up unless pushing the [START/STOP] button for 1 second or more.

Status	LED	INDICATOR	Description
Accelerating	○ **PWR** ◕ **STS** ● **ERR** ● **RMT**		Pump begins rotation.
Normal Operation	○ **PWR** ○ **STS** ● **ERR** ● **RMT**		The actual rotation speed of the pump reached 90 % of the rated rotational speed.

■ Stop

To stop the operation of the pump, press the [START/STOP] button on the front panel.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Stop	0.3 sec.		

Status	LED	INDICATOR	Description
Brake	○ PWR ◑ STS ● ERR ● RMT		The pump applies the brakes.
Standby	○ PWR ● STS ● ERR ● RMT		The pump stopped rotating completely.

■ Power OFF

To turn off the power for the pump, switch off the [POWER] switch on the front panel.

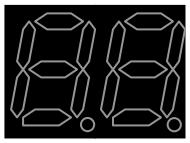
ATTENTION

Do not turn off the power until the pump has stopped completely.

Turning off the power before the pump is stopped may result in pump failure.

The pump is complete stopped if either of the following is true.

- [STS] LED turns off.
- On the [INDICATOR], the flashing lower segment becomes lighted.

Status	LED	INDICATOR	Description
Power OFF	● PWR ● STS ● ERR ● RMT		The rotor falls on the touchdown bearing. The water supply is shut off.

6.4 Remote operation

■ Power ON

To turn on the power for the pump, switch on the [power] switch on the front panel. (Refer to “6.3 Local operation”)

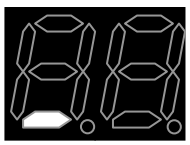
■ Change of Operating mode

For the remote operation, press the [LOCAL/REMOTE] button on the front panel, and then [RMT] LED turns on.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Change of Operating mode			3 sec.

INFO

For the preventive measures of miss-operation, the pump does not change the operating mode unless pushing the [LOCAL/REMOTE] button is pressed for 3 seconds or more.

Status	LED	INDICATOR	Description
Remote mode	○ PWR ● STS ● ERR ○ RMT		The pump is ready for remote operation.

■ Start-up

Refer to the “REMOTE Communication Instruction Manual”.

■ Stop

Refer to the “REMOTE Communication Instruction Manual”.

■ Power OFF

To turn off the power for the pump, switch off the [power] switch on the front panel. (Refer to “6.3 Local operation”)

6.5 Lowspeed mode operation

Intake of reactive gas may cause deposition or adherence of reaction products in the pump. Shutdown or exposure to the air is often required during the maintenance of the pump. But this accelerates rapid chemical reaction in the pump due to temperature drop or increase in humidity. In the worst case, reaction products depositing between the rotor and stator can stop the rotation of the rotor, and even disable the restart function of the pump.

In order to reduce the occurrence of this problem, the pump features Lowspeed mode. When operating with Lowspeed mode, the pump rotor rotate at 10 rps. under the atmospheric pressure.

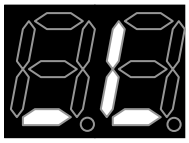
■ How to enable Lowspeed mode

To enable Lowspeed mode, keep pressing [START/STOP] button and [RESET] button for 2 seconds while pressing [LOCAL/REMOTE] button.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Enable Lowspeed mode	(2) 2 sec.	(2) 2 sec.	(1) 2 sec.

ATTENTION

Press these buttons for more than 2 seconds, in order to prevent miss-operaion.

Status	LED	INDICATOR	Description
Enable Lowspeed mode	○ **PWR** ● **STS** ● **ERR** ● **RMT**		Lowspeed mode is enabled.

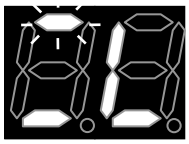
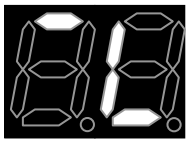
■ Start-up

With the pump at standby status (0rps) in Lowspeed mode, press [START/STOP] switch to accelerate the rotation up to Rated Rotational Speed.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Start-up	1 sec.		

ATTENTION

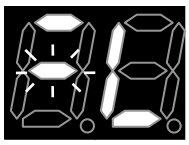
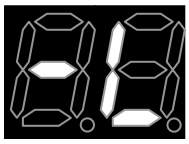
In order to prevent miss-operation, press the button for more than 1 second.

Status	LED	INDICATOR	Description
Accelerating	○ PWR ◕ STS ● ERR ● RMT		Pump starts rotating.
Normal operation (405 to 450rps)	○ PWR ○ STS ● ERR ● RMT		Pump reaches Rated Rotational Speed by exceeding 90% of its value.

■ Lowspeed

Rotational speed is decelerated to the low speed by pressing [START/STOP] button, while the pump is running at 15 rps or faster.

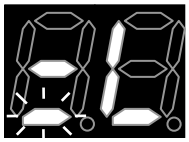
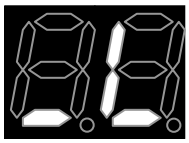
Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Lowspeed operation	 0.3 sec		

Status	LED	INDICATOR	Description
Brake	○ PWR ◑ STS ● ERR ● RMT		The pump applies to the brakes..
Low speed operation (10rps)	○ PWR ○ STS ● ERR ● RMT		The pump will enter Lowspeed running when it slows down to 10 rps.

■ Stop

Pump will decelerate rotating speed to get standby status by pressing [START/STOP] button while operating in Lowspeed mode.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Stop	0.3 sec.		

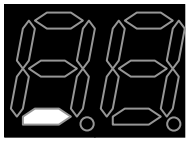
Status	LED	INDICATOR	Description
Brake	○ **PWR** ◑ **STS** ● **ERR** ● **RMT**		The pump applies to the brakes.
Standby	○ **PWR** ● **STS** ● **ERR** ● **RMT**		The pump stopped its rotation completely, and becomes standby status.

■ Disable Lowspeed mode

To disable Lowspeed mode, keep pressing [START/STOP] button and [RESET] button for 2 seconds while pressing [LOCAL/REMOTE] button.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Disable Lowspeed mode	(2) 2 sec.	(2) 2 sec.	(1) 2 sec.

ATTENTION Press these buttons for more than 2 seconds, in order to prevent miss-operation.

Status	LED	INDICATOR	Description
Disable Lowspeed mode	○ **PWR** ● **STS** ● **ERR** ● **RMT**		Lowspeed mode is disabled.

7 Various Operation

7.1 Gas process

While in the operation with processing gas, the throughput in the operation must not exceed the maximum throughput value of the pump.

The maximum throughput of the pump is shown in Table16 .

Table16 Maximum throughput

1 Pa·L/s (25 °C) = 0.543 sccm (0 °C, 1 atm)

Model	Gas	Maximum throughput *
EMT2200MK-B	N_2	8810 Pa·L/s (4400 sccm)
	Ar	4790 Pa·L/s (2600 sccm)
EMT3300MK/3400MK-B	N_2	4610 Pa·L/s (2500 sccm)
	Ar	3690 Pa·L/s (2000 sccm)

* Under the condition that the effective volume flow rate at outlet port is 5000 L/min, cooling water is 20 °C (68 °F), 5 L/min, and the pump is purged with N_2 gas.

