ecology
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NGK
CERAMIC VACUUM PUMP UNIT

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CONTENTS

Caution

This product is among the restricted product types listed in Appended Table 1 of the Export Trade Control Order. Export requires export permission based on the Foreign Exchange and Foreign Trade Act and other relevant laws.

SUPERIOR CORROSION RESISTANT CERAMIC VACUUM PUMP UNIT

We have created the world's first vacuum pump unit in which all the parts that contact the gas are composed of ceramic or other highly corrosion resistant material.

FEATURES

Superior corrosion resistant ceramic vacuum pump unit

The primary components are the liquid ring vacuum pump, gas ejector, and mechanical booster pump, and all parts that contact the gas are composed of highly corrosion resistant materials such as ceramic, glass lining, fluorocarbon resin, or carbon. The pump can be used with nearly all fluids except for hydrofluoric acid and alkalis, and resolves or reduces the following problems that occurred with the vacuum pumps previously used with corrosive liquids.

Oil sealed rotary pumps: (Oil sump type)	Recurring expenses for frequent maintenance Large expenses for regular oil changes Large expenses for regular pump replacement Expenses for additional pre-pump cleaning equipment
Oil sealed rotary pumps: (Oil dripping type)	Large oil consumption
Metal liquid ring pumps:	Large expenses for maintenance and parts replacement Large expenses for additional cleaning equipment and wastewater treatment
Steam ejectors:	Large expenses for additional condensate treatment equipment and wastewater treatment

Superior evacuation characteristics

This pump is capable of pumping speeds up to 300 m^3/h and an ultimate vacuum pressure of up to 0.04 kPa. It can be used as the core vacuum pump unit for applications ranging from bench-scale test plants up to full-scale production plants.

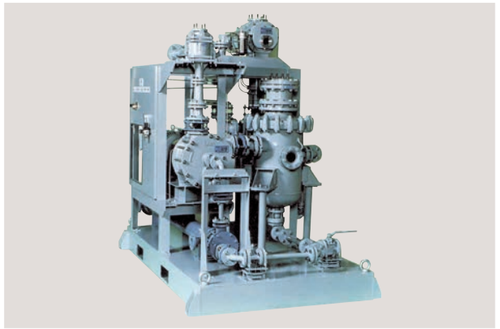
Energy-saving and space-saving vacuum pump unit

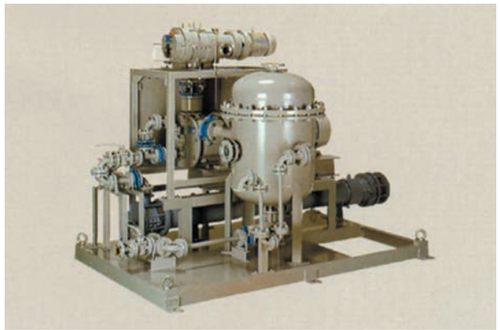
The use of partially stabilized zirconia (PSZ) with particularly excellent strength and toughness in the rotating parts allows thin walls and high rotating speeds that are on the same level as various metal vacuum pumps. This delivers superior evacuation efficiency and creates a lightweight, compact configuration.

It has particular advantages compared to a steam ejector, and can operate with approximately 50% the kinetic energy and approximately 30% the space.

Support for full instrumentation

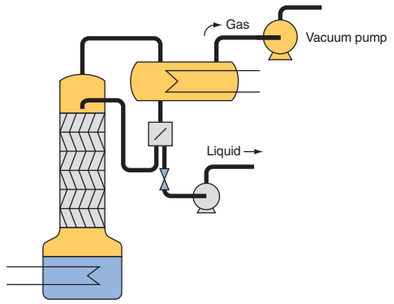
We design and produce units that fully automate all processes including pump operation, temperature and pressure detection, and valve operation.





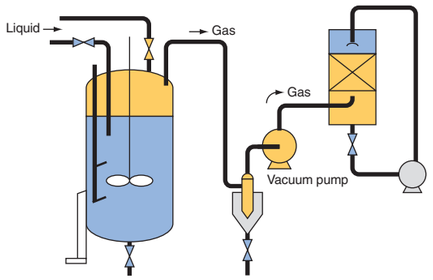
APPLICATIONS

Vacuum Distillation



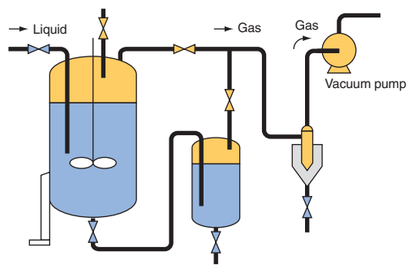
- Distillation of liquids that degenerate and decompose easily
  [0.133 ~ 1.33kPa]

Gas Evacuation Gas Conveyance



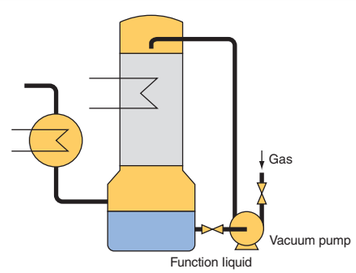
- Gas evacuation from reactor
  [0.133 ~ 1.33kPa]
- Feeding gases into other apparatus (gas blower)
  [13.3kPa ~ 0.2MPaG]

