



**OWNER'S MANUAL
FOR
DRY VACUUM PUMPS
MODELS 2010, 2022 and 2015**

Contents:	Safety Information
	Installation
	Operation
	Maintenance
	Trouble-Shooting Guide
	Specifications
	Warranty
	Parts List and Exploded View

Warning: Be sure to properly identify intake and discharge before using pump. See Section II-5.

Caution: Do not pump liquids with the pump. Pumping liquids will cause the pump to stop working.

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Welch Vacuum Technology

Read and understand the following information and instructions included with your Welch Dry Vacuum Pumps before using. This information is for your safety and to prevent damage to the pumps.

I. SAFETY INFORMATION

I-1. CAUTION: TO PREVENT INJURY...

I-1a. Never operate this product if it has a damaged cord or plug. If it is not working properly, has been dropped, damaged or has fallen into water, please return the product to a Welch service center for examination and repair.

I-1b. Keep the cord away from heated surfaces.

I-1c. Never block any air openings or place it on a soft surface where the openings may be blocked. The air openings are for ventilation of the motor inside the housing. Keep all air openings free of lint, dirt and other foreign objects.

I-1d. Model 2010 is thermally protected and can automatically restart when the protector resets. Always disconnect power source before servicing.

I-1e. Wear safety glasses or goggles when operating this product.

I-1f. Use only in well ventilated areas. The motor on all pumps are totally enclosed fan cooled. **Warning: Do not operate the pumps in an atmosphere containing flammable or explosive gases/vapors.**

I-1g. Warning: Never block the exhaust port. If the exhaust is blocked, pressure will build-up in the pump with the potential of the pump head bursting and causing possible injury to personnel in the area.

I-1k. All electrical products generate heat. To avoid serious burns never touch unit during or immediately after operation.

I-1l. Be sure to properly identify intake and discharge before using pump. See Section II-5.

I-1m. Warning! Remove plug(s) from Exhaust Port(s) Before Using. Models 2010 and 2022 have one exhaust port on top of the pump head. Model 2015 has two exhaust ports on bottom of both pump heads. See Section II-5 for additional information.

I-2 CAUTION: TO REDUCE RISK OF ELECTRICAL SHOCK..

I-2a. Do not disassemble. Disassembly or attempted repairs if accomplished incorrectly can create electrical shock hazard. Refer servicing to qualified service agencies only.

I-2b. Unit is supplied with a three pronged plug. Be sure to connect pump to a properly grounded outlet only.

I-3. WARNING: TO REDUCE RISK OF ELECTROCUTION...

I-3a. Do not use this product in or near area where it can fall or be pulled into water or other liquids.

I-3b. Do not use this product in or near area where it can fall or be pulled into water or other liquids.

I-3c. Do not reach for this product if it has fallen into liquid. Unplug immediately.

I-3d. Never operate this product outdoors in the rain or in a wet area.

I-4. DANGER: TO REDUCE RISK OF EXPLOSION OR FIRE...

I-4a. Do not use this pump in or near explosive atmospheres or where aerosol (spray) products are being used.

I-4b. Do not use this product near flames.

FAILURE TO OBSERVE THE ABOVE SAFETY PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY, INCLUDING DEATH IN EXTREME CASES.

II. INSTALLATION

II-1. INTRODUCTION

This manual has been compiled not only for the care and maintenance of the Welch Dry Vacuum pump now in your possession, but as a helpful reference and guide to prevent many problems which can occur if used improperly.

II-2. UNPACKING

Carefully remove the Dry Vacuum pump from the shipping carton. Preserve all paperwork for future reference. If damage has occurred from shipment a claim must be filed with the carrier immediately; preserve the shipping carton for inspection by the carrier. If you are required to communicate with your dealer or Welch Vacuum be sure to include your order numbers for quick identification. Do not return the pump to the factory without first calling for a returned goods number.

II-3. PUMP MOUNTING

Rubber suction feet are attached to the pump. Rubber suction feet are excellent for applications involving a semi-flexible surface such as a bench top; they help to isolate noise and eliminate creeping. Dry Vacuum Pump Models 2010, 2022 and 2015 can be installed in any position. However, the horizontal position of the motor shaft should be preferred.

II-4. PUMP LOCATION

The Dry Vacuum Pumps should be located preferably in a clean, dry and well ventilated area. Please be sure not to block the ventilation ports located on the motor housing. The pump should be placed where the surrounding

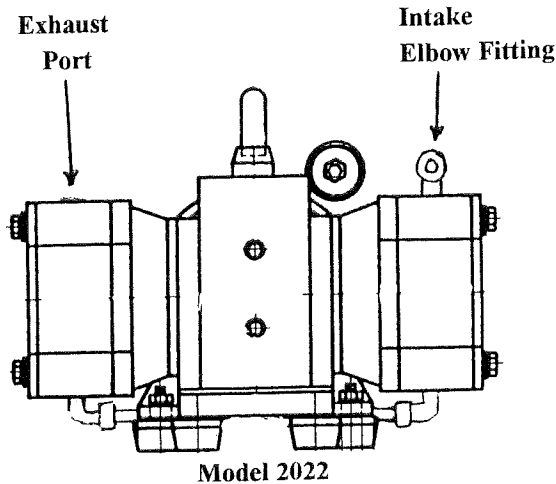
Warning: Don't pump operate this pump in an atmosphere containing flammable or explosive gases or vapors.

