



# **Liquid- Ring Vacuum Pumps**

## **2BV Series**

### **Installation and Operation Manual**

**WENZHOU ENCHEM TECHNOLOGY Co., Ltd.**

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## 1. Preface

This manual contains basic information and guidelines that must be observed during installation, operation and maintenance. Therefore, before installing and commissioning the 2BV series liquid ring vacuum pump, relevant technical and operating personnel must read this operation manual carefully to ensure proper operation and full utilization of its superior performance. Please keep this manual properly for future overhaul and maintenance of the product. The content of this manual is subject to change without prior notice due to product upgrades or optimizations.

## 2. Overview

### 2.1. Product Features and Applications

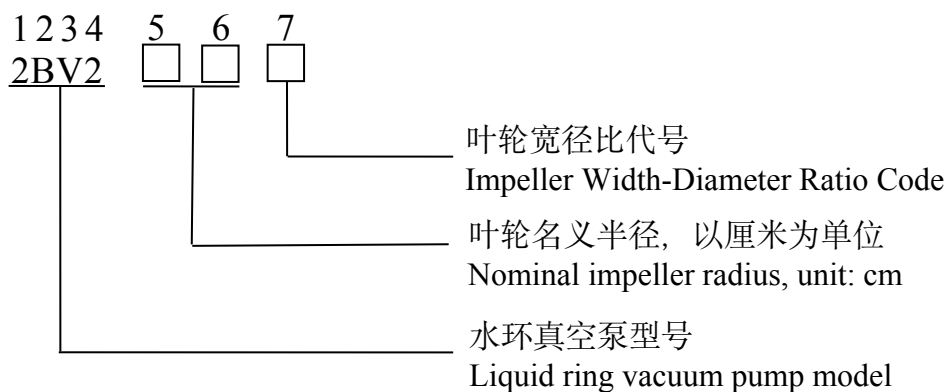
The 2BV series liquid ring vacuum pump is designed to extract air and other non-corrosive, water-insoluble, solid-particle-free gases to create vacuum inside sealed containers, meeting the process requirements of various working procedures. A small amount of liquid is permitted in the intake gas.

This manual applies to 2BV2, 2BV5 and 2BV6 series liquid ring vacuum pumps. Among them, 2BV2 and 2BV5 pumps adopt a single-stage direct-coupled structure; the 2BV6 series is equipped with a direct-connected explosion-proof motor via a support frame. Gas compression inside this type of pump proceeds under isothermal conditions during operation, which greatly reduces safety hazards when pumping flammable and explosive gases. Accordingly, the 2BV series liquid ring vacuum pumps are widely used in machinery, chemical, petroleum, food, pharmaceutical, coal mining, medical, ceramic, printing & dyeing, sugar refining, electronics, environmental protection and metallurgy industries.

Other suitable liquids can also be used as working fluid for liquid ring vacuum pumps;

pumps using any type of working fluid are collectively referred to as liquid ring vacuum pumps. The water- ring vacuum pump is the most common and widely used type among liquid ring vacuum pumps, uniformly named liquid ring vacuum pump or water ring pump in this manual.

## 2.2. Composition and Symbol Definition of Model



**Table 1: Definition of Serial No.7**

No.	Model	Code	Meaning
7	2BV2/5/6	0	Impeller width-diameter ratio = 0.4 (2BV2 series: impeller width-diameter ratio = 0.25)
7	2BV2/5/6	1	Impeller width-diameter ratio = 0.5

## 2.3. Operating Ambient & Working Conditions

- (1) The 2BV series liquid ring vacuum pump shall be installed in bright, low-dust buildings.
- (2) The allowable ambient installation temperature ranges from 5°C to 40°C. If the ambient temperature drops below 0°C, antifreeze protection must be implemented for the vacuum pump.
- (3) Sufficient clearance space must be reserved around the pump for routine inspection, maintenance, disassembly and reassembly.
- (4) When water is used as the working fluid, the temperature at the liquid ring pump's inlet and outlet must be kept below 40°C at minimum. Excessively high water temperature will cause:

- a. Deterioration of the pump's ultimate vacuum degree;
- b. Decline in the pump's pumping speed;
- c. Severe scaling inside the pump, which may even lead to pump damage.

(5) Primary causes of overheated working water in liquid ring pumps:

- a. Overhigh feed water temperature;
- b. Insufficient feed water flow rate;
- c. Excessively high suction gas temperature;
- d. Latent heat released by pumped gas inside the compression chamber.

Note: Operating this product under unsuitable environmental conditions may result in partial or complete functional failure. For use in flammable and explosive sites such as coal mines, explosion-proof motors of matching grade must be equipped.

## 2.4. Main Performance Parameters

**Table 3: General Performance Parameter Table**

Model	Max. Pumping Capacity		Ultimate Vacuum Degree mbar(MPa)	Motor Power (kW)	Motor Explosion-proof Class	Motor Protection Class	Pump Rotational Speed (r/min)	Noise dB (A)	Weight
	m <sup>3</sup> /min	m <sup>3</sup> /h							
2BV2060	0.45	27	33mbar (-0.098MPa)	0.81	Non-explosion proof	IP54	2840	62	31
2BV2061	0.86	52		1.45			2840	65	35
2BV2070	1.33	80		2.35			2860	66	56
2BV2071	1.83	110		3.85			2880	72	65
2BV5110	2.75	165		4			1440	63	103
2BV5111	3.83	230		5.5			1440	68	117
2BV5121	4.66	280		7.5			1440	69	149
2BV5131	6.66	400		11			1460	73	205
2BV5161	8.33	500		15			970	74	331
2BV6110	2.75	165		4			Ex-proof	Protection Rating:	1440

2BV6111	3.83	230		5.5	Rating: dIIBT4 or equivalent explosion- proof classificati on	IP55 or equivalent ingress protection rating	1440	68	208
2BV6121	4.66	280		7.5			1440	69	240
2BV6131	6.66	400		11			1460	73	320
2BV6161	8.33	500		15			970	74	446

Notes:

1. The performance parameters listed above are measured under test conditions: intake medium is saturated air at 20 ° C, working fluid temperature = 15 ° C, exhaust pressure = 1013 mbar.
2. Allowable performance deviation:  $\pm 10\%$ .

**Continuous water supply is mandatory during operation of 2BV series liquid ring vacuum pumps to satisfy operating demands; refer to Table 2.1 and Table 2.2 for required water flow rates.**

**Table 2.1: Working Fluid Flow Rate of 2BV2 Series Liquid Ring Vacuum Pumps (Unit: m<sup>3</sup>/h)**

Model	Required Working Fluid Flow (15°C water as working medium)	
	Without Gas-Water Separator	Equipped with Gas-Water Separator (partial working fluid recirculation)
2BV2060	0.2	0.12
2BV2061	0.23	0.12
2BV2070	0.28	0.15
2BV2071	0.40	0.25

**Table 2.2: Working Fluid Flow Rate of 2BV5/6 Series Liquid Ring Vacuum Pumps (Unit: m<sup>3</sup>/h)**

Model	Required Working Fluid Flow (15°C water as working medium)	
	Without Gas-Water Separator	Equipped with Gas-Water Separator (partial working fluid recirculation)

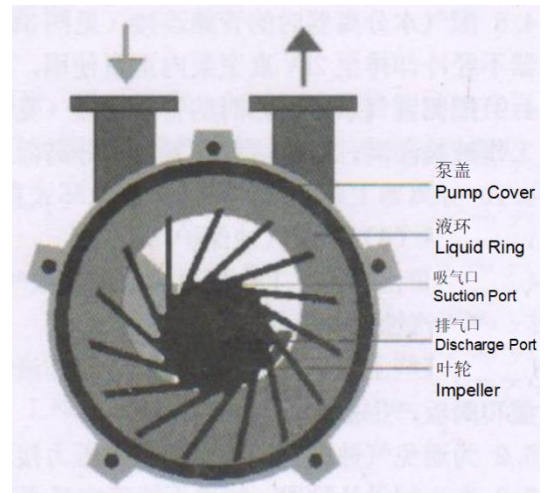
	33 ~ 200mbar	200 ~ 500mbar	500mbar	33 ~ 200mbar	200 ~ 500mbar	500mbar
2BV5/6 110	0.80	0.35	0.3	0.45	0.25	0.12
2BV5/6 111	1.00	0.40	0.35	0.50	0.30	0.12
2BV5/6 121	1.20	0.40	0.35	0.60	0.30	0.12
2BV5/6 131	1.80	0.45	0.40	0.90	0.40	0.18
2BV5/6 161	2.40	0.7	0.50	1.20	0.60	0.25

### 3. Structural Features & Working Principle

1. All 2BV series liquid ring vacuum pumps adopt direct motor-coupled transmission. Manufacturer approval is required if any other transmission form is adopted.

#### 2. Working Principle (viewed from the drive end)

The impeller is mounted eccentrically inside the pump body. A certain volume of working fluid (normally water) is injected into the pump before startup. When the impeller rotates clockwise as



shown in the diagram, centrifugal force pushes water against the pump's inner wall to form a rotating closed liquid ring. The lower inner surface of the liquid ring is tangent to the impeller hub, and the upper inner surface contacts the tips of impeller blades. A crescent-shaped cavity forms between the hub and liquid ring, which is further split into multiple small chambers equal in number to the impeller blades.

