INSTRUCTION MANUAL

MULTI-STAGE DRY VACUUM PUMP

EV-S Series (for 400V)

EV-S20
EV-S50
EV-S100
EV-S200

⚠ **CAUTION**

Read and understand this INSTRUCTION MANUAL thoroughly before using this equipment.

Be sure to keep this INSTRUCTION MANUAL on hand for future reference.

To Facility and Tool Manufactures:

Be sure to distribute this Instruction Manual to all end-user personnel actually operating this equipment.

Date	Contents
2009/5/27	Newly issued
2009/11/17	Revised

ISSUED BY PRECISION MACHINERY COMPANY

EBARA CORPORATION

PM10U

Foreword

Design of EBARA EV-S series DRY VACUUM PUMP is based on superior engineering and long experience. To prevent any possible trouble and provide satisfactory operation and long life, it is important to thoroughly understand this EBARA EV-S series DRY VACUUM PUMP by careful study of this manual. If any questions arise regarding this manual, please direct them to EBARA or your dealer. Your questions will be promptly answered and your suggestion may be considered for incorporation into our future products.

> ⚠ **WARNING**
> Before using this equipment, read this INSTRUCTION MANUAL thoroughly.
> Manufactures warranty will be void, if the EV-S series DRY PUMP has been incorrectly installed, operated or maintained or if it has been modified or repaired with parts not specified by manufacture.
> EBARA is not liable for any injury or damage arising from an individual's carelessness, or misuse.

(1) Limited Warranty

The terms of this Warranty limit the liability of EBARA CORPORATION. Read it carefully.

<Duration>

For new pumps, the Warranty period shall be one (1) year from the date of commencing operation by user or 18 months from shipment by EBARA, whichever comes first. This Warranty does not apply to service beyond these time periods.

For overhauled pumps, the warranty period shall be six (6) months from shipment by EBARA.

<Coverage>

For the duration of the Warranty period EBARA warrants this EV-S pump from failure due to defects in materials or workmanship. For such failures, EBARA will, at its option, either replace or repair the pump free of charge

Such repair or replacement will not extend the duration of the warranty beyond the original period.

For repairs not covered under this Warranty, EBARA will charge the customer for parts and labor.

<Exclusions and Limitations>

This Warranty does not cover the following:

1. Failure due to operating the pump in a manner or under conditions other than as described in the instruction manual.
2. Failure due to corrosion, byproducts or foreign material entering the pump.
3. Failure due to fire, flood, earthquake, Acts or God, Acts of War or other circumstances beyond EBARA's control.

Disassembly or repair of the pump by parties other than EBARA or EBARA-authorized suppliers will void this Warranty.

EBARA's liability is limited to repair or replacement of the pump under Warranty. EBARA accepts no liability for consequential damages, including injury to personnel and damage to facilities, tools or product.

EBARA makes no Warranty of merchanability, beyond statuatory requirements or of fitness for a specific purpose.

(2) Repair and Servicing

Requests for repair or servicing of the pump shall be made to your dealer or to EBARA.

If the pump fails, please contact EBARA or an authorized Agent/Distributor and provide the information on the nameplate and details of the problem.

EBARA cannot accept responsibility for unauthorized returns.

If you have any other inquiries about the pump, please contact EBARA.

(3) EV-S Pump Applications

1. Intended application for EV-S Series dry pumps is supporting semiconductor or LCD manufacturing tools--pumping either load locks or light duty processes, i.e. gas mixtures that do not generate byproducts that might deposit in the pump.
2. When purchasing this pump for any other purpose except the above, contact EBARA beforehand.
3. After purchase, before changing a pump application to a purpose other than as described above, check with EBARA.

(4) Safety Notice

It is essential that those operating this pump should have the knowledge to identify and avoid hazardous conditions associated with the pump. Inadequate or rash operation may cause dangerous and serious accidents. Before installation and operation, the operator should first have a good knowledge of the pump construction, operation procedure, and its hazards. The operator should read through this instruction manual and other documents issued by EBARA in detail.

The following symbols are used to highlight important information and instructions that must be followed to prevent personal injury or damage to equipment. Please study the symbols carefully so that the meaning of any warning you encounter is immediately clear.

⚠ **DANGER** : indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ **WARNING** : indicates a potentially hazardous situation which, if not avoided, could result in death or serious situation.

⚠ **CAUTION** : indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or possible damage to the equipment or machine.

Note : is used to call attention or to emphasize essential information.

Precautions necessary for safe use of the EBARA EV-S series DRY VACUUM PUMP are detailed in this instruction manual, while important items concerning precautions for handling EBARA EV-S series DRY VACUUM PUMPare listed below.

⚠ **DANGER**

- Be sure to keep the power supply to the pump turned off and lock-outed until you have finished the wiring and connecting work.
- Keep out from under the pump when lifted.

⚠ WARNING

- For lifting the pump, use only qualified operator personnel. Be sure that the wire rope and crane used for lifting the pump are in proper order and match the weight of the pump. To prevent unequal weight distribution, suspend the pump by ensuring that the slinging angle remains symmetrically centered.
- Be careful not to overturn the pump when pushing and pulling it sideways, because the width of the pump is small to its height.
- Be sure to check for leaks after you have installed the pump. Leaks will cause serious danger due to the discharge of harmful and hazardous substances and the occurrence of unpredictable reactions associated with the admission of air into the pump.
- The pump casing, inlet piping and exhaust piping become extremely hot during operation and for some time after stopping. Be sure that pump and exhaust piping do not come in contact with humans or inflammable substances. Do not remove the pump cover during operation.
- Electrical wireing shall be carried out only by qualified electricians.
- Be sure to connect the grounding wire.
- The pump and exhaust piping will remain at a high temperature during operation and for a short time after the pump has stopped. Be sure to avoid contact and keep inflammable substances out of reach. Do not remove the outer cover during operation.
- Maintenance on the vacuum and exhaust piping shall be performed by taking proper action to avoid the dispersion of inflammable, toxic and/or hazardous substances and to prevent physical contact with, and absorption of, these substances.
- ELB (or CB) is not installed in the pump unit. Please install ELB(or CB) based on the law and the standard in the installation region.
- Do not perform a withstand voltage test. Failure to comply could result in damage to the sensitive devices.
- Be sure to purge with N2 gas in order to prevent corrosion and reduce the formation / deposition of reaction by-products in the pump. When inflammable and/or toxic gases are diluted with N2 to the safe concentration, be sure to maintain a separate supply of N2 gas to the pump exhaust pipe.
- When the pump has been used for exhausting highly toxic gases such as arsenic and mercury compounds, be sure to contact EBARA Corporation before you return the pump.
- Follow the procedures in Section 2.4, Utility Disconnection, before disconnecting any lines or cables attached to the pump or performing any maintenance or repair operations.

⚠ CAUTION

- The neck portion of the casters will vibrate during caster movement. Be sure to keep your fingers and feet out.
- Do not step on the pump or place objects on it.
- The exhaust piping made by polyvinyl chloride causes the noise thrugh the pipe.
- Even when the cooling water flow rate drops, the pump will continue to operate until the pump part reach a temperature corresponding to the safety limit. The material selected for the water piping of facility side should have a heat resistance so that it can withstand a maximum temperature of at least 70℃ at the operating pressure.
- When the cooling water supply is left on while the pump is stationary dew condensation will form on the water-cooled parts in locations with high humidity. Make it a rule therefore to stop the cooling water when water droplets can be detected on the outer surface of the pump cooling water piping as this suggests the possibility of dew condensation in the pump.
- Do not apply the power supply from the pump's power pack to any other equipment as this will result in malfunctioning of the control units and in pump failure.
- Use the correct wiring materials and size to match the operating conditions in accordance with the power consumption rating and ambient air temperature of the pump.
- Without sufficient cooling water, the pump temperature will rise and problems such as rotor contact will occur.
- Abrupt rotation of the pressure adjustment knob will cause the pressure indicator needle of the regulator to wobble and result in an inaccurate pressure display.
- Unless a sufficient supply of N2 gas is maintained, serious problems will occur such as pump corrosion and accretion of reaction by-products.
- When the production process leads to react by-products in the pump or when the process handles corrosive gases, be sure not to stop the pump until after at least 30 minutes of stopping the process gases.
- Process gases will remain in the vacuum pipes and the pump even after the pump has been stopped. Be sure therefore to purge for at least 1 hour after the pumps has been stopped. Do not discontinue the N2 purge when the pump is stopped only for a short time.
- The pump will remain at a very high temperature event after it has been stopped. Be sure therefore to leave the cooling water on for about 1 hour after the pump has been stopped.
- Do not exhaust the process gases until at least 30 minutes after the pump has been started. The pump casing temperature will stabilize after about 2 hours and it is recommended not to start exhausting the process gases earlier than this.
- Do not suddenly make a pump inlet port the pressure that is higherr than atmospheric pressure.

Note

- Pump must be placed in an upright position. Do not stack as packing. When the pump was overturned, lubricating oil may leak to the pump side.
- Install pump in a location at an ambient not exceeding 30°C. Particular caution is required when the pump is operated in an enclosed room.
- If the pump is not leveled, shortage of the lubrication oil supply to the bearing may be caused.
- Floor vibrations will increase unless the adjustment feet are used.
- When several pumps are used, be sure to connect the cooling water pipes to each pump in parallel. The cooling water will flow more or less easily according to the type of pump and the piping. Be sure to select the correct piping so as to ensure the appropriate cooling water flow rate for all pipes used.
- When the cooling water connections are incorrect and the flow is reversed, a flow rate different from the normal value will be displayed. Nor will the pump will not be cooled properly. This will result in accident. Be sure therefore to connect correctly to avoid problems.
- Do not wire vacant pins.
- Apply a 12V DC power for input signals on the pump side. Do not apply this voltage on the equipment side. The output signals are generated from an open collector output. Please use it by the equipment side, impressing the power supply of DC4V to DC27V.
- Be sure to wire all signals with the correct polarity (SIG./COM.).
- When output signals are used to energize an inductive load such as a relay, be sure to insert a diode (100V. 1A class) in order to absorb the back electromotive force due to surge currents.
- Do not use the power supply for other purposes.
- The pump unit itself has no cooling water flow adjustment valve.
- For normal operation, open the N2 gas selector valve. To save N2 gas set close the valve when the production process does not lead to the formation of reaction by-products in the pump or when the process uses non-corrosive gases.
- It takes 10 odd seconds until the flow has stabilized after you have operated the N2 gas selector valve.
- The pump cannot start while the measuring instruments are warming up for 10 seconds after turn on the power supply.
- The pump will not start when an WARNING/ALARM has been generated. When the START button is pressed, "STARTFAIL" will appear on the display.

(5) Safety Warning Labels

Following safety labels are attached to pump covers.

1. High temperature warning
2. Hazardous voltage warning
3. Hazardous materials warning
4. Electric charge mark
5. Hazardous weight ganger

1. High temperature warning

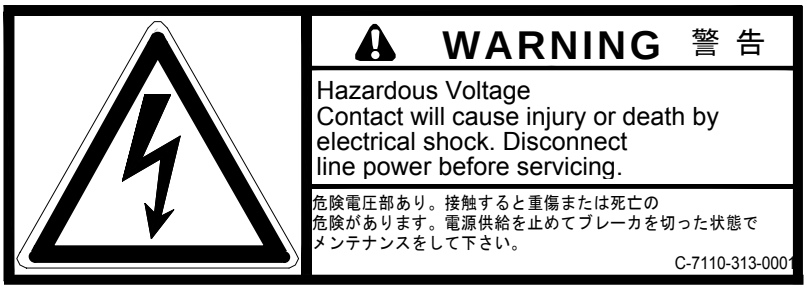
Hot surface may burn or cause injury.

Allow the piping and casing to cool before servicing.

2. Hazardous voltage warning

Hazardous voltage may shock, burn, or cause death.

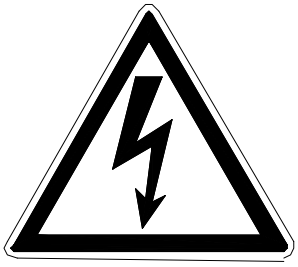
Turn power off and lockout before servicing.



3. Hazardous materials warning

In case of hazardous materials are handled. Run the pump only with N2 gas purge before servicing. Take adequate measures against dangerous reaction and contact with human body.

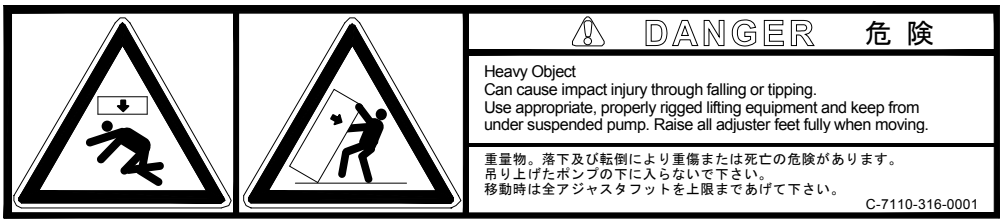
4. Electric charge mark



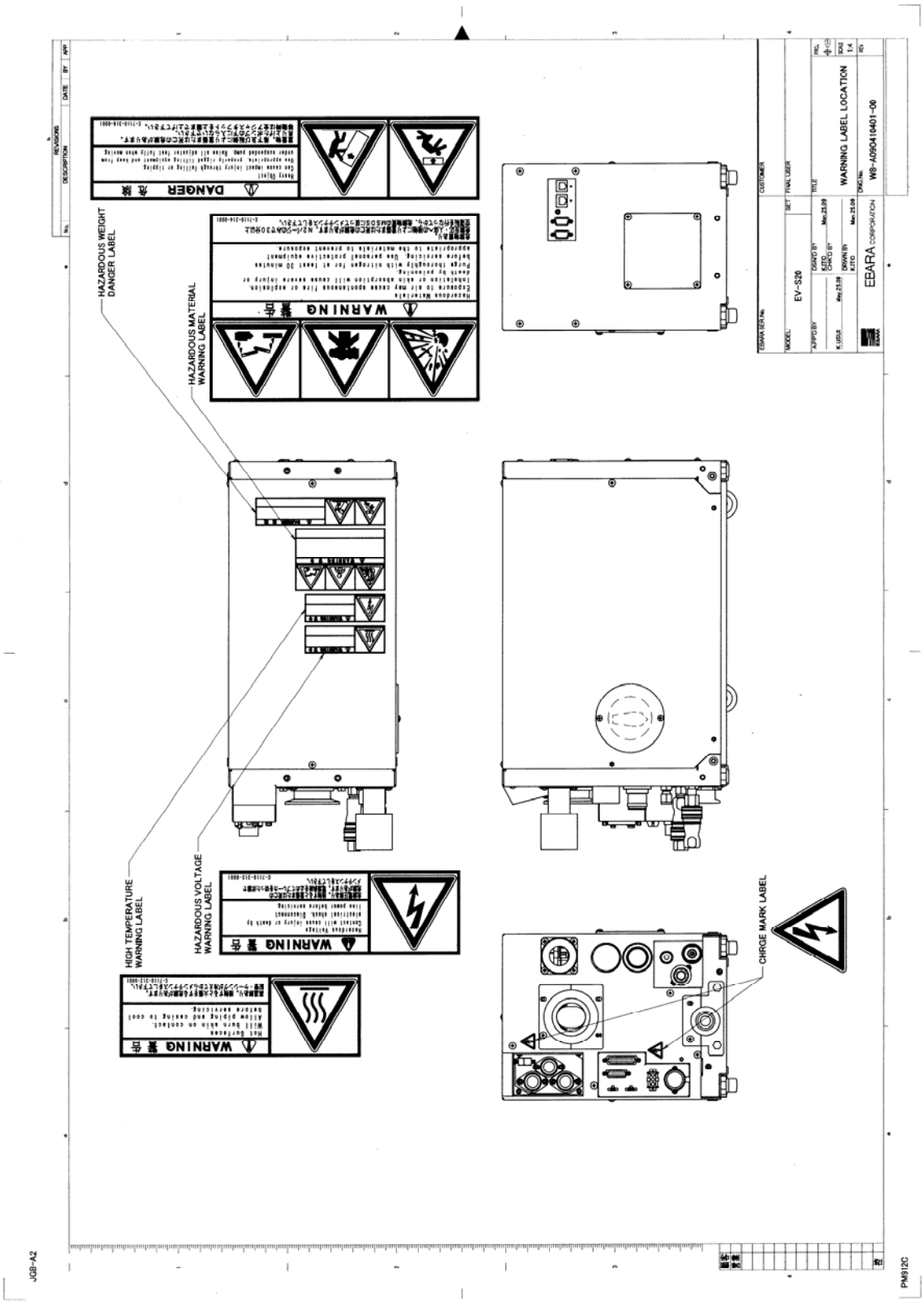
5. Hazardous weight danger

Heavy weight may cause severe injury or death due to overturningor falling pump. Keep out from under the lifted pump.

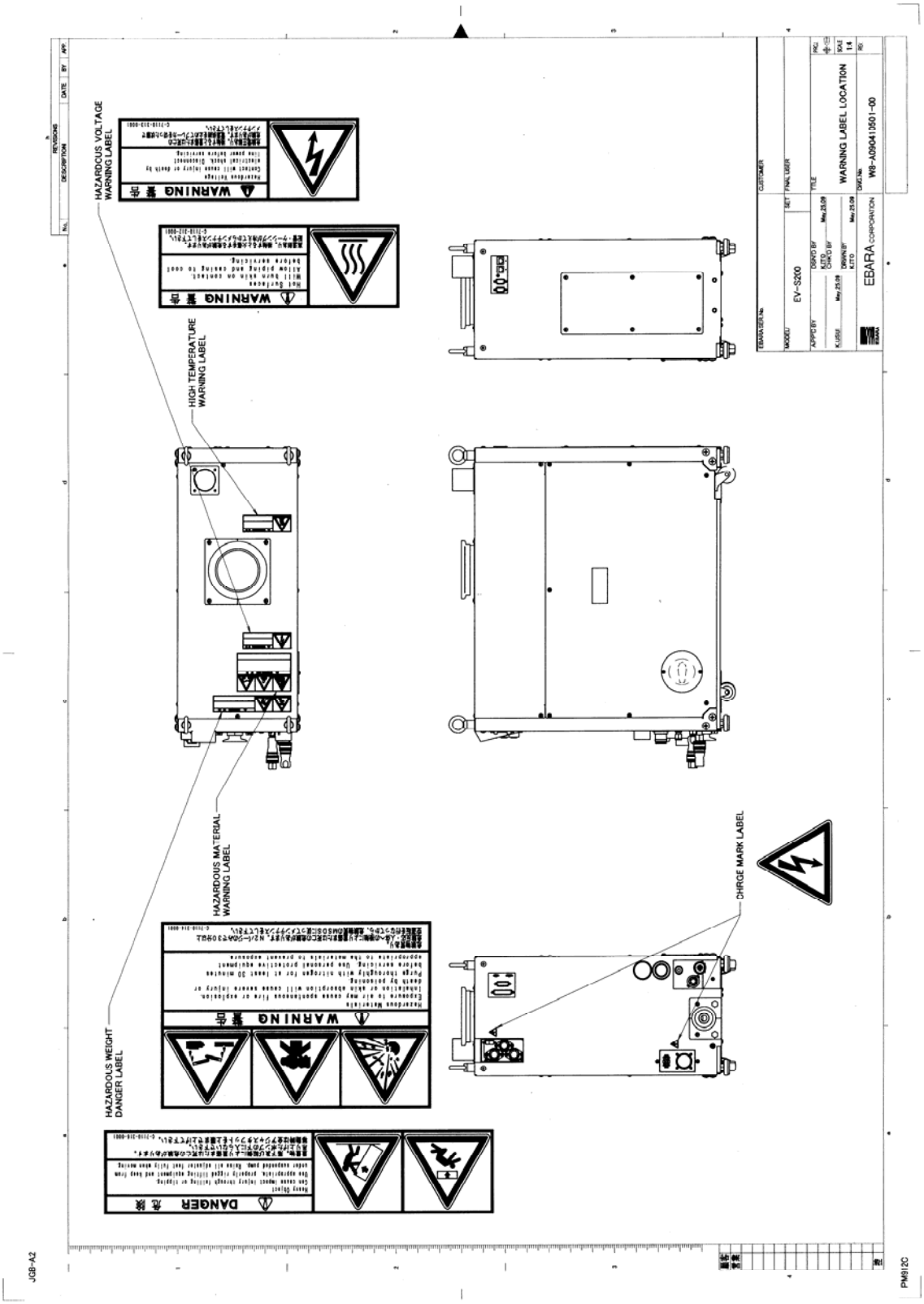
Raise all adjuster-feet fully when moving.



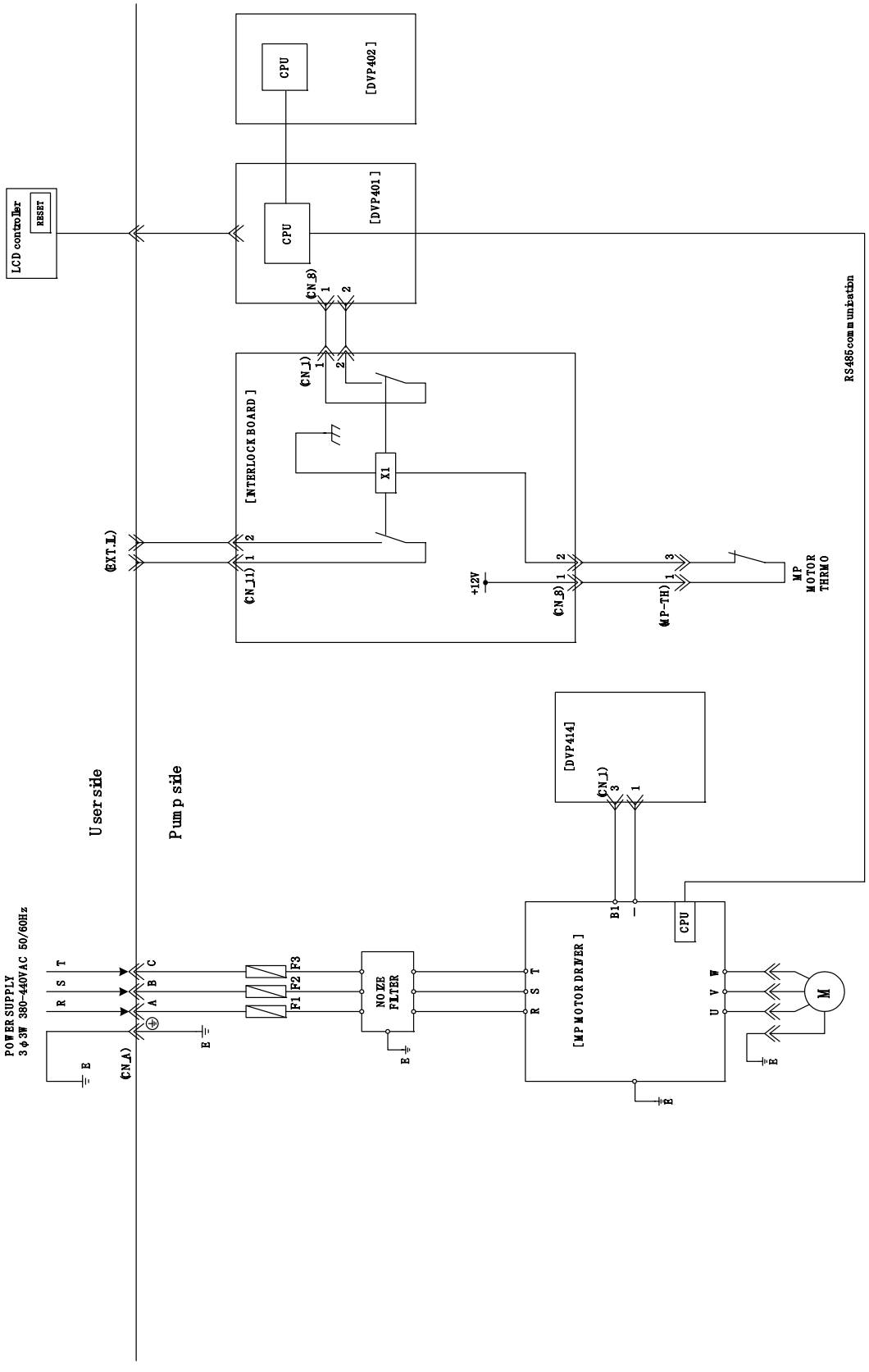
Location, Warning Label 1



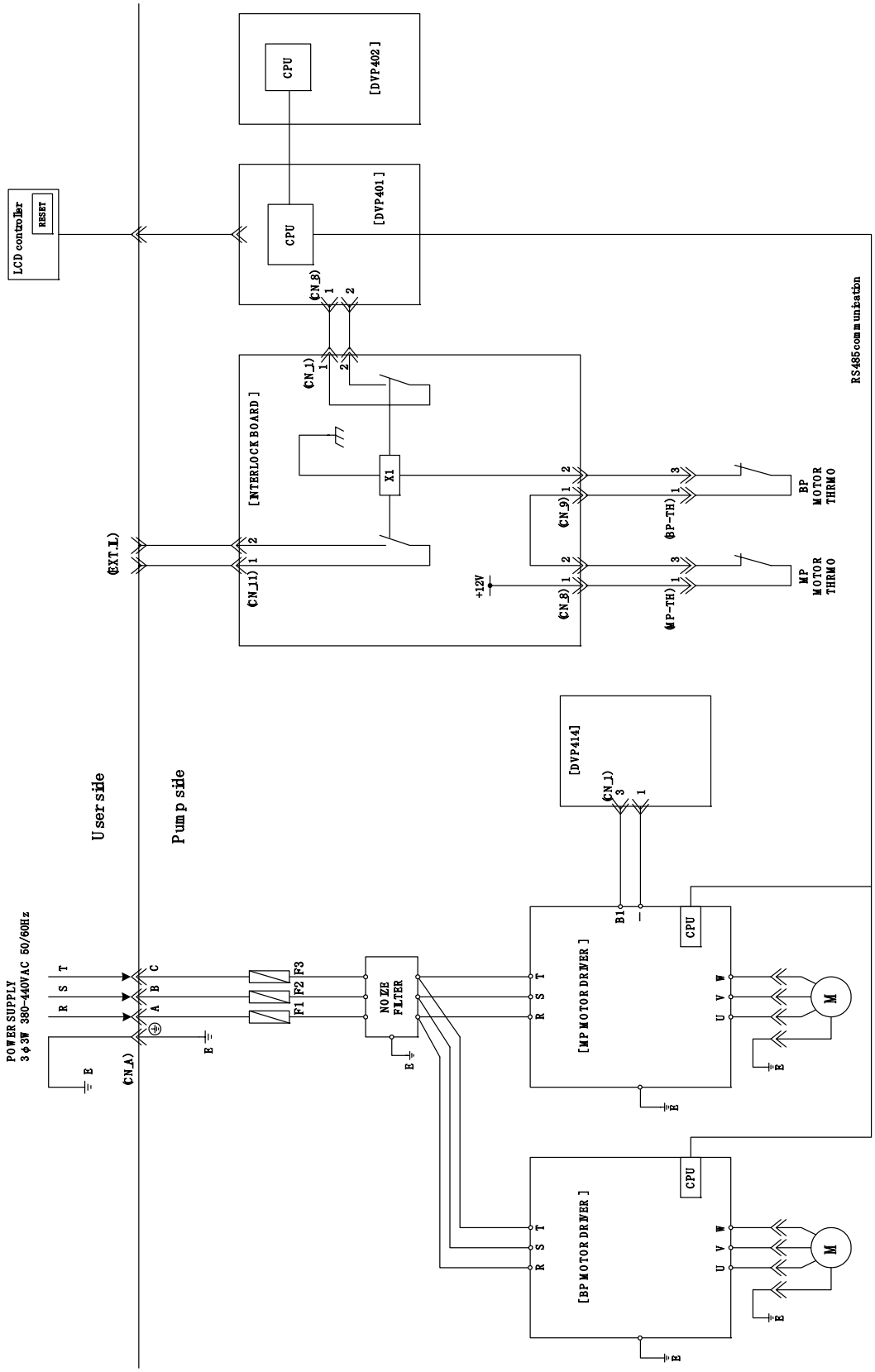
Location, Warning Label 2



Interlock Schematic (EV-S20)



Interlock Schematic (EV-S50 / EV-S100 / EV-S200)



(6) Contents

APPENDIX

1. Acceptance Check

Check the following items on receipt of the pump package.

