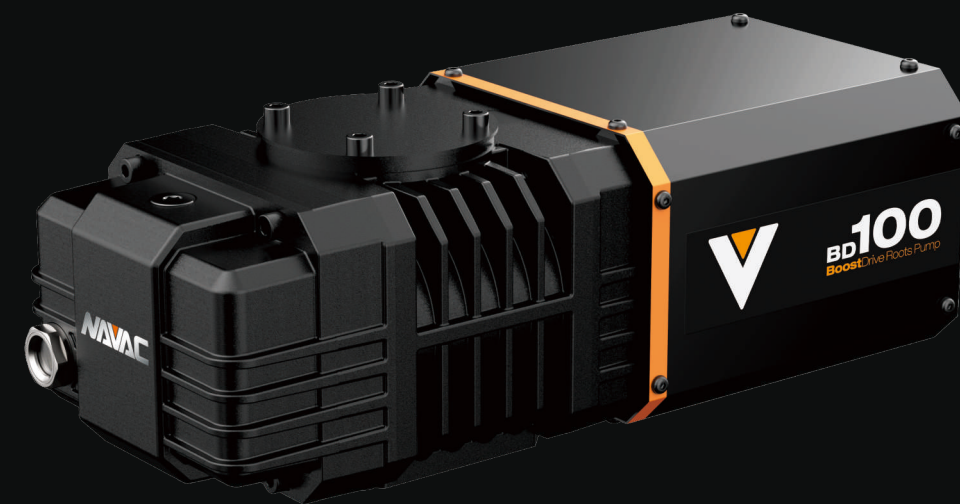




Empowering you to work smarter

BoostDrive Vacuum Pump Operating Manual



Failure to follow warnings could
result in death or serious injury.

**SAVE THIS MANUAL
FOR FUTURE REFERENCE**

NAVAC Inc.
www.NavacGlobal.com
Tel/Fax: +1 877 MY-NAVAC
877 696 2822
MADE IN PRC

Contents

1. Use information1

2. Attentions2

3. Reception and Storage4

4. Description5

 4.1 Characteristics of BD5

 4.2 Application5

 4.3 Function6

5. Technical Parameters7

 5.1 Technical parameters Table7

 5.2 Pumping speed characteristics7

6. Installation & Wiring8

 6.1 Dimensions8

 6.2 Transportation11

 6.3 Installation11

 6.4 Power Supply & Rotation Direction12

 6.5 System Wiring13

7. Operation14

8. Maintenance15

 8.1 Daily Maintenance Method15

 8.1.1 Oil Change16

 8.2 Daily Maintenance Schedule16

9. Troubleshooting17

10. Warranty19

11. Supplied Equipment 19

12. Main Parts of BD Roots Pump20

 12.1 Breakdown Drawing of BD100 Pump20

 12.2 Breakdown Drawing of BD300 Pump22

 12.3 List of Quick-wear Parts for BD Series Roots Pump24

Use Information

Dear users,
thank you for your trust and support! Welcome to use our BD high-reliability roots vacuum pump (the Product) and we will offer you high-quality services wholeheartedly. Please check if the product received is consistent with the order, the accessories and operation instructions are intact and there's damage during transport. For any problems, please feel free to contact our Business Dept. or local dealer in time.
Please read the Instructions carefully prior to installation, running, inspection or maintenance, in order to master the Product's safety contents, technical parameters and operation methods, and ensure long-term and reliable running.

 Warning

Failure to observe the terms could result in serious personal injury.

 Notice

Failure to observe the terms could result in damage to the pump.



This warning label indicates risk of electrical shock. Disconnect the pump from the power supply before beginning with connections, repair and maintenance. Make sure the cover of junction box is properly installed before running.



This warning label indicates high temperature hazard. Do not touch the pump when the pump is in operation.

 Notice

Read the operating manual carefully and follow the operating procedures. We reserve the right to modify the design and technical data of the pump without notice which may have discrepancies in the manual. Add vacuum oil as requested before starting the new pump.

Attention

In order to ensure the personal safety, read the operating manual carefully before installation, operation, repair and maintenance.

 Warning

- 1). Make sure the Product is grounded effectively. Make sure to connect it to the motor protection switch of rated value prior to startup.
- 2). The power supply used must be consistent with the Product's marked power supply. The power supply must be connected correctly by certificated electricians according to the technical standards and wiring regulations of power equipment.
- 3). The exhaust port must be kept unobstructed before running the Product. The air flow of export port shall not be blocked or restricted in any means.
- 4). Make sure to cut off power supply prior to pump installation and reparation, to avoid personal casualties due to electric shock or accidental activation of pump.

- 5). It is forbidden to pump toxic, corrosive, inflammable and explosive gas.
- 6). It is forbidden to use the Pump near explosives and inflammables, in order to avoid explosion or fire hazard.
- 7). Do not touch the Pump and motor when it is running or immediately after stop in order to avoid scald, for the pump is still hot.

! Notice

- 1). The Pump's ambient temperature is 5-40 °C.
- 2). Do not put obstacles near the motor, to avoid scald or fire hazard due to abnormal temperature rise.
- 3). The power supply used must be consistent with the Product's marked power supply.
- 4). Make sure to check the oil level of pump prior to operation. Do not use the Pump if it has insufficient or no oil; otherwise, pump failure may occur.
- 5). Check if the Pump has oil leakage to avoid slip of operators due to leaked oil.
- 6). The waste oil and other parts should be disposed according to the relevant regulations of environmental protection.
- 7). The relevant accessories should be installed to pump the gas with small amount of dust or condensable gas.

Pump Acceptance & Storage

3.1 Pump Acceptance

Upon receiving the Product, unpack it and check if:

- The Product is consistent with your order;
- The accessories (including pump oil for single use and optional parts) are equipped as contracted;
- There's damage during transport;
- The bolts (screws) or nuts are loose or falling during transport.

3.2 Pump Storage

The Pump must be stored at the following conditions to ensure its stable and reliable running:

- Ambient environment of storage:
 - 1) There's no corrosive, inflammable and explosive gas;
 - 2) The Pump must be placed indoors;
 - 3) Avoid direct sunlight;
 - 4) Keep way from heat sources;
 - 5) Be protected against dust;
 - 6) Be free from condensation.

! Notice

Please place the Pump horizontally and protect it against impact; otherwise, the Pump can be damaged.

Product Overview

As a high-speed directly-connected vacuum pump, the Product has been designed with a sealed and compact structure and smooth appearance.

The Product is featured by reasonable structure, high safety and reliability, fast vacuuming, high ultimate vacuum degree, low noise, easy maintenance and no oil leakage.