Taking the lower position of the impeller as 0°, during the first 180° of rotation, the volume of the chamber between the impeller blades gradually increases and communicates with the suction port on the pump cover. As the chamber volume increases, the gas pressure inside decreases, causing gas to be drawn into the chamber. At the end of the suction process, the chamber is isolated from the suction port.



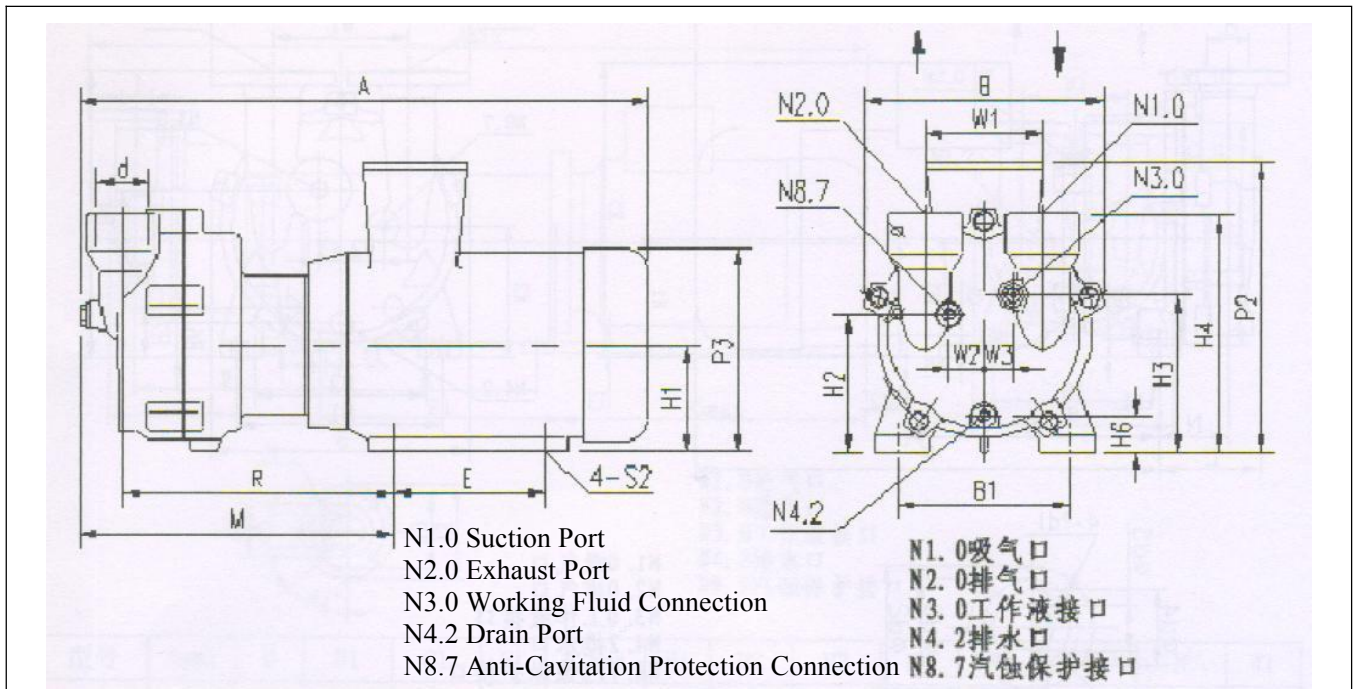
During the subsequent 180° to 360° rotation, the inner surface of the liquid ring gradually moves closer to the hub, causing the chamber volume to decrease. As a result, the gas within the chamber is compressed and its pressure rises. When the gas pressure exceeds the pressure at the discharge port and the chamber comes into communication with the discharge port, the gas is discharged.

For each complete revolution of the impeller, every chamber between adjacent blades undergoes one suction cycle and one discharge cycle. As numerous chambers operate continuously in succession, the pump provides a continuous suction and discharge of gas.

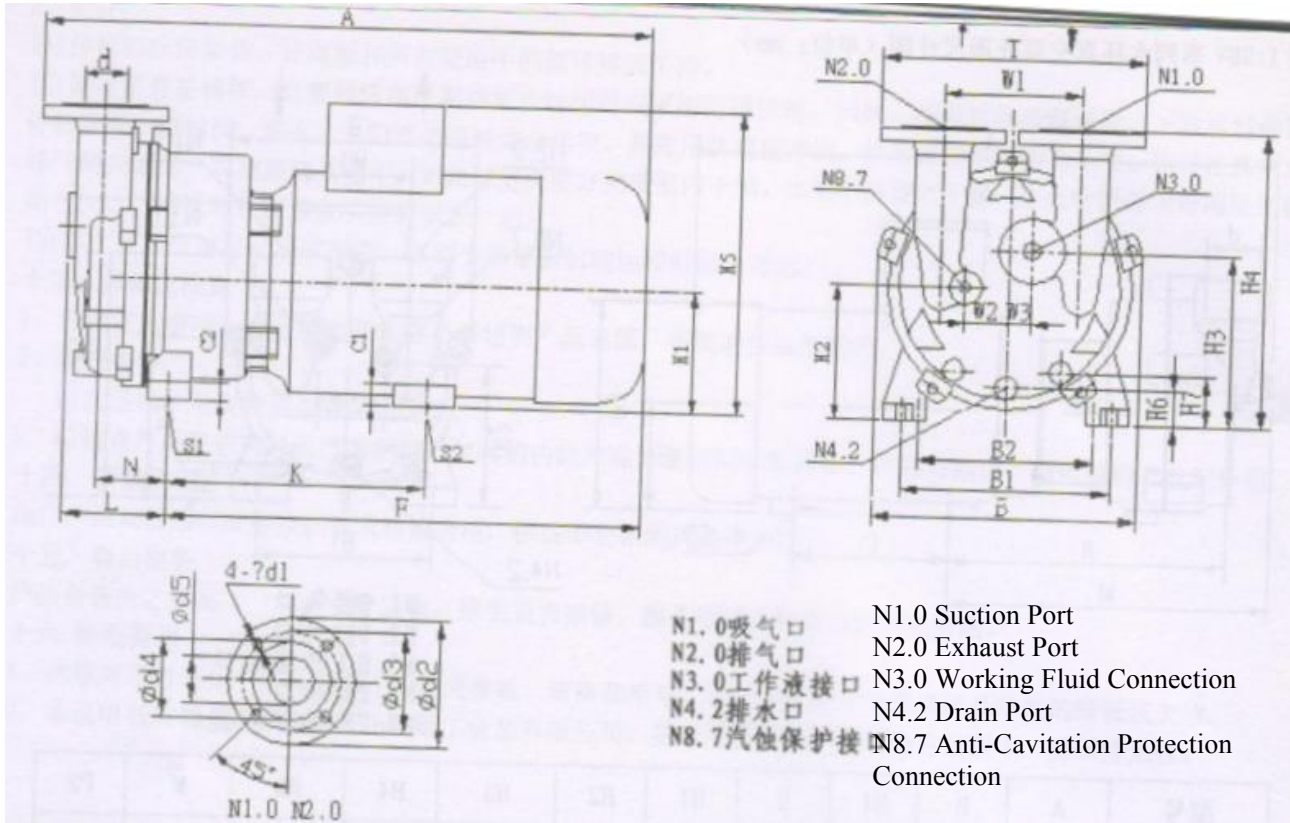
During operation, the compression process generates heat, causing the liquid ring to warm up. At the same time, a portion of the working liquid is discharged together with the gas. Therefore, fresh sealing water must be continuously supplied to the pump during operation to cool the liquid ring and replenish the water lost from the system, ensuring proper and reliable pump performance.

#### **4. Dimensions**

1. Overall Outline & Installation Dimensions (Figure 1)
2. The listed installation dimensions are for standard products; dimensions of customized special products will differ.
3. Installation dimensions are for reference only. In case of any inconsistency with the actual physical unit, the actual product shall take precedence.