Warning! The motor is thermally protected on Model 2010 and will automatically restart unexpectedly when the overload device resets.

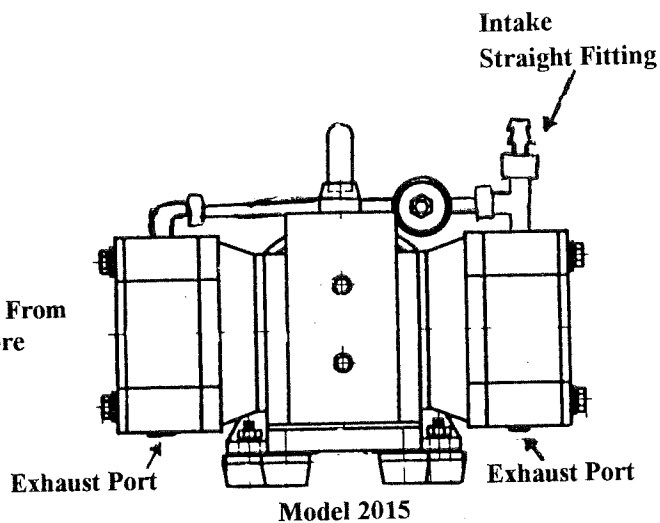
temperature remains between 10°C and 40°C (50°F and 104°F). Always check to insure the location choose is protected from direct or indirect moisture contact. Welch recommends that the pump be installed at the highest

PROPERLY IDENTIFY THE INTAKE AND EXHAUST OF THE PUMP

Warning! Remove Plug From Exhaust Port Before Operating



Warning! Remove Plugs From Both Exhaust Ports Before Operating



II-6. ELECTRICAL POWER

II-6a. Power Source Review

Review the power source and the motor rating to be sure they agree in voltage, phase and frequency. Serious damage may occur to the motor if it is connected to an improper voltage. All Welch pumps must be grounded. Grounding reduces the risk of electric shock in the event of an electrical short circuit. The plug must be plugged into an outlet properly grounded. Consult your local electrical codes if you have doubts.

II-8. DIAL VACUUM GAUGE

A dial vacuum gauge is commonly used to indicate vacuum level when operating in the rough vacuum range (0 to 29.9"Hg) Dial vacuum gauges give negative pressure -- that is pressure below atmospheric. The reference point for the gauges is atmospheric pressure.

Please keep in mind that atmospheric pressure tends to vary from day to day. As a result of this variability, a dial vacuum gauge will indicate slightly different maximum vacuum readings from day to day.