The Product's cavity is mounted with one pair of double-blade rotors which can have reverse and high-speed rotation simultaneously, and two rotors may inhale and exhaust air during operation; the Product can be used as booster pump, for the gas module has long free path, the gas may encounter high resistance when passing the small gap if the Product is working under low pressure intensity, in order to acquire high vacuum degree and compression ratio. Note: The Product should not be used alone, but be in serial connection with the backing pump, as shown in picture below:

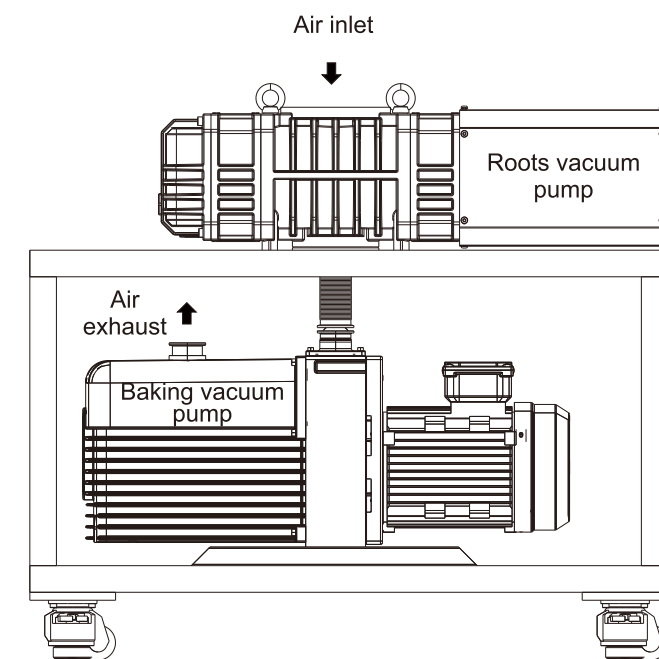


Fig. 1 Schematic Diagram of BD Series Roots Vacuum Pump

4.1 Characteristics of BD Pump

- The Pump's one pair of rotors are designed and processed by fully ensuring symmetry, and in compact structure and occupy a small area with the characteristics of high speed, small volume, light weight and small vibration.
- Based on fast startup, the Product can reach the ultimate vacuum degree in a short period, avoid compression in pump cavity, in order to eliminate condensable gas;
- Certain clearance is reserved between rotors and between rotor and pump cavity, to avoid contact and friction, and ensure low power consumption and good energy conservation;
- As no oil lubricating is required in pump cavity, it can eliminate the pollution of vacuum system due to oil steam and become insensitive to fine dust.

- Featured by stable vacuuming speed within the pressure intensity of $1.3 \times 10^3 \sim 1.3 \text{ Pa}$, the Pump can quickly exhaust any suddenly released gas, eliminate the weaknesses of oil-sealed vacuum pump and diffusion pump; so, it is suggested to use it as a booster pump; Fitted with sealed motor structure on the basis of static seal, the Product can prevent oil leakage of shaft seal;
- Different backing pumps can be selected based on the Product's characteristics and use conditions It can be matched with VRD/VSV series vacuum pumps when pumping large amount of vapor, small amount of dust and slightly corrosive gas under a relatively low vacuum degree. We can design different rooster pump vacuum units based on the requirements and use conditions of vacuum equipment of users.

4.2 Scope of Application

As a kind of basic vacuum equipment in the field of vacuum application, the Product is widely applied in the industries such as chemistry, food, medicine, smelting, coating and refrigerating.

4.3 Structure & Principle

The Product's working principle is as shown in picture below:

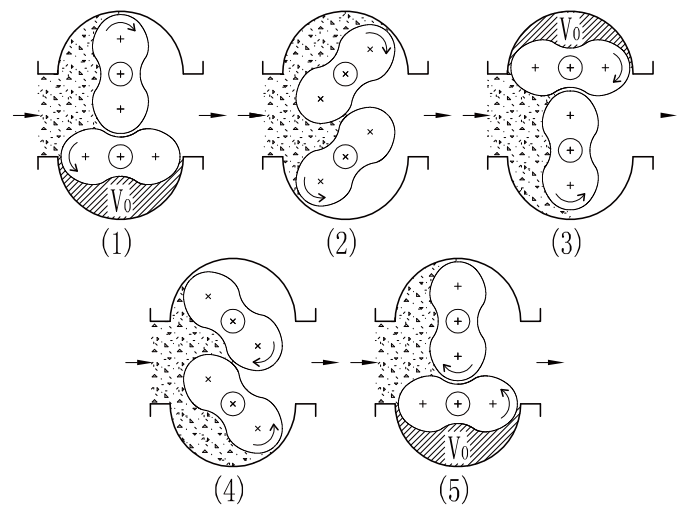


Fig. 2 Schematic Diagram of Working Principle

While the Product is running, gas from the vacuumed container will enter the Product's cavity, and the mixed gas in V_0 will be surrounded and has no compression and expansion. Along with the rotation of rotor, gas at pump exhaust port will spread to the space and pumped by the backing pump due to differential pressure when the rotor top reaches the edge of exhaust port. More gas will be sent to the exhaust port and pumped out by baking pump along with the continuous rotation of rotor, and this is the effect by volume of pump; when inlet pressure intensity of pump is very low, but the pump revolving speed is as high as 2,840 r/min, the linear speed at rotor surface is close to the thermal motion velocity of molecular, the gas that has collision with rotor will be carried by rotor to the exhaust port with high pressure intensity, so the gas will be pumped out by backing pump. The above is the principle of molecular action. Based on the combined effects of both principles, the Product may enjoy fast and stable vacuuming within the range of $1.3 \times 10^3 \sim 1.3 \text{ Pa}$.

Technical Parameters

5.1 The technical parameters are as shown in Table 1

Model		BD100	BD600
Pumping rate	m^3/h	160	600
Ultimate pressure	Pa	3.0×10^{-2}	3.0×10^{-2}
Max. allowed differential pressure	Pa	4.0×10^3	8.0×10^3
Backing pump (suggested)	/	VRD-30/48	VRD-90/VSV-100
Power supply (50Hz)	V	380	380
Power	kW	0.37	1.5
Rated speed	rpm	2880	2880
Oil viscosity	/	100	100
Oil capacity	L	0.65	0.6 (gear end)
			0.3 (motor end)
Air inlet	mm	$\phi 50$	$\phi 100$
Air outlet	mm	$\phi 50$	$\phi 63$
Ambient temperature	$^{\circ}\text{C}$	5-40	5-40
Noise	dB	62	63
Weight	lbs	50.7	218.2
Dimensions (L*W*H)	in	19.4x8.3x6.3	30.7x11.2x8.5

