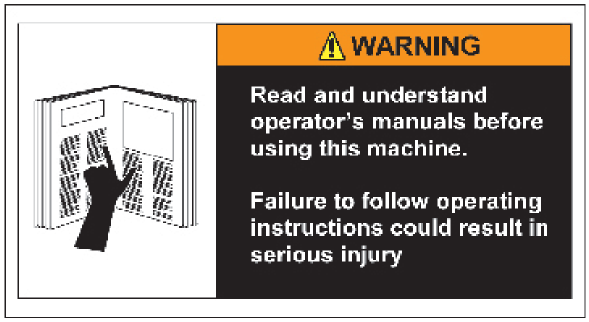
# VRS & VRSH Twin Screw Compressor

*The World's Best Compressors™ For Industrial Refrigeration*


VILTER
Since 1867

EMERSON
Climate Technologies

# Important Note:




**READ CAREFULLY BEFORE INSTALLING AND STARTING YOUR COMPRESSOR.**

The following instructions have been prepared to assist in installation, operation and removal of Vilter Twin Screw Compressors. Following these instructions will result in a long life of the compressor with satisfactory operation.

The entire manual should be reviewed before attempting to install, service or repair the compressor.

A refrigeration compressor is a positive displacement machine. It is designed to pump superheated vapor. The compressor must not be subjected to liquid carry over. Care must be exercised in properly designing and maintaining the system to prevent conditions that could lead to liquid carry over. Vilter Manufacturing LLC is not responsible for the system or the controls needed to prevent liquid carry over and as such Vilter Manufacturing LLC cannot warrant equipment damaged by improperly protected or operating systems.

Vilter Twin Screw Compressors components are thoroughly inspected at the factory, assuring the shipment of a mechanically perfect piece of equipment. Damage can occur in shipment, however. For this reason, the units should be thoroughly inspected upon arrival. Any damage noted should be reported immediately to the Transportation Company. This way, an authorized agent can examine the unit, determine the extent of damage and take necessary steps to rectify the claim with no serious or costly delays. At the same time, the local Vilter representative or the home office should be notified of any claim made.

All inquires should include the Vilter order number, compressor serial and model number. These can be found on the compressor name plate on the compressor.

All requests for information, services and or parts should be directed to:

Vilter Manufacturing LLC
Customer Service Department
5555 South Packard Ave
Cudahy, WI 53110-8904 USA
Telephone: 1-414-744-0111
Fax:1-414-744-3483
e-mail: vilter@execpc.com

Equipment Identification Numbers:

Vilter Order Number: ______________________ Serial Number: ____________
Vilter Order Number: ______________________ Serial Number: ____________
Vilter Order Number: ______________________ Serial Number: ____________
Vilter Order Number: ______________________ Serial Number: ____________

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# Long Term Storage Requirements

The procedure described is a general recommendation for extended storage (over one month of no operation) of Vilter Manufacturing packages and compressors. While this procedure is intended to cover most of the commonly encountered situations, it is the responsibility of the installation firm and end user to address any unusual conditions. We suggest using the accompanying Long Term Storage Log sheet for recording purposes to validate the appropriate procedures.

Prior to start-up, Vilter recommends that a complete system pressure check be performed. Upon verification of the system integrity, a comprehensive evacuation procedure should be completed to ensure a dry system before refrigerant is introduced. The oil circuit of any compressor is to be primed at initial start-up through the oil gauge connection on reciprocating compressors and the pre-lube oil pump on screw compressors.

Warranty of the system remains in effect as described in Section 5, Product Warranty and Procedures.

- If the unit is designed for indoor duty, it must be stored in a heated building.

- If the unit is designed for outdoor duty, and is to be stored outdoors, a canvas tarp is recommended for protection until installation is imminent. Adequate drainage should be provided, by placing wood blocks under the base skid, so that water does not collect inside the base perimeter or low spots in the tarp.

- All compressor stop valves are to be closed to isolate the compressor from the remainder of the system. All other valves, except those venting to atmosphere, are to be open. It is essential that the nitrogen holding charge integrity be maintained.

- Cover all bare metal surfaces (coupling, flange faces, etc.) with rust inhibitor.

- Desiccant is to be installed in the control panel. If the panel is equipped with a space heater, it is to be energized. If the panel does not have a space heater, use a thermostatically controlled 50-watt light bulb. Use an approved electrical spray-on corrosion inhibitor for panel components (relays, switches, etc.)

- All pneumatic controllers and valves (Fisher, Taylor, etc.) are to be covered with plastic bags and sealed with desiccant bags inside.

- System and compressor pressures (unit is shipped with dry nitrogen holding charge approximately 5 psi above atmospheric pressure) are to be monitored, on a regular basis, for leakage. It will be necessary to add a gauge to monitor the system holding charge pressure. If a drop in pressure occurs, the source of leakage must be found and corrected. The system must be evacuated and recharged with dry nitrogen to maintain the package integrity.

- Motors – (NOTE: The following are general recommendations. Consult the manufacturer of your motor for specific recommendations.)

# Long Term Storage Requirements

1) Remove the condensation drain plugs from those units equipped with them and insert silica-gel into the openings. Insert one-half pound bags of silica-gel (or other desiccant material) into the air inlets and outlets of drip-proof type motors.

**NOTE: The bags must remain visible, and tagged, so they will be noticed and removed when the unit is prepared for service.**

2) Cover the unit completely to exclude dirt, dust, moisture, and other foreign materials.

3) If the motor can be moved, it is suggested that the entire motor be encased in a strong, transparent plastic bag. Before sealing this bag, a moisture indicator should be attached to the side of the motor and several bags of silica-gel desiccant put inside the bag, around the motor. When the moisture indicator shows that the desiccant has lost its effectiveness, as by a change in color, the bag should be opened and fresh replacement desiccants installed.

   Whenever the motor cannot be sealed, space heaters must be installed to keep the motor at least 10°F above the ambient temperature.

**NOTE: There is a potential for damage by small rodents and other animals that will inhabit motors in search of warm surroundings or food. Due to this, a possibility of motor winding destruction exists. Sealing motor openings should restrict access to the motor.**

4) Rotate motor and compressor shafts several revolutions (approximately 6) per month to eliminate flat spots on the bearing surfaces. If the compressor unit is installed, wired and charged with oil, open all oil line valves and run the oil pump for 10 seconds prior to rotating the compressor shaft. Continue running the oil pump while the compressor shaft is being turned to help lubricate the surfaces of the shaft seal.

# Installation Section

# Installation

## DELIVERY INSPECTION

Vilter Twin Screw Compressor components are thoroughly inspected at the factory, assuring the shipment of a mechanically perfect piece of equipment. Damage can occur in shipment, however. For this reason, the units should be thoroughly inspected upon arrival. Any damage noted should be reported immediately to the transportation company. This way, an authorized agent can examine the unit, determine the extent of damage and take necessary steps to rectify the claim with no serious or costly delays. At the same time, the local Vilter representative or the home office should be notified of any claim made.

TABLE 1 UNIT WEIGHTS

| VILTER MODEL | CFM | WT# |
|---|---|---|
| VRS 400 | 398 | 4,200 |
| VRS 500 | 479 | 4,700 |
| VRS 600 | 568 | 5,300 |
| VRS 700 | 772 | 5,400 |
| VRS 900 | 852 | 6,400 |
| VRS 1000 | 959 | 7,500 |
| VRS 1200 | 1111 | 8,500 |
| VRS 1300 | 1262 | 8,700 |
| VRS 1500 | 1509 | 8,800 |
| VRS 1700 | 1667 | 11,000 |
| VRSH 1900 | 1879 | 11,400 |
| VRSH 2200 | 2222 | 12,000 |
| VRSH 2700 | 2670 | 16,800 |
| VRSH 3400 | 3337 | 17,500 |
| VRSH 3700 | 3754 | 18,500 |
| VRSH 4500 | 4510 | 19,500 |

Weights are approximate.

## FOUNDATIONS

Vilter Twin Screw Compressor units are basically vibration free machines, therefore, no elaborate foundations are necessary. The floor or foundation upon which the unit will be placed should be designed to support the entire operating weight of the unit. See Table 1 for unit weights.

## LOCATING UNIT - DRIVE COUPLING ALIGNMENT

The Twin Screw Compressor units are shipped with all major components mounted on structural steel. Place the entire unit on the floor on a concrete pad and securely bolt in place. Review local codes and ASHRAE Safety Code for Mechanical Refrigeration. Bolt holes are located in the unit's mounting feet. When locating the unit, provide adequate space for service work. When the compressor unit is in place on the concrete pad, check both lengthwise and crosswise to assure it is level. Use shims and wedges as needed under the mounting feet to adjust the level of the unit.

On twin screw units, the motor and compressor have been roughly aligned at the factory. The coupling center section was shipped loose to allow a check of proper electrical phasing, direction of rotation of the motor and final coupling alignment. The dial indicator alignment method is recommended. Final alignment should be within 0.004 inches total indicator reading in all direction for all models.

## SYSTEM PIPING

Refer to the ANSI/ASME B31.5 Code for Refrigeration Piping. All compressor oil supply and oil return piping has been completed at the factory. The necessary connections to be made to the screw compressor unit will vary depending on the type of oil cooling method purchased. Main line refrigerant suction and discharge connections are always necessary.

Care must be taken to avoid trapping the lines except for specific purposes. When traps are used, the horizontal dimensions should be as short as possible to avoid excessive oil trapping.

Lines for ammonia systems must be of steel pipe with specially designed ammonia service fittings. Common pipe fittings must NEVER be used as they will not provide the same service. Steel pipe is generally used in large installations when joints are welded.

In making up joints for steel pipe, the following procedures should be followed:

For threaded connections, all threads on the pipe and fitting should be carefully cleaned to remove all traces of grease or oil. Threads should then be wiped dry with a lintless cloth. Only thread filling compounds suitable for refrigeration service should be used for making steel pipe joints. These compounds should be used sparingly, and on the pipe only. Do not put any on the first two threads to prevent any of the compound from entering the piping system. Acetylene or arc welding is frequently used in making steel pipe joints, however, only a skilled welder should attempt this kind of work. Take care to see no foreign materials are left in the pipes and remove all burrs formed when cutting pipe.

It is important to avoid short, rigid pipe lines that do not allow any degree of flexibility. This must be done to prevent vibration being transmitted through the pipe lines to the buildings. One method of providing the needed flexibility to absorb the vibration is to provide long lines that are broken by 90° Ells in three directions.

Smaller Halocarbon and Hydroflourocarbon installations use copper pipes with solder type fittings where possible. The use of screw type fittings in Halocarbon systems should be held to an absolute minimum, as these refrigerants, due to their physical properties, will leak through screw type joints.

When drawn copper tubing is used for Halocarbon lines, type "K" or "L" conforming to ASTM B88 should be used. Soft annealed copper tubing conforming to ASTM B280 can also be used for tube sizes not larger than 1-3/8" in outside diameter. These requirements are in accordance with the mechanical code for refrigeration ANSI B9.1-1971. The type of copper tubing to be used for a given pressure is dependent on the strength of the copper at the design temperature. Some local codes forbid the use of Type "L". Therefore, before installation, be sure to check local requirements. Never use type "M" as it does not have adequate wall thickness to withstand the operating pressures. In selecting fittings for Halocarbon piping, only wrought copper fittings should be used. Cast fittings as used for water service are porous and will allow the refrigerant to escape. Note this exception: In larger pipe sizes, wrought fittings are not available. However, specially tested cast fittings are available and these may be used with complete safety.

In larger pipe sizes, wrought fittings are not available. However, specially tested cast fittings are available and these may be used with complete safety.

When soldering copper tubing joints, only silver solder should be used for Refrigerant-22 service. Soft solder such as "50-50" should never be used, as its melting point is to low, lacks mechanical strength, and tends to break down chemically in the presence of moisture.

A second method would be to install flexible pipe couplings as close to the compressor unit as possible with connections run in two different directions, 90° apart. These flexible connections should be installed on both the high and low side lines of the compressor unit.

Hangers and supports for coils and pipe lines should receive careful attention. During prolonged operation of the coils, they may become coated with ice and frost, adding extra weight to the coil. The hangers must have ample strength and be securely anchored to withstand the vibration from the compressor and adequately support the pipe lines.

Water supply and drain connections, and equipment using water, should be installed so all the water may be drained from the system after the plant has been shut down in cold weather. These precautions will avoid costly damage to the equipment due to freezing.

This information is taken from ASHRAE 15-89 and ANSI B31.5. The installing contractor should be thoroughly familiar with these codes, as well as any local codes.

## ELECTRICAL CONNECTIONS

The screw compressor units are shipped with all package mounted controls wired. The standard control power is 115 volts 60 Hertz, single phase. If a 115 volt supply is not available, a control transformer may be required. The power source must be connected to the control panel according to the electrical diagrams.

The units are shipped without the compressor motor starter. Field wiring is required between the field mounted starters and package mounted motors.

Additional control wiring in the field is also required. Dry contacts are provided in the control panel for starting the screw compressor motor. These contacts are to be wired in series with the starter coils. A current transformer is supplied along with the compressor unit, and is located in the motor junction box. This transformer is to be installed around one phase of the compressor motor starter. A normally open auxiliary contact from the compressor motor starter is also required.

Terminal locations for this wiring can be found on the wiring diagram supplied with this unit. Additional aspects of the electrical operation of the screw units are covered in the start up and operation section of this manual.

## TESTING REFRIGERATION SYSTEM FOR LEAKS

Vilter equipment is tested for leaks at the factory. One the most important steps in putting a refrigeration system into operation is field testing for leaks. This must be done to assure a tight system that will operate without any appreciable loss of refrigerant. To test for leaks, the system pressure must be built up. Test pressures for various refrigerants are listed in ANSI B9.1-1971 code brochure entitle “Safety Code for Mechanical Refrigeration”. These pressures will usually suffice, however, it is advisable to check local codes as they may differ. Before testing may proceed, several things must be done.

First, if test pressures exceed the settings of the system, relief valves or safety devices, they must be removed and the connection plugged during the test. Secondly, all valves should be opened except those leading to the atmosphere. Then, open all solenoids and pressure regulators by the manual lifting stems. All bypass arrangements must also be opened. Because of differences in characteristics of the various refrigerants, two different testing methods are necessary.

### A. Ammonia Systems

Dry nitrogen may be used to raise the pressure in an ammonia system to the proper level for the test. The gas may be put into the system through the charging valve or any other suitable opening. Adjust the pressure regulator on the bottle to prevent over-pressurization. Do not exceed the pressure rating on the vessel with the lowest pressure rating.

Carbon Dioxide should NOT be used as a testing gas in a system where ammonia is already dissolved in any moisture remaining. This will cause ammonium carbonate to precipitate when the CO2 is added. If heavy enough, this precipitate may cause the machine to freeze and clog the strainer.

A mixture of four parts water to one part liquid soap, with a few drops of glycerin added, makes a good solution. Apply this mixture with a one inch round brush at all flanges, threaded joints, and welds. Repair all visible leaks. If possible, leave the pressure on over night. A small pressure drop of 5 lbs. Over this period indicates a very tight system.

Remember to note the ambient temperature, as a change in temperature will cause a change in pressure.

After the system is thoroughly tested, open all valves on the lowest part of the system so the gas will float away from the compressor. This prevents any dirt or foreign particles from entering the compressor and contaminating the working parts. The oil should then be charged into the compressor.

Charge a small amount of ammonia into the system and pressurize the system to its respective design pressure. Pass a lit sulfur stick around all joints and connections. Any leaks will be indicated by a heavy cloud of smoke. If any leaks are observed during this test, they must be repaired and rechecked before the system can be considered tight and ready for evacuation.

### B. Halocarbon Refrigerant Systems

“Oil pumped” dry nitrogen, or anhydrous CO2 in this order of preference may be used to raise the pressure to the proper level for testing.

When the proper pressure is attained, test for leaks with the soap mixture previously described. After all leaks are found and marked, relieve the system pressure and repair the leaks. Never attempt to repair soldered or welded joints while the system is under pressure. Soldered joints should be opened and re soldered.

Do not simply add more solder to the leaking joint. After all the joints have been repaired and the system is considered “tight” the system may be tested with refrigerant.

Attach a drum of the refrigerant to be used in the system and allow the gas to enter until a pressure of 5 psig is reached.

Remove the refrigerant drum and bring the pressure to the recommended test level with oil pumped dry nitrogen or CO2. Then check the entire system again for leaks, using a halide torch or electronic leak detector. Be sure to check all flanged, welded, screwed and soldered joints, all gasketed joints, and all parting lines on castings. If any leaks are found, they must be repaired and rechecked before the system can be considered tight again, remembering that no repair should be made to welded or soldered joins while the system is under pressure.

### C. Evacuating The System

A refrigeration system operates best when only refrigerant is present. Steps must be taken to remove all air, water, vapor, and all other non-condensables from the system before charging it with refrigerant. A combination of moisture and refrigerant, along with any oxygen in the system, can form acids or other corrosive compounds that corrode internal parts of the system.

To properly evacuate the system, and to remove all non-condensables, air and water vapor, use a high vacuum pump capable of attaining a blanked off pressure of 50 microns or less. Attach this pump to the system and allow it to operate until system pressure is reduced somewhere below 1000 microns. Evacuation should not be done unless the room temperature is 60F or higher.

Attach vacuum gauge(s), reading in the 20 to 20,000 micron gauge range, to the refrigerant system. These gauge(s) should be used in conjunction with the high vacuum pump. The reading from the gauge(s) indicates when the system has reached the low absolute pressure required for complete system evacuation.

Connect the high vacuum pump into the refrigeration system by using the manufacturer’s instructions. Connect the pump both to the high side and low side of the system, to insure system evacuation. Attach the vacuum gauge to the system in accordance with the manufacturer’s instructions.

A single evacuation of the system does not satisfactorily remove all of the non-condensable, air and water vapor. To do a complete job, a triple evacuation is recommended.

When the pump is first turned on, bring system pressure to as low a vacuum level as possible, and continue operation for 5 to 6 hours.

Stop the pump and isolate the system. Allow the unit to stand at this vacuum for another 5 to 6 hours. After this time, break, the vacuum and bring the system pressure up to 0 psig with dry nitrogen.

To begin the second evacuation, allow the pump to operate and reduce the pressure again to within 50 to 1000 microns. After this reading is reached, allow the pump to operate 2 or 3 hours. Stop the pump and let the system stand with this vacuum. Again using dry nitrogen, raise the system pressure to zero.

For the third evacuation, follow the previous procedure with the pump operating until system pressure is reduced below the 1000 micron level. Run the pump an additional 6 hours and hold the system for approximately 12 hours at low pressure. After this, again break the vacuum with dry nitrogen and allow the pressure in the system to rise slightly above zero pounds (psig). Install new drier cartridges and moisture indicators. Charge the system once more below the 1000 micron level and use the refrigerant designed for the system.

When properly evacuating the system as outlined above, the system is dry, oxygen-free and free of non-condensables. The piping should not be insulated before the evacuation process is started. If moisture is in the system before evacuating, it condenses in low places and freezes. If this happens, it can be removed by gently heating the trap farthest away from the vacuum pump. This causes the ice to melt and water to boil. Water vapor collects in the next trap towards the vacuum pump. This process should be repeated until all pockets of water have been boiled off, and the vacuum pump has had a chance to remove all the water vapor from the system.

## UNIT OIL CHARGING

The compressor unit is shipped from Vilter with no oil charge. The initial oil charge can be made through the drain valve at the oil receiver/separator. Vilter motor driven and manually operated oil chargers are available for this purpose. Once the unit has been started and is operating above 50% capacity, oil may have to be added to bring the oil level to the normal operating point. With the unit operating, oil should be added through the charging connection at the suction strainer. The normal operating level is between the (2) sight glasses on the oil separator. See Table 2 for approximate oil charge requirements.

**TABLE 2. OIL CHARGE**

| Oil Sep. Size | *Approximate Oil Charge – Gallons |
|---|---|
| VRS Models | |
| 16” | 20 to 27 |
| 20” | 22 to 31 |
| 24” | 40 to 50 |
| 30” | 60 to 75 |
| 36” | 95 to 105 |
| 42” | 145 to 165 |
| VRSH Models | |
| 36” | 95 to 105 |
| 42” | 145 to 165 |
| 48” | |
| 54” | |

* Based on nember of oil filters method of oil cooling

The oil level may be above the top sight glass at this time. Later, when the unit is placed in operation, there will be some drop in the oil level as the various oil lines, oil filter and other piping becomes charged with the normal amount of oil that will be in circulation. This drop in oil level should bring the level in the oil receiver/separator into the normal operating range. Do not mix oils.

### A. Oil For Screw Compressors

Due to the need for adequate lubrication, Vilter recommends only the use of Vilter lubricants, designed specifically for Vilter compressors. With the extensive research that has been performed, we are able to offer refrigerant specific lubricating oils. Use of oil not specified or supplied by Vilter will void the compressor warranty.

Please contact your local Vilter representative or the Home Office for further information.

## SYSTEM REFRIGERANT CHARGING

***CAUTION***

***When charging the system, make sure the compressor unit is pressurized from the discharge side of the compressor. Pressurizing the compressor from the suction side may cause rotation of the compressor, without oil supply, which could lead to internal damage.***

After the system is leak-free and evacuation has been completed, it is ready for charging. Before actual charging, however, the entire operation of the refrigeration system should be inspected as outlined below:

### A. Low Side Equipment

1. Fans on air handling equipment running.
2. Pumps on water cooling equipment running.
3. Proper location and attachment of thermostatic expansion valve bulb to suction line.
4. Correct fan and pump rotation.
5. Evaporator pressure regulators and solenoid valves open.
6. Water pumps and motors correctly aligned.
7. Belt drives correctly aligned and tensioned.
8. Proper voltage to motors.

### B. Compressors

1. Proper oil level.
2. Voltage agrees with motor characteristics.
3. Properly sized motor fuses and heaters.
4. Direct drivers aligned and couplings tight.
5. All suction and discharge valves open.
6. All transducers and RTD’s calibrated and reading correctly.

### C. Condensers

1. Water available at water cooled condensers and supply line valve open.
2. Water in receiver of evaporative condenser and makeup water available.
3. Correct rotation of pump and fan motors.
4. Belt drives aligned and tensioned correctly.
5. Pump, fans and motors lubricated.

### D. Controls

Controls should be at the initial set points. See microprocessor manual for further information.

### E. Initial Charging – High Side Charging

There are two methods of charging refrigerant into the system, through the "high side" or through the "low side". High side charging is usually used for initial charging as filling of the system is much faster. Low side charging is usually reserved for adding only small amounts of refrigerant after the system is in operation.

High side charging of refrigerant into the system is accomplished as follows:

1. Connect a full drum of refrigerant to the liquid charging valve. This valve is generally located in the liquid line immediately after the king or liquid line valve. Purge the air from the charging line.

2. Invert the refrigerant drum if the drum is not equipped with "Liquid" and "Vapor" valves, and place in such a position so the liquid refrigerant only can enter the system. Close the liquid line or king valve, if it is not already closed. Open the "Liquid" charging valve slowly to allow refrigerant to enter the system. The vacuum in the system will draw in the refrigerant.

   It is important that, during this operation, air handling units be running and water is circulating through the chillers. The low pressures on the system can cause the refrigerant to boil at low temperature and possibly freeze the water if it is not kept circulating.

   Water freezing in a chiller can rupture the tubes and cause extensive damage to the system. It would be desirable to charge the initial amount of refrigerant without water in the shell and tube equipment to eliminate the possibility of freeze up.

3. After some refrigerant has entered the system, the compressor unit starting procedure may be followed. See Start-Up and Operation Section of this manual.

4. Continue charging refrigerant into the system until the proper operating requirements are satisfied. Then, close the liquid charging connection and open the liquid line valve allowing the system to operate normally. To check that enough refrigerant has been added, the liquid sight glass should show no bubbles, and there will be a liquid seal in the receiver. If these two conditions are not satisfied, additional refrigerant must be added.

5. When sufficient refrigerant has been charged into the system, close the charging and drum valves. Then remove the drum from the system.

6. During the charging period, observe the gauge carefully to insure no operating difficulties. Watch head pressures closely to make sure the condensers are functioning properly.

   Since it is usually necessary to use several drums when charging a system, follow the procedures in paragraphs E1 and E2 of the above description when attaching a new drum. After charging, the refrigerant drums should be kept nearby for several days as it is sometimes necessary to add more refrigerant as the system "settles down".

## MAINTENANCE SUGGESTIONS

Careful checking of a refrigeration system for leaks and proper operation of all components upon installation will start the system on its way to a long life of satisfactory service. To ensure the desired trouble-free operation, however, a systematic maintenance program is a prerequisite. The following maintenance schedule is suggested.

### A. Daily

1. Check oil levels.

2. Check all pressure and temperature readings.

3. Check micronic oil filter inlet and outlet pressures for excessive pressure drop. Change filter when pressure drop exceeds 15 psi or every six months, whichever occurs first. For proper procedure for changing micronic oil filter and for charging oil into the system, see Operation Section.

4. Clean strainers each time filter cartridge if replaced.

5. Check compressor sound for abnormal noises.

6. Check shaft seals for excessive oil leakage. A small amount of oil leakage is normal. This allows lubrication of the seal faces.

### B. Weekly

(Items 1 thru 6 above plus 7 thru 9)

7. Check the refrigeration system for leaks with a suitable leak detector.

8. Check oil pressures and review microprocessor log and log sheets.

9. Check refrigerant levels in vessels.

### C. Monthly

(Items 1 thru 8 above plus 9 thru 13)

10. Oil all motors and bearings. Follow manufacturer's instructions on lubrication.

11. Check calibration and operation of all controls, particularly safety controls.

12. Check oil cooler for any evidence of corrosion, scaling or other fouling.

13. Operate compressor capacity through the range both automatically and manually.

### D. Trimonthly

(About 2000 operating hours)

Check movement of compressor rotor at drive coupling end to determine bearing float. (Refer to Service Section.)

### E. Yearly

(Items 1 thru 13 and "D" above plus 14 thru 28)

14. Check entire system thoroughly for leaks.

15. Remove all rust from equipment, clean and paint.

16. Flush out sediment, etc. from water circuits.

17. Clean all oil strainers.

18. Clean suction strainer – compressors.

19. Check motors and fans for shaft wear and end play.

20. Check operation and general condition of microprocessor and other electrical controls.

21. Clean all water strainers.

22. Check drains to make sure water will flow away from equipment.

23. Drain and clean entire oil system at receiver drain. Recharge with new clean moisture free oil. For proper procedure for changing micronic oil filter and charging oil into the system, see Start-Up and Operation section.

24. Check compressor coupling. For integrity and alignment.

25. Check oil pump for wear.

26. Check the calibration of the microprocessor pressure transducers and RTD's for accuracy.

27. Check mounting bolts for compressor and motor.

### System Leaks

There are any number of reasons why leaks develop in a refrigeration system (i.e. such as drying out of valve packing, yielding of gaskets, improper replacement of valve caps and loosening of joints due to vibration). For these reasons, the need for periodic leak testing cannot be overemphasized. Similarly, when any service operations are performed on the system, care should be exercised to insure all opened flanges are tightened, all plugs that were removed are replaced with a suitable thread filling compound, all packing glands on valve stems are tightened, and all valve caps are replaced. When operation is restored, all joints opened or any valves moved during the servicing should be checked for leaks.

### G. Year Round Operation

On a continual basis:

1. Guard against liquid slugging of compressor.

2. Maintain unit in clean condition and paint as necessary.

3. Grease valve stems and threads for the valve caps.

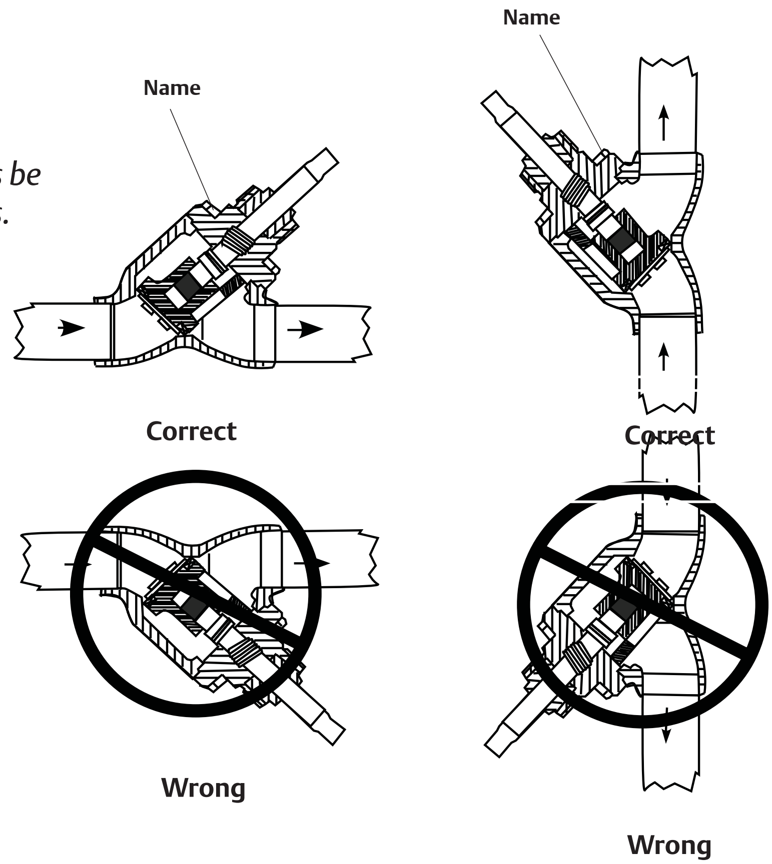
   When refrigeration equipment is operated 24 hours a day year round, it is highly recommended that a yearly check of all internal parts be made (see Service Section). While the highest material standards are maintained throughout all Vilter compressors, continuous operation and any presence of dirt may prove injurious to the machine. To forestall needless shutdowns or prevent possible machine breakdowns, the side covers should be removed yearly, and a visual inspection be made of the internal parts. In this way, a small amount of time spent checking machine conditions once a year may prevent extensive shutdowns later with subsequent product loss and expensive repairs.

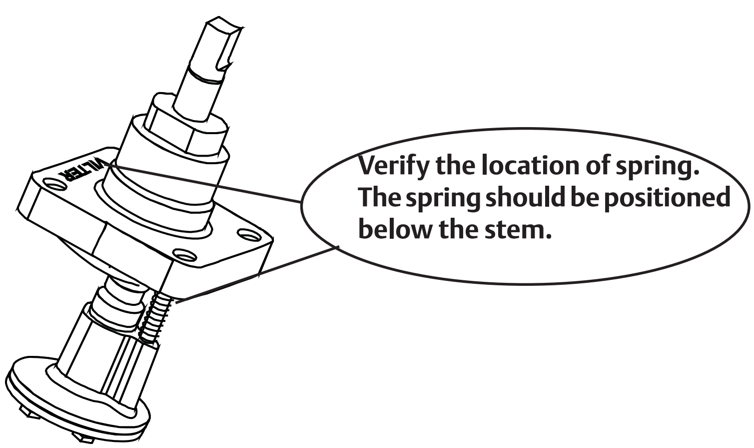
### Coupling Information

All coupling information can be found in the vnedior section of this manual.

# “Stop Check” Installation

*Stem should always be positioned upwards.*




**Installation:** The new design will apply only to the 2” thru 4” stop valves. Retrofitting a field installation will require replacing the bonnet assembly.

The bonnet must be installed with the spring towards the bottom (see illustrations above), the spring should be positioned below the stem. The drill fixture is designed so that the hole for the spring will always be drilled on the opposite side from the cast-in Vilter name on the bonnet. From the outside of the valve, the casting numbers must always be towards the top of the valve.

***See Operation Section on Stop Check Operation.***

# Operation

# Notice on using Non-Vilter Oils

Oil and its additives are crucial in refrigeration system performance. Vilter Manufacturing will NOT APPROVE non-Vilter oils for use with Vilter compressors. Due to the innumerable choices available it is not possible for us to test all oils offered in the market place, and their effects on our equipment, as we can with our own lubricants.

We realize that customers may choose compressor lubricants other than Vilter branded oil. This is certainly within the customers' right as owners of the equipment. When this choice is made, however, Vilter is unable to accept responsibility for any detrimental affects those lubricants may have on the equipment or system performance and durability.

Should a lubrication related system issue occur with the use of non-Vilter oils, Vilter may deny warranty upon evaluation of the issue. This includes any parts' failure caused by inadequate lubrication.

Certainly, there are many good refrigeration lubricants in the market place. The choice of a lubricant for a particular application involves consideration of many aspects of the lubricant and how it and its additive package, will react in the various parts of the entire refrigeration system. It is a complex choice that depends on a combination of field experience, lab and field-testing, and knowledge of lubricant chosen. Vilter will not accept those risks other than for our own compressor lubricants.

## OIL SYSTEM

### A. Oil Charge

Charge the combination oil receiver/separator with the proper quantity of lubricating oil (see Installation Section).

***CAUTION***
***It is imperative you charge the oil into the receiver/separator prior to energizing the control panel to prevent burning out the immersion heater in the separator/receiver.***

During operation, maintain the receiver/separator oil level in the normal operating range between the two bullseye sight glasses. If the oil level is visible only in the lowest sight glass, add oil to the operating compressor through the connection located at the compressor suction inlet. Pump oil into the compressor until the oil level in the separator is between the two bullseye sight glasses. Watch this level carefully to maintain proper operation. Never allow the oil to reach a level higher than indicated on the highest sight glass, since this may impair the operation and efficiency of the oil separator portion of this combination vessel.

### B. Oil Filters

Change the oil filter after the first 200 hours of operation, as noted on the hour meter. Thereafter, replace the filter every six months, or when the oil pressure drop through the filter reaches 15 psi, whichever occurs first. The pressure drop across the filter is read on the microprocessor panel. Check the pressure drop and record it daily.

To prepare for the removal of the filter, shut down the compressor. Isolate the filter housing appropriately. If unit is equipped with duplex filter housings the unit does not have to be shut down, however the filter to be serviced must be isolated before the tank or bowl can be opened.

**1. Filter Removal and installation, all VRSH Units.**

Release the pressure in the oil filter housing by opening the bleed valves at the stop valve in the block and bleed assembly, or at the bleed valve for the oil filter housing. Be sure to follow all Local, State and Federal ordinances regarding the recovery of refrigerants.

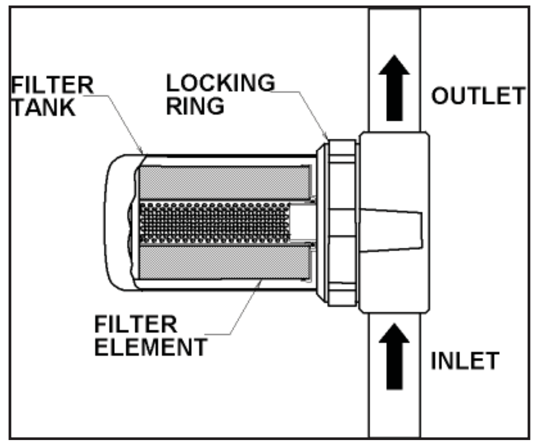



FIGURE 1.
TYPICAL CANISTER TYPE FILTER CROSS SECTION

Drain the filter bowl or housing in to an appropriate container and dispose of the oil in a appropriate manner following all Local, State and Federal ordinances regarding the disposal of used refrigeration oil.

Loosen and remove the locking ring on filter tank by turning in a counter clockwise direction. Remove filter tank with the used element.

Remove the filter element from the tank. Before reassembling, thoroughly clean the tank to lengthen the life span of the filter element.

Wet the threads and O-ring on the head and the O-ring in the new element with clean refrigeration oil.

***CAUTION***
***Do not use a pipe wrench, hammer or any other tool to tighten the locking ring.***

Insert new element into the filter tank with the open end visible. Attach tank to head and HAND TIGHTEN the locking ring.

The filter housing can be evacuated and then slowly pressurized to check for leaks before returning to service.

**2. Filter Removal, VRSH (after 5/1/00) when using Vilter Part Numbers 3111A (16" Simplex), or 3112A (39"Simplex) oil filter housings.**

Release the pressure in the oil filter housing by opening the bleed valves at the stop valve in the block and bleed assembly, or at the bleed valve for the oil filter housing. Be sure to follow all Local, State and Federal ordinances regarding the recovery of refrigerants.

Drain the filter bowl or housing in to an appropriate container and dispose of the oil in a appropriate manner following all Local, State and Federal ordinances regarding the disposal of used refrigeration oil.

Loosen and remove the cover on the bowl of the filter tank by turning it in a counter clockwise direction. Remove the used element.

Wet the O-ring in the new element with clean refrigeration oil. Insert the new element into the filter tank with the closed end visible and attach the cover to the bowl. ***HAND TIGHTEN*** the cover.

The filter housing can be evacuated and then slowly pressurized to check for leaks before returning to service.

**3. Filter Removal, VRSH Units (after 5/1/00) when using Vilter Part Numbers 3109A (16" Duplex), or 3110A (39" Duplex) oil filter housings**.

Isolate the bowl to be worked on by turning handle. The handle will cover the drain valve of active element. Close commuter valve in center of handle. Release the pressure in the isolated bowl by bleeding through the stop valve on the oil filter cover for Duplex (Vilter Part #3109A or 3110A), or through the stop valve for the oil filter housing. Be sure to follow all Local, State and Federal ordinances regarding the recovery of refrigerants.

Drain the filter bowl or housing in to an appropriate container and dispose of the oil in a appropriate manner following all Local, State and Federal ordinances regarding the disposal of used refrigeration oil.

Loosen and remove the cover on the bowl of the filter tank by turning it in a counter clockwise direction. Remove the used element.

Wet the O-ring in the new element with clean refrigeration oil. Insert the new element into the filter tank with the close end visible and attach the cover to the bowl. ***HAND TIGHTEN*** the cover.

The filter housing can be evacuated and then slowly pressurized by opening the commuter valve on handle. This will pressurize the housing. Check for leaks. The filter can now be returned to service. Repeat for other filter bowl if needed.

**4. Filter Removal, VRSH Units using Vilter Part Number 1833C oil filter elements.**

Release the pressure in the oil filter housing by opening the bleed valves at the stop valve in the block and bleed assembly, or at the bleed valve for the oil filter housing. Be sure to follow all Local, State and Federal ordinances regarding the recovery of refrigerants.

Drain the filter bowl or housing in to an appropriate container and dispose of the oil in a appropriate manner following all Local, State and Federal ordinances regarding the disposal of used refrigeration oil.

Unscrew the bolts holding the cover flange to the tank. Remove the cover flange and spring plate. Pull out the filter element(s). Before reassembling, thoroughly clean the tank and spring plate to lengthen the life span of the filter element(s).

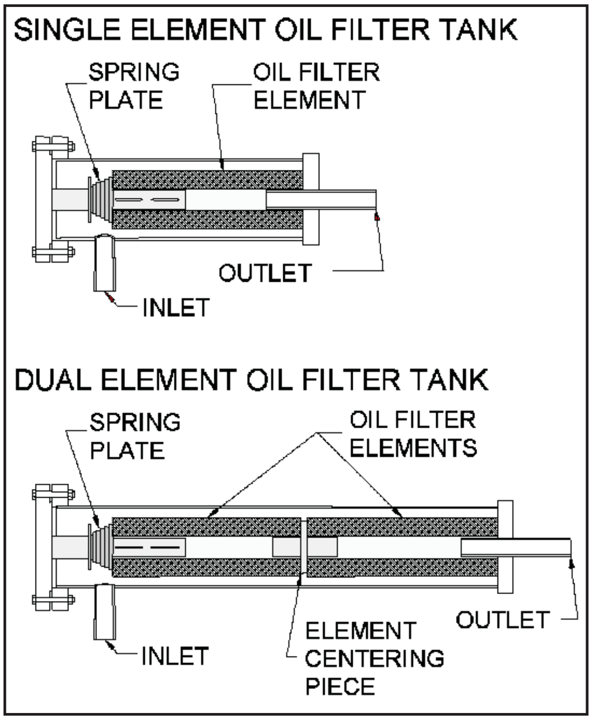



FIGURE 3.
1833C FILTER ELEMENT TANKS

To replace the filter element(s), on single element tanks, insert the element and make sure it fits onto the outlet connection. Install spring plate, and bolt the cover assembly in place. On units equipped with dual element tanks, insert inner element and make sure it fits onto the outlet connection. Put the centering piece on the outer element and slide into tank making sure the center piece fits into the inner element. Put spring plate on outer element and bolt the cover assembly in place.

***CAUTION***
***When changing filter, discard clogged filter only. Save and reuse spring plate and centering piece. This filter MUST be installed with the spring plate. A compressor that is allowed to operate without the spring plate is running with unfiltered oil.***

The filter housing can be evacuated and then slowly pressurized to check for leaks before returning to service.

## C. Oil Pressure Regulating

On units with a full time oil pump, the back pressure regulator, in the oil supply line from the separator, controls upstream pressure to the compressor bearings and should be adjusted to hold the oil pressure at 30 psi above discharge pressure. Excess oil not required for bearing lubrication is passed through the regulator and flows into the separator.

## D. Oil Cooling

### 1. Water Cooled Oil Cooler

In lieu of the three way oil temperature valve to control the temperature of the oil used for lubrication and cooling of the compressor, it is required to install a water regulating valve and solenoid valve combination to control the water supply to the oil cooler. The water inlet connection should be made on the bottom and the outlet connection on the top. The water supply is controlled by the water regulating valve to maintain the oil temperature at approximately 120°F.

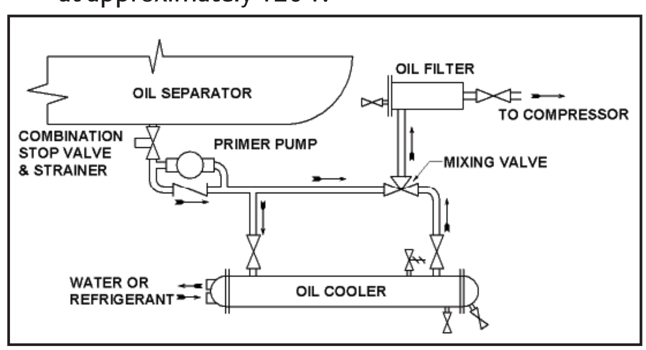



FIGURE 4.
TYPICAL WATER COOLED OIL COOLER DIAGRAM

The solenoid valve provides positive water shut-off when the compressor is not in operation.

A temperature of 150°F is considered high in most circumstances and the compressor is protected by a safety control to prevent operation of the compressor above this temperature. Unless otherwise specified, the oil cooler is sized for an 85°F water inlet temperature and 10°F temperature rise.

## 2. Liquid Injection Oil Cooling

The components are furnished with liquid injection for a typical system. The liquid solenoid valve opens whenever the compressor is in operation. The thermostatic expansion valve controls the flow of liquid refrigerant to the compressor injection port in response to the discharge temperature. The discharge temperature is maintained at 130°F for ammonia and 140°F for R-22, R-507, R-404a and R-134 and R-290. The discharge temperature can be adjusted either of two ways if there is a Sporlan expansion valve. Note that if there is a Danfoss expansion valve the outlet pressure regulator is not included and not required. First, the small outlet pressure regulator can be used to adjust superheat. Normally, this regulator should be adjusted to maintain 70 psig pressure at the external equalizing port of the expansion valve. Raising the pressure beyond 70 psig tends to raise the discharge temperature, while lowering the pressure lowers the discharge temperature. Secondly, the standard superheat adjusting screw on the thermostatic expansion valve can be used to adjust the discharge temperature.

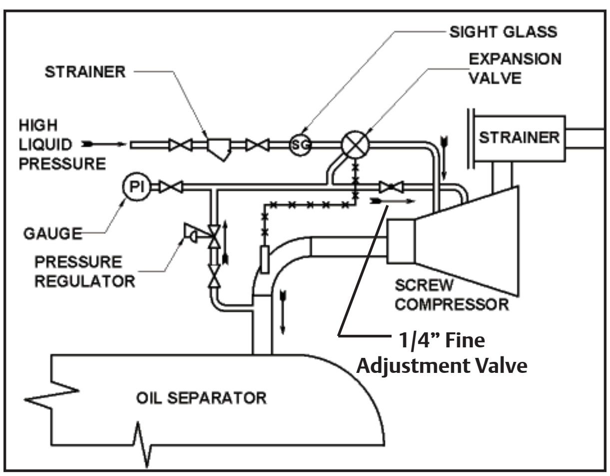



FIGURE 5.
TYPICAL LIQUID INJECTION OIL COOLING SCHEMATIC DIAGRAM

Liquid injection cooling on booster compressors is handled in the following manner. Using high pressure liquid, the point of injection can be the discharge line and no horsepower penalty is paid by injecting liquid into the compressor discharge line. In some cases to reduce excessive oil foaming in the separator, the liquid may be injected directly into the compressor. With the Sporlan expansion valve the high pressure gas source normally used for the pressure regulator would be compressor discharge pressure. Since, on a booster unit, this intermediate pressure is very rarely as high as the nominal setting of 70 psig, high stage discharge gas is used.

On high stage compressors, the liquid is injected directly into the compressor. However, there is a horsepower penalty when the liquid is injected into the compressor. This will vary with refrigerant and operating condition. The liquid is injected into the compressor at a point in the compressor cycle that minimizes the brake horsepower penalty

## 3. V-PLUS Oil Cooling System

This system consists of a liquid pump, shut-off valves, motor, solid state variable speed controller and solid state temperature controller.

The pump and solenoid valve cycle on and off in parallel with the compressor drive motor. The temperature controller receives a temperature signal from the sensor located in the discharge and oil lines and in turn, sends a signal to the motor speed controller. As the oil and desupserheating load varies, the temperature controller adjusts the speed of the pump/motor combination to maintain a constant oil temperature.

***NOTE:***
***See separate V-PLUS® instruction manual for detailed start-up and operation.***

## 4. Thermosyphon Oil Cooling

Using a brazed plate or an one pass shell and tube type vessel, similar to the water cooled oil cooler, oil is circulated on the shell side and liquid refrigerant from the receiver is circulated through the tubes.Thermosyphon systems use a 3-way temperature sensing control valve to regulate oil at 120°F. Oil is bypassed around the thermosyphon oil cooler. When oil is higher than 120°F, the oil is passed through the thermosyphon oil cooler.
A 1/4" tubing line w/valve adds high pressure gas

to the oil to quiet the sound of injection. Open this valve in small amounts, until noise subsides.

The closed type cooling circuit is free from the fouling problems associated with open circuit water cooling. Since the oil cooling load is rejected in the condenser, this type of cooling is practical. The temperature limits here are the same as those regarding the water cooled oil coolers.

## CONTROL SYSTEM

Equipped for automatic operation, the screw compressor unit has safety controls to protect it from irregular operating conditions, an automatic starting and stopping sequence, capacity and volume ratio control systems.

Check all pressure controls with a remote pressure source, to assure that all safety and operating control limits operate at the point indicated on the microprocessor.

The unit can be equipped with optional block and bleed valves that are used to recalibrate the pressure transducers. To use the block and bleed valves to recalibrate the pressure transducers, the block valve is shut off at the unit and the pressure is allowed to bleed off by opening the bleed valve near the pressure transducer enclosure. The transducer can then be calibrated at atmospheric pressure (0 psig), or an external pressure source with an accurate gauge may be attached at the bleed valve.

The discharge pressure transducer cannot be isolated from its pressure source, so it is equipped with only a valve to allow an accurate pressure gauge to be attached and the pressure transducer calibrated at unit pressure.

Recheck the transducers periodically for any drift of calibration.

## Screw Compressor Control And Operation

### 1. Starting, Stopping and Restarting the Compressor

Before the screw compressor unit may start, certain conditions must be met. All of the safety setpoints must be in a normal condition, and the suction pressure must be above the low suction pressure setpoint to assure that a load is present. When the “On-Off” switch or “Manual-Auto” button is pressed, the oil pump will start. When sufficient oil pressure is built up and the compressor capacity control and volume ratio slide valves are at or below10%, the compressor unit will start.

If the compressor is in the automatic mode, it will now load and unload in response to the system demands.

Stopping the compressor unit can be accomplished a number of ways. Any of the safety setpoints will stop the compressor unit if an abnormal operating condition exists. The compressor unit “On-Off” or stop button will turn the compressor unit off as will the low pressure setpoint. If any of these conditions turns the compressor unit off, the capacity slide valve unloader will immediately energize to drive the slide valve back to 5% limit. If there is a power failure, the compressor unit will stop. If the manual start on power failure option is selected (see appropriate Microprocessor Instruction Manual), restarting from this condition is accomplished by pushing the reset button to insure positive operator control. If the auto start on power failure option is selected (see appropriate Microprocessor Instruction Manual), the compressor unit will start up after a waiting period. With both options, the compressor slide valve must return below their respective 5% limit before the compressor unit can be restarted.

### 2. Oil Separator Heater

The oil separator heater keeps the oil in the separator from becoming too viscous and helps to boil off refrigerant entrained in the oil in the receiver section of the separator.

The heater is automatically turned on/off by a setpoint in the micro-processor.

### 3. Econ-O-Mizer Controls

Econ-O-Mizer® systems are of three types: direct expansion, flooded or flash. Systems include a back pressure regulator to control intermediate pressure.

# Operation

## Safety Setpoints

A detailed explanation of all safety setpoints can be found in the appropriate Microprocessor Instruction Manual.

**1. Oil Pressure**

Low oil pressure differential stops the compressor unit when there is an insufficient difference in pressure between the oil manifold and suction.

**2. Discharge Pressure**

High discharge pressure cutout stops the compressor unit, when the discharge pressure in the oil separator exceeds the setpoint.

**3. Suction Pressure**

Low suction pressure cutout stops the compressor unit when the suction pressure drops below the setpoint.

**4. Oil Filter Differential**

High oil filter differential cutout stops the compressor unit when the difference between the outlet and inlet of the filter exceeds the setpoint.

**5. Oil Temperature**

The oil temperature cutout stops the compressor unit when the oil temperature is too high or too low.

**6. Discharge Temperature**

The high discharge temperature cutout stops the compressor unit when the discharge temperature exceeds the setpoint.

## INITIAL START-UP

## Setting of Controls

Refer to the appropriate Microprocessor Instruction Manual for a list of initial settings.

## Valve Settings

1. The suction stop/check valve is designed to operate as a stop valve (manually open or closed) or a check valve. The valve is normally positioned in the automatic mode during unit operation. Please refer to the tag on the valve to set it in the automatic position.

2. The ¼" valve by passing the suction stop or check valve should be partially open during operation. The valve is to be set to equalize the unti within 10-15 min. This valve must be adjusted to minimize oil loss when compressor stops.

3. The discharge stop/check valve is designed to operate as a stop valve (manually open or closed) or a check valve. The valve is normally positioned in the automatic mode during unit operation. Please refer to the tag on the valve to set it in the automatic position.

4. Manually open the oil isolating valve at the oil separator outlet connection.

5. Open the isolating valve(s) before and after the oil filter housings.

6. On packages with a full time oil pump, make sure the manual opening stem on the oil regulating valve is in the auto position. See manufacturer's literature for details.

## Oil Separator

7. Manually open the stop valve on the oil bleed return line from the element section and open the expansion valve 1/3 of a turn or until no oil is backing up in sight glass.

8. The purpose of the oil bleed return assembly is to collect any oil that passes through the oil separating element and returns that oil to the compressor. The hand expansion valve should be adjusted to prevent an oil level from forming in the sight glass when the compressor is at 100% capacity. Generally 1/3 to 1 turn open is satisfactory. (See Figure 7)

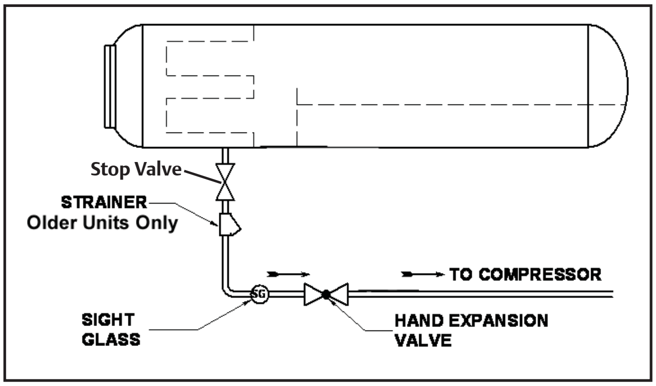



FIGURE 7.
OIL SEPARATOR BLEED LINE

## V-PLUS Oil Cooling

* Applies only to units with V-PLUS® oil cooling.

Refer to V-PLUS manual for detailed instructions.

*9. Manually open the stop valve at the inlet and outlet of the V-PLUS system.

*10. Open the needle valve in the ¼" oil supply line to the V-PLUS pump.

*11. The manual opening stem on the solenoid valve should be in the automatic position (turned counter clockwise or out).

## Liquid Injection Oil Cooling

** Applies only to units with Liquid Injection Oil Cooling.

**9. Open the stop valve at the inlet of the pressure regulator.

**10. Open the metering valve 1/8 to 1/4 of a turn.

**11. Adjust the manual opening stem to the liquid line solenoid. (Refer to Vendor Section for details.)

**12. The pressure regulator may require adjustment after the compressor is running. (Refer to the Vendor Section on details of how to adjust regulator.) The regulator should be adjusted to maintain approximately 70 psig on the external equalizing connection of the TX valve. The discharge temperature is maintained at 130°F for ammonia and 140°F for R-22, R-507, R-404a and R-134 and R-290.

To adjust oil temperature up or down, raise or lower the pressure setting on the regulator. It should not be necessary to adjust the superheat setting on the TX valve.

## Water Cooled Oil Cooler

*** Applies only to units with water cooled oil cooler.

***9. The water supply to the cooler should be opened.

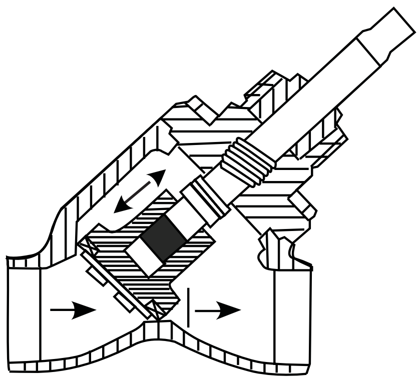
***10. Verify the water solenoid valve does open with the compressor motor starter. (if supplied)

*****11. Open 1/4" high pressure gas line valv piped to oil injection line just enough to quiet compressor at 100% capacity.**

## Compressor Pre Start-Up Check List

***Before proceeding with actual starting of the compressor, the items listed on the "Pre Start-Up Check List" must be verified. Time and money will be saved before the Vilter start-up man arrives.***

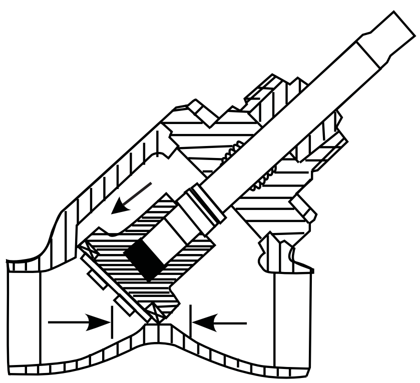
# "Stop Check" Operation



## AUTO

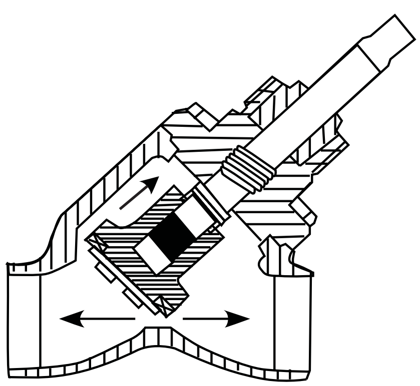
In the "Auto Position", the stop valve is operating as a check valve, allowing flow in the directions of the arrows.

To set the valve to the automatic position, fully close the valve, and turn the stem out as indicated by the chart below.



## CLOSED

In the manually "Closed Postion", the stop check is operating as a conventional stop valve, not allowing flow in either direction.



## OPEN

In the manually " Open Position", with the valve stem fully back seated, the valve disc is lifted slightly, allowing flow in either direction.

**For Normal Operating Position**

| Valve Size | 1.5" | 2" | 2.5" | 3" | 4" | 5" | 6" | 8" |
|---|---|---|---|---|---|---|---|---|
| Number of Turns Open **(from closed position)** | 2 | 2.25 | 2.75 | 3.25 | 4.5 | 3.75 | 5.75 | 7.75 |

# Pre-Start Up
# Check List

# PRE START-UP CHECKLIST
# FIELD PIPING AND MECHANICAL REQUIREMENTS

***NOTE: If start-up service has been purchased, the following items should be completed before the start-up man arrives. This will help save time and money.***

_____ 1. The unit should be leveled and secured to the mounting pad or floor.

_____ 2. The suction and Discharge line must be piped and properly supported, independent of the unit.

_____ 3. The Discharge Stop/Check Valve is shipped loose and must be installed in a vertical up flow direction or in a horizontal line with the valve stem pointing upward at a 45° angle. During off periods, refrigerant can condense in the line downstream of the Discharge Stop/Check Valve. It is recommended the Stop/Check Valve be located to minimize the quantity of liquid that can accumulate downstream of the valve.

_____ 4. A Dual Safety Relief Valve is shipped loose for field installation. A connection is provided on the oil separator for the relief valve. Refer to ASHRAE/ANSI Standard 15 (Safety Code for Refrigeration) for proper sizing and installation of Relief Valves and Vent Lines.

_____ 5. Piping For Oil Cooling

***a) Liquid Injection***

An adequate, or dedicated, liquid line is required for the Liquid Injection System. A high pressure liquid source must be piped to the stop valve at the inlet of the Thermostatic Expansion Valve. On booster units, an additional $^3/_8$" line must be piped to the regulator from high stage discharge gas for the Thermostatic Expansion Valve.

***b) V-PLUS***

A high pressure liquid source must be run to the V-PLUS® inlet. Some subcooling is desirable. A high pressure float must be installed at the inlet of the pump and a $^3/_8$" vent line must be returned to a suction trap. Refer to the V-PLUS manual for additional information.

***c) External Oil Cooler***

On thermosyphon oil coolers, the refrigerant lines must be connected to the front head of the oil cooler. On water cooled oil coolers, the water lines must be connected to the front head of the oil cooler. Installation of water regulating and solenoid valves are recommended.

_____ 6. The oil separator should be provided with oil until the oil level is between the (2) sight glasses. An oil charging connection is provided on the bottom of the oil separator.

_____ 7. The center member of the compressor coupling is shipped loose to help facilitate final field alignment and allow for motor rotation check. The motor alignment should be within 0.004" total indicator reading in all directions.

a) Both the compressor and motor hubs should be checked for concentricity and perpendicularity.

b) The motor should be checked and shimmed for soft foot prior to attempting final alignment.

c) The center section of the coupling should be left out to allow the start-up technician to verify the final alignment and motor rotations.

_____ 8. The unit should be pressure tested, evacuated and a system load should be available at the time of start-up.

**Order #_______________________________ Compressor Serial #________________________**

# PRE START-UP CHECKLIST
# FIELD WIRING REQUIREMENTS

FIELD WIRING REQUIREMENTS FOR UNITS WITH FACTORY WIRED **VISSION®** MICROPROCESSORS

***NOTE:*** ***If startup service has been purchased, to save time and money, the following items should be completed before the startup technician arrives.***

**The unit is pre-wired at the factory. The necessary field wiring connections are described below.**

1. Control power of 115 VAC 50/60 HZ must be wired to the left side terminals of the digital I/O board inside the ViSSion® cabinet. Line power (L1) is brought in to a 10-amp fuse via the terminal marked "L1" on the appropriate connector. The neutral (L1A) is brought in and connected to any of the "N" terminals located on left connectors. Two separate line power feeds for the oil heaters are brought to two additional 10 amp fuses via the terminals marked "L2" and "L3" on the same connector just below the "L1" terminal. The neutrals for these circuits (L2A and L3A) are also connected to any of the "N" terminals. For units with V-PLUS® oil cooling, L1 must also be brought to the fuse in the V-PLUS® panel, and L1A must also be brought to the terminal #2B in the V-PLUS® panel.

2. An auxiliary contact from the compressor motor starter is required. This isolated contact is connected to the K-1 input relay using any of the "L" terminals on the strip of connectors, and returned to the terminal marked "Motor Starter Aux. Safety" at the very top connector.

3. A dry contact from control relay K-22 must be wired to the compressor motor starter coil. This dry contact is wired to terminals marked "Compressor Start – N.O. #1A" and "Compressor Start – N.O. #1B". Control power for this coil should come from a source, which will be de-energized with the compressor disconnect.

4. A dry contact from control relay K-19 must be wired to the oil pump motor starter coil. This dry contact is wired to the two terminals marked "Oil Pump Starter". Control power for this coil should come from a source, which will be de-energized with the compressor disconnect.

5. An auxiliary safety cutout is available to shut down the compressor package using the K-2 input relay. A dry contact must be supplied and wired to one of the "L" terminals on any of the connectors, and returned to the terminal marked "Auxiliary #1 Safety" at the top connector. The jumper to the "Auxiliary #1 Safety" terminal must be removed to use this cutout. The contact, if closed, will allow the compressor to run. If this contact opens at any time, the compressor will shut down.

6. Indication of the compressor alarm or shutdown status is also available via two control relays. Relay K-20 is provided for remote trip indication and relay K-21 is provided for remote alarm indication. Each relay has three terminals available: a common input, a normally open contact, and a normally closed contact. For both relays, the energized state represents a "trip" or "alarm" condition. Loss of voltage to the relay coil and the resultant return to normal state indicates "safe" condition.

7. The current transformer supplied in the compressor motor conduit box should be checked to insure that the motor leads of one leg are pulled through the transformer. Note that there is a dot on one side of the current transformer. This dot must face away from the motor. Typically, a wye delta started motor should have leads 1 and 6 pulled through this transformer for a 6 lead motor. However, this should always be checked as different motors and starting methods will require different leads to be used.

**Order #________________________________Compressor Serial #_________________________**

# SERVICE INTERVAL REQUIREMENTS FOR VILTER EXTENDED WARRANTY

The following service intervals are based on the usage of Vilter Manufacturing LLC Premium Grade refrigeration oil.

| Group | Inspection Or Maintenance Item | *SERVICE INTERVAL (HOURS)* 200 | 5,000 | 10,000 | 20,000 | 30,000 | 40,000 | 50,000 | 60,000 | 70,000 | 80,000 | 90,000 | 100,000 | 110,000 | 120,000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **OIL CIRCUIT** | | | | | | | | | | | | | | | |
| | Oil Change (1) | | **R** | | **R** | | **R** | | **R** | | **R** | | **R** | | **R** |
| | Oil Analysis (2) | | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| | Oil Filters (3) | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** |
| | Oil Strainer | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** |
| **PACKAGE** | | | | | | | | | | | | | | | |
| | Coalescing Elements | | | | | **R** | | | **R** | | | **R** | | | **R** |
| | Suction Screen | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** |
| | Liquid Line Strainers | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** |
| | Coupling Alignment & Integrity | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** |
| **CONTROL CALIBRATION** | **Transducers** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** |
| | RTD's | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** | **I** |
| **COMPRESSOR** | | | | | | | | | | | | | | | |
| | Inspect Compressor | | **I** | | **I** | **I** | **I** | **R** | **I** | | **I** | **I** | **I** | **R** | **I** |
| | Bearings | | | | | | | | | | | | | | **I** |

Key
- I Inspect.
- R Replace.
- S Sample.

Notes:

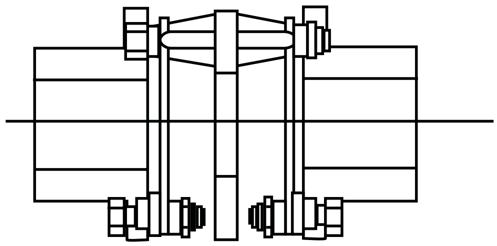
(1) The oil should be changed at these intervals, unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

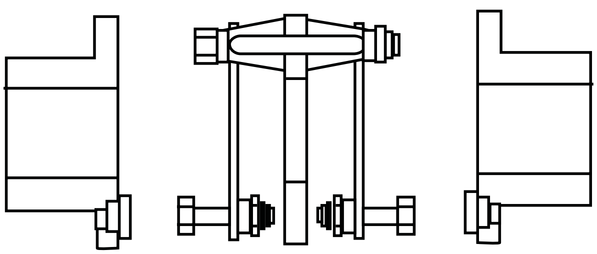
(3) The oil filter(s) on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter(s) must be changed if the oil filter differential exceeds 12 psi or oil analysis requires it.

# Vendor Assessories Section

# Coupling Information



Type DB Z-A



Ex te nd ed Hu bE   Ce nt er As se mb ly an dH DW R   xt en de dH ub

**COUPLINGS INSTALLATION AND ALIGNMENT**

These instructions are intended to help you to install and align the coupling. Covered here will be general information, hub mounting, alignment, assembly, locknut torquing, discpack replacement, and part numbers. The coupling as received, may or may not be assembled.
*If assembled, the locknuts are not torqued.
*If coupling is assembled, remove the bolts that attach the hubs to the disc packs. Remove both hubs. Leave the disc packs attached to the center member.

**A. Hub Mounting:**

1. Clean hub bores and shafts. Remove any nicks or burrs. If bore is tapered, check for good contact pattern. If the bore is straight, measure the bore and shaft diameters to assure proper fit. The key(s) should have a snug side-to-side fit with a small clearance over the top.

***NOTE:***
***If the DBZ hub position on the shaft does not allow enough room to install the short bolts in the hub after hub mounting, install the bolts and disc pack before mounting hub on shaft.***

**B. Straight Bore:**

1. Install key(s) in the shaft. If the hub is an interference fit, heat the hub in an oil bath or oven until bore is sufficiently larger than the shaft. 350º F. is usually sufficient. An open flame is not recommended. However, if flame heating is necessary, use a very large rose bud tip to give even heat distribution. A thermal heat stick will help determine hub temperature. DO NOT SPOT HEAT THE HUB OR DISTORTION MAY OCCUR. With the hubs expanded, slide it up the shaft to the desired axial position. A pre-set axial stop device can be helpful.

***NOTE:***
***All DBZ hubs have pressed in bushings. Make sure the bushings are facing the disc pack.***

**C. Taper Bore**:
(Newer models have only straight bore)

1. Put the hub on the shaft without key(s) inplace. Lightly tap hub up the shaft with a soft hammer. This will assure a metal-to-metal fit between shaft and hub. This is the starting point for the axial draw. Record this position between shaft and hub face with a depth micrometer. Mount a dial indicator to read axial hub movement. Set the indicator to “0”. Remove hub and install key(s). Remount hub, drawing it up the shaft to the “0” set point. Continue to advance hub up the taper to the desired axial position. Use the indicator as a guide only. A pre-set axial stop device can be helpful. Check the final results with a depth micrometer. The hub may have to be heated in order to reach the desired position on the shaft. DO NOT SPOT HEAT THE HUB OR DISTORTION MAY OCCUR. Install shaft locknut to hold hub in place.

**D. Shaft Alignment**.

Move equipment into place.

a. Soft Foot. The equipment must sit flat on its base. Anysoft foot must be corrected now.

b. Axial Spacing. The axial spacing of the shafts should be positioned so that the disc packs (flexing elements) are flat when the equipment is running under normal operating conditions. This means there is a minimal amount of waviness in the disc

| Coupling Size | Total Indicator Reading (T.I.R.) Angle | Parrallel | Min | Max | Torque Ft.-Lbs. (In.-Lbs.) |
|---|---|---|---|---|---|
| 50 | .004 | .004 | 1.36 | 1.37 | (24) |
| 62 | .004 | .004 | 1.74 | 1.75 | (36) |
| 75 | .004 | .004 | 1.77 | 1.78 | (36) |
| 101 | .004 | .004 | 2.08 | 2.10 | (96) |
| 126 | .004 | .004 | 2.46 | 2.48 | (156) |
| 163 | .004 | .004 | 2.46 | 2.48 | (156) |
| 201 | .004 | .004 | 2.96 | 2.98 | 25 |
| 226 | .004 | .004 | 3.83 | 3.83 | 30 |
| 263 | .004 | .004 | 4.33 | 4.35 | 40 |
| 301 | .004 | .004 | 4.90 | 4.93 | 95 |
| 351 | .004 | .004 | 5.90 | 5.93 | 175 |
| 401 | .004 | .004 | 6.71 | 6.75 | 150* |
| 451 | .004 | .004 | 7.27 | 7.31 | 190* |

pack when viewed from the side. This will result in a flexing element that is centered and parallel to its mating flange faces. Move the connected equipment to accomplish the above.

***NOTE:***
***The disc pack is designed to an optimal thickness and is not to be used for axial adjustments.***

As a guide, maximum and minimum values for dimension "E" are given. These dimensions are suggested for initial installation. Additional capacity is available to compensate for thermal and structural movement. Maximum axial capacity values for these couplings are also given. See chart above.

**E. Final assembly .**

With the coupling in good alignment the bolts will fit through the holes in the flanges and the disc packs more easily.

a. If the coupling arrived assembled, the disc packs are still attached to the center ring. Before taking the discs packs off, first install one hub bolt through each disc pack and secure with lock out. This will help when the pack is reinstalled late. If the coupling was shipped disassembled, the bolt through the pack is not required as the discs in the pack are factory taped together.

b. Remove the long bolts. Mount the disc packs on the hubs with one bolt through the disc pack aligned with a clearance hole in the hub. Install the short bolts through the hub, disc pack, bevel washer or link, and secure with a lockout.

***NOTE:***
***All bolt threads should be lubricated. A clean motor oil is recommended. On size 226 and larger, a link must be put on bolt first. Remove the disc pack alignment bolt. Proceed to mount the second disc pack to the other hub in the same way.***

c. Position one set of short bolts in each hub on top. Now slide the center ring down into place straddling the short bolts with the center ring bushings. If coupling is dynam-ically balanced, the center ring match marks must lineup with both hub match marks. When one bushing is in-line with the hole in the disc pack, slide one long bolt through washer or link, disc pack, center ring, disc pack, washer or link, and then secure with a locknut.

d. Torque the long bolt locknuts at this time. See Table on page 31 for torque values.

***NOTE:***
***With the coupling in good alignment, the bolts will fit through the holes in the flanges and the disc pack more easily. It is recommended that all locknuts be retightened after several hours of initial operation.***

***For further help with the installation or alignment, consult your Vilter representative.***

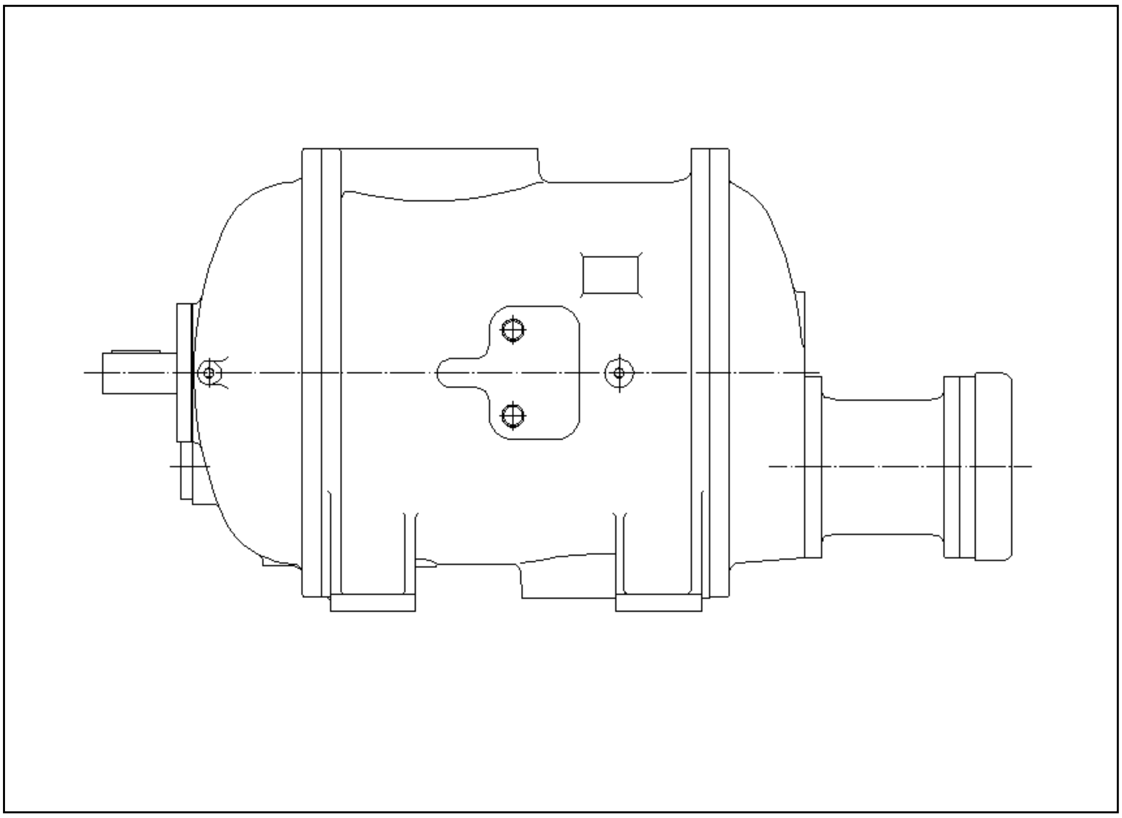
**F. Disc Pack Replacement.**

If it becomes necessary to replace the disc pack, it can be done as follows:

a. Remove all the long bolts and lower the center ring by sliding it our from between the two disc packs.

b. Remove one short bolt from the disc pack/hub connection and reinstall it through a hub clearance hole and into the hole in the disc pack. Put the nut on. This will keep the discs together and maintains the disc orientation for later reinstallation. Remove the rest of the short bolts and takeoff the disc pack. Repeat for the second disc pack.

c. Replace the pack(s) if required. Recheck alignment per Section D. Reassemble per Section E



# WRV & WRVi Compressor Range

# Installation Manual

**READ CAREFULLY BEFORE INSTALLING AND STARTING YOUR COMPRESSOR**

This manual relates to WRV and WRVi Compressors.

These instructions have been prepared to ensure that your compressor gives long and satisfactory service.

The entire manual should be read before reverting to any one specific section for information.

One copy should be given to the personnel responsible for installing and operating the compressor.

Whilst every care is taken to ensure that the information in this manual is correct, no liability can be accepted by Howden Compressors Limited for loss, damage, injury or consequential costs of any kind caused by any errors in, or omissions from, the information given.

All requests for information, service or spares should be directed to:

**HOWDEN COMPRESSORS LIMITED**
Compressor Business Unit
133 Barfillan Drive
Glasgow, G52 1BE
UNITED KINGDOM

| | |
|---|---|
| Telephone number: | +44 (0)141 882 3346 |
| Fax number: | +44 (0)141 883 5901 |
| E-mail: | sales@howdencompressors.co.uk |
| Web site: | www.howden.com |

Alternatively contact our North American Sales Office at:

**HOWDEN COMPRESSORS LLC**
1850B N Gravers Road
Plymouth Meeting
PA 19462
USA

| | |
|---|---|
| Telephone number: | 01 610 313 9800 |
| Fax number: | 01 610 313 9215 |
| E-mail: | sales@howdencompressors.com |
| Web site: | www.howden.com |

**All enquiries should be accompanied by the Howden Compressors Ltd Contract Number and the Compressor Serial Number taken from the nameplate on the side of the compressor body.**

## 2.1 THE WRV/WRVi COMPRESSOR

The Howden WRV/WRVi Oil Injected Compressor is a positive displacement, capacity controlled, oil flooded, rotary machine.

A feature of the WRVi compressor range is the facility to adjust the volume ratio by altering the size of the discharge port to obtain the desired ratio in the range 2.2:1 to 5.0:1.

The WRVi compressors are supplied with two oil injection ports on the side of the main casing. If no oil injection is required due to the duty then it is not necessary to pipe up to these connections and the plugs can remain fitted to the casing. Older compressor models, which had no oil injection, were identified as WCV units on the name plates.

**Note: The plugged WRVi is the direct replacement for a WCV unit.**

The accurately machined helical rotors are called Male and Female. The Male (driving) rotor has four lobes that mesh with six flutes in the Female (driven) rotor, both rotors having the same outside diameter. Each rotor is supported by two plain white metal thick walled journal bearings fitted adjacent to the compression chamber.

As the lubricating oil is at discharge pressure plus 2.1 bar (30 psi) for standard range compressors and at 3.1 bar (45 psi) for the 'H' designated compressors, the bearings act as shaft seals within the compressor.

Rotor end thrust is accommodated by angular contact ball bearings on both male and female rotors and balance pistons at both ends of the male rotor. One side of each balance piston is subject to pressure from lubricating oil and the other side at suction pressure. The balance pistons therefore, oppose the normal rotor end thrust, and as a result, the angular contact bearings are lightly loaded and have a long life.

In the case of the WRViT model, the thrust bearings are white metal lined tilting pads with balance piston fitted at the inlet end of the male rotor only.

Compression is achieved by the meshing of the two helical rotors on parallel shafts housed in a casing.

The male rotor has lobes formed helically along the rotor length and these mesh with corresponding flutes on the female rotor. The meshing and disengaging of the lobes and flutes within the compressor casing creates enclosed spaces which expand in volume (the suction phase) to a point determined by the shape of the suction port where the interlobe space is sealed. As the rotors continue their rotation and the rotor lobes and flutes remesh, the gas now trapped in the interlobe spaces is compressed. At a point determined by the discharge port shape, the decreasing interlobe space is opened to discharge and the gas escapes at pressure.

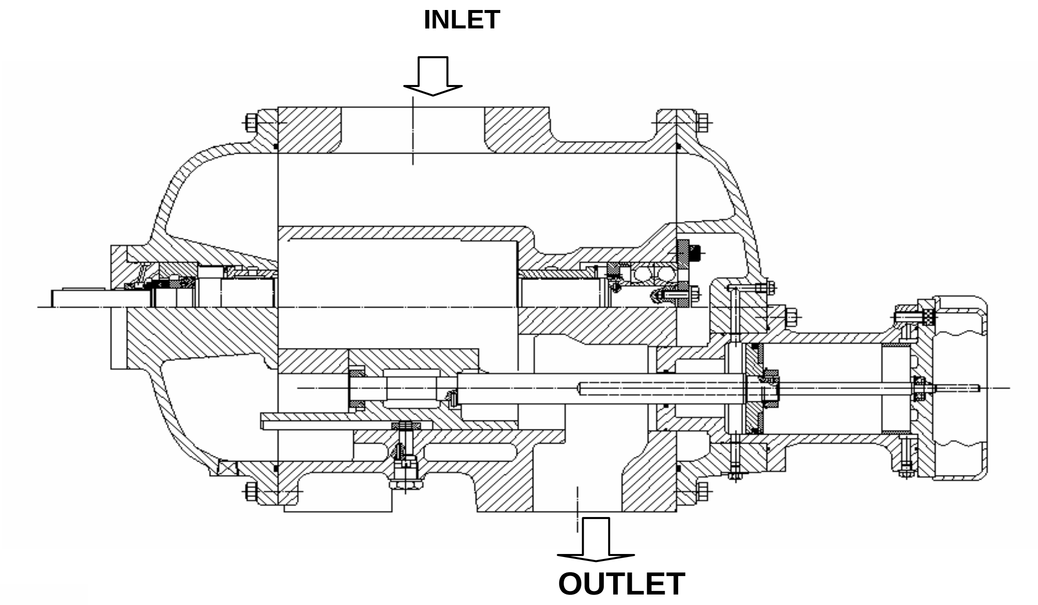
### 2.1 THE WRV/WRVi COMPRESSOR (continued)

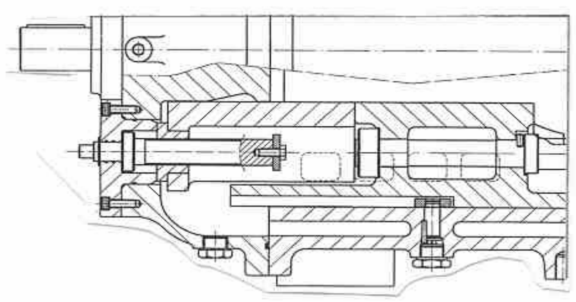
Capacity control is achieved by means of a slide valve in the casing operated by a piston in a hydraulic cylinder mounted on the compressor. Movement of the slide valve alters the point at which gas compression begins by allowing the gas from the start of the compression phase to re-circulate back to suction. This in effect decreases the volume of gas compressed. At the same time, the slide valve alters the size of the outlet port to keep the compression ratio constant. By this means, stepless capacity control is provided with an approximately proportionate saving in power.

The piston is actuated by lubricating oil fed from the lubricating oil manifold to one or other side of the piston. As oil is fed to the cylinder, the slide valve will move on load (towards the inlet end). When the oil feed is stopped, the slide valve will be locked in position. To off load the compressor, the oil trapped in the cylinder is allowed to escape to the oil return connection on the compressor and the slide valve will move off load (towards the outlet end) as oil is pumped to the opposite side of the piston.

The WRVi model, in addition to the above, also has the facility of selecting manually, a Vi ratio most suitable to the operating duty.

### 2.2 TYPICAL SECTIONAL ARRANGEMENT DRAWING:



**MANUAL Vi ADJUSTMENT-WRVi**

Howden compressors are fitted, as standard, with neoprene ‘O’ rings.

These ‘O’ rings are compatible with the majority of standard refrigerants and many oils, but compatibility with all possible combinations of refrigerant and oil cannot be guaranteed.

Should you wish to review this matter, please do not hesitate to contact Howden Compressors Limited, who will be pleased to provide recommendations and costs for any special ‘O’ ring materials which may be required.

**Typical Standard Refrigerants:**

R717, R22, R134a, R404A, R407C, R410A, R507

**Typical Oils:**

Mineral Oil
Polyol Ester Oil
Poly Alkylene Glycol Oil
Alkyl Benzene Oil

**Oil Viscosity:**

For the majority of ammonia refrigeration applications, oil viscosity of 68 centistokes at 40$^{o}$C is the appropriate selection. However, with many other refrigerants, eg; R134a with high condensing temperatures, or applications involving hydrocarbon gases, a specific oil selection is required.

Howden Compressors Limited offers a consultancy service to all users of HCL product. Please consult the applications department of HCL who will be happy to advise on grade of oil applicable to the refrigerant or gas at the specific duty application.

## 4.1 ALIGNMENT OF COMPRESSOR COUPLINGS

Misalignment causes a vibration which affects other parts of the compressor, leading to premature failure of bearings, seals, etc. Drive couplings fitted to WRV compressors must be aligned correctly.

The coupling alignment tolerance figures can be seen under Section 5.2

Coupling gap dimensions should be set with the coupling held in a repeatable position, i.e. hard together or hard apart. This ensures that each coupling half is moved to the same axial position as each check is made.

The actual coupling gap should be correct when the shafts are in their normal running condition.

When setting the gap, the axial float of each shaft should be determined and the "hard together" or "hard apart" dimensions calculated.

**Example:** Compressor driven directly by turbine

Compressor shaft float 0.000mm (0.000")

Turbine shaft float 0.250mm (0.010")

The normal running position of the compressor shaft is thrusting towards the turbine and the turbine thrusting towards the compressor.

Required coupling gap 3.175mm (0.125")

If the gap is checked with the coupling "hard apart" it should be:

| | |
|---|---|
| Required coupling gap | 3.175mm (0.125") |
| plus Compressor shaft float | 0.000mm (0.000") |
| plus Turbine shaft float | 0.250mm (0.010") |
| ===================== | ============ |
| = "Hard apart" gap | 3.425mm (0.135") |

If the gap is checked with the coupling "hard together" ie in the normal running condition, it should be equal to the required gap 3.175mm (0.125").

## 4.2 COUPLING ALIGNMENT - BASIC RULES

1. Compressor to be mounted on baseframe and mounting feet checked for soft foot and corrected where necessary.

2. Alignment to be set before connecting any pipework to the compressor.
Allowable TIR = +/- 0.15mm Radially and Axially.

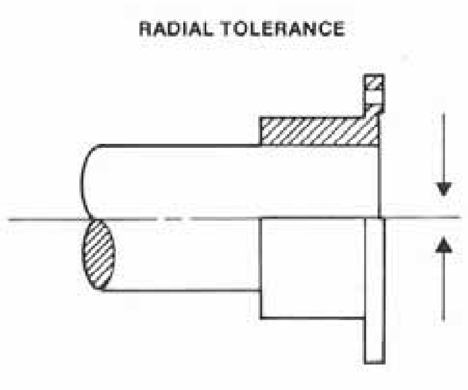
3. Under no circumstances should suction and discharge piping be strained into position. Distortion of the casing will cause premature failure of the compressor. A vertical and horizontal clock gauge must be mounted on the compressor input shaft/coupling hub to ensure no alteration occurs when pipes are being connected. Only after this is completed should the coupling hubs be connected.

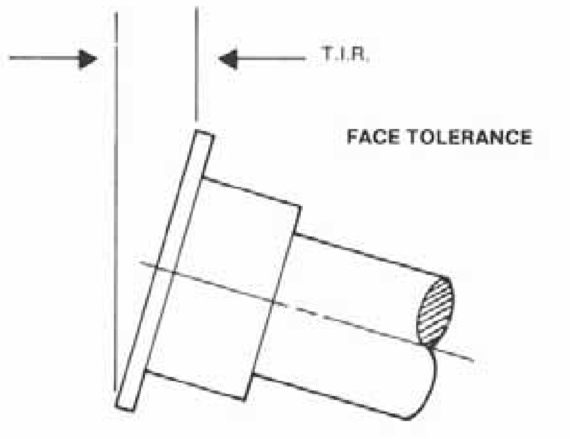
   **Note:** Coupling hubs must **not** be hammered onto the compressor shaft.

## 4.3 ALIGNMENT TOLERANCE

The maximum acceptable line-up tolerance for couplings on compressor installations is as follows:

**RADIAL TOLERANCE** **FACE TOLERANCE**




| Application | Radial Tolerance | Face Tolerance |
|---|---|---|
| A) Motor to Gearbox or Compressor ie Couplings operating up to 3,600 rpm. | A) 0.15mm (0.006") TIR | A) TIR 0.005mm/cm Dia. Of coupling |
| B) Gearbox to Compressor ie couplings Operating above 3,600 rpm. | B) 0.10mm (0.004")TIR | B) TIR 0.005"/inch Dia. Of coupling. |

**Radial Tolerance**
Eccentricity = ½ TIR on circumference
TIR denotes Total Indicator Reading obtained by Clock Gauge

## 4.4 PIPING

Before installing the piping, the compressor inlet and outlet ports should be inspected to ensure no dirt is present.

Note that the pipes and fitting used should not restrict flows. To avoid this, always use piping with a bore ¼" larger than the thread diameter of the compressor port, eg, WRVi 255 oil connection to actuator cylinder thread is 1/2" BSP and so a 3/4" OD pipe should be used.

All piping should be supported so that no strain is transmitted to the compressor casings.

The piping should be inspected for cleanliness before installation. As each pipe is connected to the compressor, the coupling alignment should be checked to ensure that no alteration has taken place.

If alignment has altered, the compressor is being strained and the piping supports must be adjusted.

It is not sufficient merely to re-align the drive unit, as this will not correct the strain being imposed on the compressor. Oil injected refrigeration compressors must have a suction strainer permanently fitted directly on the compressor inlet.

Note that the oil pipes and fittings used should not restrict flows. To avoid this, always use piping with an OD 1/4" (6mm) larger than the thread diameter of the compressor port, eg, connection thread is 3/4" BSP and so a 1"OD pipe or metric equivalent should be used.

Before installing the piping, the compressor gas inlet and outlet ports and oil injection holes should be inspected to ensure no dirt is present.

**Note: All piping should be supported so that no strain is transmitted to the compressor casing.**

The piping should be inspected for cleanliness before installation. As each pipe is connected to the compressor, the coupling alignment should be checked to ensure that no alteration has taken place.

If alignment has altered, the compressor is being strained. The pipes should be corrected and the supports adjusted accordingly.
It is not acceptable to re-align the drive unit as this will not correct the strain being imposed on the compressor.

Oil injected refrigeration compressors must have a suction strainer permanently fitted on the compressor inlet.

The set pins supplied with the suction and discharge flanges are for transport only and should be replaced with contract set pins or studs having correct thread engagement length.

When fitting the suction flange to the compressor, ensure that the tapped holes in the casing are cleaned out and free from water. Fit setpins/studs, coating the threads with pipe sealer to prevent ingress of water into tapped holes.

## 5.1 FIRST START UP

Installation of the compressor will have been carried out in accordance with Section 5 of this manual. The commissioning engineer should, however, ascertain that the correct procedures have been followed, in particular the coupling alignment must be checked, then proceed as follows:

1. Disconnect the coupling between the drive and the compressor and check that the motor rotation is correct for the compressor drive looking on the compressor input shaft.

   **WRV** and **WRVi** compressors - **CLOCKWISE**
   **MRV** compressors - **ANTI-CLOCKWISE**

2. Fill the oil tank with lubricating oil of the correct grade to the required level, as indicated on the tank level sight glass.

3. Ensure that the pipe from the oil filter to the manifold, the manifold and oil pipes to the compressor are clean and that new clean filter elements are fitted.
4. The lubricating oil pressure differential relief valve should be set to give a 2.1 bar (30 psi) oil manifold differential pressure for standard range compressors and 3.1 bar (45 psi) oil manifold differential pressure for 'H' range compressors at the correct operating temperature and with clean oil filter elements fitted.

5. Check the operation of any safety trips fitted by running the drive unit disconnected from the compressor and mechanically operating the trips.

   Check that the trips are set to act at a point which will protect the compressor from damage. The lubricating oil differential trip can be set at 0.83 bar (12 psi) on the standard range and 1.5 bar (22 psi) on 'H' range by partially closing the oil filter isolation valve to reduce the differential oil pressure to the point where the trip operates. As the filters become dirty, the differential oil pressure will drop to this figure, which is the minimum acceptable pressure.

6. Check that the compressor turns freely by hand and reconnect the coupling between the drive unit and the compressor.

7. Check that the cooling water is turned on to the lubricating oil cooler, if fitted.

8. Check that all gas inlet and outlet isolating valves are open.

9. Check that the Volume ratio Vi screw is in the minimum position.
   Rotate screw in a clockwise direction for minimum (2.2) Vi type only.

## 5.1 FIRST START UP (continued)

**Notes:**

1. Do not adjust the volume ratio Vi screw when compressor is on load.

2. The compressor should be in the unloaded position prior to start up.
   If the compressor is started without first being unloaded, a higher starting torque will be required.

10. Start the auxiliary lubricating oil pump.

11. Check that the volume ratio Vi screw is in the required operating position.
    See section 6.2 for details.

12. Calibrate the Capacity Linear Position Indicator as per Section 6.4
    **Note:** Linear Position Indicator not available on Auto Vi compressors.

13. Start the drive unit and check that all gauges are indicating correctly.

14. Run the compressor for 30 minutes at minimum gas flows and check that all readings are normal, then operate the capacity control valve to the required position. This position will be indicated on the dial mounted on the hydraulic cylinder.

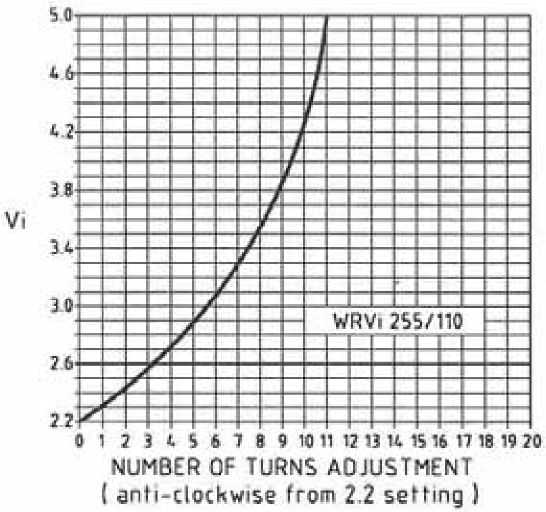
15. If possible, check the slide valve control over the full range of capacity.

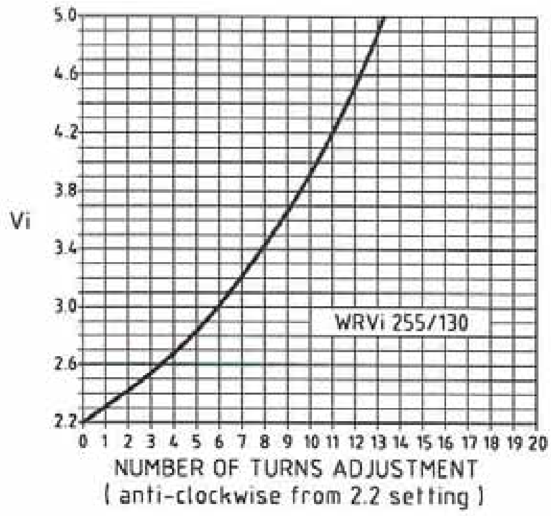
## 5.2 MANUAL Vi ADJUSTMENT (Vi type compressor)

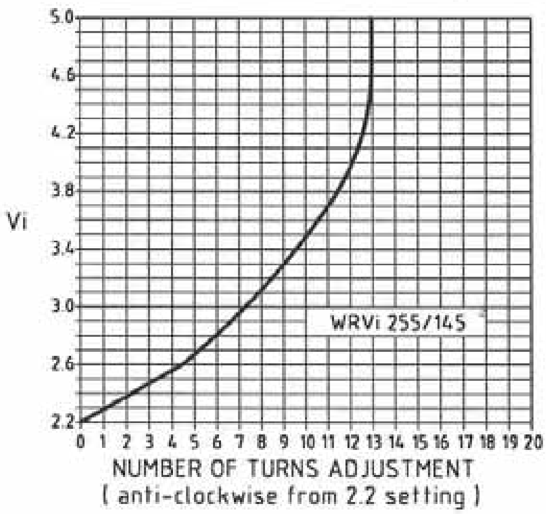
1. The Volume Ratio can be adjusted between 2.2 and 5.0 by rotating the square drive screw below the input drive shaft. Turn clockwise for minimum load (2.2) and anticlockwise for maximum load (5.0).
   Refer to graphs under section 6.3 for number of turns.

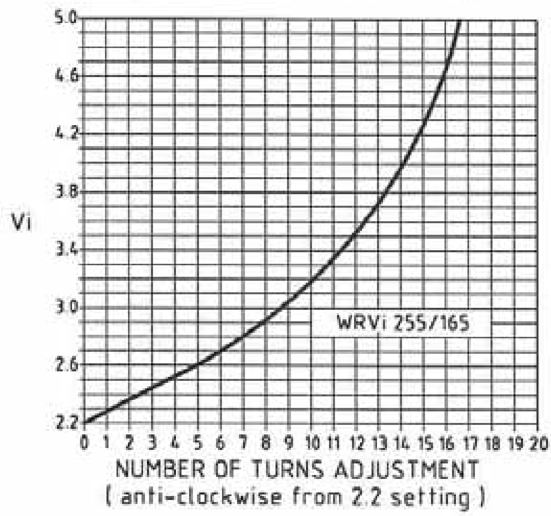
**Note:** Before making any adjustments to the Volume Ratio, the slide valve must be fully unloaded. From a safety aspect, it is recommended that the compressor be stationary.

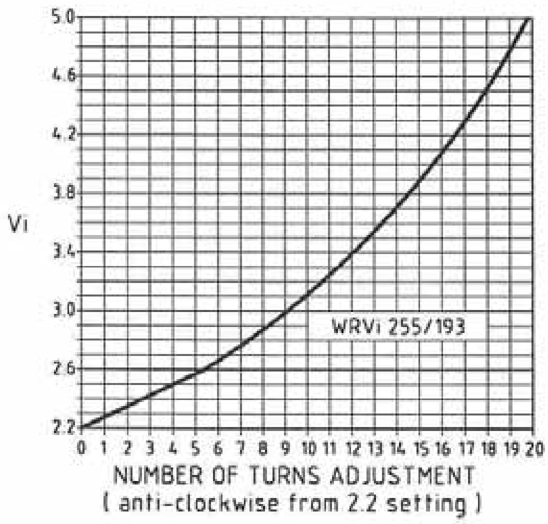
## 5.3 SLIDE VALVE STOP SETTINGS



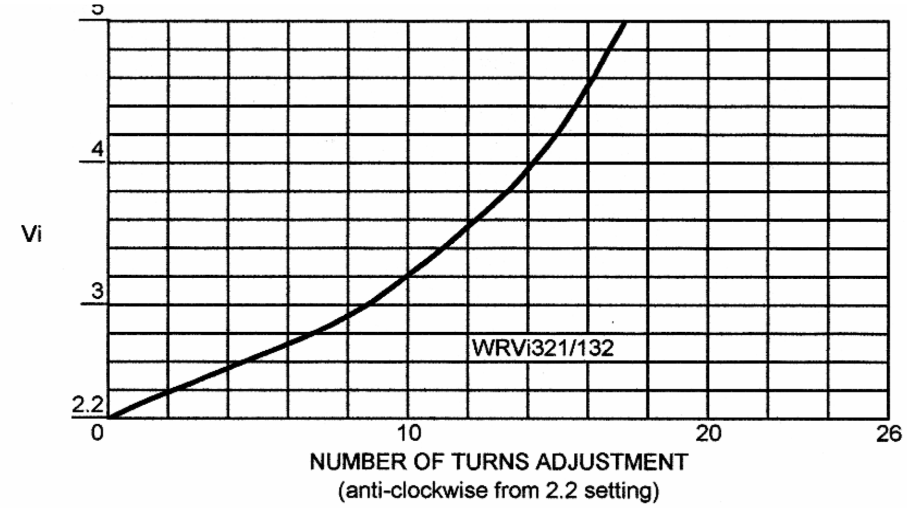



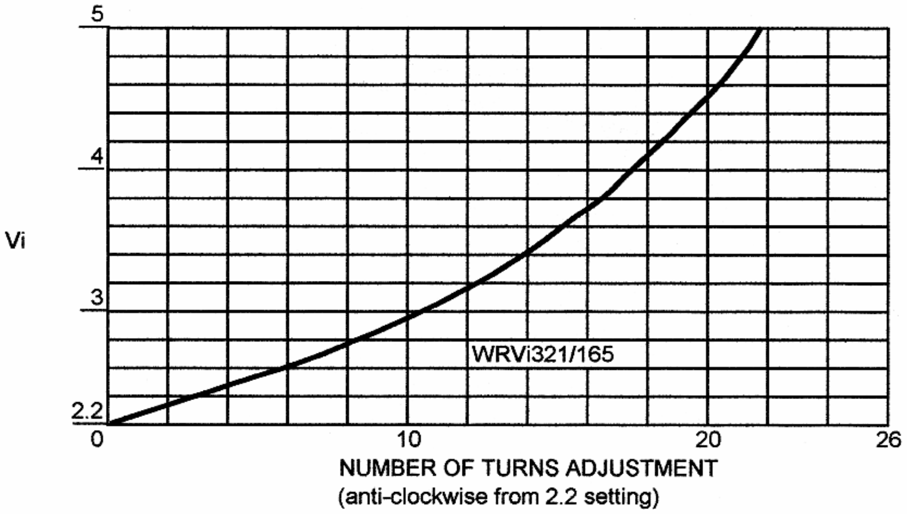



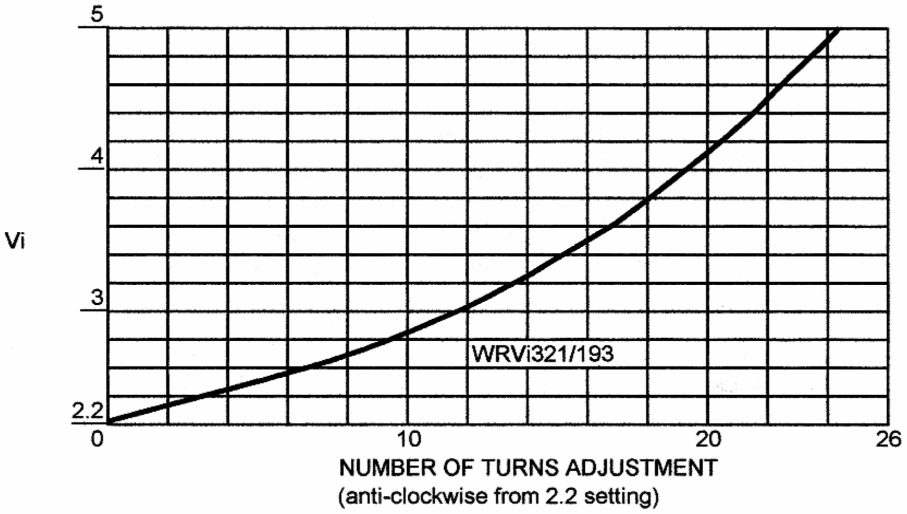



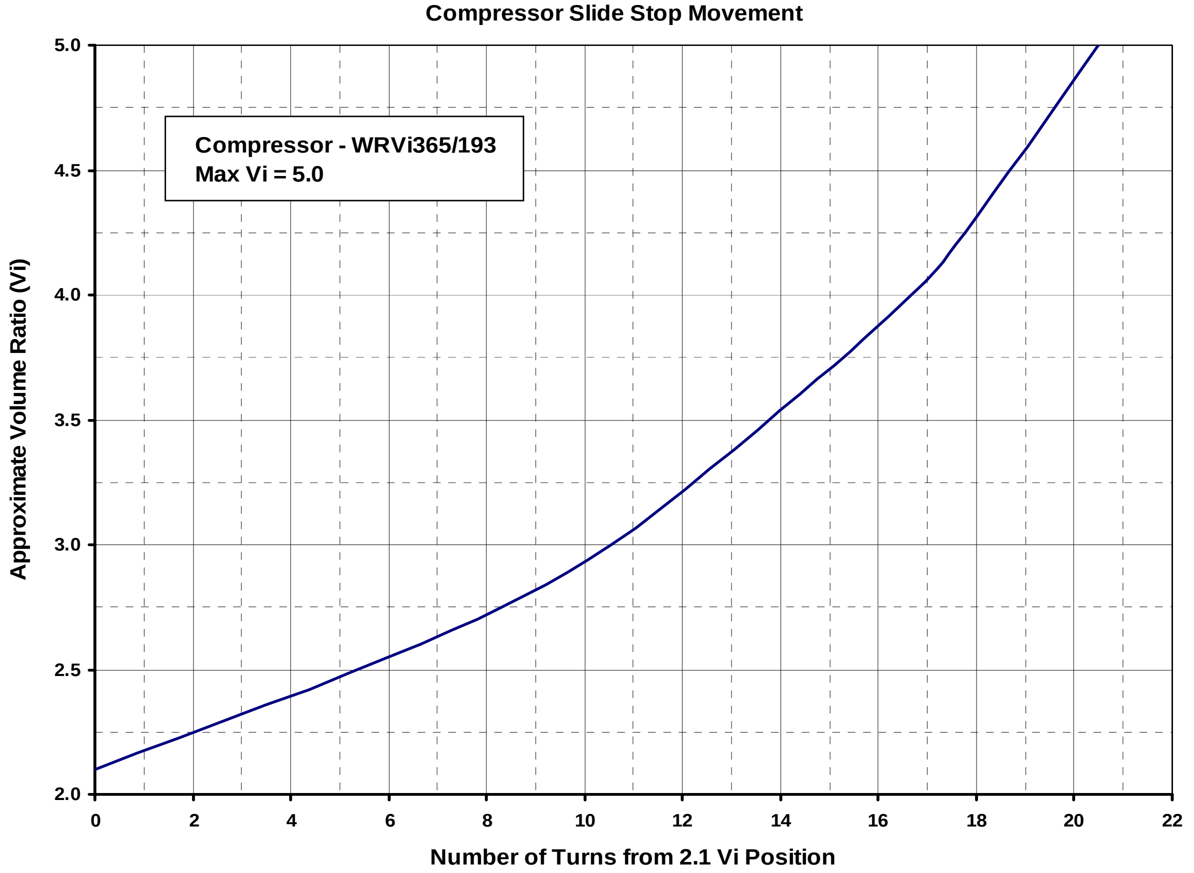
## 5.3 SLIDE VALVE STOP SETTINGS WRVi 321

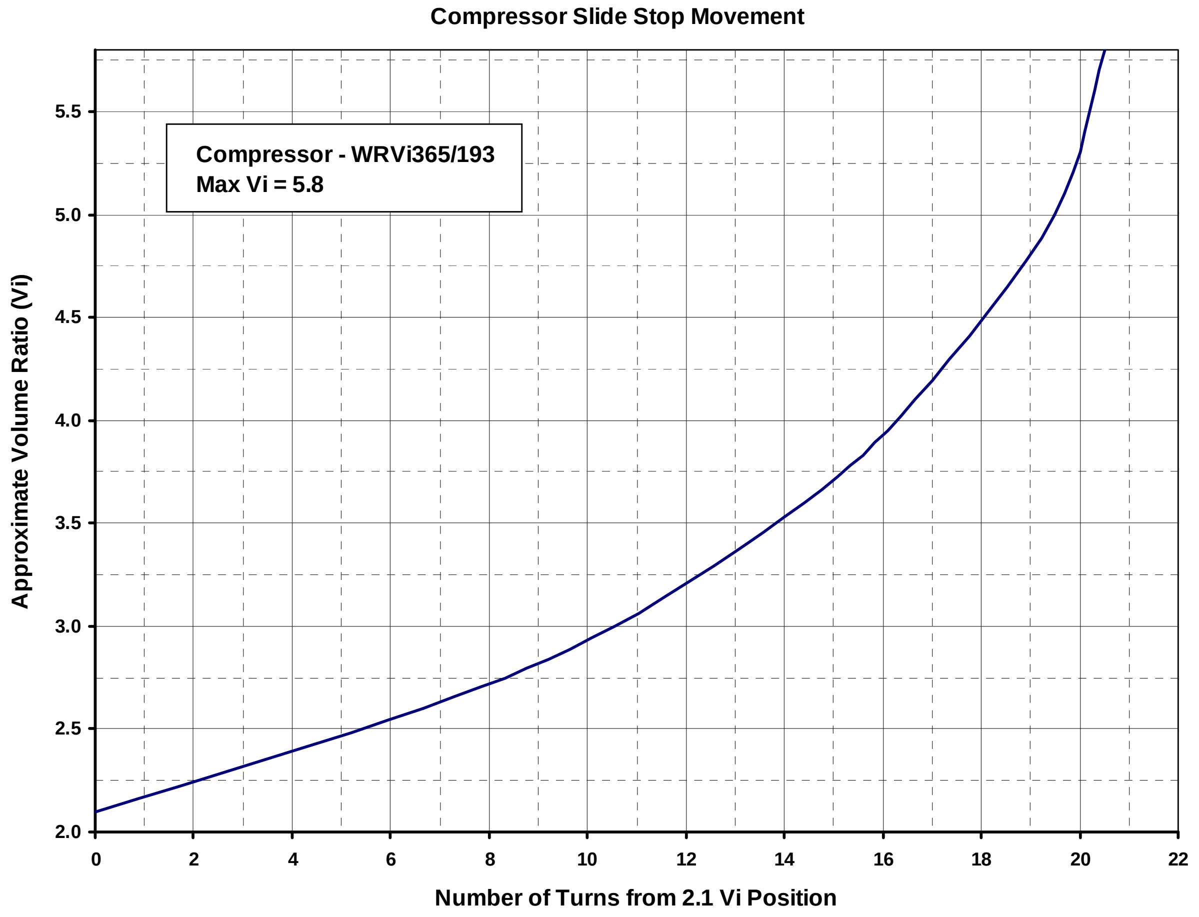


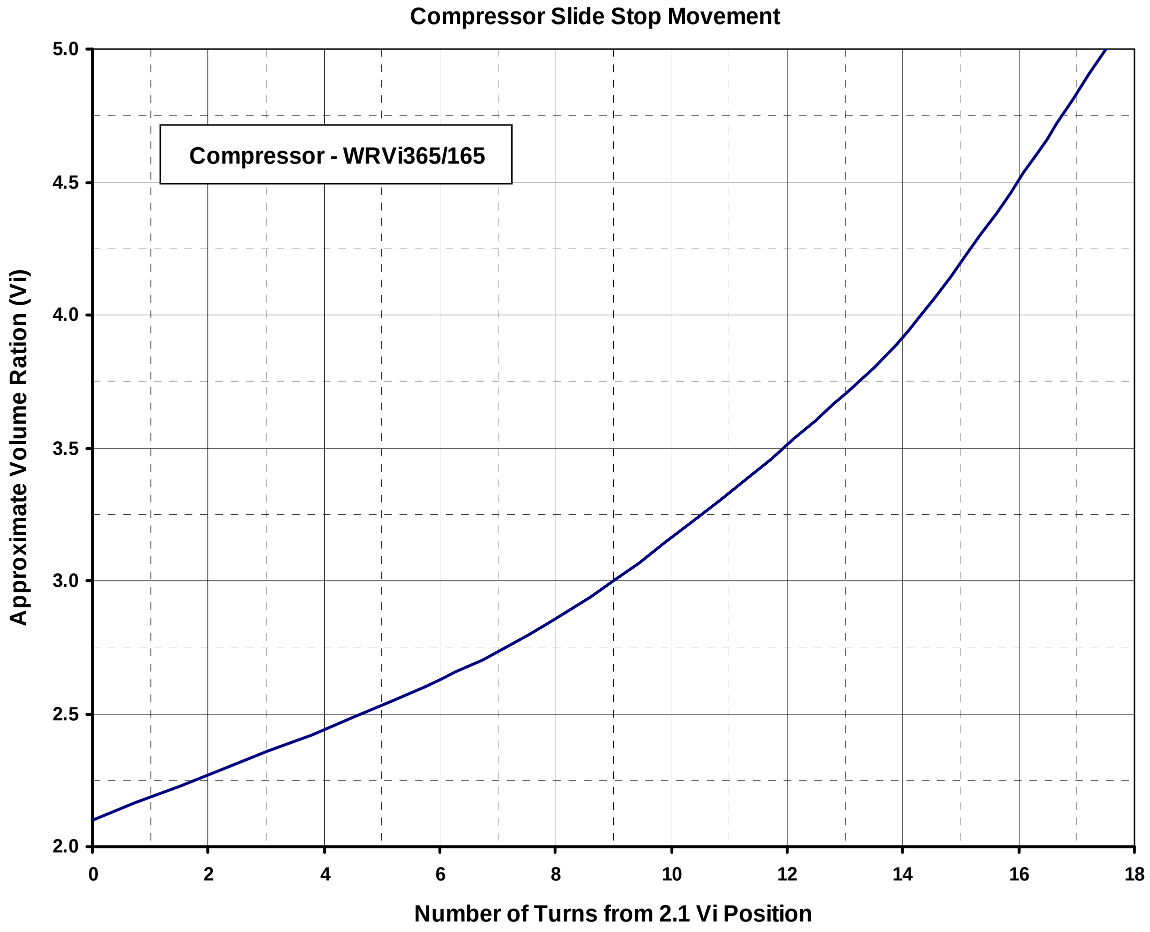



## 5.3 SLIDE VALVE STOP SETTINGS FOR WRVi365/193



## 5.3 SLIDE VALVE STOP SETTINGS FOR WRVi365/165



## 5.4 LINEAR POSITION INDICATOR (LPI)

**General:**

An electronic device called a Linear Potentiometer gives an indication of the position of the slide valve which can be used by the compressor control system.