In addition, the maximum throughput shall be reduced in the following cases;

- In case that the heat source in the chamber emits heat radiation into the pump.
- In case that heated gas flows into the pump.
- In case of high ambient temperature and/or high cooling water temperature.
- In case of small effective pumping speed of the fore-line.

ATTENTION

In the pump operation with the throughput beyond the maximum limit, the temperature inside of the pump may rise. It will result in short-life, or damage of the pump.

If you expect to exceed the maximum throughput, consult us prior to use. For our contact information, refer to the end of this manual.

7.2 Quick start-up synchronized with the backing pump

The pump and the backing pump can be started simultaneously in the following cases;

- In the case that the chamber capacity is small.
- In the case that the effective pumping speed of the fore-line is large.

If the chamber capacity is extremely large or the effective pumping speed of the fore-line is extremely small, the ICU may detect ”acceleration fault” during acceleration, bringing the pumps to a stop. (”Acceleration fault” is one of the protective functions of the controller.)

In such a case, the chamber should be exhausted by the backing pump before the pump starts (pre-evacuation / rough pumping). Reduce the pressure of the chamber down to maximum backing pressure by pre-evacuation. (As for maximum backing pressure, refer to ”13.1 Specification”.)

7.3 Bake-out

WARNING

Do not touch the pump surface during and just after bake-out.

During and just after bake-out, the pump surface becomes hot. Contact to the pump surface may result in a burn.

You should install the safety guard and display warning so as not to touch the pump surface by mistake during bake-out.

The adsorbed gas can be removed by bake-out, and this improves the ultimate pressure.

If the pump, the vacuum chamber, and/or other parts is heated, check the maximum permissible temperature of them. The temperature of the Inlet flange must not exceed 120 °C (248 °F).

ATTENTION

Do not heat the Inlet flange of the pump excessively while in bake-out.

Otherwise, the O-ring is damaged by heat, and it may result in leakage.

ATTENTION

Do not allow the heat of the chamber to overheat the pump.

The pump may become overheated and fail.

ATTENTION

Do not overheat the chamber so as not to cause leakage from the chamber.

If the leak occurs in a chamber during the pump operation, it may result in the damage of the pump.

INFO

During bake-out, the inlet port pressure can be affected momentarily, but this is not abnormal.

8 Emergency OFF (EMO) System

WARNING

Design the EMO system so that its activation does not cause sudden pressurization in the pump.

Sudden pressurization will cause the pump touchdown, and the pump will be prevented from stopping safety.

CAUTION

After activating the EMO system, do not perform recovery work until the pump has stopped completely.

Power supply is shut off when the EMO system is activated, but the pump will continue to rotate until it is stopped by the protective function.

If power is not restored after that shut off, it will take about 30 min until the pump stops completely.

Completely stop of the pump can be confirmed with display indication after power is restored.

ATTENTION

The start button of the EMO system should be installed within easy reach of the operators so that they shall not be exposed to any danger all the while in their operation.

INFO

The pump is equipped with various protective functions. If an error occurs on the pump, the pump will safely be brought to a stop. (For the protective function, refer to “9 Troubleshooting”.)

INFO

We recommend that Normal-close valves are installed at the Inlet and Outlet port both, because it can suppress the sudden rising of the pump internal pressure at the time of EMO.

EMO system should be designed by customer.

Implement the EMO system so that it can cut off the primary power to the pump.

When the power is cut off, “Mains Fault” will be detected, and the pump will be stopped by the protective function. The EMO system must be designed so that its activation is synchronized with the emergency shutdown system of the equipment. For the ”Mains Fault”, refer to error code:20 of ”9.3 Error Code List” and “9.4 Main power supply fault / Power failure”.

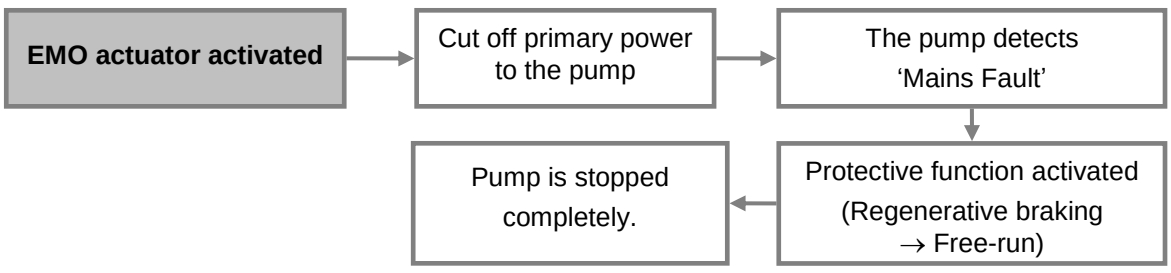


Fig.25 Emergency Off System overview

9 Troubleshooting

9.1 Protective Function

WARNING
If the some error occurs, the ICU may not indicate that the rotor is still rotating. Do not touch the pump or perform recovery work until the pump has stopped completely. In order to stop the pump completely, raise pressure inside the pump.
In case of touchdown during the pump operation, do not touch or get close to the pump until the pump completely stops. In case of touchdown, the rotor is supported by Touchdown bearing while the rotor slows down and stops. Large noise and vibration occur from the pump all the while.
Do not cut off power supply during rotating in case of freerun In case of freerun, the regenerative energy of the motor cannot work. Therefore, if the power supply is cut off, the pump cannot maintain the operation of the magnetic bearing, and then the rotor will touchdown. In that case, the regenerative brake does not work, and so an excessive load is applied to the touchdown bearing. When the rotation speed at such the touchdown is 75 rps or more, the pump detects “Change Safety Bearing” (error code: 94). The time required from rated rotation to a stop - In a vacuum : roughly 10 hours - With vent gas : roughly 10-15 min (In the case of passing 500 sccm of the vent gas when the inlet port and the outlet port are sealed)

The pump is equipped with various protective functions.

If an error occurs on the pump, the pump will stop safely. And the pump indicates a failure by error code displayed in ”INDICATOR”.

Maintenance request shall be displayed with an alarm message. (Maintenance Call as Alarm Function)

When an alarm message is displayed, please confirm alarm contents, and perform Check / Maintenance. (As for Check / Maintenance, refer to “10 Check / Maintenance”.)

Even if an alarm function is activated, the pump can continue operation.