Table 1 Technical Parameters

5.2 Pumping Rate

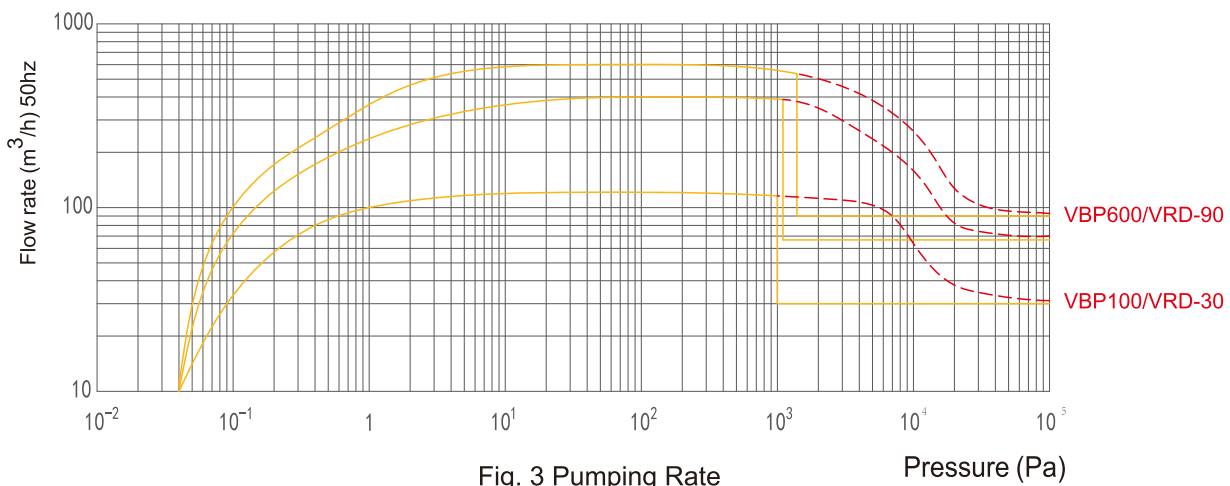


Fig. 3 Pumping Rate

Installation & Wiring

6.1 Installation Dimensions

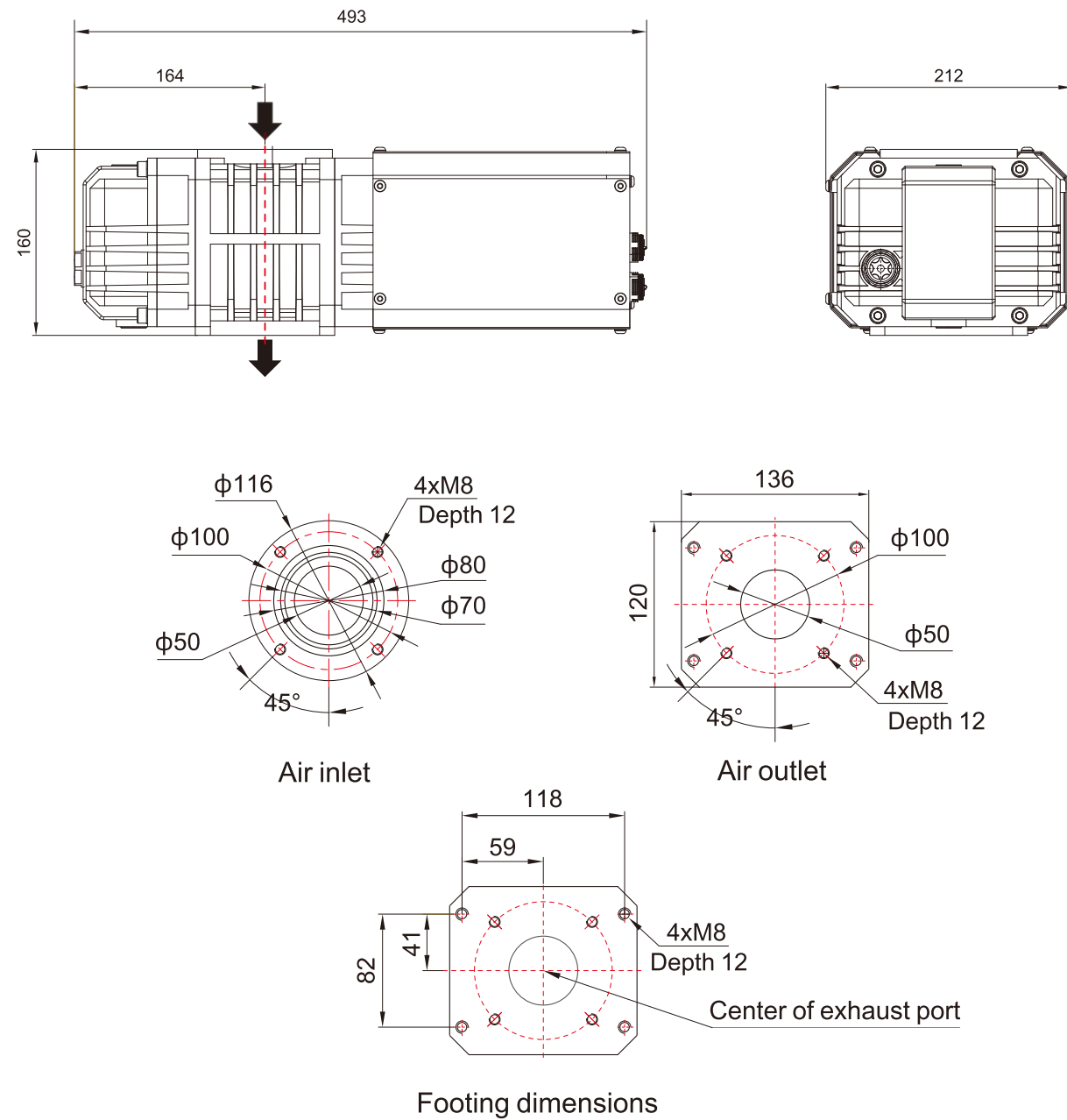


Fig. 4 Dimension Drawing of BD100 Roots Pump

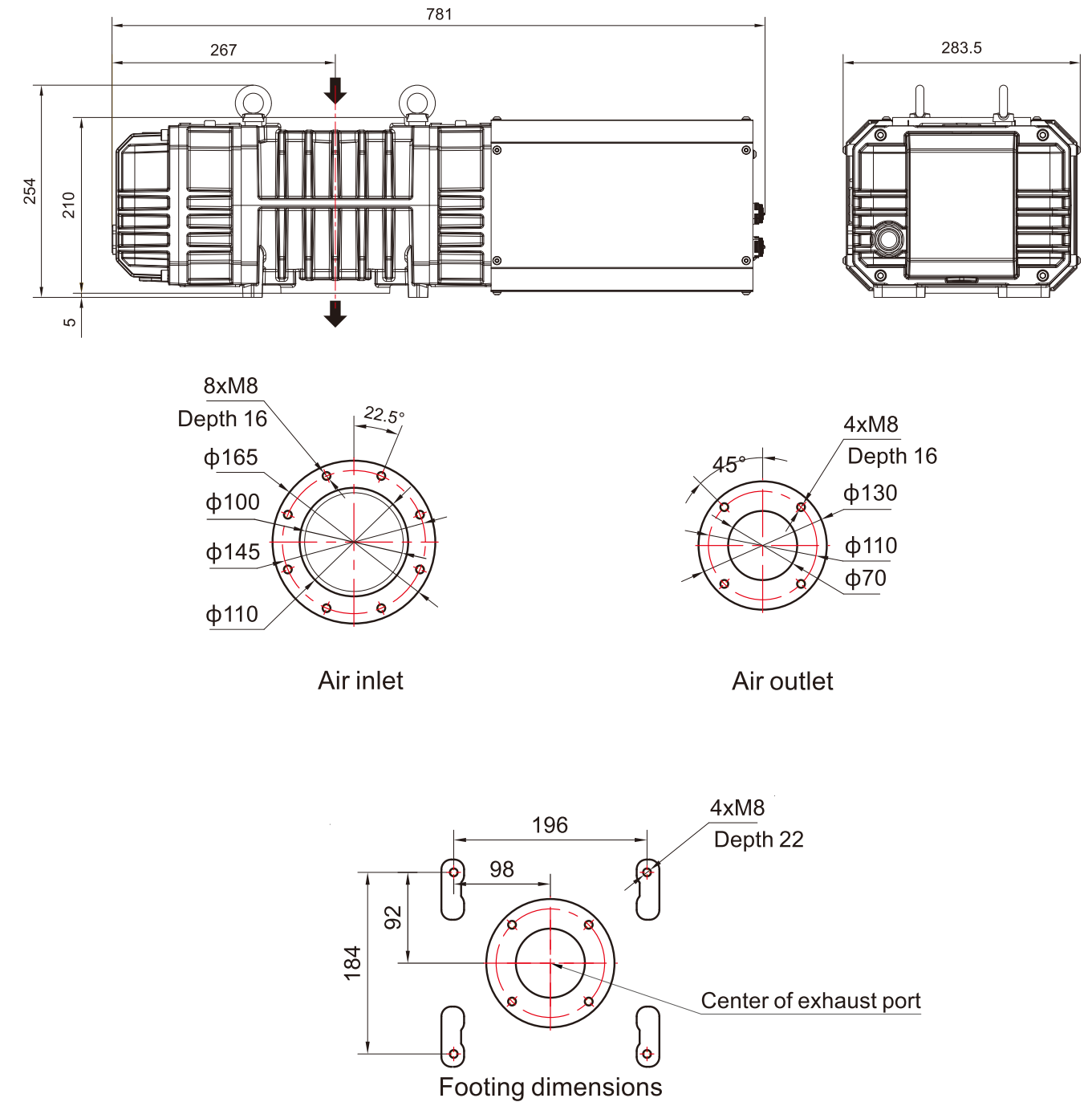


Fig. 6 Dimension Drawing of BD600 Roots Pump

6.2 Handling

Please handle the Product with care, for any negligence may lead to damages of the Product.

Warning

- 1). Do not relocate the Pump until it is stopped and powered off.
- 2). Check if the Pump has any oil leakage to avoid slip of operators due to leaked oil.

Notice

The Pump must be hoisted through the lifting bolts on it.

6.3 Installation

Notice

The Pump should be installed in well-ventilated places where installation, maintenance, dismantling and wiring can be done easily.

Warning

- 1). It is forbidden to use the Pump near explosives and inflammables, in order to avoid explosion or fire hazard.
- 2). Do not put obstacles near the motor, to avoid scald or fire hazard due to abnormal temperature rise.

Notice

- 1). The Pump must be installed in clean places. Its air inlet should be installed with anti-dust devices as required.
- 2). The pump footing can be placed on ground horizontally, or be connected through bolts when connecting the Pump to the vacuum system.
- 3). Please install the Pump stably and firmly within the horizontal degree of 10°; otherwise, the inclined installation may lead to pump vibration, increased noise and even damages.
- 4). The Pump should be used in the places with ambient temperature of 5-40°C and moisture not above 85%. Please increase the ambient temperature properly if it is below 5°C; otherwise, it may lead to increase of oil viscosity and startup difficulty.

