



HPS™ Products Series 145

Vacuum Sentry™ Safety Valve



Operation and Maintenance Manual

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p/n 100010033
Rev. A2

Vacuum Sentry™ Safety Valve

Part # 145 - _ _ _ _ _ - _ _ _ _ _ - _ _ _ _ _

Serial # _ _ _ _ _

Please fill these numbers and have them readily available when calling for service or additional information.
(The part number can be found on your packing slip, and both the part number and serial number are located on the bottom side of the housing.)

For more information or literature, contact:

MKS Instruments, Inc.

Phone: 800-227-8766

www.mksinst.com

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Vacuum Sentry™ Safety Valve

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Package Contents

Before unpacking your Series 145 Vacuum Sentry™, check all surfaces of the packing material for shipping damage.

Please be sure that your Series 145 Vacuum Sentry™ package contains these items:

- ◆ 1 Series 145 Vacuum Sentry™
- ◆ 1 Series 145 Vacuum Sentry™ Manual

Inspect the Series 145 for visible evidence of damage. If it has been damaged in shipping, notify the carrier immediately. Keep all shipping materials and packaging for claim verification. Do not return the product to HPS™

Symbols Used in this Manual

The first two symbols below, that may be located on your Series 145 Vacuum Sentry™, identify critical safety concerns. They are used throughout this manual to further define the safety concerns associated with the product.

The last two symbols identify other information in this manual that is essential or useful in achieving optimal performance from the Series 145 Vacuum Sentry™.



CAUTION: Risk of electrical shock.



CAUTION: Refer to manual. Failure to read message could result in personal injury or serious damage to the equipment or both.



Failure to read message could result in damage to the equipment.



Calls attention to important procedures, practices, or conditions.


General Description of Vacuum Sentry™

HPS™ Products Series 145 Vacuum Sentry™ is a safety valve, which protects a vacuum system in the event of power failure by isolating the vacuum system and venting the mechanical pump. This avoids oil back up and allows the motor to restart the pump more easily. Vacuum Sentry™ is offered with the ISO-KF flange sizes and solenoid voltages / frequencies most commonly found on mechanical pumps. Since it operates with atmospheric pressure and activates upon loss of electrical power, the novel design requires no external pressurized gas source. Fast acting Vacuum Sentry™ is light weight, constructed of vacuum compatible materials, and maximizes pumping conductance. Lifetimes in excess of 100,000 cycles are typical, which translates into years of trouble free use in suitable environments. The opening burst is less than the critical backing pressure for turbomolecular and diffusion pumps, when appropriately sized mechanical pumps are used. The closing burst minimized by the unique patented buffer volume design. Vacuum Sentry™ consumes little power. Installation is simplified, because the standard ISO-KF dimensions are used for the NW 40 KF and NW 50 KF sizes, allowing the valve to replace elbows, Tees, and crosses of the same size. Even when the mechanical pump is equipped with an integral anti-suckback valve, Vacuum Sentry™ should be used, because the pump's integral valve will not vent it and is undependable.

Operating Principles Vacuum Sentry™

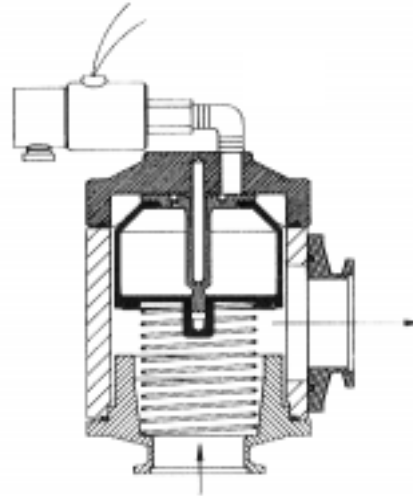
Vacuum Sentry™'s solenoid valve is connected in parallel with the mechanical pump's electrical supply either at its source or at the pump's switch. See figure 1. When the electrical power is on, the solenoid valve is closed, allowing the pump to keep Vacuum Sentry™'s body and the vacuum system evacuated. Interruption of electrical power to the mechanical pump causes the solenoid valve to open admitting air into Vacuum Sentry™ causing it to close very quickly. This isolates the vacuum system from the mechanical pump, while the pressure differential between the outside atmosphere and the vacuum system provides the force to maintain the valve in its closed position without electrical or pneumatic power. With the vacuum system isolated, a series of small orifices admits air to the inlet port of the mechanical pump until it has risen to atmospheric pressure. When the mechanical pump is restarted, it evacuates the area above the piston until the pressure is lowered to approximately that of the vacuum system. Vacuum Sentry™ automatically opens again allowing the vacuum system to be pumped at the full speed of the mechanical pump.

