INSTRUCTION MANUAL

MULTI-STAGE DRY VACUUM PUMP

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

CE / SEMI / NRTL MODEL
200-220V(50/60Hz)

⚠Caution:
Please read and understand this INSTRUCTION MANUAL thoroughly before using this equipment.
Be sure to keep this INSTRUCION MANUAL on hand for future reference.

To Facility and Tool Manufactures:
Be sure to distribute this INSTRUCTION MANUAL to all end-user personnel actually operation this equipment.

「Model OOO」 in this INSTRUCTION MANUAL is our model code.

ISSUED BY PRECISION MACHINERY COMPANY

EBARA CORPORATION

PM40U

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Manufacturer reserves the right to discontinue or change any
specifications or designs without notice and without incurring obligations.
Model OOO in this catalog is our model code.

Environmental Basic Policies

It is our responsibility, as people of the earth, to protect nature's irreplaceable treasures and to pass them on to future generations.
As we undertake our business activities, we will establish environmental management systems and implement ongoing improvements and reviews, while striving to promote harmony between technology and nature, prevent environmental pollution, and improve the overall results of our environmental management activities. We are aware that environmental protection and management activities are the responsibility of all managers and employees of the Corporation, and each person will demonstrate this awareness when carrying out his or her duties.
We will widely publicize these basic policies to regional societies and the general public and work to make Ebara's position on the environment clear to society in general.

Safety Information

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.

If you have any questions on pump operation, safety, and maintenance, please do not hesitate to contact EBARA directly. Refer to Global network for contact address.

Three terms designating the level of hazard are used in this manual.

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 injury.

CAUTION indicates an imminently hazardous situation which, if not avoided, may result in minor or moderate injury.
This term may also be used as a warning for situations liable to damage to equipment.

Important Prior Warnings

DANGER Keep out from under the pump when lifted.
Only qualified personnel shall unload and lift the pump.

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.

WARNING All electrical works must be performed by only a qualified electrician.
All national and local electrical regulations must be observed.

WARNING Circuit Breaker (CB) is not installed in the pump unit.
Please install Circuit Breaker (CB) based on the law and the standard in the installation region.

WARNING 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 Supply N_2 gas to the exhaust piping when necessary to dilute the inflammable or toxic gas up to a safe concentration.

WARNING Purge with sufficient N_2 gas before removing and washing the vacuum and exhaust piping.
Do not let inflammable, toxic or dangerous materials disperse and guard against contact with the human body.
Always work in a location with an escape route in an emergency.

WARNING Do not use the pump for another process without a previous overhaul. Gases or reaction products remaining in the pump will react and lead to accidents with the formation of large amounts of products.

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. When checking for gas leaks by pressurization, please pressurize by less than 0.05 MPa into the purge port and do check.

WARNING Do not alter the pump member nor change any parts without the EBARA's consent or approval.

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 Safety Interlock functions periodically (every 6 months) to confirm the interlocks will work correctly.

CAUTION Disposal of process by-products shall be strictly in accordance with all local and national environmental and safety regulations.

CAUTION Disposal of Printed circuit board containing Lithium battery shall be strictly in accordance with all local and national environmental and applicable regulations.

WARNING In designing the dry pumps, Ebara does not assume risks caused by hazardous chemical reactions resulted from simultaneous injection or mixture of multiple process gases in the pumps, and the pump is not equipped with a protection against the dangers from such pump usage. The tool suppliers and users must pay attention not to simultaneously inject or mix those gases.

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

CAUTION Never operate the pump without pump cover for safety.

Following safety warning 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 danger

1. High temperature warning

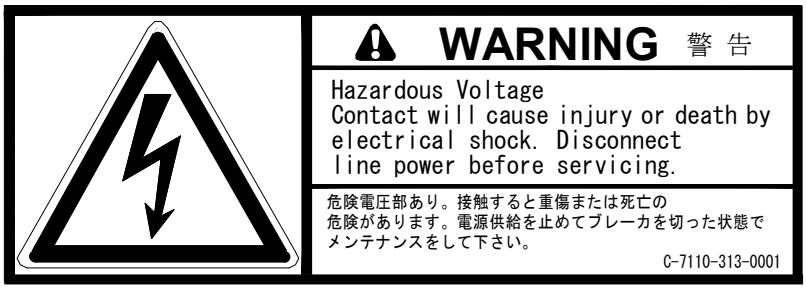
Hot surface may burn or cause injury.

Allow the piping and casing to cool before servicing.

2. Hazardous voltage warning

Hazardous Voltage may shock, burn, or cause death.

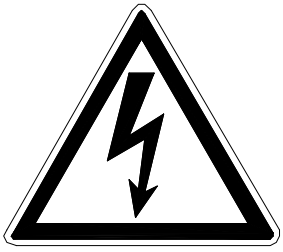
Turn power off and lockout before servicing.



3. Hazardous materials warning

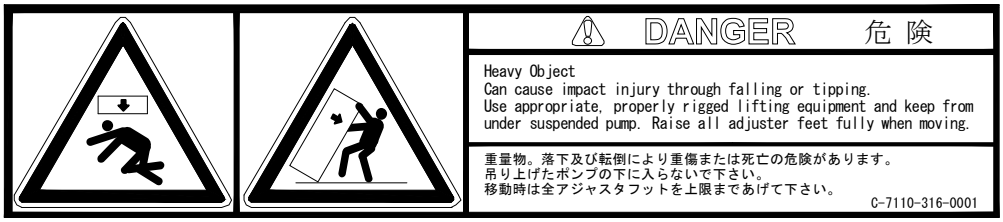
In case of hazardous materials are handled. Run the pump only with N2 gas purge before servicing. Take adequate measures against dangerous reaction and contact with human body.

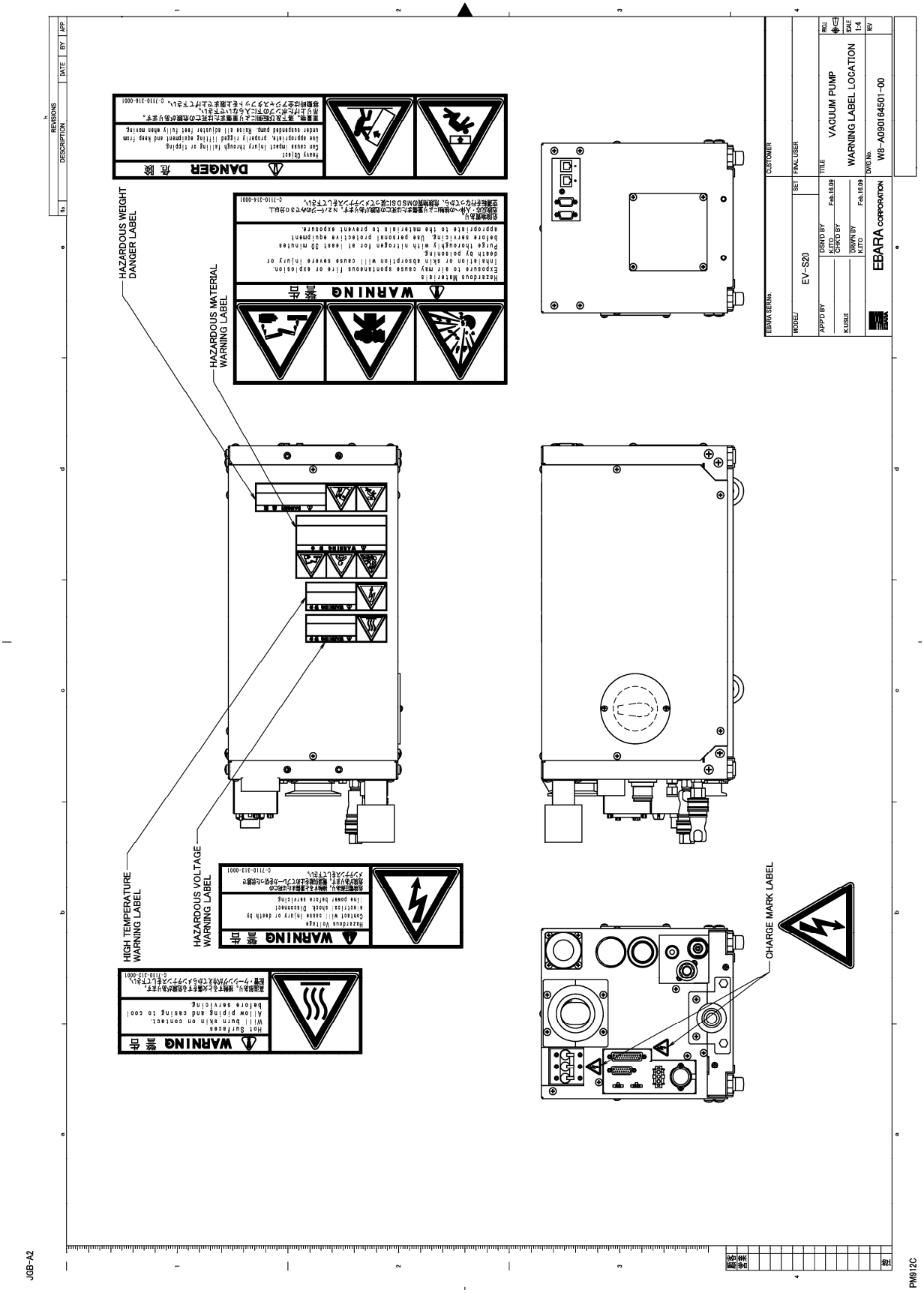
4. Electric charge mark

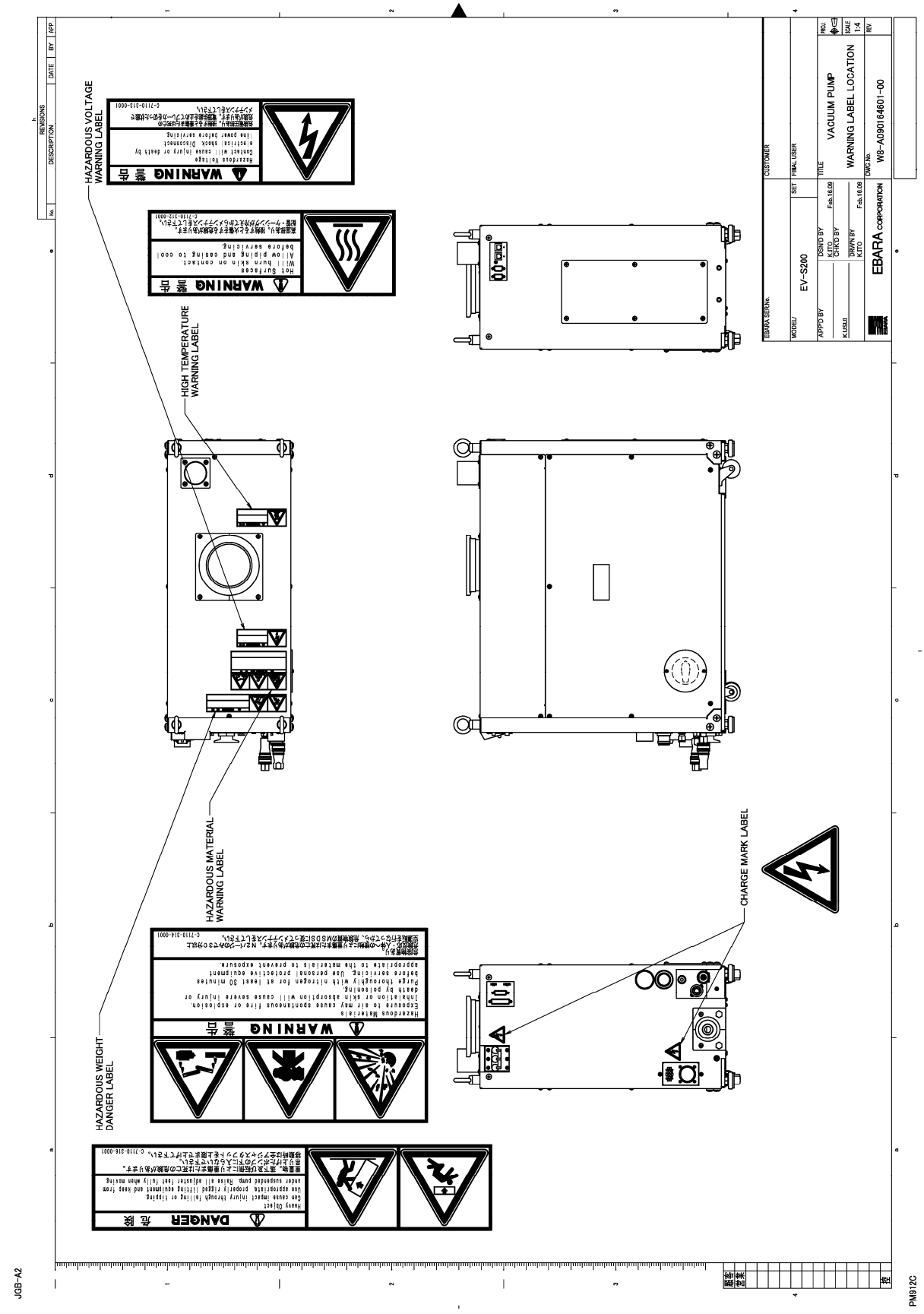


5. Hazardous weight danger

Heavy weight may cause severe injury or death due to overturning or falling pump. Keep out from under the lifted pump.
Raise all adjuster-feet fully when moving.




HAZARDOUS WEIGHT
DANGER LABEL
HAZARDOUS MATERIAL
WARNING LABEL
HIGH TEMPERATURE
WARNING LABEL
HAZARDOUS VOLTAGE
WARNING LABEL
CHARGE MARK LABEL
EBARA CORPORATION
EV-S20
VACUUM PUMP
WARNING LABEL LOCATION
W8-A0901645O1-00
PM912C
JGB-A2


HAZARDOUS VOLTAGE WARNING LABEL
HIGH TEMPERATURE WARNING LABEL
HAZARDOUS MATERIAL WARNING LABEL
HAZARDOUS WEIGHT DANGER LABEL
CHARGE MARK LABEL
WARNING 警告
DANGER 危険
EV-S200
VACUUM PUMP
WARNING LABEL LOCATION
EBARA CORPORATION
W8-A0901646O1-00
JOB-A2
PM912C

Safety Interlocks

WARNING Check Safety Interlock functions periodically (every 6 months) to confirm the interlocks will work correctly.

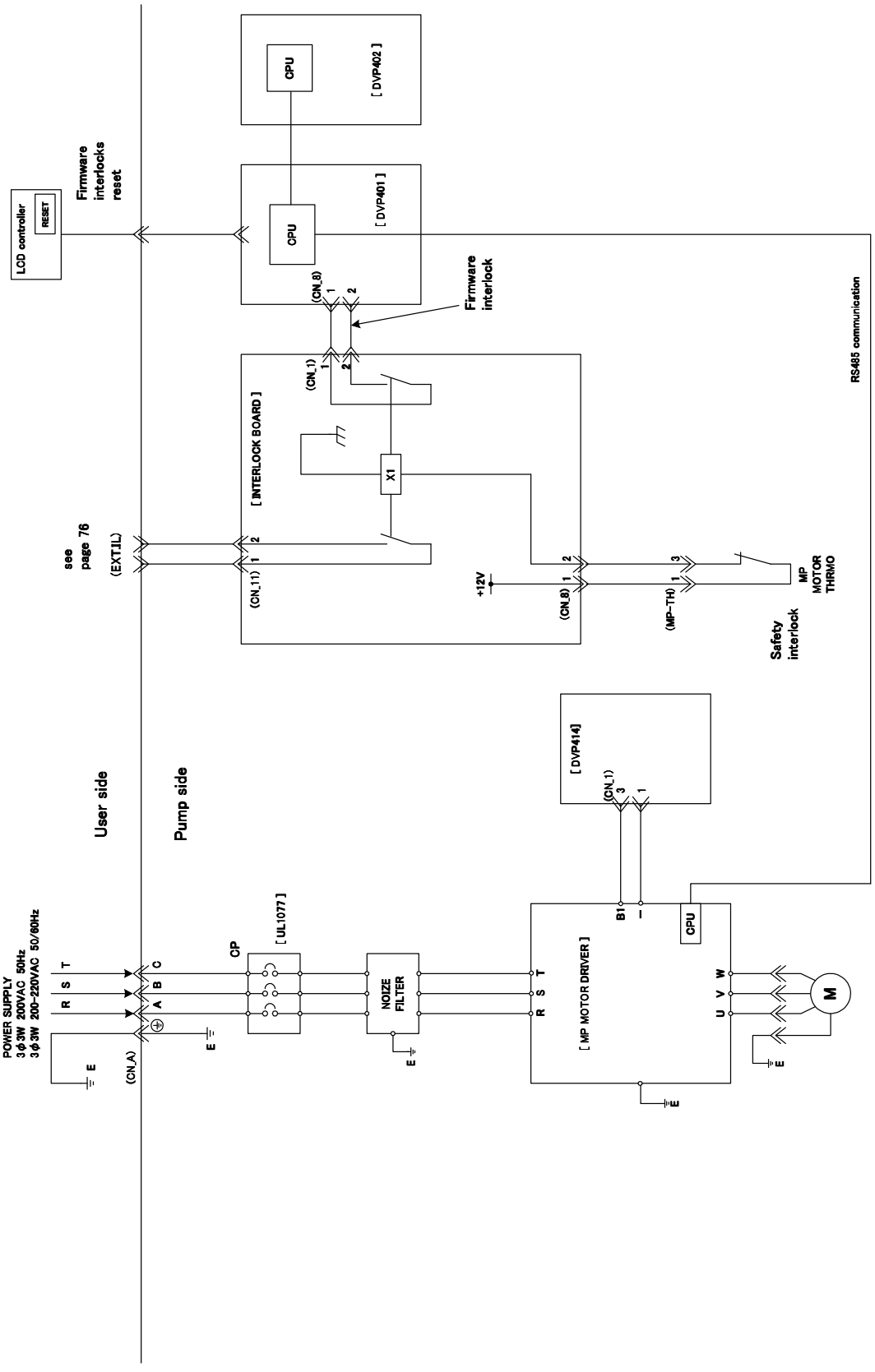
NITROGEN FLOW LOW

A normally open flow switch breaks when nitrogen supply to the pump (oil bearing(s) and inter stage injection) drops below its factory set point, opening the motor starter relay(s) and shutting down the pump. Restoration of sufficient nitrogen flow permits restarting the pump.

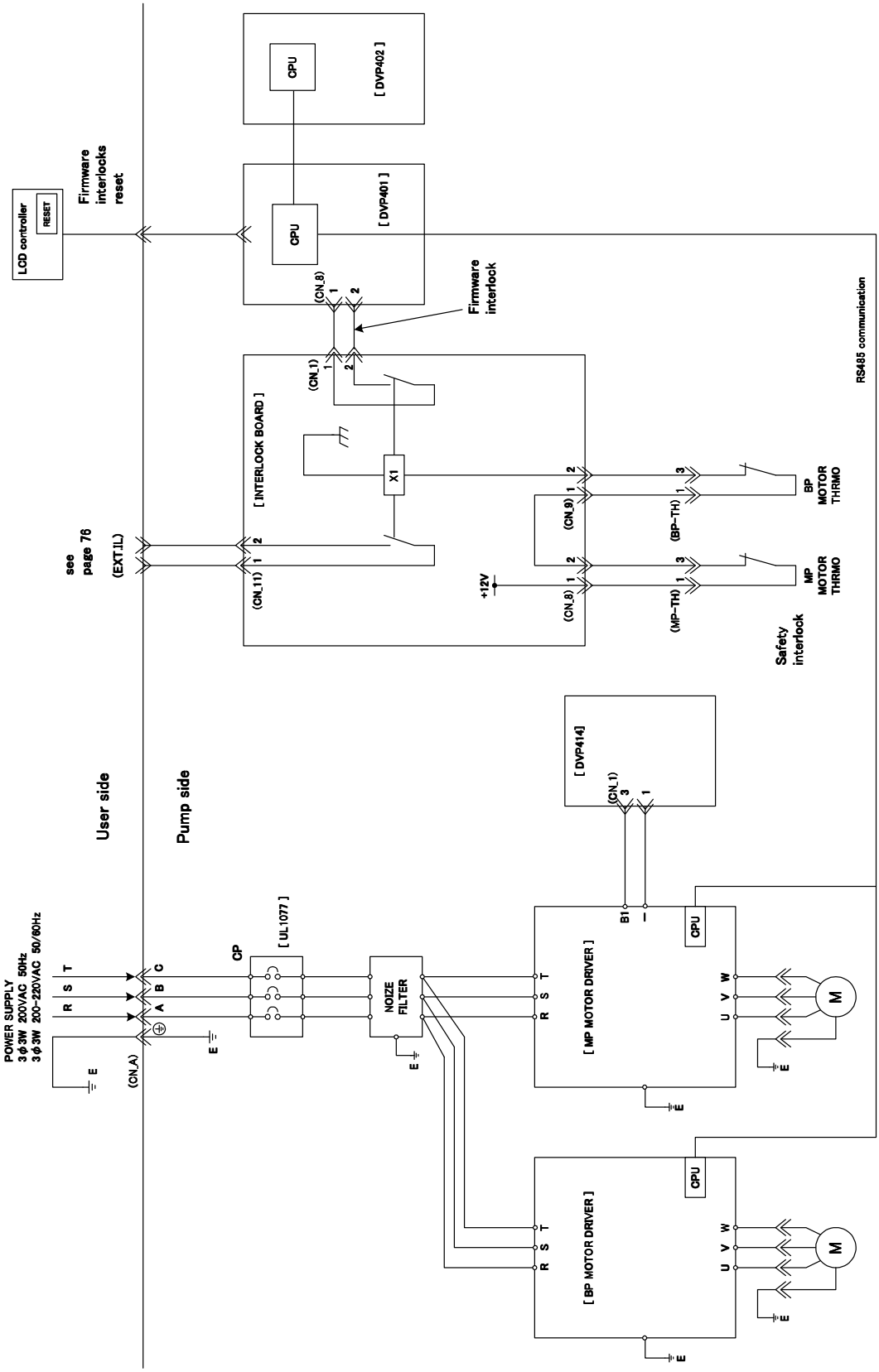
MOTOR OVERLOAD

Motor thermostat protect the pump motor from overheating due to extended current draws in excess of the motor rating. Under a persistent overload condition, motor thermostat opens a contact, which interrupts the motor run circuit. A brief cool down interval permits restarting the pump.