Liquid Transfer



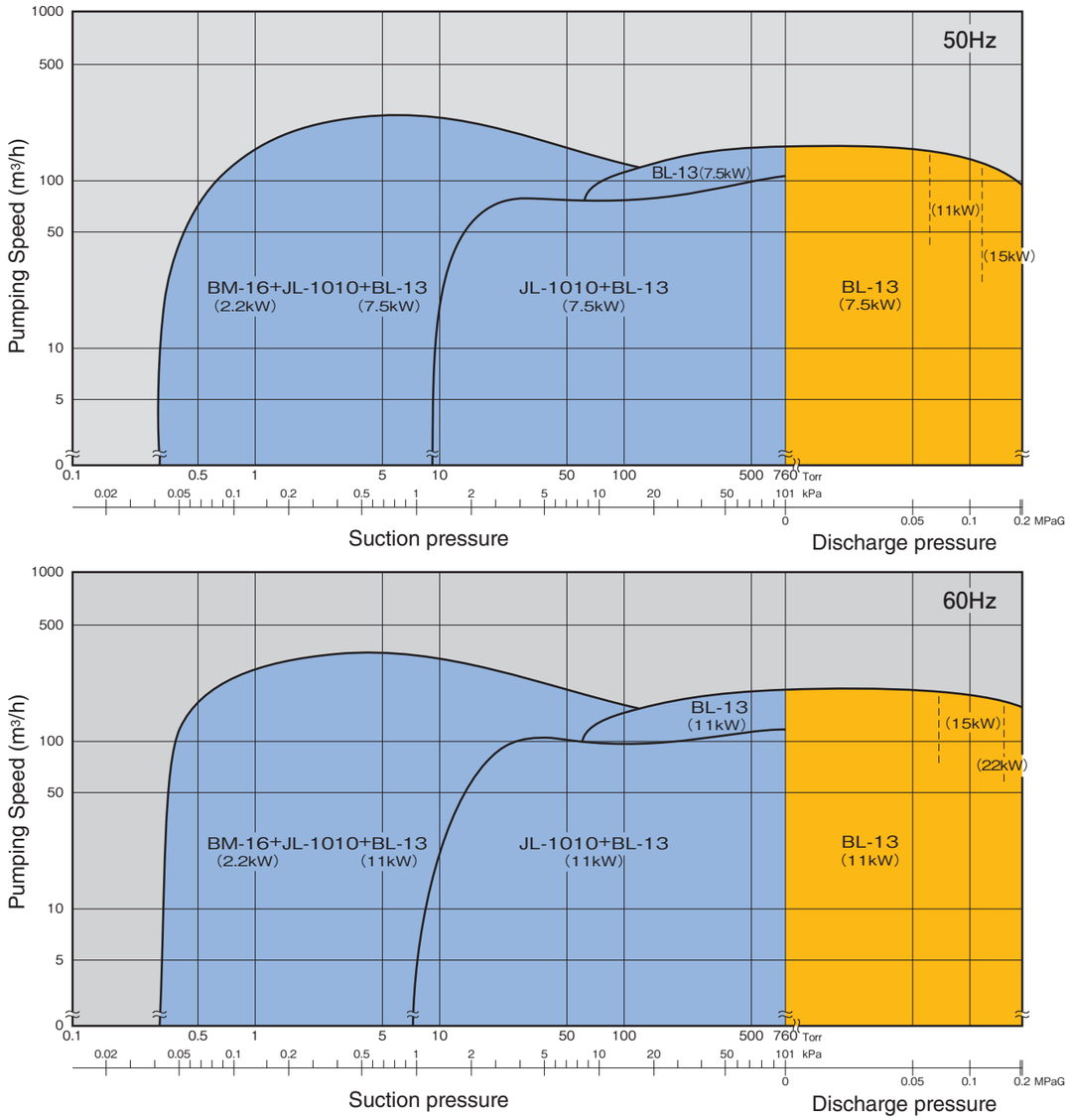
- Feeding liquids (that degenerate when transferred by a centrifugal pump) into reactors
  [13.3 ~ 53.2kPa]

Gas Absorption



- Absorbing gases by the function liquid for circulation in liquid ring pumps
  [2.66 ~ 13.3kPa]

SELECTION CHART

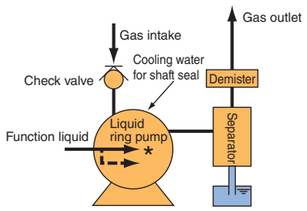
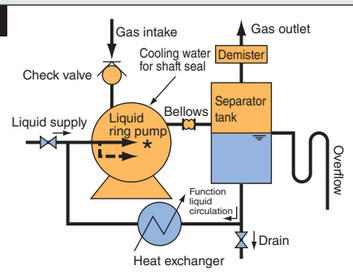
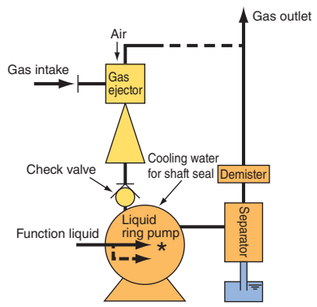
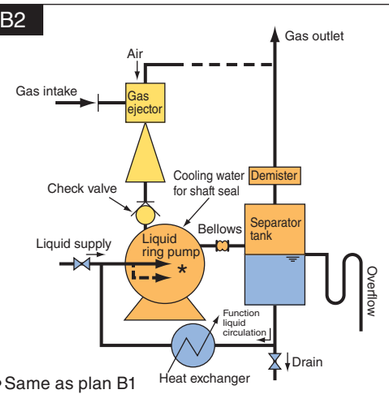
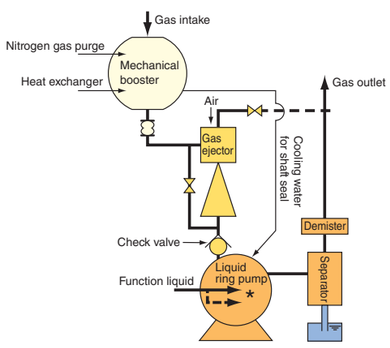
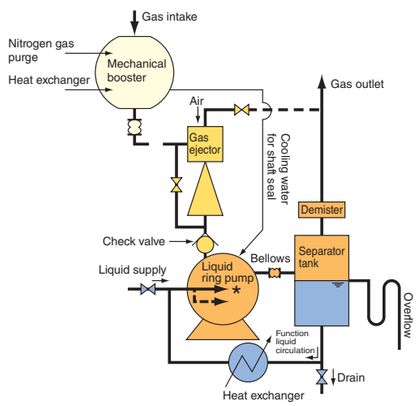


Use the ceramic vacuum pump at temperatures that do not exceed the following.

Liquid ring pump	: 80℃ (suction side)
Gas ejector	: 80℃ (suction side)
Mechanical booster pump	: 150℃ (discharge side)

BL : Liquid ring pump (compressor)
JL : Gas ejector
BM : Mechanical booster pump
( ) indicates motor power.

