



INSTRUCTION MANUAL

Compound Molecular Pump EBT2400F Series

Before using the pump, read carefully and understand thoroughly the caution in this instruction manual.

Save this instruction manual for future use and reference.

EBARA Corporation



Safety




This section provides important safety information. Be sure to read this section thoroughly before using the compound molecular pump EBT2400F, and follow all instructions.


Note that the scope of the cautions and warnings in this manual are limited to the range of our expectation. For your safety, follow all general rules (laws and regulations) in addition to the instructions provided herein.


EBARA Corporation reserves the right to make changes to the product specifications without notice, so as to maintain and improve the quality of the product. For this reason, the contents of this manual may not match exactly with the actual product.








Definitions and Symbols

In this instruction manual, “Warning” and “Caution” are defined as follows:

 Warning	<p>Important information for preventing serious bodily injuries. Failure to follow instructions labeled with this symbol may result in death or serious injury.</p>
 Caution	<p>Important information for safe use of the pump. Failure to follow instructions labeled with this symbol may result in injury and/or property damage.</p>
 Information	<p>Information that may be useful when using the pump.</p>

 Warning	Installation
	<p>Use a truck or a lift in transportation and installation. Secure the pump to a mount or floor and use the pump. Do not hang the pump above a walkway. If the pump is to be mounted to equipment, read this manual thoroughly before designing the equipment and design the equipment appropriately.</p>

 Warning	Inspection
	<p>Do not place your hands or foreign matters inside the pump.</p>

 Warning	Process gas
	Do not use the pump to exhaust gallium, mercury, their compounds, or corrosive gas. Doing so may result in pump failure.
 Warning	Overhaul
	If you could not help using the pump to exhaust toxic or reactive or flammable gas, construct the system that avoids the dangers of suction or explosion, etc. And purge the pump with inert gas before removing it from the equipment. Wear protective equipment to prevent exposure to the gas. When transporting the pump, seal the inlet, purge port, vent port, and outlet.
 Warning	Disassembly and modification
	Do not disassemble or modify the pump. It may result in serious accidents, causing death, serious injury, and/or property damage.
 Warning	Temporary inlet flange
	The temporary inlet flange is only for shipping. Do not use it for any other purpose.
 Warning	Air inrush
	Do not make air inrush into the pump when operating the pump. It may result in injury and/or pump damage.
 Warning	Heat emission
	The pump generates heat in operation. Do not touch the pump in operation, or you may get burned.
 Warning	Pump detaching
	Purge the pump with the inert gas and return it to the atmospheric pressure. Detach the pump when the rotor has stopped completely.



⚠ Caution

1) Compatibility of the pump and the power supply

A proper combination between the pump model and the power supply model is required. Use the same model of power supply as specified on the caution plate attached at the connectors of the pump.

2) Start and Stop

To start/stop the pump, use the START/STOP button on the front panel of the power supply, or send Start/Stop signal through the REMOTE connector on rear panel of the power supply. Do NOT turn the input power ON/OFF to Start/Stop the pump operation.

Do NOT disconnect the cable while the pump is in operation.

3) Gas purge

Purge the pump in operation with inert gas when evacuating dust.

4) Backing pump

Always connect the backing pump to the pump before using the pump.

5) Maximum throughput

Maximum throughput of this pump is approximately as follows. It depends on backing pressure and ambient temperature.

Standard model:

Nitrogen: 1660 Pa-L/s (900 sccm)

Argon: 1380 Pa-L/s (750 sccm)

Branch model(EBT2400F-40):

Nitrogen: 2760 Pa-L/s (1500 sccm)

Argon: 2030 Pa-L/s (1100 sccm)

Before using the pump with a higher throughput than the above, consult EBARA Corporation.



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1. Preface

1-1. Characteristics

- 1) Compound molecular pump is a vacuum pump which pumps out gases mechanically. The rotor, which consists of turbine stages and helical groove stages, rotates at high speed, and carries gas molecules from the inlet to the outlet port.
- 2) The pump and the power supply conform to the regulations and the directives as follows, as long as cable length is 20m or less.

UL61010C-1:2002 R8.02 (CU72032437: TUV Rheinland) ^{note1)}
 CAN/CSA-C22.2 No.1010.1B-97 (CU72032437: TUV Rheinland) ^{note1)}
 SEMI S2-0703 ^{note1)}
 LVD (93/68/EEC) ^{note1)}
 EMC Directive (93/68/EEC) ^{note1)}
 CE marking ^{note2)}

*note1)The conforming models are EBT2400FxyB/ETC2403 and EBT2400FxyB-40,-41,-42/ETC2403-10.
 *note2) The conforming models refer to the “CE declaration of conformity” in the end of this manual.

1-2. Warranty

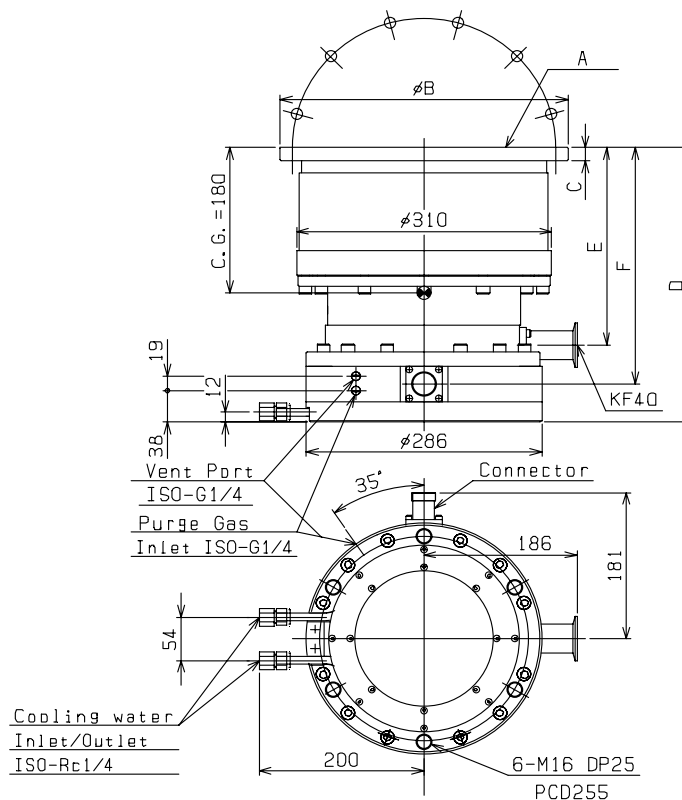
The warranty on the pump and the peripherals is specified in the attached document, “Standard Warranty Conditions” published by EBARA Corporation.