Interlock Schematic(EV-S20)



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



Standard Limited Warranty

The terms of this Warranty limit the liability of EBARA CORPORATION. Please 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 ESA 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.

EC DECLARATION OF CONFORMITY

Manufacturer: EBARA CORPORATION

Address of manufacturer: 11-1, Haneda Asahi-cho Ota-ku Tokyo 144-8510, Japan

Herewith declares that:

Type of product : Dry Vacuum Pump

Model : EV−S series

- does comply with the provisions of the "Low Voltage Directive 2006/95/EC".
- does comply with the provisions of the "EMC Directive 2004/108/EC".
- does comply with the provisions of the "Machine Directive 2006/42/EC".

- And declares that following (parts/clauses of) harmonized standards have been applied:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum Pumps
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2007	Electromagnetic compatibility (EMC) -- Part 6-4: Generic standards - Emission standard for industrial

The Technical Construction File for this machinery is retaining at the following address:

EBARA Corporation, Precision Machinery Company

4-2-1 Honfujisawa, Fujisawa, Kanagawa Pref., 251-8502, Japan

Date of Issue : Jan. 12'11

Signature : Urata

Tadashi Urata

General Manager, Components Engineering Department, Components Division

EBARA CORPORATION, Precision Machinery Company

Contents

1. Foreword

We appreciate that you have selected an EBARA Model EV-S series dry vacuum pumps. These pumps have been manufactured with much care and attention so that it can be operated safely and satisfactorily.
Incorrect operation will result in lack of performance and cause accidents and injuries to personnel.

[NOTE] This instruction manual contains all necessary information on operation and maintenance of the pump.
Be sure to operate the pump correctly in accordance with these instructions to ensure a long service life.
Keep this instruction manual in a suitable place for immediate reference whenever needed.

2. Introduction

2.1 Introduction

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 whether damage has occurred or screws/bolts have worked themselves loose in transit.

⚠ **CAUTION** 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.

(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

(4) Pump must be placed in an upright position.

2.2 Environmental Concerns

Handling or operating the unit other than specified may induce adverse impacts on the environment. Follow the descriptions below to handle, operate, and maintain the unit.

(1) Ask an authorized waste-disposal company to dispose packing materials from uncrating according to laws and ordinances applicable to the waste.

(2) Failure to do the unit maintenance (including overhaul) may trigger accidents causing injury or death, unit troubles, or environmental pollution. Plan the maintenance and perform it periodically to operate the unit efficiently.

(3) To dispose the unit, follow effective laws and ordinances applicable in the area where the unit is installed.

(4) To dispose the lubricant oil and chemicals, follow effective laws and ordinances applicable in the area where the unit is installed.

WARNING If the pump becomes damaged during shipment or if parts are missing, immediately contact EBARA. If a leaking or damaged product is used, an accident resulting in injury or death could occur or the product could become further damaged. Even if leakage occurs, take measures to ensure they will not be directly discharged from the site, as such leakage also wastes resources.

CAUTION If the product is not to be immediately installed, store it in a clean, dry location.

3. Product Description

3.1 Outline

These pumps have a compact design and includes various sensors and controls to enhance reliability and operation.

3.1.1 Pump Module

The pump is Roots type vacuum pump which rotates a pair of non-contact multi-stage rotors synchronized by timing gears.
The timing gears and bearings are enclosed in a compartment which is independent of the casing. For lubrication Perfluoro-Polyether (PFPE) oil and grease are used.
The pumps of this series are factory filled with lubrication oil. Use only the recommended lubrication oil grades shown in specification Table 3.1 for replenishing or replacing.

3.1.2 N_2 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.

N_2 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, N_2 gas is supplied to each pump component as dilution purge gas. Stopping the dilution N_2 with a selector valve can save N_2 gas, when process does not produce corrosion and reaction by-products. The correct amount of N_2 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.

3.1.3 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.

3.1.4 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.

3.2 Control System

These pumps have a built-in unit consisting of a Circuit Protector (CP), Noise Filter (NF), 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, N_2 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.

3.2.1 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.

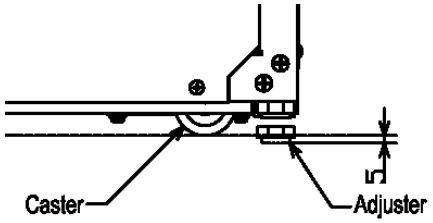
3.2.2 Operation Status Control

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.

3.3 The way of pump moving

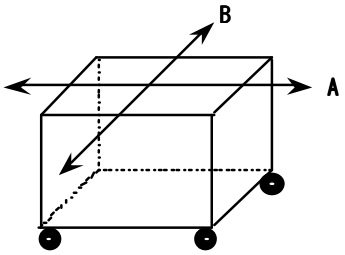
3.3.1 Preparation

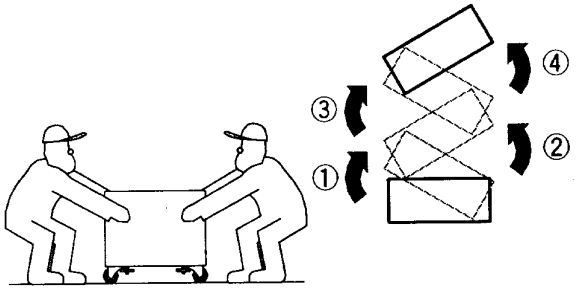
Before pump moving, all adjuster feet shall be raised fully at four places.
In case of being not raised fully, pump may be tripped over by obstacle on floor.



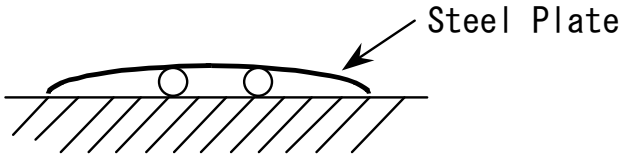
3.3.2 Moving method

Move pump slowly by pushing eye bolt toward direction A. Be sure not to be caught by toes. If pump needs to be moved toward direction B in order to be set at a corner or narrow spaces, two persons shall move the pump by pushing its terminal portion alternately as directed below.





If pump needs to be moved on steps or ditches, spread steel plate or the like which can sustain the pump weight over the steps / ditches and pump shall be moved on it by two persons with care.



If pump should lose its balance when moving and start tripping over, never try to sustain the pump, get away from the pump immediately.

3.4 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.

3.4.1 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

3.4.2 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.

3.4.3 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 N_2 regulator.
4. Turn knob counterclockwise until pressure gauge reads 0 MPa. (Both N_2 regulator knob and nitrogen pressure gauge are located on front panel of the pump.)
5. Disconnect tube connection of N_2 supply line by turning tube nut counterclockwise.
6. Plug (cap) ¼" tube connector on the pump with a tube fitting cap.

3.4.4 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.

3.5 Detailed Specifications

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

3.5.1 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

Table 3.1 Specifications (EV-S20 / EV-S20P / EV-S20N)

Model			Model EV-S20	Model EV-S20P	Model EV-S20N
Pumping Speed			1670 L/min		
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	FNPT 1/4" (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°C		
	N2 Gas	Connection	----------	1/4" Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	----------	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.012 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, 200-220V , 50 / 60Hz		
		Power Capacity	3.2 kVA		
		Connection	Amphenol C016 20C003 100 12		
Control Signal			D-sub 15 Pin + D-sub 25 Pin		
Communication			RS-232C D-sub 9 Pin X 2		
CP Rating			15 A		
SCCR			1.0 kA		
Airborne noise test data			57 dB		

[Note] The ambient temperature of the pump installation place shall be 30 degrees of centigrade of lower.

Table 3.2 Specifications (Model EV-S50 / EV-S50P / EV-S50N)

Model			Model EV-S50	Model EV-S50P	Model EV-S50N
Pumping Speed			5000 L/min		
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	FNPT 1/4" (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°C		
	N2 Gas	Connection	----------	1/4” Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	----------	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.012 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, 200-220V , 50 / 60Hz		
		Power Capacity	4.8 kVA		
		Connection	Japan Aviation Electronics Industry JL04HV-2E22-22PE-B		
Control Signal			D-sub 15 Pin + D-sub 25 Pin		
Communication			RS-232C D-sub 9 Pin X 2		
CP Rating			20 A		
SCCR			1.0 kA		
Airborne noise test data			57 dB		

[Note] The ambient temperature of the pump installation place shall be 30 degrees of centigrade of lower.

Table 3.3 Specifications (EV-S100 / EV-S100P / EV-S100N)

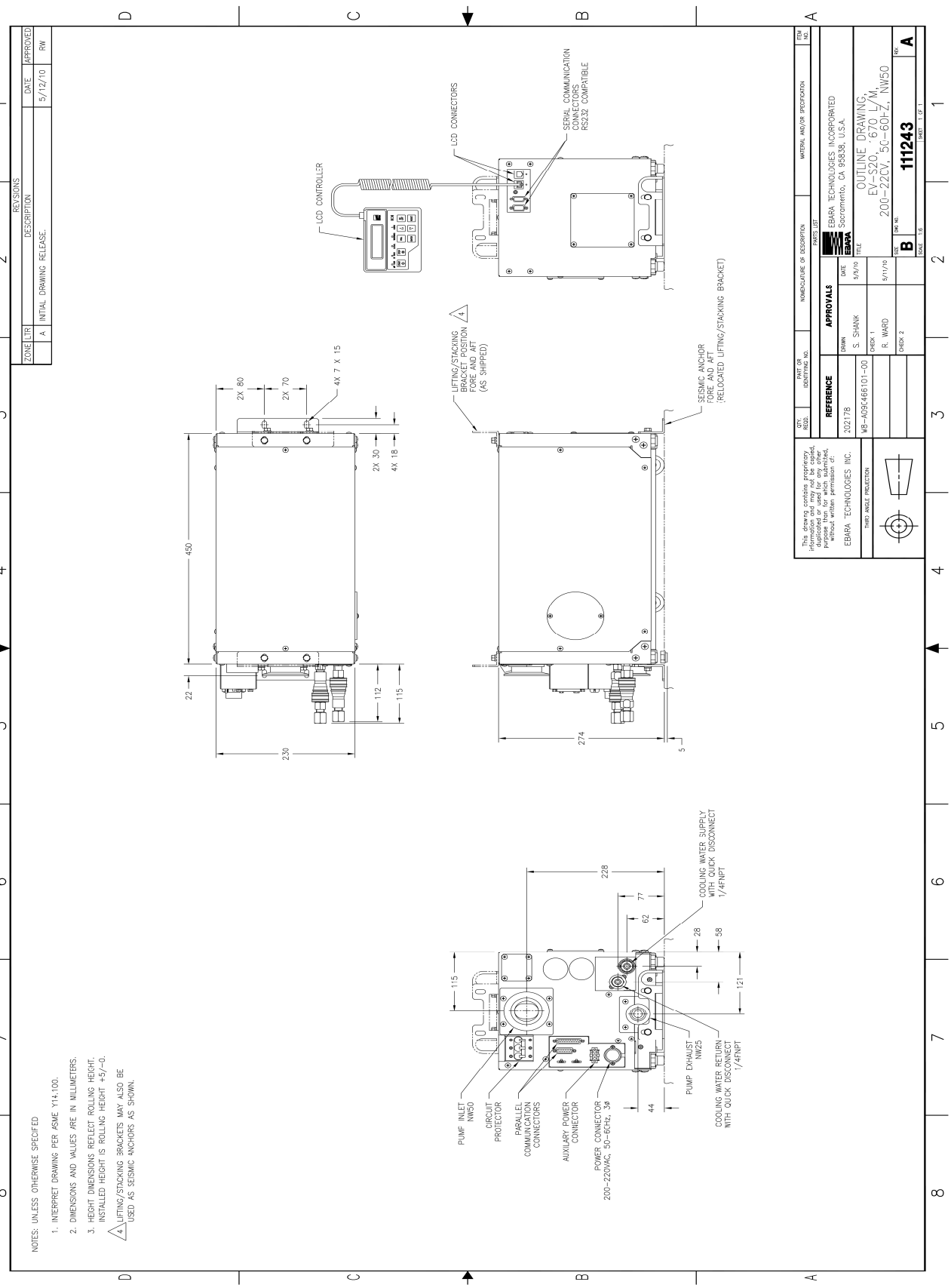
Model			Model EV-S100	Model EV-S100P	Model EV-S100N
Pumping Speed			10000 L/min		
Ultimate Pressure			0.5 Pa		
Connection		Gas Inlet	ISO80		
		Gas Outlet	NW40		
Approx. Power at Ultimate Pressure (Max. Power)			0.65 kW (4.6 kW)		
Utili-ty	Cooling Water	Connection	FNPT 1/4" (Coupler)		
		Pressure [Gauge Press.]	Differential Press.: Min. 0.2 MPa Supply: Max. 0.4 MPa		
		Flow Rate	2.0 - 3.0 L/min		
		Temperature	Max. 30°C		
	N2 Gas	Connection	----------	1/4” Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	----------	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.012 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, 200-220V , 50 / 60Hz		
		Power Capacity	6.4 kVA		
		Connection	Japan Aviation Electronics Industry JL04HV-2E22-22PE-B		
Control Signal			D-sub 15 Pin + D-sub 25 Pin		
Communication			RS-232C D-sub 9 Pin X 2		
CP Rating			30 A		
SCCR			1.0 kA		
Airborne noise test data			57 dB		

[Note] The ambient temperature of the pump installation place shall be 30 degrees of centigrade of lower.

Table 3.4 Specifications (EV-S200 / EV-S200P / EV-S200N)

Model			Model EV-S200	Model EV-S200P	Model EV-S200N
Pumping Speed			20000 L/min		
Ultimate Pressure			0.5 Pa		
Connection		Gas Inlet	ISO100		
		Gas Outlet	NW40		
Approx. Power at Ultimate Pressure (Max. Power)			0.75 kW (5.1 kW)		
Utility	Cooling Water	Connection	FNPT 1/4" (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°C		
	N2 Gas	Connection	----------	1/4” Tube Fitting (Same as SWAGELOK)	
		Pressure [Gauge Press.]	----------	Supply: 0.15 - 0.7 MPa [Setting: 0.09 - 0.012 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, 200-220V , 50 / 60Hz		
		Power Capacity	6.8 kVA		
		Connection	Japan Aviation Electronics Industry JL04HV-2E22-22PE-B		
Control Signal			D-sub 15 Pin + D-sub 25 Pin		
Communication			RS-232C D-sub 9 Pin X 2		
CP Rating			30 A		
SCCR			1.0 kA		
Airborne noise test data			63 dB		