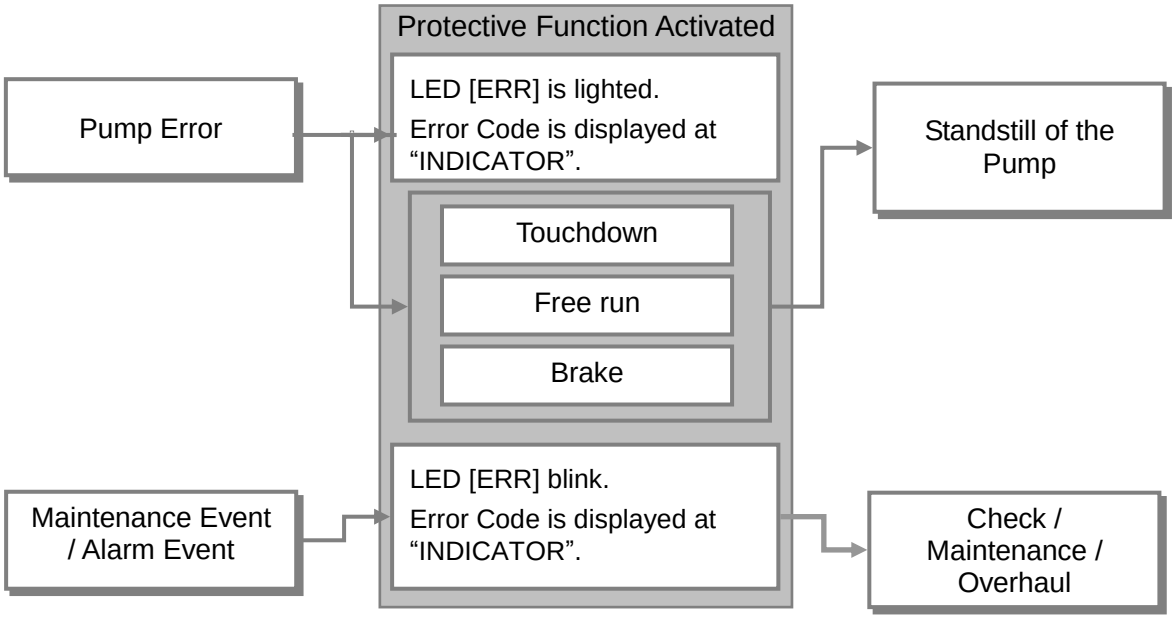


Fig.26 Protective Function Overview

9.2 Reset Method of Protective Function

■ Reset Failure Messages

When the failure occurs, correct the cause of the failure, and reset the failure messages.

To reset failure messages, push [RESET] button on the front panel.

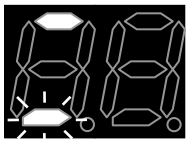
Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Reset failure messages		0.3 sec.	

INFO

This method is applied only during the local mode.
In case of the remote mode, switch to the local mode. The change method is to keep pressing the [LOCAL/REMOTE] button more than 3 seconds.

For the remote operation method, refer to the "Remote Control Instruction Manual".

When the protective function is the brake :

Status	LED	INDICATOR	Description
Brake	○ PWR ◑ STS ● ERR ● RMT		After the failure messages are reset, the pump maintains the brake

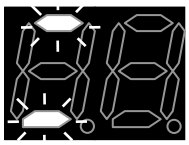
INFO

After the failure messages are reset, the pump maintains the protective function.

To restart the pump, re-input the START command.

- Local operation: Press the [START/STOP] button on the front panel.
- Remote operation: Refer to the “Remote Control Instruction Manual”.

When the protective function is the freerun :

Status	LED	INDICATOR	Description
Freerun	○ PWR ◔ STS ● ERR ● RMT		After the failure messages are reset, the pump maintains the freerun.

ATTENTION

Do not cut off the power supply, even if the failure message cannot be reset.

If the power supply is cut off during freerun, the pump will touchdown and detect “Change Safety Bearing” (error code: 94). If the pump detects “Change Safety Bearing”, the pump will not work without overhaul.
Refer to “9.1 Protective Function” for the touchdown in freerun.

INFO

After the failure messages are reset, the pump maintains the protective function.

To restart the pump, re-input the START command.

- Local operation: If the [START/STOP] button on the front panel is pressed, the pump will apply the brake. If the button is pressed again, the pump will apply the acceleration.
- Remote operation: refer to the “Remote Control Instruction Manual”.

■ Acknowledge Alarm messages

When some alarms occur, make a plan for maintenance. And then, acknowledge the alarm message.

To acknowledge alarm messages, keep pressing [RESET] button for 2 seconds while pressing [LOCAL/REMOTE] button.

Operation	Button		
	[START/STOP]	[RESET]	[LOCAL/REMOTE]
Acknowledge alarm messages		 (2) 2 sec.	 (1) 2 sec.

ATTENTION

This method is applied only during the local mode.
In case of the remote mode, switch to the local mode. The change method is to keep pressing the [LOCAL/REMOTE] button more than 3 seconds.

For the remote operation method, refer to the “Remote Control Instruction Manual”.

ATTENTION

If you keep pressing only [LOCAL/REMOTE] more than 3 seconds, a different function (Change of the Operating Mode) runs.

9.3 Error Code List

If the protective function is activated, confirm the error contents and take appropriate measures.

Error code: 01-69, 90-99 mean FAILURE (Pump Error).

Error code: 80-89 mean ALARM (Maintenance Event / Alarm Event).

ATTENTION

Do not cut off the power supply, even if the failure message cannot be reset.

If the power supply is cut off during freerun, the pump will touchdown and detect “Change Safety Bearing” (error code: 94). If the pump detects “Change Safety Bearing”, the pump will not work without overhaul.
Refer to “9.1 Protective Function” for the touchdown in freerun.

INFO

After the cause of the error has been removed, reset the protective functions. Otherwise, the protective functions cannot be reset or the error is detected again.

INFO

After the failure messages are reset, the pump maintains the protective function.
To restart the pump, re-input the START command.

- Local operation: Press the [START/STOP] button on the front panel.
- Remote operation: refer to the “Remote Control Instruction Manual”.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
01	Over Speed2	Freerun	None *)	Actual rotational speed has exceeded rated rotational speed by + 5% (one of double protection for Overspeed. The other is error code: 04) ● Failure in ICU	Please contact us.
02	Inverter CPU Fault	Freerun	None *)	Failure has occurred in inverter CPU. ● Failure in Inverter	Please contact us.
03	Sensor Fault	Freerun	None *)	Sensor circuit has stopped working in failure. ● Failure in Sensor Circuit (of ICU)	Please contact us.
04	Over Speed	Freerun	Press [RESET]	Actual rotational speed exceeds rated rotational speed by + 3%. (one of double protection for Overspeed. The other is error code: 01) ● Failure in Inverter ● Failure in Rotational Speed Sensor (of Pump) is detected.	Please contact us.

* Do not cut off the power supply, even if the failure message cannot be reset.
When the power supply is cut off during freerun, the rotor will touch down, and then the pump detects “Change Safety Bearing” (error code: 94). If the pump detects “Change Safety Bearing”, the pump will not work without overhaul. Reclose the power supply after the pump completely stop.
Refer to “9.1 Protective Function” for the touchdown in freerun.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
05	Pulse fallout	Freerun	Push [RESET]	Rotational speed picked up by sensor slows down rapidly. ● Failure in Rotational Speed Sensor (of ICU) ● Failure in Rotational Speed Sensor (of Pump) The rotational speed indicated on the display may not correspond with actual rotational speed, since the sensor cannot acquire correct data.	Please contact us.
06	Pulse Conflict	Freerun	Press [RESET]	Accuracy of Rotational Speed Sensor is deteriorated. ● Failure in Rotational Speed Sensor (of ICU) is detected. ● Failure in Rotational Speed Sensor (of Pump) is detected. The rotational speed indicated on the display may not correspond with actual rotational speed, since the sensor cannot acquire correct data.	Please contact us.
07	Brake Resistor Overheat	Freerun	None *)	Braking Resistor is heated excessively. ● Cooling efficiency is not sufficient.	Please check the ambient temperature and the condition of cooling water.
				● Failure in Braking Circuit	Please contact us.