1-3. Dimensions

1) EBT2400F series

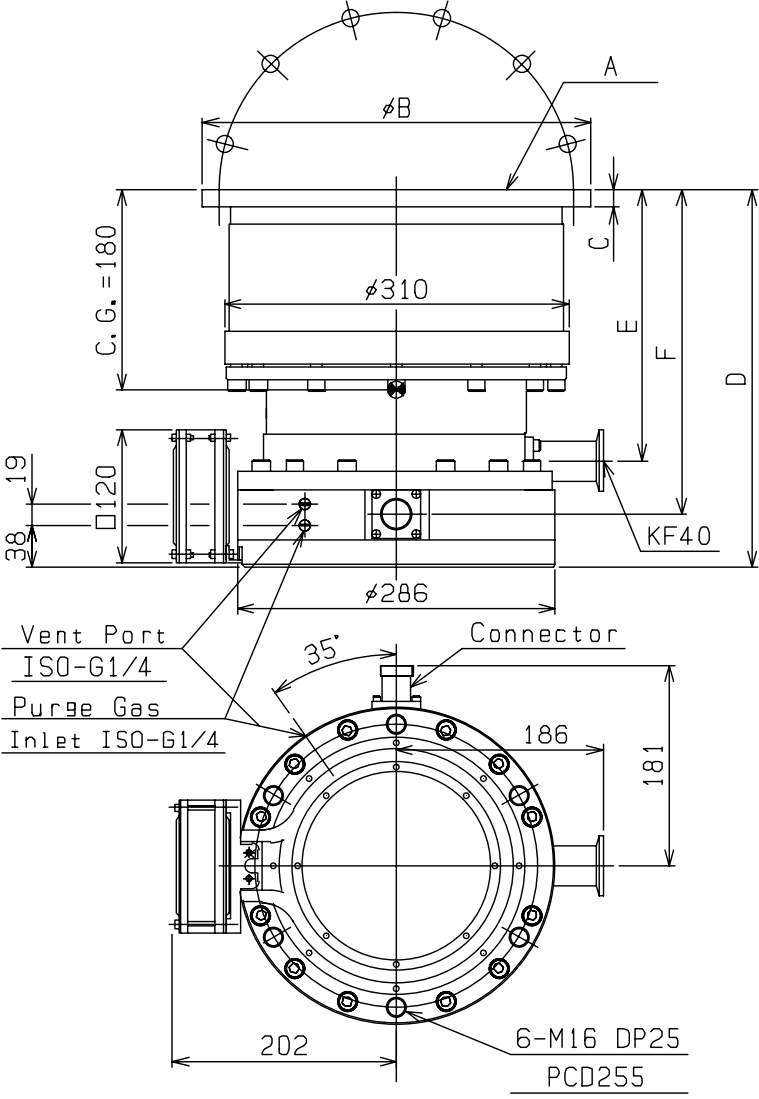
	A	B	C	D	E	F
EBT 2400F	ISO-B250	335	16	340	244.5	292.5
	VG250	350	16	340	244.5	292.5

(Water-cooling Type)