Vacuum Sentry™ Operation Sequence

 The mechanical pump is connected to the port on the right side and the vacuum system to the bottom port.

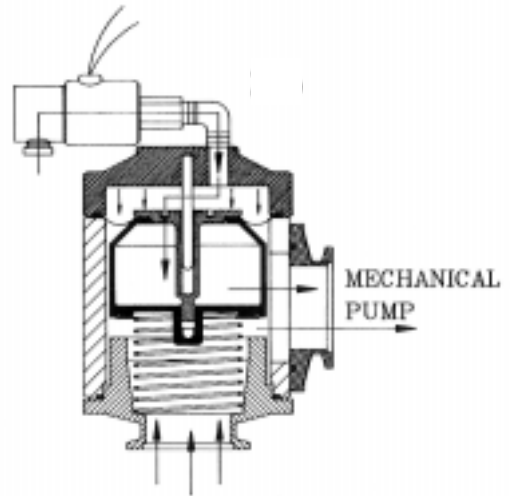
Normal Operation - Open position.

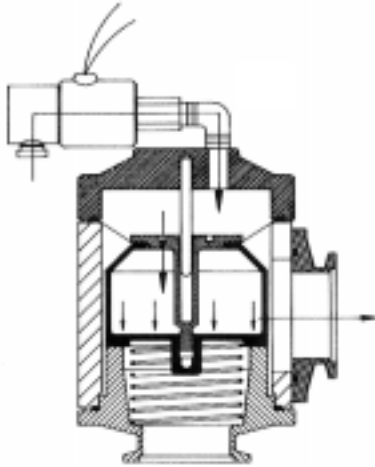
Power is on to mechanical pump and Vacuum Sentry™. The mechanical pump, inlet side of the Vacuum Sentry™, and the Vacuum Sentry™ are all under vacuum at approximately the same pressure. The spring is holding Vacuum Sentry™ open, and the vacuum system is exposed to the mechanical pump's full pumping speed.



Power Interruption

The Vacuum Sentry™ solenoid loses its power, since it is connected in parallel to that of the mechanical pump. The solenoid opens to the atmosphere. Air enters the Vacuum Sentry™ through the solenoid and creates a higher pressure above the piston than exists below it. The piston closes rapidly (30 milliseconds). During this time only the inside of the piston (buffer volume) is being filled, isolating the vacuum system from any introduction of air. The figure shows the piston in transit downward.



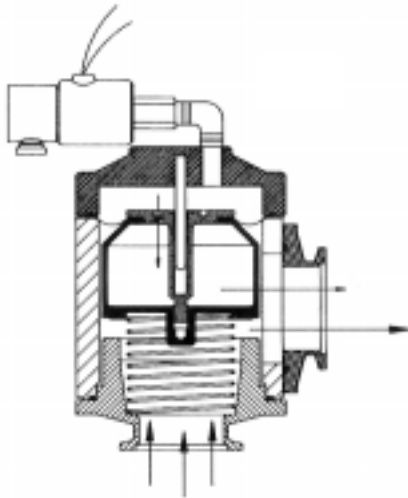


Valve closed - Mechanical pump vented

The piston is fully down and Vacuum Sentry™ is fully closed. The higher pressure above the piston forces it against the valve seat, where the Viton O-ring makes a vacuum tight seal. Air from the higher pressure area above the piston continues through the small orifice in the top of the piston into the inside of the piston, and through a second small orifice in its side into the mechanical pump's inlet port. This vents the mechanical pump to atmospheric pressure gradually. When the pump is fully vented, the pressure above the piston, inside the piston, and in the mechanical pump are the same (atmospheric). The pressure below the piston, in the vacuum system, is still lower and the piston remains down (closed), retaining the vacuum system under vacuum.