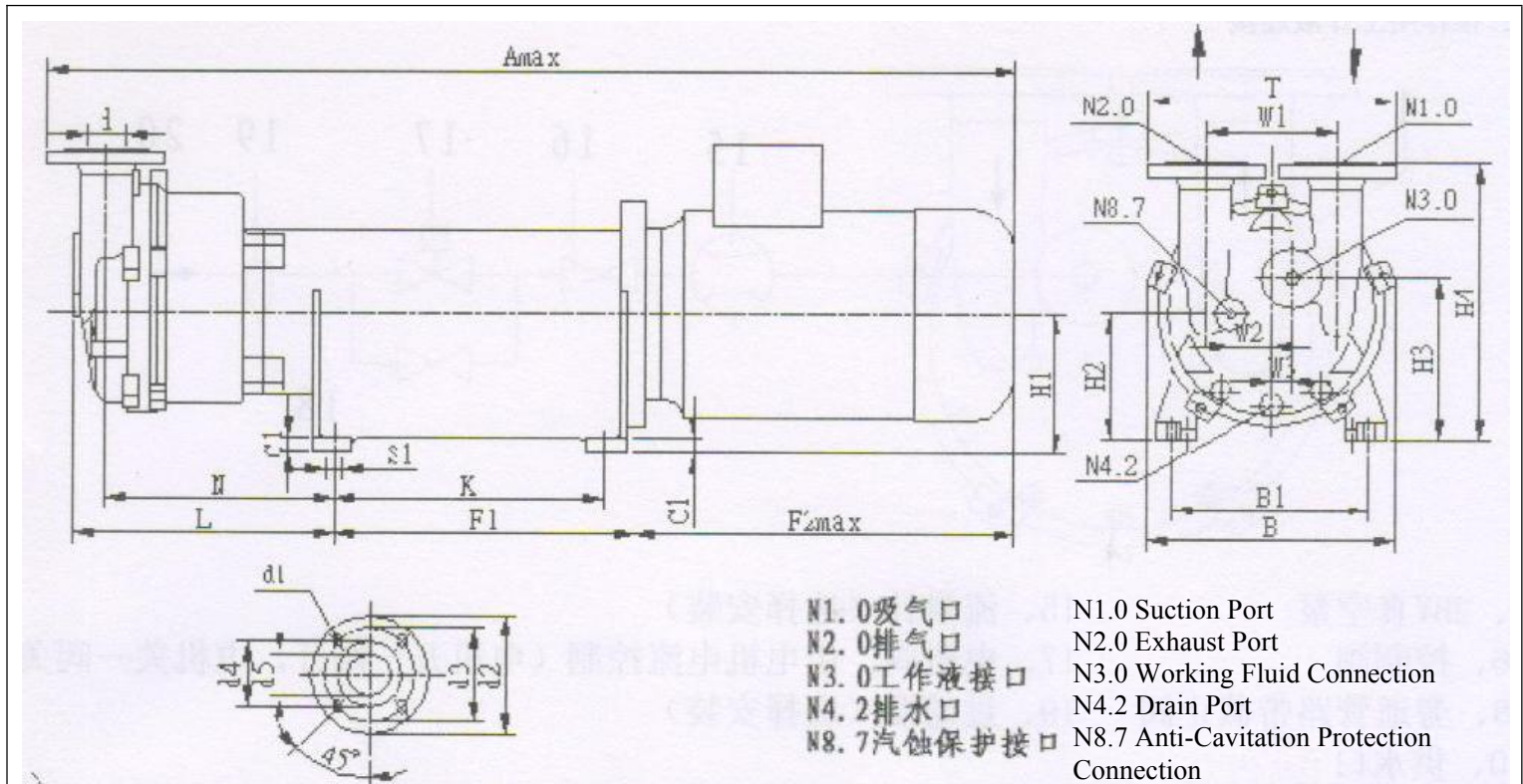


Model	A	B	B1	E	H1	H2	H3	H4	H6	M	P2
2BV2060	455	186	140	100	90	118	126	195	37.5	244	250
2BV2061	476	186	140	100	90	118	126	195	37.5	263	250
2BV2070	545	223	160	140	100	128	146	222	33	280	270
2BV2071	566	223	190	140	112	140	158	234	45	309	300
Model	P3	R	S2	W1	W2	W3	d	N3.0	N4.2	N8.7	
2BV2060	180	217	Φ10	110	25.5	21	G1"	G3/8"	G1/4"	G3/8"	
2BV2061	180	236	Φ10	110	25.5	21	G1"	G3/8"	G1/4"	G3/8"	
2BV2070	203	252	Φ12	110	33	27	G1½"	G3/8"	G1/4"	G3/8"	
2BV2071	225	278	Φ12	110	33	27	G1½"	G3/8"	G1/4"	G3/8"	



Model	A	B	B1	B2	C1	C2	H1	H2	H3	H4	H5
2BV5110	637	325	255	190	41	26	140	156	202	361	328
2BV5111	679	325	265	216	36	26	150	166	212	371	363
2BV5121	771	347	265	216	36	26	150	167	217	385	363
2BV5131	852	377	300	254	35	30	175	194	249	427	435
2BV5161	1044	479	370	279	30	30	210	225	303	521	485
Model	H6	H7	K	L	F	N	S1	S2	T	d1	d2
2BV5110	38	57	342	130	464	92	Φ12	Φ12	340	19	160
2BV5111	48	68	340	130	500	92	Φ12	Φ12	340	19	160
2BV5121	39	60	430	147	584	97	Φ12	Φ12	381.5	19	182
2BV5131	53	76	477.5	147	658.5	103	Φ15	Φ15	381.5	19	182
2BV5161	51	80	555	201	808	138	Φ15	Φ15	450	22	200
Model	d3	d4	d5	W1	W2	W3	d	N3.0	N4.2	N8.7	
2BV5110	123	97	52	180	52	27	DN50	G3/4"	G3/8"	G3/8"	

2BV5111	123	97	52	180	52	27	DN50	G3/4"	G3/8"	G3/8"	
2BV5121	142	113	66.5	200	57	29	DN65	G3/4"	G3/8"	G3/8"	
2BV5131	142	113	66.5	200	57	29	DN65	G3/4"	G3/8"	G3/8"	
2BV5161	156	130	80	250	81	41	DN80	G3/4"	G3/8"	G3/8"	



Model	Amax	B	B1	C1	F1	F2max	H1	H2	H3	H4	K	L	N	W1
2BV6110	1190	325	255	26	291	450	160	173	223	381	250	319	281	180
2BV6111	1237	325	279	26	360	470	180	196	242	401	320	365	327	180
2BV6121	1368	347	279	26	360	575	180	197	247	415	320	384	342	200
2BV6131	1495	377	320	26	461	585	215	234	287	467	414	405	357	200
2BV6161	1625	479	370	26	461	640	215	230	310	526	414	480	416	250
Model	W2	W3	S1	T	d1	d2	d3	d4	d5	d	N3.0	N4.2	N8.7	
2BV6110	52	27	Φ13	340	19	160	123	97	52	DN50	G3/4"	G3/8"	G3/8"	
2BV6111	52	27	Φ13	340	19	160	123	97	52	DN50	G3/4"	G3/8"	G3/8"	

2BV6121	57	29	Φ13	381.5	19	182	142	113	66.5	DN65	G3/4"	G3/8"	G3/8"	
2BV6131	57	29	Φ15	381.5	19	182	142	113	66.5	DN65	G3/4"	G3/8"	G3/8"	
2BV6161	81	41	Φ15	450	22	200	156	130	80	DN80	G3/4"	G3/8"	G3/8"	

## 5. Installation & Adjustment

- (1) Before installation of the liquid ring vacuum pump, rotate the motor fan to confirm no internal jamming or other damage exists inside the pump. If the complete equipment is delivered with damaged or damp packaging, or if more than eight months have elapsed since factory shipment, full disassembly and inspection must be performed prior to installation.
- (2) After adjustment work is finished, the motor fan guard and all other protective enclosures must be fully fitted.
- (3) After full adjustment of the complete pump unit, secure it rigidly to a concrete foundation or a steel frame mounted on the concrete base. It must be guaranteed that excessive operational vibration will not occur, which would degrade pump performance and create adverse environmental effects.

### (4) Pipeline Connection Ports

4.1 All pipeline ports are capped at factory delivery to block external particulate ingress; these caps must not be removed before pipe connection. Pipeline joints shall be free of mechanical stress, and extended pipe runs must be fitted with support brackets.

4.2 Connection dimensions for suction and discharge ports (refer to Figure 1 and Figure 1 Appendix for detailed sizes):

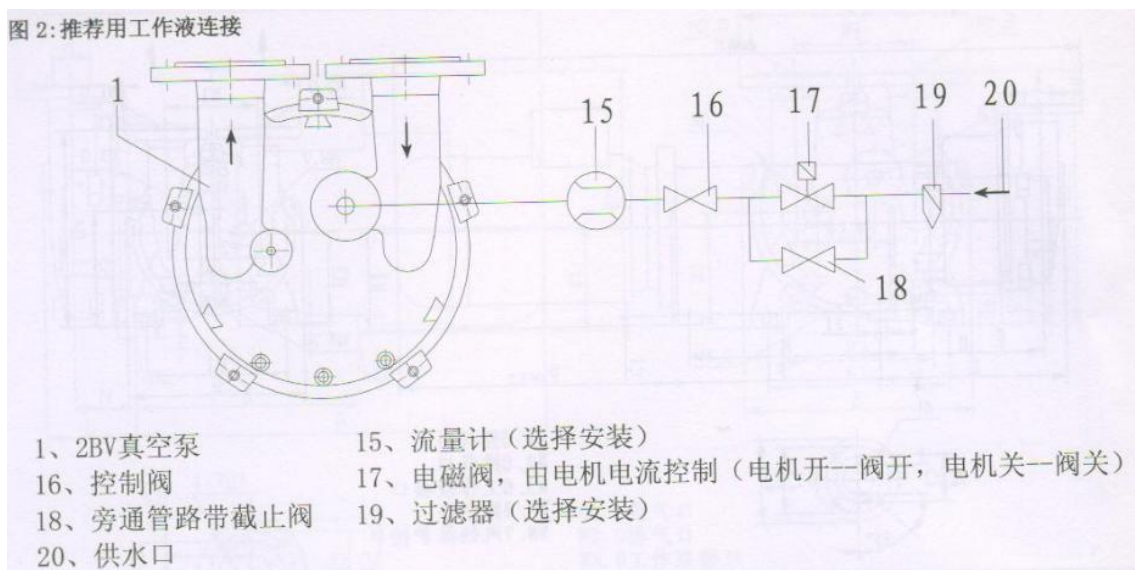
**2BV2060 / 2BV2061:** Female pipe thread G1"; 2BV2070 / 2BV2071: Female pipe thread G1½"

**2BV5(6)110 / 2BV5(6)111:** DN50 flange; 2BV5(6)121 / 2BV5(6)131: DN65 flange; 2BV5(6)161: DN80 flange.

4.3 To prevent foreign contaminants (such as welding slag) from entering the 2BV liquid ring vacuum pump, install filters or strainers on the suction pipeline and working fluid pipeline for the first 100 operating hours. Filters may be removed afterward to reduce pipeline resistance, on condition that no foreign matter can enter the pump.