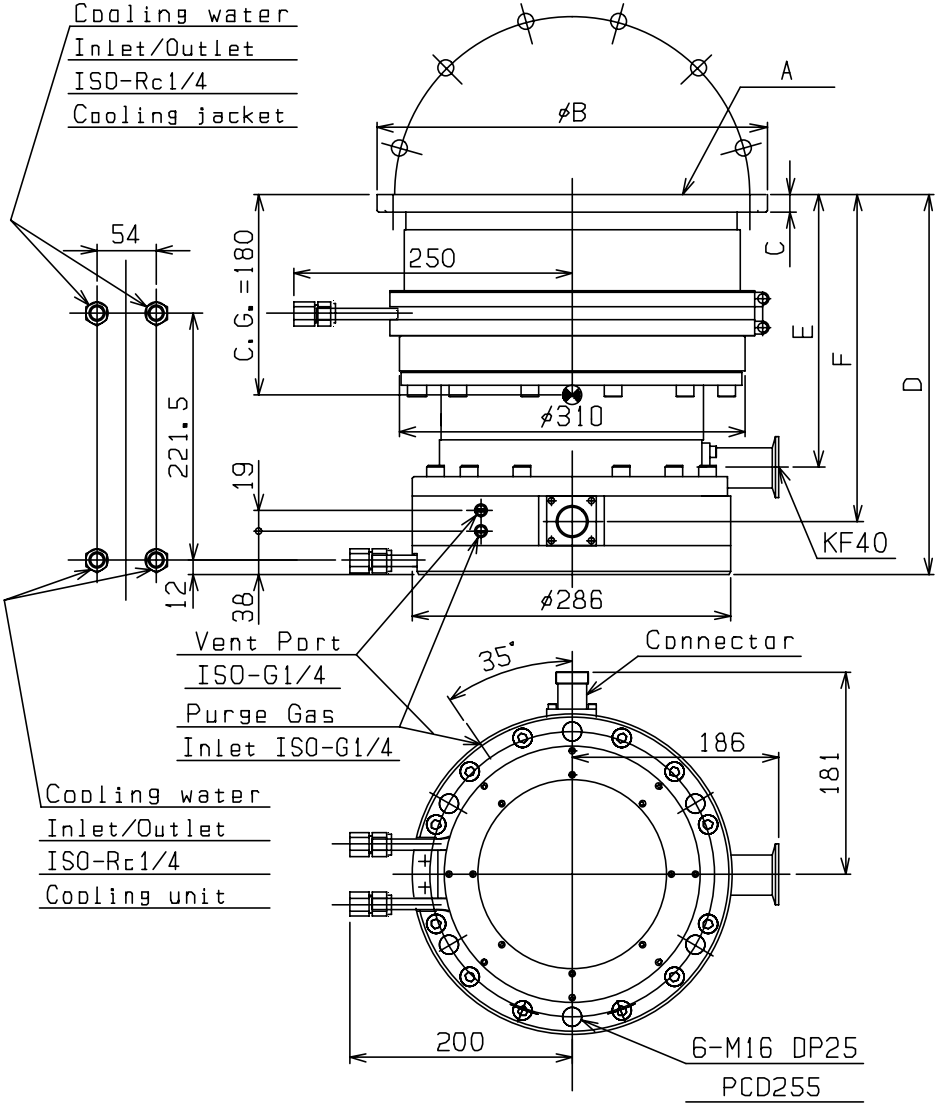


(Air-cooling Type)

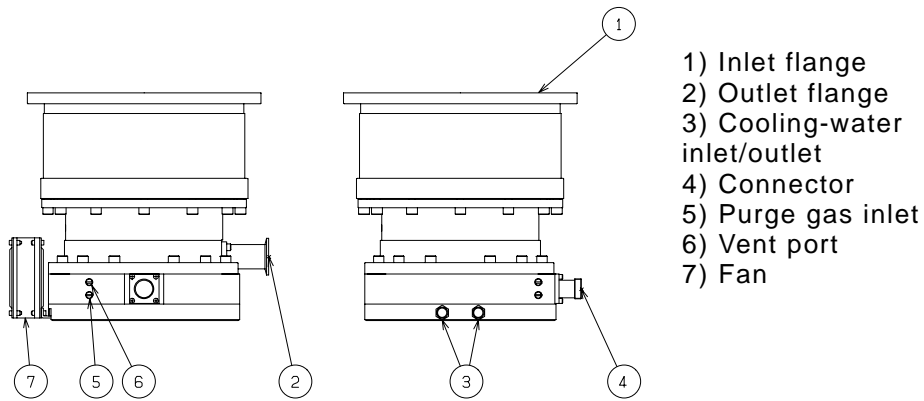




(EBT2400F-40, water-cooling type only)



1-4. Name of pump parts



- 1) Inlet flange
- 2) Outlet flange
- 3) Cooling-water inlet/outlet
- 4) Connector
- 5) Purge gas inlet
- 6) Vent port
- 7) Fan

Figure 1. Name of pump parts

1-5. Nameplates

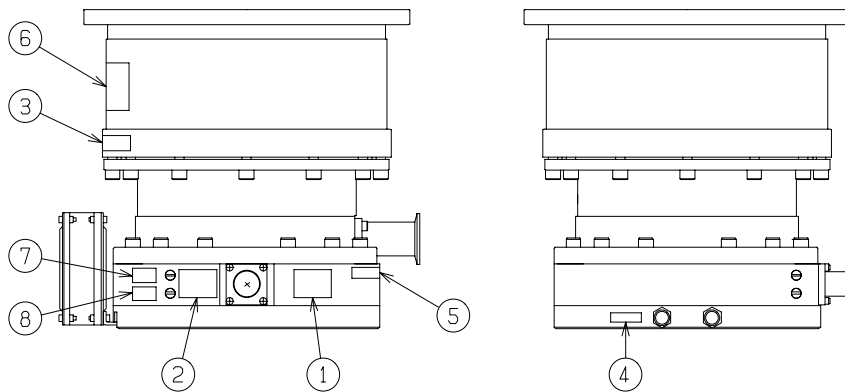
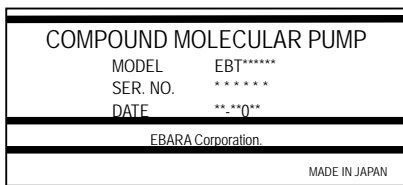
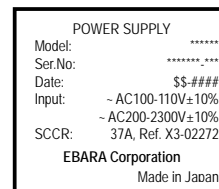


Figure 2. Nameplates

- 1) Main nameplate
Specifies pump type, manufacturing number, and manufacturing date



- 2) Power Supply model plate
Specifies the type of power supply to be used



- 3) Caution plate
Specifies the weight of pump



- 4) Caution plate
Connect the cooling-water line



5) Caution plate
Connect to the backing pump

FORELINE

6) Caution plate
During operation, the pump is hot.
Do NOT touch the pump



7) Caution plate
Connect to the venting line

VENT PORT

8) Caution plate
Connect to the purge gas line

PURGE PORT

2. Opening the crate

Confirm the following items when opening the crate.

A: Opening the crate

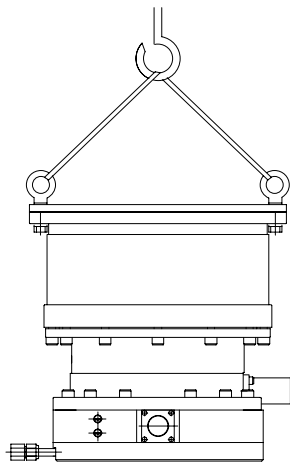


Figure 3. Example of lifting a pump

Table 1 shows the pump weight. Lift up the pump with lift etc. to put out from the crate according to figure 3.