The Linear Position Indicator (LPI) is an electronic contact-less displacement sensor inserted into a sensor well which allows the LPI to be removed from compressor without loss of oil or gas from the compressor.

The LPI has several usable options built into one device.

The slide valve position can be indicated in three different ways:

- Visual Light emitting diodes (LED)
- Visual and by an analogue output 4-20mA
- Visual and by a digital 24 V DC signal output on minimum and maximum slide valve position


**Visual:**

It is always possible to see the position of the slide valve.
At minimum load a yellow LED is illuminated at the lowest light on the left of the LPI.
At maximum load a blue LED is illuminated at the lowest light on the right of the LPI.
At part load only some of the LED are illuminated, eg, At 50% load only half of the LED will be illuminated.

**Note:** The compressor can only be allowed to start with the slide valve in the minimum load position. Therefore a signal from the minimum load electronic position switch is always required or if the 4 – 20 mA signal is being used, then a 4 mA signal is required.

## 5.4 LINEAR POSITION INDICATOR (LPI)

**Visual and by an Analogue Output (4-20mA):**

The minimum load position is given by the 4 mA output and the maximum load position is given by the 20 mA output. (**White Wire**)

Part load positions are indicated by intermediate values between 4 and 20 mA.
The LED's on the indicator also give a visual indication of part load operation. It should be noted that part load slide valve position is not a direct indication of actual compressor capacity at part load. Use of the 4 – 20 mA signal is common for many control systems and may be used on its own, if required, for all control functions for single and multiple compressor installations, subject to a suitable control system.

**Connections:**

| **Wiring Plug Connections** | **Function** |
|---|---|
| 1= Brown | Supply Voltage + 24V DC |
| 2- White | Output Signal 4-20 mA |
| 3=Blue | Common – 0 VDC |

**Visual and by a Digital 24V Output on Minimum and Maximum load:**

There is also another option that can be used to control and get the minimum signal for start-up. This option works the same as the mechanical micro-switches but instead uses the electronic switches incorporated in the LPI unit. These electronic switches give a 24 V DC output.
A digital output is given on the Minimum and Maximum position of the slide valve and an interposing relay, which must be incorporated in the control panel in place of each mechanical micro-switch, is activated by the digital signal completing the control circuit signal. This interposing relay must have contacts with suitable ratings. The interposing relay replaces the original switch function.
The LED's only give a visual indication of the slide valve position.

If the slide valve is in the minimum position and the LED for minimum is illuminated, there will be a digital output on the **green/yellow wire.**
If the slide valve is in the maximum position and all the LED's are illuminated, there will be a digital output on the **black wire**.

Existing installations equipped with the mechanical micro-switches can use this option.

**Connections:**

| **Wiring Plug Connections** | **Function** |
|---|---|
| 1= Brown | Supply Voltage + 24V DC |
| 3=Blue | Common – 0 VDC |
| 4=Black | Digital Output Max. Load |
| 5=Green/Yellow | Digital Output Min. Load |

Choose the best way for giving a start signal and connect the wires according to the table.

## 5.4 LINEAR POSITION INDICATOR OPERATION & CALIBRATION

All compressors with variable Vi are despatched from Howden Compressors facility with Vi set at 2.2 and the LPI calibrated to suit Vi 2.2.
When the Slide Valve is in the unloaded position, the 10% minimum load LED should be illuminated.
To check that the LPI indicates maximum load when the slide valve is in the fully loaded position, ie all LED's are illuminated, the following checks should be made.

Move the slide valve to 100% (by using the oil pump or if the system is shut down, use a manual oil pump or air pressure). By pressurising the outboard side of the actuator piston the slide valve will be moved to the fully loaded position. The LPI should indicate 100% by illuminating all LED's.

If this is not the case please repeat the calibration procedure as follows:

**Linear Position Indicator (LPI) Calibration Procedure**

1. Move slide valve to Minimum Load position.

2. Remove calibration button cover.

3. Connect power supply to LPI, 24v DC max.

4. With slide valve in **Minimum Load** position, push calibration button **once.** Red LED will light, after 15-20 seconds light will turn to "**Flashing Red"**.

5. Move slide valve to **Full/Maximum Load** position.

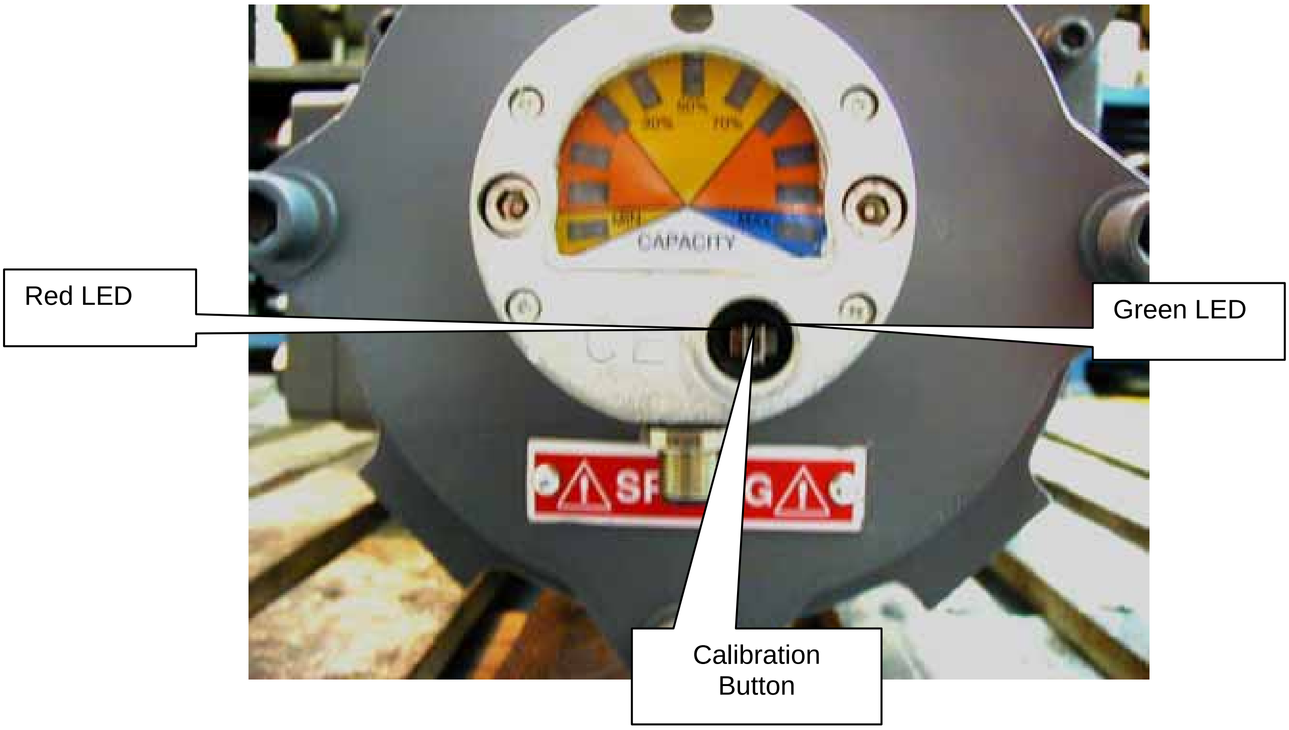
6. With slide valve in **Full/Maximum Load** position, push calibration button **once**, Red LED will light for 15 seconds and then go off. Green LED will now light.

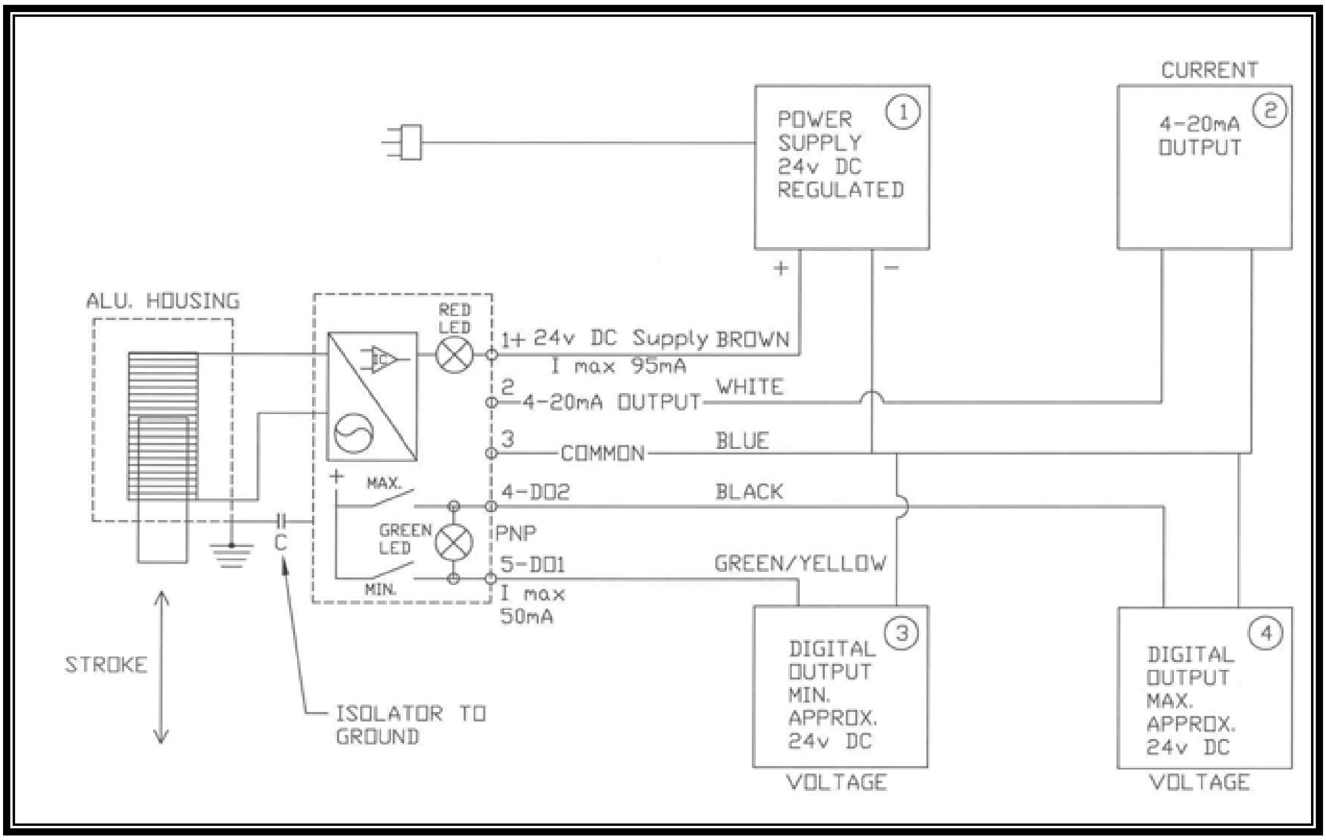
7. Calibration is now complete and sensor should now red maximum or 100% capacity.

8. Refit button cover.

**Note:**
1. If Vi is changed, LPI **must** be re-calibrated.
2. The Minimum Load position gives a 4mA output and the Maximum Load gives a 20mA output.

**The LPI Linear Position Indicator**




**LPI Wiring Diagram**

## 5.5 ATEX TYPE LINEAR POSITION INDICATOR (LPI)

**General:**
An electronic device called a Linear Position Indicator gives an indication of the position of the slide valve which can be used by the compressor control system.
The Linear Position Indicator (LPI) is an electronic non contact transmitter inserted into a sensor well which allows the LPI to be removed from compressor without loss of oil or gas from the compressor.
The slide valve position can be indicated by an analogue output 4-20mA signal.
**Note:** The compressor should only be allowed to start with the slide valve in the minimum load position.

**Analogue Output (4-20mA):**

The minimum load position is given by the 4 mA output and the maximum load position is given by the 20 mA output.
Part load positions are indicated by intermediate values between 4 and 20 mA.
Use of the 4 – 20 mA signal is common for many control systems and may be used on its own, if required, for all control functions for single and multiple compressor installations, subject to a suitable control system.

**Connections:**

| **Plug Connections** | **Function** |
|---|---|
| 1 | Supply Voltage + 24V DC |
| 2 | Common – 0 VDC |
| 3 | Output Signal 4-20 mA |

**Note:** ATEX LPI Sensors are supplied with an Intrinsic safety barrier, and installation must be carried out according to the standards in force for the country in question.

**Checking the ATEX LPI Calibration**

All compressors with variable Vi are despatched from Howden Compressors facility with Vi set at 2.2 and the LPI calibrated to suit.
When the Slide Valve is in the unloaded position a 4mA output signal is achieved, and at maximum load a 20mA output signal. However, if the factory Vi setting is not appropriate and needs to be adjusted, re-calibration of the LPI sensor will be required.

**ATEX Linear Position Indicator (LPI) Calibration Procedure**

1. Move slide valve to Minimum Load position.

2. Apply supply voltage for 5 minutes before commencing calibration.

3. Push the calibration button for 5 seconds to enter calibration mode, the red LED will change from normally flashing to off.

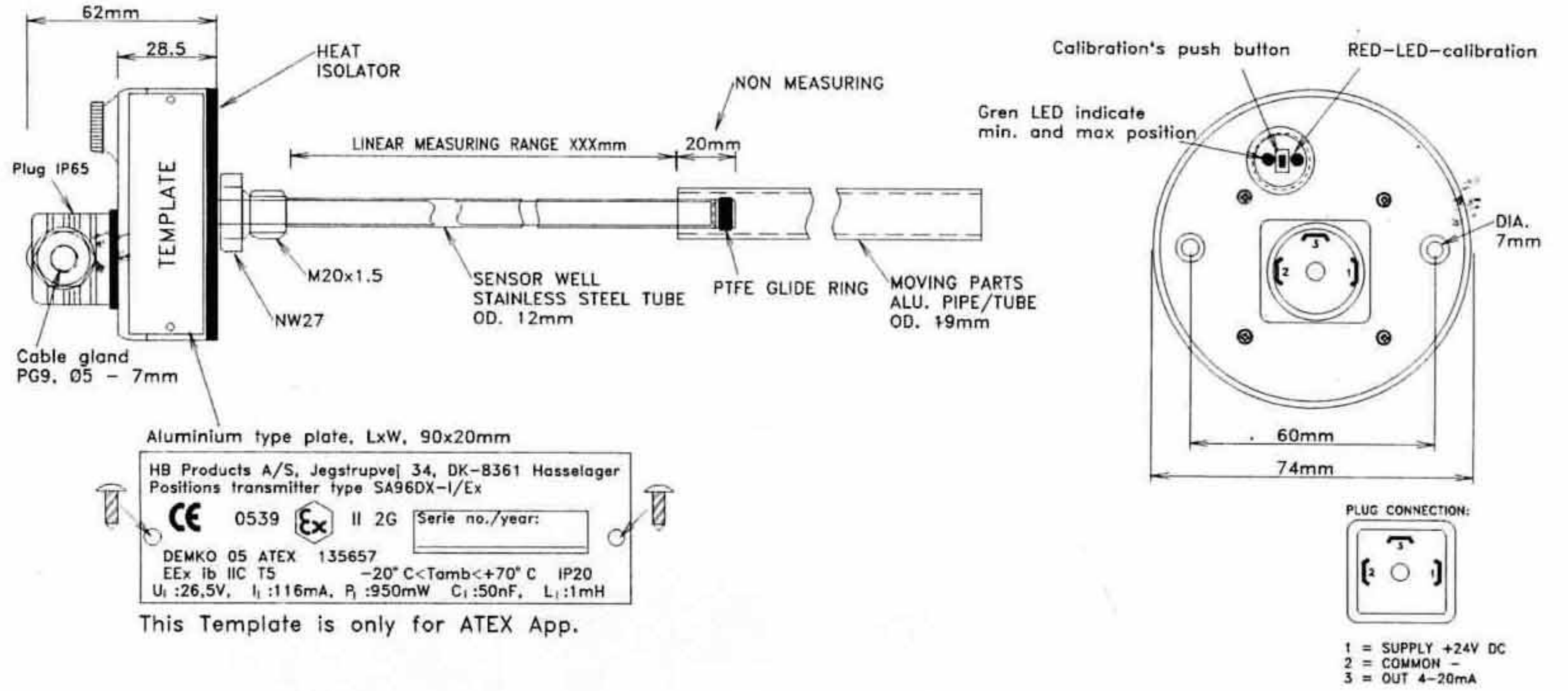
4. Move the slide valve to the minimum position, and then push the calibration button ONCE. The red LED is now illuminated constantly, when the red LED switches off it is ready for the 100% slide valve position calibration.

5. Move slide valve to the 100% maximum load position, and push the calibration button TWICE.

6. The red LED will flash quickly for a few seconds, once the LED returns to normal flash the calibration is complete.

The green LED indicates slide valve maximum and minimum valve travel end positions.

## 5.5 ATEX LPI SENSOR DRAWINGS




NOTE:

POWER SUPPLY/AMPLIFIER HAS TO MEET FOLLOWING DATA:
SUPPLY VOLTAGE : 12–26,5V DC
SHORT-CIRCUIT CURRENT : min. 50mA
TRANSFORMER TYPE: Isolated
APPROVAL: ATEX/cULus/IECEx

When used in Ex-area the installation has to be carried out according to standards in force for the country in question.

The Equipment must be electrically connected via an approved and certified galvanically isolated interface barrier placed outside the hazardous area.

| COMPRESSOR TYPE/SIZE | LENGT SENSOR WELL IN mm | ASSEMBLY PART NO. ATEX TYPE |
|---|---|---|
| XRV 127 | 165 | XR12000–A |
| XRV 163/204 | 250 | XR24000–A |
| | | |
| WRV 163 | 180 | M3001001–A |
| WRV 204 | 250 | M3001002–A |
| WRVi 255 | 350 | M3001003–A |
| WRVi 321 | 410 | M3001004–A |

| | |
|---|---|
| Date: 03–10–06 | Ver. no. 01 |
| Ver. date: | |
| Ver. date: | |
| Ver. date: | |
| Ver. date: | |
| *Approved by:* *UL–DEMKO* | |

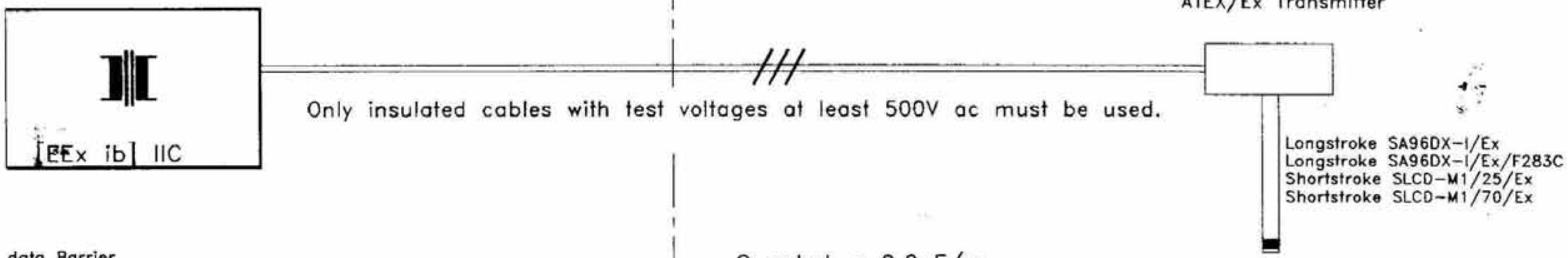
| | | | | |
|---|---|---|---|---|
| ATEX Types HOWDEN LPI | HB Products A/S Jegstrupvej 34 DK–8361 Hasselager | SA96DX–I/xxx/Ex | | |
| | | Const: ME | Drawing no. ATEX–LPI | Page: 1 |

# Installation example in Ex area zone 1

Power supply/Repeater
Ex Barriers, isolated types

SAFE AREA | Ex AREA ZONE 1

ATEX/Ex Transmitter




IS data Barrier
$U_o$: 26V, $I_o$: 93mA, $P_o$: 600mW,
$C_o$: 99nF, $L_o$: 2,82mH

Note:
This data is only for Pepperl+Fuch barrier
type KFD2-CR-Ex1.30300

C cabel = 0,2nF/m
L cabel = 0,6uH/m

Fitting criteria:
Ui > Uo
Ii ≥ Io
Co > Ci + Ccable
Lo > Li + Lcable

Aluminium type plate, LxW, 90x20mm

HB Products A/S, Jegstrupvej 34, DK-8361 Hasselager
Positions transmitter type SA96DX-I/Ex
CE 0539 Ex II 2G | Serie no./year:
DEMKO 05 ATEX 135657
EEx ib IIC T5 -20° C<Tamb<+70° C IP20
$U_i$ :26.5V, $I_i$ :116mA, $P_i$ :950mW $C_i$ :50nF, $L_i$ :1mH

IS data Transmitter

In this case: Explosion group IIC
L cabel max = Lo-Li = 2,3mH
C cabel max = Co-Ci = 49nF
i.e. Max. cable length 49/0,2 = 245 Meters

NOTE:

POWER SUPPLY/AMPLIFIER HAS TO MEET FOLLOWING DATA:

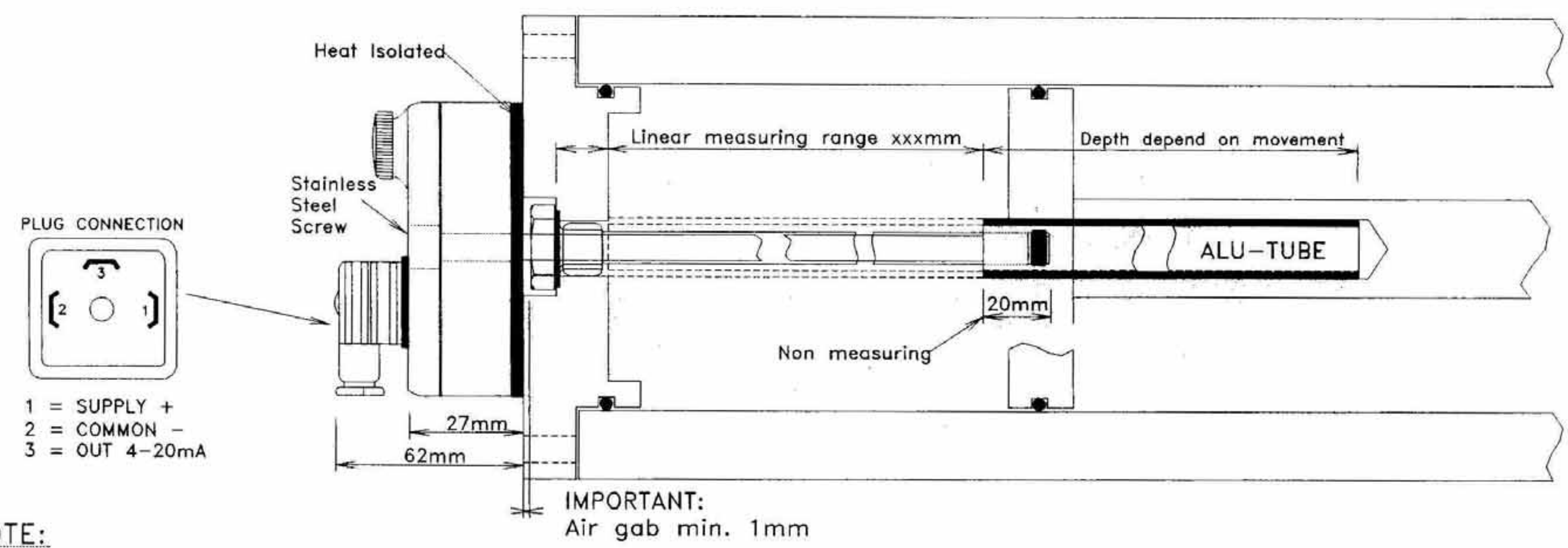
SUPPLY VOLTAGE :.................12-26,5V DC
SHORT-CIRCUIT CURRENT :..........min. 50mA
TRANSFORMER TYPE:................Isolated
APPROVAL:........................ATEX

When used in Ex-area the installation has to be carried out according to standards in force for the country in question.

The Equipment must be electrically connected via an approved and certified galvanically isolated interface barrier placed outside the hazardous area.

| | | | | | |
|---|---|---|---|---|---|
| | | | | Date: 01-12-05 | Ver. no. 01 |
| | | | | Ver. date: | |
| ATEX log: SA96DX-I | HB Products A/S | INSTALLATION: SA96DX-I/F283C/SLCD-M1__/Ex | | | *Approved by:* |
| No. A002 page 2 | Jegstrupvej 34 DK-8361 Hasselager | Const: ME | Drawing no. SA96EX02 | Page: 2 of 2 | *UL-Demko* |

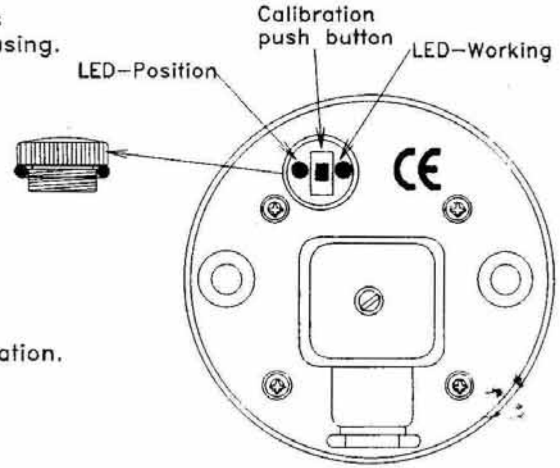
# Mounting Instruction for all Longstroke Transmitters type SA96DX–I/xxx/Ex




## NOTE:

Heat isolator should be mounted between kompressor and alu–housing, fixed with M6 stainless steell Head Cap Screw, to avoid heat transmission from the compressor to the transmitter housing.

IECEx, ATEX and cULus types:
To save power on the EX type the LED's switch OFF after 5min.
To activate the LED push once on the push button.




## Calibration must be done before operation:

1. Apply Supply voltage min. 5 min. before Calibration.
2. Push the Cal. switch for 5 sek. to get the transmitter in Calibration mode the red LED change from normal flash to OFF.
3. Move the Slide valve to 0% position, and then push the calibration's button once, the red LED is now constaintly ON, when the red LED switch OFF its ready for 100% calibration.
4. Now move the Slide valve to 100% position, and push the calibration button twice, the red LED flash quickly, when the red LED flash normaly the calibration is done.

* The green LED indicate end position.

<1% = green LED flash.
>99% = green LED ON.

## 5.6 ASSEMBLY PROCEDURE FOR MAXIMUM AND MINIMUM LIMIT SWITCHES

1. Assemble the maximum switch support bracket and the minimum switch support bracket. The holes for these brackets are pre-drilled.

2. Assemble the switches to the brackets.

3. Ensure the slide valve is in the minimum position (off load, ie, indicator spindle turned fully anti-clockwise) slip the spaces onto the cam spindle.

4. Assemble the two cams on the spindle.

5. Turn the inner cam anti-clockwise until it operates the minimum micro-switch, lock the cam in this position with the grub-screw.

6. Move the slide valve to the maximum position (on load, ie, the indicator spindle turned fully clockwise) and turn the outer cam clockwise onto its peak position until it operates the maximum switch, lock the cam in this position with the grub screw. The switches can be heard to “click” when the peak on the cams pass over the contact on the switch.

7. The slide valve can be moved to maximum and minimum position by introducing air under pressure to the actuator cylinder through the tapped holes provided. Introducing air to the hole furthest away from the compressor body will move the slide valve to the “Max-load” position.

8. Move the slide valve to the “Max-load” position as described in 7. Fit and lock the indicator knob on the cam shaft with the slot on the knob in line with the “MAX” mark on the indicator plate.

9. Check the full travel of the valve against the indicator plate and ensure the slot on the indicator knob indicates the maximum (100%) and minimum (approximately 20%) positions.

10. Connect wires to switch terminals.

## 5.7 PROCEDURE FOR FITTING POTENTIOMETER

1. Power down electrical supply.

2. Disconnect the three wires to the potentiometer.

3. Mark gear mesh point on both gears.

4. Looking on the gear, rotate it in an anti-clockwise direction until the potentiometer shaft reaches the minimum position. Now mark the gear and the potentiometer to fix their orientation to each other.

5. Rotate the shaft of the new potentiometer to the same minimum position and mark the potentiometer same as original, fit the gear and align its mark to the mark on the new potentiometer and tighten the grub screw to fix their orientation.

6. Mark the potentiometer shaft where it has to be shortened, remove gear and cut shaft. Now fit potentiometer to mounting bracket and refit gear, line up marks on gear and potentiometer to correct orientation and secure grub screw.

7. Refit the assembly to the cylinder cover with the potentiometer still in the same minimum position and ensure the original marks on the gear teeth are in the correct mesh.

8. Lightly press down the assembly when tightening the bracket to the cylinder end cover to reduce gear backlash.

9. Re-connect the three wires to the potentiometer.

## 7.1 NORMAL START

1. Check the level in the oil tank.

2. Check that all necessary gas, oil and water valves are open.

3. Start the lubricating oil pump motor.

4. Ensure the capacity control valve is in the fully unloaded position.
   Adjust the volume ratio Vi screw to the required setting. Vi type only.
   (Turning fully clockwise sets Vi = 2.2). Refer to graphs under 6.3 for number of turns.

5. After the oil pump has been running for approximately 15 – 20 seconds, start the drive unit and check that all gauges are indicating normal readings.
6. Load the compressor - oil to outer end cylinder ports activates compressor slide valve to go "on load " position.

**Note:** A log should be kept of the instrument readings so that deviations from the normal running can easily be seen by the Engineer in charge of the installation.

## 7.2 NORMAL STOP

1. Stop the drive unit.

2. After the compressor stops, the control system should be operated to move the slide valve into the off load position, unless the control system does this automatically.

3. After the compressor stops rotating, stop the lubricating pump motor

The compressor is now ready for the next start-up sequence.

## 8.1 PRECAUTIONS DURING SHUTDOWN

The Howden WRV screw compressor operates on an oil/gas mixture and short periods of shutdown will not adversely affect the unit.

If the compressor is shut down for an extended period, the suction and discharge valves should be closed and the lubricating oil pump should be run for approximately 10 minutes each week to distribute oil through the set.

Turn the compressor driveshaft a few times every week by hand. This will help to avoid Brinelling of the anti friction bearings.

If the shutdown period is three months or more, the above procedure should be continued, and in addition, the compressor set should be run for one hour every three months. See Section 7.1 - Normal Start.

During a shutdown period in cold conditions, any water cooled items of the plant should be drained or the cooling water flow maintained to prevent frost damage.

Users may use suitable inhibiting oils in the Howden Screw Compressor prior to a long shutdown.

If you have any doubts about the compatibility of any inhibiting oil with your gas or existing lubrication oil, please contact the manufacturer or your dealer.

## 9.1 GENERAL COMMENTS

The compressor is designed to give long periods of trouble free operation with the minimum of maintenance.

A yearly inspection is recommended for all Howden compressor installations. Some installations may require an annual statutory insurance survey. An Annual Inspection kit will be required for this inspection.

The purpose of the yearly inspection survey is to check if there is any wear of the journal and thrust bearings, slide valve guide block, PTFE seals and Actuator piston and seals, and if any wear is found, for these components to be renewed.

The following are the maximum acceptable floats in the Thrust Bearings:

| | |
|---|---|
| WRV 163 and 204, | 0.003mm (0.0001") |
| WRVi 255 and 321 & 365 | 0.003mm (0.0001”) |
| WRVT 255/110 and 130 | 0.160mm (0.0063") |
| WRVT 255/145,165,193 and 220 | 0.200mm (0.0079") |
| WRVT 321 | 0.275mm (0.0108") |
| WRVT 365 | 0.425mm (0.0167”) |
| WRVT 510 | 0.450mm (0.0177") |

After four years of operation it is recommended that an approved Howden service engineer completes a major overhaul on the compressor. After this time, the thrust bearings must be renewed. The bearings may still be serviceable, but all bearings have a finite lifespan and replacement at this point may forestall an expensive compressor breakdown at a later date.

When the compressor is being inspected or overhauled it must be in a clean area.

On WRV and WRVi compressors the inspection overhaul procedure is different between the 163 and the 204/255/321 compressor due to construction variations.
On all WRVT compressors the inspection procedure is different to the WRV compressor due to the thrust bearing configuration. Please ensure that the correct procedure is used for the size and type of compressor involved.

Alternatively, Howden Compressors Limited have a specialist Overhaul Department where compressors are inspected, a report sent, and only on receipt of client’s instructions the compressor will be overhauled. Prior to despatch, the compressor is fully tested and supplied with a one year warranty.

**The following are all available for the WRV and WRVi Compressor range:**

SERVICE MANUALS SPARES KITS OVERHAUL KITS

Special tools to ease dismantling and reassembly

**Please contact Howden Compressors Ltd, Compressor Business Unit, for further information. Address in the foreword of this manual.**

## 9.2 COMPRESSOR RECORD

| COMPRESSOR TYPE / SERIAL No | CONTRACT No | COMMISSIONING DATE |
|---|---|---|
| | | |

CLIENT / USER

| |
|---|
| |

OPERATING DUTY

| | |
|---|---|
| COMP. SUCTION PRESSURE | |
| COMP. DISCHARGE PRESS. | |
| OIL SUPPLY PRESSURE | |
| OIL SUPPLY TEMPERATURE | |
| PRODUCT / GAS TYPE | |
| INPUT SPEED | |

TYPE OF LUBRICATING OIL

| |
|---|
| |

SERVICE HISTORY

| | HOURS | DATE | PARTS REPLACED |
|---|---|---|---|
| 1st SERVICE | | | |

| | HOURS | DATE | PARTS REPLACED |
|---|---|---|---|
| 2nd SERVICE | | | |

| | HOURS | DATE | PARTS REPLACED |
|---|---|---|---|
| 3rd SERVICE | | | |

Our Compressor Business Unit can offer you a comprehensive range of facilities to ensure the continued reliable operation of your Howden compressor.

We can supply:

1. A comprehensive range of direct replacement compressors, supplied with a warranty.

2. Approved parts and technical information to allow **urgent** repairs to be carried out on site.

3. A field engineer to service or supervise the installation and commissioning of the compressor.

4. Quotations for price and delivery of spare parts.

5. A comprehensive service contract or survey incorporating full vibration analysis tailored specifically to meet customer requirements and time schedules.

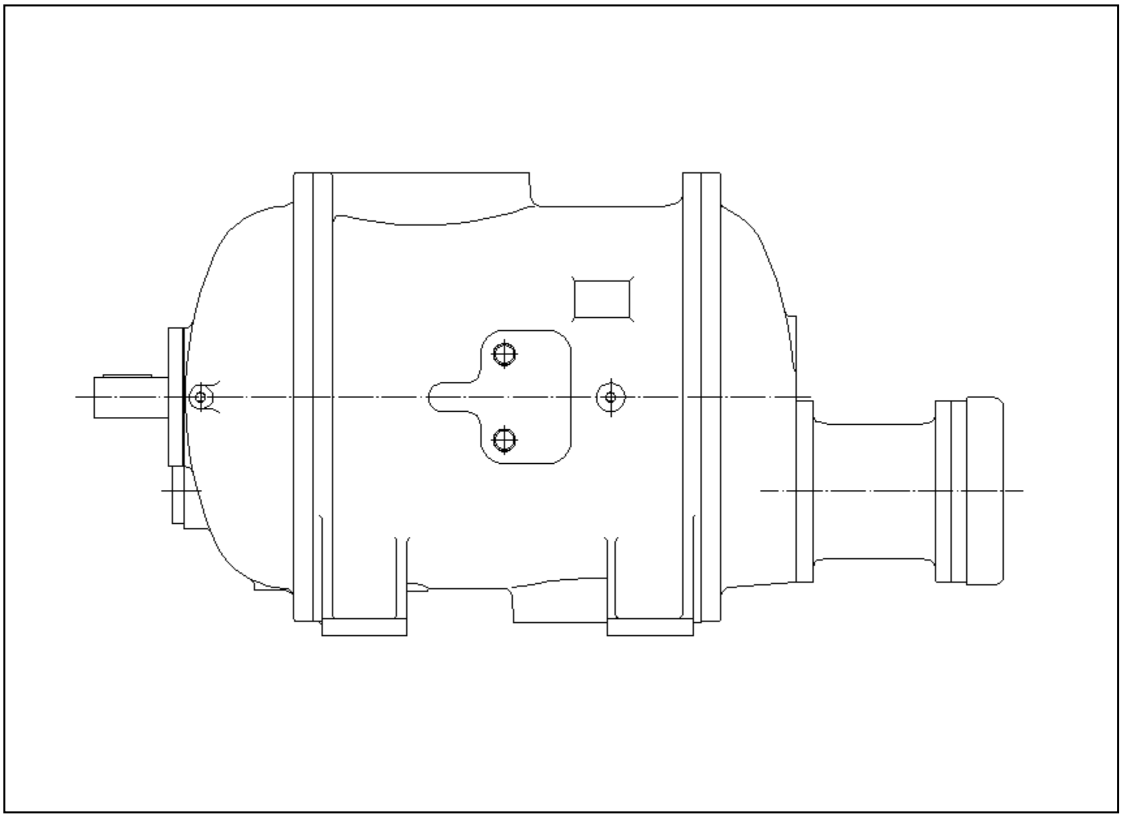
For further information and details of the above please contact the Compressor Business Unit directly at the address in the foreword of this Manual.

**Howden Compressors Limited**
Compressor Business Unit
133 Barfillan Drive
Glasgow G52 1BE
UNITED KINGDOM

Tel: +44 (0)141 882 3346
Fax: +44 (0)141 883 5901
e-mail: sales@howdencompressors.co.uk
Web: www.howden.com

**Howden Compressors LLC**
1850B North Gravers Road
Plymouth Meeting
PA 19462
USA

Tel: 001 610 313 9800
Fax: 001 610 313 9215
e-mail: sales@howdencompressors.com
Web: www.howden.com



# WRV & WRVi

## COMPRESSOR RANGE

## SERVICE MANUAL

## INDEX TO SECTIONS

# SECTION 1

# FOREWORD

**READ CAREFULLY BEFORE INSTALLING AND STARTING YOUR COMPRESSOR**

These instructions have been prepared to ensure that your compressor gives long and satisfactory service.

Detailed instructions for carrying out an annual inspection or overhaul procedure is included for the following range of compressors:

MK1G-1H/WRV163

MK6-6A-6B/WRV204

MK6-6A-6B/WRVi255

MK6-6A/WRVi321

MK1/WRVi365

The entire manual should be read before reverting to any one section for specific information.

One copy should be given to the personnel responsible for installing and operating the compressor.

All requests for information, services or spares should be directed to:

**HOWDEN COMPRESSORS** **or**
Compressor Business Unit
133 Barfillan Drive
Glasgow
G52 1BE
UK

Telephone: 0044 (0)141 882 3346
Fax: 0044 (0)141 882 8648
E-mail: hcl@aftersales@howden.com
Website: www.howden.com

**HOWDEN COMPRESSORS LLC**
1850B North Gravers Road
Plymouth Meeting
PA 19462
USA

Telephone: 001 610 313 9800
Fax: 001 610 313 9215
E-mail: sales@howdencompressors.com
Website: www.howden.com

All enquiries should be accompanied by the Howden Compressors Contract Number and the Compressor Serial Number, taken from the nameplate on the side of the compressor body.

Howden

# SECTION 2

# DESCRIPTION

## 2.1 THE WRV COMPRESSOR

The Howden WRV & WRVi Oil Injected Compressor is a positive displacement, capacity controlled, oil flooded, rotary machine.

Compression is achieved by the meshing of two helical rotors on parallel shafts housed in a casing.

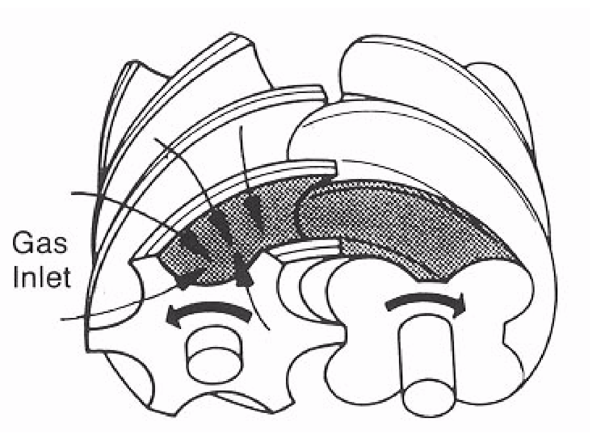
The accurately machined helical rotors are called Male and Female. The Male (driving) rotor has four lobes which mesh with six flutes in the female (driven) rotor, both rotors having the same outside diameter. Each rotor is supported by two plain white metal, thick walled, journal bearings fitted adjacent to the compression chamber. Angular contact bearings, offloaded by internal balance pistons accommodate the axial thrust load.

Capacity control is achieved by means of a hydraulically controlled slide valve in the compressor. This allows internal gas re-circulation, thus controlling the capacity from 100% down to nominally 10% with power saving.

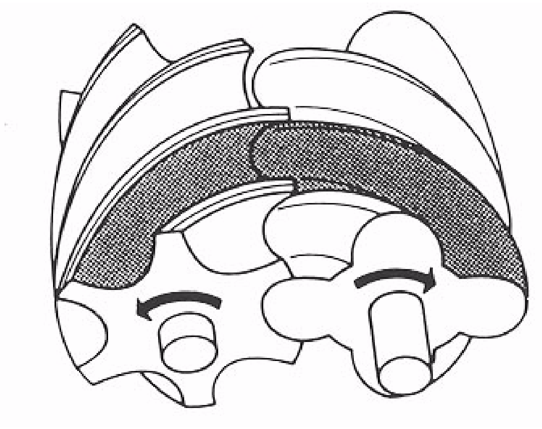
Various methods of hydraulic cylinder control are available and the appropriate literature provided by the compressor set supplier, should be studied before carrying out any work on this equipment.

## 2.2 THE COMPRESSION CYCLE (DIAGRAMMATIC ONLY)

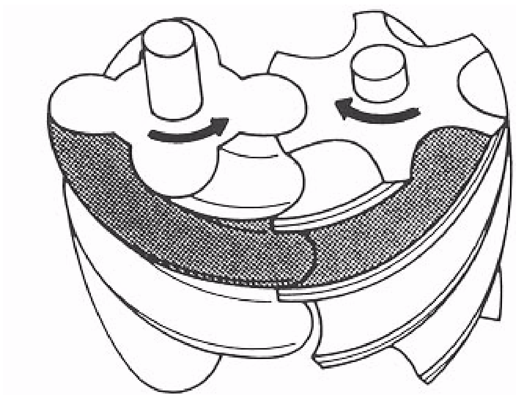
1. Gas is drawn in to fill the interlobe space between adjacent lobes on top side of rotors at Inlet End.



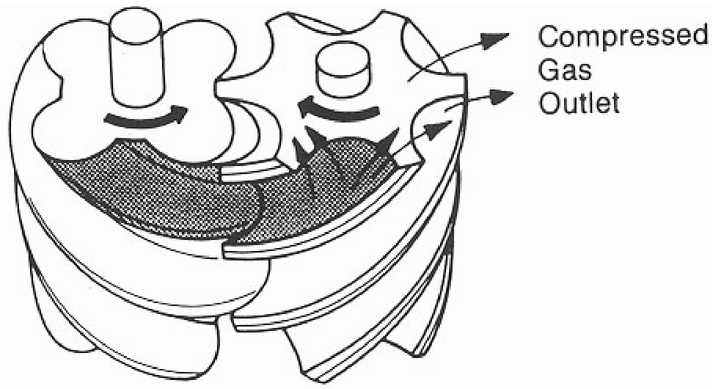

2. As the rotors rotate, the interlobe space moves past the inlet port so sealing the interlobe space. Viewed from the top side of rotors at Inlet End.



3. Continued rotation progressively reduces the space occupied by the gas, causing compression. Viewed from underside of rotors at Discharge End.



4. When the interlobe space becomes exposed to the outlet port the gas is discharged. Viewed from the underside of rotors at Discharge End.



## 2.3 DESCRIPTION OF A GAS SYSTEM FOR A TYPICAL REFRIGERATION COMPRESSOR SET

Gas is drawn into the compressor through a non-return valve and then a strainer is fitted directly on the inlet flange and discharged into an oil tank/separator. The non-return valve is necessary to prevent the compressor being “motored” in the reverse direction when it is stopped with high gas pressure at the outlet.

If necessary, a second non-return valve is positioned at the outlet of the tank to prevent the entry of gas or liquid refrigerant.

Primary separation of the oil mixed with the gas is achieved in the tank, secondary separation takes place in a wire mesh element separator positioned close to the tank outlet.

In some separator designs the wire mesh is replaced by a separator cartridge.

The separated oil drains into the oil tank. A further secondary separator vessel may also be fitted where a very high separation efficiency is required. The oil separated is usually drained into the compressor through a small bore pipe which can be fitted with a protective filter and an isolating valve.

## 2.4 DESCRIPTION OF AN OIL SYSTEM FOR A TYPICAL REFRIGERATION COMPRESSOR SET

Oil at outlet pressure is drawn from the tank by the oil pump, passed through a cooler and micronic filters to the manifold where it is fed to the bearings, balance piston, shaft seal, compression chamber and hydraulic actuator.

When liquid refrigerant injection is used there is no oil cooler.

A differential pressure relief valve in the system before the filters maintains a manifold pressure in the range of 30 psi (2 kg/cm²) for a standard range compressor set and 40 psi (2.7 kg/cm²) for an ‘H’ designated compressor set. When the compressor operates on a continuous duty, duplex micronic filters may be fitted, allowing one filter element to be changed while the other is in operation.

Approved lubricating oils for refrigeration compressors are listed under Section 2.5.

## 2.5 RECOMMENDED LUBRICATING OILS

Howden compressors are fitted, as standard, with neoprene ‘O’ rings.

These ‘O’ rings are compatible with the majority of standard refrigerants and many oils, but compatibility with all possible combinations of refrigerant and oil cannot be guaranteed.

Should you wish to review this matter, please do not hesitate to contact Howden Compressors Limited, who will be pleased to provide recommendations and costs for any special ‘O’ ring materials which may be required.

**Typical Standard Refrigerants:**

R717, R22, R134a, R404A R407C, R410A, R507

**Typical Oils:**

Mineral Oil
Polyol Ester Oil
Poly Alkylene Glycol Oil
Alkyl Benzene Oil

**Oil Viscosity:**

For the majority of ammonia refrigeration applications, oil viscosity of 68 centistokes at 40ºC is the appropriate selection. However, with many other refrigerants, eg; R134a with high condensing temperatures, or applications involving hydrocarbon gases, a specific oil selection is required.

Howden Compressors Limited offer a consultancy service to all users of HCL product.
Please consult the applications department of HCL who will be happy to advise on grade of oil applicable to the refrigerant or gas at the specific duty application.

# SECTION 3

# INSTALLATION

## 3.1 ALIGNMENT OF COMPRESSOR COUPLINGS

The couplings supplied with this compressor must be aligned using the method described below:

If a compressor only is supplied the coupling alignment tolerance figures can be seen under Section 3.2.

During alignment checks, both half couplings should be rotated together from 0° to 90°, 180°, 270° and 360° and readings of radial and facial alignment recorded. Turning both half couplings together ensures that readings are recorded at the same point on each half coupling, thus eliminating the effect of any irregularities on the outside diameters, or faces of the half coupling.

Commence alignment by setting the faces of the coupling halves parallel in the vertical plane. The axes will now be parallel in the horizontal plane and further adjustment to obtain the correct centre heights will require equal shimming under each foot of the unit being adjusted. The units are now positioned vertically and horizontally.

Further adjustment to obtain the correct coupling gap, radial and facial alignment, will only require movement of one unit on the existing shim size.

Coupling gap dimensions should be set with the couplings held in a repeatable position, ie, hard together or hard apart. This ensures that each coupling half is removed to the same axial position as each check is made.

The actual coupling gap should be correct when the shafts are in their normal running condition. If the combined float of the driving and driven shaft exceeds the coupling gap tolerance, the value and direction of float for both shafts will be shown on the General Arrangement Drawing.

When setting the gap the axial float of each shaft should be determined and the “hard together” or “hard apart” dimension calculated.

Example: Compressor driven directly by a turbine.

| | |
|---|---|
| Compressor shaft float | 0.050mm (0.002”) |
| Turbine shaft float | 0.250mm (0.010”) |

The normal running position of the compressor shaft is towards the turbine and the turbine normally runs thrusting towards the compressor.

| | |
|---|---|
| Required gap | 3.175mm (0.125”) |

If the gap is checked with the couplings “hard apart” it should be:

| | |
|---|---|
| Plus Compressor shaft float | 0.000mm (0.000”) |
| Plus Turbine shaft float | 0.250mm (0.010”) |
| = “Hard apart” gap | 3.425mm (0.135”) |

### 3.1 ALIGNMENT OF COMPRESSOR COUPLINGS (Continued)

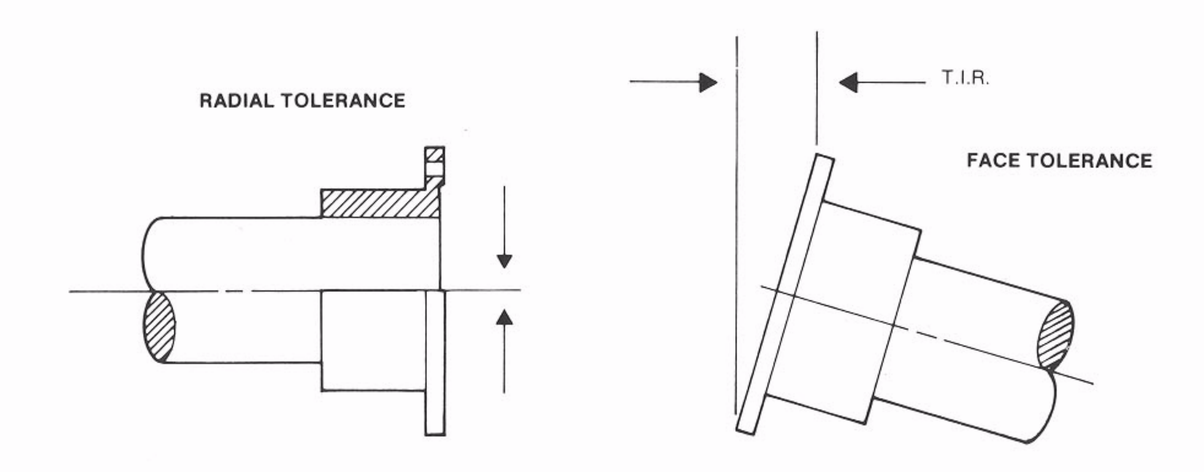
If the gap is checked with the couplings "hard together", ie, in the normal running condition, it should be equal to the required coupling gap: 3.175mm (0.125").

**NOTE:** If a "limited float" coupling is used with an electric motor whose shaft has no thrust bearing, the gap must be correct with the motor shaft on its magnetic centre. In this instance the facial alignment check should be made, rotating the driven half coupling only as the drive (motor) half coupling is not located axially, or preferably by a "double-clock" method, which avoids the problem of repeated axial position.

### 3.2 ALIGNMENT TOLERANCE

The maximum acceptable line-up tolerance for couplings on compressor installations is as follows:

**RADIAL TOLERANCE** **FACE TOLERANCE**




**Application**

**A. Motor to Gearbox or Compressor ie couplings operating up to 3,600 rpm**

| **Radial Tolerance** | **Face Tolerance** |
|---|---|
| 0.15mm (0.006") TIR | TIR 0.005mm/cm or 0.005"/in Dia. Of coupling |

**B. Gearbox to Compressor i.e. couplings operating above 3,600 rpm**

| **Radial Tolerance** | **Face Tolerance** |
|---|---|
| 0.10mm (0.004") TIR | TIR 0.005mm/cm or 0.005"/inch Dia. Of coupling |

**Radial Tolerance**
Eccentricity = ½ TIR on circumference

TIR denotes Total Indicator Reading obtained by Clockgauge

## 3.3 DOWELLING

Only one unit of any assembly will be dowelled before despatch. Dowels should be fitted to ease re-alignment when components are removed for overhaul.

## 3.4 PIPING

Before installing the piping the compressor inlet and outlet ports should be inspected to ensure no dirt is present.

Note that the pipes and fitting used should not restrict flows. To avoid this always use piping with a bore ¼" larger than the thread diameter of the compressor port, eg, WRV 204 oil injection connection thread is ¾" BSP and so a 1" OD pipe should be used.

**NOTE:** All piping should be supported so that no strain is transmitted to the compressor casings.

The piping should be inspected for cleanliness before installation. As each pipe is connected to the compressor, the coupling alignment should be checked to ensure that no alteration has taken place.

If alignment has altered the compressor is being strained and the piping supports must be adjusted.

It is not sufficient merely to re-align the drive unit as this will not correct the strain being imposed on the compressor. Oil injected refrigeration compressors must have a suction strainer permanently fitted directly on the compressor inlet.

# SECTION 4

# FIRST START UP

## 4.1 FIRST START

Installation of the compressor will have been carried out in accordance with Section 3 of this manual. The Commissioning Engineer should however ascertain that the correct procedures have been followed, in particular the coupling alignment must be checked, then proceed as follows:

1. Disconnect the coupling between the drive and the compressor and check that the direction of rotation is correct to drive the compressor in a clockwise direction, looking on the compressor input shaft. (Anti-clockwise if compressor MRV model).
2. 
3. Fill the oil tank with lubricating oil of the correct grade to the required level as indicated on the tank level sight glass.

4. Ensure that the manifold and oil pipes to the compressor are clean then start the lubricating pump motor to circulate the oil and clean the system.

5. The lubricating oil pressure differential control valve should be set to give a 30 psi (2 $kg/cm^2$) oil manifold differential pressure for a standard range compressor and 40 psi (2.7 $kg/cm^2$) oil manifold differential pressure for an 'H' designated compressor at correct operating temperature, with clean oil filter elements fitted.

6. Check the operation of any safety trips fitted by running the drive unit disconnected from the compressor and mechanically operating the trips, check that the actual settings are in accordance with the contract specification. The lubricating oil differential pressure trip can be set at 12 psi (0.85 $kg/cm^2$) on a standard range compressor and 22 psi (1.54 $kg/cm^2$) on 'H' designated compressors by partially closing the oil filter outlet isolation valve and thereby reducing the differential oil pressure. As the filters become dirty the differential oil pressure will drop to these figures, which are the minimum accepted value.

7. Check that the compressor turns freely by hand and reconnect the coupling between the drive unit and the compressor.

8. Check that the cooling water is turned on to the lubricating oil cooler, if fitted.

9. Check that all gas inlet and outlet isolating valves are open.

10. Start the lubricating oil pump motor.

    **NOTE:** The compressor should be unloaded prior to start up. If the compressor is started without first being unloaded a higher starting torque will be required.

11. Start the drive unit and check that all gauges are indicating correctly.

12. Run the compressor for 30 minutes at minimum gas flows and check that all readings are normal, then operate the capacity control valve to the required position. This position will be indicated on the dial mounted on the hydraulic cylinder.

13. If possible, check the slide valve control over the full range of capacity.

# SECTION 5

# NORMAL OPERATION

## 5.1 NORMAL START

1. Check the level of the oil in the tank.

2. Check that all the necessary gas, oil and water valves are open.

3. Start the lubricating oil pump motor.

4. Ensure the capacity control valve is in the fully unloaded position.

5. Start the drive unit and check that all gauges are indicating normal readings.

## 5.2 NORMAL STOP

1. Stop the drive unit.

2. After the compressor stops, the control system should be operated to move the slide valve into the off load position unless the control system does this automatically.

3. After the compressor stops rotating, stop the lubricating oil pump motor.

4. Close all gas and water isolating valves.

The compressor is now ready for the next start up sequence.

**NOTE:** A log should be kept of the instrument readings so that deviations from normal running conditions can be easily seen by the Engineer in charge of the installation.

# SECTION 6

# PROCEDURES DURING SHUTDOWN

## 6.1 PROCEDURES DURING SHUTDOWN

The Howden WRV Screw Compressor operates on an oil/gas mixture and short periods of shutdown will not adversely affect the unit.

If the compressor is shut down for an extended period the lubricating oil pump should be operated for approximately ten minutes weekly, to distribute oil throughout the set.

Turn the compressor driveshaft a few times every week by hand. This will help to avoid Brinelling of the anti-friction bearings.

If the shutdown period is three months or more the above procedure should be continued and, in addition, the compressor set should be run for one hour every three months.

Alternatively, for greater corrosion protection, the normal lubricating oil can be drained off, replaced with inhibiting oil and the set run for one hour initially, then one hour every three months.

**NOTE:** Before the compressor set is returned to normal use, the inhibiting oil must be removed and the system filled with regular oil.

During a shutdown period in cold conditions any water cooled items of plant should be drained, or the cooling water flow maintained to prevent frost damage.

## 6.2 INHIBITING OILS APPROVED FOR USE WITH HOWDEN SCREW COMPRESSORS

A list of approved inhibiting oils suitable for use on the Howden Screw Compressor prior to a prolonged shutdown is shown in Fig. 1.

If you have any doubts about the compatibility of these oils with your gas please contact the manufacturer or your dealer.

| | |
|---|---|
| SHELL | ENSIS ENGINE OIL 10W |
| ESSO | RUST-BAN 335 OR 337 |
| MOBIL | MOBILARMA 524 |
| CALTEX | CALTEX PRESERVATION OIL 10W |

Fig. 1

# SECTION 7

# MAINTENANCE

## 7.1 GENERAL COMMENTS

The compressor is designed to give long periods of trouble free operation with the minimum of maintenance. A yearly inspection is recommended for all Howden Compressor installations. Some installations may require an annual statutory insurance survey.

The purpose of the yearly inspection survey is to check if there is any significant wear of the thrust bearings, slide valve guide block or PTFE seals and, if any wear is found, for these components to be renewed.

Where axial movement condition monitoring equipment is fitted to the compressor, a continuous indication of the thrust bearing condition is monitored and the bearing check can be extended to once every two years.

It is not anticipated, however, that a major overhaul will be required until approximately after four years operation. After this time the thrust bearings must be renewed.

When the compressor is being inspected or overhauled it must be dismantled in a clean area.

The inspection overhaul procedure is different between the WRV163 & WRV204 compressors and the, WRVi255, WRVi321 & WRVi365 compressors due to construction variations. Please ensure that the correct procedure is used for the size of compressor involved.

Always refer to the sectional and external arrangement drawings.

All fasteners should be torqued to the value specified as stated under Torque Specifications in Section 9.1 using appropriate torque wrenches.

All lockwashers, tabwashers, ‘O’ rings and PTFE seals must be renewed on assembly. Section 9.2 describes lockwasher assembly procedure.

Special tools to ease dismantling and re-assembly can be provided, as listed in Section 9.3. Details of these can be obtained from the Compressor Business Unit, Howden Compressors. Section 10 details all Part Numbers of normally replaceable components.

### 7.2 PREPARATION FOR ANNUAL INSPECTION

Before dismantling the compressor, certain precautions should be taken in the interests of safety:

1. Isolate the drive unit.

2. Depressurise and purge the system.

3. Disconnect the drive unit coupling from the compressor.

4. Place a receptacle under the outlet end of the compressor to catch any oil which may drip from the hydraulic cylinder when the cylinder cover is removed or when the outlet end cover is removed.

5. Ensure all lifting equipment, ie, eye bolts, slings, and shackles are safe and serviceable.

To enable a check to be made of floats and condition of seals and guide block on the compressor during annual maintenance, a certain amount of dismantling is required. This differs slightly between the 163 compressor and the 204, 255, 321 & 365 compressors.

### 7.3 DISMANTLING PROCEDURE FOR ANNUAL INSPECTION

**Commence at discharge end with the Hydraulic Actuator**

No matter which size compressor is involved, extract the 3 off cap screws holding the Aluminium cover to the cylinder cover, if fitted, and remove. Extract the cap screws securing the Cylinder Cover to the Hydraulic Cylinder and remove the cover, including the limit switches and indicator spindle which are attached to it (Fig. 2).

**NOTE:** Some compressors will have a LPI sensor fitted as an option instead of switches, and will not have the cylinder switch cover fitted.

## 7.3 DISMANTLING PROCEDURE FOR ANNUAL INSPECTION (Continued)

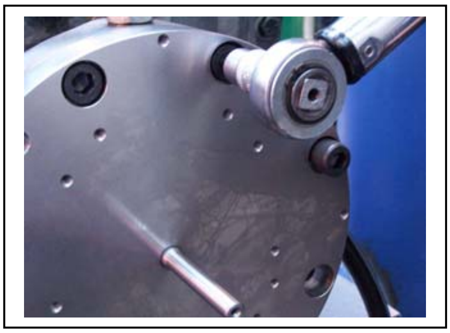


Fig. 2

Fig. 3

**NOTE:** The indicator spindle has to clear a dowel pin which moves along the spiral groove in the spindle, therefore this cover must be kept in an axial position when withdrawing until the spindle clears the dowel pin (Fig 3). The LPI Sensor is housed inside a sensor well attached to the cover and this must also be removed axially.

**IMPORTANT**: It is essential that the spiral groove engaging the dowel pin is marked for correct re-assembly to avoid damage to the potentiometer.

Move the slide valve to bring the actuator piston to the outer end of the cylinder. Do not move the slide valve past its minimum position at the capacity stop as it may come off the guide block at the inlet end of the compressor when unlocking the piston lockwasher and locknut.

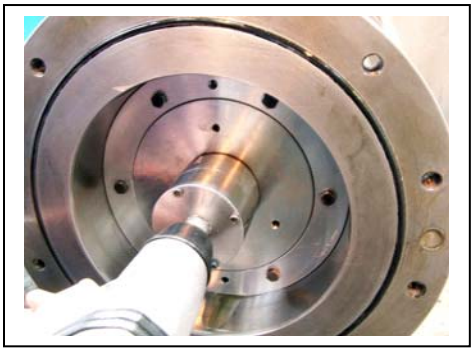


Fig. 4

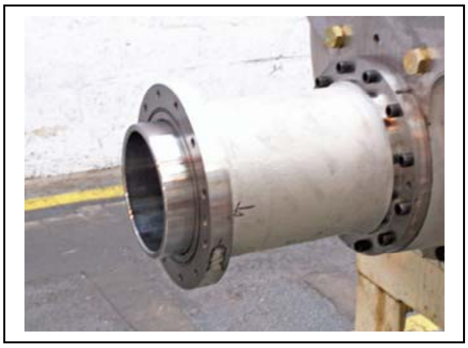


Fig. 5

Unlock the piston lockwasher and locknut and remove (Fig. 4).
Remove the actuator stop sleeve, if fitted, from the cylinder bore (Fig. 5).
Withdraw the piston (Fig. 6) using the appropriate tool listed for the compressor size. See Section 9.3.

## 7.3 DISMANTLING PROCEDURE FOR ANNUAL INSPECTION (Continued)

### Removing the Combined Outlet Cover/Cylinder 163 Compressor

Fit an eyebolt to the tapped hole at the top of the outlet cover, attach a sling to the eyebolt to support the weight of the cover (Fig. 7).

Fig. 6

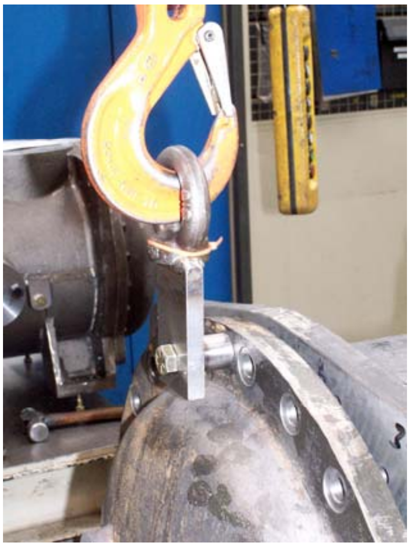


Fig. 7

**7.3 DISMANTLING PROCEDURE FOR ANNUAL INSPECTION (Continued)**

Extract the set pins securing the discharge cover to the main casing body. (Fig. 8) Push the piston rod to the bottom of the cylinder.

Carefully draw the cover clear of the piston rod/valve spindle. Care should be taken to prevent damage to the actuator cylinder which is part of the cover.

At this stage, the slide valve can be withdrawn from the compressor for a visual inspection. (Fig. 9)

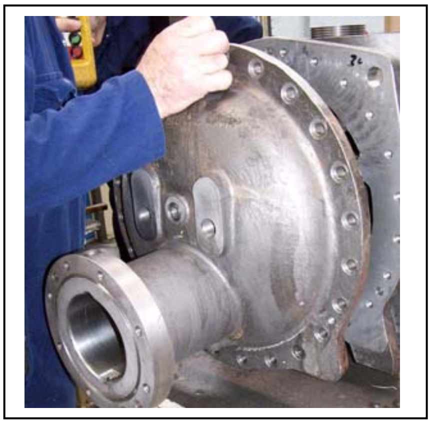


Fig. 8

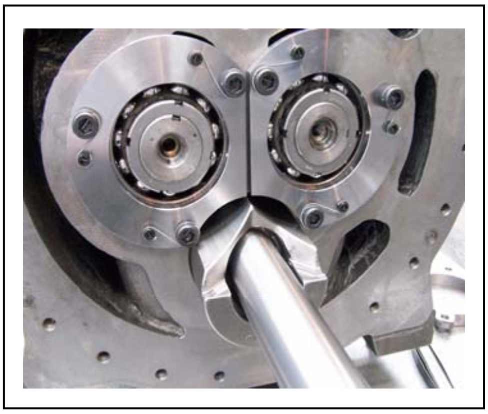


Fig. 9

A light shone from the slide valve bore will permit a visual inspection of the rotors. (Fig. 10-11)

Fig. 10

Fig. 11

## 7.3 DISMANTLING PROCEDURE FOR ANNUAL INSPECTION (Continued)

**Removing the Cylinder and End Cover WRV204, WRVi255, WRVi321 & WRVi365 Compressors**

The hydraulic cylinder and end cover are separate items in the above compressor and are removed as follows:

**Removing the Hydraulic Cylinder**

Extract the cap screws or setscrews securing the cylinder to the end cover (Fig. 12). Support the cylinder with a sling and using the jacking holes provided in the cylinder flange, jack out the cylinder (Fig. 13).

Fig. 12

Fig. 13

**Removing the End Cover**

Extract most of the set pins securing the outlet end cover to the main casing (Fig. 14).

Fig. 14

## 7.3 DISMANTLING PROCEDURE FOR ANNUAL INSPECTION (Continued)

Fit an eye bolt to the top of the outlet cover flange and use suitable lifting equipment to support the weight of the cover (Fig. 15).
Remove the set pins locating the cover to the main casing and remove the cover.

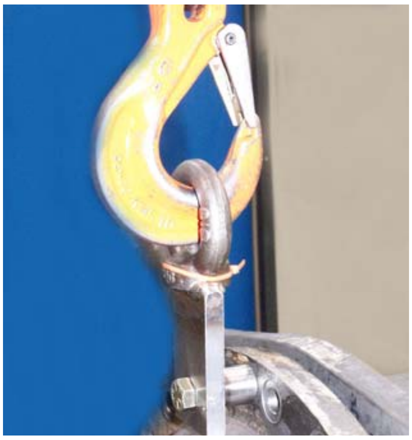


Fig. 15

Fig. 16

Take care to avoid damage to the piston rod/valve spindle (Fig. 16).

**Removing the Slide Valve**

Withdraw the slide valve using suitable lifting equipment to support the weight of the valve, especially on WRVi255, WRVi321, & WRVi365 compressors (Fig. 17).

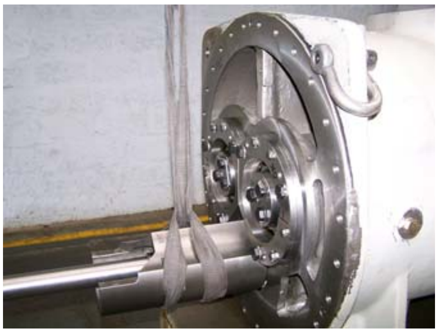


Fig. 17

## 7.3 DISMANTLING PROCEDURE FOR ANNUAL INSPECTION (Continued)

Now that the slide valve has been removed by shining a light from the valve bore, a visual inspection of the rotors can be achieved (Figs. 18 - 19).

Fig. 18

Fig. 19

**PTFE Seals.**

The compressor has now been dismantled enough to permit the inspection and replacement of the PTFE seals and ‘O’ rings in the actuator cylinder, (Fig. 20) also the piston, should they be required (Fig. 21).

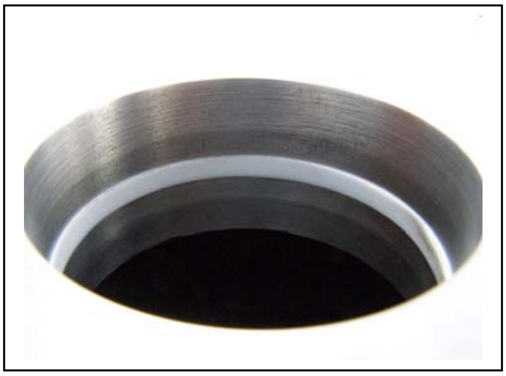


Fig. 20

Fig. 21

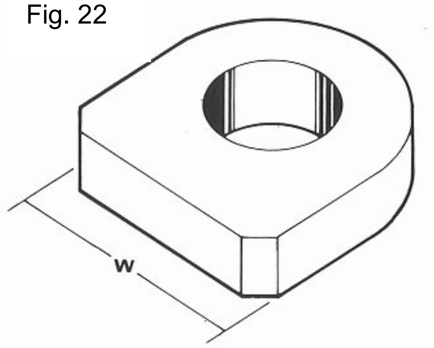
## 7.4 CHECKING CLEARANCES

### Guide Block

The guide block which locates the slide valve should also be checked for wear every 30,000 hours or every 4 years whichever comes first. See Fig. 22 and relative table for dimensions.

### Guide Block to Slide Valve Slot

Fig. 22




| Compressor Size by Rotor Diameter | Dimension 'W' | Clearance |
|---|---|---|
| 163 mm | 24.987/24.975 mm (0.984"/0.9833") | 0.046/0.013 mm (0.0018"/0.005") |
| 204mm | 29.987/29.975 mm (1.181"/1.180") | 0.046/0.013 mm (0.0018"/0.005") |
| 255mm | 41.262/41.250 mm (1.625"/1.624") | 0.050/0.013 mm (0.002"/0.005") |
| 321mm | 44.990/44.965 mm (1.771"/1.770") | 0.060/0.010mm (0.0024"/0.004") |
| 365mm | 49.991/49.965mm | 0.065/0.009mm (0.0025"/0.004") |

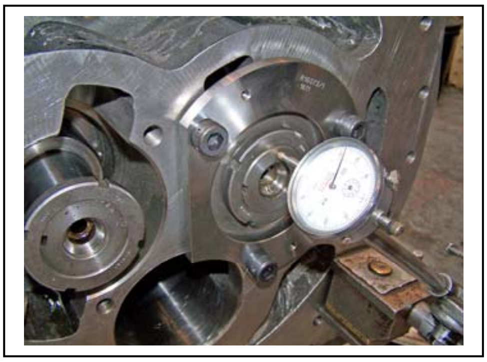
### 7.4 CHECKING CLEARANCES (Continued)

**To check the Thrust Bearing Float**

To check the thrust bearing float, set a dial indicator up axially on the shaft end. Access must be gained to the inlet end of the female rotor by removing the rotor cover. Push or pull the rotor, to its limit in either direction.

Record the indicator reading and then push or pull the rotor to its limit in the opposite direction. The difference in indicator readings is the thrust bearing axial float. This procedure must be followed for both male and female rotors. This reading should not exceed 0.025mm (0.001"). Any increase over this reading will necessitate replacement of the thrust bearings. The thrust bearings are fitted with a small pre-load, the maximum float permitted is 0.025mm (0.001"). If in excess of this the bearings must be changed.

**NOTE:** Should the thrust bearing float be within limits, no further work on the rotors is recommended, i.e. journal bearing clearances would not necessarily be measured.
Any increase on this figure will necessitate replacement of the thrust bearings, the procedure for which is described per Section 8.2-8.3 or 8.4-8.5.



**Maximum Thrust Bearing Float**

Please note that due to a change in bearing selection, which now means that bearings are fitted with a pre-load condition, the maximum float permitted is 0.025mm (0.001") regardless of compressor size.

Fig. 23

**NOTES:**

It is extremely important that the fasteners on the thrust bearing retaining plates of the WRV163 and WRV204 compressors are torqued exactly to the specified setting of 14Nm. Over-torquing will not permit correct operation of the thrust bearing, resulting in premature failure.

Should the thrust bearing float be within limits, no further work on the rotors is recommended, ie, journal bearing clearances would not necessarily be measured. Where the thrust bearing float is outside limits and, therefore, the thrust bearings have to be slackened off and removed, the opportunity would then be taken to measure journal bearing condition, and proceed as for major overhaul.

Where a compressor is fitted with condition monitoring, no check on the thrust bearings will be required. See Section 7.1. A 4 yearly check on the guide block wear, and an annual check on the PTFE seal condition is all that is necessary.

## 7.5 RE-ASSEMBLY AFTER ANNUAL INSPECTION

When all checks and corrections have been made, and assuming no major problems have developed, the compressor can be re-assembled. (Refer to the Sectional Arrangement drawing supplied and torque specifications as advised under Section 9.1)

**WRV163 Compressor**

Ensure the guide block is in position in the slide valve bore, insert the slide valve and push it all the way to the ‘on load’ position (Fig. 24).
Insert an eyebolt into the outlet end cover flange and with the aid of suitable lifting equipment re-assemble the outlet end cover/hydraulic cylinder (Fig. 25).
Secure with set pins to the main casing. Remove the lifting sling and eyebolt.

Fig. 24

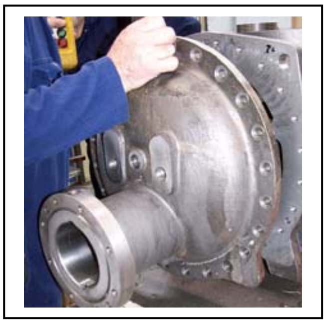


Fig. 25

Refit the piston into place in the hydraulic cylinder. Secure with new lockwasher and locknut (Fig. 26). Replace the actuator stop sleeve. Fit the cylinder end cover, taking care to ensure the dowel is properly located in the spiral groove of the indicator spindle (Fig. 27).

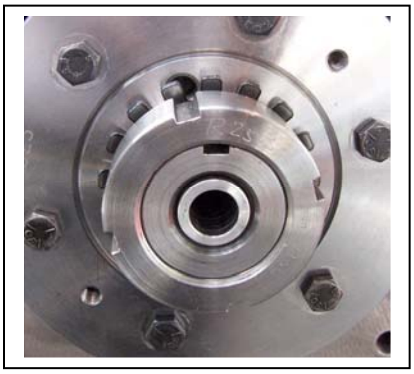


Fig. 26

Fig. 27

Secure the cover with cap screws. Ensure the limit switches are in position securely fastened, assemble the limit switch cover, if fitted, and secure with cap screws.

For compressors fitted with LPI sensors, refit the cylinder end cover and secure the cover with capscrews. Refit and secure the LPI sensor.

## 7.5 REASSEMBLY PROCEDURE FOR ANNUAL INSPECTION (Continued)

**WRV204, WRVi255, WRVi321 & WRVi365**

Ensure the guide block is in position in the slide valve bore, insert the slide valve and push it all the way to the on load position (Fig. 28).
Insert an eyebolt into the outlet end cover flange and with the aid of suitable lifting equipment re-assemble the outlet end cover and secure (Fig. 29).

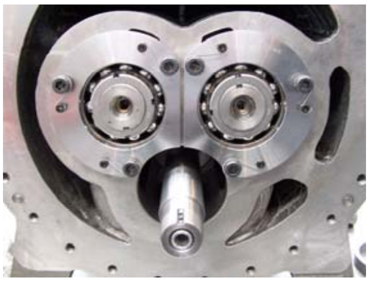


Fig. 28

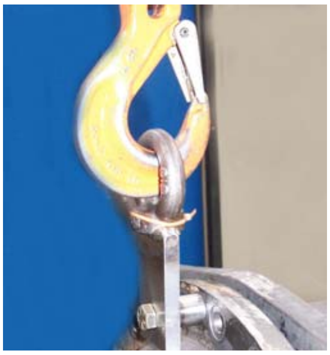


Fig. 29

Attach a sling to the hydraulic cylinder, re-assemble to the outlet end cover and secure with cap screws (Fig. 30).

Refit the piston into place in the hydraulic cylinder. Secure with new lockwasher and locknut (Fig. 31). Replace the actuator stop sleeve. Fit the cylinder end cover taking care to ensure the dowel is properly located in the spiral groove of the indicator spindle (Fig. 32).

Fig. 30

Fig. 31

Fig. 32

Secure the cover with cap screws. Ensure the limit switches are in position securely fastened, assemble the limit switch cover, if fitted, and secure with cap screws.

For compressors fitted with LPI sensors, refit the cylinder end cover and secure the cover with capscrews. Refit and secure the LPI sensor.

# SECTION 8

# OVERHAUL

## 8.1 GENERAL PROCEDURES

Although a yearly inspection and maintenance programme is recommended if no condition monitoring equipment is fitted, it is essential that a major overhaul is carried out after approximately 4 years operation or earlier, dependant on site conditions.

To carry out a major overhaul proceed as follows:

1. If necessary, isolate, depressurise and purge the system.
2. Disconnect the driving and driven half coupling.
3. Disconnect all gas and oil pipes attached to the compressor.
4. Remove the ¾” or 1” BSP taper plug from the bottom of the inlet end cover, and collect the oil which drains off.
5. Remove the gas inlet strainer.
6. Remove the dowel pins (if fitted) and the holding down bolts from the compressor feet.
7. Lift the compressor to the location, which should be a clean, dry area, where dismantling and assembly will take place.

**Notes about Dismantling and Re-assembly**

The dismantling and assembly method varies slightly between the WRV163 & WRV204 compressors and the WRVi255, WRVi321 & WRVi365 compressors due to differences in construction. It is, therefore, essential the correct procedure is used for the size of compressor involved.

Reference should always be made to the Sectional Arrangement drawing supplied.

Use only proper locknut spanners to avoid damage to the locknut slots.

Special tools to facilitate assembly and dismantling operations can be supplied on request.

A list of special tools is located in Section 9.3 of this manual.

All lockwashers, tabwashers, ‘O’ rings and PTFE seals must be renewed on assembly.

All lockwashers must be assembled according to the procedure as described per Section 9.2.

All fasteners should be torqued to the specified values as stated under Section 9.1.

## 8.2 DISMANTLING 163 COMPRESSOR FOR MAJOR OVERHAUL

**The compressor to be dismantled as per procedures for Annual Inspection under Section 7.3 then proceed:**

**Checking Journal Bearing Clearance (163mm)**

At this point in the dismantling procedure the journal bearing clearance should be checked to determine whether the journal bearings need to be replaced as part of the compressor overhaul.

Ensure the thrust retaining plate on the WRV163 compressor is removed (Figs. 33-34).

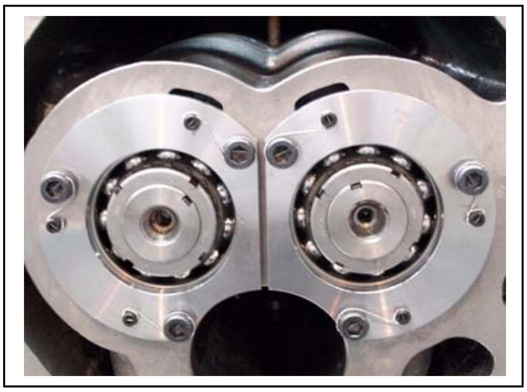


Fig. 33

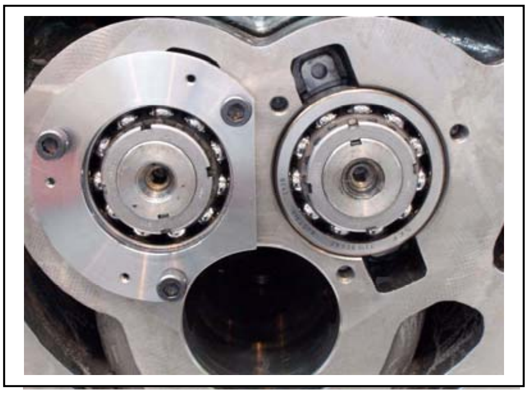


Fig. 34

Procure a piece of round bar ½" (13mm) diameter and approximately 14" (355mm) long. Set up a dial indicator in a convenient position on the main casing to allow the spindle of the dial indicator to lie on the rotor or rotor locknut.

Set the dial indicator to zero.

Insert the short piece of bar into the hole on the end of the rotor shaft.
By raising and lowering the bar, a reading is shown on the dial indicator. This reading is the shaft lift, by removing 0.001" (0.025mm) from this reading because of the angle of lift, you are left with the bearing clearance.
Check this figure against the table of bearing clearances shown on Fig. 35.

## 8.2 DISMANTLING 163 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

Repeat the procedure on both rotors. If there is any doubt about the clearance of a bearing, renew the bearing.

As the inlet end bearings are more lightly loaded they then only require to be inspected if the outlet end bearings require to be replaced.

| Compressor Size | Drawing Clearance mm | Drawing Clearance inches | Maximum Allowable Clearance |
|---|---|---|---|
| 163 | 0.070/0.1102 | 0.0028"/0.0043" | 0.150mm/0.006" |

Fig. 35 WRV163 Bearing Journal Clearances

Carry on the dismantling procedure by unlocking the lockwashers and locknuts securing the thrust bearings (Figs.36 & 37) and remove. The adjusting ring behind the thrust bearing has threaded extensions which enable the ring to be extracted by the use of jacking screws, the operation of jacking out the adjusting ring withdraws the thrust bearing with it (Figs. 37-39).

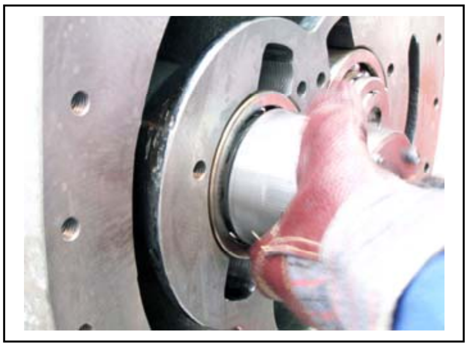


Fig. 36

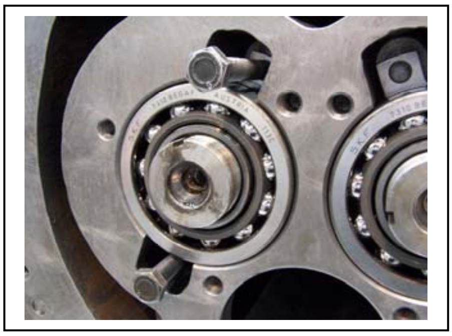


Fig. 37

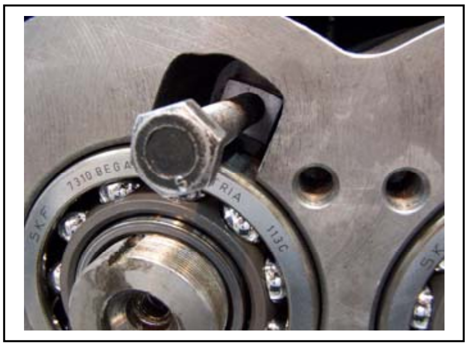


Fig. 38

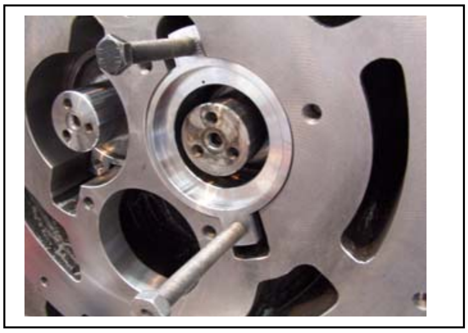


Fig. 39

## 8.2 DISMANTLING 163 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

**Removing the Inlet Shaft Seal (163mm)**

Withdraw the driven half coupling key from the input shaft. Extract the cap screws (Fig. 40) from the shaft seal cover and, using the jacking screw holes provided in conjunction with the T-bar jacking tools, remove the shaft seal cover. Follow on with the removal of the Input Shaft Seal Assembly (Figs. 41-42), ie, the stationary seat with 'O' ring seal, the shaft seal and balance piston/labyrinth seal. Jacking holes are provided for withdrawing the balance piston using 'T' bar tools.

Fig. 40

Fig. 41

Fig. 42

## 8.2 DISMANTLING 163 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

**Removing the Inlet End Cover (WRV163mm)**

Fit an eyebolt into the tapped hole at the top of the inlet cover flange.

Attach a sling to the eyebolt and support the weight of the cover using some form of lifting gear (Fig. 43).

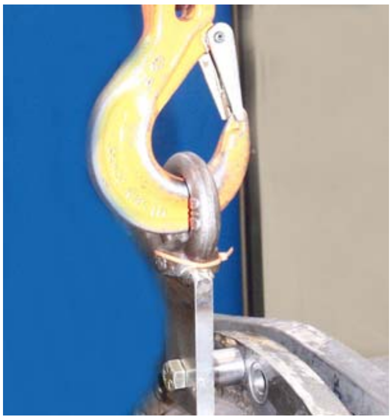


Fig. 43


Fig. 44

Extract most of the screws securing the inlet cover to the main casing. Remove the dowel pins locating the inlet cover to the main casing (Fig.44). Remove the rest of the screws and carefully slide the inlet cover over the extended shaft of the male rotor, taking the 'O' ring seal with it taking great care to avoid damaging the inlet end journal bearings, which are situated in the inlet end cover (Fig. 45).


Fig. 45

## 8.2 DISMANTLING 163 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

**Removing the Rotors (163mm)**

Now that the inlet and outlet end casings and the thrust bearings have been removed as described previously, the rotors can be withdrawn from the main casing as shown in Figs.46-47. See table Fig. 48 for estimated rotor weight.

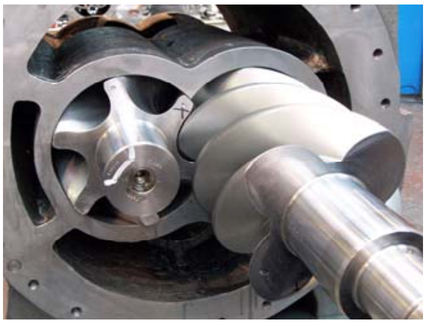


Fig. 46

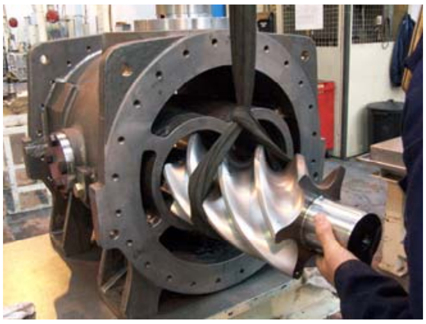


Fig. 47

ESTIMATED WEIGHTS OF ROTORS

| Rotor Size | Male | | Female | |
|---|---|---|---|---|
| | lbs | kg | lbs | kg |
| 163/1.80 | 93 | 42 | 71 | 32 |
| 163/1.45 | 79 | 36 | 59 | 27 |

Fig. 48

The journal bearings can now be extracted from the Main and Inlet casings using an extractor tool. See Tool List Section 9.3.

Fit new journal bearings using assembly tool in preparation for re-assembly.

The journal bearings are located by a dowel pin and are retained by circlips.

## 8.3 RE-ASSEMBLY 163 COMPRESSOR AFTER OVERHAUL

When repair or rectification work has been completed the compressor should be assembled as follows.

1. Lubricate the bearing bores with lubricating oil and lift in the rotors, ensure the lobes mesh at the serial numbers on the rotors.
2. Assemble the inlet casing to the main casing, locate with the dowel pins, and secure with set pins. (See Torque Specification in Section 9.1)
3. Locate the thrust bearing adjustment plates over the rotor shafts at the outlet end and slide them into position. Heat the angular contact thrust bearings using an oil bath or induction heater to a temperature of approx 100°C and assemble to the rotors.
4. Prior to wire locking the thrust retaining plate in place, it is necessary to check that the rotor outlet end clearance is correct.
5. Fit lockwasher/locknut and secure (Fig. 36).

## 8.3 RE-ASSEMBLY 163 COMPRESSOR AFTER OVERHAUL (Continued)

### Checking Rotor to main casing Outlet End Clearance (163mm)

1. Remove the thrust retaining plate (if fitted).
2. The adjusting plate behind the thrust bearings has two lugs with tapped holes for withdrawal purposes.
3. Insert jacking screws into the lugs and lightly tension the screws until resistance if felt (Fig. 49).
4. The action of tightening the screws draws the rotors hard against the outlet end of the main casing.
5. Remove the jacking screws.
6. Replace the thrust retaining plate and the retaining screws (Figs. 33-34).
7. Fit a clock gauge in a suitable point on the casing with the spindle of the gauge touching the end of the rotor (Fig 50).
8. Set the clock dial to zero.
9. Torque up the plate retaining screws using a torque wrench to 14Nm.
10. Note the movement on the clock gauge. This is the rotor outlet end clearance and should correspond to the table as per Fig. 51.
11. Adjustment, if necessary, is carried out by machining of the thrust bearing withdrawal plates.

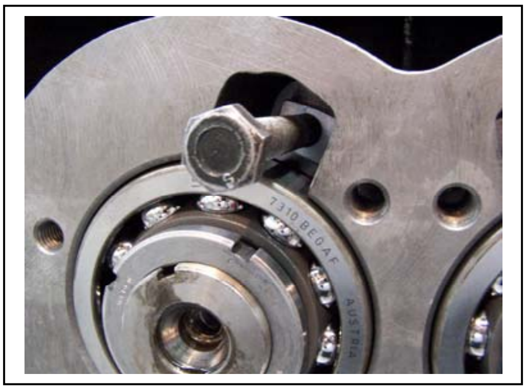


Fig. 49

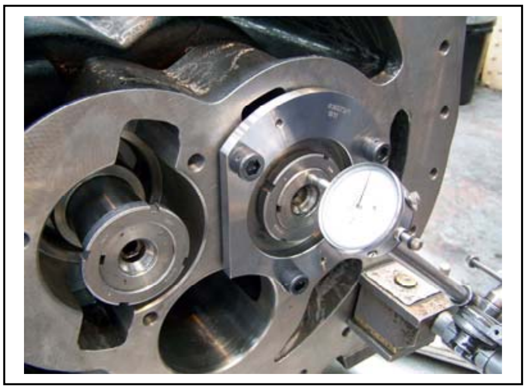


Fig. 50

| Rotor Outlet End Clearance<br>163 Compressor | Maximum Allowable Clearance |
|---|---|
| 0.050/0.075mm | 0.100mm |
| 0.002/0.003” | 0.004” |

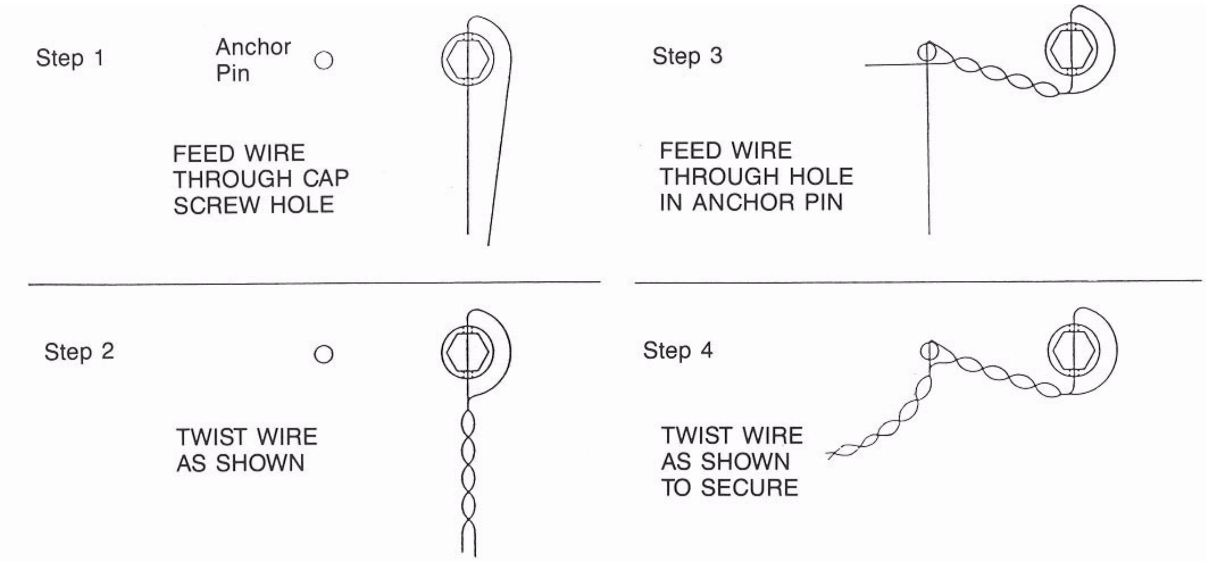
Fig. 51 WRV 163 Outlet End Clearance

## 8.3 RE-ASSEMBLY 163 COMPRESSOR AFTER OVERHAUL (Continued)

When the clearances are finalised, the retaining cap screws on the Thrust Retaining Plate should be wire locked using the following method:

The grade of wire used should be 1/16" diameter Annealed S.S. Safety Wire.

Adjustment, if necessary, is carried out by machining of the adjusting plate behind the thrust bearings (Fig. 52).




**Re-assemble the combined outlet cover/cylinder (163mm)**

Re-assembly as described per Section 7.5 for 163 compressor, then proceed:

**Re-assemble the input shaft seal (163mm)**

Re-assemble the components in the following sequence:

1. Assemble the balance piston on the rotor shaft, locating dowel with the driving pin facing outward.
2. Lubricate the shaft seal and assemble to the rotor shaft, locate in the outward facing dowel/driving pin of the balance piston.
3. Assemble the stationary seat with a new 'O' ring fitted on the outside diameter recess.
4. Fit the seal housing with new 'O' ring and secure with capscrews, tightening them in a systematic order to avoid tilting.

The torque setting of the cap screws is 35lbs ft (48Nm).
To complete the assembly fit the coupling key and compressor driven half coupling.

## 8.4 DISMANTLING WRV204, WRVi255, WRVi321 & WRVi365 COMPRESSORS FOR MAJOR OVERHAUL

The compressor to be dismantled as per procedure for Annual Inspection under Section 7.2, then proceed:

**Checking Journal Bearing Clearance (WRV204)** As per procedure for WRV163 Section 8.2

**Checking Journal Bearing Clearance (WRVi255, WRVi321 & WRVi365)**

Slacken back the set pins securing the thrust housing end cover, to ensure it is not binding on the outer rim of the thrust bearing (Figs. 53-54).
This necessitates the use of a slightly different technique for measuring bearing lifts, since there is no longer a hole in the rotor end in which to insert a lever to lift the rotor.
In this case, the dial indicator must be mounted on top of the rotor. The rotor end must be jacked or levered up at the bottom of the thrust retaining plate to obtain a reading.
The bearing clearance is equal to the indicated reading minus 0.001” (0.025mm).
Repeat the procedure on the other rotor. If there is any doubt about the clearance of a bearing, renew the bearing. As the inlet end bearings are more lightly loaded they only require to be inspected if the outlet end bearings show signs of wear.

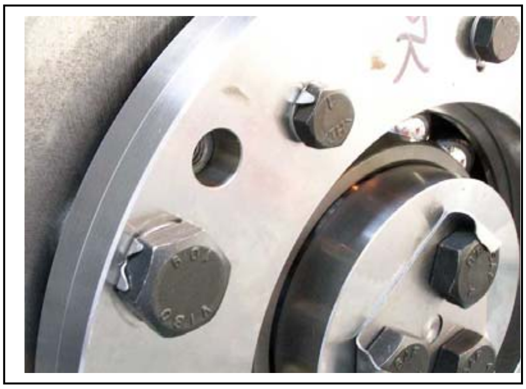


Fig. 53

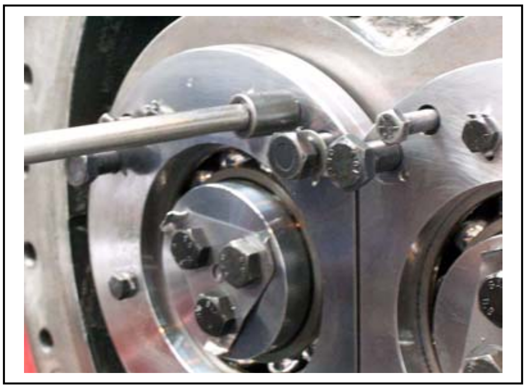


Fig. 54

## 8.4 DISMANTLING 204, 255, 321 & 365 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

If the journal bearing clearance inspection shows the bearing diametrical clearance is less than the maximum allowable, (see Fig. 55), the advantages of a further period of trouble free running with new journal bearings should be considered before deciding to re-use the existing bearings.

| Compressor Size | Drawing Clearance | | Maximum Allowable Clearance |
|---|---|---|---|
| | mm | Inches | |
| 204 | 0.070/0.110 | 0.0028”/0.0043” | 0.150mm/0.006” |
| 255 | 0.095/0.136 | 0.0037”/0.0054” | 0.180mm/0.007” |
| 321 | 0.130/0.170 | 0.0052”/0.0068” | 0.226mm/0.009” |
| 365 | 0.175/0.220 | 0.0069”/0.0087” | 0.295mm/0.012” |

Fig. 55 Journal Bearing Clearances

**Removing the Input Shaft Seal**

After the driven half coupling and key have been removed, extract the cap screws from the shaft end cover and using the jacking holes provided and using ‘T’ bar jacking tools, remove the shaft cover (Fig. 56).

Fig. 56

## 8.4 DISMANTLING 204, 255, 321 & 365 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

**Removing the Input Shaft Seal (Continued)**

Pull out the shaft seal, taking care not to damage the carbon face of the seal. (Fig. 57) Withdraw the inlet balance piston using T-bar jacking tools in the jacking holes provided. (Fig. 58) Follow this up by removing the stationary seat from the seal cover.

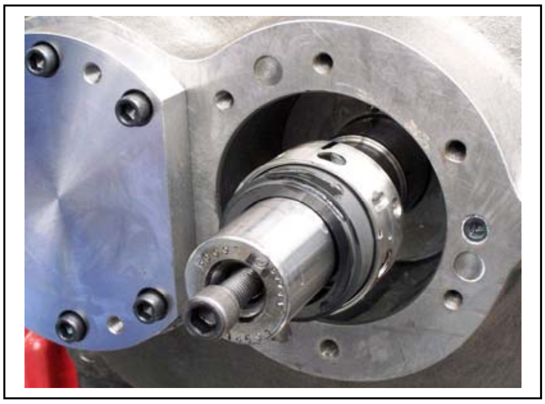


Fig. 57

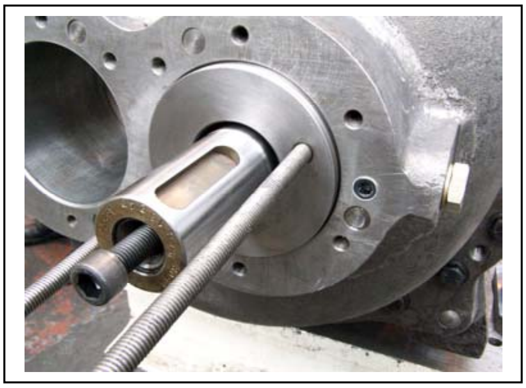


Fig. 58

**Removing the Vi adjuster-WRVi255, WRVi321 & WRVi365 Compressors.**

Remove the retaining clip at the back of the square Vi adjusting screw and push the adjusting screw into the compressor.
Extract the capscrews fixing the Vi cover and remove the cover.