#### 4.4 Working Fluid Connection (Figure 2)

Figure 2: Recommended Working Fluid Connection Arrangement



1: 2BV Vacuum Pump

15: Flowmeter (optional)

16: Control Valve

17: Solenoid Valve, motor current actuated (valve opens when motor energized; valve closes when motor de-energized)

18: Bypass line with globe valve

19: Filter (optional)

20: Water Supply Inlet

Note: Unless special delivery terms are agreed upon, the supply package only contains the liquid ring vacuum pump. Accessories including gas-water separators, valves, pressure gauges and flowmeters are not included. Auxiliary components (pressure gauges, flowmeters, valves, etc.) may be selected and installed per site installation requirements.

4.5 To ensure reliable operation of the 2BV liquid ring vacuum pump, a sufficient supply of working liquid shall be maintained at all times. The discharged working

liquid may be fully drained and replaced with fresh liquid as required.

Once the pump casing has been filled with water prior to startup, the pump is capable of self-priming. However, the resistance of the working liquid pipeline shall be kept to a minimum, and the suction height shall not exceed 2 m, otherwise the pump performance may be affected.

#### 4.6 Pipeline Connection Examples (see Figure 3)

##### 4.6.1 Pipeline Connection without Gas-Water Separator (See Figure 3a)

##### 4.6.2 Pipeline Connection with Gas-Water Separator (See Figure 3b)

The primary purpose of this piping configuration is to conserve water. Part of the working liquid discharged from the pump is separated in the gas-liquid separator and recirculated back to the 2BV liquid ring vacuum pump without cooling. The balance of the working liquid is supplemented with fresh make-up water to compensate for losses and ensure stable pump operation.

Figure 3: Pipeline Connection Diagram A

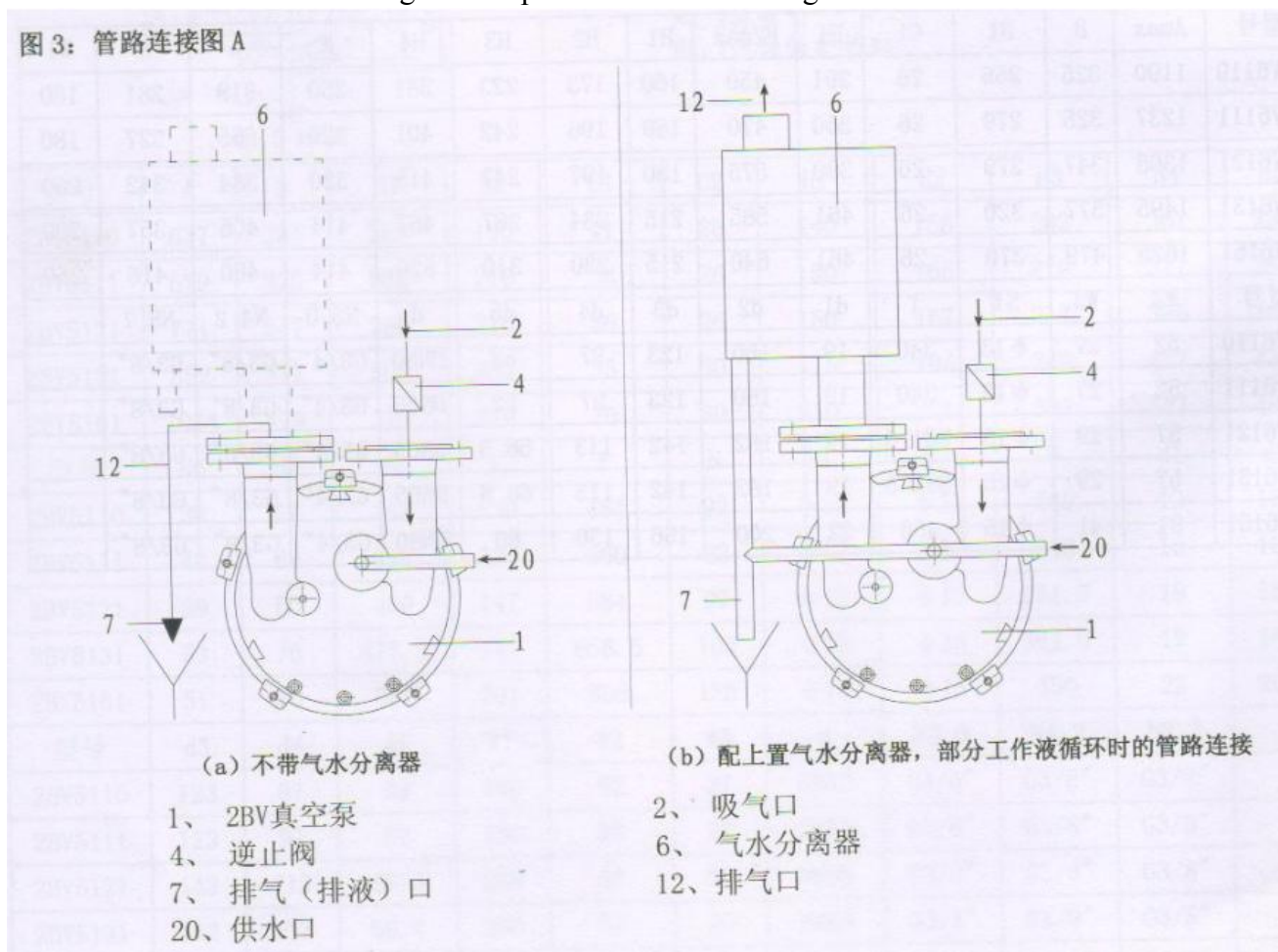


Figure 3a: Without Gas-Water Separator

- 1. 2BV Vacuum Pump
- 4. Check Valve
- 7. Exhaust (Liquid Discharge) outlet
- 20. Water Supply Inlet

Figure 3b: Pipeline Connection with Top-Mounted Gas-Water Separator for Partial Working Fluid Recirculation

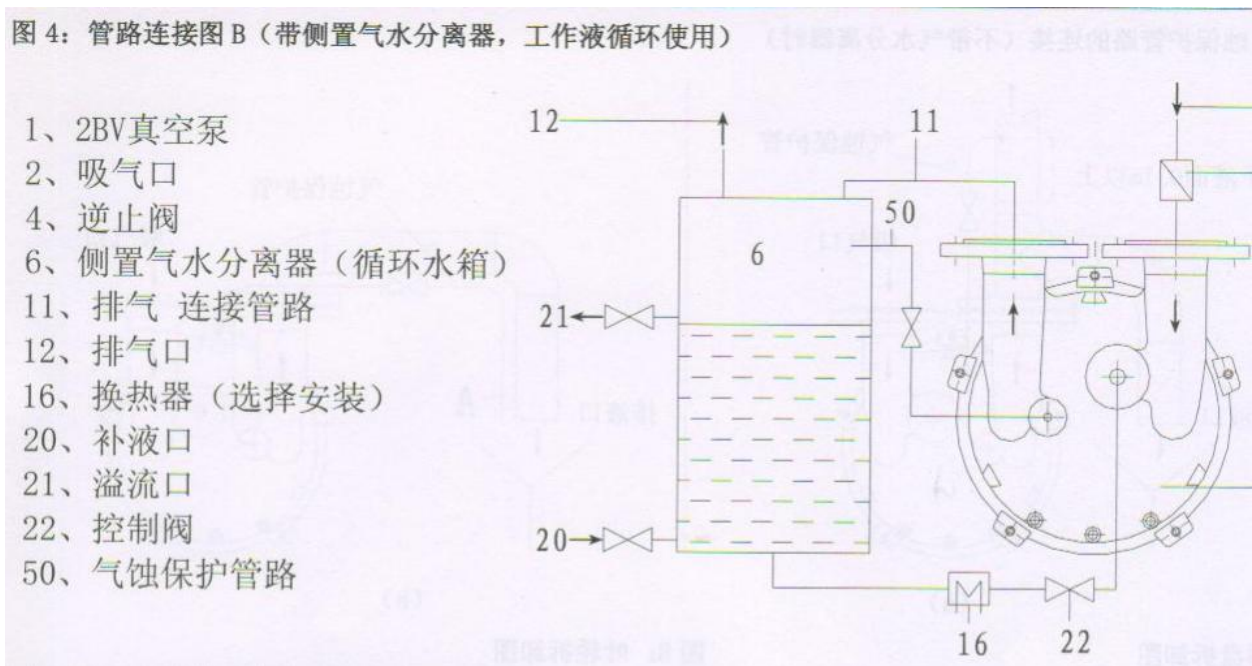
- 2. Suction Port
- 6. Gas-Water Separator
- 12. Vent outlet

#### 4.7 Pipeline Connection with A Side-Mounted Gas-liquid Separator (See Figure 4)

The side-mounted gas-liquid separator arrangement is illustrated in Fig. 4. Alternatively, a circulating water reservoir may be used in place of the side-mounted separator.