(1) Check that the nameplate affixed to the outer cover of the pump to confirm that the pump supplied agrees with your order. Check the accessories against the packing list and the previously submitted drawings and documents to confirm that the all ordered accessories have been supplied.

(2) Check that no damage for the pump has occurred in transit.

(3) Store the pump in a dry and clean place if it is not installed at once after delivery.

Temperature : 5-40°C

Humidity : 80% or less

Note

Notify EBARA without delay when damage is discovered or when components are missing. Do not use when a leak is present as this will result in accident.

Note

Pump must be placed in an upright position. Do not stack as packing. When the pump was overturned, lubricating oil may leak to the pump side.

2. Product Description

2.1 Outline

The EV-S Series dry vacuum pump has a compact design and includes various sensors and controls to enhance reliability and operation.

2.1.1 Pump Module

The pump is a Roots type vacuum pump which rotates a pair of non-contact multi-stage rotors synchronized by timing gears. In the unit, a Booster Pump (BP) and the Main Pump (MP) are connected in series for ventilation.

The timing gears and bearings are enclosed in a compartment that is independent of the casing. For lubrication Perfluoro-Polyether (PFPE) oil and grease are used.

The pumps of this series are filled with lubrication oil at the factory. Use only the recommended lubrication oil grades shown in specification Table 3.1 for replenishing or replacing.

2.1.2 N2 Gas (EV-S**P / EV-S**N)

Introduce nitrogen gas to dilute the hazardous gases to an unharmful level. Properly connect the nitrogen gas line to the purge port provided according to the instructions in Table 3.1 and the descriptions in Section 4.2.3. In the cases the gas concentration may become higher than the specified for safe gas exhaust, introduce the nitrogen gas to lines to the exhaust outlet. The tool user shall provide the purge port for this purpose.

N2 gas is also required to supply to seal the shaft section. This protects the penetration to bearing section, such as corrosive gas. To reduce pump corrosion due to process gas or accumulation of reaction by-products, N2 gas is supplied to each pump component as dilution purge gas. Stopping the dilution N2 with a selector valve can save N2 gas, when process does not produce corrosion and reaction by-products. The correct amount of N2 gas is supplied for those two types of purge operation, by adjusting the regulation pressure to the specified value. The nitrogen gas selector is locating on the right side of the unit, facing the utility connectors. It is under the outer cover.

2.1.3 Cooling Water

Because the pump compresses gas from a vacuum to atmospheric pressure, compression heat is generated. Therefore cool the pump with cooling water.

The cooling water connector takes the form of a coupler for easy connection and disconnection.

2.1.4 Exhaust

A check valve is built into the pump unit to prevent reverse flow of gas from the exhaust through the pump to the vacuum chamber when pump is stopped.

2.2 Control System

EV-S Series dry vacuum pumps have a built-in measuring unit consisting of a Main Fuse, Noise Filter (NF) and control source. To improve reliability and safety, the condition of each utility and pump section is monitored by a sensor. During pump operation all operating conditions are monitored, including power supply, cooling water flow, N2 gas flow, casing and motor coil temperature, motor speed, and electric power for motor. Continuous operation is possible when there is a momentarily power failure (170V or less) of 1 sec or less.

2.2.1 Warning

To assure the reliability of the pump as a vacuum exhaust system, the pump protection system generates two levels of alarm： WARNING and ALARM.

A WARNING signal is generated when pump operation exceeds the normal range. It therefore only draws attention that the normal operating values are not adhered to but does not signify that danger is imminent. The pump will continue to operate in this condition.

An ALARM signal output is generated and the pump will stop automatically when the upper mechanical safety limit is reached during pump operation.

When an ALARM output is suddenly generated, while the plant unit is operational, a WARNING signal will be generated to ensure that the plant operation is not discontinued. This enables the operator to check the pump after the equivalent of one cycle has been completed.

Be sure to contact EBARA Corporation for details on checking the WARNING and ALARM setting conditions.

2.2.2 Operation Status Control

The sensor data are displayed on the LCD provided on the controller to facilitate operation status control and daily inspection.

All WARNING and ALARM signals are displayed on the LCD. For remote operation and monitoring, the signals are available as individual and group outputs.

2.3 Detailed Specifications

The following tables and figures should be consulted for pump specification, dimension and performance details.

2.3.1 Model Description

EV – S 20 P

Mark	Description
Pumping Speed	
20	1670 L/min
50	5000 L/min
100	10000 L/min
200	20000 L/min
Materials / N2 Purge Unit	
-	Standard / Without N2 purge unit
P	Standard / With N2 purge unit
N	Corrosion Resistant / With N2 purge unit

2.3.2 Specifications

Table 2.1 Specification (EV-S20 / EV-S20P / EV-S20N)

Model			EV-S20	EV-S20P	EV-S20N
Pumping Speed			1670		
Ultimate Pressure			3.0 Pa	5.0 Pa	
Connection		Gas Inlet	NW50		
		Gas Outlet	NW25		
Approx. Power at Ultimate Pressure (Max. Power)			0.4 kW (2.2 kW)		
Utility	Cooling Water	Connection	Rc1/4 (Coupler)		
		Pressure [Gauge Press.]	Differential Press.: Min. 0.2 MPa Supply: Max. 0.4 MPa		
		Flow Rate	1.5～3.0 L/min		
		Temperature	Max. 30℃		
	N2 Gas	Connection	—	1/4" Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	—	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.12 MPa]	
		Approx. Flow Rate [N2-0 Mode]	—	17～20 Pa m^3/s [2.4 Pa m^3/s]	
	Duct Venti-lation	Connection	—	ϕ50 mm	
		Pressure	—	-196 Pa	
		Approx. Flow rate	—	0.5 m^3/min	
Lubrication Oil		Brand	BARRIERTA J100ES （NOK）		
		Quantity	0.05 L		
Approx. Weight			60 kg		
Power Supply		Phase/Volt/Freq.	3 Phase, 380-440V±10% (50/60Hz±5%)		
		Power Capacity	3.2 kVA		
		Connection	Amphenol		
			C016 20C003 100 12		
Control Signal			D-sub 15pin ＋ D-sub 25pin		
Communication			RS-232C D-sub 9pin X 2		
Main Fuse			15A		
SCCR			10 kA		

Table 2.2 Specification (EV-S50 / EV-S50P / EV-S50N)

Model			EV-S50	EV-S50P	EV-S50N
Pumping Speed			5000		
Ultimate Pressure			0.5 Pa		
Connection		Gas Inlet	NW50		
		Gas Outlet	NW25		
Approx. Power at Ultimate Pressure (Max. Power)			0.55 kW (3.6 kW)		
Utility	Cooling Water	Connection	Rc1/4 (Coupler)		
		Pressure [Gauge Press.]	Differential Press.: Min. 0.2 MPa Supply: Max. 0.4 MPa		
		Flow Rate	2.0～3.0 L/min		
		Temperature	Max. 30℃		
	N2 Gas	Connection	—	1/4” Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	—	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.12 MPa]	
		Approx. Flow Rate [N2-0 Mode]	—	17～20 Pa m^3/s [2.4 Pa m^3/s]	
	Duct Venti-lation	Connection	—	ϕ50 mm	
		Pressure	—	-196 Pa	
		Approx. Flow rate	—	0.5 m^3/min	
Lubrication Oil		Brand	BARRIERTA J100ES （NOK）		
		Quantity	0.1 L		
Approx. Weight			100 kg		
Power Supply		Phase/Volt/Freq.	3 Phase, 380-440V±10% (50/60Hz±5%)		
		Power Capacity	4.8 kVA		
		Connection	Japan Aviation Electronics Industry		
			JL04HV-2E22-22PE-B		
Control Signal			D-sub 15pin ＋ D-sub 25pin		
Communication			RS-232C D-sub 9pin X 2		
Main Fuse			20A		
SCCR			10 kA		

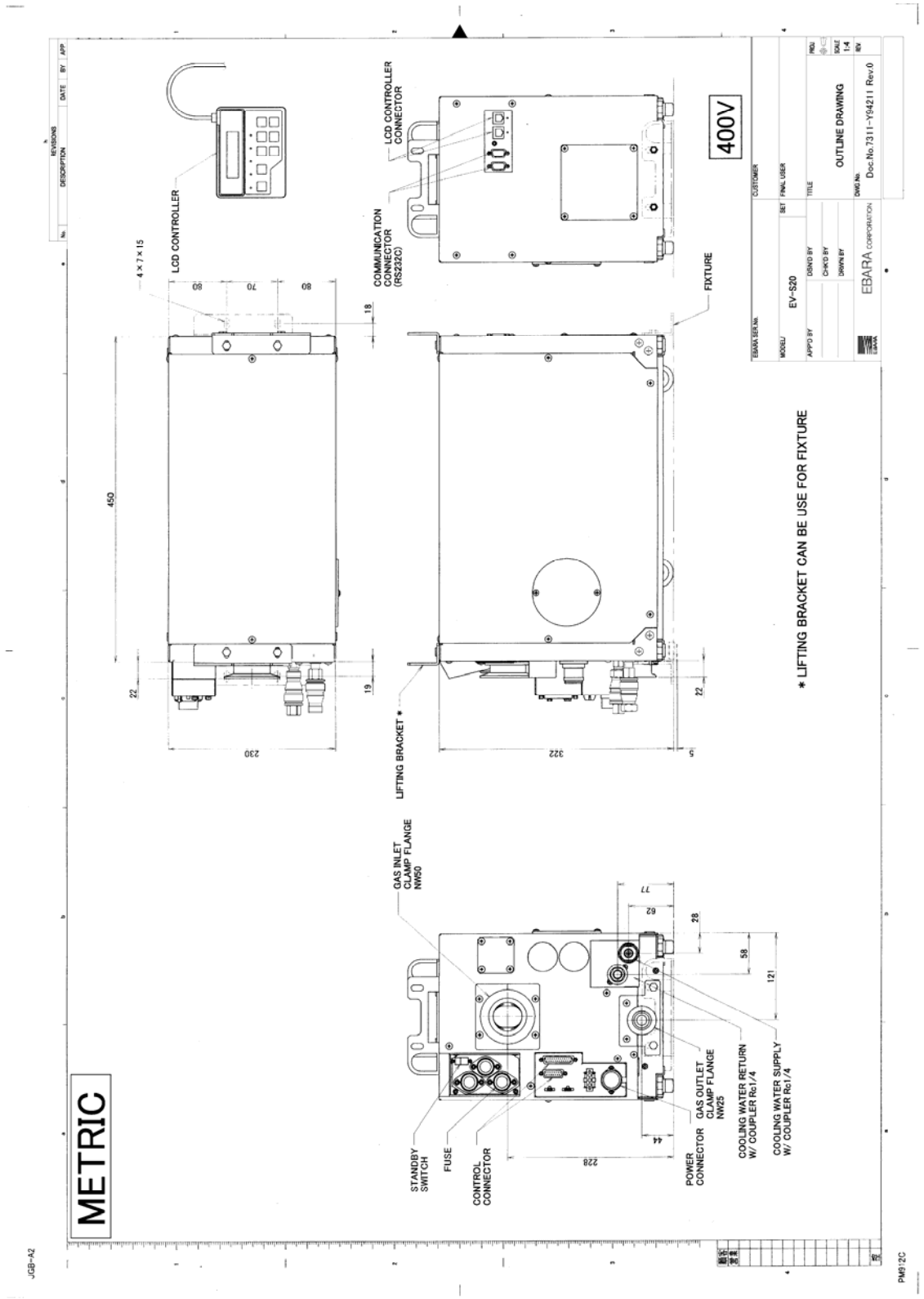
Table 2.3 Specification (EV-S100 / EV-S100P / EV-S100N)

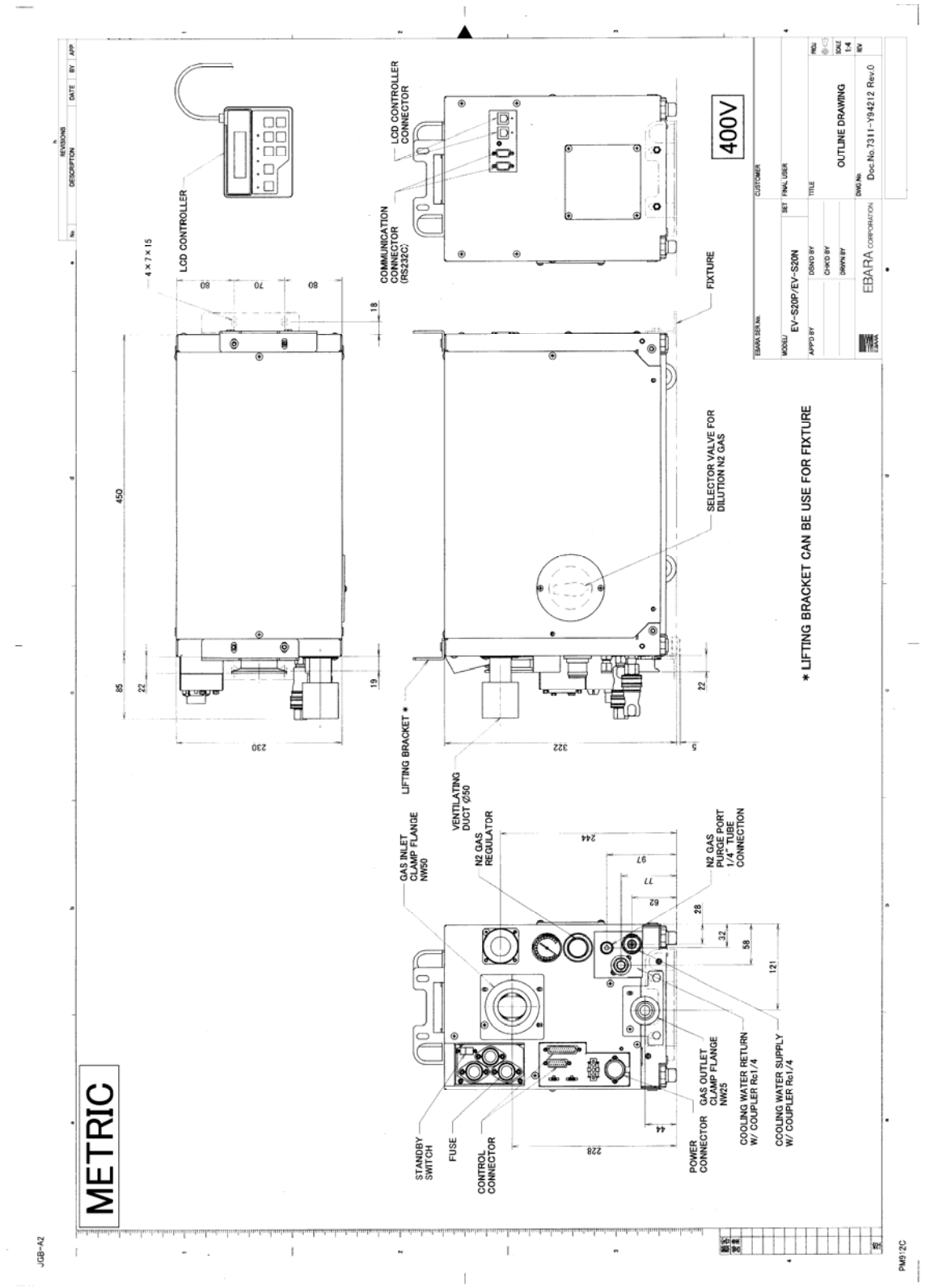
Model			EV-S100	EV-S100P	EV-S100N
Pumping Speed			10000		
Ultimate Pressure			0.5 Pa		
Connection		Gas Inlet	NW80		
		Gas Outlet	NW40		
Approx. Power at Ultimate Pressure (Max. Power)			0.65 kW (4.6 kW)		
Utility	Cooling Water	Connection	Rc1/4 (Coupler)		
		Pressure [Gauge Press.]	Differential Press.: Min. 0.2 MPa Supply: Max. 0.4 MPa		
		Flow Rate	2.0～3.0 L/min		
		Temperature	Max. 30℃		
	N2 Gas	Connection	—	1/4” Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	—	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.12 MPa]	
		Approx. Flow Rate [N2-0 Mode]	—	17～20 Pa m^3/s [2.4 Pa m^3/s]	
	Duct Venti-lation	Connection	—	ϕ50 mm	
		Pressure	—	-196 Pa	
		Approx. Flow rate	—	0.5 m^3/min	
Lubrication Oil		Brand	BARRIERTA J100ES （NOK）		
		Quantity	0.1 L		
Approx. Weight			120 kg		
Power Supply		Phase/Volt/Freq.	3 Phase, 380-440V±10% (50/60Hz±5%)		
		Power Capacity	6.4 kVA		
		Connection	Japan Aviation Electronics Industry		
			JL04HV-2E22-22PE-B		
Control Signal			D-sub 15pin ＋ D-sub 25pin		
Communication			RS-232C D-sub 9pin X 2		
Main Fuse			20A		
SCCR			10 kA		

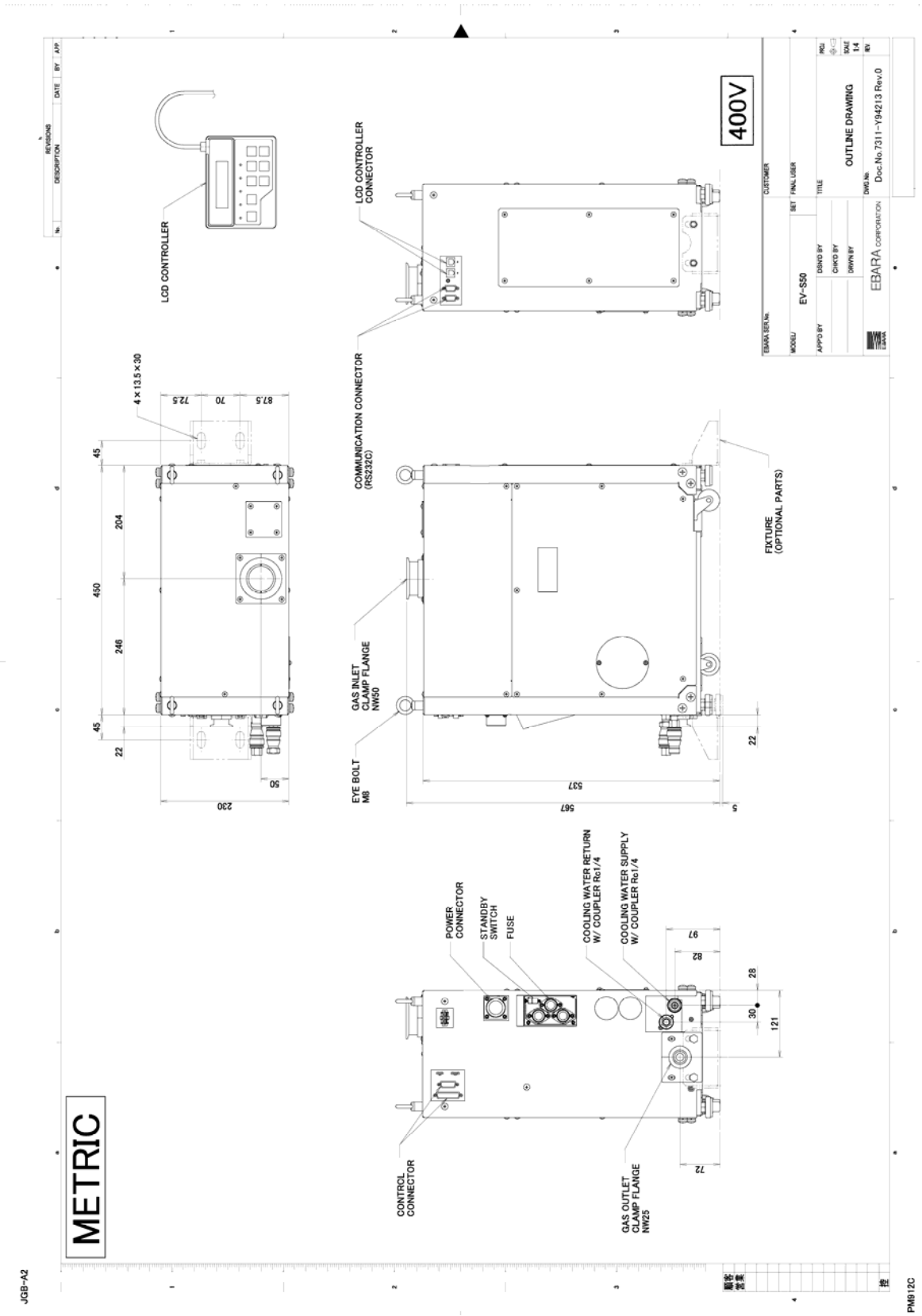
Table 2.4 Specification (EV-S200 / EV-S200P / EV-S200N)

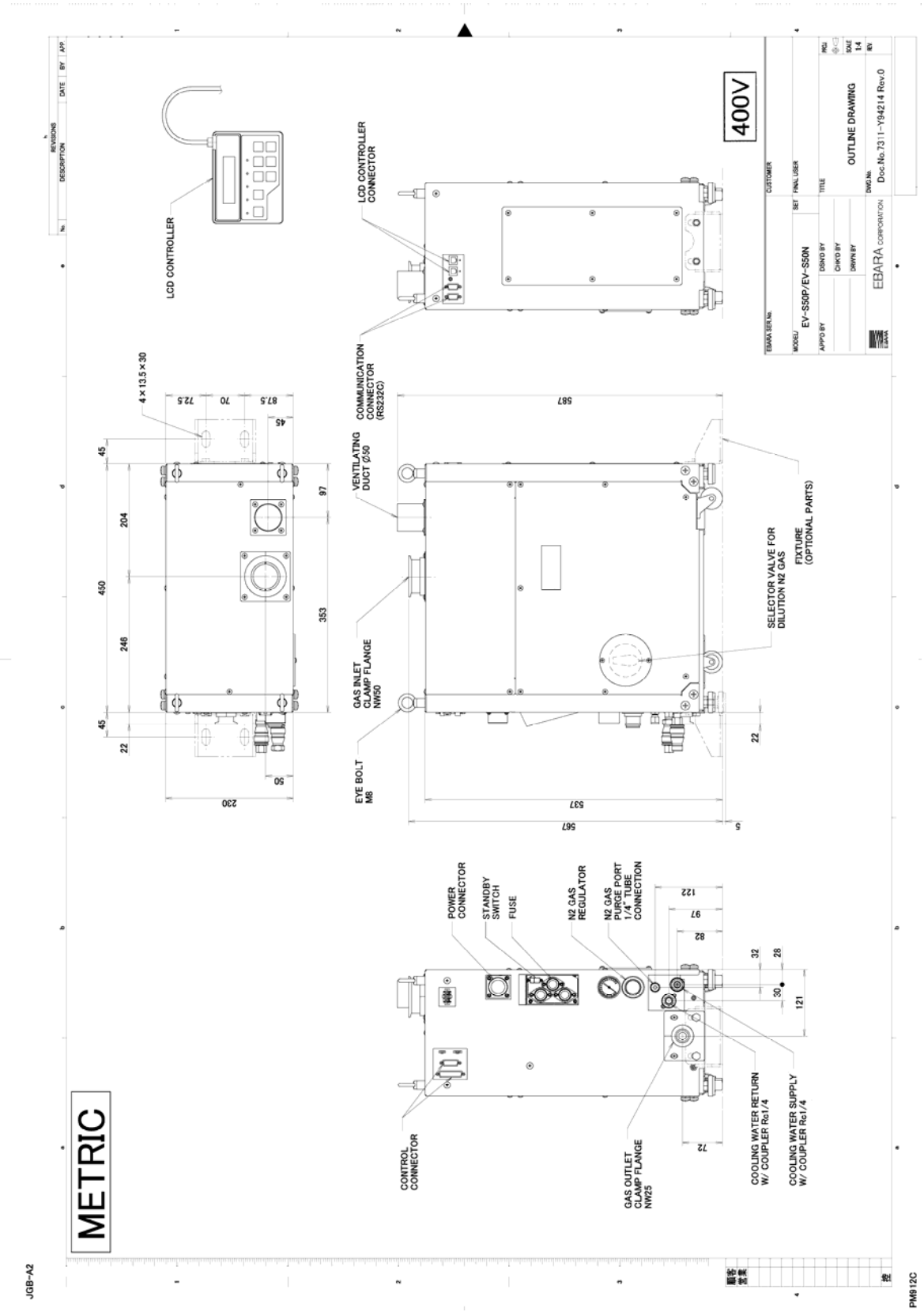
Model			EV-S200	EV-S200P	EV-S200N
Pumping Speed			20000		
Ultimate Pressure			0.5 Pa		
Connection		Gas Inlet	NW100		
		Gas Outlet	NW40		
Approx. Power at Ultimate Pressure (Max. Power)			0.75 kW (5.1 kW)		
Utility	Cooling Water	Connection	Rc1/4 (Coupler)		
		Pressure [Gauge Press.]	Differential Press.: Min. 0.2 MPa Supply: Max. 0.4 MPa		
		Flow Rate	2.0～3.0 L/min		
		Temperature	Max. 30℃		
	N2 Gas	Connection	—	1/4" Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	—	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.12 MPa]	
		Approx. Flow Rate [N2-0 Mode]	—	17～20 Pa m^3/s [2.4 Pa m^3/s]	
	Duct Venti-lation	Connection	—	ϕ50 mm	
		Pressure	—	-196 Pa	
		Approx. Flow rate	—	0.5 m^3/min	
Lubrication Oil		Brand	BARRIERTA J100ES （NOK）		
		Quantity	0.15 L		
Approx. Weight			170 kg		
Power Supply		Phase/Volt/Freq.	3 Phase, 380-440V±10% (50/60Hz±5%)		
		Power Capacity	6.8 kVA		
		Connection	Japan Aviation Electronics Industry		
			JL04HV-2E22-22PE-B		
Control Signal			D-sub 15pin ＋ D-sub 25pin		
Communication			RS-232C D-sub 9pin X 2		
Main Fuse			20A		
SCCR			10 kA		

2.3.3 Outline Drawing




400V
METRIC
OUTLINE DRAWING
Doc.No.7311-Y94212 Rev.0
EV-S20P/EV-S20N
EBARA CORPORATION
LCD CONTROLLER
LCD CONTROLLER CONNECTOR
COMMUNICATION CONNECTOR (RS232C)
FIXTURE
SELECTOR VALVE FOR DILUTION N2 GAS
* LIFTING BRACKET CAN BE USE FOR FIXTURE
LIFTING BRACKET *
VENTILATING DUCT Ø50
GAS INLET CLAMP FLANGE NW50
N2 GAS REGULATOR
N2 GAS PURGE PORT 1/4" TUBE CONNECTION
GAS OUTLET CLAMP FLANGE NW25
COOLING WATER RETURN W/ COUPLER Rc1/4
COOLING WATER SUPPLY W/ COUPLER Rc1/4
POWER CONNECTOR
CONTROL CONNECTOR
FUSE
STANDBY SWITCH