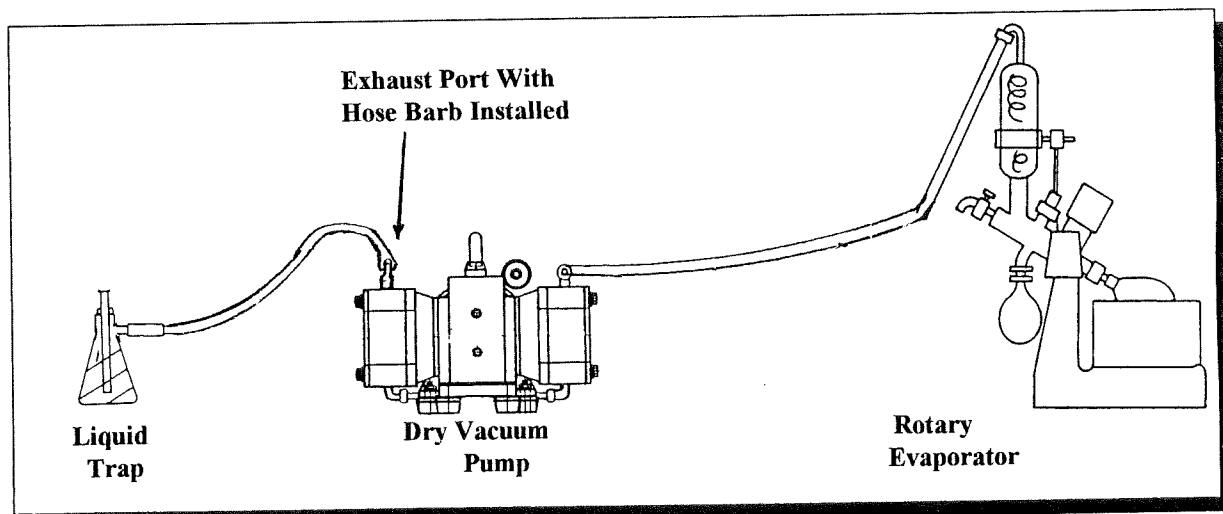
II-9. Traps

II-9a. When To Use A Trap

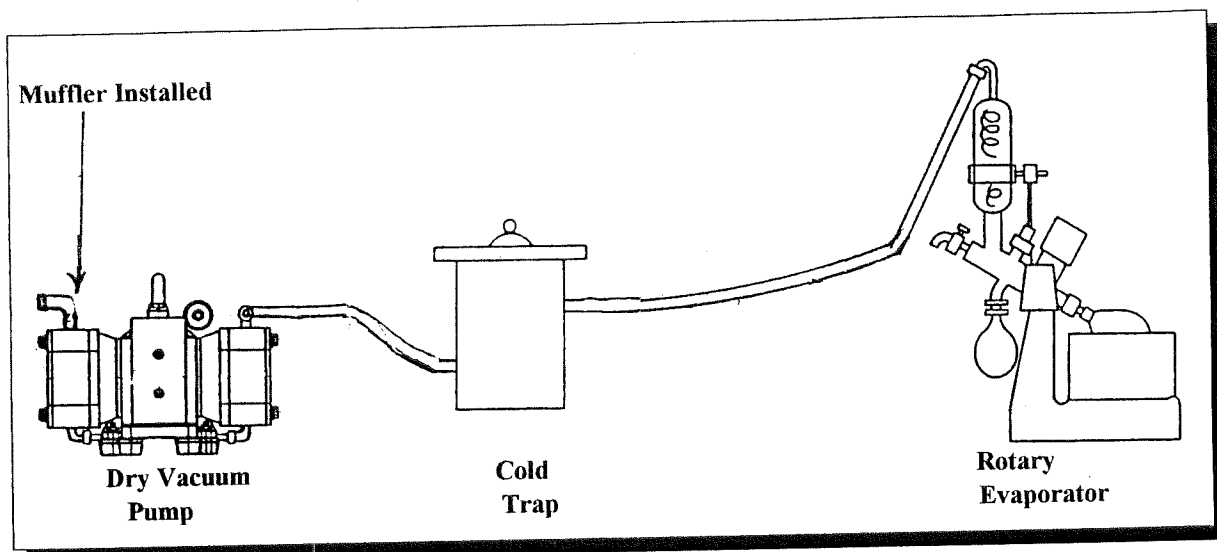
The use of PTFE or fluorinated plastics for all wetted parts resists chemical attack allowing the pump to handle aggressive solvent, base and acid vapors. A totally oil free diaphragm mechanism removes the need for a lubricating and sealing fluid for pulling a vacuum. When pumping gases or low vapor loads, a trap is not necessary unless you want to capture vapors evolved from the process.

When a heavy load of water or organic vapor is evolved from the vacuum process, condensation of vapor in the pump mechanism may occur. The reason is the pump is compressing the vapor as it passes through the pump. If the vapor is dense enough, the compression will cause condensation of the vapor in the pump mechanism. The valve system in the pump mechanism is designed to pass the small quantity of liquified vapor formed when pumping heavy vapor loads. The liquid formed will be ejected from the exhaust port(s). See Section IV. on pump maintenance on suggestions for purging the vacuum pump of condensed liquids prior to shutting it off.

The ejected liquid from the exhaust port(s) can either be collected in a liquid trap attached to the exhaust port or the vapor trapped in a cold trap placed in-line between the pump and the vacuum chamber. A simple, inexpensive liquid trap can be made from a filtering flask. The filtering flask is connected by 1/4" ID hose to the exhaust port by using the loose hose barb provided. The muffler need not be installed on the filtering flask. The liquid trap will act to muffle the pump's noise.



The use of a cold trap when pumping heavy vapor loads will eliminate the need for a liquid trap attached to the exhaust port. The cold trap is installed between the pump and the vacuum chamber. The water or organic vapors evolved from the vacuum process will entering the cold trap will come in contact with the surfaces of the trap and condense. Commonly used refrigerants are liquid nitrogen or dry ice with alcohol slurry. Dry ice provides sufficient cooling to freeze out most heavy water vapor loads. A variety of cold traps are available from Welch. Please call our customer service department for additional information at (847) 676-8800.



II-9b. The Care of a Liquid Trap

A liquid trap needs no refrigerant. The key maintenance issue when pumping high vapor loads is to regularly drain the trap of liquid ejected from the dry vacuum pump.

II-9c. The Care of a Cold Trap

When using a cold trap the refrigerant should be maintained at a high level in the flask to keep the trap at a uniformly low temperature. If the trap is rewarmed it may allow re-evaporation of the condensate. If the trap becomes saturated it should be disconnected from the system, drained and cleaned. An increase in pressure in the vacuum system will normally indicate that the trap has become saturated. To clean the trap, remove the trap from the system and allow the trap to warm up and rinse off the condensate with a suitable solvent in a fume hood. Thoroughly clean and dry the trap before reinstalling the system.