To avoid flooding the pump chamber with working liquid during startup, the liquid level in the side-mounted gas-liquid separator or circulating water reservoir must be maintained below the level of the working liquid inlet connection on the pump cover.

Figure 4: Piping Connection Diagram B (With Side-Mounted Gas-liquid Separator for Working Fluid Recirculation)



- 1. 2BV Vacuum Pump
- 2. Suction Port
- 4. Check Valve
- 6. Side-Mounted Gas-liquid Separator (Circulation Water Tank)
- 11. Exhaust Connection Pipeline
- 12. Exhaust outlet
- 16. Heat Exchanger (Optional)
- 20. Make-up Fluid Port
- 21. Overflow Port
- 22. Control Valve
- 50. Anti-Cavitation Protection Pipeline

#### 4.8 Main Functions of the Separator

- 1) Separate the gas-liquid mixture discharged by the liquid ring vacuum pump
- 2) Recirculate water for repeated use
- 3) Lower exhaust noise of the liquid ring vacuum pump
- 4) Interface for cavitation protection piping

4.9 Install low-resistance check valves (also called vacuum check valves, liquid baffles, etc.) on the suction pipeline to prevent the reverse flow of gas and working fluid.

## 6. Cavitation Protection

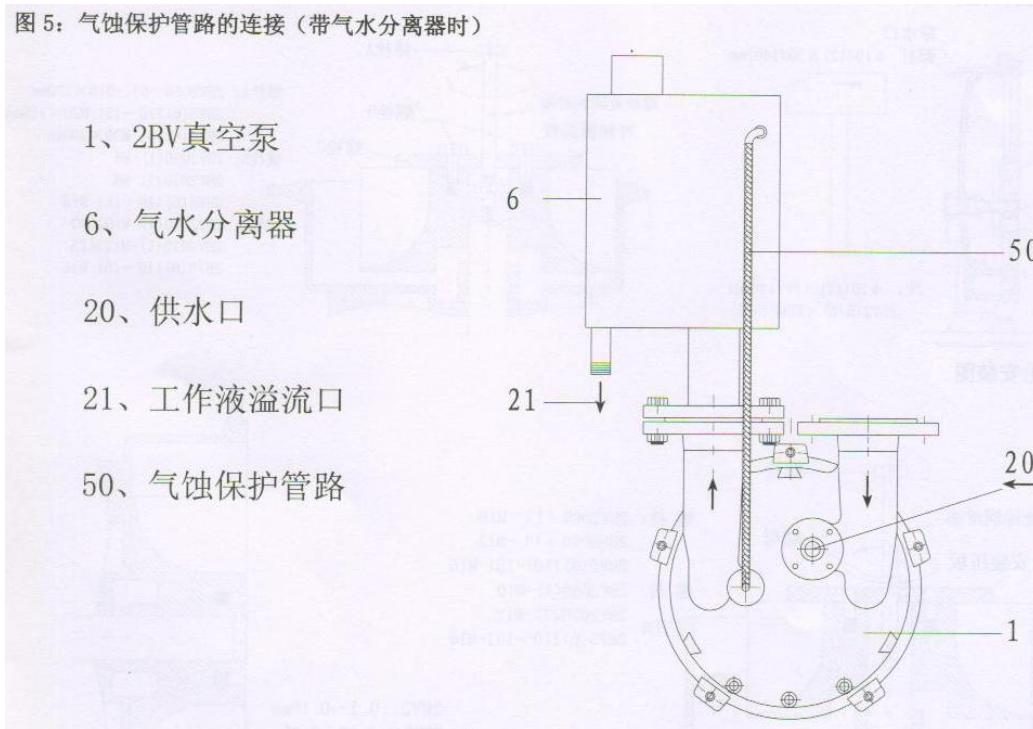
- (1) Under specific working conditions (when suction pressure approaches the saturated vapor pressure of the working fluid), cavitation will form inside the compression chamber. Cavitation will erode and damage the impeller, disk and valve plate.
- (2) Cavitation protection measures must be equipped when the pump's suction pressure is close to the saturated vapor pressure of the working fluid to prevent cavitation damage.
- (3) If the possibility of cavitation cannot be fully assessed during the engineering design phase, the pump shall be inspected for cavitation during initial startup and commissioning.

An increase in operating noise, particularly the occurrence of fine crackling or clicking sounds, is generally an indication of cavitation within the liquid ring pump. When such symptoms are detected, cavitation protection measures must be adopted immediately.

Should these symptoms continue after the implementation of cavitation protection measures, the user is advised to contact the manufacturer for technical assistance and recommendations on corrective actions.

- (4) The cavitation protection pipe port is dedicated for anti-cavitation protection; connect it as marked Item 50 in Figure 4 & Figure 5, or follow the layout in Figure 6.

Figure 5: Connection of Anti-Cavitation Protection Pipeline (Equipped with Gas-Water Separator)



1. 2BV Vacuum Pump

20. Water Supply Port

50. Anti-Cavitation Protection Pipeline

6. Gas-Water Separator

21. Working Fluid Overflow Port

#### 4.1 When air is suitable for cavitation protection

a) Route the cavitation protection pipe to the exhaust pipeline or gas-water separator, and ensure the pipe opening is positioned above the liquid level (Figure 4, Figure 5, Figure 6a).

b) The cavitation protection line may be connected to the liquid discharge outlet. However, the A-end of the cavitation protection line shall not extend below the liquid surface, nor shall it be connected directly to the discharge outlet (refer to Fig. 6b).

**Note:** This piping configuration may result in a certain amount of operating noise while the pump is running.

Figure 6: Connection of Anti-Cavitation Protection Pipeline (Without Gas-Water Separator)

图 6: 气蚀保护管路的连接 (不带气水分离器时)

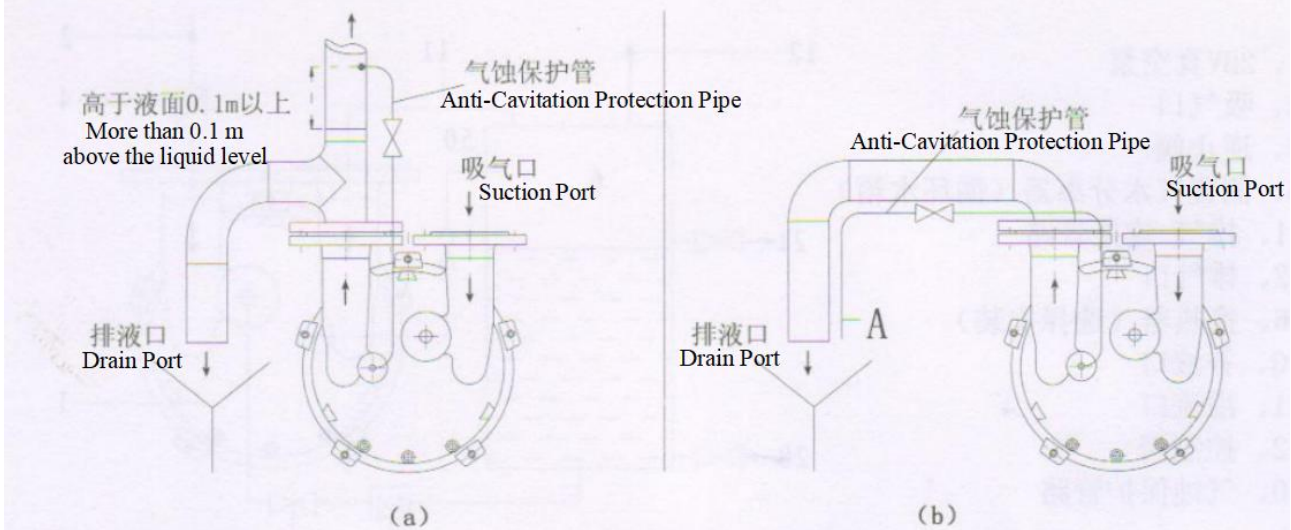


Figure. 6a

Figure. 6b

## 4.2 If inert gas is required for cavitation protection

All pipes and containers storing the inert gas must be hermetically sealed against the atmosphere, and the gas pressure shall be maintained at standard atmospheric pressure.

### (5) Alternative cavitation prevention method

Connect the cavitation protection port directly to a non-return valve, with the opposite side of the valve vented to atmosphere or connected to a suitable protective gas supply.

Attention should be paid to the fact that a small quantity of working liquid may be discharged from the valve during operation and after the pump has stopped. Where the working liquid is corrosive, flammable, or harmful to health, suitable piping shall be provided to safely collect and drain any leakage.

## 7. Initial Startup

### 7.1. Pre-Startup Preparation

(1) This clause only applies to drained or dried pumps (i.e., first startup, restart after

maintenance, or restart following long-time standby shutdown mid-operation).

(2) For the initial state, all suction gas pipelines and working fluid pipelines shall be correctly connected, and all valves shall be fully closed. Gate valves or check valves must not be fitted on the exhaust side, which would block and seal off the exhaust pipeline.

(3) Adjust the working fluid flow rate, open the working fluid control valve (Item 16 in Figure 2) for about 10 seconds, filling the pump cavity to roughly 1/2 capacity with working fluid.

**Note:** Jog the 2BV liquid ring vacuum pump momentarily to verify rotation direction. Reverse rotation of the vacuum pump is strictly prohibited. Dry running of the liquid ring vacuum pump without working fluid is completely forbidden.