400V
METRIC
OUTLINE DRAWING
EV-S50
EBARA CORPORATION
Doc.No.7311-Y94213 Rev.0
LCD CONTROLLER
LCD CONTROLLER CONNECTOR
COMMUNICATION CONNECTOR (RS232C)
4×13.5×30
GAS INLET CLAMP FLANGE NW50
EYE BOLT M8
FIXTURE (OPTIONAL PARTS)
POWER CONNECTOR
STANDBY SWITCH
FUSE
COOLING WATER RETURN W/ COUPLER Rc1/4
COOLING WATER SUPPLY W/ COUPLER Rc1/4
CONTROL CONNECTOR
GAS OUTLET CLAMP FLANGE NW25
JGB-A2
PM912C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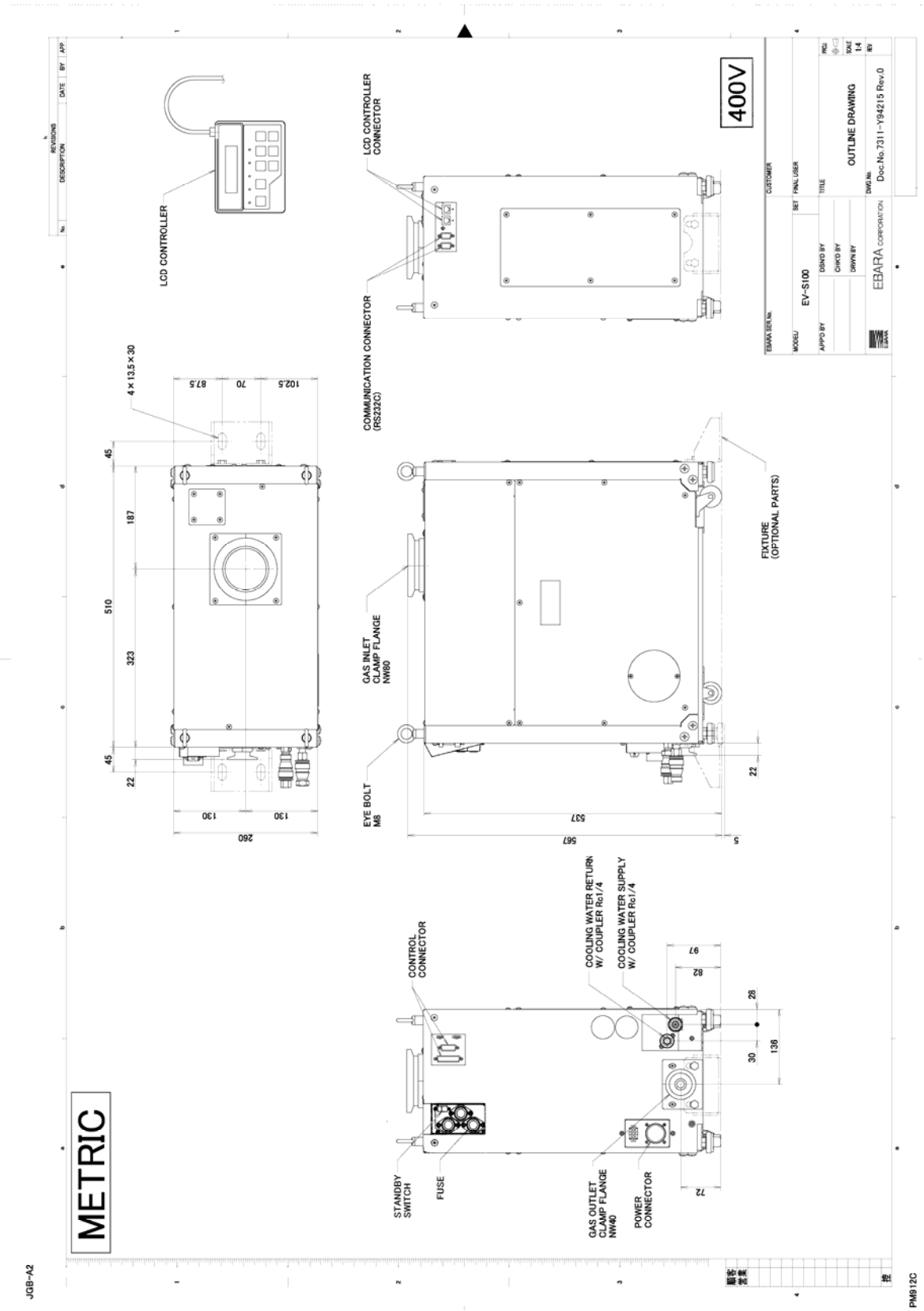
METRIC
OUTLINE DRAWING
EV-S50P/EV-S50N
EBARA CORPORATION
Doc.No.7311-Y94214 Rev.0
LCD CONTROLLER
LCD CONTROLLER CONNECTOR
COMMUNICATION CONNECTOR (RS232C)
VENTILATING DUCT Ø50
GAS INLET CLAMP FLANGE NW50
EYE BOLT M8
SELECTOR VALVE FOR DILUTION N2 GAS
FIXTURE (OPTIONAL PARTS)
4×13.5×30
POWER CONNECTOR
STANDBY SWITCH
FUSE
N2 GAS REGULATOR
N2 GAS PURGE PORT 1/4" TUBE CONNECTION
CONTROL CONNECTOR
GAS OUTLET CLAMP FLANGE NW25
COOLING WATER RETURN W/ COUPLER Rc1/4
COOLING WATER SUPPLY W/ COUPLER Rc1/4
JGB-A2
PM912C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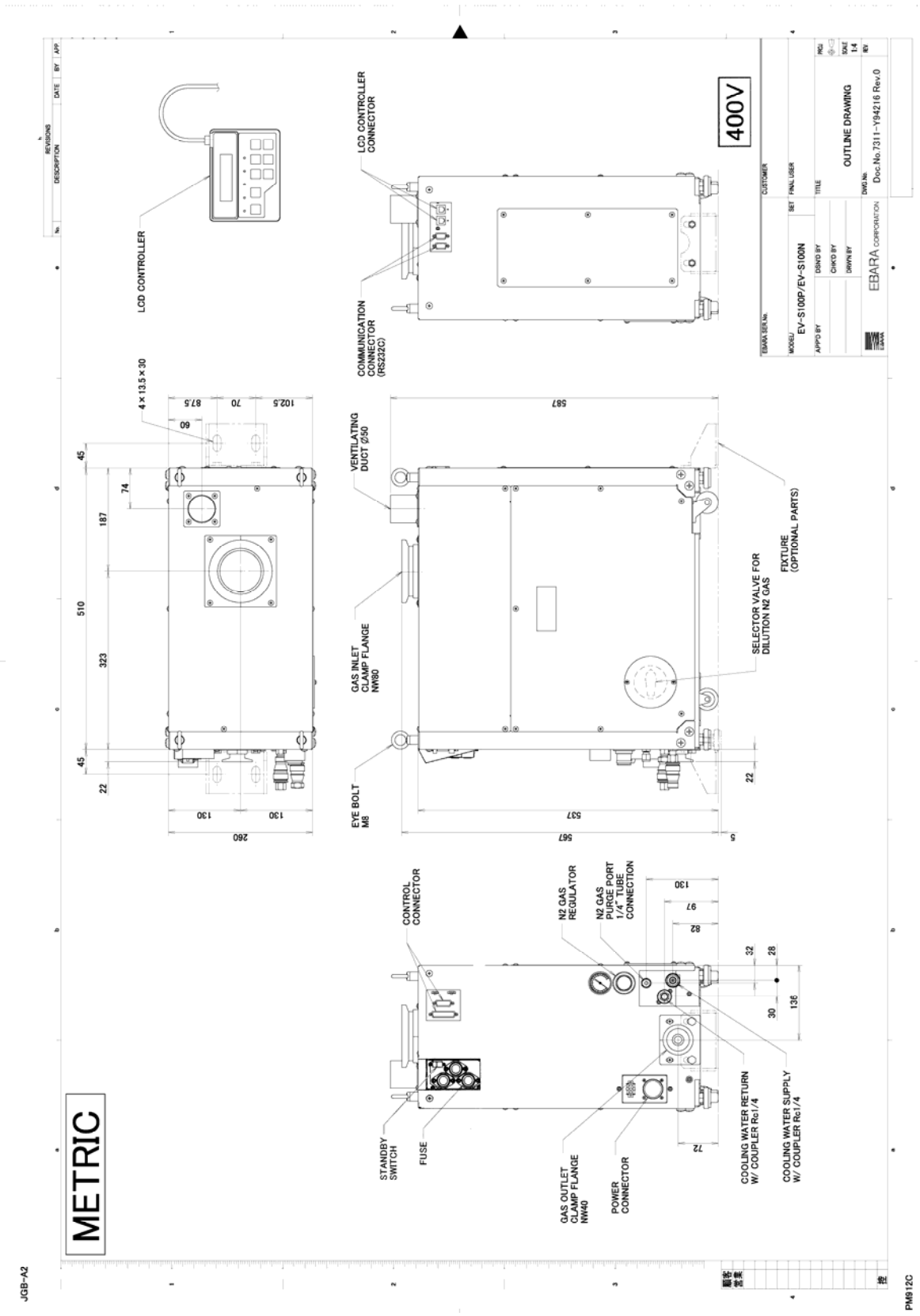
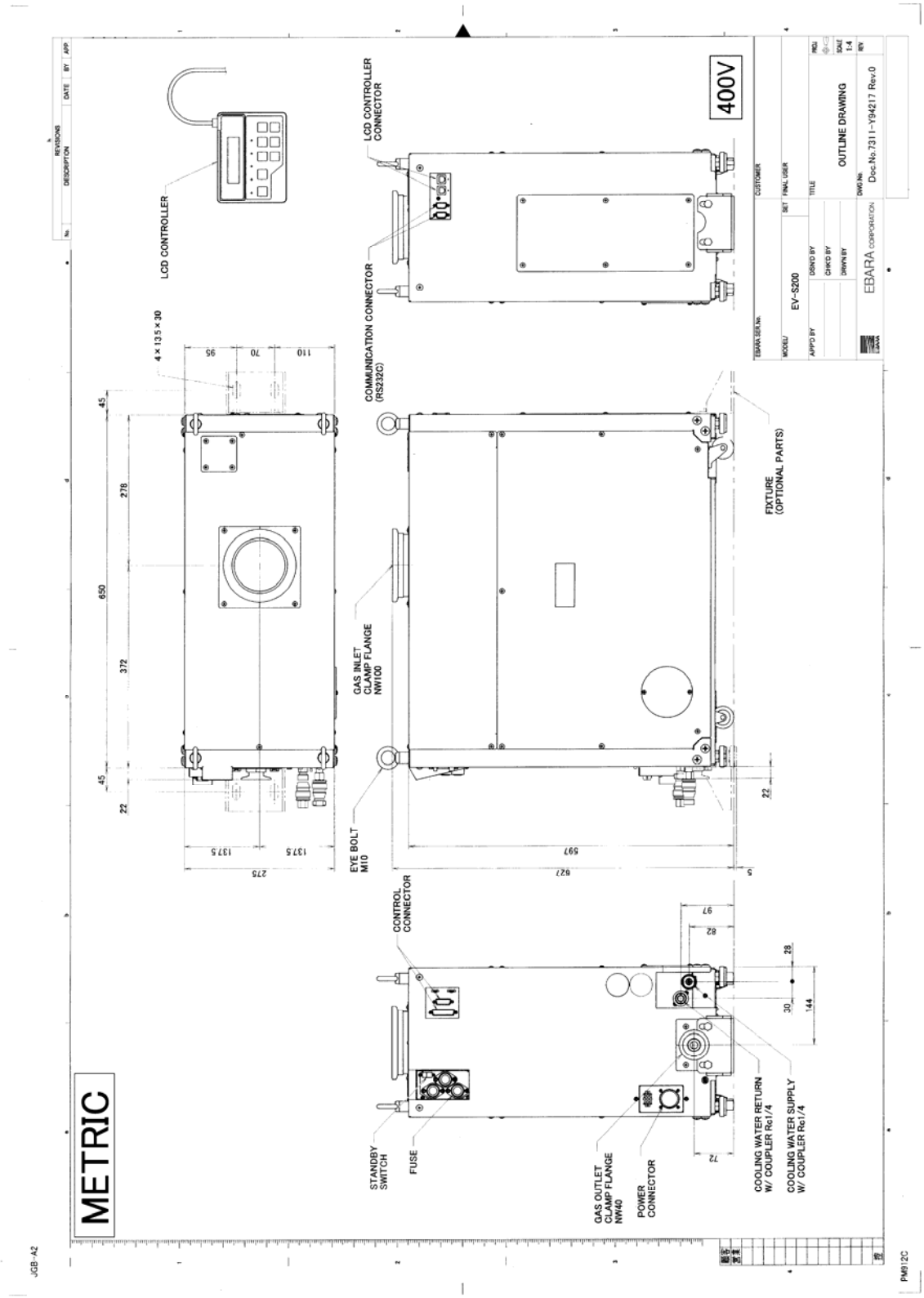
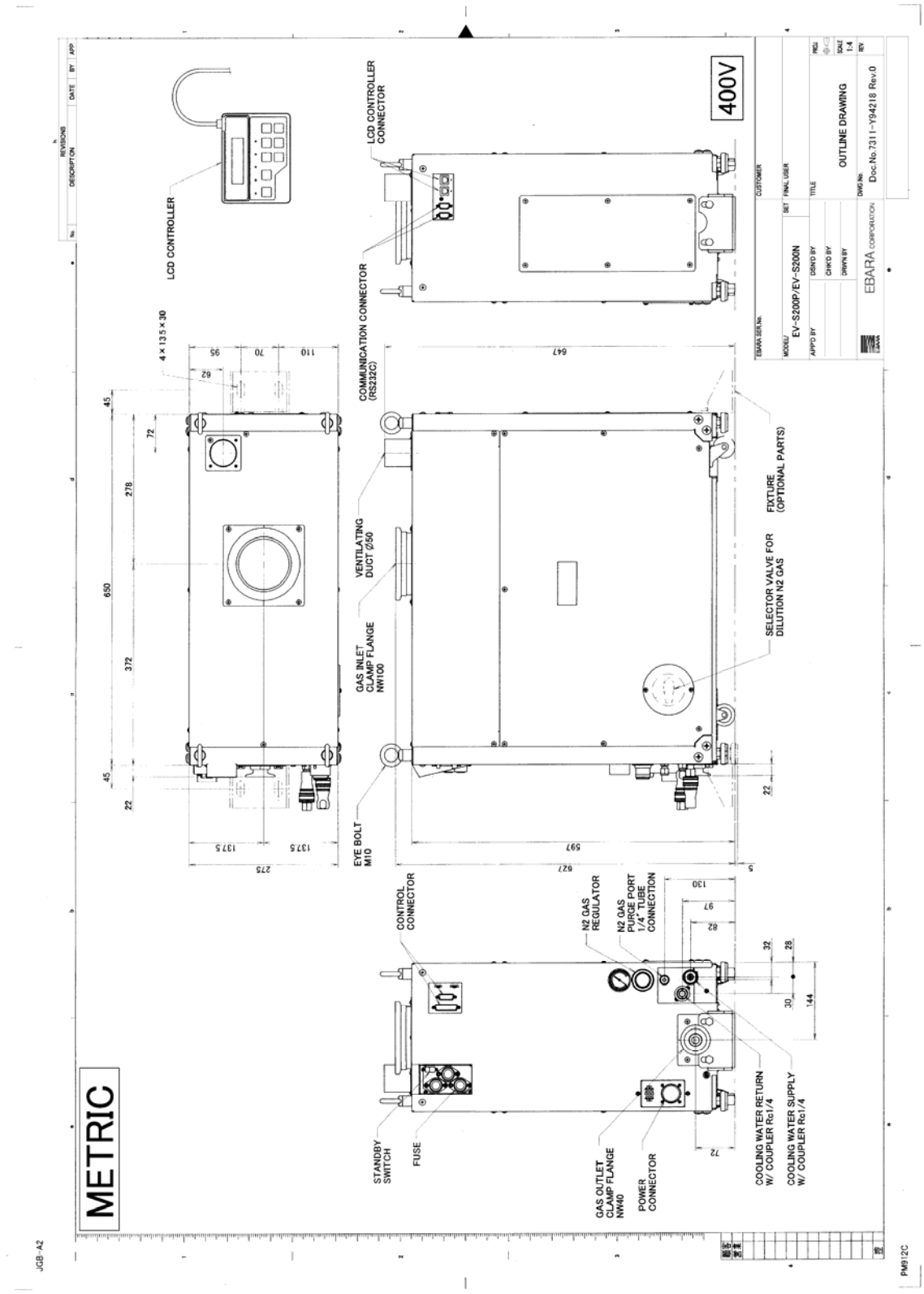
METRIC
OUTLINE DRAWING
EV-S100
EBARA CORPORATION
Doc.No.7311-Y94215 Rev.0
LCD CONTROLLER
LCD CONTROLLER CONNECTOR
COMMUNICATION CONNECTOR (RS232C)
4 × 13.5 × 30
FIXTURE (OPTIONAL PARTS)
GAS INLET CLAMP FLANGE NW80
EYE BOLT M8
CONTROL CONNECTOR
COOLING WATER RETURN W/ COUPLER Rc1/4
COOLING WATER SUPPLY W/ COUPLER Rc1/4
STANDBY SWITCH
FUSE
GAS OUTLET CLAMP FLANGE NW40
POWER CONNECTOR
JGB-A2
PM912C


400V
METRIC
LCD CONTROLLER
LCD CONTROLLER CONNECTOR
COMMUNICATION CONNECTOR (RS232C)
4×13.5×30
VENTILATING DUCT Ø50
GAS INLET CLAMP FLANGE NW80
EYE BOLT M8
SELECTOR VALVE FOR DILUTION N2 GAS
FIXTURE (OPTIONAL PARTS)
CONTROL CONNECTOR
N2 GAS REGULATOR
N2 GAS PURGE PORT 1/4" TUBE CONNECTION
STANDBY SWITCH
FUSE
GAS OUTLET CLAMP FLANGE NW40
POWER CONNECTOR
COOLING WATER RETURN W/ COUPLER Rc1/4
COOLING WATER SUPPLY W/ COUPLER Rc1/4
EBARA CORPORATION
EV-S100P/EV-S100N
OUTLINE DRAWING
Doc.No.7311-Y94216 Rev.0
JGB-A2
PM912C


400V
METRIC
OUTLINE DRAWING
Doc.No.7311-Y94217 Rev.0
EV-S200
EBARA CORPORATION
LCD CONTROLLER
LCD CONTROLLER CONNECTOR
COMMUNICATION CONNECTOR (RS232C)
4×135×30
FIXTURE (OPTIONAL PARTS)
GAS INLET CLAMP FLANGE NW100
EYE BOLT M10
CONTROL CONNECTOR
STANDBY SWITCH
FUSE
GAS OUTLET CLAMP FLANGE NW40
POWER CONNECTOR
COOLING WATER RETURN W/ COUPLER Rc1/4
COOLING WATER SUPPLY W/ COUPLER Rc1/4


400V
METRIC
LCD CONTROLLER
LCD CONTROLLER CONNECTOR
COMMUNICATION CONNECTOR (RS232C)
VENTILATING DUCT Ø50
GAS INLET CLAMP FLANGE NW100
EYE BOLT M10
FIXTURE (OPTIONAL PARTS)
SELECTOR VALVE FOR DILUTION N2 GAS
CONTROL CONNECTOR
N2 GAS REGULATOR
N2 GAS PURGE PORT 1/4" TUBE CONNECTION
STANDBY SWITCH
FUSE
GAS OUTLET CLAMP FLANGE NW40
POWER CONNECTOR
COOLING WATER RETURN W/ COUPLER Rc1/4
COOLING WATER SUPPLY W/ COUPLER Rc1/4
EV-S200P/EV-S200N
OUTLINE DRAWING
Doc.No.7311-Y94218 Rev.0
EBARA CORPORATION