**Removing the Inlet End Cover**

Fit an eyebolt at the top of the inlet end cover to the main casing (Fig. 59).

Remove the dowel pins locating the inlet cover to the main casing.

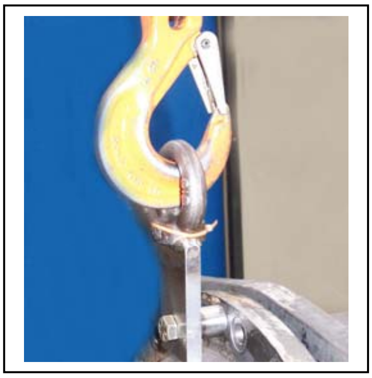


Fig. 59

Fig. 60

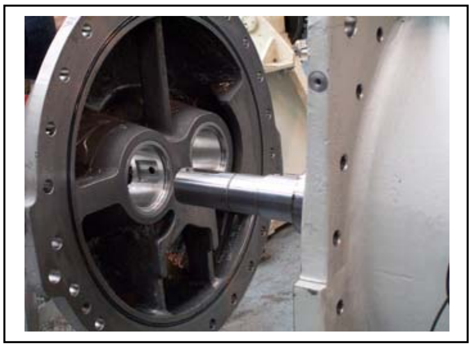


Fig. 61

## 8.4 DISMANTLING 204, 255, 321 & 365 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

**Removing the Inlet End Cover (Continued)**

Remove the rest of the set pins and carefully slide the inlet cover over the extended shaft of the male rotor taking the ‘O’ ring seal with it (Figs. 60-61).

**Removing the Rotors**

In preparation for removing the rotors, unlock the thrust bearing lockwasher (Fig. 62) and remove the bolts from the male and female rotors (Fig. 63).

A construction variation between the above compressors and the WRV163 & WRV204 compressor is that thrust bearing housings are fitted in the WRVi255, WRVi321 & WRVi365 compressors.

Before removing the rotors, the thrust bearings must be withdrawn. It has been known that the thrust housings, which have jacking holes provided for removal purposes, have been used as bearing extractors by jacking out the housings and drawing the bearings off with them. This method of thrust bearing removal is not recommended. The risk of the thrust housing flange being distorted, due to the tight fit of the thrust bearing, is a possibility and would have a detrimental effect on the outlet end clearance. The correct procedure is as follows:

1. Remove the set screws securing the thrust housings to the main casing.
2. Fit three long studs and a jacking plate (See Tool Section 9.3).
3. Using a suitable hydraulic jack and cylinder between the jacking plate and the end of the rotor shaft , apply pressure to the cylinder with the pump, press each rotor in turn out of the thrust bearings and the casings (Fig. 64).
4. The rotors will require to be carefully supported as shown (Figs. 65-66) and the weight of the various sizes of rotors is given in the following table (Fig. 67).

Fig. 62

Fig. 63

8.4 DISMANTLING 204, 255, 321 & 365 COMPRESSOR FOR MAJOR OVERHAUL (Continued)

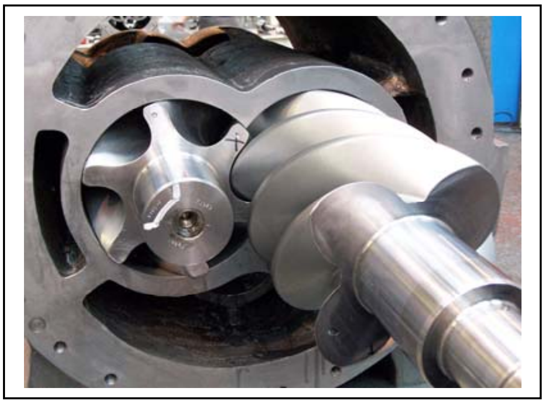


Fig. 64

Fig. 65

Fig. 66

| Rotor Size | Estimated Weights | | | |
|---|---|---|---|---|
| | Male | | Female | |
| | lbs | Kgs | lbs | kgs |
| 204/1.10 | 128 | 58 | 98 | 44 |
| 204/1.65 | 171 | 78 | 131 | 59 |
| 255/1.10 | 267 | 121 | 231 | 106 |
| 255/1.65 | 353 | 160 | 298 | 135 |
| 255/2.20 | 437 | 198 | 364 | 161 |
| 321/1.32 | 527 | 239 | 435 | 197 |
| 321/1.65 | 630 | 286 | 515 | 234 |
| 321/1.93 | 763 | 346 | 593 | 269 |
| 365/1.65 | 990 | 450 | 770 | 350 |
| 365/1.93 | 1111 | 505 | 891 | 405 |

Fig. 67. Rotor Weights

The thrust bearing sleeves and the angular contact thrust bearings can now be easily removed. The balance piston and balance piston sleeves are now accessible and, with the aid of the screwed 'T' bars, (see Special Tool List, Section 9.3) the pistons and sleeves are removed.

The journal bearings can now be extracted from the Main and Inlet casings using an extractor tool. See Tool List Section 9.3.

Fit new journal bearings using assembly tool in preparation for re-assembly.

The journal bearings are located by a dowel pin and are retained by circlips.

## 8.5 RE-ASSEMBLY WRV204, WRVi255, WRVi321 & WRVi365 COMPRESSORS AFTER OVERHAUL

When repair or rectification work has been completed, the compressor should be assembled as follows:

1. Lubricate the bearing bores with lubricating oil and lift in the rotors, ensure the lobes mesh at the serial numbers on the rotors.
   Assemble the inlet casing to the main casing, locate with the dowel pins, and secure with set pins. (See Torque Specification in Section 9.1)
2. For WRV204 Refer to Section 8.2 Re-assembly WRV163 Compressor after overhaul.
3. For WRVi255, WRVi321 & WRVi365 compressors proceed as follows:
4. Assemble the balance piston sleeves into the outlet end casing, fit the balance pistons followed by the thrust bearing sleeves.
5. Heat the angular contact thrust bearings using an oil bath or induction heater to a temperature of approx 100°C, and assemble to the rotors.
6. Fit bearing retaining plate and lockwasher and secure (Fig. 63). Torque as per specification Section 9.1

The angular contact thrust bearings are designed to take axial thrust only. The thrust bearing is not a tight fit on the OD in the thrust housing. This being the case, it is necessary to clamp the outer ring of the bearing to prevent it from rotating with the rotor. To do this the thrust plate is to be ground to give an interference on the outer race of the bearings and the required interference is as shown in the table below (Fig. 68).

| Compressor Size | Interference fit in outer race | |
|---|---|---|
| 255 mm | 0.0015”/ 0.004” | 0.038mm/ 0.100mm |
| 321 mm | 0.0015”/ 0.0045” | 0.040mm/ 0.115mm |
| 365 mm | 0.0015”/ 0.004” | 0.038mm/ 0.100mm |

Fig. 68 Thrust Bearing Nip

Fig. 69

At this stage of the assembly, the rotor outlet end clearance must be checked to ensure the clearance is correct (Fig. 69).

**Checking Rotor to Main Casing Outlet End Clearance**

For WRV204 Compressors refer to WRV163 procedure Sect 8.3
For WRVi255, WRVi321 & WRVi365 Compressors slacken the set screws securing the thrust bearing housing to the main casing. Do not remove them.

**8.5 RE-ASSEMBLY WRVi255, WRVi321 & WRVi365 COMPRESSORS AFTER OVERHAUL (Continued)**
**Checking Rotor Outlet End Clearance**

Insert the jacking screw into the holes provided on the bearing housing flange and lightly tighten the jacking screws until resistance is felt.

The action of tightening the jacking screws draws the rotors against the outlet face of the main casing. Ensure the adjusting pieces are located between the flange of the thrust sleeve and main casing. (Fig 71)

Set up a dial indicator on a convenient part of the main casing with the indicator spindle touching on the end of the rotor. Remove the tension from the jacking screws and ease them back a few threads. Set the dial indicator to zero.

Apply the torque wrench to the set screw securing the thrust bearing housing to the main casing and tighten the screws to the specified torque value (used in Section 9.1).

**NOTE:** The movement shown on the indicator dial is the rotor outlet end clearance. Check it against the table, Fig. 70.

| Compressor Size | Rotor Outlet End Clearance | Maximum Allowable Clearance |
|---|---|---|
| 204 mm | 0.002”/0.003” (0.050/0.075mm) | 0.004” (0.100mm) |
| 255 mm | 0.003”/0.004” (0.075.0.100mm) | 0.005” (0.125mm) |
| 255/220 | 0.008”/0.010” (0.200/0.250mm) | 0.011” (0.280mm) |
| 321 mm | 0.012”/0.014” (0.300/0.350mm) | 0.015” (0.375mm) |
| 365mm | 0.012”/0.014” (0.300/0.350mm) | 0.015” (0.375mm) |

Fig. 70 Rotor to Main Casing Outlet End Clearance

Adjustment, if necessary, is carried out by machining of the adjusting washers behind the thrust bearing sleeve (WRVi255, WRVi321 & WRVi365) (Fig. 71).
WRV204 Compressor rotor outlet end clearance is carried out by grinding the balance pistons (Fig 72 ) .

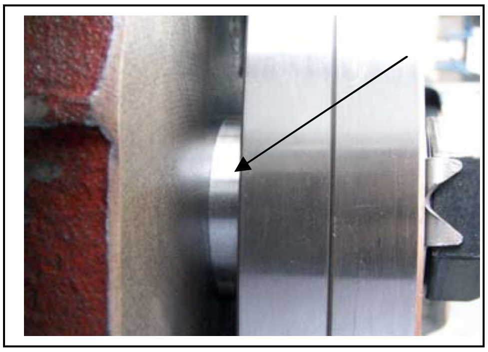


Fig. 71

Fig. 72

## 8.5 RE-ASSEMBLY WRV204, WRVi255, WRVi321 & WRVi365 COMPRESSORS AFTER OVERHAUL (Continued)

### Re-assemble the Outlet End Cover and Hydraulic Cylinder

Re-assembly as described per Section 7.5 for WRV204, WRVi255, WRVi321 & WRVi365 compressors.
Then proceed:

### Re-assemble the Vi Cover WRVi255, WRVi321 & WRVi365 Compressors.

Pull Vi adjusting screw until the nut is against the inlet cover.
Refit the Vi adjuster cover ensuring new ‘O’ rings are in place and secure with fixing capscrews.
Refit circlip retaining ring to secure adjusting screw to cover.

**NOTE:** Reset Vi adjusting screw to original position.

### Re-assemble the Input Shaft Seal

Re-assemble the component in the following sequence:

1. Enter the inlet balance piston ensuring it locates on the drive dowel.
2. Lubricate the shaft seal and assemble to the rotor shaft, locate in the outward facing dowel/driving pin of the inlet balance piston.
3. Refit balance piston sleeve (WRV204 Only).
4. Fit new ‘O’ ring to stationary seat and fit to seal cover, ensuring seat locates on anti-rotation dowel.
5. Fit the seal cover with a new ‘O’ ring and secure with cap screws, tightening in a systematic fashion to avoid tilting.

To complete the assembly, fit the coupling key and the compressor driven half coupling.

Howden

# SECTION 9

# SPECIAL INSTRUCTIONS

Howden

## 9.1 TORQUE SPECIFICATIONS

Fig.73 Torque Specifications for Fasteners on WRV163 compressors.

| PART NUMBER | TYPE OF FASTENER | TORQUE lb ft | TORQUE Nm |
|---|---|---|---|
| R25055 | 40mm Locknut<br>Actuator Piston | 206 | 150 |
| G26019 | ¼” UNC x 5/8” Long Set Screw<br>Piston Seal Retaining Plate | 8 | 11 |
| M0216050 | M12 x 60 Long Capscrew<br>Cylinder to outlet cover | 69 | 95 |
| M0313050 | ½” x 2” Long Set Screw<br>Inlet and Outlet Casings | 80 | 110 |
| R16154 | Locknut M42<br>Slide Valve | 225 | 165 |
| G25062 | ½” x 1” Long Capscrew<br>Thrust Bearing Clamp Plate | 10 | 14 |
| G39007 | 50mm Locknut<br>Thrust Bearing Retaining Locknut | 210 | 284 |
| G25058 | 3/8” x 1” Long Capscrew<br>Rotor Cover Plates | 35 | 48 |
| G29012 | M16 x 40mm Long Capscrew<br>Cylinder End Cover to Cylinder | 175 | 240 |
| G21015 | 5/8” x 2” Long Setscrew<br>Superfeed Flange | 160 | 220 |

Fig.74 Torque Specifications for Fasteners on WRV204 compressors.

| PART NUMBER | TYPE OF FASTENER | TORQUE lb ft | TORQUE Nm |
|---|---|---|---|
| R25055 | 40mm Locknut<br>Actuator Piston | 150 | 206 |
| G26019 | ¼” UNC x 5/8” Long Set Screw<br>Piston Seal Retaining Plate | 8 | 11 |
| M0216050 | M12 x 60 Long Capscrew<br>Cylinder to outlet cover | 69 | 95 |
| M0316060 | M16 x 60mm Long Set Screw<br>Inlet and Outlet Casings | 175 | 240 |
| R20313 | 36mm Locknut<br>Slide Valve | 125 | 167 |
| G29012 | M16 x 40mm Long Capscrew<br>Thrust Bearing Clamp Plate | 10 | 14 |
| G27001 | M12 x 40mm Long Setscrew<br>Bearing Retaining Plate | 69 | 95 |
| G29007 | M10 x 30 Long Capscrew<br>Rotor Cover Plates | 40 | 55 |
| G29012 | M16 x 40mm Long Capscrew<br>Cylinder End Cover to Cylinder | 175 | 240 |
| G21047 | 3/4” x 1-3/4” Long Setscrew<br>Superfeed Flange | 208 | 285 |

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## 9.1 TORQUE SPECIFICATIONS (Continued)

Fig. 75 Torque Specifications for Fasteners on WRVi255 compressors.

| PART NUMBER | TYPE OF FASTENER | TORQUE lb ft | TORQUE Nm |
|---|---|---|---|
| R25055 | 40mm Locknut<br>Actuator Piston | 150 | 206 |
| G26019 | ¼" UNC x 5/8" Long Set Screw<br>Piston Seal Retaining Plate | 8 | 11 |
| M0212045 | M12 x 45 Long Capscrew<br>Cylinder to outlet cover | 69 | 95 |
| M0116070 | M16 x 70 Long Set Screw<br>Inlet and Outlet Casings | 175 | 240 |
| M0212035 | M12 x 35 Long Capscrew<br>Vi Housing & Rotor Cover | 69 | 95 |
| VR25126-2 | Locknut M42<br>Slide Valve | 165 | 225 |
| M0116050 | M16 x 50 Long Capscrew<br>Bearing Retaining Plate | 175 | 240 |
| M0116060 | M16 x 60 Long Setcrew<br>Thrust Housing | 175 | 240 |
| G21026 | 3/8" UNC x 1" Setscrew<br>Thrust Plate | 35 | 48 |
| M0112025 | M12 x 25 Setscrew<br>Vi Screw Stop Plate | 69 | 95 |
| G21039 | 5/8"UNC x 1-1/2" Long<br>Setscrew<br>Superfeed Flange | 160 | 220 |

Fig. 76 Torque Specifications for Fasteners on WRVi321 compressors.

| PART NUMBER | TYPE OF FASTENER | TORQUE lb ft | TORQUE Nm |
|---|---|---|---|
| R32115 | 1-3/4" Locknut<br>Actuator Piston | 180 | 245 |
| G21026 | 3/8"UNC x 1" Long Set Screw<br>Piston Seal Retaining Plate | 35 | 48 |
| M0216060 | M16 x 50 Long Capscrew<br>Cylinder to outlet cover | 175 | 240 |
| M0216050 | M16x 70 Long Set Screw<br>Inlet and Outlet Casings | 175 | 240 |
| M0324080 | M24 x 80 Long Capscrew<br>End Casings to Main Casings | 585 | 790 |
| M0216040 | M16 x 40 Long<br>Vi Housing to Inlet | 175 | 240 |
| VR3149-2 | M60 Locknut<br>Piston Rod to Slide Valve | 270 | 371 |
| G21016 | ½"UNC x 1" Long Setcrew<br>Bearing Retaining Plate | 80 | 110 |
| M0120070 | M20 x 70 Long Setscrew<br>Thrust Housing | 334 | 460 |
| M0120060 | M20 x 60 Long Setscrew<br>Thrust Plate | 334 | 460 |
| M0116040 | M16 x 40 Long Setscrew<br>Vi Screw Stop Plate | 175 | 240 |
| G22006 | ¾" UNC x 2" Long Set Screw<br>Superfeed Flange | 285 | 391 |

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## 9.1 TORQUE SPECIFICATIONS (Continued)

Fig. 77 Torque Specifications for Fasteners on WRVi365 compressors.

| PART NUMBER | TYPE OF FASTENER | TORQUE lb.ft | TORQUE Nm |
|---|---|---|---|
| VR36148-2 | 45mm Locknut<br>Actuator Piston | 180 | 245 |
| G21026 | 3/8”UNC x 1” Long Set Screw<br>Piston Seal Retaining Plate | 35 | 48 |
| M0216060 | M16 x 60 Long Capscrew<br>Cylinder to outlet cover | 175 | 240 |
| M0124100 | M24 x 100 Long Set Screw<br>Inlet and Outlet Casings | 575 | 790 |
| M0216045 | M16 x 45 Long<br>Vi Housing to Inlet | 175 | 240 |
| VR36149-2 | 45mm Locknut<br>Piston Rod to Slide Valve | 180 | 245 |
| M0110030 | M10 x 30 Long Setcrew<br>Bearing Retaining Plate | 22 | 30 |
| M0216060 | M16 x 60 Long Capscrew<br>Rotor covers | 175 | 240 |
| M0120070 | M20 x 70 Long Setscrew<br>Thrust Housing | 170 | 230 |
| M0120060 | M20 x 60 Long Setscrew<br>Bearing retaining Plate | 334 | 460 |
| M0216045 | M16 x 45 Long Setscrew<br>Cylinder End cover | 175 | 240 |
| G22019 | ¾” UNC x 2¼”” Long Set Screw<br>Superfeed Flange | 285 | 391 |

## 9.2 PROCEDURE FOR FITTING LOCKWASHERS

This instruction applies to all lockwashers used on Howden Compressors, for the purpose of retaining, in position, the locknuts locating the bearings, thrust collars, pistons, etc.

A typical example of the items concerned is shown below (Fig.105).

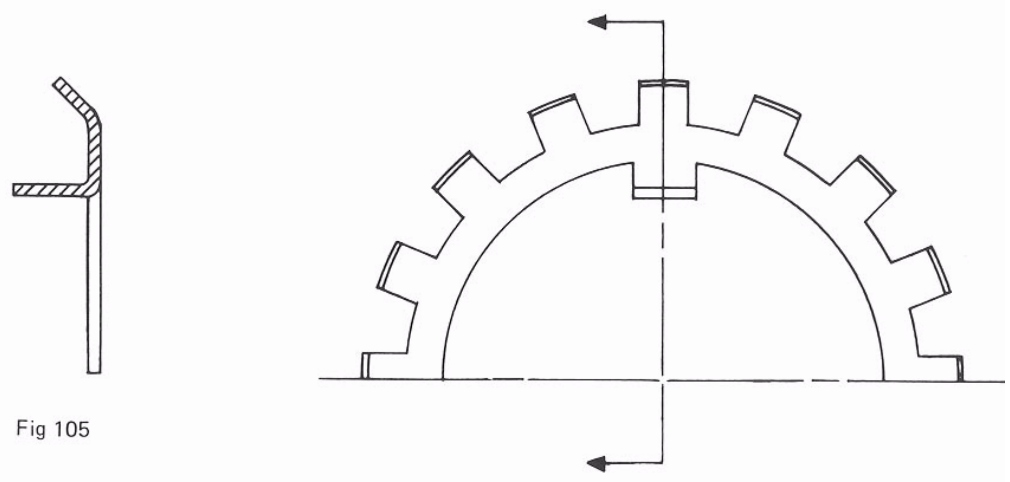

Fig 105

Assembly method:
In all cases where this type of lockwasher is used, the components must be assembled without the lockwasher and torqued to the prescribed value. The locknut must then be removed, the lockwasher dipped in oil and placed on the shaft, the locknut replaced and again torqued to the prescribed value.

This assembly process limits the amount of relative movement between the locknut and the lockwasher under torque, and avoids the possibility of the inner tank being damaged.

## 9.3 SPECIAL TOOLS

Tools can be provided for ease of dismantling/assembly. However, they are not a mandatory requirement.

| **WRV163 Compressor Tools** | **Part No.** |
|---|---|
| Locknut Spanner 30mm for Valve Spindle | 19274J |
| Locknut Spanner 40mm for Piston | 19187J |
| Locknut Spanner 50mm for Thrust Bearing | 17916J |
| Piston Withdrawal Gear | 163045J |
| Pull Rod for Slide Valve | 163046J |
| Withdrawal Tool for Output Shaft Balance Piston | 163122J |
| Jacking Screws to Thrust Bearing | 163123J |
| Bearing Extraction Tools for WRV163 | 163063J |
| Dummy Thrust Bearing WRV163 | 163188J |
| Jacking Bolt 14T ¼" UNC | 32436JC |

| **WRV204 Compressor Tools** | **Part No.** |
|---|---|
| Locknut Spanner 40mm for Piston Locknut | 19187J |
| Locknut Spanner 36mm | 204-5009 |
| Assembly/Withdrawal Tool for Journal Bearings | 204-5101 |
| Jacking Plate for Rotor Removal when using Hydraulic Jack | 204-5088 |

| **WRVi 255 Compressor Tools** | **Part No.** |
|---|---|
| Locknut Spanner M50 | 33152J |
| T-Screws for Extractor purposes | 17411J |
| Assembly/Withdrawal Tool for Crane Seal and Labyrinth Seal | 17413J |
| Assembly Tool for Journal Bearings | 17414J |
| Assembly/Withdrawal Tool for Balance Piston | 17418J |
| Withdrawal Tool for Balance Piston Sleeves | 32747J |
| Locknut Spanner 40mm for Piston Locknut | 19187J |
| Locknut Spanner 60mm Piston Rod to Slide Valve | 33181J |
| T-Screws for Pulling Piston to Off Load Position | 32784J |
| Rotor Jacking Plate | 33180J |

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## 9.4 SPECIAL TOOLS (Continued)

| **WRVi 321 & WRVi365 Compressor Tools** | **Part No.** |
|---|---|
| Jacking Plate for Rotor Removal when using a Hydraulic Jack | 32919J |
| Extractor for Balance Pistons | 32920J |
| Extractor for Inlet Balance Piston Sleeve and Mechanical Seal | 32921J |
| Locknut Spanner for Piston – (WRVi321 Only) | 32922J |
| T-Screws for Extraction purposes 5/8” UNC | 32924J |
| T-Screws for Pulling Piston to Off Load Positions | 32993J |
| Extractor Tool for Balance Piston Sleeves | 32949J |
| Extractor Tool for Piston | 32927J |
| Thrust Bearing Assembly Tool | 32928J |
| Journal Bearing Assembly and Withdrawal Tool | 32929J |
| Jacking Screws for Thrust Housings | 32994J |
| Locknut Spanner for Coupling | 32995J |
| Locknut Spanner M60 | 32948J |
| | |
| Locknut Spanner for Piston – (WRVi365 Only) | 360001J |

# SECTION 10

# SPARES

### 10.1 WRV WRVi RECOMMENDED SPARES LIST

Spares are available for all WRV compressors in the form of the following kits:

SHAFT SEAL KIT
Shaft seal and cover 'O' Ring

ANNUAL INSPECTION KIT
All 'O' Rings and seals required for an annual inspection.

JOURNAL BEARING KIT
1 Set of Inlet and Outlet Journal Bearings.

THRUST BEARING KIT
1 Set of Thrust Bearings.

**NOTE:**
An Annual Inspection Kit is required when changing the journal bearing or the thrust bearings.

For further information and details of the above, please contact our Compressor Business Unit directly.


**HOWDEN COMPRESSORS**
Compressor Business Unit
133 Barfillan Drive
Glasgow
G52 1BE
UK

Telephone: 0044 (0)141 882 3346
Fax: 0044 (0)141 882 8648
E-mail: hcl@aftersales@howden.com
Website: www.howden.com

**or**

**HOWDEN COMPRESSORS LLC**
1850B North Gravers Road
Plymouth Meeting
PA 19462
USA

Telephone: 001 610 313 9800
Fax: 001 610 313 9215
E-mail: sales@howdencompressors.com
Website: www.howden.com

**RECOMMENDED SPARES LIST**

**HOWDEN COMPRESSOR MODELS: Mk1G/H WRV(H) 163/145 & 180**

☐ **Replacement Shaft Seal Kit – KWS163-1G**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| KWS163-1G | Input Shaft Seal c/w Cover 'O' Ring | 1 |

☐ **Annual Inspection Kit – KW163-1**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31002 | Spring Washer – ½" | 48 |
| G33001 | Bonded Seal ⅜" BSP | 3 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking Wire – 1/32" Dia. | 2 metres |
| Q4521 | Lockwasher 50mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R16044 | Lockwasher 30mm (Piston Rod / Slide Valve) | 1 |
| R16164 | PTFE Ring (Actuator Piston) | 1 |
| R20044 | Joint for Superfeed | 2 |
| R25145 | PTFE Ring (Piston rod) | 1 |
| R16101 - OK | 'O' - Ring Kit containing: | |
| | G44001 – 'O'Ring (Piston Rod) | 1 |
| | G44005 – 'O'Ring (Actuator Spindle) | 1 |
| | G44006 –' O'Ring (Cylinder Cover) | 1 |
| | G44052 – 'O'Ring (Main / Inlet / Outlet) | 2 |
| | G44053 – 'O'Ring (Actuator Piston) | 1 |
| | G44054 – 'O'Ring (Rotor Covers) | 2 |
| | G44055 – 'O'Ring (Cylinder Spigot) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60114 | Retaining Ring (Journal Bearings) | 4 |

**Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.**

☐ **Replacement Thrust Bearing Kit – KWT163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51081 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R16063 | Outlet End Journal Bearing | 2 |
| R16083 | Inlet End Journal Bearing | 2 |
| G34045 | Dowel Pin ¼" | 4 |

Note: For Viton or Fluorosilicone 'O' Rings please contact:
Howden Compressors Limited, Compressor Business Unit, 133 Barfillan Drive, Glasgow, G52 1BE, UK
Telephone: +44 (0)141 882 3346 Fax: +44 (0)141 882 8648

**RECOMMENDED SPARES LIST**

**HOWDEN COMPRESSOR MODELS: Mk6 6A & 6B WRV(H) 204/110, 145, 165 & 193**

**Replacement Shaft Seal Kit – KWS204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| KWS204 | Input Shaft Seal c/w Cover 'O' Ring | 1 |

**Annual Inspection Kit – KW204-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20224 | Rotor Locking Plate | 2 |
| G26019 | Tuflock Screw ¼" UNC x ⅝" LG | 6 |
| G31015 | Spring Washer M16 | 56 |
| G33001 | Bonded Seal ⅜" BSP | 2 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 3 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G34060 | Dowel Pin 6mm Dia. x 10mm LG | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking wire – 1/32" Dia. | 2 metres |
| Q5163 | Lockwasher 40mm ( Actuator Piston) | 1 |
| R20313 | Locknut (Slide Valve) | 1 |
| R20493 | Superfeed Joint | 1 |
| R25055 | Piston Locknut 40mm | 1 |
| R20065 | PTFE Piston Ring | 1 |
| R25145 | PTFE Piston Rod Ring | 1 |
| R20101 - OK | 'O' Ring Kit containing: | |
| | G44001 – 'O'Ring (Piston Rod) | 1 |
| | G44005 – 'O'Ring (Actuator Spindle) | 1 |
| | G44007 – 'O'Ring (Actuator Piston) | 1 |
| | G44021 – 'O'Ring (Main / Inlet / Outlet) | 2 |
| | G44071 – 'O'Ring (Rotor Covers) | 2 |
| | G44072 – 'O'Ring (Cylinder Spigot) | 1 |
| | G44073 –' O'Ring (Cylinder Dia.) | 1 |
| | G44074 – 'O'Ring (Cylinder Face) | 2 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60178 | Circlip (Journal Bearings) | 4 |

**Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.**

**Replacement Thrust Bearing Kit – KWT204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51034 | Angular Contact Bearing | 4 |

**Replacement Journal Bearing Kit – KWJ204-5/6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20232 | Inlet End Journal Bearing | 2 |
| R20242 | Outlet End Journal Bearing | 2 |
| G34060 | Dowel Pin 6mm | 4 |

Note: For Viton or Fluorosilicone 'O' Rings please contact:
Howden Compressors Limited, Compressor Business Unit, 133 Barfillan Drive, Glasgow, G52 1BE, UK
Telephone: +44 (0)141 882 3346 Fax: +44 (0)141 882 8648

**RECOMMENDED SPARES LIST**

**HOWDEN COMPRESSOR MODELS: Mk6 & 6A 6B WRVi 255/110, 130, 145, 165, 193**

☐ **Replacement Shaft Seal Kit – KWS255-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| KWS255-6 | Input Shaft Seal c/w Cover 'O' Ring | 1 |

☐ **Annual Inspection Kit – KW255-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x ⅝" LG | 6 |
| G32009 | Straight Tab Washer ⅜" | 8 |
| G32013 | Straight Tab Washer ⅝" | 6 |
| VR25500-BK | Bonded Seal Kit containing: | |
| | G33001 – Bonded Seal ⅜" BSP | 6 |
| | G33003 – Bonded Seal ¾" BSP | 3 |
| | G33004 – Bonded Seal 1" BSP | 2 |
| | G33005 – Bonded Seal 1-¼" BSP | 2 |
| | G33008 – Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55012 | Gasket – S/Feed | 1 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R25125 | PTFE Ring (Actuator Piston) | 1 |
| R25135 | Adjusting Washer (Thrust Bearings) | 6 |
| R25883 | Rotor Locking Plate | 2 |
| G60009 | Circlip (Journal Bearings) | 4 |
| G60086 | Circlip (Vi Adjuster) | 1 |
| M0702016 | Spring Washer – 16 Dia. | 56 |
| R25145 | PTFE Ring (Piston Rod / Guide Bracket) | 1 |
| VR25101 - OK | 'O' Ring Kit containing: | |
| | G44001 – 'O'Ring (Piston Rod) | 1 |
| | G44002 – 'O'Ring (Piston) | 1 |
| | G44005 –' O'Ring (Ind. Spindle) | 1 |
| | G44008 – 'O'Ring (Casing) | 2 |
| | G44020 – 'O'Ring (Cylinder. Spigot) | 1 |
| | G44070 – 'O'Ring (Covers) | 3 |
| | G44075 –' O'Ring (Act. Cylinder.) | 2 |
| | M6000269 –' O'Ring (Cylinder. Flange.) | 1 |
| | M6002962 – 'O'Ring (Vi Spindle) | 2 |
| | M6009453 – 'O'Ring (Cover) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |

**Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.**

☐ **Replacement Thrust Bearing Kit – KWT255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51035 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R25663 | Inlet End Journal Bearing | 2 |
| R25643 | Outlet End Journal Bearing | 2 |
| G36005 | Dowel Pin | 4 |

Note: For Viton or Fluorosilicone 'O' Rings please contact:
Howden Compressors Limited, Compressor Business Unit, 133 Barfillan Drive, Glasgow, G52 1BE, UK
Telephone: +44 (0)141 882 3346 Fax: +44 (0)141 882 8648

**RECOMMENDED SPARES LIST**

**HOWDEN COMPRESSOR MODELS: Mk6 6A WRV 321, ALL L/D'S**

- **Replacement Shaft Seal Kit – KWS321-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| KWS321-6 | Input Shaft Seal c/w Cover 'O' Ring | 1 |

- **Annual Inspection Kit – KW321-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32009 | Straight Tab Washer ⅜" | 6 |
| G32014 | Straight Tab Washer ½" | 8 |
| G33001 | Bonded Seal ⅜" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" | 4 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-¼" BSP | 1 |
| G33006 | Bonded Seal 1-½" BSP | 2 |
| G33007 | Bonded Seal 2" | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip (Female I.E. Journal Bearing) | 2 |
| G60071 | Circlip (O.E. Journal Bearings) | 2 |
| M0702024 | Spring Washer – M24 | 64 |
| M0704020 | Straight Tab Washer – M20 | 6 |
| M6602040 | Circlip (Vi Adjuster) | 1 |
| R32015 | PTFE Piston Ring (Actuator Piston) | 1 |
| R32055 | PTFE Piston Rod Ring (Piston Rod / Guide Bracket) | 1 |
| R32135 | Lockwasher 1-¾" UNC (Actuator Piston) | 1 |
| R32175 | Adjusting Washer (Thrust Bearings) | 6 |
| R32555 | Rotor Locking Plate | 2 |
| VR32101 - OK | WRV 321 'O' Ring Kit containing: | |
| | G44005 –'O'Ring (Actuator Spindle) | 1 |
| | G44030 – 'O'Ring (Actuator Cylinder Spigot) | 1 |
| | G44038 – 'O'Ring (Actuator Piston) | 1 |
| | G44046 – 'O'Ring (Seal housing / Rotor Covers) | 3 |
| | G44048 – 'O'Ring (Piston Rod / Cylinder Bore) | 1 |
| | G44049 – 'O'Ring (Actuator Cylinder / End Cover) | 2 |
| | G44050 – 'O'Ring (Balance Piston Sleeves) | 2 |
| | G44051 – 'O'Ring (Main Casing / Inlet / Outlet) | 2 |
| | G44072 – 'O'Ring (Vi Adjuster Dia) | 1 |
| | M6003962 – 'O'Ring (Vi Adjuster Face) | 2 |
| | M6026935 – 'O'Ring (Actuator Cylinder Dia) | 1 |

**Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.**

- **Replacement Thrust Bearing Kit – KWT321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51063 | Angular Contact Bearing | 4 |

- **Replacement Journal Bearing Kit – KWJ321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R32063 | Inlet End Journal Bearing | 2 |
| R32083 | Outlet End Journal Bearing | 2 |
| G36013 | Dowel Pin | 4 |

Note: For Viton or Fluorosilicone 'O' Rings please contact:
Howden Compressors Limited, Compressor Business Unit, 133 Barfillan Drive, Glasgow, G52 1BE, UK
Telephone: +44 (0)141 882 3346 Fax: +44 (0)141 882 8648

**RECOMMENDED SPARES LIST**

**MODELS Mk1 WRVi 365, ALL L/D'S**

**Replacement Shaft Seal Kit – KWS365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| KWS365 | Input Shaft Seal c/w Cover O'ring XR12112-3 | 1 |

**Annual Inspection Kit – KW365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32020 | Tab Washer ¾" | 8 |
| G32021 | Tab Washer 7/16" | 12 |
| G55074 | Joint 4" NB (Superfeed Port) | 1 |
| M0701024 | Plain Washer 24mm | 72 |
| M6601240 | Circlip – Internal (Journal Bearings) | 4 |
| M6602060 | Circlip – External (Vi Adjuster) | 1 |
| Q4521 | Lockwasher 50mm (Piston Rod / Actuator Piston) | 1 |
| R32175 | Adjusting Washer (Thrust Bearings) | 8 |
| R32555 | Rotor Locking Plate | 2 |
| R36401-BK | Bonded Seal Kit | |
| | G33001 Bonded Seal 3/8" BSP | 5 |
| | G33002 Bonded Seal ½" BSP | 3 |
| | G33003 Bonded Seal ¾" BSP | 4 |
| | G33004 Bonded Seal 1" BSP | 2 |
| | G33006 Bonded Seal 1-1/2" BSP | 2 |
| | G33007 Bonded Seal 2" BSP | 3 |
| VR36101-OK | O-Ring Kit containing: | |
| | G44005 – O'Ring – (Actuator Spindle) | 1 |
| | G44079 – O'Ring – (Core Hole Cover, bott) | 1 |
| | G44050 – O'Ring – (Female Rotor Cover) | 2 |
| | XR12112-3 – O'Ring - (Seal Housing) | 4 |
| | M6005953 – O'Ring – (Adjusting Screw) | 2 |
| | M6009453 – O'Ring – (Core Hole Cover, Side) | 1 |
| | M6011453 – O'Ring – (Vi Cover) | 1 |
| | M6022625 – O'Ring – (Cylinder Spigot) | 1 |
| | M6031935 – O'Ring – (Cylinder Spigot) | 1 |
| | M6035935 – O'Ring – (Actuator Cylinder) | 2 |
| | M6089168 – O'Ring – (Main Casing / Covers) | 2 |
| VR36134-3 | Turcon Glyd Ring T40 | 1 |
| VR36135-3 | O'Ring (Glyd Seal) | 1 |
| VR36141-3 | Turcon Glyd Ring T40 | 1 |

**Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.**

**Replacement Thrust Bearing Kit – KWT365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51063 | Angular Contact Bearing | 5 |

**Replacement Journal Bearing Kit – KWJ365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M6510020 | Spring Pin | 4 |
| VR36086-2 | Inlet End Journal Bearing | 2 |
| VR36088-2 | Outlet End Journal Bearing | 2 |

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Printed in the UK – Issue HCL/September 2007

HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

## *Mk1A-F WRV 163/145 & 180*

☐ **Replacement Shaft Seal Kit – KWS163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60205 | Input Shaft Seal | 1 |
| G44054 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW163-1**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31002 | Spring Washer – ½" | 48 |
| G33001 | Bonded Seal 3/8" BSP | 3 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking Wire – 1/32" Dia. | 2 metres |
| Q4521 | Lockwasher 50mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R16044 | Lockwasher 30mm (Piston Rod / Slide Valve) | 1 |
| R16164 | PTFE Ring (Actuator Piston) | 1 |
| R20044 | Joint for Superfeed | 2 |
| R25145 | PTFE Ring (Piston rod) | 1 |
| R16101 - OK | O' - Ring Kit | 1 Kit containing: |
| | G44001 – O'Ring (Piston Rod) | 1 |
| | G44005 – O'Ring (Actuator Spindle) | 1 |
| | G44006 – O'Ring (Cylinder Cover) | 1 |
| | G44052 – O'Ring (Main / Inlet / Outlet) | 2 |
| | G44053 – O'Ring (Actuator Piston) | 1 |
| | G44054 – O'Ring (Rotor Covers) | 2 |
| | G44055 – O'Ring (Cylinder Spigot) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60114 | Retaining Ring (Journal Bearings) | 4 |

Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51081 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R16063 | Outlet End Journal Bearing | 2 |
| R16083 | Inlet End Journal Bearing | 2 |
| G34045 | Dowel Pin ¼" | 4 |

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## *Mk1G WRV(H) 163/145 & 180*

☐ **Replacement Shaft Seal Kit – KWS163-1G**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60235 | Input Shaft Seal | 1 |
| G44054 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW163-1**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31002 | Spring Washer – ½" | 48 |
| G33001 | Bonded Seal 3/8" BSP | 3 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking Wire – 1/32" Dia. | 2 metres |
| Q4521 | Lockwasher 50mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R16044 | Lockwasher 30mm (Piston Rod / Slide Valve) | 1 |
| R16164 | PTFE Ring (Actuator Piston) | 1 |
| R20044 | Joint for Superfeed | 2 |
| R25145 | PTFE Ring (Piston rod) | 1 |
| R16101 - OK | O' - Ring Kit | 1 Kit containing: |
| | G44001 – O'Ring (Piston Rod) | 1 |
| | G44005 – O'Ring (Actuator Spindle) | 1 |
| | G44006 – O'Ring (Cylinder Cover) | 1 |
| | G44052 – O'Ring (Main / Inlet / Outlet) | 2 |
| | G44053 – O'Ring (Actuator Piston) | 1 |
| | G44054 – O'Ring (Rotor Covers) | 2 |
| | G44055 – O'Ring (Cylinder Spigot) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60114 | Retaining Ring (Journal Bearings) | 4 |

Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51081 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R16063 | Outlet End Journal Bearing | 2 |
| R16083 | Inlet End Journal Bearing | 2 |
| G34045 | Dowel Pin ¼" | 4 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

*Mk1A-F WRV 163/145 & 180*

**Fitted with viton O'rings**

☐ **Replacement Shaft Seal Kit – KWS163-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60205-V | Input Shaft Seal | 1 |
| M6200347 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW163-1-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31002 | Spring Washer – ½" | 48 |
| G33001 | Bonded Seal 3/8" BSP | 3 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking Wire – 1/32" Dia. | 2 metres |
| Q4521 | Lockwasher 50mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R16044 | Lockwasher 30mm (Piston Rod / Slide Valve) | 1 |
| R16164 | PTFE Ring (Actuator Piston) | 1 |
| R20044 | Joint for Superfeed | 2 |
| R25145 | PTFE Ring (Piston rod) | 1 |
| R16102 - OK | O' - Ring Kit (Viton) | 1 Kit containing: |
| | M6200112 – O'Ring (Piston Rod) | 1 |
| | M6200226 – O'Ring (Actuator Spindle) | 1 |
| | M6200241 – O'Ring (Cylinder Cover) | 1 |
| | M6200242 – O'Ring (Main / Inlet / Outlet) | 2 |
| | M6200261 – O'Ring (Actuator Piston) | 1 |
| | M6200347 – O'Ring (Rotor Covers) | 2 |
| | M6203848 – O'Ring (Cylinder Spigot) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60114 | Retaining Ring (Journal Bearings) | 4 |

Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51081 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R16063 | Outlet End Journal Bearing | 2 |
| R16083 | Inlet End Journal Bearing | 2 |
| G34045 | Dowel Pin ¼" | 4 |

**HOWDEN**
**COMPRESSORS**

# RECOMMENDED SPARES LIST
## HOWDEN COMPRESSOR MODEL
## *Mk1G WRV(H) 163/145 & 180*

**Fitted with viton O'rings**

☐ **Replacement Shaft Seal Kit – KWS163-1G-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60235-V | Input Shaft Seal | 1 |
| M6200347 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW163-1-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31002 | Spring Washer – ½" | 48 |
| G33001 | Bonded Seal 3/8" BSP | 3 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking Wire – 1/32" Dia. | 2 metres |
| Q4521 | Lockwasher 50mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R16044 | Lockwasher 30mm (Piston Rod / Slide Valve) | 1 |
| R16164 | PTFE Ring (Actuator Piston) | 1 |
| R20044 | Joint for Superfeed | 2 |
| R25145 | PTFE Ring (Piston rod) | 1 |
| R16102 - OK | O' - Ring Kit (Viton) | 1 Kit containing: |
| | M6200112 – O'Ring (Piston Rod) | 1 |
| | M6200226 – O'Ring (Actuator Spindle) | 1 |
| | M6200241 – O'Ring (Cylinder Cover) | 1 |
| | M6200242 – O'Ring (Main / Inlet / Outlet) | 2 |
| | M6200261 – O'Ring (Actuator Piston) | 1 |
| | M6200347 – O'Ring (Rotor Covers) | 2 |
| | M6203848 – O'Ring (Cylinder Spigot) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60114 | Retaining Ring (Journal Bearings) | 4 |

Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51081 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R16063 | Outlet End Journal Bearing | 2 |
| R16083 | Inlet End Journal Bearing | 2 |
| G34045 | Dowel Pin ¼" | 4 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk2A-H WRV(H) 204/110 & 165

☐ **Replacement Shaft Seal Kit – KWS204-2/3/4**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60056 | Shaft Seal | 1 |
| G44033 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW204-2**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32010 | Straight Tab Washer ¼" | 6 |
| G32014 | Straight Tab Washer ½" | 12 |
| G44001 | O'Ring (Piston Rod) | 2 |
| G44005 | O'Ring (Actuator Spindle) | 1 |
| G44006 | O'Ring (Cylinder / Cylinder End Cover) | 2 |
| G44007 | O'Ring (Actuator Piston) | 1 |
| G44010 | O'Ring (Main / Outlet Mk2) | 1 |
| G44013 | O'Ring (F/m Balance Piston Sleeve) | 1 |
| G44017 | O'Ring (O.E. Journal Bearings – old brgs only) | 2 |
| G44021 | O'Ring (Main / Inlet) | 1 |
| G44031 | O'Ring (Guide Bracket) | 1 |
| G44032 | O'Ring (Oil injection Pipe Mk2) | 2 |
| G44033 | O'Ring (Rotor Covers) | 4 |
| G44034 | O'Ring (Injection Pipe) | 1 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60006 | Retaining Ring (I.E. Journal Bearings) | 2 |
| G60068 | Oil Return Pipe Lock Plate | 4 |
| Q4522 | Lockwasher 45mm (Coupling) | 1 |
| Q4683 | Lockwasher 65mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Actuator Piston) | 1 |
| R20065 | PTFE Piston Ring | 1 |
| R20155 | Adjusting Washer | 8 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25205 | PTFE Connecting Tube Ring | 2 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51034 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ204-2/3/4**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20103 | Inlet End Journal Bearing | 2 |
| R20123 | Male Outlet End Journal Bearing | 1 |
| R20143 | Outlet End Journal Bearing | 1 |
| G34004 | Dowel Pin 5/16" Dia. x 5/8" LG | 2 |
| G34007 | Dowel Pin 5/16" Dia. x ½" LG | 2 |

# HOWDEN COMPRESSORS

# RECOMMENDED SPARES LIST
## HOWDEN COMPRESSOR MODELS
### Mk3/4-4B WRV(H) 204/110 & 165

☐ **Replacement Shaft Seal Kit – KWS204-2/3/4**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60056 | Shaft Seal | 1 |
| G44033 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW204-3-4B**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32010 | Straight Tab Washer ¼" | 6 |
| G32014 | Straight Tab Washer ½" | 12 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 3 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G44001 | O'Ring (Piston Rod) | 2 |
| G44005 | O'Ring (Actuator Spindle) | 1 |
| G44006 | O'Ring (Cylinder / Cylinder End Cover) | 2 |
| G44007 | O'Ring (Actuator Piston) | 1 |
| G44013 | O'Ring (F/m Balance Piston Sleeve) | 1 |
| G44017 | O'Ring (O.E. Journal Bearings – old brgs only) | 2 |
| G44021 | O'Ring (Main / Inlet) | 2 |
| G44031 | O'Ring (Guide Bracket) | 1 |
| G44033 | O'Ring (Rotor Covers) | 4 |
| G44034 | O'Ring (Injection Pipe) | 1 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60006 | Retaining Ring (I.E. Journal Bearings) | 2 |
| Q4522 | Lockwasher 45mm (Coupling) | 1 |
| Q4683 | Lockwasher 65mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Actuator Piston) | 1 |
| R20044 | Joint for Superfeed | 2 |
| R20065 | PTFE Piston Ring | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R20155 | Adjusting Washer | 8 |
| R20204 | PTFE Sleeve | 1 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25205 | PTFE Connecting Tube Ring | 2 |

Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51034 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ204-2/3/4**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20103 | Inlet End Journal Bearing | 2 |
| R20123 | Male Outlet End Journal Bearing | 1 |
| R20143 | Outlet End Journal Bearing | 1 |
| G34004 | Dowel Pin 5/16" Dia. x 5/8" LG | 2 |
| G34007 | Dowel Pin 5/16" Dia. x ½" LG | 2 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

## Mk5-5E WRV(H) 204/110, 145, 165 & 193

☐ **Replacement Shaft Seal Kit – KWS204-5**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60179 | Shaft Seal | 1 |
| G44071 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW204-5**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20224 | Rotor Locking Plate | 2 |
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G31015 | Spring Washer M16 | 56 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 3 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G34060 | Dowel Pin 6mm Dia. x 10mm LG | 4 |
| G39006 | Locknut 45mm (Coupling) | 1 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking wire – 1/32" Dia. | 2 metres |
| Q4522 | Lockwasher 45mm (Coupling) | 1 |
| Q5163 | Lockwasher 40mm ( Actuator Piston) | 1 |
| R20313 | Locknut (Slide Valve) | 1 |
| R20493 | Superfeed Joint | 1 |
| R25055 | Locknut 40mm (Actuator Piston) | 1 |
| R20065 | PTFE Piston Ring | 1 |
| R25145 | PTFE Piston Rod Ring | 1 |
| R20101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44001 - O'Ring (Piston Rod) | 1 |
| | G44005 - O'Ring (Actuator Spindle) | 1 |
| | G44007 - O'Ring (Actuator Piston) | 1 |
| | G44021 - O'Ring (Main / Inlet / Outlet) | 2 |
| | G44071 - O'Ring (Rotor Covers) | 2 |
| | G44072 - O'Ring (Cylinder Spigot) | 1 |
| | G44073 - O'Ring (Cylinder Dia.) | 1 |
| | G44074 - O'Ring (Cylinder Face) | 2 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60178 | Circlip (Journal Bearings) | 4 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51034 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ204-5/6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20232 | Inlet End Journal Bearing | 2 |
| R20242 | Outlet End Journal Bearing | 2 |
| G34060 | Dowel Pin 6mm | 4 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk 5 WRV(H) 204  ALL L/D'S

**Replacement Shaft Seal Kit – KWS204-5-V**

☐ **Annual Inspection Kit – KW204-5-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G31015 | Spring Washer M16 | 56 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 3 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G34060 | Dowel Pin 6mm Dia. x 10mm LG | 4 |
| G39006 | Locknut 45mm (Actuator Piston) | 1 |
| G51001 | Ball  Bearing (Actuator Spindle) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60178 | Circlip (Journal Bearings) | 4 |
| G72002 | Locking wire – 1/32" Dia. | 2 metres |
| Q4522 | Lockwasher 45mm (Coupling) | 1 |
| Q5163 | Lockwasher 40mm ( Actuator Piston) | 1 |
| R20065 | PTFE Piston Ring | 1 |
| R20102 - OK | Viton O' Ring Kit | 1 Kit containing: |
| | M6200112 - O'Ring (Actuator spindle) | 1 |
| | M6200226 - O'Ring (Piston rod) | 1 |
| | M6200428 - O'Ring (Actuator Piston) | 1 |
| | M6203885 - O'Ring (Main/Inlet/Outlet) | 2 |
| | M6212453 - O'Ring (Cylinder / Main) | 1 |
| | M6213453 - O'Ring (Rotor Covers) | 2 |
| | M6216453 - O'Ring (Cylinder Spigot) | 1 |
| | M6218453 - O'Ring (Cylinder) | 2 |
| R20224 | Rotor Locking Plate | 2 |
| R20313 | Locknut (Slide Valve) | 1 |
| R20493 | Superfeed Joint | 1 |
| R25055 | Piston Locknut 40mm | 1 |
| R25145 | PTFE Piston Rod Ring | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51034 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ204-5/6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20232 | Inlet End Journal Bearing | 2 |
| R20242 | Outlet End Journal Bearing | 2 |
| G34060 | Dowel Pin 6mm | 4 |

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# RECOMMENDED SPARES LIST
## HOWDEN COMPRESSOR MODELS
### Mk6 & 6A WRV(H) 204/110, 145, 165 & 193

☐ **Replacement Shaft Seal Kit – KWS204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60236 | Shaft Seal | 1 |
| G44071 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW204-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20224 | Rotor Locking Plate | 2 |
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G31015 | Spring Washer M16 | 56 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 3 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G34060 | Dowel Pin 6mm Dia. x 10mm LG | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G72002 | Locking wire – 1/32" Dia. | 2 metres |
| Q5163 | Lockwasher 40mm ( Actuator Piston) | 1 |
| R20313 | Locknut (Slide Valve) | 1 |
| R20493 | Superfeed Joint | 1 |
| R25055 | Piston Locknut 40mm | 1 |
| R20065 | PTFE Piston Ring | 1 |
| R25145 | PTFE Piston Rod Ring | 1 |
| R20101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44001 - O'Ring (Piston Rod) | 1 |
| | G44005 - O'Ring (Actuator Spindle) | 1 |
| | G44007 - O'Ring (Actuator Piston) | 1 |
| | G44021 - O'Ring (Main / Inlet / Outlet) | 2 |
| | G44071 - O'Ring (Rotor Covers) | 2 |
| | G44072 - O'Ring (Cylinder Spigot) | 1 |
| | G44073 - O'Ring (Cylinder Dia.) | 1 |
| | G44074 - O'Ring (Cylinder Face) | 2 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60178 | Circlip (Journal Bearings) | 4 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51034 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ204-5/6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20232 | Inlet End Journal Bearing | 2 |
| R20242 | Outlet End Journal Bearing | 2 |
| G34060 | Dowel Pin 6mm | 4 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk 6 WRV(H) 204, ALL L/D'S

☐ **Annual Inspection Kit – KW204-6-F (Flourosilicone)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G31015 | Spring Washer M16 | 56 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 3 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G34060 | Dowel Pin 6mm Dia. x 10mm LG | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60178 | Circlip (Journal Bearings) | 4 |
| G72002 | Locking wire – 1/32" Dia. | 2 metres |
| Q5163 | Lockwasher 40mm ( Actuator Piston) | 1 |
| R20065 | PTFE Piston Ring | 1 |
| R20103 - OK | O' Ring Kit | 1 Kit containing: |
| | M6300112 - O'Ring (Actuator spindle) | 1 |
| | M6300226 - O'Ring (Piston rod) | 1 |
| | M6300428 - O'Ring (Actuator Piston) | 1 |
| | M6303885 - O'Ring (Main/Inlet/Outlet) | 2 |
| | M6312453 - O'Ring (Cylinder / Main) | 1 |
| | M6313453 - O'Ring (Rotor Covers) | 2 |
| | M6316453 - O'Ring (Cylinder Spigot) | 1 |
| | M6318453 - O'Ring (Cylinder) | 2 |
| R20224 | Rotor Locking Plate | 2 |
| R20313 | Locknut (Slide Valve) | 1 |
| R20493 | Superfeed Joint | 1 |
| R25055 | Piston Locknut 40mm | 1 |
| R25145 | PTFE Piston Rod Ring | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

Rev

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk 6 WRV(H) 204, ALL L/D'S

☐ **Annual Inspection Kit – KW204-6-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G31015 | Spring Washer M16 | 56 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 3 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G34060 | Dowel Pin 6mm Dia. x 10mm LG | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60178 | Circlip (Journal Bearings) | 4 |
| G72002 | Locking wire – 1/32" Dia. | 2 metres |
| Q5163 | Lockwasher 40mm ( Actuator Piston) | 1 |
| R20065 | PTFE Piston Ring | 1 |
| R20102 - OK | O' Ring Kit | 1 Kit containing: |
| | M6200112 - O'Ring (Actuator spindle) | 1 |
| | M6200226 - O'Ring (Piston rod) | 1 |
| | M6200428 - O'Ring (Actuator Piston) | 1 |
| | M6203885 - O'Ring (Main/Inlet/Outlet) | 2 |
| | M6212453 - O'Ring (Cylinder / Main) | 1 |
| | M6213453 - O'Ring (Rotor Covers) | 2 |
| | M6216453 - O'Ring (Cylinder Spigot) | 1 |
| | M6218453 - O'Ring (Cylinder) | 2 |
| R20224 | Rotor Locking Plate | 2 |
| R20313 | Locknut (Slide Valve) | 1 |
| R20493 | Superfeed Joint | 1 |
| R25055 | Piston Locknut 40mm | 1 |
| R25145 | PTFE Piston Rod Ring | 1 |

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HOWDEN
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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

## Mk1-4F WRV(H) 255/110, 130, 145, 165, 193 & 220

☐ **Replacement Shaft Seal Kit – KWS255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60206 | Shaft Seal | 1 |
| G44070 | O'Ring (Was G44013) | 1 |

☐ **Annual Inspection Kit – KW255-1-4F**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32010 | Straight Tab Washer ¼" | 6 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G44003 | O'Ring (Pre Mk4 models – Injection tube) | 2 |
| G44022 | O'Ring (Pre Mk4 models – Balance Pistons) | 2 |
| G44027 | O'Ring (Pre Mk4 models – Journal Bearings) not required when new bearings are fitted. | 2 |
| G51001 | Ball Bearing (Actuator Spindle) (Actuator Spindle) | 1 |
| G72002 | Locking Wire – 1/32" Dia. | 2 metres |
| Q4274 | Lockwasher 60mm (Couplng) | 1 |
| Q4506 | Lockwasher 85mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R20085 | Lockwasher 50mm (Slide Valve- where fitted) | 1 |
| R25135 | Adjusting Washer | 6 |
| R25154 | Superfeed Joint | 2 |
| R25205 | PTFE Ring (Injection Tube – Pre Mk4) | 2 |
| R20204 | PTFE Sleeve (Injection Tube - Mk4) | 1 |
| R25125 | PTFE Ring (Actuator Piston) | 1 |
| R25145 | PTFE Ring (Piston Rod) | 2 |
| R25101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44001 – O'Ring (piston Rod) | 2 |
| | G44002 – O'Ring (Actuator Piston) | 1 |
| | G44005 – O'Ring (Actuator Spindle) | 1 |
| | G44008 – O'Ring (Main / Inlet / Outlet) | 2 |
| | G44070 – O'Ring (Rotor covers - Was G44013) | 4 |
| | G44020 – O'Ring (Piston Rod Guide Bracket) | 1 |
| | G44034 – O'Ring (Injection Tube) | 1 |
| | G44075 – O'Ring (Cylinder – Was G44004) | 2 |
| G55012 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip (Journal Bearings) | 3 |

☐ **Replacement Thrust Bearing Kit – KWT255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51035 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R25663 | Inlet End Journal Bearing | 2 |
| R25643 | Outlet End Journal Bearing | 2 |

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk4G WRV(H) 255/110, 130, 145, 165, 193 & 220

☐ **Replacement Shaft Seal Kit – KWS255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60206 | Shaft Seal | 1 |
| G44070 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW255-4G**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| Q4274 | Lockwasher 60mm (Couplng) | 1 |
| Q4506 | Lockwasher 85mm (Thrust Bearings) | 2 |
| Q5163 | Lockwasher 40mm (Piston) | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R25135 | Adjusting Washer | 6 |
| R20204 | PTFE Sleeve | 1 |
| R25125 | PTFE Piston Ring | 1 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44001 – O'Ring (piston Rod) | 2 |
| | G44002 – O'Ring (Actuator Piston) | 1 |
| | G44005 – O'Ring (Actuator Spindle) | 1 |
| | G44008 – O'Ring (Main / Inlet / Outlet) | 2 |
| | G44070 – O'Ring (Rotor covers - Was G44013) | 4 |
| | G44020 – O'Ring (Piston Rod Guide Bracket) | 1 |
| | G44034 – O'Ring (Injection Tube) | 1 |
| | G44075 – O'Ring (Cylinder – Was G44004) | 2 |
| G55012 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 3 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51035 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R25663 | Inlet End Journal Bearing | 2 |
| R25643 | Outlet End Journal Bearing | 2 |

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### WRV(H) 255, MK4G MODEL, ALL L/D'S

☐ **Annual Inspection Kit – KW255-4G-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball  Bearing (Actuator Spindle) | 1 |
| G55012 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 3 |
| Q4274 | Lockwasher 60mm | 1 |
| Q4506 | Lockwasher 85mm | 2 |
| Q5163 | Lockwasher 40mm | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R20204 | PTFE Sleeve | 1 |
| R25102 - OK | O' Ring Kit - Viton | 1 Kit containing: |
| | M6200112 – O'Ring | 1 |
| | M6200226 – O'Ring | 2 |
| | M6200227 – O'Ring | 1 |
| | M6200258 – O'Ring | 4 |
| | M6200266 – O'Ring | 2 |
| | M6203925 – O'Ring | 2 |
| | M6204375 – O'Ring | 1 |
| | M6204385 – O'Ring | 1 |
| R25125 | PTFE Piston Ring | 1 |
| R25135 | Adjusting Washer | 6 |
| R25145 | Piston Rod Ring | 2 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk5 WRV(H) 255/110, 130, 145, 165, 193 & 220

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☐ **Replacement Shaft Seal Kit – KWS255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60206 | Shaft Seal | 1 |
| G44070 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW255-5**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| Q5163 | Lockwasher 40mm | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R25135 | Adjusting Washer | 6 |
| R25883 | Rotor Locking Plate | 2 |
| R20204 | PTFE Sleeve | 1 |
| R25125 | PTFE Piston Ring | 1 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44001 – O'Ring (piston Rod) | 2 |
| | G44002 – O'Ring (Actuator Piston) | 1 |
| | G44005 – O'Ring (Actuator Spindle) | 1 |
| | G44008 – O'Ring (Main / Inlet / Outlet) | 2 |
| | G44070 – O'Ring (Rotor covers - Was G44013) | 4 |
| | G44020 – O'Ring (Piston Rod Guide Bracket) | 1 |
| | G44034 – O'Ring (Injection Tube) | 1 |
| | G44075 – O'Ring (Cylinder – Was G44004) | 2 |
| G55012 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 3 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51035 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R25663 | Inlet End Journal Bearing | 2 |
| R25643 | Outlet End Journal Bearing | 2 |

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### MK1-4F WRV(H) 255, ALL L/D'S

☐ **Annual Inspection Kit – KW255-1-4F-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32010 | Straight Tab Washer ¼" | 6 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55012 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 3 |
| G72002 | Locking Wire | 2 |
| Q4274 | Lockwasher 60mm | 1 |
| Q4506 | Lockwasher 85mm | 2 |
| Q5163 | Lockwasher 40mm | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R20204 | PTFE Sleeve | 1 |
| R25102 - OK | Viton O' Ring Kit | 1 Kit containing: |
| | M6200112 - O'Ring | 1 |
| | M6200226 - O'Ring | 2 |
| | M6200227 – O'Ring | 1 |
| | M6200258 – O'Ring | 4 |
| | M6200266 – O'Ring | 2 |
| | M6203925 – O'Ring | 2 |
| | M6204375 – O'Ring | 1 |
| | M6204385 – O'Ring | 1 |
| R25125 | PTFE Piston Ring | 1 |
| R25135 | Adjusting Washer | 6 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25154 | Superfeed Joint | 2 |
| R25205 | Connecting Tube Ring (PTFE) | 2 |

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk5 WRV(H) 255 ALL L/D'S

□ **Annual Inspection Kit – KW255-5-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G31003 | Spring Washer – 5/8" | 48 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55012 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 3 |
| Q5163 | Lockwasher 40mm | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R20204 | PTFE Sleeve | 1 |
| R25102 - OK | Viton O' Ring Kit | 1 Kit containing: |
| | M6200112 - O'Ring | 1 |
| | M6200226 - O'Ring | 2 |
| | M6200227 – O'Ring | 1 |
| | M6200258 – O'Ring | 4 |
| | M6200266 – O'Ring | 2 |
| | M6203925 – O'Ring | 2 |
| | M6204375 – O'Ring | 1 |
| | M6204385 – O'Ring | 1 |
| R25125 | PTFE Piston Ring | 1 |
| R25135 | Adjusting Washer | 6 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25883 | Rotor Locking Plate | 2 |

Suction and Discharge joints are not part of Inspection Kit.
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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk6 WRVi 255 ALL L/D'S

☐ **Annual Inspection Kit – KW255-6-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55012 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 4 |
| G60086 | Circlip | 1 |
| M0702016 | Spring Washer – M16 | 56 |
| Q5163 | Lockwasher 40mm | 1 |
| R25125 | Piston Ring (PTFE) | 1 |
| R25135 | Adjusting Washer | 6 |
| R25145 | Piston Rod Ring | 1 |
| R25883 | Rotor Locking Plate | 2 |
| VR25102 - OK | WRVi 255 Viton O' Ring Kit | 1 Kit containing: |
| | M6200112 - O'Ring | 1 |
| | M6200226 - O'Ring | 1 |
| | M6200258 – O'Ring | 3 |
| | M6200266 – O'Ring | 2 |
| | M6200269 – O'Ring | 1 |
| | M6202962 - O'Ring | 2 |
| | M6203925 – O'Ring | 2 |
| | M6204375 – O'Ring | 1 |
| | M6204385 – O'Ring | 1 |
| | M6209453 – O'Ring | 1 |
| VR25500-BK | WRVi255 Bonded Seal Kit | 1 |
| | G33001 - Bonded Seal 3/8" BSP | 4 |
| | G33002 - Bonded Seal ½" BSP | 2 |
| | G33003 - Bonded Seal ¾" BSP | 3 |
| | G33004 - Bonded Seal 1" BSP | 2 |
| | G33005 - Bonded Seal 1 ¼" BSP | 2 |
| | G33008 - Bonded Seal ¼" BSP | 4 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

## Mk4-4E – 5 WRVT 255/110, 130, 145, 165, 193 & 220

☐ **Replacement Shaft Seal Kit – KWST255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60198 | Shaft Seal | 1 |
| G44070 | O'Ring | 1 |

☐ **Annual Inspection Kit – KWT255-4-5**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R20224 | Rotor Locking Plate | 2 |
| G31003 | Spring Washer – 5/8" | 48 |
| G32010 | Straight Tab Washer ¼" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G44027 | O'Ring | 2 |
| R25101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44001 – O'Ring (piston Rod) | 2 |
| | G44002 – O'Ring (Actuator Piston) | 1 |
| | G44005 – O'Ring (Actuator Spindle) | 1 |
| | G44008 – O'Ring (Main / Inlet / Outlet) | 2 |
| | G44070 – O'Ring (Rotor covers - Was G44013) | 4 |
| | G44020 – O'Ring (Piston Rod Guide Bracket) | 1 |
| | G44034 – O'Ring (Injection Tube) | 1 |
| | G44075 – O'Ring (Cylinder – Was G44004) | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 4 |
| Q4274 | Lockwasher 60mm | 1 |
| Q5163 | Lockwasher 40mm | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R20204 | PTFE Sleeve | 1 |
| R25125 | PTFE Piston Ring | 1 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25154 | Superfeed Joint | 2 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWTT255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51114 | Floating Seal | 2 |
| G51115 | Tilting Pad | 44 |

☐ **Replacement Journal Bearing Kit – KWJ255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R25663 | Inlet End Journal Bearing | 2 |
| R25643 | Outlet End Journal Bearing | 2 |

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COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

### Mk4 – 5 WRVT 255 ALL L/D'S

**Annual Inspection Kit – KWT255-4-5-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 48 |
| G32010 | Straight Tab Washer ¼" | 6 |
| G32014 | Straight Tab Washer ½" | 4 |
| G33001 | Bonded Seal 3/8" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 2 |
| G33008 | Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60009 | Circlip | 4 |
| M6200252 | O'Ring | 2 |
| Q4274 | Lockwasher 60mm | 1 |
| Q5163 | Lockwasher 40mm | 1 |
| R20085 | Lockwasher 50mm | 1 |
| R20204 | PTFE Sleeve | 1 |
| R20224 | Rotor Locking Plate | 2 |
| R25102 - OK | WRV Viton O' Ring Kit | 1 Kit containing: |
| | M6200112 O'Ring | 1 |
| | M6200226 O'Ring | 2 |
| | M6200227 O'Ring | 1 |
| | M6200258 O'Ring | 4 |
| | M6200266 O'Ring | 2 |
| | M6203925 O'Ring | 2 |
| | M6204375 O'Ring | 1 |
| | M6204385 O'Ring | 1 |
| R25125 | PTFE Piston Ring | 1 |
| R25145 | PTFE Piston Rod Ring | 2 |
| R25154 | Superfeed Joint | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk6 WRVi 255/110, 130, 145, 165, 193

☐ **Replacement Shaft Seal Kit – KWS255-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60238 | Shaft Seal | 1 |
| G44070 | O'Ring – Seal Cover | 1 |

☐ **Annual Inspection Kit – KW255-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G26019 | Tuflock Screw ¼" UNC x 5/8" LG | 6 |
| G32009 | Straight Tab Washer 3/8" | 8 |
| G32013 | Straight Tab Washer 5/8" | 6 |
| VR25500-BK | Bonded Seal Kit | 1 Kit containing: |
| | G33001 – Bonded Seal 3/8" BSP | 6 |
| | G33003 – Bonded Seal ¾" BSP | 3 |
| | G33004 – Bonded Seal 1" BSP | 2 |
| | G33005 – Bonded Seal 1-1/4" BSP | 2 |
| | G33008 – Bonded Seal ¼" BSP | 4 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55012 | Gasket – S/Feed | 1 |
| Q5163 | Lockwasher 40mm | 1 |
| R25125 | Piston Ring | 1 |
| R25135 | Adjusting Washer | 6 |
| R25883 | Rotor Locking Plate | 2 |
| G60009 | Circlip | 4 |
| G60086 | Circlip | 1 |
| M0702016 | Spring Washer – 16 Dia. | 56 |
| R25145 | PTFE Piston Rod Ring | 1 |
| VR25101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44001 - O'Ring – Piston Rod | 1 |
| | G44002 - O'Ring – Piston | 1 |
| | G44005 – O'Ring – Ind. Spindle | 1 |
| | G44008 – O'Ring – Casing | 2 |
| | G44020 – O'Ring – Cylinder. Spigot | 1 |
| | G44070 – O'Ring – Covers | 3 |
| | G44075 – O'Ring – Act. Cylinder. | 2 |
| | M6000269 – O'Ring – Cylinder. Flange. | 1 |
| | M6002962 – O'Ring – Vi Spindle | 2 |
| | M6009453 – O'Ring – Cover | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51035 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ255**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R25663 | Inlet End Journal Bearing | 2 |
| R25643 | Outlet End Journal Bearing | 2 |



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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS
## Mk4-4F WRV(H) 321/132, 165, 193 & 220

☐ **Replacement Shaft Seal Kit – KWS321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60207 | Shaft Seal | 1 |
| G44046 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW321-4**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32014 | Straight Tab Washer ½" | 8 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G33007 | Bonded Seal 2" BSP | 2 |
| G40001 | Lockwasher 100mm – Thrust Bearings | 2 |
| G44006 | O'Ring (Old Bearings) | 2 |
| G44047 | O'Ring (Old Bearings) | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| Q4683 | Lockwasher 65mm – Coupling | 1 |
| R32035 | PTFE Connecting Tube Ring | 2 |
| R32134 | Superfeed Joint (132/165) | 2 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32175 | Adjusting Washer | 6 |
| R32255 | Lockwasher 60mm | 1 |
| R 32015 | PTFE Piston Ring | 1 |
| R32055 | PTFE Piston Rod Ring | 2 |
| R32274 | PTFE Sleeve | 1 |
| R32101-OK | O' Ring Kit | 1 Kit containing: |
| | G44004 – O' Ring | 2 |
| | G44005 – O' Ring | 1 |
| | G44030 – O' Ring | 1 |
| | G44038 – O' Ring | 1 |
| | G44041 – O' Ring | 1 |
| | G44046 – O' Ring | 4 |
| | G44048 – O' Ring | 2 |
| | G44049 – O' Ring | 2 |
| | G44050 – O' Ring | 2 |
| | G44051 – O' Ring | 2 |
| G55101 | Superfeed Joint (193/220) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |

☐ **Replacement Thrust Bearing Kit – KWT321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51063 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R32063 | Inlet End Journal Bearing | 2 |
| R32083 | Outlet End Journal Bearing | 2 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

### Mk4 WRV(H) 321 ALL L/D'S

**Annual Inspection Kit – KW321-4-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32014 | Straight Tab Washer ½" | 8 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G33007 | Bonded Seal 2" BSP | 2 |
| G40001 | Lockwasher 100mm | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Superfeed Joint (193/220) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |
| M6200261 | O'Ring | 2 |
| Q4683 | Lockwasher | 1 |
| R32015 | PTFE Piston Ring | 1 |
| R32035 | PTFE Connecting Tube Ring | 2 |
| R32055 | PTFE Piston Rod Ring | 2 |
| R32102 - OK | O' Ring Kit | 1 Kit containing: |
| | M6200112 – O'Ring | 2 |
| | M6200229– O'Ring | 1 |
| | M6200235– O'Ring | 1 |
| | M6200265 – O'Ring | 1 |
| | M6200267 – O'Ring | 1 |
| | M6200271 – O'Ring | 4 |
| | M6200399 – O'Ring | 2 |
| | M6200445– O'Ring | 2 |
| | M6200446– O'Ring | 2 |
| | M620452A – O'Ring | 2 |
| R32134 | Superfeed Joint (132/165) | 2 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32175 | Adjusting Washer | 6 |
| R32255 | Lockwasher 60mm | 1 |
| R32274 | Sleeve (PTFE) | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

## Mk4-4E WRVT 321/132, 165, 193 & 220

☐ **Replacement Shaft Seal Kit – KWS321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60207 | Input Shaft Seal | 1 |
| G44046 | O'Ring | 1 |

☐ **Annual Inspection Kit – KWT321-4**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| Q4683 | Lockwasher 65mm | 1 |
| R32134 | Superfeed Joint (132/165) | 2 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32255 | Lockwasher 60mm | 1 |
| R32434 | Rotor Locking Plate | 2 |
| R32015 | Piston Ring | 1 |
| R32035 | PTFE Connecting Tube Rings | 2 |
| R32055 | PTFE Piston Rod Ring | 2 |
| R32274 | PTFE Sleeve | 1 |
| R32101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44004 – O'Ring | 2 |
| | G44005 – O'Ring | 1 |
| | G44030 – O'Ring | 1 |
| | G44038 – O'Ring | 1 |
| | G44041 – O'Ring | 1 |
| | G44046 – O'Ring | 4 |
| | G44048 – O'Ring | 2 |
| | G44049 – O'Ring | 2 |
| | G44050 – O'Ring | 2 |
| | G44051 – O'Ring | 2 |
| G55101 | Superfeed Joint (193/220) | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Journal Bearing Kit – KWJ321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R32063 | Inlet End Journal Bearing | 2 |
| R32083 | Outlet End Journal Bearing | 2 |

HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk4 WRVT 321, ALL L/D'S

☐ **Annual Inspection Kit – KWT321-4-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |
| Q4683 | Lockwasher 65mm | 1 |
| R32015 | PTFE Piston Ring | 1 |
| R32035 | PTFE Connecting Tube Ring | 2 |
| R32055 | PTFE Piston Rod Ring | 2 |
| R32102 - OK | WRV-321 Viton O' Ring Kit | 1 Kit |
| R32134 | Superfeed Joint (132/165) | 2 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32255 | Lockwasher 60mm | 1 |
| R32274 | PTFE Sleeve | 1 |
| R32434 | Rotor Locking Plate | 2 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

## Mk5 WRV(H) 321/132, 165, 193 & 220

☐ **Replacement Shaft Seal Kit – KWS321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60207 | Shaft Seal | 1 |
| G44046 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW321-5**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32014 | Straight Tab Washer ½" | 8 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G33007 | Bonded Seal 2" BSP | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| R32135 | Lockwasher 1-3/4" UNC Piston/Rod | 1 |
| R32175 | Adjusting Washer | 6 |
| R32255 | Lockwasher 60mm S/U Piston Rod | 1 |
| R32555 | Rotor Locking Plate | 2 |
| R32015 | PTFE Piston Ring | 1 |
| R32055 | PTFE Piston Rod Ring | 2 |
| R32274 | PTFE Sleeve | 1 |
| R32101 – OK | O' Ring Kit | 1 Kit containing: |
| | G44004 – O'Ring | 2 |
| | G44005 – O'Ring | 1 |
| | G44030 – O'Ring | 1 |
| | G44038 – O'Ring | 1 |
| | G44041 – O'Ring | 1 |
| | G44046 – O'Ring | 4 |
| | G44048 – O'Ring | 2 |
| | G44049 – O'Ring | 2 |
| | G44050 – O'Ring | 2 |
| | G44051 – O'Ring | 2 |
| G55101 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51063 | Angular Contact Bearing | 4 |

☐ **Replacement Journal Bearing Kit – KWJ321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R32063 | Inlet End Journal Bearing | 2 |
| R32083 | Outlet End Journal Bearing | 2 |

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk5 WRV(H) 321, ALL L/D'S

☐ **Annual Inspection Kit – KW321-5-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32014 | Straight Tab Washer ½" | 8 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 2 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G33007 | Bonded Seal 2" BSP | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Superfeed Joint | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |
| R32015 | PTFE Piston Ring | 1 |
| R32055 | PTFE Piston Rod Ring | 2 |
| R32102 – OK | Viton O' Ring Kit | 1 Kit containing: |
| | M6200112 – O'Ring | 1 |
| | M6200229 – O'Ring | 2 |
| | M6200235 – O'Ring | 1 |
| | M6200265 – O'Ring | 2 |
| | M6200267 – O'Ring | 4 |
| | M6200271 – O'Ring | 2 |
| | M6200399 – O'Ring | 2 |
| | M6200445 – O'Ring | 1 |
| | M6200446 – O'Ring | 1 |
| | M620452A – O'Ring | 2 |
| R32135 | Lockwasher 1-3/4" UNC Piston/Rod | 1 |
| R32175 | Adjusting Washer | 6 |
| R32255 | Lockwasher 60mm S/U Piston Rod | 1 |
| R32274 | PTFE Sleeve | 1 |
| R32555 | Rotor Locking Plate | 2 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk5 WRVT 321, ALL L/D'S

☐ **Annual Inspection Kit – KWT321-5**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |
| Q4683 | Lockwasher 65mm | 1 |
| R32015 | PTFE Piston Ring | 1 |
| R32055 | PTFE Piston Rod Ring | 2 |
| R32101 - OK | WRV-321 Neoprene O' Ring Kit | 1 Kit |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32255 | Lockwasher 60mm | 1 |
| R32274 | PTFE Sleeve | 1 |
| R32434 | Rotor Locking Plate | 2 |

Suction and Discharge joints are not part of Inspection Kit.
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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk5 WRVT 321, ALL L/D'S

☐ **Annual Inspection Kit – KWT321-5-V (Viton)**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G31003 | Spring Washer – 5/8" | 12 |
| G31011 | Spring Washer 7/8" Dia. | 64 |
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32013 | Straight Tab Washer 5/8" | 4 |
| G32014 | Straight Tab Washer ¾" | 8 |
| G32020 | Straight Tab Washer ¾" | 6 |
| G33001 | Bonded Seal 3/8" BSP | 4 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" BSP | 6 |
| G33004 | Bonded Seal 1" BSP | 2 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 3 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 1 |
| G60071 | Circlip | 2 |
| R32015 | PTFE Piston Ring | 1 |
| R32055 | Piston Rod Ring (PTFE) | 2 |
| R32102 – OK | WRV 321 Viton O' Ring Kit | 1 Kit |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32255 | Lockwasher 60mm | 1 |
| R32274 | Sleeve (PTFE) | 1 |
| R32434 | Rotor Locking Plate | 2 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk6 WRV 321, ALL L/D'S

☐ **Replacement Shaft Seal Kit – KWS321-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60239-N | Input Shaft Seal | 1 |
| G44046 | O'Ring | 1 |

☐ **Annual Inspection Kit – KW321-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32014 | Straight Tab Washer ½" | 8 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" | 4 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 2 |
| G33007 | Bonded Seal 2" | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 2 |
| G60071 | Circlip | 2 |
| M0702024 | Spring Washer – M24 | 64 |
| M0704020 | Straight Tab Washer – M20 | 6 |
| M6602040 | Circlip | 1 |
| R32015 | Piston Ring (PTFE) | 1 |
| R32055 | PTFE Piston Rod Ring (PTFE) | 1 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32175 | Adjusting Washer | 6 |
| R32555 | Rotor Locking Plate | 2 |
| VR32101 - OK | WRV 321 Neoprene O' Ring Kit | 1 Kit containing: |
| | G44005 – O'Ring | 1 |
| | G44030 – O'Ring | 1 |
| | G44038– O'Ring | 1 |
| | G44046 – O'Ring | 3 |
| | G44048 – O'Ring | 1 |
| | G44049 – O'Ring | 2 |
| | G44050 – O'Ring | 2 |
| | G44051– O'Ring | 2 |
| | G44072 – O'Ring | 1 |
| | M6003962 – O'Ring | 2 |
| | M6026935 – O'Ring | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

Rev: 06.02

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk6 WRV(H) 321, ALL L/D'S

☐ **Annual Inspection Kit – KW321-6-F**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32014 | Straight Tab Washer ½" | 8 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" | 4 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 2 |
| G33007 | Bonded Seal 2" | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 2 |
| G60071 | Circlip | 2 |
| M0702024 | Spring Washer – M24 | 64 |
| M0704020 | Straight Tab Washer – M20 | 6 |
| M6602040 | Circlip | 1 |
| R32015 | Piston Ring (PTFE) | 1 |
| R32055 | PTFE Piston Rod Ring (PTFE) | 1 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32175 | Adjusting Washer | 6 |
| R32555 | Rotor Locking Plate | 2 |
| VR32103 – OK | WRV 321 Fluorosilicone O' Ring Kit | 1 Kit containing: |
| | M6300112 – O'Ring | 1 |
| | M6300229 – O'Ring | 1 |
| | M6300267 – O'Ring | 3 |
| | M6300271 – O'Ring | 2 |
| | M6300399 – O'Ring | 2 |
| | M6300445 – O'Ring | 1 |
| | M6300446 – O'Ring | 1 |
| | M6303962 – O'Ring | 2 |
| | M630452A – O'Ring | 2 |
| | M6312453 – O'Ring | 1 |
| | M6326935 – O'Ring | 1 |

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**HOWDEN**
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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### Mk6 WRVi (H) 321, ALL L/D'S

☐ **Replacement Shaft Seal Kit (Viton) – KWS321-6-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60239-V | Input Shaft Seal | 1 |
| M620067 | O'Ring | 1 |

☐ **Annual Inspection Kit (Viton) – KW321-6-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32014 | Straight Tab Washer ½" | 8 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" | 4 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 2 |
| G33007 | Bonded Seal 2" | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 2 |
| G60071 | Circlip | 2 |
| M0702024 | Spring Washer – M24 | 64 |
| M0704020 | Straight Tab Washer – M20 | 6 |
| M6602040 | Circlip | 1 |
| R32015 | Piston Ring (PTFE) | 1 |
| R32055 | PTFE Piston Rod Ring (PTFE) | 1 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32175 | Adjusting Washer | 6 |
| R32555 | Rotor Locking Plate | 2 |
| VR32102 - OK | WRV i321 Viton O' Ring Kit | 1 Kit containing: |
| | M6200112 – O'Ring | 1 |
| | M6200229 – O'Ring | 1 |
| | M6200267 – O'Ring | 3 |
| | M6200271 – O'Ring | 2 |
| | M6200399 – O'Ring | 2 |
| | M6200445 – O'Ring | 1 |
| | M6200446 – O'Ring | 1 |
| | M6203962 – O'Ring | 2 |
| | M620452A – O'Ring | 2 |
| | M6212453 – O'Ring | 1 |
| | M6226935 – O'Ring | 1 |

Suction and Discharge joints are not part of Inspection Kit.
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HOWDEN
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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

### Mk6 WRVi 321, ALL L/D'S

**Replacement Shaft Seal Kit – KWS321-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60239-N | Input Shaft Seal | 1 |
| G44046 | O'Ring | 1 |

**Annual Inspection Kit – KW321-6**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32009 | Straight Tab Washer 3/8" | 6 |
| G32014 | Straight Tab Washer ½" | 8 |
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 4 |
| G33003 | Bonded Seal ¾" | 4 |
| G33004 | Bonded Seal 1" BSP | 1 |
| G33005 | Bonded Seal 1-1/4" BSP | 1 |
| G33006 | Bonded Seal 1-1/2" BSP | 2 |
| G33007 | Bonded Seal 2" | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G55101 | Joint 3" NB | 1 |
| G60004 | Retaining Ring (Actuator spindle – Outer) | 1 |
| G60005 | Retaining Ring (Actuator spindle – Inner) | 1 |
| G60070 | Circlip | 2 |
| G60071 | Circlip | 2 |
| M0702024 | Spring Washer – M24 | 64 |
| M0704020 | Straight Tab Washer – M20 | 6 |
| M6602040 | Circlip | 1 |
| R32015 | Piston Ring (PTFE) | 1 |
| R32055 | PTFE Piston Rod Ring (PTFE) | 1 |
| R32135 | Lockwasher 1-3/4" UNC | 1 |
| R32175 | Adjusting Washer | 6 |
| R32555 | Rotor Locking Plate | 2 |
| VR32101 - OK | WRV 321 Neoprene O' Ring Kit | 1 Kit containing: |
| | G44005 – O'Ring | 1 |
| | G44030 – O'Ring | 1 |
| | G44038 – O'Ring | 1 |
| | G44046 – O'Ring | 3 |
| | G44048 – O'Ring | 1 |
| | G44049 – O'Ring | 2 |
| | G44050 – O'Ring | 2 |
| | G44051 – O'Ring | 2 |
| | G44072 – O'Ring | 1 |
| | M6003962 – O'Ring | 2 |
| | M6026935 – O'Ring | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

**Replacement Thrust Bearing Kit – KWT321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51063 | Angular Contact Bearing | 4 |

**Replacement Journal Bearing Kit – KWJ321**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| R32063 | Inlet End Journal Bearing | 2 |
| R32083 | Outlet End Journal Bearing | 2 |

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS
## Mk1 WRVi 365, ALL L/D'S

☐ **Replacement Shaft Seal Kit – KWS365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| VR36225-3 | Input Shaft Seal | 1 |
| XR12112-3 | O'Ring | 2 |

☐ **Annual Inspection Kit – KW365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32020 | Tab Washer ¾" | 8 |
| G32021 | Tab Washer 7/16" | 12 |
| G55074 | Joint 4" NB | 1 |
| M0701024 | Plain Washer 24mm | 72 |
| M6601240 | Circlip – Internal | 4 |
| M6602060 | Circlip – External | 1 |
| Q25036-1 | Lockwasher 50mm | 1 |
| R32175 | Adjusting Washer | 8 |
| R32555 | Rotor Locking Plate | 2 |
| R36401-BK | Bonded Seal Kit | |
| | G33001 Bonded Seal 3/8" BSP | 5 |
| | G33002 Bonded Seal ½" BSP | 3 |
| | G33003 Bonded Seal ¾" BSP | 4 |
| | G33004 Bonded Seal 1" BSP | 2 |
| | G33006 Bonded Seal 1-1/2" BSP | 2 |
| | G33007 Bonded Seal 2" BSP | 3 |
| VR36101-OK | O-Ring Kit (Viton) | |
| | G44005 – O'Ring – (Actuator Spindle) | 1 |
| | G44079 – O'Ring – (Core Hole Cover, bott) | 1 |
| | G44050 – O'Ring – (Female Rotor Cover) | 2 |
| | XR12112-3 – O'Ring - (Seal Housing) | 4 |
| | M6005953 – O'Ring – (Adjusting Screw) | 2 |
| | M6009453 – O'Ring – (Core Hole Cover, Side) | 1 |
| | M6011453 – O'Ring – (Vi Cover) | 1 |
| | M6022625 – O'Ring – (Cylinder Spigot) | 1 |
| | M6031935 – O'Ring – (Cylinder Spigot) | 1 |
| | M6035935 – O'Ring – (Actuator Cylinder) | 2 |
| | M6089168 – O'Ring – (Main Casing / Covers) | 2 |
| VR36134-3 | Turcon Glyd Ring T40 | 1 |
| VR36135-3 | O'Ring (Glyd Seal) | 1 |
| VR36141-3 | Turcon Glyd Ring T40 | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51063 | Angular Contact Bearing | 5 |

☐ **Replacement Journal Bearing Kit – KWJ365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M6510020 | Spring Pin | 4 |
| VR36086-2 | Inlet End Journal Bearing | 2 |
| VR36088-2 | Outlet End Journal Bearing | 2 |

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HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS
## Mk1 WRVi 365, ALL L/D'S (Viton)

☐ **Replacement Shaft Seal Kit – KWS365-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| N0xxxx08040 | Input Shaft Seal | 1 |
| M6223935 | O'Ring | 2 |

☐ **Annual Inspection Kit – KW365-V**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G32020 | Tab Washer ¾" | 8 |
| G32021 | Tab Washer 7/16" | 12 |
| G55074 | Joint 4" NB | 1 |
| M0701024 | Plain Washer 24mm | 72 |
| M6601240 | Circlip – Internal | 4 |
| M6602060 | Circlip – External | 1 |
| Q25036-1 | Lockwasher 50mm | 1 |
| R32175 | Adjusting Washer | 8 |
| R32555 | Rotor Locking Plate | 2 |
| R36401-BK | Bonded Seal Kit | |
| | G33001 Bonded Seal 3/8" BSP | 5 |
| | G33002 Bonded Seal ½" BSP | 3 |
| | G33003 Bonded Seal ¾" BSP | 4 |
| | G33004 Bonded Seal 1" BSP | 2 |
| | G33006 Bonded Seal 1-1/2" BSP | 2 |
| | G33007 Bonded Seal 2" BSP | 3 |
| VR36102-OK | O-Ring Kit (Viton) | |
| | M6200112 – O'Ring – (Actuator Spindle) | 1 |
| | M6200262 – O'Ring – (Core Hole Cover, bott) | 1 |
| | M6200271 – O'Ring – (Female Rotor Cover) | 2 |
| | M6205953 – O'Ring – (Adjusting Screw) | 2 |
| | M6209453 – O'Ring – (Core Hole Cover, Side) | 1 |
| | M6211453 – O'Ring – (Vi Cover) | 1 |
| | M6222625 – O'Ring – (Cylinder Spigot) | 1 |
| | M6231935 – O'Ring – (Cylinder Spigot) | 4 |
| | M6235935 – O'Ring – (Actuator Cylinder) | 2 |
| | M6289168 – O'Ring – (Main Casing / Covers) | 2 |
| VR36136-3 | Turcon Glyd Ring T40 | 1 |
| VR36135-3 | O'Ring (Glyd Seal) | 1 |
| VR36141-3 | Turcon Glyd Ring T40 | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

☐ **Replacement Thrust Bearing Kit – KWT365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G51063 | Angular Contact Bearing | 5 |

☐ **Replacement Journal Bearing Kit – KWJ365**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M6510020 | Spring Pin | 4 |
| VR36086-2 | Inlet End Journal Bearing | 2 |
| VR36088-2 | Outlet End Journal Bearing | 2 |

HOWDEN
COMPRESSORS

# RECOMMENDED SPARES LIST
## HOWDEN COMPRESSOR MODELS
### Mk2, 2A & 2B XRV 127/165 R1

☐ **Replacement shaft seal kit – KXDS127**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| XR12096-3 | Input Shaft Seal | 1 |
| G44059 | O'Ring – Inlet Cover | 1 |

☐ **Annual Inspection Kit – KX127-2**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G44059 | O'Ring – Inlet Cover | 1 |
| XR12059-3 | Actuator Piston Seal | 1 |
| XR12106-3 | O'Ring – Actuator Cyl. Cover | 2 |
| XR16102-3 | O'Ring - Piston/Slide Valve | 1 |
| XR16515-3 | Locknut M30 (S/Lock) | 1 |
| XR16522-2 | Indicator Pin | 1 |
| M0905010 | Grub Screw | 1 |

☐ **Overhaul Kit – KXD127-2**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 3 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G57057 | Microswitch | 2 |
| G60004 | Retaining Ring | 1 |
| G60005 | Retaining Ring | 1 |
| M1701008 | Washer – 8mm Dia. | 1 |
| M1701010 | Washer – 10mm Dia. | 10 |
| M1701012 | Washer – 12mm Dia. | 26 |
| M1701020 | Washer – 20mm Dia. | 4 |
| Q4273 | Lockwasher S | 1 |
| Q5163 | Lockwasher 40mm | 2 |
| XR12014-2 | Labyrinth Insert | 1 |
| XR12032-2 | Floating Bush | 2 |
| XR12033-2 | Bearing Spacer | 2 |
| XR12060-3 | Disc Spring | 2 |
| XR12457-3 | Cylindrical Roller Bearing | 3 |
| XR12097-3 | Cylindrical Roller Bearing | 1 |
| XR12101-3 | Angular Contact Bearing | 4 |
| XR16295-3 | Potentiometer (1k OHM) | 1 |
| XR12101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44005 – O'Ring – Indicator Spindle | 1 |
| | G44059 - O'Ring – G' Box Cover | 1 |
| | G44076 - O'Ring – G' Box/Main | 1 |
| | XR12106-3 - O'Ring – Covers | 6 |
| | XR12107-3 - O'Ring – Gas Seal | 2 |
| | XR16102-3 – O'Ring – Piston/Slide Valve | 1 |
| | XR12109-3 - O'Ring – Man. Vi Spindle | 2 |
| | XR12112-3 - O'Ring - Main/Outlet | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.

**When undertaking a compressor overhaul, all of the above three Kits are required**.

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HOWDEN COMPRESSORS

# RECOMMENDED SPARES LIST
## HOWDEN COMPRESSOR MODELS
### Mk2, 2A & 2B XRV 127/165 R3-5

☐ **Replacement Shaft Seal Kit – KXGS127**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| XR12124-3 | Input Shaft Seal (Short Seat) | 1 |
| XR12105-3 | O'Ring – Shaft Seal Hsg. | 1 |
| XR12110-3 | O'Ring – Shaft Seal Hsg. | 1 |

☐ **Annual Inspection Kit – KX127-2**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G44059 | O'Ring – G'Box Cover | 1 |
| XR12059-3 | Actuator Piston Seal | 1 |
| XR12106-3 | O'Ring – Act. Cyl Cover | 2 |
| XR16102-3 | O'Ring – Piston/Slide Valve | 1 |
| XR16515-3 | Locknut M30 (S/Lock) (up to Mk2) | 1 |
| XR16522-2 | Indicator Pin | 1 |
| M0905010 | Grub Screw | 1 |

☐ **Overhaul Kit – KXG127-2**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 3 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G57057 | Microswitch | 2 |
| G60004 | Retaining Ring | 1 |
| G60005 | Retaining Ring | 1 |
| G60156 | Circlip | 1 |
| M1701008 | Washer – 8mm Dia. | 1 |
| M1701010 | Washer – 10mm Dia. | 10 |
| M1701012 | Washer – 12mm Dia. | 26 |
| M1701020 | Washer – 20mm Dia. | 4 |
| Q4273 | Lockwasher | 1 |
| Q5163 | Lockwasher 40mm | 2 |
| XR12014-2 | Labyrinth Insert | 1 |
| XR12032-2 | Floating Bush | 2 |
| XR12033-2 | Bearing Spacer | 2 |
| XR12060-3 | Disc Spring | 2 |
| XR12457-3 | Cylindrical Roller Bearing | 4 |
| XR12101-3 | Angular Contact Bearing | 4 |
| XR12103-3 | Cylindrical Roller Bearing | 1 |
| XR12116-3 | Angular Contact Thrust Bearing | 2 |
| XR16295-3 | Potentiometer (1k OHM) | 1 |
| XR12102 - OK | O' Ring Kit | 1 Kit containing: |
| | G44005 - O'Ring – Indicator Spindle | 1 |
| | G44059 - O'Ring – G'Box Cover | 1 |
| | G44076 - O'Ring – G'Box/Main | 1 |
| | XR12105-3 - O'Ring – Shaft Seal Hsg. | 1 |
| | XR12106-3 - O'Ring – Covers | 6 |
| | XR12107-3 - O'Ring – Gas Seal | 2 |
| | XR16102-3 - O'Ring – Piston/Slide Valve | 1 |
| | XR12109-3 - O'Ring – Man.Vi Spindle | 2 |
| | XR12110-3 - O'Ring – Shaft Seal Hsg. | 1 |
| | XR12112-3 - O'Ring – Main/Outlet | 1 |

Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.

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HOWDEN
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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODEL

### XRV 127 VITON

☐ **Replacement Shaft Seal Kit – Viton - KXDS127 - XRV127/R1 Compressors, All Models**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M6222953 | O'Ring | 1 |
| XR12096-3 | Input Shaft Seal | 2 |

☐ **Annual Inspection Kit – Viton - KX127-2-V - XRV127/R1-5 Compressors, Mk2 Model**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M0905010 | Grub Screw | 1 |
| M6208453 | O'Ring | 2 |
| M6222953 | O'Ring | 2 |
| XR12059-3 | Actuator Piston Seal | 1 |
| XR16522-2 | Indicator Pin – Solid (4.8) | 1 |
| XR16527-2 | Lock Nut M30 (Extended) | 1 |

☐ **Overhaul Kit – Viton - KXD127-2-V - XRV127/R1 Compressors, MK 2 Model**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G33001 | Bonded Seal 3/8" BSP | 2 |
| G33002 | Bonded Seal ½" BSP | 1 |
| G33003 | Bonded Seal ¾" BSP | 1 |
| G33008 | Bonded Seal ¼" BSP | 3 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G57057 | Microswitch | 2 |
| G60004 | Retaining Ring | 1 |
| G60005 | Retaining Ring | 1 |
| M1701008 | Washer – 8mm Dia. | 1 |
| M1701010 | Washer – 10mm Dia. | 10 |
| M1701012 | Washer – 12mm Dia. | 26 |
| M1701020 | Washer – 20mm Dia. | 4 |
| Q4273 | Lockwasher | 1 |
| Q5163 | Lockwasher 40mm | 2 |
| XR12014-2 | Labyrinth Insert | 1 |
| XR12032-2 | Floating Bush | 2 |
| XR12033-2 | Bearing Spacer | 2 |
| XR12060-3 | Disc Spring | 2 |
| XR12097-3 | Cylindrical Roller Bearing | 1 |
| XR12101-3 | Angular Contact Bearing | 4 |
| XR12103 - OK | XRV (R1) Viton O' Ring Kit | 1 |
| XR12457-3 | Cylindrical Roller Bearing | 3 |
| XR13295-3 | Potentiometer (1K OHM) | 1 |

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HOWDEN
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# RECOMMENDED SPARES LIST

## HOWDEN COMPRESSOR MODELS

### Mk2, 2A, 2B, 2C & 2D XRV 163/165 & 193

☐ **Replacement Shaft Seal Kit – KXS163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60205 | Input Shaft Seal | 1 |
| XR16105-3 | O'Ring – Seal Housing | 1 |

☐ **Annual Inspection Kit – KX163-2C**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M0905010 | Grub Screw | 1 |
| M1701010 | Washer – 10mm Dia. | 4 |
| XR16079-3 | Actuator Piston Seal | 1 |
| XR16102-3 | O'Ring – Piston/Slide Valve | 1 |
| XR16105-3 | O'Ring – Covers | 3 |
| XR16522-2 | Indicator Pin | 1 |
| XR16515-3 | Locknut M30 (S/Lock) (up to Mk2B) | 1 |

☐ **Overhaul Kit – KX163**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G33002 | Bonded Seal ½" BSP | 3 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33010 | Bonded Seal 1/8"BSP | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G57057 | Microswitch | 2 |
| G60004 | Retaining Ring | 1 |
| G60005 | Retaining Ring | 1 |
| G60175 | Circlip | 2 |
| M1701010 | Washer – 10mm Dia. | 27 |
| M1701016 | Washer – 16mm Dia. | 30 |
| M1701020 | Washer – 20mm Dia. | 12 |
| Q4521 | Lockwasher 50mm | 2 |
| Q4792 | Lockwasher 30mm | 1 |
| XR16029-2 | Outlet End Floating Bush | 2 |
| XR16047-2 | Labyrinth Insert | 1 |
| XR16049-4 | Thrust Bearing Assembly | 2 |
| XR16072-3 | Superfeed Joint | 1 |
| XR16080-2 | Disc Spring | 2 |
| XR16531-3 | Cylindrical Roller Bearing | 4 |
| XR16295-3 | Potentiometer (1k OHM) | 1 |
| XR16101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44005 – O'Ring – Ind. Spindle | 1 |
| | G44065 – O'Ring – Main/Outlet | 2 |
| | XR16102-3 – O'Ring – Piston/Slide Valve | 1 |
| | XR16101-3 - O'Ring – Man. Vi Spindle | 2 |
| | XR16104-3 - O'Ring – Gas Seals | 2 |
| | XR16105-3 - O'Ring – Covers etc. | 9 |
| | XR16106-3 - O'Ring – Inlet Bearings | 2 |
| | XR16460-3 - O'Ring – Vi Cover | 1 |

Suction and Discharge joints are not part of Inspection Kit.
These are available at extra cost as required.
**When undertaking a compressor overhaul, all of the above three Kits are required.**

☐ **Additional Parts: KX163 – AUTO Vi**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M1701004 | Washer – 4mm. | 2 |
| M1701005 | Washer – 5mm. | 3 |
| G33010 | Bonded Seal 1/8" BSP | 2 |
| XR20776-3 | O'Ring | 1 |
| XR16280-3 | Variseal 4mm. | 1 |
| XR16265-3 | Glyd Ring | 1 |
| XR16266-3 | Slyd Ring | 1 |

Rev: 09.00

Howden Compressors Limited, Compressor Business Unit, 133 Barfillan Drive, Glasgow, G52 1BE, UK
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HOWDEN COMPRESSORS

# RECOMMENDED SPARES LIST
## HOWDEN COMPRESSOR MODELS
### Mk3, 3A, 3B, 3C, 3D & 3E XRV 204/110, 145, 165 & 193

☐ **Replacement Shaft Seal Kit – KXS204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G60224 | Shaft Seal | 1 |
| XR20104-3 | O'Ring - Seal Housing | 1 |

☐ **Annual Inspection Kit – KX204-3D**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M1701012 | Washer – 12mm Dia. | 4 |
| R25065 | Indicator Pin | 1 |
| XR20100-3 | O'Ring – Slide Valve/Piston | 1 |
| XR20104-3 | O'Ring – Act. Cylinder Cover | 4 |
| XR20875-3 | Actuator Piston Seal | 1 |
| XR20782-3 | Locknut M35 (S/Lock) (up to Mk 3C) | 1 |
| M0905010 | Grub Screw | 1 |

☐ **Overhaul Kit – KX204**

| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| G33002 | Bonded Seal ½" BSP | 3 |
| G33003 | Bonded Seal ¾" BSP | 4 |
| G33008 | Bonded Seal ¼" BSP | 1 |
| G33010 | Bonded Seal 1/8"BSP | 2 |
| G51001 | Ball Bearing (Actuator Spindle) | 1 |
| G57057 | Microswitch | 2 |
| G60004 | Retaining Ring | 1 |
| G60005 | Retaining Ring | 1 |
| G60017 | Circlip | 2 |
| M1701012 | Washer – 12mm Dia. | 12 |
| M1701016 | Washer – 16mm Dia. | 34 |
| M1701020 | Washer – 20mm Dia. | 12 |
| Q4683 | Lockwasher 65mm | 2 |
| Q5163 | Lockwasher 40mm | 1 |
| XR16295-3 | Potentiometer (1k OHM) | 1 |
| XR20042-2 | Outlet End Floating Bush | 2 |
| XR20053-2 | Labyrinth Insert | 1 |
| XR20237-3 | O'Ring – Man. Vi Adjustment | 2 |
| XR20060-2 | Disc Spring | 2 |
| XR20910-3 | Cylindrical Roller Bearing | 2 |
| XR20101 - OK | O' Ring Kit | 1 Kit containing: |
| | G44005 - O'Ring – Indicator Spindle | 1 |
| | G44066 - O'Ring – Inlet/Main/Outlet | 2 |
| | XR16105-3 - O'Ring – Vi Adj. Cover | 1 |
| | XR20100-3 – O'Ring – Slide Valve/Piston | 1 |
| | XR20102-3 - O'Ring – Gas Seal | 2 |
| | XR20104-3 - O'Ring – Covers etc. | 8 |
| | XR20105-3 - O'Ring – Inlet Bearing | 2 |
| XR20520-4 | Thrust Bearing Assembly | 2 |
| XR20823-3 | Cylindrical Roller Bearing | 2 |

Suction and Discharge joints are not part of Inspection Kit. These are available at extra cost as required.