Note that , given enough time, the pressure in the vacuum system will rise due to outgassing, leaks, etc., or venting by the operator, and when the pressure is high enough, the spring will open the piston and the vacuum system will be at the same pressure as the mechanical pump (atmospheric).



Power restored

The solenoid coil is energized causing the solenoid to close, isolating the inside of Vacuum Sentry™ from the outside atmosphere. The mechanical pump evacuates the inside of the piston through the small orifice in its side and the area above the piston through the small orifice in the top of the piston. When the pressure above the piston is approximately equal to that in the vacuum system, the spring pushes the piston upward, fully opening Vacuum Sentry™. The vacuum system is now back in normal operation and exposed to the full pumping speed of the mechanical pump.

Specifications

| | |
|-------------------------------------|---|
| Nominal body ID | 2 inches (50mm) |
| Leak rate | |
| - body | < 1 x 10 ⁻⁹ T-l/s |
| - seal | < 1 x 10 ⁻⁹ T-l/s |
| Closing time | 30 ms |
| Closing burst | 1 x 10 ⁻³ T-l |
| Power | 7 Watts @ 115 VAC |
| Materials | |
| - body & flanges | extruded aluminum A1 6061-T6 |
| - piston | machined aluminum A1 2024 |
| - seals (O-ring & diaphragm) | Viton |
| - guide pin | 304 stainless steel |
| Temperature range (valve) | 0° to 100° C |
| Temperature range (solenoid) | 0° to 50° C |
| Venting time | 10 s/l of vented volume (NW 40 & 50) 50 s/l of vented volume (NW 25) |

Installation

Electrical

The solenoid coil leads should be connected in parallel to the rotary vane pump electrical source, preferably at the pump switch. Be sure that the solenoid voltage and frequency are compatible with those of the pump motor. In the case of three phase electrical power, the solenoid may be connected to one leg and ground.

 **Ground the solenoid securely using the provided lug before operation.**

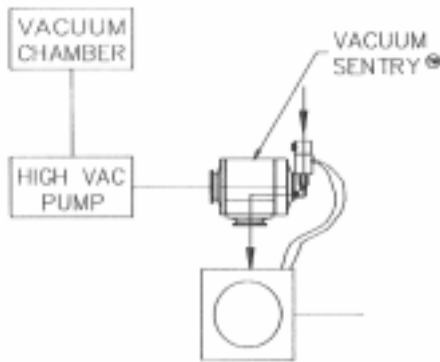
Mechanical

Vacuum Sentry™ is installed between the mechanical pump and vacuum chamber or high vacuum pump. Refer to figure 1. Note that the flow arrows on the unit's label point from the vacuum system to the mechanical pump. While it is preferable to mount it directly on the mechanical pump, it may be located remotely. For best performance, the maximum volume should be on the vacuum system side, and the minimum volume on the mechanical pump side, of the Vacuum Sentry™. Operation is position independent and standard ISI-KF centering ring assemblies and clamps are used to connect Vacuum Sentry™. The valve body can operate in ambient temperatures up to 100° C., but the solenoid is limited to about 50° C., because of the heat generated by the coil. This should be kept in mind when selecting a mounting location.

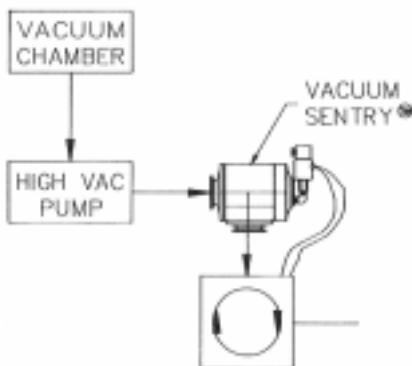
The body of the Vacuum Sentry™ is very rugged, and it is difficult to deform it in any normal piping arrangement used in vacuum systems. It is possible however that tremendous forces could result from thermal expansion, or from a long run of pipe cantilevered from a fixed valve. Where this possibility exists, it is necessary to provide stress relief for the valve by installing a short bellows, and supporting the attached piping other than with the valve.

Valves are shipped with plastic snap-on covers over the ports, in order to protect the delicate seal surfaces and to keep the valve clean. These covers should be left in place until the moment when the valve is to be installed in the piping. A single fiber or bit of lint on an O-ring seal is enough to prevent leak tight sealing. The usual cleaning techniques in vacuum practice should be observed in installing the valve.