2.3.4 Performance Curve

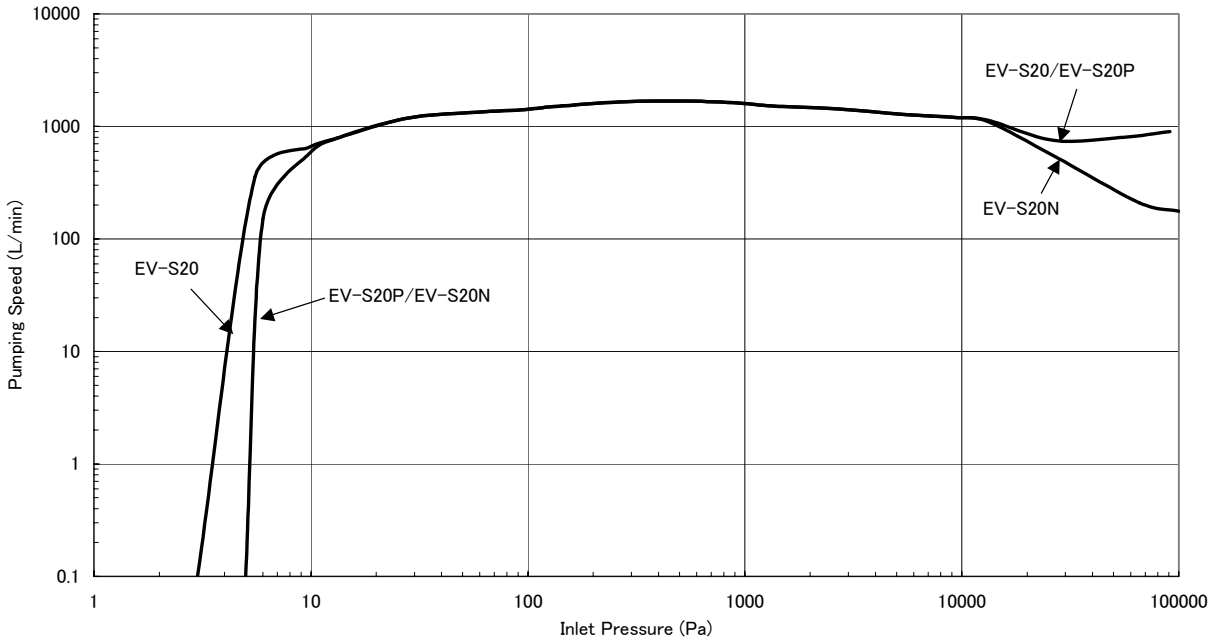


Fig 2.1 EV-S20(P/N) Performance Curve

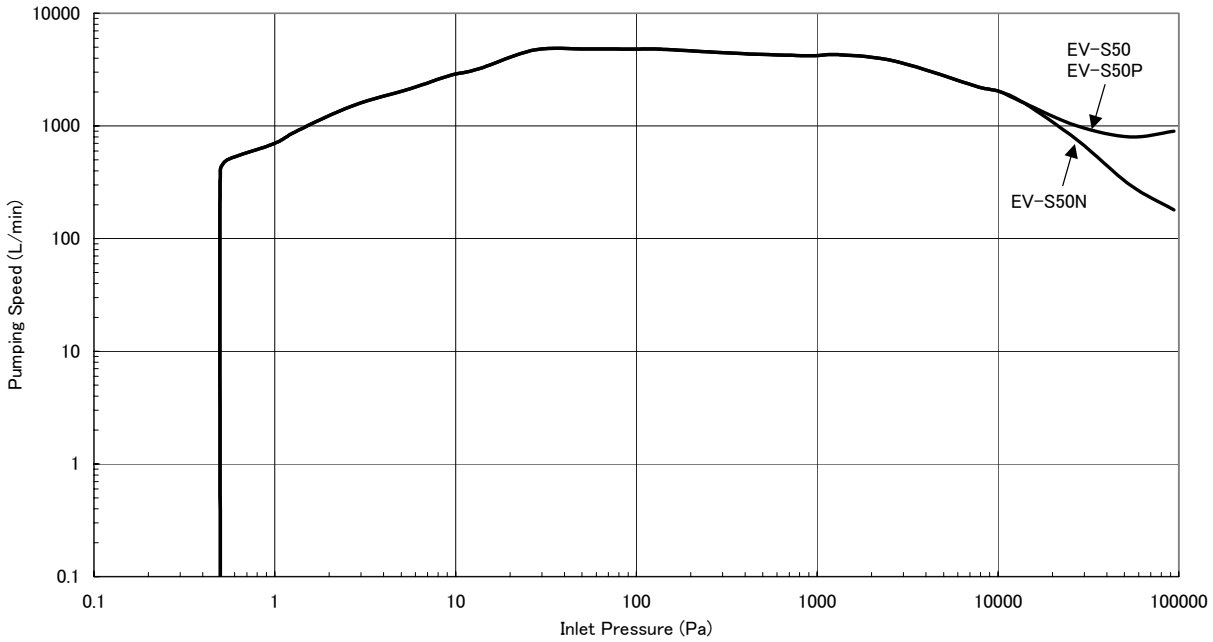


Fig 2.2 EV-S50(P/N) Performance Curve

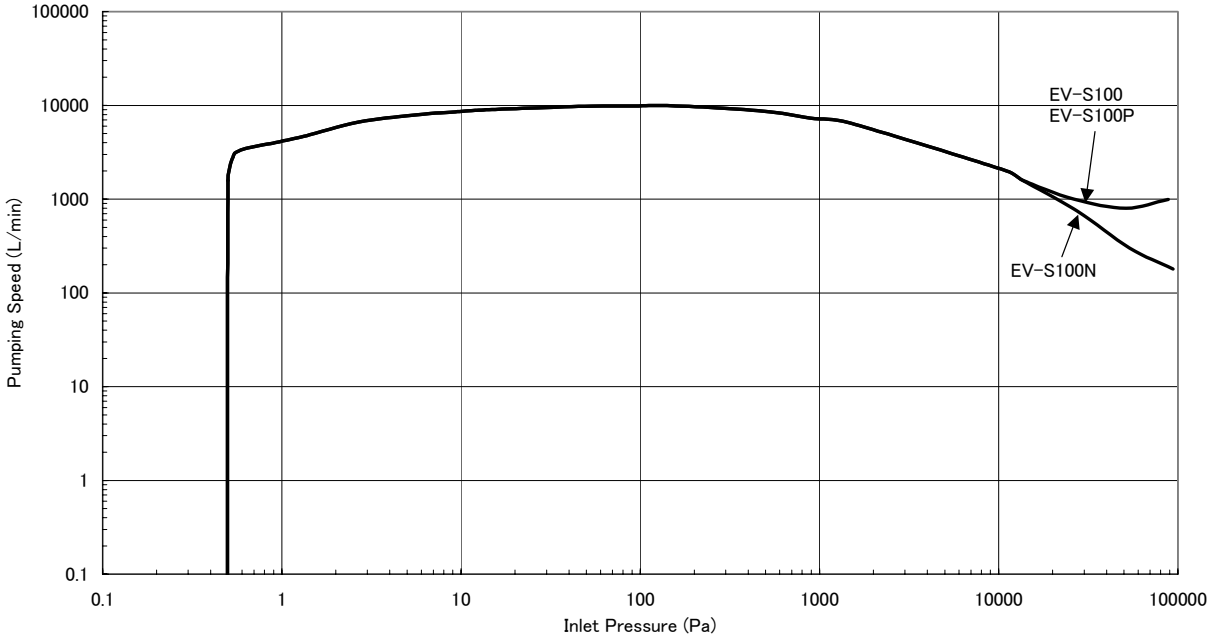


Fig 2.3 EV-S100(P/N) Performance Curve

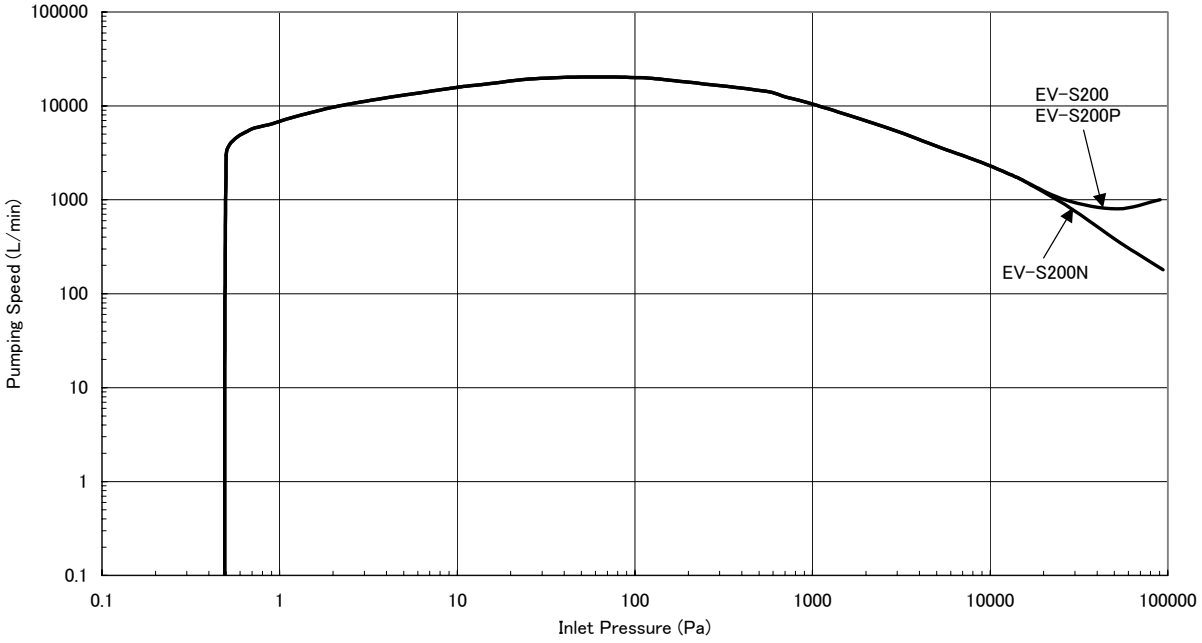
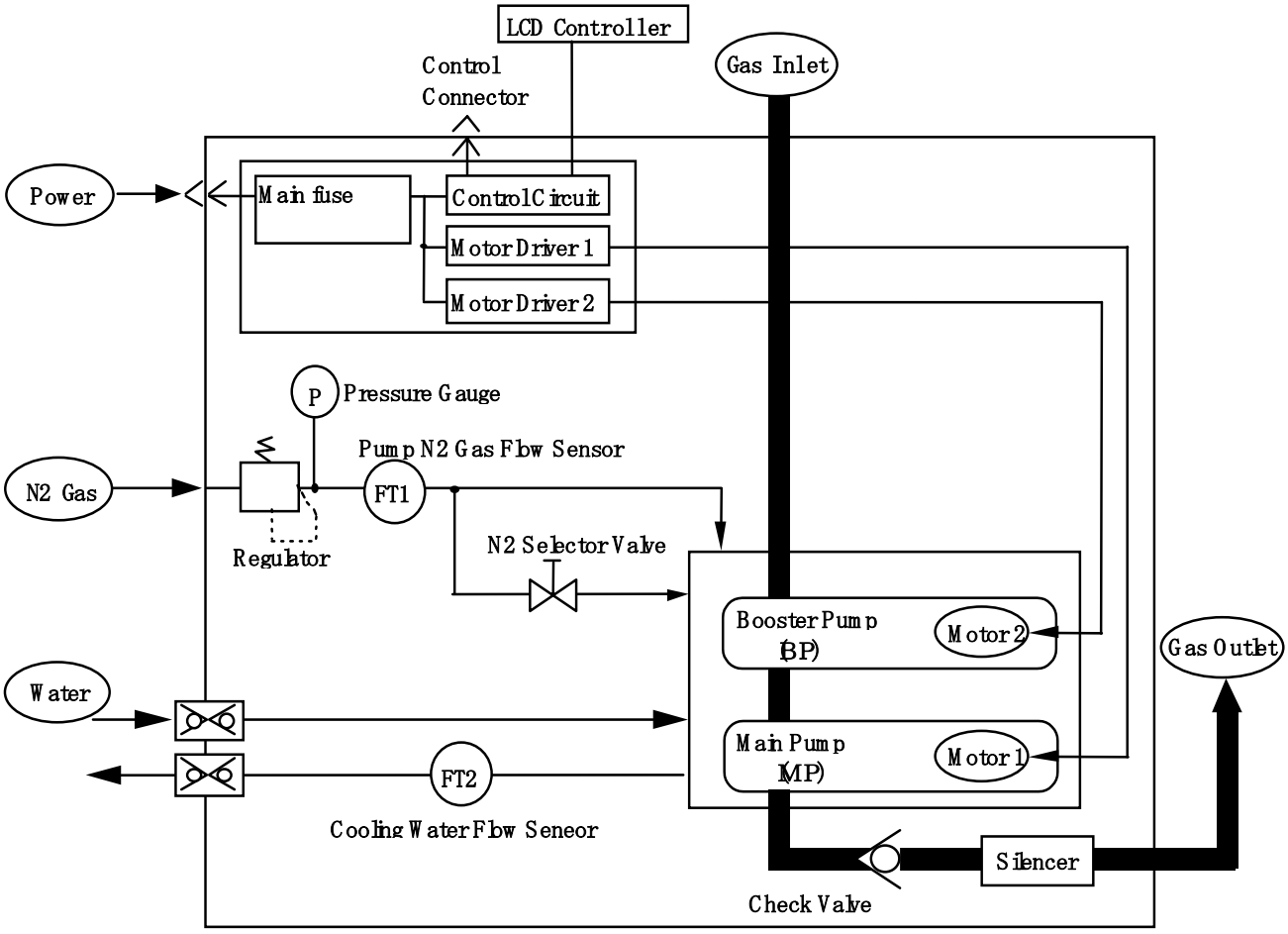


Fig 2.4 EV-S200(P/N) Performance Curve

2.3.5 System Flow



* The EV-S20 pump is supplied without a booster pump (BP).

Fig 2.5 System Flow

2.4 Release and shut off residual internal energy

> ⚠ **WARNING**
>
> To avoid dangers potentially encountered during maintenance, transportation or storage, follow instructions below to shut off power.

> ⚠ **WARNING**
>
> Capacitors within the control panel retain residual energy after interruption of power supply. Wait five (5) minutes after shutting off breaker before opening the control panel. Carefully check that bleed circuits have discharged the residual energy before servicing the control panel.

> ⚠ **WARNING**
>
> To comply with SEMI S2, install lockable shutoff devices on electrical, nitrogen and cooling water supplies. These devices should be adjacent to and within sight of the pump.

2.4.1 Electrical Power - Lockout and Tagout

Lock the branch circuit in the OFF position and tag it out to perform maintenance or troubleshooting.

1. Verify that the LCD display is lit (confirming that pump is powered).
2. Turn the branch circuit disconnect off.
3. Insert padlock through holes provided on locking device. Close padlock and attach tag.
4. Keep the key with you while working. Prepare the tagout label per factory procedures.
5. Verify that LCD display is unlit (confirming that pump is unpowered).
6. If unable to confirm interruption of power via LCD display, use a voltmeter to probe contacts at Connector CN-C. Potential between any two pins indicates that electrical power to the pump is not interrupted.
7. The Lockout/Tagout procedures must comply with OSHA 29 CFR 1910.147 and 1910.331-335

2.4.2 Cooling water

1. Close [facility] water supply to stop water supply to the pump, then close water return valve. Follow [facility] procedures for locking these valves in the off position.
2. Push the knurled outer ring of the quick-connect couplers toward the pump to disconnect the water hoses. Carefully remove the male coupling halves from the hoses and remake the quick-connects to drain the pump lines. Have a catchment vessel and absorbent cloths at hand before removing the couplings.
3. Make sure water outflow stops from both the facility lines and the pump.

2.4.3 Nitrogen (N_2)

1. Close [facility] nitrogen supply valve and follow facility procedures for locking this valve in the off position.
2. Verify that the nitrogen pressure gauge (on front panel of the pump) drops to 0 MPa, confirming that no pressurized gas energy is stored in the pump.
3. Pull out the red detent ring on the N2 regulator.
4. Turn knob counterclockwise until pressure gauge reads 0 MPa. (Both N2 regulator knob and nitrogen pressure gauge are located on front panel of the pump.)
5. Disconnect tube connection of N2 supply line by turning tube nut counterclockwise.
6. Plug (cap) ¼" tube connector on the pump with a tube fitting cap.

2.4.4 Returning to Service

1. Unlock and open water and nitrogen valves.
2. Remove handle stop bracket and switch circuit breaker on.
3. Restrart pump and open foreline valve only after appropriate leak checks and safety verifications.

3. Installation

Pump performance is changed by the setting conditions such as the size / length of pump Iinlet / outlet.

Please choose the parts suitable for use condition in the piping and a seal part.

For lifting the pump, use only qualified operator personnel. Be sure that the wire rope and crane used for lifting the pump are in proper order and match the weight of the pump. To prevent unequal weight distribution, suspend the pump by ensuring that the slinging angle remains symmetrically centered.

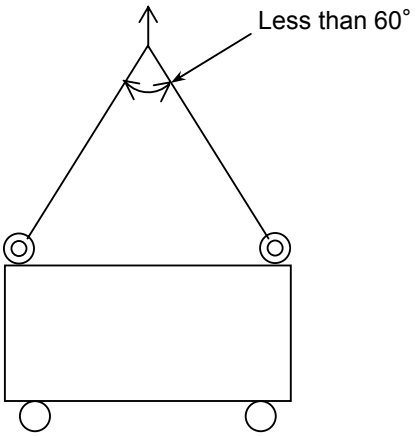


Fig 3.1 Lifting the Punp

> ⚠ **DANGER**
>
> Do not enter the zone underneath the suspended pump.

> ⚠ **WARNING**
>
> For lifting the pump, use only qualified operator personnel. Be sure that the wire rope and crane used for lifting the pump are in proper order and match the weight of the pump. To prevent unequal weight distribution, suspend the pump by ensuring that the slinging angle remains symmetrically centered.

3.1 Movement and Fixation

3.1.1 Location

This pump is designed for indoor installation. To install the pump, select a place with little exposure to dust and humidity and not subject to dew condensation. Also allow for sufficient space to ensure easy pump installation and disassembly for maintenance. In case of installing interface box to the pump, the distance between pump and interface box shall be 3m or less.

Note

Install pump in a location at an ambient not exceeding 30°C. Particular caution is required when the pump is operated in an enclosed room.

Note

A gap of at least 50mm should be left open for ventilation between the pump cover and the adjacent equipment.

3.1.2 Caster and adjustment foot

Casters and adjusters of four each are attached under the pump base. When moving the pump, lift up all of the four adjusters. To lift them up, use the wrench and turn them to the left.

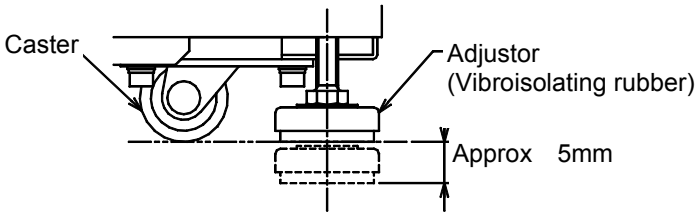


Fig 3.2 Caster

⚠ WARNING

Be careful not to overturn the pump when pushing and pulling it sideways, because the width of the pump is small to its height.

⚠ CAUTION

The neck portion of the casters will vibrate during caster movement. Be sure to keep your fingers and feet out.

⚠ CAUTION

Do not step on the pump or place objects on it.

(1) To fix the pump, turn the adjusters to the right to lower them.

(2) Adjust the height of the feet evenly to ensure that the pump base is level.

Note

If the pump is not leveled, shortage of the lubrication oil supply to the bearing may be caused.

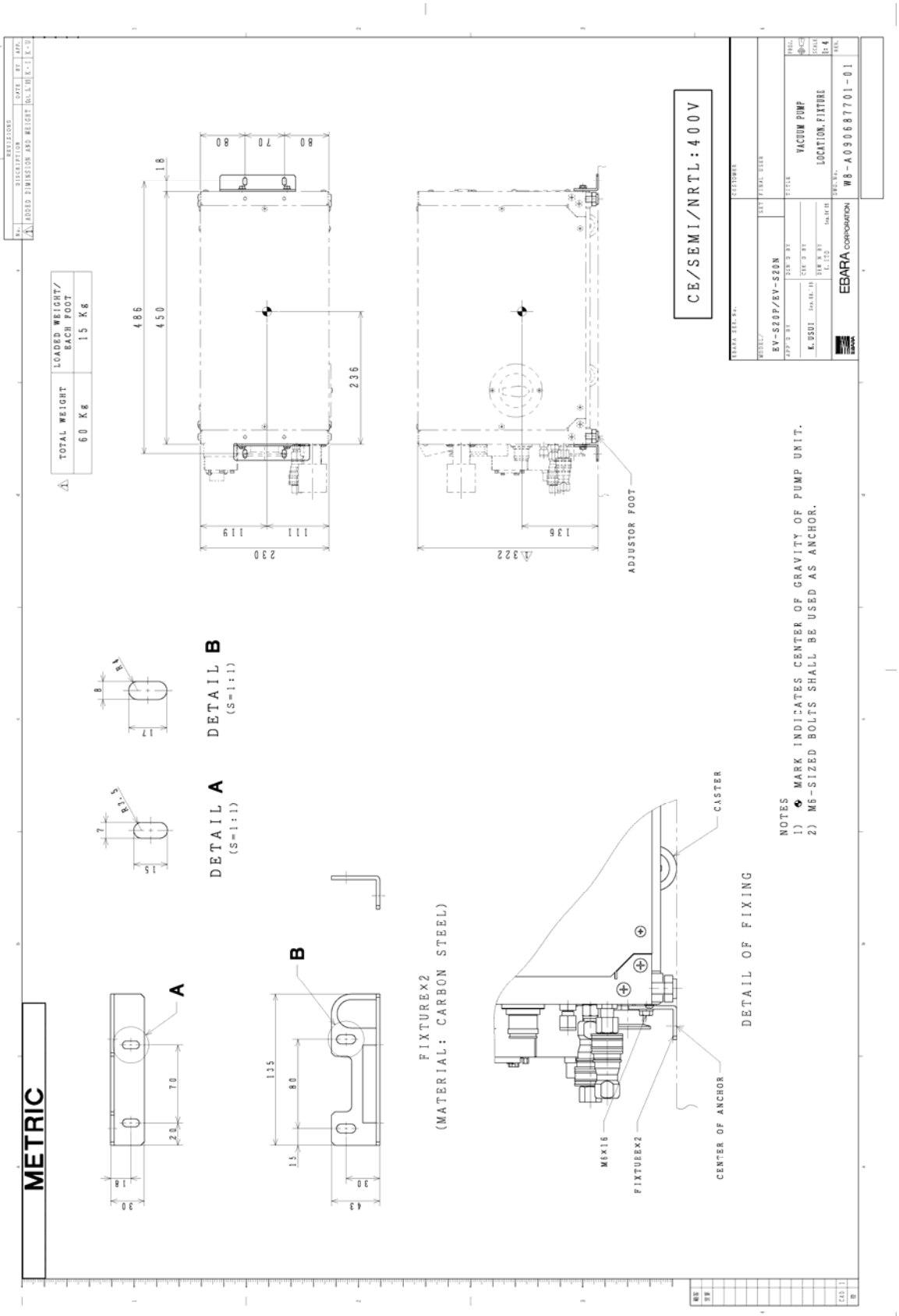
> **Note**
> Floor vibrations will increase unless the adjustment feet are used.

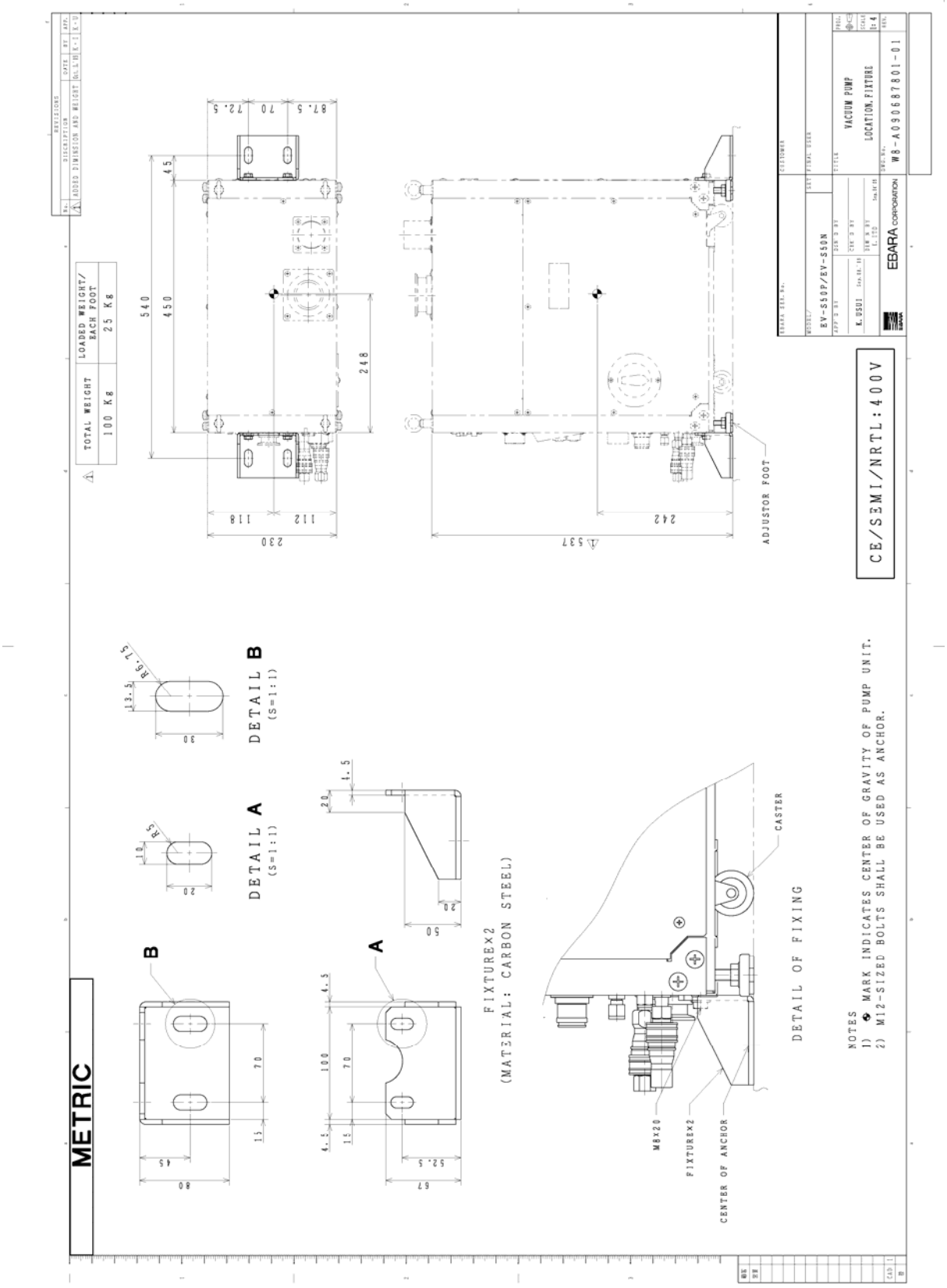
3.1.3 Pump Fixation (Option)

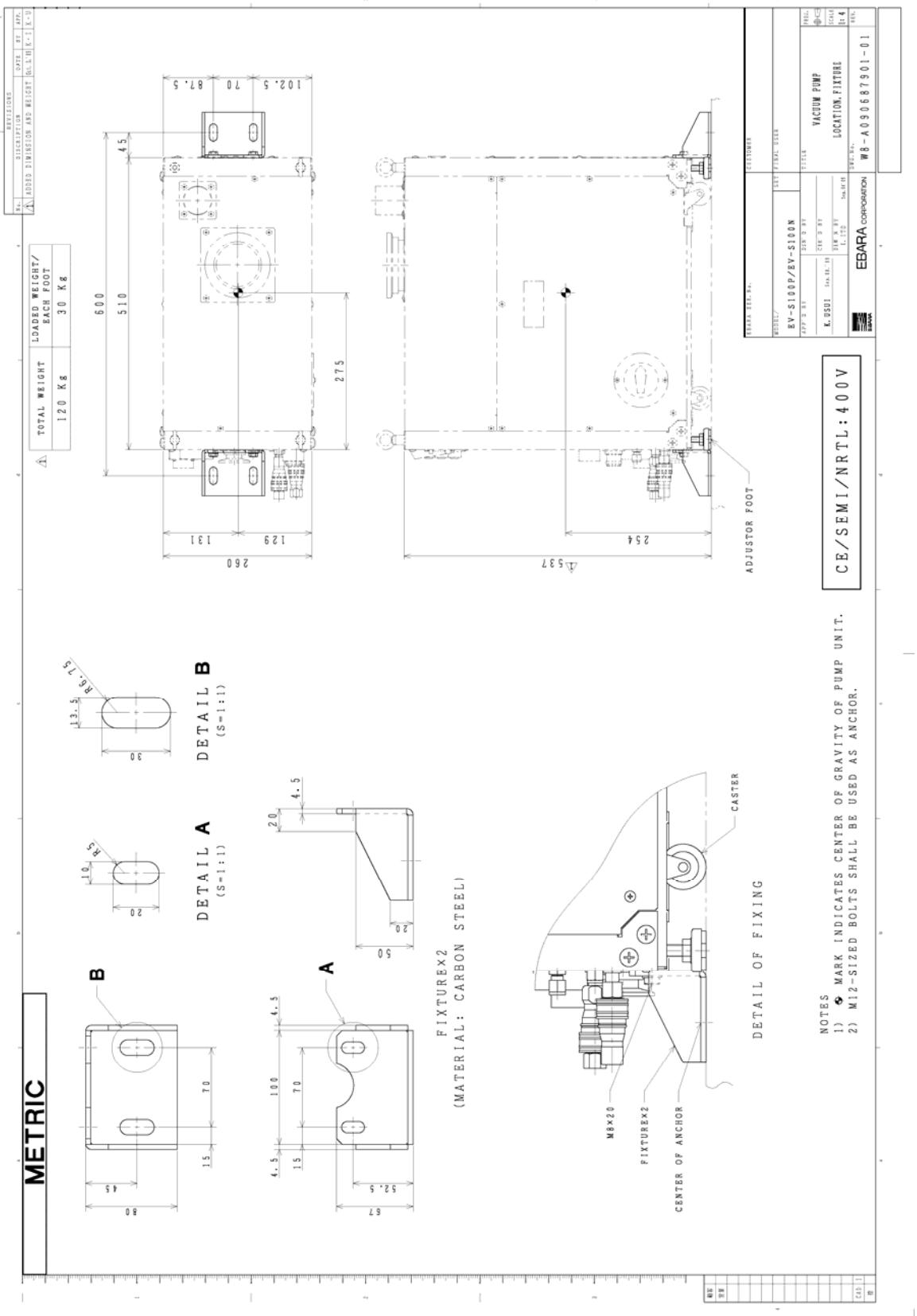
The pumps are provided with casters for easy transportation and foot adjustments for anchoring and height adjusting, as described in Section 3.1.2. The pump, however, may unexpectedly move or fall down when an earthquake occurs. To prevent such events, EV-S dry pumps (CE/SEMI compliant) are equipped with brackets to secure the pump body to the floor. Fix the pump to the floor or other firm ground with the brackets at the installation.

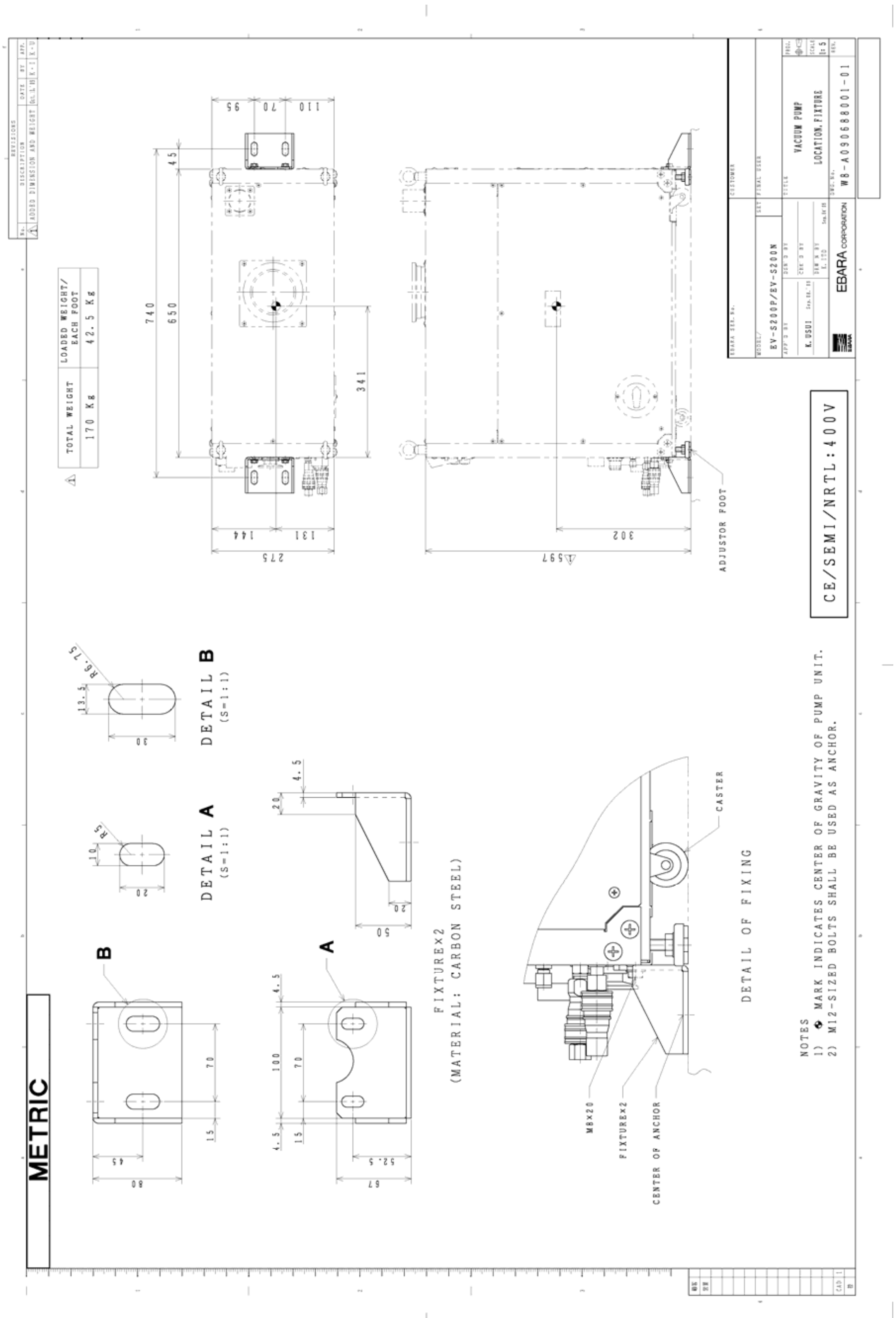
For dimensions of the bracket, see the accompanying drawing.

Anchor bolts should be fit for conditions of the floor where the pump is anchored.


CE/SEMI/NRTL:400V
EBARA CORPORATION
EV-S20P/EV-S20N
VACUUM PUMP
LOCATION.FIXTURE
W8-A09068770I-01
TOTAL WEIGHT
60 Kg
LOADED WEIGHT/ EACH FOOT
15 Kg
ADJUSTOR FOOT
DETAIL A
(S=1:1)
DETAIL B
(S=1:1)
FIXTURE×2
(MATERIAL: CARBON STEEL)
DETAIL OF FIXING
CASTER
CENTER OF ANCHOR
FIXTURE×2
M6×16
NOTES
1) ◆ MARK INDICATES CENTER OF GRAVITY OF PUMP UNIT.
2) M6-SIZED BOLTS SHALL BE USED AS ANCHOR.
METRIC


TOTAL WEIGHT
100 Kg
LOADED WEIGHT/ EACH FOOT
25 Kg
EV-S50P/EV-S50N
YACUUM PUMP
LOCATION, FIXTURE
EBARA CORPORATION
W8-A0906878O1-01
CE/SEMI/NRTL:400V
METRIC
DETAIL A
(S=1:1)
DETAIL B
(S=1:1)
FIXTUREX2
(MATERIAL: CARBON STEEL)
DETAIL OF FIXING
CASTER
M8X20
FIXTUREX2
CENTER OF ANCHOR
ADJUSTOR FOOT
NOTES
1) ✥ MARK INDICATES CENTER OF GRAVITY OF PUMP UNIT.
2) M12-SIZED BOLTS SHALL BE USED AS ANCHOR.