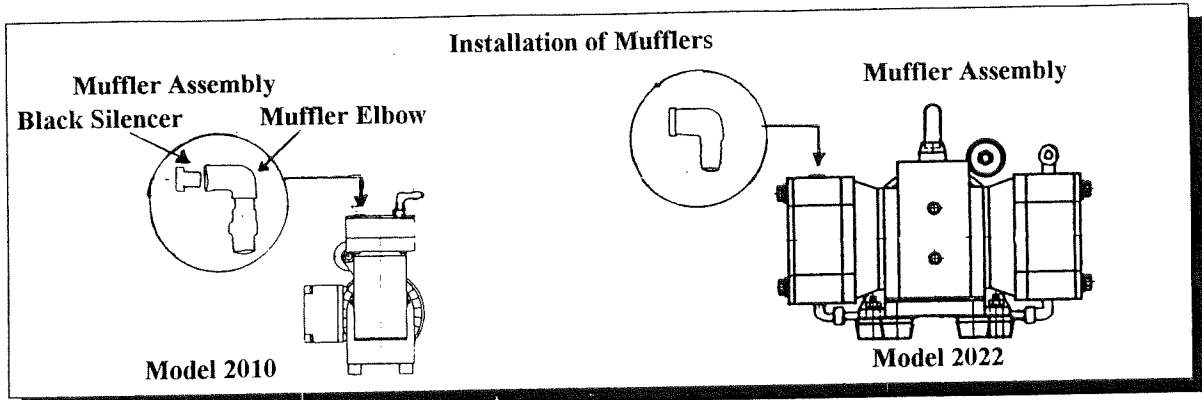
If a liquid nitrogen trap is used, the refrigerant add tube on the liquid nitrogen trap should not be obstructed as the refrigerant boil-off can produce dangerously high pressures.

II-10 Muffler

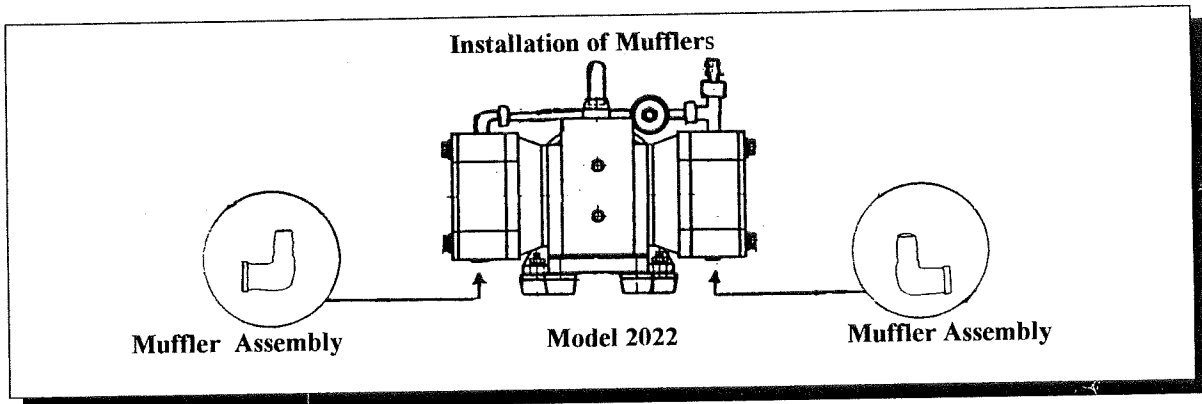
All models come with mufflers which are to be installed in the exhaust port of the pump. The muffler acts to lower the noise emitted from the pumping mechanism due to flexing of the diaphragm during operation. A liquid trap or vessel similar to it will also lower the noise. **Warning: Do not block the exhaust port of the vacuum pump.** See Section II-5.

Use the muffler(s) when pumping low vapor loads or when using a cold trap. See Section II Traps for a complete information.

Models 2010 and 2022 come with one muffler each. Installation consists of threading the muffler assembly into the exhaust port hole (See Exploded Pump Views). To ease installation of the muffler on Model 2010, Welch recommends removing the black silencer threaded in the elbow prior to threading the elbow into the exhaust port. Once the elbow is installed, the black silencer can be reinstalled. By following these simple steps, one avoids the problem of overlapping of the muffler elbow with the intake elbow during installation.



Since Model 2015 has two exhaust ports, two mufflers are provided. The mufflers are installed on the exhaust ports of the pump.



III. OPERATION

III-1. STARTING PROCEDURES

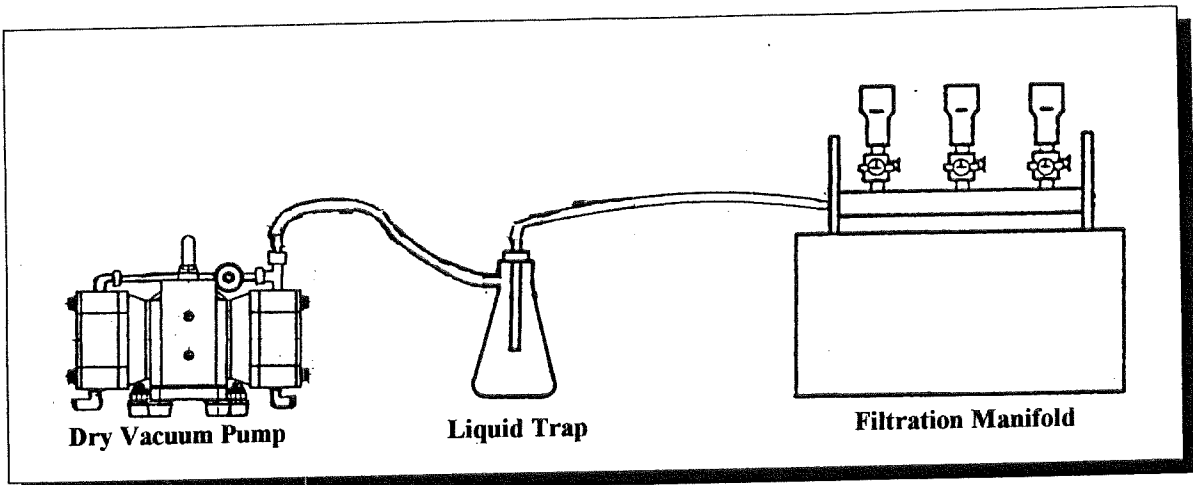
III-1a. Starting A Welch Pressure/Vacuum Pump.