When installing the valve, adequate clearance should be allowed between adjacent components so there is no sliding of seal surfaces against each other. Flanges that have been assembled for some time may stick together. They should be separated gently. Do not set the valve down on the seal surfaces unless they are protected.



MECHANICAL PUMP POWER OFF



MECHANICAL PUMP POWER ON

Figure 1

Service

Vacuum components must be kept free of both particulate contamination and all foreign materials which have a significant vapor pressure. Before repairing a vacuum valve, prepare a clean dust-free work area and use clean, degreased tools devoted to precision assembly.



Periodically, the Vacuum Sentry™ should be tested for proper operation.

Disassembly

These instructions refer to figure 3, Vacuum Sentry™ Assembly View:

1. Remove six 10-32 x 7/8 socket head cap screws (9) from bonnet (10)
2. Remove bonnet (10) with solenoid valve (18) still attached.
3. Remove diaphragm / piston assembly (4, 3, & 11) by gently prying up the diaphragm at one edge and pulling free of the body (7) around the full circumference. Inspect the diaphragm for holes, tears, or accumulated contamination. Also inspect the orifices (19) and (20) for blockage. Finally, inspect the nose piece O-ring (5) carefully. If it is scratched or if there is imbedded foreign material, this O-ring must be replaced.



The bulk of service can be done with disassembly to this point. If further disassembly is needed, continue with steps 4-7.

4. Remove four 10-32 x 5/8 socket head cap screws (16) from side port flange (12).
5. Remove side port flange (12) with O-ring (14).
6. Remove six 10-32 x 5/8 socket head cap screws (16) from bottom port flange (8).
7. Remove bottom port flange (8), O-ring (15) and return spring (13). Inspect the seat for scratches, other damage or contamination that could prevent sealing.

Repair of Subassemblies

Piston / Diaphragm Subassembly

1. Remove diaphragm (11) from piston by unscrewing sleeve (3) from the piston using a spanner wrench, or two 1/8" drill bits, in the 1/8 holes provided in the sleeve. Inspect orifices (19) and (20) and clean if necessary. Be careful not to enlarge the orifices, because performance may suffer. Inspect the diaphragm (11) for holes, tears, or accumulated contamination. Discard if damaged
2. Inspect the dry bushings (2) pressed into sleeve (3). These bushings are normally good for several hundred thousand cycles, but they can be replaced when they have worn out. A worn bushing can be identified by excessive exposure of the sintered bronze matrix, which is not normally visible. A modest amount of lead / TEFLON[®] flakes in and around the bushing and pin is normal and does not constitute abnormal wear of the bushing. If there is any doubt about the condition of the bushings, they should be replaced. Removal is readily accomplished by inserting a number 10 machine screw and pulling. There are two 1/4 inch long bushings used in tandem. After removal of the old bushings inspect the bore in the sleeve (3) for debris and burrs. Clean as necessary. Press two new bushings into the bore, one at a time, flush to the top of the sleeve.
3. To reassemble, place diaphragm (11) on the piston with the inner bead down and the outer bead up. See figure 3. A small amount of vacuum compatible grease should be smeared on the sleeve side of the diaphragm / sleeve contact area to prevent puckering of the diaphragm during tightening of the sleeve. Also, if the piston and sleeve have been decreased prior to assembly, then a small amount of vacuum compatible lubrication should be applied to the male threads of the sleeve to prevent seizing of the sleeve to the piston. DuPont KRYTOX[®] GPL 206 is acceptable. Tighten the sleeve hand tight. Do not over tighten, this is not a vacuum grade seal.

Nose Piece O-ring Replacement

1. The nosepiece O-ring (5) should be removed only if a new replacement is available. To remove the old O-ring, insert a sharp pointed tool, such as a machinist's scribe obliquely into the ring. The sharp point must not pass through the seal or the surface of the groove will be damaged. Lift the seal out with the scribe. Use care not to scratch any of the sealing surfaces.

-
2. Prepare the new seal by smearing a very light but continuous coat of a vacuum compatible grease on the O-ring. We recommend DuPont KRYTOX[®] GPL 206, which is a high quality fluorinated grease offering low vapor pressure, excellent temperature stability and is chemically inert. It is important to not skip this step. Tests have indicated that a dry O-ring nose piece O-ring used in a valve that has been closed for more than two hours is subject to a breakaway friction exceeding the modest return spring force.