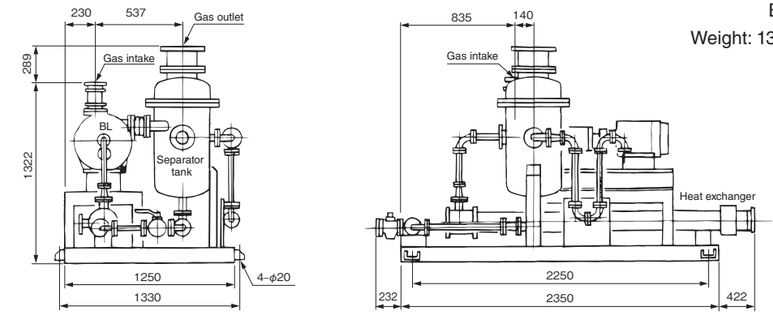
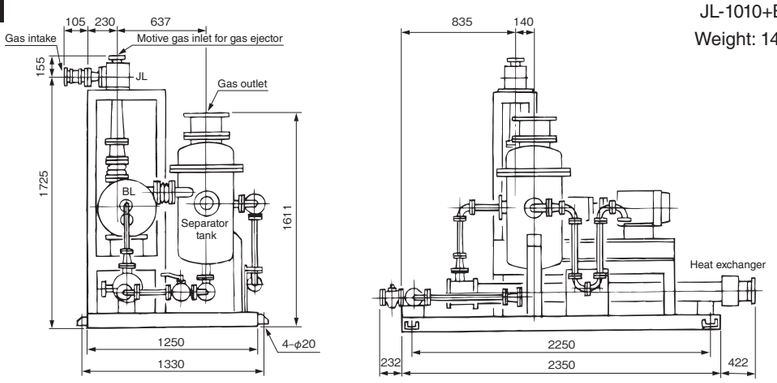
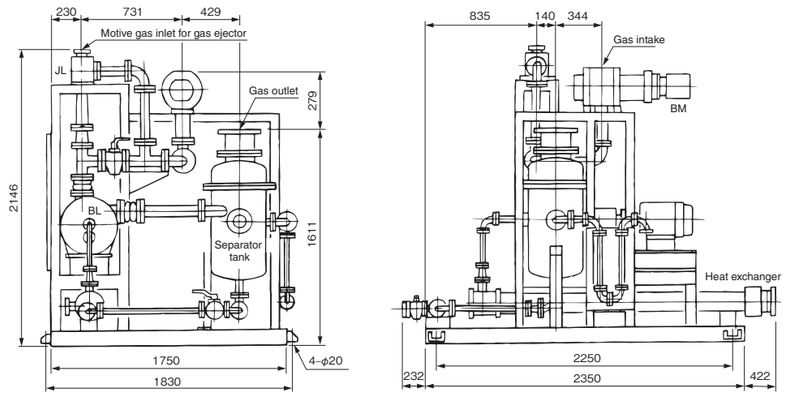
CONFIGURATION AND FEATURES OF STANDARD UNIT

Degree of Vacuum	Without function liquid circulation	With function liquid circulation
8～101.3kPa	**A1**  • One injection port (*) for function liquid is standard. • Check valve is not necessary for compression applications.	**A2**  • Function liquid is self-circulated by differential pressure of pump, minimizing liquid supply and waste liquid. • Check valve is not necessary for compression applications.
1.33～13.3kPa	**B1**  • Discharge gas can be used as a gas ejector motive gas. (Connect on --- line.)	**B2**  • Same as plan B1
0.04～1.33kPa	**F1**  • Motive gas valve for gas ejector can be opened or closed manually or by actuator. • Discharge gas can be used as a gas ejector motive gas. (Connect on --- line.)	**F2**  • Same as plan F1

[Standard material of auxiliary equipment]

Separator tank	: ETFE lining, Glass-lining	Piping	: PTFE lining, Glass-lining
Check valve	: PTFE / PFA + FCD-S	Valve	: Ceramics + FCD-S
Heat exchanger	: Carbon	Demister	: Glass-lining + FEP mesh (Option)
Bellows	: PTFE		

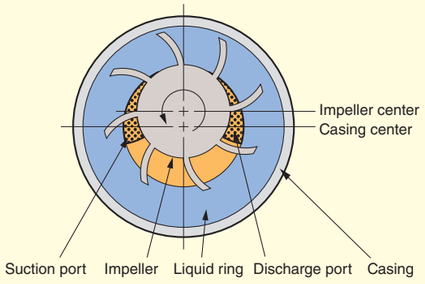
DIMENSIONS AND WEIGHT OF STANDARD UNIT

Degree of Vacuum	Dimensions and weight* (for unit with function liquid circulation)
8～101.3kPa	**A2** BL-13 Weight: 1300kg 
1.33～13.3kPa	**B2** JL-1010+BL-13 Weight: 1400kg 
0.04～1.33kPa	**F2** BM-16+JL-1010+BL-13 Weight: 1900kg 

*The dimensions and weight may vary depending on the details of the specifications.

LIQUID RING VACUUM PUMP [BL-SERIES]

Principle of Operation



As shown in the figure at left, the function liquid is injected into the cylindrical casing. When the impeller that is installed eccentric to the casing center rotates, the function liquid rotates in a circle that is concentric with the casing, forming a liquid ring.

Due to the impeller position, spaces of varying sizes are formed between the impeller blades. When a suction port and discharge port are installed as shown at left, continuous pump operation occurs in the following cycle: gas expansion → gas suction → gas compression → gas discharge.

FEATURES

Superior corrosion resistance

Using ceramics and PSZ in all gas-contacting parts ensures superior corrosion resistance and is ideal for pumping of gases containing chlorine-based organic substances and organic solvents.

The separator, heat exchanger, piping, and other auxiliary equipment are also made from corrosion resistant materials.

Excellent pumping performance

The Elmo-type single-acting structure and thin impeller blades that utilize the high strength and toughness of PSZ produce high evacuation performance on the same level as a metal pump.

By connecting it with a gas ejector and mechanical booster, this pump can be used as a high-performance vacuum generator.

It can also be used as a compressor (blower) for gas feeding.

Easy gas absorption

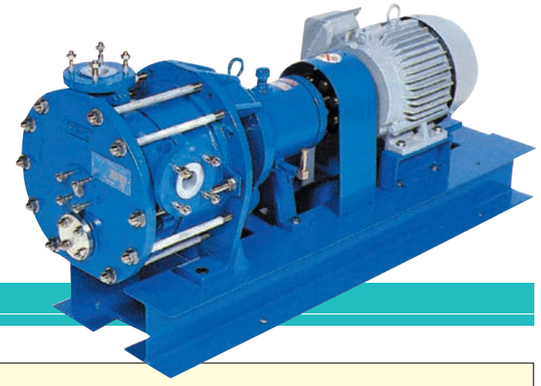
Because the liquid ring pump continuously stirs and mixes the function liquid with gases, it can be used as a highly efficient gas absorption unit by properly selecting the type of liquid. It also does not require a special gas scrubber.