TOTAL WEIGHT
120 Kg
LOADED WEIGHT/
EACH FOOT
30 Kg
600
510
45
275
260
131
129
537
254
ADJUSTOR FOOT
EV-S100P/EV-S100N
VACUUM PUMP
LOCATION, FIXTURE
W8-A0906B7901-01
EBARA CORPORATION
CE/SEMI/NRTL:400V
METRIC
DETAIL A
(S=1:1)
DETAIL B
(S=1:1)
R6.75
13.5
30
R5
10
20
FIXTURE×2
(MATERIAL: CARBON STEEL)
4.5
20
50
100
70
15
80
45
67
52.5
DETAIL OF FIXING
CASTER
M8×20
FIXTURE×2
CENTER OF ANCHOR
NOTES
1) ✤ MARK INDICATES CENTER OF GRAVITY OF PUMP UNIT.
2) M12-SIZED BOLTS SHALL BE USED AS ANCHOR.


METRIC
TOTAL WEIGHT
170 Kg
LOADED WEIGHT/ EACH FOOT
42.5 Kg
DETAIL A
(S=1:1)
DETAIL B
(S=1:1)
FIXTURE×2
(MATERIAL: CARBON STEEL)
ADJUSTOR FOOT
CASTER
M8×20
FIXTURE×2
CENTER OF ANCHOR
DETAIL OF FIXING
CE/SEMI/NRTL:400V
NOTES
1) ✦ MARK INDICATES CENTER OF GRAVITY OF PUMP UNIT.
2) M12-SIZED BOLTS SHALL BE USED AS ANCHOR.
EV-S200P/EV-S200N
VACUUM PUMP
LOCATION, FIXTURE
W8-A090688001-01
EBARA CORPORATION

3.2 Piping

3.2.1 Vacuum and Exhaust Piping

Connect the vacuum and exhaust pipes to the suction and exhaust flanges.

A narrow clearance is maintained in the pump for rotor rotation. The ingress of foreign objects into the pump interior will therefore prevent the pump from operating. Be sure therefore to heed the following cautions when making the pipe connections.

a) Remove all foreign matter from inside the piping.

b) When connecting be sure that no dirt or dust particles adhere to the flange surfaces and/or that the flange surfaces are damaged. Provide a suitable means of preventing the ingress of reaction by-products adhering to the pipes and wafer fragments. For this purpose, a filter may be installed.

c) The weight of the pipes attached to the pump can cause misalignment and leaks from the flange connections. Be sure therefore to support the piping properly and not to apply undue force when aligning the flange faces. It is recommended to insert flexible bellows when connecting the pipes to the suction and exhaust flanges of the pump. The length of the flexible bellows on the vacuum (suction) side will vary according to the vacuum drawn. Be sure to connect so that no undue force can be applied to the flexible bellows.

d) Please decide a part to connect to the pump exhaust so that the exhaust pressuret is not beyond atmospheric pressure.

> ⚠ **WARNING**
>
> Be sure to check for leaks after you have installed the pump. Leaks will cause serious danger due to the discharge of harmful and hazardous substances and the occurrence of unpredictable reactions associated with the admission of air into the pump (for a leak check with pressurization, apply a pressure of 0.05 MPa at the N2 gas purge port).

> ⚠ **WARNING**
>
> The pump casing, inlet piping and exhaust piping become extremely hot during operation and for some time after stopping. Be sure that pump and exhaust piping do not come in contact with humans or inflammable substances. Do not remove the pump cover during operation.

> ⚠ **CAUTION**
> The exhaust piping made by polyvinyl chloride causes the noise thrugh the pipe.

3.2.2 Cooling Water Piping

Be sure to connect the cooling water pipes to the correct inlet and outlet ports. The connector ports are provided with couplers. Push in the plug till the end of socket. Socket sleeve returns to front. When the coupler is pulled out the water pipe will be automatically blocked. Use cooling water corresponding to the specifications of Table 3.1 below.

Table 3.1 Industrial Water Supply Quality Specification
(Japan Industrial Water Association, Industrial Water Quality Standards Committee)

Turbidity	(ppm)	20
pH		6.5-8.0
Alkalinity(CaCO3)	(ppm)	75
Hardness(CaCO3)	(ppm)	120
Evaporation residue	(ppm)	250
Chlorine ion	(ppm)	80
Iron	(ppm)	0.3
Manganese	(ppm)	0.2

> ⚠ **CAUTION**
> Even when the cooling water flow rate drops, the pump will continue to operate until the pump part reach a temperature corresponding to the safety limit. The material selected for the water piping of facility side should have a heat resistance so that it can withstand a maximum temperature of at least 70℃ at the operating pressure.

> **Note**
> When several pumps are used, be sure to connect the cooling water pipes to each pump in parallel. The cooling water will flow more or less easily according to the type of pump and the piping. Be sure to select the correct piping so as to ensure the appropriate cooling water flow rate for all pipes used.

> **Note**
> When the cooling water connections are incorrect and the flow is reversed, a flow rate different from the normal value will be displayed. Nor will the pump will not be cooled properly. This will result in accident. Be sure therefore to connect correctly to avoid problems.

⚠ CAUTION

When the cooling water supply is left on while the pump is stationary dew condensation will form on the water-cooled parts in locations with high humidity. Make it a rule therefore to stop the cooling water when water droplets can be detected on the outer surface of the pump cooling water piping as this suggests the possibility of dew condensation in the

3.2.3 N2 Gas Piping

Cut tube at right angles and make the end-face perfectly smooth. Then connect the tube to the tube fitting assembly of the N2 gas purge port. The tube is a push-fit onto the shoulder of the tube fitting assembly. Secure the tube fitting assembly properly and tighten the retaining nut by hand. After this, use a tool to tighten the nut further by 1 + 1/4 turns. To connect the tube again after this, install the tube already fitted to the ferrule and re-tighten the retaining nut slightly after the initial tightening (generally, tighten by a further quarter turn after tightening by hand).

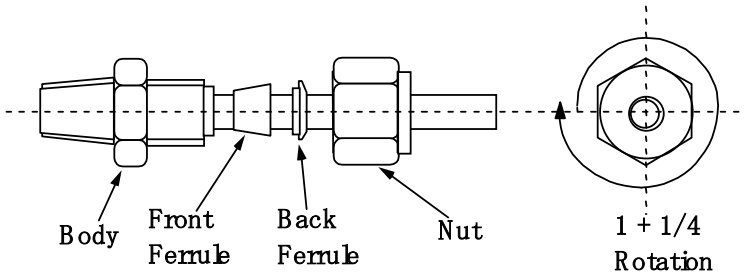


Fig 3.3 Tube Fitting Assembly

⚠ WARNING

Safe operation with toxic, flammable or pyrophoric gases may require nitrogen dilution to reduce gas concentrations below flammable, explosive or toxic limits (LFL, LEL or TLV). Determining the N2 dilution flow requirement and connect a nitrogensupply to the pump exhaust line. Use an appropriate device, e.g. a switched flow meter, with a set point appropriate to the N2 requirements to monitor this nitrogen flow. Connect the normally open (LOW Flow = Open) contacts on the flow switch to an external contactor to create a Dilution N2 Interlock that de-energizes the pump if N2 flow drops below the set point.
See Appendix 5.

3.3 Electrical Wiring

> ⚠ **DANGER**
> Be sure to keep the power supply to the pump turned off and lock-outed until you have finished the wiring and connecting work. Also interrupt the Circuit Protector (CP) during

> ⚠ **WARNING**
> Electrical wireing shall be carried out only by qualified electricians.

> ⚠ **WARNING**
> ELB (or CB) is not installed in the pump unit. Please install ELB(or CB) based on the law and the standard in the installation region. (Refer to “9. For SEMI S2 standard” about the SEMI S2 standard correspondence.)

> ⚠ **WARNING**
> Do not perform a withstand voltage test. Failure to comply could result in damage to the sensitive devices.

> ⚠ **CAUTION**
> Do not apply the power supply from the pump's power pack to any other equipment as this will result in malfunctioning of the control units and in pump failure.

3.3.1 Power Supply Wiring

> ⚠ **WARNING**
> Be sure to connect

> ⚠ **CAUTION**
> Use the correct wiring materials and size to match the operating conditions in accordance with the power consumption rating and ambient air temperature of the pump.

Wire the connector for the main power supply (380-440V AC at 3-phase and 50 / 60Hz). Figs. 3.4 and 3.5 and Tables 3.2, 3.3, 3.4 and 3.5 show the connector pin assignment. Connector pin is a screw fix type. Please make sure to tighten the screw enough to fix the connector pin. Please wire the connector pin by the specialized tool.

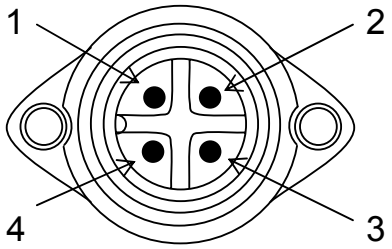


Fig 3.4 Power Supply Receptacle
(As seen from connecting side)

Table 3.2 Pin Assignment
of Power Supply Receptacle

NO.	Phase
1	R
2	S
3	T
4	GND

Table 3.3 Receptacle Specification

Pump model	EV-S20
Receptacle type	C016 20C003 100 12
Recep. Manufacturer	Amphenol
Adapted plug type	C016 20D003 100 12
Suitable wire	AWG #14
Power capacity kVA	3.2

* Plug contact is a screw fix type. Please make sure to tighten the screw enough to fix the Plug contact.

Table 3.4 Pin Assignment
of Power Supply Receptacle

NO.	Phase
A	R
B	S
C	T
D	GND

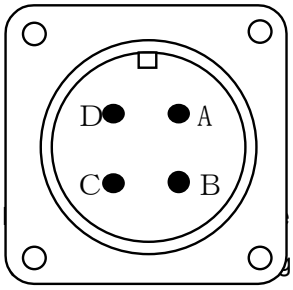


Fig 3.5 (side)

Table 3.5 Receptacle Specification

Pump model	EV-S50	EV – S100	EV – S200
Receptacle type	JL04HV-2E22-22PE-B		
Recep. Manufacturer	Japan Aviation Electronics Industry Co., Ltd.		
Adapted plug type	JL04V-6A22-22SE-EB		
Suitable wire	AWG #12	AWG #10	
Power capacity kVA	4.8	6.4	6.8

3.3.2 Control Signal Wiring

Connect wires to the control connector for remote operation and remote monitoring.

Tables 3.6, 3.7, 3.8 and 3.9 and Figs 3.6 and 3.7 show the pin assignment.

Table 3.6 Receptacle Specification

Connector No.	Connector type
CN-Z	15 pin D sub-miniature Female receptacle (In accordance with SEMI-F-73-0299)
CN-Y	25 pin D sub-miniature Female receptacle

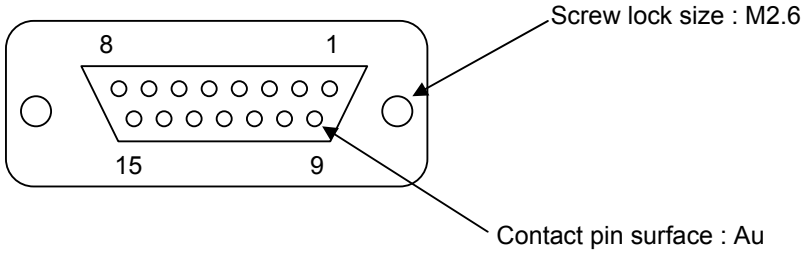


Fig 3.6 15 Pin D Sub-Miniature Female Receptacle

(As seen from connecting side)

Table 3.7 Control Connector Pin Assignment (CN-Z: In accordance with SEMI-F-73-0299)

Pin. No.	Signal name	I/O	Signal type
1	MP START (+)	IN	Run:CLOSE , Alternate
2	BP START (+)	IN	Run CLOSE, Alternate
3	MP START STATUS (+)	OUT	Run:CLOSE, Alternate
4	BP START STATUS (+)	OUT	Run:CLOSE, Alternate
5	WARNING STATUS (+)	OUT	WARNING:OPEN, Alternate
6	ALARM STATUS (+)	OUT	ALARM:OPEN, Alternate
7	REMOTE STATUS (+)	OUT	REMOTE:CLOSE
8	−		
9	MP START (−)		
10	BP START (−)		
11	MP START STATUS (−)		
12	BP START STATUS (−)		
13	WARNING STATUS (−)		
14	ALARM STATUS (−)		
15	REMOTE STATUS (−)		

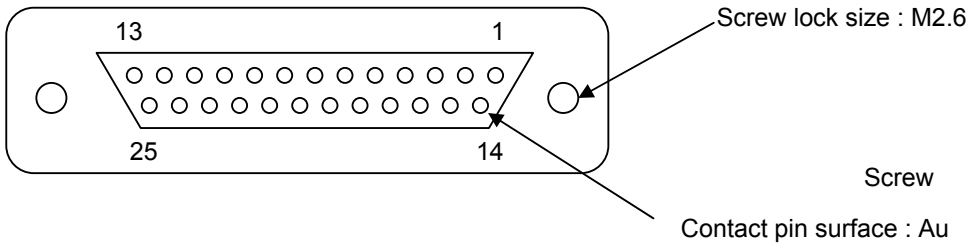


Fig. 3.7 25 Pin D Sub-Miniature Female Receptacle
(As seen from connecting side)

Table 3.8 Control Connector Pin Assignment (CN-Y)

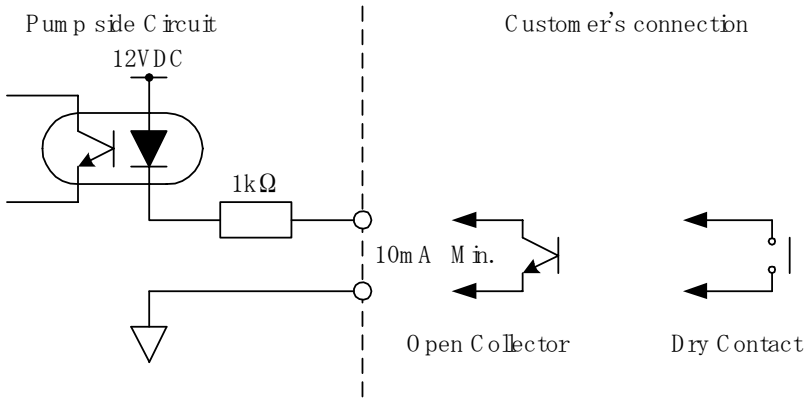
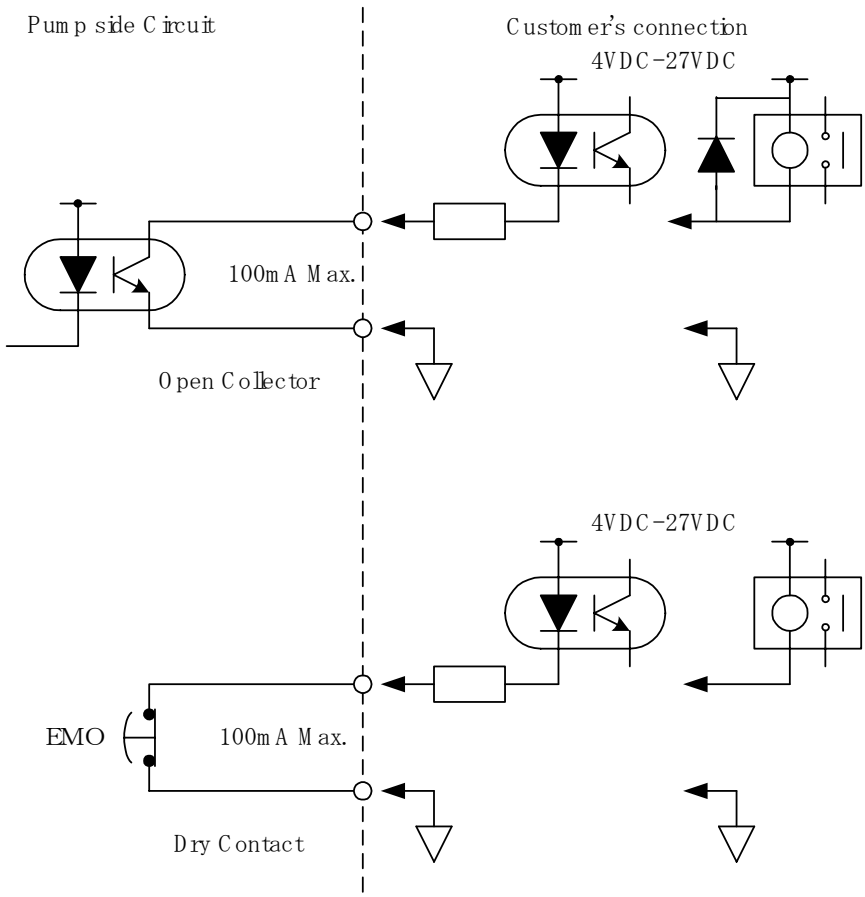
Pin No.	Signal name	I/O	Signal type
1	RESET (+)	IN	RESET:CLOSE
2	SAVING ENERGY CONTROL (+)	IN	SAVING ENERGY:CLOSE, Alternate
3	RESERVED (+)	IN	
4	RESERVED (+)	IN	
5	RESERVED (+)	IN	
6	EMO STATUS (+)*1	OUT	Abnormality:OPEN, Alternate
7	PUMP N2 WARNING STATUS (+) *2	OUT	Abnormality:OPEN, Alternate *3
8	RESERVED (+)	OUT	
9	SAVING ENERGY STATUS (+)	OUT	SAVING ENERGY:CLOSE, Alternate
10	RESERVED (+)	OUT	
11	RESERVED (+)	OUT	
12	RESERVED (+)	OUT	
13	-		
14	RESET (−)		
15	SAVING ENERGY CONTROL (−)		
16	RESERVED (−)		
17	RESERVED (−)		
18	RESERVED (−)		
19	EMO STATUS (−)*1		
20	PUMP N2 WARNING STATUS (−)		
21	RESERVED (−)		
22	SAVING ENERGY STATUS (−)		
23	RESERVED (−)		
24	RESERVED (−)		
25	RESERVED (−)		

*1 EMO is optional.

*2 Only EV-**P / EV-**N

*3 Switching to N.C. is allowed by changing the DIP switch settings (see 5.4 DIP Switch).

Table 3.9 CN-Z & CN-Y Signal Contacts

Input Signal	
Output Signal	

Note

Do not wire vacant pins.

Note

Apply a 12V DC power for input signals on the pump side. Do not apply this voltage on the equipment side. The output signals are generated from an open collector output. Please use it by the equipment side, impressing the power supply of DC4V to DC27V.

Note

Be sure to wire all signals with the correct polarity (SIG./COM.).

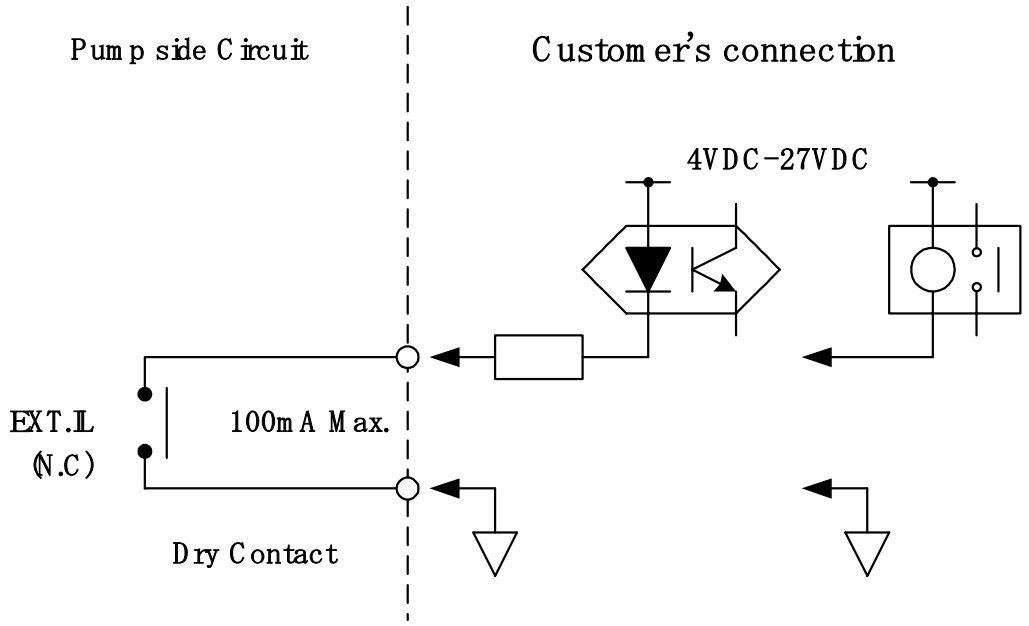
Note

When output signals are used to energize an inductive load such as a relay, be sure to insert a diode (100V. 1A class) in order to absorb the back electromotive force due to surge currents.

3.3.3 External Interlock Connector (EXT I/L)

The EXT I/L connector, which provides contacts that open in the event of a pump ALARM, may be used to signal an external device, such as a gas dispense box, of a pump problem.

Wire this connector as shown below:



4. Power Supply for the Options (Connector CN-C)

This Power Supply is used for the options listed below and should not be used for other purposes.

For example:

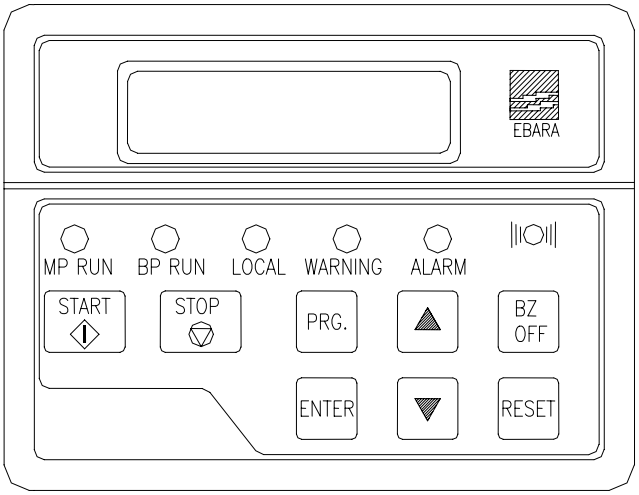
ADAPTER for Central Monitoring System

Interface Controller

> **Note**
> Do not use the power supply for other purposes.

5. LCD Controller

5.1 LCD Outline



[Buttons]	START	For start of MP
	STOP	For stop of MP
	▲ ▼	For changing LCD indication
	RESET	For resetting WARNING and ALARM
	BZ. OFF	For "buzzer mute in WARNING / ALARM "
	ENTER	For using at DIP switch selection
[LED]	BP RUN	BP running (It doesn't operate in EV-S20(P/N))
	MP RUN	MP running
	LOCAL	LOCAL mode
	WARNING	WARNING condition
	ALARM	ALARM condition

Fig 5.1 LCD controller

5.2 LCD Indication

The operating status of the pump is displayed on the LCD of the controller.

For details of display, see Tables 5.1.

Table 5.1 LCD controller indication

No	ITEM	INDICATION
1	Power	BP: ##.## kW MP: ##.## kW
2	Control mode Pump running mode	CONTROL:LOCAL MODE:NORMAL
3	Running history (Indication of history)	PUMP RUNNING HISTORY?
4	Alarm history (Indication of history)	ALARM/WARNING HISTORY?
5	Pump type voltage Pump unit No.	******### V &&&&&&&&
6	Total operation time	OPE.TIME #####h
7	Back Pressure	BACK PRESSURE ###.#kPa
8	Pump N2 gas flow	PUMP N2 FLOW ##.#Pam3/s
9	Cooling water flow	WATER FLOW ##.#L/min
10	Pump casing temperature	CASING TEMP. ###°C
11	Motor speed	BP: #.# kmin-1 MP: #.# kmin-1
12	WARNING/ALARM	$$$$$:$$$$$$$ % $$$$$$$$$$$$$

1. Two control modes are available: ”LOCAL (local operation) “ and “REMOTE (remote operation) ”.
2. Two running modes are available “NORMAL (rate operation)” and “S.ENERGY (energy-saving operation)”
3. " % " shows present number of WARNING/ALARM.
4. Upper row "$$$$$" distinguishes between WARNING/ALARM and indicates the position where WARNING/ALARM has occurred.

5. Total pump operating time gives the total hours of operation after shipment from the factory.
6. The display will return to the motor current indication when no operation takes place after the lapse of 1 minute.
7. Use the Display Select Switch (▲ ▼) to change the display. The WARNINGs/ALARMs that have currently been generated can be displayed with the Display Select Switch.

See Fig. 6.2 for the key operation of the pump operation status display.

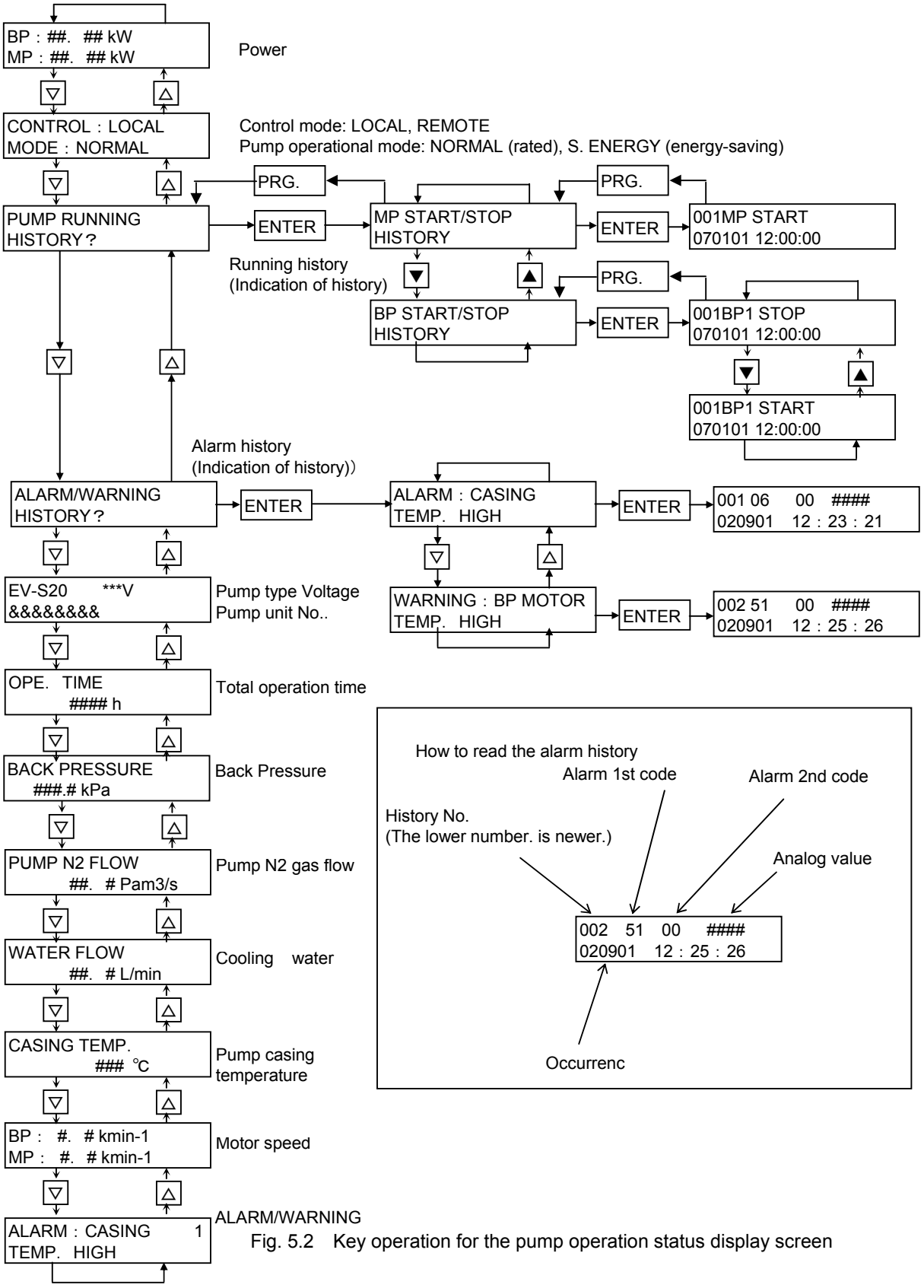


Fig. 5.2 Key operation for the pump operation status display screen

Table 5.2 Alarm code list

ALARM name	Code 1st code	Code 2nd code
MP casing temp.	50	01
BP motor temp.	51	00
MP motor temp.	52	00
Water Leakage (▲)	53	00
Back pressure high (▲)	63	00
Power failure	64	00
MP's driver protective circuit activated (OC)	65	01
MP's driver protective circuit activated (OV)	65	02
MP's driver protective circuit activated (OH1)	65	04
MP's driver protective circuit activated (OH2)	65	05
MP's driver protective circuit activated (CPF)	65	06
MP's driver protective circuit activated (UV)	65	07
MP's driver protective circuit activated (DRE)	65	09
BP's driver protective circuit activated (OC)	66	01
BP's driver protective circuit activated (OV)	66	02
BP's driver protective circuit activated (OH1)	66	04
BP's driver protective circuit activated (OH2)	66	05
BP's driver protective circuit activated (CPF)	66	06
BP's driver protective circuit activated (UV)	66	07
BP's driver protective circuit activated (DRE)	66	09
BP overload 2	67	00
MP overload 2	68	00
BP step out	69	00
MP step out	70	00
Emergency stop (EMO) (▲)	71	00
Low cooling water	73	00
External interlock	74	00
Motor thermostat	81	00
Inner communication error (MP driver)	81	01
Inner communication error (IO)	81	02
Inner communication error (BP driver)	81	03
MP Driver Gate OFF	81	20
BP Driver Gate OFF	81	21

WARNING name	Code 1st code	Code 2nd code
Low cooling water	00	01
MP casing temp.	05	01
High board inner temp.	13	00
Pump N2 0mode error	14	01
Low pump N2	18	01
Back pressure high (▲)	21	01
Back pressure wire broke (▲)	21	02
BP motor temp.	23	00
MP motor temp.	24	00
Inner communication error (MP driver)	26	01
Inner communication error (BP driver)	26	02
Inner communication error (IO)	26	03
Inner communication error (AI)	26	04
Inner communication error (DVP413)	26	20

The mark "▲" indicates the item is optional.