Note that the return spring has intentionally been designed to be soft so as to minimize the opening pressure burst, thereby necessitating a boundary layer lubrication at the nose piece O-ring to control the breakaway friction between the valve seat and the O-ring.

3. To replace the seal, position the piston (4) so that the groove faces upward. Be sure that the bottom of the groove and surfaces of the new O-ring are free of scratches. If necessary, a suitable solvent may be used to clean the groove. Particulate contamination may be blown off with DUST-OFF[®] or dry nitrogen. Place the prepared O-ring from step #2 above on top of the groove. Place two thumbs on the o-ring at points 180° apart, and push the o-ring into the groove. Avoid twisting the O-ring as it is pushed in. Then push in the opposite intermediate points, and so on, until the ring is uniformly in place.

Bonnet Subassembly

1. The bonnet subassembly consists of the bonnet (10), guide pin (1), and a solenoid valve (18) with fittings. The pin is press fit into the bonnet. The pin is not replaceable, therefore if the guide pin is bent, heavily scored, or loose then the bonnet and the pin will need to be replaced as a unit by a factory replacement part.
2. If necessary, the solenoid valve (18) may be removed by unscrewing from the bonnet. Inspect the small O-ring and seal surfaces for damage. Replace if damaged.

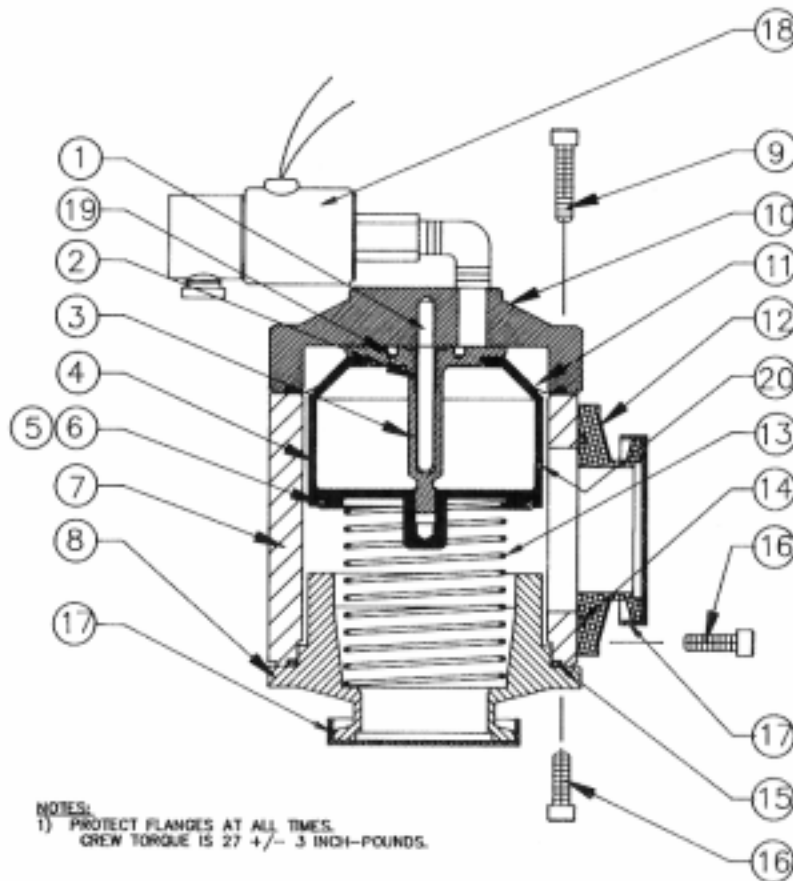
Reassembly

1. Slide the piston / diaphragm subassembly on guide pin (1). With the piston (4) facing up so it does not slide off of the guide pin, place the body (7) down over the piston, flat surface to the diaphragm. Now invert the body with the bonnet held close and align the bolt holes. Insert six 10-32 x 7/8 socket head cap screws (9) and tighten to 27 inch-lb torque.