Table 1. Pump weight

Pump	Inlet flange	Weight
EBT2400FBAB	ISO-B250	45kg (100 lb)
EBT2400FVAB	VG250	
EBT2400FBWB	ISO-B250	47kg (104 lb)
EBT2400FVWB	VG250	



B: Damage to the contents

If any damage to the contents is found, notify EBARA Corporation of the damage before use.

C: Components

Standard components are as follows.

- (1) Inlet flange gasket (O-ring) 1 pc.
- (2) Inlet protective screen 1 pc.
- (3) Temporary inlet blank flange with bolts & nuts 1 set
- (4) Outlet port blank flange with clamp and centering ring 1 set
- (5) Instruction manual 1 set

3. Preparation

3-1. Transportation

Use a truck or a lift etc. in transportation, installation to or removal from system.

Keep the pump stable. Keep the pump from impact.

3-2. Compatibility of the pump and power supply

Confirm both the pump model and the power supply model before installation. The caution plate at the pump connector on the pump shows the power supply model to be used.

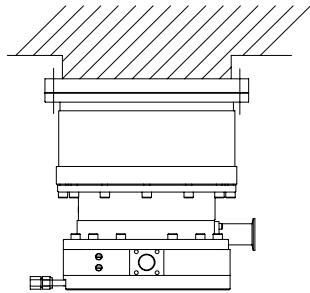
⚠ Caution	
The compatibility of the pump model and the power supply model is as follows.	
Pump model	Power supply model
EBT2400F	----- ETC2403
EBT2400F-40	----- ETC2403-10

3-3. Pump installation

⚠ Caution
Be careful not to contaminate and/or scratch the inlet flange and do not touch inside the pump, because the pump may not be able to get sufficient performance by leak and/or contamination.

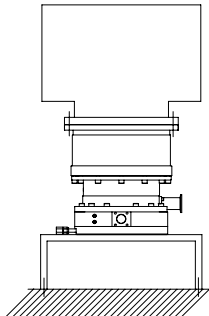
Secure the pump to the system or the frame not only at the inlet flange but also at the bottom utilizing the threaded holes prepared for securing the pump. Do not use the legs for shipping (if any) to secure the pump.

Be sure to use the bolts listed in table 3 to secure the pump.



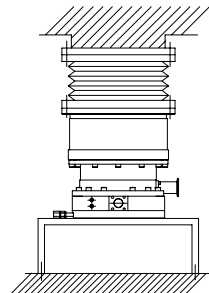
Securing method A

When the inlet flange of the pump installs to the rigid system, firmly secure the pump with the bolts listed in table 3.



Securing method B

When the chamber installs to the inlet flange of the pump, secure the pump to the pump stand with the bolts listed in table 3 and also firmly secure the pump stand to the rigid floor or the frame.



Securing method C

When the inlet flange of the pump installs to soft system such as bellows, secure the pump to the pump stand with the bolts listed in table 3 and also firmly secure the pump stand to the rigid floor or the frame.

Figure 4. Example of pump installation

⚠ Warning

If an accident happens to the rotor during the pump operation, damage to the rotor will generate a large torque. This torque will try to make the entire pump rotate. Be sure to secure the pump to the frame firmly, in order to avoid any danger caused by this torque.

Use the securing bolts listed in table 3 to secure the pump. If you could not prepare the securing bolts listed in table 3, consult with EBARA Corporation before installation.

Do not use the legs for shipping (if any) to secure the pump.

Use metal flexible tubing or bellows to isolate the vibration of the backing pump that conducts to the pump. Also, install the backing pump separately from the pump or use a vibration absorber if the pump and the backing pump are installed in the same frame.

When planning how to secure the pump to the system, the frame or the floor, take into consideration the rotation torque listed in table 2. Make sure the pump is secured strong enough to withstand the torque.



Table 2. Torque that can be generated when the pump is damaged

Pump model	Rotation torque (N·m)
EBT2400F	26300

Table 3 shows the size and the quantity of securing bolts of the pump at the bottom of the pump and the inlet flange. Be sure to tighten all the bolts equally and firmly.

Table 3. Securing bolts of the pump

Securing bolts location		Securing bolts (qty & size)	P.C.D.	Recommended torque	Bolt material (property class)
EBT2400F					
Inlet flange	VG250	12 x M12	320	46 - 57 N·m	SUS304 (70 or higher) or SCM435 (8.8 or higher)
	ISO-B250	12 x M10	310	30 - 38 N·m	
Bottom of the pump		6 x M16	255	130 - 160 N·m	

3-4. Maintenance space

Keep an adequate space around the pump.

3-5. External effect on the pump

1) Ambient temperature

Ambient temperature of the water-cooling (air-cooling) pump in operation must not exceed 40°C (104°F) (32°C (90°F)). If the temperature rises, the maximum throughput will decrease.

⚠ Caution

The pump generates heat in operation. If the ambient temperature exceeds 40°C (104°F) in water-cooling type (32°C (90°F) in air-cooling type), it may cause pump failure.

2) Ambient humidity or water drip or dewfall

Ambient relative humidity must not exceed 85%. And do not use the pump where water drip or dewfall. It may cause pump failure.

⚠ Caution

If you use the pump in an area with high humidity or water drip or dewfall, it may cause a failure.

3) Magnetic field

Do not operate the pump in magnetic field. The permissible magnetic field of the pump is 3mT (30 Gauss) in the direction perpendicular to the axis, and 25mT (250 Gauss) in the direction of the axis. When the pump will operate in stronger magnetic field than the limit, prepare magnetic shield or special pump. Consult with EBARA Corporation before operation.

⚠ Caution

The temperature of the rotor rises when the pump operates in magnetic field, and it will cause damage of the rotor.