* Do not cut off the power supply, even if the failure message cannot be reset.
When the power supply is cut off during freerun, the rotor will touch down, and then the pump detects “Change Safety Bearing” (error code: 94). If the pump detects “Change Safety Bearing”, the pump will not work without overhaul. Reclose the power supply after the pump completely stop.
Refer to “9.1 Protective Function” for the touchdown in freerun.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
08	DC Bus Overvoltage	Freerun	None *)	Output voltage of Mains circuit is increasing. ● Power Supply voltage is incorrect.	Please check the Power Supply voltage.
				● Failure in Mains circuit ● Failure in Voltage Sensor	Please contact us.
09	Over Current	Freerun	Press [RESET]	Excessive amount of motor current ● Short-circuit or grounding fault in the motor driving circuit. Failure in Current Sensor	Please contact us.
10	Inverter Overheat	Freerun	Press [RESET]	Failures in Inverter (Over Current/Over Heating/ Extreme Loss in Control Voltage for Electromagnets) are detected. ● Cooling water is not sufficient.	Please check the ambient temperature and the status of cooing water.
				Short-circuit or grounding fault in the motor driving circuit. ● Failure in Inverter	Please contact us.
11	Motor Overheat	Freerun	Press [RESET]	Motor temperature rose to the maximum degree. ● Overload or high temperature of intake gas	Please measure the throughput and intake gas temperature.
				● Cooling water is not sufficient.	Please check the ambient temperature and the status of cooing water.
				● Pump is heated excessively.	Please check the condition of bake-out.
				● Pump repeated start and stop too frequently.	Expand the interval between start and stop operations.

* Do not cut off the power supply, even if the failure message cannot be reset.
When the power supply is cut off during freerun, the rotor will touch down, and then the pump detects “Change Safety Bearing” (error code: 94). If the pump detects “Change Safety Bearing”, the pump will not work without overhaul. Reclose the power supply after the pump completely stop.
Refer to “9.1 Protective Function” for the touchdown in freerun.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
12	Brake Fault	Freerun	Press [RESET]	Rotational speed does not slow down normally, while in deceleration. ● Failure in Braking Circuit ● Failure in Rotational Speed Sensor (of ICU) is detected.	Please contact us.
13	Acceleration Fault	Brake	Press [RESET]	Rotational speed does not increase normally, while in acceleration. ● Overload of intake gas	Please check load (pressure, gas flow rate).
				● Small effective pumping speed of the fore-line.	Please check the fore-line.
				● Rotor is stuck with foreign materials or reaction products. ● Failure in Inverter Circuit	Please contact us.
14	Open Phase	Freerun	Press [RESET]	Open phase condition of motor wiring occurred. ● Open phase condition of motor wiring ● Circuit of Inverter is opened. ● The cable between Pump and ICU is disconnected.	Please contact us.
15	Current Sensor Error	Freerun	Press [RESET]	Failure in Motor Current Sensor ● Failure in ICU	Please contact us.
16	Drive Signal Error	Freerun	Press [RESET]	Failure in Inverter Driving Signal ● Failure in ICU	Please contact us.
17	Brake Resistor Thermistor Error	Freerun	Press [RESET]	The thermistor protecting Braking-Resistor is disconnected or short circuited. ● Failure in thermistor of Braking Resistor	Please contact us.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
18-19	-blank-	---	---	---	---
20	Mains Fault	Refer to 9.4	Refer to 9.4	Power Supply voltage goes down.	Please check the Power Supply voltage.
				Fuse in ICU is melted to open the circuit	Please contact us.
21	DSP Fault	Brake	None *)	Failure in DSP controlling Active Magnetic Bearings ● Failure in ICU	Please contact us.
22	PK EEPROM Error	Brake	Press [RESET]	Checksum value indicates that some failure has occurred in the memory installed in the pump. ● Failure in ICU	Please contact us.
23	Control Unit EEPROM Error	Brake	Press [RESET] and then Reclosing power.	Checksum value indicates that some failure has occurred in the memory installed in ICU. ● Failure in ICU	Please contact us.
24	CPU Over voltage	Brake	Press [RESET]	Overvoltage is detected at the internal power supply in ICU. ● Failure in ICU	Please contact us.
25	PK Overvoltage	Brake	Press [RESET]	Overvoltage is detected at the internal power supply for the memory installed in the pump. ● Failure in ICU	Please contact us.
26	DSP Over voltage	Brake	Press [RESET]	Overvoltage is detected at the internal power supply for DSP that controls Active Magnetic Bearings. ● Failure in ICU	Please contact us.