Superior durability

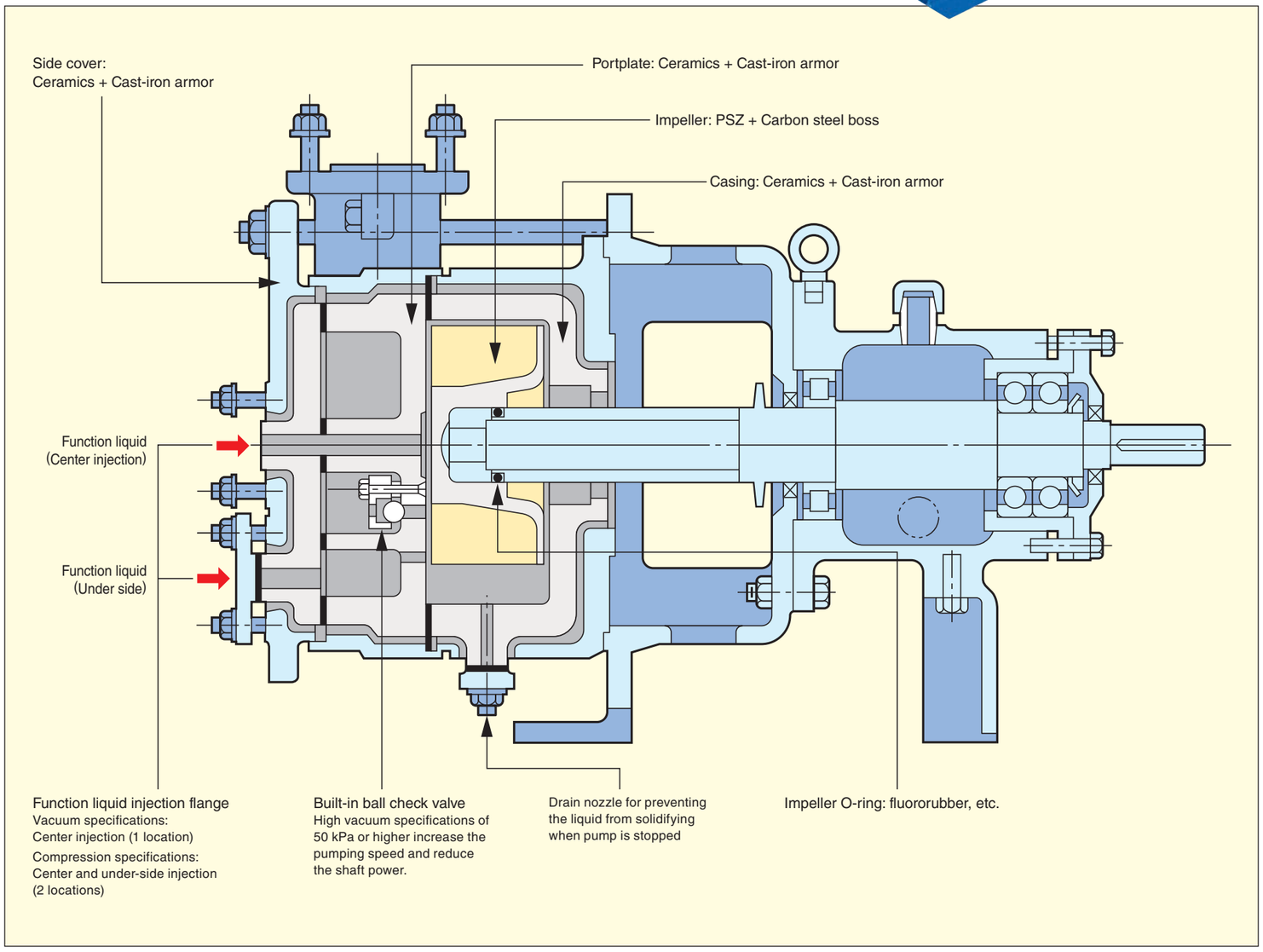
Unlike oil-sealed rotary vacuum pumps, the liquid ring pump has no sliding parts, leaving it free from trouble caused by parts wear.

Easy maintenance

Because of the cantilever impeller, all parts can be individually replaced from the end of the pump, and the small number of parts allows for easy maintenance.



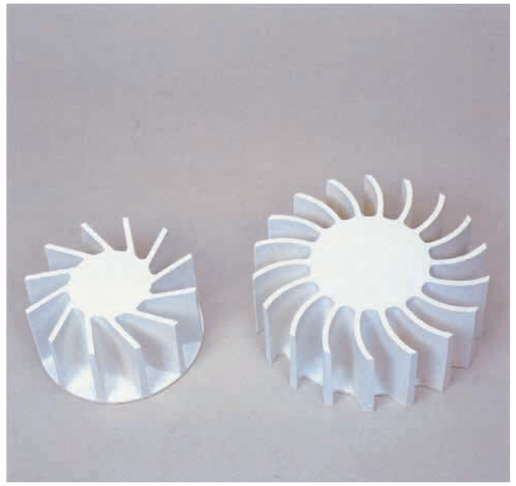
CONSTRUCTION AND MATERIALS



REQUIRED FUNCTION LIQUID FEED

BL-13 (65mm diameter)	
Single nozzle injection	Double nozzle injection
15±2 ℓ/min	30±4 ℓ/min

Double nozzle injection is also used for vacuum in cases when there is substantial heating of the function liquid due to gas absorption, and when the temperature of the function liquid is likely to rise, such as during the summer.