6.4 Power Supply & Rotation Direction

Warning

The power supply used must be consistent with the Product's marked power supply. The power supply must be connected correctly by the certificated electricians according to the technical standards and wiring regulations of power equipment. For 3-phase motor, measure the phase sequence U, V and W of incoming power supply clockwise, then connect them as shown in Fig. 5 and 6.

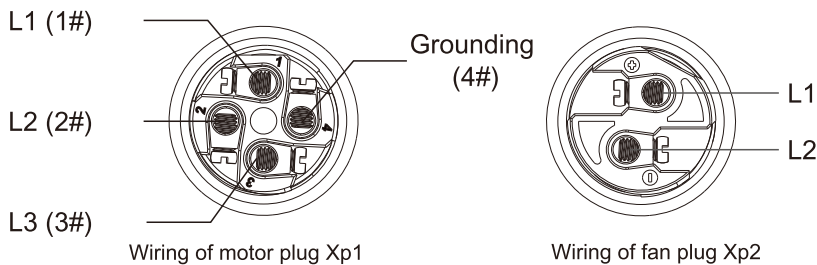


Fig. 7 Wiring of 3-phase Motor

Definition of 3-phase power cable:

1. Phase A line: Also known as Line L1 or Line U;
2. Phase B line: Also known as Line L2 or Line V;
3. Phase C line: Also known as Line L3 or Line W;
4. Grounding line: Also known as Line PE.

When the Product is used for the very first time, make sure to disconnect the air exhaust pipe, open the air inlet of roots pump, connect the Product's power supply according to sequence in Fig. 5, conduct short-term inching of the Pump's starting power supply, check if rotor blade direction is consistent with the arrow direction on the Pump; if the direction is not inconsistent, cut off power supply immediately, exchange two phase wires (any 2 wires of U, V and W) to correct the rotation direction of motor.

- It can be matched with a frequency converter to better improve pumping rate and overpressure protection capability;
- It is suggested to use the specific frequency converter of NAVAC to ensure reliable performance;
- The frequency converter from different suppliers should be recognized by NAVAC prior to use.

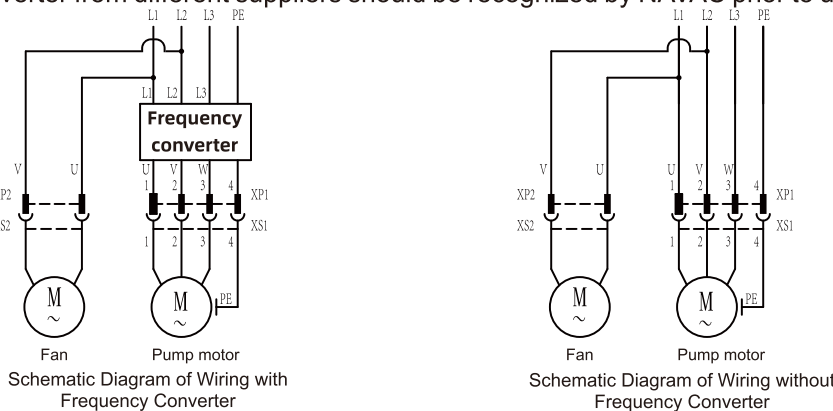


Fig. 8 Schematic Diagram of Wiring



Notice

“XP”: Plug; “XS”: Socket; the wiring must be performed according to the sequence of Fig. 6, for wrong wiring may lead to electrical safety accident.