* Do not cut off the power supply, even if the failure message cannot be reset.
When the power supply is cut off during freerun, the rotor will touch down, and then the pump detects “Change Safety Bearing” (error code: 94). If the pump detects “Change Safety Bearing”, the pump will not work without overhaul. Reclose the power supply after the pump completely stop.
Refer to “9.1 Protective Function” for the touchdown in freerun.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
27	Analog Power Over voltage	Brake	Press [RESET]	Overvoltage is detected at the internal power supply for the analog circuit. ● Failure in ICU	Please contact us.
28	Magnet Power Over voltage	Brake	Press [RESET]	Overvoltage is detected at the internal power supply for the amplifier installed for Active Magnetic Bearings. ● Failure in ICU	Please contact us.
29	Power Section Fault	Brake	Press [RESET]	Output voltage of main power supply circuit goes down. ● Fuse in the ICU has melted to open the circuit. ● Failure in main power supply circuit.	Please contact us
30	CPU Under voltage	Brake	Press [RESET]	Internal power supply voltage of ICU goes down. ● Failure in ICU	Please contact us.
31	PK Under voltage	Brake	Press [RESET]	Internal power supply voltage of the memory installed in the pump goes down. ● Failure in ICU	Please contact us.
32	DSP Power Under voltage	Brake	Press [RESET]	Internal power supply voltage of DSP that controls Active Magnetic Bearings goes down. ● Failure in ICU	Please contact us.
33	Analog Power Under voltage	Brake	Press [RESET]	Internal power supply voltage for analog circuit of ICU goes down. ● Failure in ICU	Please contact us.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
34	Magnet Power Under voltage	Brake	Press [RESET]	Internal power supply voltage of amplifier installed for Active Magnetic Bearings goes down. ● Failure in ICU	Please contact us.
35	Valve Power Under voltage	Brake	Press [RESET]	Output voltage for water valve goes down. ● Failure in connecting cable	Check for cable connection.
				● Failure in water valve ● Failure in ICU	Please contact us.
36	PK Communication Error	Brake Walter Valve Close Vent Valve Close	Press [RESET]	Communication with the memory installed in the pump is disrupted. ● Failure in ICU	Please contact us.
37	Inverter Communication Error	Brake	Press [RESET]	Communication with the memory installed in ICU is disrupted. ● Failure in ICU	Please contact us.
38	DSP Communication Error	Brake	Press [RESET]	Communication with DSP, which controls Active Magnetic Bearings and is installed in ICU, is disrupted. ● Failure in ICU	Please contact us.
39	Panel Communication Error	Brake	Press [RESET]	Communication with the panel installed in ICU is disrupted. ● Failure in ICU	Please contact us.
40	Interface module Communication Error	Brake	Press [RESET]	Communication with AnyBus (Profibus) or PLC module, either of which shall be installed in ICU, is failed. ● Failure in ICU	Please contact us.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
41	Unbalance Error	Brake	Press [RESET]	Rotating unbalance has increased to excess. ● The external vibrations affect to the pump.	Please check effect of external vibrations.
				● Reaction products deposits on the surface of the rotor.	Check for reaction products deposition built up at the outlet port. Please contact us for overhauling.
42	Displacement Error	Brake	Press [RESET]	Rotor position is faulty. ● The external vibrations affect to the pump.	Please check effect of external vibrations.
				● Failure in Active Magnetic Bearings	Please contact us.
43	Overload AMB	Brake	Press [RESET]	Active Magnetic Bearings are overloaded. ● Air inrush, overload of intake gas	Check load (pressure, gas flow rate).
				● Rotor is stuck with foreign material or reaction products. ● Failure in displacement sensor ● Failure in amplifier for Active Magnetic Bearings	Please contact us.
44	Motor Temperature Sensor Error	Brake	Press [RESET]	Failure (disconnection/short circuit) is detected in the temperature sensor of the motor. ● Circuit of temperature sensor is open or short circuited.	Please contact us.
45	Control Unit Temperature Sensor Error	Brake	Press [RESET]	Temperature sensor in ICU does not work. ● Failure in temperature sensor	Please contact us.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
46	Control Unit Overheat	Brake	Press [RESET]	Temperature in ICU reached 75 °C or higher. ● Cooling water is not sufficient.	Please check the ambient temperature and the condition of cooling water.
				● Pump is heated excessively.	Please check the conditions of bake-out.
				● Pump repeats start and stop too frequently.	Expand the interval between start and stop operations.
47	Control Unit Overcool	Brake	Press [RESET]	Temperature in ICU goes down to -5 °C or lower. ● Excessive cooling	Please check the ambient temperature and the condition of cooling water.
				● Failure in temperature sensor	Please contact us.
48	PK Overheat	Brake	Press [RESET]	Surface temperature of PK circuit board reached 70 °C or higher. ● Overload gas	Please check the throughput.
				● Cooling water is not sufficient.	Please check the ambient temperature and the condition of cooling water.
				● Pump is heated excessively.	Please check the condition of bake-out.
				● Pump repeats start and stop too frequently.	Expand the interval between start and stop operations.
49	PK Overcool	Brake	Press [RESET]	Surface temperature of PK circuit board goes down to -5 °C or lower. ● Pump is cooled excessively.	Please check the ambient temperature and the condition of cooling water.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
50	Condensation Fault	Brake Water valve closed	Press [RESET]	Condensation has occurred in ICU. ● Pump is cooled excessively.	Please check the ambient temperature and the condition of cooling water.
				● Humid environment.	Please check the ambient temperature and humidity.
51-54	-blank-	---	---	---	---
55	Protection Signal Open	Brake	Press [RESET]	Protection Signal is open-state in the “Parallel I/O Ver.2” of the Remote communication module. (Refer to the “Remote Control Instruction Manual”)	Make the Protection Signal into close-state.
56-69	-blank-	---	---	---	---

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
80	Touch Down Count Alarm	only displayed	Press [LOCAL/REMOTE] + [RESET]	Total number of touchdowns reached alarm level. ● Touchdown count is reached alarm level.	Please contact us for overhauling to replace touchdown bearings. *)
81	Maintenance Alarm	only displayed	Press [LOCAL/REMOTE] + [RESET]	Pump activates an alarm every 40000 hours of its accumulated power-on hours. ● The lifetime of parts and components is ending.	Please prepare for overhauling.
82	Unbalance Alarm	only displayed	None	Rotating unbalance rate has reached warning level. ● Reaction products deposits on the surface of the rotor.	Please check for reaction products deposition built up at the outlet port. Please contact us for overhauling.
83	Motor Temperature Alarm	only displayed	None	Motor temperature reached warning level. ● Overload gas	Please check the throughput.
				● Cooling water is not sufficient.	Please check the ambient temperature and the status of cooing water.
				● Pump is heated excessively.	Please check the condition of bake-out.
				● Pump repeated start and stop too frequently.	Expand the interval between start and stop operations.
84-89	-blank-	---	---	---	---

* When the touchdown count reaches the error level, the pump detects the “Change Safety Bearing” (error code: 94). When the error is detected, the pump cannot be operated any longer without the overhaul of the touchdown bearing. Refer to the “10.3 Touchdown Bearing” for the touchdown count.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
90	Matching Error	Freerun	None *)	Pump and ICU are not compatible. ● Faulty settings	Please contact us.
91	Cable Disconnect	Brake	None *)	Cable connection between pump and ICU is disconnected. ● Internal joints are loosened.	Please contact us.
92	Sensor Tuning Error	Brake	Power off and then Press [RESET] + Reclosing Power	Sensor calibration data is faulty.	Please perform calibration again.
				● Reaction products deposits on the surface of the rotor.	Please check for reaction product deposition built up at the outlet port.
				● Displacement sensor is damaged. ● Touchdown bearings are damaged.	Please contact us.
93	Self Check Error	Brake	None *)	Pump detected failure by performing self check. ● Failure in ICU	Please contact us.
94	Change Safety Bearing (CSB)	Brake	None	Total number of touchdowns has reached the maximum amount. ● Touchdown count is reached the maximum amount. Once this error is reported, pump will not start without replacing touchdown bearings. Indication of error code 80:Safety Bearing Alarm precedes this error code 94. Please perform overhauling regularly.	Please contact us.

* Do not cut off the power supply, even if the failure message cannot be reset.
When the power supply is cut off during freerun, the rotor will touch down, and then the pump detects “Change Safety Bearing” (error code: 94). If the pump detects “Change Safety Bearing”, the pump will not work without overhaul. Reclose the power supply after the pump completely stop.
Refer to “9.1 Protective Function” for the touchdown in freerun.

Error code	Error Name	Protection Behavior	Reset Method	Possible Cause	Solution
95	A/D Converter Fault	Brake	None	Failure in analog-to-digital converter installed in ICU ● Failure in ICU	
96-98	-blank-	---	---	---	---
99	CPU Fault	Brake	None	Failure in CPU installed in ICU is detected. ● Failure in ICU	Please contact us.

9.4 Main power supply fault / Power failure

WARNING

If the main power supply fault / power failure occurs when the pump is running at warning condition or low-speed condition, the INDICATOR may not give any indication that the rotor is still running.