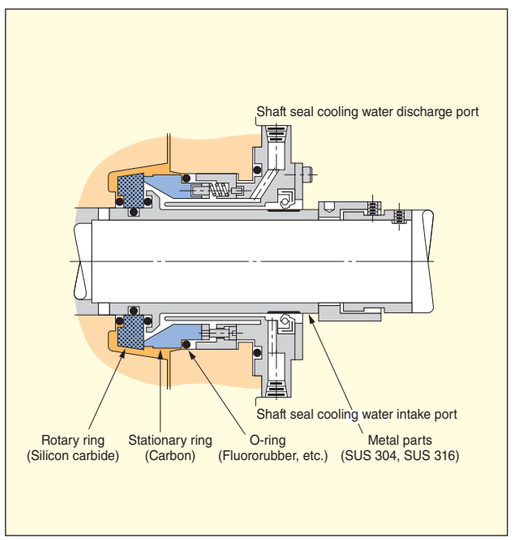


PSZ impeller

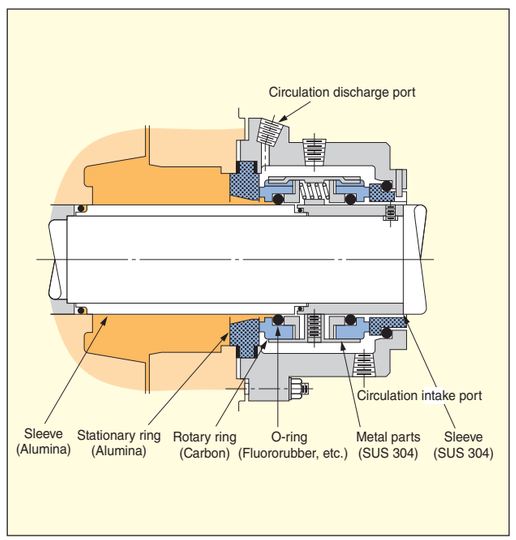
SHAFT SEAL

BL-series liquid ring vacuum pumps can be equipped with a single (standard) or double mechanical seal.

( ) Standard material

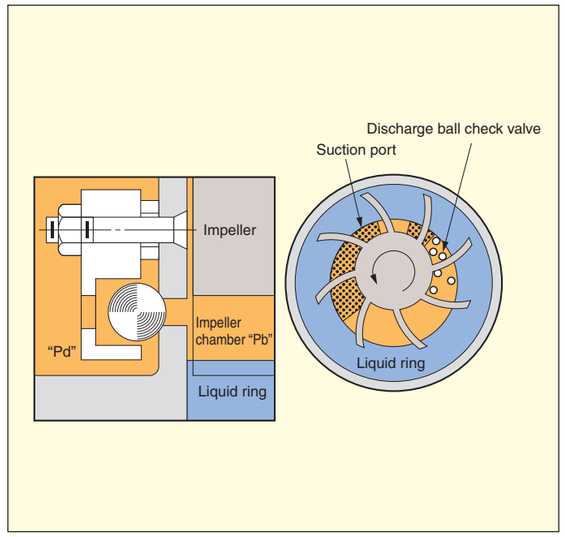


Single mechanical seal (stationary type)



Double mechanical seal (rotary type)

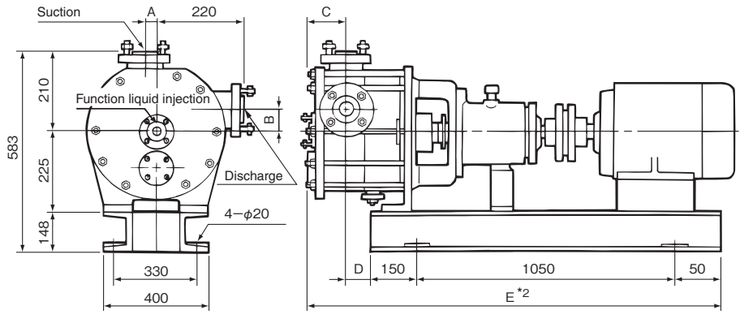
BALL CHECK VALVE



Although the liquid ring vacuum pump has a constant discharge pressure Pd, it has a variable suction pressure and as a result, the impeller chamber internal pressure Pb, which is related to the suction pressure, also varies.

A ball check valve installed on the discharge port makes it possible to prevent excessive gas compression in low vacuum ranges at pressures of 50 kPa and higher, to prevent liquid backflow in high vacuum ranges at pressures of lower than 50 kPa, and to prevent noise and drops in pumping speed.

DIMENSIONS, WEIGHT, AND MOTOR



Cat. No.	Flange*1			Dimensions (mm)					Weight*3 (kg)	Motor (kW) ／ Max. rpm	
	Suction	Discharge	Function liquid	A	B	C	D	E*2		Vacuum application	Compression application
BL-13	65	65	15	60	95	104	120	1475	180	7.5～11kW/1750rpm	7.5～15kW/1750rpm

*1 : 10K thin flange with stud bolts, conforming to JIS 10K equivalent. The flanges for suction, discharge, and function liquid require sufficient space around the piping and a short spacer pipe for disassembly and assembly.

*2 : Dimension when the largest possible motor is used.

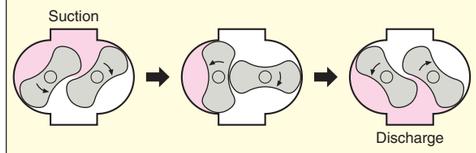
*3 : The motor weight is not included.

Accessories : Separators, heat exchangers, demisters, check valves, etc., are provided as required. (For vacuum applications)

MECHANICAL BOOSTER PUMP [BM-SERIES]

PSZ parts

Principle of Operation



The two-lobe rotors are fixed to two parallel shafts and are rotated in opposite directions simultaneously by a timing gear. The gas taken in from the suction nozzle is enclosed in the space between the stators and rotors and is continuously expelled from the discharge nozzle.
(Roots-type pump structure)

FEATURES

Superior evacuation performance

It is possible to connect a liquid ring vacuum pump or other rear stage pump and configure an economical vacuum pump system that improves the pumping speed of the entire system, in particular for high vacuum ranges where the pumping speed of the rear stage pump declines. Improved part machining accuracy minimizes leakage from the seal parts between the rotor and stator, and the use of an internal cooling water jacket reduces heating caused by adiabatic compression, resulting in superior evacuation characteristics.

Utilizing the superior characteristics of PSZ

Using ceramics and PSZ in all gas-contacting parts ensures superior corrosion resistance and is ideal for pumping of gases containing chlorine-based organic substances and organic solvents.

Because PSZ is extremely strong, the pump can be made more lightweight and compact, and can operate at high speeds.