Before attaching the pump to a system it is well to familiarize yourself with the function and action of the Dry Vacuum Pump which you have acquired. Review the power requirements as described in Section II-6. Welch recommends running the pump for a few minutes to warm it up before use. The warm-up improves the pumps ability to pass water and organic vapor. A warm pump will handle more vapor without liquifying it than a cold pump.

III-1b. Cleanliness

Take every precaution to prevent foreign particulates or liquid from entering the pump. Particulates or a flow of liquid will damage the pumps performance. If you find that particulates or liquid will come off the process during evacuation, a simple liquid trap can be made out of readily available material for protecting the pump. The trap

would consist of a filtering flask placed between the pump and the vacuum chamber.



III-2. LEAK DETECTION

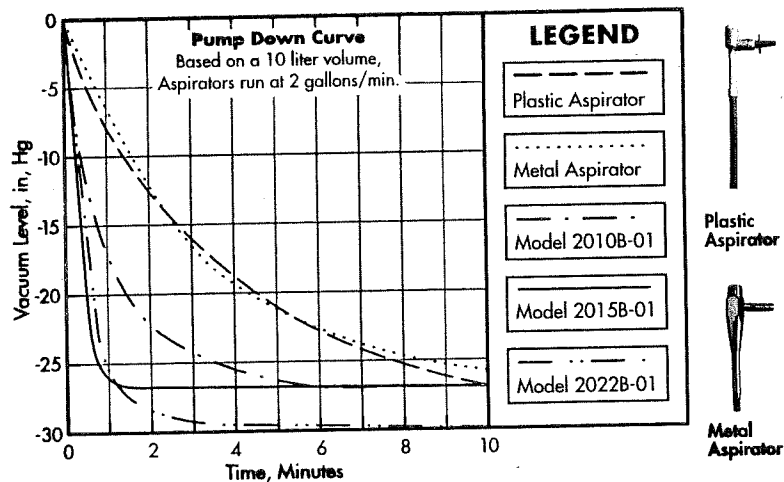
The importance of eliminating all leaks in a vacuum system is obvious. The pump must remove this added volume of leaked gas to maintain the desired vacuum. Leaks for these pump can be located by slightly pressuring the system and painting the suspected area with a thick soap solution. Escaping air will produce soap bubbles.

III-3. OPERATING PRESSURE RANGE

Vacuum pumps are designed to be run from slightly below atmospheric to their maximum vacuum level on the intake side. Consult the Specification Table in the back of this manual for the ratings for your specific model.

IV-4. OPERATION AS A REPLACEMENT FOR WATER ASPIRATORS

Models 2010, 2022 and 2015 are ideal for replacing common water aspirators used for vacuum distillation/extraction, filtration, degassing, low pressure source and/or gas transfer. The three basic models are available with free air displacements from 12.7 to 45 L/min and vacuum to 29.6 inches of Hg. water aspirators have been the researcher's traditional source of rough vacuum to 28.5" Hg(36 Torr) and pumping speed up to 20 L/min. Compare the pump down curves for the three Welch Models to a standard water aspirator.



Note: Plastic and Metal Aspirator run at 30 PSIG water pressure.

See table below to cross reference the correct Welch Dry Vacuum pump with your water aspirator.

Cross Reference Welch Dry Vacuum Pump With Your Water Aspirator

Style of Aspirator Pump	Water Flow (gal/min)	Water Pressure ¹ (PSIG)	Matching Welch DRY Pump Catalog Number	Welch Pump Replaces Up To ²
Plastic or Metal	2	30	2010	1 aspirator
			2022	2 aspirators
			2015	3 aspirators

Note: 1. Common water pressure found when using one water aspirator. Water pressure drops as more water aspirators are turned on leading to poorer vacuum from all.
 2. Higher water flow rates and/or higher water pressure will increase the pumping speed and ultimate pressure of a water aspirator. Model 2022 is the best choice if this is the case since it provides the deepest vacuum.

Welch Recommendation: To extend the service life of the diaphragm membrane, turn off the Dry Vacuum Pump when not in use. Running the pump when not being use only creates wear on the flexing membrane. When running the pump for several hours at a time in an application, Welch recommends air, vapor or gas pass through the pump rather than run in a blank-off condition. The air, vapor or gas aid in cooling of the pump mechanism extending the membrane's service life.

III-4. SHUTDOWN PROCEDURES

After use, Welch recommends the pump be run for about 2 minutes disconnected from the vacuum process. The air pumped through the mechanism will purge out water vapor or droplets of water condensate that may have formed on the inside of the pump. This purge of the pump mechanism helps prevent build up of solute crystals inside of pump head. Over time, these crystals will shorten pump lifetime.