**When undertaking a compressor overhaul, all of the above three Kits are required.**

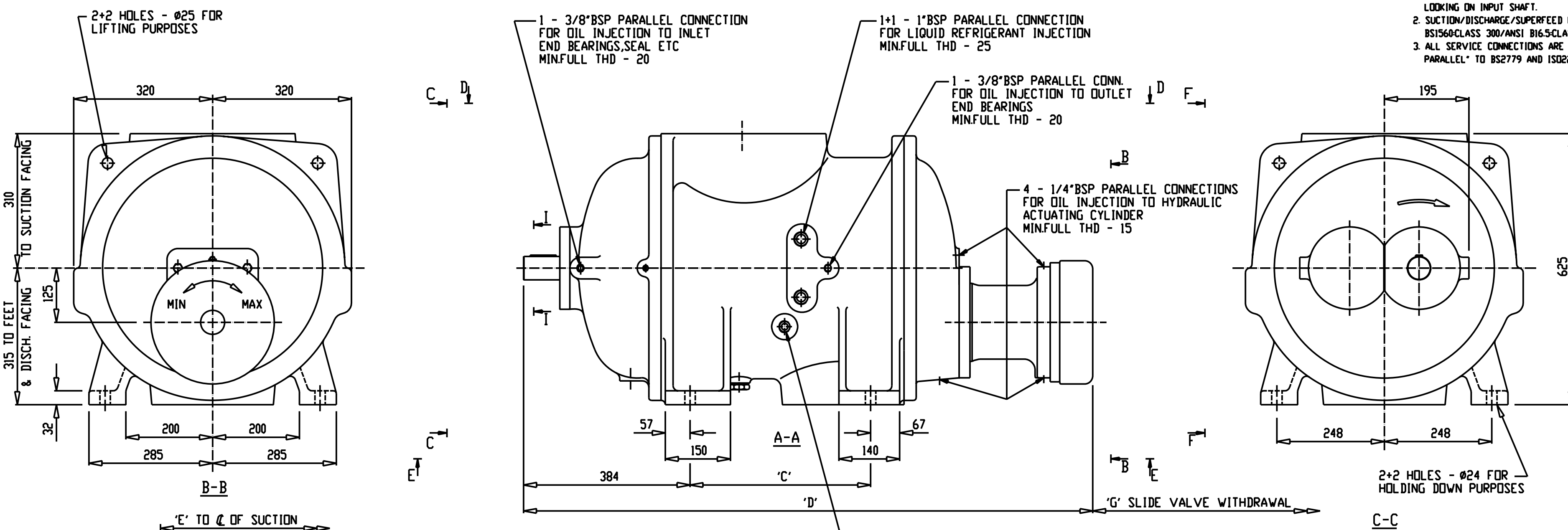
☐ **Additional Parts: KX204 – AUTO Vi**

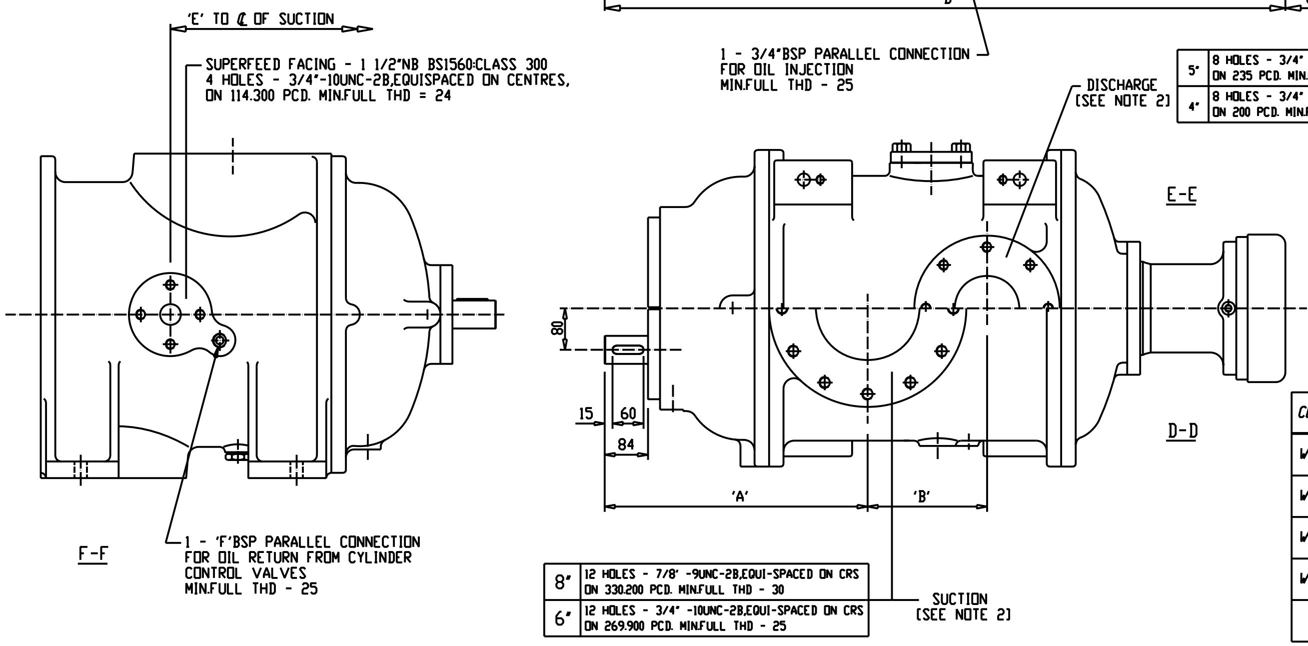
| PART NUMBER | DESCRIPTION | QUANTITY |
|---|---|---|
| M1701004 | Washer – 4mm Dia. | 2 |
| M1701005 | Washer – 5mm Dia. | 6 |
| G33010 | Bonded Seal 1/8" BSP | 2 |
| XR20776-3 | O'Ring | 1 |
| XR16280-3 | Variseal 4mm | 1 |
| XR20730-3 | Glyd Ring | 1 |

Rev:

**NOTE**

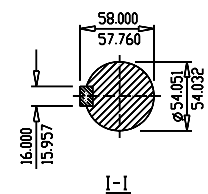
1. ROTATION OF INPUT SHAFT IS CLOCKWISE WHEN LOOKING ON INPUT SHAFT.
2. SUCTION/DISCHARGE/SUPERFEED FACINGS ARE TO BS1560:CLASS 300/ANSI B16.5:CLASS 300
3. ALL SERVICE CONNECTIONS ARE THREADED "BSP PARALLEL" TO BS2779 AND ISO228/1-SERIES 'G'




| | |
|---|---|
| 5" | 8 HOLES - 3/4" -10UNC-2B,EQUI-SPACED */** CRS ON 235 PCD. MIN.FULL THD - 21 (SEE TABLE) |
| 4" | 8 HOLES - 3/4" -10UNC-2B,EQUI-SPACED ON CRS ON 200 PCD. MIN.FULL THD - 21 |

| | |
|---|---|
| 8" | 12 HOLES - 7/8" -9UNC-2B,EQUI-SPACED ON CRS ON 330.200 PCD. MIN.FULL THD - 30 |
| 6" | 12 HOLES - 3/4" -10UNC-2B,EQUI-SPACED ON CRS ON 269.900 PCD. MIN.FULL THD - 25 |




| COMPRESSOR | DIMN A | DIMN B | DIMN C | DIMN D | DIMN E | DIMN F | DIMN G | SUCTION BORE | DISCH BORE | COMPR WEIGHT(Kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| WRV/204110 | 504 | 119 | 303 | 1201 | 13 | 1/2" | 195 | 6" DN150 | 4" DN100 | 790 |
| WRV/204145 | 507 | 188 | 375 | 1273 | 80 | 1/2" | 300 | 8" DN200 | 5"* DN125 | 885 |
| WRV/204165 | 504 | 230 | 416 | 1314 | 123 | 3/4" | 300 | 8" DN200 | 5"** DN125 | 905 |
| WRV/204193 | 507 | 285 | 470 | 1370 | 175 | 3/4" | 345 | 8" DN200 | 5"* DN125 | 940 |

NOTE:- * = ON CENTRES FOR L/D=1.45 AND 1.93
** = OFF CENTRES FOR L/D=1.65

| MOD. | ZONE | MODIFICATION | SIGN DATE | MOD. | ZONE | MODIFICATION | SIGN DATE | MOD. | ZONE | MODIFICATION | SIGN DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | | | | 6 | | | | 3 | | MODEL USAGE UPDATED | 99.01.18 |
| 8 | | | | 5 | | | | 2 | | DRILLING DETAILS AMENDED FOR 5" DISCHARGE FACING | C MacL 97.07.22 |
| 7 | | | | 4 | | | | 1 | | DRILLING DETAILS AMENDED FOR DISCHARGE FACING | VMacL 96.03.06 |

UNLIMITED MACHINED SIZES TO BE WITHIN ±

MODEL 6 6A

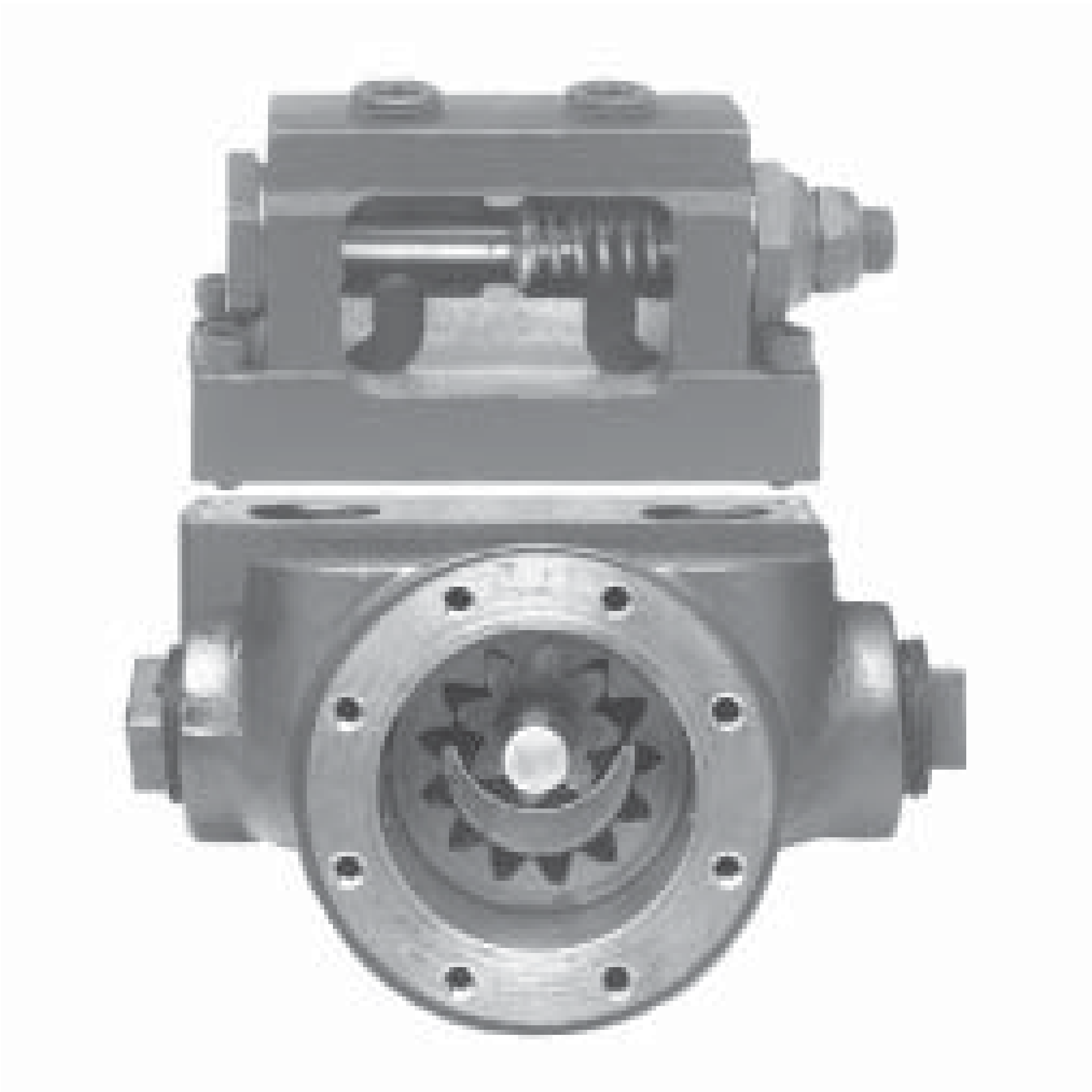


| | | | |
|---|---|---|---|
| DRN. | GH | WRV204/RANGE COMPRESSOR | SCALE:- |
| CHKD. | V MacL | EXTERNAL ARRANGEMENT | DRAWING No. R20737 |
| DATE | 93.09.21 | | MOD. 3 |

HOWDEN COMPRESSORS LIMITED, GLASGOW, U.K.

Pump Documentation

# Haight Pumps . . .
# For Superior Performance



# Operating, Maintenance, and Instruction Manual

HAIGHT® PUMPS
DIVISION OF: BAKER MANUFACTURING COMPANY

HPOM9/02

# Operating Manual for Haight Positive Displacement Rotary Gear Pumps

## Pre-Installation

1. Choose a location that is easily accessible for pump servicing. Ensure adequate electrical service is available.

2. Locate the pump for direct piping. Special attention should be given to the suction piping which should be as large, or larger, than the pump intake port. ***For efficient operation, it is essential the suction side of a gear pump not be restricted.*** Avoid tees, elbows, valves, and other flow devices within 12 pipe diameters of the pipe inlet. Provide adequate support for the piping. The pump should not be used to support piping.

3. Pumps are shipped with the suction port marked - **IN**; the discharge port marked - **OUT**. The suction port on pumps with relief valves is the port nearest to the relief valve adjusting screw.

4. Pumps will operate in either direction. However, the relief valve will only function in one direction. Relief valve components are symmetrical and can be installed to operate with either clockwise or counter-clockwise shaft rotation.

5. Have an electrician connect the motor using sound practice. Provide adequate overload protection. ***Note: When checking the direction of rotation, the pump must be full of liquid. Pumps fitted with mechanical seals must not run dry, not even momentarily.*** Determine the direction of rotation by watching the motor fan, which must turn clockwise.

6. The motor selected meets the requirements of the specified operating conditions. Changed conditions, for example, higher viscosity, higher specific gravity, or lower head losses, can overload the motor. When changing operating conditions, or whenever there is any doubt, please contact your local distributor with the full details.

## Installation

1. Provide a solid foundation free from excessive vibration.

2. Shim to prevent distortion of the pump mount base. Securely anchor the pump and motor to the foundation.

3. All pipe connections on the suction side of the pump must be air tight. An air leak on the suction side of the pump will result in the loss of prime.

4. Provide priming tee on the discharge line of the pump.

5. If the media pumped contains solids, a suction strainer is recommended to exclude solid particles from the pump. Contact Haight Pump for a recommendation.

6. Support the piping independent of the pump. Excessive strain on the pump casing can interfere with gear alignment.

7. When the piping is complete, loosen the bracket set screws and allow the pump to align with the piping. Tighten the bracket set screws and re-check the shaft alignment. Make sure there is no metal to metal contact of the coupling halves. Do not over tighten the pipe/pump connections, as damage can result.

8. A vacuum gauge can be installed in the pipe plug on the relief valve nearest the adjustment screw. A pressure gauge can be installed in the opposite pipe plug.

9. Check the shaft rotation to ensure it is correct. Normal rotation is clockwise as viewed from the shaft side of the pump.

**Precautionary Notes**

1. Prior to performing any service on the pump or motor:
   (a) Disconnect and lockout the power source to the motor (refer to OSHA 1910.147.)
   (b) Shut off any liquid heating source.
   (c) If the unit operates at elevated temperatures, allow it to cool to room temperature before performing any service.

2. Drain the pump and piping of excess liquid. *Caution: Handle and dispose of liquids in accordance to the manufacturers Material Safety Data Sheets.*

**Disassembly for Inspection Purposes Only**

1. Remove the bolts from the drive plate.

2. Carefully separate the drive cover and housing. Rotate the pump shaft by hand. It should turn freely. If resistance is present, check for built up residue.

3. Use a soft marker to mark the rotor/pinion location. Remove the rotor from the housing.

4. Inspect the housing, shaft/pinion, rotor, and drive plate for signs of wear or damage. Excessive wear will decrease pump performance.

5. Inspect the O-rings, gaskets, and bearings for chipping, splitting, or missing sections.

6. Inspection of the pump seal requires complete removal of the pump from the motor and bracket.

**Complete Disassembly for Repair or Replacement**

1. Complete precautionary steps 1 and 2.

2. Loosen the support bracket screws that secure the pump to the bracket.
   (a) Size 1-8 pumps: 3 set screws
   (b) Size 10-80 pumps: 4 cap screws

3. Remove the coupling and shaft key. Inspect the shaft end for burrs or other damage.

4. Rotate the pump shaft by hand. It should rotate freely.

5. Remove the bolts from the drive plate.

6. Carefully separate the drive cover and housing.

7. Use a soft marker to mark the rotor/pinion location. Remove the rotor from the housing.

8. Remove the shaft/pinion assembly from the housing.

9. Carefully pry the cover off the housing.

10. Inspect, repair, or replace all damaged parts. *Note: If significant damage is evident to the major pump components, it is best to replace the pump.* If possible, determine the cause of the damage and correct the identified problem.

**Reassembly**

1. Pump reassembly is the reverse of disassembly. However, care should be exercised in three areas:
   (a) It is good practice to replace elastomer sealing devices and gaskets every time the pump is reassembled. This is mandatory for Teflon O-rings and lip seals. Gently stretch the O-rings before placing them in the O-ring groove.
   (b) Place the rotor into position with your mark facing out.
   (c) Use a cross bolt tightening pattern to re-assemble the housing and covers. Periodically turn the pump shaft. Check for unusual noise. Improper tightening will cause the pump to bind.

2. The pump will function best if primed first. Return the pump to service and check for leaking and loose connections. Air leaks on the suction side of the pump will reduce pump performance.

**Relief Valve Components**

1. See precautionary notes.

2. To change the relief valve for reverse rotation:
   (a) Loosen the locknut on the adjusting screw while holding the adjusting screw stationary.
   (b) Remove the bonnet and bonnet washer.
   (c) Remove the adjusting screw, spring, and poppet.
   (d) Remove the cap and cap washer.

3. Reassemble in reverse order. Remember the spring and adjusting screw must be on the suction side of the pump for the relief valve to operate.

**Special Seal Components**

1. Standard 1 through 40 D/DR pumps use a lip seal as the main shaft seal, and two wiper seals function to keep the bearings clean. These seals are available in Buna-N or Viton synthetic materials.

2. Packed pumps use 4 or 5 element V-cup Teflon shaft seals. Shaft seals are also available in Graphite rope, Graphfoil, and virgin Teflon. A gland is included to provide tension for the packing.

3. Crane Type 9 and Type 21 mechanical seals are available. Contact Haight Pump for special drawings for pumps with mechanical seals.

**Maintenance Parts or Factory Repair**

1. When ordering parts, locate the pump serial number stamped on the machined face of the cover or body of the pump housing.

2. Haight Pump maintains a repair service shop that will rebuild, test, and return pumps promptly.

3. Remove pipes, coupling, and mounting bracket before returning the pump to the factory.

4. Contact Haight Pump for a Return Authorization number before sending the pump to the factory.

## General Information

The following is general information about Haight rotary gear pumps. Due to the variety of options and configurations available, it is not possible to provide detailed information in this manual. Detailed drawings and bill of materials will be provided upon request.

***Never operate a pump with the discharge line closed or plugged. Severe damage to the pump and/or system will result.***

***Haight Pump does not accept responsibility or liability for damage or injury resulting from improper application and/or operation of the pump and/or system.***

Direction of Rotation. Haight pumps are designed to operate in either direction by simply changing the shaft rotation. Pumps supplied with relief valves are the exception to this rule. Failure to reverse the relief valve components will render the relief valve inoperable. The procedure for reversing the flow direction in the relief valve is covered in the *Assembly and Disassembly* instructions.

Pump Alignment. Bedplate mounted pumps and motor combinations are aligned and tested at the factory. Vibration during shipment and/or poor bedplate mounting conditions can cause premature failure or unacceptable noise and vibration.

Simple alignment checks can be performed by placing a straight edge on the top and side of the coupling. Improper alignment is indicated by a separation between the coupling and straight edge. Adjust the motor and pump location until any separation disappears in both planes.

Bedplate Mounting. Install nuts on the foundation bolts to provide location adjustment. Loosely place the bedplate on the foundation bolts. Adjust the bedplate height and location to meet the inlet and outlet piping. Ensure the bedplate is level and true. Fasten in place with lock washers or lock nuts. Check coupling alignment.

Piping. Improper suction piping is the leading cause of poor pump performance, including cavitation, noisy operation, inadequate performance, and premature pump failure. Particular care should be taken to avoid long, restricted pipe runs, the use of elbows, tees, valves, or other flow devices within twelve (12) pipe diameters of the pump inlet. Inlet piping should be at least equal to the pump inlet size.

The discharge piping arrangement is somewhat less critical than the inlet side, however, good engineering practice, as defined by the *Hydraulic Institute*, should be followed.

Pumps are not designed to be used as piping system support devices. Piping systems should have adequate, independent hangers to provide support. Again, the *Hydraulic Institute* offers guidelines for proper pipe support design.

Seals. Haight Pump offers three standard type seals, each with specific operating characteristics.

- *Lip seals:* Available in Buna-N, Viton, Teflon, Silicone, and Kalraz seals. Lip seals are inexpensive, but have certain limitations, which include:
    - Expected operating life of 2,000 -3,000 hours
    - Should not be used with system pressures over 75 psig
    - Should not be used in vacuum applications over 3" Hg

**General Information: Seals (cont'd)**

- *Packing gland:* Available in Graphfoil, or Teflon, and other materials upon request. Packing glands are useful at high temperatures and pressures, resist shock and vibration, and can be adjusted to accommodate wear. However, packing glands *must* *weep* to function properly and require adjustment during the start-up operation.

  During start-up, or after repacking, run the pump to pressurize the stuffing box. Steady weepage should occur in less than ten (10) minutes. If steady weepage has not begun within ten (10) minutes, stop the pump and allow it to cool. Overheating the gland will damage the packing gland and shaft. Do not loosen the gland adjustment screws. Repeat this process until steady weepage is established.

  Adjust the packing gland screws 1/6th of a turn in a cross bolt tightening pattern. Allow to run ten (10) minutes. Continue this process until the weepage rate is approximately one (1) drop per minute. Periodic inspection and adjustment will be required. *Do* *not* over tighten the packing gland as damage to the gland and shaft will result.

**Bearings and Rotor/Pinion Shaft**

*DU Bearings*. Recommended for applications over 100 PSI and for thin fluids.

*Teflon Rotor*. Do not use Teflon rotors in applications exceeding 100 PSI, and 200° F. The pump is provided with open tolerances. Increased slip will reduce efficiency with fluids below 200 SSU.

*Delrin Rotor*. Do not use above 120° F and 80 PSI. Delrin rotors provide better abrasion resistance than Teflon rotors. The pump is provided with open tolerances. Increased slip will reduce efficiency with fluids below 200 SSU.

*Stainless Steel Rotor and Pinion.* Manufactured with open tolerances as standard. Increased slip will reduce efficiency with fluids below 200 SSU.

*Note: For applications above 175 PSI, vent both shaft bearings to the suction side of pump.*

**Spares and Repairs**

Haight Pump operates a repair service for all pumps for which records exist. To ensure the correct parts are supplied, the pump serial number is required. The serial number is stamped into the metal of the pump body or cover, in a prominent position on the top area of the pump.

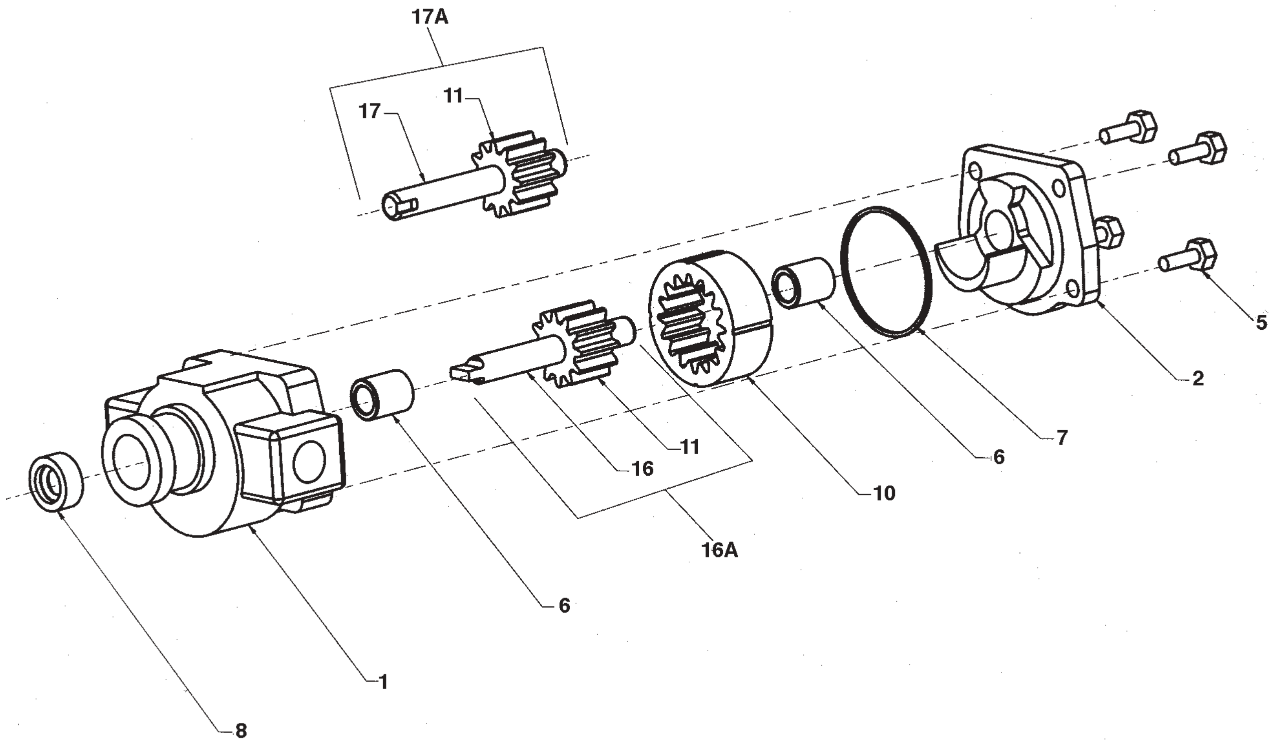
We advise customers whose pumps are custom fabricated to have spare pumps or parts on hand. Custom fabricated pumps and parts generally have long delivery times for replacement.

***Pumps That Perform. Pumps That Fit.***

**Troubleshooting**

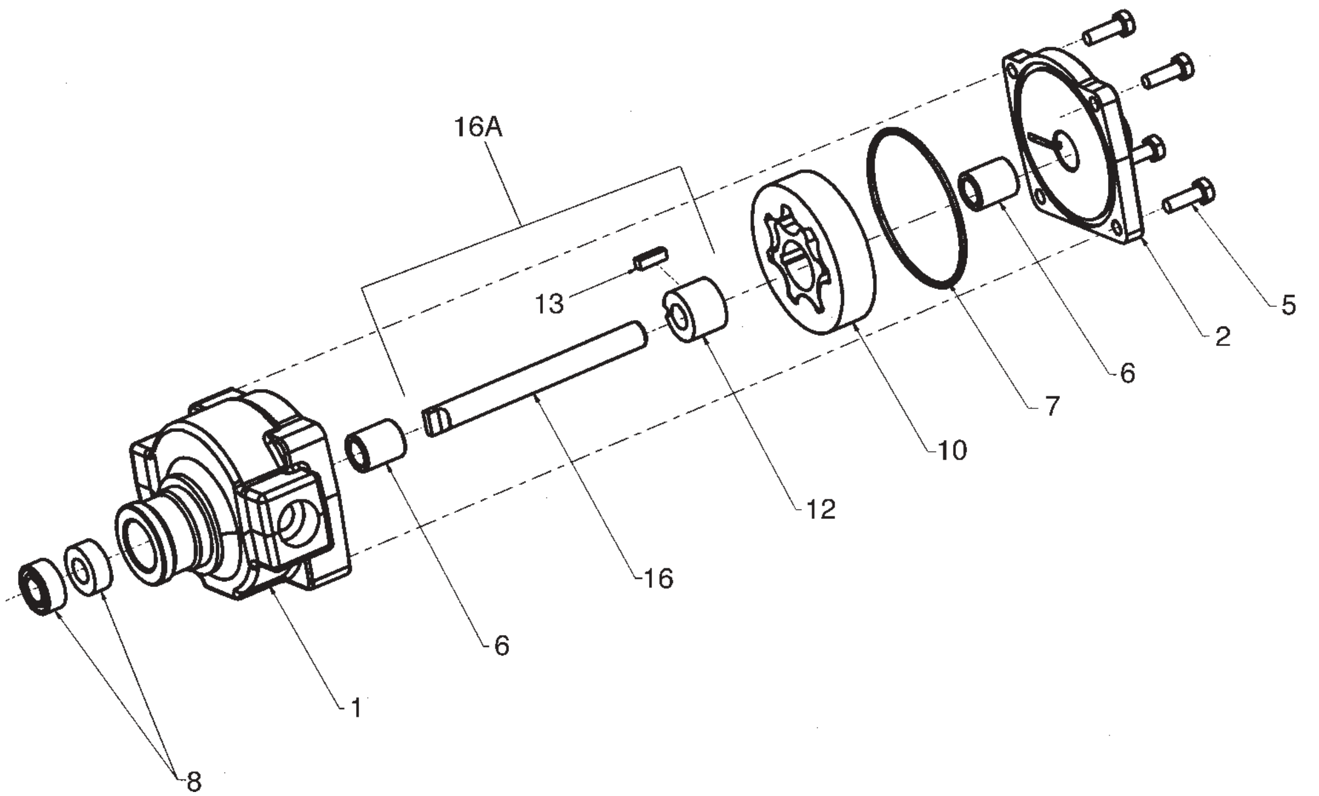
| Problem | Probable Cause |
|---|---|
| *No liquid delivered.* | • Pump not primed<br>• Suction lift too high; check with a gauge at the pump suction<br>• Wrong direction of rotation<br>• Pump not rotating (failure of drive from prime mover) |
| *Not enough liquid delivered.* | • Air leaks in suction line or through stuffing box<br>• Speed too low<br>• Suction lift too high, or not enough suction head (for hot liquids)<br>• Foot valve too small or obstructed<br>• Foot valve or end of suction pipe not immersed deeply enough<br>• Piping improperly installed, permitting air or gas to pocket in pump<br>• Mechanical defects:<br>  • Pump damaged<br>  • Pump badly worn<br>  • Packing defective<br>  • Relief valve not sealing or jammed by foreign matter |
| *Pump works for awhile, then loses suction.* | • Leaky suction lines<br>• Suction lift too high<br>• Air or gases in liquid<br>• Plugged lines or filter |
| *Pump takes too much power.* | • Speed too high<br>• Liquid heavier or more viscous than design condition<br>• Suction or discharge line obstructed<br>• Mechanical defects:<br>  • Shaft bent<br>  • Rotating element binds<br>  • Stuffing boxes too tight<br>  • Misalignment due to improper connection of pipe lines or driver<br>• Check pressure is being measured at the pump and not some distance away from the pump, thus ignoring pressure losses in piping, valves, etc.<br>• Poor piping conditions |
| *Noisy pump.* | • Speed too high<br>• Suction lift or viscosity too high (piping diameter too small)<br>• Wrong direction of rotation (recesses in the pump covers to prevent hydraulic noise operate only in one direction)<br>• Badly supported pipe or bedplates causing resonant vibration<br>• Relief valve chattering<br>• Pressure too low; an increase in pressure can prevent gear noise in low pressure applications<br>• Cavitation due to inlet or outlet conditions |
| *Gland leakage.* | • Packing hard and shaft scored<br>• Pressure on pump too high or pressure relief passage blocked<br>• Shaft run out excessive<br>• When re-packing a gland, all the old packing must be removed; it is not good enough to just add extra rings as the original packing becomes compressed |

## 3E & 5E STANDARD "Hot Oil" PUMP REPLACEMENT PARTS




| Item Number | Description | Style | Part Number | Qty Required |
|---|---|---|---|---|
| 1 | E style casing | 3E & 5E | ED53F5 | 1 |
| 2 | 3E Cover | 3E | ED330F | 1 |
| | 5E Cover | 5E | ED530F | 1 |
| 5 | Cover Bolts | 3E & 5E | E90HC.7 | 4 |
| 6 | Bearing | 3E & 5E | E11F | 2 |
| 7 | Cover o-ring | 3E & 5E | E28V1 | 1 |
| 8 | Lip Seal | 3E & 5E | E18V | 1 |
| 10 | Rotor | 3E | D326F1 | 1 |
| 10 | Rotor | 5E | D526F1 | 1 |
| 11 | Pinion | 3E & 5E | N/A | 1 |
| 13 | Screw | 3E & 5E | E46C | 2 |
| 16 | Shaft - Tang | 3E & 5E | N/A | 1 |
| 16A | Tang Shaft-Pinion Assy | 3E | ED3C13BC | 1 |
| 16A | Tang Shaft-Pinion Assy. | 5E | ED5C13BC | 1 |
| 17 | Keyed Shaft | 3E & 5E | N/A | 1 |
| 17A | Keyed Shaft-Pinion Assy. | 3E | D3C13C | 1 |
| 17A | Keyed Shaft-Pinion Assy. | 5E | D5C13C | 1 |

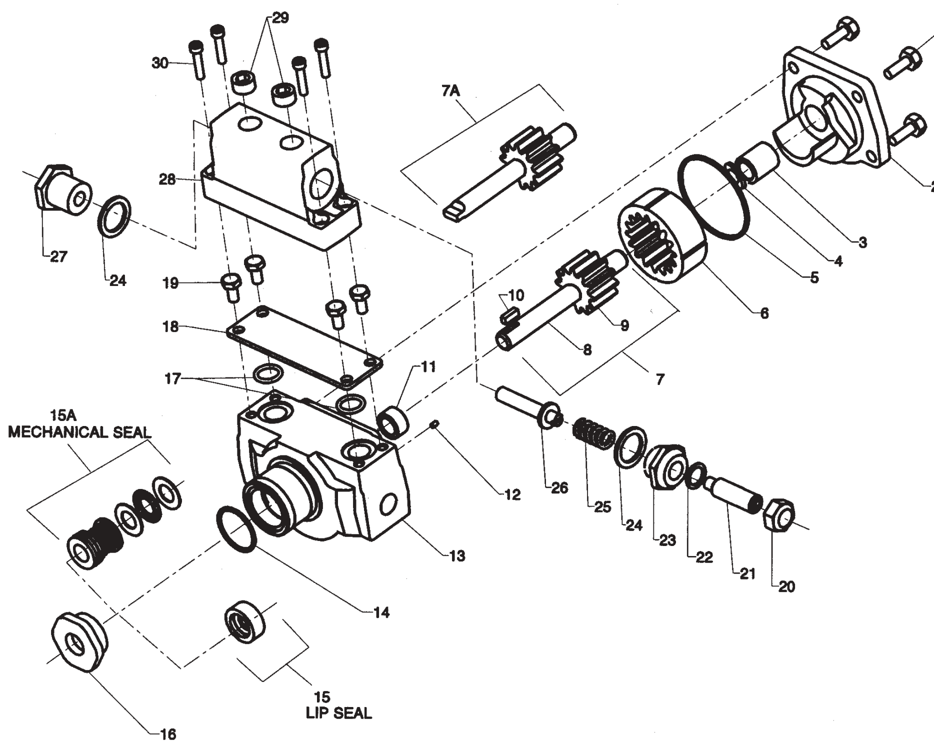
# 6G & 8G Hot Oil Gerotor Pump
# Replacement Parts




| Item Number | Description | Style | Part Number | Qty Required |
|---|---|---|---|---|
| 1 | G style casing | 6G | EG63F7A | 1 |
| | | 8G | DG83F7A | 1 |
| 2 | 6G cover | 6G & 8G | EG830F | 1 |
| 5 | Cover bolts | 6G & 8G | E90HC.7 | 4 |
| 6 | Bearing | 6G & 8G | E11F | 2 |
| 7 | Cover o-ring | 6G & 8G | SE2151V76 | 1 |
| 8 | Lip Seal | 6G & 8G | E18V | 2 |
| 10 | Gerotor Set | 6G | HJ169A | 1 |
| | | 8G | HJ89A | 1 |
| 12 | Spacer | 6G & 8G | HJ80A | 1 |
| 13 | Key | 6G & 8G | F18C50 | 2 |
| 16 | Shaft-Tang | 6G | F18C50 | 1 |
| | | 8G | ED524BC | 1 |
| 16A | Shaft/Spacer/Key Assy | 6G | ED514BC | 1 |
| 16A | Tang Shaft-Pinion Assy. | 8G | ED5C13BC | 1 |
| 17 | Keyed Shaft | 8G | N/A | 1 |
| 17A | Keyed Shaft-Pinion Assy. | 8G | D5C13C | 1 |

Viton® is a registered trademark of DuPont Dow Elastomers

# 1U through 5U Haight Pump w/o Relief Valve
# 1U through 5U Haight Pump with Relief Valve




| Item Number | Description | Qty Required |
|---|---|---|
| 1 | Screw-cover | 4 |
| 2 | Cover | 1 |
| 3 | Shaft bearing | 1 |
| | -Iron | |
| | -Bronze | |
| | -Carbon Graphite | |
| | -DU-Iron Sleeve | |
| 4 | Wiper Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 5 | O-Ring Cover | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| | -Teflon | |
| 6 | Rotor*-C.I. Standard | 1 |
| 7 | Shaft & Pinion Assembly | 1 |
| 7A | Tanged Shaft & Pinion Assy. | 1 |
| 7B | Outboard Bearing Shaft (not shown) | 1 |
| 8 | Shaft | 1 |
| 9 | Pinion | 1 |
| 10 | Key | 1 |
| 11 | Shaft Bearing | 1 |
| | -Iron | |
| | -Bronze | |
| | -Carbon Graphite | |
| | -Du-Iron Sleeve | |
| 12 | Set Screw | 1 |
| 13 | Case 1/2" ports | 1 |
| 14 | O-ring Gland | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| | -Teflon | |

| Item Number | Description | Qty Required |
|---|---|---|
| 15 | Lip Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 15A | Mechanical T-21 Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Pinned Viton | |
| | -Neoprene | |
| 16 | Gland | 1 |
| 17 | O-ring (cover plate, relief valve) | 2 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 18 | Cover Plate | 1 |
| 19 | Cover Plate Screw | 4 |
| 20 | Lock Nut | 1 |
| 21 | Adjusting Screw | 1 |
| 22 | Gasket | 1 |
| | -Metallic | |
| | -Buna | |
| | -Viton® | |
| 23 | Bonnet | 1 |
| 24 | Gasket | 2 |
| | -Buna | |
| | -Neoprene | |
| | -Viton® | |
| 25 | Spring | 1 |
| 26 | Poppet | 1 |
| 27 | Relief Valve Cap | 1 |
| 28 | Valve Housing | 1 |
| 29 | Pipe Plug | 2 |
| 30 | Relief Valve Screw | 4 |

***** Designate Rotor Material
- -Cast Iron-Standard
- -Delrin
- -Teflon
- -Ni-Resist

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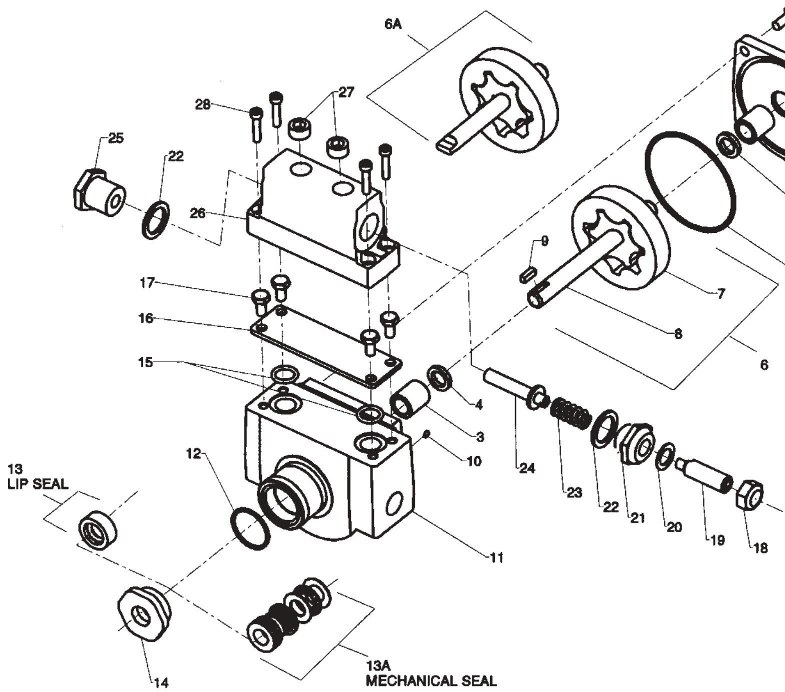
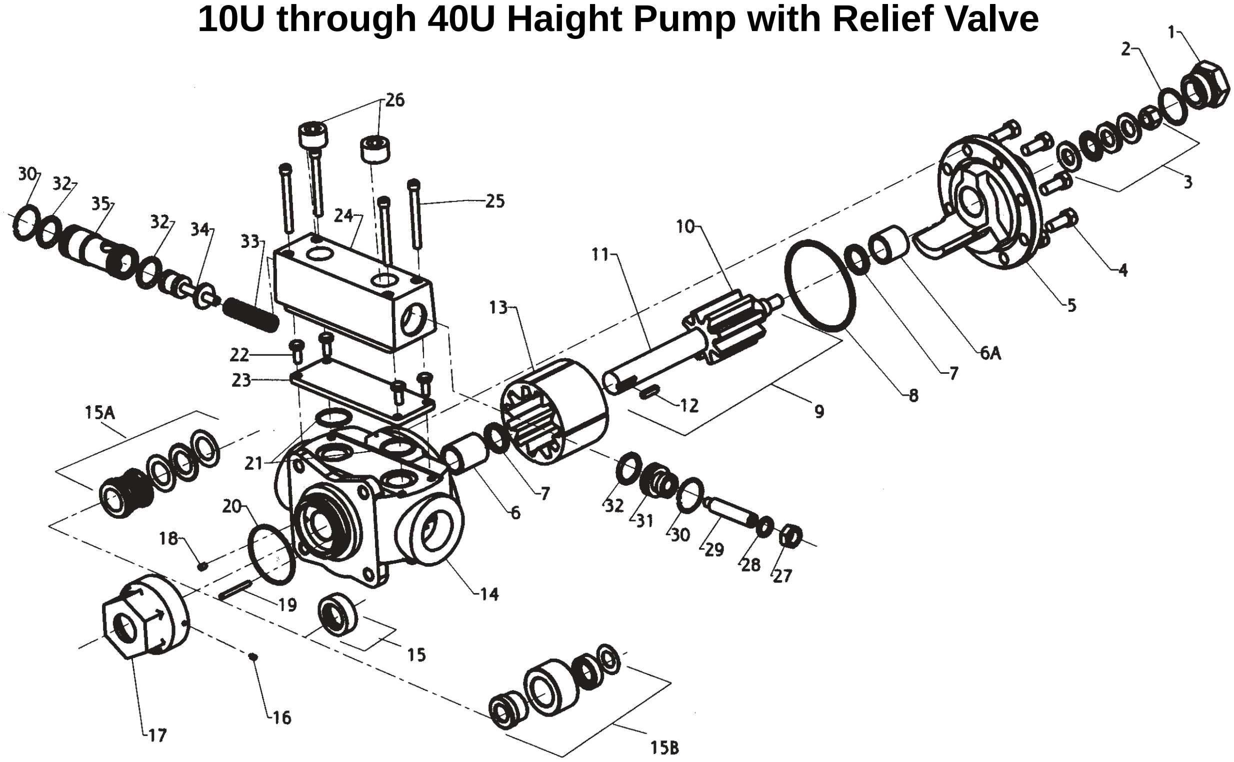
# 6U & 8U Haight Pump w/o Relief Valve
# 6U & 8U Haight Pump with Relief Valve




| Item Number | Description | Qty Required |
|---|---|---|
| 1 | Screw-cover | 4 |
| 2 | Cover | 1 |
| 3 | Shaft bearing | 2 |
| | -Iron | |
| | -Bronze | |
| | -Carbon Graphite | |
| | -DU-Iron Sleeve | |
| 4 | Wiper Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 5 | O-Ring Cover | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| | -Teflon | |
| 6 | Gerotor & Shaft Assemby | 1 |
| 6A | Gerotor & Tang Shaft Assembly | 1 |
| 7 | Gerotor Set | 1 |
| 8 | Shaft | 1 |
| 9 | Key | 1 |
| 10 | Set Screw | 1 |
| 11 | Case 1/2" ports | 1 |
| 12 | O-ring Gland | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| | -Teflon | |
| 13 | Lip Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 13A | Mechanical T-21 Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Pinned Viton | |
| | -Neoprene | |
| 14 | Gland | 1 |
| 15 | O-ring (cover plate, relief valve) | 2 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 16 | Cover Plate | 1 |
| 17 | Cover Plate Screw | 4 |
| 18 | Lock Nut | 1 |
| 19 | Adjusting Screw | 1 |
| 20 | Gasket | 1 |
| | -Metallic | |
| | -Buna | |
| | -Viton® | |
| 21 | Bonnet | 1 |
| 22 | Gasket | 1 |
| | -Buna | |
| | -Neoprene | |
| | -Viton® | |
| 23 | Spring | 1 |
| 24 | Poppet | 1 |
| 25 | Relief Valve Cap | 1 |
| 26 | Valve Housing | 1 |
| 27 | Pipe Plug | 2 |
| 28 | Relief Valve Screw | 4 |

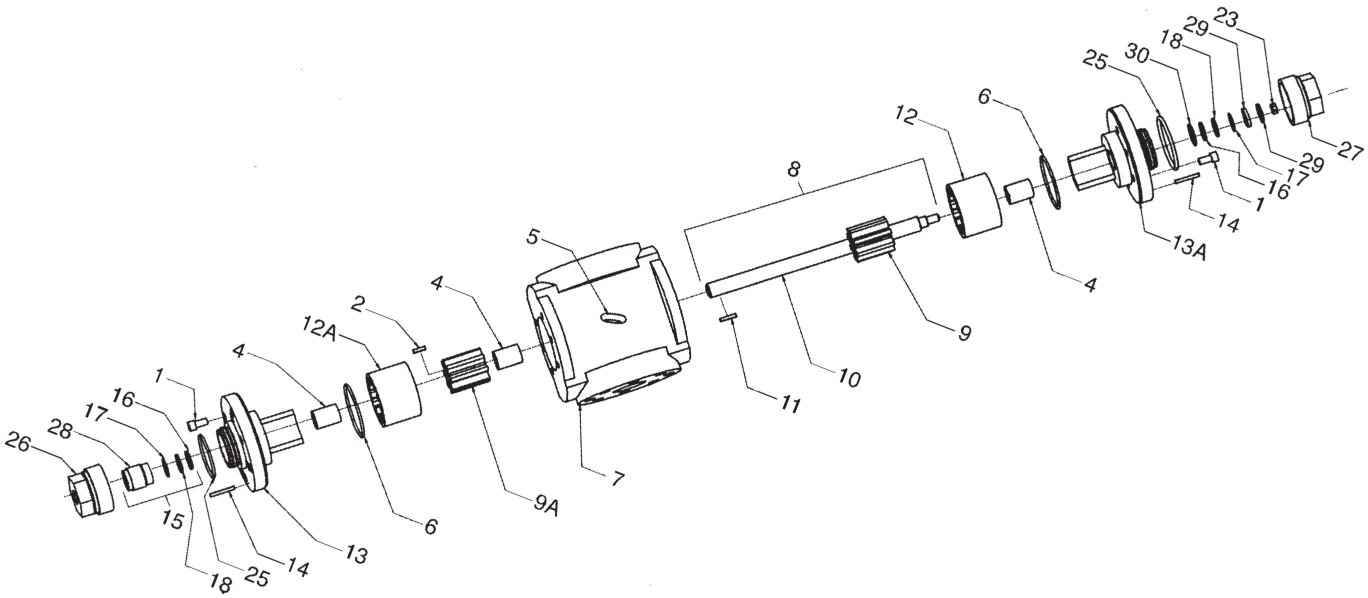
# 10U through 40U Haight Pump w/o Relief Valve
# 10U through 40U Haight Pump with Relief Valve




| Item Number | Description | Qty. Required |
|---|---|---|
| 1 | Screw on O-ring gland | 1 |
| 2 | O-Ring | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| | -Kalrez® | |
| | -Teflon | |
| 3 | Thurst Washer Kit | 1 |
| | Nut | |
| | Washer | |
| | Washer | |
| | Washer | |
| | Bearing | |
| | Washer | |
| 4 | Screw | 8 |
| 5 | Cover | 1 |
| 6 & 6A | Bearing | 2 |
| | -Bronze | |
| | -Iron | |
| | -Graphite | |
| | -DU | |
| 7 | Wiper Seal | 2 |
| | -Buna | |
| | -Neoprene | |
| | -Viton® | |
| 8 | O-Ring | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| | -Kalrez® | |
| | -Teflon | |
| 9 | Shaft & Pinion Assy-std. | 1 |
| 9 | Shaft & Pinion Assy-OBB | 1 |
| 10 | Pinion | 1 |

| Item Number | Description | Qty. Required |
|---|---|---|
| 11 | Shaft | 1 |
| 12 | Key | 1 |
| 13 | Rotor*-C.I. Standard | 1 |
| 14 | Case | 1 |
| | -1" ports | |
| | -1-1/4" ports | |
| | -1-1/2" ports | |
| 15 | Lip Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 15A | Mechanical Seal | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 15B | Packing Seal | 1 |
| | -Graphoil | |
| | -Teflon | |
| 16 | Set Screw | 1 |
| 17 | Gland | 1 |
| 18 | Set Screw | 1 |
| 19 | Roll Pin | 1 |
| 20 | O-Ring | 1 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| 21 | O-Ring | 2 |
| | -Buna | |
| | -Viton® | |
| | -Neoprene | |
| | -Teflon | |
| 22 | Screw | 4 |
| 23 | Cover Plate | 1 |
| 24 | Valve Body | 1 |

# 44D through 80D Double Pump




| Item Number | Description | Qty Required |
|---|---|---|
| 1 | .375 x .875 UNC HSCS | 12 |
| 2 | .188 x .75 Sq. key | 1 |
| 4 | **Shaft Bearing** .877 x 1.5 x 1.128 | 3 |
| | - Iron | |
| | - Bronze | |
| | - Carbon Graphite | |
| 5 | **Eyebolt** | 1 |
| 6 | **Cover Gasket** | 2 |
| | - Neoprene | |
| | - Buna N | |
| | - Viton® | |
| 7 | **44-80 Dual Casing** | 1 |
| 8 | **Shaft & Pinion Assembly** | 1 |
| | - 44gpm | |
| | - 54gpm | |
| | - 60gpm | |
| | - 70gpm | |
| | - 80gpm | |
| 9 | **Standard Pinion-Only** | 1 |
| | - 44gpm | |
| | - 54gpm | |
| | - 60gpm | |
| | - 70gpm | |
| | - 80 gpm | |
| 9A | **Keyed Pinion** | 1 |
| | - 44gpm | |
| | - 54gpm | |
| | - 60gpm | |
| | - 70gpm | |
| | - 80 gpm | |
| 10 | **Shaft** | 1 |
| 11 | **Square Key** - .188x 1.0 | 1 |
| 12 | **Rotor** | 1 |
| | - 44gpm | |
| | - 54gpm | |
| | - 60gpm | |
| | - 70gpm | |
| | - 80gpm | |

| Item Number | Description | Qty Required |
|---|---|---|
| 12A | **Mating Rotor** | 1 |
| | - 44gpm | |
| | - 54gpm | |
| | - 60gpm | |
| | - 70gpm | |
| | - 80gpm | |
| 13 | **Drive Plate** | 1 |
| | - 44gpm | |
| | - 54gpm | |
| | - 60gpm | |
| | - 70gpm | |
| | - 80gpm | |
| 13A | **Cover** | 1 |
| | - 44gpm | |
| | - 54gpm | |
| | - 60gpm | |
| | - 70gpm | |
| | - 80gpm | |
| 14 | **Roll Pin** .156x1.13 | 2 |
| 15 | **Seal Kit** (See Pg. 20) | 1 |
| 16 | **Washer** .625x1.12x.094 | 2 |
| 17 | **Thrust Bearing** (Keyed end) | 1 |
| 18 | **Thrust Bearing** | 1 |
| 23 | **Locking Nut** | 1 |
| 25 | **O-ring-gland cap** | 2 |
| | Neoprene | |
| | Buna N | |
| | Viton® | |
| | Teflon | |
| 26 | **Gland Cap**-shaft | 1 |
| 27 | **Gland Cap** | 1 |
| 28 | **Mechanical shaft seal** | 1 |
| 29 | **Washer** .53x1.12x.023 spherical | 1 |
| 30 | **Washer** .656x1.66x.094 | 1 |

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## Product Service Log

Model Number: ______________________ Serial Number: ___________________________

Date Purchased: _____________________ Date Entered Service: ____________________

Location: ___________________________ Tag #: __________________________________

Application Data:

Liquid: ________________________

Flow: __________________________

Pressure: ______________________

Elastomers: ____________________

Motor:

Horsepower: ________________________

Enclosure: _________________________

Speed ______________________________

Service History:

| Date of Service | Type of Service |
| --- | --- |
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**INSTALLATION, START UP, TROUBLESHOOTING, PREVENTIVE MAINTENANCE, DO'S & DON'TS SERIES SG-04, SG-05 & SG-07 SPUR GEAR PUMPS**







**INSTALLATION, START UP, TROUBLESHOOTING, PREVENTIVE MAINTENANCE, DO'S & DON'TS SERIES SG-04, SG-05 & SG-07 SPUR GEAR PUMPS**

## CONTENTS



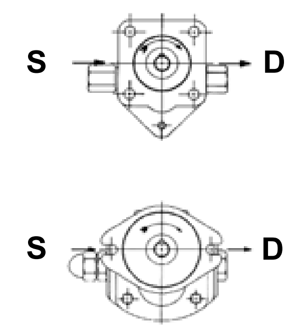



FIGURE 1

# INSTALLATION

## General

The following items must be considered prior to pump installation:

**1.** Location - locate the pump as close as possible to the liquid supply. If possible locate the pump below the liquid supply. Viking pumps are self-priming; but the better the suction conditions, the better the pump will perform.

**2.** Accessibility – the pump must be accessible for inspection, maintenance and repair.

**3.** Suction/Discharge - SG Series pumps are designed for clockwise rotation as standard (viewed from end of shaft). Refer to Figure 1.

**4.** Pressure Relief Valve - the SG Series is a positive displacement pump and requires some form of over pressure protection. Without pressure protection, if the discharge line is blocked or becomes closed, pressure will build up until the motor stalls, drive equipment fails, a pump part breaks, or the piping and/or other equipment in the system bursts. To prevent the possibility of any one or more of the above from occurring, the use of a pressure relief valve is recommended.

**5.** Storage - drain the pump and apply a light coat of non-detergent SAE 30 weight oil to all internal pump parts. Apply grease to the pump shaft extension. Viking suggests rotating the pump shaft by hand one complete revolution every 30 days to circulate the oil.

IDEX CORPORATION VIKING PUMP, INC. • A Unit of IDEX Corporation • Cedar Falls, IA 50613 USA

# MOUNTING

**1.** Surfaces to which the pump mounts must be clean and flat.

**2.** Use SAE Grade 5 or better capscrews to mount pump.

**3.** The 4 mounting capscrews for the SG-04 and SG-05 pumps must have a minimum of ½ inch thread engagement, and must be torqued evenly to 12-15 ft-lbs.

**4.** The 2 mounting capscrews for the SG-07 pumps must have a minimum of ½ inch thread engagement, and be evenly torqued to 50-55 ft-lbs.

**5.** Standard SG Series pumps are designed to be used with jaw type couplings that do not induce axial thrust on the pump shaft. If an improper type of coupling is used, internal damage may result.

**6.** Do not strike or press the pump drive coupling to install. Internal pump damage will result. If the coupling does not slide onto the shaft, inspect the coupling, shaft and key for nicks or burrs and remove.

**7.** If the pump is to be belt or gear driven, the overhung load option must be specified.

**8.** Once the pump has been mounted and the coupling installed, it is recommended to put lube oil into the suction port and turn the pump by hand to make sure it turns freely.

## Alignment

Check alignment after mounting.

**1.** If the unit has a flexible coupling, remove any coupling guards or covers and check alignment of coupling halves. A straight edge (piece of key stock will work) across the coupling must rest evenly on both rims at the top, bottom and sides. See Figure 3.

**2.** Make a final check on alignment after the piping is hooked up.

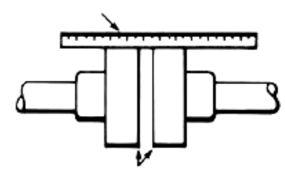



**FIGURE 3**

## Piping/Hose

The cause of many pumping problems can be traced to the suction piping. It should always be as large in diameter and as short in length as possible.

Before starting the layout and installation of your piping system, consider the following points:

**1.** Never use piping smaller than the pump port connections. Piping larger in diameter than the port connection is sometimes required to reduce friction losses.

**3. DO** obtain, read and keep all maintenance instructions furnished with pump.

VIKING PUMP

IDEX CORPORATION

## WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, FOB. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of IDEX Corporation or Viking Pump, Inc.. is authorized to alter this warranty.



**2.** Be sure the inside of the pipe is clean before installing.

**3.** When approaching an obstacle to the suction line, go around instead of over it. Going over an obstacle can create an air pocket. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.

**4.** A strainer on the suction side of the pump should always be considered in any pumping system. The strainer will keep foreign matter from entering the pump. The strainer mesh or perforation size should be large enough so that it does not cause excessive pressure drop, but fine enough to protect the pump. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale and other foreign objects.

**5.** A pressure relief valve is required in the discharge line. See Pressure Relief Valves, General page 1 item 4.

**6.** The pump must not be used to support the piping. Hangers, supports, stands, etc. must carry the weight of the pipes.

**7.** When fastening piping to the pump do not impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.

**8.** All joints of piping system must be tight; liquid thread sealant will help assure leak free threaded joints. Loose joints result in liquid leaks or suction side leaks. Air leaks make the pump noisy and reduce flow. **CAUTION:** Be careful not to over tighten fittings as this can cause cracked joints. Do not use Teflon tape. Reduced friction makes over tightening very easy and will result in cracked ports. Leaks in the suction line can permit air to be drawn in, and will cause a noisy pump and reduction in capacity.

**9.** Drive alignment must be checked after piping is hooked up.

**10.** Provide a pressure relief device in any part of a pump and piping system that can be valved off and, thus, completely isolated. A rise in temperature will cause a liquid to expand. If there is no provision for pressure relief in the closed off section, there is a chance that the pump or piping will rupture.

### Danger !

**Before starting pump, be sure all drive equipment guards are in place. Failure to properly mount guards may result in serious injury or death.**

## START UP

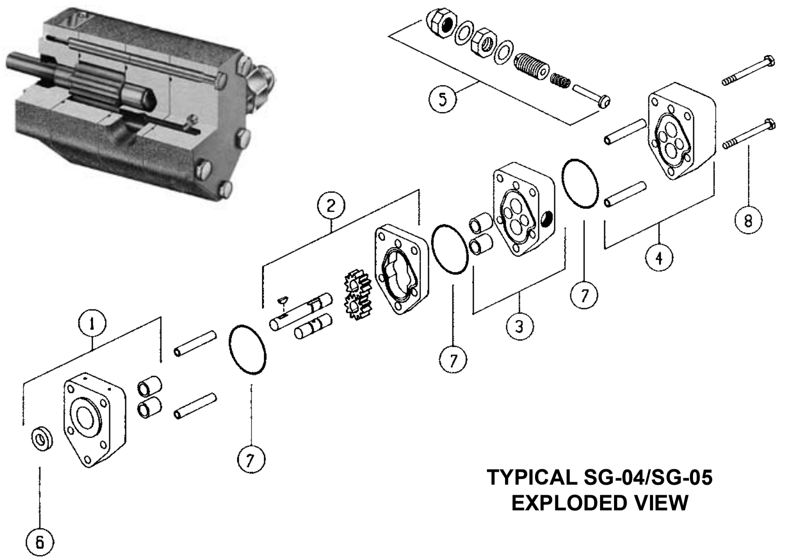
Before pushing "start" button, check the following:

**1.** Are vacuum and pressure gauges (liquid filled) mounted on or near the pump? Gauges are the quickest and most accurate way of finding out what is happening in the pump.

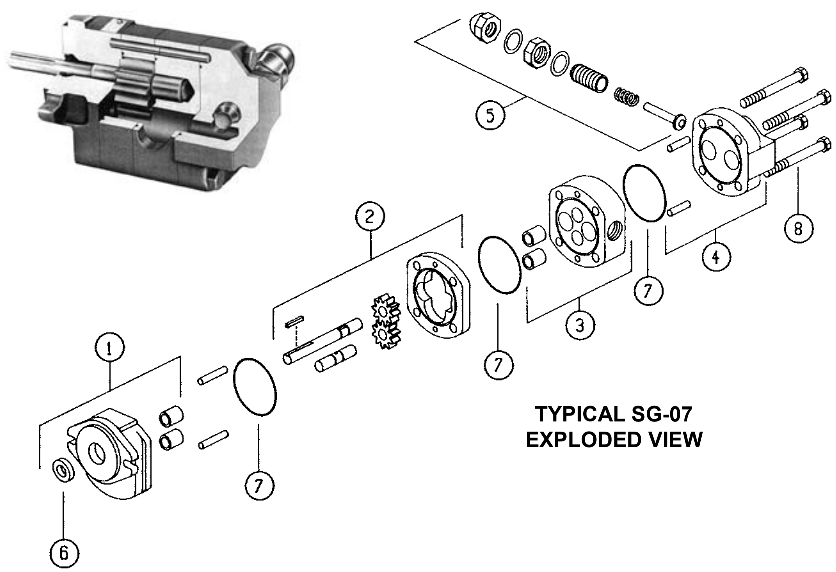
**2.** Is the pump is correctly aligned with the drive equipment?

**3.** Make sure there is no pipe strain on the pump ports.

**4.** Rotate the pump shaft by hand to be sure it turns freely.




**TYPICAL SG-04/SG-05**
**EXPLODED VIEW**




**TYPICAL SG-07**
**EXPLODED VIEW**

| ITEM | DESCRIPTION | ITEM | DESCRIPTION |
|---|---|---|---|
| 1. | Bracket, lipseal & bearing section | 5. | Relief valve kit |
| 2. | Match ground casing & (2) gears, driver & driven shafts | 6. | Lipseal |
| 3. | Separation plate & bearing assy. | 7. | O-ring |
| 4. | Head and alignment sleeve assy. | 8. | Assembly capscrews |



**Pump takes too much power (stalls motor):**

1. The pump sequence valve set too high.
2. Liquid is more viscous than the is unit sized to handle.
3. The system pressure relief valve set too high.
4. The pump is misaligned.

# DO'S AND DON'TS

Do's and Don'ts for installation, operation and maintenance of Viking pumps to assure safe, long, trouble free operation.

## Installation:

1. **DO** install the pump as close to supply tank as possible.
2. **DO** leave working space around the pumping unit.
3. **DO** use large, short and straight suction port.
4. **DO** install a strainer in the suction line.
5. **DO** a double check of alignment after unit is mounted and piping is hooked up.
6. **DO** provide pressure relief valve for discharge side of pump.
7. **DO** check for proper rotation.
8. **DO** use a return line filter.
9. **DO** use an industrial grade hydraulic oil.
10. **DO** use piping, hose and fittings rated for maximum system pressure.

## Operation

1. **DON'T** run the pump at speeds faster than 3600 RPM.
2. **DON'T** allow the pump to develop pressure higher than those shown in catalog at that size.
3. **DON'T** operate pumps at temperatures above or below limits shown in catalog for model.
4. **DON'T** operate unit without all guards in place.
5. **DON'T** operate pump without pressure relief valve in discharge piping; be sure valve is mounted and set correctly.
6. **DON'T** stick fingers in ports of pump!!! Fingers may be pinched between gears.
7. **DON'T** work on the pump unless driver has been "locked out" so it cannot be started while work is being done on the pump.

## Maintenance:

1. **DO** record pump model number and serial number and file for further use.
2. **DO** have spare parts, pump or stand by units available, particularly if pump is essential part of key operation process.

## Miscellaneous

### Pump does not pump:

1. The pump has lost its prime from air leak or low level in tank.
2. The suction lift is too high.
3. Rotating in the wrong direction.
4. The motor does not come up to speed.
5. The strainer is clogged.
6. The bypass valve is open, pressure relief valve set too low or pressure relief valve poppet stuck open.
7. The pump is worn out.
8. Any changes in liquid, system or operation that would help explain the trouble, e.g. new liquid, additional lines or process changes.

### Pump starts, then looses its prime:

1. The supply tank is empty.
2. The liquid is vaporizing in the suction line.
3. There is an air leak or air pockets in the suction line.
4. The pump is worn out.

### Pump is noisy:

1. The pump is cavitating (liquid vaporizing in suction line) or being starved (heavy liquid cannot get to pump fast enough). Increase the suction pipe size and/or reduce the length, or decrease the pump speed. If the pump is above the liquid, raise the liquid level closer to the center line of the inlet port. If the liquid is above the pump, increase the head of the liquid.
2. Check alignment.
3. Anchor the base or piping to eliminate vibration.

### Pump not delivering up to capacity:

1. The pump is starving or cavitating – see **Pump is noisy**, item 1.
2. The strainer partially clogged.
3. Air leak somewhere in the suction line.
4. Running too slow. Is the motor the correct speed and wired up correctly?
5. Pressure relief valve is set too low, stuck open or has damaged poppet seat.
6. The bypass line around the pump partially opened.
7. The pump is worn out.



5. Before connecting to the motor, jog it to be sure it is running in the correct direction. Refer to **"General"** on page 1.
6. Is the pressure relief valve installed properly?
7. Make sure suction piping is properly connected and sealed, and valves are open.
8. Make sure the discharge piping is properly connected and sealed, valves are open, and there is a place for the liquid to go.
9. Make sure all guards are in place.
10. The above checklist is a general guideline to be used prior to starting the pump. Since Viking Pump cannot foresee every application for our product and possible system design, the final responsibility is with the user. The pump must be utilized within the catalog specifications and the pump system must be designed to provide safe working conditions.

The "start" button may now be pushed.

The pump should begin to deliver liquid within 15 seconds! If not, push the stop button. Do not run the pump without liquid flow longer than 30 seconds or the pump may be ruined.

Review **Startup** steps 1 through 10. Consider what the suction and discharge gauges may indicate. If everything appears in order, re-prime pump. Refer to **Mounting,** page 2, item 8.

Push the "start" button. If nothing is flowing within 30 seconds, stop the pump. The pump is not a compressor, it will not build up much air pressure. It may be necessary to vent discharge line until liquid begins to flow.

If pump still does not deliver, consider one or more of the following:

1. The suction line has air leaks.
2. The end of the suction pipe is not submerged deeply enough in the liquid.
3. The suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points, the pump still does not deliver liquid, review all points given under **START UP** and read through the **TROUBLESHOOTING** guide and try again. If pump still will not deliver liquid, contact your Viking Pump supplier.

# TROUBLESHOOTING

A Viking pump that is properly installed and maintained will give long satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to install a vacuum gauge in the suction line and a pressure gauge in the discharge line. Readings on these gauges often give a clue on where to start looking for trouble.

## DANGER !

**Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting etc.) be sure:**

1. **That any pressure in chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.**

2. **That the driving means (motor, turbine, engine, etc.) has been “locked out” or made non-operational so that it cannot be started while work is being done on the pump.**

3. **That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.**

**Failure to follow the above listed precautionary measures may result in serious injury or death.**

## Vacuum Gauge - Suction Port

### High vacuum reading would indicate:

1. The suction line is blocked, valve closed, a strainer is plugged or a pinched suction line.
2. The suction line is too small.
3. The liquid is too viscous to flow through the piping.
4. The lift required is too high.

### Low reading would indicate:

1. There may be an air leak in the suction line.
2. The end of the pipe is not in the liquid.
3. The pump is worn.
4. The pump is dry and should be primed.



### Fluttery, jumping or erratic reading would indicate:

1. The liquid is vaporizing.
2. Liquid is coming in to the pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
3. Vibration from cavitation, misalignment, or damaged parts.

## Pressure Gauge - Discharge Port

### High reading would indicate:

1. High viscosity and small diameter and/or lengthy discharge line.
2. The strainer or filter is plugged.
3. The pressure relief valve is set too high.
4. Valve in the discharge line partially closed.
5. Line partially plugged from build up on inside of pump, solidified product or foreign object.
6. Liquid in the pipe not up to temperature.

### Low reading would indicate:

1. Pressure relief valve set too low.
2. Pressure relief valve poppet not seating properly.
3. Pump mounting capscrews into torqued to specifications (GP-04 and GP-05 Series 12-15 ft.-lbs.).
4. Pump assembly bolts not torqued into specifications (GP-07 Series 50-55 ft.-lbs.).
5. The bypass around pump partially open.
6. Pump is damaged or worn.
7. The pump has too much internal clearance.

### Fluttery, jumping or erratic reading would indicate:

1. Cavitation.
2. Liquid is coming to the pump in slugs.
3. Air leak in the suction line.
4. Vibrating from misalignment or mechanical problems.

# HANSEN TECHNOLOGIES CORPORATION

2" Strainer: ST200

## Specifications, Applications, Service Instructions & Parts

# ST STRAINERS (FILTERS)

**½" thru 6" (13 mm thru 150 mm) for refrigerants**

## INTRODUCTION

These rugged, refrigerant strainers (filters) are designed to remove foreign materials, like dirt and weld slag, from refrigeration systems. Strainers help prevent damage to valves and other components, reducing costly service and downtime. Strainers are usually close-coupled to solenoid valves, pressure regulators and other flanged valves.

## ORDERING INFORMATION

| CAT NO. | FOR VALVE SIZE inch (mm) | FLANGE STYLE AND SIZES CONNECTIONS AVAILABLE | | |
|---|---|---|---|---|
| | | FPT, SW, WN | | ODS |
| | | STD | ALSO | STD |
| ST050 | ½ (13)<br>5/32 (4) | ½ | ¼ | 5/8 |
| ST100 | ¾ (20) | ¾ | 1, 1¼ | 7/8 |
| | 1 (25) | 1 | ¾, 1¼ | 1 1/8 |
| | 1¼ (32) | 1¼ | ¾, 1 | 1 3/8 |
| ST200 | 1½ (40) | 1½ | 2 | 1 5/8 |
| | 2 (50) | 2 | 1½ | 2 1/8 |
| ST250 | 2½ (65) | 2½ | 3 | 2 5/8 |
| ST300 | 3 (80) | 3 | – | 3 1/8 |
| ST400 | 4 (100) | 4 | – | 4 1/8 |
| STW500 | 5 (125) | 5 WN ‡ | – | – |
| STW600 | 6 (150) | 6 WN ‡ | – | – |

‡Integral butt weld end only

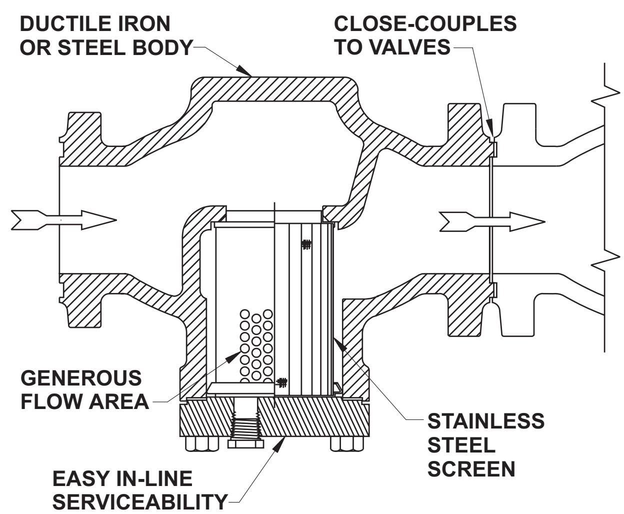
### OPTIONS

**Strainer Basket:** heavy duty, available for ST100.
**Perforated Metal Strainer:** necessary for suction side port applications (1½" through 3"); contact factory.
**Cloth Bags:** available up to 4" for system start-up.
**Filter System:** An extra-fine filter system with double the cleansing capacity of standard strainers is available. See bulletin T782 for more information.

**TO ORDER:** Specify catalog number and if strainer will be close-coupled to valve or installed as a separate unit. If it will be a separate unit, also specify flange connection style and size.

## KEY FEATURES

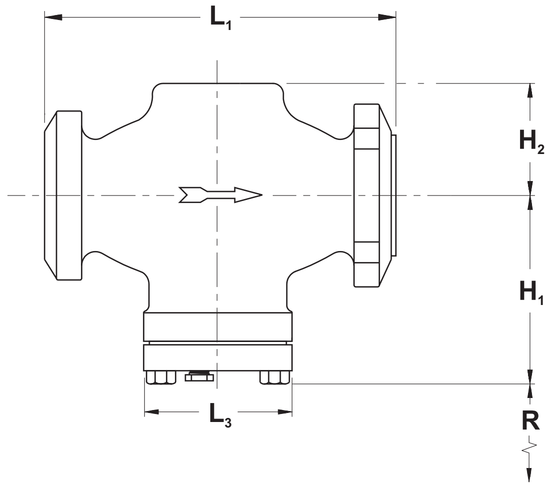
ISO 9002




## MATERIAL SPECIFICATIONS

Body: ½" through 4": Ductile iron, ASTM A536, (nodular iron GGG-40), 65,000 psi tensile
5" and 6": Cast steel, ASTM A352
Bottom Cover: ½": Steel, ASTM 108
¾" through 1¼": Ductile iron, ASTM A536
1½" through 6": Steel, ASTM A36
Drain Plug: Standard on ¾" through 1¼" (¼" NPT),
1½" through 4" (½" NPT),
5" & 6" (¾" NPT)
Screen: Stainless steel, 60 mesh (233 micron rating)
ST050 has 100 mesh (150 micron rating)
Gaskets: Nonasbestos, graphite composite
Safe Working Pressure: 400 psig (27 bar)
Operating Temperature: –60°F to +240°F (–50 to +115°C)

## INSTALLATION DIMENSIONS
## inches (mm)




| CAT NO. | $H_1$ | $H_2$ | $L_1$ | $L_3$ | R | W | Screen Area $in^2$ ($cm^2$) |
|---|---|---|---|---|---|---|---|
| ST050 | 3.32 (84) | 0.68 (17) | 2.03 (52) | 1.38 (35) | 3.00 (76) | 2.03 (52) | 5.40 (35) |
| ST100 | 5.15 (130) | 1.56 (40) | 3.75 (95) | 4.59 (117) | 3.00 (76) | 4.59 (117) | 63.00 (407) |
| ST200 | 5.34 (136) | 2.79 (71) | 9.88 (251) | 4.25 (108) | 4.00 (102) | 4.58 (116) | 84.50 (545) |
| ST250 | 6.10 (155) | 3.62 (92) | 9.88 (251) | 5.38 (137) | 4.50 (114) | 5.62 (143) | 134.50 (868) |
| ST300 | 6.56 (167) | 4.06 (103) | 12.25 (311) | 5.38 (137) | 4.75 (121) | 6.50 (165) | 134.50 (868) |
| ST400 | 7.38 (187) | 4.73 (120) | 14.12 (359) | 6.75 (171) | 5.75 (146) | 8.06 (205) | 219.00 (1413) |
| STW500 | 14.34 (364) | 6.40 (163) | 20.40 (518) | 12.75 (324) | 8.00 (203) | 12.75 (324) | 536.50 (3462) |
| STW600 | 14.34 (364) | 6.40 (163) | 20.40 (518) | 12.75 (324) | 8.00 (203) | 12.75 (324) | 536.50 (3462) |

W = Maximum width of strainer body
R = Clearance for screen assembly removal

## SERVICE AND MAINTENANCE

Repeated inspection of strainers during system start-up or repairs is essential for optimum benefit. Before opening a strainer or any other component, be sure it is isolated from the system, and all refrigerant is removed (pumped out to zero pressure). The ¾" through 6" strainers have a drain plug in the bottom cover for connecting a drain valve and hose for proper and safe removal of any trapped liquid refrigerant.

**Screen Removal and Cleaning:** Be careful to avoid any refrigerant which may still be in the strainer. For the ½" strainer, slowly remove the hex bottom cap, then remove the screen assembly. For ¾" through 6" strainers, loosen the bottom cover bolts and bottom cover, check for refrigerant presence, and then remove the bolts, cover, and screen assembly. Clean the screen assembly with a good solvent, blow dry, and inspect. If the screen is damaged or sediment cannot be removed from the screen, replace the screen assembly. Carefully align the screen assembly in the center of the strainer body and replace the bottom cover. Pressure test for leaks before returning to service.

## CAUTION

Hansen strainers are for refrigeration systems only. Read these instructions and related safety precautions completely before selecting, using, or servicing these strainers. Only knowledgeable, trained refrigeration mechanics should install, operate, or service these strainers. Stated temperature and pressure limits should not be exceeded. The bottom cover should not be removed from strainers unless the system has been evacuated to zero pressure. See also Safety Precautions in the current List Price Bulletin and the Safety Precautions Sheet supplied with the product. Escaping refrigerant can cause injury, particularly to the eyes and lungs.

## WARRANTY

Hansen strainers and valves are guaranteed against defective materials or workmanship for one year F.O.B. our plant. No consequential damages or field labor is included.

## REPLACEMENT SCREEN KITS

| DESCRIPTION | QTY | PART NO. |
|---|---|---|
| **Screen Kit for ST050** Consists of: | | **78-1001** |
| Screen Assembly | 1 | 78-0005 |
| Bottom Cap Gasket | 1 | 78-0016 |
| **Screen Kit for ST100 (standard)** Consists of: | | **78-1003** |
| Screen Assembly | 1 | 78-0028 |
| Bottom Cover Gasket | 1 | 78-0026 |
| **Screen Kit for ST100 (optional, heavy duty)** Consists of: | | **78-1013** |
| Screen Assembly | 1 | 78-0135 |
| Bottom Cover Gasket | 1 | 78-0026 |
| **Screen Kit for ST200** Consists of: | | **78-1005** |
| Screen Assembly | 1 | 78-0052 |
| Bottom Cover Gasket | 1 | 75-0196 |
| **Screen Kit for ST250** Consists of: | | **78-1006** |
| Screen Assembly | 1 | 78-0040 |
| Bottom Cover Gasket | 1 | 75-0128 |
| **Screen Kit for ST300** Consists of: | | **78-1007** |
| Screen Assembly | 1 | 78-0054 |
| Bottom Cover Gasket | 1 | 75-0128 |
| **Screen Kit for ST400** Consists of: | | **78-1008** |
| Screen Assembly | 1 | 78-0057 |
| Bottom Cover Gasket | 1 | 75-0234 |
| **Screen Kit for STW500 & STW600** | | **78-1009** |
| Screen Assembly | 1 | 78-0071 |
| Bottom Cover O-Ring, Inner | 1 | 75-0605 |
| Bottom Cover O-Ring, Outer | 1 | 75-0606 |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# Refrigerant Strainer

**Type RSW**
**Size: 125mm - 200mm (5" - 8")**
**For Ammonia, R-22, R134a, R404a, R-507**
**and other common Refrigerants**

## Features

- Stainless Steel (60 Mesh) Screen
- Drain Connection for Safe Cleaning
- Ample Screen Area
- Low Pressure Drop
- Desigh Pressure: 27.6 bar (400 psig)

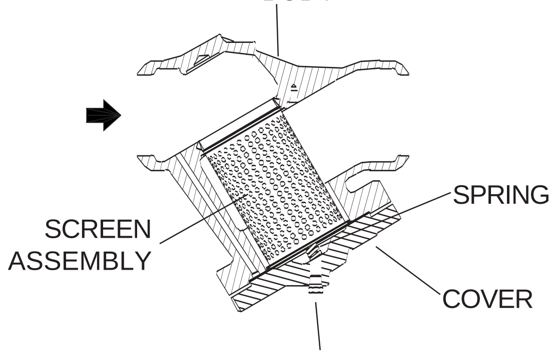



Fig. 1

**Description**
These rugged valve bodies are made of ASTM A352, Grade LCB cast steel and they butt weld directly into the pipe line, with connections suitable for either metric or U. S. pipe sizes. Refrigerant Strainers with stainless steel screen are designed especially for the protection of R/S Control Valves from foreign materials present in refrigeration systems. The fine stainless screen mesh will collect particles as small as six thousands of an inch in diameter. Generous available screen area allows maximum dirt capacity at minimum pressure drop.

**Purpose**
The RSF Refrigerant Strainer collect foreign materials and dirt in a refrigerant system at minimal pressure drop in order to minimize damage to or prevent malfunction of control valves. This, of course, is extremely important upon start-up of a new refrigeration system where dirt, scale, and weld particles may be present in the system and are disturbed and circulated when pressure testing or upon system start-up. Also when an existing system is revised, any settled dirt or foreign matter may be disturbed and circulated throughout the system. It is not safe to omit strainers upstream of the control valves unless there is a certainty that the system will always be clean.

**Bulletin 00-12**
**Type RSW**

**March 2003**
**Installation, Service and Parts Information**

**Service Pointers**
It is very important that the strainer is frequently inspected for dirt and cleaned during system start-up and until no further dirt is found.

Before beginning to loosen cover screws, be sure that the strainer has been pumped out and any entrapped refrigerant liquid is properly removed. Then remove Screen Assembly #2 by removing Strainer Cover #3. The screen assembly should be washed with a good solvent and blown dry. The inside of the Strainer Body #1 should also be cleaned.

After the strainer has been thoroughly inspected and cleaned, insert the screen assembly into the strainer body, making sure that it is properly centered to avoid crushing (and that the Spring #6 is properly located). Lightly oil and place gasket on the valve body and fasten the strainer cover in place. Cover bolts must be tightened evenly to the torque values shown.

**Additional Service Pointers**
Ruptured Screen Assembly: (a) Screen is clogged causing excessive pressure drop to rupture the screen - check and clean more frequently. (b) Fluid velocity too great. Use oversized strainer, or a restricting hand valve to reduce fluid flow.
Collapsed Screen Assembly: (a) Possibly caused by reverse flow through the strainer (avoid reverse flow and never open a hand valve downstream of a strainer before a valve upstream has been opened first). (b) Screen Assembly crushed during installation.
Dirt Passing Through Strainer: (a) Ruptured or collapsed screen assembly. (b) Spring #6 is broken or missing. (c) Fine dirt, less than several thousandths of an inch in size requires more frequent cleaning of the strainer or possible temporary insertion of R/S Filter Bag where applicable.

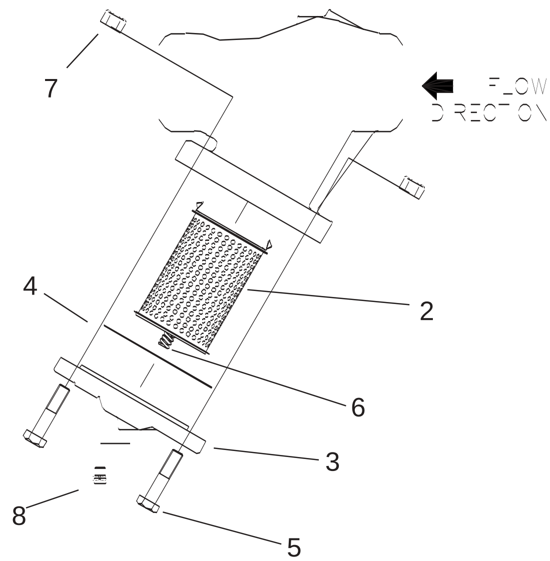
**Safe Operation (See also Bulletin RSBCV)**
People doing any work on a refrigeration system must be qualified and completely familiar with the system and the Refrigerating Specialties Division valves involved, or all other precautions will be meaningless. This includes reading and understanding pertinent Refrigerating Specialties Division

product bulletins and Safety Bulletin RSB prior to installation or servicing work.

Where cold refrigerant liquid lines are used, it is necessary that certain precautions be taken to avoid damage that could result from liquid expansion.  Temperature increase in a piping section full of solid liquid will cause high pressure, due to the expanding liquid that can possibly rupture a gasket, pipe or valve. All hand valves isolating such sections should be marked, warning against accidental closing, and must not be closed until the liquid is removed.  Check valves must never be installed upstream of solenoid valves or regulators with electric shut-off, nor should hand valve upstream of solenoid valves or downstream of check valves be closed until the liquid has been removed.  It is advisable to properly install relief devices in any section where liquid expansion could take place.
Avoid all piping or control arrangements that might produce thermal or pressure shock. For the protection of people and products, all refrigerant must be removed from the section to be worked on before a valve, strainer, or other device is opened or removed.

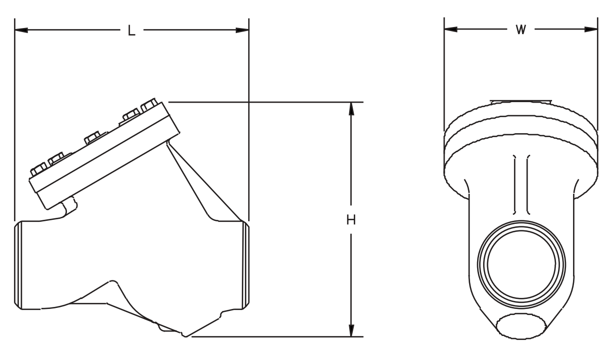
**Installation (see also Bulletin RSBHV)**
Strainer must be installed in a horizontal line with the cover on the bottom. Allow sufficient space below the Strainer Cover #3 (see page 1), to permit the Screen Assembly #2 to be removed for cleaning. If the strainer is insulated make sure the insulation can be easily removed to allow access to the strainer cover. Installation must be done according to all applicable Safety Codes and Standards, and by personnel qualified to install refrigeration systems. Refrigerating Specialties Division control valves and strainers must be installed according to the specific valve's instructions, this bulletin, and generally known safe practices.
ince most maintenance problems caused by dirt occur at the start-up of a system, it is advisable to delay insulating the control valves and strainers until the system has operated for several days. During that time the strainers should be checked for dirt and cleaned as necessary. During installation of strainer remove pipe plug #5 (see page 1) from cover and install a refrigerant drain valve

**Warranty**
All Refrigerating Specialties products are warranted against defects in workmanship and materials for a period of one (1) year from date of shipment from originating factory.  This warranty is in force only when products are properly installed, field assembled, maintained, and operated in use and service as specifically stated in Refrigerating Specialties catalogs or bulletins for normal refrigeration applications, unless otherwise approved in writing by Refrigerating Specialties Division.  Defective products or parts of returned to the factory with transportation charges prepaid and found to be defective by factory inspection will be replaced or repaired at Refrigerating Specialties option, free of charge F.O.B. factory.  Warranty does not cover products that have been altered or repaired in the field, damaged in transit as a result of accidents, misuse, or abuse. Products disabled by dirt or other foreign substances will not be considered defective.
The express warranty above constitutes the only warranty of 8.5 particular purpose. In no event is Refrigerating Specialties responsible for any consequential damages of any nature whatsoever.  No employee, agent, dealer or other person is authorized neither to give any warranties on behalf of Refrigerating Specialties nor to assume for Refrigerating Specialties any other liability in connection with any of it products.




| SPARE PARTS | | | | | |
|---|---|---|---|---|---|
| Item | Description | Qty | 5" | 6" | 8" |
| 2 | Screen Assembly | 1 | | | |
| 3 | Cover | 1 | | | |
| 4 | Gasket | 1 | 303005 | 301703 | 303002 |
| 5 | Bolt | 8 | | | |
| 6 | Spring | 1 | | | |
| 2, 4, 6 | Screen Kit | | 201561 | 201562 | 201563 |
| 7 | Nut | 8 | | | |
| 4, 5, 7 | Bolt Kit | | 201555 | 201556 | 201557 |
| 8 | Plug Package | 12 | 202553 | 202553 | 202553 |

| | LENGTH | HEIGHT | WIDTH |
|---|---|---|---|
| 5" | 381mm 15" | 406 mm 16" | 267 mm 10.5" |
| 6" | 483 mm 19" | 483 mm 19" | 318 mm 12.5" |
| 8" | 622 mm 24.5" | 635 mm 25" | 381 mm 15" |



Parker

# Check Valves (C Series)

Catalog 4130-C
August 2005

# Introduction

Parker C Series Check Valves are designed for uni-directional flow control of fluids and gases in industries such as chemical processing, oil and gas production and transmission, pharmaceutical, pulp and paper, power and utilities.

## Features

- Resilient, custom molded, blow-out resistant seat design
- Back stopped poppet minimizes spring stress
- 100% factory tested for both crack and reseat
- Cracking pressures include: 1/3, 1, 5, 10, 25, 50, 75, and 100 psi.
- Port connections include male and female NPT, CPI™, A-LOK®, UltraSeal, VacuSeal, BSP, SAE and Seal-Lok®
- Heat code traceability

## Materials of Construction

| Item # | Part | Stainless Steel Valve | Brass Valve |
|---|---|---|---|
| 1 | Cap | ASTM A 276, TYPE 316 | ASTM B 16 Alloy C36000 |
| 2 | Seat* | Fluorocarbon Rubber* | |
| **3** | **Poppet** | **ASTM A 479, TYPE 316** | **ASTM B 16 Alloy C36000** |
| **4** | **Spring** | **316 Stainless Steel** | |
| **5** | **Body** | **ASTM A 276, TYPE 316** | **ASTM B 16 Alloy C36000** |

* Optional seat materials are available. See How to Order section. Lubrication: Silicone Paste.

**Note:** PTFE seated valves employ an additional PTFE coated 316 SS gasket between the seat and the body and are distinguishable from elastomeric seated valves by the gap designed between the body and cap.

**See Pressure Rating note on page 4.

## Specifications

### Pressure Rating:**

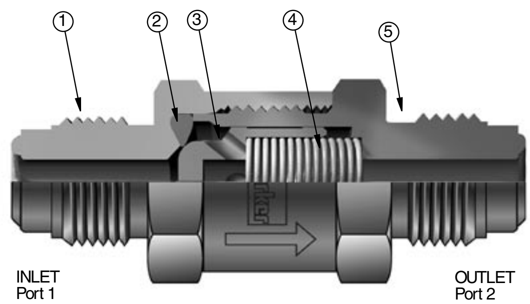
316 SS – 1/8" to 3/4": ....................6000 psig (414 bar) CWP
1": ..................................5000 psig (345 bar) CWP
All sizes with PTFE Seats: .............4000 psig (276 bar) CWP
Brass – 1/8": to 1": .........................3000 psig (207 bar) CWP

### Temperature Rating:

Fluorocarbon Rubber.......-15°F to +400°F (-26°C to +204°C)
Nitrile ..............................-30°F to +275°F (-34°C to +135°C)
Ethylene Propylene Rubber
........................................-70°F to +275°F (-57°C to +135°C)
Neoprene Rubber............-45°F to +250°F (-43°C to +121°C)
PTFE ..............................-65°F to +400°F (-54°C to +204°C)
Highly Fluorinated Fluorocarbon Rubber
..........................................-15°F to +200°F (-26°C to +93°C)

**Orifice:**......................... .078" to .656" (2.0 mm to 16.7 mm)

**$C_v$:** ...................................................................... .18 to 6.56




Model Shown: **4V-C4L-5-SS**

## Flow Calculations with 1000 psig (69 bar) Inlet Pressure

| Valve Series | Maximum $C_v$ | Pressure Drop ΔP | | Water @ 60°F (16°C) | | Air @ 60°F (16°C) | |
|---|---|---|---|---|---|---|---|
| | | psig | bar | gpm | m³/hr | scfm | m³/hr |
| C2 | 0.31 | 10 | 0.7 | 1.0 | 0.2 | 30.8 | 52.1 |
| | | 50 | 3.4 | 2.2 | 0.5 | 67.2 | 112.8 |
| | | 100 | 6.9 | 3.1 | 0.7 | 92.0 | 155.3 |
| C4 | 0.75 | 10 | 0.7 | 2.4 | 0.5 | 74.6 | 126.1 |
| | | 50 | 3.4 | 5.3 | 1.2 | 162.7 | 273.0 |
| | | 100 | 6.9 | 7.5 | 1.7 | 222.8 | 376.2 |
| C6 | 2.26 | 10 | 0.7 | 7.1 | 1.6 | 225.3 | 380.9 |
| | | 50 | 3.4 | 16.0 | 3.6 | 495.2 | 831.0 |
| | | 100 | 6.9 | 22.6 | 5.1 | 685.1 | 1157.2 |
| C8 | 3.53 | 10 | 0.7 | 11.2 | 2.5 | 352.0 | 595.0 |
| | | 50 | 3.4 | 25.0 | 5.6 | 774.3 | 1299.4 |
| | | 100 | 6.9 | 35.3 | 8.0 | 1072.4 | 1811.6 |
| C12 | 6.01 | 10 | 0.7 | 19.0 | 4.3 | 596.6 | 1008.3 |
| | | 50 | 3.4 | 42.5 | 9.6 | 1287.5 | 2160.4 |
| | | 100 | 6.9 | 60.1 | 13.7 | 1738.5 | 2934.5 |
| C16 | 6.56 | 10 | 0.7 | 20.7 | 4.7 | 648.9 | 1096.6 |
| | | 50 | 3.4 | 46.4 | 10.5 | 1379.4 | 2314.7 |
| | | 100 | 6.9 | 65.6 | 14.9 | 1824.4 | 3077.6 |

## Available End Connections

**A** -Two ferrule A-LOK® compression port

**M** -ANSI/ASME B1.20.1 External pipe threads

**TA** -Tube adapter connection

**L** -SAE J1453, Fitting – O-ring face seal – External thread with O-ring groove designed to seal with an elastomer against a sleeve

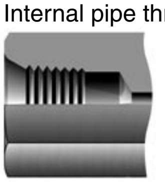
**Z** -Single ferrule CPI™ compression port

**Q** -UltraSeal face seal port

**F5** -SAE J1926/2, Part 2: Heavy-duty (S Series) stud ends

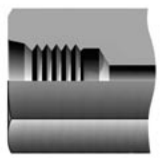
**KF** -British Standard BS 21 (ISO 7-1), Internal pipe threads

**F** -ANSI/ASME B1.20.1 Internal pipe threads



**V** -VacuSeal face seal port

**G5** -SAE J1926/1, Part 1: Threaded port with O-ring seal in truncated housing



**KM** -British Standard BS 21 (ISO 7-1), External pipe threads

## Kit Information

To order repair kits for the C Series Check Valves simply fill in the designators from the chart below.

| Size | Crack Pressure | Seat Material |
|---|---|---|
| C2 | 1/3 | V - Fluorocarbon Rubber |
| C4 | 1 | BN - Nitrile |
| C6 | 5 | EPR - Ethylene Propylene Rubber |
| C8 | 10 | NE - Neoprene Rubber |
| C12 | 25 | T - PTFE |
| C16 | 50 | KZ - Highly Fluorinated Fluorocarbon |
| | 75 | |
| | 100 | |

**Examples:** **KIT-C8-10-V**
**KIT-C16-100-BN**


**Check Valve Kits Contain:**
Seat
Spring
Instructions

### ⚠ WARNING

FAILURE, IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

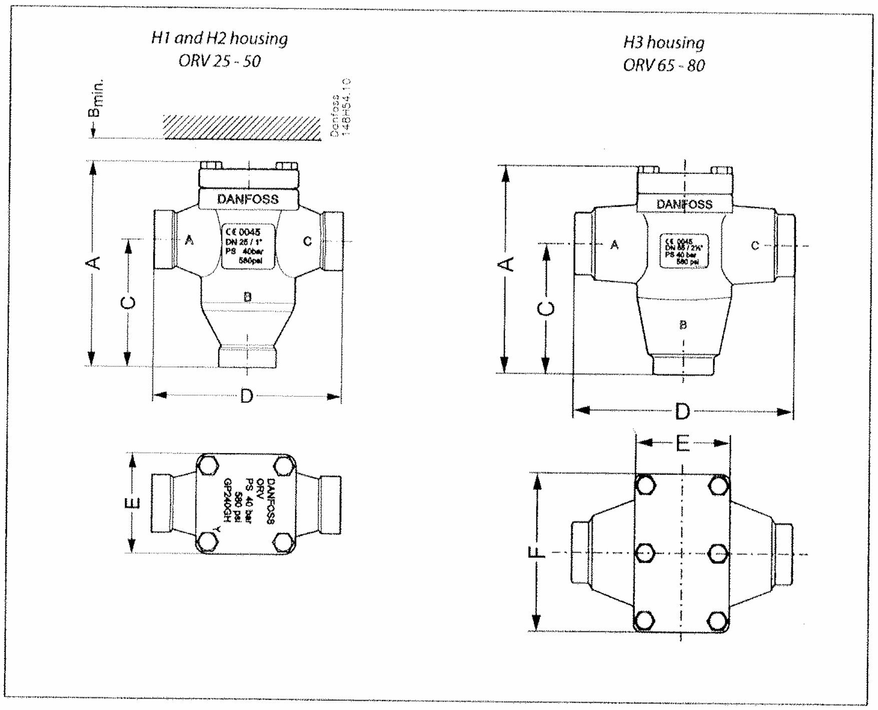
The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

### Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the “Offer of Sale” located in Catalog 4110-U Needle Valves (U Series).

| | | | |
|---|---|---|---|
| 5555 S. Packard Ave.<br>Cudahy, WI 53110 | Drawn By: JDA | Date: 6-14-04 | **3214 R0** |
| | Redrawn By: | Approved By: RPK | |

# DANFOSS REGULATING/MIXING VALVES




**NOTE:**
PORT A IS FOR THE OUTLET
PORT B IS FOR THE HOT INLET
PORT C IS FOR THE COLD INLET

| Valve size | Valve size | | A | $B_{MIN}$ | C | D | E | F | Weight |
|---|---|---|---|---|---|---|---|---|---|
| H1 housing | ORV 25-40 | mm | 178 | 75 | 110 | 165 | 87 | - | 4.5 kg |
| | (1-1½) | in. | 7.00 | 3.00 | 4.33 | 6.50 | 3.43 | - | 10 lb |
| H2 housing | ORV 40-50 | mm | 215 | 80 | 138 | 196 | 110 | - | 9.0 kg |
| | (1½-2) | in. | 8.46 | 3.15 | 5.43 | 7.72 | 4.33 | - | 20 lb |
| H3 housing | ORV 65-80 | mm | 252 | 80 | 155 | 266 | 115 | 190 | 18 kg |
| | (2½-3) | in. | 9.92 | 3.15 | 6.10 | 10.47 | 4.53 | 7.48 | 40 lb |

| VILTER PART NO. | BODY HOUSING TYPE | OIL FLOW (GPM) | | NOMINAL PIPE DIAMETER | NO OF THERMOSTATIC ELEMENTS | VALVE TYPE | DANFOSS CODE NO. |
|---|---|---|---|---|---|---|---|
| | | 2 PSID | 7PSID | | | | |
| 3214A | H1 | 20 | 40 | 1” SW | 1 | ORV 25 SOC H1 49°C/120°F | 148H3229 |
| 3214B | H2 | 42 | 71 | 1-1/2” SW | 1 | ORV 40 SOC H2 49°C/120°F | 148H3232 |
| 3214C | H2 | 44 | 83 | 2” SW | 1 | ORV 50 SOC H2 49°C/120°F | 148H3235 |
| 3214D | H3 | 80 | 150 | 2-1/2” BW | 2 | ORV 65 A H3 49°C/120°F | 148H3237 |

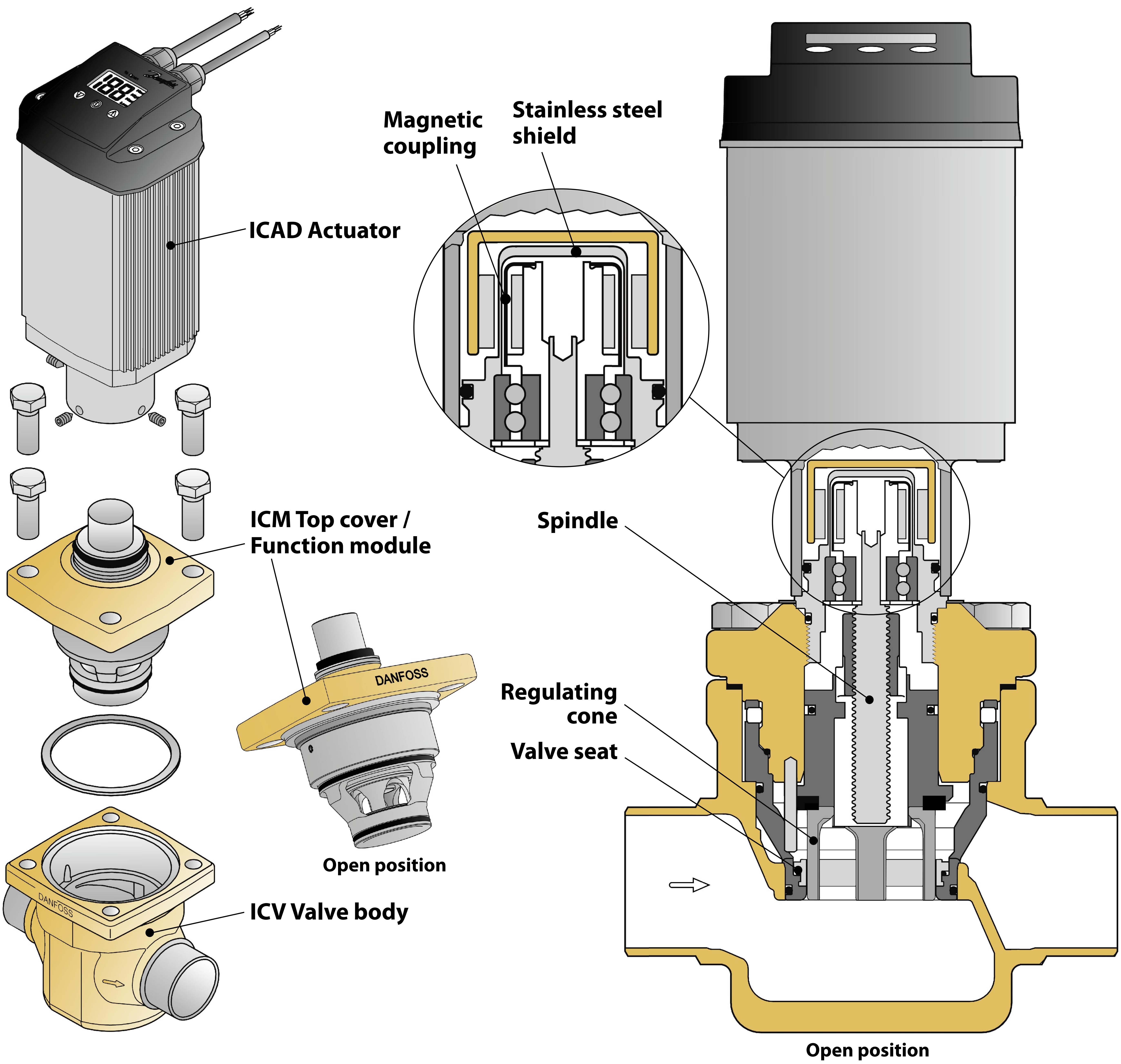
**SPARE/REPLACEMENT**
**THERMOSTAT 49°C/120°F AND GASKET + GUIDE RING**

| SPARE PARTS FOR | CODE NO. | VILTER PART NO. |
|---|---|---|
| ORV 25 AND ORV 40 H1 | 148H3243 | 3214X |
| ORV 40 AND ORV 50 H2 | 148H3244 | 3214Y |
| ORV 65 AND ORV 80 H3 | 148H3245 | 3214Z |

NOTES:
-FLAMMABLE HYDROCARBONS ARE NOT RECOMMENDED.
-CAN BE MOUNTED IN ANY DIRECTION
-DESIGNED FOR MAX WORKING PRESSURE 580 PSIG
-STAINLESS STEEL NICKEL PLATED THERMOSTATIC ELEMENT

Revisions

# ICM Motor Operated Valve with ICAD Actuator






DKRCI.PV.HT0.A1.02 / 520H0566, 06-2005

Refrigeration Note
Sales Info


# ICM valves used in $CO_2$ applications

## Introduction

***ICM used in $CO_2$ low temperature liquid lines***
Since release of the ICM in September 2004, we have experienced some technical problems in the above mentioned $CO_2$ applications.

Even though the problems only have occured with ICM used in $CO_2$ liquid lines with phase change (ICM with type -A cone*), Danfoss has decided to offer a special ICM dedicated for use in ***all*** $CO_2$ applications in general.

The dedicated ICM $CO_2$ solution is designed to regulate $CO_2$ expansion process in liquid lines with or without phase change or control pressure/temperature in dry and wet suction lines and hot gas lines.

The ICM $CO_2$ solution is only available as ICM function modules. I.e not complete ICM $CO_2$ valves.

The ICM designations with type -A and type -B remain the same as for the standard function modules**.


## Product class and stat. no

| **Proudct class** | **Stat. no.** |
|---|---|
| 530 | 01042 |

## Code numbers

| Description | Code No. |
|---|---|
| ICM 20-A $CO_2$ Module | **027H1183** |
| ICM 20-B $CO_2$ Module | **027H1184** |
| ICM 20-C $CO_2$ Module | **027H1185** |
| ICM 25-A $CO_2$ Module | **027H2183** |
| ICM 25-B $CO_2$ Module | **027H2184** |
| ICM 32-A $CO_2$ Module | **027H3183** |
| ICM 32-B $CO_2$ Module | **027H3184** |
| ICM 40-A $CO_2$ Module | **027H4183** |
| ICM 40-B $CO_2$ Module | **027H4184** |
| ICM 50-A $CO_2$ Module | **027H5183** |
| ICM 50-B $CO_2$ Module | **027H5184** |
| ICM 65-B $CO_2$ Module | **027H6184** |

## Delivery

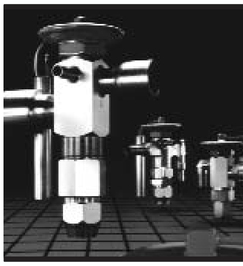
Danfoss can receive orders from week 5, 2007.
The lead time is 2 weeks

For further information please contact:
Kurt M. Sand
*Global Product Manager*
Phone: +45 8738 9625
E-mail: KMS.DKACD@Danfoss.com

* For ICM 20, both types, -A,-B and -C cones.

** *ICM 25-65*
-A: Liquid lines with phase change / expansion
-B: Control of pressure or temperature in dry and wet suction lines and hot gas lines.