6.5 System Wiring

The BD series pump is connected to vacuum system through flange, the size of which should be confirmed carefully. The Product must be fitted with a vacuum fore pump as the backing pump instead of being used independently. If oil-sealed mechanical vacuum pump is used as backing pump, it should not be used for pumping explosive gas that has high oxygen content, has corrosion to ferrous metal, chemical reaction to vacuum oil and contains dust; otherwise, the service life of backing pump can be shortened.

Wiring of vacuum system:

- It is recommended to install a hole (metal corrugated pipe) to the connection pipeline between the Product and the backing pump; the pipe should be as short as possible, have few joints and bends; the pipe diameter should not be less than that of pump;
- The pipe that connects the Product and vacuum system should be as short as possible;
- The pipe that connects the Product and vacuum system should have consistent diameter with the air inlet. Inspect the filter screen of air inlet regularly and keep it clean;
- The connection pipe of pump exhaust port should have a consistent diameter with the exhaust port;
- Carry out leakage inspection to the position where pipe and flange are connected. Good vacuum airtightness is crucial for the Product to reach the ultimate pressure;
- It is recommended to install vacuum valve to the Product's air inlet pipe, in order to maintain vacuum state of pump cavity when the pump is stopped.



Warning

Do not use blocked or narrow exhaust pipe. Make sure to open the baffles or similar block devices in the exhaust pipe, avoid blockage of exhaust pipe due to sediments prior to start of the Product.

Initial Startup & Functioning

7.1 Functioning

Inspection prior to functioning:

- The Product's exhaust port must be smooth. Do not start the Product when the exhaust port is blocked;
- Check if the motor revolving direction conforms to the requirements;
- Check if the motor is grounded effectively;
- Check if motor power supply is consistent with the voltage and frequency on nameplate;

Functioning without frequency converter:

- Start the backing pump;
- Open the Product's air inlet valve;
- The Product's allowed starting pressure, which depends on the proportion between the roots valve and backing valve, can be calculated according to the following formula:

Entrance pressure P entrance at startup of pumps≤
$$\frac{P_{\text{max.}} \text{ (max. allowed differential pressure of pump)}}{\text{Pumping rate/pumping rate of backing pump} -1}$$

Example : VBP100 / VRD30, $P_{\text{in}} \leq \frac{4000}{160/30-1} = 923 \text{ Pa}$

- Check if the Product has stable running and rotor is free from collision sound; otherwise, stop the Product immediately for inspection;
- For any fault, such as local temperature rise, sudden current change and irregular noise during functioning, stop the Product immediately for inspection.

Functioning with frequency converter:

- The roots pump can be started at the atmosphere, but the startup and acceleration period vary along with the size of container. The frequency converter can improve the speed and bring certain overload protection capability.
- Start the backing pump;
- Open the air inlet valve of pump;
- Check if the Product has stable running and rotor is free from collision sound; otherwise, stop the Product immediately for inspection;
- For any fault, such as local temperature rise, sudden current change and irregular noise during functioning, stop the Product immediately for inspection.

Stop running:

- Close the air inlet valve on air inlet pipe firstly;
- Close the roots vacuum pump;
- When the roots vacuum pump is stopped, close the backing pump.

Long-term idling of pump:

- Close the air inlet valve on air inlet pipe firstly;
- Close the roots vacuum pump;
- When the roots vacuum pump is stopped, close the backing pump.
- Disconnect the water and electric circuit; disconnect the air inlet pipe if necessary, cover the air inlet with cover plate against dust and moisture.

Inspection & Maintenance

Warning

- 1). Make sure to cut off power supply prior to inspection. Do not connect power supply during inspection; otherwise, personal injury may occur.
- 2). Make sure the Product is cooled completely prior to inspection in order to avoid scald, for the product is still hot after stop.

8.1 Daily Maintenance Method

Warning

- 1). Make sure to lubricate all parts regularly, replace the oil in time when oil is deteriorated or becomes dirty and ensure good sealing, in order to guarantee good performance and long life.

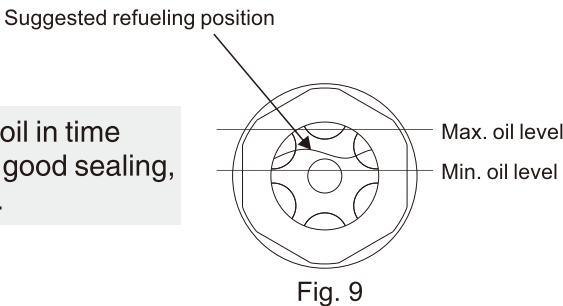


Fig. 9

- 2). The lubricating liquid should be maintained within the range of MAX – MIN while the Product is running. Please add oil when it is below the MIN oil level, or open the oil drain plug to drain the excessive oil if the oil level is above the MAX oil level.

Notice

Observe the pump oil color and it should be clean and transparent. Please replace the oil when it becomes dark or turbid.

Warning

Confirm the hazard properties and follow the relevant safety regulations if hazardous substances exist. If the potential hazards remain, make sure to do pollution treatment to the Product before running it.

Notice

Do not replace oil while the Product is hot. The Product must be lower than 50°C and wear proper protective clothes before oil is replaced.

8.1.1 Oil Replacement

- Open the oil drain plug, drain the used oil into a proper container, then fasten the oil drain plug when oil flow stops;
- Fasten the oil drain plug (check the O-ring and replace it in case of damage);
- Open the oil drain plug, inject fresh oil, keep the oil level within the MAX ~ MIN range of oil indicator, or at the upper level of oil cup; then fasten the oil drain plug or close the seal cover.

Notice

Make sure the Product is powered off and motor is not hot before replacing the oil.