[Note] The ambient temperature of the pump installation place shall be 30 degrees of centigrade of lower.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LCD CONTROLLER
LCD CONNECTORS
SERIAL COMMUNICATION CONNECTORS RS232 COMPATIBLE
LIFTING/STACKING BRACKET POSITION FORE AND AFT (AS SHIPPED)
SEISMIC ANCHOR FORE AND AFT (RELOCATED LIFTING/STACKING BRACKET)
4X 7 X 15
2X 80
2X 70
2X 30
4X 18
450
22
112
115
230
274
5
228
77
62
28
58
115
121
44
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4"NPT
PUMP INLET NW50
CIRCUIT PROTECTOR
PARALLEL COMMUNICATION CONNECTORS
AUXILIARY POWER CONNECTOR
POWER CONNECTOR 200-220VAC, 50-60Hz, 3Ø
PUMP EXHAUST NW25
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4"NPT
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
2. DIMENSIONS AND VALUES ARE IN MILLIMETERS.
3. HEIGHT DIMENSIONS REFLECT ROLLING HEIGHT. INSTALLED HEIGHT IS ROLLING HEIGHT +5/-0.
4 LIFTING/STACKING BRACKETS MAY ALSO BE USED AS SEISMIC ANCHORS AS SHOWN.
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NOMENCLATURE OR DESCRIPTION
MATERIAL AND/OR SPECIFICATION
ITEM NO.
PARTS LIST
REFERENCE
202178
WB-A09C466101-00
APPROVALS
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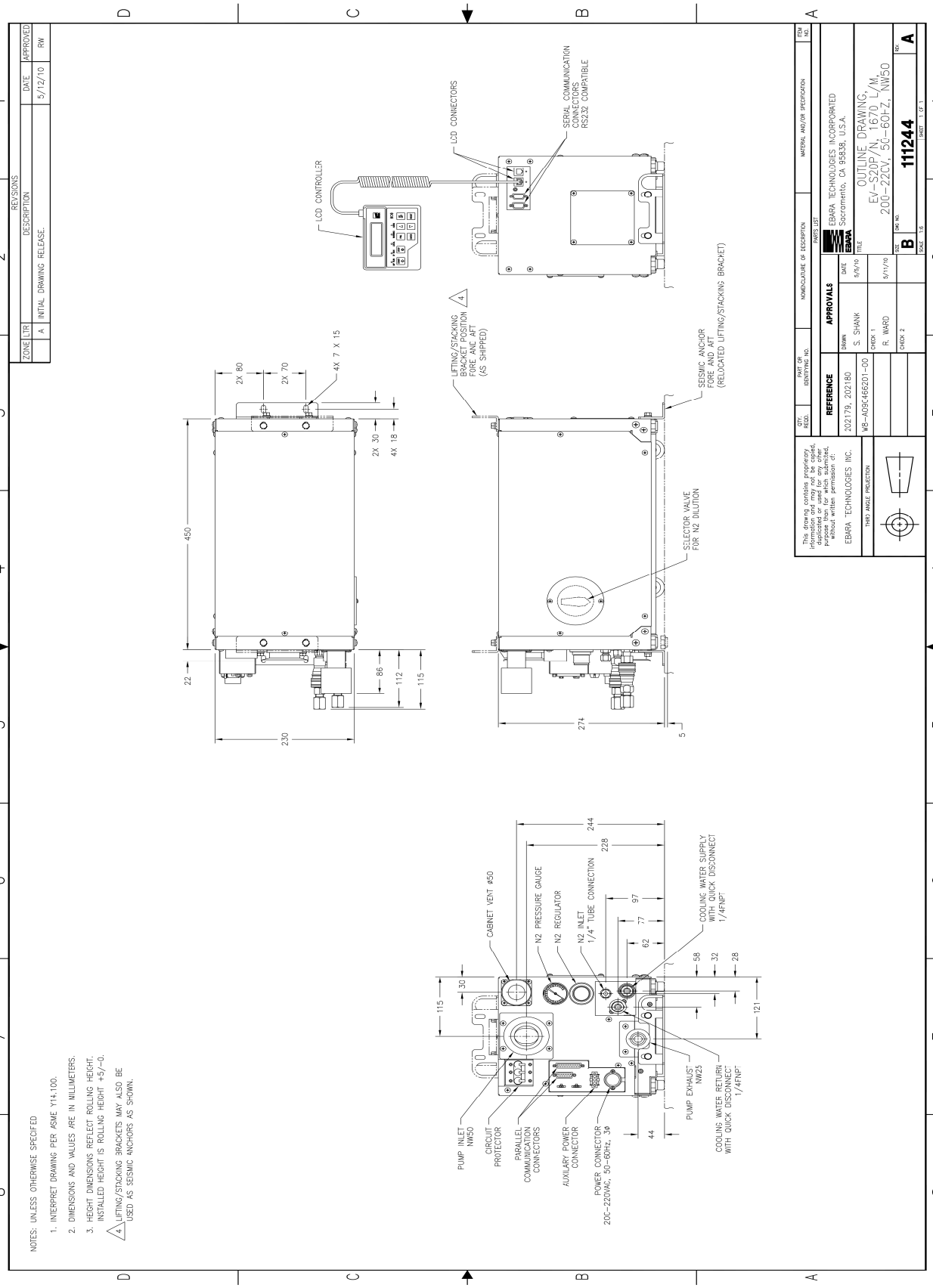
CHECK 1 R. WARD 5/11/10
CHECK 2
DATE
EBARA TECHNOLOGIES INCORPORATED
Sacramento, CA 95838, U.S.A.
TITLE
OUTLINE DRAWING,
EV-S20, 670 L/M,
200-22CV, 5C-60HZ, NW50
SIZE B
DWG NO. 111243
REV A
SCALE 1:6
SHEET 1 OF 1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LCD CONTROLLER
LCD CONNECTORS
SERIAL COMMUNICATION CONNECTORS RS232 COMPATIBLE
LIFTING/STACKING BRACKET POSITION /4 FORE AND AFT (AS SHIPPED)
SEISMIC ANCHOR FORE AND AFT (RELOCATED LIFTING/STACKING BRACKET)
SELECTOR VALVE FOR N2 DILUTION
4X 7 X 15
2X 80
2X 70
2X 30
4X 18
450
22
86
112
115
230
274
5
CABINET VENT ø50
N2 PRESSURE GAUGE
N2 REGULATOR
N2 INLET 1/4" TUBE CONNECTION
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4FNPT
244
228
97
77
62
58
32
28
30
115
121
44
PUMP INLET NW50
CIRCUIT PROTECTOR
PARALLEL COMMUNICATION CONNECTORS
AUXILIARY POWER CONNECTOR
POWER CONNECTOR 20C-220VAC, 50-60Hz, 3ø
PUMP EXHAUST NW25
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4FNPT
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
2. DIMENSIONS AND VALUES ARE IN MILLIMETERS.
3. HEIGHT DIMENSIONS REFLECT ROLLING HEIGHT. INSTALLED HEIGHT IS ROLLING HEIGHT +5/-0.
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NOMENCLATURE OR DESCRIPTION
MATERIAL AND/OR SPECIFICATION
ITEM NO.
REFERENCE
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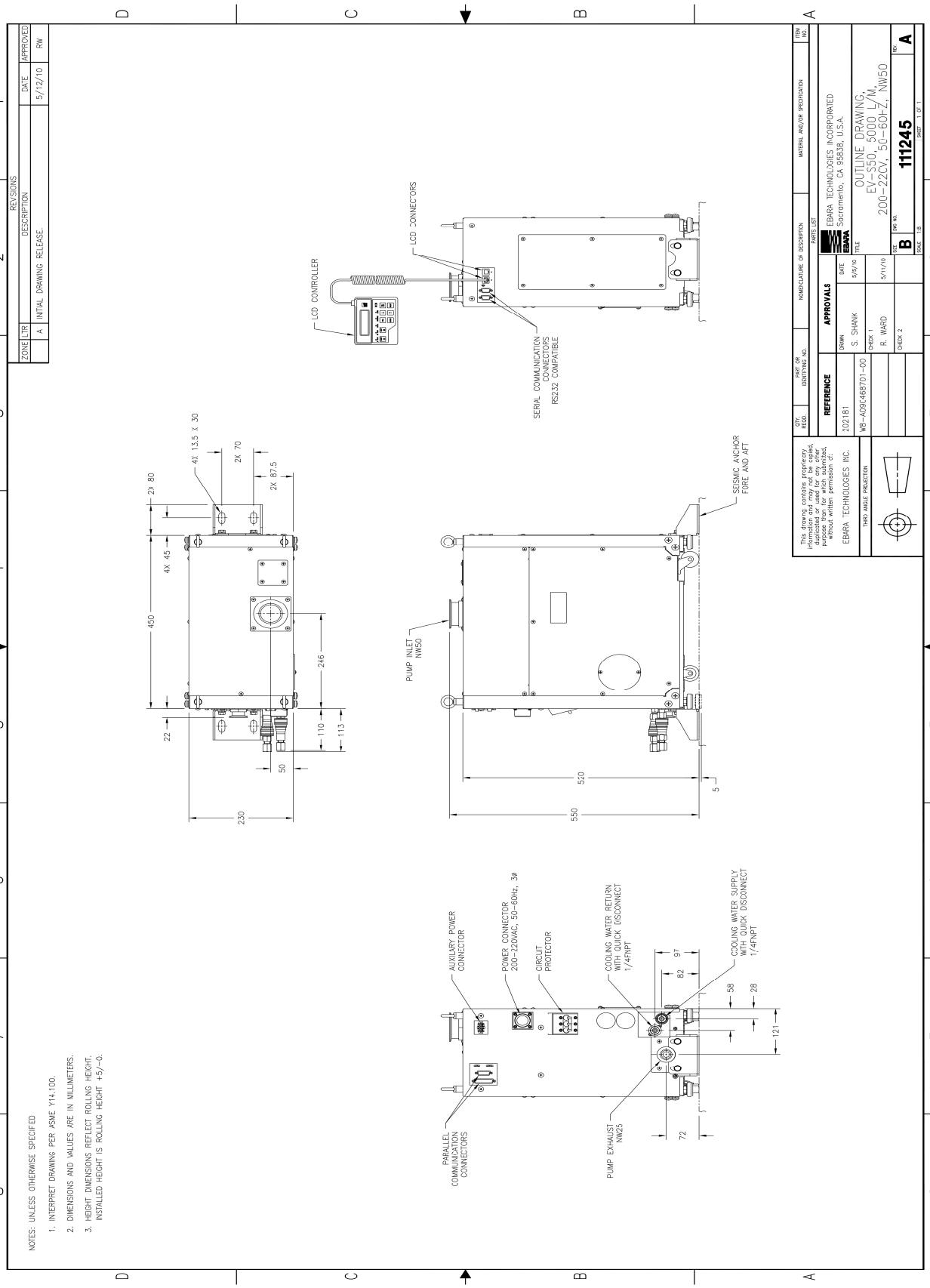
APPROVALS
DRAWN S. SHANK DATE 5/5/10
CHECK 1 R. WARD 5/11/10
CHECK 2
MATRL LIST
EBARA TECHNOLOGIES INCORPORATED
Sacramento, CA 95838, U.S.A.
TITLE
OUTLINE DRAWING,
EV-S20P/N, 1670 L/M,
200-220V, 50-60HZ, NW50
SIZE B
DWG NO. 111244
REV A
SCALE 1/5
SHEET 1 OF 1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LCD CONNECTORS
SERIAL COMMUNICATION CONNECTORS RS232 COMPATIBLE
4X 13.5 X 30
2X 70
2X 87.5
2X 80
4X 45
450
246
110
113
22
50
230
PUMP INLET NW50
SEISMIC ANCHOR FORE AND AFT
520
550
5
AUXILIARY POWER CONNECTOR
POWER CONNECTOR 200-220VAC, 50-60Hz, 3ø
CIRCUIT PROTECTOR
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4FNPT
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4FNPT
97
82
58
28
121
72
PARALLEL COMMUNICATION CONNECTORS
PUMP EXHAUST NW25
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
2. DIMENSIONS AND VALUES ARE IN MILLIMETERS.
3. HEIGHT DIMENSIONS REFLECT ROLLING HEIGHT.
INSTALLED HEIGHT IS ROLLING HEIGHT +5/-0.
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NOMENCLATURE OR DESCRIPTION
MATERIAL AND/OR SPECIFICATION
ITEM NO.
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202181
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APPROVALS
DRAWN S. SHANK 5/5/10
CHECK 1 R. WARD 5/11/10
CHECK 2
EBARA TECHNOLOGIES INCORPORATED
Sacramento, CA 95838, U.S.A.
TITLE
OUTLINE DRAWING,
EV-S50, 5000 L/M,
200-22CV, 50-60HZ, NW50
SIZE B
DWG NO. 111245
REV A
SCALE 1:8
SHEET 1 OF 1
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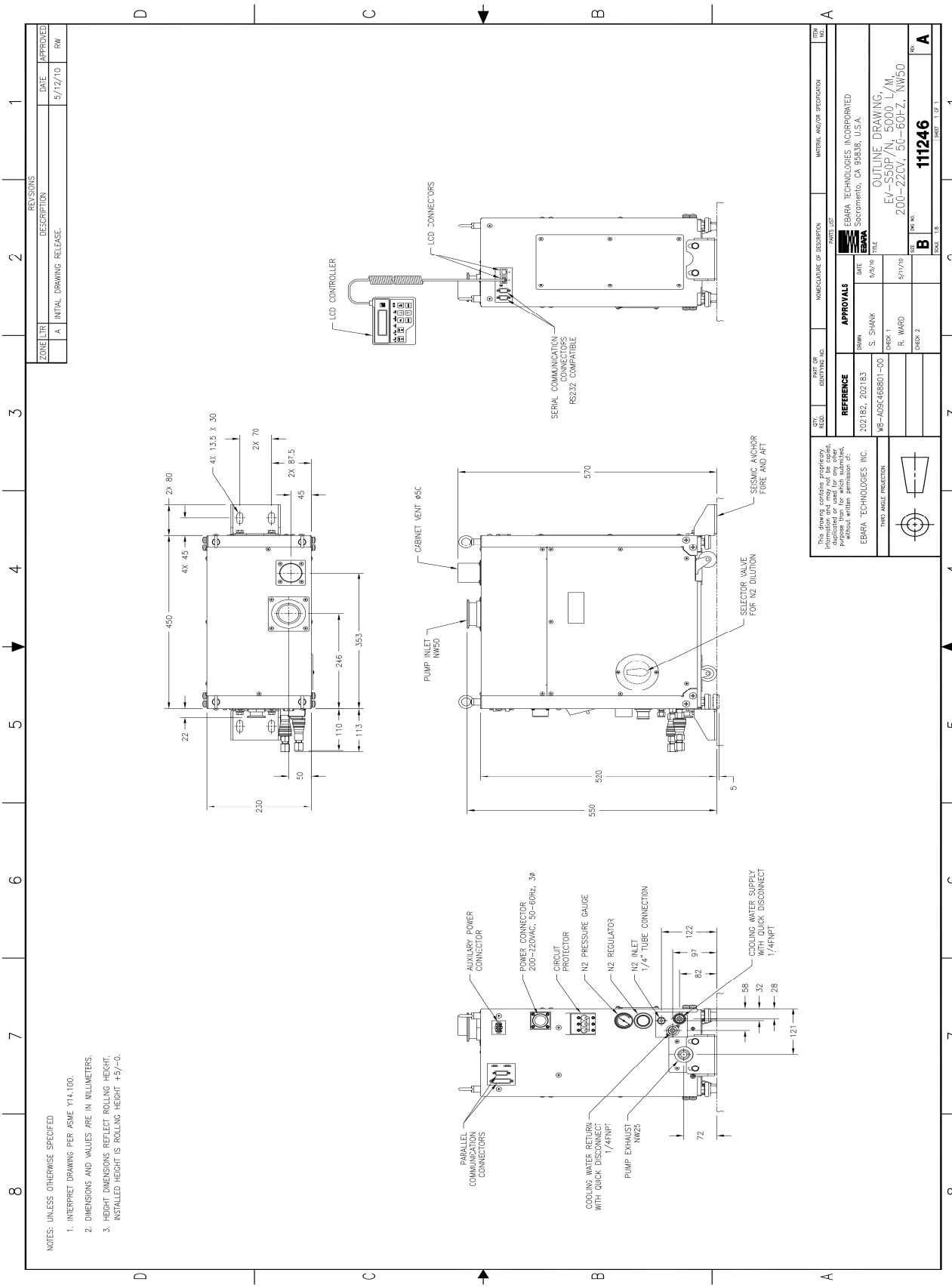
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LCD CONTROLLER
LCD CONNECTORS
SERIAL COMMUNICATION CONNECTORS RS232 COMPATIBLE
4X 13.5 X 30
2X 70
2X 87.5
2X 80
4X 45
45
450
353
246
110
113
22
50
230
CABINET VENT ø5C
570
SEISMIC ANCHOR FORE AND AFT
PUMP INLET NW50
SELECTOR VALVE FOR N2 DILUTION
520
5
550
AUXILIARY POWER CONNECTOR
POWER CONNECTOR 200-220VAC, 50-60Hz, 3ø
CIRCUIT PROTECTOR
N2 PRESSURE GAUGE
N2 REGULATOR
N2 INLET 1/4" TUBE CONNECTION
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4FNPT
122
97
82
58
32
28
121
72
PARALLEL COMMUNICATION CONNECTORS
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4FNPT