IV. MAINTENANCE

Welch dry vacuum units are 100% oil-free. The pump employs a diaphragm with an uninterrupted Teflon[®] coating. All bearings are sealed and permanently lubricated. Lubrication should not be attempted. The units are built for duty operation just like a water aspirator, but with the quietness, performance and durability of a diaphragm.

V. TROUBLESHOOTING

V-1. VACUUM PROBLEMS

Leakage, contamination and unusual outgassing are the general causes of problems associated with poor vacuum. To operate at maximum efficiency a system must be thoroughly clean. If the system is completely clean and free from leaks, and unwarranted vacuum problems still exist, the pump should be check. A simple criterion for the condition of the pump is the determination of its maximum vacuum capability. This can be accomplished by blocking of the intake and reading the vacuum level on the gauge (See Section II-8).

VI. SPECIFICATIONS

Welch Model	2010	2022	2015
Free Air Displacement CFM(L/min)@60Hz CFM(L/min)@50Hz	0.45(12.7) 0.38(10.6)	0.78(22) 0.64(18)	1.6(45) 1.3(38)
Vacuum Level, in. Hg	26.7	29.6	26.7
Ultimate Pressure, Torr(mBar)	82.5(110)	11(15)	82.5(110)
Tubing Needed, I.D. in.	1/4	1/4	1/4
Weight, lbs(kg)	5.25(2.4)	14(6.4)	14(6.4)
Catalog Number Wired for 115V, 60Hz, 1Ph with N. American 115V Plug	2010B-01	2022B-01	2015B-01
Catalog Number Wired for 230V, 60Hz, 1Ph with N. American 230V Plug	2010C-01	2022C-01	2015C-01
Catalog Number* Wired for 220V, 50Hz, 1Ph with Cont. Euro(Schuko) Plug	2010C-02	2022C-02	2015C-02

* Note: 50 Hz models provided with CE mark.

WARRANTY

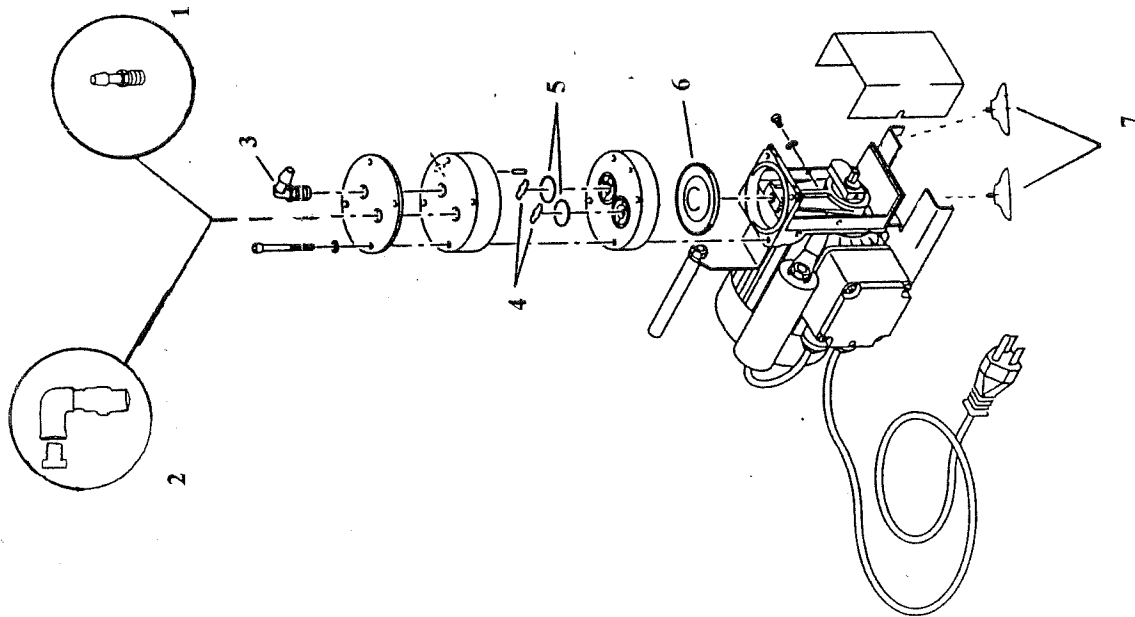
This Welch Vacuum product is warranted to be free from defects in material and workmanship. This liability of Welch Vacuum, Thomas Industries, Inc. under this warranty is limited to servicing, adjusting, repairing, or replacing any unit or component part which in the judgment of Welch Vacuum, Thomas Industries, Inc. has not been misused, abused, or altered in any way or damaged by ingestion of foreign material causing impaired performance or rendering it inoperative. Foreign material includes solids, liquids, corrosive gases, and recondensed water or solvent vapor. No other warranties are expressed or implied. The method of executing this warranty: servicing, adjusting, repairing, or replacing, shall be at the discretion of Welch Vacuum, Thomas Industries, Inc. Vacuum pumps that have been operated within a vacuum system, or other system, for any period, however short, will be repaired under this warranty rather than replaced.

The warranty is effective for one year from the date of original purchase when:

1. The warranty card has been completed and returned.
2. The product is returned to the factory or other designated service centers, freight prepaid.
3. The product in our judgment is defective through no action or fault of the user.