8.2 Daily Maintenance Schedule

Inspection Contents	Operation & Test	Maintenance Frequency	Remarks
Inspection of lubricating oil level	Do visual inspection to the oil level	For every 3 days	Please fill oil when oil level is lowered
Inspection of lubricating oil color	Do visual inspection to see if pump at oil observation window has abnormal color	For every 3 days	The oil should be clean and transparent. If oil becomes dark, please replace it by referring to 8.1.1
Inspection of pump sound	Check if there's abnormal sound	For every 3 days	For any abnormal sound or high noise, please refer to IX Fault Analysis
Inspection of pump vibration	Check if there's excessive vibration	For every 3 days	Check if pump footing and foundation bolts are loose
Inspection of pump temperature	Measure the pump temperature with a thermometer	Weekly	Check if the fan of pump and motor has sediments; if so, please clean it.
Inspection of air inlet filter screen	Check if there are foreign matters	Trimonthly	Remove the foreign matters and dry it with compressed air
First oil replacement	Do statistics of running period	500h after the first running	Refer to 8.1.1 for the oil replacement method

Table 2

Fault Analysis

Fault	Cause	Troubleshooting
Pump start failure	1. Power supply is disconnected	1. Inspect the power supply, switch and wiring conditions
	2. Input power supply has voltage error	2. Make sure voltage fluctuation is within the range of $\pm 10\%$ of rated voltage
	3. Motor failure	3. Replace the motor
	4. The ambient temperature is too low	4. Increase the ambient temperature
	5. The pump is blocked by a foreign matter	5. Repair the pump
	6. The pump body is rusted due to long-term idling, inhalation of water and organic solvents	6. Repair the pump
	7. The internal parts of pump are damaged	7. Repair the pump
The pump fails to reach ultimate pressure	1. The vacuum system configuration is improper, or the pump is too small	1. Reselect the pump
	2. The connected container or connection pipe has air leakage	2. Inspect and eliminate the air leakage
	3. Measurement method or gauge is improper	3. Please use the proper measurement method or gauge; measure the vacuum degree directly at the air inlet of pump
	4. Vacuum gauge is inaccurate or improper	4. Select proper vacuum gauge
Pumping is too slow	1. The air inlet pipe is blocked	1. Clean the air inlet pipe
	2. The air inlet pipe is too small or too long	2. Please use short and thick air inlet pipe
	3. Air exhaust pipe is unsmooth	3. Keep the air exhaust pipe smooth
	4. Air exhaust filter screen is blocked	4. Clean or replace the air exhaust filter screen

Fault	Cause	Troubleshooting
Pump has abnormal sound	1. Input power voltage is abnormal	1. Inspect the power supply, switch and wiring conditions
	2. Motor error	2. Make sure voltage fluctuation is within the range of $\pm 10\%$ of rated voltage
	3. The pump has foreign matters	3. Dismantle the pump for repairing and removing the foreign matters
	4. The oil level of pump is too low	4. Fill oil to proper level
	5. The internal parts of pump are damaged	5. Dismantle, repair and replace the parts
	6. The bearing has fatigue damage	6. Replace the bearing
	7. Rotor clearance is changed	7. Remove the gear for cleaning, reinstall it and adjust the clearance
	8. Gear has fatigue damage	8. Replace the gear
Pump temperature is too high	1. Pressure intensity between air inlet/outlet has high difference	1. Inspect the pressure of vacuum system
	2. Oil level of pump is too low	2. Fill oil as specified
	3. Temperature of pumped gas is too high	3. Install a cold trap at the air inlet
	4. Poor ventilation	4. Improve the ventilation environment
	5. The ambient temperature is too high	5. Reduce the ambient temperature
	6. Friction resistance is too high; the bearing or oil is polluted	6. Clean the bearing or replace the oil

Table 3

Warranty

The Product enjoys 1-year warranty since the date of procurement. For any fault of the Product within the warranty when used at normal conditions, the Company will offer maintenance services for free. The Company will offer paid services in any of the following cases:

- (1)The fault caused by natural disasters or human factors;
- (2)The fault caused by special operation environment;
- (3)Damage of sealing elements and quick-wear parts (see Table 2, 3 and 4);
- (4)The fault caused by misoperation or misuse according to identification of our technicians;
- (5)Please explain whether the pump is polluted or contains hazardous substances before returning it to the factory for maintenance; if the pump is polluted, please describe it in details; otherwise, the pump will be returned to the consigner if no pollution statement is provided.

Supplied Equipment

11.1 Standard Equipment

The supplied equipment includes standard pump, air inlet dust cover, sealing pads, motor plug, fan plug, excluding switch and power cable.

11.2 Accessories

Please use the attached accessories to keep the Product stable. Please provide the model of pump when placing an order.

- 1. Inlet vacuum filter
- 2. Inlet/outlet interface
- 3. Frequency converter
- 4. Vacuum gauge
- 5. Corrugated pipe
- 6. Other accessories

Note: The accessories are optional parts. For any demand for accessories, please contact us.