4) Reactive/corrosive/toxic gas

⚠ Caution

Do not use the pump in an area with reactive, corrosive and/or toxic gas. It may cause pump failure.



5) Radiation

⚠ Caution
Do not use the pump in a radiation area. It may cause pump failure.

6) External shock and vibration

⚠ Caution
Do not apply shock and vibration to the pump during operation.

7) Dust

⚠ Caution
Do not use the pump in an area exposed to dust.

8) Sea breeze

⚠ Caution
Do not use or store the pump where it is exposed to salt-laden atmosphere.

3-6. Cooling of pump

The pump should be cooled during operation.

For water-cooling type:

- 1) Set the power supply for water-cooling type. See the instruction manual of the power supply.
- 2) Connect the cooling water pipes to the cooling water inlet and outlet ports (ISO Rc 1/4 female screw). There are two openings and either can be applied as inlet/outlet. As for EBT2400F-40, it has a cooling unit and a cooling jacket. See the drawing in section 1-2 and check the inlets/outlets.
- 3) Connect it securely so as not to leak when you connect piping.
- 4) Make sure that cooling water supply pressure is 0.6 MPa (5kgf/cm²G, 72.5psiG) or lower. The minimum required flow rate of cooling water is 1.5 L/min. Use as clean water as possible.
- 5) Control the temperature of cooling water in the range of 10°C (50°F) to 35°C (95°F) at inlet.
- 6) Be careful that cooling water does not freeze in cold temperatures.
- 7) The pump can be stopped when the cooling water is interrupted by application of flow switch to the cooling water outlet. Connect the contact (normally closed) of the flow switch to the protection terminal of the control connector of the power supply. Refer to the instruction manual of the power supply.

For air-cooling type:

- 1) Set the power supply for air-cooling type. See the instruction manual of the power supply.
- 2) Connect the fan cable to the fan.

⚠ Caution
Please secure clearance so as not to restrict air flow around the fan.

4. Vacuum piping

4-1. Inlet port piping

- 1) Use materials for the piping with a small out gassing rate such as stainless steel or aluminum alloy.
- 2) Take the piping conductance into consideration when designing the piping.
- 3) Minimize the leak rate at the piping and the system. Degrease the wall surface of the vacuum piping in order to minimize the out gas.
- 4) When the pump is installed in a system, do not remove the protective screen at the inlet. The protective screen prevents foreign objects from falling into the pump.



⚠ Caution

Even with a protective screen, foreign objects may fall into the pump. It will cause trouble or damage.

5) Connect it securely so as not to leak when you connect piping.

4-2. Selection of backing pump

- 1) The performance of the pump depends on the capacity of the backing pump. Refer to table 4 for the backing pump selection. Recommended backing pump capacity is shown in the table. Use a backing pump that has a capacity at this level or higher.

Table 4. Recommended backing pump capacity

Pump model	Recommended backing pump capacity
EBT2400F series	500L/min (17.7cfm) or higher

⚠ Caution

If the performance of the backing pump deteriorates, the performance of the pump also deteriorates.

4-3. Foreline piping

- 1) Use stainless steel, aluminum or metal flexible tubing etc. for piping to connect the pump to the backing pump.
- 2) The length and diameter of the piping will affect the pump performance. Minimize the piping length and maximize the diameter for a larger conductance.
- 3) Use metal flexible tubing or bellows to isolate the vibration of the backing pump that conducts to the pump. Also, install the backing pump separately from the pump or use a vibration absorber if the pump and backing pump are installed in the same frame.
- 4) Connect it securely so as not to leak when you connect piping.

⚠ Caution

Do not block the outlet port. Connect the outlet port to a backing pump.

4-4. Purge gas line piping

When pumping a dust, purge the inside of the pump from the purge gas inlet. Refer to figure 5.

Nitrogen is commonly used as purge gas. Set the flow rate to 9.2 Pa·L/sec (5sccm).

When the pump is not being purged, shut the purge gas inlet with a blank plug.

Connect it securely so as not to leak when you connect piping.

Make sure that purge gas supply pressure is 0.2 MPa (1kgf/cm²G, 14.3psiG) or lower.

⚠ Caution

Excessive or insufficient purge gas flow rate causes failure or deterioration of the pump performance.