PUMP EXHAUST NW25
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
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TITLE
OUTLINE DRAWING;
EV-550P/N, 5000 L/M,
200-220V, 50-60HZ, NW50
SIZE B DWG NO. 111246 REV. A
SCALE 1:8 SHEET 1 OF 1
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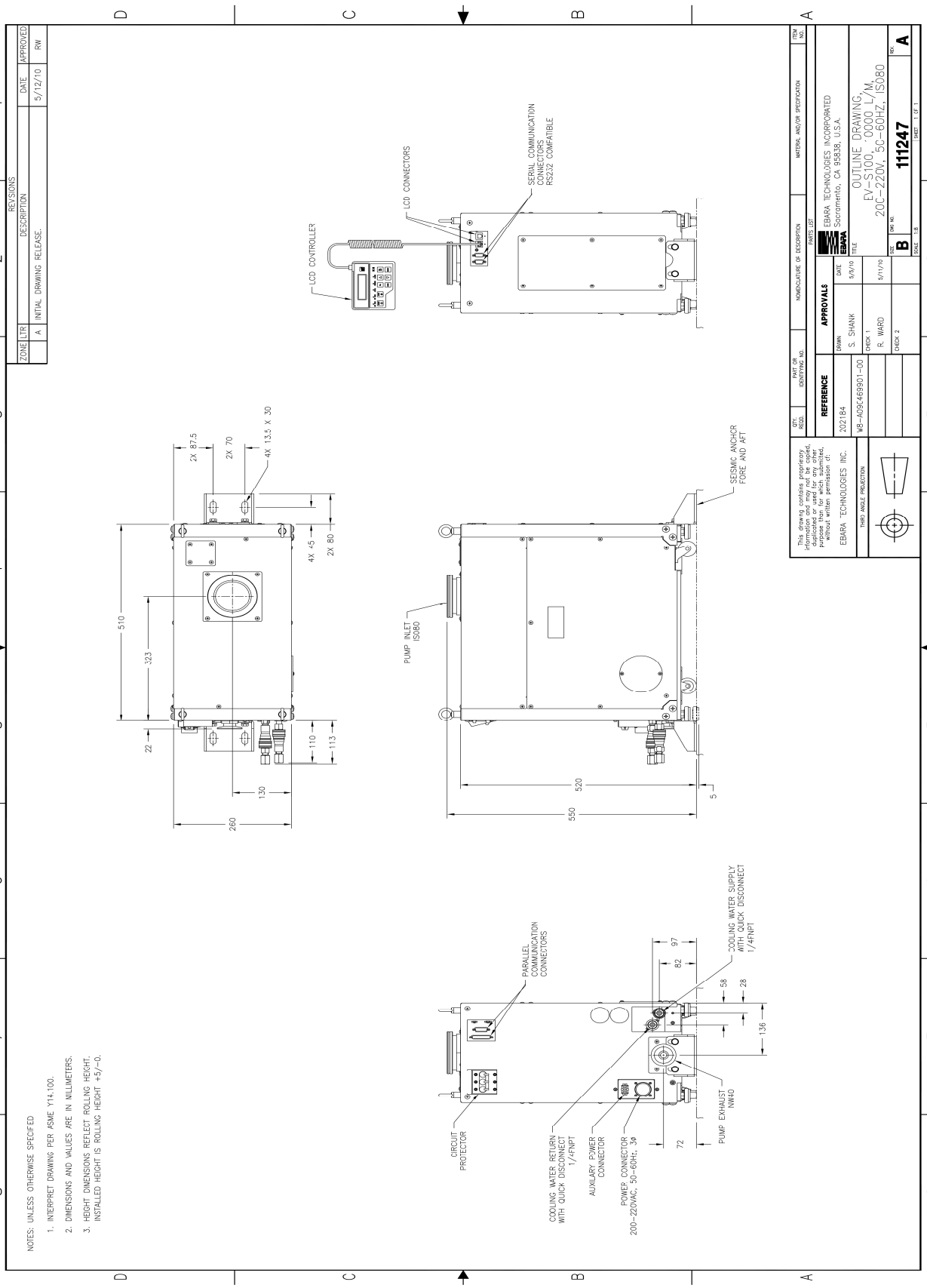
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LCD CONNECTORS
SERIAL COMMUNICATION CONNECTORS RS232 COMPATIBLE
2X 87.5
2X 70
4X 13.5 X 30
4X 45°
2X 80
510
323
22
110
113
130
260
SEISMIC ANCHOR FORE AND AFT
PUMP INLET ISO80
520
5
550
PARALLEL COMMUNICATION CONNECTORS
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4FNPT
97
82
58
28
136
CIRCUIT PROTECTOR
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4FNPT
AUXILARY POWER CONNECTOR
POWER CONNECTOR 200-220VAC; 50-60Hz; 3Φ
72
PUMP EXHAUST NW40
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
2. DIMENSIONS AND VALUES ARE IN MILLIMETERS.
3. HEIGHT DIMENSIONS REFLECT ROLLING HEIGHT.
INSTALLED HEIGHT IS ROLLING HEIGHT +5/-0.
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CHECK 2
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TITLE
OUTLINE DRAWING,
EV-S100, 0000 L/M,
200-220V, 50-60HZ, ISO80
SIZE B DWG NO. 111247 REV A
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THIRD ANGLE PROJECTION
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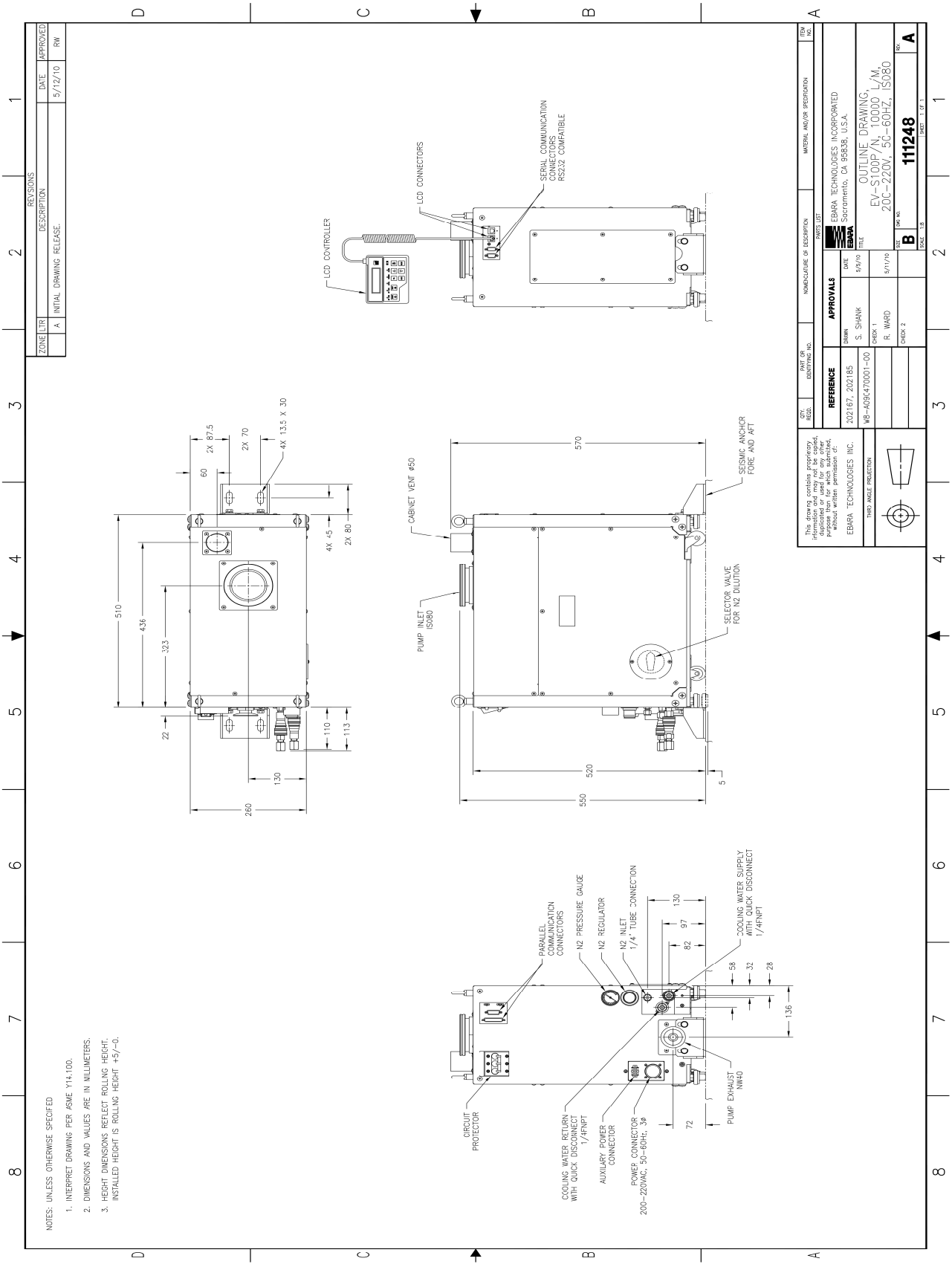
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LCD CONNECTORS
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CABINET VENT ø50
SEISMIC ANCHOR FORE AND AFT
PUMP INLET ISO80
SELECTOR VALVE FOR N2 DILUTION
PARALLEL COMMUNICATION CONNECTORS
N2 PRESSURE GAUGE
N2 REGULATOR
N2 INLET 1/4" TUBE CONNECTION
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4FNPT
CIRCUIT PROTECTOR
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4FNPT
AUXILIARY POWER CONNECTOR
POWER CONNECTOR 200~220VAC, 50~60Hz, 3ø
PUMP EXHAUST NW40
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
2. DIMENSIONS AND VALUES ARE IN MILLIMETERS.
3. HEIGHT DIMENSIONS REFLECT ROLLING HEIGHT.
INSTALLED HEIGHT IS ROLLING HEIGHT +5/-0.
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R. WARD
5/11/10
CHECK 2
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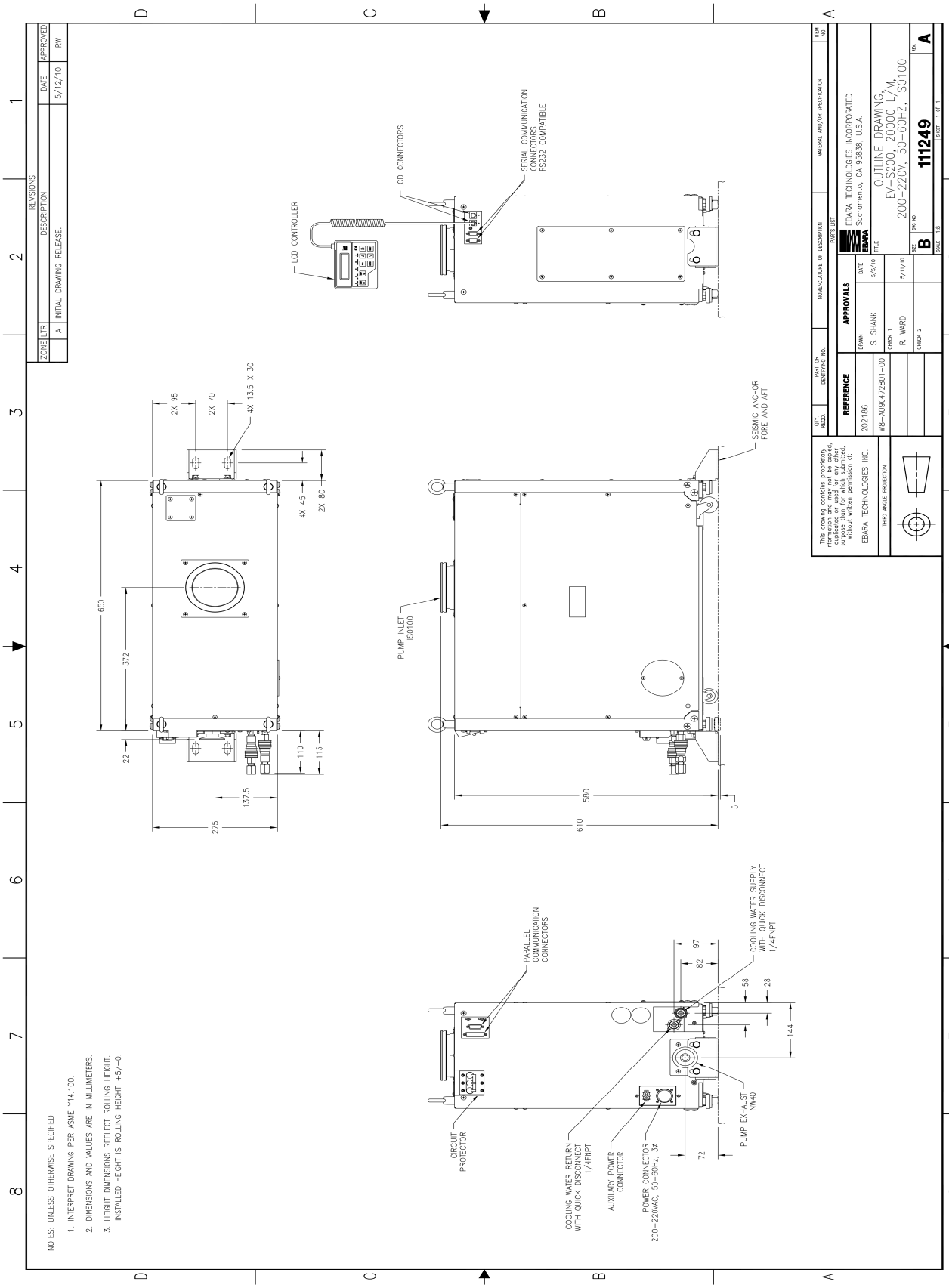
OUTLINE DRAWING,
EV-S100P/N, 10000 L/M,
20C~220V, 50~60HZ, IS080
DWG NO.
111248
REV
A
SCALE 1:8
SHEET 1 OF 1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LCD CONTROLLER
LCD CONNECTORS
SERIAL COMMUNICATION CONNECTORS RS232 COMPATIBLE
2X 95
2X 70
4X 13.5 X 30
4X 45
2X 80
653
372
22
110
113
137.5
275
SEISMIC ANCHOR FORE AND AFT
PUMP INLET ISO100
580
5
610
PARALLEL COMMUNICATION CONNECTORS
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4FNPT
97
82
58
28
144
CIRCUIT PROTECTOR
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4FNPT
AUXILIARY POWER CONNECTOR
POWER CONNECTOR 200~220VAC, 50~60Hz, 3ø
72
PUMP EXHAUST NW40
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
2. DIMENSIONS AND VALUES ARE IN MILLIMETERS.
3. HEIGHT DIMENSIONS REFLECT ROLLING HEIGHT. INSTALLED HEIGHT IS ROLLING HEIGHT +5/-0.
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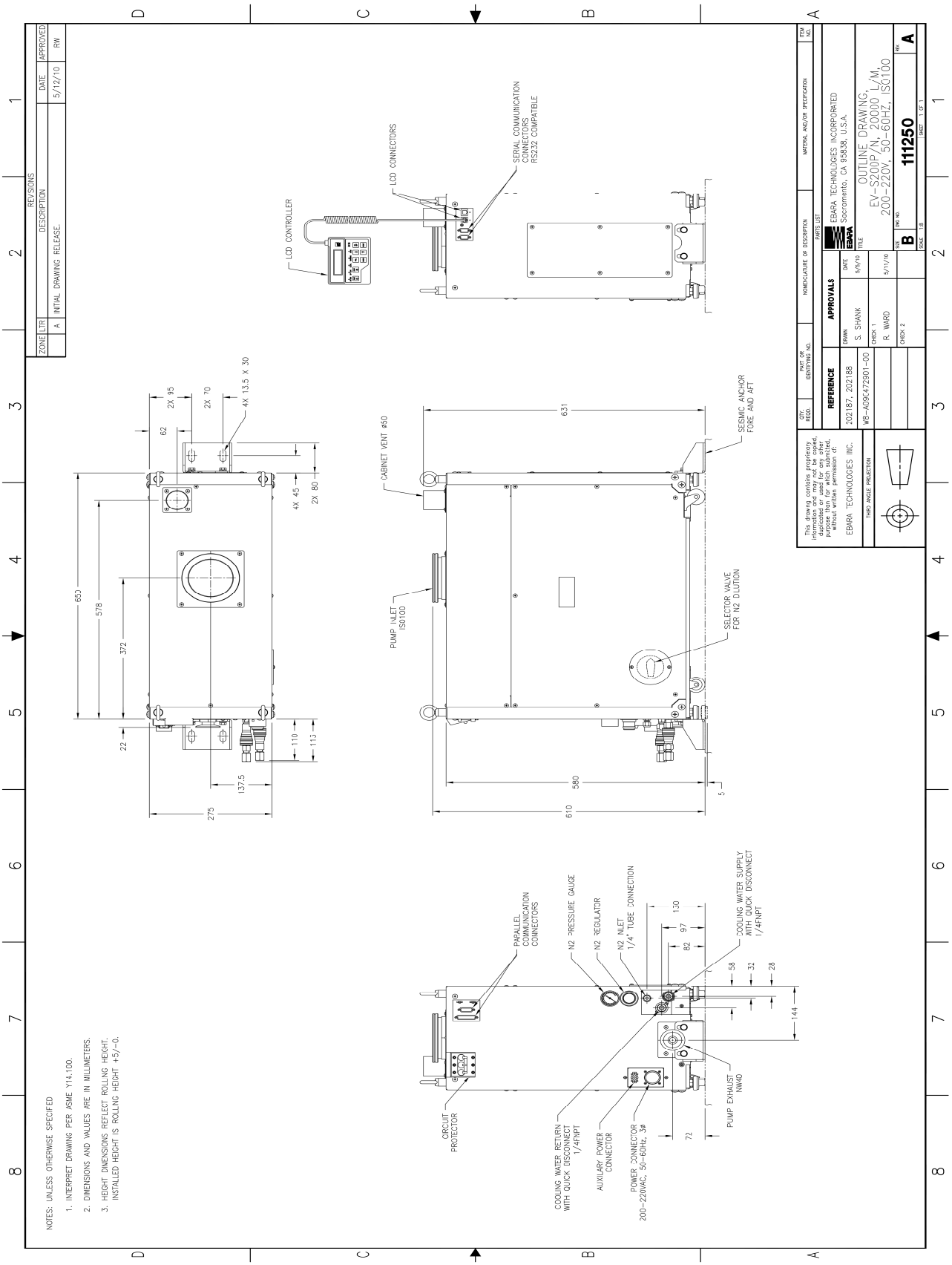
CHECK 2
DATE
THIRD ANGLE PROJECTION
EBARA TECHNOLOGIES INCORPORATED
Sacramento, CA 95838, U.S.A.
TITLE
OUTLINE DRAWING
EVI-S200, 20000 L/M,
200~220V, 50~60HZ, ISO100
SIZE B
DWG NO. 111249
REV A
SCALE 1:8
SHEET 1 OF 1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4X 13.5 X 30
2X 95
2X 70
62
4X 45
2X 80
650
578
372
22
110
113
137.5
275
CABINET VENT ø50
631
SEISMIC ANCHOR FORE AND AFT
PUMP INLET IS0100
SELECTOR VALVE FOR N2 DLUTION
580
5
610
PARALLEL COMMUNICATION CONNECTORS
N2 PRESSURE GAUGE
N2 REGULATOR
N2 INLET 1/4" TUBE CONNECTION
COOLING WATER SUPPLY WITH QUICK DISCONNECT 1/4FNPT
130
97
82
58
32
28
144
CIRCUIT PROTECTOR
COOLING WATER RETURN WITH QUICK DISCONNECT 1/4FNPT
AUXILIARY POWER CONNECTOR
POWER CONNECTOR 200-220VAC, 50-60Hz, 3ø
72
PUMP EXHAUST NW40
NOTES: UNLESS OTHERWISE SPECIFIED
1. INTERPRET DRAWING PER ASME Y14.100.
2. DIMENSIONS AND VALUES ARE IN MILLIMETERS.
3. HEIGHT DIMENSIONS REFLECT ROLLING HEIGHT. INSTALLED HEIGHT IS ROLLING HEIGHT +5/-0.
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NOMENCLATURE OR DESCRIPTION
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MATERIAL AND/OR SPECIFICATION
ITEM NO.
REFERENCE
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DRAWN
S. SHANK
5/6/10
CHECK 1
R. WARD
5/11/10
CHECK 2
DATE
EBARA TECHNOLOGIES INCORPORATED
Sacramento, CA 95838, U.S.A.
TITLE
OUTLINE DRAWING
EV-S200P/N 20000 L/M
200-220V, 50-60HZ, IS0100
SIZE
B
DWG NO.
111250
REV
A
SCALE 1:8
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THIRD ANGLE PROJECTION