Main Parts of BD Roots Pump

12.1 The breakdown drawing of BD100 pump is as shown in picture below:

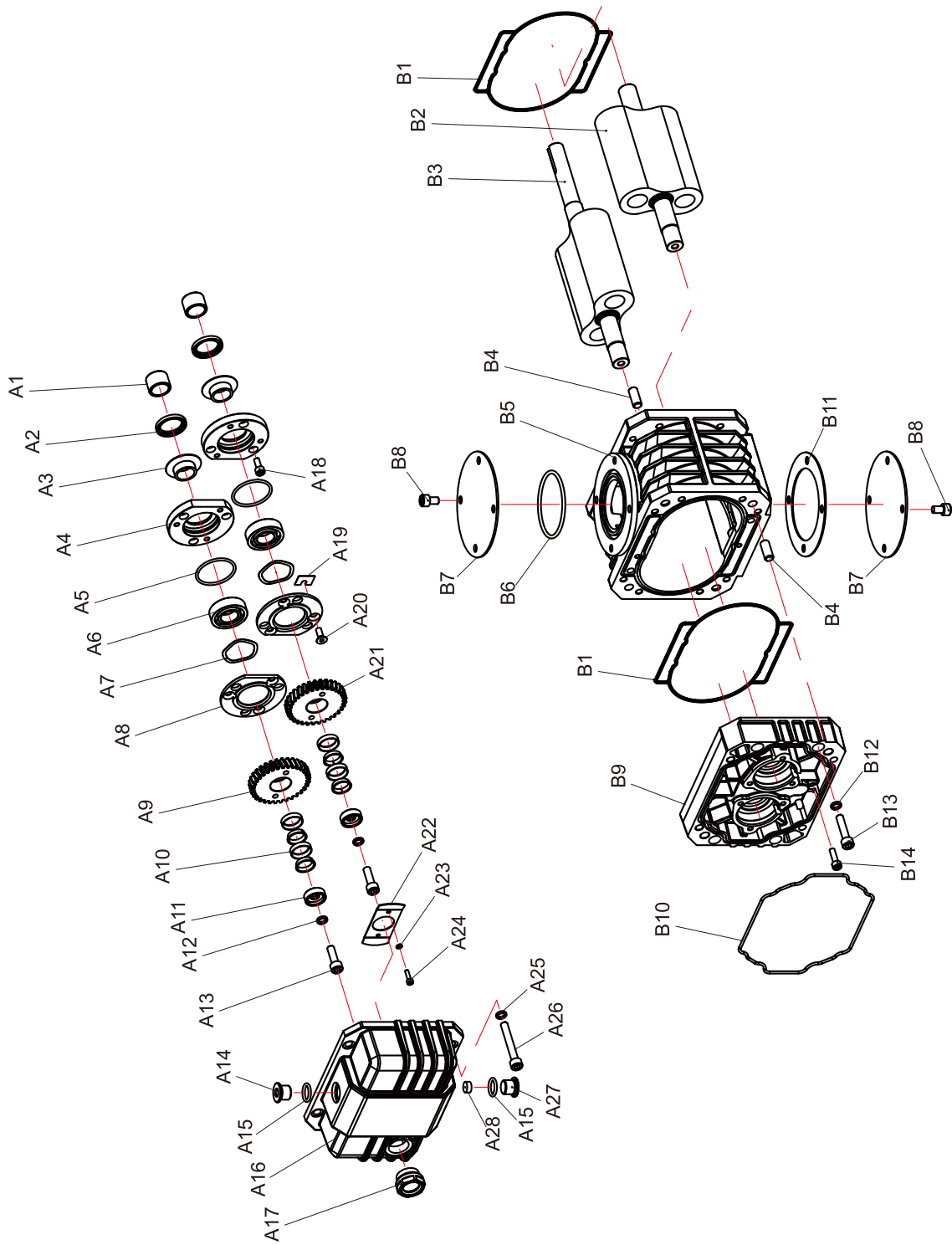


Fig. 10

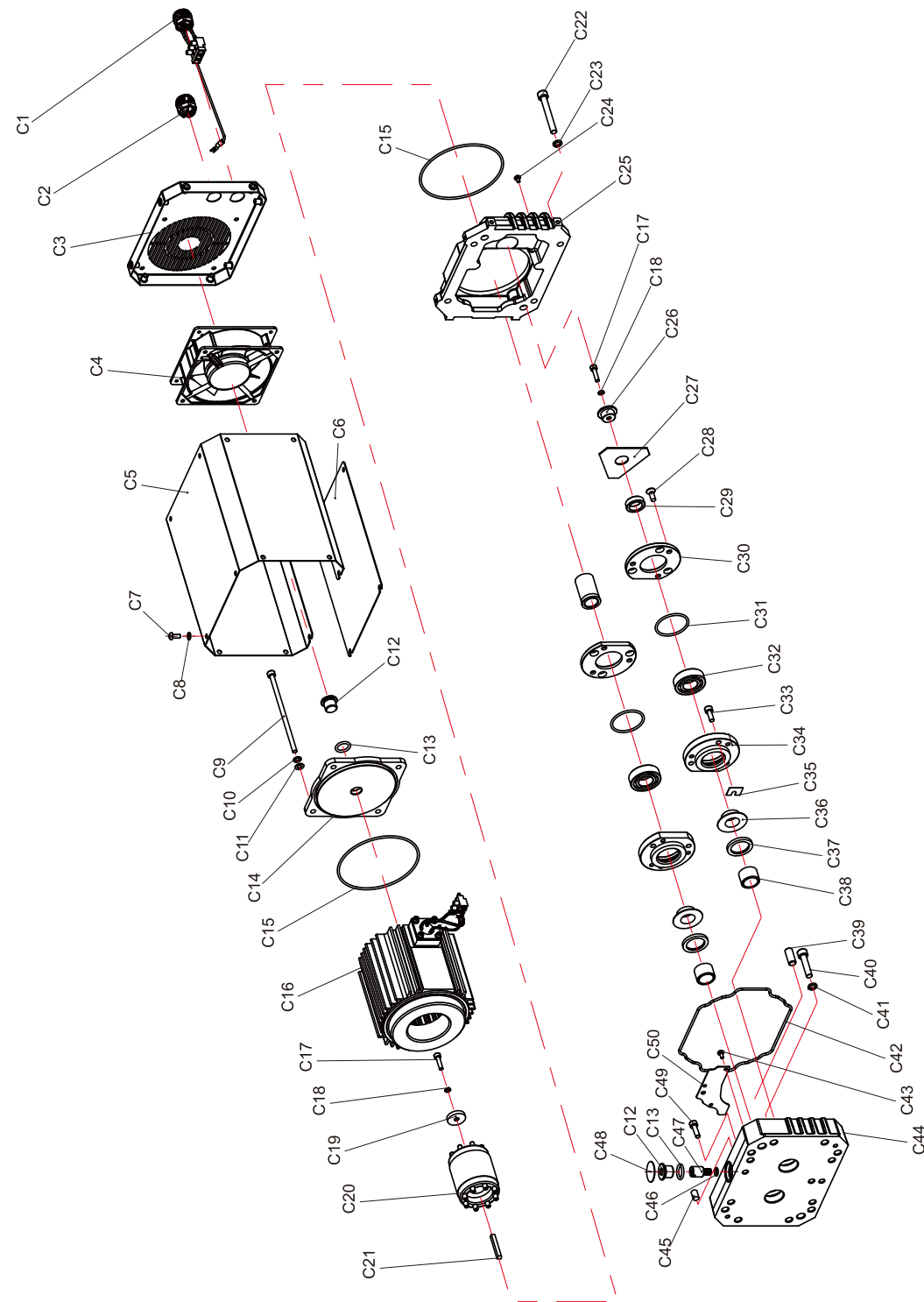


Fig. 11

12.2 The breakdown drawing of BD600 pump is as shown in picture below:

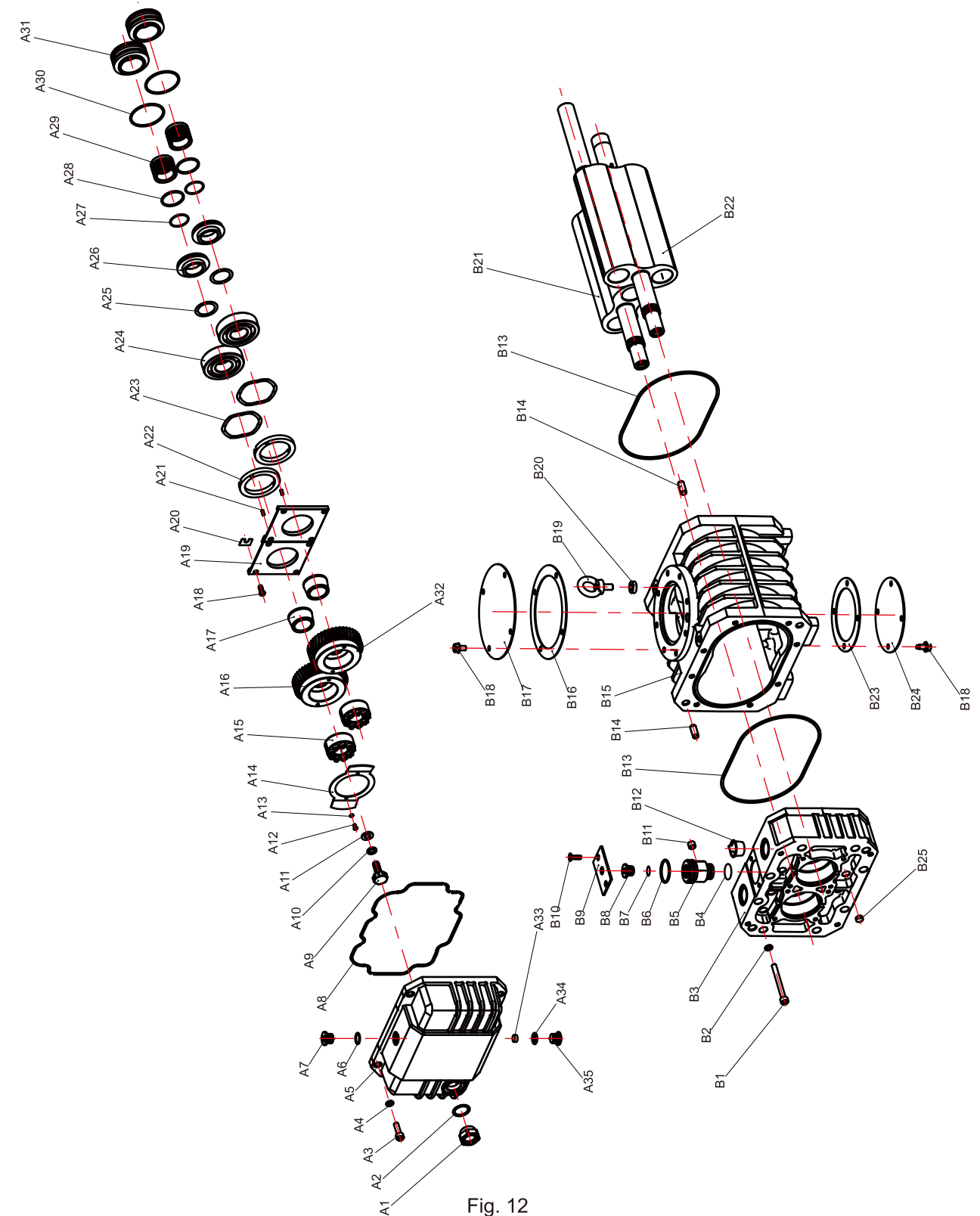


Fig. 12

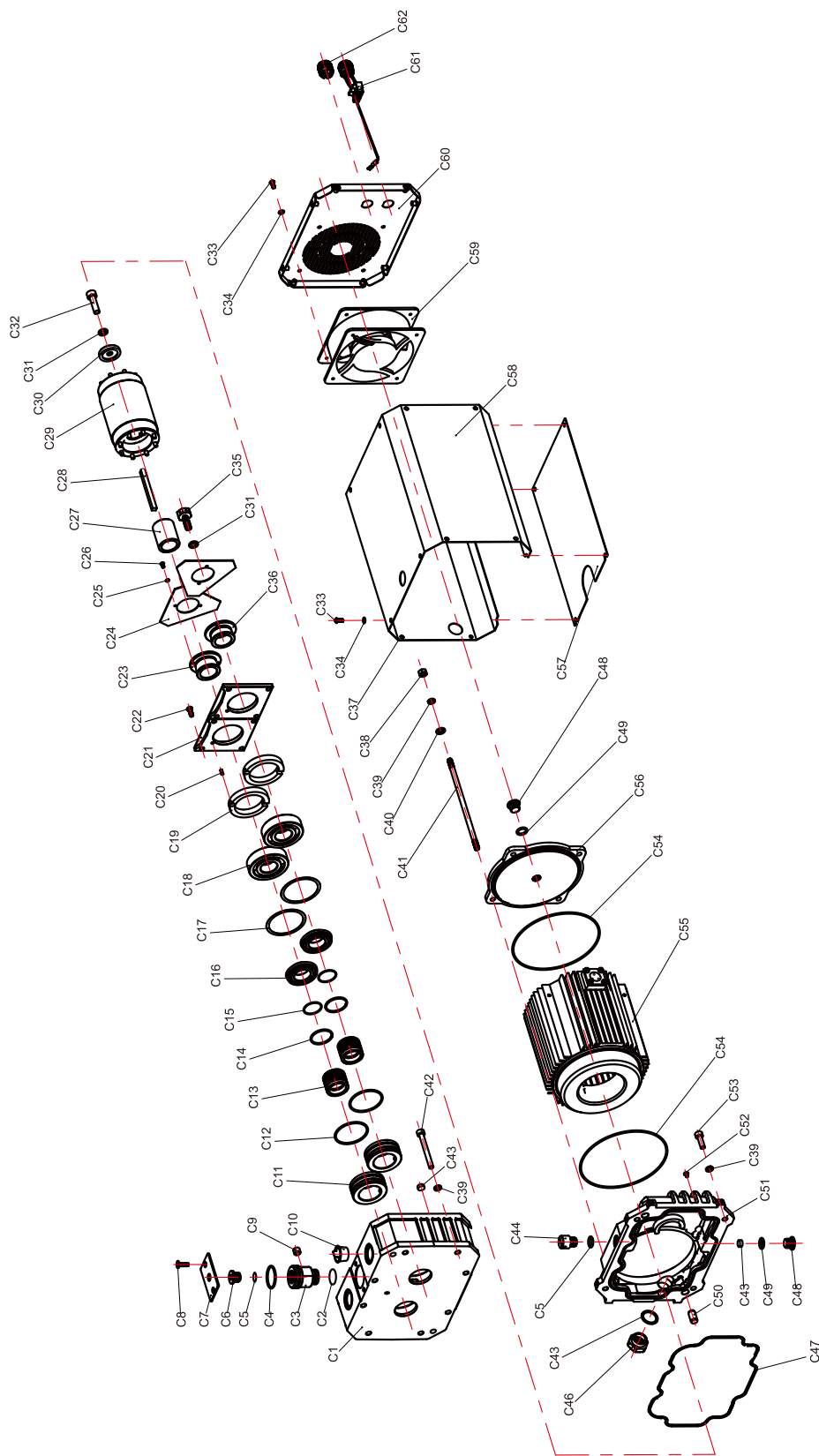


Fig .13

12.3 List of Quick-wear Parts for VBP Series Roots Pump

S/N	Product Name	Material	Qty.
B6	O-ring Φ 69 (inner) *3.55	Fluororubber	1
A15 C13	O-ring Φ 14 (inner) *3	Fluororubber	2

Table 4 List of Quick-wear Parts for BD Roots Pump

S/N	Product Name	Material	Qty.
A6 C5	O-ring Φ 16.5 (inner) *1.8	Fluororubber	2
A34 C49	O-ring Φ 14 (inner) *3	Fluororubber	2

Table 5 List of Quick-wear Parts for BD600 Roots Pump

Correct Disposal of this product:

This marking indicates that this product should not be disposed with other household wastes. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please use the return and collection systems or contact the retailer where the product was purchased. They can take this product for environmental safe recycling.