2. With the bottom flange as shown in figure 3, slide O-ring (15) over the boss. Place the return spring (13) inside the bottom flange, as shown in figure 3. Place the body subassembly from step 1 above onto the bottom flange. Align the bolt holes and insert six 10-32 x 5/8 (16) socket cap screws. Tighten to 27 inch-lb torque.
3. Place the O-ring (14) into the groove on the side of the body and position the flange (12) on the body. Be sure that the O-ring and groove are clean. Insert four 10-32 x 5/8 socket cap screws (16) and tighten to 27 inch - lb torque.
4. Before returning the valve to service it should be leak tested.



Note that power will need to be supplied to the solenoid in order to check the integrity of the body seals as well as the solenoid itself.



Assembly View

Troubleshooting

This section is a guide for solving problems that may occur with the HPS™ Vacuum Sentry™ Valve. Listed below are symptoms with possible causes and suggestions for help.

Valve Cannot Be Pumped Down to High Vacuum

1. Valve leaks from external atmosphere into vacuum system. First check that the solenoid has proper electrical power applied to the coil. If the solenoid appears to be functional, then carefully leak test with a quality leak detector.



With careless leak detection, a leak a large distance away can be picked up and the leaking component not found. Some possible sources of leaks are:

- a. Non-sealing flanges between valve and system may be due to damaged flanges, damaged O-ring, dirt, loose clamps, or incorrect assembly. Locate the problem and assemble correctly.
- b. If a leak signal is obtained at the solenoid / bonnet connection, disassemble, clean, and reassemble.
- c. A leak signal at the solenoid intake indicates a defective solenoid valve. Disassembly of the solenoid valve is not recommended. Install a new solenoid valve.



If the solenoid valve is replaced by a unit not supplied by HPS™, it is the responsibility of the user to insure that it is sufficiently leak tight to meet the specifications.

- d. Leaks are found between the body and the bolted flanges or bonnet. Isolate the offending seal interface and disassemble. Inspect for damage or dirt at the seal surfaces. Clean and reassemble as described above.
2. Valve is dirty and contaminated with a material that is outgassing or blocking the orifices. Correct by thoroughly cleaning the valve.

Valve Leaks in Closed Position

1. Check for proper installation. The valve has been designed to vent the roughing pump upon closure. If the valve has inadvertently been installed backwards it would isolate the pump and vent the system. Reinstall the valve correctly with the flow arrow on the body label pointing toward the mechanical vacuum pump.
2. Nosepiece O-ring leaks. Confirm leak using a leak detector. Replace O-ring as described previously.
3. O-ring (15) leaks. Check for loose screws. Confirm leak using a leak detector. Replace O-ring as described previously.

Valve Closes Too Slowly

1. Inlet filter to solenoid valve is clogged. Clean or replace filter.
2. Solenoid valve is defective. Replace with a new solenoid valve.
3. There is excess friction between bushing (2) and guide pin (1). Clean and repair the bushing and guide pin as described above.
4. The spring is restricted by contamination. Disassemble, clean, or replace.

Valve Opens Too Slowly or Not Completely

1. The orifices are partially blocked. Clean and reassemble.
2. There is excess friction between bushing (2) and guide pin (1). Clean and repair the bushing and guide pin as described above.
3. The diaphragm or spring is contaminated. Disassemble, clean or replace, and reassemble.

Valve Fails to Open

1. The solenoid valve has a leak or will not close properly preventing the evacuation of the chamber over the piston (4). Check to make sure that electrical power has been restored to the solenoid valve. If the solenoid valve is energized then leak check to confirm leak and replace solenoid, if unit is found to be defective.

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2. Foreline between the mechanical pump and Vacuum Sentry™ has a major leak preventing the evacuation of the chamber over the piston (4). Isolate and correct the leak.
 3. Excess friction between bushing (2) and guide pin (1). Clean and repair bushing as described above.
 4. Nosepiece O-ring is stuck to valve seat due to excess heat, contamination or the improper installation of a dry (ungreased) O-ring. Follow the directions in section on nose piece O-ring replacement.
 5. The diaphragm or spring is contaminated. Disassemble, clean or replace, and reassemble.

Closing Causes Large Burst of Air into System

1. Diaphragm is damaged. Replace with a new diaphragm.
2. Diaphragm has become detached from piston (4) and sleeve (3). Inspect and reassemble as described above.