Check the rotation state by turning the power on or hearing the rotation sound.

When the input voltage drops due to power failure, the pump applies the brakes, and maintains its operation by regenerative electric power. Low rotational speed makes the pump unable to generate enough power for operation, and leads the rotor to touchdown.

For implementing EMO system associating with “Mains Fault”, refer to ”8 Emergency OFF (EMO) System”.

Protection behavior of the pump in power failure is illustrated in Fig.27.

ATTENTION When the rotor touchdowns in freerun at 75 rps or higher speed, the maximum number of touchdowns will be counted.

ATTENTION Do not turn the power on/off frequently. Keep the time interval about 1minute.

INFO When power failure occurs, the light of [PWR] LED goes out.

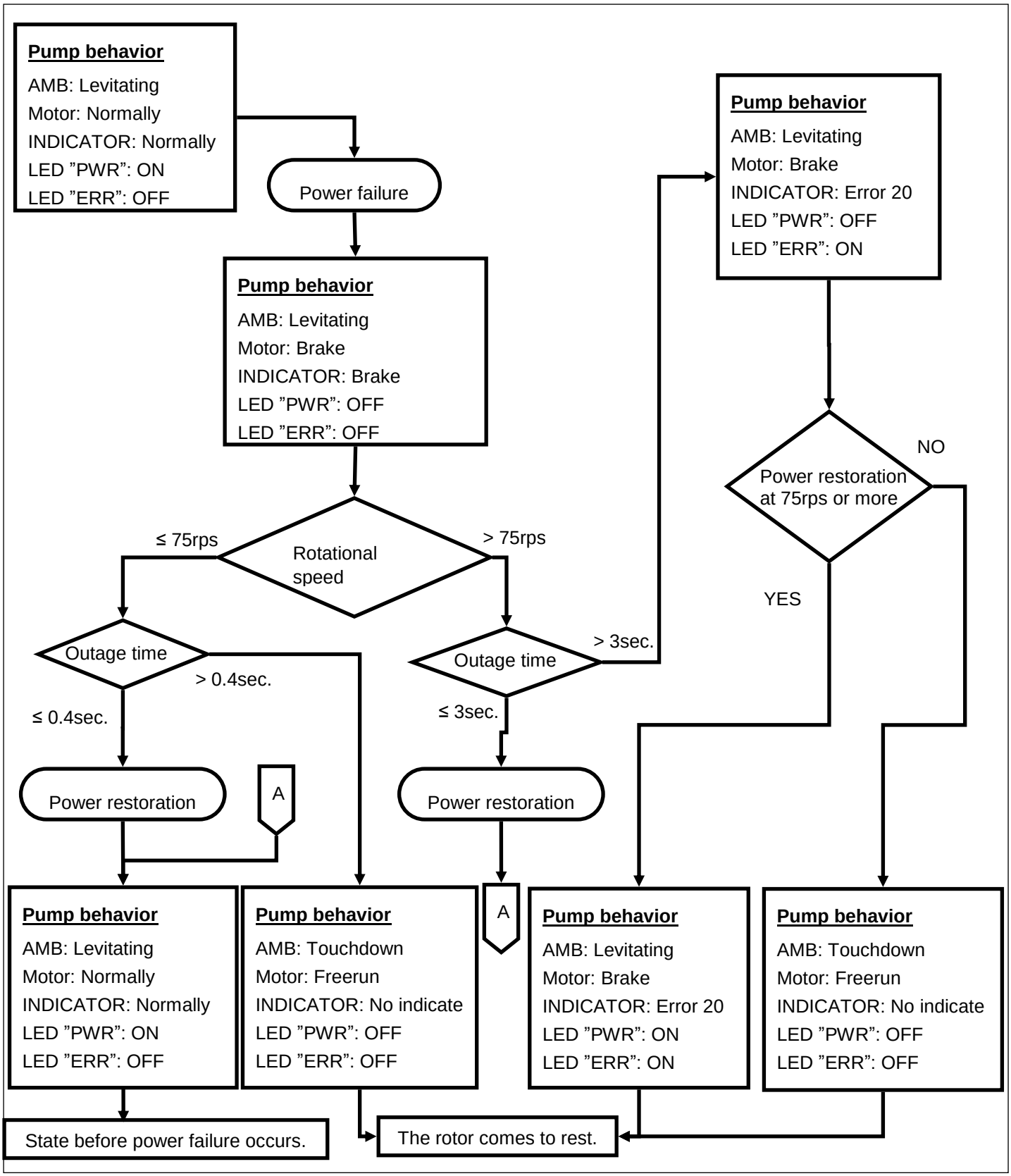


Fig.27 Normal protection behavior against power failure

10 Check / Maintenance

WARNING

Before Check / Maintenance, firstly confirm that the pump completely stops, secondly turn off the [POWER] switch, lastly disconnect the power supply cable.

Otherwise, it may cause an injury, and/or the property damage.

For safety use of the pump, you should perform 'Daily Check' (see "10.1 Daily Check"), keep checking and maintenance on a regular basis as well.

When you check or maintain or remove the pump, be sure to purge the pump of residual gases. For reference, the capacity of the pump is shown in Table17

Table17 Pump Capacity

Model	Capacity
EMT2200MK-B	about 10 L
EMT3300MK/3400MK-B	about 14 L

10.1 Daily Check

WARNING

Do not check the pump other than the maintenance worker.

Otherwise, it may result in accidents, causing an injury, and/or the property damage.

Ensure that the pump is mounted securely.

Unstable mounting of the pump may result in serious accidents such as crashed pump, due to an earthquake, vibration from the outside, vibration of pump itself.

It may result in causing death, a serious injury, and/or the property damage because the pump falls from the equipment and the damaged parts scatters from Inlet vigorously.

Do not fall the tools, the bolts, and/or others, in the pump.

Protective mesh screen is not sufficient to prevent the entrance of all foreign matters.

Do not use the pump when some kind of objects passed through the Protective mesh screen and fell in the pump. If you force the pump to operate, serious trouble happens.

Do not bend Protective mesh screen.

Because Protective mesh screen is not solid, it can be deformed with pressure. Deformed Protective mesh screen may result in pump crashing because it contacts to the rotating rotor.

Make sure to perform 'daily check items' regularly for safety.

- Ensure that the pump is mounted securely.
- Ensure that the Inlet pressure of the pump is not rising.
- Ensure that the Outlet port and/or the Exhaust Piping are not blocked up.
- Ensure that cooling water does not have any problem.
- Ensure that purge gas does not have any problem.
- Ensure that ambient environment of the pump is not abnormal.
- Ensure that all connectors and cables are connected securely.

If the Inlet pressure rises, the pump may be damaged because the inside pressure of the pump rises.

If the Outlet port and/or the Exhaust Piping are blocked up, the pump may not perform at its best performance, or be damaged, because the pressure inside of the pump can rises.

Check for leak Tightness

- Measuring pressure rise after isolating or switching off the pump
- Enveloping the pump or vacuum system with helium gas, and using a mass spectrometer to measure the amount of gas leaking in the system

If the cooling function is insufficient, the pump and/or ICU may be damaged due to overheating.