5.3 Setting the operational mode

This section describes how to set the operational mode. In the normal state, the LCD controller displays pump status. To display the operational mode setting screen, press the key "PRG." for three seconds or longer. Pressing the key for one second or longer again returns to the pump status display screen. Table 5.3 below shows indications and the details of the operational mode setting.

Table 5.3 Operational mode setting screen

Item	Indication	Description
Setting the pump operation control mode	SET CONTROL MODE?	Switches the control modes: local and remote.
Setting the DIP switch	SET DIP SW?	Performs the DIP switch settings (see 6.4).
Setting the pump running mode	SET RUNNING MODE?	Switches the running modes: NORMAL and S. ENERGY.
Setting the rotational speed in the NORMAL mode	SET NORMAL SPEED?	Sets the pump rotational speed in the NORMAL mode.
Setting the rotational speed in the S. ENERGY mode	SET S.ENERGY SPEED?	Sets the pump rotational speed in the S. ENERGY mode.
Setting the pump N2 flow low warning threshold	SET POINT PUMP N2 WARNING?	Set the pump N2 flow low warning threshold
Setting the Cooling Water flow low warning threshold	SET POINT WATER FLOW?	Setting the Cooling Water flow low warning threshold
Setting the Back pressure high warning threshold	SET POINT BACK PRES.?	Set the Back pressure high warning threshold

Keys work as below for the setting screen.

START	Valid
STOP	Stops the pump.
RESET	Resets WARNING and /or ALARM.
BZ.OFF	Switches the DIP switch No.
▲	Sets the DIP switch to ON. Switches the display of the operational mode setting screen.
▼	Sets the DIP switch to OFF. Switches the display of the operational mode setting screen.
ENTER	Determines the selected setting.

See Fig. 5.3 for how to set the operational modes.

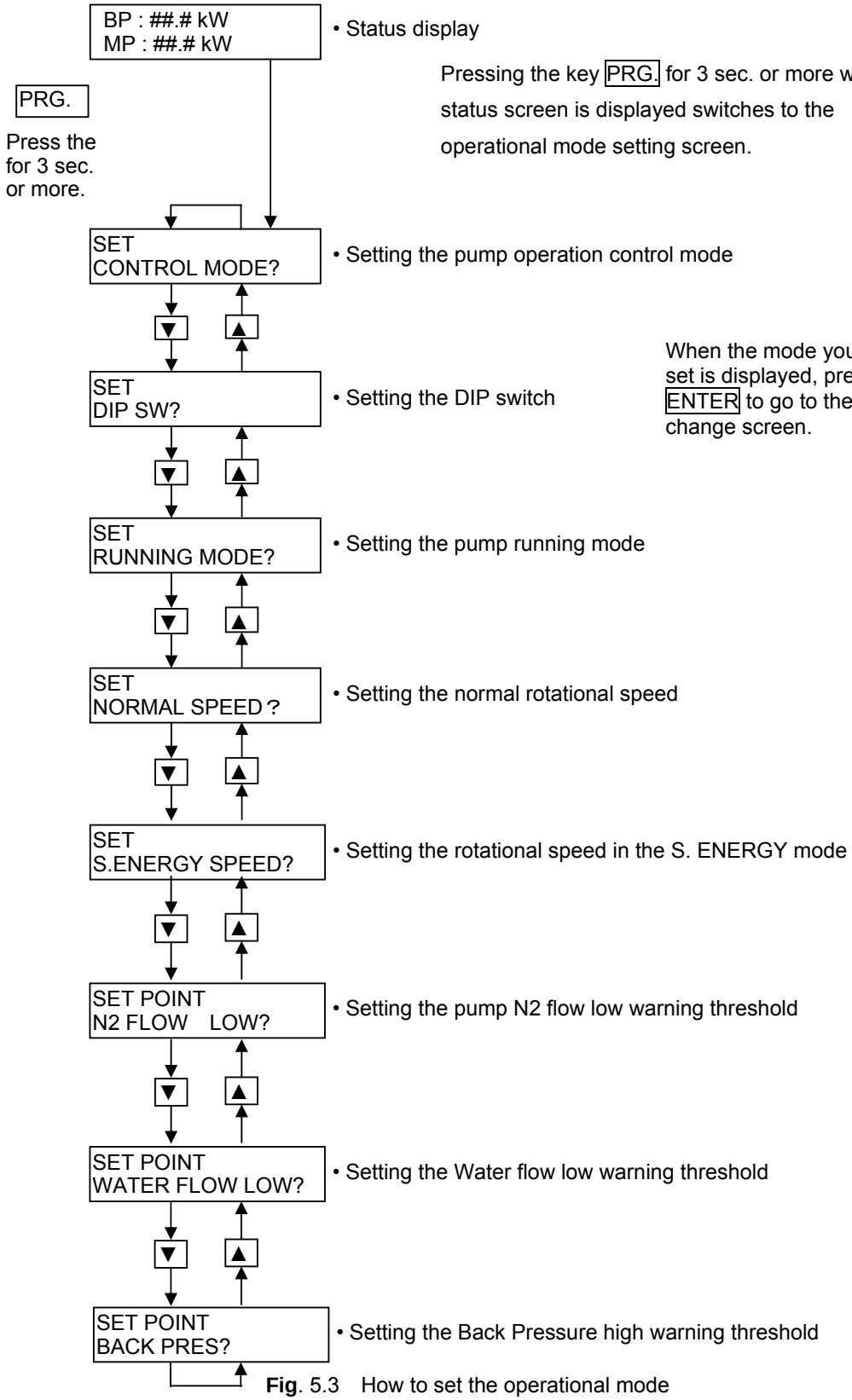
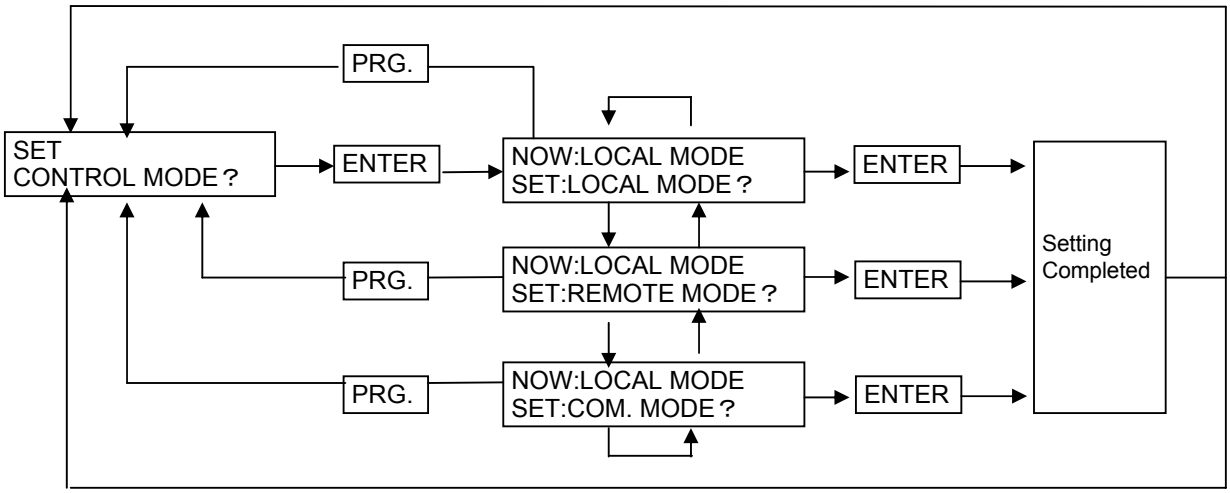


Fig. 5.3 How to set the operational mode

5.3.1 Setting the pump operation control mode

A case of display if Local mode selected.



REMOTE MODE : Enables the remote operation
(start/stop with external signals)

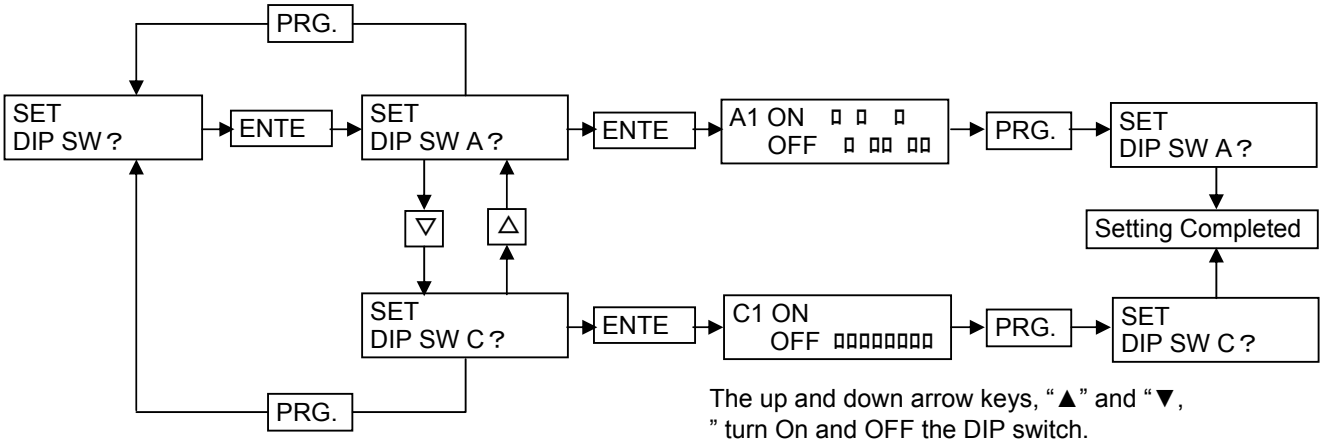
LOCAL MODE : Enables the local operation
(start/stop with the LCD controller)

COM MODE : Enables the communication operation
(start/stop with RS232C communication)

The mode which is currently not set is displayed.

If you do not need to set, press PRG. key to go back to the previous screen.

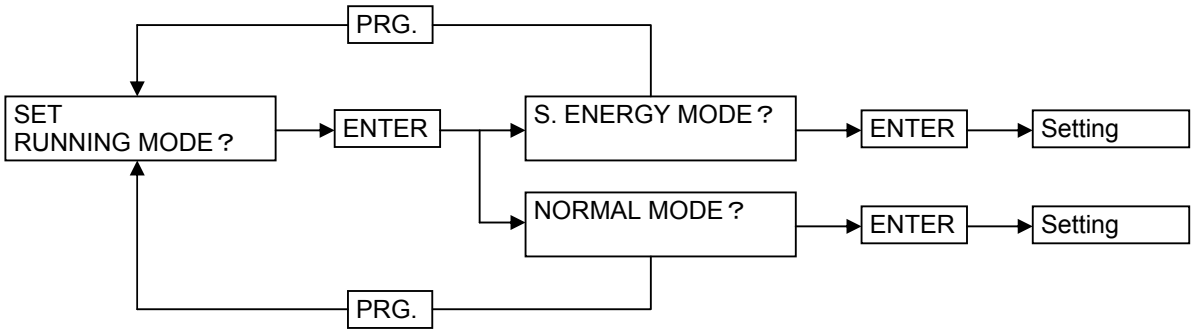
5.3.2 Setting the DIP switch



The up and down arrow keys, "▲" and "▼, " turn On and OFF the DIP switch.
The key BZ.OFF switches the selection from 1 to 8.

See 5.4 for details of the DIP switch.

5.3.3 Setting the pump running mode



S.ENERGY MODE : Enables the energy-saving operation

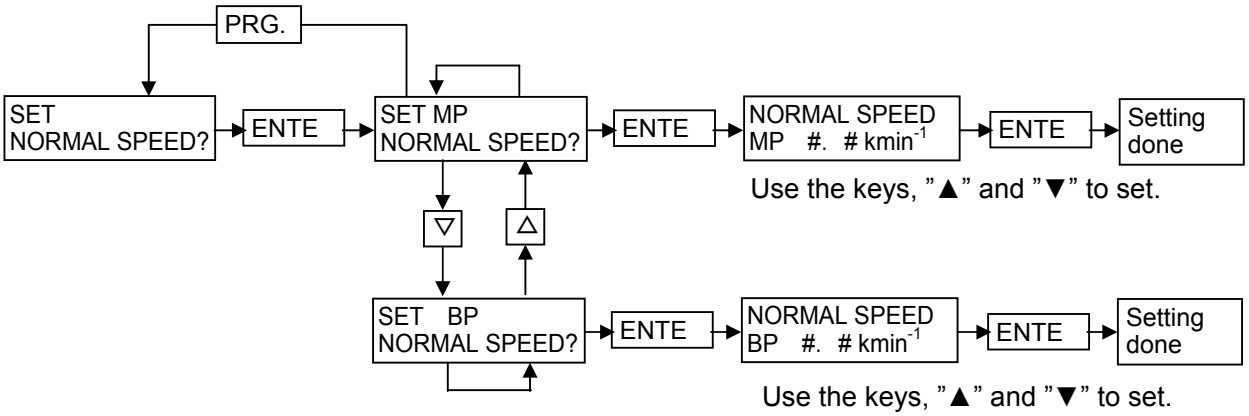
NORMAL MODE : Enables the rated operation.

The mode which is currently not set is displayed.

If you do not need to set, press the key

PRG. to go back to the previous screen.

5.3.4 Setting the rotational speed in the NORMAL mode



▲ ▼ Use the up and down arrow keys to change the setting value.

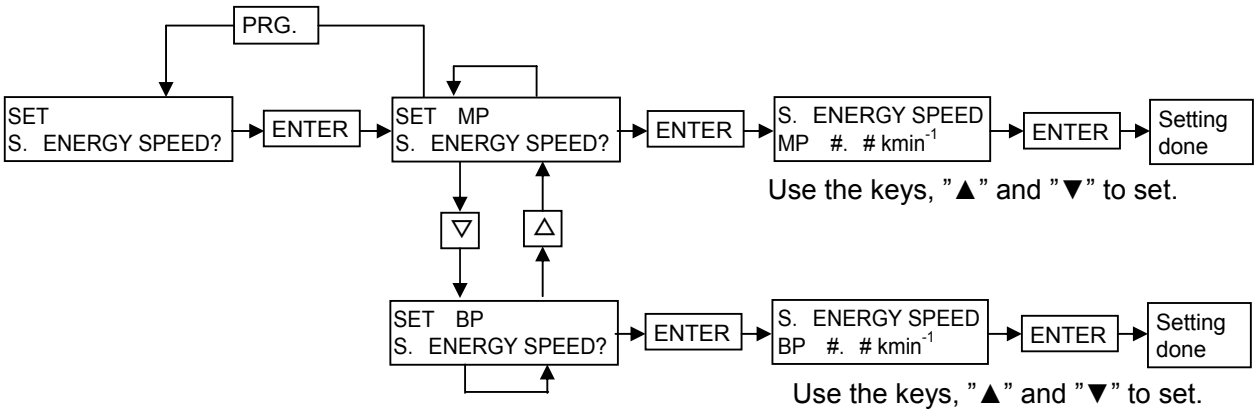
▲: Increase the setting speed by 0.1 $kmin^{-1}$.

▼: Decrease the setting speed by 0.1 $kmin^{-1}$

Upper limit MP/BP: The value lower than the set value for the rated speed

Lower limit MP/BP: 4.0 $kmin^{-1}$

5.3.5 Setting the rotational speed in the S. ENERGY mode



△ ▽ Use the up and down arrow keys to change the setting value.

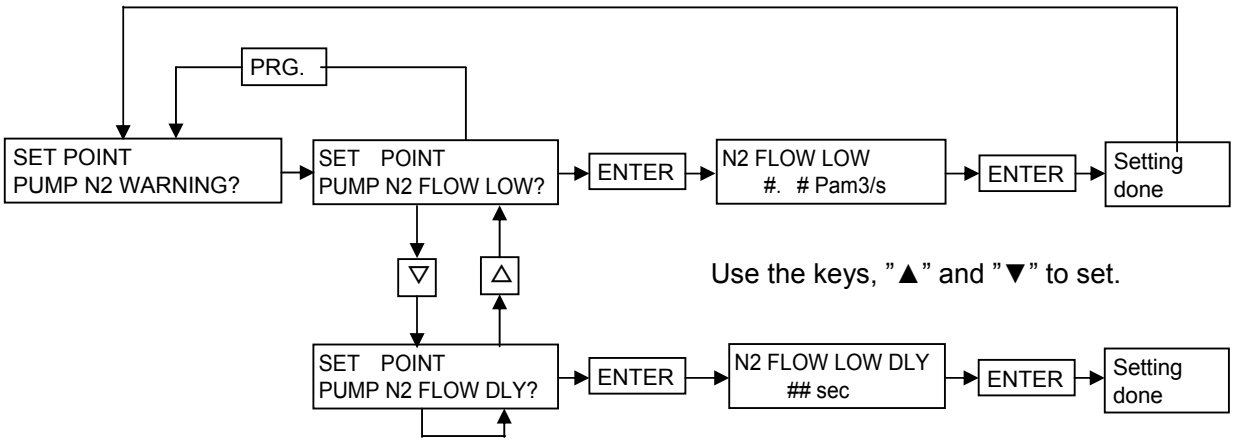
△ : Increase the setting speed by 0.1 $kmin^{-1}$.

▽ : Decrease the setting speed by 0.1 $kmin^{-1}$

Upper limit MP/BP : The value lower than the set value for the rated speed

Lower limit MP/BP : 1.0 $kmin^{-1}$

5.3.6 Setting the pump N2 flow low warning threshold



△ ▽ Use the up and down arrow keys to change the setting value.

△ : Increase the setting speed by 0.1 Pam^3/s (Delay time : 1 sec)

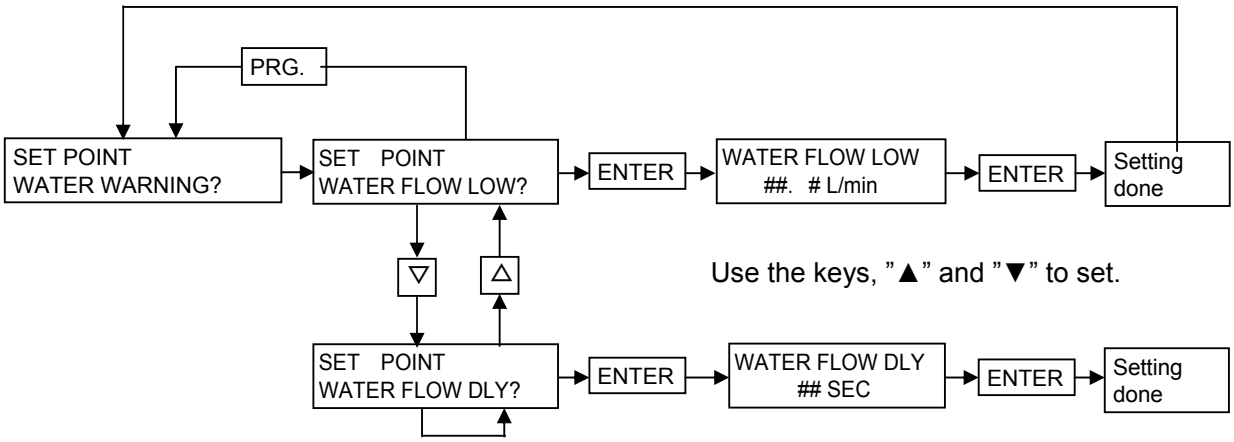
▽ : Decrease the setting speed by 0.1 Pam^3/s (Delay time : 1 sec)

Upper limit : 81.0 Pam^3/s (Delay time : 60 sec)

Lower limit : 3.0 Pam^3/s (Delay time : 5 sec) (DIP SW A7:OFF)

Lower limit : 1.6 Pam^3/s (Delay time : 5 sec) (DIP SW A7:ON)

5.3.7 Setting the Water flow low warning threshold



△ ▽ Use the up and down arrow keys to change the setting value.

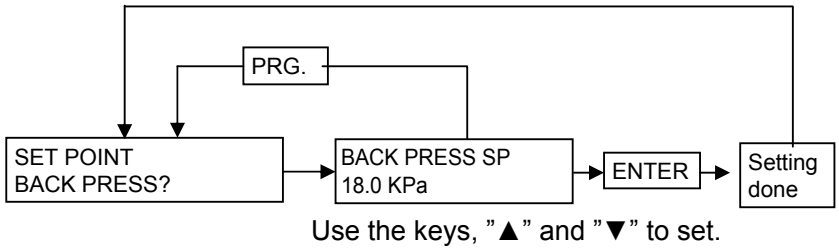
△ : Increase the setting speed by 0.1 L/min (Delay time：1 sec)

▽ : Decrease the setting speed by 0.1 L/min (Delay time：1 sec)

Upper limit : 10.0 L/min (Delay time：60 sec)

Lower limit : 1.0 L/min (Delay time：5 sec)

5.3.7 Setting the Back Pressure high warning threshold



△ ▽ Use the up and down arrow keys to change the setting value.

△ : Increase the setting speed by 0.5 kPa

▽ : Decrease the setting speed by 0.5 KPa

Upper limit : 30.0 KPa

Lower limit : 5.0 KPa

5.4 Dip Switch

Set the dip switches to select the operating modes as shown in Tables 5.4, 5.5 and 5.6

Table 5.4 Dip Switch-A Settings

No.	Mode	Off	On	Default
1	Data length	7 bits	8 bits	On
2	Cooling water & N2 monitoring	Constant	Only during operation	Off
3	Buzzer	Not used	Used	On
4	Operation switched to Remote	According to signal	PUMP STOP	Off
5	-------	-------	-------	-------
6	-------	-------	-------	-------
7	Dil N2 mode	Standard mode	Dil N2-0 mode	Off
8	the BP start mode	Automatic	Manual	Off

Table 5.5 Dip Switch-B Settings

No.	Mode	Off	On	Default
1	MP Speed control	Not used	Used	Off
2	BP Speed control	Not used	Used	Off
3	-------	-------	-------	-------
4	-------	-------	-------	-------
5	-------	-------	-------	-------
6	Equipped with the remote interface.	Optional	Standard	On
7	-------	-------	-------	-------
8	Initializes the LCD screen.	Initializes	Not initialize	Off

Table 5.6 Dip Switch-C Settings

No.	Mode	Off	On	Default
1	Outputs the pump N2 warning.	Normal Open	Normal Close	Off
2	-------	-------	-------	-------
3	-------	-------	-------	-------
4	-------	-------	-------	-------
5	-------	-------	-------	-------
6	-------	-------	-------	-------
7	-------	-------	-------	-------
8	-------	-------	-------	-------

DIP SW-A. No.1 This switch allows you to select the data length out of 7 or 8 bits for the pump running status monitoring with the RS232C communication port.

DIP SW-A. No. 2 This switch allows you to select out of “Constant” or “Only during operation ” for the cooling water and N2 monitoring. When “Only during operation” is selected for the cooling water monitoring, monitoring will be continued for 15 minutes after the pump operation has stopped for cooling the pump. Note that the N2 purging is recommended to continue during the pump stoppage as well because it will reduce accumulation of by-products and corrosion of the pump.

DIP SW-A. No. 3 This switch allows you to select whether an acoustic alarm (buzzer) should be sounded or not when a WARNING/ALARM signal has been generated.

> **Note**
> You can change the setting of No. 3 (Buzzer) and tEMOTR/LOCAL switch anytime. When the DIP SW settings other than No. 3 are changed, the LCD controller starts counting down from 10 seconds right after the setting change, which is similar to the situation when

DIP SW-A. No. 4 This switch allows you to select "According to Signal" or "PUMP STOP" when this switch is moved from the LOCAL to the REMOTE position. When the former is selected, the pump is started/stopped in response to the external start signal. When the latter is selected, the pump is stopped regardless of the external signal.

DIP SW-A. No. 7

DIP SW-A. No. 8 When dip switch-A No. 8 has been set to the REMOTE (Remote Operation) position, it is possible to operate the Booster Pump (BP) by selecting "AUTOMATIC Operation" or "START/STOP in Response to External Signal Input."

DIP SW-B. No. 1 When you control MP speed by external signal, set dip switch-B No.1 to ON.

DIP SW-B. No. 2 When you control BP speed by external signal , set dip switch-B No.2 to ON.

DIP SW-B. No. 6 This switch allows you to select "USE" or "UNUSE" of the Interface Box (an option) using the LAN-W.To use the interface: set the switch to ON.Not to use the interface: set the switch to OFF.

> **Note**
> With this switch set to ON, signal output from the control signal connectors (CN-Z and CN-Y) that are directly connected to the pump is prevented although that from the dedicated interface is allowed.

DIP SW-B. No.8 This switch allows you to select "Initializes" or "Not initialize" for LCD screen display (by default, the screen display returns to a current reading display in 60 seconds).

DIP SW-C. No.1 This switch allows you to select "NORMAL OPEN" or "NORMAL CLOSE" for PUMP N2 WARNING output.

5.5 DIP Switch setting display

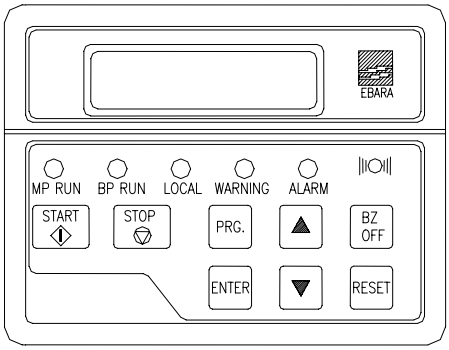


Fig 5.4 LCD controller

Key functions will be as follows on the setting display.

START	:	Invalid
STOP	:	This stops pump operation.
RESET	:	This resets ALARM and WARNING.
BZ . OFF	:	This switches the dip switch numbers.
△	:	This sets the selected dip switch ON.
▽	:	This sets the selected dip switch OFF.
ENTER	:	Move display level. Or indicate set up conditions.

DIP Switch-A

A ＊ ON / OFF □□□□□□□□

DIP Switch-B

B ＊ ON / OFF □□□□□□□□

* indicates the dip switch number (1 to 8) currently you are setting.

Fig 5.5 DIP Switch

Note

Duration of pump operation, dip switches, except A-3 (BUZZER) and B-3 (Initializes the LCD screen), can not be used for parameter setting.

Note

When parameter setting of the dip switches, other than dip switch-A No.3 (BUZZER) and B-8 (Initializes the LCD screen), is performed, the LCD controller counts down 10 seconds, the same as at the power on state, right after the completion of the parameter setting.

Note

If any warning or alarm occurs during the parameter setting, the setting session will be stopped automatically and the display will be changed to the warning & alarm display screen.