Solenoid Valve is Hot

1. This is a continuous duty valve equipped with Viton seals capable of sustained high temperature operation. A 85° C temperature rise is normal for this valve.
2. Coil and operating voltage / frequency not matched. Change the solenoid coil to one with a voltage / frequency compatible with the pump.
3. The ambient temperature is too high. The ambient temperature near the solenoid is limited to less than 50° C due to the temperature rise inherent in the solenoid valve. Higher temperature rated coils are available on a special request basis if the ambient cannot be controlled to the 50° C temperature limit. Replace the solenoid valve with a new one if the unit is too hot and verify that the ambient air temperature is within limits. It is permissible to remote the solenoid valve up to twelve inches away from the Vacuum Sentry™ using standard 1/4 inch tubing, but this could adversely affect the closing time. An adapter is available from HPS™.



If the solenoid valve is replaced by a unit not supplied by HPS™, it is the responsibility of the user to insure that it is sufficiently leak tight to meet the specifications. Further, the operational characteristics of the Vacuum Sentry™ may be significantly degraded.

Factory Repair

Vacuum Sentry™ was designed for user repair, but occasionally it is necessary to return a valve to the factory. Before shipping, observe the following steps:

1. Contact MKS and obtain a Returned Material Report (RMR) number. Use this number on all packing slips, boxes, and asked to answer these questions:
 - a. What is the problem?
 - b. What are the symptoms and how are they observed?
 - c. What is the application?
 - d. Has the valve been used with any dangerous, toxic, or radioactive substances? See Product Return Policy below.
 - e. Is it an emergency repair?
 - f. Is it a warranty repair? When was the valve shipped to you?
 - g. Who in your organization can answer technical questions about the use of the valve?
2. Prepare the valve for shipment by capping the ports to prevent entry of foreign material and to protect the seal surfaces. Place the valve in a sealed plastic bag, and pack it securely in a sturdy shipping container. Insert a packing slip of letter referencing the RMR number.
3. If inspection shows the problem to be a warranty matter, the valve will be repaired and returned free of charge. If it is not covered by warranty, you will be charged for repairs.

Accessories / Part Replacement

| Item | Quantity | Description | Part Number |
|------|----------|------------------------------------|-------------|
| 1 | 1 | Pin | 100003946 |
| 2 | 2 | Bearing, .19"ID X .25"L | 100003897 |
| 3 | 1 | Sleeve | 100003862 |
| 4 | 1 | Piston NW 40 and NW 50 | 100003861 |
| | or | Piston NW 25 | 100005110 |
| 5 | 1 | O-ring, 2-142, Viton | 100003879 |
| 6 | .01 oz. | Grease, vacuum, KRYTOX™ | 100003907 |
| 7 | 1 | Body | 100003868 |
| 8 | 1 | Flange, bottom, NW 25 | 100003909 |
| | or | Flange, bottom, NW 40 | 100003869 |
| | or | Flange, bottom, NW 50 | 100003911 |
| 9 | 6 | Screw, SHCS, 10-32 x .87"L, SST | 100003937 |
| 10 | 1 | Bonnet | 100003870 |
| 11 | 1 | Diaphragm | 100003864 |
| 12 | 1 | Flange, side, NW 25 | 100003908 |
| | or | Flange, side, NW 40 | 100003866 |
| | or | Flange, side, NW 50 | 100003910 |
| 13 | 1 | Spring | 100003867 |
| 14 | 1 | O-ring, 2-137, Viton | 100003878 |
| 15 | 1 | O-ring, 2-151, Viton | 100003880 |
| 16 | 10 | Screw, SHCS, 10-32 x .62"L, SST | 100001554 |
| 17 | 2 | Protector, flange, NW 25 | 100003046 |
| | or | Protector, flange, NW 40 | 100003047 |
| | or | Protector, flange, NW 50 | 100001737 |
| 18 | 1 | Solenoid valve 120 Volt / 60 Hz | 100003865 |
| | or | Solenoid valve 100 Volt / 50 Hz | 100003898 |
| | or | Solenoid valve 220 Volt / 50-60 Hz | 100003899 |
| | or | Solenoid valve 208 Volt / 60 Hz | 100003900 |
| | or | Solenoid valve 24 Volt / 50-60 Hz | 100003901 |
| | or | Solenoid valve 24 Volt dc | 100003903 |
| 19 | 1 | Orifice | |
| 20 | 1 | Orifice | |
| | 1 | Spanner wrench | 100001695 |



Item numbers refer to figure 3.