If the cooling function cools off excessively, the pump and/or ICU condenses dew and may short-circuit..

If the flow rate of the purge gas is too small, it will cause pump failure by corrosive gas, reactive gas, or dust.

If the flow rate of the purge gas is too large, it will cause the performance of the pump to become degraded and/or cause a pump failure.

10.2 Corrosive Gas / Reaction Products

Corrosive gas taken into the pump can cause corrosion inside of the pump. It may be impossible to overhaul the pump, if it is corroded extremely.

If the pump takes (exhausts) reactive gas, reaction products may accumulate or stick inside the pump. This may lead it impossible to operate the pump.

Leaving accumulation and/or adhesion of reaction products may result in corrosion inside of the pump. This situation makes an overhaul merely difficult.

According to the conditions of use, please request overhaul of the pump regularly.

The overhaul interval varies with the conditions of use. Please consult us for details. For our contact information, refer to the end of this manual.

10.3 Touchdown Bearing

When a magnetic bearing error occurs, the rotor touches down. The rotor is supported by the Touchdown bearing as it slows down and stops.

You can continue using the pump after an alarm display is displayed. However, once the touchdown count reaches the error level, the error code ”94:CSB” is detected, and protective function is activated, you will no longer be able to operate the pump. Request the overhaul. For our contact information, refer to the end of this manual.

The error level and the alarm level is listed in Table18.

Table18 Touchdown Count Alarm / Error Level

Model	Alarm level	Error level
EMT2200MK-B EMT3300MK/3400MK-B	4	6

IMPORTANT

According to the conditions of use, please request the overhaul regularly.

The Touchdown Bearing is important part for safety. If there is a trouble, such as a power failure or the magnetic bearing problem, the rotor turning at high speed is supported by Touchdown Bearing until the rotor stops. If the rotor is damaged due to negligence of overhaul, it becomes difficult to repair the pump.

The overhaul interval varies with the conditions of use. Consult us for details. For our contact information, refer to the end of this manual.

10.4 Removal of Pump

WARNING

Before removal of the pump, be sure to confirm the type of the using gas and obtain its SDS from the gas supplier. Take necessary protection measures according to the characteristic of the gas in order to secure the safety of the workers.

Failure to take protection measures may result in serious accidents such as cause death, a serious injury, and/or the property damage.

Wear the suitable ‘personal protective equipment’, such as suits, goggles, gloves, to prevent exposure to the hazardous gas.

If you should be exposed to toxic gas or reactive gas, take appropriate measures immediately, and see a doctor.

Do not pressurize pump more than 0.2 MPa.

If the pressure rises excessively, it may result in serious accidents accompanied with the pump burst or scattering of connection parts. And it may cause death, a serious injury, and/or the property damage.

WARNING	
	**Keep the pump away from flame when removing the pump. And before removal of the pump, be sure to purge the used pump of explosive gas and flammable gas by introducing inert gas such as nitrogen.** Otherwise, it may result in serious accidents such as an explosion or a fire. And it may cause death, a serious injury, and/or the property damage.
	**If the pump has been used to intake (exhaust) of toxic or reactive gas, be sure to purge the pump of these gases by introducing gas such as nitrogen before removal of the pump.** Failure in purging may result in exposure to the hazardous gas, such as toxic gas, or reactive gas. And it may cause serious injury or death. If you should be exposed to toxic gas or reactive gas, take appropriate measures immediately, and see a doctor.
	**Before transporting the pump, be sure to fill the pump with nitrogen or dry air, and completely seal up the Inlet Port, the Outlet Port and the Purge Port.** Failure in this procedure may result in leak of hazardous gas during transportation. And it may cause death, a serious injury, and/or the property damage.
	**Use a crane or a lift with eyenut when you remove the pump.** The pump is about 60-70 kg in weight. If the pump carried by hand, the pump may fall, causing an injury and/or the property damage.

CAUTION	
	**Before removing the fixation parts of the pump, be sure to remove the cables.** If the fixation parts are removed with cables connected, the cables may be pulled by mistake. So it may result in accidents such as a cable break.
	**Do not put your hands in the pump.** Doing so may result in injury.

Do not put foreign objects into the pump.
If foreign objects are put into the pump, it may cause pump damage.

10.5 Request of Overhaul / Maintenance

WARNING	
	**Do not disassemble or modify the pump.** Contact us on the occasion of overhaul and/or repair. When it was found out the pump disassembled or modified, we decline repair and overhaul of the pump.
	**If you request overhaul of the pump, regardless of the kind of handling gas, be sure to specify the kind of handling gas and safety notes on 'inspection order form' as well as on 'the face of the package'.** Otherwise, our employee may be exposed the hazardous gas, such as toxic gas, reactive gas, or the compounds of these gases which remains in the pump. And it may cause our employee's death, serious injury.
	**If you request overhaul, be sure to purge the pump of hazardous gases, such as toxic gas, corrosive gas, explosive gas, flammable gas, reactive gas.** Otherwise, our employee may be exposed the hazardous gas which remains in the pump. And it may cause our employee's death, serious injury..
	**Do not pressurize pump more than 0.2 MPa.** If the pressure rises excessively, it may result in serious accidents accompanied with the pump burst or scattering of connection parts. And it may cause death, a serious injury, and/or the property damage.
	**Use the packing materials with enough strength if you send the pump.** Insufficient strength of packing materials may result in serious accidents, such as a drop or a fall of the pump, due to damage of packing materials during the transportation. And it may cause serious injury, and/or property damage. Use the original packaging or the packaging of equivalent quality, so as not to have the pump be damaged by external force.

Pack the pump firmly.

Inadequate packing may result in pump damage due to external force.

If the pump repeats touchdown for some reason, the pump requires replacement of the Touchdown bearing.

Depending on the conditions of use, replacement of the Touchdown bearing and/or disassembly and cleaning of the entire pump may become necessary. A periodical overhaul is recommended.

If the pump needs to be overhauled or repaired, complete the attached “Inspection Request Form”, and contact EBARA Corporation or one of our service centers. For our contact information, refer to the end of this manual.

When sending your pump, be sure to disclose all gases that the pump was used with. Disclosure is required of all gases, toxic or harmless, reactive or non-reactive. We will not overhaul or repair the pump if the gases are not disclosed.

11 Storage and Disposal

11.1 Storage

WARNING	
	**Before storage of the pump, be sure to purge the pump of hazardous gases, such as toxic gas, corrosive gas, explosive gas, flammable gas, reactive gas.** Remains of such hazardous gas inside of the pump may result in gas leak during storage. And it may cause death, a serious injury, and/or the property damage.
	**Do not expose the inside of the pump to air.** Exposure to air will accelerate the growth of reaction products in the pump, causing pump damage or failure.
	**Be sure to store the pump upright on a flat floor.** The pump weighs about 60-70 kg per unit. Storage of the pump at high or unstable place may result in serious accidents, such as a drop or a fall of the pump, due to vibration or an earthquake. And it may cause death, a serious injury, and/or the property damage.