## 7.2. Startup Procedure

It is recommended to follow the steps below for startup:

- (1) Open the suction pipeline valve
- (2) Open the working fluid valve
- (3) Start the liquid ring vacuum pump
- (4) Regulate the working fluid valve to adjust flow rate to meet the specifications in Table 2.1 and Table 2.2

## 7.3. Shutdown Procedure

It is recommended to follow the steps below for shutdown:

- (1) Close the intake pipeline valve
- (2) Close the working fluid valve
- (3) Turn off motor power and stop operation

**Note:** If ambient temperature drops below 0 ° C, fully drain all liquid from the pump cavity, gas-water separator and all pipelines after shutdown.

## 8. Usage & Operation

- (1) Pre-operation Preparation and Inspection: Follow the pre-startup preparation steps specified in Item 6, Clause 1.
- (2) Safety precautions, protective measures, safety symbols and instructions before and during operation
  - a. When any deviation from normal operation is observed, such as excessive power consumption, abnormal temperature rise, excessive vibration, abnormal noise, unusual odors, or abnormal responses from monitoring and detection systems, it indicates that a malfunction has occurred in the pump.

In such cases, to prevent direct or indirect serious personal injury or property damage, the maintenance supervisor must be notified immediately.

- b. Any abnormal operational deviation (excessive power consumption, overheating, abnormal vibration, unusual noise, strange odors, faulty detection signals, etc.) signals pump malfunction. To avoid severe personal injury or property damage (direct or indirect), notify the maintenance supervisor immediately.
    - c. Shut down all associated equipment right away if the fault cause is unclear!
    - d. Appropriate safety protection measures must be taken when the pump conveys hazardous media or uses toxic working fluid.

(3) Startup sequence: Follow procedures outlined in Item 6, Clause 2.

(4) Record the following parameters regularly during operation:

- a. Working fluid inlet temperature;
  - b. Working fluid outlet temperature;
  - c. Suction pressure;
  - d. Working fluid flow rate;
  - e. Working fluid pressure;
  - f. Vacuum pump operating current;
  - g. Running condition (noise, vibration, etc.)

(5) Shutdown procedures, methods and precautions: Follow steps specified in Item 6,

## 9. Fault Analysis and Troubleshooting

**Table 5. Fault & Troubleshooting Chart**

Common Fault	Root Cause	Solution
Difficult to turn the vacuum pump rotor by hand	Pump disc rusted after long idle time since factory delivery	A. Fill pump cavity with 10% oxalic acid solution and soak for 30 minutes B. Loosen pump cover bolts, turn rotor smoothly, then retighten all pump cover bolts
	Excessively high water temperature inside pump cavity (>70°C) or scaling/fouling of working fluid	A. Soak with 10% oxalic acid solution for 30 minutes B. Optimize process to reduce water temperature C. Lower the fouling factor of working fluid
Abnormal operation of vacuum pump motor	Motor phase loss	Check if power supply connector is loose
	Abnormal power supply voltage	Calibrate the supply voltage
	Damaged AC contactor	Replace the AC contactor
Abnormal noise when liquid ring pump starts	Pump cavity fully filled with liquid during startup	Open drain port, drain liquid to 1/2~2/3 cavity liquid level before restarting
Abnormal running noise of liquid ring pump	Solid particles such as welding slag enter the pump	A. Shut down pump, open large water flow for blowdown B. Dismantle pump cover to clear foreign debris
	Anti-cavitation protection valve closed or blocked	Open and unclog the anti-cavitation protection pipeline
	Insufficient protective gas flow for anti-cavitation	Adjust valve to eliminate cavitation noise
	Anti-cavitation pipe connection sits below separator liquid level	Lower separator liquid level or raise the pipe connection port
Liquid ring pump cannot build vacuum	No working fluid supplied	Inspect the working fluid supply system
	Incorrect rotation direction	Correct motor rotation direction
	Undersized pump model with insufficient pumping speed	Replace with a vacuum pump of higher pumping capacity
Too low vacuum degree of liquid ring pump	Insufficient working fluid supply	Increase the feed flow of working fluid
	Excessively high working fluid temperature	Lower inlet water temperature
	Air leakage across the whole	Inspect and seal leaks on all pipelines

	pipeline system	
	Corrosion and wear of exhaust disc / impeller	Dismantle and replace exhaust disc or impeller
Excessive running current of liquid ring pump	Over-high drain pipeline or mismatched pipe diameter	Adjust pipeline height or install matched pipe size
	Over-supply of working fluid	Reduce feed water flow rate
	Limescale and foreign matter adhered to impeller	Clean limescale and hard impurities
	Blocked exhaust disc leading to high exhaust resistance	Clear exhaust holes and reduce exhaust pipeline resistance
Excessively high temperature of liquid ring pump	High inlet temperature of working fluid	Lower inlet water temperature
	Insufficient supply volume of working fluid	Increase feed water flow rate
	Over-high temperature of sucked gas	Lower inlet gas temperature
	Heat generation from compression of pumped gas	Install condenser upstream of gas inlet to cool condensable gas
	Exhaust holes of disc blocked by foreign matter	Unclog exhaust holes on the disc
Mechanical seal leakage	Dry running without working fluid	Replace mechanical seal and revise operation procedure
	Seal components corroded by process medium	Replace corrosion-resistant mechanical seal
	Seal worn by solid particles contained in medium	Replace seal parts; install filters on suction and working fluid pipelines
	Wear of seal friction mating surface	Fit brand-new mechanical seal
Honeycomb pinholes at impeller root (Cavitation damage)	Long-term operation under cavitation-prone conditions	Install anti-cavitation protection pipeline to eliminate cavitation
Bending deformation at impeller tip	Hard solid foreign objects enter pump cavity	Replace impeller; install filters on inlet and outlet pipelines
	Large volume of liquid entrained in sucked gas	Add liquid storage tank at gas inlet and drain accumulated liquid regularly
Fracture at impeller root	Excessively frequent pump start-stop cycles	Optimize process to reduce start-stop frequency
	Excessive working fluid inside pump cavity during startup/shutdown	Optimize pipeline layout; control liquid level at 1/2~2/3 pump cavity volume for start/stop

## **10. Safety Protection Devices & Emergency Fault Handling**

When a liquid ring vacuum pump is used for handling flammable, explosive, toxic, or corrosive media, appropriate safety protection measures must be implemented.

- (1) Improper application, incorrect operation, insufficient maintenance, or unauthorized intervention by non-professional personnel may lead to serious personal injury or property damage. Particular attention shall be paid when handling or conveying high-temperature, high-pressure, or hazardous media.
- (2) The basic installation plan of the equipment, as well as all activities related to lifting, installation, commissioning, maintenance, and repair, must be carried out by qualified professionals and inspected by a technically competent responsible person.
- (3) In special cases, if the equipment is used in more demanding non-industrial applications, additional protective measures provided on-site must be implemented during installation to ensure that all requirements are fully met.

## **11. Routine Maintenance**

### **11.1. Mechanical Seal Maintenance & Replacement**

- (1) All 2BV liquid ring vacuum pumps are equipped with mechanical seals. Continuous, uninterrupted working fluid supply is mandatory during operation; insufficient working fluid will burn out the pump's mechanical seal assembly.
- (2) Immediately replace the mechanical seal with a new spare if leakage or damage is detected.
- (3) When ordering replacement mechanical seals, provide the pump model and factory serial number to the original manufacturer for genuine spare part procurement.

## 11.2. Bearing Maintenance & Replacement

- (1) Under normal operating conditions with a 50 Hz motor, after 20,000 hours of operation, or at the latest within 3 years, the grease consumed in the bearings and surrounding spaces shall be removed and replaced with fresh grease. The grease filling shall account for approximately 50% of the free bearing space and 65% of the bearing cover space. Under poor operating conditions, the lubrication interval shall be shortened accordingly.
- (2) When replacing bearings, the bearing shall be heated to 80 – 100 ° C prior to installation. Do not apply strong impact (e.g., hammering) to the bearing. When replacing bearing grease, it is recommended to replace any worn seals at the same time.
- (3) Since the bearings are integrated motor components, the bearing model may vary depending on the motor manufacturer. The bearing models listed in Table 6 are for reference only; the actual bearing model shall be subject to the physical product.
- (4) The vacuum pump bearing models are shown in Table 6 (for reference only).