If the product has become defective through misuse, abuse, alteration, or ingestion of foreign material, repairs will be billed regardless of the age of the product. In this event, an estimate of the repair costs will be submitted and authorization of these charges will be required before the product is repaired and returned.

Exploded View of Model 2010



- The pump must be at zero current.
- It must be checked for possible contamination. Apply the respective safety precautions (gloves, protective goggles, adequate ventilation).



- Positions indicate disassembly sequence. Reassemble in reverse order.

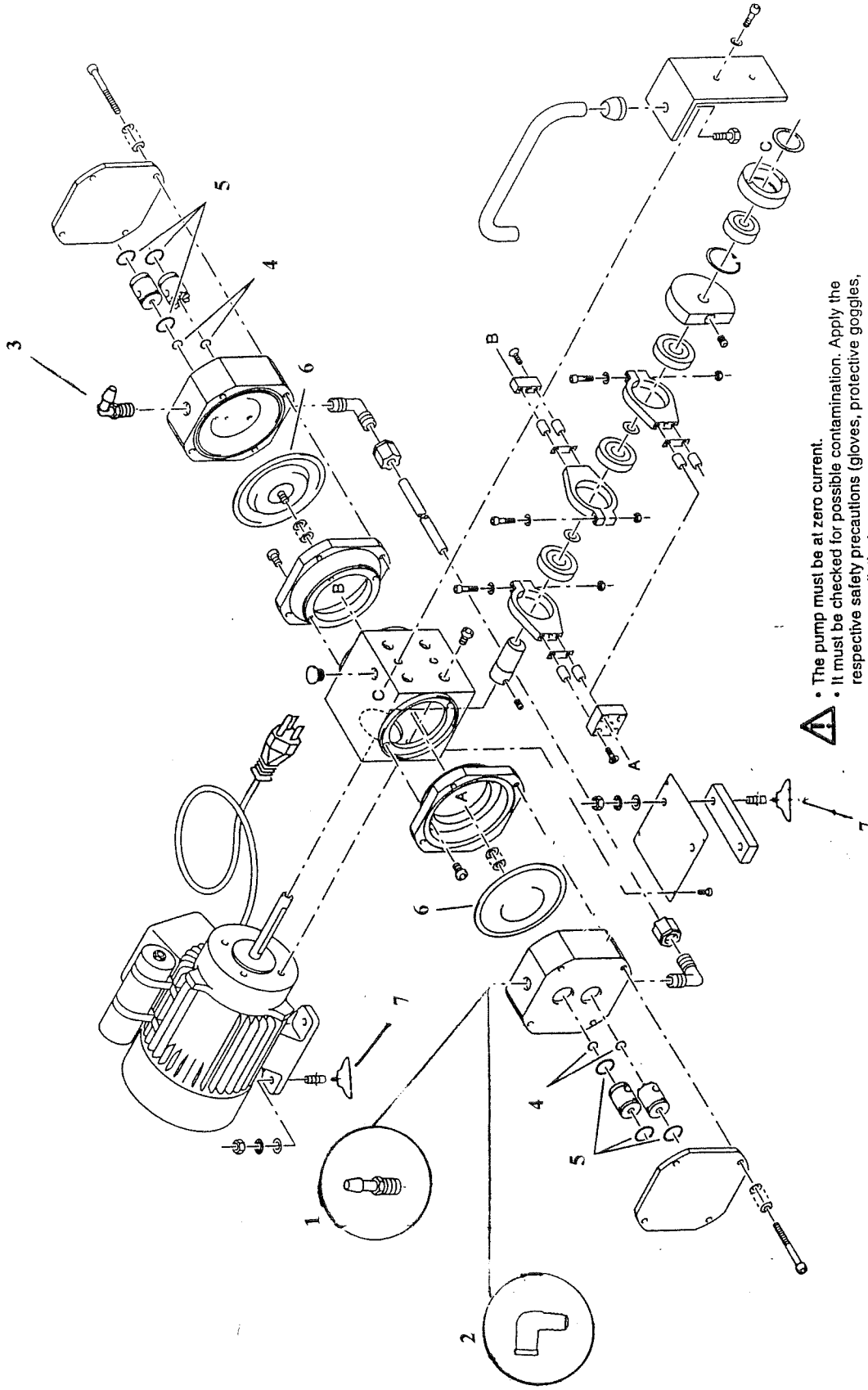


- After reassembly there must be no foreign particles within the machine.
- All components must be grease-free.

Parts List For Model 2010

Item Number	Quantity	Part No.	Description	Rebuild Kit Cat. No. 2010K-01
1	1	1417D-10	Muffler Assembly	
2	1	66-0145	Exhaust Hose Barb	
3	1	66-0144	Intake Elbow Hose Barb	
4	2	70-1300	Flapper Valve	2
5	2	70-1301	O-ring	2
6	1	70-1302	Diaphragm	1
7	4	70-1303	Suction Feet	