*ICM 20*
-A, -B, -C : Liquid lines with phase change / expansion and control of pressure or temperature in dry and wet suction lines and hot gas lines.



# Thermostatic Expansion Valves

## Installation, Field Service, and Assembly

## Table of Contents

### Installation



## Installation

For peak performance, it is important to select a Sporlan Thermostatic Expansion Valve (TEV) with correct capacity, selective charge, external or internal equalizer, etc. See Bulletins 10-9 and 10-10 for complete application information. Equally important is the proper installation, which can determine the success or failure of the entire system.

### Valve Location

TEVs may be mounted in any position, but they should be installed as close to the evaporator as possible. If a refrigerant distributor is used with the expansion valve, best performance is obtained if the distributor is mounted directly to the valve outlet. If the distributor cannot be mounted directly to the valve outlet, the distance between the valve outlet and distributor should not exceed 24 inches or refrigerant distribution problems may occur. Also, the tube connecting the valve outlet and distributor can be sized smaller to maintain refrigerant velocity and better distribution. Elbows located between the expansion valve and distributor will hinder proper distribution and therefore, are not recommended.

Best distribution is usually obtained if the expansion valve feeds vertically up or down into the distributor. System manufacturers, however, have successfully applied distributors in other orientations. See Bulletin 20-10 for application and selection information on refrigerant distributors.

While not always convenient or possible, valve Types BI, F, FB, and O are easier to service if mounted in a vertical and upright position. If mounted in a horizontal position, the internal parts must be carefully reassembled to prevent damage to them. Also, some consideration should be taken in mounting larger sized expansion valves. They must be adequately supported since system vibration and the weight of the valve may cause valve connections to fracture.

If a hand valve is located on the outlet side of the TEV it should have a full sized port. No restrictions should appear between the TEV and the evaporator, except a refrigerant distributor if one is used.

Sporlan TEVs having Selective Charges C, Z, L, or X may be installed and operated in most locations. The amount of thermostatic charge and the bulb size are such that the bulb retains control despite a colder valve body or diaphragm case. The exception is when the element is subjected to sub-zero temperatures for extended periods of time during an off-cycle. In this case, start-up may be prolonged until the bulb and element are warmed sufficiently to open the valve.

To minimize the possibility of charge migration, the Sporlan MOP type charges (CP series, ZP series, and VGA) should be installed so the diaphragm case is warmer than the bulb. Special non-condensable charges without MOP and double diaphragm hydraulic elements with MOP are available for system manufacturers to overcome this potential problem.

Occasionally, TEVs are located in corrosive atmospheric conditions that can damage the valve and/or the element assembly. Due to this possibility, the valve must be protected with appropriate materials to prevent premature failure. Consult specialists in protective coatings.

**Precautions:**

**When the evaporator and TEV are located above the receiver**, there is a static pressure loss in the liquid line. This is due to the weight of the column of liquid refrigerant, and this weight may be interpreted in terms of pressure loss in pounds per square inch as shown in Table 3, Bulletin 10-9. If the vertical lift is great enough, vapor or ***flash gas*** will form in the liquid line causing a serious reduction in the capacity of the TEV.

When an appreciable vertical lift is unavoidable, precautions should be taken to prevent the accompanying pressure loss from producing liquid line vapor. This can be accomplished by providing enough subcooling to the liquid refrigerant, either in the condenser or after the liquid leaves the receiver. Subcooling is determined by subtracting the actual liquid temperature from the condensing temperature (corresponding to the condensing pressure). A subcooling calculation example is provided in the "subcooling" section of Bulletin 10-9.


Bulletin 10-11, October 2003 Supersedes Bulletin 10-11, September 1996 and all prior publications.

***Liquid subcooling is provided by the following methods:***

1. ***In the condenser***
2. ***Suction – liquid heat exchanger***
3. ***Special devices***

**Method 1** – will provide sufficient subcooling for the simple short-coupled system that has only moderate liquid line pressure drop.

**Method 2** – will usually not provide more than 20°F subcooling on air conditioning systems operating at normal head pressures. The amount of subcooling will depend on the design and size of the heat exchanger and on the operating suction and discharge pressures.

**Method 3** – may be used to provide considerable subcooling required for systems with excessive vertical lift. The following special devices are the most commonly used methods:

- Water coils in heat exchange relationship with the liquid line.
- Separate refrigeration system.
- Special heat exchanger which uses a portion of the refrigerant to cool the main body of liquid. See Figure 1.

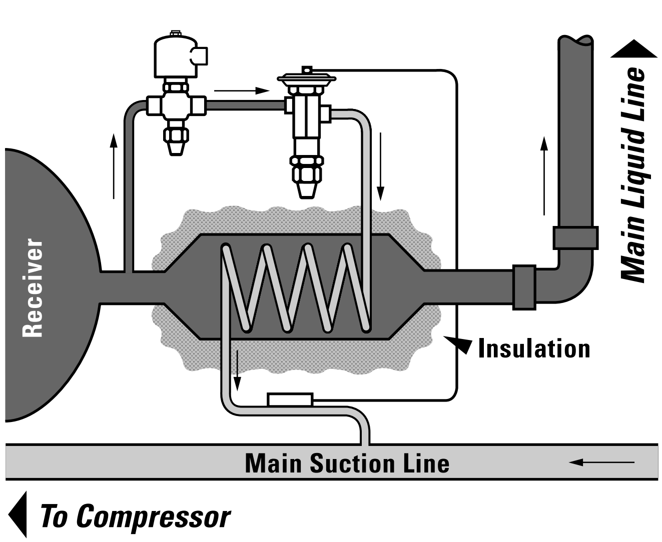



**Figure 1**

Ordinarily the conventional suction-liquid heat exchanger is installed near the evaporator, where the suction vapor is the coldest, to re-condense any vapor in the liquid line. When the primary purpose of the heat exchanger is to prevent the formation of flash gas – particularly on systems that have a long liquid line or excessive vertical lift – install the heat exchanger near the receiver ***before the vertical lift occurs***. (This also applies to the special devices described in Method 3). Because vapor in the liquid line considerably increases friction losses, the total pressure drop available across the expansion device on these types of systems is reduced. Also, the suction line and liquid line should be carefully insulated to minimize heat gain if subcooled below ambient temperature.

**Important**
Preventing the formation of vapor in liquid lines having high pressure losses does not eliminate the requirement that an adequate pressure drop must be available across the TEV. The capacity tables show valve capacities at pressure drops lower than normal. For TEV application data and capacities at pressure drops below those listed, ***consult Sporlan Valve Company***.

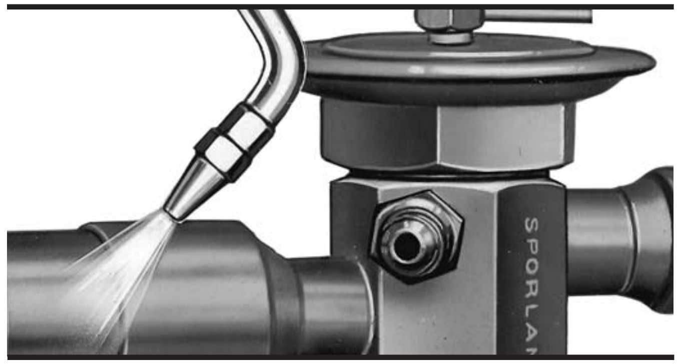



**Figure 2**

## *Solder Techniques*

It is not necessary to disassemble solder type valves when soldering to the connecting lines. Any of the commonly used types of solders, e.g., 95-5, Sil-Fos, Easy-Flo, Phos-Copper, Stay Brite 8 or equivalents may be used for copper to copper connections. When soldering a brass refrigerant distributor to the valve, appropriate solders for these connections, such as 95-5, Easy-Flo, Stay Brite 8 or equivalents must be used. It is important however, regardless of the solder used, to direct the flame away from the valve body and avoid excessive heat on the diaphragm, Figure 2. As an extra precaution, a wet cloth may be wrapped around the body and element during the soldering operation.

This precaution will prevent overheating the valve body which could damage the superheat spring and result in flood back problems. In addition, the Type O, EBF/SBF, and EBS valve contain synthetic parts which can be damaged due to overheating, resulting in poor valve performance.

## *Bulb Location and Installation*

The location and installation of the bulb is extremely important to the proper performance of the system and care should be taken with its final location.

Accepted principles of good suction line piping should be followed to provide a bulb location that will give the best possible valve control. When system manufacturers have piping recommendations that differ from the general industry recommendations and Sporlan's suggestions shown in this section, those recommendations should be used. When specific recommendations are not available, the suggestions below should be used.

The bulb should be attached to a horizontal suction line at the evaporator outlet (See Figures 3, 4, and 5) If the bulb cannot be located in that manner, it may be located on a ***descending*** vertical line only (as shown in Figure 5 for "pumpdown control"). The bulb should never be located in a trap or downstream of a trap in the suction line. Liquid refrigerant or mixture of liquid refrigerant and oil boiling out of the trap will falsely influence the temperature of the bulb and result in poor valve control.

On suction lines 7/8" OD and larger, the surface temperature may vary slightly around the circumference of the line. On these lines, it is generally recommended that the bulb be installed at 4 or 8 o'clock on the side of the horizontal line, and parallel with respect to the direction of flow. On smaller lines the bulb may be mounted at any point around the circumference, however locating the bulb on the bottom of the line is not recommended as an oil-refrigerant mixture is generally present at that point. Certain conditions peculiar to a particular system may require a different bulb location than normally

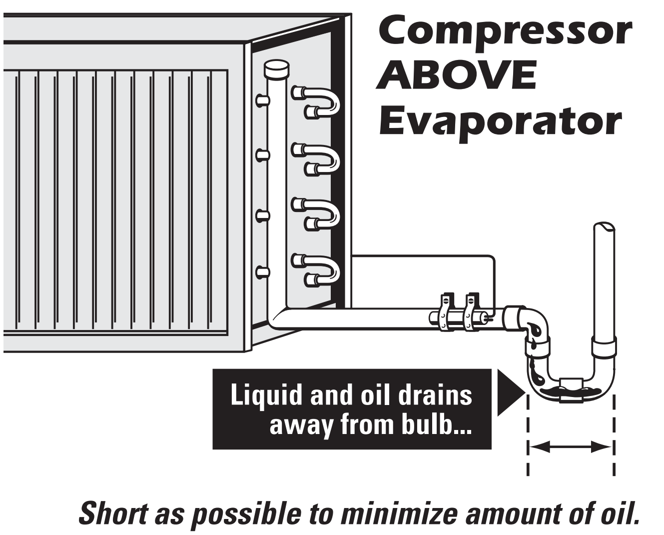



**Figure 3**

recommended. In these cases the proper bulb location may be determined by trial.

For satisfactory expansion valve control, ***good thermal contact*** between the bulb and suction line is essential. The bulb should be securely fastened with two bulb straps, supplied with each expansion valve, to a clean straight section of the suction line.

Recommended suction line piping usually includes a horizontal line leaving the evaporator to which the TEV bulb is attached. This line is pitched slightly downward, and when a vertical riser follows, a short trap is placed immediately ahead of the vertical line, see Figure 3. The trap will collect any liquid refrigerant or oil passing through the suction line and prevent it from influencing the bulb temperature.

**On multiple evaporator installations** the piping should be arranged so that the flow from any valve cannot affect the bulb of another. Approved piping practices including the proper use of traps

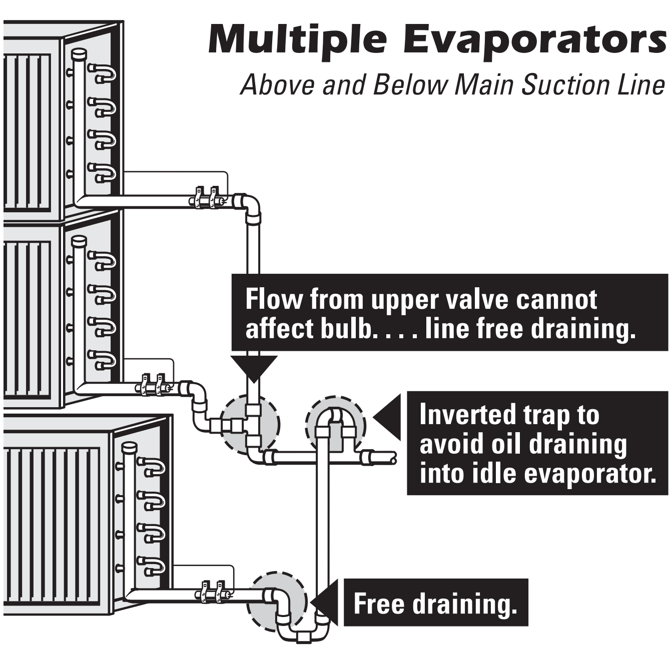



**Figure 4**

insures individual control for each valve without the influence of refrigerant and oil flow from other evaporators.

For recommended suction line piping when the compressor is located below the evaporator see Figure 5. The vertical riser extending to the height of the evaporator prevents refrigerant from draining by gravity into the compressor during the off-cycle. When a pumpdown control is used the suction line may turn immediately down without a trap.

**On commercial and low temperature applications** requiring Sporlan Selective Charges C, Z, or X the bulb should be clamped on the suction line at a point where the bulb temperature will be the same as the evaporator temperature during the off-cycle. This will insure tight closing of the valve when the compressor stops. If bulb insulation is used on lines operating below 32°F, use non-water absorbing insulation to prevent water from freezing around the bulb.

On brine tanks and water coolers, the bulb should be below the liquid surface where it will be at the same temperature as the evaporator during the off-cycle. When locating the bulb in a brine tank, paint it and the capillary tubing with pitch or other corrosion resistant paint.

If, for practical reasons, the bulb must be located where its temperature will be higher than the evaporator during the off-cycle, a solenoid valve must be used ahead of the TEV.

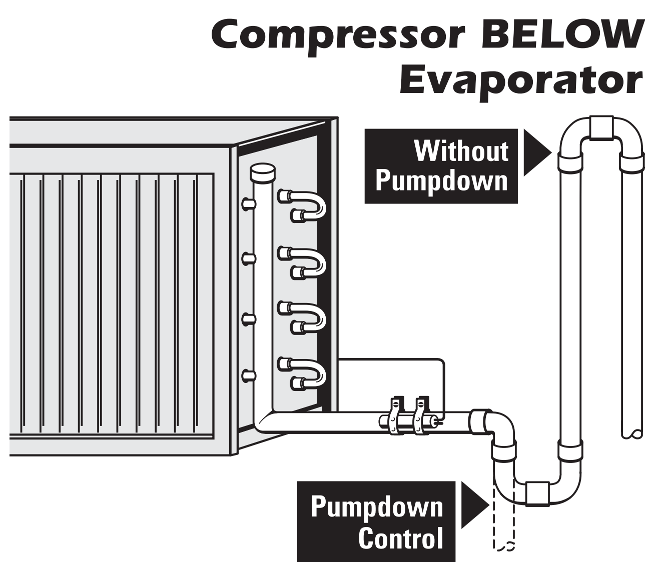



**Figure 5**

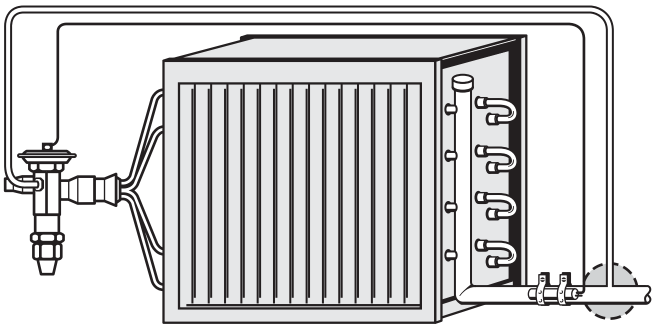
**On air conditioning applications** having TEVs equipped with VCP100 or VGA elements, the bulb may be located inside or outside the cooled space or duct. The valve body should not be located in the air stream leaving the evaporator. Avoid locating the bulb in the return air stream unless it is well insulated.

## External Equalizer Connection

For a complete explanation of when an externally equalized valve should be used, refer to "equalization method," Bulletin 10-9. Valves supplied with an external equalizer ***will not operate*** unless this connection is made.

The equalizer connection should be made at a point that will most accurately reflect the pressure existing in the suction line at the bulb location. See Figure 6. Generally, the connection is immediately downstream of the bulb. However, equipment manufacturers sometimes locate them in return bends or suction headers that are

## External Equalizer Connection



***It must be connected - NEVER CAPPED!***
***Must be free of crimps, solder, etc.***

**Figure 6**

compatible with their specific design requirements. The difference between the pressure at the equalizer connection and the suction pressure at the bulb location should not exceed reasonable pressure drop values. The values shown in Table 1 of Bulletin 10-9 can be used as a guide in determining the value.

If any evaporator pressure or temperature control valves are located in the suction line at or near the evaporator outlet, the equalizer must be connected on the evaporator side of these valves.

## Driers, Strainers, and Accessories

Most Sporlan TEVs are equipped with built-in screens of varying mesh sizes depending on the valve size and type. These strainers are effective only in removing particles of scale, solder, etc. which could obstruct the closure of the pin and seat.

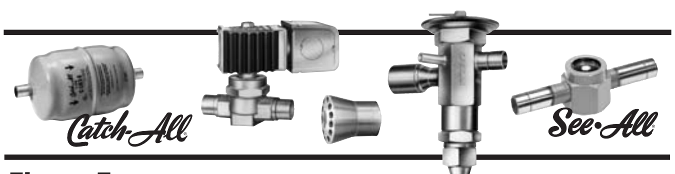



**Figure 7**

Moisture and smaller particles of foreign materials are equally harmful to the system and must be removed for peak system performance. Field experience has proven that, without a doubt, most expansion valve failures are due to the presence of dirt, sludge, and moisture in the system. Furthermore, the performance and life of other system components are also seriously affected by these foreign materials. The Sporlan **Catch-All Filter-Drier®** removes dirt, moisture, acids, and sludge, and insures the circulation of clean, dry refrigerant through the system at all times.

For all refrigeration and air conditioning applications we recommend that a Sporlan Catch-All Filter-Drier be installed in the liquid line ahead of the TEV. See Bulletin 40-10 for complete Catch-All Filter-Drier specifications.

Further system protection is easily and inexpensively provided with the installation of a Sporlan **See-All®**. The See-All is a combination liquid and moisture indicator that visually indicates if there is a shortage of refrigerant in the liquid line, or if the moisture content of the refrigerant is at a dangerous level. See Bulletin 70-10 for complete See-All specifications.

## Test Pressures and Dehydration Temperatures

**Inert dry gases such as nitrogen, helium or $CO_2$ are often used for leak detection**.

**CAUTION: Inert gases must be added to the system carefully through a pressure regulator. Unregulated gas pressure can seriously damage the system and endanger human life. Never use oxygen or explosive gases.**

Excessive test pressures can shorten the life of the TEV diaphragm. Table 1 lists the maximum pressure that can safely be applied with the expansion valve connected to the evaporator. These maximum pressures are well above the minimum field leak test pressures for low sides, listed by the ANSI/ASHRAE Standard 15-2001 or latest revision.

The external equalizer line should be disconnected if there is any possibility of exceeding the recommended maximum pressures listed below.

If elevated temperatures are used to assist in dehydrating the system, the TEV should not be exposed to temperatures exceeding those shown in Table 2.

Table 2 refers to the maximum dehydration temperatures when the bulb and valve body are subjected to the same temperature. On L, C, Z, and X charges, 250°F maximum valve body temperature is permissible ***if the bulb temperature*** does not exceed those shown in the table.

**Table 1**
**Maximum Low Side Test Pressures**

| Valve Type | psig |
|---|---|
| (B)I, X, NI, F, FB, (E)BF/SBF, RI, G, EG, C, S, EBS, Small O | 450 |
| D, P, H, Large O | 425 |
| A, M, V, W | 400 |

**Table 2**
**Maximum Dehydration Temperatures – Degrees F**

| Refrigerant | Thermostatic Charge | | | | | |
|---|---|---|---|---|---|---|
| | L | C | Z | X | VGA | P Type, ZP Series |
| 12, 134a | 190 | 190 | 250 | | --- | |
| 22 | 160 | 160 | 185 | 210 | 250 | 250 |
| 404A, 502, 507 | 150 | 150 | 170 | | --- | |
| 717 (Ammonia) | 150 | 190 | 235 | --- | --- | --- |

## Expansion Valve Adjustment

Each Sporlan TEV is thoroughly tested and set at the factory before shipment. This factory superheat setting will be correct and no further adjustment is required for the majority of applications. However, there are many factors which can affect the performance of a TEV. These factors are independently variable and all of them cannot be compensated for in the design of a valve. When the application or operating conditions require a different valve setting due to one or more of the factors listed below, the valve may be adjusted to obtain the required operating superheat. Therefore, an adjusting stem is provided on all standard valves. The valve should be set with the system as near as possible to design conditions.

Factors which affect valve performance and may make it necessary to adjust the valve are:

1. Low temperature difference (TDs) between the refrigerant and the air
2. TEV bulb location
3. Balance between compressor and evaporator
4. Ratio of load to TEV capacity
5. Condenser capacity
6. Operation of several fixtures on multiple installation
7. Seasonal variation in head pressure caused by extreme changes in ambient air temperature.

**Note:** Valve Types F, (E)BF/SBF, Q, A, M, V, K, and W have non-rising adjusting stems and a change in adjustment does not change the stem position.

When setting valves on multi-evaporator refrigeration systems with pressure or temperature sensitive evaporator control valves, the following procedure is recommended:

1. Evaporator Pressure Regulating Valve (ORI Type): the ORI valve is set first at the minimum load condition. Then, if necessary, the expansion valve is adjusted to the desired superheat setting while under the normal operating load condition.
2. Temperature Sensitive Evaporator Regulating Valves (CDS Type): The CDS valve is forced into a fully open position first. Then the expansion valve is adjusted to the desired superheat setting at full load condition. Finally, the controller for the CDS is set to the desired temperature. Contact Sporlan Valve Company, or the case manufacturer, for additional details on setting the CDS controller.

When the adjustment is completed on the TEV, always tighten the adjusting stem packing nut and replace the seal cap tightly.

Many expansion valves are made ***non-adjustable*** for use on Original Equipment Manufacturer's units, particularly those valves used on residential air conditioning and heat pump systems. These valves are set at a superheat predetermined by the manufacturer's laboratory tests and cannot be adjusted in the field.

Some ***non-adjustable*** models are modifications of standard adjustable type valves. This is done by using a solid bottom cap instead of one equipped with an adjusting stem and seal cap. These valves can be identified by an **N** preceding the standard valve designation. Adjustable bottom cap assemblies are available for converting most non-adjustable valves to the adjustable type. However, this is rarely required. If symptoms indicate that a valve adjustment is needed, carefully check the other possible causes of incorrect superheat, pages 6 through 10, before attempting an adjustment.

## How to Determine Superheat Correctly

1. Measure the temperature of the suction line at the bulb location.
2. Obtain the suction pressure that exists in the suction line at the bulb location by **either** of the following methods:
   a. If the valve is externally equalized, a gauge in the external equalizer line will indicate the desired pressure directly and accurately.
   b. Read the gauge pressure at the suction valve of the compressor. To the pressure add the estimated pressure drop through the suction line between bulb location and compressor suction valve. The sum of the gauge reading and the estimated pressure drop will equal the approximate suction line pressure at the bulb.
3. Convert the pressure obtained in **2a** or **2b** above to saturated evaporator temperature by using a temperature-pressure chart.
4. Subtract the two temperatures obtained in **1** and **3** – the difference is superheat.

Figure 8 illustrates a typical example of superheat measurement on an air conditioning system using Refrigerant 22. The temperature of the suction line at the bulb location is read at 52°F. The suction pressure at the compressor is 66 psig and the estimated suction line pressure drop is 2 psi …66 psig + 2 psig = 68 psig at the bulb, which is equivalent to a 40°F saturation temperature. (Use dew point temperature for refrigerant blends.) 40°F subtracted from 52°F = 12°F superheat.

**Note:** Refrigerated case manufacturers frequently use a "temperature difference" method to approximate superheat. This procedure consists of measuring the temperature of a location on the evaporator which is representative of saturated vapor temperature; and, then subtracting that temperature from the outlet evaporator temperature which is measured at the bulb location.

While this method of reading "superheat" is acceptable on those manufacturer's cases where the pressure drop through the evaporator is low, Sporlan does not recommend the "temperature difference" method for other types of systems.

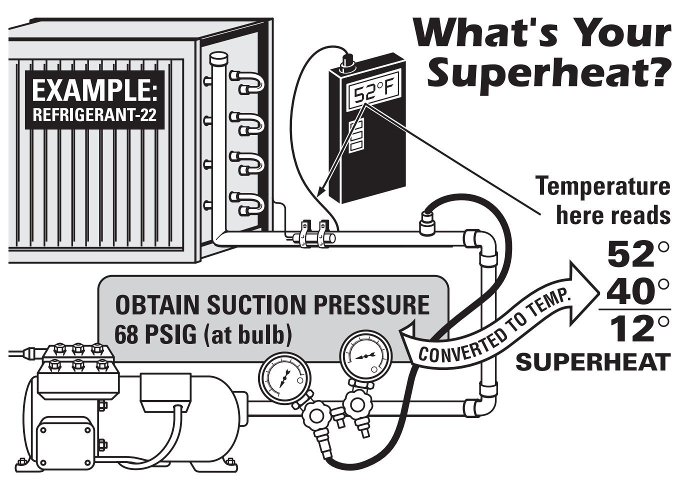



**Figure 8**

## How to Change the Superheat Setting

***Note: There are some valve bodies (G, EG, C, S, EBS and EMC) that have a packing nut around the adjustment stem. It may be necessary to loosen the packing nut slightly to turn the adjusting stem. Do not forget to retighten the nut after the superheat is set.***

To reduce the superheat, turn the adjusting stem **counter-clockwise**. To increase the superheat, turn the adjusting stem **clockwise**. When adjusting the valve, make no more than one turn of the stem at a time and observe the change in superheat closely to prevent ***over-shooting*** the desired setting. As much as 30 minutes may be required for the new balance to take place after an adjustment is made.

If in doubt about the correct superheat setting for a particular system, consult the equipment manufacturer. As a general rule, the proper superheat setting will depend on the amount of temperature difference **(TD)** between refrigerant temperature and the temperature of the air or other substance being cooled. Where high **TD's** exist, such as on air conditioning applications, the superheat setting can be made as high as 15°F without noticeable loss in evaporator capacity. Where low **TD's** exist, such as in low temperature blower coil applications, a superheat setting of 10°F or below is usually recommended for maximum evaporator capacity. It is these applications that the TEV will more than likely need to be adjusted.

For the correct valve setting on factory built equipment, manufacturers' recommendations should be followed. Some manufacturers specify the superheat directly; others may recommend valve adjustment to a given suction pressure at certain operating conditions, or until a certain frost line is observed. Such recommendations, however they are stated, represent the results of extensive laboratory testing to determine the best possible operation.

# ■ Field Servicing

The TEV is erroneously considered by some to be a mysterious and complex device. As a result, many valves are needlessly replaced when the cause of the system malfunction is not immediately recognized.

Actually the TEV performs only one very simple function – **it keeps the evaporator supplied with enough refrigerant to satisfy all load conditions**. It is not a temperature control, suction pressure control, a control to vary the compressor's running time, or a humidity control.

How effective the valve performs is easily determined by measuring the superheat as outlined in Figure 8. Observing the frost on the suction line, or considering only the suction pressure may be misleading. **Checking the superheat is the first step in a simple and systematic analysis of TEV performance.**

- **If not enough refrigerant is being fed to the evaporator— the superheat will be high.**
- **If too much refrigerant is being fed to the evaporator — the superheat will be low.**

Although these symptoms may be attributed to improper TEV control, more frequently the origin of the trouble lies elsewhere.

**Note:** TEVs with permanent bleed ports **(BP)** or Rapid Pressure Balancer **(RPB)** construction are applied on many air conditioning and refrigeration systems by original equipment manufacturers. Each application is tested and approved by the manufacturer. The primary function of these devices is to equalize high-to-low side pressures during the off cycle on systems equipped with low starting torque compressors.

However, some BP type valves are applied to allow small amounts of liquid refrigerant to pass for compressor motor cooling. The specific function of the feature on a given unit must be determined from the system manufacturer. Once that is determined, it is easier to troubleshoot the system.

The primary cause of difficulty with either the BP or RPB feature is dirt and other foreign materials that restrict or plug them. And if the system purpose intended for either feature is not being satisfied, the valve probably needs cleaning or replacing.

As stated in Bulletin 10-9, the RPB type valve is not to be applied on systems using high starting torque compressors or "hard-start" electrical components, on outdoor coils of heat pumps, or on any refrigeration system, and it should ***not*** be used to replace BP type valves that are applied on those types of systems. On systems other than those described above, the RPB type valve can replace the BP type valve when necessary. Usually it is advisable to replace a valve with one of the same specification unless advised differently. Consult with the system manufacturer for assistance.

## Complaint "A"

***"Valve does not feed enough refrigerant."***

***SYMPTOMS:***

- ***Load temperature (air or water leaving evaporator) too high.***
- ***Superheat too high.***
- ***Suction pressure lower than normal with compressor unloaders locked out or hot gas bypass shut off.****

**THE CAUSE MAY BE:**

1. ***Moisture*** — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation. This is a common source of trouble on expansion valves. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is frozen in the intermediate position so that flow is restricted, the superheat will be high.

   **Remedy** — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

   To determine a safe level of moisture in the system, install a Sporlan See•All Moisture and Liquid Indicator. See Bulletin 70-10.

   **Excessive moisture has a damaging effect on all system components regardless of the evaporating temperature. Moisture must be removed for trouble-free performance.**

2. ***Dirt or foreign material*** — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. will restrict the flow of refrigerant when it collects in strainers or other liquid line accessories. This produces a shortage of refrigerant at the TEV port. Conventional strainers frequently allow the material to pass through the screen and obstruct the flow at the valve port. If a See•All is installed downstream of the restriction, bubbles will be visible. This should not be confused, however, with a refrigerant shortage or excessive liquid line pressure loss which are also indicated by bubbles in the See•All.

   **Remedy** — Locate and remove the foreign material creating the restriction. Install a Sporlan Catch-All Filter-Drier to provide effective filtration of the refrigerant. See Bulletin 40-10.

***** When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.

**3. *Wax*** — Certain systems are contaminated with small amounts of wax which will precipitate at low temperatures in systems with Refrigerants 22 or 502. Since the TEV represents the first cold point in the refrigeration cycle, wax is most likely to form at the valve port.

It is sometimes difficult to observe the wax in a valve because it may exist in solid form only at very low temperatures. By the time the valve has been taken apart, the temperature has increased enough to cause the wax to melt and thus become difficult to detect. When wax is suspected, it can usually be detected on the pin and seat by packing the valve in dry ice while disassembling.

**Remedy** — Clean the valve with solvent before reassembling the valve. The Sporlan HH style Catch-All Filter-Driers have a special activated charcoal desiccant that is designed to remove wax in the liquid line before it causes trouble. Therefore, to prevent wax problems, use these HH style driers (e.g., C-415-S-HH) on all low temperature systems using Refrigerants 22 or 502.

**4. *Refrigerant shortage*** — See•All or sight glass in the liquid line will show bubbles when the system is short of refrigerant charge. Before adding more refrigerant however, be sure the bubbles are not produced by other causes (See Paragraphs **A-2** and **A-5**).

A lack of refrigerant charge may also be detected by a hissing sound at the TEV. Some systems not equipped with a liquid line sight glass will have test cocks or other devices for checking the refrigerant level in the receiver.

**Remedy** — Add enough refrigerant to obtain desired result.

**5. *Gas in the liquid line*** — As explained in Paragraphs **A-2** and **A-4**, liquid line vapor can be produced by a partially plugged strainer or drier and by a shortage of refrigerant charge. In addition, gas in the liquid line can be caused by air or other non-condensable gases in the system or by excessive pressure losses in the liquid line as a result of:

- Long or undersized line.
- Liquid line vertical lift.

**Remedy** — Verify the correct liquid line size for the equivalent length and system tonnage. Consult liquid line sizing data published in many manufacturers' catalogs and in textbooks. If undersized, repipe with the correct size.

Determine amount of vertical lift, and obtain the resulting pressure loss from Table 3, Bulletin 10-9. Using the subcooling calculation example provided in the "subcooling" section of Bulletin 10-9, find required subcooling necessary to prevent gasification with the existing pressure losses. Provide the necessary subcooling by using one of the methods described on Page 1.

**6. *Misapplication of internally equalized valve or incorrect location of external equalizer*** — If the pressure drop through the evaporator exceeds the predetermined values shown in Table 1, Bulletin 10-9, an externally equalized valve must be used. When an externally equalized valve is used, the equalizer connection should be made at a point in the suction line that will reflect the pressure existing in the line at the bulb location.

**Remedy** — Replace internally equalized valve with one having an external equalizer.

If external equalizer is installed incorrectly, change to correct location. See Page 3.

**7. *Insufficient pressure drop across valve*** — One of the factors that influence expansion valve capacity is the pressure drop that exists between the inlet and outlet. Anything contributing to a reduction in this pressure drop will reduce valve capacity. Abnormally low condensing pressures, excessive liquid line pressure losses (even with adequate subcooling), undersized distributor nozzle or distributor tubes may also be responsible for a very low net pressure drop across the valve port.

**Remedy** — Remove source of pressure loss, or install valve with adequate capacity at the reduced pressure drop. If inlet pressure to valve is low due to low condensing pressure, raise pressure.

If the refrigerant distributor nozzle is undersized replace with correct size. See Bulletin 20-10.

**8. *Dead thermostatic element or wrong thermostatic charge*** — If the element has partially or completely lost its thermostatic charge, the valve will be unable to feed sufficient refrigerant or will remain closed. A wrong charge may cause insufficient feed also.

**Remedy** — Replace the element if it is dead. If charge is incorrect, replace with proper selective charge. See Bulletin 10-9.

**9. *Charge migration (CP series, ZP series, and VGA charges only)*** — In order for valves with these charges to maintain control at the bulb, the bulb must be kept at a lower temperature than the element (diaphragm case). If the thermostatic charge does migrate to the element because of a lower element temperature, the valve will throttle.

**Detection** — Warm the element with a cloth saturated with hot water. If this produces more refrigerant feed and reduces the superheat to normal, charge migration is responsible for the starved evaporator.

**Causes** —

- Insufficient pressure drop between the valve outlet and bulb location, possibly due to an oversized distributor nozzle or no nozzle at all.
- Excessive pushrod leakage, which allows the leaking refrigerant to cool the diaphragm case before passing into the equalizer line. This is a rare occurrence and should be carefully checked before arriving at this conclusion.
- Cold location of TEV, or condensate drippage on the diaphragm case.

**Remedies** —

- Install distributor nozzle correctly sized in accordance with nozzle sizing procedure given in Sporlan Bulletin 20-10.
- On valves with packed pushrod construction, remove element and tighten the pushrod packing nuts.
- Relocate the TEV away from cold outlet air, or condensate drippage.

**10. *Undersized valve***

**Remedy** — Install valve sized in accordance with procedure given in Bulletin 10-9, or Bulletin 10-10.

**11. *High Superheat adjustment***

**Remedy** — Turn the adjusting stem counter clockwise until the correct superheat is indicated.

**12. *Feed-back from another valve*** — Review instructions for Bulb Location and Installation, Page 2.

**Remedy** — Check the bulb temperature and calculate the superheat. If superheat is normal but too little refrigerant is flowing through the evaporator, check the piping for possible refrigerant flow from another evaporator affecting the bulb. Re-pipe if necessary. See Figure 4.

**13. *High pressure drop through evaporator***

**Remedy** — Check the pressure at the evaporator inlet and outlet with gauges. If pressure difference is greater than the values shown in Table 1, Bulletin 10-9, use an externally equalized valve.

**14. *Restricted, plugged, or capped external equalizer*** — If the pressure under the diaphragm builds up due to pushrod leakage and cannot escape through the external equalizer line, the valve will remain closed.

**Remedy** — Check the external equalizer line to be sure it is open or not capped.

## Complaint "B"

***"Valve feeds too much refrigerant."***

**SYMPTOMS:**

- ***Liquid returns to compressor.***
- ***Superheat is low.***
- ***Suction pressure is normal or higher than normal.***

**THE CAUSE MAY BE:**

**1. Moisture** — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation. This is the most common source of trouble on TEVs. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is held in the open position by ice, liquid flood-back will occur.

**Remedy** — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

For additional protection, install a Sporlan See•All Moisture and Liquid Indicator for a positive indication of when a safe moisture level is reached. See Bulletin 70-10.

**2. Dirt or foreign material** — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. may pass through ordinary strainers and lodge at the TEV port and prevent the valve from closing.

**Remedy** — Disassemble the valve and remove all foreign material from the internal parts. Install a Sporlan Catch-All Filter-Drier in the liquid line. The Catch-All filters out the smallest particles of foreign material that might interfere with the operation of any system component.

**3. Expansion valve seat leak** — When the valve port does not seat tightly, refrigerant will pass through during the off-cycle and fill the evaporator with refrigerant. If the seat leak is severe, the valve will feed too much refrigerant during the operating cycle as well. (Not applicable to valves with permanent bleed ports or RPB feature.)

**Remedy** — If the valve seat is leaking, a gurgling or hissing sound can usually be heard during the off-cycle. Also, a sight glass or See•All in the liquid line may indicate continued refrigerant flow for a long period after the compressor has stopped. Make certain however, that the bubbles are not the result of ***back-flow*** through a vertical liquid line.

Disassemble the valve to be certain that dirt or foreign material is not responsible (see **B-2**). If the pin and seat are worn or damaged and an internal parts kit is available, replace the parts. When parts are not available, the valve must be replaced.

**4. Oversized valve** — Check valve ratings considering all the factors which affect its capacity. See Page 16, Bulletin 10-9, or Page 3, Bulletin 10-10.

**Remedy** — Install correctly sized valve.

**5. Incorrect bulb installation** — The bulb should be securely fastened to a straight, clean, section of the suction line using two bulb straps for good thermal contact. Also, the temperature of the bulb should not be influenced by ambient temperature — an external heat source such as a steam pipe or heating coil.

**Remedy** — Install bulb correctly. See Bulb Location and Installation, Page 2.

**6. *Low superheat adjustment***

**Remedy** — Turn the adjusting stem clockwise until the correct superheat is indicated. See Page 4.

**7. *Incorrect thermostatic charge***

**Remedy** — Select and install the correct selective charge. See Bulletin 10-9.

**8. *Incorrectly located external equalizer***

**Remedy** — Relocate external equalizer or the connection between evaporator and any other temperature or pressure sensitive evaporator control valve near bulb location. See Page 3 for recommendations.

**9. Inefficient compressor** — If the compressor is inefficient or for some other reason lacks capacity, the suction pressure will operate higher than normal. This may or may not be accompanied by low superheats.

**Remedy** — Consult with compressor manufacturer.

## Complaint "C"

***"Valve feeds too much refrigerant <u>at start-up only</u>."***

**SYMPTOMS:**

- ***Liquid returns to compressor.***
- ***No superheat.***
- ***Suction pressure higher than normal.***

**THE CAUSE MAY BE:**

**1. Refrigerant drainage** — Drainage of refrigerant from the evaporator (during the off-cycle) when installed at a higher level than the compressor.

**Remedy** — Install a trap-riser to top of evaporator or use pump-down control. See Figure 5.

**2. *Compressor or suction line in cold location*** — During the period when the system is not in operation, liquid refrigerant will condense at the coldest point in the system. Liquid will condense in the compressor or suction line, if they are located in an ambient temperature below that of the evaporator during the off-cycle. Upon re-starting, this liquid will slug the compressor.

**Remedy** — Keep compressor or suction line warm during the off-cycle. Some compressors are equipped with crankcase heaters for this purpose. Another corrective measure is to install a suction line solenoid valve that is de-energized during the off-cycle.

3. ***Restricted or plugged external equalizer*** — A momentary flood can occur when the load increases suddenly, such as at start-up because the higher suction pressure cannot reach the underside of the diaphragm and help close the valve. If the pressure under the diaphragm increases due to any pressure leakage around the pushrods, the valve will eventually throttle.

   **Remedy** — Remove the restriction or plugged portion of the external equalizer.

4. ***Liquid line solenoid valve seat leak or interrupted pumpdown*** — Liquid refrigerant can continue to feed the TEV and/or remain in evaporator upon shut-down causing flood-back to the compressor upon start-up.

   **Remedy** — Disassemble and clean solenoid valve and/or replace damaged internal parts if seat leakage is the problem. If the pumpdown cycle isn't completed before the compressor cycles off, or the thermostat calls for cooling and reopens the liquid line solenoid before the evaporator has been properly evacuated, check the low pressure cut-off setting or the electrical controls for possible causes.

## Complaint "D"

***"Valve doesn't feed properly."***

***SYMPTOMS:***

- ***Poor system performance.***
- ***Superheat normal or lower than normal.***
- ***Suction pressure lower than normal with compressor unloaders locked out or hot gas bypass shut off.****

***THE CAUSE MAY BE:***

1. ***Unequal circuit loading (Multi-circuit evaporators and parallel evaporators connected to a single refrigerant distributor)*** — When each circuit is not subjected to the same heat load, the lightly loaded circuits will allow unevaporated refrigerant or low temperature vapor to enter the suction line and throttle the valve. This will cause normally loaded circuits to be deprived of their share of refrigerant. The net result is a loss of refrigerated evaporator surface.

   **Remedy** — Make necessary modifications which will allow each evaporator circuit to receive the same percentage of the total load. See Bulletin 20-10 for application information on multi-circuit evaporators using a refrigerant distributor.

2. ***Poor refrigerant distribution (Multi-circuit evaporators and parallel evaporators connected to a single refrigerant distributor)*** — If the refrigerant distribution is faulty, the circuits receiving the largest portion of refrigerant will have the controlling influence on the TEV. The result is the same as in paragraph 1 above.

   **Remedy** — Correct refrigerant distribution. See Bulletin 20-10 for complete information on Refrigerant Distributors.

3. ***Low load***— Low evaporator load may be caused by insufficient air over the coil as a result of an undersized blower, dirty air filters, or an obstruction in the air stream. In addition, frost formation on the coil or low entering air temperatures will reduce the evaporator load.

   **Remedy** — Correct the condition responsible.

4. ***Flow from one coil affecting TEV bulb of another (Multiple evaporator systems only)*** — The temperature of the bulb may be falsely influenced by flow from another evaporator usually because of incorrect piping.

   **Remedy** — Correct the piping. See Figure 4, Page 3.

5. ***Improper compressor-evaporator balance*** — If the compressor is too large for the load and evaporator capacity, the low suction pressure which results will cause poor system performance.

   **Remedy** — Consult with the manufacturer or consulting engineer, or the ASHRAE Handbook on component balancing. If necessary, change or correct the improperly sized component. Hot gas bypass may be used to balance properly.

6. ***Evaporator oil-logged*** — Poor heat transfer occurs and unpredictable performance takes place. If erratic performance is observed over a period of time, and other causes are omitted from consideration, review the amount of oil in the system. Turbulent compressor oil level with little or no return to the compressor sump indicates oil problems.

   **Remedy** — Remove excessive oil from evaporator and connecting piping. Many times the evaporator temperature will be too low for the oil to be removed. Therefore, the system must be allowed to warm sufficiently to get cold oil to drain. Analyze system components for possible causes of oil problem before restarting the system. Consult with the compressor manufacturer for specific details on their compressor.

## Complaint "E"

***"System hunts or cycles."***

***SYMPTOMS:***

- ***Suction pressure fluctuates****
- ***Superheat fluctuates.***
- ***Valve does not feed enough, and then too much refrigerant.***

***THE CAUSE MAY BE:***

1. ***System characteristics*** — Certain design characteristics of the system may have an effect on the system's tendency to hunt or cycle. As an example, after the valve admits refrigerant to the evaporator inlet, there is a time delay before the bulb senses the effect at the evaporator outlet. This time delay is dependent on evaporator length, tube size, and load. Generally, there is more likelihood for hunting to occur when this time interval is long. Other influencing factors are circuit arrangement, load per circuit, and temperature difference.

   **Remedy** — When hunting is moderate particularly with no floodback, the effect on the system is insignificant and correc-

* When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.

tions are not necessary. If hunting is severe with floodback to the compressor, check the possible remedies shown in paragraphs below.

2. ***Valve size*** — An over-sized valve usually aggravates hunting. Carefully check the valve rating considering all the factors affecting its capacity. See Bulletin 10-9, or Bulletin 10-10.

   **Remedy** — Replace valve with one correctly sized. On multiple circuit evaporators using a refrigerant distributor, the capacity of the valve can be reduced, within certain limits, by installing a smaller distributor nozzle. See Bulletin 20-10.

3. **Bulb location** — If the bulb is located in a suction line trap, its temperature will be affected by liquid oil and refrigerant alternately collecting and evaporating at this point. This condition frequently results in severe hunting.

   **Remedy** — As a temporary measure relocate the bulb away from the trap, and any turbulent areas created by elbows, tees, etc. Also remove the bulb from the air stream or insulate. Re-pipe if necessary. Sometimes another position around the circumference of the suction line will minimize hunting. Follow the Bulb Location and Installation instructions given on Page 2 for the best TEV control.

4. ***Refrigerant and load distribution*** — In addition to the effects of poor distribution explained in paragraphs **D-1** and **D-2**, hunting also frequently results. This is caused by liquid refrigerant from the overfed circuits occasionally reaching the bulb of the valve.

   **Remedy** — Correct the faulty distribution.

5. ***Superheat adjustment*** — All Sporlan TEVs are preset at the factory to give the best performance on the average system. A valve should not be adjusted unnecessarily, but occasionally another setting may prove to be better.

   **Remedy** — Turn the adjusting stem clockwise a turn at a time. If the hunting stops or is reduced, turn the adjusting stem counter clockwise a turn at a time to obtain the lowest superheat with stable operation.

6. **Moisture** — As ice forms in a TEV from excessive moisture, a very erratic hunt may result.

   **Remedy** — Remove the moisture with the installation of a Sporlan Catch-All Filter-Drier. A safe moisture level can be determined by installing a Sporlan See•All.

## Complaint "F"

***"System won't perform properly."***

***SYMPTOM:***

- ***Cannot get valve to react or regulate at all.***

***THE CAUSE MAY BE:***

1. ***No refrigerant being fed to evaporator***. See Section **A** on Pages 6 & 7.

2. ***Too much refrigerant being fed to evaporator***. See Section **B** on Page 8.

3. ***Too much refrigerant being fed to evaporator at start-up only***. See Section **C** on Page 8.

4. ***Refrigerant control is erratic***. See Section **D** on Page 9.

5. ***System is hunting or cycling***. See Section **E** on Page 9.

6. ***The TEV has been physically abused in an effort to make the valve work properly.*** This is usually the result of a mistaken analysis. It is frequently assumed that if a valve does not feed properly, it is stuck (either opened or closed). Beating the valve body with a hammer will only distort the body and make it impossible for the valve to work once the real cause is determined.

   If a valve "sticks," it is usually due to moisture freezing in the port, dirt and other foreign material restricting or plugging the internal parts, wax forming on the internal parts at low temperatures, or the valve has been physically abused so it **cannot** function.

   ***Remedy*** — Inspect the valve and its internal parts, including the inlet strainer. If plugged or restricted in any way, clean the parts thoroughly, oil the parts with a good grade of refrigerant oil, and reassemble the parts. Complete details on this subject are found on Pages 10 through 12.

   If the valve is beyond normal cleaning processes, or if it is physically damaged in any way, replace the valve with its proper replacement model.

## ■ Field Assembly Instructions

Sporlan valves my be opened easily for inspection.

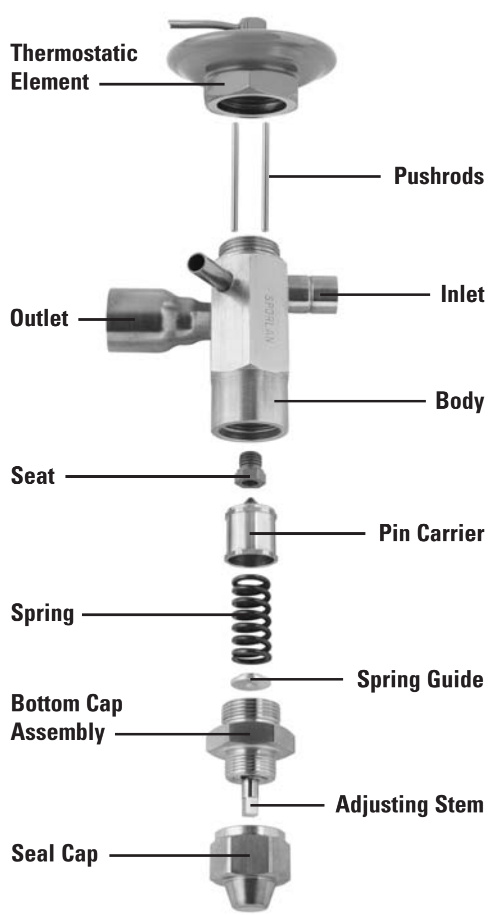



***Figure 9***

**Note**: These Field Assembly Instructions apply in part to all Sporlan TEVs. See Figure 9 for an "exploded" view of those models that can be completely disassembled. When a TEV is to be disassembled for inspection and cleaning, or for replacement of the thermostatic element or the internal parts, the following information should be reviewed for assistance.

Types F dated approximately C84 or earlier and Types I, BI, NI, RI, FB manufactured prior to 1994 do not have replaceable elements nor internal parts kits, but can be disassembled for inspection and cleaning. Type F dated D84 or later, Type S valves dated B69 or later, Type C valves dated C70 or later, and **ALL** Type G, X, (E)BF/SBF and EBS valves employ packless pushrod construction and internal parts are NOT available for use with them. However, their elements can be replaced and they can be disassembled for inspection and cleaning. Due to the single pushrod construction of the Type (E)BF/SBF and EBS valves, only the bottom cap assembly, pin guide, and superheat spring may be removed for inspection and cleaning.

Early production of the Type F valve with the replaceable element requires a 15/16" **thin jaw**, open end type element wrench such as a Bonney 1230. Subsequent production of the Type F valve and all Types (E)BF/SBF, I, BI, NI, RI, and FB valves require a 1" **thin jaw**, open end type element wrench such as the one available from Sporlan wholesalers. An open end wrench is necessary because of limited space between the body and element of these valves. Precautions must be taken in removing the KT-43 element (F) so the element, body, or connections are not damaged by the wrenches.

While standard open end or adjustable wrenches fit the other element sizes, the **thin jaw** type wrenches are also available for the other element sizes: Bonney 1236 (1-1/8") for KT-53 elements, Bonney 1240 (1-1/4") for KT-83 elements, Bonney 1248 for KT-33 elements, and Bonney 1252 for KT-63 and 7 elements.

Replaceable elements and internal parts kits are available for current valves with ***packed*** pushrod construction:
Types P, H, M, D, and A.

Replaceable elements for Types O, V, W, and U are also available. However, special field assembly instructions are included with their internal parts kits.

## Assembling Instructions

The following steps are necessary in properly disassembling, inspecting, cleaning, and reassembling a TEV whether the valve is in or out of the refrigerant piping.

**1.** Before disassembling the valve, be sure the refrigerant pressure in the system has been reduced to a safe level **(0 psig)**.

**2.** Remove the seal cap and turn the adjustment stem counter-clockwise to relieve the spring force. Count and record the number of turns so adjustment can be returned to its original position.

**3.** Using appropriate wrenches or a vise to properly support the valve body, remove the element (if a replaceable type), the bottom cap assembly, and the internal parts. (Only remove the bottom cap, pin guide, and superheat spring on Type (E)BF/SBF and EBS valves. **DO NOT** remove the single pushrod from these valves.)

**Caution:** Regardless of whether the valve is in the system or in a vise, care must be taken to prevent distorting the body by exerting too much pressure in tightening the element or in clamping the body in the vise. Also, do not use a wrench on the outer welded edge of the element.

**4.** Inspect parts, element, and body for any foreign materials or physical damage.

**5.** On valves with replaceable elements and/or internal parts, replace any items that appear damaged.

**6.** Clean all parts with solvent, preferably by applying and then blowing off with clean dry compressed air.

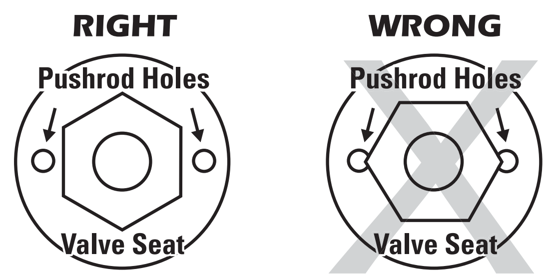



**Figure 10**

**7.** To reassemble valves with replaceable seats, screw seat into body with a fairly light pressure since it does not require a heavy pressure to make this small knife-edge joint.

**Caution:** Be sure hexagon corners of seat do not protrude into pushrod holes (see Figure 10).

For valves that do not have replaceable elements or for Type O valves, place the pushrod(s) into the body now.

**8.** Next, slip the pin and carrier (which have been pressed together at the factory) into the body and tap the pin into the seat to form a true seating surface. It is generally advisable, before tapping these parts together, to check the concentricity of both the pin and seat by engaging the parts by pressing them lightly together with one finger and noting that there is no tendency to stick together. This should be repeated several times after rotating the pin carrier a quarter of a turn. In assembling valves with port sizes of 1/4" and larger which use the flat disc instead of the tapered pin, **DO NOT TAP THE DISC AGAINST THE SEAT.**

**9.** Now place the spring guide stamping (when used), and spring, in the pin carrier, place the lower spring guide on the opposite end of the spring and screw the bottom cap in place. (Replace the pin guide, spring, and bottom cap assembly together on Type (E)BF/SBF and EBS valves.) After screwing bottom cap assembly in place, carefully tighten, preferable with two 10" wrenches, to seal the metal-to-metal knife edge joint. The sealing surfaces should be free of any foreign material or nicks that might prevent a leak-tight joint.

**10.** On valves with replaceable elements (except Types O, (E)BF/SBF and EBS), place the pushrods into the body and open the valve several times by pressing down on the pins with a flat metal surface. This will help seat the pin properly.

**11.** Check the height of the pushrod(s) above the element sealing surface with the pushrod gauge (see Figure 11). The gauge is supplied with internal parts kits or can be obtained at no charge

**Table 3**

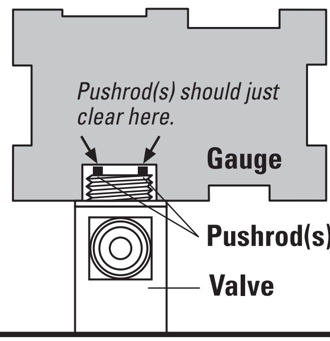
| Valve Type① Current | Valve Type① Obsolete | Gauge Number |
|---|---|---|
| AA(E), LMC-AA(E) | --- | 1 |
| DA(E), LMC-DA(E) | --- | 2 |
| PFE or HFE-1½, 3, 4, 5, 8, 12 | PFE or HFE-6, 7½, 10, 11 | 3 |
| PVE or HVE-2½, 5½, 7, 11, 16, 20 | PVE or HVE-2, 5, 8, 10, 12, 15, 17, 18 | |
| PDE or HDE-5, 8, 14 | PDE or HDE-6, 7½, 9, 12, 13 | |
| PRE or HRE-1½, 4, 6½, 9, 12 | PRE or HRE-6, 7½, 11, 13 | |
| --- | UFE-12, 17 | |
| | UVE-22, 30 | |
| | UDE-15, 21 | |
| | URE-16, 22 | |
| OFE-23, 32, 40 | UFE-23 | 3A |
| OVE-40, 55, 70 | UVE-40 | |
| ODE-28, 40, 50 | UDE-28 | |
| ORE-30, 35, 45 | URE-30 | |
| All F Models② except FF(E)-⅛, FV(E)-¼, FD(E)-⅛, FR(E)-⅛ | --- | 4 |
| All G Models except GF(E)-⅛, GV(E)-¼, GR(E)-⅛ | All small K models | 5 |
| All X Models | --- | |
| MFE-5, 7½, 11, 13, 15, 20 | MFE-12, 17 | 6 |
| MVE-8, 12, 18, 21, 26, 34 | MVE-30 | |
| MDE-6, 9, 13, 15, 18, 25 | MDE-14, 20 | |
| MRE-9, 15, 20, 25 | --- | |
| KFE or VFE-45, KVE or VVE-70 | | |
| KDE or VDE-55, KRE or VRE-50 | | |
| MFE-25 | MFE-22 | 6A |
| MVE-42 | MVE-40 | |
| MDE-30 | MDE-26 | |
| MRE-30 | --- | |
| KFE or VFE-35, 55 | VFE-50 | |
| KVE or VVE-52, 100 | VVE-90 | |
| KDE or VDE-40, 65 | VDE-42, 60 | |
| KRE or VRE-38, 70 | --- | |
| WFE-80, 110 | WFE-75, 100 | 7 |
| WVE-135, 180 | --- | |
| WDE-95, 130 | WDE-90, 120 | |
| WRE-100, 130 | --- | |
| CF(E) or SF(E)-¼, ½, 1, 1½, 2, 2½, 3 | R and T Models with 83 elements | 8 |
| CV(E) or SV(E)-½, 1, 1½, 2, 3, 4, 5 | | |
| CD(E) or SD(E)-¼, ½, 1, 1½, 2, 2½, 3, 3½ | | |
| CR(E) or SR(E)-¼, ½, 1, 1½, 2, 3, 4 | | |
| CFE-5, SFE-5, 6 | --- | 8A |
| CVE-8, SVE-8, 10 | | |
| CDE-6, SDE-6, 7 | | |
| CRE-6, SRE-6, 7 | | |
| OFE-6, 9, 12 | | |
| OVE-10, 15, 20 | | |
| ODE-7, 11, 14 | | |
| ORE-6, 9, 12 | | |
| OFE-16, OVE-30 ODE-20, ORE-21③ | --- | 8B |

upon request. (Since the internal parts of the Type (E)BF/SBF and EBS valves cannot be replaced, it is not necessary to check the pushrod height of these valves.)

The appropriate gauge numbers for the various TEV's are given in Table 3.

**Caution:** If the element-to-body joint utilizes a gasket, the gasket must be removed before checking pushrod height.

If the pushrod(s) are too long, they must be carefully ground off to the proper length. Clean the pushrod(s) of all dirt and grindings and place them into the body.




**Check Height of Pushrod(s) with Gauge**

**Figure 11**

**12. Element Replacement** — If the element is damaged or has lost its thermostatic charge, replace it with the same type.

To properly replace the element without damaging the element or the valve body on valves which utilize a gasketed joint, be sure only one gasket is used before assembling the element. In assembling gasketed elements held in place by two cap screws, be sure to pull up the cap screws evenly.

On valves which utilize the threaded type of element with metal-to-metal knife edge joints, always use an appropriate wrench (10") on the wrench flats. **DO NOT** use a wrench on the outer welded edge of the element. The sealing surfaces should be free of any foreign materials or nicks that might prevent a leak-tight joint. A few drops of refrigerant oil on the element threads will facilitate easy assembling and removal.

**13.** Return the superheat spring adjustment to its original position. Replace the seal cap tightly.

① Type F (internally and externally equalized) valves dated D84 or later, Type S valves dated B69 or later, Type C valves dated C70 or later, and all Type G (externally equalized only) and X valves have packless pushrod construction and internal parts kits are not available for use with them.

② Applies only to Type F valves with a replaceable element.

③ Formerly used the KT-33-8 element and gauge number 33-8 (redesignated 8B). The KT-33-8 element has been replaced by the KT-83.

**Bulletin C401d**
March, 2002

# HANSEN TECHNOLOGIES CORPORATION

HCK4-4 Check Valve

**Specifications, Applications, Service Instructions & Parts**

## HCK4 IN-LINE CHECK VALVES
## 5/8" thru 4" PORT (16 thru 100 mm)

**Flanged**
**3/8" thru 4"**
**FPT, SW, WN, ODS**
**for refrigerants**

## INTRODUCTION

The HCK4 series of dependable, compact, rugged in-line check valves (disc type non-return valves) is ideally suited for refrigerant flow control applications. Valves open wide for flow in the arrow direction on the valve body. Valves close quickly and reliably when flow reversals occur.

Plated bodies and stainless steel seat discs and springs enable them to withstand expected industrial refrigeration conditions. Furthermore, these check valves can be mounted in any position, close-coupled to other valves, and use same flanges as Parker R/S, Frick, and Henry.

## ADVANTAGES

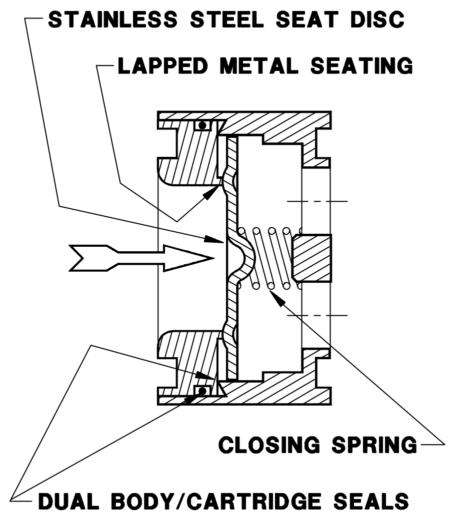
These compact check valves offer reliable operation regardless of position. Corrosion resistant stainless steel seat disc. Metal-to-metal seats facilitate durable, tight closing of valves.

## APPLICATIONS

These in-line check valves are designed to provide refrigerant flow control to hot gas lines, liquid lines, compressor discharge lines, suction lines, and hot gas heated drain pans.

These valves are not recommended for use with pulsating loads such as low speed compressor discharge and screw compressor side port applications. For applications such as these, use Hansen HCK1 piston type check valves.

## KEY FEATURES




## ADDITIONAL FEATURES

Mounts in any position
Less than 1 PSID wide opening pressure
Can be close-coupled
Low bubble leakage tolerance
For Ammonia, R22, R134a, and other approved refrigerants
Dimensionally replaces R/S CK4A-2, -3, -4, -8, & -1
U.L. Listed

## MATERIAL SPECIFICATIONS

Body:
- 5/8" thru 1¼": Steel, ASTM A108, zinc chromate plated
- 1½" thru 4": Ductile iron, ASTM A536, zinc chromate plated

Seat Disc: Stainless steel
Seat Cartridge:
- 5/8" thru 1¼": Stainless steel, ASTM A582
- 1½" thru 4": Steel, ASTM A108, zinc chromate plated

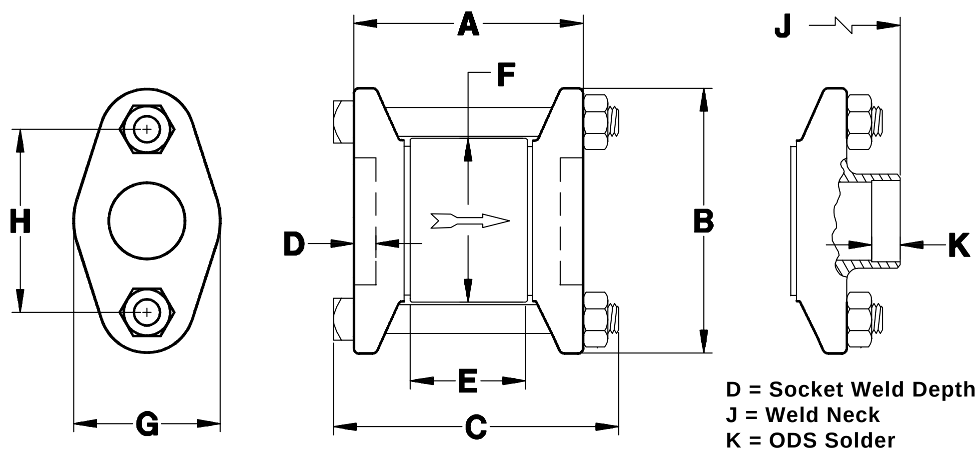
Spring: Stainless steel
Safe Working Pressure: 400 PSIG (27 bar)
Operating Temperature: -60F to 240F (-50 to 115°C)

## INSTALLATION

Valve may be located in any position. Arrow on valve body should match direction of flow. Secure valve with gaskets between flanges and tighten bolts evenly. Do not use this valve or any component to align pipes or tighten gap between flanges.

Do not install on inlet side of solenoid valves or control valves with electric shut-off or shut-off valves unless a relief valve is used from therein between piping. Do not install on inlet side of outlet pressure regulators where liquid may become trapped. Instead, check valves should be located on outlet side of these valves. Check valves can be close-coupled to other matching solenoid valves, pressure regulators, or strainers by using a Male Adapter Ring and longer bolts supplied when so specified on order.

## INSTALLATION DIMENSIONS




D = Socket Weld Depth
J = Weld Neck
K = ODS Solder

| DIMENSION LETTER | HCK4-2* 5/8" PORT | HCK4-3* ¾" PORT | HCK4-4* 1" PORT | HCK4-5 1¼" PORT | HCK4-7 1½" PORT | HCK4-8* 2" PORT | HCK4-9 2½" PORT | HCK4-0 3" PORT | HCK4-1* 4" PORT |
|---|---|---|---|---|---|---|---|---|---|
| A | 2.50" (64 mm) | 3.25" (83 mm) | 3.25" (83 mm) | 3.25" (83 mm) | 5.06" (129 mm) | 5.06" (129 mm) | 6.06" (154 mm) | 6.06" (154 mm) | 6.39" (162 mm) |
| B | 3.19" (81 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 4.56" (116 mm) | 4.56" (116 mm) | 6.00" (152 mm) | 6.00" (152 mm) | 7.13" (181 mm) |
| C | 3.50" (89 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 6.38" (162 mm) | 6.38" (162 mm) | 7.50" (191 mm) | 7.50" (191 mm) | 8.00" (203 mm) |
| D | 0.38" (10 mm) | 0.50" (13 mm) | 0.50" (13 mm) | 0.50" (13 mm) | 0.75" (19 mm) | 0.75" (19 mm) | 1.00" (25 mm) | 1.00" (25 mm) | 1.00" (25 mm) |
| E = | 1.03" (26 mm) | 1.22" (31 mm) | 1.22" (31 mm) | 1.22" (31 mm) | 2.56" (65 mm) | 2.56" (65 mm) | 2.92" (74 mm) | 2.92" (74 mm) | 3.50" (89 mm) |
| F | 1.50" (38 mm) | 2.37" (60 mm) | 2.37" (60 mm) | 2.37" (60 mm) | 3.62" (92 mm) | 3.62" (92 mm) | 4.84" (123 mm) | 4.84" (123 mm) | 6.06" (154 mm) |
| G | 1.56" (40 mm) | 2.50" (64 mm) | 2.50" (64 mm) | 2.50" (64 mm) | 4.56" (116 mm) | 4.56" (116 mm) | 6.00" (152 mm) | 6.00" (152 mm) | 7.13" (181 mm) |
| H | 2.19" (56 mm) | 3.12" (79 mm) | 3.12" (79 mm) | 3.12" (79 mm) | 3.06" (78 mm) | 3.06" (78 mm) | 4.00" (102 mm) | 4.12" (105 mm) | 5.00" (127 mm) |
| J | 3.26" (83 mm) | 4" (102 mm) | 4" (102 mm) | 4" (102 mm) | 6.06" (154 mm) | 6.06" (154 mm) | 7.06" (179 mm) | 7.06" (179 mm) | 9.89" (251 mm) |
| K | 0.33" (8 mm) | 0.49" (12 mm) | 0.59" (15 mm) | 0.62" (16 mm) | 0.71" (18 mm) | 0.87" (22 mm) | 0.96" (24 mm) | 1.08" (27 mm) | 1.40" (36 mm) |
| Valve Cv (Kv) | 5.8 (5) | 8.2 (7) | 11.7 (10) | 14.0 (12) | 39 (33) | 50 (43) | 74 (63) | 93 (80) | 210 (180) |
| Pipe Size | ½", ¾" | ¾" | 1" | 1¼" | 1½" | 2" | 2½" | 3" | 4" |

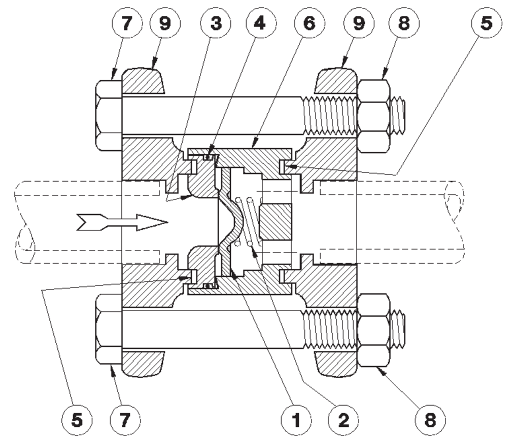
*Dimensionally replaces R/S check valve models CK4A-2, -3, -4, -8, and -1. = "E" dimension is check valve body outside edge to outside edge. Flange groove depth: nominal 0.12" each of two; gasket thickness: nominal 0.06" each of two.

# PARTS LIST

## HCK4-2 (2-BOLT)

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Valve Assembly Kit** | | |
| | Above Kit Consists of: | | |
| 1 | Seat Disc | 1 | 72-0069 |
| 2 | Closing Spring | 1 | 72-0070 |
| 3 | Seat Cartridge | 1 | 72-0068 |
| 4 | Seat Cartridge O-ring | 1 | 72-0071 |
| 5 | Flange Gasket | 2 | 70-0065 |
| 6 | Body, HCK4-2 | 1 | 72-0067 |
| 7 | Bolt (7/16" - 14 x 3.25") | 2 | 70-0225 |
| 8 | Nut (7/16" - 14) | 2 | 70-0055 |
| 9 | Flange (FPT, SW, WN, ODS) | 2 | FACTORY |

## HCK4-2 (2-BOLT)

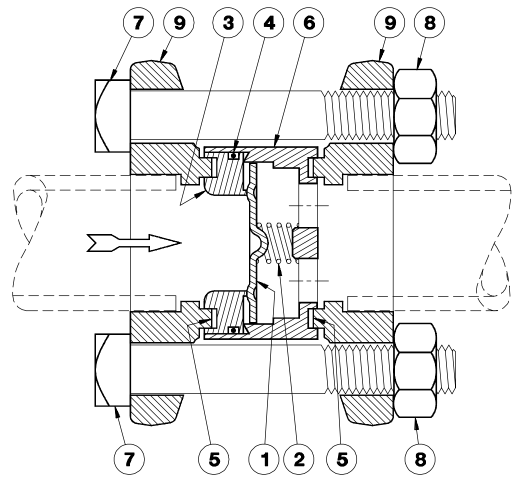



Socket weld shown. FPT, weld neck, ODS: available.

## HCK4-3, -4, -5 (2-BOLT)

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Valve Assembly Kit** | | |
| | Above Kit Consists of: | | |
| 1 | Seat Disc | 1 | 72-0006 |
| 2 | Closing Spring | 1 | 70-0204 |
| 3 | Seat Cartridge | 1 | 72-0002 |
| 4 | Seat Cartridge O-ring | 1 | 72-0003 |
| 5 | Flange Gasket | 2 | 70-0132 |
| 6a | Body, HCK4-3 | 1 | 72-0004 |
| 6b | Body, HCK4-4 | 1 | 72-0008 |
| 6c | Body, HCK4-5 | 1 | 72-0001 |
| 7 | Bolt (5/8" -11 x 4") | 2 | 72-0005 |
| 8 | Nut (5/8" -11) | 2 | 70-0136 |
| 9 | Flange (FPT, SW, WN, ODS) | 2 | FACTORY |

## HCK4-3, -4, -5 (2-BOLT)

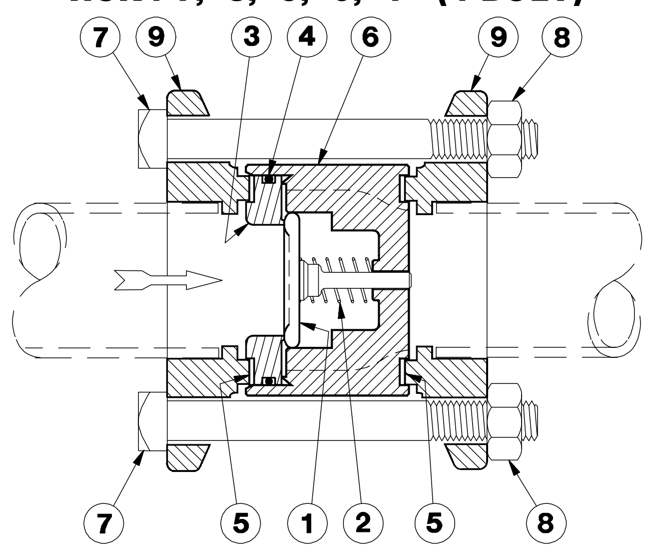



Socket weld shown. FPT, weld neck, ODS: available.

## HCK4-7, -8, -9, -0, -1 (4-BOLT)

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| 1a | Seat Disc 1½", 2" | 1 | 72-0016 |
| 1b | Seat Disc 2½", 3" | 1 | 72-0034 |
| 1c | Seat Disc 4" | 1 | 72-0053 |
| 2a | Closing Spring 1½", 2" | 1 | 72-0021 |
| 2b | Closing Spring 2½", 3" | 1 | 72-0032 |
| 2c | Closing Spring 4" | 1 | 72-0048 |
| 3a | Seat Cartridge 1½", 2" | 1 | 72-0020 |
| 3b | Seat Cartridge 2½" | 1 | 72-0029 |
| 3c | Seat Cartridge 3" | 1 | 72-0028 |
| 3d | Seat Cartridge 4" | 1 | 72-0047 |
| 4a | Seat Cartridge O-ring 1½", 2" | 1 | 72-0017 |
| 4b | Seat Cartridge O-ring 2½", 3" | 1 | 72-0027 |
| 4c | Seat Cartridge O-ring 4" | 1 | 72-0049 |
| 5a | Flange Gasket 1½", 2" | 2 | 75-0138 |
| 5b | Flange Gasket 2½" | 2 | 75-0125 |
| 5c | Flange Gasket 3" | 2 | 75-0137 |
| 5d | Flange Gasket 4" | 2 | 75-0253 |
| 6a | Body, HCK4-7 | 1 | 72-0042 |
| 6b | Body, HCK4-8 | 1 | 72-0019 |
| 6c | Body, HCK4-9 | 1 | 72-0025 |
| 6d | Body, HCK4-0 | 1 | 72-0026 |
| 6e | Body, HCK4-1 | 1 | 72-0046 |
| 7a | Bolt, HCK4-7, -8 (5/8" - 11 x 6") | 4 | 70-0268 |
| 7b | Bolt, HCK4-9, -0 (¾" - 10 x 7") | 4 | 72-0033 |
| 7c | Bolt, HCK4-1 (7/8" - 9 x 7.5") | 4 | 72-0051 |
| 8a | Nut, HCK4-7, -8 (5/8" - 11) | 4 | 70-0136 |
| 8b | Nut, HCK4-9, -0 (¾" - 10) | 4 | 75-0210 |
| 8c | Nut, HCK4-1 (7/8" - 9) | 4 | 75-0280 |
| 9 | Flange (FPT, SW, WN, ODS) | 2 | FACTORY |

## HCK4-7, -8, -9, -0, -1 (4-BOLT)




Socket weld shown. Weld neck, ODS: available.

## OPERATION

HCK4 check valves are normally closed valves. As inlet pressure increases, it overcomes the closing spring force. As the seat disc is pushed back and away from the seat cartridge, flow through the valve occurs. The valve will remain open until the inlet pressure drops below the closing spring force or there is a flow reversal, at which time the seat disc will close against the seat cartridge, preventing reverse flow.

## SIZING

Check valves are normally selected on the basis of line size. However, for gas flow applications at low load conditions, a minimum of 1 psid across the valve is essential. This will maintain valve at full open position. Valve Cv (Kv) is listed in the installation dimension table on page 2. Factory valve sizing assistance is available.

## SERVICE AND MAINTENANCE

These valves are a reliable part of a refrigeration system. However, if valve does not appear to be operating satisfactorily, isolate it from the refrigeration system. Remove all refrigerant from associated piping and valves. Follow the guidelines in the caution section. Loosen each flange nut on the check valve. Break each flange gasket seal. Carefully loosen flange bolts one at a time, being cautious to avoid any refrigerant which still may be present. Remove check valve from flanges and inspect. Lapped seating surfaces should be smooth and free of pits or scratches.

To confirm valve operation, move seat disc with eraser end of pencil. Movement should be free from friction. If not, disassemble and visually inspect for dirt in valve or burrs on seat disc. Clean or replace parts as necessary. Valve discs and seats can be restored by lapping on a flat plate.

Reassemble valve and insert between flanges. Replace and tighten bolts and nuts evenly. Carefully check for leaks before returning to service.

## CAUTION

Hansen check valves are only for refrigeration systems. These instructions and related safety precautions must be completely read and understood before selecting, using, or servicing these valves. Only knowledgeable, trained refrigeration mechanics should install, operate, or service these valves. Stated temperature and pressure limits should not be exceeded. Valves should not be removed unless system has been evacuated to zero pressure. See also Safety Precautions in current List Price Bulletin and Safety Precautions Sheet supplied with product. Escaping refrigerant might cause personal injury, particularly to the eyes and lungs.

## WARRANTY

Hansen valves are guaranteed against defective materials or workmanship for one year F.O.B. our plant. No consequential damages or field labor is included.

## ORDERING INFORMATION, HCK4 CHECK VALVES

| TYPE | PORT SIZE (mm) | FLANGE CONNECTION STYLE & SIZES | | |
|---|---|---|---|---|
| | | FPT, SW, WN | | ODS |
| | | STD | ALSO | STD |
| HCK4-2* | 5/8" (16) | ½" | 3/8", ¾" | 5/8" |
| HCK4-3* | ¾" (20) | ¾" | 1", 1¼" | 7/8" |
| HCK4-4* | 1" (25) | 1" | ¾", 1¼" | 1 1/8" |
| HCK4-5 | 1¼" (32) | 1¼" | ¾", 1" | 1 3/8" |
| HCK4-7 | 1½" (40) | 1½" | 2" | 1 5/8" |
| HCK4-8* | 2" (50) | 2" | 1½" | 2 1/8" |
| HCK4-9 | 2½" (65) | 2½" | 3" | 2 5/8" |
| HCK4-0 | 3" (80) | 3" | -- | 3 1/8" |
| HCK4-1* | 4" (100) | 4" | -- | 4 1/8" |

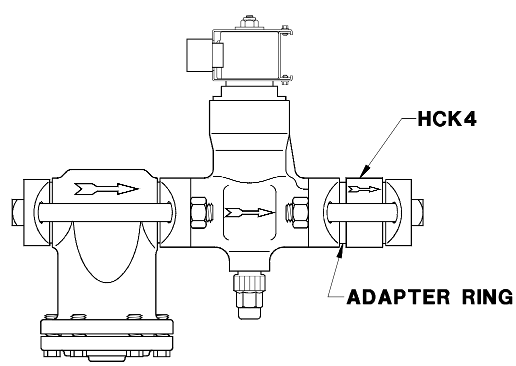
*Replaces R/S CK4A-2, CK4A-3, CK4A-4, CK4A-8, & CK4A-1.
HCK4-2 close-couples to HS6 & HS8 Solenoid Valves.
HCK4-3, -4, & -5 close-couples to HS7 Solenoid Valve.
FPT available only 3/8" to 1¼".

**TO ORDER:** Specify valve type, connection style and size, and close-coupling information if needed.

## TYPICAL SPECIFICATIONS

"Refrigeration in-line check valves shall have steel or ductile iron bodies, stainless steel seat discs, stainless steel closing springs, and be suitable for a safe working pressure of 400 PSIG, as manufactured by Hansen Technologies Corporation type HCK4 or approved equal."

**Typical close-coupling to solenoid valve.**

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 Printed in U.S.A.

# Lubrication Instructions For Ball Bearing Motors

**Lubrication**
This motor is supplied with pre-lubrication ball bearings. No lubrication required before start up.

**Relubrication Intervals**
The following intervals are suggested as a guide:

| SUGGESTED RELUBRICATION INTERVALS | | |
|---|---|---|
| HOURS OF SERVICE PER YEAR | H.P. RANGE | RELUBE INTERVAL |
| 5,000 | Sub Fractional to 7 1/2<br>10 to 40<br>50-200 | 5 Years<br>3 Years<br>1 Year |
| Continuous Normal Applications | Sub Fractional to 7 1/2<br>10 to 40<br>50 to 200 | 2 Years<br>1 Year<br>9 Months |
| Season Service Motor<br>Idle 6 Months or More | All | 1 Year<br>(Beginning of Season) |
| Continuous High Ambients<br>Dirty or Moist Locations<br>High Vibrations<br>Where Shaft End is Hot (Pumps-Fans) | Sub Fractional to 40<br>50 to 200 | 6 Months<br>3 Months |

**Lubrication**

Use high quality ball bearing lubricant. Use consistency of lubricant suitable for class of insulation stamped on nameplate as follows:

| LUBRICATION CONSISTENCY | | | | |
|---|---|---|---|---|
| INSULATION CLASS | CONSISTENCY | TYPE | TYPICAL LUBRICATION | FRAME TYPE |
| B & F<br><br>F & H | Medium | Polyurea | Shell Dolium R<br>and/or<br>Chevron SR1 2 | Sub Fractional<br>to 447T<br>All |

**Procedure**

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215T frame and smaller. Use 2 to 3 strokes on NEMA 254T thru NEMA 365 T frame. Use 3 to 4 strokes on NEMA 404T frames and larger. On motors having drain plugs, remove drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215T frame and smaller. Insert 3 to 5 inch length on larger motors. For motors having drain plug and operate motor for 20 minutes before replacing drain plug.

**CAUTION:** Keep lubricant clean. Lubricate motors at standstill. remove and replace drain plugs at standstill. Do not mix petroleum lubricant and silicone lubricant in motor bearings.

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# Installation Maintenance Instructions
# AC Induction Motors

### Installation

After unpacking, check for damage. Be sure that shaft rotates freely. Before making electrical power connections, check for proper grounding of motor and application. All electrical contacts and connections must be properly insulated and enclosed. Couplings, belts, chains or other mounted devices must be in proper alignment, balance and secure to insure safe motor operation.

### Electrical Wiring

Prior to connecting to the power line, check nameplate for proper voltage and rotation connection. This motor should be installed in compliance with the National Electrical Code and any other applicable codes. Voltage at motor not to exceed + or -10% of nameplate. Authorized person should make all electrical connections.

### Mounting

This motor should be securely mounted to the application. Sufficient ventilation area should be provided to insure proper operation.

## RECOMMENDED COPPER WIRE & TRANSFORMER SIZE

**SINGLE PHASE MOTORS - 230 VOLTS**

| H.P. | TRANSFORMER KVA | DISTANCE - MOTOR TO TRANSF. IN FT. | | | | |
|---|---|---|---|---|---|---|
| | | 100 | 150 | 200 | 300 | 500 |
| 1 1/2 | 3 | 10 | 8 | 8 | 6 | 4 |
| 2 | 3 | 10 | 8 | 8 | 6 | 4 |
| 3 | 5 | 8 | 8 | 6 | 4 | 2 |
| 5 | 7 1/2 | 6 | 4 | 4 | 2 | 0 |
| 7 1/2 | 10 | 6 | 4 | 3 | 1 | 0 |

**THREE PHASE MOTORS - 230 & 460 VOLTS**

| H.P. | VOLTS | TRANSFORMER KVA | DISTANCE - MOTOR TO TRANSF. IN FT. | | | | |
|---|---|---|---|---|---|---|---|
| | | | 100 | 150 | 200 | 300 | 500 |
| 1 1/2 | 230 | 3 | 12 | 12 | 12 | 12 | 10 |
| 1 1/2 | 460 | 3 | 12 | 12 | 12 | 12 | 12 |
| 2 | 230 | 3 | 12 | 12 | 12 | 10 | 8 |
| 2 | 460 | 3 | 12 | 12 | 12 | 12 | 12 |
| 3 | 230 | 5 | 12 | 10 | 10 | 8 | 6 |
| 3 | 460 | 5 | 12 | 12 | 12 | 12 | 10 |
| 5 | 230 | 7 | 10 | 8 | 8 | 6 | 4 |
| 5 | 460 | 1/2 | 12 | 12 | 12 | 10 | 8 |
| 7 1/2 | 230 | 7 1/2 | 8 | 6 | 6 | 4 | 2 |
| 7 1/2 | 460 | 10 | 12 | 12 | 12 | 10 | 8 |
| 10 | 230 | 10 | 6 | 4 | 4 | 4 | 1 |
| 10 | 460 | 15 | 12 | 12 | 12 | 10 | 8 |
| 15 | 230 | 15 | 4 | 4 | 4 | 2 | 0 |
| 15 | 460 | 20 | 12 | 10 | 10 | 8 | 6 |
| 20 | 230 | 20 | 4 | 2 | 2 | 1 | 000 |
| 20 | 460 | | 10 | 8 | 8 | 6 | 4 |
| 25 | 230 | | 2 | 2 | 2 | 0 | 000 |
| 25 | 460 | Consult | 8 | 8 | 6 | 6 | 4 |
| 30 | 230 | Local | 2 | 1 | 1 | 00 | 0000 |
| 30 | 460 | Power | 8 | 6 | 6 | 4 | 2 |
| 40 | 230 | Company | 1 | 0 | 00 | 0000 | 300 |
| 40 | 460 | | 6 | 6 | 4 | 2 | 0 |
| 50 | 230 | | 1 | 0 | 00 | 0000 | 300 |
| 50 | 460 | | 4 | 4 | 2 | 2 | 0 |
| 60 | 230 | | 1 | 00 | 000 | 250 | 500 |
| 60 | 460 | | 4 | 2 | 2 | 0 | 00 |
| 75 | 230 | | 0 | 000 | 0000 | 300 | 500 |
| 75 | 460 | | 4 | 2 | 0 | 00 | 000 |

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# Motor Trouble-Shooting Chart

Caution:
1. Disconnect power to the motor before performing service or maintenance.
2. Discharge all capacitors before servicing motor.
3. Always keep hands and clothing away from moving parts.
4. Be sure required safety guards are in place before starting equipment.

| Problem: | Like Causes: | What To Do: |
|---|---|---|
| Motor fails to start upon initial installation. | Motor is miswired. | Verify motor is wired correctly. |
| | Motor damaged and rotor is striking stator. | May be able to reassemble; otherwise, motor should be replaced. |
| | Fan guard bent and contacting fan. | Replace fan guard. |
| Motor has been running, then fails to start. | Fuse or circuit breaker tripped. | Replace fuse or reset the breaker. |
| | Stator is shorted or went to ground. Motor will make a humming noise and the circuit breaker or fuse will trip. | Disassemble motor and inspect windings and internal connections. A blown stator will show a burn mark. Motor must be replaced or the stator rewound. |
| | Motor overloaded or load jammed. | Inspect to see that the load is free. Verify amp draw of motor versus nameplate rating. |
| | Capacitor (on single phase motor) may have failed. | First discharge capacitor. To check capacitor, set volt-ohm meter to RX100 scale and touch its probes to capacitor terminals. If capacitor is OK, needle will jump to zero ohms, and drift back to high. Steady zero ohms indicates a short circuit; steady high ohms indicates an open circuit. |
| | Starting switch has failed. | Disassemble motor and inspect both the centrifugal and stationary switches. The weights of the centrifugal switch should move in and out freely. Make sure that the switch is not loose on the shaft. Inspect contacts and connections on the stationary switch. Replace switch if the contacts are burned or pitted. |
| Motor runs but dies down. | Voltage drop. | If voltage is less than 10% of the motor's rating contact power company or check if some other equipment is taking power away from the motor. |
| | Load increased. | Verify the load has not changed. Verify equipment hasn't got tighter. If fan application verify the air flow hasn't changed. |
| Motor takes too long to accelerate. | Defective capacitor | Test capacitor per previous instructions. |
| | Faulty stationary switch. | Inspect switch contacts and connections. Verify that switch reeds have some spring in them. |
| | Bad bearings. | Noisy or rough feeling bearings should be replaced. |
| | Voltage too low. | Make sure that the voltage is within 10% of the motor's name-plate rating. If not, contact power company or check if some other equipment is taking power away from the motor. |
| Motor runs in the wrong direction. | Incorrect wiring. | Rewire motor according to wiring schematic provided. |
| Motor overload protector continually trips. | Load too high. | Verify that the load is not jammed. If motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a stock motor may not be able to duplicate the performance. Remove the load from the motor and inspect the amp draw of the motor unloaded. It should be less than the full load rating stamped on the nameplate. |
| | Ambient temperature too high. | Verify that the motor is getting enough air for proper cooling. Most motors are designed to run in an ambient temperature of less than 40°C. (Note: A properly operating motor may be hot to the touch.) |
| | Protector may be defective. | Replace the motor's protector with a new one of the same rating. |
| | Winding shorted or grounded. | Inspect stator for defects, or loose or cut wires that may cause it to go to ground. |

# Motor Trouble-Shooting Chart

**10/13/00 (continued)**

| Problem: | Like Causes: | What To Do: |
|---|---|---|
| Motor vibrates. | Motor misaligned to load. | Realign load. |
| | Load out of balance. (Direct drive application.) | Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is .001" runout per every inch of shaft length. |
| | Motor bearings defective. | Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Replace bearings. Add oil if a sleeve of bearing. Add grease if bearings have grease fittings. |
| | Rotor out of balance. | Inspect motor by itself with no load attached. If it feels rough and vibrates but the bearings are good, it may be that the rotor was improperly balanced at the factory. Rotor must be replaced or rebalanced. |
| | Motor may have too much endplay. | With the motor disconnected from power turned shaft. It should move but with some resistance. If the shaft moves in and out too freely, this may indicate a preload problem and the bearings may need additional shimming. |
| | Winding may be defective. | Test winding for shorted or open circuits. The amps may also be high. Replace motor or have stator rewound. |
| Bearings continuously fail. | Load to motor may be excessive or unbalanced. | Besides checking load, also inspect drive belt tension to ensure it's not too tight may be too high. An unbalanced load will also cause the bearings to fail. |
| | High ambient temperature. | If the motor is used in a high ambient, a different type of bearing grease may be required. You may need to consult the factory or a bearing distributor. |
| The motor, at start up, makes a loud rubbing or grinding noise. | Rotor may be striking stator. | Ensure that motor was not damaged in shipment. Frame damage may not be repairable. If you cannot see physical damage, inspect the motor's rotor and stator for strike marks. If signs of rubbing are present, the motor should be replaced. Sometimes simply disassembling and reassembling motor eliminates rubbing. Endbells are also sometimes knocked out of alignment during transportation. |
| Start capacitors continuously fail. | The motor is not coming up to speed quickly enough. | Motor may not be sized properly. Verify how long the motor takes to come up to speed, Most single phase capacitor start motors should come up to speed within three seconds. Otherwise the capacitors may fail. |
| | The motor is being cycled too frequently. | Verify duty cycle. Capacitor manufacturers recommend no more than 20, three-second starts per hour. Install capacitor with higher voltage rating, or add bleed resistor to the capacitor. |
| | Voltage to motor is too low. | Verify that voltage to the motor is within 10% of the nameplate value. If the motor is rated 208-230V, the deviation must be calculated from 230V. |
| | Starting switch may be defective, preventing the motor from coming out of start winding. | Replace switch. |
| Run capacitor fail. | Ambient temperature too high. | Verify that ambient does not exceed motor's nameplate value. |
| | Possible power surge to motor, caused by lightning strike or other high transient voltage. | If a common problem, install surge protector. |

LEESON®
ELECTRIC MOTORS
GEARMOTORS AND DRIVES

# DC Motor Trouble-Shooting Chart

Caution:
1. Disconnect power to the motor before performing service or maintenance.
2. Discharge all capacitors before servicing motor.
3. Always keep hands and clothing away from moving parts.
4. Be sure required safety guards are in place before starting equipment.

| Problem: | Like Causes: | What To Do: |
|---|---|---|
| Motor fails to start upon initial installation. | Motor is miswired. | Verify that the motor is wired correctly. |
| | No output power from controller. | Measure voltage coming from the controller. |
| | Motor damaged and the fan guard is contacting the cooling fan. | Replace fan guard. |
| | Motor is damaged and the armature is rubbing against the magnets. | Disassemble motor and see if the armature can be realigned by reassembly. Motor may have to be replaced. |
| Motor has been running, then fails to start. | Fuse or circuit breaker is tripped. | Replace the fuse or reset the breaker. |
| | Armature is shorted or went to ground. Motor may make a humming noise and the circuit breaker or fuse will trip. | Disassemble motor and inspect the armature for a burnt coil. Inspect the commutator for burnt bars. If this condition exists, the motor needs to be replaced. To test, set your OHM meter to the RX1 scale, touch probes to bars 180 degrees apart all around the commutator. The reading should be equal. |
| | The brushes may be worn down too far and no longer make contract with the commutator. | Inspect the brushes to make sure that they are still making contact with the commutator. Refer to manufacturer's recommended brush length chart. |
| | Controller may be defective. | Verify voltage is coming out of the controller. |
| Motor runs but loses power. | Load had increased. | Verify the load has not changed. Measure the amp draw of motor against the full load amp rating of the motor. If the amp draw is higher then rating, motor is undersized for application. |
| | Motor controller not properly set. | Check controller manual for adjustments. The torque and/or IR compensation settings may need adjustment. |
| | Motor may have an open connection. | Inspect the armature for an open connection. |
| | Brushes may not be seated properly or worn beyond their useful length. | Verify that the brushes are properly seated and measure their length against the recommended brush length chart. |
| Motor takes too long to accelerate. | Motor controller not properly set. | The accel trim pot of the controller should be adjusted. |
| | Brushes are worn. | Verify brush length. |
| | Bearings may be defective. | Inspect bearings for proper service. Noisy or rough bearings should be replaced. |
| Motor runs in the wrong direction. | Incorrect wiring. | Interchange the two motor leads. |
| Motor runs ok but has a clicking noise. | Suspect a burr on the commutator. | Stone the armature commutator with a commutator stone to remove burr. |

Bulletin F210-70-12
September 1995
Supersedes April 1981

## SPORLAN VALVE COMPANY

### SUBJECT: CONSTANT PRESSURE EXPANSION VALVE FOR AMMONIA (R-717)

### TYPE PDA-1-0/80

Limited: M & W

The PDA-1-0/80 constant pressure or automatic expansion valve is a downstream pressure regulating device that is applicable on ammonia (R-717) systems. The valve regulates the mass flow rate of refrigerant to maintain downstream pressure at a constant value. The normal application of this valve is to feed liquid refrigerant to an evaporator with a relatively constant heat load. However, the PDA-1-0/80 can be used to maintain a constant downstream pressure on other applications as well.

For example, the PDA-1-0/80 is applicable as a discharge bypass valve for compressor capacity control as long as the pressure drop between the outlet of the valve and the control point (usually compressor suction) is below 4-5 psi. For applications beyond that range, an externally equalized model would be required (contact Sporlan Valve Company). A unique application of this valve is to control the external equalizer pressure of a thermostatic expansion valve specially designed for cooling the oil of a screw type compressor. For other applications, contact your Sporlan Valve Company Sales Engineer.

**Specifications** - The PDA-1-0/80 embodies the same design and construction details as the Type D thermostatic expansion valve. However, the valve utilizes an element with an adjustable spring assembly in place of the thermostatic element. Also, a non-adjustable bottom cap replaces the external superheat adjustment. The adjustment range is 0 to 80 psig with a standard setting of 60 psig.

**Specifications**

| Valve Type | Nominal Capacity (Tons) | Port Size (Inches) | Discharge Tube Size (Inches) | Adjustment Range (psig) | Connections (Inches - FPT) | | Flange Ring Size (Approx.) OD x ID (Inches) | Net Weight (lb.) | Ship Weight (lb.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Inlet | Outlet | | | |
| PDA-1-0/80 | 1 | 1/16 | 1/32 | 0/80 | 1/4, 3/8 or 1/2 | | 1.12 x 0.75 | 8 | 9 |

**Inlet Strainer** - The need for an inlet strainer is a function of system cleanliness and proper installation procedures. The PDA-1-0/80 is supplied automatically with a cleanable internal strainer which is removable when the inlet flange is removed. A Type **XD-074** (1/2" FPT) strainer is available if an external, cleanable strainer is specified.

**Installation** - The PDA-1-0/80 can be installed in any position, whichever best suits the application and permits easy adjustment and accessibility. However, consideration should be given to locating these valves so they don't act as oil or liquid refrigerant traps which can cause poor system performance. It is always important that some precautions be taken in mounting the valves. They should be adequately supported to prevent excessive stress on the connections.

**Piping** - Sporlan recommends that recognized piping references, such as equipment manufacturer's literature and the ASHRAE Handbook, be consulted for assistance with proper piping procedures. Sporlan is not responsible for system design, any damage arising from faulty system design, or for misapplication of its products. If these valves are applied in any manner other than as described in this bulletin, and other Sporlan product literature, the Sporlan warranty is void.

Actual system piping must be done so as to protect the compressor at all times. This includes protection against overheating, slugging with liquid refrigerant, and trapping oil in various system locations.

Since the PDA-1-0/80 may be applied in a bypass line between the discharge line and the low side of the system, the valve may be subjected to compressor vibrations which result from discharge pulses and inertia forces associated with the moving parts. These pulses and forces must be controlled by accepted industry practices.

| Capacity - Tons of Refrigeration | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Evaporator Temperature - °F | | | | | | | | | | | |
| 40 | | | | 20 | | | | 5 | | | |
| Pressure Drop Across Valve - psi | | | | | | | | | | | |
| 80 | 100 | 120 | 140 | 100 | 120 | 140 | 160 | 100 | 120 | 140 | 160 |
| 1.91 | 2.24 | 2.53 | 2.79 | 1.77 | 2.04 | 2.27 | 2.48 | 1.39 | 1.62 | 1.82 | 2.00 |
| Evaporator Temperature - °F | | | | | | | | | | | |
| -10 | | | | -20 | | | | -30 | | | |
| Pressure Drop Across Valve - psi | | | | | | | | | | | |
| 120 | 140 | 160 | 180 | 120 | 140 | 160 | 180 | 120 | 140 | 160 | 180 |
| .89 | 1.00 | 1.11 | 1.21 | .73 | .84 | .93 | 1.01 | .63 | .73 | .81 | .88 |

The ratings are based on 86°F liquid entering the expansion valve, a maximum superheat change of 7°F, and standard factory setting.

**Refrigerant Liquid Temperature Correction Factors**

| Refrigerant Liquid Temperature - °F | 100 | 90 | 86 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correction Factor | 0.96 | 0.99 | 1.00 | 1.02 | 1.05 | 1.08 | 1.11 | 1.14 | 1.17 | 1.20 | 1.24 | 1.27 |

**Valve Setting and Adjustment** - The PDA-1-0/80 can be set to maintain any downstream pressure from 0 to 80 psig. The valve setting should be selected to utilize evaporator surface effectively when the system load is at a minimum to avoid the possibility of floodback to the compressor during low load operation. When the load is at a maximum, the increase in evaporator pressure will cause the valve to modulate to a more closed position. This prevents the pressure from rising further and overloading the compressor.

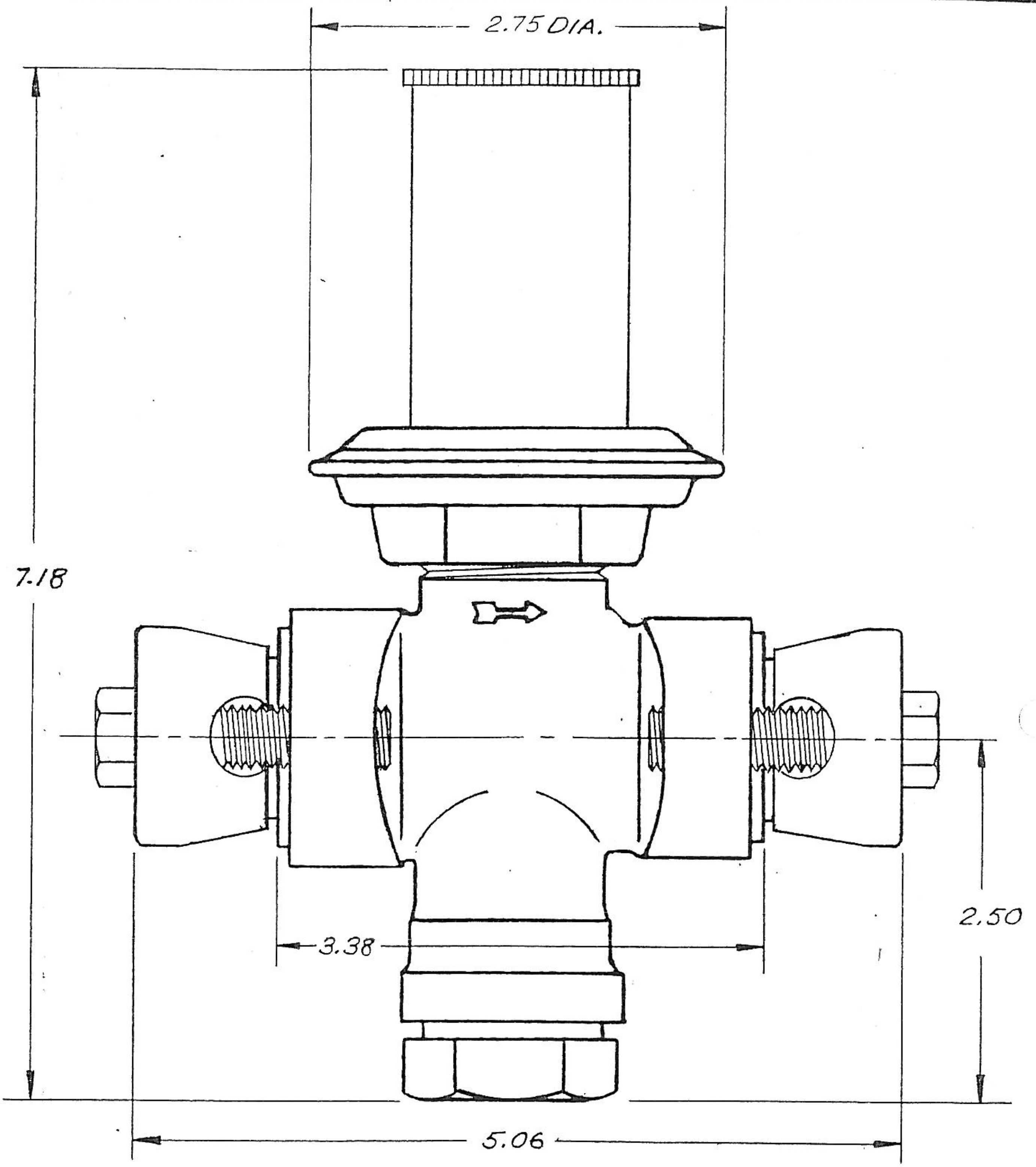
To adjust the PDA-1-0/80, remove the cap and turn the adjustment nut with a 5/16" hex wrench. A clockwise rotation increases the setting and a counter clockwise rotation decreases the setting. Replace the cap after completing the adjustment procedure.

**Service Instructions** - There are several possible causes for system malfunction when the PDA-1-0/80 is applied. As with any form of trouble shooting, it is essential to know the symptoms or existing operating temperatures and pressures for the type of application before the malfunction can be determined. Once the actual malfunction is pinpointed, it is easier to isolate the cause and then take appropriate corrective action.

| Problem | Possible Cause | Remedy |
|---|---|---|
| Failure to Open | 1. Dirt or foreign material in valve<br>2. Inlet strainer plugged | 1. Disassemble valve and clean<br>2. Clean strainer |
| Failure to Close | 1. Dirt or foreign material in valve<br>2. Diaphragm failure<br>3. Equalizer passageway plugged<br>4. Damaged internal parts | 1. Disassemble valve and clean<br>2. Replace element only<br>3. Disassemble valve and clean<br>4. Replace internal parts |

| Replacement Parts | | | | | | |
|---|---|---|---|---|---|---|
| Valve Type | Replaceable Element Kit | Internal Parts Kit | Flange 1/4" FPT | Flange 3/8" FPT | Flange 1/2" FPT | Flange Gasket |
| PDA-1-0/80 | A-2-0/80 | KP10-0010 * | 225-000 | 225-001 | 225-002 | 106-004 |

* The PDA-1-0/80 internal parts kit is identical to the internal parts kit for the DA(E)-1 thermostatic expansion valve. However, the pushrod height required for the PDA-1-0/80 is different than the pushrod height for the DA(E)-1. All DA(E) thermostatic expansion valves use the #2 pushrod gauge (refer to the pushrod gauge included with the kit) which provides a pushrod height of 0.222". The PDA-1-0/80 requires a pushrod height of 0.230". When sizing the PDA-1-0/80 pushrod height, use the #2 gauge and allow for an additional 0.008".