**Table 6: Bearing Model Cross-Reference Table**

Pump Model	Motor Frame Size	Front Bearing (Shaft Extension End) Model	Rear Bearing (Guard End) Model
2BV2060	90S	6206	6205
2BV2061	90S	6206	6205
2BV2070	100L	6207	6206
2BV2071	112M	6308	6206
2BV5110	112M	6209	6206
2BV5111	132S	6209	6208
2BV5121	132M	6211	6208
2BV5131	160M	6211	6209
2BV5161	180L	6313	6311
Pump Model	Front Bearing (Non-Drive End)	Rear Bearing (Drive End)	

	Model	Model	
2BV6110	6211	6209	
2BV6111	6313	6211	
2BV6121	6313	6211	
2BV6131	6315	6311	
2BV6161	6315	6311	

### 11.3. Pump Cleaning & Inspection

- (1) The foreign materials accumulated in the pump chamber should be cleaned every month. This can be done by briefly opening the valve on the discharge line or temporarily opening the drain plug.
- (2) If excessive scaling occurs during operation of the liquid ring pump, the pump should be flushed at regular intervals (every 5 – 10 days). During flushing, a suitable solvent (such as 10% oxalic acid, alcohol, etc.) shall be used first, followed by rinsing with clean water.
- (3) All strainers and filters installed in the piping system must be periodically cleaned or replaced (inspection every month).
- (4) The subsequent cleaning interval shall be determined based on the level of scaling observed in the pump discharge chamber or the degree of clogging in the pipeline strainers and filters during the initial inspection.
- (5) When compressed gas is used for cleaning, appropriate personal protective equipment (such as goggles, masks, etc.) must be worn, and the discharged gas must be vented through the designated pipeline. When chemical cleaning agents are used, the warnings and instructions in the relevant safety data must be strictly followed. The chemical agents must be compatible with the materials used, and attention shall be paid to possible corrosion of internal pump components.

## 12. Maintenance of Liquid Ring Vacuum Pumps

### 12.1. Repair Instructions

- (1) To avoid safety hazards or equipment damage, strictly follow the operation manual and attached documents delivered with the pump, including
- (2) Custom or modified pumps may have minor structural differences. If faults are found, contact the manufacturer immediately, provide the pump model and factory serial number, or ship the pump directly to the manufacturer for professional repair.
- (3) All repair work must be completed by qualified professional maintenance technicians. After repair, reassemble all matched pipelines, protective guards and electrical components completely.
- (4) Replacement spare parts for maintenance can only be used after obtaining official confirmation from the manufacturer. When ordering spare parts, clearly state the full product name and individual component name.
- (5) If limescale accumulates inside the pump cavity, perform descaling before disassembly. Soak the pump in 10% oxalic acid solution for 30 minutes. Oxalic acid harms human health upon skin contact or accidental ingestion; strictly abide by safety operating rules.
- (6) If the pump's working fluid is toxic, corrosive or otherwise hazardous to people and the environment, fully flush the pump with clean water while running before opening for maintenance.
  - a. Draining steps: Unscrew the three drain plugs on the pump cover to discharge liquid. While draining, manually rotate the motor fan to reverse the impeller (follow the directional arrow marked on the pump body) until no working fluid flows out.
  - b. Tilt the pump 45° toward the pump cover side to drain all residual working fluid thoroughly.
  - c. Note: If it cannot be verified whether the pump previously handled hazardous media, drain and disinfect the pump completely before transporting it to the

maintenance workshop.

**Attention:**

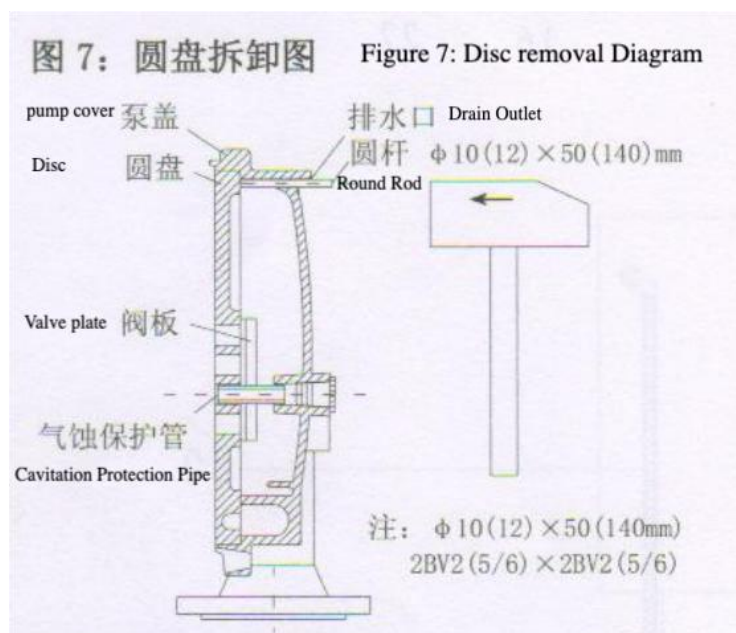
- All repair work must be carried out with the motor power supply fully disconnected!
- Maintenance for pumps fitted with explosion-proof motors must take place in an explosion-risk-free workshop, or only after formal approval from the site safety department.

## 12.2. Disassembly & Assembly Procedures

During maintenance, all components must be thoroughly cleaned. If necessary, the condition of the parts shall be inspected, and appropriate corrective actions shall be taken, including repair or replacement of worn or damaged components.

### 12.2.1. Dismantling of Pump Cover and Disk

- (1) Place the motor fan guard end of the liquid ring vacuum pump vertically downward on the ground. Remove the screws, and take off the pump cover and disc assembly as a whole along the axial direction.

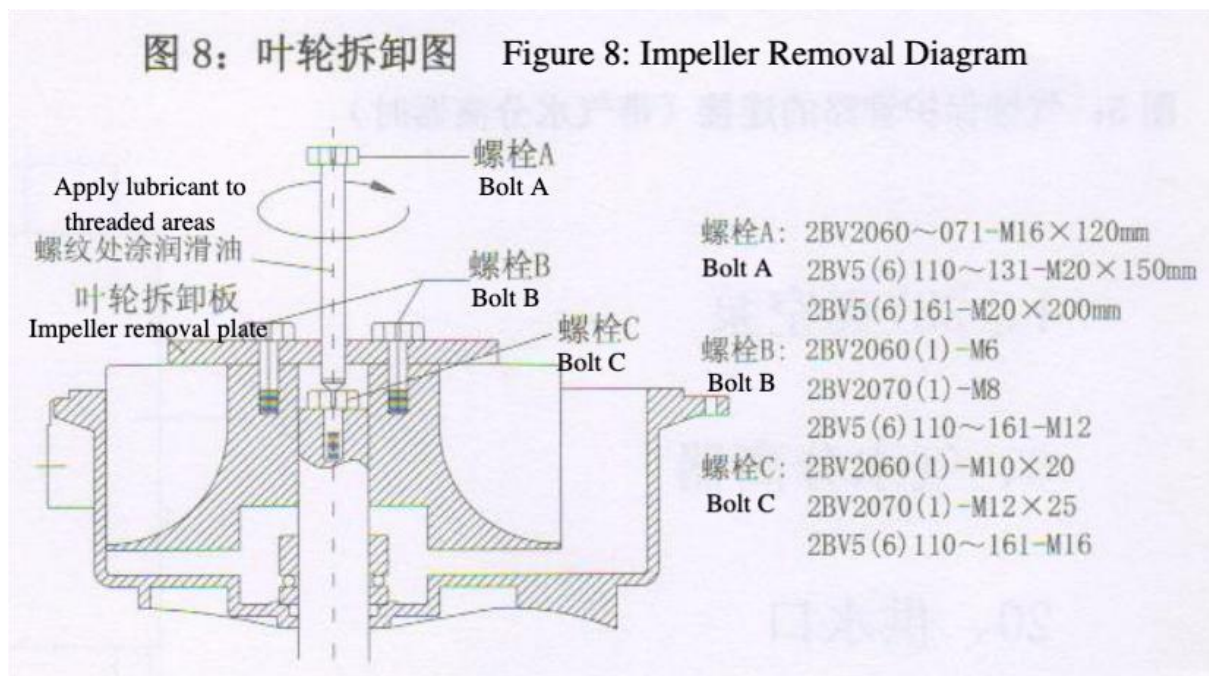


- (2) Under normal conditions, it is not necessary to remove the disc from the pump cover. However, if replacement of the disc, cleaning, or replacement of the valve plate or cavitation protection pipe is required, disassembly is necessary.
- (3) When removing the disc from the pump cover, insert a round rod with dimensions of  $\Phi 10$  (12) mm and  $L = 50$  (140) mm through the air discharge port of the pump cover and gently tap it out, as shown in Fig. 7. After the disc is removed, the

pressure plate, valve plate, and cavitation protection pipe can be disassembled from the disc.

### 12.2.2. Dismantling of the Impeller and Mechanical Seal

- (1) Remove the bolts, and take off the pump cover together with the disc assembly.
- (2) Pull out the impeller using a suitable pulling tool (see Fig. 8), and remove the parallel key from the motor shaft. Then remove the washer and the rotating part of the mechanical seal. To facilitate removal of the rotating seal component, the motor shaft in front of the mechanical seal may be lubricated with water. (For rubber bellows mechanical seals, the use of oil or grease for lubrication is strictly prohibited.)
- (3) If scale or calcium deposits are present on the motor shaft, they must be thoroughly cleaned before removing the mechanical seal; otherwise, the mechanical seal may be damaged during disassembly.



### 12.2.3. Disassembly of Pump Body, Pump Shaft & Bearings (2BV6 Series)

- (1) First, remove the impeller according to Section 2.2. However, it is not necessary

to remove the stationary part of the mechanical seal, as it will be pushed out when the pump body is removed from the motor or bracket.