Performance Curve

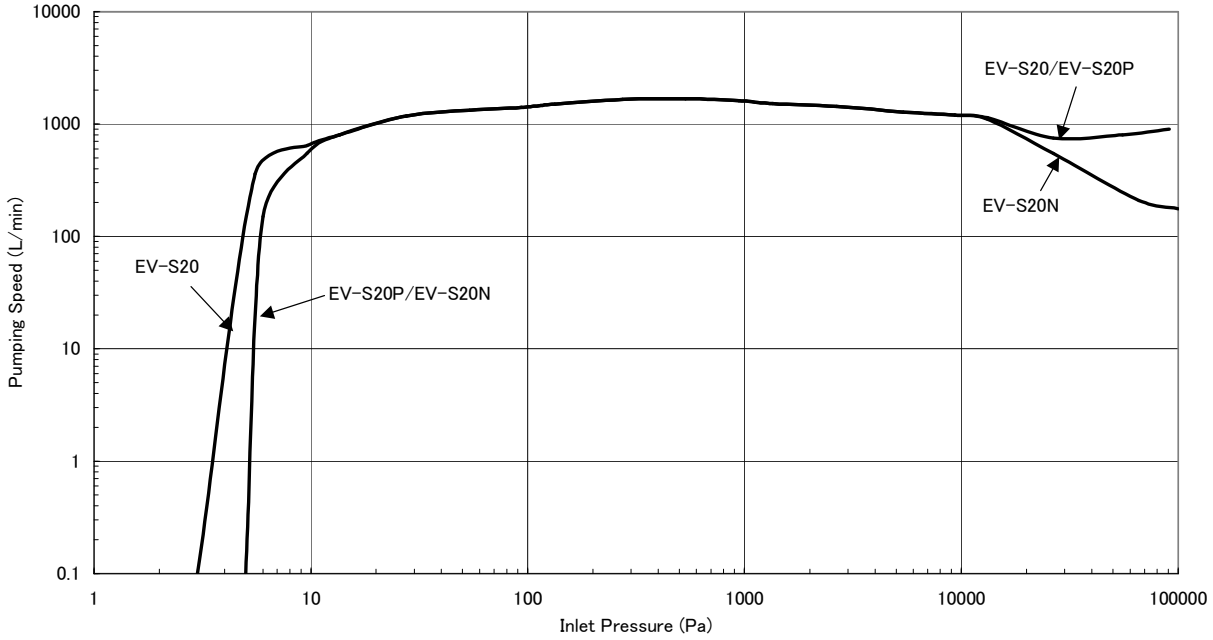


Fig 3.1 EV-S20(P/N) Performance Curve

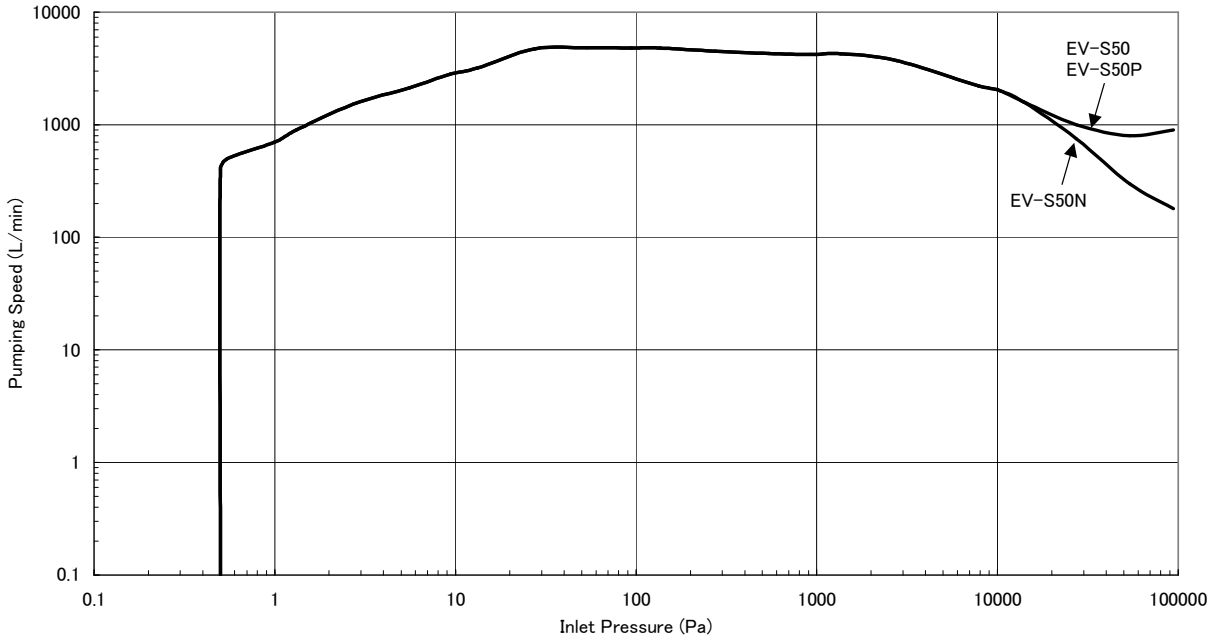


Fig 3.2 EV-S50(P/N) Performance Curve

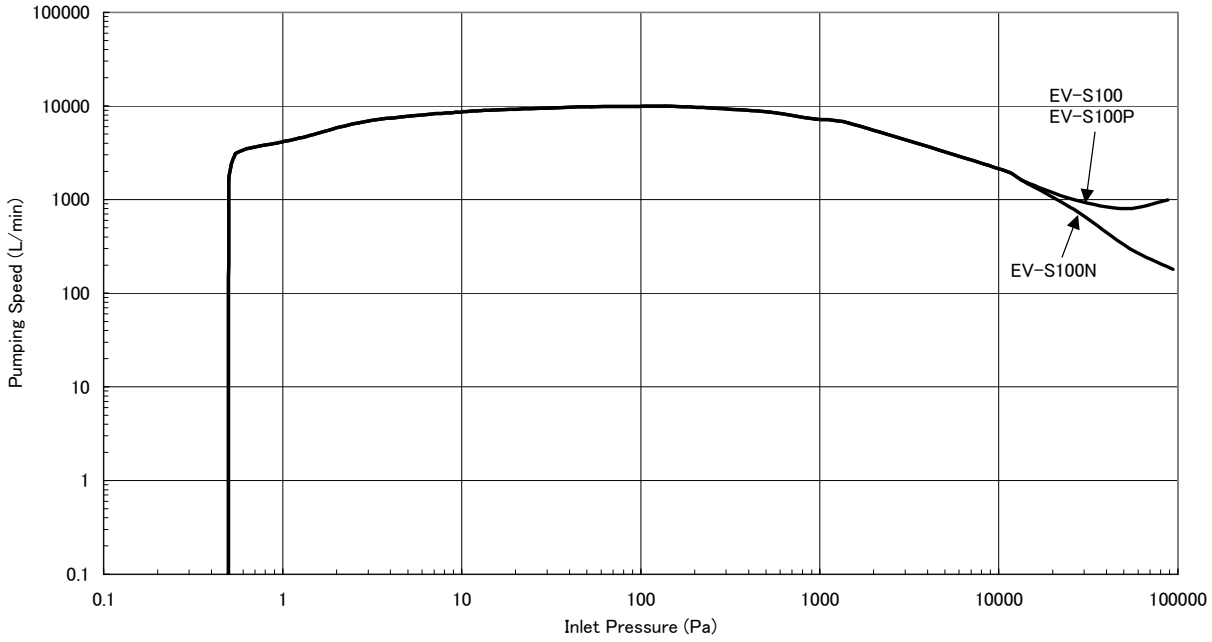


Fig 3.3 EV-S100(P/N) Performance Curve

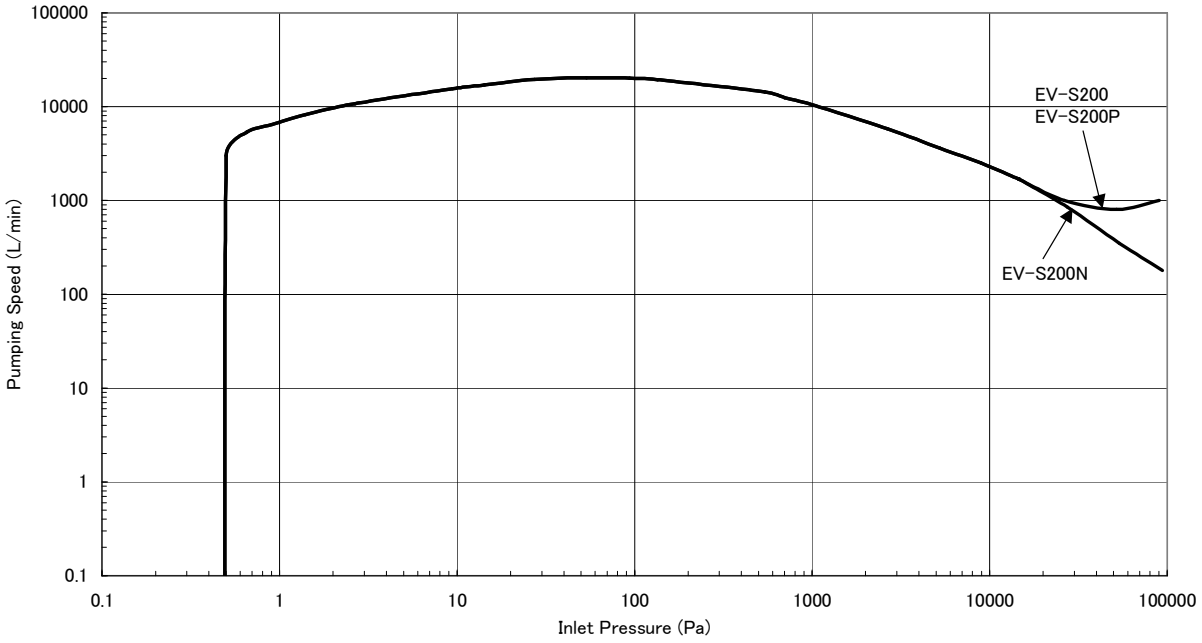
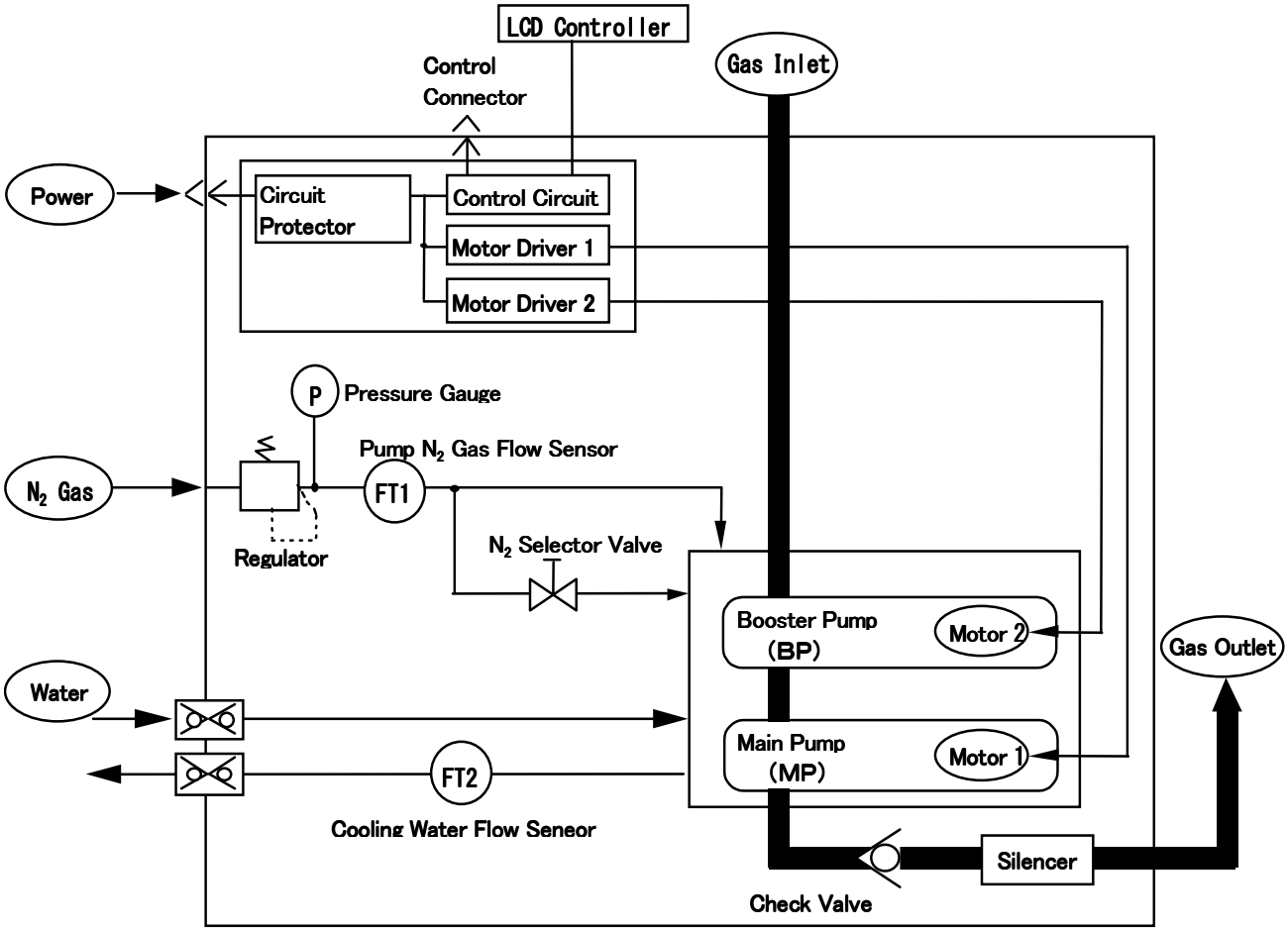


Fig 3.4 EV-S200(P/N) Performance Curve



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

Figure 3.5 System Flow

4. Installation

Be sure to take the following cautions and instructions into account when installing the pump.

4.1 Movement and Fixation

4.1.1 Location

These pumps are 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.

CAUTION 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.

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

4.1.2 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.

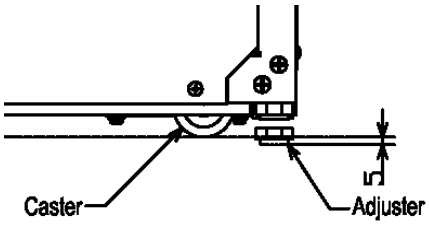


Fig. 4.1 Caster

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.

(3) To fix the pump, turn the adjusters to the right to lower them.
(4) Adjust the height of the feet evenly to ensure that the pump base is level.
The difference in height between the two sides of the pump base shall not exceed 1mm.
The adjustment allowance is approximately 5 mm.

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

[NOTE] To prevent vibrations and airborne noises, keep horizontal level of pump with the adjustment feet.

4.1.3 How to stack pumps (Only Model EV-S20(P/N))

(1) Adjust both pumps by adjuster-foot, then stack and fix them at both front and back side by the fixing bracket. Please refer to Fig.4.2

(2) Please make sure to tighten the fixing bolt enough to fix the bracket.

(3) Please fix a lower pump and the floor.

CAUTION Please do not move the pumps with stacked.

CAUTION Please do not stack three pumps or more.

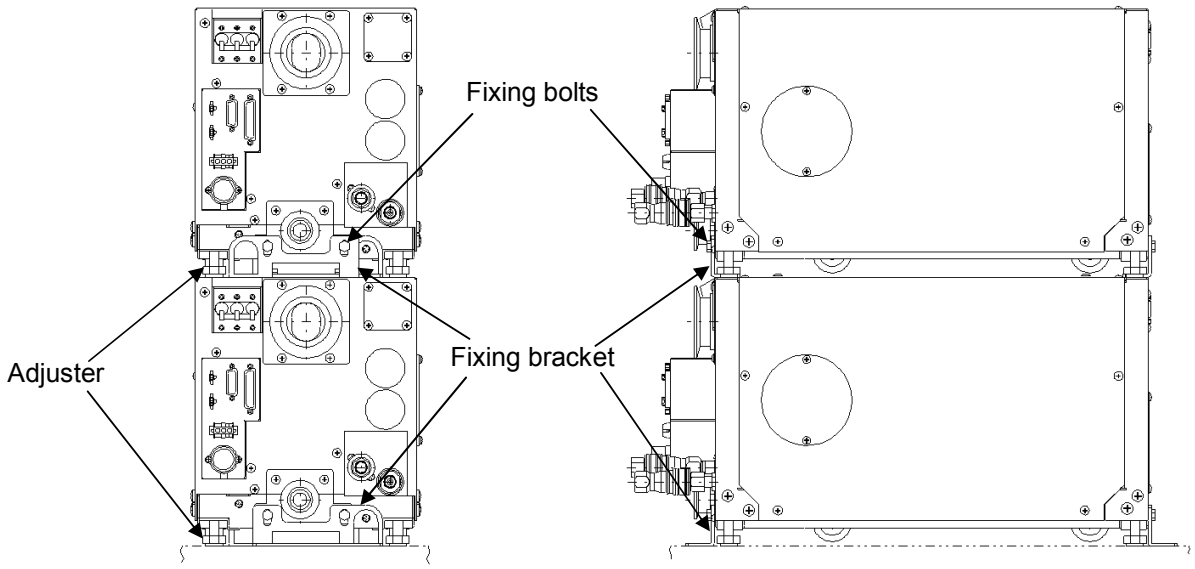


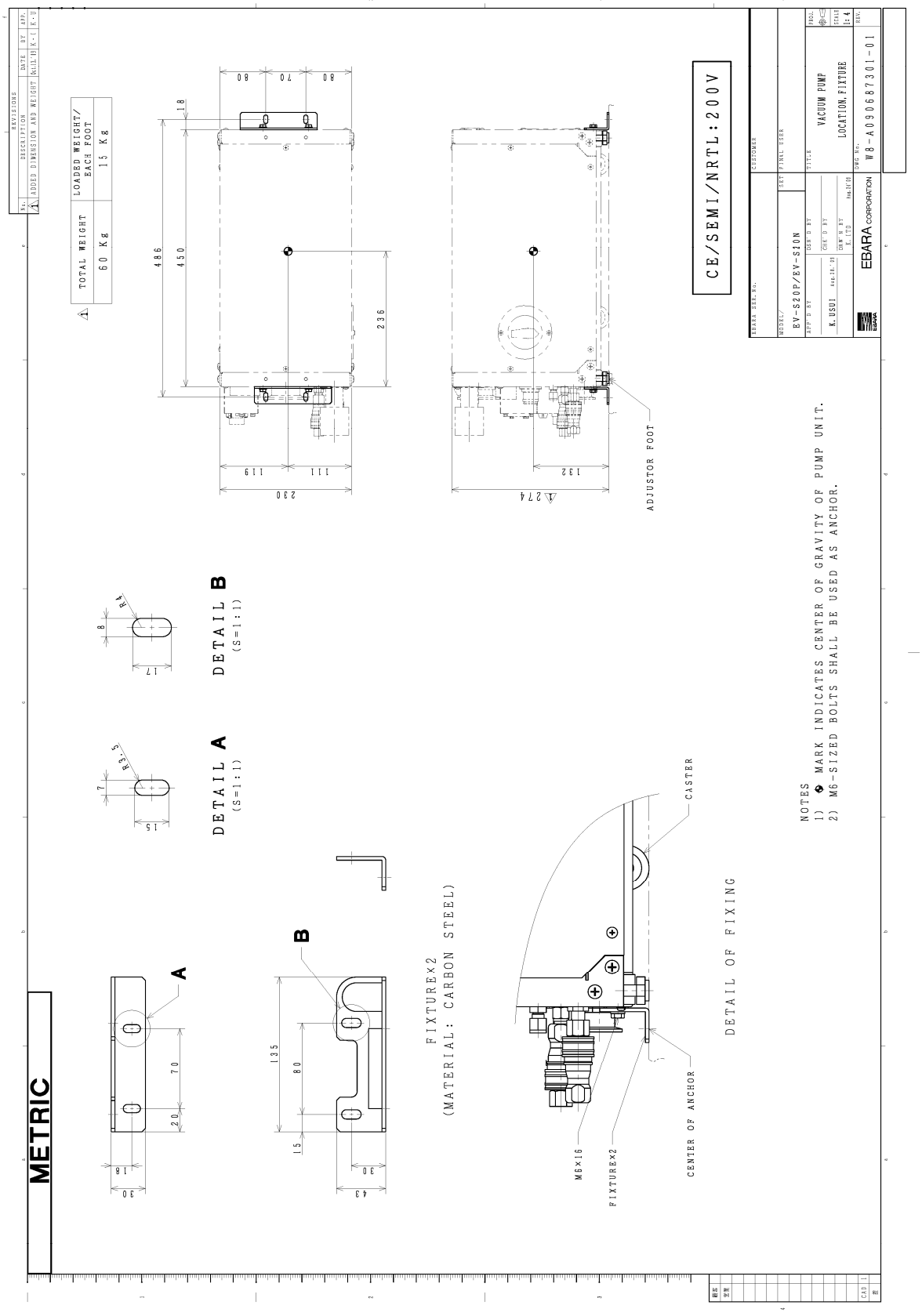
Fig. 4.2 How to stack pumps

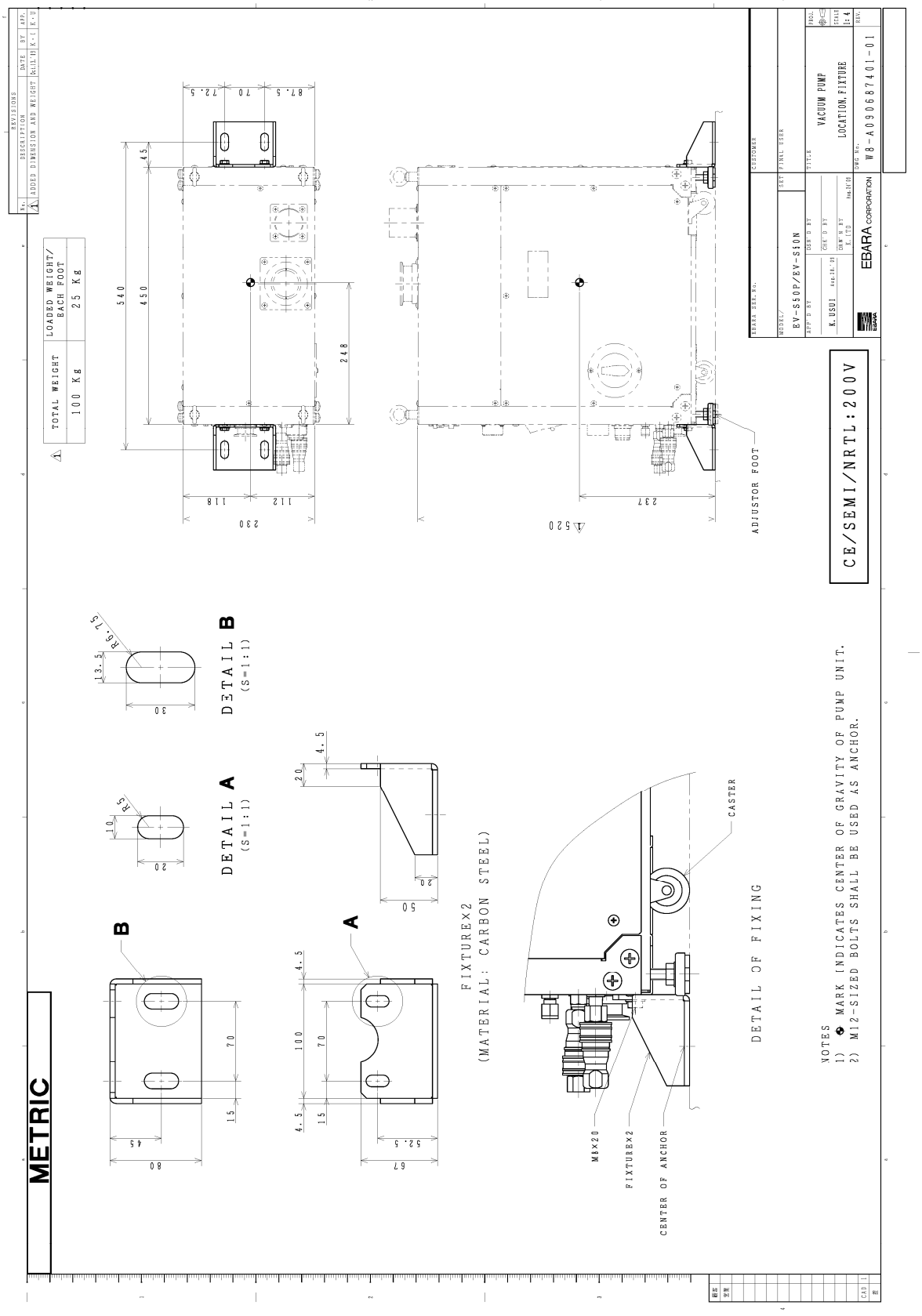
4.1.4 Pump Fixation (Option)

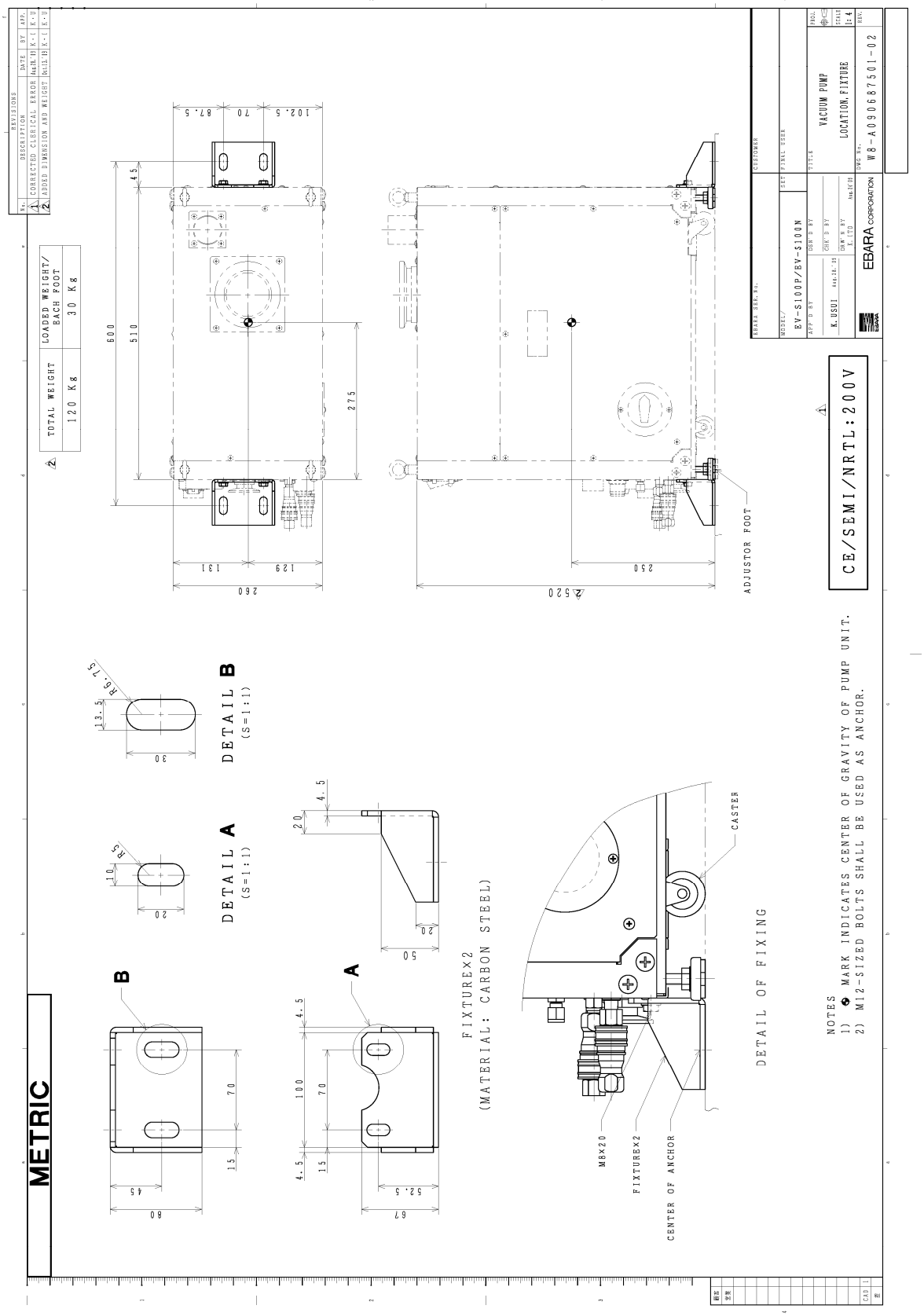
The pumps are provided with casters for easy transportation and foot adjustments for anchoring and height adjusting, as described in Section 3.1.2. The pump, however, may unexpectedly move or fall down when an earthquake occurs. To prevent such events, EV-S dry pumps (CE/SEMI compliant) are equipped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