The dip switch setting at the time of shipment from the factory are as follows.

Data length	:	8bits
BUZZER	:	USE
Operation switched to Remote	:	According to signal
Pump N2 Mode	:	Standard Mode
Cooling water & N2 monitoring	:	Constant
BP Operation in Remote	:	Automatic Operation

6. Operation

6.1 Before Starting

(1) Turn on the cooling water supply and check that there are no leaks at the pipe connections.

> ⚠ **CAUTION**
> Without sufficient cooling water, the pump temperature will rise and problems such as rotor contact will occur.

> **Note**
> The pump unit itself has no cooling water flow adjustment valve.

(2) Turn on the N2 gas supply. (Only EV-S**P / EV-S**N)

Check that the regulator attached to the pump is closed. (It is closed when the pressure adjustment knob is fully turned in the counterclockwise direction.) Open the main valve and check that there are no N2 gas leaks from the pipe connections.

Slowly turn the pressure adjustment knob clockwise to set the pressure (gauge pressure) to 0.1 MPa first. Then press the red stopper to lock the knob in position.

> ⚠ **WARNING**
> Be sure to purge with N2 gas in order to prevent corrosion and reduce the formation / deposition of reaction by-products in the pump. When inflammable and/or toxic gases are diluted with N2 to the safe concentration, be sure to maintain a separate supply of N2 gas to the pump exhaust pipe.

> ⚠ **CAUTION**
> Abrupt rotation of the pressure adjustment knob will cause the pressure indicator needle of the regulator to wobble and result in an inaccurate pressure display.

> ⚠ **CAUTION**
> Unless a sufficient supply of N2 gas is maintained, serious problems will occur such as pump corrosion and accretion of reaction by-products.

Operate the N2 gas selector valve in accordance with the dilution N2 mode set by DIP switch-A No. 7.

If DIP Switch is set to OFF	Open Valve.
If DIP Switch is set to ON	Close Valve.

Note

For normal operation, open the N2 gas selector valve. To save N2 gas set close the valve when the production process does not lead to the formation of reaction by-products in the pump or when the process uses non-corrosive gases.

Note

The N2 gas selector valve is positioned on the right panel when viewing facing the utility side of the pump.

Note

It takes 10 odd seconds until the flow has stabilized after you have operated the N2 gas selector valve.

(3) Turn on the power supply to the pump.

⚠ WARNING

CB is not installed in the pump unit. Please install CB based on the law and the standard in the installation region.

(4) Turn on the standby switch. （LCD is illuminated）

(5) The LCD controller counts down 10 seconds after turn on the standby switch.

Note

The pump cannot start while the measuring instruments are warming up for 10 seconds after turn on the standby switch.

(6) Check on the WATER FLOW display of the LCD Controller. (EV-S20 : 1.5L/min or more , EV-S50/EV-S100/EV-S200 : 2.0L/min or more)

(7) Re-check on the PUMP N2 FLOW display of the LCD Controller that the dilution N2 gas flow rate is within the 17 – 21Pam3/s range. Also check that the pressure gauge shows a reading of 0.09 - 0.12MPa. After setting the pressure, press the red stopper to lock the knob in position. In this condition, the shaft sealing N2 flow rate is 2.0 – 2.5Pam3/s. (The shaft sealing N2 flow rate is contained in pump N2 flow rate currently displayed on the LCD controller.)

(8) When the WARNING/ALARM display appears on the LCD controller or when any abnormal symptoms are found other than the display, take action in accordance with 10. "Troubleshooting." Even when the cause of the WARNING/ALARM display has been removed, it is maintained until the RESET signal is entered. Either press the RESET button or enter an external RESET signal from the control signal connector. In the BUZZER Enabled mode using DIP switches, it is possible to stop the buzzer by pressing the BZ.OFF button when the alarm is being generated.

(9) When the pump exhaust pipe is equipped with a valve, open this valve before starting the pump.

> ⚠ **CAUTION**
> Problems will occur when the pump is operated with the valve closed as the exhaust pipe will be pressurized.

6.2 START/STOP

The DIP switches can be set at any time to select the REMOTE/LOCAL/COM modes and BUZZER Enabled function. Set in accordance with the operating conditions. (See 5.3. Setting the operational mode.)

> ⚠ **WARNING**
> The pump and exhaust piping will remain at a high temperature during operation and for a short time after the pump has stopped. Be sure to avoid contact and keep inflammable substances out of reach. Do not remove the outer cover during operation.

> ⚠ **CAUTION**
> When the production process leads to react by-products in the pump or when the process handles corrosive gases, be sure not to stop the pump until after at least 30 minutes of stopping the process gases.

> ⚠ **CAUTION**
> Process gases will remain in the vacuum pipes and the pump even after the pump has been stopped. Be sure therefore to purge for at least 1 hour after the pumps has been stopped. Do not discontinue the N2 purge when the pump is stopped only for a short

> ⚠ **CAUTION**
> The pump will remain at a very high temperature event after it has been stopped. Be sure therefore to leave the cooling water on for about 1 hour after the pump has been stopped.

> ⚠ **CAUTION**
> Do not exhaust the process gases until at least 30 minutes after the pump has been started. The pump casing temperature will stabilize after about 2 hours and it is recommended not to start exhausting the process gases earlier than this.

> ⚠ **CAUTION**
> Do not suddenly make a pump inlet port the pressure that is higherr than atmospheric pressure.

When DIP switch-A No. 4 is placed into the ON position and this switch is changed from the LOCAL to the REMOTE setting the pump will stop regardless of the external signal input.

6.2.1 LOCAL (Pump Side) Start/Stop

a) START

Press the START button on the controller.

The Main Pump (MP) will start and the MP RUN lamp on the controller will light.

After this, the Booster Pump (BP) will start automatically and the B.P. RUN lamp on the controller will light.

The current is indicated on the display during pump operation.

For other status display indications, refer to Table 5.1.

> **Note**
> The pump will not start when an WARNING/ALARM has been generated. When the START button is pressed, "STARTFAIL" will appear on the display.

b) STOP

Press the STOP button on the controller. The MP and BP will stop simultaneously.

The RUN lamp goes out and the display gives a power reading of 0.0kW.

6.2.2 REMOTE Start/Stop

a) START

Enter the external "MP" start signal input from the control connector. The MP will start.

In the case of DIP SW A-8 ⇒ OFF : “MP” rotation reaches 3000 rpm, “BP” will start automatically.

In the case of DIP SW A-8 ⇒ ON : “MP” rotation reaches 3000 rpm, input the external “BP” start signal. BP will start.

The power is indicated on the display during pump operation. For other status display indications, refer to Table 5.1.

> **Note**
> The pump will not start when an WARNING/ALARM has been generated. When the START button is pressed, "STARTFAIL" will appear on the display.

b) STOP

Interrupt the external MP start signal and the pump will stop.

6.2.3 COM Start/Stop

a) START

Input the "MP" start command from the comunication connector. The MP will start.

In the case of DIP SW A-8 ⇒ OFF : “MP” rotation reaches 3000 rpm, “BP” will start automatically.

In the case of DIP SW A-8 ⇒ ON : “MP” rotation reaches 3000 rpm, input the external “BP” start signal. BP will start.

The power is indicated on the display during pump operation. For other status display indications, refer to Table 5.1.

> **Note**
> The pump will not start when an WARNING/ALARM has been generated. When the START button is pressed, "STARTFAIL" will appear on the display.

b) STOP

Input the "MP" stopt command from the comunication connector. The MP will stop.

Interrupt the external MP start signal and the pump will stop.

> **Note**
> Please contact EBARA Sales office or service center for detail about communication specifications.

6.3 Operation when momentarily power failure happens

The momentarily power failure means that power supply voltage become 15% or less than specification (3400V or less). Pump operation is continued when the supply voltage is back to normal (more than 340V) within 1 second. Pump operation is stopped when the momentarily power failure is continued more than 1 second. Then control function is reset to original. (Additional new alarm/trip by to the momentarily power failure is not displayed in the LCD controller). There is a capacitor array in the control panel that will support the pump electronics through a power failure up to one (1) second in duration. Charging this capacitor array requires five (5) minutes after the pump is connected to line power. Following a momentary power failure, the capacitor array may need up to five (5) minutes to recharge ("reset") before the pump can ride through another one-second interruption in line power. There is no operator action required following a momentary power failure; the pump will recover automatically. In the momentarily power failure condition, pump rotor is driven by inertia due to interception of power supply. Thus, pumping performance may be decreased than guaranteed specification.

7. Maintenance and Inspection

7.1 Routine Inspection

Check periodically that ALARM signal is not output on the LCD controller or remote output. When the WARNING/ALARM display appears, take action in accordance with Section 10. "Troubleshooting". If the lubrication oil amount is lower than the lower limit line of the oil level gauge, supply the lubrication oil. See the section 7.3 “Lubrication oil“ when adding the oil.

> ⚠ **DANGER**
> Switch off the power supply to the pump first and lockout and disconnect the power supply connector before you start on maintenance.

> ⚠ **WARNING**
> The pump and exhaust piping will remain at a high temperature during operation and for a short time after the pump has stopped. Be sure to avoid contact and keep inflammable substances out of reach. Do not remove the outer cover during operation.

Table 7.1 Typical check items

No.	Item	How to check	Interval (recommended)
1	Motor Current	LCD	1 time/week
2	N2 Gas Flow (EV-S**P/EV-S**N)	LCD	
3	Vibration / Noise	-----	
4	Cooling water flow	LCD	
5	Pump casing Temp.	LCD	
6	Color of lubricating oil	Visual	1 time/month

Even when the cause of the WARNING/ALARM signal has been removed the signal will be maintained until the RESET signal is entered. After you have taken the remedial action, press the RESET button on the controller or enter the RESET signal from the control signal connector to reset the WARNING.

> ⚠ **CAUTION**
> The pump will not stop when an WARNING signal is generated. When pump operation is continued in this condition an ALARM signal will be generated or a serious breakdown will occur. Be sure therefore to check the pump in accordance with the instructions of Section 10. "Troubleshooting" before the pump stops for ALARM.

> **⚠ CAUTION**
>
> When a ALARM signal has been generated in the REMOTE operating mode, do not start the maintenance tasks until you have interrupted the external start signal. When the external ALTERNATE start signal input is maintained, the pump will start while the ALARM is being reset.

If any abnormal symptoms other than those displayed on the LCD controller appear, take action in accordance with the instruction of Section 10. "Troubleshooting".

When the BZ.OFF button is pressed in the BUZZER Enable mode, the buzzer will stop even during a warning status.

7.2 Vacuum and Exhaust Piping

> **⚠ WARNING**
>
> Maintenance on the vacuum and exhaust piping shall be performed by taking proper action to avoid the dispersion of inflammable, toxic and/or hazardous substances and to prevent physical contact with, and absorption of, these substances.

> **⚠ WARNING**
>
> The pump and exhaust piping will remain at a high temperature during operation and for a short time after the pump has stopped. Be sure to avoid contact and keep inflammable substances out of reach. Do not remove the outer cover during operation.

> **⚠ WARNING**
>
> Be sure to check for gas leaks after you have finished pipe maintenance work.

Be sure to following the instructions below when carrying out maintenance work on the vacuum and exhaust piping of the pump.

(1) Before you remove and wash the piping be sure to purge with a sufficient volume of N2 gas.

(2) When an exhaust gas scrubber unit is used, close the inlet valve of the exhaust gas scrubber after the N2 gas purge has been discontinued and then remove the piping.

(3) Be sure to switch off the power supply.

(4) After you have washed the piping do not reconnect until it has dried completely.

7.3 Lubricating Oil

If the oil level is lower than the lower limit line of the oil level gauge in typical check and maintenance, supply the oil is needed.

Follow the steps below to supply the oil.

(1) Stop the pump and remove the closing board (LCD connector side) on the pump. (See Figs. 7.1)

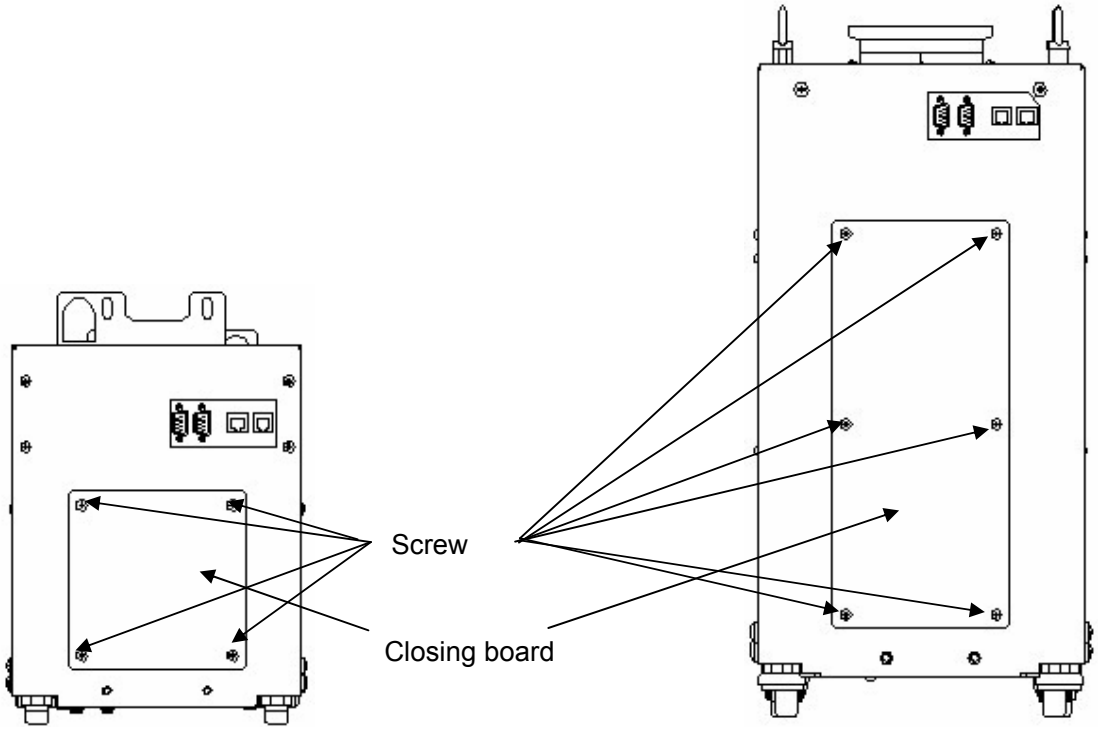


Fig. 7.1 How to remove closing board

(2) After you have waited until the internal pump pressure returns to atmospheric (normal) pressure, remove the plug from the oil-filler inlet. (See Figs. 7.2)

(3) Check the level through the window of the oil level gauge. Then, add the oil so that the level is between the upper and lower limit lines (see Figs. 7.2 and 7.3).

(4) After you have checked that there are no depositions and fragments adhering to the O ring attached to the plug, close the oil-filler inlet.

(5) Please check the air leak after supplying lubricating oil.

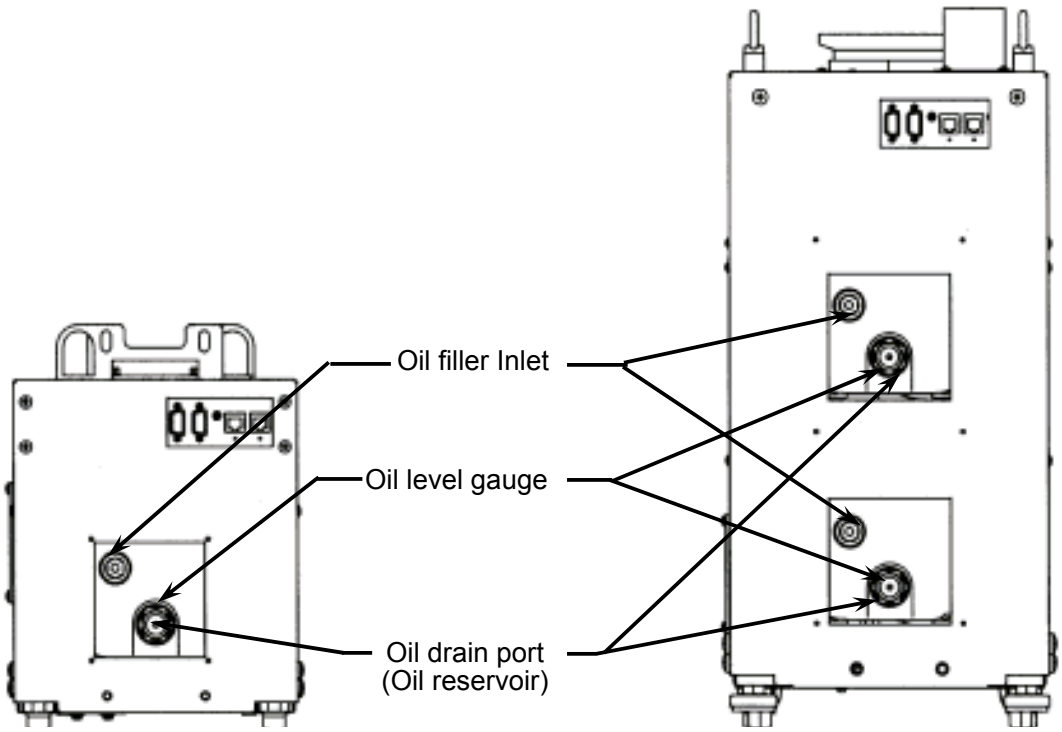


Fig. 7.2 Oil filler inlet, oil level gauge, and oil drain port positions

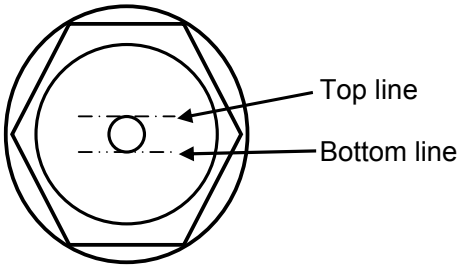


Fig. 7.3 Oil Level Gauge

⚠ CAUTION

Be sure only to use the lubricant oils listed in specification table 3.1.

Note

Waste oil shall be disposed of by industrial waste disposal dealer in accordance with Material Safety Data sheets. (appendix1)

⚠ CAUTION

When the lubrication oil level exceeds the upper limit, the oil may leak to the pump side. Thus, be sure no to exceed the upper limit line when adding the oil.

⚠ CAUTION

When the lubrication oil level is lower than the lower limit line, serious failure may be caused. If you find out the shortage, add the oil immediately.

7.4 Spare (Maintenance) Parts List

Following parts are needed for maintenance in customers' site.

Table. 8.2 Spare parts list

1. Standard consumption Part.

Parts' Name	Type	Part No.
Ruburicant oil	BARRIERTA J100ES	C-0402-000-0111

2. Recommendable Spare Parts (Not needed for each pump.)

Parts' Name	Type	Part No.
Oil level gauge	-----	C-5350-000-7900
Water flow sensor	10 L/min	C-5138-107-0001
N2 flow sensor	84.4 Pa m3/s	C-5300-000-5300
T/C bolt	T TYPE, M8	C-1019-121-0001
N2 gas pressure regulator	R31-200-C121	C-2300-000-3400
Main Fuse (EV-S20)	15A	C-5500-000-6000
Main Fuse (EV-S50/100/200)	20A	C-5500-000-6100

Following labels are attached to pump covers. When they are hard to read for discoloring or peeling off, please stick them again as directed.

Table 8.3 Labels

Label's Name		Parts No.
[DANGER]	HAZARDOUS WEIGHT DANGER LABEL	C-7110-316-0001
[WARNING]	HAZARDOUS VOLTAGE WARNING LABEL	C-7110-313-0001
[WARNING]	HIGH TEMPERATURE WARNING LABEL	C-7110-312-0001
[WARNING]	HAZARDOUS MATERIAL WARNING LABEL	C-7110-314-0001
[CAUTION]	CHARGE MARK LABEL	C-7110-315-0001

7.5 Overhaul

Some parts used in the EV-S dry pumps are consumables. Overhauls including periodical component replacement and inspections ensure safe and high-performance pump operations. The overhauls require well-trained personnel who have up-to-date knowledge of the pump structure and are familiar with hazardous chemical gases and safe work procedures. Factories where the overhauls are conducted must be equipped with special tools and facilities as well as exhaust air ducts to protect against toxic gas hazards. Ebara-designated overhaul factories provide services with well-trained personnel and relevant facilities supported by an established supply system of up-to-date pump information and genuine brand name parts. These advantages offer users superior overhaul services for the pumps in various states.

Ebara recommends the users to send the pumps for the periodical overhaul to the Ebara-designated factories. These factories equip special tools, sufficient evacuation duct. Contact EBARA Sales office or Overhaul service center for detail.

To avoid dangers potentially encountered during pump overhauls, follow instructions below to send your pump to an Ebara-designated factory for overhaul or repair.

Fill all necessary items in a form shown in Appendix 3 and fax it in advance to Ebara Service Center or one of the agents listed in Section 11 of this manual. Ask Ebara service center for latest form. The original copy must accompany the pump you send. Failure to meet these requirements may restrict Ebara from providing any overhaul services to avoid associated risks.

When you send back the pump to service center in the United States, contact Ebara Service Center first to obtain a RMA number for identification. Enter this RMA number to an Environmental Health & Safety Clearance Form shown in Appendix 4. Ask Ebara Service Center for latest form. Then, fax it in advance to Ebara Service Center and attach its original copy to the pump you send. Be sure to take these prior actions; otherwise Ebara refuses any overhaul services to avoid associated risks.

8. Disconnection and Transportation

> ⚠ **WARNING**
>
> When the pump has been used for exhausting highly toxic gases such as arsenic and mercury compounds, be sure to contact EBARA Corporation before you return the pump. Refer to Appendix 3 and 4 for the format required when customer returns their pump to Ebara service center for overhaul or rebuild.

> ⚠ **CAUTION**
>
> In the interest of safety during the transportation, disassembly and cleaning of the pump, be sure to take note of the gases that have been handled.

Toxic gases may be generated from by-products in the piping or pump in pump disconnection from the tool piping for repair and replacement or flange removal for maintenance. Gain relevant information about the process gases from your tool suppliers, and be sure that the gas concentrations in the work areas are at quarter or under the acceptable values specified using appropriate measurement equipment.

Without assurance of gas safety, instruct the workers to wear proper personnel protective equipment if necessary to protect them from gas hazards. The personnel protective equipment must include at least gloves, safety goggles, and a gas mask.

To disconnect and transport the pump, proceed as follows.

(1) Stop the pump and replace all gases inside the pump by purging them with N2 gas.
(2) Turn off the power supply to the pump and unplug the power and signal cables.
(3) After you have fully closed the N2 regulator, remove the N2 pipe, seal off the N2 purge port with a sealing flange.
(4) Remove the cooling water pipes.
(5) Remove the vacuum and exhaust pipes and completely seal off the inlet and exhaust ports of the pump with a blind flange or similar seal. Seal off all process gas discharge points such as the differential port by using a blind flange.
(6) Attach the LCD controller on the front panel of the control board. Fix it with the tape.
(7) Wrap the pump in a vinyl sheet.
(8) Use the eyebolts provided on the pump for slinging the pump to load and unload. Fasten eyebolts completely and push in until flush with the seating surface. For sling, use a wire with a length so that the slinging angle (that is, the angled subtended by the two wires) is within 60 degrees.

> ⚠ **DANGER**
>
> Do not enter the zone underneath the suspended pump.

> ⚠ **WARNING**
>
> For lifting the pump, use only qualified operator personnel. Be sure that the wire rope and crane used for lifting the pump are in proper order and match the weight of the pump. To prevent unequal weight distribution, suspend the pump by ensuring that the slinging angle remains symmetrically centered.

(9) When options such as an interface box are attached to the pump, be careful to avoid damage due to contact by the wire rope.

(10) For transportation, secure the pump by lowering the adjustment feet. Place a protective cloth around the pump to avoid shock and position protective members between the outer cover and the wires in order to distribute the load of the fastening wires.

9. For SEMI S2 standard

Additional electrical parts required for compliance with SEMI standards are shown in Table 9.1. The process tool panel may provide these items or they may appear in an auxiliary control panel mounted on the pump or remotely.

SEMI standards require provision of means to isolate the pump from **all** hazardous energies. Install valves that can be locked **only in the closed position** on the nitrogen supply and water lines

These valves and the supply power disconnect must be within sight of the pump, readily identifiable and provided with permanent means for locking in the “off” position only. These items and the EMO switch must be adjacent to the pump (within 3m [10 feet]) and readily accessible to the operator without serious risk of tripping or falling or coming into contact with energized electrical parts, moving machinery, high-temperature surfaces or objects, or other hazardous equipment.

See Section 2.4 regarding utility disconnection.

If safe operation requires dilution of the process gases, the installation must provide a normally open (i.e. open-on-low-flow) switched flow meter or other device tied to an external contactor that interrupts supply power to the pump when the nitrogen flow switch opens.

Table 9.1 Necessary parts for SEMI S2 standard

Parts name	Conditions
Overcurrent Protection CB (Circuit Breaker) or Fuses	Coordinate Short Circuit Current Rating (SCCR) and current limiting capacity of the circuit breaker or fuse set with the pump SCCR and the facility electrical distribution system.
EMO (Emergency Off)	Interrupt the power supply to the pump when EMO operates.
Nitrogen Dilution Interlocki	Supply as needed for toxic or flammable gases. See Appendix 5.

10. Troubleshooting

⚠ DANGER

Interrupt Circuit Protector (CP) before starting on wiring and maintenance work. Do not switch on the power supply to the pump until work is completed.

⚠ WARNING

The pump casing and exhaust piping become extremely hot during operation and for some time after stopping. Be sure that pump and exhaust piping do not come in contact with humans or inflammable substances. Do not remove the pump cover during operation.

⚠ WARNING

Check for gas leaks after installing and maintaining the piping. Gas leaks will result in the discharge of harmful and dangerous substances and in abnormal reactions due to the ingress of air into the pump.

10.1 Troubleshooting (1) Basic trouble

Abnormal symptom	Check Item	Corrective Action
Main fuse interruption	Incorrect wiring	Check wiring.
	Short circuit	Replace or overhaul pump.
Nothing appears on LCD	No power supply to pump.	Check power supply.
	Connector is not connected.	Connect power connector.
	Main fuse is interrupted.	Check main fuse.
	Disconnection of the LCD's connector	Connect LCD's connector
	Instrument failure	Replace instruments.
MP does not start when applying START button.	"Remote" or "COM" mode has been selected.	Set switch to "Local" mode.
	Start-up conditions are not satisfied. ("Startfail" is displayed.)	Satisfy all start-up conditions.
	Instrument failure	Replace instruments.
MP does not start when entering external "MP start" signal input.	"Local" or "COM" mode has been selected.	Set switch to "Remote".
	Start-up conditions are not satisfied. ("Startfail" is displayed.)	Satisfy all start-up conditions.
	Instrument failure	Replace instruments.
BP does not start.	BP start signal is not entered in "REMOTE" or "COM" mode.	Enter the start signal.
	Instrument failure	Replace Instruments.
Abnormal noise Excessive vibration	Adjustment feet are not applied.	Use the adjustment feet.
	Some object is making contact with the outer cover.	Remove the object.
	The fastening screws of the outer cover have worked themselves loose.	Tighten the fastening screws.
	Parts of the pump are damaged.	Replace or overhaul pump.
Vacuum pressure increase.	Accumulation of by-products in pipes.	Clean piping.
	N2 pressure setting is high.	Set pressure for correct value.
	Leak from vacuum piping.	Check piping.
	Accumulation of by-products in pumps.	Replace or overhaul pump.
MEMORY ERROR is displayed on LCD.	None	Need "Countermeasure against electric Noise" to pump.