REVISIONS

① REVISED 3-17-81 RGK/EPS

| | | | |
|---|---|---|---|
| TOLERANCE EXCEPT AS NOTED | SPORLAN VALVE COMPANY<br>ST. LOUIS, MO. 63143 | | |
| TWO PLACE DECIMALS ±.01 | PDA-1-0/80<br>AUTOMATIC VALVE | | |
| THREE PLACE DECIMALS ±.005 | PART NO. | | MATERIAL |
| | DRAWN RGK | APPROVED EPS | DRAWING NO. |
| ANGULAR ± 0.5° | SCALE NONE | DATE 4-2-80 | A(S)2048 |

**Bulletin C401d**
March, 2002

# HANSEN TECHNOLOGIES CORPORATION

HCK4-4 Check Valve

**Specifications, Applications, Service Instructions & Parts**

## HCK4 IN-LINE CHECK VALVES
## $^5/_8$" thru 4" PORT
## (16 thru 100 mm)

**Flanged**
**$^3/_8$" thru 4"**
**FPT, SW, WN, ODS**
**for refrigerants**

## INTRODUCTION

The HCK4 series of dependable, compact, rugged in-line check valves (disc type non-return valves) is ideally suited for refrigerant flow control applications. Valves open wide for flow in the arrow direction on the valve body. Valves close quickly and reliably when flow reversals occur.

Plated bodies and stainless steel seat discs and springs enable them to withstand expected industrial refrigeration conditions. Furthermore, these check valves can be mounted in any position, close-coupled to other valves, and use same flanges as Parker R/S, Frick, and Henry.

## ADVANTAGES

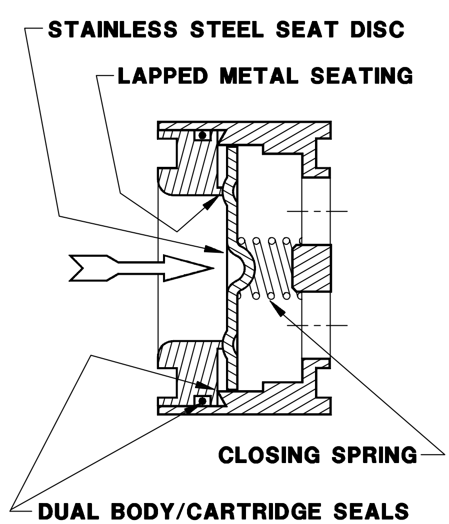
These compact check valves offer reliable operation regardless of position. Corrosion resistant stainless steel seat disc. Metal-to-metal seats facilitate durable, tight closing of valves.

## APPLICATIONS

These in-line check valves are designed to provide refrigerant flow control to hot gas lines, liquid lines, compressor discharge lines, suction lines, and hot gas heated drain pans.

These valves are not recommended for use with pulsating loads such as low speed compressor discharge and screw compressor side port applications. For applications such as these, use Hansen HCK1 piston type check valves.

## KEY FEATURES




## ADDITIONAL FEATURES

Mounts in any position
Less than 1 PSID wide opening pressure
Can be close-coupled
Low bubble leakage tolerance
For Ammonia, R22, R134a, and other approved refrigerants
Dimensionally replaces R/S CK4A-2, -3, -4, -8, & -1
U.L. Listed

## MATERIAL SPECIFICATIONS

Body:
- 5/8" thru 1¼": Steel, ASTM A108, zinc chromate plated
- 1½" thru 4": Ductile iron, ASTM A536, zinc chromate plated

Seat Disc: Stainless steel

Seat Cartridge:
- 5/8" thru 1¼": Stainless steel, ASTM A582
- 1½" thru 4": Steel, ASTM A108, zinc chromate plated

Spring: Stainless steel

Safe Working Pressure: 400 PSIG (27 bar)

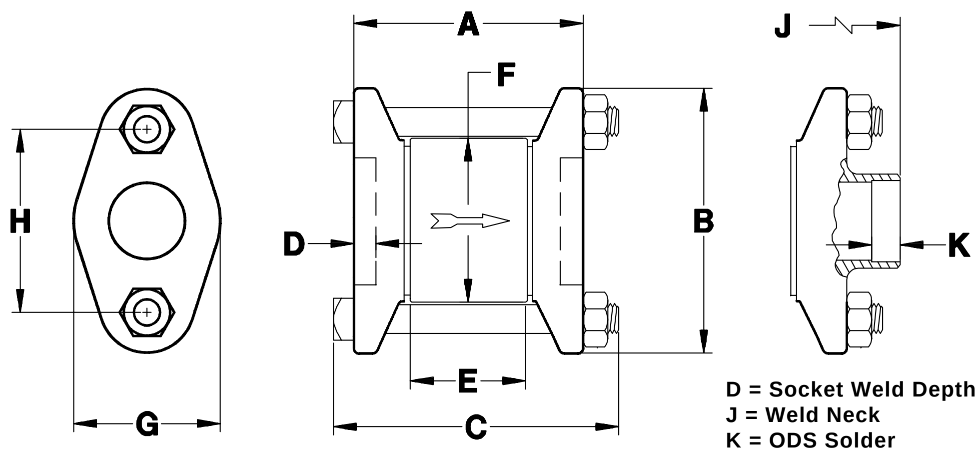
Operating Temperature: -60F to 240F (-50 to 115°C)

## INSTALLATION

Valve may be located in any position. Arrow on valve body should match direction of flow. Secure valve with gaskets between flanges and tighten bolts evenly. Do not use this valve or any component to align pipes or tighten gap between flanges.

Do not install on <u>inlet</u> side of solenoid valves or control valves with electric shut-off or shut-off valves unless a relief valve is used from therein between piping. Do not install on <u>inlet</u> side of outlet pressure regulators where liquid may become trapped. Instead, check valves should be located on outlet side of these valves. Check valves can be close-coupled to other matching solenoid valves, pressure regulators, or strainers by using a Male Adapter Ring and longer bolts supplied when so specified on order.

## INSTALLATION DIMENSIONS




D = Socket Weld Depth
J = Weld Neck
K = ODS Solder

| DIMENSION LETTER | HCK4-2* 5/8" PORT | HCK4-3* ¾" PORT | HCK4-4* 1" PORT | HCK4-5 1¼" PORT | HCK4-7 1½" PORT | HCK4-8* 2" PORT | HCK4-9 2½" PORT | HCK4-0 3" PORT | HCK4-1* 4" PORT |
|---|---|---|---|---|---|---|---|---|---|
| A | 2.50" (64 mm) | 3.25" (83 mm) | 3.25" (83 mm) | 3.25" (83 mm) | 5.06" (129 mm) | 5.06" (129 mm) | 6.06" (154 mm) | 6.06" (154 mm) | 6.39" (162 mm) |
| B | 3.19" (81 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 4.56" (116 mm) | 4.56" (116 mm) | 6.00" (152 mm) | 6.00" (152 mm) | 7.13" (181 mm) |
| C | 3.50" (89 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 4.50" (114 mm) | 6.38" (162 mm) | 6.38" (162 mm) | 7.50" (191 mm) | 7.50" (191 mm) | 8.00" (203 mm) |
| D | 0.38" (10 mm) | 0.50" (13 mm) | 0.50" (13 mm) | 0.50" (13 mm) | 0.75" (19 mm) | 0.75" (19 mm) | 1.00" (25 mm) | 1.00" (25 mm) | 1.00" (25 mm) |
| E = | 1.03" (26 mm) | 1.22" (31 mm) | 1.22" (31 mm) | 1.22" (31 mm) | 2.56" (65 mm) | 2.56" (65 mm) | 2.92" (74 mm) | 2.92" (74 mm) | 3.50" (89 mm) |
| F | 1.50" (38 mm) | 2.37" (60 mm) | 2.37" (60 mm) | 2.37" (60 mm) | 3.62" (92 mm) | 3.62" (92 mm) | 4.84" (123 mm) | 4.84" (123 mm) | 6.06" (154 mm) |
| G | 1.56" (40 mm) | 2.50" (64 mm) | 2.50" (64 mm) | 2.50" (64 mm) | 4.56" (116 mm) | 4.56" (116 mm) | 6.00" (152 mm) | 6.00" (152 mm) | 7.13" (181 mm) |
| H | 2.19" (56 mm) | 3.12" (79 mm) | 3.12" (79 mm) | 3.12" (79 mm) | 3.06" (78 mm) | 3.06" (78 mm) | 4.00" (102 mm) | 4.12" (105 mm) | 5.00" (127 mm) |
| J | 3.26" (83 mm) | 4" (102 mm) | 4" (102 mm) | 4" (102 mm) | 6.06" (154 mm) | 6.06" (154 mm) | 7.06" (179 mm) | 7.06" (179 mm) | 9.89" (251 mm) |
| K | 0.33" (8 mm) | 0.49" (12 mm) | 0.59" (15 mm) | 0.62" (16 mm) | 0.71" (18 mm) | 0.87" (22 mm) | 0.96" (24 mm) | 1.08" (27 mm) | 1.40" (36 mm) |
| Valve Cv (Kv) | 5.8 (5) | 8.2 (7) | 11.7 (10) | 14.0 (12) | 39 (33) | 50 (43) | 74 (63) | 93 (80) | 210 (180) |
| Pipe Size | ½", ¾" | ¾" | 1" | 1¼" | 1½" | 2" | 2½" | 3" | 4" |

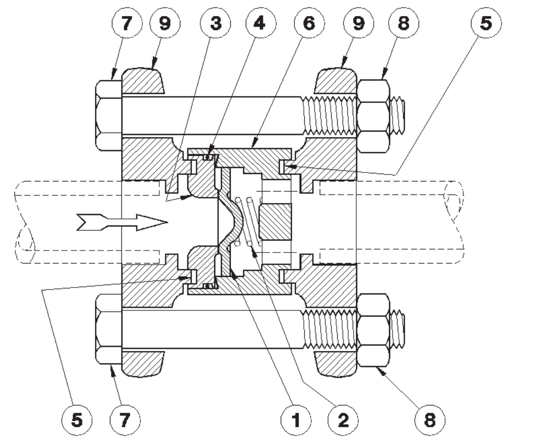
*Dimensionally replaces R/S check valve models CK4A-2, -3, -4, -8, and -1. = "E" dimension is check valve body outside edge to outside edge. Flange groove depth: nominal 0.12" each of two; gasket thickness: nominal 0.06" each of two.

# PARTS LIST

## HCK4-2 (2-BOLT)

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Valve Assembly Kit** | | |
| | Above Kit Consists of: | | |
| 1 | Seat Disc | 1 | 72-0069 |
| 2 | Closing Spring | 1 | 72-0070 |
| 3 | Seat Cartridge | 1 | 72-0068 |
| 4 | Seat Cartridge O-ring | 1 | 72-0071 |
| 5 | Flange Gasket | 2 | 70-0065 |
| 6 | Body, HCK4-2 | 1 | 72-0067 |
| 7 | Bolt (7/16" - 14 x 3.25") | 2 | 70-0225 |
| 8 | Nut (7/16" - 14) | 2 | 70-0055 |
| 9 | Flange (FPT, SW, WN, ODS) | 2 | FACTORY |

HCK4-2 (2-BOLT)

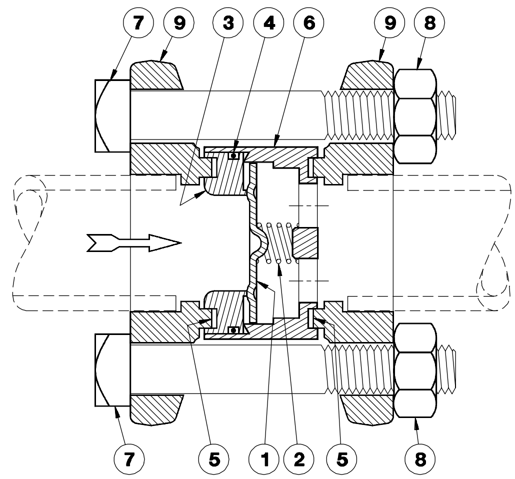



Socket weld shown. FPT, weld neck, ODS: available.

## HCK4-3, -4, -5 (2-BOLT)

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Valve Assembly Kit** | | |
| | Above Kit Consists of: | | |
| 1 | Seat Disc | 1 | 72-0006 |
| 2 | Closing Spring | 1 | 70-0204 |
| 3 | Seat Cartridge | 1 | 72-0002 |
| 4 | Seat Cartridge O-ring | 1 | 72-0003 |
| 5 | Flange Gasket | 2 | 70-0132 |
| 6a | Body, HCK4-3 | 1 | 72-0004 |
| 6b | Body, HCK4-4 | 1 | 72-0008 |
| 6c | Body, HCK4-5 | 1 | 72-0001 |
| 7 | Bolt (5/8" -11 x 4") | 2 | 72-0005 |
| 8 | Nut (5/8" -11) | 2 | 70-0136 |
| 9 | Flange (FPT, SW, WN, ODS) | 2 | FACTORY |

HCK4-3, -4, -5 (2-BOLT)

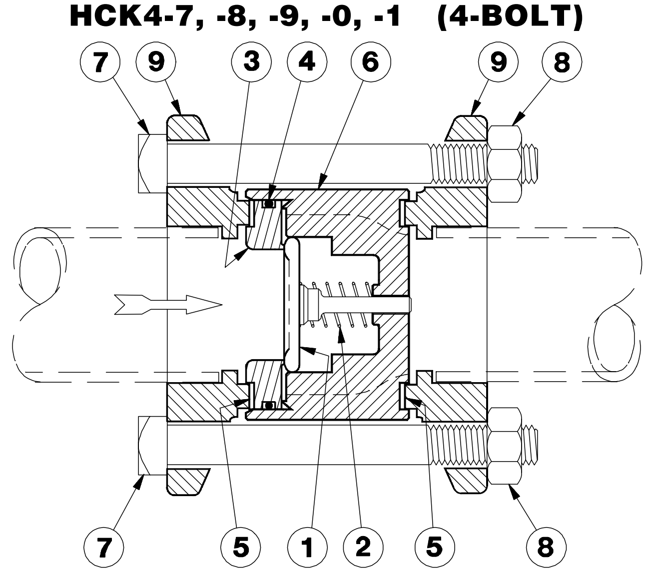



Socket weld shown. FPT, weld neck, ODS: available.

## HCK4-7, -8, -9, -0, -1 (4-BOLT)

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| 1a | Seat Disc 1½", 2" | 1 | 72-0016 |
| 1b | Seat Disc 2½", 3" | 1 | 72-0034 |
| 1c | Seat Disc 4" | 1 | 72-0053 |
| 2a | Closing Spring 1½", 2" | 1 | 72-0021 |
| 2b | Closing Spring 2½", 3" | 1 | 72-0032 |
| 2c | Closing Spring 4" | 1 | 72-0048 |
| 3a | Seat Cartridge 1½", 2" | 1 | 72-0020 |
| 3b | Seat Cartridge 2½" | 1 | 72-0029 |
| 3c | Seat Cartridge 3" | 1 | 72-0028 |
| 3d | Seat Cartridge 4" | 1 | 72-0047 |
| 4a | Seat Cartridge O-ring 1½", 2" | 1 | 72-0017 |
| 4b | Seat Cartridge O-ring 2½", 3" | 1 | 72-0027 |
| 4c | Seat Cartridge O-ring 4" | 1 | 72-0049 |
| 5a | Flange Gasket 1½", 2" | 2 | 75-0138 |
| 5b | Flange Gasket 2½" | 2 | 75-0125 |
| 5c | Flange Gasket 3" | 2 | 75-0137 |
| 5d | Flange Gasket 4" | 2 | 75-0253 |
| 6a | Body, HCK4-7 | 1 | 72-0042 |
| 6b | Body, HCK4-8 | 1 | 72-0019 |
| 6c | Body, HCK4-9 | 1 | 72-0025 |
| 6d | Body, HCK4-0 | 1 | 72-0026 |
| 6e | Body, HCK4-1 | 1 | 72-0046 |
| 7a | Bolt, HCK4-7, -8 (5/8" - 11 x 6") | 4 | 70-0268 |
| 7b | Bolt, HCK4-9, -0 (¾" - 10 x 7") | 4 | 72-0033 |
| 7c | Bolt, HCK4-1 (7/8" - 9 x 7.5") | 4 | 72-0051 |
| 8a | Nut, HCK4-7, -8 (5/8" - 11) | 4 | 70-0136 |
| 8b | Nut, HCK4-9, -0 (¾" - 10) | 4 | 75-0210 |
| 8c | Nut, HCK4-1 (7/8" - 9) | 4 | 75-0280 |
| 9 | Flange (FPT, SW, WN, ODS) | 2 | FACTORY |

HCK4-7, -8, -9, -0, -1 (4-BOLT)




Socket weld shown. Weld neck, ODS: available.

## OPERATION

HCK4 check valves are normally closed valves. As inlet pressure increases, it overcomes the closing spring force. As the seat disc is pushed back and away from the seat cartridge, flow through the valve occurs. The valve will remain open until the inlet pressure drops below the closing spring force or there is a flow reversal, at which time the seat disc will close against the seat cartridge, preventing reverse flow.

## SIZING

Check valves are normally selected on the basis of line size. However, for gas flow applications at low load conditions, a minimum of 1 psid across the valve is essential. This will maintain valve at full open position. Valve Cv (Kv) is listed in the installation dimension table on page 2. Factory valve sizing assistance is available.

## SERVICE AND MAINTENANCE

These valves are a reliable part of a refrigeration system. However, if valve does not appear to be operating satisfactorily, isolate it from the refrigeration system. Remove all refrigerant from associated piping and valves. Follow the guidelines in the caution section. Loosen each flange nut on the check valve. Break each flange gasket seal. Carefully loosen flange bolts one at a time, being cautious to avoid any refrigerant which still may be present. Remove check valve from flanges and inspect. Lapped seating surfaces should be smooth and free of pits or scratches.

To confirm valve operation, move seat disc with eraser end of pencil. Movement should be free from friction. If not, disassemble and visually inspect for dirt in valve or burrs on seat disc. Clean or replace parts as necessary. Valve discs and seats can be restored by lapping on a flat plate.

Reassemble valve and insert between flanges. Replace and tighten bolts and nuts evenly. Carefully check for leaks before returning to service.

## CAUTION

Hansen check valves are only for refrigeration systems. These instructions and related safety precautions must be completely read and understood before selecting, using, or servicing these valves. Only knowledgeable, trained refrigeration mechanics should install, operate, or service these valves. Stated temperature and pressure limits should not be exceeded. Valves should not be removed unless system has been evacuated to zero pressure. See also Safety Precautions in current List Price Bulletin and Safety Precautions Sheet supplied with product. Escaping refrigerant might cause personal injury, particularly to the eyes and lungs.

## WARRANTY

Hansen valves are guaranteed against defective materials or workmanship for one year F.O.B. our plant. No consequential damages or field labor is included.

## ORDERING INFORMATION, HCK4 CHECK VALVES

| TYPE | PORT SIZE (mm) | FLANGE CONNECTION STYLE & SIZES | | |
|---|---|---|---|---|
| | | FPT, SW, WN | | ODS |
| | | STD | ALSO | STD |
| HCK4-2* | ⅝" (16) | ½" | ⅜", ¾" | ⅝" |
| HCK4-3* | ¾" (20) | ¾" | 1", 1¼" | ⅞" |
| HCK4-4* | 1" (25) | 1" | ¾", 1¼" | 1⅛" |
| HCK4-5 | 1¼" (32) | 1¼" | ¾", 1" | 1⅜" |
| HCK4-7 | 1½" (40) | 1½" | 2" | 1⅝" |
| HCK4-8* | 2" (50) | 2" | 1½" | 2⅛" |
| HCK4-9 | 2½" (65) | 2½" | 3" | 2⅝" |
| HCK4-0 | 3" (80) | 3" | -- | 3⅛" |
| HCK4-1* | 4" (100) | 4" | -- | 4⅛" |

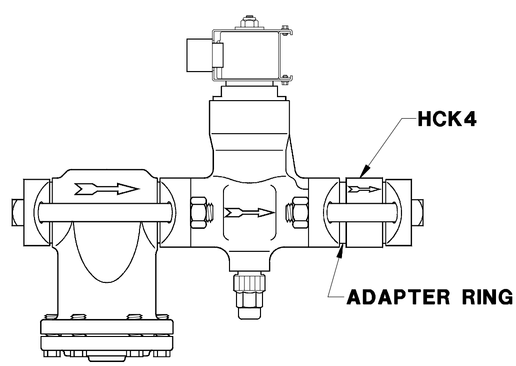
*Replaces R/S CK4A-2, CK4A-3, CK4A-4, CK4A-8, & CK4A-1.
HCK4-2 close-couples to HS6 & HS8 Solenoid Valves.
HCK4-3, -4, & -5 close-couples to HS7 Solenoid Valve.
FPT available only ⅜" to 1¼".

**TO ORDER:** Specify valve type, connection style and size, and close-coupling information if needed.

## TYPICAL SPECIFICATIONS

"Refrigeration in-line check valves shall have steel or ductile iron bodies, stainless steel seat discs, stainless steel closing springs, and be suitable for a safe working pressure of 400 PSIG, as manufactured by Hansen Technologies Corporation type HCK4 or approved equal."

**Typical close-coupling to solenoid valve.**




ISO 9002
Hansen Technologies Corp.
Burr Ridge, IL Cert. # 000472
Orlando, FL Cert. # 001523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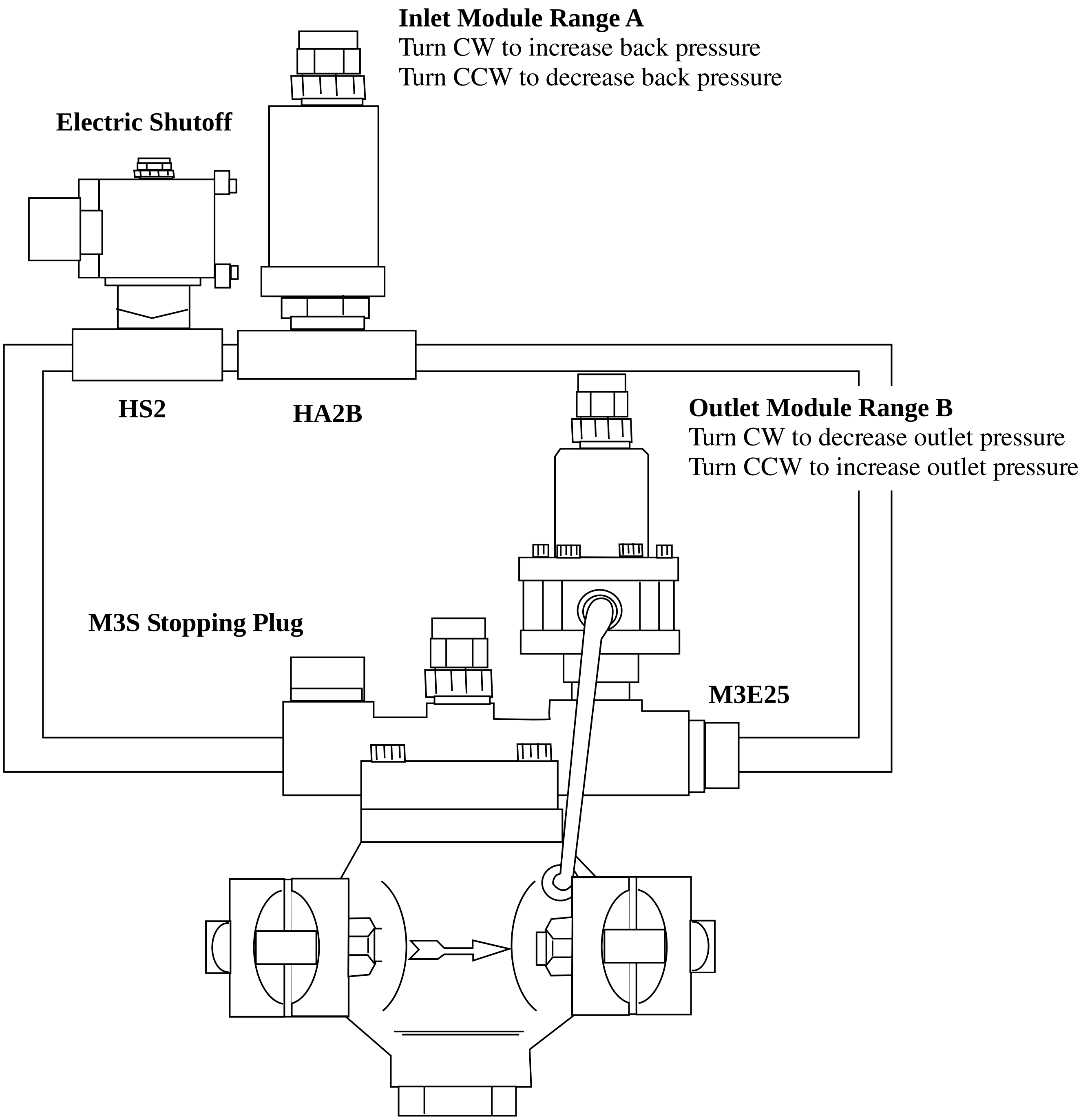
Printed in U.S.A.

# Hansen HA4AOAS

**Inlet/Outlet Regulator for Screw Compressor Economizer**

(Controls Pressure of accumulator or other types of vessels that is economized and controls outlet pressure to economizer port on screw compressor)



# HA4AOAS - Inlet/Outlet Economizer Port / Side Load Pressure Regulator

**Purpose:** To maintain an operating pressure in the economizer or side load vessel, while providing a means of protecting the compressor motor from overloading from high economizer loads during start-up, or from high side loads.

**Construction:** This valve is made up of an Outlet Pressure Regulator Base, an Inlet Pressure Regulator Module, and a Shut Off Solenoid.

**Operation:** The Shut Off Solenoid must be energized to activate the HA4AOAS valve. For a flash type or shell & coil type economizer, or for side load applications, the solenoid must be activated when the compressor starts. For a direct expansion type, the solenoid is generally activated when the compressor reaches 30% to 70% compressor capacity, depending on the system.

## Adjusting the Inlet / Economizer or Side Load Pressure

The estimated economizer operating pressure of the valve will be as shown on the performance printout for the compressor unit. Side load pressure settings would be set as required for the system. By means of a pressure gauge, the actual economizer operating pressure can be determined by placing the Inlet Pressure Regulator module range spring at minimum force (control module stem should be fully turned counter-clockwise). Leaving the regulator in this position, the actual economizer compressor port pressure can be read. NOTE: The compressor must be at 100% capacity and at normal operating suction and discharge pressures before the actual port pressure can be determined. Once this pressure is known, the module stem should be turned clockwise until there is a slight increase in pressure shown on the gauge. Increasing the turns on the module stem will raise the inlet pressure.

## Adjusting the Outlet / Maximum Port Pressure

The Outlet Pressure setting is a maximum pressure setting that will allow the compressor to load to 100%. If too much economizer or side port gas flow occurs, port pressure increases resulting in a motor amperage increase, which may result in amp limiting and the compressor will not load to 100%. In order to adjust the Outlet Pressure Module, its range spring should be set near maximum force (control module stem should be fully turned clockwise). If the compressor is not able to fully load because of Amp limiting, the outlet pressure needs to be decreased by turning the stem counter-clockwise until there is a decrease in pressure shown on the gauge. Reduce outlet pressure until motor amperage drops and the compressor is able to load to 100% capacity. Make sure that the Outlet Pressure setting is at least 10 psig higher than the inlet pressure to prevent a conflict in operation of the inlet and outlet features of the valve. NOTE: There must be abnormally high gas flow to set the outlet feature. It may not be necessary to use the outlet feature if the compressor motor has been sized large enough so that the unit does not amp limit on high economizer or side load gas flow.

**Bulletin G359b**
January, 2003

**HANSEN TECHNOLOGIES CORPORATION**

**Specifications, Applications, Service Instructions & Parts**

# BUTT WELD SHUT-OFF VALVES

**2" through 14"
(50 mm through 350 mm)
Globe & Angle
for refrigerants**

AW301H 3" (80 mm)
Butt Weld Angle Valve

## INTRODUCTION

These low pressure drop refrigerant shut-off valves are designed to be butt-welded directly to steel piping, thereby eliminating potential leaky flanges or threaded joints and simplifying installation. Cast steel bodies are lightweight, yet have substantial wall thickness to overcome corrosion potential. The cast steel body is rigid, reducing the potential for seat leakage due to flexing of the valve body under abnormal conditions. The "heart" of Hansen shut-off valves is the patented no-leak seal-plus-stem-packing design. This seal design is used exclusively on Hansen shut-off valves and virtually eliminates stem seal leakage.

## APPLICATIONS

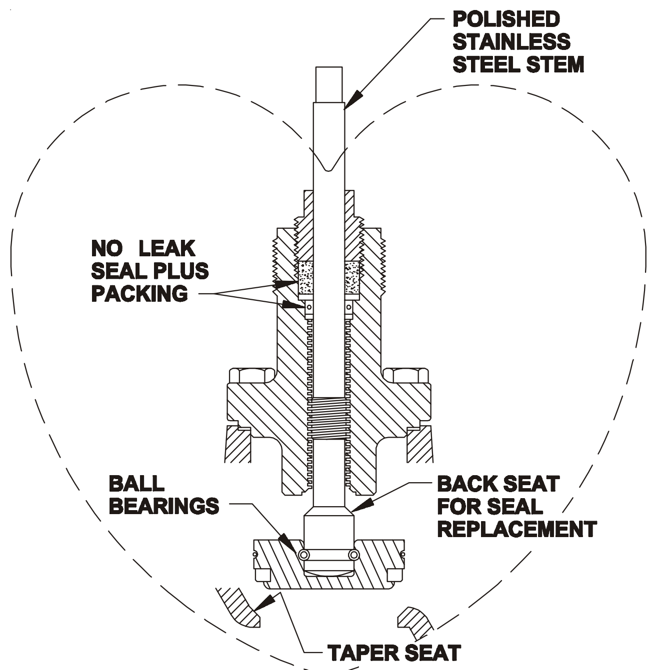
Typical uses include:

Ammonia refrigeration system suction, liquid, discharge, recirculating liquid, hot gas, thermosyphon, and oil lines, using handwheel or seal cap models.

The low friction, no leak stem seal design permits the use of chain actuation for crossover applications without the need to retighten the packing.

Steel pipe portions of halocarbon, commercial, industrial, and air conditioning systems, using seal cap models.

## KEY FEATURES




## ADDITIONAL FEATURES

Globe and angle valves available.
Interchangeable handwheel or seal cap.
2" thru 10" machined to Schedule 40 pipe, 12" and above Standard Weight pipe.
Teflon seat disc.
Chain actuators available.
Suitable for ammonia, R22, R134a, R507, and other compatible refrigerants.
Suitable for $CO_2$ systems on request.

## MATERIAL SPECIFICATIONS

Body: Cast steel, ASTM A-352, Grade LCB
Bonnet: Ductile iron, 2"-8" A-536;
10", 12", &14 " ASME SA-395
Stem: Polished stainless steel
Disc Holder: Plated steel
Seat Disc: Retained PTFE Teflon
Ball Bearings: Stainless steel
Packing Nut: Zinc plated steel
Stem Packing: Graphite composite plus neoprene O-ring in series
Handwheel: Zinc plated iron alloy 2"-4"; cast aluminum 5"-14"
Seal Cap: Zinc plated steel 2"-4"; cast aluminum 5"-14"
Temperature Range:
–60°F to 240°F (–50°C to 115°C), temperatures below –60°F (–50°C) at lower pressures
Safe Working Pressure: 400 psig (27 bar), 600 psig (40bar) upon request.
Connection Dimensions: 2"-10"Match Schedule 40 pipe , 12" & Up Match Standard Weight Pipe

## ADVANTAGES

Compared to conventional stem seal designs, Hansen's patented no leak seal-plus-stem-packing virtually eliminates stem seal leakage. In addition, the stem is polished to avoid packing wear, the precision stem threads avoid stem wobble and the packing nut is close fitting to remove dirt particles and frost from the stem. This results in infrequent maintenance or tightening and almost no refrigerant loss.

Compared to threaded valves, Hansen welding valves eliminate the chance of future leaks at pipe threads. In addition, a butt weld pipe-to-valve body joint eliminates the inherent weakness and corrosion vulnerability of the threaded portion of pipe immediately adjacent to a screwed valve body or flange.

Compared to flanged valves, Hansen welding valves eliminate the gasket joint leakage potential at the flange joint. This gasket can leak due to pipe and bolt-nut movement as the result of temperature and pressure fluctuations. The pressure drop of Hansen valves is lower than conventional flanged cast valve bodies. In addition, nearly all other refrigeration flanged valves are made of cast iron or "semi-steel." The cast steel bodies of Hansen valves have much greater tensile strength, ductility, and impact resistance than cast iron or "semi-steel."

Compared to pressed-sheet-steel welding valves, Hansen valves have thicker walls for greater rigidity and corrosion resistance.

Compared to ball valves, Hansen welding valves have no threaded or flanged-gasket pipe joints. Hansen valves also will not open or close so rapidly as to cause severe pipe shock due to sudden change in liquid velocity. In addition, ball valve stem packing typically cannot be replaced while the valve is in a pressurized line. The stem packing on these Hansen valves can be replaced while the valve is in a pressurized line. Also, dirt or damage to ball valve Teflon seats cannot be overcome by greater stem closing forces, an advantage of Hansen valves.

## INSTALLATION

All Hansen weld valves can be installed in horizontal or vertical pipe lines. Stems are normally installed horizontally, but, depending on the application, stems may be installed vertically. Inlet pressure or direction of flow for all valve sizes should normally be under valve seat disc. However, to avoid installing an angle valve with the stem down, it is better to install the valve with the normal flow opposite the direction of the arrow.

Care must be taken when handling and installing large valves. Proper lifting devices and safety precautions must be observed.

A valve should have its bonnet assembly removed before welding. This reduces weight during welding, protects the Teflon seat disc from welding sparks, and facilitates cleaning of welding debris from the body interior prior to valve operation. The valve stem should be several turns open when removing and replacing the bonnet assembly. The Teflon seat disc should be protected when outside of the valve. Do not allow the Teflon seat to bump the valve body when removing it or stand the bonnet on the seat disc. Where it is necessary or standard practice to weld a valve into the line without bonnet removal, the stem should be opened several turns to prevent heat damage to the seat disc. Extra care should be taken when welding angle valves without disassembly to avoid welding sparks striking the seat from the outlet weld connection.

Use of welding rings is recommended. They help alignment, control the gap for full penetration welding, and reduce the potential of welding debris entering the system. Welds should be annealed as necessary in accordance with good practice. Painting of valves and welds is recommended for corrosion protection. Pipe covering, where applied, should have a proper moisture barrier.

Before putting valves into service, all pipe weld connections, valve seats, bonnet seals, and stem seals should be tested for leaks at pressure levels called for in appropriate codes.

Shut-off valves leading to the atmosphere must not be left unsupervised and must be plugged or capped to prevent corrosion inside the valve as well as leakage due to seat expansion, vibration, pressure shock, or improper opening. The valve seat should be cracked open to prevent hydrostatic expansion between the valve and the cap. Valves should never directly feed a water tank because of potential internal corrosion or seat opening caused by vibration.

## INSULATION

Conventional valve-shaped block insulation can occasionally be used for both angle and globe valves. However, fabricated insulation shapes are recommended. If not available locally, Hansen can recommend a source of high quality, economical valve insulation. See page 5 of this bulletin for exterior valve dimensions.

# FLOW CAPACITIES
# PIPING AND VALVE SIZING GUIDE FOR AMMONIA

| SERVICE | CONDITIONS | | | | CAPACITIES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TEMPERATURE | | PRESSURE | | 2" (50 MM) | | 2½" (65 MM) | | 3" (80 MM) | | 4" (100 MM) | | 5" (125MM | |
| | °F | °C | PSIG | BAR | TONS | kW | TONS | kW | TONS | kW | TONS | kW | TONS | kW |
| Suction Lines Single Stage Compressor | +20 | -7 | 33.5 | 2.3 | 35.7 | 126 | 51.1 | 180 | 81.5 | 287 | 146 | 513 | 235 | 352 |
| | 0 | -18 | 15.7 | 1.1 | 22.7 | 80 | 34.0 | 120 | 53.9 | 190 | 94.6 | 333 | 156 | 549 |
| Suction Lines Booster | -20 | -29 | 3.6 | 0.3 | 16.8 | 59 | 24.8 | 87 | 39.7 | 140 | 68.9 | 242 | 114 | 401 |
| | -40 | -40 | 8.7 | 0.6 | 9.9 | 35 | 14.4 | 51 | 23.4 | 82 | 40.8 | 144 | 66.8 | 235 |
| Liquid Overfeed Return Lines (4X) | +20 | -7 | 33.5 | 2.3 | 20.6 | 72 | 29.4 | 103 | 47.0 | 165 | 84.3 | 296 | 135 | 475 |
| | 0 | -18 | 15.7 | 1.1 | 13.6 | 48 | 20.5 | 72 | 32.4 | 114 | 56.8 | 200 | 93.8 | 330 |
| | -20 | -29 | 3.6 | 0.3 | 8.9 | 31 | 13.1 | 46 | 21.0 | 74 | 36.4 | 128 | 60.5 | 213 |
| | -40 | -40 | 8.7 | 0.6 | 5.4 | 19 | 7.9 | 28 | 12.8 | 45 | 22.4 | 79 | 36.7 | 129 |
| Hot Gas Feed | +70 | +21 | 114.1 | 7.9 | 36.5 | 128 | 53 | 186 | 82.5 | 290 | 145 | 510 | 231 | 812 |
| Hot Gas Main | +70 | +21 | 114.1 | 7.9 | 73.0 | 257 | 106 | 373 | 165 | 580 | 290 | 1020 | 463 | 1682 |
| Compressor Discharge | +86 | +30 | 154.5 | 10.7 | 62.6 | 220 | 90.3 | 318 | 142 | 499 | 249 | 876 | 397 | 1396 |
| Condenser Drains | +86 | +30 | — | — | 140 | 492 | 220 | 774 | 375 | 1319 | 740 | 2603 | 1320 | 4642 |
| Liquid Mains | +86 | +30 | — | — | 454 | 1597 | 657 | 2311 | 1031 | 3626 | 1808 | 6359 | 2886 | 10150 |
| Liquid Feed Branch | +86 | +30 | — | — | 881 | 3098 | 1273 | 4477 | 1999 | 7030 | 3506 | 12330 | 5596 | 19681 |
| Liquid Overfeed Supply (4X) | +10 | -13 | — | — | 144 | 506 | 208 | 732 | 327 | 1150 | 573 | 2015 | 915 | 3218 |

| SERVICE | CONDITIONS | | | | CAPACITIES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TEMPERATURE | | PRESSURE | | 6"(150MM) | | 8"(200MM) | | 10"(250MM) | | 12"(300MM) | | 14"(350MM) | |
| | °F | °C | PSIG | BAR | TONS | kW | TONS | kW | TONS | kW | TONS | kW | TONS | kW |
| Suction Lines Single Stage Compressor | +20 | -7 | 33.5 | 2.3 | 343 | 1206 | 628 | 2209 | 1020 | 3387 | 1490 | 5240 | 1821 | 6404 |
| | 0 | -18 | 15.7 | 1.1 | 225 | 791 | 414 | 1456 | 662 | 2328 | 946 | 3327 | 1156 | 4066 |
| Suction Lines Booster | -20 | -29 | 3.6 | 0.3 | 165 | 580 | 306 | 1076 | 486 | 1709 | 709 | 2494 | 867 | 3049 |
| | -40 | -40 | 8.7 | 0.6 | 97.8 | 344 | 181 | 637 | 288 | 1013 | 419 | 1474 | 512 | 1801 |
| Liquid Overfeed Return Lines (4X) | +20 | -7 | 33.5 | 2.3 | 198 | 696 | 362 | 1273 | 587 | 2064 | 856 | 3010 | 1046 | 3679 |
| | 0 | -18 | 15.7 | 1.1 | 135 | 475 | 249 | 876 | 398 | 1400 | 568 | 1998 | 694 | 2441 |
| | -20 | -29 | 3.6 | 0.3 | 87.5 | 308 | 162 | 570 | 256 | 900 | 375 | 1319 | 458 | 1611 |
| | -40 | -40 | 8.7 | 0.6 | 53.7 | 189 | 100 | 352 | 158 | 556 | 232 | 816 | 284 | 999 |
| Hot Gas Feed | +70 | +21 | 114.1 | 7.9 | 338 | 1189 | 595 | 2093 | 949 | 3338 | 1377 | 4843 | 1683 | 5919 |
| Hot Gas Main | +70 | +21 | 114.1 | 7.9 | 673 | 2367 | 1190 | 4185 | 1898 | 6675 | 2754 | 9686 | 3366 | 11838 |
| Compressor Discharge | +86 | +30 | 154.5 | 10.7 | 580 | 2040 | 1021 | 3591 | 1629 | 5729 | 2363 | 8311 | 2888 | 10157 |
| Condenser Drains | +86 | +30 | — | — | 2030 | 7140 | 4200 | 14771 | — | — | — | — | — | — |
| Liquid Mains | +86 | +30 | — | — | 4218 | 14835 | — | — | — | — | — | — | — | — |
| Liquid Feed Branch | +86 | +30 | — | — | 8179 | 28766 | — | — | — | — | — | — | — | — |
| Liquid Overfeed Supply (4X) | +10 | -13 | — | — | 1337 | 4702 | — | — | — | — | — | — | — | — |

## SIZING GUIDE

These flow capacity recommendations are not affected by the length of the pipe line. These are approximate optimum sizes based on power costs versus the investment costs of piping and its total installed cost. Piping sized to this capacity will have a 1°F (0.6°C) pressure drop for the following equivalent lengths:

suction lines . . . . . . . 700 diameters

discharge lines . . . . . 1400 diameters

liquid lines . . . . . . . . . 2400 diameters

Example: 275 feet (84 m) of 3" (80 mm) pipe and equivalent fittings amount to 1100 diameters, pressure drop for a suction line handling 81.5 tons (287 kW) at 20°F (–7°C) is 1100/700 times 1°F (0.6°C) drop, equals 1.6°F (1°C) or 1.8 psi (0.12 bar).

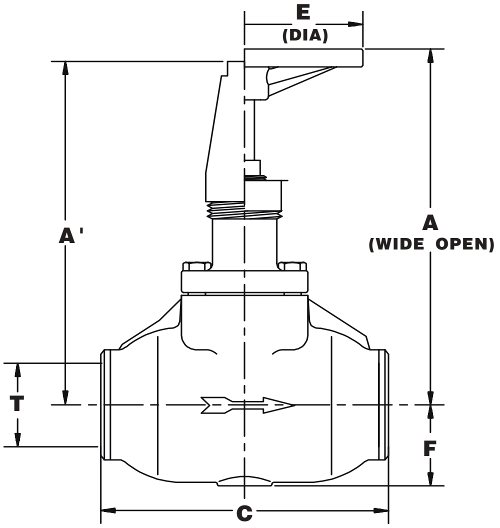
Example: Hansen valves have about 145 diameters of equivalent flow resistance, or 145/700 = 0.2°F (0.12°C) of equivalent pressure drop at the suction line capacities shown for a valve in a suction line.

The rational for the vapor line sizing was developed by William V. Richards in two papers: “Refrigerant Vapor Line Sizing Not Dependent of Length,” 16th International Congress of Refrigeration, IIR, Paris, 1983; and “Practical Pipe Sizing for Refrigerant Vapor Lines,” Sixth Annual Meetings, IIAR, San Francisco, 1984.

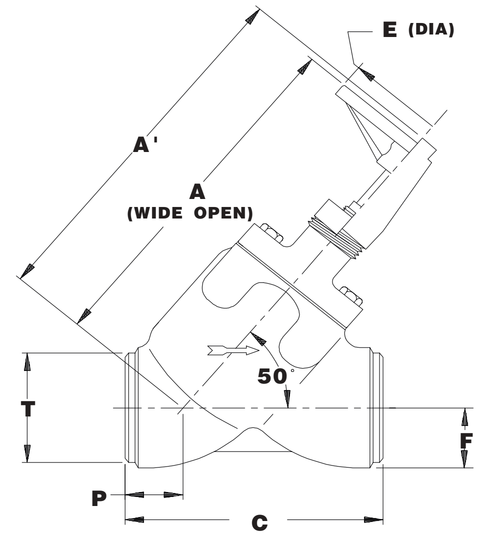
## FLOW COEFFICIENTS

| SIZE | | ANGLE | | | | GLOBE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cv | Kv | EQUIVALENT LENGTH FEET | EQUIVALENT LENGTH METERS | Cv | Kv | EQUIVALENT LENGTH FEET | EQUIVALENT LENGTH METERS |
| 2" | (50 MM) | 80 | 69 | 28 | 8.5 | 67 | 58 | 40 | 12.2 |
| 2½" | (65 MM) | 176 | 152 | 14 | 4.3 | 163 | 141 | 16 | 4.9 |
| 3" | (80 MM) | 205 | 177 | 31 | 9.5 | 195 | 169 | 34 | 10.4 |
| 4" | (100 MM) | 320 | 277 | 51 | 15.6 | 290 | 251 | 62 | 18.9 |
| 5" | (125 MM) | 600 | 519 | 45 | 13.7 | 575 | 497 | 49 | 14.9 |
| 6" | (150 MM) | 820 | 709 | 61 | 18.6 | 790 | 683 | 66 | 20.1 |
| 8" | (200 MM) | 1435 | 1241 | 84 | 25.6 | 1380 | 1194 | 91 | 27.7 |
| 10" | (250 MM) | 2450 | 2121 | 93 | 28.4 | 2350 | 2035 | 101 | 30.8 |
| 12" | (300 MM) | 3400 | 2944 | 117 | 35.7 | 3270 | 2731 | 126 | 38.4 |
| 14" | (350 MM) | 4600 | 3983 | 143 | 43.6 | 4350 | 3766 | 156 | 47.6 |

## GLOBE INSTALLATION DIMENSIONS
## 2" THROUGH 8" (50 MM THROUGH 200 MM)

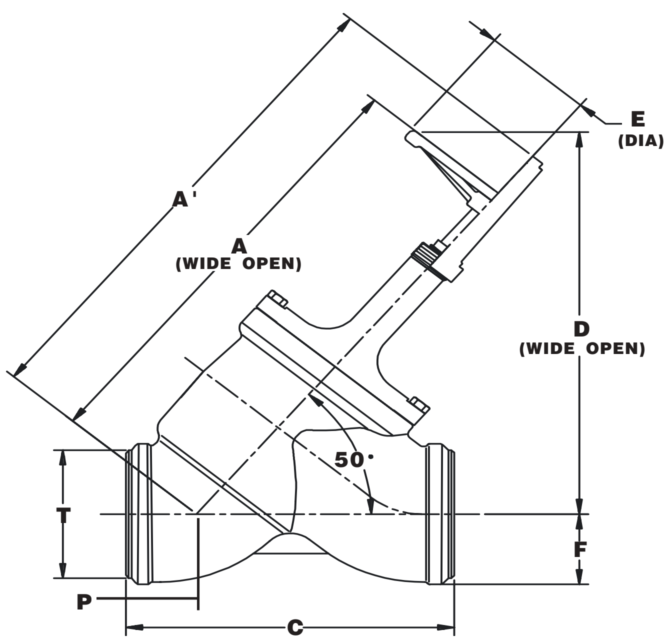



**2", 2½", AND 3"**
**(50 MM, 65 MM, AND 80 MM)**




**4", 5", 6", AND 8"**
**(100 MM, 125 MM, 150 MM, AND 200 MM)**

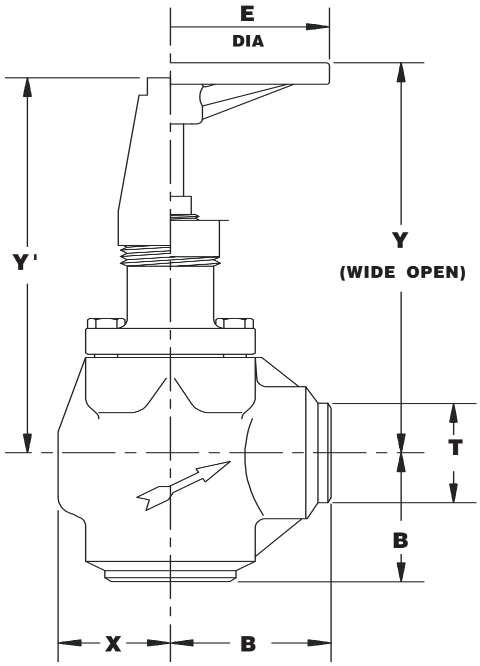
| SIZE | A | A' | C | E | F | P | T |
|---|---|---|---|---|---|---|---|
| 2" (50 mm) | 8.88" (225 mm) | 9.13" (232 mm) | 7.25" (184 mm) | 4.25" (108 mm) | 2.13" (54 mm) | -- | 2.38" (60 mm) |
| 2½" (65 mm) | 12.13" (308 mm) | 11.75" (298 mm) | 9.25" (235 mm) | 7.63" (194 mm) | 2.75" (70 mm) | -- | 2.88" (73 mm) |
| 3" (80 mm) | 12.13" (308 mm) | 11.75" (298 mm) | 9.25" (235 mm) | 7.63" (194 mm) | 2.75" (70 mm) | -- | 3.50" (89 mm) |
| 4" (100 mm) | 13.75" (349 mm) | 14.25" (362 mm) | 10.00" (254 mm) | 14.00" (356 mm) | 2.50" (64 mm) | 2.50" (64 mm) | 4.50" (114 mm) |
| 5" (125mm) | 21.38" (543mm) | 21.63" (549mm) | 11.65" (396 mm) | 10.00" (254 mm) | 3.00" (76mm) | 2.65" (67 mm) | 5.56" (141 mm) |
| 6" (150mm) | 22.10" (561 mm) | 22.15" (563 mm) | 13.26" (337 mm) | 10.00" 254 mm) | 3.50" (89 mm) | 2.73" (69 mm) | 6.63" (168 mm) |
| 8" (200mm) | 29.10" (739 mm) | 29.51" (750mm) | 18.10" (459 mm) | 16.00" (406mm) | 4.61" (117 mm) | 3.98" (101 mm) | 8.63" (219 mm) |




## GLOBE INSTALLATION DIMENSIONS
## 10", 12", AND 14"
## (250 MM, 300 MM, AND 350 MM)

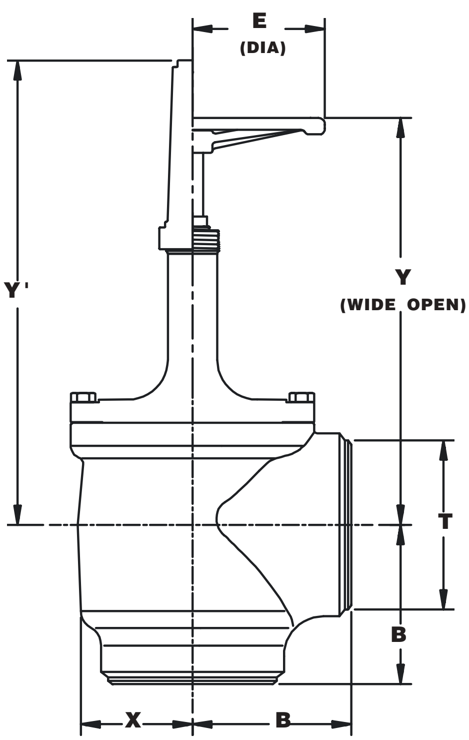
| SIZE | A | A' | C | D | E | F | P | T |
|---|---|---|---|---|---|---|---|---|
| 10" (250mm) | 35.29" (896 mm) | 36.16" (918 mm) | 23.38" (594 mm) | 33.24" (844 mm) | 16.00" (406 mm) | 5.81" (148 mm) | 5.19" (132 mm) | 10.75" (273 mm) |
| 12" (300mm) | 42.16" (1071 mm) | 46.39" (1178 mm) | 29.20" (742 mm) | 38.51" (978 mm) | 20.00" (508 mm) | 7.00" (178 mm) | 6.27" (159 mm) | 12.75" (324 mm) |
| 14" (350mm) | 47.55" (1208 mm) | 49.66" (1261 mm) | 32.86" (835 mm) | 47.55" (1208 mm) | 20.00" (508 mm) | 7.63" (194 mm) | 7.23" (184 mm) | 14.00" (356 mm) |

## ANGLE INSTALLATION DIMENSIONS
## 2" THROUGH 8" (50 MM THROUGH 200 MM)



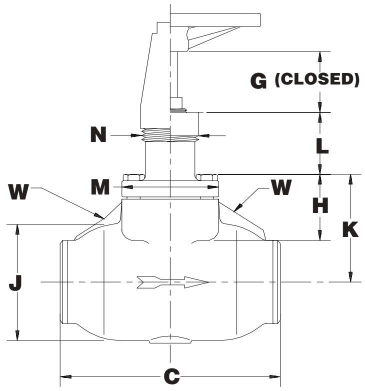

| SIZE | B | E | T | X | Y | Y' |
|---|---|---|---|---|---|---|
| **2" (50 mm)** | 3.38" (86 mm) | 4.25" (108 mm) | 2.38" (60 mm) | 1.88" (48 mm) | 7.75" (197 mm) | 8.00" (203 mm) |
| **2 1/2" (65 mm)** | 3.38" (86 mm) | 7.63" (194 mm) | 2.88" (73 mm) | 2.38" (60 mm) | 11.00" (280 mm) | 10.63" (270 mm) |
| **3" (80 mm)** | 3.38" (86 mm) | 7.63" (194 mm) | 3.50" (89 mm) | 2.38" (60 mm) | 11.00" (280 mm) | 10.63" (270 mm) |
| **4" (100 mm)** | 3.88" (98 mm) | 7.63" (194 mm) | 4.50" (114 mm) | 3.00" (76 mm) | 11.00" (280 mm) | 10.63" (270 mm) |
| **5" (125 mm)** | 4.47" (131 mm) | 10.00" (254 mm) | 5.56" (141 mm) | 3.47 (88 mm) | 16.42 (417 mm) | 16.62 (422 mm) |
| **6" (150 mm)** | 5.15" (131 mm) | 10.00" (254 mm) | 6.63" (168 mm) | 3.85" (98 mm) | 16.55" (420 mm) | 16.78" (426 mm) |
| **8" (200 mm)** | 6.90" (175 mm) | 16.00" (406 mm) | 8.63" (219 mm) | 6.11" (155 mm) | 22.12" (562 mm) | 22.52" (572 mm) |

## ANGLE INSTALLATION DIMENSIONS
## 10", 12", AND 14" (250 MM, 300 MM, AND 350 MM)

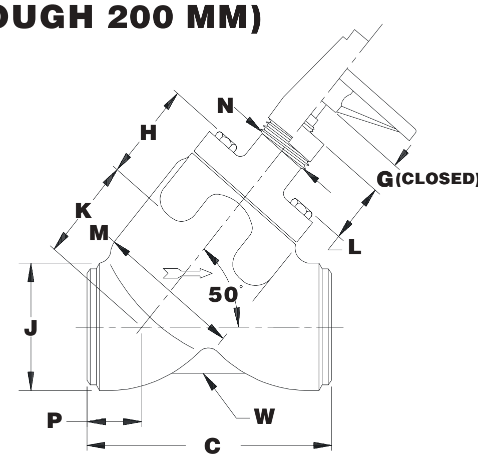



| SIZE | B | E | T | X | Y | Y' |
|---|---|---|---|---|---|---|
| **10" (250mm)** | 9.44" (240 mm) | 16.00" (406 mm) | 10.75" (273 mm) | 6.63" (168 mm) | 26.47" (672 mm) | 27.34" (694 mm) |
| **12" (300mm)** | 12.00" (305 mm) | 20.00" (508 mm) | 12.75" (324 mm) | 8.66" (220 mm) | 30.34" (783 mm) | 33.86" (860 mm) |
| **14" (350mm)** | 12.97" (329 mm) | 20.00" (508 mm) | 14.00" (356 mm) | 9.20" (234 mm) | 34.92" (887 mm) | 36.91" (938 mm) |

# GLOBE INSULATION DIMENSIONS
# 2" THROUGH 8" (50 MM THROUGH 200 MM)



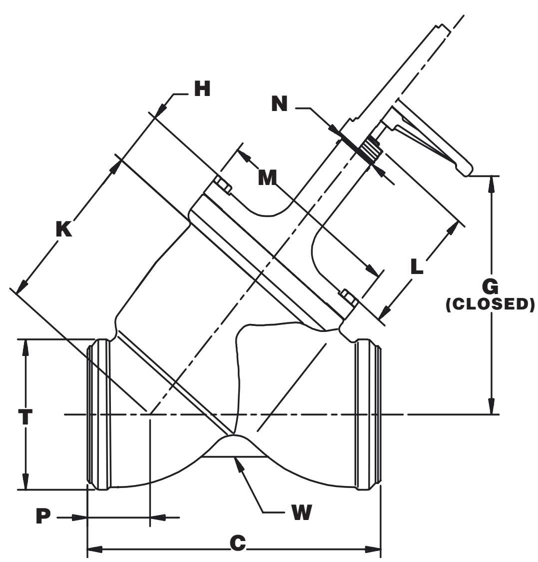

2", 2½", AND 3"
(50 MM, 65, MM, AND 80 MM)




4", 5", 6", AND 8"
(100 MM, 125 MM, 150 MM, AND 200 MM)

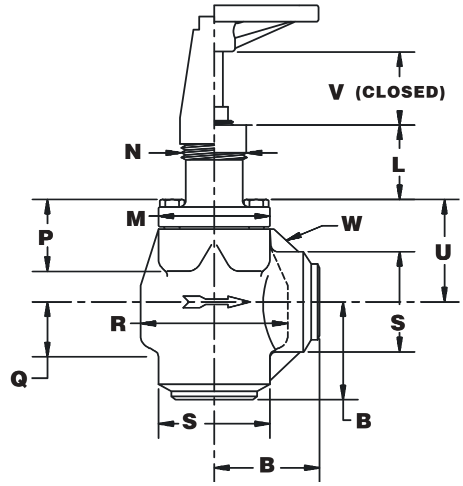
| SIZE | C | G | H | J | K | L | M | N | P | W |
|---|---|---|---|---|---|---|---|---|---|---|
| **2"** **(50 mm)** | 7.25" (184 mm) | 1.38" (35 mm) | 3.00" (76 mm) | 4.00" (102 mm) | 4.38" (111 mm) | 1.63" (41 mm) | 3.50" (89 mm) | 1.25" (38 mm) | -- | 1.00" (25 mm) |
| **2½"** **(65 mm)** | 9.25" (235 mm) | 1.88" (48 mm) | 3.00" (76 mm) | 5.38" (137 mm) | 5.00" (127 mm) | 2.75" (70 mm) | 4.00" (102 mm) | 2.25" (57 mm) | -- | 1.75" (45 mm) |
| **3"** **(80 mm)** | 9.25" (235 mm) | 1.88" (48 mm) | 3.00" (76 mm) | 5.38" (137 mm) | 5.00" (127 mm) | 2.75" (70 mm) | 4.00" (102 mm) | 2.25" (57 mm) | -- | 1.75" (45 mm) |
| **4"** **(100 mm)** | 10.00" (254 mm) | 7.50" (191 mm) | 4.00" (102 mm) | 5.00" (127 mm) | 1.25" (32 mm) | 2.25" (57 mm) | 5.75" SQ. (146 mm) | 2.25" (57 mm) | 2.50 (64 mm) | 1.75" (45 mm) |
| **5"** **(125 mm)** | 11.65" (296 mm) | 1.73" (44 mm) | 3.73" (95 mm) | 5.94" (151 mm) | 5.32" (135 mm) | 4.75" (121 mm) | 6.81" (173 mm) | 2.75" (70 mm) | 2.65" (67 mm) | 1.60" 41 mm) |
| **6"** **(150 mm)** | 13.26" (337 mm) | 1.00" (25 mm) | 2.80" (71 mm) | 7.00" (178 mm) | 6.69" (170 mm) | 4.38" (111 mm) | 7.75" (197 mm) | 2.75" (70 mm) | 2.73" (69 mm) | 2.10" (53 mm) |
| **8"** **(200 mm)** | 18.10" (459 mm) | 1.17" (30 mm) | 4.24" (108 mm) | 9.22" (234 mm) | 10.53" (267 mm) | 5.59" (142 mm) | 11.75" (298 mm) | 3.00" (76 mm) | 3.98" (101 mm) | 4.00" (102 mm) |

# GLOBE INSULATION DIMENSIONS
# 10", 12", AND 14" (250 MM, 300 MM, AND 350 MM)



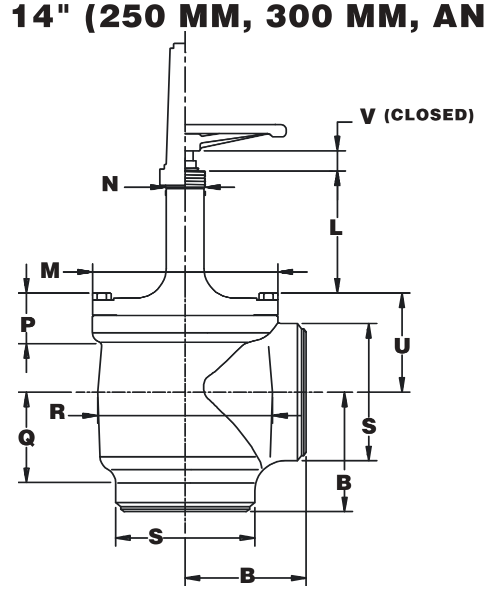

| SIZE | C | G | H | J | K | L | M | N | P | W |
|---|---|---|---|---|---|---|---|---|---|---|
| **10"** **(250mm)** | 23.38" (594 mm) | 16.79" (427 mm) | 3.59" (91 mm) | 11.60" (295 mm) | 12.02" (305 mm) | 10.00" (254 mm) | 14.50" (368 mm) | 3.00" (76 mm) | 5.19" (132 mm) | 1.00" (25 mm) |
| **12"** **(300 mm)** | 29.20" (742 mm) | 21.45" (545 mm) | 4.91" (125 mm) | 14.00" (356 mm) | 16.29" (414 mm) | 12.40" (315 mm) | 18.37" (467 mm) | 4.00" (102 mm) | 6.27" (159 mm) | 1.00" (25 mm) |
| **14"** **(350 mm)** | 32.86" (835 mm) | 24.94" (634 mm) | 5.76" (146 mm) | 15.25" (387 mm) | 17.80" (452 mm) | 13.35" (339 mm) | 19.00" (483 mm) | 4.00" (102 mm) | 7.23" (184 mm) | 1.00" (25 mm) |

## ANGLE INSULATION DIMENSIONS
## 2" THROUGH 8" (50 MM THROUGH 200 MM)




| SIZE | B | L | M | N | P | Q | R | S | U | V | W |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2" (50 mm) | 3.38" (86 mm) | 1.63" (41 mm) | 3.50" (89 mm) | 1.25" (38 mm) | -- | 1.50" (38 mm) | 3.75" (95 mm) | 3.00" (76 mm) | 3.13" (79 mm) | 1.25" (32 mm) | 1.00" (25 mm) |
| 2 1/2" (65 mm) | 3.38" (86 mm) | 2.75" (70 mm) | 4.00" (102 mm) | 2.25" (57 mm) | 2.88" (73 mm) | 2.00" (51 mm) | 4.75" (121 mm) | 3.75" (95 mm) | 4.00" (102 mm) | 1.13" (29 mm) | 1.75" (45 mm) |
| 3" (80 mm) | 3.38" (86 mm) | 2.75" (70 mm) | 4.00" (102 mm) | 2.25" (57 mm) | 2.88" (73 mm) | 2.00" (51 mm) | 4.75" (121 mm) | 3.75" (95 mm) | 4.00" (102 mm) | 1.13" (29 mm) | 1.75" (45 mm) |
| 4" (100 mm) | 3.88" (98 mm) | 2.25" (57 mm) | 5.50" (140 mm) | 2.25" (57 mm) | 3.00" (76 mm) | 2.63" (67 mm) | 6.00" (152 mm) | 4.75" (121 mm) | 4.25" (108 mm) | 1.13" (29 mm) | -- |
| 5" (125 mm) | 4.47" (114 mm) | 4.75" (121 mm) | 6.75" (171 mm) | 2.75" (70 mm) | 3.73" (95 mm) | 3.46" (88 mm) | 6.81" (173 mm) | 5.92" (150 mm) | 4.65" (118 mm) | 1.75" (44 mm) | -- |
| 6" (150 mm) | 5.15" (131 mm) | 4.38" (111 mm) | 9.88" (251 mm) | 2.75" (70 mm) | 2.80" (71 mm) | 3.98" (99 mm) | 7.75" (197 mm) | 7.0" (178 mm) | 5.19" (132 mm) | 1.00" (25 mm) | -- |
| 8" (200 mm) | 6.90" (175 mm) | 5.59" (142 mm) | 12.22" (310 mm) | 3.00" (76 mm) | 4.24" (108 mm) | 6.90" (175 mm) | 12.22" (310 mm) | 9.15" (232 mm) | 7.78" (198 mm) | 1.17" (30 mm) | -- |

## ANGLE INSULATION DIMENSIONS
## 10", 12", AND 14" (250 MM, 300 MM, AND 350 MM)




| SIZE | B | L | M | N | P | Q | R | S | U | V |
|---|---|---|---|---|---|---|---|---|---|---|
| 10" (250mm) | 9.44" (240 mm) | 10.00 (254 mm) | 14.50 (368 mm) | 3.00 (76 mm) | 3.59 (91 mm) | 4.30 (109 mm) | 13.25 (337 mm) | 11.60 (295 mm) | 8.20 (208 mm) | 1.69 (43 mm) |
| 12" (300mm) | 12.00 (305 mm) | 12.40 (315 mm) | 18.37 (467 mm) | 4.00 (102 mm) | 4.91 (125 mm) | 9.07 (230 mm) | 17.33 (440 mm) | 13.79 (350 mm) | 9.81 (249 mm) | 1.31 (33 mm) |
| 14" (350mm) | 12.97 (329 mm) | 13.33 (339 mm) | 19.00 (483 mm) | 4.00 (102 mm) | 5.76 (146 mm) | 11.38 (289 mm) | 18.40 (467 mm) | 15.25 (387 mm) | 10.69 (272 mm) | 2.64 (67 mm) |

## SERVICE AND MAINTENANCE

Hansen steel butt welding shut-off valves require practically no service or maintenance due to the combination of polished stainless steel stems and reliable O-ring stem seals plus graphite composite packing. This almost entirely eliminates stem leakage, the common ailment of shut-off valves.

To help ensure safety, verify the tightness of the packing nut whenever the position (open or closed) is changed on isolation shut-off valves before opening the system. Ensuring that the packing nut is tight helps reduce the possibility that any line or system vibration may cause a slight unseating of a closed valve.

## STEM PACKING

When verifying the tightness of the packing nut, use an adjustable wrench. Extrusion of some black graphite packing material along the stem is normal. If the O-ring or the adjustable packing ever needs replacement as evidenced by refrigerant or oil leakage at the stem, open the valve stem firmly to the back-seat position. This separates the O-ring and packing from the system refrigerant. See the CAUTION section. Remove the packing nut carefully and then use a wire hook or a small blade screwdriver to remove the packing and O-ring. Take care not to scratch the stem or bonnet sealing surfaces. Carefully install a backup washer, new lubricated stem O-ring, stem washer, and stem packing. Tighten the packing nut only enough to give the handwheel slight turning friction.

## VALVE SEAT

To inspect or replace the valve seat disc, isolate the valve from the system and safely pump out all refrigerant to zero pressure with the stem open at least one turn. Evenly loosen all bolts one to two turns. Using a screwdriver, break the seal between the bonnet and valve body, proceeding cautiously to avoid any refrigerant which may still remain inside the valve body. Remove the bonnet bolts and bonnet assembly, being careful not to damage the Teflon seat disc surface.

If the seat surface in the body is marred, it may be possible to repair the seat by polishing with emery paper.

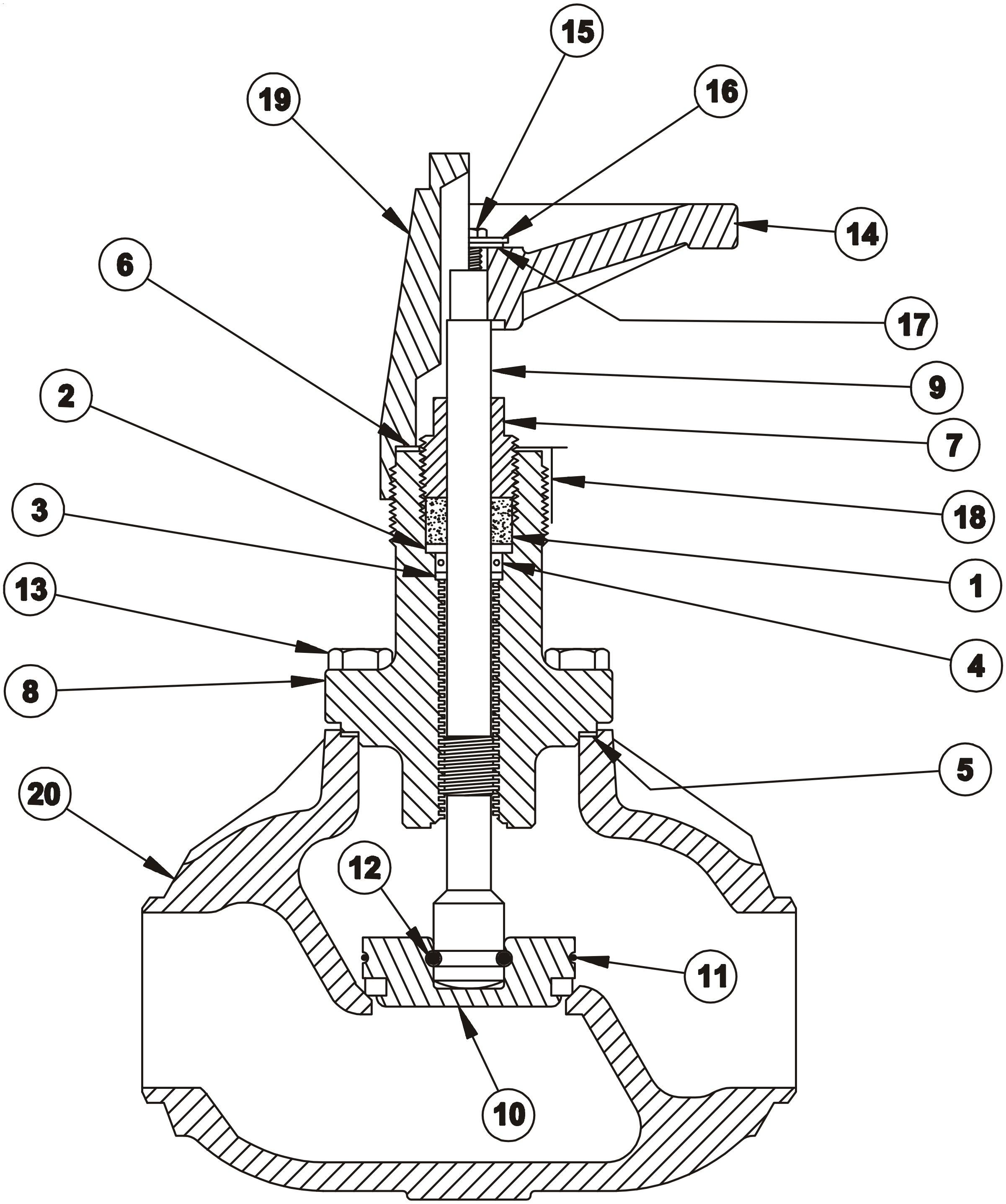
If the Teflon seat disc is damaged, replace the entire disc assembly 2" thru 4" by first removing the ball retainer spring and ball bearings. Install a new disc assembly. Alternately, use a lathe to take a $^{1}/_{64}$" (0.4 mm) by 45° surface cut on the Teflon seat.

The 5" thru 14" Teflon seats can be replaced by disassembling the disk holder by loosening and removing the disk screws. Replace Teflon ring and reassemble disk.

Replace body gasket or o-ring and reassemble bonnet into body using care not to damage Teflon seat surface. Ensure the stem is opened at least several turns.

The bonnet cap screws on the 2" (50 m) require a torque of 40 ft.-lbs (55Nm); 2 $^{1}/_{2}$" and 3" (65mm and 80mm) require valves require a torque of 60 ft-lbs (82 Nm); 180 ft-lbs (245 Nm) on the 4" (100 mm) valves, 200 ft-lbs (270 Nm) on the 5", 6", 8", 10", 12" and 14" valves. Test the valve for leaks before returning it to service.

# 2" THROUGH 4" (50 MM THROUGH 100 MM)
# BUTT WELD VALVE



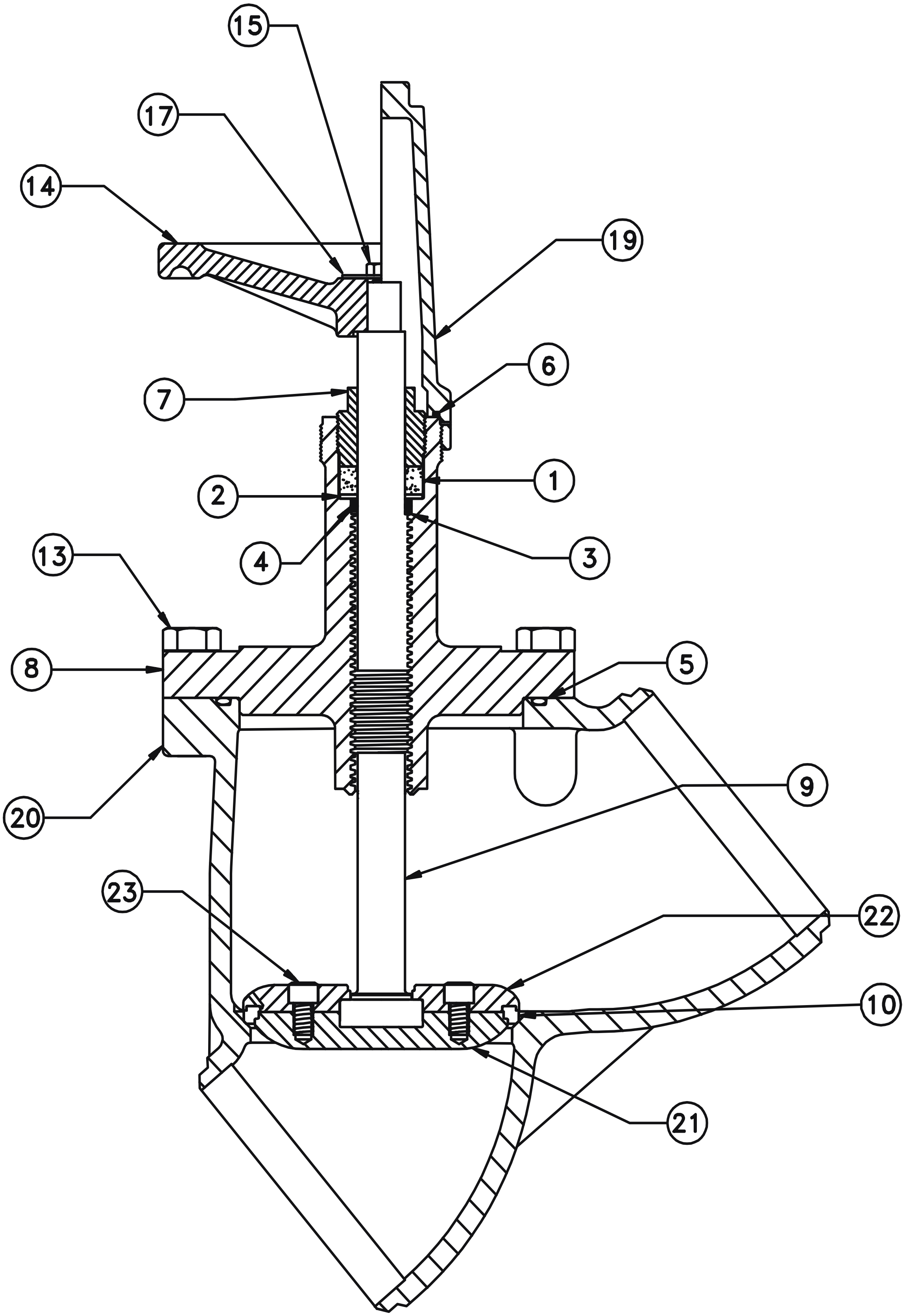
# 2" THROUGH 4" (50 MM THROUGH 100 MM) BUTT WELD VALVE

## REPLACEMENT PARTS

| ITEM | DESCRIPTION | QTY. | PART NO. |
|---|---|---|---|
| | **Gasket Kit 2" (50 mm)** | | **50-1023** |
| | **Gasket Kit 2$^1/_2$", 3" (65 mm, 80 mm)** | | **50-1043** |
| | **Gasket Kit 4" (100 mm)** | | **50-1065** |
| | Above kits consist of: | | |
| 1a | Stem Packing 2" | 1 | 50-0248 |
| 1b | Stem Packing 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0290 |
| 2a | Stem Washer 2" (50 mm) | 1 | 50-0247 |
| 2b | Stem Washer 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0299 |
| 3a | Back-Up Washer 2" (50 mm) | 1 | 50-0351 |
| 3b | Back-Up Washer 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0324 |
| 4a | Stem O-Ring 2" (50 mm) | 1 | 50-0253 |
| 4b | Stem O-Ring 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0293 |
| 5a | Bonnet Gasket 2" (50 mm) | 1 | 50-0259 |
| 5b | Bonnet Gasket 2$^1/_2$", 3" (65 mm, 80 mm) | 1 | 50-0310 |
| 5c | Bonnet Gasket 4" (100 mm) | 1 | 50-0537 |
| 6a | Seal Cap Gasket 2" (50 mm) | 1 | 50-0270 |
| 6b | Seal Cap Gasket 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0315 |
| 7a | Packing Nut 2" (50 mm) | 1 | 50-0251 |
| 7b | Packing Nut 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0292 |
| | **Bonnet Ass'y Kit 2" (50 mm)** | | **50-1024** |
| | **Bonnet Ass'y Kit 2$^1/_2$", 3" (65 mm, 80 mm)** | | **50-1044** |
| | **Bonnet Ass'y Kit 4" (100 mm)** | | **50-1066** |
| | Above kits consist of: | | |
| 8a | Bonnet 2" (50 mm) | 1 | 50-0239 |
| 8b | Bonnet 2$^1/_2$", 3" (65 mm, 80 mm) | 1 | 50-0286 |
| 8c | Bonnet 4" (100 mm) | 1 | 50-0515 |
| 9a | Stem 2" (50 mm) | 1 | 50-0242 |
| 9b | Stem 2$^1/_2$", 3", 4" (65 mm 80 mm, 100 mm) | 1 | 50-0287 |
| 10a | Disc Assembly 2" (50 mm) | 1 | 50-0363 |
| 10b | Disc Assembly 2$^1/_2$", 3" (65 mm, 80 mm) | 1 | 50-0374 |
| 10c | Disc Assembly 4" (100 mm) | 1 | 50-0524 |
| 11a | Ball Retainer 2" (50 mm) | 1 | 50-0257 |
| 11b | Ball Retainer 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0297 |
| 12a | Balls 2" (50 mm) | 16 | 50-0016 |
| 12b | Balls 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 15 | 50-0305 |
| 13a | Bonnet Bolts 2" (50 mm) | 4 | 50-0473 |
| 13b | Bonnet Bolts 2$^1/_2$", 3" (65 mm, 80 mm) | 4 | 50-0294 |
| 13c | Bonnet Bolts 4" (100 mm) | 4 | 50-0521 |
| | **Gasket Kit 2" (50 mm)** | **1** | **50-1023** |
| | **Gasket Kit 2$^1/_2$", 3"(65, 80 mm)** | **1** | **50-1043** |
| | **Gasket Kit 4" (100 mm)** | **1** | **50-1065** |

| ITEM | DESCRIPTION | QTY. | PART NO. |
|---|---|---|---|
| | **Disc Assembly Kit 2" (50 mm)** | | **50-1025** |
| | **Disc Assembly Kit 2$^1/_2$", 3" (65 mm, 80 mm)** | | **50-1045** |
| | **Disc Assembly Kit 4"(100 mm)** | | **50-1067** |
| | Above kits consist of: | | |
| 10a | Disc Assembly 2" (50 mm) | 1 | 50-0363 |
| 10b | Disc Assembly 2$^1/_2$", 3" (65 mm, 80 mm) | 1 | 50-0374 |
| 10c | Disc Assembly 4" (100 mm) | 1 | 50-0524 |
| 11a | Ball Retainer 2" (50 mm) | 1 | 50-0257 |
| 11b | Ball Retainer 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0297 |
| 12a | Balls 2" (50 mm) | 16 | 50-0016 |
| 12b | Balls 2$^1/_2$", 3", 4" (65, 80, 100 mm) | 15 | 50-0305 |
| 5a | Bonnet Gasket 2" (50 mm) | 1 | 50-0259 |
| 5b | Bonnet Gasket 2$^1/_2$", 3" (65 mm, 80 mm) | 1 | 50-0310 |
| 5c | Bonnet Gasket 4" (100 mm) | 1 | 50-0537 |
| | **Handwheel Kit 2" (50 mm)** | | **50-1026** |
| | **Handwheel Kit 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm)** | | **50-1037** |
| | Above kits consist of: | | |
| 14a | Handwheel 2" (50 mm) | 1 | 50-0321 |
| 14b | Handwheel 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0319 |
| 15a | Screw 2" (50 mm) | 1 | 50-0254 |
| 15b | Screw 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0295 |
| 16a | Nameplate 2" (50 mm) | 1 | 50-0094 |
| 16b | Nameplate 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0318 |
| 17 | Support Washer 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0480 |
| 18 | Bonnet Thread Cap 2" (50 mm) | 1 | 50-0263 |
| | **Seal Cap Kit 2" (50 mm)** | | **50-1027** |
| | **Seal Cap Kit 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm)** | | **501038** |
| | Above kits consist of: | | |
| 19a | Seal Cap 2" (50 mm) | 1 | 50-0260 |
| 19b | Seal Cap 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0304 |
| 6a | Seal Cap Gasket 2" (50 mm) | 1 | 50-0270 |
| 6b | Seal Cap Gasket 2$^1/_2$", 3", 4" (65 mm, 80 mm, 100 mm) | 1 | 50-0315 |
| 20a | Body, Globe, 2" (50 mm) BW | 1 | 50-0391 |
| 20b | Body, Globe, 2$^1/_2$" (65 mm) BW | 1 | 50-0454 |
| 20c | Body, Globe, 3" (80 mm) BW | 1 | 50-0455 |
| 20d | Body, Globe, 4" (100 mm) BW (GW402) | 1 | 50-0671 |
| 20e | Body, Angle, 2" (50 mm) BW | 1 | 50-0354 |
| 20f | Body, Angle, 2$^1/_2$" (65 mm) BW | 1 | 50-0285 |
| 20g | Body, Angle, 3" (80 mm) BW | 1 | 50-0289 |
| 20h | Body, Angle, 4" (100 mm) BW | 1 | 50-0516 |

## 5", 6", AND 8" (125 MM, 150 MM, AND 200 MM)
## BUTT WELD VALVE



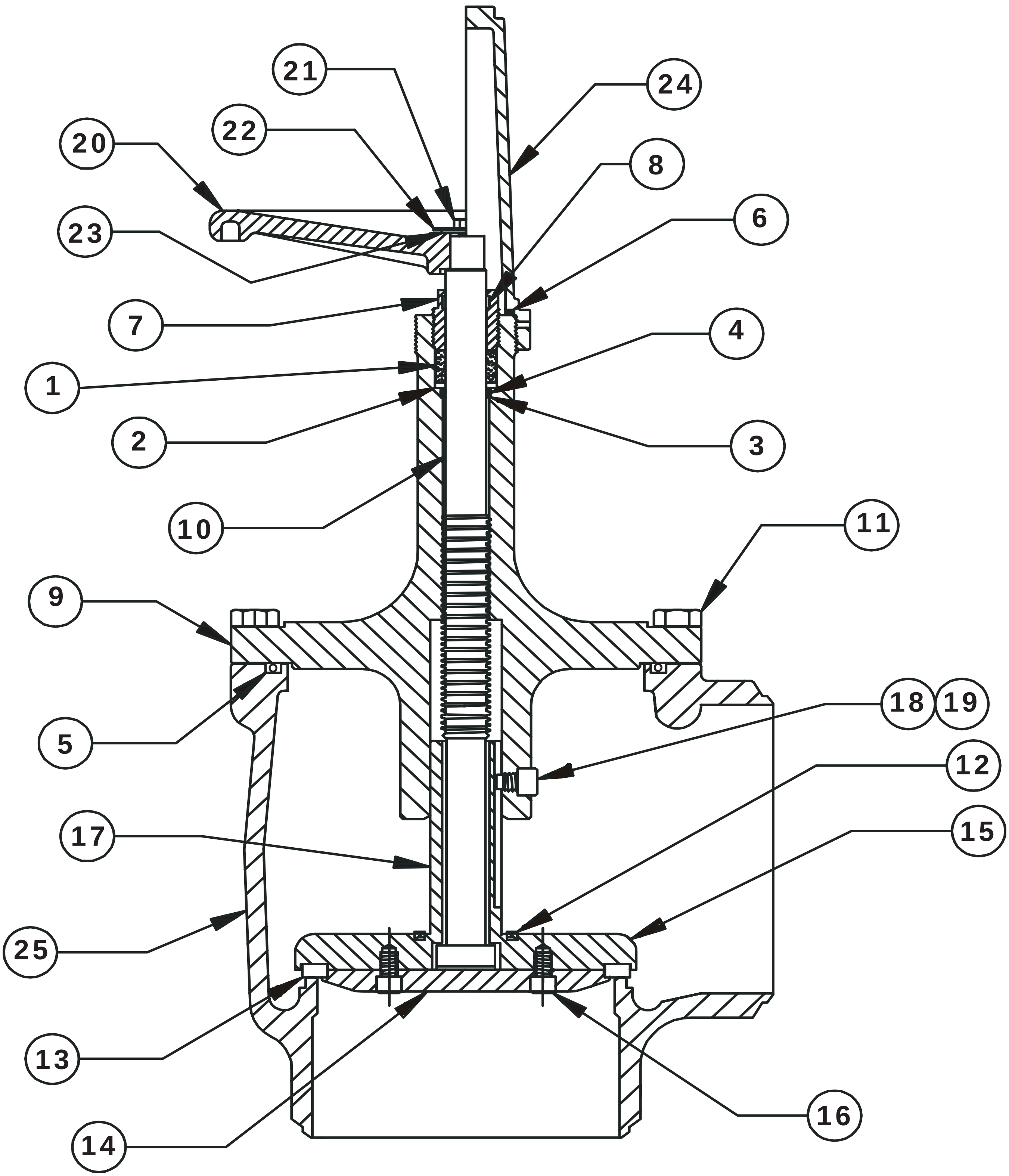
# 5", 6", AND 8" (125 MM, 150 MM, AND 200 MM) BUTT WELD VALVE

## REPLACEMENT PARTS

| ITEM | DESCRIPTION | QTY. | PART NO. |
|---|---|---|---|
| | **Gasket Kit 5" (125 mm)** | | **50-1082** |
| | **Gasket Kit 6" (150 mm)** | | **50-1083** |
| | **Gasket Kit 8" (200 mm)** | | **20-1084** |
| | Above kits consist of: | | |
| 1a | Stem Packing 5", 6" | 1 | 50-0703 |
| 1b | Stem Packing 8" | 1 | 50-0745 |
| 2a | Stem Washer 5", 6" | 1 | 50-0705 |
| 2b | Stem Washer 8" | 1 | 50-0747 |
| 3a | Back-Up Washer 5", 6" | 1 | 50-0706 |
| 3b | Back-Up Washer 8" | 1 | 50-0748 |
| 4a | Stem O-Ring 5", 6" | 1 | 50-0707 |
| 4b | Stem O-Ring 8" | 1 | 50-0749 |
| 5a | Bonnet O-Ring 5" | 1 | 50-0708 |
| 5b | Bonnet O-Ring 6" | 1 | 50-0709 |
| 5b | Bonnet O-Ring 8" | 1 | 50-0750 |
| 6a | Seal Cap O-Ring 5", 6" | 1 | 50-0730 |
| 6b | Seal Cap O-Ring 8" | 1 | 50-0761 |
| 7a | Packing Nut 5", 6" | 1 | 50-0704 |
| 7b | Packing Nut 8" | 1 | 50-0746 |
| | **Bonnet Ass'y Kit 5" (125 mm)** | | **50-1080** |
| | **Bonnet Ass'y Kit 6" (150 mm)** | | **50-1081** |
| | **Bonnet Ass'y Kit 8" (200 mm)** | | **50-1085** |
| | Above kit consists of: | | |
| 9a | Bonnet 5" | 1 | 50-0675 |
| 9b | Bonnet 6" | 1 | 50-0682 |
| 9c | Bonnet 8" | 1 | 50-0699 |
| 10a | Stem Assembly 5", 6" | 1 | 50-0734 |
| 10b | Stem Assembly 8" | 1 | 50-1093 |
| 11a | Bonnet Bolts 5" | 4 | 50-0521 |
| 11b | Bonnet Bolts 6" | 6 | 50-0521 |
| 11c | Bonnet Bolts 8" | 8 | 50-0959 |
| | Gasket Kit 5" (125 mm) | 1 | 50-1082 |
| | Gasket Kit 6" (150 mm) | 1 | 50-1083 |
| | Gasket Kit 8" (200 mm) | 1 | 20-1084 |
| | Disc Kit 5" (125 mm) | 1 | 50-1086 |
| | Disc Kit 6" (150 mm) | 1 | 50-7087 |
| | Disc Kit 8" (200 mm) | 1 | 50-1088 |

| ITEM | DESCRIPTION | QTY. | PART NO. |
|---|---|---|---|
| | **Disc Kit 5" (125)** | | **50-1086** |
| | **Disc Kit 6" (150)** | | **50-1087** |
| | **Disc Kit 8" (200)** | | **50-1088** |
| | Above kits consist of: | | |
| 10a | Seat Disc 5" | 1 | 50-0717 |
| 10b | Seat Disc 6" | 1 | 50-0716 |
| 10c | Seat Disc 8" | 1 | 50-0755 |
| 21a | Lower Disc Holder 5" | 1 | 50-0713 |
| 21b | Lower Disc Holder 6" | 1 | 50-0711 |
| 21c | Lower Disc Holder 8" | 1 | 50-0752 |
| 22a | Upper Disc Holder 5" | 1 | 50-0712 |
| 22b | Upper Disc Holder 6" | 1 | 50-0710 |
| 22c | Upper Disc Holder 8" | 1 | 50-0751 |
| 23a | Disc Holder Screw 5", 6" | 4 | 50-0729 |
| 23b | Disc Holder Screw 8" | 6 | 50-0760 |
| 5a | Bonnet O-Ring 5" | 1 | 50-0708 |
| 5b | Bonnet O-Ring 6" | 1 | 50-0709 |
| 5c | Bonnet O-Ring 8" | 1 | 50-0750 |
| | **Handwheel Kit 5", 6" (125 mm, 150 mm)** | | **50-1089** |
| | **Handwheel Kit 8" (200m)** | | **50-1090** |
| | Above kits consist of: | | |
| 14a | Handwheel 5", 6" | 1 | 50-0727 |
| 14b | Handwheel 8" | 1 | 50-2229 |
| 15a | Screw 5", 6" | 1 | 50-0732 |
| 15b | Screw 8" | 1 | 50-0763 |
| 17a | Nameplate 5", 6" | 1 | 50-0728 |
| 17b | Nameplate 8" | 1 | 50-0759 |
| | **Seal Cap Kit 5", 6" (125 mm, 150 mm)** | | **50-1091** |
| | **Seal Cap Kit 8" (200 mm)** | | **50-1092** |
| | Above kits consist of: | | |
| 19a | Seal Cap 5", 6" | 1 | 50-0715 |
| 19b | Seal Cap 8" | 1 | 50-0754 |
| 6a | Seal Cap Gasket 5", 6" | 1 | 50-0730 |
| 6b | Seal Cap Gasket 8" | 1 | 50-0761 |
| 20a | Body, Globe, 5" Butt Weld | 1 | 50-0677 |
| 20b | Body, Globe, 6" Butt Weld | 1 | 50-0693 |
| 20c | Body, Globe, 8" Butt Weld | 1 | 50-0812 |
| 20d | Body, Angle, 5" Butt Weld | 1 | 50-0673 |
| 20e | Body, Angle, 6" Butt Weld | 1 | 50-0680 |
| 20f | Body, Angle, 8" Butt Weld | 1 | 50-0695 |

## 10", 12', AND 14" (250 MM, 300 MM, AND 350 MM)
## BUTT WELD VALVE



# 10", 12', AND 14" (250 MM, 300 MM, AND 350 MM) BUTT WELD VALVE

## REPLACEMENT PARTS

| ITEM | DESCRIPTION | QTY. | PART NO. |
|---|---|---|---|
| | **Gasket Kit 10" (250 mm)** | | **50-1122** |
| | **Gasket Kit 12" (300 mm)** | | **50-1123** |
| | **Gasket Kit 14" (350 mm)** | | **20-1124** |
| | Above kits consist of: | | |
| 1a | Stem Packing 10" | 1 | 50-2309 |
| 1b | Stem Packing 12" | 1 | 50-2310 |
| 1c | Stem Packing 14" | 1 | 50-2311 |
| 2a | Packing Washer 10" | 1 | 50-2278 |
| 2b | Packing Washer 12" | 1 | 50-2215 |
| 2c | Packing Washer 14" | 1 | 50-2254 |
| 3a | Back-Up Washer 10" | 1 | 50-2217 |
| 3b | Back-Up Washer 12" | 1 | 50-2216 |
| 3c | Back-Up Washer 14" | 1 | 50-2253 |
| 4a | Stem O-Ring 10" | 1 | 50-2224 |
| 4b | Stem O-Ring 12" | 1 | 50-2264 |
| 4c | Stem O-Ring 14" | 1 | 50-2245 |
| 5a | Bonnet O-Ring 10" | 1 | 50-2223 |
| 5b | Bonnet O-Ring 12" | 1 | 50-2260 |
| 5c | Bonnet O-Ring 14" | 1 | 50-2243 |
| 6a | Seal Cap O-Ring 10" | 1 | 50-0761 |
| 6b | Seal Cap O-Ring 12", 14" | 1 | 50-2259 |
| 7a | Packing Nut 10" | 1 | 50-2149 |
| 7b | Packing Nut 12" | 1 | 50-2218 |
| 7c | Packing Nut 14" | 1 | 50-2144 |
| 8a | Bushing, Stem Guide 10" | 1 | 50-2179 |
| 8b | Bushing, Stem Guide 12" | 1 | 50-2274 |
| 8c | Bushing, Stem Guide 14" | 1 | 50-2161 |
| | **Bonnet Ass'y Kit 10" (254 mm)** | | **50-1125** |
| | **Bonnet Ass'y Kit 12" (254 mm)** | | **50-1126** |
| | **Bonnet Ass'y Kit 14" (254 mm)** | | **50-1127** |
| | Above kit consists of: | | |
| 9a | Bonnet 10" | 1 | 50-2306 |
| 9b | Bonnet 12" | 1 | 50-2307 |
| 9c | Bonnet 14" | 1 | 50-2308 |
| 10a | Stem Assembly 10" | 1 | 50-2303 |
| 10b | Stem Assembly 12" | 1 | 50-2304 |
| 10c | Stem Assembly 14" | 1 | 50-2305 |
| 11a | Bonnet Screw 10" | 8 | 50-2235 |
| 11b | Bonnet Screw 12" | 12 | 50-2250 |
| 11c | Bonnet Screw 14" | 16 | 50-2250 |
| | Disk Kit 10" | 1 | 50-1128 |
| | Disk Kit 12" | 1 | 50-1129 |
| | Disk Kit 14" | 1 | 50-1130 |
| | Gasket Kit 10" (254 mm) | 1 | 50-1122 |
| | Gasket Kit 12" (305 mm) | 1 | 50-1123 |
| | Gasket Kit 10" (356 mm) | 1 | 50-1124 |

| ITEM | DESCRIPTION | QTY. | PART NO. |
|---|---|---|---|
| | **Disk Kit 10" (254 mm)** | | **50-1128** |
| | **Disk Kit 12" (305 mm)** | | **50-1129** |
| | **Disk Kit 14" (356 mm)** | | **50-1130** |
| | Above kits consist of: | | |
| 12a | Ring, Teflon Back Seat 10" | 1 | 50-2233 |
| 12b | Ring, Teflon Back Seat 12" | 1 | 50-2213 |
| 12c | Ring, Teflon Back Seat 14" | 1 | 50-2248 |
| 13a | Ring, Teflon Main Seat 10" | 1 | 50-2234 |
| 13b | Ring, Teflon Main Seat 12" | 1 | 50-2212 |
| 13c | Ring, Teflon Main Seat 14" | 1 | 50-2249 |
| 14a | Lower Disk Holder 10" | 1 | 50-2153 |
| 14b | Lower Disk Holder 12" | 1 | 50-2211 |
| 14c | Lower Disk Holder 14" | 1 | 50-2145 |
| 15a | Upper Disk Holder 10" | 1 | 50-2154 |
| 15b | Upper Disk Holder 12" | 1 | 50-2210 |
| 15c | Upper Disk Holder 14" | 1 | 50-2146 |
| 16a | Disk Screw 10", 12" | 8 | 50-2236 |
| 16b | Disk Screw 14" | 8 | 50-2251 |
| 17a | Guide Tube 10" | 1 | 50-2155 |
| 17b | Guide Tube 12" | 1 | 50-2209 |
| 17c | Guide Tube 14" | 1 | 50-2143 |
| 18a | Screw Guide 10", 12" | 1 | 50-2237 |
| 18b | Screw Guide 14" | 1 | 50-2252 |
| 19 | Washer, Screw Guide 10", 12", 14" | 1 | 50-2238 |
| 5a | Bonnet O-Ring 10" | 1 | 50-2223 |
| 5b | Bonnet O-Ring 12" | 1 | 50-2260 |
| 5c | Bonnet O-Ring 14" | 1 | 50-2243 |
| | **Handwheel Kit 10" (254 mm)** | | **50-1131** |
| | **Handwheel Kit 12", 14"** | | **50-1132** |
| | **(305 mm, 356 mm)** | | |
| | Above kits consist of: | | |
| 20a | Handweheel 10" | 1 | 50-2229 |
| 20b | Handweheel 12", 14" | 1 | 50-2242 |
| 21 | Screw 10", 12", 14" | 1 | 50-0763 |
| 22 | Nameplate 10", 12", 14" | 1 | 50-0759 |
| 23 | Flat Washer 10", 12", 14" | 1 | 50-0764 |
| | Seal Cap Kit 10" (254 mm) | | 50-1133 |
| | Seal Cap Kit 12", 14" | | 50-1134 |
| | (305 mm, 356 mm) | | |
| | Above kits consist of: | | |
| 24a | Seal Cap 10" | 1 | 50-0754 |
| 24b | Seal Cap 12", 14" | 1 | 50-2258 |
| 6a | Sea Cap O-Ring 10" | 1 | 50-0761 |
| 6b | Sea Cap O-Ring 12", 14" | 1 | 50-2259 |
| 25a | Body, Angle 10" | 1 | 50-2177 |
| 25b | Body, Globe 10" | 1 | 50-2197 |
| 25c | Body, Angle 12" | 1 | 50-2186 |
| 25d | Body, Globe 12" | 1 | 50-2199 |
| 25e | Body, Angle 14" | 1 | 50-2148 |
| 25f | Body, Globe 14" | 1 | 50-2195 |

## ORDERING INFORMATION, BUTT WELD VALVES

| SIZE | DESCRIPTION | CAT. NO. |
|---|---|---|
| 2" (50 mm) | Globe, Handwheel | GW200H |
| | Angle, Handwheel | AW200H |
| | Globe, Seal Cap | GW200C |
| | Angle, Seal Cap | AW200C |
| 2$^{1}/_{2}$" (65 mm) | Globe, Handwheel | GW251H |
| | Angle, Handwheel | AW251H |
| | Globe, Seal Cap | GW251C |
| | Angle, Seal Cap | AW251C |
| 3" (80 mm) | Globe, Handwheel | GW301H |
| | Angle, Handwheel | AW301H |
| | Globe, Seal Cap | GW301C |
| | Angle, Seal Cap | AW301C |
| 4" (100 mm) | Globe, Handwheel | GW402H |
| | Angle, Handwheel | AW402H |
| | Globe, Seal Cap | GW402C |
| | Angle, Seal Cap | AW402C |
| 5" | Globe, Handwheel | GW500H |
| | Angle, Handwheel | AW500H |
| | Globe, Seal Cap | GW500C |
| | Angle, Seal Cap | AW500C |
| 6" | Globe, Handwheel | GW600H |
| | Angle, Handwheel | AW600H |
| | Globe, Seal Cap | GW600C |
| | Angle, Seal Cap | AW600C |
| 8" | Globe, Handwheel | GW800H |
| | Angle, Handwheel | AW800H |
| | Globe, Seal Cap | GW800C |
| | Angle, Seal Cap | AW800C |
| 10" | Globe, Handwheel | GW1000H |
| | Angle, Handwheel | AW1000H |
| | Globe, Seal Cap | GW1000C |
| | Angle, Seal Cap | AW1000C |
| 12" | Globe, Handwheel | GW1200H |
| | Angle, Handwheel | AW1200H |
| | Globe, Seal Cap | GW1200C |
| | Angle, Seal Cap | AW1200C |
| 14" | Globe, Handwheel | GW1400H |
| | Angle, Handwheel | AW1400H |
| | Globe, Seal Cap | GW1400C |
| | Angle, Seal Cap | AW1400C |

**TO ORDER:** Specify the catalog number.

 Printed in USA

## CAUTION

Hansen valves are for refrigeration systems only. Read these instructions completely before selecting, using, or servicing these valves. Only knowledgeable, trained refrigeration technicians should install, operate, or service these valves. Stated temperature and pressure limits should not be exceeded. Bonnets should not be removed from valves unless the system has been evacuated to zero pressure. See also Safety Precautions in the current List Price Schedule and the Safety Precautions Sheet supplied with the product.

## WARRANTY

Hansen valves are guaranteed against defective materials or workmanship for one year F.O.B. our factory. No consequential damages or field labor is included.

## TYPICAL SPECIFICATIONS

"Weldable refrigerant shut-off valves shall have stainless steel stems with dual seals, cast steel bodies, back-seating design for packing replacement, bonnet threads for installation of stem seal caps, butt weld ends machined dimensionally correct for Schedule 40 pipe (sizes 2"-10") size and gauge or Standard Weight pipe (sizes 12" and above), and suitability for a safe working pressure of 400 psig (27 bar), as manufactured by Hansen Technologies Corporation, or approved equal."

**HANSEN TECHNOLOGIES CORPORATION**
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Burr Ridge, Illinois 60527 USA
Telephone: 630-325-1565
Toll-free: 800-426-7368
FAX: 630-325-1572
E-mail: info@hantech.com
Web Site: www.hantech.com

HANSEN TECHNOLOGIES CORPORATION

**Bulletin R429d**
MAR 2002

**Specifications, Applications, Service Instructions & Parts**

# HA4A MODULAR PRESSURE REGULATORS ¾" THROUGH 6" PORT (20 MM THROUGH 150 MM)

**Various Connection Styles and Sizes for Refrigerants**

HA4AB
Regulator With Electric Wide Opening

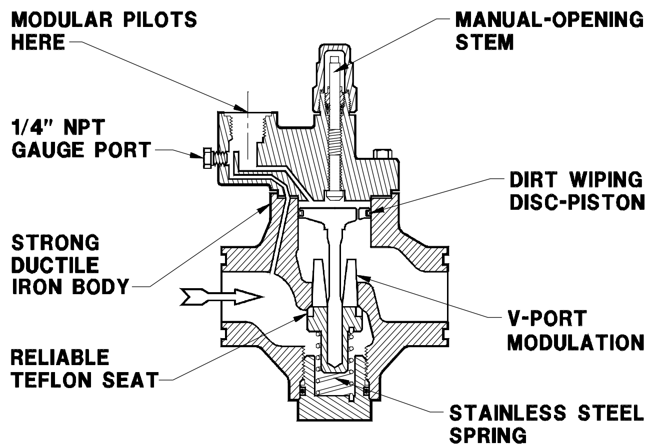
## INTRODUCTION

These advanced-design, strong-bodied, precision-manufactured MODULAR regulators are superior in their ability to overcome dirt and sticky oil during opening and tight closing. Models are available for nearly every control function requirement of industrial ammonia and commercial halocarbon refrigeration. These regulators are ideal for cold storage plants, poultry plants, meat packing, fish processing, freezers, ice plants, breweries, bottling plants, heat recovery units, petrochemical plants, pharmaceutical plants, supermarkets, and many others.