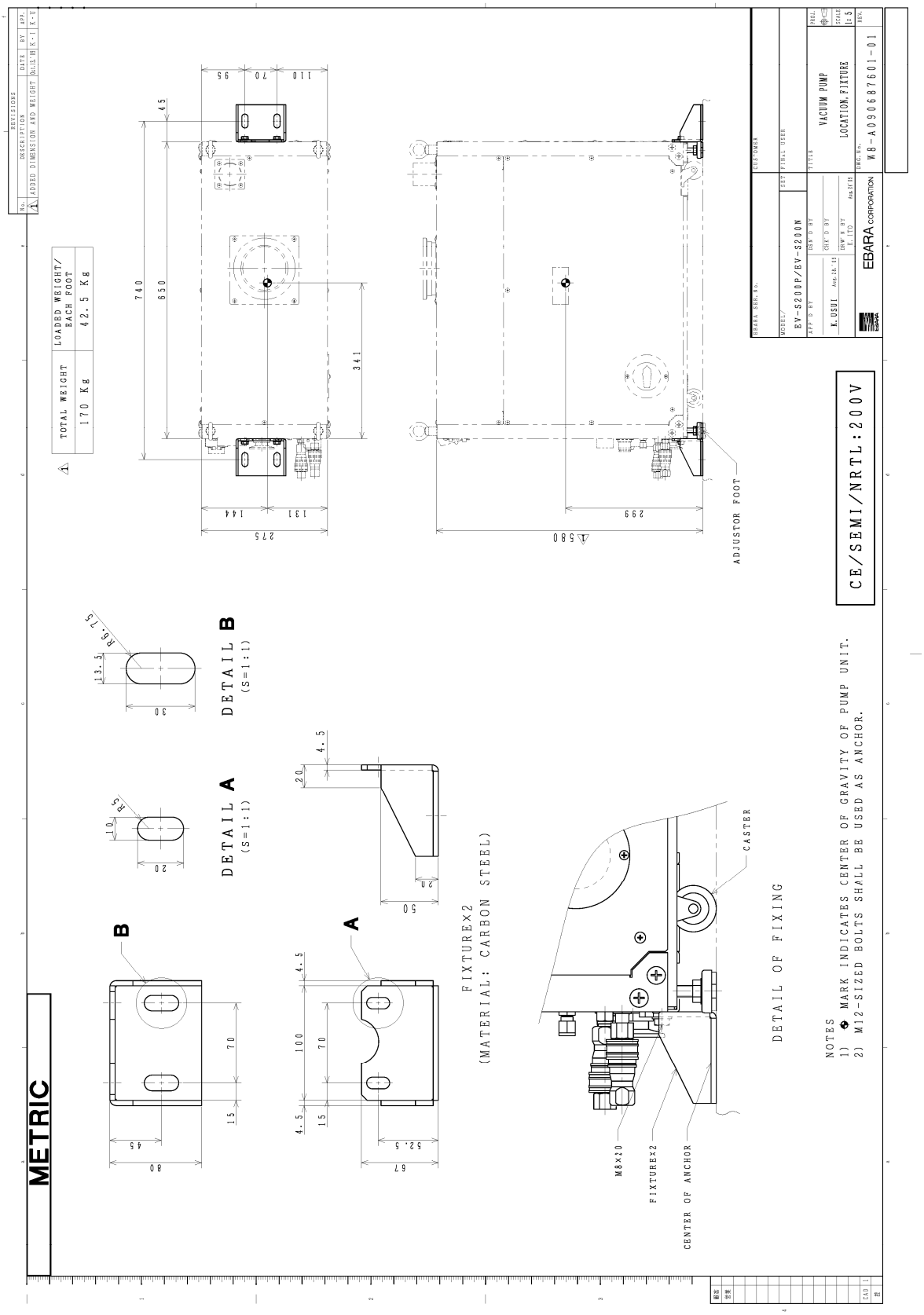
For dimensions of the bracket, see the accompanying drawing.

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


CE/SEMI/NRTL:200V
EBARA CORPORATION
EV-S20P/EV-S10N
VACUUM PUMP
LOCATION.FIXTURE
W8-A09068730I-01
TOTAL WEIGHT 60 Kg
LOADED WEIGHT/ EACH FOOT 15 Kg
ADDED DIMENSION AND WEIGHT
ADJUSTOR FOOT
DETAIL A (S=1:1)
DETAIL B (S=1:1)
FIXTURE×2 (MATERIAL: CARBON STEEL)
DETAIL OF FIXING
CASTER
CENTER OF ANCHOR
M6×16
FIXTURE×2
METRIC
NOTES
1) ◆ MARK INDICATES CENTER OF GRAVITY OF PUMP UNIT.
2) M6-SIZED BOLTS SHALL BE USED AS ANCHOR.


TOTAL WEIGHT
100 Kg
LOADED WEIGHT/ EACH FOOT
25 Kg
ADJUSTOR FOOT
CE/SEMI/NRTL:200V
EBARA CORPORATION
EV-S50P/EV-S10N
YACUUM PUMP
LOCATION.FIXTURE
W8-A0906874O1-01
DETAIL A
(S=1:1)
DETAIL B
(S=1:1)
FIXTUREX2
(MATERIAL: CARBON STEEL)
DETAIL OF FIXING
CASTER
M8x20
FIXTUREX2
CENTER OF ANCHOR
METRIC
NOTES
1) ◆ MARK INDICATES CENTER OF GRAVITY OF PUMP UNIT.
2) M12-SIZED BOLTS SHALL BE USED AS ANCHOR.


REVISIONS
DESCRIPTION
DATE
BY
APP.
CORRECTED CLERICAL ERROR
ADDED DIMENSION AND WEIGHT
TOTAL WEIGHT
120 Kg
LOADED WEIGHT/ EACH FOOT
30 Kg
600
510
275
260
131
129
87.5
70
102.5
4.5
2,520
250
ADJUSTOR FOOT
CE/SEMI/NRTL:200V
EBARA CORPORATION
EV-S100P/BV-S100N
YACUUM PUMP
LOCATION.FIXTURE
W8-A09068750I-02
METRIC
DETAIL A
(S=1:1)
DETAIL B
(S=1:1)
R5
10
20
R6.75
13.5
30
FIXTURE×2
(MATERIAL: CARBON STEEL)
4.5
20
50
100
70
15
45
60
52.5
67
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.


TOTAL WEIGHT
170 Kg
LOADED WEIGHT/ EACH FOOT
42.5 Kg
ADJUSTOR FOOT
DETAIL A
(S=1:1)
DETAIL B
(S=1:1)
FIXTUREx2
(MATERIAL: CARBON STEEL)
DETAIL OF FIXING
CASTER
M8x10
FIXTUREx2
CENTER OF ANCHOR
METRIC
CE/SEMI/NRTL:200V
VACUUM PUMP
LOCATION.FIXTURE
EV-S200P/EV-S200N
W8-A0906876601-01
EBARA CORPORATION
NOTES
1) ◆ MARK INDICATES CENTER OF GRAVITY OF PUMP UNIT.
2) M12-SIZED BOLTS SHALL BE USED AS ANCHOR.

4.2 Piping

4.2.1 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 APC valve 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. When checking for gas leaks by pressurization, please pressurize by less than 0.05 MPa into the purge port and do check.

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.

4.2.2 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.
Be sure that the supply/return plugs are not connected in reverse. The diameters are slightly different. In/Out markings are provided on each plugs.
When the coupler is pulled out the water pipe will be automatically blocked. Use cooling water corresponding to the specifications of Table 4.1 below.

Table 4.1 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.

CAUTION 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.

CAUTION 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 pump.

4.2.3 N_2 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 N_2 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).

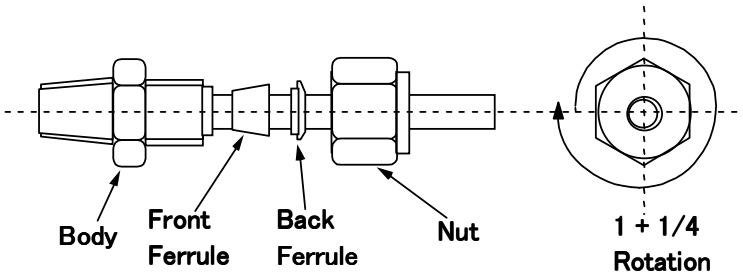


Fig. 4.2 Tube Fitting Assembly

CAUTION For safety, be sure to use N_2 gas which purity is more than 99.999%. Impurities of N_2 gas may cause an accident when the pump is used for exhausting toxic and/or inflamable gases.

4.3 Electrical Wiring

WARNING 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 this.

WARNING Electrical wiring shall be carried out only by qualified electricians.

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.

CAUTION 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. (Please attach the Circuit breaker(CB) type of UL489 to SEMI correspondence.)

4.3.1 Power Supply Wiring

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.

CAUTION Be sure to connect the grounding wire.

CAUTION Wiring should be hard-wired or using twist-lock Hubbel type connector at power source side.

Wire the connector for the main power supply (3-phase, 200-220V and 50Hz/60Hz). Fig. 4.3, 4.4 and Tables 4.2, 4.3, 4.4 and 4.5 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.

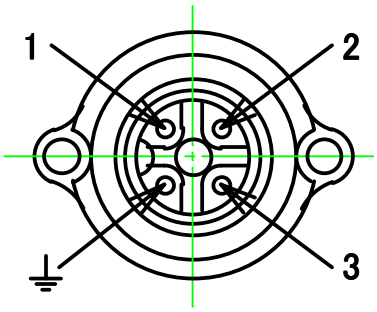


Fig 4.3 Power Supply Receptacle
(As seen from connecting side)

No.	Phase
1	R
2	S
3	T
GND	GND

Table 4.2 Pin Assignment of Power Supply Receptacle

Table 4.3 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.

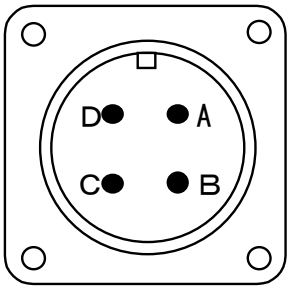


Fig 4.4 Power Supply Receptacle (As seen from connecting side)

Table 4.4 Pin Assignment of Power Supply Receptacle

NO.	Phase
A	R
B	S
C	T
D	GND

Table 4.5 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

4.3.2 Control Signal Wiring

Connect wires to the control connector for remote operation and remote monitoring.
Tables 4.6, 4.7, 4.8 and 4.9 and Figs. 4.5 and 4.6 show the pin assignment.

Table 4.6 Receptacle Specification

Connector No.	Connector type
CN-Z	15 pin D sub-miniature Female receptacle (In accordance with SEMI-E73)
CN-Y	25 pin D sub-miniature Female receptacle

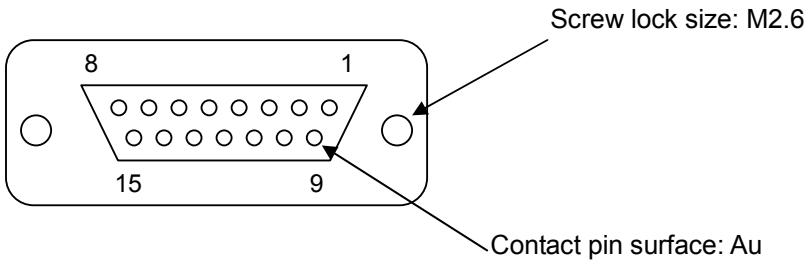


Fig. 4.5
15 Pin D Sub-Miniature Female Receptacle
(As seen from connecting side)

Table 4.7 Control Connector Pin Assignment
(CN-Z: In accordance with SEMI-E73)

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: ON
8	−		
9	MP START (−)		
10	BP START (−)		
11	MP START STATUS (−)		
12	BP START STATUS (−)		
13	WARNING STATUS (−)		
14	ALARM STATUS (−)		
15	REMOTE STATUS (−)		

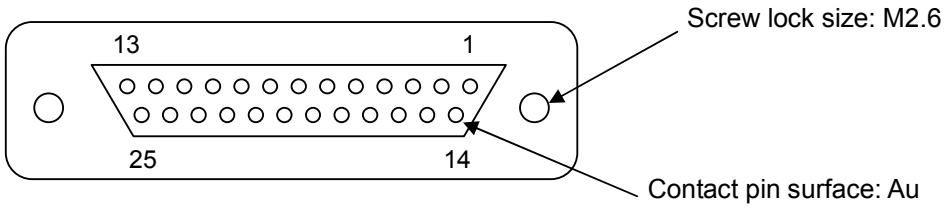


Fig. 4.6

25 Pin D Sub-Miniature Female Receptacle

(As seen from connecting side)

Table 4.8 Control Connector Pin Assignment (CN-Y)

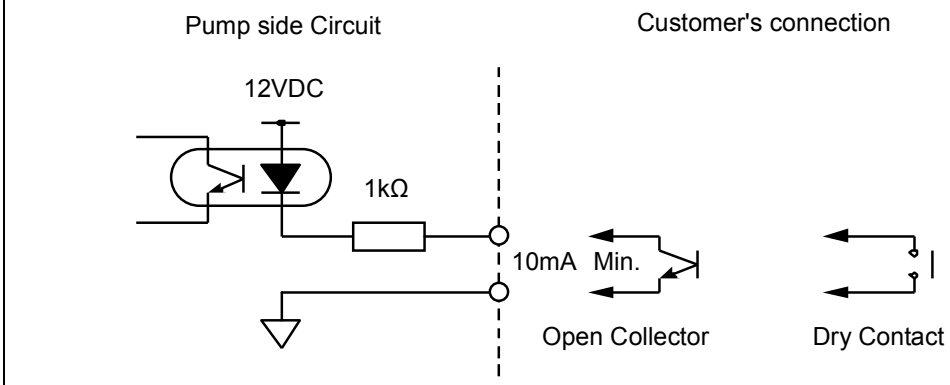
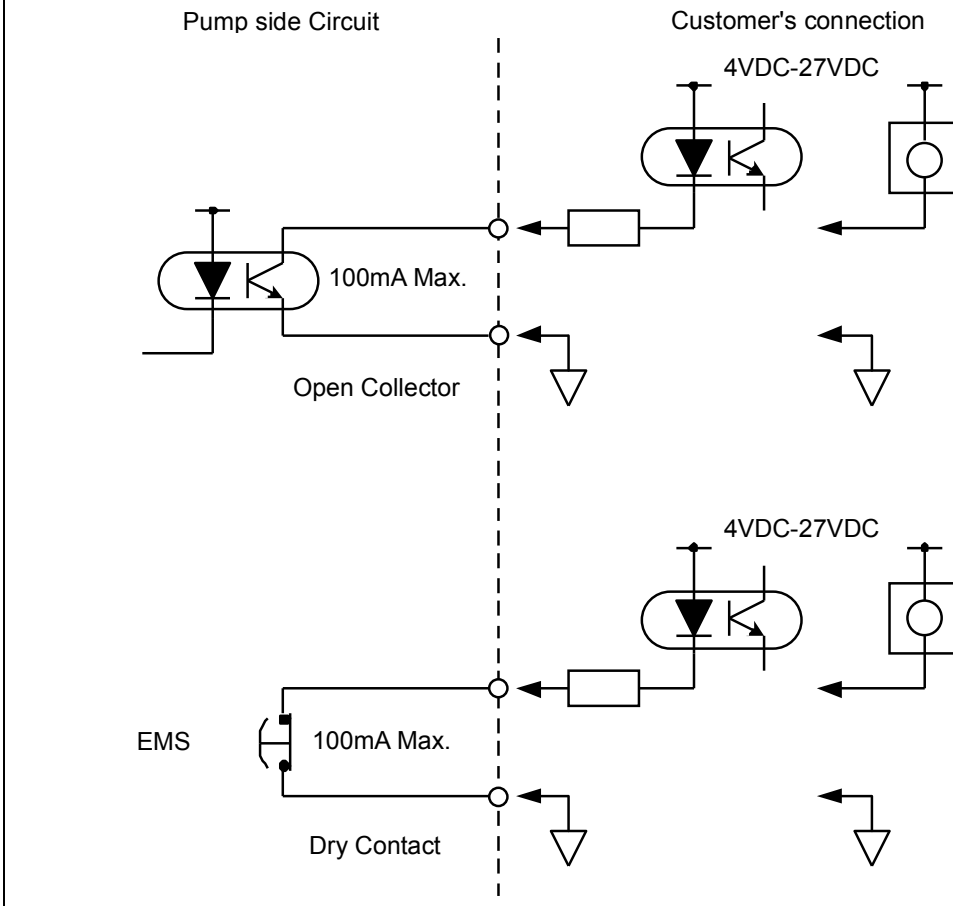
Pin No.	Signal name	I/O	Signal type
1	RESET (+)	IN	RESET: CLOSE
2	SAVING ENERGY CONTROL (+)	IN	SAVING ENERGY MODE:CLOSE, Alternate
3	RESERVED (+)	IN	
4	RESERVED (+)	IN	
5	RESERVED (+)	IN	
6	EMS STATUS (+) *1	OUT	EMS:OPEN, Alternate
7	PUMP N2 WARNING STATUS (+) *2	OUT	Abnormality: CLOSE, Alternate *3
8	RESERVED (+)	OUT	
9	SAVING ENERGY STATUS (+)	OUT	SAVING ENERGY MODE: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	EMS STATUS (−) *1		
20	PUMP N2 WARNING STATUS (−)*2		
21	RESERVED (−)		
22	SAVING ENERGY STATUS (−)		
23	RESERVED (−)		
24	RESERVED (−)		
25	RESERVED (−)		

*1 : Optional

*2 : Applicable to Only “P” and “N” model.

*3 : It can change to “Abnormality: OPEN, Alternate” by DIP SW. setting.

Table 4.9 CN-Z & CN-Y Signal Contacts

Input Signal	
Output Signal	

CAUTION Do not wire vacant pins.

CAUTION 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.

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

CAUTION 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.

4.3.3 Emergency Stop Switch Box (EMS Switch Box) – Optional

This pump has optional EMS Switch Box. Details of EMS Switch are shown as follows.

1. Outline of function of EMS

   EMS means Emergency Stop. When EMS switch is pushed and activated for emergency, pump is stopped running. This EMS switch can also work as “Emergency Off” which shut down pump power supply with additional components to be prepared by users (see section 4 for detail).

2. EMS System Flow

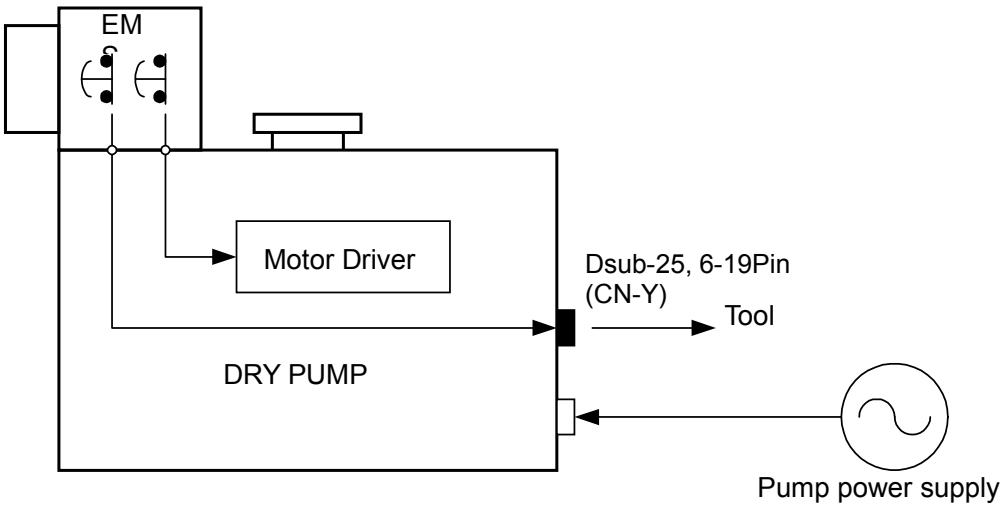


Fig. 4.7 System Flow

3. Operation control

3-1. Push EMS Button to stop dry pump

Push red EMS button (Alternate)

Motor Driver output is turned off and pump stops

6-19 pin at Dsub-25 pins (CN-Y) Connector : Close → Open

(See Table 1 and Figure 1, 2, 3)

The following alarm is shown on LCD controller.

ALARM: EMERGENCY STOP

3-2. Release EMS

Check that pump can be operated and turn the button head to release lock. Press the RESET button on the LCD controller, the pump to lift the status of the ALARM.

4. Example of System Flow diagram for EMO (Emergency OFF)

This EMS switch can also work as Emergency Off (EMO, Hardware interlock to shut off the pump power supply) with additional components to be prepared by users.