Capable of dry evacuation

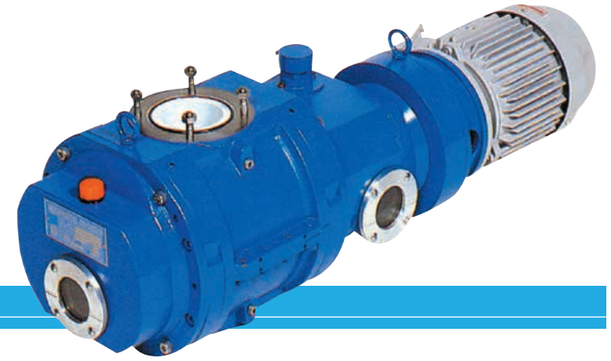
The special shaft seal structure and lack of sliding parts make it possible to perform dry evacuation with no oil back diffusion into the vacuum system.

Ability to start from a low vacuum range

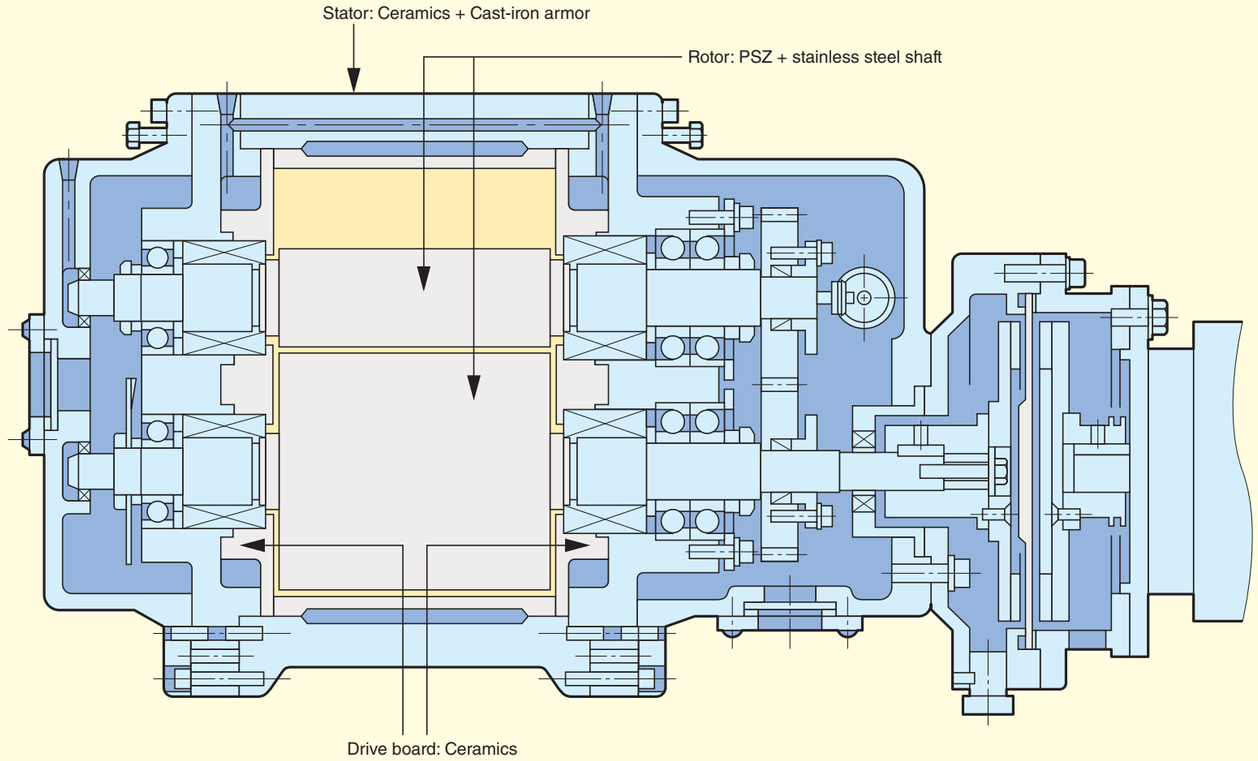
Hysteresis magnetic coupling is used between the motor and pump, and slipping of the magnetic coupling reduces overload on the pump side. This makes it possible to start from 4.0 kPa shortening the evacuation time and allowing a simple vacuum pump system configuration without bypass pipes, cut-off valves, or pressure switches.

Complete seal structure

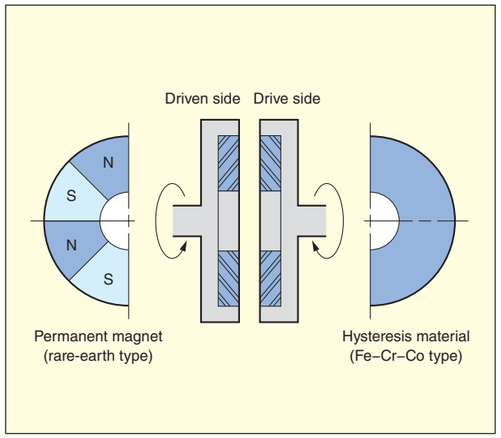
Non-contact seals with no sliding parts are used, simplifying maintenance of the shaft seal and extending the pump lifetime.



CONSTRUCTION AND MATERIALS



HYSTERESIS MAGNETIC COUPLING



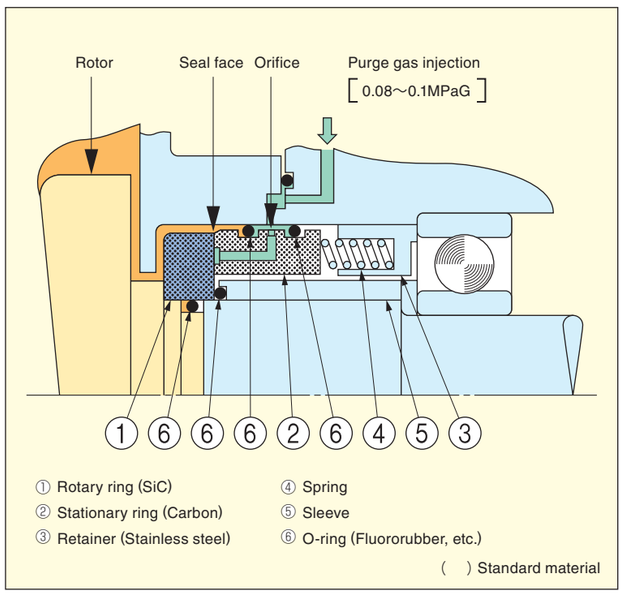
The hysteresis magnetic coupling is configured as shown in the figure at left. The coupling transmits torque by means of the hysteresis characteristics of the hysteresis material magnetic poles that are induced by the magnetic force of the magnet.