10.2 Troubleshooting (2) WARNING

Display	Symptom	Check Item	Corrective Action
WARN: WATER FLOW LOW	Water flow is reduced.	Coupler is disconnected.	Connect coupler.
		Pressure is not sufficient.	Apply sufficient pressure.
		Root valve is closed.	Open valve.
		Water pipe is clogged.	Clean or replace piping.
		Tube fittings are loosened.	Re-tighten.
		Instrument failure	Replace instrument.
		Outlet & inlet pipes are reverse. (flow value 0 L/min)	Connect pipes correctly.
WARN: PUMP N2 FLOW LOW	Pump N2 flow is reduced.	N2 port is not connected.	Connect N2 pipe fitting.
		Primary pressure is insufficient.	Apply sufficient pressure.
		Regulator setting value LOW.	Increase pressure setting.
		N2 pipe is clogged.	Replace N2 piping.
		Leaks on N2 pipe.	Check the fittings.
		Instrument failure	Replace instrument.
WARN: CASING TEMP HIGH	Casing temperature rises.	Pump back pressure rises.	Check exhaust pipe
		Increase of the gas load.	Reduce the inflow gas amount.
		Accumulation of by-product	Replace or overhaul pump.
		Cooling water flow is reduced.	Increase cooling water flow.
WARN: BP MOTOR TEMP HIGH WARN: MP MOTOR TEMP HIGH	Booster pump (BP) motor coil temp. rises. Main pump (MP) motor coil temp. rises.	Cooling water flow is reduced.	Cool pump thoroughly and reset.
		Motor failure	Replace or overhaul pump.
WARN: BP DRIVER TEMP HIGH #### WARN: MP DRIVER TEMP HIGH ####	Booster pump (BP) driver temp. rises. Main pump (MP) driver temp. rises.	Cooling water flow is reduced.	Increase cooling water flow.
WARN: ## COMM.ERROR	Communication is not established.	Connection error of the instrumented units	Check the connection of the instrumented unit.
		Instrument failure	Replace instrument.
WARN: PUMP BOX TEMP HIGH	Temp. rises in pump cover.	Cooling water flow is reduced.	Increase cooling water flow.
		The ambient temperature is high.	Confirm the ambient temperature (less than 30℃).

After you have taken the remedial actions above, reset the pump. If the problem that has caused the WARNING signal still remains, the WARNING display will appear again even after you have reset.

10.3 Troubleshooting (3) ALARM

Display	Symptom	Check Item	Corrective Action
ALARM: WATER FLOW LOW	Water flow is reduced.	Coupler is disconnected.	Connect coupler.
		Pressure is not sufficient.	Apply sufficient pressure.
		Root valve is closed.	Open valve.
		Water pipe is clogged.	Clean or replace piping.
		Tube fittings are loosened.	Re-tighten.
		Instrument failure	Replace instrument.
		Outlet & inlet pipes are reverse. (flow value 0 L/min)	Connect pipes correctly.
ALARM: CASING TEMP H.HIGH	Pump casing temp. rises.	Pump back press. rises.	Check exhaust pipe.
		Increase of the gas load.	Reduce the inflow gas amount.
		Cooling water flow is reduced.	Cool pump thoroughly and reset.
		Accumulation of by-products	Replace or overhaul pump.
ALARM:BP MOTOR TEMP H.HIGH ALARM:MP MOTOR TEMP H.HIGH	Booster Pump (BP) motor coil temp. rises. Main Pump (MP) motor coil temp. rises.	Cooling water flow is reduced.	Cool pump thoroughly and reset.
		Motor failure	Replace or overhaul pump.
ALARM:BP MOTOR OVERLOAD 2 ALARM:MP MOTOR OVERLOAD 2	BP motor current rises. MP motor current rises.	Pump back press. rises.	Check exhaust pipe & silencer.
		Increase of the gas load.	Reduce the inflow gas amount.
		Rotor makes contact. (Accumulation of by-products) (Substance plunge)	Replace or overhaul pump.
		Instrument failure	Replace instrument.
ALARM:BP MOTOR STEP OUT ALARM:MP MOTOR STEP OUT	Booster Pump (BP) motor step out. Main Pump (MP) motor step out. Can not restart.	Pump back press. rises.	Check exhaust pipe.
		Increase of the gas load.	Reduce the inflow gas amount.
		Rotor makes contact. (Accumulation of by-products) (Substance plunge)	Replace or overhaul pump.
		Instrument failure	Replace instrument.
ALARM: BP DRIVER ### ALARM: MP DRIVER ###	BP Motor driver protection MP Motor driver protection Can not restart	Pump back press. rises.	Check exhaust pipe.
		Increase of the gas load.	Reduce the inflow gas amount.
		Rotor makes contact. (Accumulation of by-products) (Substance plunge)	Replace or overhaul pump.
		Cooling water flow rate is reduced.	Cool pump thoroughly and reset.
		Motor driver has broken down.	Replace motor driver.
ALARM: PHASE ERROR	Open phase	Instrument failure	Replace instrument.
		Incorrect wiring	Check power supply
ALARM:STARTFAIL ALARM/WARN EXIST	Start fault	Starting during WARNING/ALARM status	Make sure that all starting conditions are met.
		Instrument failure	Replace instrument.

After you have taken the remedial actions above, reset the pump. If the problem that has caused the WARNING signal still remains, the WARNING display will appear again even after you have reset.

10.4 Troubleshooting (4) Option

Display	Symptom	Check Item	Corrective Action
ALARM: WATER LEAKAGE	Water leakage	Tube fittings are loosened.	Re-tighten.
		Instrument failure	Replace instrument.
ALARM : BACK PRESS.HIGH	Exhaust pressure rises.	Exhaust valve is closed.	Check exhaust pipe.
		Accumulation of by-products in pipes.	Check exhaust pipe.
		Instruments failure	Replace instruments.
WARN: PRESS.HIGH ##.#	Exhaust pressure rises.	Exhaust valve is closed.	Check exhaust pipe.
		Accumulation of by-products in pipes.	Check exhaust pipe.
		Instruments failure	Replace instruments.
ALARM: EMERGENCY STOP	Emergency Stop switch	Stop by emergency Stop button.	Check that pump can be operated and turn the button head to release lock.

After you have taken the remedial actions above, reset the pump. If the problem that has caused the ALARM signal still remains, the ALARM display will appear again even after you have reset.

11. Inquiries

For all inquiries and queries in connections with any of the details given in this Operating Instruction Manual and/or the pump in general, please contact EBARA Corporation directly after checking the pump type and unit number.

11.1 North America

EBARA TECHNOLOGIES INCORPORATED

(1) Western Region CALIFORNIA

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45 Plumeria Drive,
San Jose, CA 95134-2103, U.S.A.
Phone: (408) 934-2888 Fax: (408) 934-2801

(2) Eastern Region VIRGINIA

10342 Battleview Parkway,
Manassas, VA 20109, U.S.A.
Phone: (703) 392-4286 Fax: (703) 330-9708

(3) Southwest Region TEXAS

8201-6 E. Riverside Drive, Suite 600
Austin, TX 78744,U.S.A.
Phone: (512) 389-3993 Fax: (512) 389-3995

11.2 Asia

(1) Japan

EBARA CORPORATION
1-6-34 KOUNAN, MINATO-KU, TOKYO 108-8480, JAPAN
Phone : (03)5461-4033 Fax : (03)5461-6009

(2) Korea

EBARA PRECISION MACHINERY KOREA INC.
15 FL, KANGNAM BLDG. 1321SEOCHO-DONG, SEOCHO-KU,
SEOUL, KOREA
Phone : 02-581-6901～5 Fax : 02-581-4211

(3) Taiwan

TAIWAN EBARA DENSAN (TED)
NO.7 NAN YUEN 2ND ROAD CHUNGLI TAO YUEN, TAIWAN, R.O.C.
Phone : 03 4522181 Fax : 03 4522186

EBARA PRECISION MACHINERY TAIWAN INC.
EBARA CORPORATION, TAIPEI OFFICE

ROOM 1402, CHIA HSIN BLDG, No.96 SEC 2, CHUNG SHAN N RD.,
TAIPEI TAIWAN. R.O.C.
Phone : 02-2560-1166 Fax : 02-2560-1177

(4) Singapore

EBARA ENGINEERING SINGAPORE (E.E.S.)
NO.1 TUAS LINK2 SINGAPORE. 638550
Phone : 862-3536 Fax : 861-0589

11.3 EUROPE

(1) U.K.

EBARA CORPORATION SCOTLAND BRANCH (EBARA SCOTLAND)
3. ADAM SQUARE-BRUCEFIELD INDUSTRIAL ESTATE LIVINGSTON.
SCOTLAND. U.K
Phone : 1506-460232 Fax : 1506-460222

(2) Germany

EBARA TECHNOLOGIES INCORPORATED (CRYO PUMP OPERATION)
44 JARMUIDEN. AMSTERDAM. NETHERLAND
Phone : 20-611-4345 Fax : 20-611-4375

EBARA GERMANY GmbH
DONAU STRASSE 7, D-63452 HANAU. GERMANY
Phone : 06181-1876-0 Fax : 06181-1876-40

APPENDIX

1. Material Safety Data Sheet of Lubricant oil
2. Material Safety Data Sheet of Lithium Battery
3. Overhaul/Repair Request form
4. Overhaul/Repair Request form in United States
5. Information of typical hazardous materials
6. Leak Check procedure

Appendix 1 Material safety Data Sheet of Lubricant. (5pages)

Material Safety Data Sheet

Product name: BARRIERTA J100ES **Date:** September 10, 2002

Revision Date: September 27, 2002

MSDS No. 1863

1. Product and company identification

Product name: **BARRIERTA J100ES**

Company: NOK KLÜBER CO.,LTD

955-4, Aza Ohishi, Isoharamachi, Kitaibaraki city, Ibaraki 319-1541, Japan

Telephone: +81-293-42-5365

Fax: +81-293-43-3817

2. Composition/information on ingredients

Chemical names and synonyms: Fluorinated lubricating oil

CAS No.	Components	Value
	Perfluoropolyether	>95wt%
	Additives	<5wt%

Hazardous ingredients:

3. Hazardous identification

>280°C traces of fluorinated products

Some materials (e.g. titanium, aluminum or alloys of these materials) may cause lower decomposition temperatures.

Prolonged skin contact may cause skin irritation and/or dermatitis.

4. First aid measures

After inhalation

Remove victim to fresh air. If symptoms persist, call a physician.

After contact with skin

Wash off with mild cleaners and plenty of water. If symptoms persist, call a physician.

After contact with eyes

Rinse with plenty of water. If symptoms persist, call a physician.

After ingestion

If large amounts are swallowed, do not induce vomiting. Obtain medical attention.

5. Fire-fighting measures

Suitable extinguishing media

The product itself does not burn. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Special hazards

In case of fire the following can be released: traces of fluorinated products

Special protective equipment for firefighters

Standard procedure for chemical fires.

Additional information

Water mist may be used to cool closed containers.
In the event of the fire and/or explosion do not breathe fumes.

6. Accidental release measures

Personal precautions

Risk of slipping due to leakage/spillage of product.

Environmental precautions

Do not flush into surface water or sanitary sewer system.

Methods for cleaning up/taking up

Use mechanical handling equipment. Dispose of absorbed material in accordance with the regulations.

7. Handling and storage

Handling

Advice on safe handling

No special handling advice required.

Advice on protection against fire and explosion

No special precautions required.

Storage

Requirements on storage conditions

Store at room temperature in the original container.

Incompatible materials

Do not store together with food.

8. Exposure controls/personal protection

Additional advice on system design

not applicable

Ingredients and specific control parameters

None

Personal protective equipment

Respiratory protection

No special protective equipment required.

Hand protection

Wear chemical-resistant gloves.

Eye protection

Wear safety glasses. Do not wear contact lenses when working with chemicals.

Body protection

Wear clean, body-covering clothing to minimize dermal exposure.

General protection and hygiene measures

Avoid prolonged and/or repeated contact with skin. Remove soiled or soaked clothing immediately. Clean skin thoroughly after work; apply skin cream. Keep away from tobacco products.

9. Physical and chemical properties

Form:	liquid
Color:	colorless
Odor:	none
Density:	approx. 1.89 g/cm^3,20°C
Flash point:	none °C
Ignition temperature:	not applicable °C
Lower explosion limit:	not applicable
Upper explosion limit:	not applicable
Water solubility:	insoluble
Vapor pressure:	approx. 6.5E-5Pa (20°C)

10. Stability and reactivity

Stability

Stable

Conditions to avoid

None

Materials to avoid

Strong bases, alkali metals, alkaline earth metals, Lewis acids

Hazardous decomposition products

>280°C traces of fluorinated products

Additional information

None

11. Toxicological information

The toxicological data has been taken from products of similar composition.

Acute toxicity: LD50/oral/rat=>37.4g/kg(literature data)

Prolonged skin contact may cause skin irritation and/or dermatitis.

12. Ecological information

Information on elimination (persistence and degradability)

Product is insoluble in water. May be separated out mechanically in purification plants.

Behavior in environmental compartments

Ecological injuries are not known or expected under normal use.

Ecotoxic effects

Aquatic toxicity is unlikely due to low solubility.

Additional information

Should not be released into the environment.

13. Disposal considerations

This product can be incinerated when in compliance with local, state and federal regulations.
This product contains halogen.
Offer rinsed packaging material to local recycling facilities.

14. Transport information

UN class : not applicable

UN No.: not applicable

Advice on transportation

Not classified as dangerous in the meaning of transport regulations.

15. Regulatory information

16. Other information

The information provided in this Material Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid if the material is used in combination with any other materials or if it is processed, unless specified in the text.

Appendix 2 Material Safety Data Sheet for Lithium battery. (2 pages)

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard.
29 CFR 1910. 1200. Standard must be
consulted for specific requirements.

U. S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No.1218-0072

IDENTITY (As Used on Label and List)
Lithium/Thionyl Chloride Battery (ER3V)

Note: Blank spaces are not permitted. If any item is not applicable. or no information is available. the space must be marked to indicate that.

Section I

Manufacture's Name: TOSHIBA BATTERY CO.,LTD.	Emergency Telephone Number
Address (Number. Street. City. State. and ZIP Code)	Telephone Number for Information: TOKYO 03-5479-8237
4-10. MINAMI-SHINAGAWA 3-CHOME,	Date Prepared: 24-March-2003
SHINAGAWA-KU, TOKYO 140-004, JAPAN	Signature of Prepare (optional)

Section II -Hazardous Ingredients / Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	%(optional)
The following chemical contents are enclosed in strong stainless-steel can and hermetically sealed.				
1) Lithium Metal	0.31g/Cell		3.7%	
2) Thionyl chloride (Electrolyte)			41.2%	
		Battery Weight	8.5g / Cell	

* This battery is installed with safety vent.

Section III - Physical / Chemical Characteristics

Boiling Point	N/A	Specific Gravity (H_2O=1)	2.175
Vapor Pressure (mm Hg)	N/A	Melting Point: Lithium Metal (The content)	179℃
Vapor Density (AIR=1)	N/A	Evaporation Rate (Butyl Acetate = 1)	N/A

Solubility in Water: N/A

Appearance and Odor: * Cylindrical - Shape, Odorless.

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
N/A			

Extinguishing Media: N/A * Pouring Water against bare Lithium Metal is prohibited.

Special Fire Fighting Procedures: * Sand and / or large quantity of water.

Unusual Fire and Explosion Hazards
* Combustible at the conditions of abnormally high temperature and or in the fire with safety vent being operated and gas being flown out. * Keeping under 212 ° F is required (UL)

Section V - Reactivity Data

Stability	Unstable		Conditions to Avoid Never short-circuit, pouring water of sea water, and heat.
	Stable	X	

Incompatibility (Materials to Avoid)

* Never put cartons in water.

Hazardous Decomposition or Byproducts

* No problem if handle with care.

Hazardous Polymerization	May Occur		Conditions to Avoid NONE
	Will Not Occur	X	

SectionVI- Health Hazard Data

*** Stimulative liquid will come out when destroyed.

Route(s) of Entry Inhalation? Skin? Ingestion?

* SO2 and HCl gas will come out when destroyed. * Never put in mouth.

Health Hazards (Acute and Chronic)

(If destroyed) * Inhalation of SO2 and HCl gas inflames respiratory organs.

(Acute) * Inflames eyes and skin (Acute)

* Excessively stimulate the mucous membrane of the mouth and throat.

Carcinogenicity: NTP? Unknown IARC Monographs? Unknown OSHA Regulated? Unknown

Signs and Symptoms of Exposure

* Inflames of sores, if touched SO2 gas of SOCl2.

Medical Conditions
Generally Aggravated by Exposure

* Skin inflammation hard cough. * Loss of eyesight.

Emergency and First Aid Procedures

* Wash with clean water.

Section VII- Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled

* Wash out with large quantity of water.

* Distinguish fire if ignited.

Waste Disposal Method

* Dispose of according to appropriate local, state and Federal waste regulations.

Precautions to Be Taken in Handling and Storing

* Keep unused cells in a cool and dry place.

* Do not short or heat.

Other Precautions

* Do not dispose of in fire.

* Do not disassemble nor destroy.

SectionVIII- Control Measures

Respiratory Protection (Specify Type)

Anti-Sulfurous acid gas (If cells are destroyed) under normal use and conditions.

Ventilation	Local Exhaust N/A	Special N/A
	Mechanical (General) N/A	Other N/A

Protective Gloves * To be used under abnormal conditions.	Eye Protection * To be used under abnormal conditions.

Other Protective Clothing Equipment

N/A

Work/Hygienic Practices

N/A

*USGPO 1986-491-529/45775

Appendix 3

Overhaul/Repair Request form

To avoid dangers potentially encountered during pump overhauls, follow instructions below to send your pump to an Ebara-designated factory for overhaul or repair.

Fill all necessary items in a form shown in next page, and fax it in advance to Ebara Service Center or one of the agents listed in Section 11 of this manual. The original copy must accompany the pump you send.

Failure to meet these requirements may restrict Ebara from providing any overhaul services to avoid associated risks.

エバラドライ真空ポンプ　オーバーホール依頼書

宛先：　　行

TEL No.

FAX No.

＊当社営業担当宛にFAX後ポンプに添付の上御返却下さい。

貴社名：
部署名：
御氏名：
御住所：
TEL　：
FAX　：
E-mail：

お願い
弊社における、作業（分解、洗浄など）の人的安全および環境安全の確保のため、弊社の製品を御返却の際は、お手数ですが、必ずこの用紙で弊社に御連絡頂き、製品に添付して下さい。

貴社注文書番号、整理番号など：

1. ポンプ機名	
2. ポンプシリアル番号	
3. 付属品の有無	□無　□有（具体的に　　）
4. 装置名	（装置メーカー名）　　（装置モデル名）
5. ﾌﾟﾛｾｽ名	□ LP-CVD　□ PE-CVD　□ EPI　□ MO-CVD　□ ALD □ METAL-CVD　□ OXIDE-ETCH　□ POLY-ETCH □ ASHING　□ PVD　□ ION-IMPLANTOR　□ SEM/METROGY □ L/Lなど　□ その他（　　） ＊エッチング、L／L等でも、As（ヒ素）を排出する可能性のある場合は、As排出と明記してください。 ＊Copper（銅）汚染が有る場合は営業に相談してください。
6. 使用ｶﾞｽ名	＊As（ヒ素）等、有毒性のガスを使用されている場合は必ず明記し、ポンプの吸排気口には閉止フランジを取り付けて下さい。明記なき場合、閉止なき場合はお引取を致しかねます。
7. 電圧・周波数	
8. ﾎﾟﾝﾌﾟ停止時の状況	
9. 運転期間	年　月　日～　年　月　日
10. ｵｰﾊﾞｰﾎｰﾙ後の状態	□現状仕様　□改造（手直し）希望（　　）
11. 御返却日／引取り希望日	年　月　日　午前　午後
12. ｵｰﾊﾞｰﾎｰﾙ御希望納期	年　月　日　午前　午後 ＊　予備機の有無　（　有　、　無　）
13. 備考	

Appendix 4

Overhaul Request form (USA)

In the United States, returned pump shipments must conform to Department of Transportation regulations:

- Hermetically seal contaminated equipment in two heavy gauge polyethylene bags or equivalent.
- Tag or label equipment stating the possible hazardous material and/or the environment in which it was used.
- Obtain an RMA number from the EBARA Service department and post on all bags, containers, and packing list along with a copy of the Environmental Health &Safety Clearance Form. See next page for sample of the form.

Be sure to take these prior actions; otherwise Ebara refuses any overhaul services to avoid associated risks.

ENVIRONMENTAL HEALTH & SAFETY CLEARANCE FORM

☐ EBARA TECHNOLOGIES INCORPORATED
51 MAIN AVENUE
SACRAMENTO, CA 95838-2014
PHONE: (916) 920-5451
FAX: (916) 920-1033

☐ EBARA TECHNOLOGIES INCORPORATED
8201-6 EAST RIVERSIDE DRIVE, SUITE 600,
AUSTIN, TEXAS 78744
PHONE: (512) 389-3993
FAX: (512) 389-3995

P.O. #:

RMA #:

CALL SERVICE CENTER FOR RMA #

PLEASE FAX OR MAIL A COMPLETED COPY OF THIS FORM (#9-0008) TO EBARA SERVICE CENTER PRIOR TO SHIPPING EQUIPMENT

1.0 PRODUCT AND CUSTOMER IDENTIFICATION DATA

SITE NAME: _____ MODEL NO.: _____

ADDRESS: _____ SERIAL NO.: _____

_____ PART NO.: _____

PHONE/FAX: _____ TOOL TYPE: _____

IS THIS EQUIPMENT USED OR CONTAMINATED? TOOL I.D.: _____

IF YES, CHECK HERE ☐ COMPLETE SECTIONS 2.0, 3.0, 4.0 & 5.0 LENGTH OF SERVICE: _____

IF NO, CHECK HERE ☐ COMPLETE SECTIONS 4.0 & 5.0

2.0 PROCESS TYPE (CHECK ALL APPLICABLE BOXES)

LPCVD: ☐ BPSG ☐ BSG ☐ PSG ☐ POLY-Si ☐ DOPED POLY-Si ☐ HTO ☐ NITRIDE ☐ TEOS BPSG ☐ TEOS USG

PECVD: ☐ BPSG ☐ BSG ☐ PSG ☐ HDP USG ☐ SiON ☐ NITRIDE ☐ TEOS BPSG ☐ TEOS USG

ETCH: ☐ METAL (Al) ☐ NITRIDE ☐ OXIDE ☐ POLY-Si ☐ W

MISC: ☐ COPPER ☐ ASHING ☐ EPI ☐ ION IMP. ☐ IPO DEP. ☐ CVD Ti-N ☐ MO-CVD ☐ PVD/SPUTTER ☐ SPACER ☐ W-CVD ☐ NO PROCESS ☐ OTHER: _____

3.0 IDENTIFICATION AND LISTING OF ALL CONTAMINANTS (GASES, LIQUIDS, SOLIDS)

3.1 WAS THE EQUIPMENT USED WITH ANY OF THE FOLLOWING PROCESS MATERIALS?

3.1.1 RADIOACTIVE HAZARDS? YES ☐ NO ☐ **IF YES, DO NOT DISPATCH. CONTACT SERVICE CENTER**

3.1.2 BIOLOGICAL HAZARDS? YES ☐ NO ☐ **IF YES, DO NOT DISPATCH. CONTACT SERVICE CENTER**

3.1.3 TOXIC HYDRIDE MAT'LS? YES ☐ NO ☐ (E.G., ARSINE, PHOSPHINE)

3.1.4 OTHER HAZARDOUS MAT'LS? YES ☐ NO ☐ (E.G., PROCESS GASES, BY-PRODUCTS, SOLIDS)

3.1.5 COPPER? YES ☐ NO ☐ (E.G., PROCESS GASES, BY-PRODUCTS, SOLIDS)

3.2 PLEASE LIST ALL SUBSTANCES OR BY-PRODUCTS **WHICH MAY HAVE** COME INTO CONTACT WITH THE EQUIPMENT:

	CHEMICAL NAME	CHEMICAL SYMBOL	SPECIAL INSTRUCTIONS
Process Gas:			
By-Product:			

ATTACHED ADDITIONAL FORMS AND/OR ADDITIONAL DOCUMENTATION? YES ☐ NO ☐

4.0 REASON FOR RETURN OR SERVICING OF EQUIPMENT

4.1 BRIEFLY DESCRIBE ANY EQUIPMENT ANOMALIES: _____

_____

4.2 IS THIS A WARRANTY OR SERVICE CONTRACT JOB? YES ☐ NO ☐ IF YES, ORDER OR CONTRACT #: _____

5.0 DECLARATION: I CERTIFY TO THE BEST OF MY KNOWLEDGE THAT THE INFORMATION ON THIS FORM IS CORRECT AND THE PROCESS OUTLINED IN DOCUMENT #914-00-000 HAS BEEN FOLLOWED.

NAME: _____ SIGNATURE DATE: _____

SIGNATURE: _____

JOB TITLE: _____ EST. SHIPPING DATE: _____

COMPANY: _____

PHONE/FAX #: _____ EST. DELIVERY DATE: _____

Appendix 5, Information on Typical Hazardous Gases

The table lists typical gases used in semiconductor-processing tools. Personnel operating, maintaining and services of the process tools and pumps must understand fully the properties and hazards of the gases used in those devices.

Many of these process gases can react explosively with other chemicals or gases. Some are pyrophoric; they will ignite spontaneously if exposed to air. Mixing combustion gases and combustion support gases or exhausting them together can result in explosive reactions—causing serious damage and personnel injury.

This list neither encompass all explosive gases nor describes all risks and dangers that they may cause. While general safe practice is diluting gases to 25% of LEL, LFL or TLV, EBARA strongly advises contacting your process tool supplier and/or chemical supplier to obtain complete and current information on potential risks and hazards of the process gases and instructions on the safe operation of the tool. It is the user's responsibility to observe safe practices to avoid potential risks.

WARNING	The process tool suppiler and end user must avoid concurrent pumping of gases that may react in the pump. EBARA does not assume risks caused by hazardous chemical reactions resulting from simultaneous injection or mixture of multiple process gases in the pump. The pump has no protection features against the dangers from such usage.
WARNING	To avoid any hazard induced by toxicity, flammability and explosiveness of the process gases used in the tool, be sure to operate the tool according to the operations safety guidelines supplied by tool suppliers. The table below lists typical process gases used in a semiconductor-processing tool. However, details concerning the tool gases and other concerns specific to your tool should be directed to the respective tool suppliers.

APPENDIX 5　Typical Hazardous Gas Information

1. Etching process

Gas	Combustion Support	Flammable	Toxic	Corrosive	Global Warming	Allowable Level*
NF_3	○		○	○		10ppm
HF			○	○		3ppm
Cl_2	○		○	○		0.5ppm
BCl_3			○	○		5ppm as HCl
HBr			○	○		3ppm
Br_2			○	○		0.1ppm
CF_4					○	N/A
CHF_3					○	N/A
C_2F_6					○	N/A

*Allowable level is specified as TLV of ACGIH.

2. LP-CVD

Gas	Combustion Support	Flammable	Toxic	Corrosive	Global Warming	Allowable Level
SiH_2Cl_2		○	○	○		5ppm as HCl
SiH_4		○	○			5ppm
Si_2H_6		○	○			5ppm
$Si(OC_2H_5)_4$ (TEOS)		○				10ppm
$As(OC_2H_5)_4$ (TEOA)		○	○			0.01mg/m3 as As
NH_3		○	○	○		25ppm
H_2		○				4% LEL*
NF_3	○		○	○		10ppm
ClF_3	○		○	○		0.1ppm

*LEL : Lower Explosion Level

3. Ion-implant

Gas	Combustion Support	Flammable	Toxic	Corrosive	Global Warming	Allowable Level
AsH_3		○	○			0.05ppm
B_2H_6		○	○			0.1ppm
PH_3		○	○	○		0.3ppm
BF_3			○	○		1ppm

Appendix 6

Typical Leak Check Procedure

NOTE: This general procedure is not a substitute for user's work instructions or leak detector operations manual. Read and follow the instructions for your leak detection apparatus.

Perform leak check after initial system assembly and after any breach of the system for maintenance.

Check pump down time (that is time to go from atmosphere to target pressure) of fore line to confirm the absence of gross leaks.

For vacuum systems and process pump exhaust lines, pressurize the system with helium and run the probe ("sniffer") of a mass spectrometer leak detector around all joints, seals and fittings.

Realign joints, tighten fittings, replace seals, etc.

Repeat as necessary to eliminate all leaks.

Disconnect helium supply and place system in operating condition.