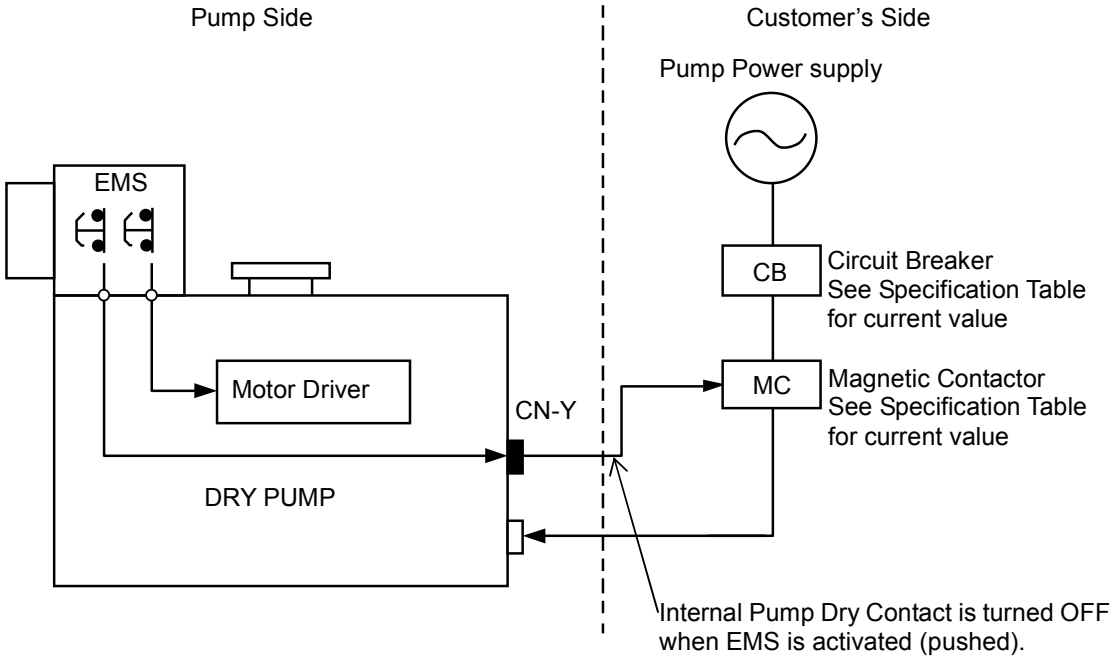


Fig. 4.8 Example, EMO System Flow

4.4 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.

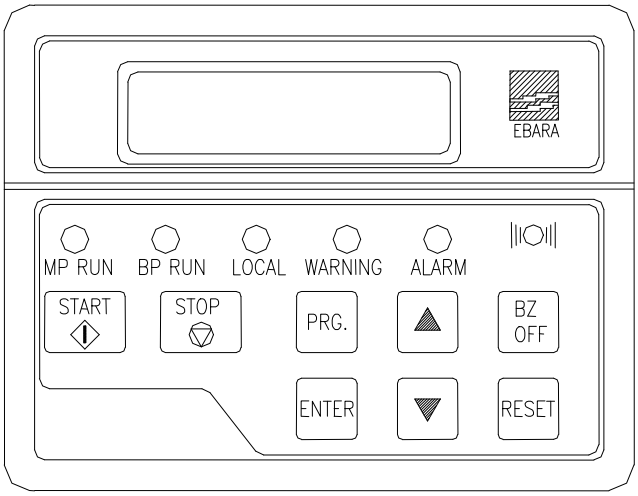
For example:
ADAPTER for Central Monitoring System
Interface Controller

DANGER Power Supply for the options is kept applying voltage during the pump is supplied the power.

WARNING 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 "
	PRG.	For changing screen of pump status and Dip Switch selection
	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
	ERROR	Microprocessor malfunction

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	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 N_2 gas flow	PUMP N2 FLOW ##.#Pam^3/s
9	Cooling water flow	WATER FLOW ##.#L/min
10	Pump casing temperature	CASING TEMP. ###°C
11	Motor speed	BP:#.#k min-1 MP:#.#k min-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 "$$$$$" distinguishes between WARNING/ALARM and indicates the position where WARNING/ALARM has occurred.
   Lower row "$$$$$" displays details of WARNING/ALARM.

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. 5.2 for the key operation of the pump operation status display.

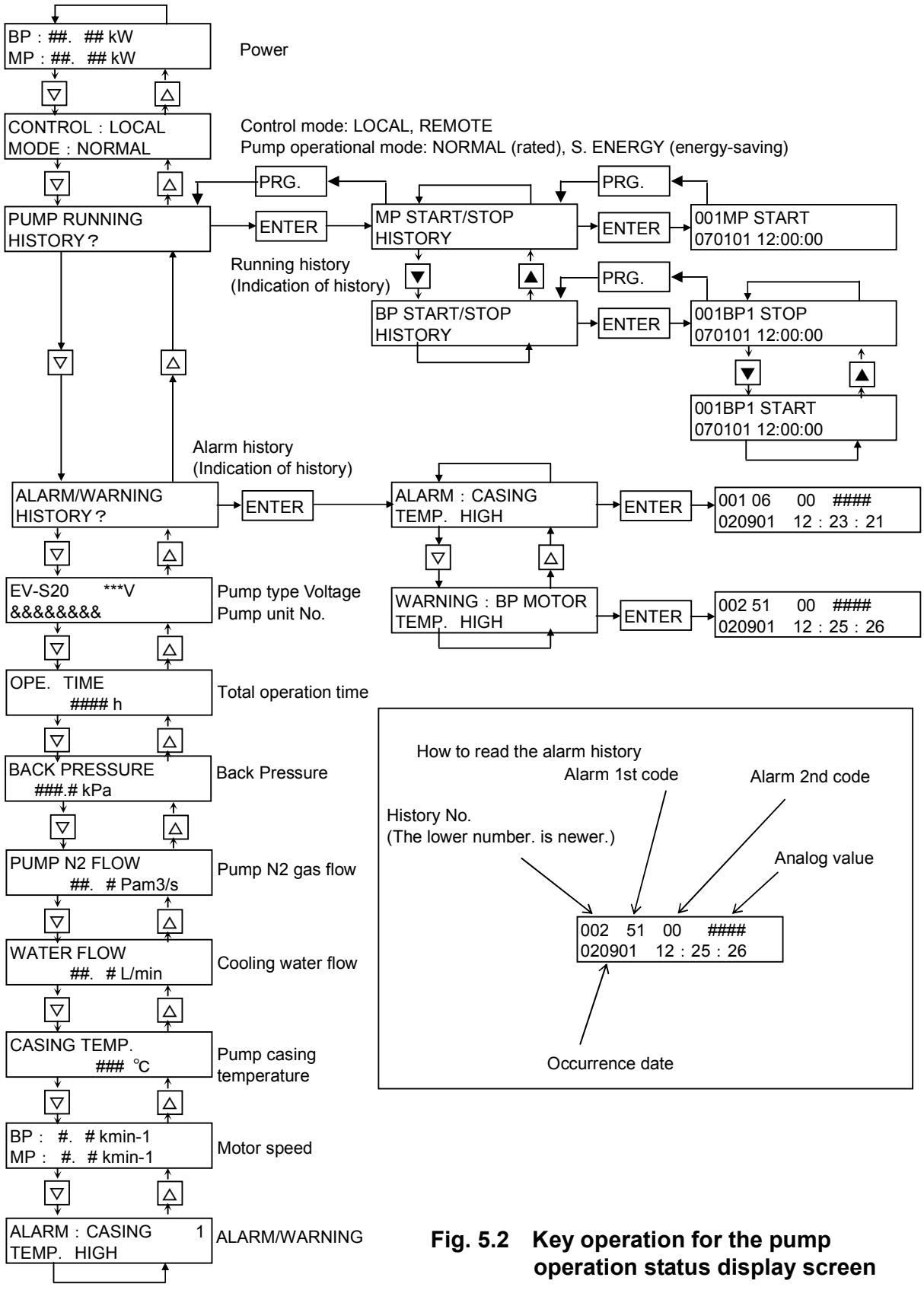


Fig. 5.2 Key operation for the pump operation status display screen

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)		02
MP's driver protective circuit activated (OH1)		04
MP's driver protective circuit activated (OH2)		05
MP's driver protective circuit activated (CPF)		06
MP's driver protective circuit activated (UV)		07
MP's driver protective circuit activated (DRE)		09
BP's driver protective circuit activated (OC)	66	01
BP's driver protective circuit activated (OV)		02
BP's driver protective circuit activated (OH1)		04
BP's driver protective circuit activated (OH2)		05
BP's driver protective circuit activated (CPF)		06
BP's driver protective circuit activated (UV)		07
BP's driver protective circuit activated (DRE)		09
BP overload 2	67	00
MP overload 2	68	00
BP step out	69	00
MP step out	70	00
Emergency Stop (EMS) (▲)	71	00
Cooling water flow low	73	00
External interlock	74	00
Motor thermostat	81	00
Inner communication error (MP driver)		01
Inner communication error (IO)		02
Inner communication error (BP driver)		03
MP Driver Gate OFF		20
BP Driver Gate OFF		21

WARNING name	Code 1st code	Code 2nd code
Cooling water flow low	00	01
MP casing temp.	05	01
High board inner temp.	13	00
Pump N2 0mode error (▲)	14	01
Pump N2 flow low	18	01
Back pressure high (▲)	21	01
Back pressure wire broke (▲)		02
BP motor temp.	23	00
MP motor temp.	24	00
Inner communication error (MP driver)	26	01
Inner communication error (BP driver)		02
Inner communication error (IO)		03
Pump N2 valve error (▲)	27	02

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.
Pump N_2 WARNING setting	SET POINT PUMP N2 WARNING?	Sets the WARNING value for N_2 flow.
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.

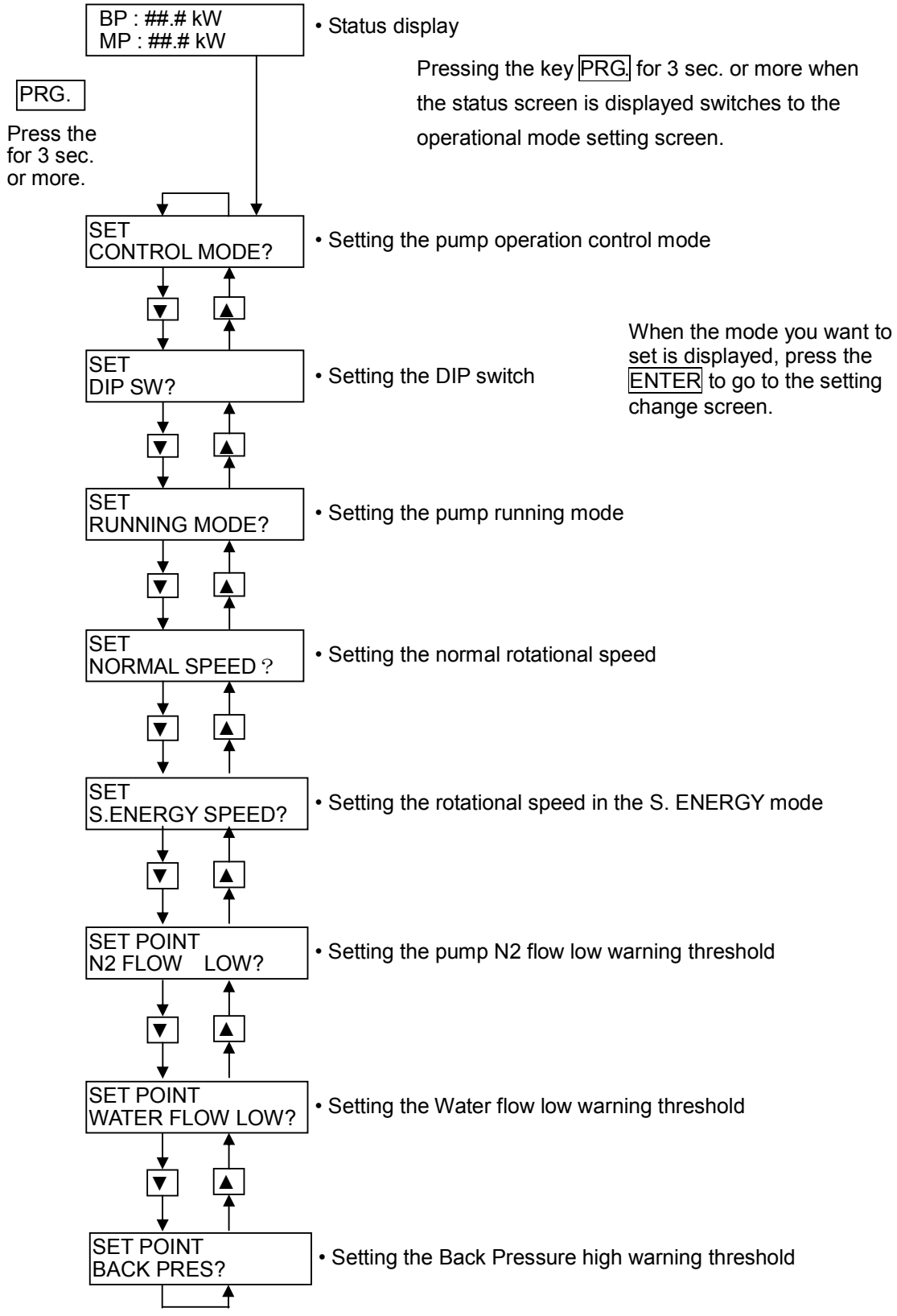
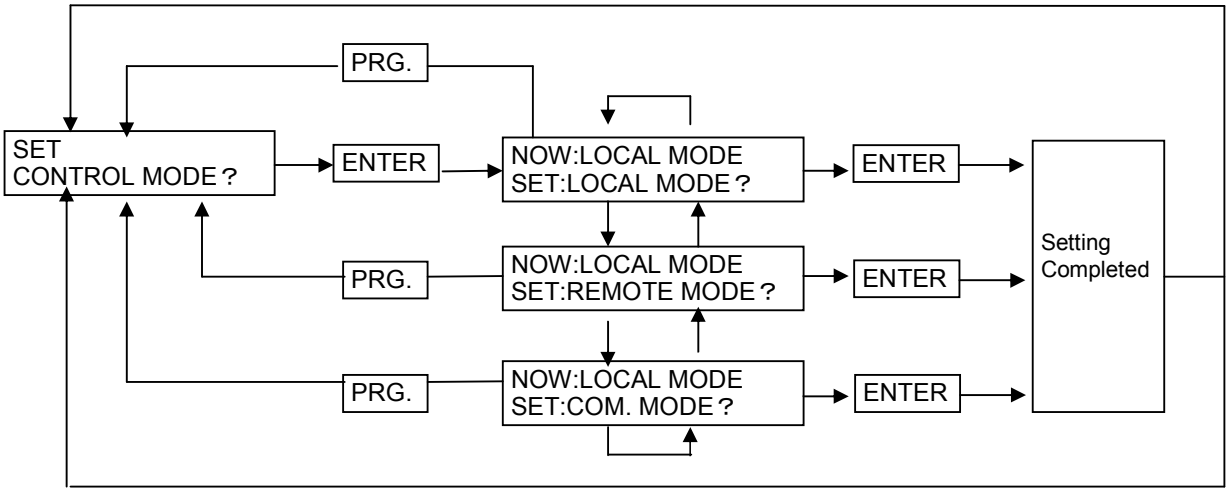


Fig. 5.3 How to set the operational mode

5.3.1 Setting the pump operation control mode

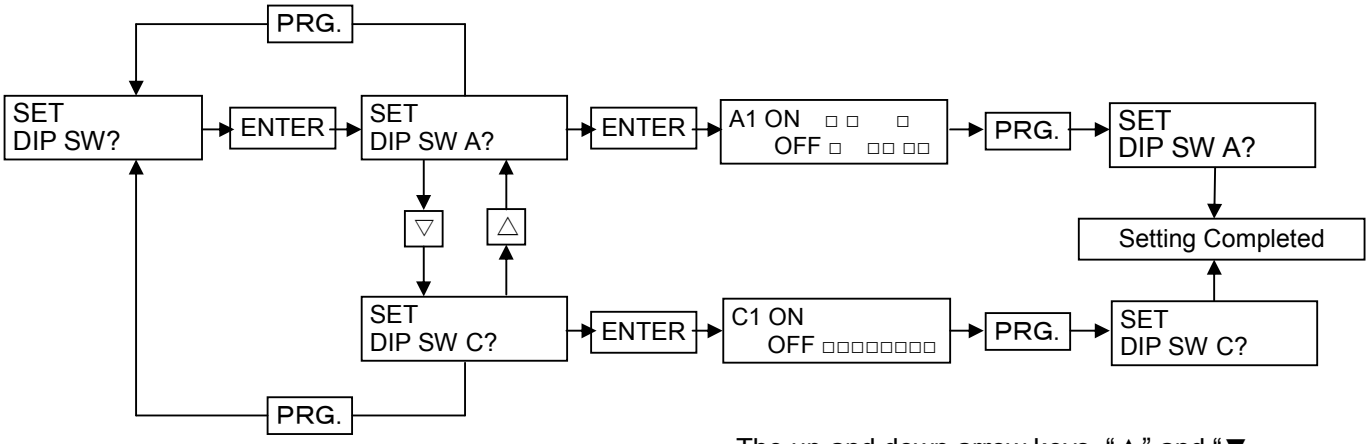
A case of display if Local mode selected.



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.

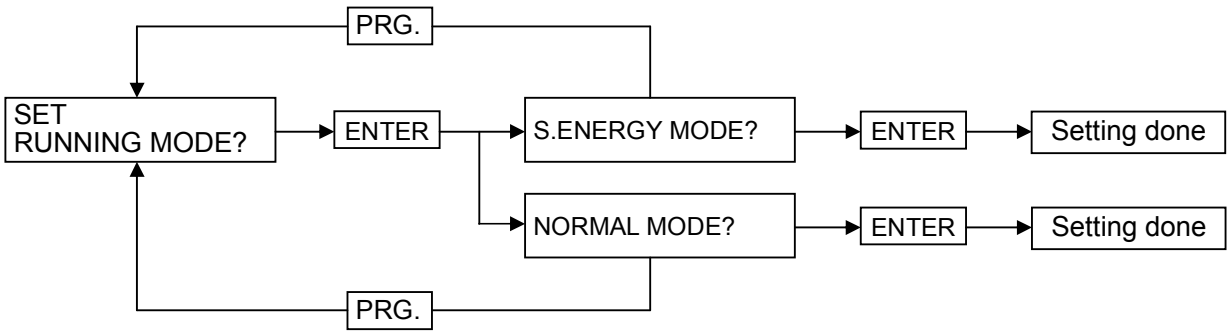
5.3.2 Setting the DIP switch



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

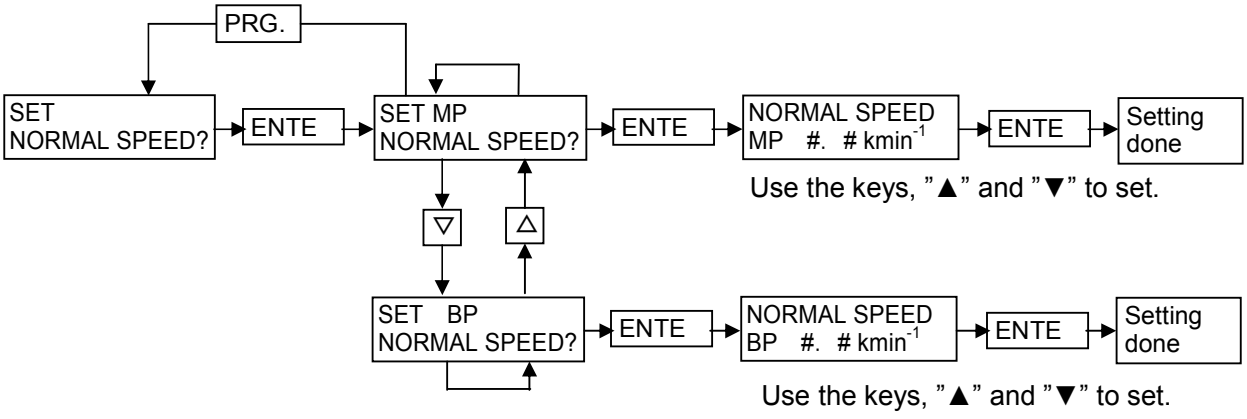
NORMAL MODE: Enables the rated operation.

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 S. ENERGY mode



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

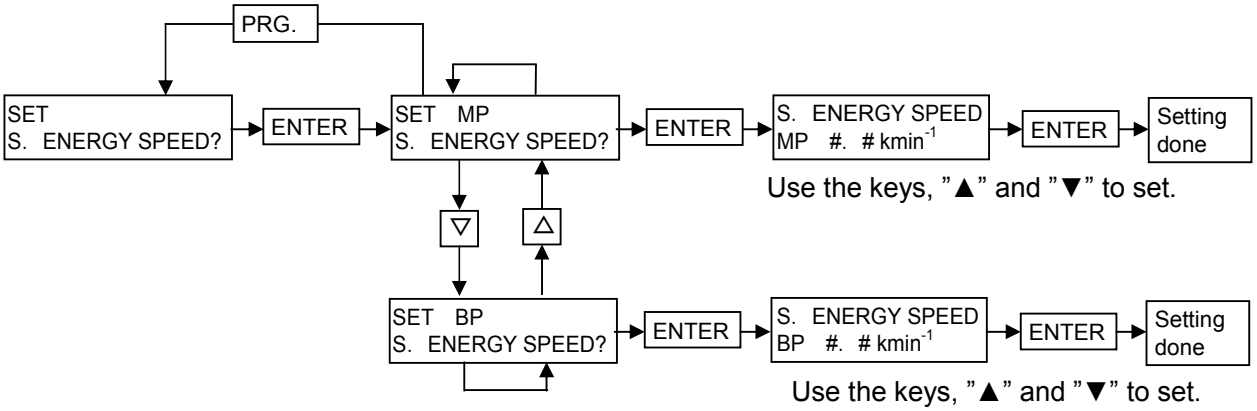
▲: Increase the setting speed by 0.1 $kmin^{-1}$.