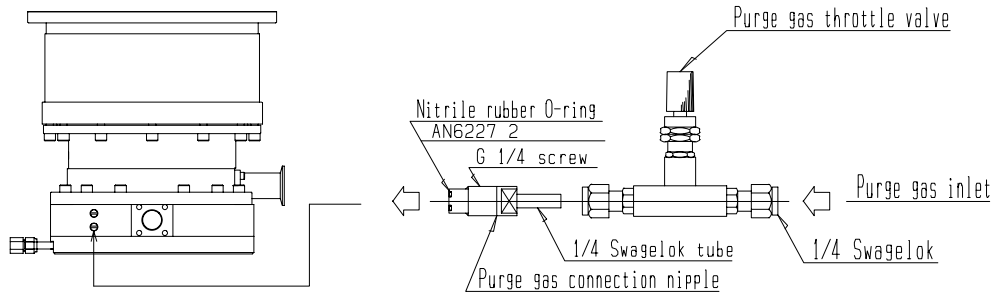


Figure 5. An example of purge gas line piping

5. Cable connection

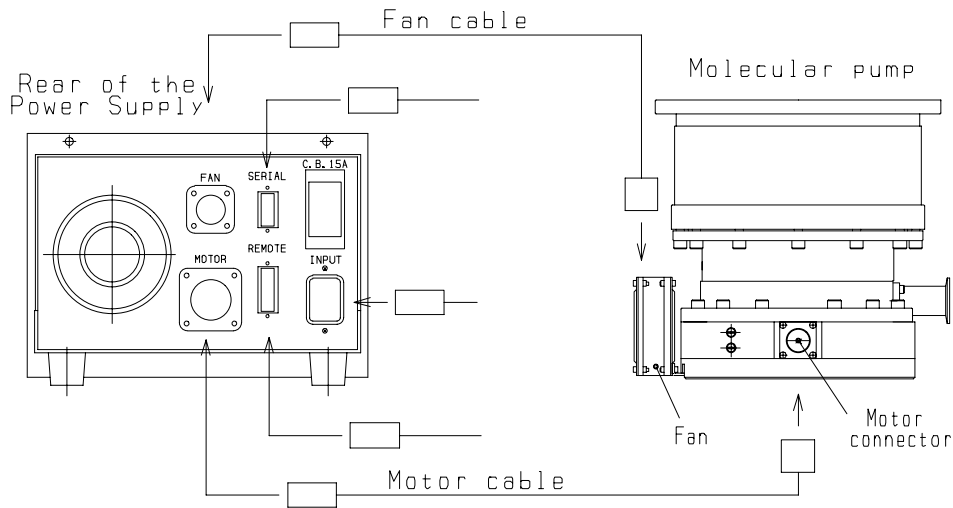


Figure 6. Connection of ETC2403/ETC2403-10

⚠ Warning

Be sure to shut the input power off to the power supply before connecting the cables. Otherwise, you may get an electric shock.

Be sure to confirm the combination between the pump model and power supply model. Connect the connector on the pump and “MOTOR” connector or “OUTPUT” connector on the rear panel of the power supply with motor cable. Connect the connector on the fan and “FAN” connector on the rear panel of the power supply with fan cable.

⚠ Caution

When connecting the motor cable, set the pins to correct position, plug in the connector at a straight angle and fasten the coupling nut to the end.



6. Operation

6-1. Precautions before operation

- 1) Be sure to confirm the combination of the pump model and the power supply model.
- 2) Make electrical connection of the pump and the power supply. Refer to the instruction manual of the power supply.
- 3) The pump needs to be cooled during operation. See also section 3-6.

For water-cooling type:

Connect the cooling water line to the cooling water inlet/outlet at the pump. Use as clean water as possible. Be sure that the interlock is operating so that the pump will stop automatically if the cooling water flow stops or the flow rate becomes too low. The minimum required flow rate of cooling water is 1.5 L/min, and acceptable temperature range is 10 - 35°C (50 - 95°F) and water pressure is below 0.6 MPa (5kgf/cm²G, 72.5psiG).

For air-cooling type:

Connect the fan cable to the fan.

⚠ Caution

If cooling is insufficient, it may cause pump failure.

- 4) The pump and backing pump can be started up together. However, the pump may have a failure of "oL1" which means acceleration time over during acceleration and the pump may stop, if the volume of the chamber is very large. In this case, follow the next procedure.

If the chamber pressure does not reach 200 Pa (1.5 Torr) within 7 minutes only with the backing pump, continue to pump the chamber only with the backing pump. Once the chamber pressure reaches 200 Pa (1.5 Torr), then start the pump.

- 5) When pumping dust, purge the inside of the pump from the purge gas inlet. Set the purge gas flow rate 9.2 Pa·L/sec (5sccm).

⚠ Caution

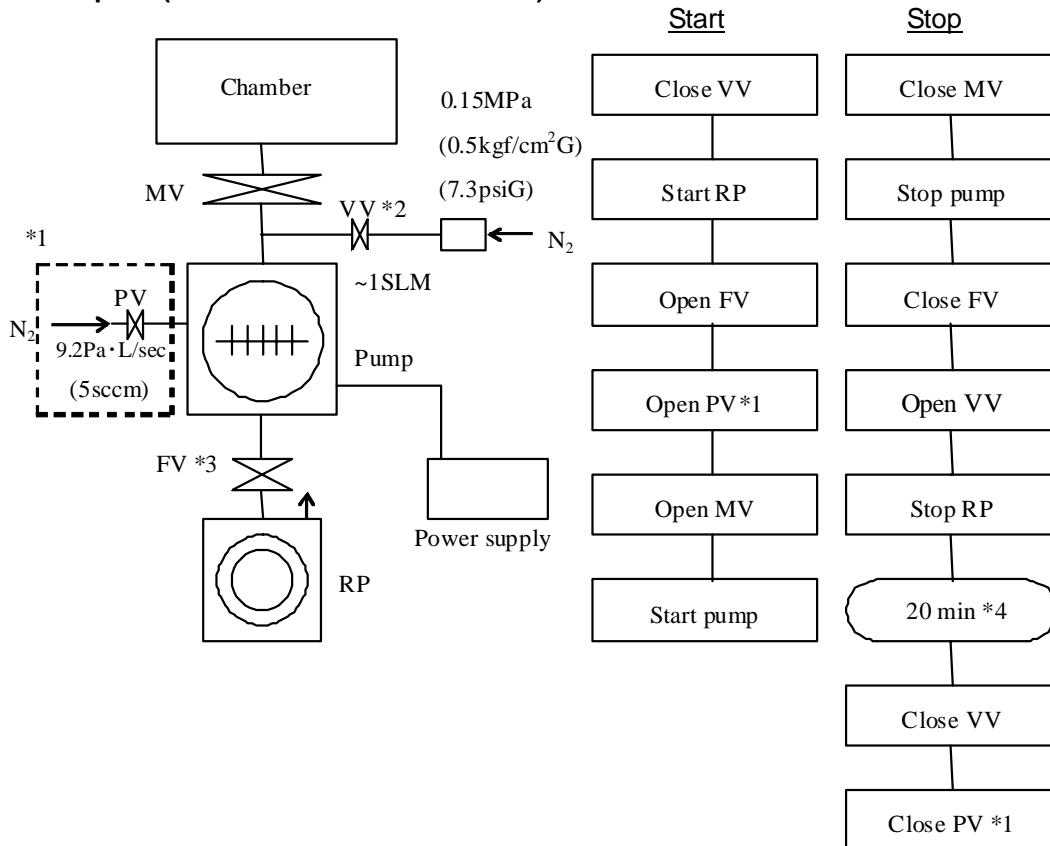
Excessive or insufficient purge gas flow may cause deterioration or failure of the pump.