Be sure to have on hand the serial number and flange type when ordering replacement parts.

Product Warranty

Extent of the Warranty

MKS Instruments, Inc. HPS™ Division, warrants the HPS™ 145 Vacuum Sentry® and its accessories to be free from defects in materials and workmanship for one (1) year from the date of shipment by HPS™ or authorized representative to the original purchaser (PURCHASER). Any product or parts of the product repaired or replaced by HPS™ under this warranty are warranted only for the remaining unexpired part of its one (1) year original warranty period. After expiration of the applicable warranty period, the PURCHASER shall be charged HPS™ current prices for parts and labor, plus any transportation for any repairs or replacement.

ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE WARRANTY PERIOD. NO WARRANTIES, EXPRESS OR IMPLIED, WILL APPLY AFTER THIS PERIOD.

Warranty Service

The obligations of HPS™ under this warranty shall be at its option: (1) to repair, replace, or adjust the product so that it meets applicable product specifications published by HPS™ or (2) to refund the purchase price.

What Is Not Covered

The product is subject to above terms only if located in the country of the seller from whom the product was purchased. The above warranties do not apply to:

- I. Damages or malfunctions due to failure to provide reasonable and necessary maintenance in accordance with HPS™ operating instructions.
- II. Damages or malfunctions due to chemical or electrolytic influences or use of the product in working environments outside the specification.
- III. Fuses and all expendable items which by their nature or limited lifetime may not function for a year. If such items fail to give reasonable service for a reasonable period of time within the warranty period of the product; they will, at the option of HPS, be repaired or replaced.
- IV. Defects or damages caused by modifications and repairs effected by the original PURCHASER or third parties not authorized in the manual.

Condition of Returned Products

HPS™ will not accept for repair, replacement, or credit any product which is asserted to be defective by the PURCHASER, or any product for which paid or unpaid service is desired, if the product is contaminated with potentially corrosive, reactive, harmful, or radioactive materials, gases, or chemicals. When products are used with toxic chemicals, or in an atmosphere that is dangerous to the health of humans, or is environmentally unsafe, it is the responsibility of the PURCHASER to have the product cleaned by an independent agency skilled and approved in the handling and cleaning of contaminated materials before the product will be accepted by HPS™ for repair and/or replacement. In the course of implementing this policy, HPS™ Customer Service Personnel may inquire of the PURCHASER whether the product has been contaminated with or exposed to potentially corrosive, reactive, harmful, or radioactive materials, gases, or chemicals when the PURCHASER requests a return authorization. Notwithstanding such inquiries, it is the responsibility of the PURCHASER to ensure that no products are returned to HPS which have been contaminated in the aforementioned manner.

Other Rights and Remedies

- I. These remedies are exclusive. HPS™ SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, FOR ANTICIPATED OR LOST PROFITS, INCIDENTAL DAMAGES OR LOSS OF TIME, OR OTHER LOSSES INCURRED BY THE PURCHASER OR BY ANY THIRD PARTY IN CONNECTION WITH THE PRODUCT COVERED BY THIS WARRANTY, OR OTHERWISE. Some states do not allow exclusion or limitation of incidental or consequential damage or do not allow the limitation on how long an implied warranty lasts. If such laws apply, the limitations or exclusions expressed herein may not apply to PURCHASER.
- II. Unless otherwise explicitly agreed in writing, it is understood that these are the only written warranties given by HPS™. Any statements made by any persons, including representatives of HPS™, which are inconsistent or in conflict with the terms of the warranty shall not be binding on HPS™ unless reduced to writing and approved by an authorized officer of HPS™.
- III. This warranty gives PURCHASER specific legal rights, and PURCHASER may also have other rights which vary from state to state.
- IV. For HPS™ products sold outside of the U.S., contact your MKS representative for warranty information and service.

Warranty Performance

To obtain warranty satisfaction, contact the following: MKS Instruments, Inc., at phone number (800) 227-8766. You may be required to present proof of original purchase.

Notes