▼: 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: 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.

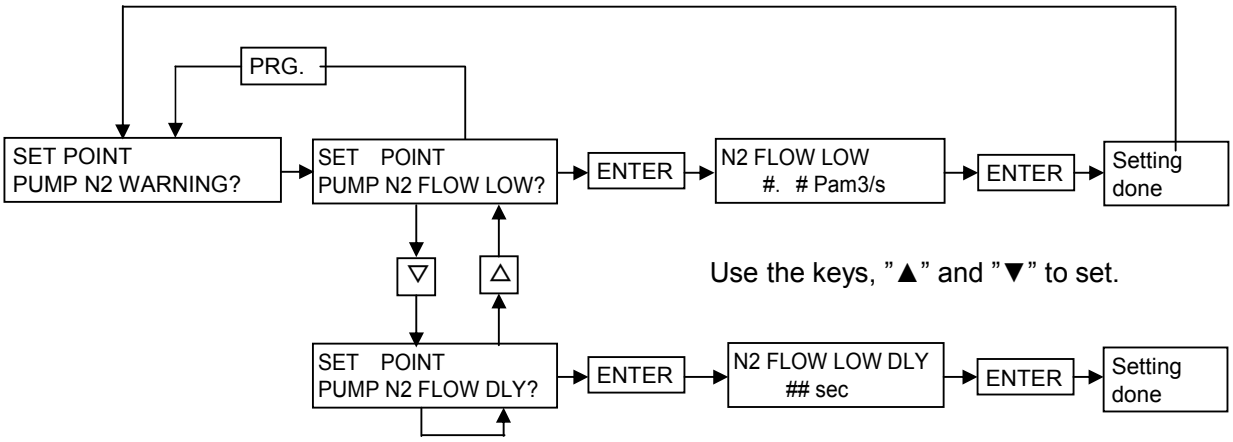
△ : Increase the setting speed by 0.1 $kmin^{-1}$.

▽ : 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)

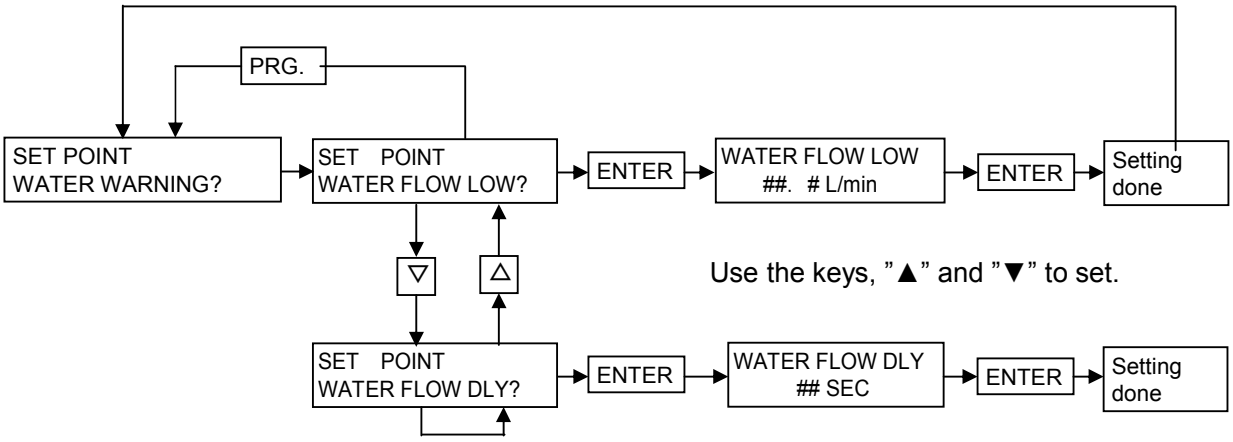
▽ : Decrease the setting speed by 0.1 Pam^3/s (Delay time : 1 sec)

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.

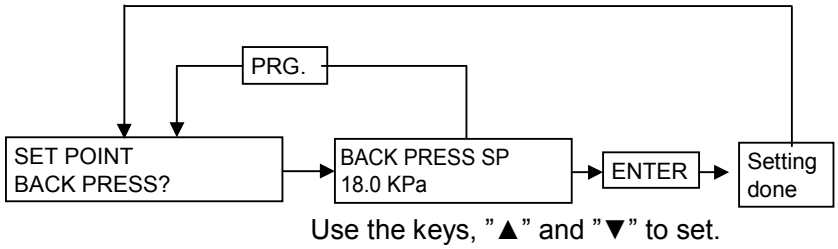
△ : Increase the setting speed by 0.1 L/min (Delay time：1 sec)

▽ :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)

5.3.8 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 Table 5.4 / 5.5 / 5.6.

Table 5.4 Dip Switch-A Settings

No.	Mode	Off	On	Factory setting
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	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	Remote Interface (IF)	Exclusive special IF	No use / standard IF	ON
7	-------	-------	-------	-------
8	LCD screen initialize	Carry out initialize	Do 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.

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.

[NOTE] You can change the setting of No. 3 (Buzzer) and this switch anytime. When the 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 the power is on.

DIP SW-A. No. 7 (dip switch-A No. 7 lets you select whether dilution N_2 gas is used or not. Set dip switch-A No. 7 to ON 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. Then close the N_2 gas selector valve to save N_2 gas. Be sure always to use the N_2 gas selector valve and dip switch-A No. 7 in combination.

[NOTE] The N_2 gas selector valve is positioned on the right panel when viewing facing the utility side of the pump.

[NOTE] It takes ten odd seconds until the flow has stabilized after you have operated the N_2 gas selector valve.

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 Activate or inactive the special interface.
- Set this to OFF to activate the interface (optional).
- Set this to ON to inactivate the interface (default).

DIP SW-B. No.8 Locks or unlocks the currently selected operation status display, which usually returns to the power 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

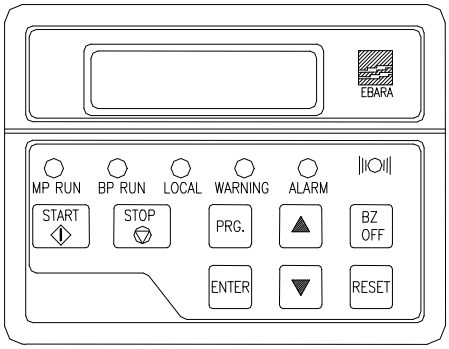
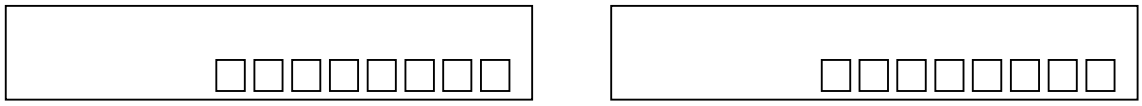


Fig 5.4 LCD controller

Key functions will be as follows on the setting display.

START	:	Invalid
STOP		This stops pump operation.
RESET		This resets trip and alarm.
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 **DIP Switch-B**



* 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-8 (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
Cooling water & N2 monitoring	:	Constant
BUZZER	:	USE
Operation switched to Remote	:	According to signal
DILUTION N2 mode	:	Standard
BP Operation in Remote	:	Automatic Operation
MP SPEED CONTROL	:	Not used
BP SPEED CONTROL	:	Not used
Remote IF	:	Not used
LCD screen initialize	:	Carry out initialize
Output the pump N2 warning	:	Normal Open

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 N_2 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 N_2 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 N_2 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 N_2 to the safe concentration, be sure to maintain a separate supply of N_2 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 N_2 gas is maintained, serious problems will occur such as pump corrosion and accretion of reaction by-products.

Operate the N_2 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 N_2 gas selector valve is positioned on the right panel when viewing facing the utility side of the pump.

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

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

(4) The LCD controller counts down 10 seconds after placing the Circuit Protector (CP) into the ON position.

[NOTE] The pump cannot start while the measuring instruments are warming up for 10 seconds after the CP is placed in the ON position.

(5) Check on the WATER FLOW display of the LCD Controller that the cooling water flow rate is 1.5L/min. or more.

(6) Re-check on the PUMP N2 FLOW display of the LCD Controller that the dilution N_2 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 N_2 flow rate is 2.0 – 2.5Pam3/s.
(The shaft sealing N_2 flow rate is contained in pump N_2 flow rate currently displayed on the LCD controller.)

(7) 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.

(8) 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/ COMMUNICATION modes and BUZZER Enabled function. Set in accordance with the operating conditions. (See 6.3. 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 N_2 purge when the pump is stopped only for a short time.

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.

[NOTE] 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.

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 6.1.

[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 6.1.

[NOTE] The pump will not start when a WARNING/ALARM has been generated. When a START signal is entered, "STARTFAIL" will appear on the display.

b) STOP

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

6.2.3 COMMUNICATION 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 6.1.

[NOTE] The pump will not start when a WARNING/ALARM has been generated. When a START signal is entered, "STARTFAIL" will appear on the display.

b) STOP

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

***Please refer to the COMMUNICATION SPECIFICATIONS in detail.**

6.3 Operation when momentarily power failure happens

The momentarily power failure means that power supply voltage become 15% or less than specification (170V or less). Pump operation is continued when the supply voltage is back to normal (more than 170V) 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 Internal energies

Following items show internal energies that shall be considered before start service maintenance.

7.1.1 Power source

This pump is supplied with AC200V power source. Aside from the pump, the accessory power source locating in the vicinity of the power connectors are supplied with voltage even when the pump is completely stopped. To conduct pump maintenance or service, be sure to keep the power supply to the pump turned off and lock-outed and then unplug the power cable.

7.1.2 Cooling water

This pump is supplied with cooling water at pressure of maximum 0.4 MPa. Disconnection of the cooling water resulted from improper handling may cause electrification and unit damage. For service and transportation, unplug the cooling water connection plugs on the inlet and outlet, and seal off with plastic cap. The self-sealing plug is used for the cooling water connection plug in these pumps.

7.1.3 Nitrogen gas

This pump is supplied with nitrogen gas at pressure of maximum 0.7 MPa for diluting and sealing inside the pump. For service and transportation, close the supply-source valve to reduce the pressure with the regulator and detach the gas connection. Close nitrogen port with blank off plug. If the pump has already operated with process gases, purge the residual gases with nitrogen gas after stopping the pump operation. Then, conduct maintenance.

7.2 Routine Inspection

Check periodically that ALARM signal is not output on the LCD controller or remote output.

Table 7.1 Typical check items

No.	Item	How to check	Interval (recommended)
1	Motor Current	LCD	1 time/week
2	N_2 Gas Flow(EV-S**P / EV-S**P)	LCD	
3	Vibration / Noise	-----	
4	Cooling water flow	LCD	
5	Pump casing Temp.	LCD	
6	Color of lubricating oil	Visual	1 time/month

When the WARNING/ALARM display appears, take action in accordance with Section 11. "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 8.3 “Lubrication oil“ when adding the oil.

WARNING Switch off the power supply to the pump first and interrupt the Circuit Protector (CP) and lockout 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.

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" after the process plant has completed 1 cycle.

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.

7.3 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. 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. When checking for gas leaks by pressurization, please pressurize by less than 0.05 MPa into the purge port and do check.

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 N_2 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.

7.4 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)

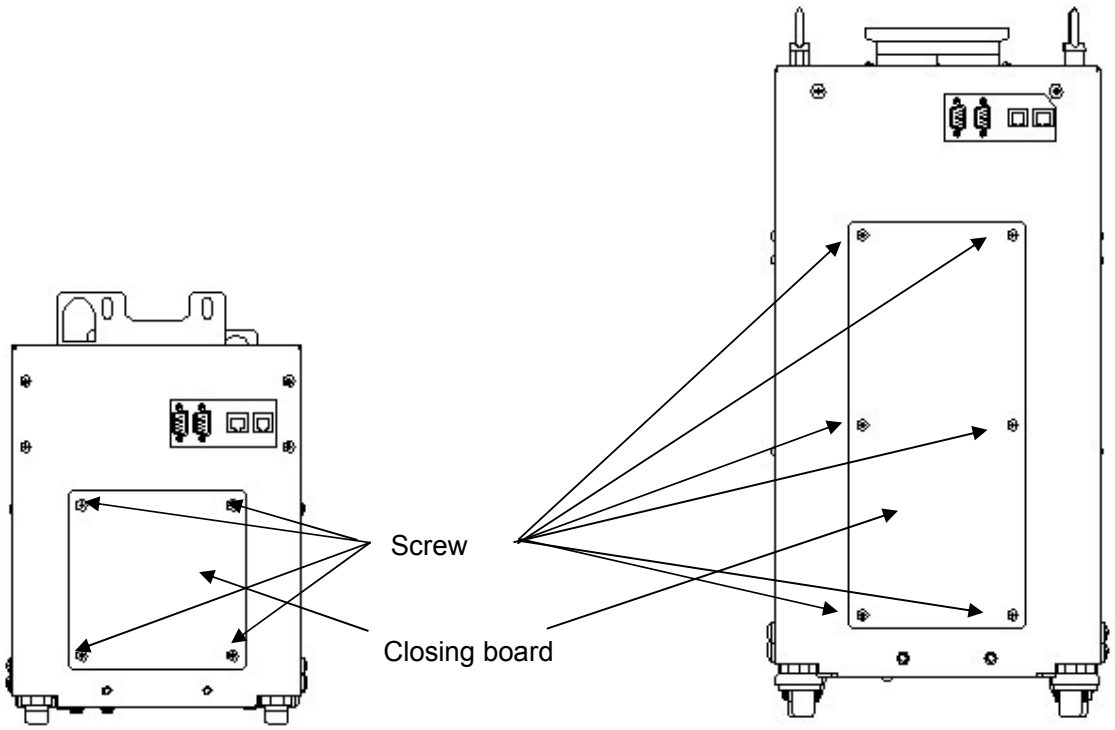


Fig. 7.1 How to remove closing board

(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.

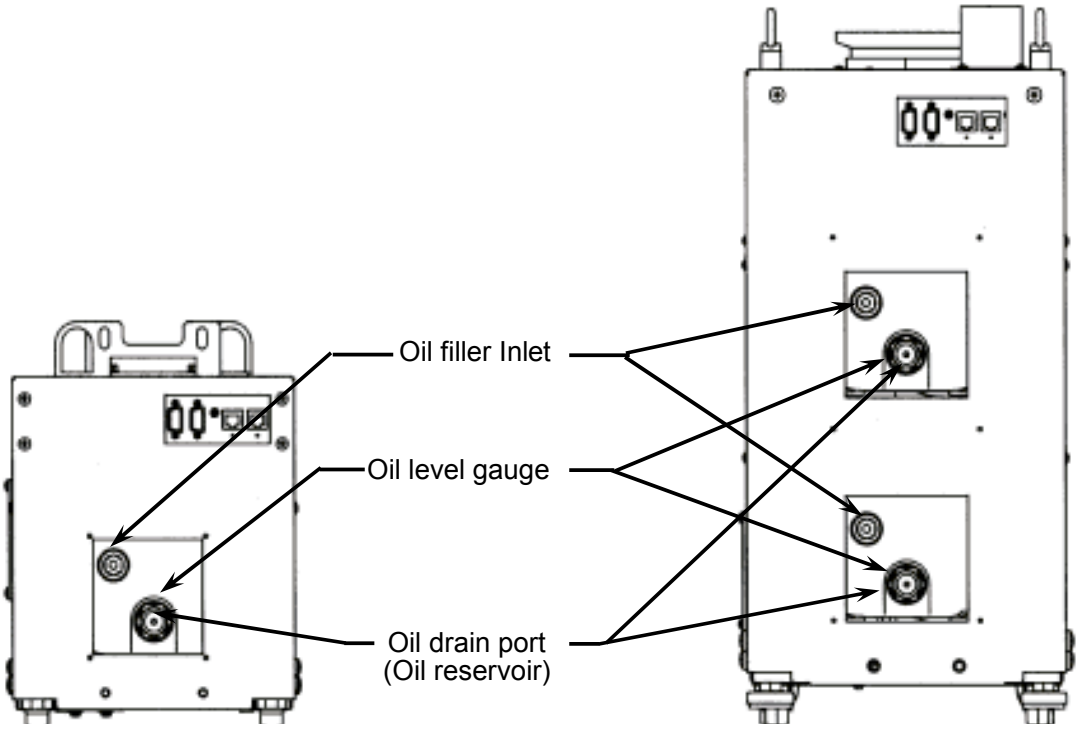


Fig. 7.2 Oil filler inlet, oil level gauge, and oil drain port positions

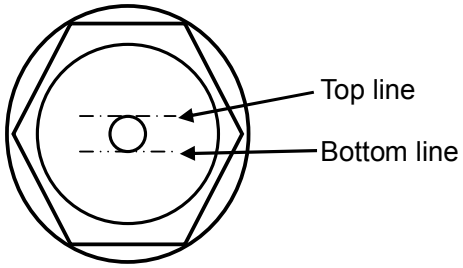


Fig. 7.3 Oil Level Gauge

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

CAUTION Waste oil shall be disposed of by industrial waste disposal dealer in accordance with Material Safety Data sheets. (appendix1,2)

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.

7.5 Spare (Maintenance) Parts List

Following parts are needed for maintenance in customers' site.

Table. 7.2 Spare (Maintenance) 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 m^3/s	C-5300-000-5300
T/C bolt	T TYPE, M8	C-1019-121-0001
N2 gas pressure regulator *	RC31886	C-2300-000-3400

* for EV-S**P / EV-S**N

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 7.3 Labels

Label's Name		Parts No.
[DANGER]	HAZARDOUS WAIGHT 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

7.6 List of wastes during maintenance

Table 7.4 lists wastes from general user maintenance. Dispose the wastes properly according to your local waste disposal regulations in each area.

Table 7.4 List of wastes during maintenance

Part	Equipped on	Remarks
Lubricant oil	Inside of pump module. See section 7.3.	Refer to Appendix 1,2 for Material Safety Data Sheet.
Lithium battery	CPU board. (No necessary to replace at usual maintenance.)	Refer to Appendix 3 for Material Safety Data Sheet.
O-ring	Connection of vacuum line	Usual industrial waste.

7.7 Overhaul

Overhaul is performed in EBARA.
Contact EBARA Sales office or Overhaul service center.
Please overhaul once a year.

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.

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 N_2 gas.

(2) Switch off the power supply to the pump and remove the power and signal wires.

(3) After you have fully closed the N_2 regulator remove the N_2 pipe, seal off the N_2 purge port with a sealing flange.

(4) Remove the cooling water pipes.

(5) Remove the vacuum and exhaust pipes and completely seal off the suction 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.

[notes] Differential port is option.

(6) Put the LCD controller on the upper part of the pump. Fix it with the tape.

(7) Wrap the pump in a vinyl sheet.

(8) Use the lifting brackets provided on the pump for slinging the pump to load and unload. Fasten lifting brackets 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.

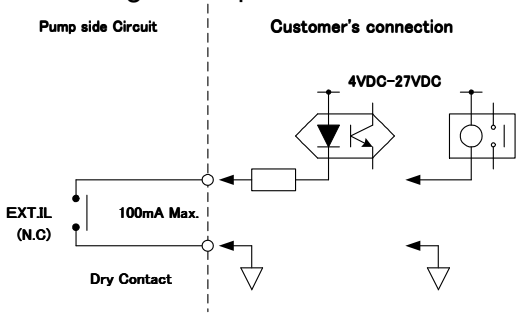
(9) When options such as an interface box are attached to the pump, be careful to avoid damage due to contact by the wire rope.

(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 SEMI application 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.

Table 9.1 Necessary parts for SEMI S2 standard

Parts name	Conditions
CB (Circuit Breaker)	Please use CB of 10 kA or more in the breaking current capacity. (UL489 corresponding)
EMO (Emergency Off)	Please select it based on the law and the standard of installation features. Please intercept the power supply of the pump when EMO operates. Optional EMS Switch Button can be used as EMO Button with External CB and Magnetic Switch.
Safty Interlock	Hard interlock signal is output as the final safty protection by EXT.IL connector. Please intercept the power supply of the pump when Hard interlock signal is open. 

10. Troubleshooting

WARNING 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. When checking for gas leaks by pressurization,
please pressurize by less than 0.05 MPa into the purge port and do check.

10.1 Troubleshooting (1) Basic trouble

Abnormal symptom	Check Item	Corrective Action
Circuit Protector is activated.	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.
	CP is not ON.	Place CP to ON.
	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 after activating CP or changing the dip switch setting.	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℃).
WARN:PUMP N2 VALVE ERROR	N2 valve open.	Setting is N2 0 mode.	Close N2 valve. (at the side of pump)

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.