6-2. Starting / Stopping the pump

The pump can be operated with signal from the START/STOP button on the front panel of the power supply for LOCAL operation or can be controlled remotely with signals from the system for REMOTE operation. Refer to the instruction manual of the power supply for operation in detail.

Refer to the following two examples of start/stop procedure.

a. Example 1 (with main and foreline valves)

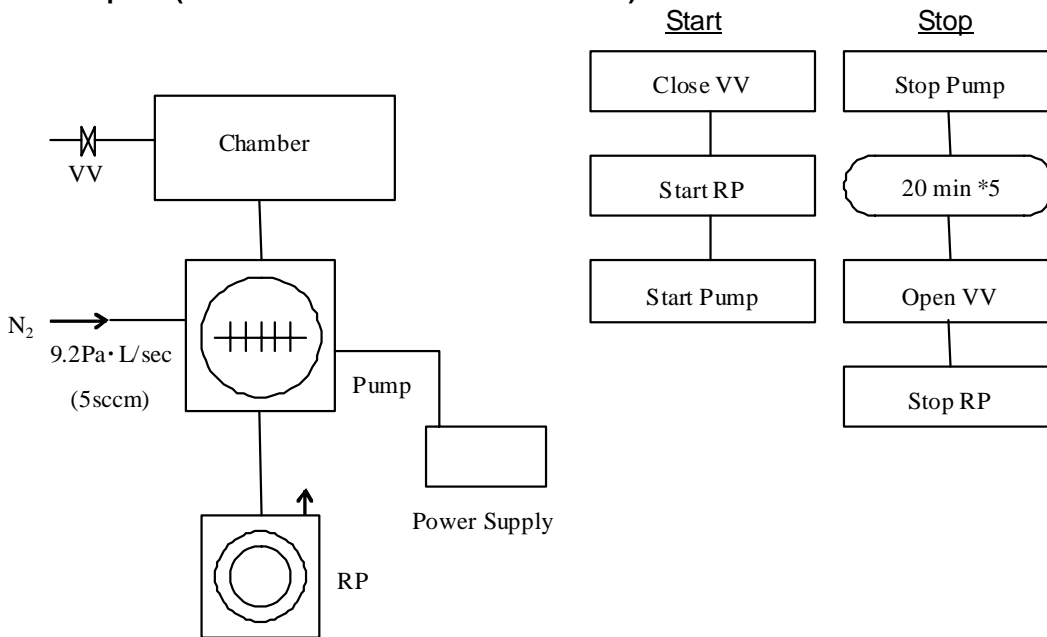


Pump: EBT2400F series
 RP: Rotary pump
 MV: Main valve
 VV: Vent valve
 FV: Fore valve
 PV: Purge valve *1

- *1 In case the pump is gas-purged.
- *2 Install VV between FV and Pump on some system.
- *3 It is possible to remove FV if RP has shut-off valve.
- *4 Venting time to avoid the back streaming from lubricant.

Figure 9. Example 1 of start/stop procedure

b. Example 2 (without main valve or foreline valve)



*5 Deceleration time for rotational speed of the rotor.

Figure 10. Example 2 of start/stop procedure

⚠ Warning

Vent the inside of the pump to atmosphere when the pump stops completely. Oil vapor may flow back to whole inside of the pump if the pump is kept in vacuum. Backflow like this case may cause deterioration. Do not exceed pressure inside the pump to 0.17 MPa (0.7 kgf/cm²G, 10.2psiG). Otherwise, the pump may damage.

6-3. Starting / Stopping the pump during operation

The pump can be stopped during acceleration or can be re-accelerated during deceleration.

7. Baking

Better ultimate pressure can be reached when the pump and the chamber are baked. Mount a baking heater on top of the pump casing for baking of the pump as shown below: Keep baking temperature below 120°C (248°F). The baking heater is provided as the option.

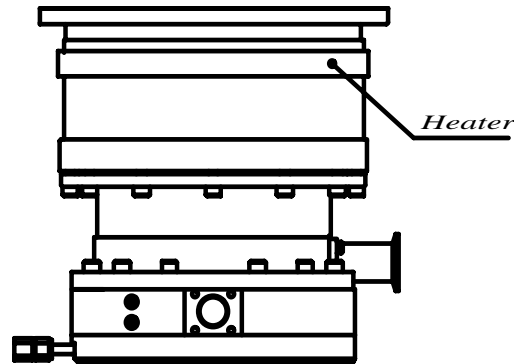


Figure 11. Position of the heater

⚠ Caution

A wrong position of a baking heater or an excessive baking temperature may result in the pump failure. Do not exceed 120°C (248°F) of the baking temperature at inlet flange.

8. Maintenance

8-1. Vibration

If the level of pump vibration increases abnormally during normal operation, which you can feel by hand or measured full amplitude of the vibration is 1 μm or more with vibration meter, contact EBARA Corporation.