- (2) Remove the bolts and gently tap along the shaft extension direction to detach the pump body from the motor (or from the bracket in the case of 2BV6 series pumps).
- (3) If replacement of the pump body or mechanical seal is required, remove the stationary seal ring from the pump body.
- (4) For 2BV6 series vacuum pumps, remove the bolts and detach the motor, the motor-side coupling assembly, and the coupling elastic pads.
- (5) Remove the bolts and coupling pressure plate, then use a puller to remove the pump-side coupling hub from the pump shaft. Afterwards, remove the parallel key.
- (6) Remove the bolts and the bearing cover on the drive end, and take out the spacer washer.
- (7) Remove the bolts and the bearing cover on the non-drive end.
- (8) From the drive end, tap the end face of the pump shaft to remove the pump shaft and bearings as an assembly from the bracket. **Important:** When tapping the shaft end face, a protective block shall be placed on the shaft end to prevent damage to the shaft.
- (9) If bearing replacement is required, use a puller to remove the bearings from the pump shaft. For bearing types and maintenance instructions, refer to Section 10, Paragraph 2.4.

#### **12.2.4. Installation of Pump Shaft and Bearing assembly**

- (1) Bearing installation shall be carried out in accordance with Section 10, Paragraph 2.
- (2) Insert the integrated pump shaft and bearing assembly into the bracket from the non-drive end. The pump shaft can be installed into the bracket by gently tapping the outer ring of the bearing. Note: When tapping the bearing, a protective block or sleeve tool must be placed on the bearing end face to prevent damage.

- (3) Install the non-drive end bearing cover and tighten the bolts.
- (4) Install the spacer washer and the drive-end bearing cover, then tighten the bolts.  
Rotate the pump shaft by hand to ensure smooth rotation. If the shaft rotation is tight, slightly loosen the bolts and adjust until smooth rotation is achieved.
- (5) Install the parallel key, the pump-side coupling hub, and the coupling pressure plate, and then tighten all bolts.

#### **12.2.5. Installation of Pump Body and Mechanical Seal Stationary Ring**

- (1) Install the stationary part of the mechanical seal onto the pump body.
- (2) When installing the stationary seal ring, it may be lightly moistened with water and then pressed evenly into the pump body by hand. Do not apply excessive force. After assembly, check that the stationary seal ring is properly and securely fitted to the pump body.
- (3) Press the pump body onto the motor (or onto the bracket for 2BV6 series), and tighten the bolts. Take care not to damage the stationary part of the mechanical seal during installation.
- (4) Install the spacer washer into the rear motor end cover, then assemble the pump body, motor front cover, bearings, motor rotor, and inner bearing cover into the motor housing, and tighten all bolts.
- (5) Install the motor fan, retaining ring, motor fan cover, and screws in sequence. After assembly, place the motor fan cover end of the pump (or the drive end of the bracket for 2BV6 series) vertically downward on the ground, ready for installation of the remaining components.

#### **12.2.6. Installation of Mechanical Seal Rotating Ring**

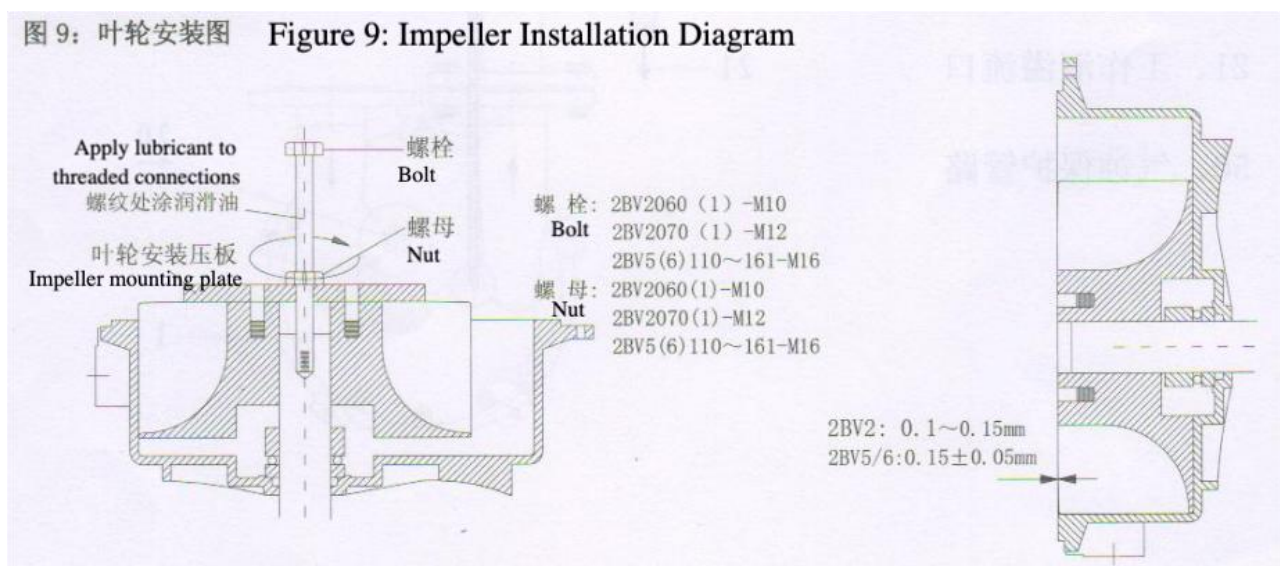
- (1) Thorough cleaning is extremely important. Damage to the polished sealing surfaces of the mechanical seal and the elastomeric sealing components must be strictly avoided. The assembly surfaces of elastomeric seals shall be smooth and free from any damage.
- (2) When installing the rotating part of the mechanical seal, a slotted sleeve may be

used to press the seal and washer onto the shaft to the proper position. After that, install the parallel key onto the motor shaft.

- (3) For liquid ring vacuum pumps made of stainless steel or other special materials, the O-rings of the mechanical seal are made of polytetrafluoroethylene (PTFE). For PTFE mechanical seals, the stationary ring must be fixed with a locating pin to prevent relative movement during operation, which could affect sealing performance. The rotating ring is locked to the shaft using set screws.

### 12.2.7. Installation of Impeller

- (1) Press the impeller onto the shaft, ensuring a clearance of  $0.15 \pm 0.05$  mm between the impeller and the front face of the pump body. Place the vacuum pump in a horizontal position and check the clearance (see Fig. 9).
- (2) If the clearance is too small, mechanical failure may occur. If the clearance is too large, the pumping speed of the vacuum pump will be reduced.



- (3) After adjusting the clearance between the impeller and the front face of the pump body, use a depth micrometer to measure the height difference between the outer edge of the pump body and the impeller plane. Based on this measurement, the required clearance shall be set and maintained as follows:

- 2BV2: **0.1–0.15 mm**



- 2BV5/6:  $0.15 \pm 0.05$  mm

### **12.2.8. Installation of Pump Cover and Disk**

- (1) Place the motor fan guard end (or bracket end for 2BV6 series) vertically downward on the ground.
- (2) Place the prepared disc onto the pump body. Ensure that the small holes with a diameter of 4.2 mm on the disc and pump body are accurately aligned and engaged with the locating pin.
- (3) Apply a continuous and even layer of sealant on the sealing surface of the disc facing the pump cover. The recommended sealant is HZ-1312 oil-resistant silicone sealant. After applying the sealant, install the pump cover onto the pump body and disc assembly, and tighten the bolts.
- (4) During installation of the pump cover, ensure that both ends of the cavitation protection pipe are correctly inserted into the corresponding holes on the disc and pump cover respectively.

### **12.2.9. Installation of the pump cover and disc assembly**

- (1) Place the motor with the base feet downward and the shaft in a horizontal position on the ground.
- (2) The pump cover and disc form an integrated assembly. Push the pump cover onto the pump body, ensuring that the locating pin is properly aligned with the locating holes of the pump body and disc. Secure the pump cover to the pump body using bolts.
- (3) After assembly, rotate the motor fan by hand. The pump must rotate smoothly. If the rotation is not smooth or any rubbing noise is observed during operation, the pump cover shall be removed, the impeller clearance shall be checked, and the assembly shall be readjusted accordingly.

## 13. Transportation & Storage

### 13.1. Lifting & Transportation Precautions

- (1) The load capacity of lifting slings and hoisting equipment must at least match the weight of the vacuum pump (see Table 4).
- (2) Slings shall be long enough to ensure the included angle between sling segments is less than 90°.
- (3) Select appropriate designated lifting points.
- (4) Place slings correctly to guarantee stable hoisting.
- (5) Slings must not have any damaged attachments.
- (6) Always confirm the rated load capacity of hoisting equipment!

### 13.2. Storage

- (1) Fully drain all liquid inside the pump body, gas-water separator and all pipelines after shutdown.
- (2) If the pump has rust-prone components and will stand idle for two weeks or more, implement anti-rust protection measures.

For example: If a long idle interval follows a short performance test run, the pump must be completely drained, flushed with corrosion inhibitor, drained once more and fully dried. An auxiliary vacuum pump can be connected to the exhaust port for faster, more thorough internal drying.

If thorough drying cannot be achieved, rotate the impeller every two weeks to prevent rust seizure between the impeller and disk.

- (3) Keep complete records or reports of all preservation procedures for reference before restarting the pump.

#### **Disclaimer:**

This manual is provided for reference purposes only and is intended to assist customers in understanding and operating the vacuum pump. It does not constitute

any form of liability, warranty, or technical guarantee.

For specific design, equipment selection, installation, operation, maintenance, and safety requirements, please refer to the official technical documentation issued by the vacuum pump manufacturer. In case of any discrepancy between this document and the manufacturer's documentation, the manufacturer's documentation shall prevail.

If any clarification is required, please contact the vacuum pump manufacturer directly.