## APPLICATIONS

Evaporator Pressure Control
Defrost Pressure Control
Condensing Pressure Regulation
Receiver Pressure Control
Hot Gas Bypass Capacity Regulation
Suction Pressure Control
Air or Liquid Temperature Regulation
Internal System Pressure Relief

## KEY FEATURES




## ADDITIONAL FEATURES

Tolerant of Dry Systems
For Ammonia, R22, R134a and other Hansen-Approved Refrigerants
Wide Range of Options
Inlet, Outlet, or Differential Pressure
Wide Pressure Ranges
Electric Shut-Off, Dual, or Wide-Opening Available
Safe Working Pressure: 400 psig (27 bar)
CSA Certified, CRN for Canada

| Contents | Page |
|---|---|

## MATERIAL SPECIFICATIONS

Body:
¾" through 4": Ductile iron, ASTM A536
5" & 6": Cast steel, ASTM A352 LCB
Adapter: Ductile iron, ASTM A536

Piston: Steel, disc type, Teflon piston seal
V-Port/Seat: ductile iron, with Teflon seat
Main Seat: ¾" through 1¼": integral ductile iron
1½" through 6": stainless steel, removable
Gaskets: Nonasbestos, graphite composite
Manual Opening Stem: Steel, plated
Pilots: Stainless steel trim
Pilot Orifice: Stainless steel
Flanges: Forged steel, ASTM A105
Safe Working Pressure: 400 psig (27 bar)
Operating Temperature: –60F to +240F (–50°C to +115°C), lower temperatures possible at pressure downratings

## ADVANTAGES

These valves combine modern design and new age materials with advanced manufacturing techniques and **intense** quality control to offer a significantly superior and reliable product. Their ductile iron bodies are stronger and more rugged than common cast iron, or so called semi-steel (class B iron), valves. They are more dirt resistant than full skirted-piston-design valves. All regulators use energized Teflon dirt-wiping piston seals which operate reliably, even under dry, oil-free conditions. The screw-on control modules (pilots) are easy to change and can be used on all valve sizes. All valves incorporate Teflon seating and stainless steel spring closing. Manual-opening stems are located on top of valves, up and away from dirt and rust particles to avoid thread jamming. Nonasbestos gaskets are standard. These standard regulator valves use the same flanges and spacing as R/S model A4A, except 1¼" (32 mm). Special Hansen 1¼" 4-bolt regulators are available from stock to exactly replace R/S 1¼" A4A only.

## SIZING

Proper regulator valve sizing is important for smooth operation and long, trouble-free life of the valve. Therefore, capacity of the regulator at both the maximum and minimum flow and **pressure drop** should be analyzed. Pressure regulators will operate satisfactorily to approximately 15% of the maximum capacity of valve based on the corresponding pressure drop. In extreme cases, downsizing or two smaller regulators in parallel are necessary. For pressure drops exceeding 45 psi (3.1 bar), special construction may be required. Contact the factory.

## INSTALLATION

Regulators should be protected from dirt and moisture during storage. The arrow on the body should be in the normal direction of refrigerant flow. *These valves will not prevent reverse flow;* use check valves where necessary. Regulators are normally in horizontal pipe lines with pilots and manual-opening stems on top. Do not rotate the position of the valve adapter or the valve will not operate.

The system should be free of dirt, weld slag, and rust particles. Regulators can be equipped with separate, close-coupled inlet strainers. No small, hidden, internal screens are used. Gauges and gauge valves should be installed on the inlet and outlet to help in system diagnosis. Because of the many regulator pilot combinations, during installation of a large job, the regulator nameplates should be checked against piping drawings to guarantee proper function for each location. Where pilot solenoid control modules are used, the nameplate coil voltage should be checked before wiring. Pipe sizing, anchoring, valve rating, system design, and other precautionary factors should be taken into consideration to ensure "liquid hammer" will not occur when the valve opens or closes.

The 5" and 6" valves are type HA4W with integral butt weld end only. These steel-bodied regulators are directly welded into the pipe line. During welding, the manual-opening stem should be opened downward several turns to protect the Teflon seat from weld heat.

Welds should be annealed as necessary in accordance with good practice. Painting of valves and welds is recommended for corrosion protection. Pipe covering, where applied, should have proper moisture barrier. Before putting valves into service, all pipe connections, valve seats, cover seals, and stem seals should be tested for leaks at pressure levels called for in appropriate codes.

## ELECTRICAL

When the electric shut-off, wide-opening, or dual feature is supplied, a Hansen low-wattage, molded electrical coil is included. Standard coil voltages are 115V, 208/230V, or 24V at 50/60Hz. Other voltages available. The coil properly operates between 85% and 110% of the rated voltage. Coils should only be energized while on the pilot solenoid tube. Unless otherwise specified, the standard coil with a ½" fitting for conduit is supplied with valves.

A **watertight solenoid coil** with 18" (450 mm) long wire pigtail leads and a steel frame housing with a ½" conduit fitting is **standard.**

Optional **DIN Plug Coils** are for grounded cord connections and include the necessary DIN plug socket with gasket.

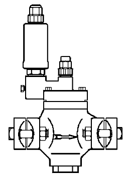
**Coils with Junction Boxes** are optional. Integral, steel junction box for connection of the 18" (450 mm) long wire pigtail leads.

Vibration-resistant, bright, long-life, neon **pilot lights** are available. These pilot lights operate on primary voltage; a special coil with secondary winding is not necessary. Optional **watertight pilot light** assembly is also available; see page 20.

# REGULATOR VARIATIONS

### HA4A STANDARD REGULATOR

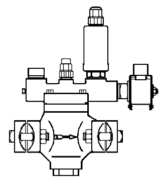
This most common pressure regulator modulates to control evaporator pressure, condensing pressure, pressure in a vessel, or pressure in a portion of a system. It is frequently called an evaporator pressure regulator (EPR) or back pressure regulator. Opens on rising inlet pressure. See page 10. Shown with M3W pilot.



HA4A

### HA4AS REGULATOR WITH ELECTRIC SHUT-OFF

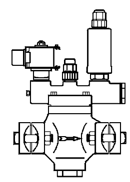
This control is commonly used for temperature control or defrost. Regulates at the set-for pressure when energized. When de-energized, the valve closes tight regardless of the pressure setting. See page 11.



HA4AS

### HA4AB REGULATOR WITH ELECTRIC WIDE OPENING

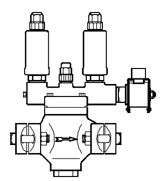
Commonly regulates for defrost or temperature, but opens wide for maximum cooling. Regulating at the set-for pressure when de-energized; regulator opens when energized. See page 11.



HA4AB

### HA4AD DUAL PRESSURE REGULATOR

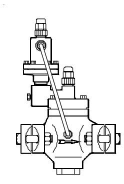
Regulates (evaporator) pressure at a setting when energized, and at a higher setting for defrost, temperature control, or pressure relief when de-energized. See page 11.



HA4AD

### HA4AL DIFFERENTIAL PRESSURE REGULATOR

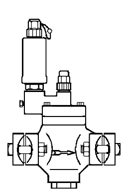
Commonly used as liquid pump relief, condenser-receiver pressure difference control, discharge pressure boosting for defrosting or heat recovery, and other similar applications. This control modulates to maintain the set-for difference between inlet and outlet pressure. See page 10.



HA4AL

### HA4AK RESEATING RELIEF REGULATOR

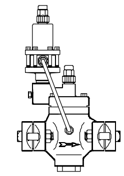
Used for defrost, high-to-low side relief, or nonatmosphere relief to other parts of the system. This control opens when system upstream pressure is above the tagged and sealed set point pressure, and repeatedly reseats after operation. See page 10.



HA4AK

### HA4AO OUTLET PRESSURE REGULATOR

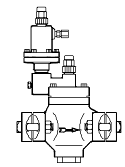
Controls outlet pressure by opening as downstream pressure falls below the set point. Used for hot gas to provide artificial refrigeration loading, for condenser and receiver pressure control by means of gas bypass, limiting hot gas pressure supply in defrosting evaporator in conjunction with liquid drain traps, or for compressor suction pressure limitation. Can be combined with electric shut-off, temperature-operated, dual, or wide-opening features. See page 11.



HA4AO

### HA4AP PNEUMATICALLY COMPENSATED REGULATOR

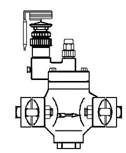
Commonly used for precise air or liquid temperature control via pneumatic controller. An air, vapor, or liquid pressure signal to the control module bonnet increases inlet pressure from the set-for pressure value at a 1:1 ratio. See page 12.



HA4AP

### HA4AT TEMPERATURE OPERATED REGULATOR

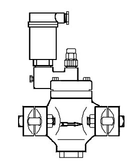
The vapor pressure capillary tubing and bulb system modulates the regulator open as temperature increases to control air or liquid temperature. See page 12.



HA4AT

### HA4AJ ELECTRONICALLY CONTROLLED REGULATOR

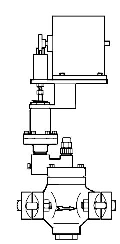
Electronic pilot and controller provides very precise temperature control of various cooled media under fluctuating load conditions. See page 12.



HA4AJ

### HA4AM ELECTRIC MOTOR COMPENSATED REGULATOR

Commonly used for precise room temperature control or liquid chiller control. The controlling motor changes regulator pressure setting in accordance with a temperature controller. See page 13.



HA4AM

NOTE: Many other control functions can be achieved by combining the control modules in different arrangements. For example: a dual regulator with electronic pilot and secondary relief pilot; i.e. HA4ADJ.

# SUCTION VAPOR CAPACITIES (TONS)

(1 Ton= 12,000 Btu/hr= 3.517 kW= 3042 kcal/hr)

| PORT SIZE (mm) | Cv (Kv) | PRESSURE DROP ACROSS VALVE‡ | R717 | | | | | R22 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | EVAPORATING TEMPERATURE | | | | | EVAPORATING TEMPERATURE | | | | |
| | | | –40F† (–40°C) | –20F† (–28.9°C) | 0F (–17.8°C) | +20F (–6.7°C) | +40F (+4.4°C) | –40F† (–40°C) | –20F† (–28.9°C) | 0F (–17.8°C) | +20F (–6.7°C) | +40F (+4.4°C) |
| 3/4"* (20) | 6.4 (5.5) | 2 psi | 4.7 | 6.4 | 7.4 | 9.5 | 12 | 2.1 | 2.8 | 2.8 | 3.6 | 4.4 |
| | | 5 psi | 6.7 | 9.7 | 8.7 | 15 | 19 | 3.2 | 4.3 | 4.4 | 5.5 | 6.9 |
| | | 10 psi | — | 13 | 15 | 20 | 26 | — | 5.8 | 6.0 | 7.7 | 9.6 |
| | | 20 psi | — | — | 19 | 27 | 35 | — | — | 7.8 | 10 | 13 |
| 1" (25) | 11.7 (10) | 2 psi | 8.5 | 12 | 13 | 17 | 22 | 3.9 | 5.2 | 5.2 | 6.5 | 8.0 |
| | | 5 psi | 12 | 18 | 16 | 27 | 34 | 5.8 | 7.9 | 8.0 | 10 | 13 |
| | | 10 psi | — | 23 | 28 | 37 | 47 | — | 11 | 11 | 14 | 18 |
| | | 20 psi | — | — | 36 | 49 | 64 | — | — | 14 | 19 | 24 |
| 1 1/4" (32) | 16.4 (14) | 2 psi | 12 | 16 | 19 | 24 | 31 | 5.4 | 7.2 | 7.2 | 9.1 | 11.3 |
| | | 5 psi | 17 | 25 | 22 | 38 | 48 | 8.1 | 11 | 11 | 14 | 18 |
| | | 10 psi | — | 32 | 39 | 52 | 66 | — | 15 | 15 | 20 | 25 |
| | | 20 psi | — | — | 50 | 69 | 90 | — | — | 20 | 26 | 34 |
| 1 1/2" (40) | 35 (30) | 2 psi | 25 | 35 | 40 | 52 | 65 | 12 | 15 | 15 | 19 | 24 |
| | | 5 psi | 37 | 53 | 48 | 81 | 102 | 17 | 24 | 24 | 30 | 38 |
| | | 10 psi | — | 69 | 84 | 111 | 141 | — | 31 | 33 | 42 | 53 |
| | | 20 psi | — | — | 106 | 147 | 193 | — | — | 43 | 56 | 72 |
| 2" (50) | 47 (40) | 2 psi | 34 | 47 | 54 | 70 | 87 | 16 | 21 | 21 | 26 | 32 |
| | | 5 psi | 49 | 71 | 64 | 108 | 137 | 23 | 32 | 32 | 41 | 51 |
| | | 10 psi | — | 92 | 113 | 149 | 190 | — | 42 | 44 | 56 | 71 |
| | | 20 psi | — | — | 143 | 198 | 259 | — | — | 57 | 76 | 96 |
| 2 1/2" (65) | 77 (66) | 2 psi | 56 | 77 | 89 | 114 | 143 | 25 | 34 | 34 | 43 | 53 |
| | | 5 psi | 81 | 116 | 105 | 177 | 224 | 38 | 52 | 53 | 67 | 83 |
| | | 10 psi | — | 151 | 185 | 243 | 311 | — | 69 | 72 | 92 | 116 |
| | | 20 psi | — | — | 234 | 324 | 424 | — | — | 94 | 124 | 158 |
| 3" (80) | 104 (89) | 2 psi | 76 | 104 | 120 | 154 | 193 | 34 | 46 | 46 | 58 | 71 |
| | | 5 psi | 109 | 157 | 141 | 239 | 303 | 51 | 70 | 71 | 90 | 112 |
| | | 10 psi | — | 204 | 250 | 329 | 420 | — | 93 | 97 | 125 | 156 |
| | | 20 psi | — | — | 316 | 438 | 572 | — | — | 127 | 167 | 213 |
| 4" (100) | 166 (142) | 2 psi | 121 | 166 | 191 | 246 | 309 | 55 | 73 | 73 | 92 | 114 |
| | | 5 psi | 174 | 251 | 226 | 382 | 483 | 82 | 112 | 114 | 144 | 179 |
| | | 10 psi | — | 325 | 398 | 525 | 671 | — | 149 | 155 | 199 | 249 |
| | | 20 psi | — | — | 505 | 699 | 913 | — | — | 203 | 267 | 340 |
| 5" (125) | 242 (207) | 2 psi | 176 | 242 | 278 | 358 | 450 | 80 | 107 | 107 | 135 | 166 |
| | | 5 psi | 254 | 365 | 329 | 557 | 704 | 120 | 163 | 166 | 210 | 261 |
| | | 10 psi | — | 474 | 581 | 765 | 978 | — | 218 | 226 | 290 | 363 |
| | | 20 psi | — | — | 736 | 1019 | 1331 | — | — | 295 | 390 | 496 |
| 6" (150) | 413 (354) | 2 psi | 300 | 412 | 475 | 611 | 768 | 136 | 182 | 183 | 230 | 283 |
| | | 5 psi | 434 | 624 | 562 | 950 | 1202 | 204 | 278 | 282 | 358 | 446 |
| | | 10 psi | — | 809 | 991 | 1305 | 1669 | — | 371 | 386 | 496 | 620 |
| | | 20 psi | — | — | 1256 | 1739 | 2272 | — | — | 504 | 665 | 847 |

‡ 2 psi= 0.14 bar 5 psi= 0.35 bar 10 psi= 0.69 bar 20 psi= 1.38 bar

*Optional 25% or 50% reduced capacity ¾" (20 mm) plugs are available for unusually low loads if requested.

† –40F (–40°C) and –20F (–28.9°C) capacities are based on a two stage system.

For liquid overfeed evaporator suction between normal 2:1 to 5:1 rate, add 20% to the evaporator load or use the next larger port size to accommodate liquid volume accompanying the suction gas and to reduce impact velocity.

**Conditions:** Capacities are based on the evaporator temperatures shown and +86F (+30°C) liquid. R717: For each 10F (5.6°C) lower liquid temperature, increase the above table capacity by 3%. R22: For each 10F (5.6°C) lower liquid temperature, increase the above table capacity by 5%. To convert for R134a, multiply the R22 table values by 0.73 (accuracy within 8%). For other refrigerant capacities and suitability, contact the factory.

## LIQUID CAPACITIES (U.S. GPM)

APPLICATION: REFRIGERANT PUMP RELIEF REGULATOR (HA4AL)

| PORT SIZE (mm) | | R717 △P= 30 psi (2 bar) | R22 △P= 30 psi (2 bar) |
|---|---|---|---|
| 3/4" | (20) | 45 | 30 |
| 1" | (25) | 82 | 56 |
| 1 1/4" | (32) | 114 | 78 |
| 1 1/2" | (40) | 256 | 168 |
| 2" | (50) | 324 | 230 |
| 2 1/2" | (65) | 553 | 377 |
| 3" | (80) | 733 | 505 |

Capacities assume no gas flashing. No capacity correction required for temperatures between –40F (–40°C) and +40F (+4.4°C).

## OIL CAPACITIES (U.S. GPM)

APPLICATION: SCREW COMPRESSOR OIL PUMP RELIEF REGULATOR (HA4AL)

| PORT SIZE (mm) | | OIL △P= 30 psi (2 bar) |
|---|---|---|
| 3/4" | (20) | 48 |
| 1" | (25) | 87 |
| 1 1/4" | (32) | 122 |
| 1 1/2" | (40) | 260 |
| 2" | (50) | 350 |
| 2 1/2" | (65) | 574 |
| 3" | (80) | 775 |

Capacities based on oil with less than 300 SSU viscosity.

## HOT GAS DEFROST NOMINAL VALVE SIZING CAPACITIES

(DEFROSTING EVAPORATOR SIZE TONS)

| REFRIG. | APPLICATION | PORT SIZE (mm) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 3/4" (20) | 1" (25) | 1 1/4" (32) | 1 1/2" (40) | 2" (50) | 2 1/2" (65) |
| R717 | Hot Gas Solenoid * | 9 to 15 | 15 to 28 | 28 to 39 | 39 to 73 | 73 to 106 | 106 to 165 |
| | Defrost Relief Regulator | 17 to 24 | 24 to 45 | 45 to 60 | 60 to 96 | 96 to 140 | 140 to 225 |
| R22 | Hot Gas Solenoid * | 6 to 8 | 8 to 15 | 15 to 20 | 20 to 32 | 32 to 47 | 47 to 75 |
| | Defrost Relief Regulator | 6 to 8 | 8 to 15 | 15 to 20 | 20 to 32 | 32 to 47 | 47 to 75 |

*Or an outlet pressure regulator with electric shut-off (HA4AOS).

Evaporator tons at 10F (5.6°C) TD (temperature differential), valve capacities are conservative. These capacities can be modified up or down depending on type of evaporator, temperature, mass, frost thickness, defrosting time, etc. Typical for –20F (–28.9°C) evaporator.

## GAS CAPACITIES (TONS)*

(1 Ton= 12,000 Btu/hr= 3.517 kW= 3042 kcal/hr)

| SIZE (mm) | | DISCHARGE GAS REGULATOR | | | | HOT GAS BY-PASS TO SUCTION | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | R717 | | R22 | | R717 | | R22 | |
| | | +86F (+30°C) Condensing +140F (+60°C) Discharge | | +86F (+30°C) Condensing +140F (+60°C) Discharge | | +86F (+30°C) Condensing +140F (+60°C) Discharge | +15F (–9.4°C) Condensing +15F (–9.4°C) Discharge † | +86F (+30°C) Condensing +140F (+60°C) Discharge | +15F (–9.4°C) Condensing +15F (–9.4°C) Discharge † |
| | | 2 psid | 5 psid | 2 psid | 5 psid | | | | |
| 3/4"** | (20) | 17 | 27 | 6.1 | 9.5 | 88 | 27 | 32 | 12 |
| 1" | (25) | 31 | 49 | 11 | 17 | 160 | 49 | 58 | 22 |
| 1 1/4" | (32) | 44 | 69 | 16 | 24 | 224 | 68 | 81 | 31 |
| 1 1/2" | (40) | 94 | 147 | 33 | 52 | 479 | 146 | 173 | 66 |
| 2" | (50) | 126 | 197 | 45 | 70 | 643 | 196 | 232 | 89 |
| 2 1/2" | (65) | 206 | 323 | 73 | 115 | 1054 | 321 | 380 | 146 |
| 3" | (80) | 279 | 437 | 99 | 155 | 1424 | 434 | 513 | 197 |
| 4" | (100) | 445 | 698 | 158 | 241 | | | | |
| 5" | (125) | 649 | 1017 | 230 | 361 | | | | |
| 6" | (150) | 1108 | 1735 | 393 | 616 | | | | |

Hot gas bypass capacities are based on above given temperatures. Liquid temperature is the same as condensing temperature. Evaporator temperature +40F (+4.4°C) or less for +86F (+30°C) condensing; –22F (–30°C) evaporator for +15F (–9.4°C) condensing.

= Bypass from intermediate pressure at saturation temperature to booster suction.

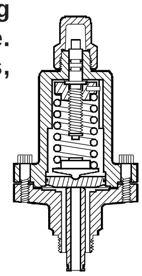
*These capacities are not for hot gas defrost relief. See the chart in the middle of this page.

**Optional 25% and 50% reduced capacity 3/4" (20 mm) plugs are available.

Discharge gas capacities are based on +15F (+10°C) evaporator temperature.

# CONTROL MODULES (PILOTS) FOR ANY REGULATOR

When installed, these control modules (pilots) enable the main regulator to perform different control functions (see page 3, Regulator Variations). Pilots are normally factory installed, but can be retrofitted or interchanged in the field. The nonrising stem can be adjusted by using a ¼" wrench. Catalog numbers are for the screw-on pilot module. Interchangeable with Danfoss PM Series, size permitting.

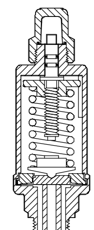


M3

## INLET PRESSURE

Opens as inlet pressure rises. Range: A, 0 to 150 psig (0 to 10 bar), Part 75-1097; or B, 30 to 300 psig (2 to 21 bar), Part 75-1098. Also, Range V, 20" to 130 psig (–0.67 to +9 bar), Part 75-1099. Catalog M3.

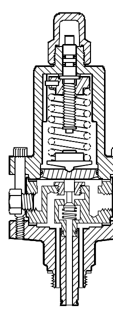
Compact welded pressure pilot. Range A, 0 to 150 psig (0 to 10 bar), Part 75-1126. Standard only on valve sizes ¾" to 1¼". Catalog M3W.



M3W

## OUTLET PRESSURE

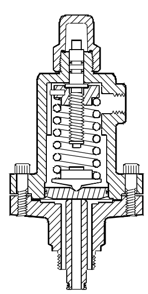
Opens as outlet pressure drops. For hot gas bypass to suction or for controlled supply pressure of defrost hot gas. Also used for compressor suction pressure limiting (crankcase pressure regulator). ¼" NPT connections for outlet pressure gauge and sensing line (tubing not included). Range B, 30 to 300 psig (2 to 21 bar), Part 75-1101; or Range V, 20" to 130 psig (–0.67 to +9 bar), Part 75-1100. Catalog M3O, specify range.



M3O

## DIFFERENTIAL PRESSURE

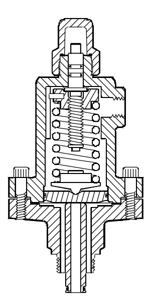
Maintains set-for differential between inlet and outlet or other pressure source. For pump relief or any differential control. ¼" NPT connection for pressure sensing line (tubing not included). Range A, 0 to 150 psi (0 to 10 bar) difference, Part 75-1081, Catalog M3L.



M3L

## PNEUMATICALLY COMPENSATED

Air or other pressure in the bonnet raises inlet pressure on a 1:1 ratio. ¼" NPT connection. Range A, 0 to 150 psig (0 to 10 bar), Part 75-1081, Catalog M3P.

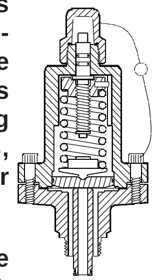


M3P

## RESEATING RELIEF

Opens wide when pressure exceeds pressure setting and repeatedly reseats after operation. Defrost relief or high-to-low system relief. Set and tagged. The standard setting for ammonia defrost is 70 psig (4.8 bar). Range A, 0 to 150 psig (0 to 10 bar), Part 75-1103; or Range B, 30 to 300 psig (+2 to 21 bar), Part Number 75-1104. Catalog M3K.

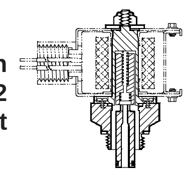
Compact welded pressure pilot. Range A, 0 to 150 psig (0 to 10 bar), Part 75-1127. Standard on valve sizes ¾" to 1¼". Catalog M3KW.



M3K

## SOLENOID

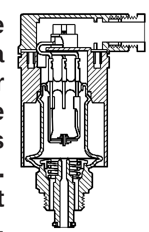
Normally closed. Opens wide when energized. Requires coil. See page 2 for coil selection. Less coil: Part 70-1052, Catalog MS.



MS

## ELECTRONICALLY CONTROLLED

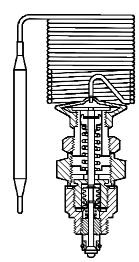
Mounted electronic actuator changes the pressure set point in conjunction with a controller and temperature sensor for either air or liquid. Very precise. See page 12 for the control package which includes the necessary controller and sensor. Range: J1, 0 to 85 psig (0 to 6 bar), Part 27B1140; or J2, 25 to 115 psig (1.7 to 8 bar), Part 27B1141. Catalog M3J.



M3J

## TEMPERATURE OPERATED

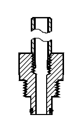
Bulb opens the control module on temperature rise to maintain a constant temperature. Part 27B1110 with a range of –40F to +30F (–40°C to 0°C) or Part 27B1111 with a range of +15F to +75F (–10 to +25°C). Catalog M3T.



M3T

## EXTERNAL CONNECTION

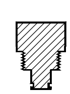
Enables a remote pressure source to be introduced to the control via a pilot line (replaces a pilot). ¼" NPT with separate 4" (100 mm) long weld nipple, Part 35-1015, Catalog M3E25.



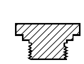
M3E25

## BLANKING PLUGS

To be used in a control module port when the port is not utilized. Stopping plugs have square head and are marked with "0" (75-1063). Straight through flow plugs have a hex head and are marked with "1" (75-1064). Catalog M3S (stopping) or M3B (straight through).



M3S



M3B

## MAIN REGULATORS ONLY (AR1, AR3)

Hansen regulators are normally furnished with control modules (pilots) installed and tested (see page 3). However, modular regulators less pilots and flanges are available on order from ¾" to 6" (20 mm to 150 mm). Each AR1 and AR3 includes flange gaskets, nuts and bolts, and a plugged ¼" FPT outlet pressure access port. The access port is for connecting outlet or differential control module sensing lines or gauges.

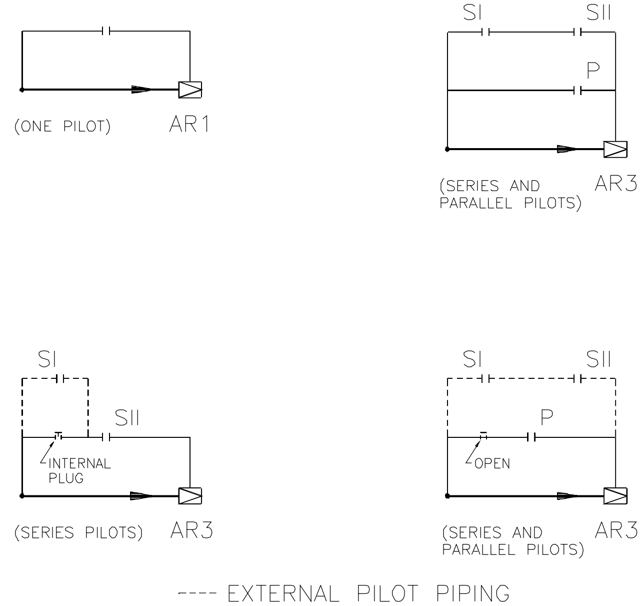
AR1 is the main regulator body with ONE control module (pilot) port, control module not included.

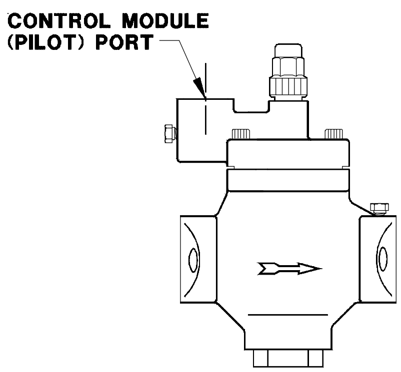
AR3 is the main regulator body with THREE control module (pilot) ports, for a maximum of three control modules, not included. The 5" and 6" (125 mm and 150 mm) AR3 regulators have a single control module port with connection points for up to three total ports via mounted pilot piping.

**TO ORDER:** (Main Regulators only) Specify port size and catalog number (AR1 or AR3).

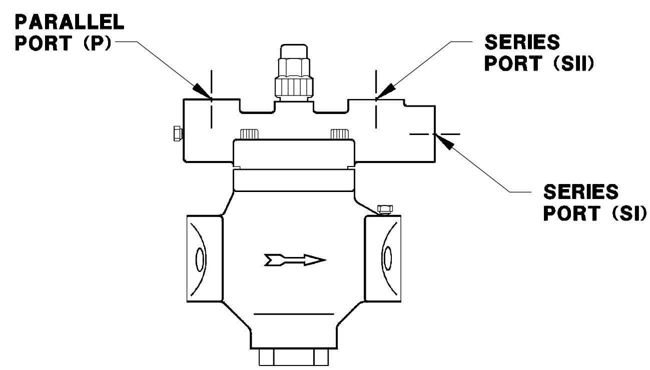
**¾" through 6" (20 mm through 150 mm)**

**¾" through 4" (20 mm through 100 mm)**




**AR1**

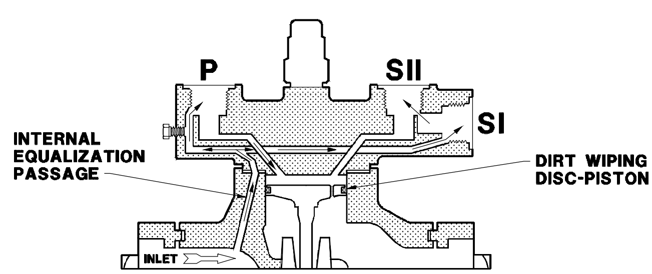



**AR3**

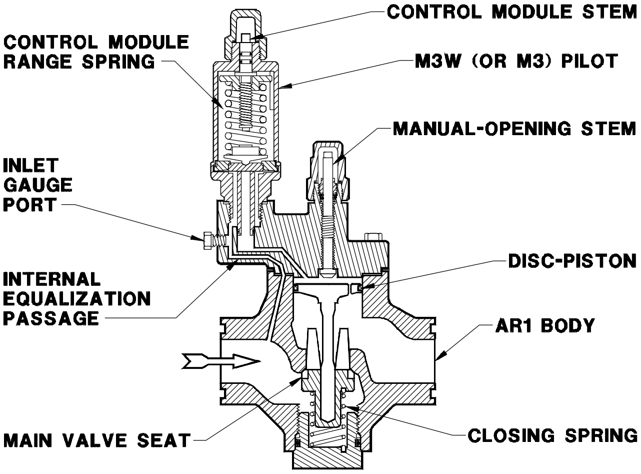
## OPERATION OF REGULATORS

The regulator adapter (top cover) is available with one control module port or three control module ports. One control module port is often used for a solenoid valve or a single pressure regulator. Three control module ports are often used for a dual regulator and other multiple function variations.

When the modular regulator has three control module ports, two are in series (SI and SII) and one is in parallel (P). Inlet pressure enters the internal equalization passage and goes to both the P port and the SI port. Inlet pressure enters the SII when the control module SI port is open. When the control module in the SI and SII port or the P port is open, pressure enters the space above the piston which forces the main valve seat to open and regulate flow.



## HA4A STANDARD REGULATOR




### OPERATION

Inlet pressure is channeled through the internal equalization passage to the inlet pressure control module. The valve modulates open when inlet pressure exceeds the pressure setting on the control module. The gas or liquid passes through the inlet pressure control module to enter the space on top of the piston, which forces the main valve seat to open and regulate flow. As inlet pressure increases, the main valve seat opens further to maintain the selected inlet pressure. A minimum pressure difference of 2 psi (0.14 bar) is adequate to fully open the main valve. When inlet pressure decreases below the pressure setting on the control module, the closing spring will cause the main valve seat to throttle closed.

### ADJUSTMENT

Connect a pressure gauge via a gauge valve at the gauge port on the regulator adapter. Set the control module range spring at minimum force (control module stem turned counterclockwise). Operate the refrigeration compressor system and achieve approximate desired suction pressure. Turn the control module stem clockwise until a slight increase in inlet pressure is detected by the gauge. The inlet pressure setting can now be increased by turning the control module stem clockwise or decreased by turning it counterclockwise. The system should be allowed to operate for a period of time before the final adjustment is made. The inlet pressure control module is available in Range A, 0 to 150 psig (0 to 10 bar); or Range B, 30 to 300 psig (2 to 21 bar). A vacuum Range V, 20" to 130 psig (–0.67 to +9 bar) is also available.

## HA4AK RESEATING RELIEF REGULATOR

### OPERATION

(Same as HA4A) Inlet pressure is channeled through the internal equalization passage to the reseating relief control module. When inlet pressure exceeds the relief setting, the control module opens wide to allow pressure to enter the space on top of the piston. This causes the main valve seat to open and relieve the inlet pressure, provided the outlet pressure is at least 2 psi (0.14 bar) lower. A 5 psid (.35 bar) closing spring is standard on ¾" through 1¼" valves. See page 6 for M3K pilot details.

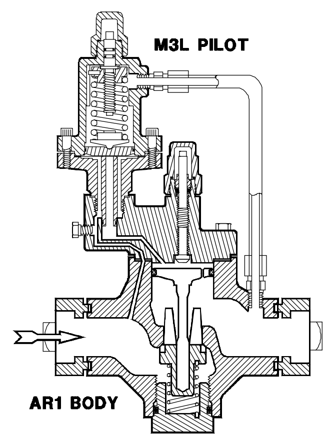
When used for defrost relief from low side to an intermediate pressure, a check valve on the outlet is required to prevent back flow during refrigeration.

### ADJUSTMENT

The control module is nonadjustable, factory-set and sealed. Available in Range A, 0 to 150 psig (0 to 10 bar); or Range B, 30 to 300 psig (2 to 21 bar).

## HA4AL DIFFERENTIAL PRESSURE REGULATOR

### OPERATION

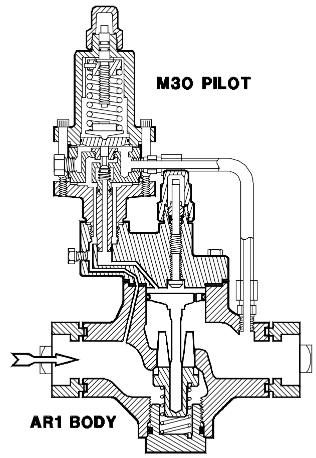



Inlet pressure is channeled through the internal equalization passage to the differential pressure control module. Outlet pressure (or other) is introduced to the space on top of the differential pressure control module diaphragm via an external sensing tube. A range spring on the top of the control module diaphragm allows the control of the differential between inlet and outlet pressure. Increased range spring force increases the differential setting. Inlet pressure, counteracted by the range spring plus outlet pressure, enters the space on top of the piston which forces the main valve seat to open and regulate flow. The external sensing tube on the 5" & 6" valves must be customer supplied and field installed.

### ADJUSTMENT

Connect a pressure gauge via a gauge valve at the gauge port on the regulator adapter for the inlet pressure reading. A pressure gauge downstream is also required. With the control module range spring force at the minimum (control module stem turned fully counterclockwise, at this point pressure differential is at minimum), slowly turn the control module stem clockwise until the desired pressure difference between the two gauges is achieved. A final adjustment should be made after system has operated for a period of time. The system must be capable of generating the desired pressure difference for the regulator to open. Range A, 0 to 150 psig (0 to 10 bar).

## HA4AO OUTLET PRESSURE REGULATOR



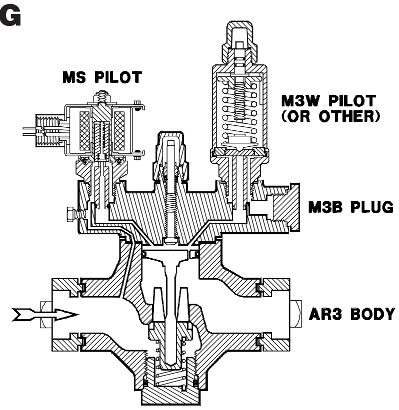

### OPERATION

Outlet pressure is channeled through an external sensing tube to the outlet pressure control module. The outlet pressure is introduced to the space under the control module diaphragm. When outlet pressure decreases below the outlet pressure setting the range spring forces the control module to open further. As the control module opens, more inlet pressure enters the space on top of the piston forcing the main valve seat to open further and regulate flow. As outlet pressure rises the control module reduces the inlet pressure to the piston and the main valve seat starts closing. The external sensing tube on the 5" & 6" valves must be customer supplied and field installed. A 5 psid (.35 bar) closing spring is standard on ¾" through 1¼" valves. A lighter spring is available for applications where a low pressure drop is required, such as holdback or crankcase pressure regulators.

### ADJUSTMENT

Connect a pressure gauge via a gauge valve to the outlet gauge port located on the outlet pressure control module or the pipe after the regulator. With the control module range spring at minimum force (control module stem turned counterclockwise) operate the refrigeration compressor. Turn the control module stem clockwise until the desired outlet pressure is achieved. Ranges available: B, 30 to 300 psig (2 to 21 bar); or vacuum range V, 20" to 130 psig (–0.67 to +9 bar).

## HA4AB REGULATOR WITH ELECTRIC WIDE OPENING



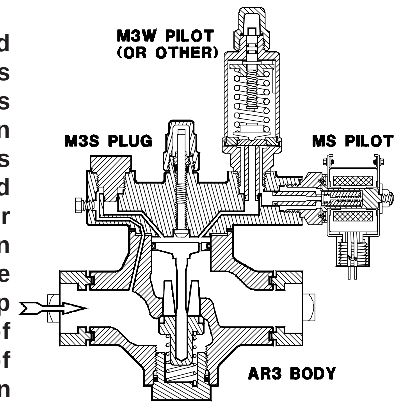

### OPERATION

When the solenoid control module is de-energized, this control operates in the same manner as the HA4A Standard Regulator or other pilot functions. When energized, inlet pressure bypasses the constant pressure control module and enters the space on top of the piston which forces the main valve seat to open wide to permit flow in the direction of arrow.

### ADJUSTMENT

With solenoid control module de-energized, follow adjustment procedures for the HA4A Standard Regulator. See page 10.

## HA4AS REGULATOR WITH ELECTRIC SHUT-OFF



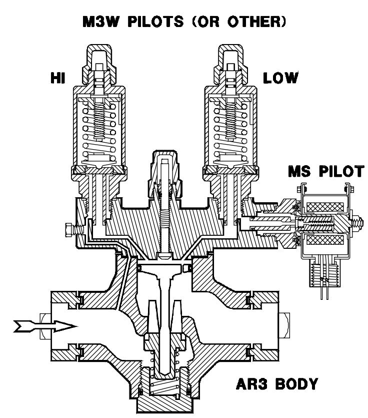

### OPERATION

When the solenoid control module is energized, this control operates in the same manner as the HA4A Standard Regulator or other pilot functions. When de-energized, valve closes tight to stop flow in direction of arrow regardless of pressure setting on the control module.

### ADJUSTMENT

Energize the solenoid control module and follow the control module adjustment procedures for the HA4A Standard Regulator. See page 10.

## HA4AD DUAL PRESSURE REGULATOR




### OPERATION

When the solenoid control module is energized, this valve operates in the same manner as the HA4A Standard Regulator or other pilot functions. When the solenoid control module is de-energized, the inlet pressure is channeled to the higher-setting inlet pressure control module and operates in the same manner as the HA4A regulator. When inlet pressure rises above the higher setting, the control module opens to allow inlet pressure to enter the space on top of the piston which forces the main valve seat to open and regulate flow. Typically used as a combined evaporator pressure regulator and defrost internal relief valve.

### ADJUSTMENT

Connect a pressure gauge via a gauge valve at the gauge port on the regulator adapter. With the solenoid control module de-energized, adjust the constant pressure control module in the P port for the high-pressure setting. This may require a warm room or hot gas supply to the evaporator. Then, energize the solenoid control module located on the series SI port and adjust the constant pressure module in the series SII port for the low-pressure setting. For control module adjustment, follow the adjustment procedures for the HA4A Standard Regulator. See page 10.

## HA4AP PNEUMATICALLY COMPENSATED REGULATOR

### OPERATION

A pneumatic controller regulates the amount of air pressure applied to the top of the M3P control module diaphragm. A rise in temperature sensed by the pneumatic controller reduces the air pressure to the control module, allowing inlet pressure to enter the space on top of the piston which forces the main valve seat to open and regulate flow. A decrease in sensed temperature increases the pressure of air to the M3P control module. This increase in air pressure reduces the opening at the M3P control module and restricts the flow of inlet pressure to the piston, thus reducing the opening at the valve main seat. See page 6 for M3P pilot details.

### ADJUSTMENT

Disconnect the air line to the M3P control module and follow the adjustment procedures for the HA4A Standard Regulator. See page 10. This sets the low inlet pressure setting for the regulator. Connect the air line back to the M3P control module. For every 1 psi (0.069 bar) of increase in air pressure, the inlet refrigerant pressure setting increases 1 psi (0.069 bar). Adjust the controller as specified by the manufacturer. In lieu of air, low-pressure refrigerant or other fluid can be used for compensation. The differential between inlet pressure and pressure to the M3P control module must not exceed 45 psi (3.1 bar). Range A, 0 to 150 psig (0 to 10 bar).

## HA4AT TEMPERATURE OPERATED REGULATOR

### OPERATION

Temperature changes are detected by the thermal bulb. The expansion or contraction of the charge inside the bulb and capillary tube is transferred across the diaphragm in the M3T control module. A rise in temperature above the set-for temperature opens the M3T control module and allows inlet pressure to enter the space on top of the piston which forces the main valve seat to open and regulate flow. A decrease in temperature closes the M3T control module which allows the piston to rise and close the main valve seat. A reverse acting model is also available: rising temperature closes the regulator, as for reheat. See page 6 for M3T pilot details.

### ADJUSTMENT

Connect a pressure gauge via a gauge valve at the gauge port on the regulator adapter. Place a thermometer in the cooled medium. With the system operating, set the M3T regulator control module to the desired temperature by turning the adjustment ring clockwise to lower opening temperature or counterclockwise to increase opening temperature. One turn is equivalent to a change of approximately 11F (6.1°C). Tighten the locking ring after the final adjustment has been made. Range –40F to +30F (–40°C to 0°C); or +15F to +75F (–10°C to +25°C).

## HA4AJ ELECTRONICALLY CONTROLLED REGULATOR

### OPERATION

The controller receives signals from an air or liquid sensor and transmits an electrical voltage to the M3J electronic actuator control module. An increase in temperature lowers the voltage to actuator, opening the regulator to increase flow. A decrease in sensor temperature increases the voltage from the controller to the M3J electronic actuator control module closing the valve to reduce flow. This precision control can maintain temperatures within 1F (0.5°C) of setting. The M3J electronic actuator control module *must* be operated by one of the control packages below. See page 6 for M3J pilot details.

#### CONTROL PACKAGES

**ECP** This standard electronic control package consists of a controller, controller base, sensor, and transformer.

**DDS** This control package includes the standard ECP components plus a digital temperature readout, set-for/actual temperature switch to easily check temperature, assembled and mounted on a metal back plate. To display the set-for temperature, simply depress and hold the set-for/actual temperature switch. When released, the digital readout will again display the actual temperature at the sensor.

**DDL** Same as the DDS with a minimum evaporator pressure adjustment. This adjustment sets an evaporator pressure “floor” independent of temperature. This is ideal to prevent too cold of an evaporator surface in flooded evaporators or during loading of critical, temperature-sensitive products.

**WTE2** Watertight controller enclosure for the above “DD” series control packages. This industrial-grade enclosure is polycarbonate with clear gasketed cover.

**EKA46** This computer interface is available for direct connection of the electronic actuator control module to a plant computer, PLC, or other controlling device. Input to interface is a regulated 4–20 mA or 0 to 10 volt signal from an intelligent control device. The EKA46 package includes interface module and transformer.

### ADJUSTMENT

Set the desired temperature (REF) using both coarse and fine adjustments. Set the alarm limits (LIM) on deviation from the desired temperature, +1°C to +5°C. Adjust the alarm delay timer (DEL) to delay alarm release from 10 to 60 minutes. Both Proportional amplification (Kp) and Integration time (Tn) are factory set to 4. Consult the instruction manual or contact the factory if adjustment is necessary. See the instructions supplied with the EKA46 for its adjustment recommendations. M3J electronic actuator control module ranges: J1, 0 to 85 psig (0 to 6 bar); or J2, 25 to 115 psig (1.7 to 8 bar).

# HA4AM ELECTRIC MOTOR COMPENSATED REGULATOR

## OPERATION

The regulator pressure setting is altered as the motor receives a signal from a suitable temperature controller. The motor responds to maintain the balance in the electrical circuit. The rotation of the motor is transmitted through a cam, valve stem, and range spring to the top of the control module diaphragm. An increase in temperature decreases the range spring force on top of the control module diaphragm. This decrease in force on the diaphragm allows inlet pressure to pass through the control module to enter the space on top of the piston which forces the main valve seat open to reduce the evaporator pressure. A decrease in temperature causes an increase in the range spring force. This restricts the flow of inlet pressure to the piston causing a reduction in the opening of the main valve seat, reducing regulator flow by raising the pressure setting.

## APPLICATIONS

This motor compensated regulator is popular for fruit storage, precision air temperature control, and liquid chiller control.

## ADJUSTMENT

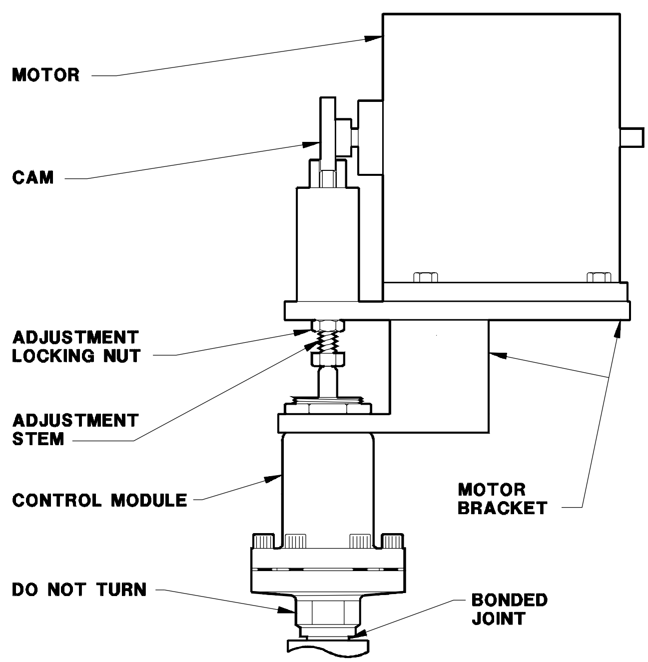
Adjust the temperature controller as specified by the manufacturer. Fully open the regulator manually by turning in (clockwise) the manual-opening stem to cool the product or room. Once the temperature at the sensing device is approximately as desired, adjust the controller output so that the cam is rotated to the center position. Put regulator back in automatic operation by turning the manual-opening stem out (counterclockwise). Loosen the adjustment locking nut. See the diagram to the right. Turn the adjustment stem clockwise to raise the inlet pressure setting or counterclockwise to lower the inlet pressure setting. When the desired refrigerant pressure setting is achieved, tighten the adjustment locking nut. A final adjustment should be made after the system has operated for a period of time.

Using a potentiometer slide wire type of controller (typically 135 ohm), depending on product heat load, a deviation from desired temperature of about +2F to +5F (+1.1°C to +2.8°C) is normal to rotate the regulator cam for maximum load satisfaction. As the load is reduced or as the temperature becomes lower, the cam rotates to create a higher evaporator pressure just adequate to balance the load and maintain the desired temperature, usually with ±1°F (0.5°C). Other controllers are available to operate the motor/cam rotation.

The basic Electric Motor Compensated Regulator consists of a nonremovable control module with a motor bracket and cam. The control module is available in either Range A, 0 to 150 psig (0 to +10 bar); or Range V, 20" to 130 psig (–0.67 to +9 bar). The motor bracket comes mounted on the control module and is suitable for use with either PENN (standard) or HONEYWELL motors. Two cams are available: Low Rise (standard) and High Rise. The table below indicates the pressure change possible for each cam and motor combination.

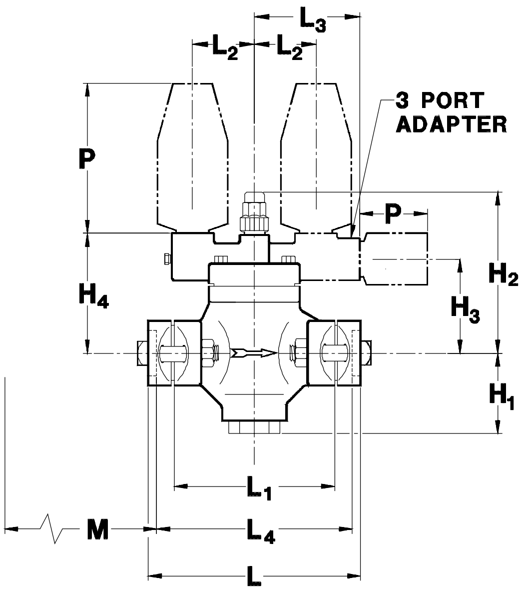
| RANGE | CAM | PRESSURE CHANGE | |
|---|---|---|---|
| | | PENN | HONEYWELL |
| A or V | LOW RISE | 45 psig (3.1 bar) | 30 psig (2.1 bar) |
| | HIGH RISE | 90 psig (6.2 bar) | 60 psig (4.1 bar) |

The PENN motor (standard) has 270° of rotation travel and the HONEYWELL motor has 160° of rotation travel. Motors are available for either 135 ohm or 4–20 mA control signal input and require 24 VAC power input. Electric proportional thermostat controllers (135 ohm output), electronic PID controllers (4–20 mA output) with sensor, and 24V transformers are available accessories.

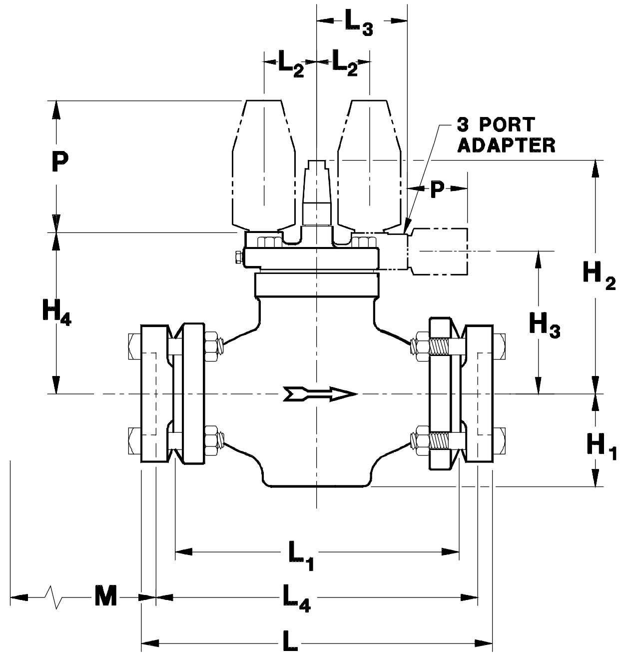


# INSTALLATION DIMENSIONS (MM)

**¾" THROUGH 1¼" REGULATORS**




**1½" THROUGH 4" REGULATORS**




**M = Additional length for close-coupled strainer**

| PORT SIZE (mm) | $H_1$ | $H_2$ | $H_3$ | $H_4$ | L | | $L_1$ | $L_2$ | $L_3$ | $L_4$ | M | W* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | FPT,SW | WN,ODS | | | | | | |
| ¾", 1", 1¼" (20, 25, 32) | 3.09" (78) | 6.77" (172) | 3.75" (95) | 4.63" (117) | 8.20" (208) | 8.94" (227) | 6.19" (157) | 2.38" (60) | 4.07" (103) | 7.20" (183) | 3.70" (94) | 4.50" (114) |
| 1½", 2" (40, 50) | 2.87" (73) | 8.84" (225) | 4.90" (124) | 5.72" (145) | 12.39" (315) | 13.39" (340) | 9.88" (251) | 2.35" (60) | 4.04" (103) | 10.89" (277) | 9.83" (250) | 4.50" (114) |
| 2½" (65) | 3.62" (92) | 9.69" (246) | 5.57" (141) | 6.53" (166) | 13.01" (330) | 14.03" (356) | 9.88" (251) | 2.35" (60) | 4.04" (103) | 11.01" (280) | 9.83" (250) | 5.62" (143) |
| 3" (80) | 4.06" (103) | 10.00" (254) | 6.03" (153) | 6.88" (175) | 15.38" (391) | 16.40" (417) | 12.25" (311) | 2.35" (60) | 4.04" (103) | 13.38" (340) | 12.20" (310) | 6.50" (165) |
| 4" (100) | 4.69" (119) | 10.56" (268) | 6.58" (167) | 7.46" (189) | 17.01" (432) | 20.51" (521) | 14.12" (359) | 2.69" (68) | 4.38" (111) | 15.01" (381) | 14.07" (357) | 8.06" (205) |

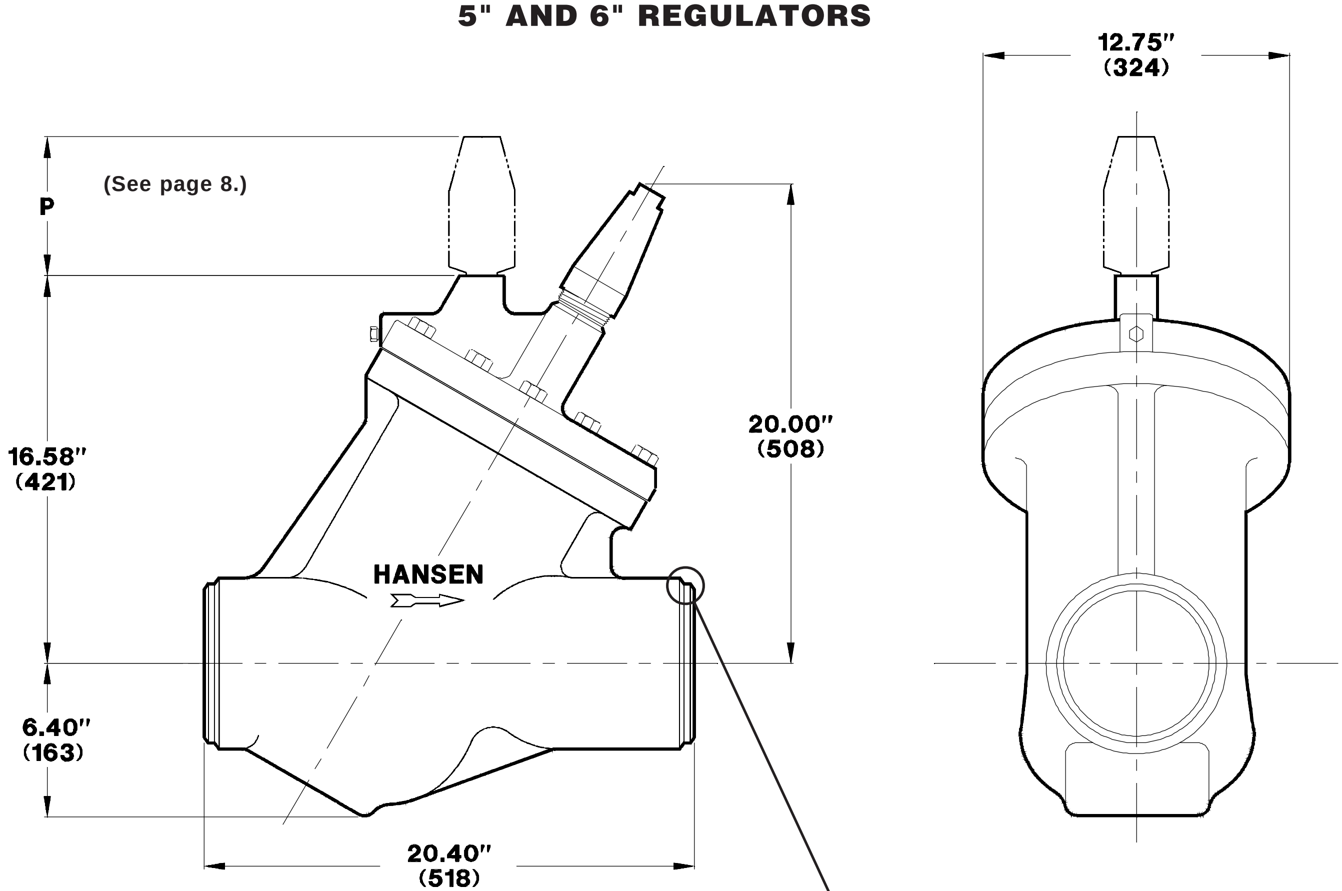
*Maximum width of valve.
For ¾", 1", 1¼" valves add 3" (80 mm) to one side of the valve for external piping as found on HA4AO and HA4AL.
An alternate 4-bolt version of the 1¼" valve is available with face-to-face dimension ($L_1$) same as R/S 1¼" for replacements.

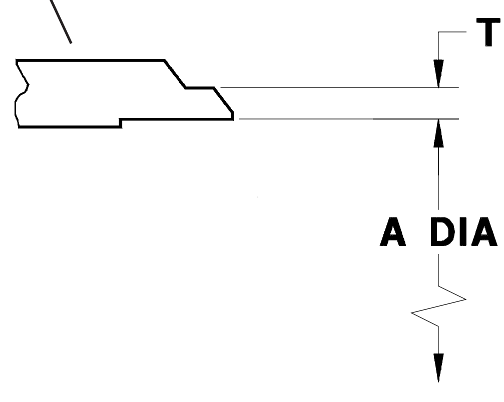
# "P" DIMENSION FOR CONTROL MODULES (MM)

| CATALOG | M3 | M3W | MS | M3O | M3K | M3KW | M3L | M3P | M3J | M3T | M3E25 | M3M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size (mm) | 6.5" (165) | 5.12" (130) | 3.25" (83) | 7.75" (197) | 6.5" (165) | 5.12" (130) | 6.5" (165) | 6.5" (165) | 4.63" (118) | 4.5" (114) | 1" (25) | 14.9" (378) |

The above dimensions do not include seal cap and solenoid coil removal height, or motor-access clearance.
M3E25 = Less 4" (100 mm) long weld nipple. M3M = Electric motor compensated control module with motor.

## INSTALLATION DIMENSIONS (MM)
## 5" AND 6" REGULATORS

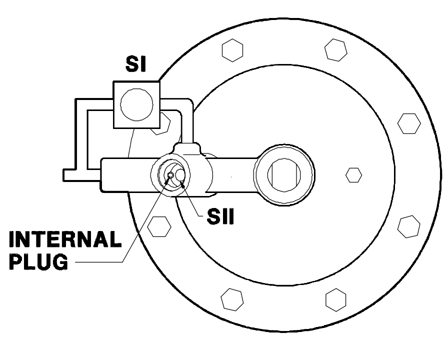


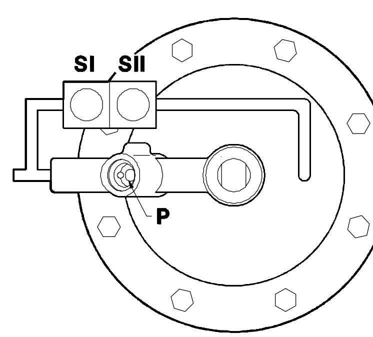

### WELD END DIMENSIONS (MM)

| PORT SIZE | A | T |
|---|---|---|
| 5"<br>(125) | 5.05"<br>(128) | 0.26"<br>(6.6) |
| 6"<br>(150) | 6.06"<br>(154) | 0.28"<br>(7.1) |

### 5" AND 6" PILOT PIPING (TOP VIEW)



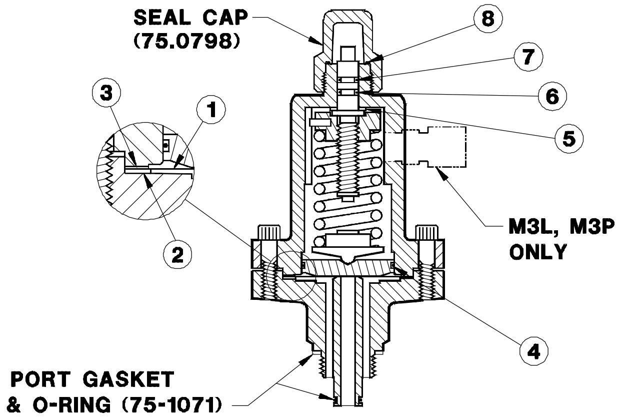

FOR SERIES ARRANGEMENT (AS)
SI, solenoid; SII pressure pilot




FOR SERIES AND PARALLEL ARRANGEMENT (AD)
SI, solenoid; SII & P pressure pilots

# PARTS LIST CONTROL MODULES

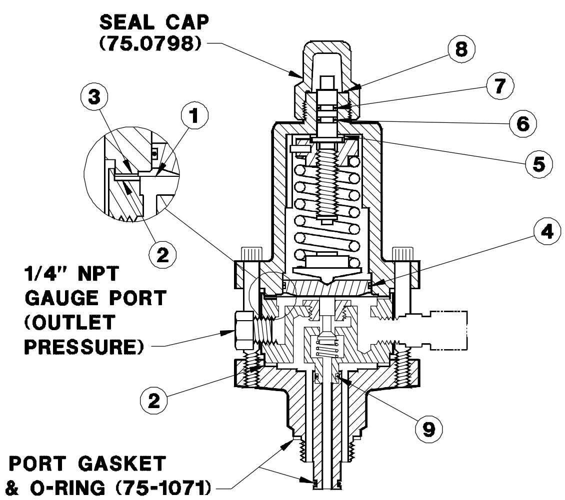
## M3, M3K, M3L, M3P



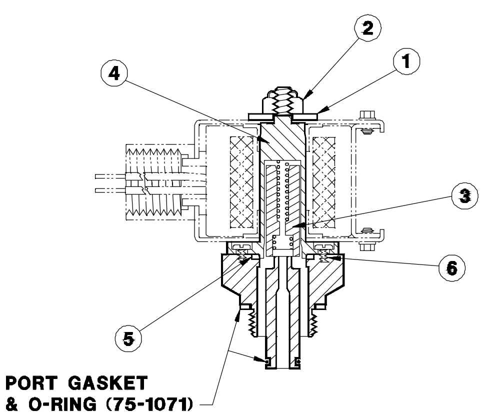

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Diaphragm/Gasket Kit (M3, M3K, M3L, M3P)** | | **75-1107** |
| | Above Kit Consists of: | | |
| 1 | Diaphragm | 1 | 75-0716 |
| 2 | Lower Gasket (thick) | 1 | 75-0426 |
| 3 | Upper Gasket (thin) | 1 | 75-0636 |
| 4 | Follower O-ring | 1 | 75-0337 |
| 5 | Fiber Washer | 1 | 75-0617 |
| 6 | Lower Stem O-ring (green dot) | 1 | 75-0520 |
| 7 | Upper Stem O-ring | 1 | 75-0521 |
| 8 | Seal Cap O-ring | 1 | 70-0011 |

*** M3W and M3KW control modules are hermetically sealed, welded assemblies having no replaceable internal parts. See page 6 for replacement part numbers. Standard on ¾"–1¼" (20–32 mm) valves.**

## M3O

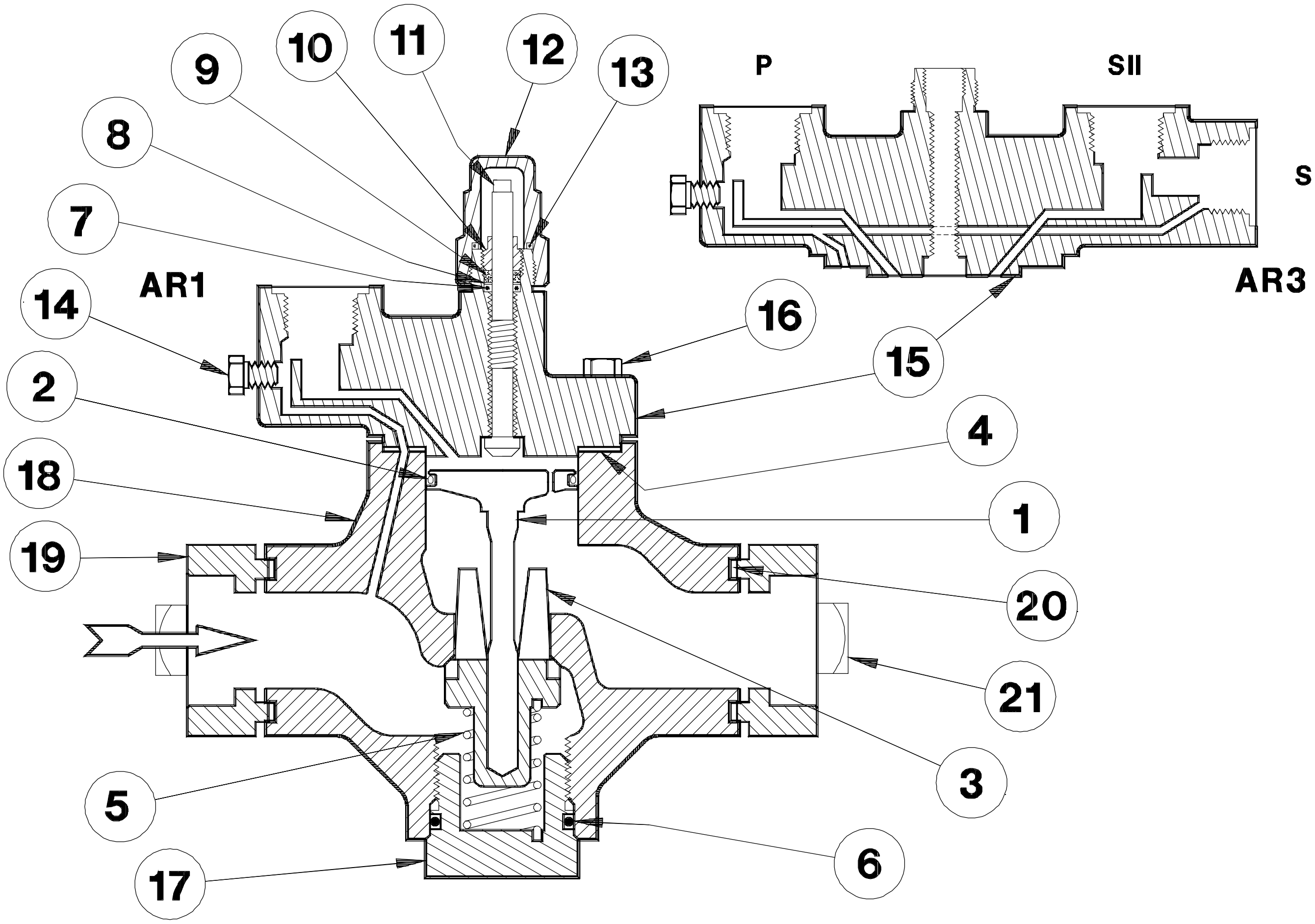



| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Diaphragm/Gasket Kit (M3O)** | | **75-1108** |
| | Above Kit Consists of: | | |
| 1 | Diaphragm | 1 | 75-0716 |
| 2 | Lower Gasket (thick) | 2 | 75-0426 |
| 3 | Upper Gasket (thin) | 1 | 75-0636 |
| 4 | Follower O-ring | 1 | 75-0337 |
| 5 | Fiber Washer | 1 | 75-0617 |
| 6 | Lower Stem O-ring (green dot) | 1 | 75-0520 |
| 7 | Upper Stem O-ring | 1 | 75-0521 |
| 8 | Seal Cap O-ring | 1 | 70-0011 |
| 9 | Cartridge O-ring | 1 | 75-0496 |




| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Solenoid Tube/Plunger Kit (MS)** | | **70-1059** |
| | Above Kit Consists of: | | |
| 1 | Coil Washer | 1 | 70-0289 |
| 2 | Coil Nut | 1 | 70-0281 |
| 3 | Plunger | 1 | 70-0295 |
| 4 | Solenoid Tube | 1 | 70-0298 |
| 5 | Solenoid Tube Gasket | 1 | 70-0301 |
| 6 | Tube Screws | 4 | 70-0297 |

## PARTS LIST ¾" THROUGH 1¼" (20 MM THROUGH 32 MM)




| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Piston Kit** consists of: | | **75-1019** |
| 1 | Piston | 1 | 75-0191 |
| 2 | Piston Seal | 1 | 75-0353 |
| 4 | Adapter Gasket | 1 | 75-0489 |
| 20 | Flange Gasket | 2 | 70-0132 |
| | **V-Port/Seat Kit ¾"*** | | **75-1020** |
| | **V-Port/Seat Kit 1"*** | | **75-1021** |
| | **V-Port/Seat Kit 1¼"*** | | **75-1022** |
| | Above kits consist of: | | |
| 3a | 3/4" V-Port/Seat | 1 | 75-0194 |
| 3b | 1" V-Port/Seat | 1 | 75-0193 |
| 3c | 1 1/4" V-Port/Seat | 1 | 75-0192 |
| 5 | Closing Spring | 1 | 75-0287 |
| 6 | Bottom Cap O-ring | 1 | 75-0183 |

| *HA4AK AND HA4AO V-PORT/SEAT KITS | |
|---|---|
| **DESCRIPTION** | **PART NO** |
| **V-Port/Seat Kit 3/4"** | 75-1129 |
| **V-Port/Seat Kit 1"** | 75-1130 |
| **V-Port/Seat Kit 1 1/4"** | 75-1131 |

**Above kits contain V-Port/Seat, bottom cap O-ring, and a 5 psid (.35 bar) closing spring (Part 75-0622). A lighter spring is available (Part 75-0287).**

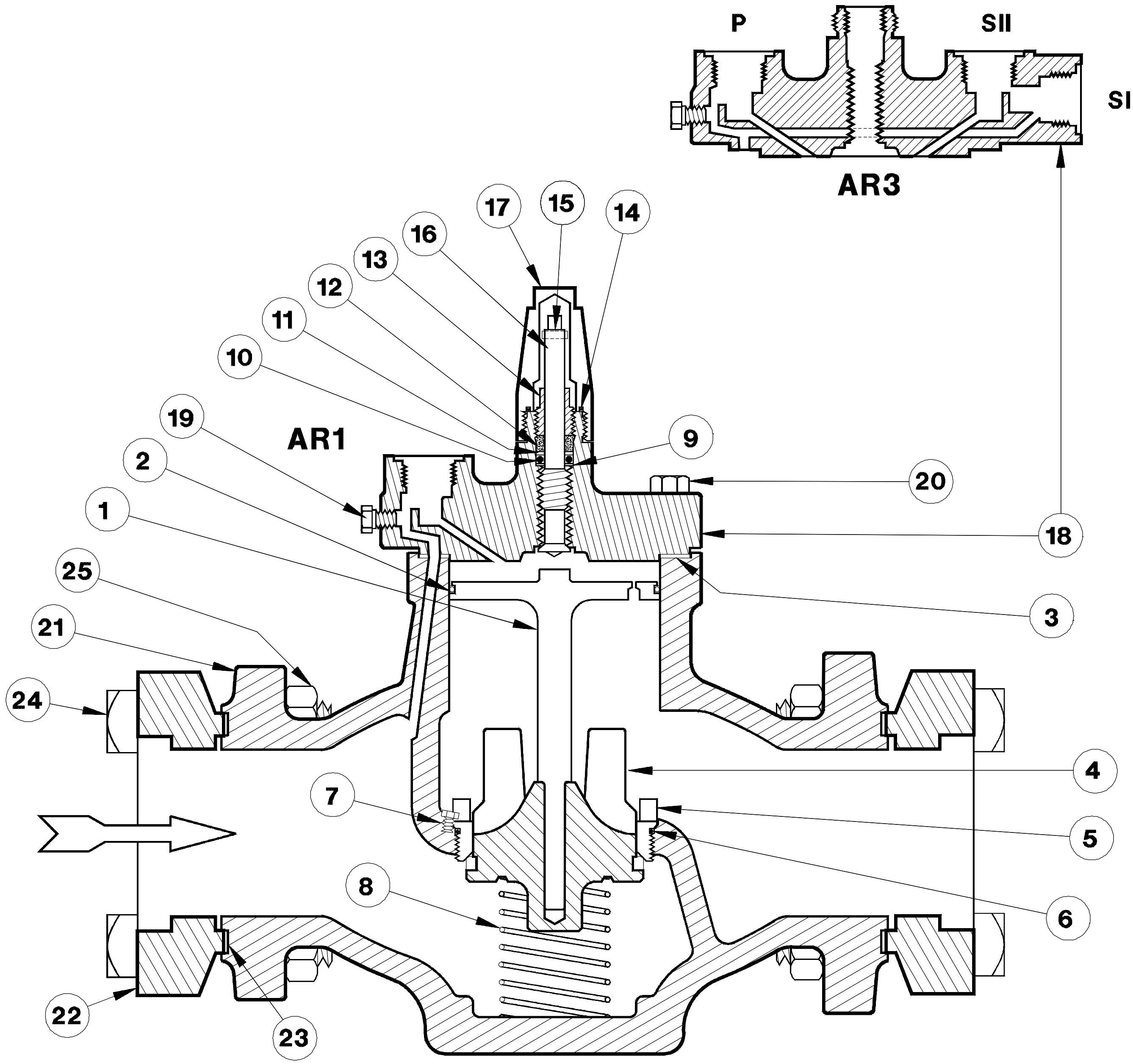
| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Gasket Kit** consists of: | | **75-1023** |
| 4 | Adapter Gasket | 1 | 75-0489 |
| 6 | Bottom Cap O-ring | 1 | 75-0183 |
| 7 | Stem O-ring | 1 | 70-0010 |
| 8 | Stem Washer | 1 | 70-0026 |
| 9 | Stem Packing | 1 | 70-0025 |
| 10 | Packing Nut | 1 | 70-0019 |
| 13 | Seal Cap O-ring | 1 | 70-0011 |
| 20 | Flange Gasket | 2 | 70-0132 |
| | Solenoid Tube Gasket | 1 | 70-0301 |
| | Port Gasket & O-ring | 3 | 75-1071 |
| 11 | Manual-Opening Stem | 1 | 75-0164 |
| 12 | Seal Cap | 1 | 50-0411 |
| 14 | Gauge Port Plug (1/4" NPT) | 1 | 75-0189 |
| 15a | Adapter, 1 Port | 1 | 75-0163 |
| 15b | Adapter, 3 Port | 1 | 75-0162 |
| 16 | Adapter Bolts, socket cap | 4 | 75-0190 |
| 17 | Bottom Cap | 1 | 75-0155 |
| 18a | Body 3/4", 1" | 1 | 75-0156 |
| 18b | Body 1 1/4", 2-Bolt | 1 | 75-0154 |
| 19 | Flange (Various) | 2 | FACTORY |
| 21 | Flange Bolt (5/8"-11x2.75") | 4 | 70-0339 |
| | Flange Nut (5/8"-11) | 4 | 70-0136 |

# PARTS LIST 1½" THROUGH 4" (40 MM THROUGH 100 MM)

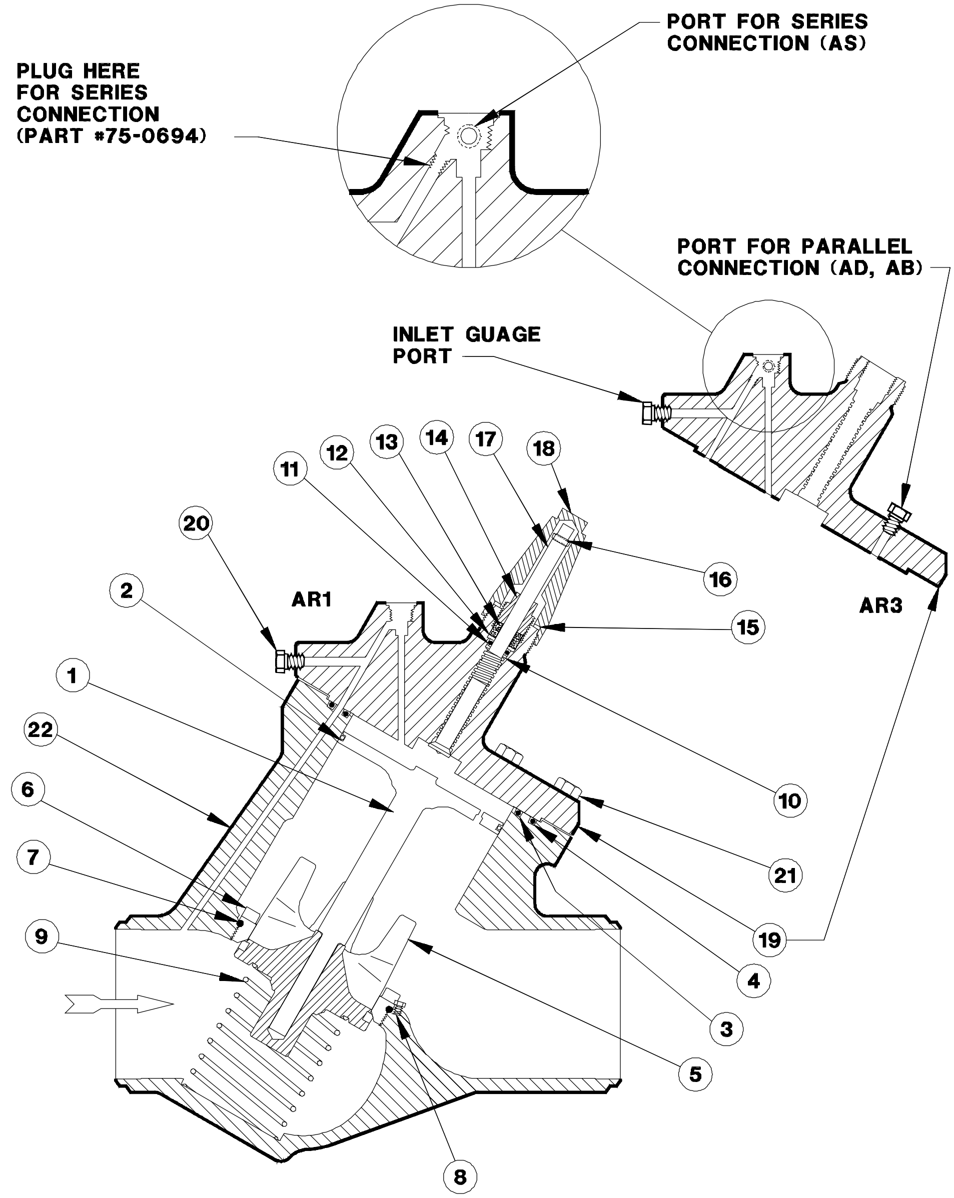
| ITEM | DESCRIPTION | QTY. | PART NO |
|---|---|---|---|
| | **Piston Kit 1½", 2"** | | **75-1025** |
| | **Piston Kit 2½"** | | **75-1026** |
| | **Piston Kit 3"** | | **75-1027** |
| | **Piston Kit 4"** | | **75-1028** |
| | Above kits consist of: | | |
| 1a | Piston 1½", 2" | 1 | 75-0168 |
| 1b | Piston 2½" | 1 | 75-0169 |
| 1c | Piston 3" | 1 | 75-0159 |
| 1d | Piston 4" | 1 | 75-0278 |
| 2a | Piston Seal 1½", 2" | 1 | 75-0292 |
| 2b | Piston Seal 2½", 3" | 1 | 75-0293 |
| 2c | Piston Seal 4" | 1 | 75-0236 |
| 3a | Adapter Gasket 1½", 2" | 1 | 75-0113 |
| 3b | Adapter Gasket 2½", 3" | 1 | 75-0093 |
| 3c | Adapter Gasket 4" | 1 | 75-0233 |
| 23a | Flange Gasket 1½", 2" | 2 | 75-0138 |
| 23b | Flange Gasket 2½" | 2 | 75-0125 |
| 23c | Flange Gasket 3" | 2 | 75-0137 |
| 23d | Flange Gasket 4" | 2 | 75-0253 |
| | **V-Port/Seat Kit 1½"** | | **75-1029** |
| | **V-Port/Seat Kit 2"** | | **75-1030** |
| | **V-Port/Seat Kit 2½"** | | **75-1031** |
| | **V-Port/Seat Kit 3"** | | **75-1032** |
| | **V-Port/Seat Kit 4"** | | **75-1033** |
| | Above kits consist of: | | |
| 4a | V-Port/Seat 1½" | 1 | 75-0369 |
| 4b | V-Port/Seat 2" | 1 | 75-0177 |
| 4c | V-Port/Seat 2½" | 1 | 75-0178 |
| 4d | V-Port/Seat 3" | 1 | 75-0179 |
| 4e | V-Port/Seat 4" | 1 | 75-0313 |
| 3a | Adapter Gasket 1½", 2" | 1 | 75-0113 |
| 3b | Adapter Gasket 2½", 3" | 1 | 75-0093 |
| 3c | Adapter Gasket 4" | 1 | 75-0233 |
| 6a | Seat Seal O-ring 1½", 2" | 1 | 75-0274 |
| 6b | Seat Seal O-ring 2½" | 1 | 75-0275 |
| 6c | Seat Seal O-ring 3", 4" | 1 | 75-0276 |
| 7 | Seat Screw | 1 | 75-0220 |
| 8a | Closing Spring 1½", 2" | 1 | 75-0171 |
| 8b | Closing Spring 2½" | 1 | 75-0201 |
| 8c | Closing Spring 3" | 1 | 75-0248 |
| 8d | Closing Spring 4" | 1 | 75-0235 |
| 5a | Seat Ring 1½", 2" | 1 | 75-0084 |
| 5b | Seat Ring 2½" | 1 | 75-0170 |
| 5c | Seat Ring 3" | 1 | 75-0071 |
| 5d | Seat Ring 4" | 1 | 75-0231 |
| 16a | Manual-Opening Stem 1½" through 3" | 1 | 75-0079 |
| 16b | Manual-Opening Stem 4" | 1 | 75-0427 |
| 17a | Seal Cap 1½" through 3" | 1 | 75-0139 |
| 17b | Seal Cap 4" | 1 | 50-0260 |

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Gasket Kit 1½", 2"** | | **75-1039** |
| | **Gasket Kit 2½"** | | **75-1040** |
| | **Gasket Kit 3"** | | **75-1041** |
| | **Gasket Kit 4"** | | **75-1042** |
| | Above kits consist of: | | |
| 3a | Adapter Gasket 1½", 2" | 1 | 75-0113 |
| 3b | Adapter Gasket 2½", 3" | 1 | 75-0093 |
| 3c | Adapter Gasket 4" | 1 | 75-0233 |
| 6a | Seat Seal O-ring 1½", 2" | 1 | 75-0274 |
| 6b | Seat Seal O-ring 2½" | 1 | 75-0275 |
| 6c | Seat Seal O-ring 3", 4" | 1 | 75-0276 |
| 9a | Back-Up Washer 1½" through 3" | 1 | 75-0245 |
| 9b | Back-Up Washer 4" | 1 | 50-0351 |
| 10a | Stem O-ring 1½" through 3" | 1 | 50-0179 |
| 10b | Stem O-ring 4" | 1 | 50-0253 |
| 11a | Stem Washer 1½" through 3" | 1 | 50-0046 |
| 11b | Stem Washer 4" | 1 | 50-0247 |
| 12a | Stem Packing 1½" through 3" | 1 | 50-0045 |
| 12b | Stem Packing 4" | 1 | 50-0248 |
| 13a | Packing Nut 1½" through 3" | 1 | 50-0013 |
| 13b | Packing Nut 4" | 1 | 50-0251 |
| 14a | Seal Cap O-ring | 1 | 50-0432 |
| 14b | Seal Cap Gasket | 1 | 50-0270 |
| 15a | Stem Pin 1½" through 3" | 1 | 75-0173 |
| 15b | Stem Pin 4" | 1 | 75-0434 |
| 23a | Flange Gasket 1½", 2" | 2 | 75-0138 |
| 23b | Flange Gasket 2½" | 2 | 75-0125 |
| 23c | Flange Gasket 3" | 2 | 75-0137 |
| 23d | Flange Gasket 4" | 2 | 75-0253 |
| | Solenoid Tube Gasket | 1 | 70-0301 |
| | Port O-ring and Gasket | 3 | 75-1071 |
| 18a | Adapter, 1 Port 1½", 2" | 1 | 75-0060 |
| 18b | Adapter, 3 Port 1½", 2" | 1 | 75-0384 |
| 18c | Adapter, 1 Port 2½", 3" | 1 | 75-0056 |
| 18d | Adapter, 3 Port 2½", 3" | 1 | 75-0493 |
| 18e | Adapter, 1 Port 4" | 1 | 75-0334 |
| 18f | Adapter, 3 Port 4" | 1 | 75-0801 |
| 19 | Gauge Port Plug (¼" NPT) | 1 | 75-0189 |
| 20a | Adapter Bolts 1½", 2" | 4 | 75-0175 |
| 20b | Adapter Bolts 2½", 3" | 4 | 65-0057 |
| 20c | Adapter Bolts 4" | 4 | 75-0291 |
| 21a | Body 1½", 2" | 1 | 75-0016 |
| 21b | Body 2½" | 1 | 75-0018 |
| 21c | Body 3" | 1 | 75-0019 |
| 21d | Body 4" | 1 | 75-0215 |
| 22 | Flange (Various) | 2 | FACTORY |
| 24a | Flange Bolt 1½", 2" | 8 | 70-0135 |
| 24b | Flange Bolt 2½", 3" | 8 | 75-0202 |
| 24c | Flange Bolt 4" | 8 | 75-0279 |
| 25a | Flange Nut 1½", 2" (⅝"-11) | 8 | 70-0136 |
| 25b | Flange Nut 2½", 3" (¾"-10) | 8 | 75-0210 |
| 25c | Flange Nut 4" (⅞"-9) | 8 | 75-0280 |

## PARTS LIST 1½" THROUGH 4" (40 MM THROUGH 100 MM)



# PARTS LIST 5" AND 6" (125 MM AND 150 MM)




| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **Piston Kit** | | **75-1110** |
| | Above Kit consists of: | | |
| 1 | Piston | 1 | 75-0570 |
| 2 | Piston Seal | 1 | 75-0602 |
| 3 | Adapter O-ring, Inner | 1 | 75-0605 |
| 4 | Adapter O-ring, Outer | 1 | 75-0606 |
| | **Gasket Kit** | | **75-1111** |
| | Above Kit consists of: | | |
| 3 | Adapter O-ring, Inner | 1 | 75-0605 |
| 4 | Adapter O-ring, Outer | 1 | 75-0606 |
| 7 | Seat Seal O-ring | 1 | 75-0613 |
| 10 | Back-up Washer | 1 | 50-0324 |
| 11 | Stem O-ring | 1 | 50-0293 |
| 12 | Stem Washer | 1 | 50-0299 |
| 13 | Stem Packing | 1 | 50-0290 |
| 14 | Packing Nut | 1 | 50-0292 |
| 15 | Seal Cap Gasket | 1 | 50-0315 |
| 16 | Manual-Opening Stem Pin | 1 | 75-0607 |
| | Solenoid Tube Gasket | 1 | 70-0301 |
| | Port O-ring and Gasket | 3 | 75-1071 |

| ITEM | DESCRIPTION | QTY | PART NO |
|---|---|---|---|
| | **V-Port/Seat Kit 5"** | | **75-1112** |
| | **V-Port/Seat Kit 6"** | | **75-1113** |
| | Above Kits consist of: | | |
| 5a | V-Port/Seat 5" | 1 | 75-0640 |
| 5b | V-Port/Seat 6" | 1 | 75-0641 |
| 3 | Adapter O-ring, Inner | 1 | 75-0605 |
| 4 | Adapter O-ring, Outer | 1 | 75-0606 |
| 7 | Seat Seal O-ring | 1 | 75-0613 |
| 8 | Seat Screw (1/4"-20 x 1/2") | 1 | 75-0220 |
| 9 | Closing Spring | 1 | 75-0601 |
| 6 | Seat Ring | 1 | 75-0558 |
| 17 | Manual-Opening Stem | 1 | 75-0581 |
| 18 | Seal Cap | 1 | 50-0304 |
| 19a | Adapter, 1 Port | 1 | 75-0554 |
| 19b | Adapter (1 Port) with Plugged Access Holes for Mutiple Pilots | 1 | 75-0720 |
| 20 | Gauge Port Plug | 1 | 75-0189 |
| 21 | Adapter Bolts | 8 | 75-0604 |
| 22a | Body, 5" | 1 | 75-0542 |
| 22b | Body, 6" | 1 | 75-0541 |

## SERVICE AND MAINTENANCE

**Failure to open:** Wrong coil or control module pilot; low line voltage; controlling switch or thermostat not contacting; coil is burned-out; adjacent shut-off valve closed; adapter gasket hole not aligned with hole in body and adapter; dirt packed under Teflon seal ring enabling excessive blow by; large quantity of dirt particles in solenoid module passages; dirt blocking internal pilot passages; main valve seat is dirt jammed.

**Failure to close:** Controlling switch or thermostat not opening contacts; manual-opening stem is turned in; valve installed in wrong direction; damage or dirt at main valve seat or pilot seat; piston bleed hole plugged. Under extreme conditions of liquid or oil "slugging" or pressure drops exceeding 45 psi (3.1 bar), special construction may be required. Contact the factory.

**Before opening the regulator or disassembling the pilot for service, be sure it is isolated from the system and all refrigerant is removed (pumped out to zero pressure).** Follow usual refrigeration system safe servicing procedures. Read the CAUTION section of this bulletin on page 20.

To check solenoid pilot section of valve, disconnect the electrical coil. Unscrew the coil nut and remove washer. Lift coil housing away from valve. Remove the four solenoid tube screws and remove solenoid tube from valve. Inspect for dirt and damage to Teflon seat and stainless steel pilot orifice. Clean, polish or replace parts as necessary, then reassemble.

**¾" through 1¼" (20 mm through 32 mm):** Use a 3/8" male hexagon wrench to loosen the four adapter bolts, proceeding slowly to avoid refrigerant which may still remain in the valve. If piston parts are stuck, remove the 2" hex bottom cap in order to separate the valve V-port/seat from the disc piston. Inspect disc and piston bore for burrs, nicks, and other damage. Remove burrs and nicks, clean or replace disc piston and Teflon seal ring as necessary. Long-life seal on disc piston need only be replaced when damaged or severely worn. If replacing the disc piston seal, make sure the seal is properly installed, with the edge up, and does not "twist" during installation. Inspect V-port/seat and main valve seat for nicks, marks, etc. The main valve seat may be lapped by hand or power drill to remove marks. Clean, polish or replace parts as necessary. If necessary, the V-port tapered seat may be reconditioned by removing up to 0.04" (1 mm) of Teflon from it on a lathe. Lightly lubricate all parts and gaskets with soft rag containing refrigerant oil. Align hole in valve body, adapter gasket, and adapter to assure proper operation. Reassemble valve. Carefully check valve for leaks before returning it to service.

**1½" through 6" (40 mm through 150 mm):** Loosen adapter bolts using a 12" adjustable wrench (15" wrench for 5" and 6" valves), being careful to avoid any refrigerant which may still remain in the valve. If disc piston is difficult to remove, insert a ¼"-20 threaded screw (3/8"-16 for 5"& 6" valves) into center of piston and lift straight-up. Inspect piston and piston bore for burrs, nicks and other damage. Remove burrs and nicks, clean or replace piston as necessary. Long-life seal on disc piston need only be replaced when damaged or severely worn. If replacing the disc piston seal, make sure the seal is properly installed, with the edge up, and does not "twist" during installation. These valves also have a removable stainless steel main valve seat. To remove seat ring for inspection, first remove small hex head seat screw. Turn the seat ring counterclockwise by turning it out with a wrench and a steel bar tool positioned horizontally or by carefully tapping the seat ring notch with a punch and a hammer. Inspect the V-port/seat and main valve seat for nicks, marks, and divots. The main valve seat may be lapped by hand or power drill to remove marks. Grease and replace the seat seal O-ring. Clean and polish, or replace the parts as necessary. If necessary, the V-port tapered seat may be reconditioned by removing up to 0.04" (1 mm) of Teflon from it on a lathe. Lightly lubricate all parts and gaskets with a soft rag containing refrigerant oil. Align the hole in the valve body, adapter gasket, and adapter to assure proper operation. Reassemble the valve. Carefully check the entire valve for leaks before restoring it to service.

## MANUAL OPENING

The manual-opening stem is designed to open the valve, allowing upstream and downstream pressures to equalize when needed for servicing, but not necessarily to create a full-flow condition. The stem is located on the top of the adapter cover. Slowly remove the seal cap from the manual-opening stem, being cautious to avoid any refrigerant which may have collected under the cap. Using an appropriate wrench, turn the stem in (clockwise) to open the valve manually; counterclockwise to return the valve to automatic operation. Do not leave the stem partially open because it may be dynamically damaged.

## ABBREVIATIONS

BW: Butt Weld end to match American Pipe Schedule 40
CRN: Canadian Registration Number
CSA: Canadian Standards Association
Cv: Valve capacity factor GPM (U.S.) of water at 1 psi differential
FPT: Female Pipe Thread, American National Standard
Kv: Valve capacity factor $m^3$/hr of water at 1 bar differential
mA: milliampere
MPT: Male Pipe Thread, American National Standard
NEMA: National Electrical Manufacturers Association: Class 4, watertight, approximate equivalent to IP65; Class 1, general purpose, approximate equivalent to IP20
NPT: National Pipe Thread
ODS: Outside Diameter Sweat, for copper tubing
PLC: Programmable Logic Controller
psig: Pounds per square inch, gauge
R/S: Refrigerating Specialties Division, Parker Hannifin Corp.
SPDT: Single Pole Double Throw
SW: Socket Weld to accommodate American and API pipe
WN or Weld: Weld Neck to match American Pipe Schedule 40

## CAUTION

Hansen pressure regulators are only for refrigeration systems. These instructions and related safety precautions must be read completely and understood before selecting, using, or servicing these valves. Only knowledgeable, trained refrigeration technicians should install, operate, or service these valves. Stated temperature and pressure limits should not be exceeded. Adapters, bottom cap, control modules, etc., should not be removed from valves unless system has been evacuated to zero pressure. See also Safety Precautions in the current List Price Bulletin and the Safety Precautions Sheet supplied with the product. Escaping refrigerant can cause injury, particularly to the eyes and lungs.

## WARRANTY

All Hansen Technologies products, except electric motors and electronic items, are warranted against defects in workmanship and materials for a period of one year F.O.B. our plant. Electric motors and electronic items are warranted against defects for 90 days. No consequential damages or field labor is included.

## REGULATOR ACCESSORIES

### STRAINERS

Generous capacity, separate, close-coupled, 60 mesh (233 Micron Rating), accessible.

### GAUGES

Pressure gauges have 3½" (90 mm) diameter faces, safe plastic lenses, ¼" NPT connection, and recalibration features. Available for ammonia and halocarbon.

### GAUGE VALVES

HGV1 "Long Neck" Gauge Valve, Seal Cap, ¼" MPT x FPT.

### PILOT LIGHTS

(specify voltage)
Pilot Light with NEMA 1 Box (green, red, or amber light)
Watertight Pilot Light assembly with NEMA 4 box. (green, red, or amber light)

## CONVERSIONS

1" (inch) = 25.4 mm
1°F∆ = 5/9°C∆
Temperature in °F = 1.8°C + 32
Temperature in °C = 5/9 (°F – 32)
1 psi = 0.06895 bar = 6.895 kPa
Cv (U.S. GPM) = Kv multiplied by 1.156
1 U.S. Gallon = 0.8327 Imperial Gallons = 3.7854 liters
1 U.S. GPM (gallons per minute) = 0.06309 $dm^3/s$ (or L/s) = 0.227124 $m^3/hr$
1 American Standard Commercial Ton of Refrigeration = 12000 Btu/h = 3024 kcal/h = 3.517 kW

## ORDERING INFORMATION, HA4A MODULAR PRESSURE REGULATORS

| PORT SIZE (mm) | | FLANGE CONNECTION STYLES & SIZES | | |
|---|---|---|---|---|
| | | FPT, SW, WN | | ODS |
| | | STD | ALSO | STD |
| = 3/4" | (20) | 3/4" | 1", 1 1/4" | 7/8" |
| 1" | (25) | 1" | 3/4", 1 1/4" | 1 1/8" |
| 1 1/4" | (32) | 1 1/4" | 3/4", 1" | 1 3/8" |
| 1 1/2" | (40) | 1 1/2" | 2" | 1 5/8" |
| 2" | (50) | 2" | 1 1/2" | 2 1/8" |
| 2 1/2" | (65) | 2 1/2" | 3" | 2 5/8" |
| 3" | (80) | 3" | — | 3 1/8" |
| 4" | (100) | 4" | — | 4 1/8" |
| 5" | (125) | 5" BW | — | — |
| 6" | (150) | 6" BW | — | — |

5" & 6" are type HA4W with integral butt weld end only.
1¼" is standard 2-bolt flange design; 4-bolt flange style available upon request to field replace 1¼" R/S.
=25% and 50% Reduced Capacity Plugs are also available.

**TO ORDER:** Specify type, connection style and size, range, voltage for coil, and close-coupled strainer if required. The strainer is a separate stainless steel 60 mesh unit which usually connects directly to the regulator inlet. Optional pilot lights are available in green, red, and amber. Please specify color and voltage when ordering the valve.

## TYPICAL SPECIFICATIONS

"Refrigerant pressure regulators shall be pilot-operated, with disc-type pistons having Teflon seals, manual-opening stems, equipped with removable pilot modules, Teflon main seats and stainless steel pilot trim and optional, close-coupled inlet strainers, as manufactured by Hansen Technologies Corporation or approved equal."

## OTHER PRODUCTS

Small Pressure Regulators and Reliefs
Gauge, Purge, and Needle Valves
Shut-Off Valves
Hand Expansion Valves (Regulators)
Refrigerant Solenoid Valves
Refrigerant Check Valves
Gas-Powered Valves
Refrigerant Float Switches
Float Drain Regulators
Refrigerant Liquid Pumps
AUTO-PURGER®s
Vari-Level® Adjustable Level Controls
Techni-Level® Transducer Probes
Frost Master® Defrost Controllers
Pressure-Relief Valves

HANSEN TECHNOLOGIES CORPORATION
6827 High Grove Boulevard
Burr Ridge, Illinois 60527 USA
Tel: (630) 325-1565 Fax: (630) 325-1572
Toll: (800) 426-7368 http://www.hantech.com

**Bulletin G209h**
May, 2000

**HANSEN TECHNOLOGIES CORPORATION**

2" Globe Valve: GS200H

**Specifications, Applications, Service Instructions & Parts**

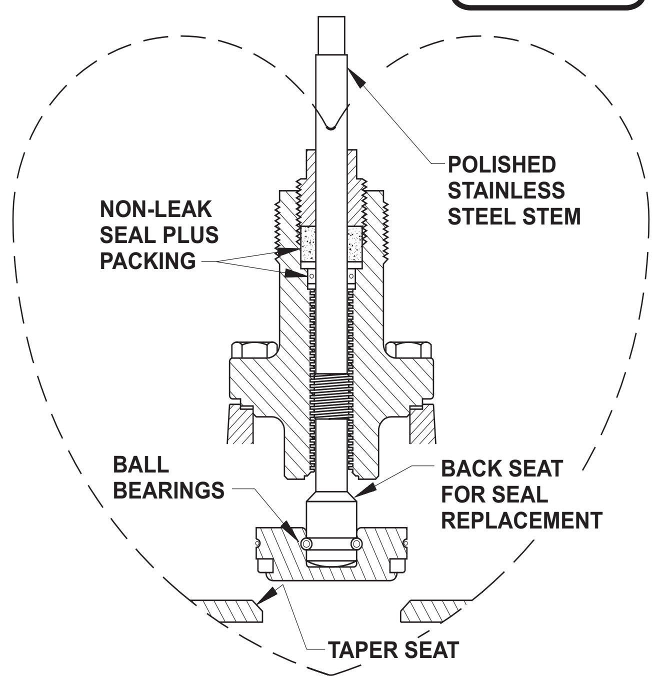
# SOCKET WELD SHUT-OFF VALVES

**½" through 2½"***
**(13 mm through 65 mm)**
**Globe and Angle**
**for Refrigerants**

*2" (50 mm) to 16" (400 mm) available as butt weld

## KEY FEATURES

ISO 9002




## INTRODUCTION

The advanced design and materials of the Hansen Steel Body Socket Weld Refrigerant Valves make them stronger and far superior to other commonly available products. This is especially true in regard to leakage from seats, stems, bonnets, and piping connections. Socket weld steel bodies permit these valves to be quickly and easily welded directly into piping without the inconvenience of pipe threading or using bulkier iron-flanged valves with socket weld steel flanges requiring bolts, nuts, and gaskets. Compared to butt weld valves, the Hansen socket weld bodies allow quicker welding, easier pipe alignment, and cleaner pipe and valve interiors.

## APPLICATIONS

Typical uses include:

Ammonia refrigeration system suction, liquid, discharge, recirculating liquid, hot gas, and oil lines using handwheel or seal cap models.

Steel pipe portions of halocarbon commercial, industrial, and air conditioning systems using seal cap models.

Compressor suction and discharge connections and condenser and evaporator inlet and outlet connections for ammonia, R22, R134a, and other Hansen-approved refrigerants.

## ADDITIONAL FEATURES

Suitable for ammonia, R22, R134a, and other Hansen-approved refrigerants
Globe and angle available
Teflon seat disc (no lead)
Available also as an expansion valve
Handwheels or seal caps are interchangeable
400 psig (27 bar) safe working pressure
Temperature range: –60°F to +240°F (–50°C to +115°C)
Below –60°F (–50°C) at lower pressures
Nonasbestos gaskets
Made entirely in the USA

## MATERIAL SPECIFICATION

Body: ½" and ¾", ASTM A108 (connections ASTM A513)
1" through 2½", cast steel, ASTM A352, grade LCB

Stem: stainless steel

Disc Holder: steel

Seat Disc: PTFE Teflon, retained

Ball Bearings: stainless steel

Packing Nut: ½" through 1¼", corrosion resistant coated steel
1½" through 2½", electroless nickel plated steel

Stem Packing: graphite composite plus neoprene o-ring

Handwheel: ½" through 1¼", zinc-plated Zamak alloy
1½" through 2½", zinc-plated iron alloy

Bonnet: ½" through 1¼", zinc-chromate plated steel
1½" through 2½", ductile iron ASTM A536

Seal Cap: ½" through 1¼", glass-filled polymer, safety vented
1½" through 2½", zinc-plated steel

## ADVANTAGES

Compared to threaded valves, Hansen Socket Weld Valves eliminate the chance of future leaks at pipe threads. In addition, a socket welded pipe-to-body joint eliminates the inherent weakness and vulnerability of the threaded portion of pipe immediately adjacent to a screwed valve body or flange.

Socket welding is easier than butt welding for alignment. It also provides cleaner interior weld joints.

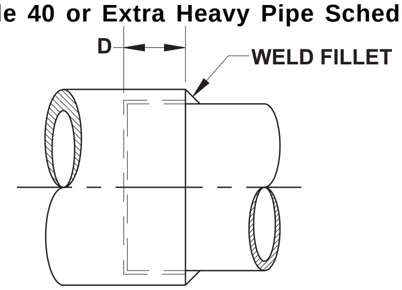
Compared to flanged valves, Hansen Socket Weld Valves eliminate the leak potential at the gasket joint. In addition, nearly all refrigeration flanged valves are made of cast iron or "semi-steel," a type of cast iron. Hansen's steel valves have much greater tensile strength, ductility, and impact resistance than cast iron.

Compared to pressed-sheet-steel weld valves, Hansen valves have heavier cast steel wall thickness for greater rigidity and a corrosion safety margin.

All Hansen socket weld valves have rising stems. This allows the operator to know at a glance whether the valve is open or closed.

## CONNECTION DIMENSIONS

The body sockets accommodate US Standard Pipe Schedule 40 or Extra Heavy Pipe Schedule 80.




The D dimension represents the socket depth. See pages 4, 6, 8, and 10.

## INSTALLATION

All Hansen weld valves can be installed in horizontal or vertical pipe lines. Stems are normally installed horizontally, but, depending on the application, stems may be installed vertically. Globe valves in horizontal suction lines, liquid overfeed return lines, condenser drain lines, purge lines, oil pot drain lines, or level control column isolation valves should have stems horizontal to avoid liquid or vapor being trapped at the valve seat orifice. Inlet pressure or direction of flow for all valve sizes should normally be under valve seat disc. However, to avoid installing an angle valve with the stem down, it is better to install the valve with the normal flow opposite the direction of the arrow.

The valve stem should be opened several turns during welding to prevent heat damage to the seat disc. Normally, it is not necessary to disassemble these socket weld valves for installation welding. However, if welding is prolonged enough to overheat the valve body, a wet rag should be wrapped around the valve bonnet and upper body while welding. Socket weld fitting and valve codes require that the pipe be inserted until bottomed against the stop, then backed out approximately 1/16" (1.5 mm) before welding.

Welds should be annealed as necessary in accordance with good practice. Painting valves and welds is recommended for corrosion protection. Pipe covering, where applied, should have a proper moisture barrier.

Before putting valves into service, all pipe weld connections, valve seats, bonnet seals, and stem seals should be tested for leaks at pressure levels called for in appropriate codes. If necessary, retighten at 75 ft-lbs (100 Nm) the threaded bonnet on ½" (13 mm) through 1¼" (32 mm) valves. These may have a loosened secondary knife-edge seal after installation due to excessive heating of valve body.