Exploded View of Model 2022

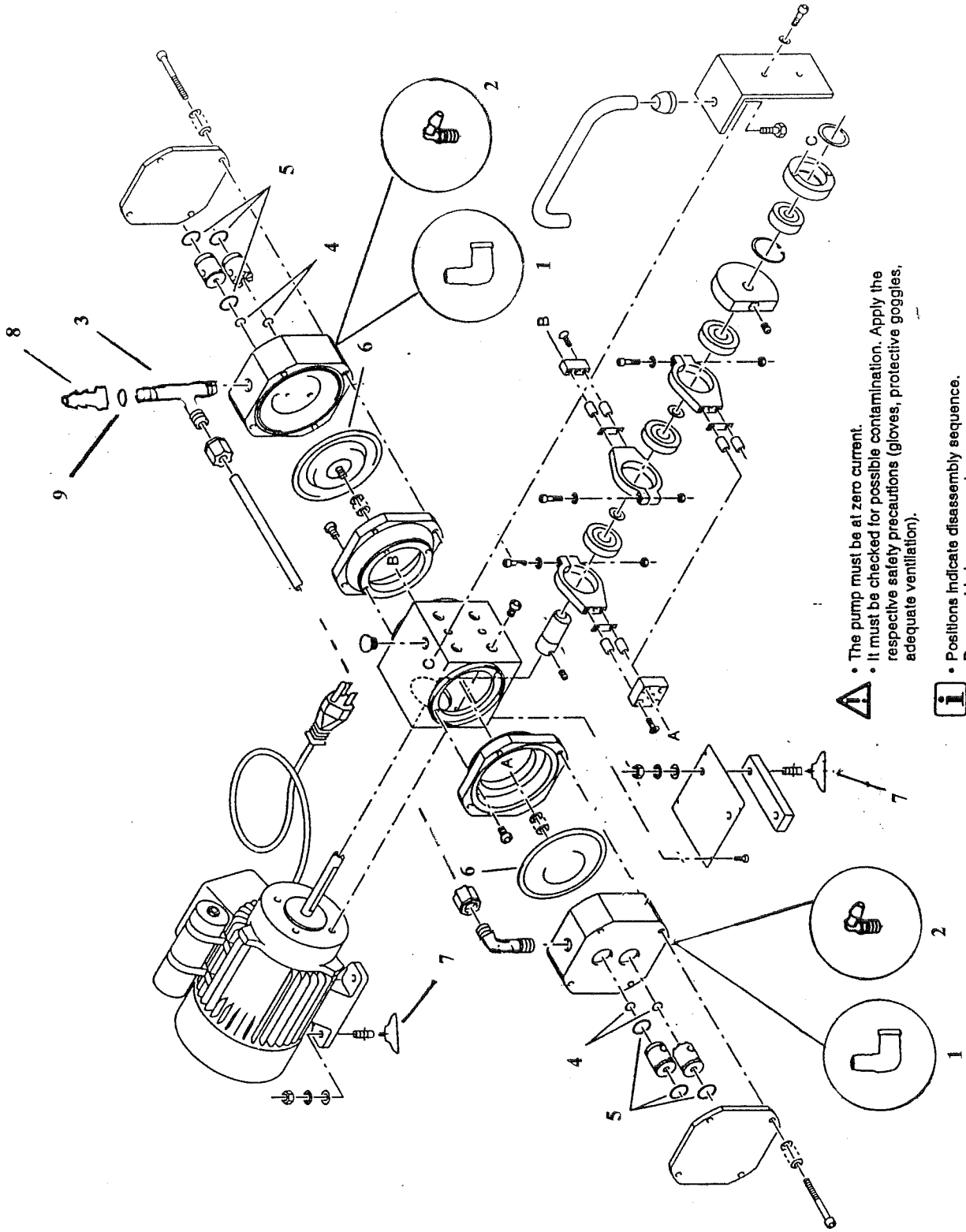





- ⚠** • The pump must be at zero current.
- It must be checked for possible contamination. Apply the respective safety precautions (gloves, protective goggles, adequate ventilation).
- i** • Positions indicate disassembly sequence. Reassemble in reverse order.
- i** • After reassembly there must be no foreign particles within the machine.
- All components must be grease-free.

Parts List for Model 2022

Item Number	Quantity	Part No.	Description	Rebuild Kit Cat. No. 2022K-01
1	1	1417D-20	Muffler Assembly	
2	1	66-0140	Exhaust Hose Barb	
3	1	66-0141	Intake Elbow Hose Barb	/
4	4	70-1304	Flapper Valve	2
5	6	70-1305	O-ring	3
6	2	70-1306	Diaphragm	1
7	4	70-1307	Suction Feet	

Exploded View of Model 2015



-  • The pump must be at zero current.
- It must be checked for possible contamination. Apply the respective safety precautions (gloves, protective goggles, adequate ventilation).
-  • Positions indicate disassembly sequence. Reassemble in reverse order.
-  • After reassembly there must be no foreign particles within the machine.
- All components must be grease-free.

Parts List for Model 2015

Item Number	Quantity	Part No.	Description	Rebuild Kit Cat. No. 2022K-01
1	2	1417D-20	Muffler Assembly	
2	2	66-0140	Exhaust Hose Barb	
3	1	66-0125	Tee	
4	4	70-1304	Flapper Valve	2
5	6	70-1305	O-ring	3
6	2	70-1306	Diaphragm	1
7	4	70-1307	Suction Feet	
8	1	61-5047	Barbed Connector	
9	1	62-0119	O-ring	