Do not store the pump in the following locations.

- An area exposed to high temperature and/or high humidity.
- An area in which condensation may occur.
- An area where water may drop.
- An area exposed to direct sunlight.
- An area exposed to reactive, corrosive and/or toxic gas.
- An area exposed to explosive and/or flammable gas.
- An area with a lot of dust.
- An area exposed to a strong electromagnetic field.
- An area with a lot of vibration.
- An area exposed to radiation.
- An area exposed to sea breeze.

Store the pump with the connector covers tightly closed. (Connectors: [INPUT], [WATER VALVE], [VENT VALVE], [SERVCE PORT], [COM.SLOT])

If you are not careful, it may cause damage or trouble of the pump.

For long-term storage of the pump, the remaining cooling water may flow out with compressed air.

For long-term (over several months) storage of the pump, refer to the following instructions.

(1) Close and completely seal the inlet flange.

(2) Discharge any gas remaining in the pump.

(3) Introduce inert gas (i.e. nitrogen) into the pump through the outlet or the purge port.

(4) Close and completely seal the outlet and the purge port.

11.2 Disposal

WARNING
 **Before disposing the pump, take proper measures to discharge any gas remaining in the pump, such as hazardous gas or reaction products.** Remains of hazardous gas or reaction products in the pump may result in serious accidents. And it may cause death, a serious injury, and/or the property damage.

Dispose the pump as an industrial waste, in accordance with national and regional regulations.

12 Spares

Name	Note
Instruction manual	for EMT-K series (This manual)
Remote control instruction manual	for EMT-K series
for inlet port of VG250	
Temporary blank flange	
Protective mesh screen	
Bolt for carriage	SUS304 M12x40
Nut for carriage	SUS304 M12
Eye-nut for carriage	SUS304 M12
O-ring	V275
for inlet port of ISO-B250	
Temporary blank flange	
Protective mesh screen	
Bolt for carriage	SUS304 M10x35
Stud bolt for carriage	SUS304 M10x50
Nut for carriage	SUS304 M10
Eye-nut for carriage	SUS304 M10
Centering ring	for ISO-B250
for inlet port of VG300	
Temporary blank flange	
Protective mesh screen	
Bolt for carriage	SUS304 M12x40
Nut for carriage	SUS304 M12
Eye-nut for carriage	SUS304 M12
O-ring	V325
for inlet port of ISO-B320	
Temporary blank flange	
Protective mesh screen	
Bolt for carriage	SUS304 M12x40
Nut for carriage	SUS304 M12

Eye-nut for carriage	SUS304 M12
Centering ring	for ISO-B320
for inlet port of VG350	
Temporary blank flange	
Protective mesh screen	
Bolt for carriage	SUS304 M12x40
Nut for carriage	SUS304 M12
Eye-nut for carriage	SUS304 M12
O-ring	V380
for outlet port of KF40 / KF50	
Blank flange	
Centering ring	
Clamp	
Power supply plug	
Connector hood for ”COM. slot”	

13 Specification

13.1 Specification

Speciation \ Model		EMT2200MK-B series	EMT3300MK/3400MK-B series
Flange size	Inlet port	VG250 / ISO-B250	VG300 / ISO-B320 / VG350
	Outlet port	KF40 / KF50	
Input Voltage		AC 200 to 240 V	
Voltage fluctuation		-15% +10%	
Phase		Single	
Frequency		50 / 60 Hz	
Current		Max. 5.3 A (at 170V)	Max. 5.9 A (at 170V)
Power		Max. 0.9 kVA	Max. 1.0 kVA
Short-circuit current rating (SCCR)		5 kA	
Overvoltage category (IEC60664-1)		III	
Protection class (IEC60335)		Class I	
Cooling system		Water cooling	
Bearing system		5-axis active magnetic bearing	
Communication interface (selectable)		RS232C , RS485 , Profibus , Parallel I/O ver.1 , Parallel I/O ver.2	
Volume flow rate (without protective screen)	N_2	2200 L/s	3300 L/s
	H_2	1800 L/s	2700 L/s
Maximum compression ratio	N_2	$> 2.0\times10^8$	$> 1.0\times10^8$
	H_2	3×10^3	
Ultimate pressure [1]		$< 2\times10^{-7}$ Pa ($< 1.5\times10^{-9}$ Torr)	
Maximum throughput [2]	N_2	8110 Pa·L/s (4400 sccm)	4610 Pa·L/s (2500 sccm)
	Ar	4790 Pa·L/s (2600 sccm)	3690 Pa·L/s (2000 sccm)
Maximum backing pressure		100 Pa (0.75 Torr)	110 Pa (0.82 Torr)
Maximum continuous running pressure of N_2 gas		220 Pa (1.65 Torr)	170 Pa (1.28 Torr)
Recommended backing pump		≥ 2000 L/min	
Startup time		≤ 10 min	
Shutdown time		≤ 10 min	≤ 12 min
Permissible bake-out temperature at inlet flange		≤ 120 °C (248 °F)	
Vibration (0 to Peak)		≤ 0.01 μm (10 nm)	
Rated rotational speed		$27000\ min^{-1}$	

Speciation \ Model		EMT2200MK-B series	EMT3300MK/3400MK-B series
Mounting orientation		Any	
Cooling water	Required flow rate	3 to 5 L/min	
	Required temperature	15 to 30 °C (59 to 86 °F)	
	Maximum water pressure	0.6 MPa (5 kgf/cm^{2}G, 72.5 psiG)	
Usage environment	Permissible ambient temperature	10 to 40 °C (50 to 104 °F)	
	Relative humidity	5 to 80 % (with no condensation)	
	Pollution degree (IEC60664-1)	2	
Sound power level (L_w)		65 dB	
Protection rating (IEC60529)		IP54 (with the exclusion of inlet and outlet)	
Gas purge flow rate		73.6 Pa·L/s (40 sccm)	
Mass		62 kg	68 kg : VG300 69 kg : ISO-B320 71 kg : VG350

1) Pressure attained after 48 hours of bake-out.

2) Under the condition that the effective volume flow rate at outlet port is 5000 L/min, cooling water is 20 °C , 5 L/min, and the pump is purged with N_2 gas.

13.2 Model Code

Model	EMT	w	0	x	MK	y	W	z	- B	nn

(1) Model : EMT-K series

(2) Pump size
w = 22 : Volume flow rate 2200 L/s (N_2) , 10 inch for inlet port
= 33 : Volume flow rate 3300 L/s (N_2) , 12 inch for inlet port
= 34 : Volume flow rate 3300 L/s (N_2) , 14 inch for inlet port

(3) Outlet port flange
x = 4 : KF40
= 5 : KF50

(4) Bearing system
= MK : Magnetically suspended

(5) Inlet flange
y = B : ISO - B
= V : VG

(6) Cooling system
= W : Water cooling type

(7) Specification type
z = B : Basic type
= C : Corrosion resistant type

(8) Configuration of controller
= - B : Bottom mounted (Omit)

(9) Special specification
nn = numberless : Normal type
= number : Special type **
(** Refer to us for details of specification.)

Contacting EBARA

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