Unlike an ordinary magnet-magnet coupling, slipping occurs when torque above a certain level is applied to the driven side of this coupling, and it recouples when the overload is eliminated. This is effective in the following circumstances:

- Preventing damage when a foreign object is caught in the rotor
- Preventing motor overload when starting the pump from a low vacuum range

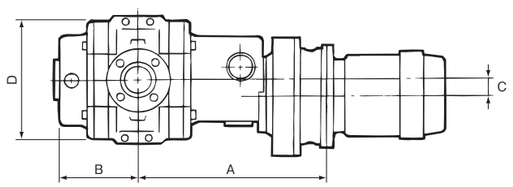
SHAFT SEAL

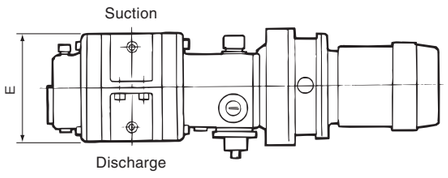
The non-contact gas seal offers maintenance-free operation. This fully floating construction is achieved by a static-pressure effect provided by purge gas supplied from the outside, and a dynamic-pressure effect generated by the spiral grooved rotating ring.



Sealing parts

DIMENSIONS, WEIGHT, AND MOTOR



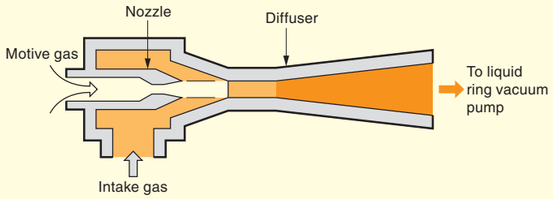


Cat. No.	Flange*1	Dimensions (mm)					Weight*2 (kg)	Motor (kW)	Max. rpm
		A	B	C	D	E			
BM-16	80	423	200.5	46	302	280	140	2.2	3500

*1 : JIS vacuum flange equivalent with tapped holes
*2 : Includes motor weight.
Accessories : Filter regulator for purge gas and oil filter

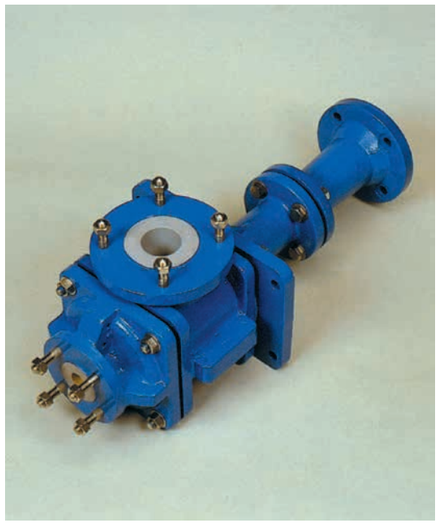
GAS EJECTOR [JL-SERIES]

Principle of Operation



When the liquid ring vacuum pump starts, the gas ejector pressure decreases, and the motive gas (usually air or discharge gas from the liquid ring vacuum pump) passes through the nozzle at supersonic speed and jets into the diffuser.

The intake gas mixes with the motive gas that was sucked into the diffuser. At the end of the diffuser, the energy is converted from speed to pressure, and the gases are suctioned into the liquid ring vacuum pump.



FEATURES

Improving the degree of generated vacuum

By connecting the gas ejector to the suction side of a liquid ring vacuum pump, it is possible to achieve vacuum without exceeding the vapor pressure of the function liquid and without the use of steam, compressed air, or other special drive source.

Examples of ultimate vacuum

Suction side of the liquid ring vacuum pump using 20°C water as the function liquid	➡ Approx. 8.0 kPa
Suction side of the gas ejector when a gas ejector is connected under the conditions above	➡ Approx. 0.93 – 1.6 kPa

Preventing cavitation in the liquid ring vacuum pump

When a gas ejector is connected to the suction side of a liquid ring vacuum pump, the liquid ring vacuum pump suction side will not reach high vacuum of higher than 8.0 – 12.0 kPa, regardless of the degree of vacuum in the suctioned system.

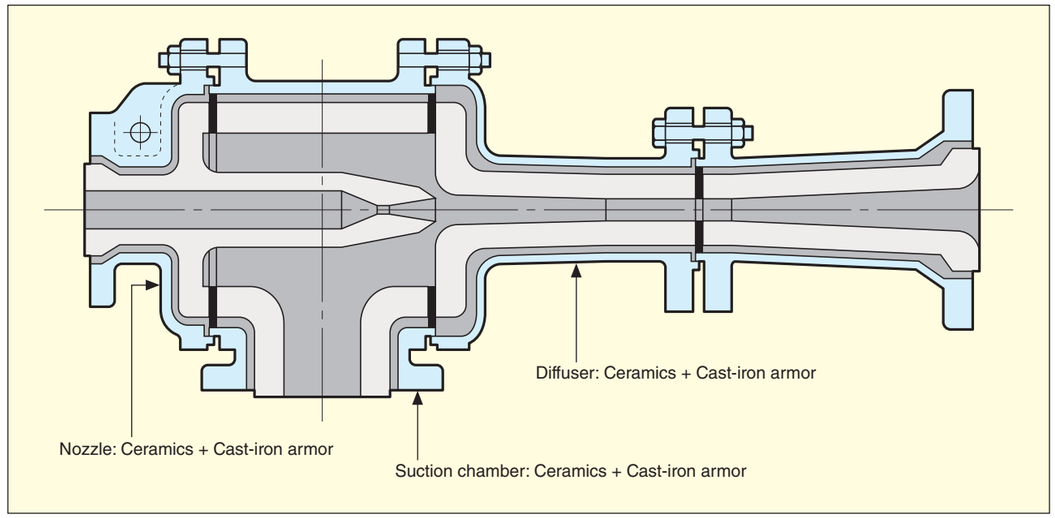
Consequently, this can prevent cavitation which occurs as the vapor pressure of the function liquid approaches the pump degree of vacuum, preventing cavitation damage to vacuum pump components and reducing operating noise.