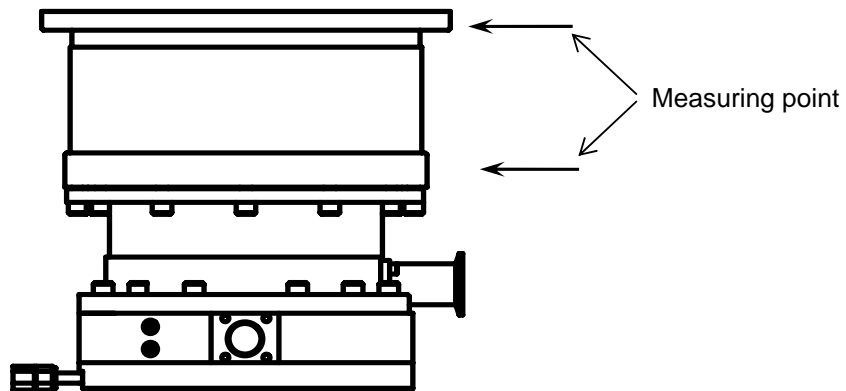


Figure 12. Measurement of vibration at inlet flange and/or bottom of casing



8-2. Reactive products

Much accumulation of reaction products in the pump may render the pump inoperable and cause more serious issues. Overhaul the pump periodically if the pump has accumulation of reaction products.

⚠ Caution

If reactive products are left inside the pump, the parts will be corroded, and the pump will be unable to be overhauled.

8-3. Replacement of bearings

The lifetime of the bearing varies with process. Periodical overhaul is recommended to replace the bearings, every 30,000 hours with non-reactive gas. Consult with EBARA Corporation about replacement of the bearing if the pump needs to evacuate dust.

8-4. Air inrush

The pump can be restarted easily after an accidental air inrush. Contact EBARA Corporation if you experience any difficulties.

8-5. Precaution of operation in low temperature

Be careful not to allow the cooling water to freeze in low temperatures.

It is possible that the pump gets failure of "oL1", acceleration time over, during acceleration when operating the pump in cold temperatures. Because the viscosity of the lubricant rises by low temperature and it requires larger torque. In this case, re-start the pump after resetting the failure.

9. Storing the pump

Cover the inlet flange, the outlet flange and the purge gas inlet with blank flanges and plugs before storing the pump for a long time.

Purge the pump with an inert gas such as nitrogen, so as not to leave any reactive or corrosive gas in the pump.

If the reactive products deposit inside the pump, overhaul the pump before storing.

Do not store the pump in the following environments:

- 1) High temperature and/or high humidity
- 2) In strong electric and/or magnetic field
- 3) Near reactive, corrosive and/or toxic gas
- 4) Radiation area
- 5) Under dripping water
- 6) Near strong vibrations
- 7) Dusty place
- 8) Dewfall area
- 9) Sea breeze area

It is possible to get failure caused by bad lubrication when the pump is stored more than 6 months. If the pump develops any problems, contact EBARA Corporation.

It is available for operation check of the pump at EBARA Corporation service center. Or operate the pump every 6 months for lubrication of the bearing.



10. Recommended Overhaul and service

The meantime of overhaul of the pump varies in applications and natures of gases pumping.

Be sure to overhaul the pump before 30,000 hours operation, which is lifetime of bearing when the pump evacuates non-reactive gas only. The pump has to be overhauled, even with no problem when operation time reaches 30,000 hours. Consult with EBARA Corporation about replacement of the bearings when the pump needs to evacuate corrosive gas, reactive gas or dust.

Contact EBARA Corporation or a service agent contracted with EBARA Corporation when the pump needs overhaul or repair.

Be sure to disclose all the evacuated gases that are harmful and/or reactive and/or flammable, and even non-harmful and non-reactive and non-flammable gases before shipping back to EBARA Corporation or service agent. Otherwise, the pump cannot be overhauled or repaired.

Purge inside the pump with non-reactive gas before sending back. Cover the inlet flange, the outlet flange, the vent port and the purge gas inlet firmly to avoid leaking the reactive products from the pump.

Warning

Purge the pump with inert gas before dismounting it from the system if the pump has evacuated harmful or reactive or flammable gas. Take protective measures not to expose the human body to harmful or reactive or flammable gases or its products.

Be sure to disclose all the evacuated gases that are harmful and/or reactive and/or flammable, and even non-harmful or non-reactive or non-flammable gases before shipping back to EBARA Corporation or service agent. Otherwise, the pump cannot be overhauled or repaired.

Purge inside the pump with non-reactive gas before sending back. Cover the inlet flange, the outlet flange, the vent port and the purge gas inlet firmly to avoid leaking the reactive products from the pump.

11. Disposal

When the pump is disposed, the customer should follow the instructions by each self-governing community as the industrial waste.

Warning

Dispose the pump after treating the gases and byproducts inside of the pump appropriately.



12. Specifications

EBT2400F

Volume flow rate	for nitrogen	2400 L/s
	for nitrogen with protective screen	2300 L/s
	for hydrogen	1100 L/s
Maximum compression ratio	for nitrogen	1×10^8
	for hydrogen	1400
Ultimate pressure ¹⁾		$< 1 \times 10^{-6}$ Pa (7.5×10^{-9} Torr)
Maximum backing pressure		200 Pa (1.5 Torr)
Recommended backing pump		≥ 500 L/min (17.7 CFM)
Startup time		5 - 7 min
Shutdown time		15 - 18 min
Permissible bake-out temperature at inlet flange		≤ 120 °C (248 °F)
Rated rotational speed		31200 min^{-1}
Installation position ²⁾		Any
Cooling water	Required flow rate	≥ 1.5 L/min (0.39 gpm)
	Temperature at inlet	10 – 35 °C (50 – 95 °F)
Permissible ambient temperature	Water-cooling type	10 – 40 °C (50 – 104 °F)
	Air-cooling type	10 – 32 °C (50 – 90 °F)
Permissible humidity		5 - 85 %
Weight	Water-cooling type	47 kg (104 lbs)
	Air-cooling type	45 kg (100 lbs)
Pollution degree		2
IP rating		IP10 (service areas)
Maximum noise level		90dB (A)

1) Pressure attained after 48 hours of bake-out

2) Pump must be firmly secured to your system



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