Superior corrosion resistance

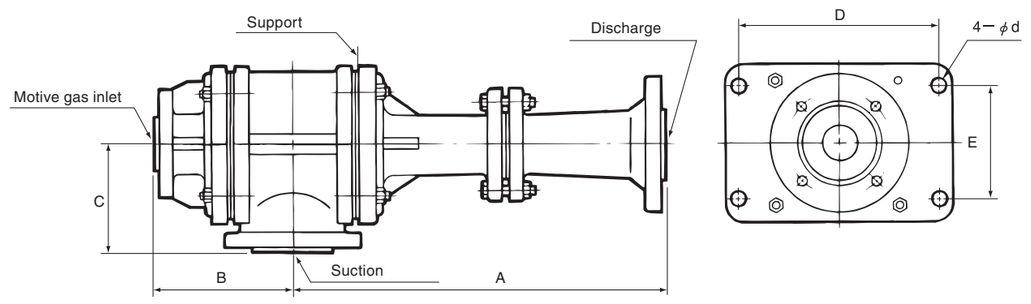
Alumina ceramic with superior corrosion resistance is used for the parts that contact the gas.

This not only provides excellent corrosion resistance, but also makes it possible to use the discharge gas from the liquid ring vacuum pump as the motive gas, preventing the intrusion of other gases into the suction gas.

CONSTRUCTION AND MATERIALS



DIMENSIONS AND WEIGHT



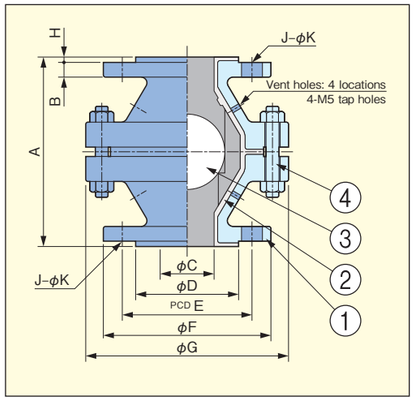
The above drawing shows the JL-1010 type.

Cat. No.	Flange*1			Dimensions (mm)						Weight (kg)
	Motive gas	Suction	Discharge	A	B	C	D	E	ϕ d	
JL-1008	25	50	40	285	155	120	230	130	15	32
JL-1010	25	50	50	425	155	120	230	130	15	36

*1: JIS 10K flange thin type equivalent.
The motive gas flange and suction flange have tapped holes, and the discharge flange has drilled holes.

AUXILIARY EQUIPMENT

BALL CHECK VALVE



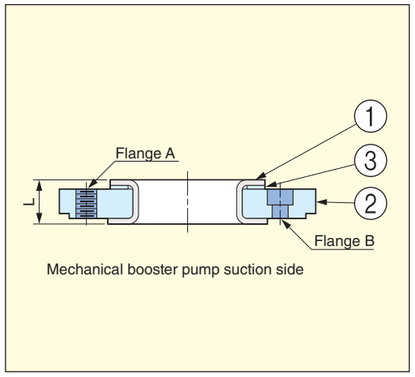
Used to prevent backflow of the function liquid to the evacuated vacuum system when the BL type liquid ring vacuum pump is stopped.

	Parts	Material
①	Valve chamber	FCD-S
②	Liner	PFA
③	Ball	PTFE
④	Stud bolt, nut	SS400

Cat. No.	Size	A	B	ϕC	ϕD	PCD.E
JO-00304-SE	50A	178mm	16mm	50.8mm	95mm	120mm

Cat. No.	ϕF	ϕG	H	J – ϕK	Weight (kg)
JO-00304-SE	155mm	188mm	3.1mm	4–19mm	14

CONVERSION FLANGE



Mechanical booster pump suction side

Used to connect the suction flange of a BM-series mechanical booster pump (JIS vacuum flange equivalent) to a JIS 10K flange.

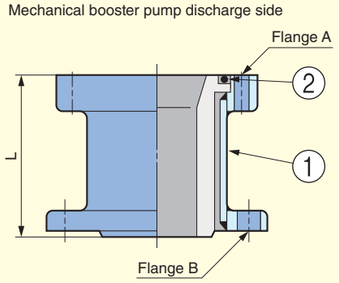
	Parts	Material
①	Liner	PTFE
②	Metal flange	SS400
③	Cushion	Joint sheet

Cat. No.	L (mm)	Flange A*1	Flange B*2
BMTH-16	25	80mm	80mm

*1 JIS 10K flange thin type equivalent with tapped holes
*2 JIS vacuum flange flat type VF series (no gasket groove) equivalent

ADAPTER

Mechanical booster pump discharge side



Used to connect the discharge flange of a BM-series mechanical booster pump (JIS vacuum flange equivalent) to a JIS 10K flange.

	Parts	Material
①	Adapter	Ceramics + SS400
②	O-ring	FKM

Cat. No.	L (mm)	Flange A*1	Flange B*2
BMT-16-A	150	80mm	65mm

*1 JIS vacuum flange flat type VG series (with gasket groove) equivalent
*2 JIS 10K flange thin type equivalent with drilled holes

SPECIFICATIONS FOR SELECTING

For selection, please specify the following items in as much detail as possible.

1. Process outline with flowchart

2. Pump performance

2 - 1 Pressure

- Vacuum application
  Degree of design vacuum and ultimate vacuum [kPa]
- Compression application
  Design discharge pressure and suction pressure [kPa, MPaG]

2 - 2 Pumping speed

- Required pumping speed for each gas type [m^3/h, gas type and kg/h]
- Evacuation time
  Required time to reach ultimate vacuum [min]
  System volume [m^3]

2 - 3 Operation time

- Continuous or intermittent

3. Gas specifications

- Type, specific heat, boiling point, and corrosive, explosive, crystallizing and condensation properties (For a mixed gas, indicate the specific heat, boiling point, and other properties of the mixture.)
- Inlet gas temperature
- Material used for gaskets and O-rings (PTFE, FKM, FFKM, Kalrez, etc.)

4. Attached equipment

- Necessary range of instrumentation

5. Utilities

- Frequency and voltage of power supply
- Cooling medium for heat exchanger
  (brine, industrial water, or other, and its temperature)
- Function liquid
  Water or specified chemicals (for specified chemicals, their specific gravity, viscosity, specific heat, heat conductivity, and vapor pressure)
  Open or closed circulation