Shut-off valves leading to the atmosphere must not be left unsupervised and must be plugged or capped to prevent corrosion inside the valve as well as leakage due to seat expansion, vibration, pressure shock, or improper opening. The valve seat should be cracked open to prevent hydrostatic expansion between the valve and the cap. Valves should never directly feed a water tank because of potential internal corrosion or seat opening caused by vibration.

## INSULATION

Readily available, valve shaped block insulation can be used for both angle and globe valves. Exterior valve dimensions for insulation are shown on pages, 4, 6, 8, and 10. The W dimension on pages 6, 8, and 10 represents the width of the reinforcement web.

## SERVICE AND MAINTENANCE

Hansen Steel Body Socket Weld Shut-Off Valves require practically no service or maintenance. Stem leakage, a common problem of shut-off valves, is almost entirely eliminated by the combination of polished stainless steel stems and reliable, conventional, adjustable packing supplementing fluid-tight o-ring stem seals. For optimum maintenance, occasional cleaning of the valve stem with a soft rag and refrigerant oil is helpful. The patented o-ring stem seal design permits low torque operation to open and close the valve.

# FLOW CAPACITIES
# PIPING AND VALVE SIZING GUIDE FOR AMMONIA

| SERVICE | CONDITIONS | | | | CAPACITIES | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temp. | | PRESSURE | | ½" (13 mm) | | ¾" (20 mm) | | 1" (25 mm) | | 1¼" (32 mm) | | 1½" (40 mm) | | 2" (50 mm) | | 2½" (65 mm) | |
| | °F | (°C) | PSIG | (BAR) | TONS | (kW) | TONS | (kW) | TONS | (kW) | TONS | (kW) | TONS | (kW) | TONS | (kW) | TONS | (kW) |
| Suction Lines Single Stage Compressor | +20 | (–6.7) | 33.5 | (2.3) | — | — | — | — | 8.6 | (30) | 15.8 | (56) | 21.3 | (75) | 35.7 | (126) | 51.1 | (180) |
| | 0 | (–17.8) | 15.7 | (1.1) | — | — | — | — | 5.7 | (20) | 10.4 | (37) | 13.9 | (49) | 22.7 | (80) | 34.0 | (120) |
| Suction Lines Booster | –20 | (–28.9) | 3.6 | (0.2) | — | — | — | — | 4.2 | (15) | 7.4 | (26) | 10.3 | (36) | 16.8 | (59) | 24.8 | (87) |
| | –40 | (–40) | 8.7" | (–0.3) | — | — | — | — | — | — | 4.4 | (15) | 6.3 | (22) | 9.9 | (35) | 14.4 | (51) |
| Liquid Overfeed Return Lines (4X) | +20 | (–6.7) | 33.5 | (2.3) | — | — | — | — | 5.0 | (18) | 9.1 | (32) | 12.3 | (43) | 20.6 | (73) | 29.4 | (103) |
| | 0 | (–17.8) | 15.7 | (1.1) | — | — | — | — | 3.4 | (12) | 6.3 | (22) | 8.5 | (30) | 13.6 | (48) | 20.5 | (72) |
| | –20 | (–28.9) | 3.6 | (0.2) | — | — | — | — | 2.2 | (8) | 4.0 | (14) | 5.5 | (19) | 8.9 | (31) | 13.1 | (46) |
| | –40 | (–40) | 8.7" | (–0.3) | — | — | — | — | — | — | 2.4 | (8) | 3.4 | (12) | 5.4 | (19) | 7.9 | (28) |
| Hot Gas Feed | +70 | (+21.1) | 114.1 | (7.9) | 2.2 | (8) | 4.3 | (15) | 7.3 | (26) | 14.1 | (50) | 19.6 | (69) | 36.5 | (128) | 53 | (187) |
| Hot Gas Main | +70 | (+21.1) | 114.1 | (7.9) | 4.4 | (15) | 8.6 | (30) | 14.7 | (52) | 28.1 | (99) | 39.2 | (138) | 73.0 | (257) | 106 | (373) |
| Compressor Discharge | +86 | (+30) | 154.5 | (10.7) | — | — | — | — | 12.6 | (44) | 24.1 | (85) | 33.6 | (118) | 62.6 | (220) | 90.3 | (318) |
| Condenser Drains | +86 | (+30) | — | — | 6.0 | (21) | 14.5 | (51) | 24.0 | (84) | 50.0 | (176) | 77.0 | (271) | 140 | (493) | 220 | (774) |
| Liquid Mains | +86 | (+30) | — | — | 28.3 | (100) | 53.1 | (187) | 90.8 | (320) | 143 | (503) | 202 | (711) | 454 | (1598) | 657 | (2313) |
| Liquid Feed Branch | +86 | (+30) | — | — | 54.9 | (193) | 103 | (363) | 176 | (620) | 277 | (975) | 392 | (1380) | 881 | (3101) | 1273 | (4481) |
| Liquid Overfeed Supply (4X) | +10 | (–12.2) | — | — | 9.0 | (32) | 17.0 | (60) | 29.0 | (102) | 46.0 | (162) | 65.0 | (229) | 144 | (507) | 208 | (732) |

## SIZING GUIDE

These capacity recommendations are not affected by the length of the pipe line. These are approximate optimum sizes based on power costs versus the investment cost of piping and its total installed cost. Piping sized to these capacities will have 1°F (0.6°C) pressure drop for the following equivalent lengths:

Suction lines ........................... 700 diameters

Discharge lines........................ 1400 diameters

Liquid lines .............................. 2400 diameters

Example: Hansen angle socket weld valves have about 145 diameters of equivalent flow resistance, or 145/700 = 0.2°F (0.1°C) of equivalent pressure drop at the suction line capacities shown for a valve in a suction line. Globe valves equal about 225 diameters.

The rational for the vapor line sizing was developed by William V. Richards in two papers: “Refrigerant Vapor Line Sizing Not Dependent on Length,” 16th International Congress of Refrigeration, IIR, Paris, 1983, and “Practical Pipe Sizing for Refrigerant Vapor Lines,” Sixth Annual Meeting, IIAR, San Francisco, 1984.

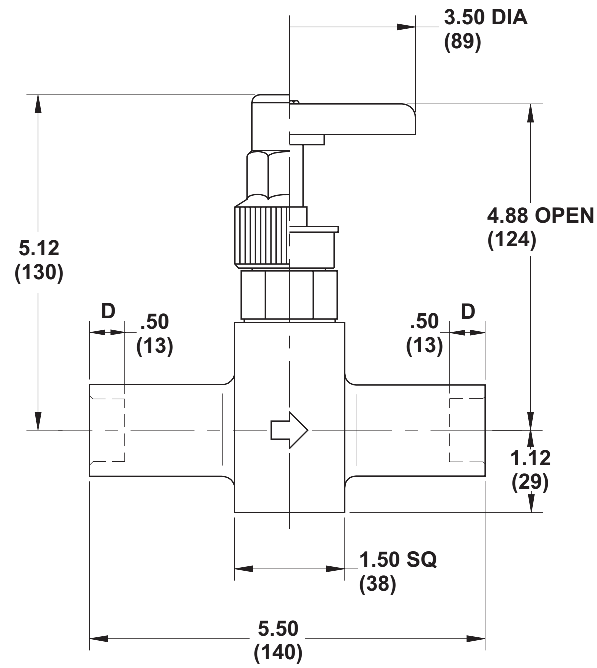
# FLOW COEFFICIENTS

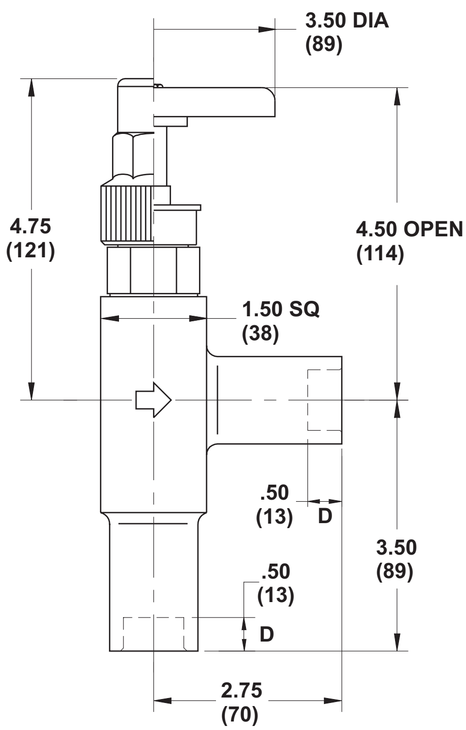
| NOMINAL SIZE | | ANGLE | | | | GLOBE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | FLOW COEFFICIENT | | EQUIVALENT LENGTH* | | FLOW COEFFICIENT | | EQUIVALENT LENGTH* | |
| INCH | (MM) | Cv | (Kv) | FEET | (METERS) | Cv | (Kv) | FEET | (METERS) |
| ½ | (13) | 6 | (5.2) | 5 | (1.5) | 4 | (3.5) | 9 | (2.7) |
| ¾ | (20) | 9 | (7.8) | 8 | (2.4) | 8 | (6.9) | 8 | (2.4) |
| 1 | (25) | 26 | (22) | 5 | (1.5) | 18 | (16) | 8 | (2.4) |
| 1¼ | (32) | 30 | (26) | 14 | (4.3) | 21 | (18) | 21 | (6.4) |
| 1½ | (40) | 53 | (46) | 11 | (3.4) | 41 | (35) | 14 | (4.3) |
| 2 | (50) | 80 | (69) | 27 | (8.2) | 67 | (58) | 34 | (10.4) |
| 2½ | (65) | 173 | (150) | 18 | (5.5) | 163 | (141) | 20 | (6.1) |

*Schedule 80 pipe under 2" size

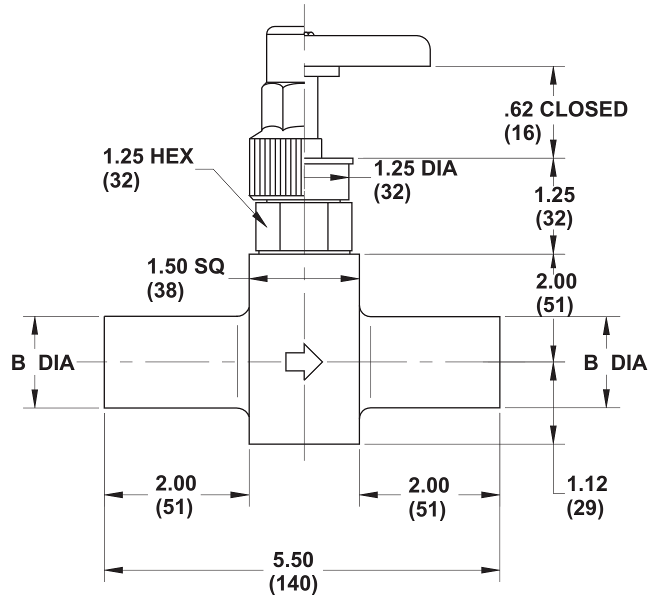
# ½" (13 MM) AND ¾" (20 MM) SOCKET WELD VALVE

## INSTALLATION DIMENSIONS INCHES (MM)

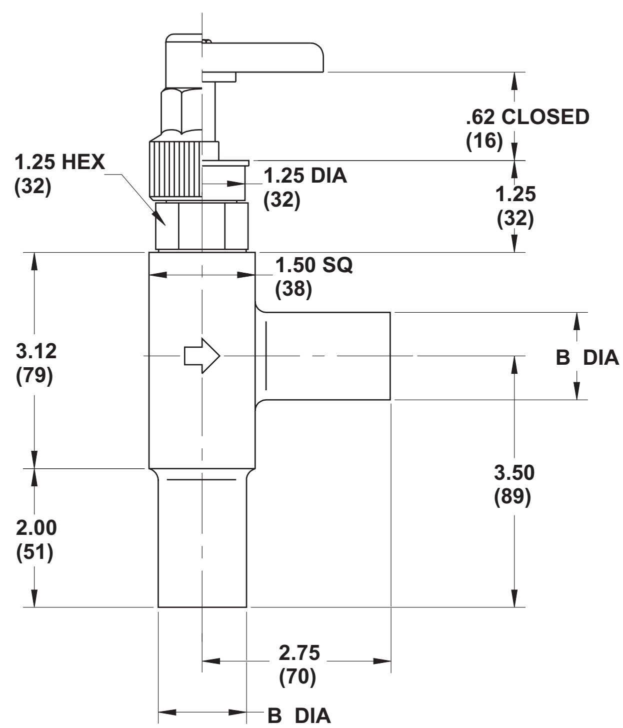



## INSULATION DIMENSIONS INCHES (MM)

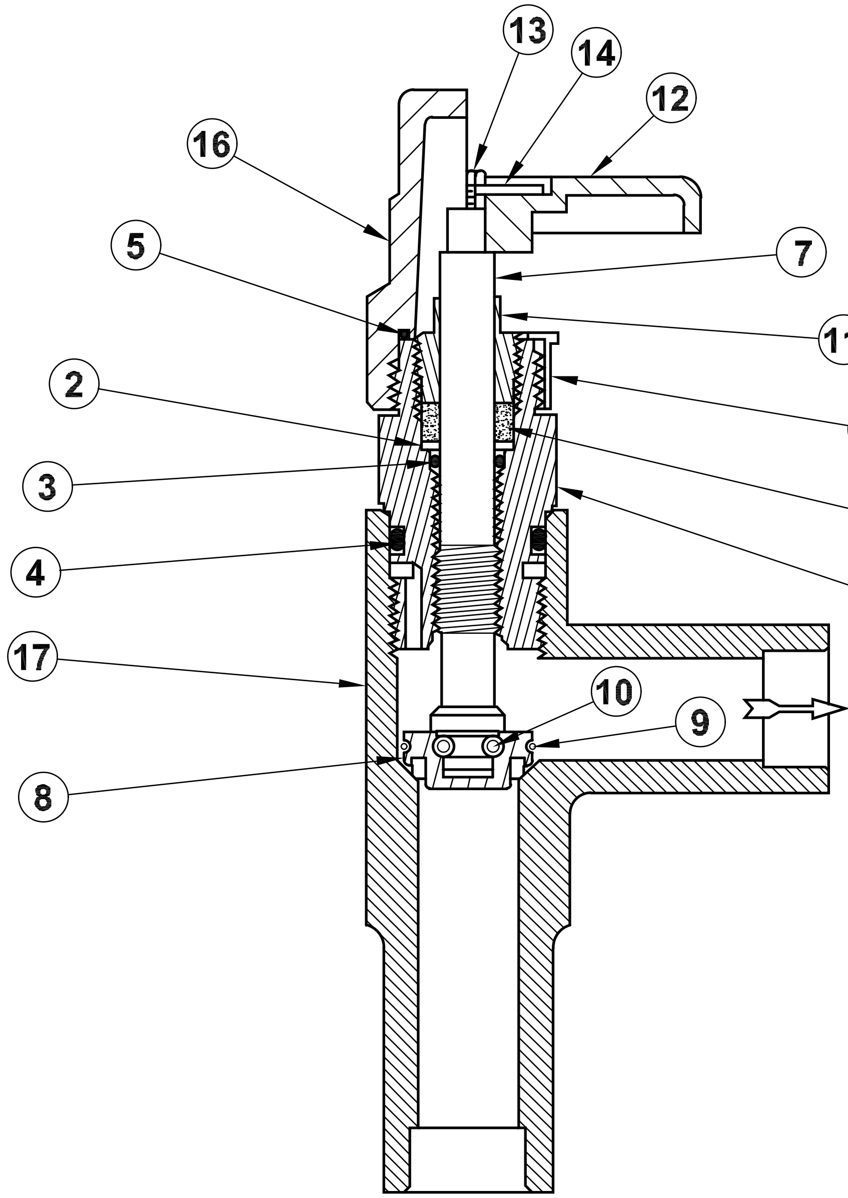



| SIZE | B |
|---|---|
| 1/2 (13) | 1.25 (32) |
| 3/4 (20) | 1.50 (51) |




| SIZE | B |
|---|---|
| 1/2 (13) | 1.25 (32) |
| 3/4 (20) | 1.50 (51) |

# ½" (13 MM) AND ¾" (20 MM) SOCKET WELD VALVE




## PARTS LIST

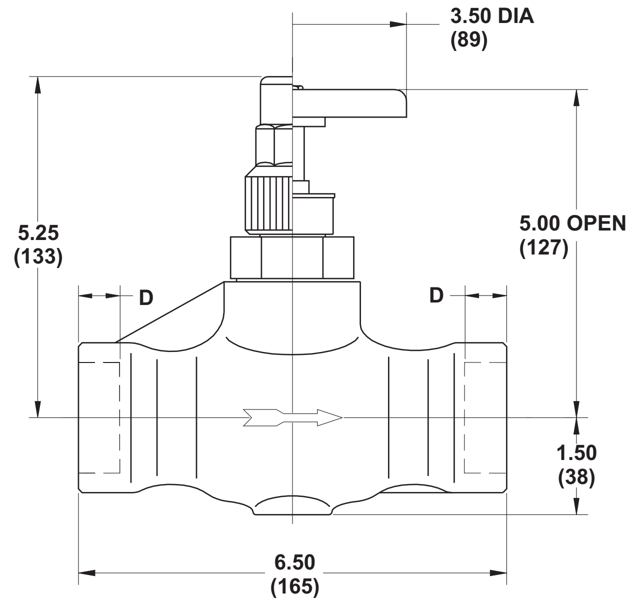
| ITEM | DESCRIPTION | QTY | PART NO* |
|---|---|---|---|
| | **Gasket Kit** consist of: | | **50-1040** |
| 1 | Stem Packing | 1 | 50-0045 |
| 2 | Stem Washer | 1 | 50-0046 |
| 3 | Stem O-ring | 1 | 50-0179 |
| 4 | Bonnet O-ring | 1 | 50-0453 |
| 5 | Seal Cap O-ring | 1 | 50-0432 |
| 11 | Packing nut | 1 | 50-0933 |
| | **Bonnet Assembly Kit** | | **50-1041** |
| | Above Kit consists of: | | |
| 6 | Bonnet | 1 | 50-0422 |
| 7 | Stem | 1 | 50-0012 |
| 8 | Disc Assembly | 1 | 50-0803 |
| 9 | Ball Retainer | 1 | 50-0439 |
| 10 | Balls | 10 | 50-0016 |
| | Gasket Kit | 1 | 50-1040 |
| | **Disc Assembly Kit** consists of: | | **50-1042** |
| 8 | Disc Assembly | 1 | 50-0803 |
| 9 | Ball Retainer | 1 | 50-0439 |
| 10 | Balls | 10 | 50-0016 |
| 4 | Bonnet O-ring | 1 | 50-0453 |

| ITEM | DESCRIPTION | QTY | PART NO* |
|---|---|---|---|
| | **Handwheel Kit** consist of: | | **50-1005** |
| 12 | Handwheel | 1 | 50-0953 |
| 13 | Screw | 1 | 50-0479 |
| 14 | Name Plate | 1 | 50-0094 |
| 15 | Bonnet Thread Cap | 1 | 50-0434 |
| | **Seal Cap Kit** consists of: | | **50-1036** |
| 16 | Seal Cap | 1 | 50-0423 |
| 5 | Seal Cap O-ring | 1 | 50-0432 |
| 17a | Body, Globe ½" S.W. | 1 | 50-0449 |
| 17b | Body, Globe ¾" S.W. | 1 | 50-0451 |
| 17c | Body, Angle ½" S.W. | 1 | 50-0450 |
| 17d | Body, Angle ¾" S.W. | 1 | 50-0452 |

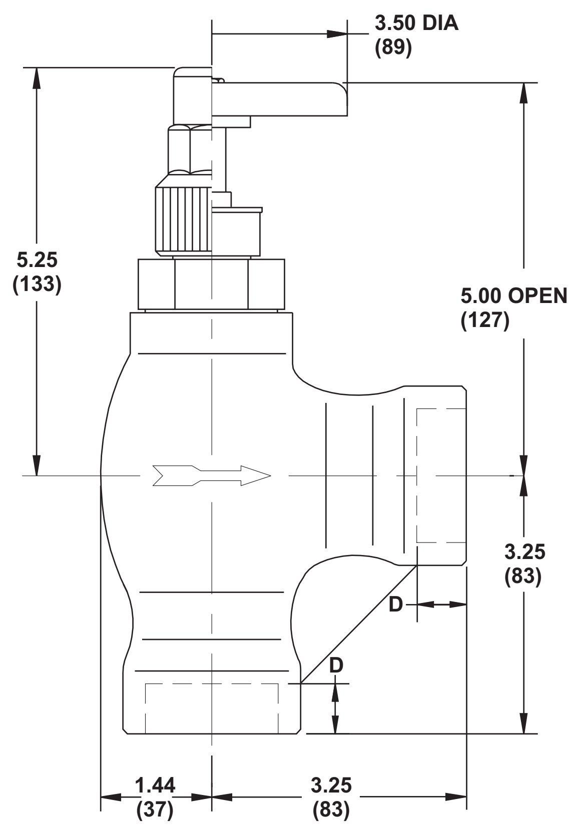
***Prior to 1989, ½" and ¾" socket weld valves had cast steel bodies. Replacement parts and numbers for these valves are the same as the 1" and 1¼" valves listed on page 7. A plated steel seal cap is available. To order specify part number 50-1064.**

## 1" (25 MM) AND 1¼" (32 MM) SOCKET WELD VALVE

### INSTALLATION DIMENSIONS
### INCHES (MM)

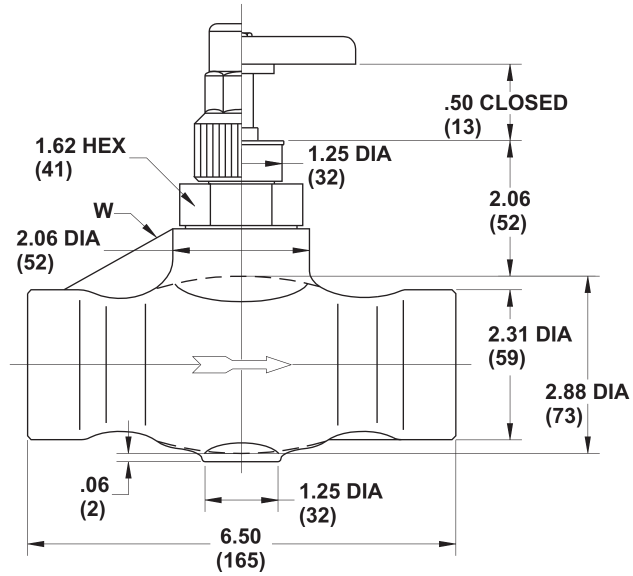



| SIZE | D |
|---|---|
| 1 (25) | 0.50 (13) |
| 1¼ (32) | 0.62 (16) |

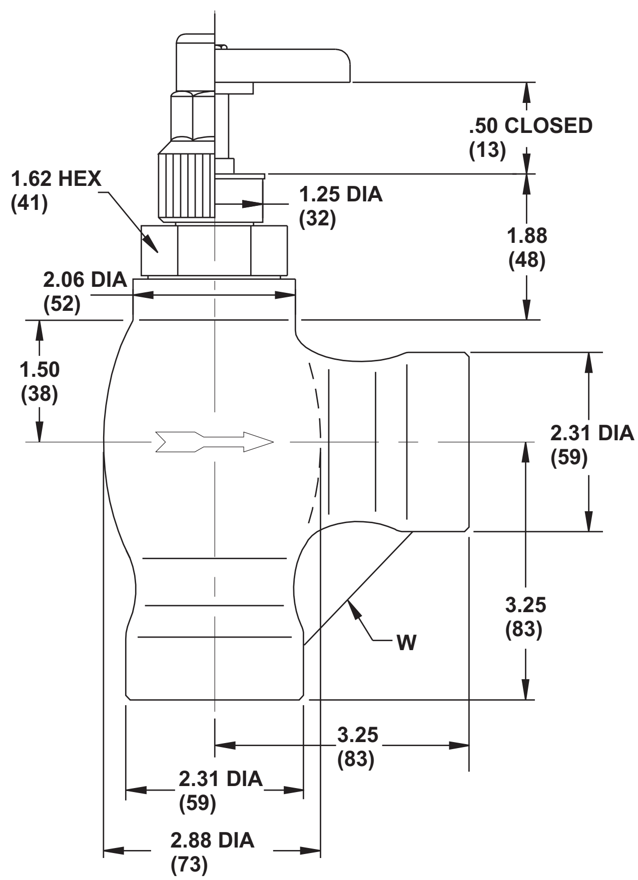



| SIZE | D |
|---|---|
| 1 (25) | 0.50 (13) |
| 1¼ (32) | 0.62 (16) |

### INSULATION DIMENSIONS
### INCHES (MM)

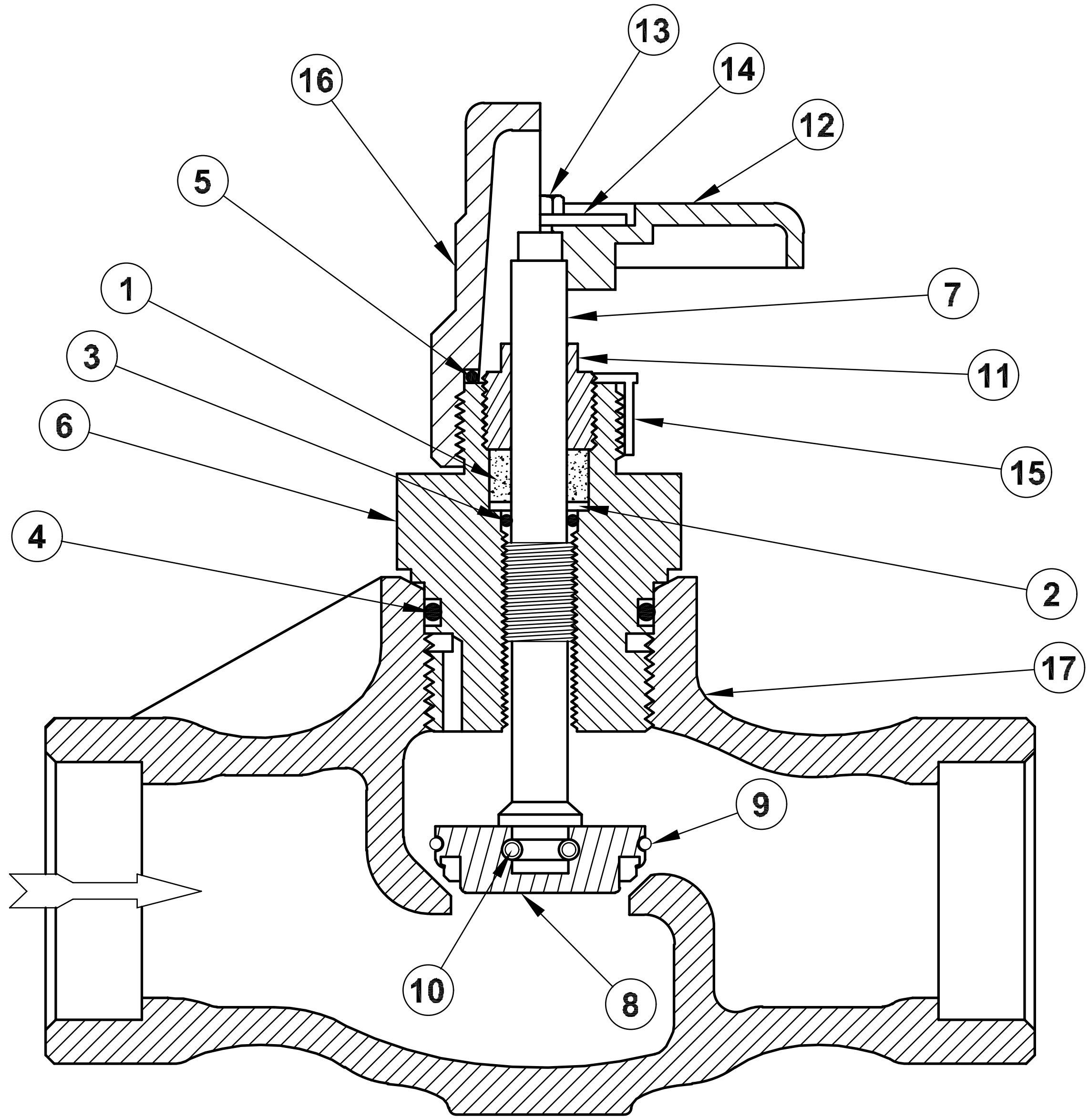



W=1.00 (25), WEB THICKNESS




W=1.00 (25), WEB THICKNESS

## 1" (25 MM) AND 1¼" (32 MM) SOCKET WELD VALVE




## PARTS LIST

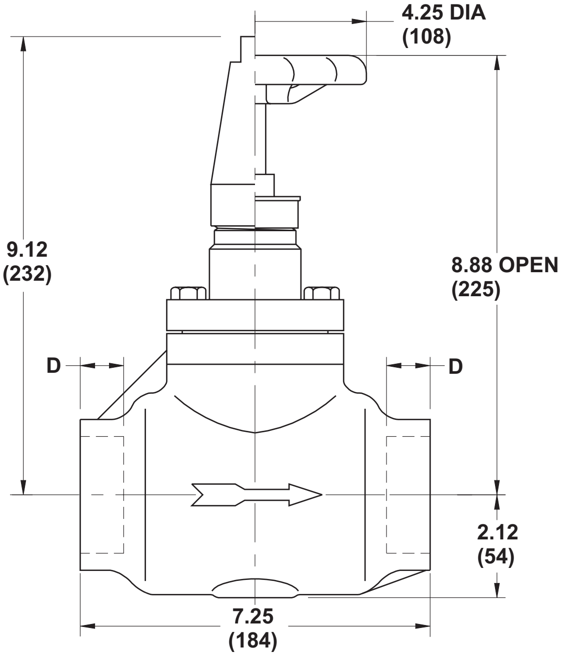
| ITEM | DESCRIPTION | QTY | PART NO. |
|---|---|---|---|
| | **Gasket Kit** consists of: | | **50-1040** |
| 1 | Stem Packing | 1 | 50-0045 |
| 2 | Stem Washer | 1 | 50-0046 |
| 3 | Stem O-ring | 1 | 50-0179 |
| 4 | Bonnet O-ring | 1 | 50-0017 |
| 5 | Seal Cap O-ring | 1 | 50-0432 |
| 11 | Packing nut | 1 | 50-0933 |
| | **Bonnet Assembly Kit** | | **50-1021** |
| | Above kit consists of: | | |
| 6 | Bonnet | 1 | 50-0429 |
| 7 | Stem | 1 | 50-0012 |
| 8 | Disc Assembly | 1 | 50-0804 |
| 9 | Ball Retainer | 1 | 50-0026 |
| 10 | Balls | 10 | 50-0016 |
| | Gasket Kit | 1 | 50-1040 |
| | **Disc Assembly Kit c**onsists of: | | **50-1004** |
| 8 | Disc Assembly | 1 | 50-0804 |
| 9 | Ball Retainer | 1 | 50-0026 |
| 10 | Balls | 10 | 50-0016 |
| 4 | Bonnet O-ring | 1 | 50-0017 |

| ITEM | DESCRIPTION | QTY | PART NO. |
|---|---|---|---|
| | **Handwheel Kit** consists of: | | **50-1005** |
| 12 | Handwheel | 1 | 50-0953 |
| 13 | Screw | 1 | 50-0479 |
| 14 | Name Plate | 1 | 50-0094 |
| 15 | Bonnet Thread Cap | 1 | 50-0434 |
| | **Seal Cap Kit** consists of: | | **50-1036** |
| 16 | Seal Cap | 1 | 50-0423 |
| 5 | Seal Cap O-ring | 1 | 50-0432 |
| 17a | Body, Globe 1" S.W. | 1 | 50-0386 |
| 17b | Body, Globe 1¼" S.W. | 1 | 50-0387 |
| 17c | Body, Angle 1" S.W. | 1 | 50-0389 |
| 17d | Body, Angle 1¼" S.W. | 1 | 50-0390 |

***Plated steel seal cap kits are available (p/n 50-1064).**

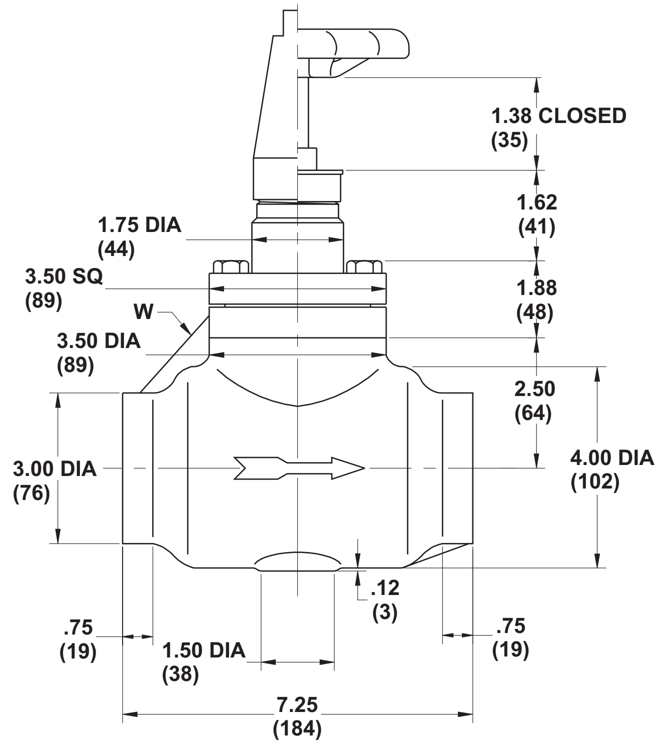
# 1½" (40 MM) AND 2" (50 MM) SOCKET WELD VALVE

## INSTALLATION DIMENSIONS INCHES (MM)

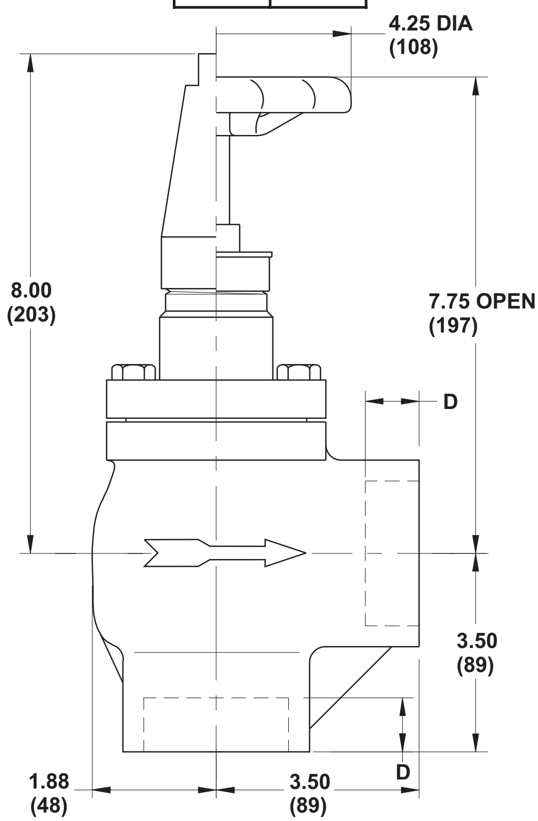



| SIZE | D |
|---|---|
| 1½ (40) | .62 (16) |
| 2 (50) | .88 (22) |

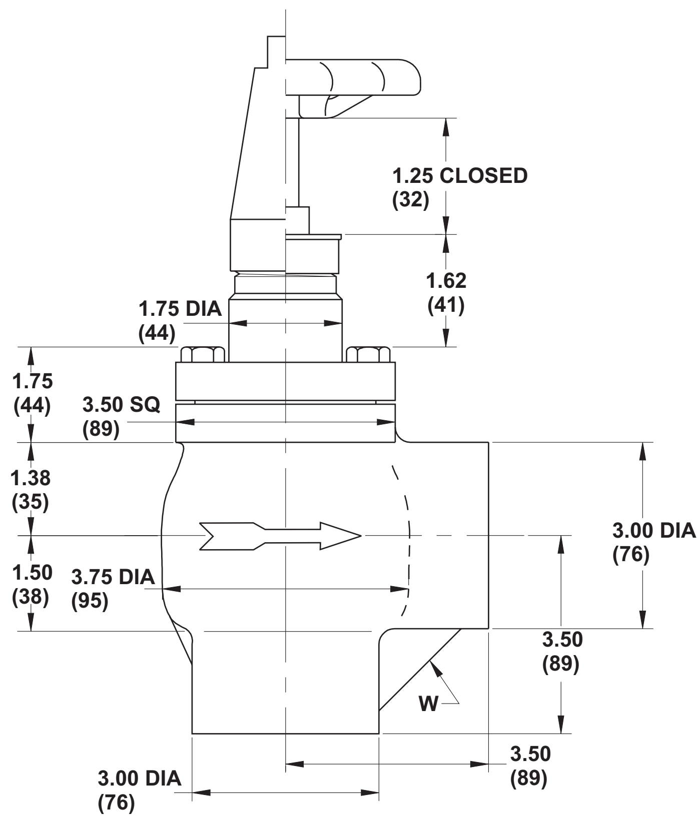
## INSULATION DIMENSIONS INCHES (MM)




W=1.00 (25), WEB THICKNESS

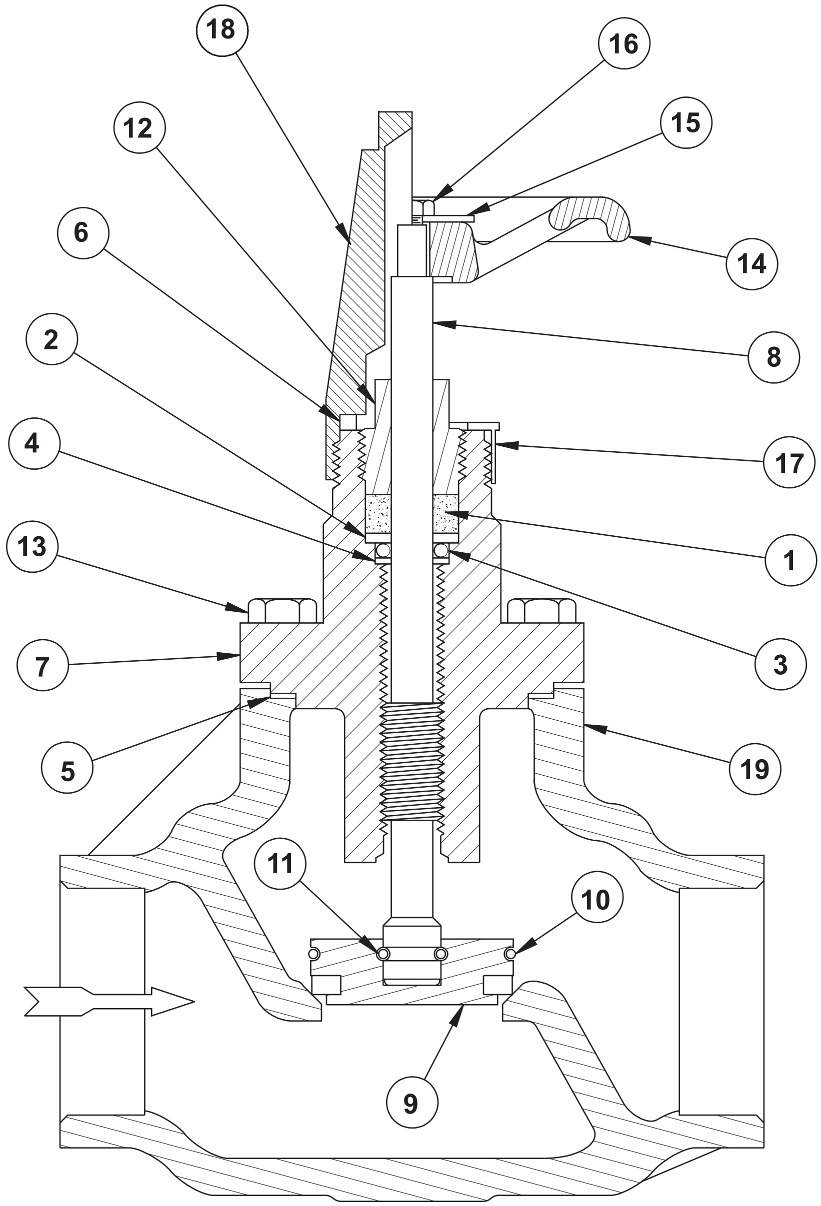



| SIZE | D |
|---|---|
| 1½ (40) | .62 (16) |
| 2 (50) | .88 (22) |




W=1.00 (25), WEB THICKNESS

## 1½" (40 MM) AND 2" (50 MM) SOCKET WELD VALVE



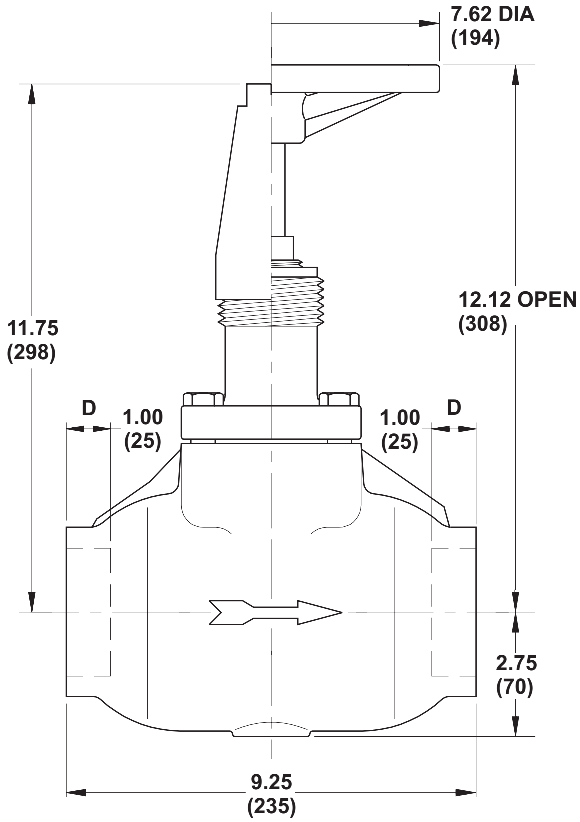

## PARTS LIST

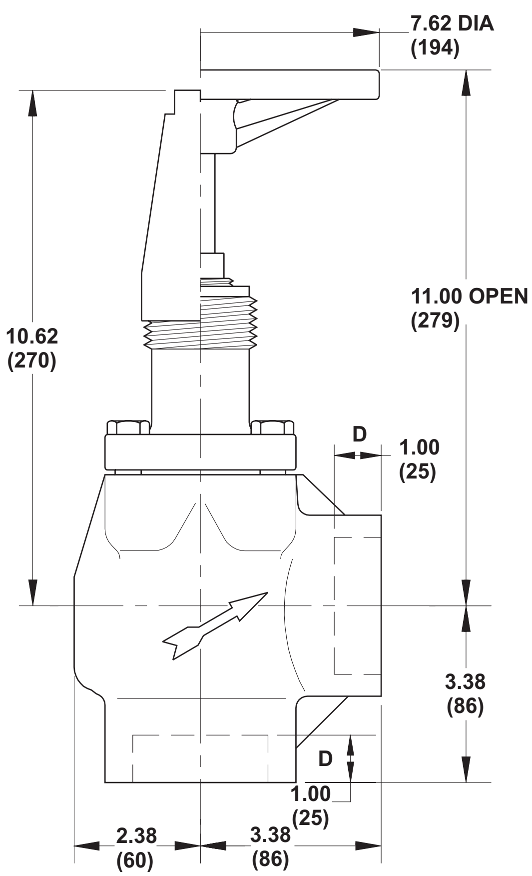
| ITEM | DESCRIPTION | QTY | PART NO. |
|---|---|---|---|
| | **Gasket Kit** consists of: | | **50-1023** |
| 1 | Stem Packing | 1 | 50-0248 |
| 2 | Stem Washer | 1 | 50-0247 |
| 3 | Stem O-ring | 1 | 50-0253 |
| 4 | Back-Up Washer | 1 | 50-0351 |
| 5 | Bonnet Gasket | 1 | 50-0259 |
| 6 | Seal Cap Gasket | 1 | 50-0270 |
| 12 | Packing nut | 1 | 50-0251 |
| | **Bonnet Assembly Kit** | | **50-1024** |
| | Above kit consists of: | | |
| 7 | Bonnet | 1 | 50-0239 |
| 8 | Stem | 1 | 50-0242 |
| 9 | Disc Assembly | 1 | 50-0363 |
| 10 | Ball Retainer | 1 | 50-0257 |
| 11 | Balls | 16 | 50-0016 |
| 13 | Bonnet Bolts | 4 | 50-0473 |
| | Gasket Kit | 1 | 50-1023 |

| ITEM | DESCRIPTION | QTY | PART NO. |
|---|---|---|---|
| | **Disc Assembly Kit** consists of: | | **50-1025** |
| 9 | Disc Assembly | 1 | 50-0363 |
| 10 | Ball Retainer | 1 | 50-0257 |
| 11 | Balls | 16 | 50-0016 |
| 5 | Bonnet Gasket | 1 | 50-0259 |
| | **Handwheel Kit** consists of: | | **50-1026** |
| 14 | Handwheel | 1 | 50-0321 |
| 15 | Name Plate | 1 | 50-0094 |
| 16 | Screw | 1 | 50-0254 |
| 17 | Bonnet Thread Cap | 1 | 50-0263 |
| | **Seal Cap Kit** consists of: | | **50-1027** |
| 18 | Seal Cap | 1 | 50-0260 |
| 6 | Seal Cap Gasket | 1 | 50-0270 |
| 19a | Body, Globe 1½" S.W. | 1 | 50-0232 |
| 19b | Body, Globe 2" S.W. | 1 | 50-0233 |
| 19c | Body, Angle 1½" S.W. | 1 | 50-0268 |
| 19d | Body, Angle 2" S.W. | 1 | 50-0269 |

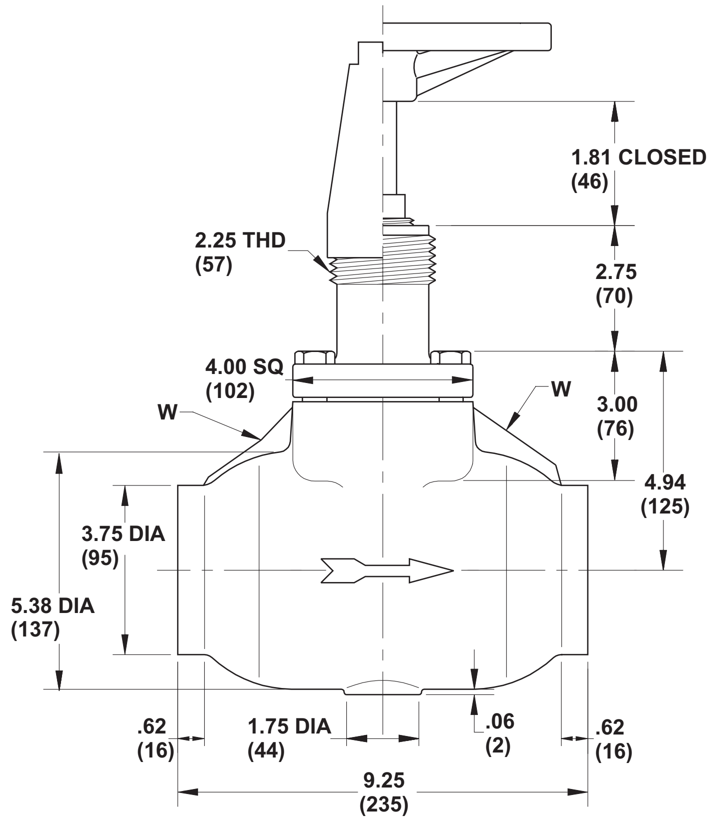
## 2½" (65 MM) SOCKET WELD VALVE

### INSTALLATION DIMENSIONS INCHES (MM)

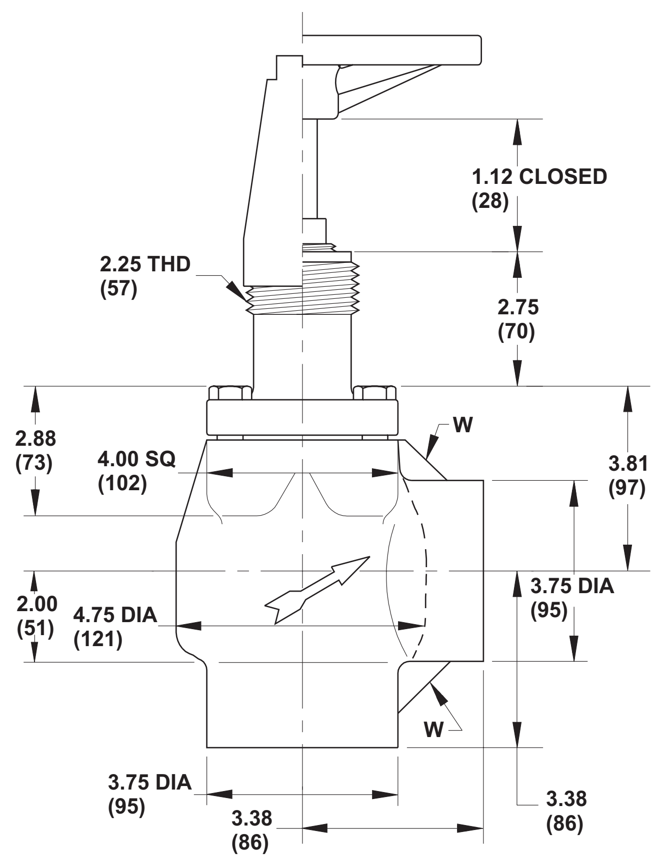



### INSULATION DIMENSIONS INCHES (MM)

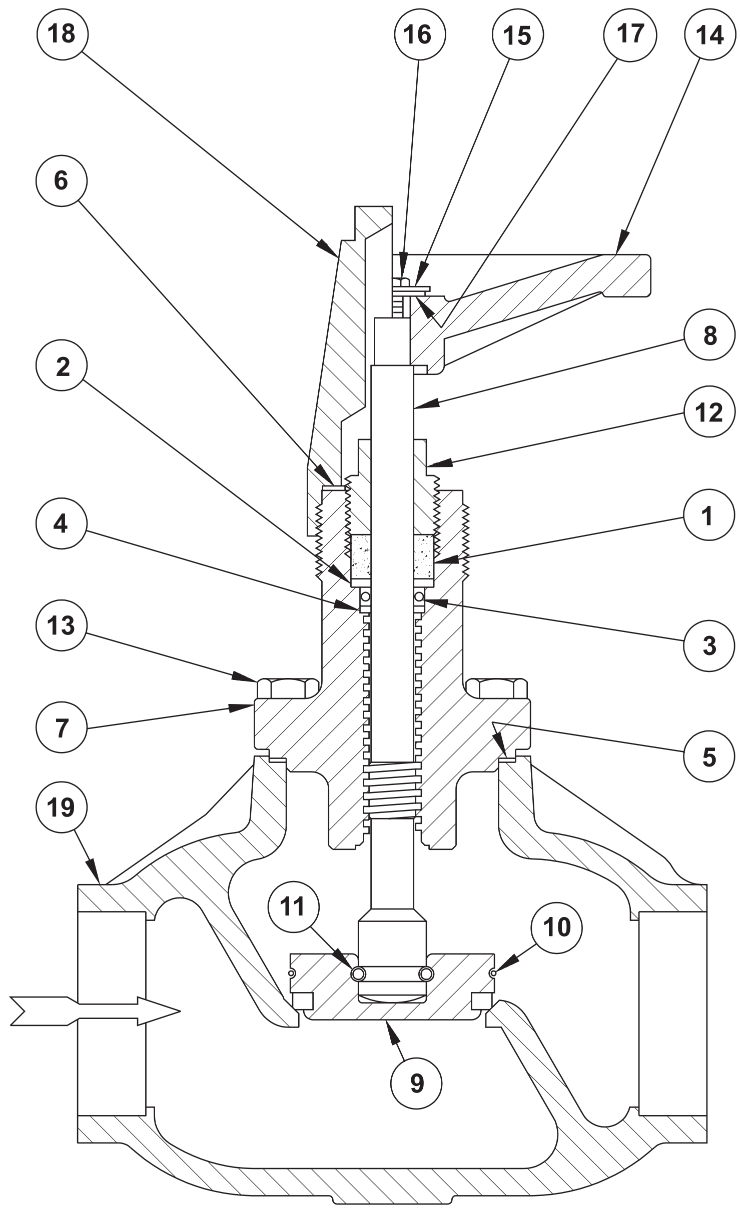



W=1.75 (44), WEB THICKNESS




W=1.75 (44), WEB THICKNESS

## 2½" (65 MM) SOCKET WELD VALVE




## PARTS LIST

| ITEM | DESCRIPTION | QTY | PART NO. |
|---|---|---|---|
| | **Gasket Kit** consists of: | | **50-1043** |
| 1 | Stem Packing | 1 | 50-0290 |
| 2 | Stem Washer | 1 | 50-0299 |
| 3 | Stem O-ring | 1 | 50-0293 |
| 4 | Back-Up Washer | 1 | 50-0324 |
| 5 | Bonnet Gasket | 1 | 50-0310 |
| 6 | Seal Cap Gasket | 1 | 50-0315 |
| 12 | Packing nut | 1 | 50-0292 |
| | **Bonnet Assembly Kit** | | **50-1044** |
| | Above kit consists of: | | |
| 7 | Bonnet | 1 | 50-0286 |
| 8 | Stem | 1 | 50-0287 |
| 9 | Disc Assembly | 1 | 50-0374 |
| 10 | Ball Retainer | 1 | 50-0297 |
| 11 | Balls | 15 | 50-0305 |
| 13 | Bonnet Bolts | 4 | 50-0294 |
| | Gasket Kit | 1 | 50-1043 |

| ITEM | DESCRIPTION | QTY | PART NO. |
|---|---|---|---|
| | **Disc Assembly Kit** consists of: | | **50-1045** |
| 9 | Disc Assembly | 1 | 50-0374 |
| 10 | Ball Retainer | 1 | 50-0297 |
| 11 | Balls | 15 | 50-0305 |
| 5 | Bonnet Gasket | 1 | 50-0310 |
| | **Handwheel Kit** consists of: | | **50-1037** |
| 14 | Handwheel | 1 | 50-0319 |
| 15 | Name Plate | 1 | 50-0318 |
| 16 | Screw | 1 | 50-0295 |
| 17 | Support Washer | 1 | 50-0480 |
| | **Seal Cap Kit** consists of: | | **50-1038** |
| 18 | Seal Cap | 1 | 50-0304 |
| 6 | Seal Cap Gasket | 1 | 50-0315 |
| 19a | Body, Globe 2½" S.W. | 1 | 50-0456 |
| 19b | Body, Angle 2½" S.W. | 1 | 50-0457 |

## STEM PACKING

When verifying the tightness of the packing nut, use an 8" adjustable wrench. Extrusion of some black graphite packing material along the stem is normal. If the o-ring or the adjustable packing ever needs replacement as evidenced by refrigerant or oil leakage at the stem, open the valve stem firmly to the back-seat position. This separates the o-ring and packing from the system refrigerant. See the CAUTION section. Remove the packing nut carefully and then use a wire hook or a small blade screwdriver to remove the packing and o-ring. Take care not to scratch the stem or bonnet sealing surfaces. Carefully install a backup washer, new lubricated stem o-ring, stem washer, and stem packing. Tighten the packing nut only enough to give the handwheel slight turning friction.

## VALVE SEAT

To inspect or replace the valve seat disc, isolate the valve from the system and safely pump out all refrigerant to zero pressure. With the stem open several turns, carefully remove the bonnet assembly. Proceed slowly and cautiously since some refrigerant may still be inside the valve body. The ½" (13 mm) through 1¼" (32 mm) valves have a unique safety vent to warn of internal pressure when removing the threaded bonnet. The 1½" (40 mm) and larger valves have bolted bonnets. Evenly loosen all bolts one to two turns. Using a screwdriver, break the seal between the bonnet and valve body, proceeding cautiously to avoid any refrigerant which may still remain inside the valve body. Remove the bonnet bolts and bonnet assembly, being careful not to damage the Teflon seat disc surface.

If the conical seat surface in the body is marred, remove the marks with emery paper by hand or with a power drill. If the seat disc is damaged, replace the entire disc assembly by first removing the ball retainer ring and ball bearings. Install a new disc assembly, including new bearings and retainer ring. Prior to 1998, seat discs in ½" (13 mm) to 1¼" (32 mm) socket weld shut-off valves were made with lead. All seat discs are now made with Teflon. The new seat disc assemblies and replacement kits are interchangeable with the old. Install new stem packing, stem o-ring, stem washers, and bonnet o-ring or gasket, if necessary. Reassemble the bonnet into the valve body with the stem still open several turns. Tighten the threaded bonnet to a minimum torque of 75 ft-lbs (100 Nm). Bonnet bolts for the 1½" (40 mm) and 2" (50 mm) valves require a torque of 40 ft-lbs (55 Nm), and 2½" (65 mm) valves require 60 ft-lbs (80 Nm).

## CAUTION

Hansen valves are for refrigeration systems only. Read these instructions completely before selecting, using, or servicing these valves. Only knowledgeable, trained refrigeration technicians should install, operate, or service these valves. Stated temperature and pressure limits should never be exceeded. Bonnets should not be removed from the valves unless the system has been evacuated to zero pressure. See also Safety Precautions in the current List Price Bulletin and the Safety Precautions Sheet supplied with the product. Escaping refrigerant may cause injury, particularly to the eyes and lungs.

 Printed in USA

## ORDERING INFORMATION, SOCKET WELD SHUT-OFF VALVES

| NOMINAL SIZE | DESCRIPTION | CAT. NO. |
|---|---|---|
| ½" (13 mm) | Globe, Handwheel | GS051H |
| | Angle, Handwheel | AS051H |
| | Globe, Seal Cap | GS051C |
| | Angle, Seal Cap | AS051C |
| ¾" (20 mm) | Globe, Handwheel | GS076H |
| | Angle, Handwheel | AS076H |
| | Globe, Seal Cap | GS076C |
| | Angle, Seal Cap | AS076C |
| 1" (25 mm) | Globe, Handwheel | GS100H |
| | Angle, Handwheel | AS100H |
| | Globe, Seal Cap | GS100C |
| | Angle, Seal Cap | AS100C |
| 1¼" (32 mm) | Globe, Handwheel | GS125H |
| | Angle, Handwheel | AS125H |
| | Globe, Seal Cap | GS125C |
| | Angle, Seal Cap | AS125C |
| 1½" (40 mm) | Globe, Handwheel | GS150H |
| | Angle, Handwheel | AS150H |
| | Globe, Seal Cap | GS150C |
| | Angle, Seal Cap | AS150C |
| 2" (50 mm) | Globe, Handwheel | GS200H |
| | Angle, Handwheel | AS200H |
| | Globe, Seal Cap | GS200C |
| | Angle, Seal Cap | AS200C |
| 2½" (65 mm) | Globe, Handwheel | GS251H |
| | Angle, Handwheel | AS251H |
| | Globe, Seal Cap | GS251C |
| | Angle, Seal Cap | AS251C |

All of the above valves are also available as expansion valves except the 2½".

## WARRANTY

Hansen valves are guaranteed against defective materials and workmanship for one year F.O.B. our plant. No consequential damages or field labor is included.

## TYPICAL SPECIFICATIONS

"Refrigerant shut-off valves from ½" (13 mm) through 2½" (65 mm) sizes shall have steel bodies machined for socket weld connections, stainless steel stems, back-seating design for packing replacement, bonnet threads for installation of stem seal caps, and suitability for a safe working pressure of 400 psig (27 bar), as manufactured by Hansen Technologies Corporation or approved equal."

**HANSEN TECHNOLOGIES CORPORATION**
6827 High Grove Boulevard
Burr Ridge, Illinois 60521 USA
Telephone: 630-325-1565
Toll-free: 800-426-7368
FAX: 630-325-1572
E-mail: info@hantech.com
Web Site: www.hantech.com

**Bulletin G109i**
February, 1999

# HANSEN TECHNOLOGIES CORPORATION


¾" (20 mm) Globe Valve: GT076H

ISO 9002

**Specifications, Applications, Service Instructions & Parts**

## THREADED SHUT-OFF VALVES

**³/₈" through 1¼" (10 mm through 32 mm) FPT Globe & Angle for refrigerants**

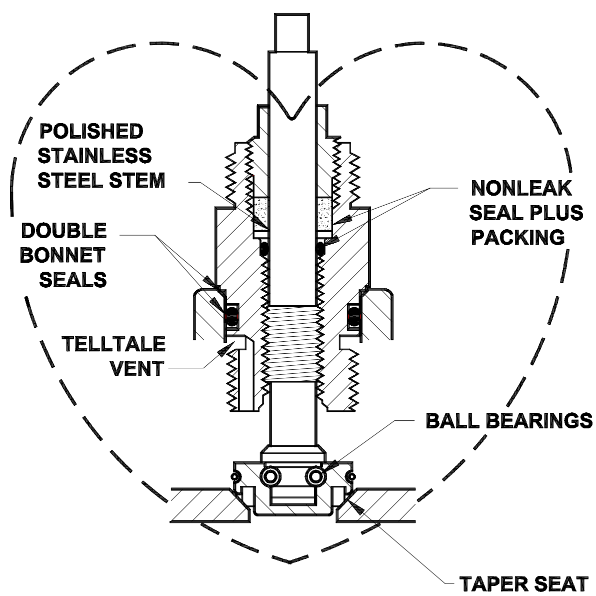
## INTRODUCTION

The advanced design and materials of Hansen threaded refrigerant shut-off valves make them far superior to commonly-available products, especially in regard to nonleakage of seats, stems, and bonnets. Anyone who has experienced the failure of a shut-off valve at a crucial time will take care to insist upon these highly-reliable valves.

## APPLICATIONS

Hansen refrigeration valves are ideal for shut-off of liquid, suction, discharge, recirculating liquid, hot gas, and oil lines in ammonia refrigeration systems. When used with seal caps, these valves are also suitable for R22, R134a, and other Hansen-approved refrigerants in steel piping systems where threaded joints are desired. Valves can be ordered initially with seal caps, or valves can be converted later by removing the handwheel and plastic bonnet thread cap and installation of seal cap with its O-ring.

## KEY FEATURES




## ADDITIONAL FEATURES

Perfected for ammonia refrigeration
Removable disc on conical polished seat
Teflon seat disc (no lead)
400 PSIG (27 bar) safe working pressure
Temperature range: –60F to +240F
(–50°C to +115°C)
Back seating for packing replacement
Globe and angle available
Handwheel or seal cap versions
U.S. Patent #4,550,896
Converts to Expansion Valve
Individually packaged and labeled
Nonasbestos gaskets
Made entirely in the USA

## MATERIAL SPECIFICATIONS

Body: ductile iron, A-536
Bonnet: steel, zinc chromate plated
Stem: stainless steel
Disc holder: steel, zinc chromate plated
Seat disc: PTFE Teflon, retained
Ball bearings: stainless steel
Ball retainer ring: stainless steel
Packing nut: steel, zinc chromate plated
Stem packing: graphite composite plus neoprene O-ring
Handwheel: zamak alloy, zinc chromate plated
Seal cap: glass filled polymer, safety vented
Seal cap O-ring: neoprene
Bonnet gasket: Neoprene O-ring plus steel knife edge
Bonnet thread cap: polyethylene (remove above 200F)

## ADVANTAGES

Compared to other ammonia threaded shut-off valves, Hansen valves are stronger, seals and seats are tighter, construction is simpler, and pressure drop is lower. One very important feature is the standard usage of stainless steel stems. This avoids packing deterioration and leakage by rust abrasion.

## FLOW CAPACITIES (U.S. GPM/PSI)

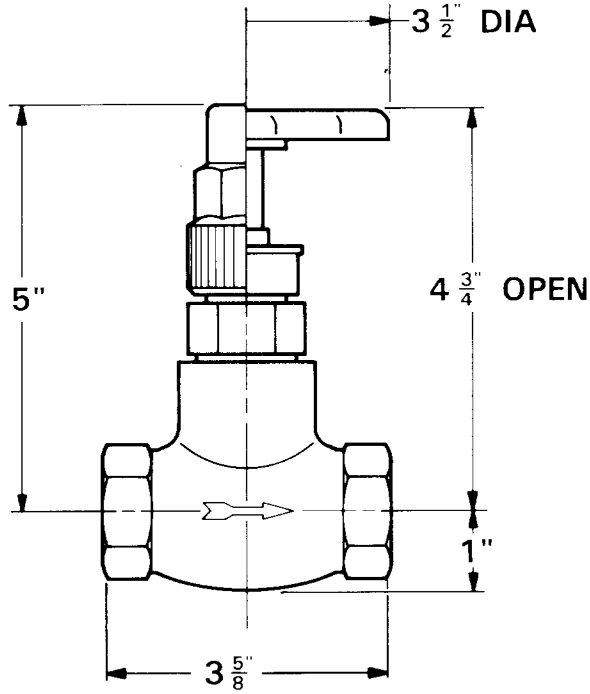
| SIZE | ANGLE | | GLOBE | |
|---|---|---|---|---|
| | Cv | Eq. Length FT. | Cv | Eq. Length Ft. |
| 3/8" | 8 | 3.0 | 5 | 5.0 |
| 1/2" | 9 | 3.7 | 6 | 5.5 |
| 3/4" | 10 | 6.7 | 7 | 13.4 |
| 1" | 26 | 3.9 | 18 | 8.1 |
| 1 1/4" | 30 | 13.5 | 21 | 29.0 |

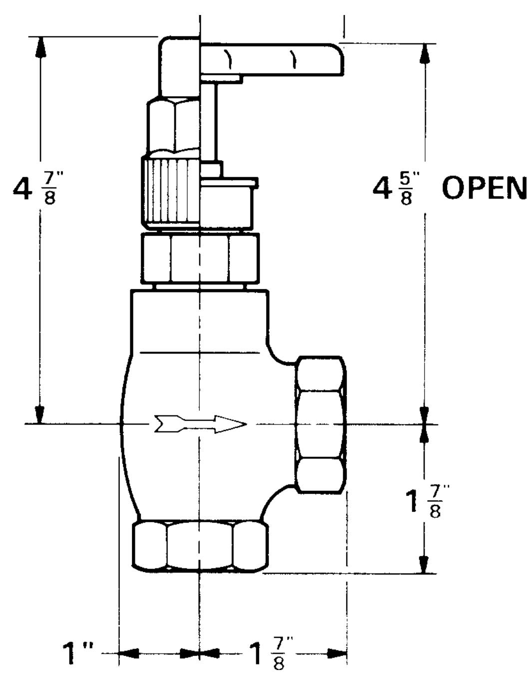
## INSTALLATION

The most important factor, other than the valve itself, in achieving a leak-tight and secure threaded valve installation is selection and preparation of mating piping. Pipe 1½" and smaller should be Schedule 80 Steel ASTM A-106 Grade B or equal, properly cut to the correct length, and cleanly and properly threaded with U.S. National Tapered Male Pipe Threads. The male threads on the piping and the female threads in the valves should be cleaned and inspected. Proper pipe thread sealant is recommended. Sealant should be applied evenly to act as a lubricant between the ductile iron and steel threads to avoid any chance of metal-to-metal thread "galling." Valve and piping should be adequately tightened with two wrenches positioned as close together as possible, but not touching the pipe threads. While "backwelding" the threaded steel pipe to the ductile iron body is possible for total elimination of thread leakage, this is not recommended in the field because a special welding rod and special techniques are necessary. Hansen weld valves should be used instead wherever a tight welded joint is desired. **In the horizontal piping of suction, overfeed gas return, or condenser drain lines, globe valve or angle valve stems should be horizontal to avoid liquid trapping of gas flow at the valve body casting seat orifice.**

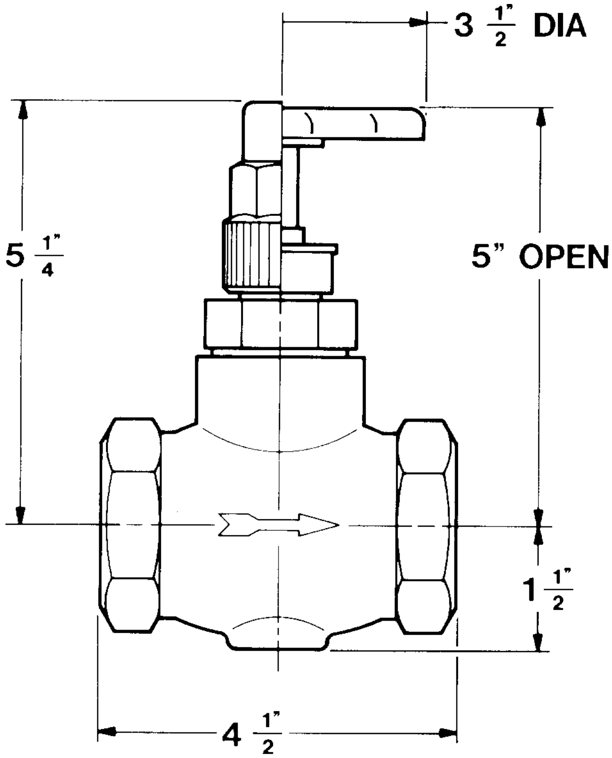
Before putting valves into service, all pipe connections, valve seats, bonnet seals, and stem seals should be tested for leaks at pressure levels called for in appropriate codes.

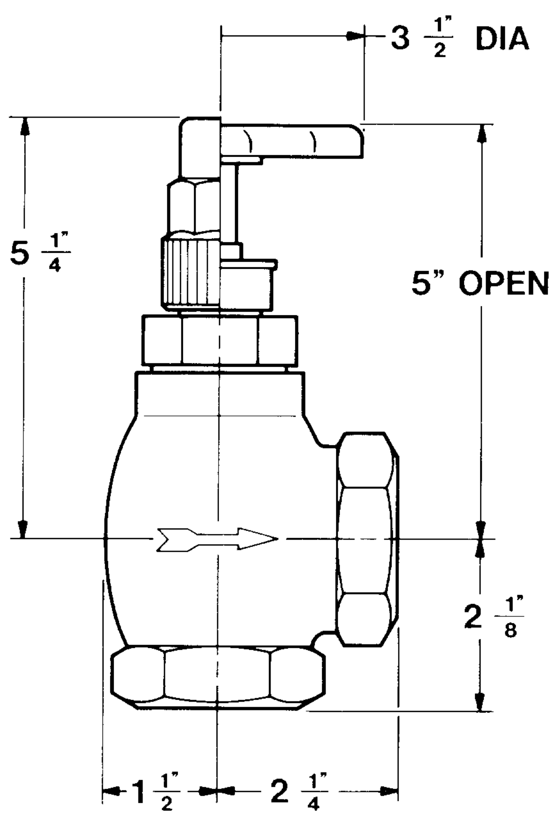
## 3/8" TO 3/4" INSTALLATION DIMENSIONS



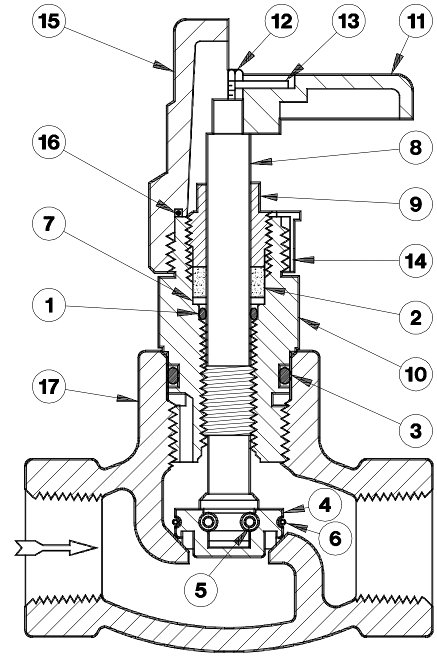



## 1" AND 1¼" INSTALLATION DIMENSIONS




## PARTS LIST




See page 4 for valve catalog numbers.

| ITEM | DESCRIPTION | QTY | PART NO. |
|---|---|---|---|
| | **GASKET KIT** consists of: | | **50-1040†** |
| 1 | Stem O-ring | 1 | 50-0179 |
| 2 | Stem Packing | 1 | 50-0045 |
| 3a | Bonnet O-ring 3/8", 1/2", 3/4" | 1 | 50-0453 |
| 3b | Bonnet O-ring 1", 1 1/4" | 1 | 50-0017 |
| 7 | Stem Washer | 1 | 50-0046 |
| 16 | Seal Cap O-ring | 1 | 50-0432 |
| 9 | Packing Nut | 1 | 50-0013 |
| | **BONNET ASSEMBLY KIT** 3/8",1/2",3/4" | | **50-1041†** |
| | **BONNET ASSEMBLY KIT** 1",1 1/4" | | **50-1021** |
| | Above kits consist of: | | |
| 4a | Disc Assembly 3/8", 1/2", 3/4" | 1 | 50-0803 |
| 4b | Disc Assembly 1", 1 1/4" | 1 | 50-0804 |
| 5 | Balls | 10 | 50-0016 |
| 6a | Ball Retainer 3/8", 1/2", 3/4" | 1 | 50-0439 |
| 6b | Ball Retainer 1", 1 1/4" | 1 | 50-0026 |
| 8 | Stem | 1 | 50-0012 |
| 10a | Bonnet 3/8", 1/2", 3/4" | 1 | 50-0422 |
| 10b | Bonnet 1", 1 1/4" | 1 | 50-0429 |
| | Gasket Kit | 1 | 50-1040 |
| | **DISC ASSEMBLY KIT** 3/8",1/2",3/4" | | **50-1042†** |
| | **DISC ASSEMBLY KIT** 1", 1 1/4" | | **50-1004** |
| | Above kits consist of: | | |
| 4a | Disc Assembly 3/8", 1/2", 3/4" | 1 | 50-0803 |
| 4b | Disc Assembly 1", 1 1/4" | 1 | 50-0804 |
| 5 | Balls | 10 | 50-0016 |
| 6a | Ball Retainer 3/8", 1/2", 3/4" | 1 | 50-0439 |
| 6b | Ball Retainer 1", 1 1/4 | 1 | 50-0026 |
| 3a | Bonnet O-ring 3/8", 1/2", 3/4" | 1 | 50-0453 |
| 3b | Bonnet O-ring 1", 1 1/4" | 1 | 50-0017 |
| | **HANDWHEEL KIT** consists of: | | **50-1005** |
| 11 | Handwheel | 1 | 50-0027 |
| 12 | Screw | 1 | 50-0479 |
| 13 | Name Plate | 1 | 50-0094 |
| 14 | Bonnet Thread Cap | 1 | 50-0434 |
| | **SEAL CAP KIT** consists of: | | **50-1036** |
| 15 | Seal Cap | 1 | 50-0423 |
| 16 | Seal Cap O-ring | 1 | 50-0432 |
| 17a | Body, Globe 3/8" | 1 | 50-0504 |
| 17b | Body, Globe 1/2" | 1 | 50-0505 |
| 17c | Body, Globe 3/4" | 1 | 50-0506 |
| 17d | Body Globe 1" | 1 | 50-0035 |
| 17e | Body, Globe 1 1/4" | 1 | 50-0036 |
| 17f | Body, Angle 3/8" | 1 | 50-0507 |
| 17g | Body, Angle 1/2" | 1 | 50-0508 |
| 17h | Body, Angle 3/4" | 1 | 50-0509 |
| 17i | Body, Angle 1" | 1 | 50-0037 |
| 17j | Body, Angle 1 1/4" | 1 | 50-0038 |

**†Replacement part kits for older, larger style ½" and ¾" shut-off valves (GT050, AT050, GT075, AT075): Gasket Kit, 50-1040; Bonnet Assembly Kit, 50-1028; Disc Assembly Kit, 50-1042 (includes bonnet O-Ring 50-0017).**

## SERVICE AND MAINTENANCE

Hansen shut-off valves require practically no service or maintenance. The common ailment of valves—stem leakage—is almost entirely eliminated by the combination of polished stainless steel stems and reliable, conventional, adjustable packing supplementing fluid-tight O-ring stem seals. For optimum maintenance, occasional cleaning of the valve stem with a soft rag containing refrigerant oil is helpful. The patented O-ring stem seal design permits low torque hand operation to open and close the valve because the packing nut does not require much tightening. Do not use a wrench on these small handwheels; it is not necessary and could bend or break the handwheel.

## STEM PACKING

Tightening of the packing nut is seldom necessary because the O-ring portion of stem sealing is continuous. However, if tightening is ever needed, use a ½" open end wrench or an 8" adjustable wrench. Extrusion of some black graphite packing material along the stem is normal. If the O-ring or the adjustable packing ever needs replacement, as evidenced by refrigerant or oil leakage at the stem, open the valve stem firmly to back-seat position. This separates the O-ring and packing from the system refrigerant. Carefully remove the packing nut and then use a wire hook or a small blade screwdriver to remove the packing and O-ring. Take care not to scratch the stem or bonnet sealing surfaces. Carefully install a new O-ring and packing. Tighten the packing nut only enough to give the handwheel a slight turning friction.

## VALVE SEAT

To inspect or replace the valve seat disc, isolate the valve from the system and safely pump out refrigerant. With stem open at least one turn, carefully remove the bonnet assembly. An 18" wrench is required. If the conical seat surface in the body is marred, remove the marks with emery paper by hand or power drill. If the seat disc is damaged, replace the entire disc assembly by first removing the ball retainer ring and ball bearings. Install the new disc assembly, including new balls and retainer ring. Prior to 1998, seat discs in 3/8" to 1¼" threaded shut-off valves were made with lead. Now all seat discs are made with Teflon. New seat disc assemblies (and replacement kits) are interchangeable with the old. Install new stem packing, stem O-ring, and bonnet O-ring if necessary. Reassemble the bonnet into the valve body with the stem still open at least several turns, and tighten the bonnet to a minimum torque of 75 foot pounds (102 Nm). This prevents the seal cap or valve stem excess opening torque from unscrewing the bonnet. A tattletale vent hole in the bonnet warns of interior valve pressure before the bonnet can be removed. Test the valve for leaks before returning it to service.

## CAUTION

Hansen valves are for refrigeration systems only. Read these instructions completely before selecting, using, or servicing these valves. Only knowledgeable, trained refrigeration technicians should install, operate, or service these valves. Stated temperature and pressure limits should not be exceeded. Bonnets should not be removed from the valves unless the system has been evacuated to zero pressure. See also Safety Precautions in the current List Price Schedule and the Safety Precautions Sheet supplied with this product. Escaping refrigerant can cause injury, especially to the eyes and lungs.

## WARRANTY

Hansen valves are guaranteed against defective materials or workmanship for one year F.O.B. our plant. No consequential damages or field labor is included.

## ORDERING INFORMATION, THREADED VALVES

| SIZE | DESCRIPTION | CAT. NO. |
|---|---|---|
| 3/8" | Globe, Handwheel | GT038H |
| | Angle, Handwheel | AT038H |
| | Globe, Seal Cap | GT038C |
| | Angle, Seal Cap | AT038C |
| 1/2" | Globe, Handwheel | GT051H |
| | Angle, Handwheel | AT051H |
| | Globe, Seal Cap | GT051C |
| | Angle, Seal Cap | AT051C |
| 3/4" | Globe, Handwheel | GT076H |
| | Angle, Handwheel | AT076H |
| | Globe, Seal Cap | GT076C |
| | Angle, Seal Cap | AT076C |
| 1" | Globe, Handwheel | GT100H |
| | Angle, Handwheel | AT100H |
| | Globe, Seal Cap | GT100C |
| | Angle, Seal Cap | AT100C |
| 1 1/4" | Globe, Handwheel | GT125H |
| | Angle, Handwheel | AT125H |
| | Globe, Seal Cap | GT125C |
| | Angle, Seal Cap | AT125C |

## TYPICAL SPECIFICATIONS

"Threaded refrigerant shut-off valves shall have stainless steel stems, ductile iron bodies, back-seating design for packing replacement, bonnet threads for installation of stem seal caps, and be suitable for a safe working pressure of 400 psig (27 bar), as manufactured by Hansen Technologies Corporation or approved equal."

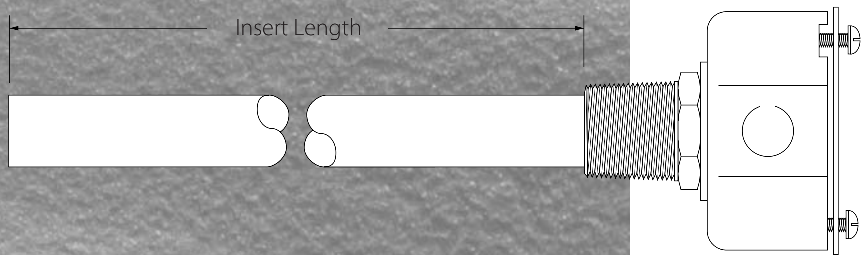
**HANSEN TECHNOLOGIES CORPORATION**
6827 High Grove Boulevard
Burr Ridge, Illinois 60521 U.S.A.
Telephone: (630) 325-1565
Toll-free: 1-800-426-7368
FAX: (630) 325-1572



Printed in USA

# HI-TEMP/STANDARD CARTRIDGE
# IMMERSION HEATERS

## FIBERGLASS LEADS



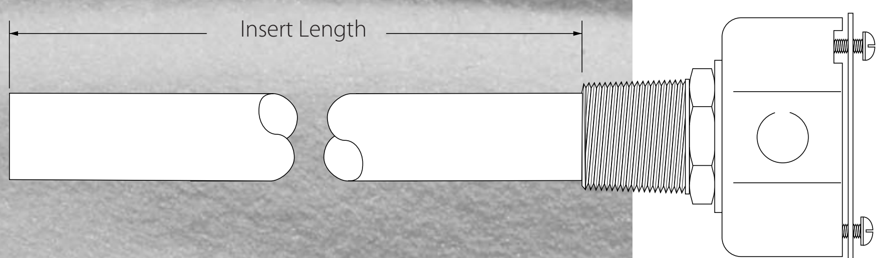

### 5/8" (15.9 MM) DIA. OIL/WATER

5/8" (15.9 mm) dia.

10" (25.4 cm) fiberglass leads inside octagonal terminal box.

1/2" (12.7 mm) N. P. T. brass bushing.

## FIBERGLASS LEADS



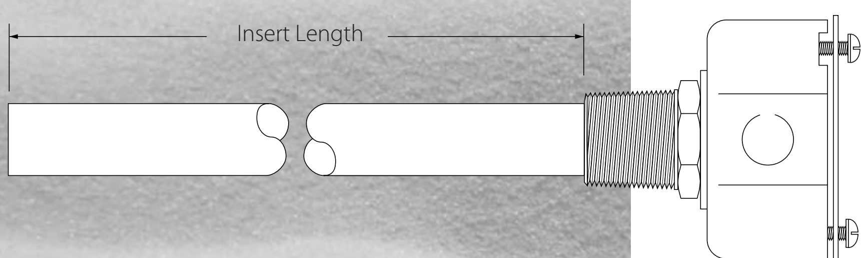

### 3/4" (19.1 MM) DIA. OIL/WATER

3/4" (19.1 mm) dia.

10" (25.4 cm) fiberglass leads inside octagonal terminal box.

3/4" (19.1 mm) N. P. T. steel bushing.

## SCREW TERMINALS



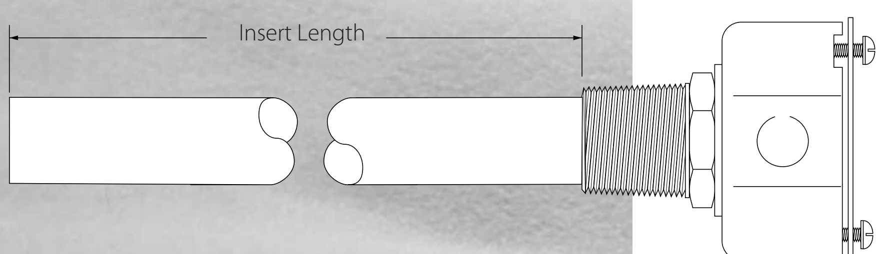

### 5/8" (15.9 MM) DIA. OIL/WATER

5/8" (15.9 mm) dia.

Screw terminals inside octagonal terminal box.

1/2" (12.7 mm) N. P. T. brass bushing.

## SCREW TERMINALS




### 3/4" (19.1 MM) DIA. OIL/WATER

3/4" (19.1 mm) dia.

Screw terminals inside octagonal terminal box.

3/4" (19.1 mm) N. P. T. brass bushing.

### FITTING CHART

| MALE PIPE N.P.T. FITTINGS FOR CARTRIDGE HEATERS | | | | | |
|---|---|---|---|---|---|
| N.P.T. SIZE | 1/8" (3.2 mm) | 1/4 (6.4) | 3/8 (9.5) | 1/2 (12.7) | 3/4 (19.1) |
| CART. DIA. | 1/4" (6.4 mm) | 3/8 (9.5) | 1/2 (12.7) | 5/8 (15.9) | 3/4 (19.1) |

Brass, steel or stainless steel fittings are available for liquid immersion applications. Other heater N.P.T. combinations available.

### 7.3.4 Capacity Control

**The Linear Position Indicator (LPI)**

General:

An electronic device called a Linear Potentiometer gives an indication of the position of the slide valve which can be used by the compressor control system.
The Linear Position Indicator (LPI) is an electronic contact-less displacement sensor inserted into a sensor well which allows the LPI to be removed from compressor without loss of oil or gas from the compressor.

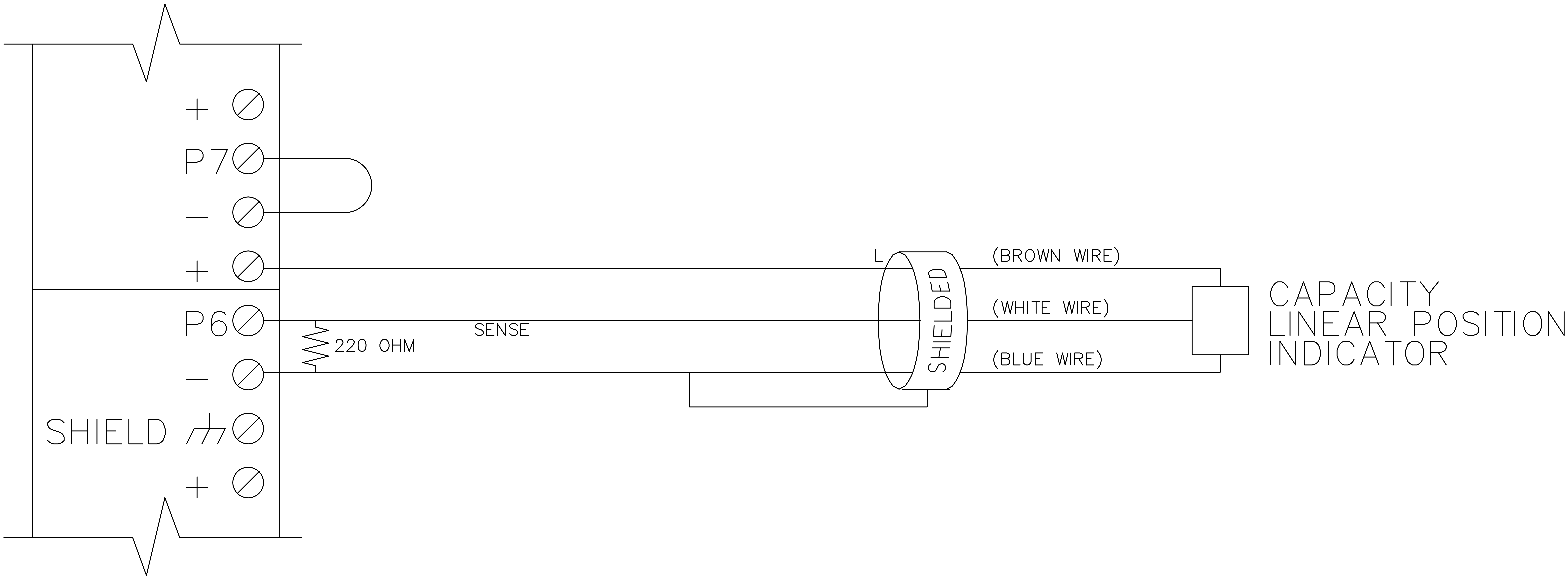
The LPI has several usable options built into one device.

The slide valve position can be indicated in three different ways:
Visual Light Emitting Diodes (LED)
Visual and by an analogue output 4-20mA
Visual and by a digital 24 V DC signal output on minimum and maximum slide valve position


Visual:

It is always possible to see the position of the slide valve.
At minimum load a green LED is illuminated at the lowest light on the left of the LPI.
At maximum load all red LED are illuminated.
At part load only some of the LED are illuminated, eg, at 50% load only half of the red LED will be illuminated.

**NOTE:** The compressor can only be allowed to start with the slide valve in the minimum load position. Therefore a signal from the minimum load electronic position switch is always required or if the 4 – 20 mA signal is being used, then a 4 mA signal is required.


P7
+
−
+
P6
−
SHIELD
+
220 OHM
SENSE
L
SHIELDED
(BROWN WIRE)
(WHITE WIRE)
(BLUE WIRE)
CAPACITY
LINEAR POSITION
INDICATOR

### 7.3.4 Capacity Control (cont'd)

Visual and by an Analogue Output (4-20mA):
The minimum load position is given by the 4 mA output and the maximum load position is given by the 20 mA output. (White Wire)

Part load positions are indicated by intermediate values between 4 and 20 mA.
The LED's on the indicator also give a visual indication of part load operation. It should be noted that part load slide valve position is not a direct indication of actual compressor capacity at part load. Use of the 4 – 20 mA signal is common for many control systems and may be used on its own, if required, for all control functions for single and multiple compressor installations, subject to a suitable control system.

Connections:

| Wiring Plug Connections | Function |
|---|---|
| 1=Brown | Supply Voltage + 24V DC |
| 2=White | Output Signal 4-20 Ma |
| 3=Blue | Common – 0 VDC |

Visual and by a Digital 24V Output on Minimum and Maximum load:
There is also another option that can be used to control and get the minimum signal for start-up. This option works the same as the mechanical micro-switches but instead uses the electronic switches incorporated in the LPI unit. These electronic switches give a 24 V DC output.
A digital output is given on the Minimum and Maximum position of the slide valve and an interposing relay, which must be incorporated in the control panel in place of each mechanical micro-switch, is activated by the digital signal completing the control circuit signal. This interposing relay must have contacts with suitable ratings. The interposing relay replaces the original switch function.
The LED's only give a visual indication of the slide valve position.

If the slide valve is in the minimum position and the LED for minimum is illuminated, there will be a digital output on the green/yellow wire.
If the slide valve is in the maximum position and all the LED's are illuminated, there will be a digital output on the black wire.
Existing installations equipped with the mechanical micro-switches can use this option.

Connections:

| Wiring Plug Connections | Function |
|---|---|
| 1=Brown | Supply Voltage + 24V DC |
| 3=Blue | Common – 0 VDC |
| 4=Black | Digital Output Max. Load |
| 5=Green/Yellow | Digital Output Min. Load |

Choose the best way for giving a start signal and connect the wires according to the table.

### 7.3.4 Capacity Control (cont'd)

Checking the LPI Calibration

All compressors with variable Vi are despatched from Howden with Vi set at 2.2 and the LPI calibrated to suit Vi 2.2.
When the Slide Valve is in the unloaded position, the 10% minimum load LED should be illuminated.
To check that the LPI indicates maximum load when the slide valve is in the fully loaded position, ie all LED's are illuminated, the following checks should be made.
Move the slide valve to 100% (by using the oil pump or if the system is shut down, use a manual oil pump or air pressure). By pressurising the outboard side of the actuator piston the slide valve will be moved to the fully loaded position. The LPI should indicate 100% by illuminating all LED's.
If this is not the case please do the calibration again as follows:

Move the piston to the minimum load position.

Adjust the Vi screw to set VI to suit operating conditions.
**Note: This adjustment must only be done when slide valve is in the minimum load (10% position).**

Remove the calibration button cover, Switch power on and disconnect the electrical plug under the LPI.

**Wait for 2 minutes.** Re-connect the plug. All the capacity array lights and red LED at the calibration button will light for 2/3 seconds and then go out. After approximately 20 seconds, the green LED light at the calibration button will start flashing (the minimum capacity array light may come on).

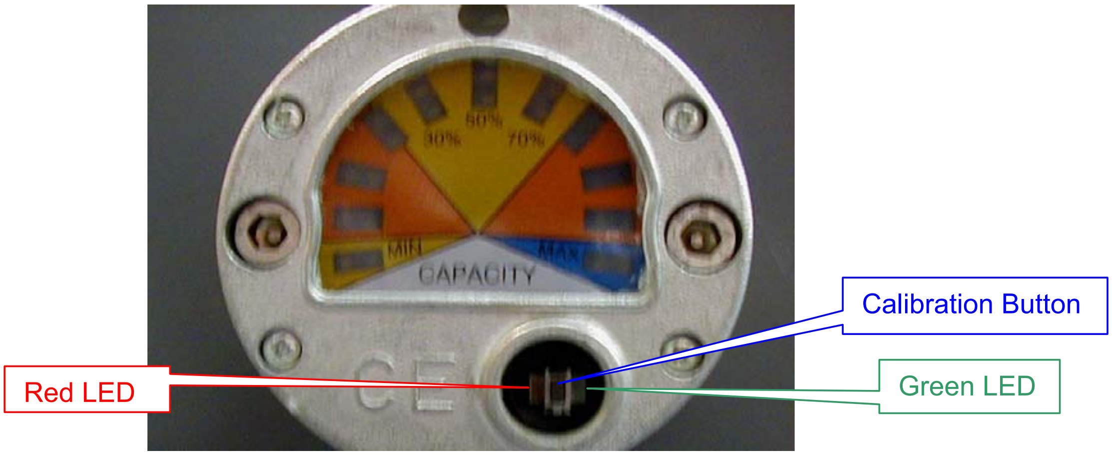
Allow **5 minutes** to elapse before starting calibration.

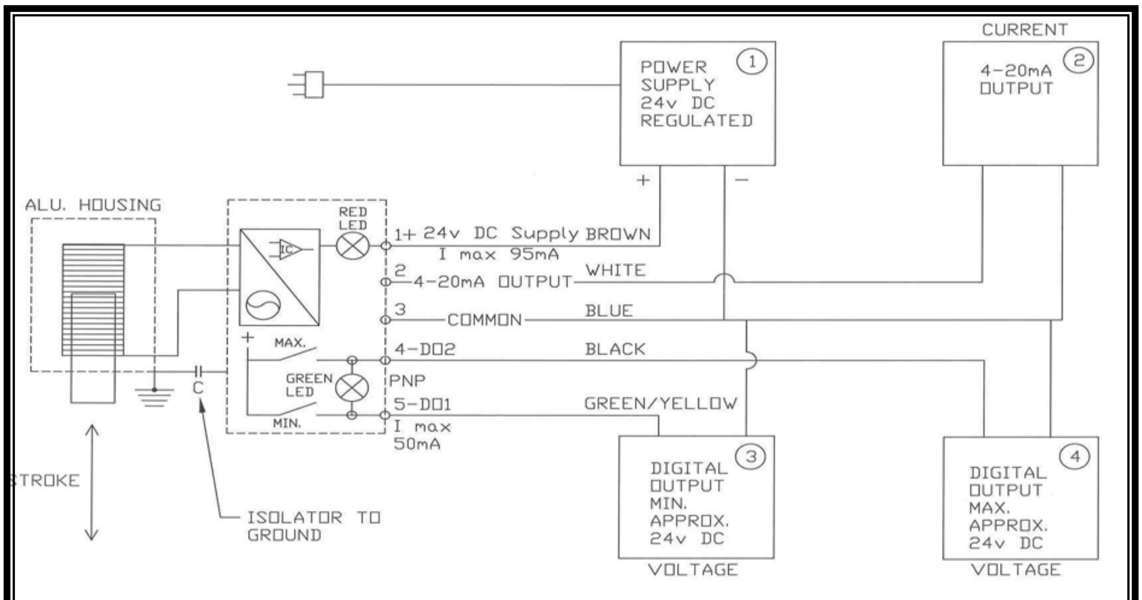
To start calibration, press the calibration button once. The green LED by the calibration button will go off and the red Led by the calibration button will come on steady for approximately 15 seconds and then start flashing.

Now move the slide valve to the maximum load position. During this movement the cylinder capacity array lights will start to light. When the slide valve is in the max. load position, push the calibration button once. The red LED by the calibration button will stay on for approximately 15 seconds and then go off. The green LED light will come on, possibly flashing.
The calibration is now complete. Refit the calibration button cover.
**Note:** If the operating Vi is changed, then the LPI will have to be re-calibrated as from 6 above.

### 7.3.4 Capacity Control (cont'd)

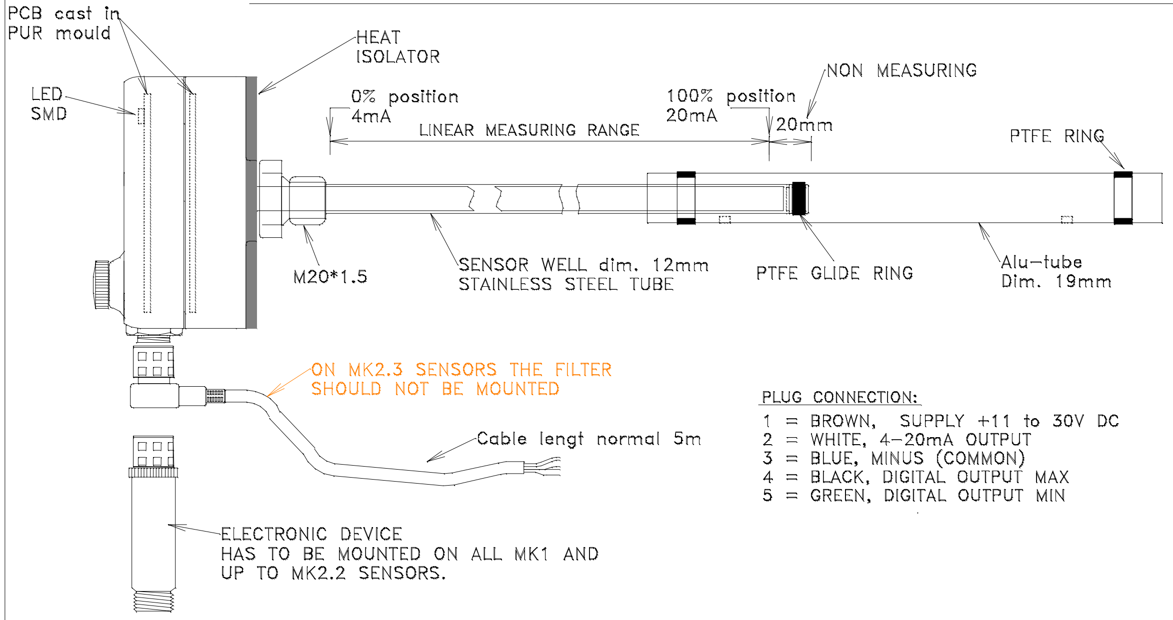
The LPI Linear Position Indicator

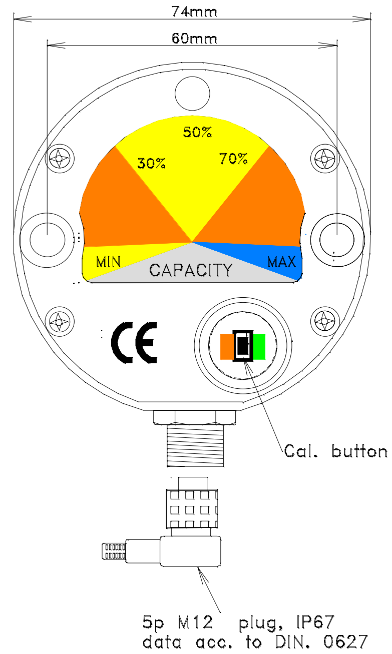


LPI Wiring Diagram

# LONG STROKE LINEAR CONTACTLESS DISPLACEMENT SENSOR TYPE LLCD-M1




PLUG CONNECTION:

1 = BROWN, SUPPLY +11 to 30V DC
2 = WHITE, 4-20mA OUTPUT
3 = BLUE, MINUS (COMMON)
4 = BLACK, DIGITAL OUTPUT MAX
5 = GREEN, DIGITAL OUTPUT MIN

Turn on time from power on is 20 seconds.

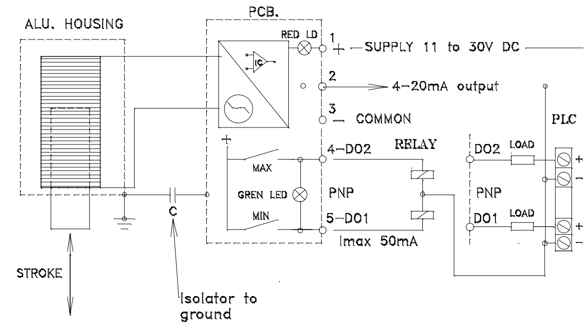
Calibration must be done before operation:

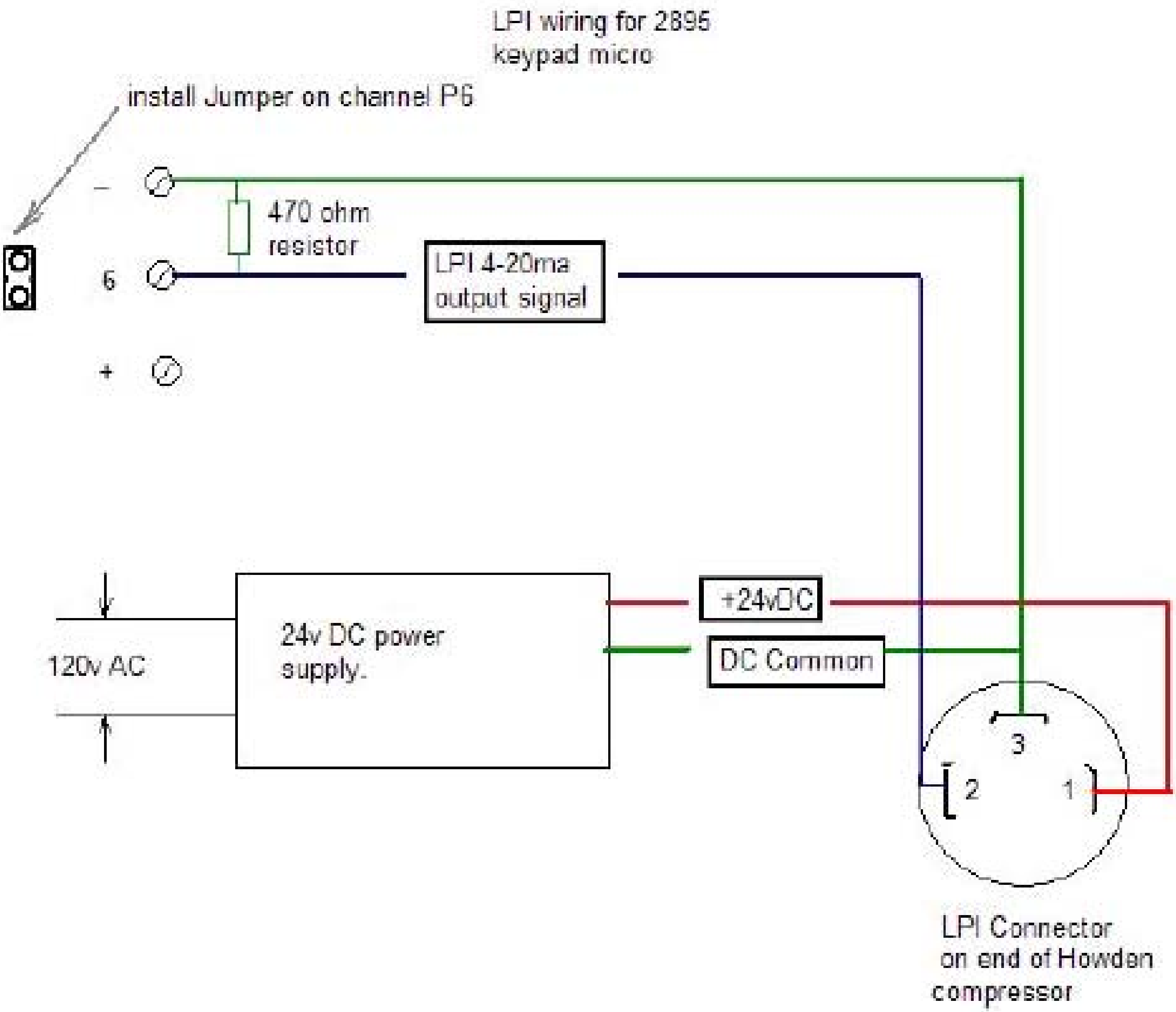
1. Apply Supply voltage min. 5 min. before Calibration.
2. Move the piston/alu-tube to 4mA position, and push the calibration button once.
   The red LED will light up constantly (ON) for 30 sek. then the red LED will flash to indicate ready for 100% calibration.
3. Now move the piston/alu-tube to 20mA position, and push the calibration button once again.
   The red LED will light up constantly for 30 sek., when the red LED is off, the calibration is done.

* Green LED indicates end position: Output <5% "flashing quickly", >95% "constantly on".
* Between 5 and 95% output there is no function, "LED off".

SPECIFICATIONS:

Supply:............................ 11 to 30V DC.
Measuring ranges:.......... Type1: up to 500mm, type2: up to 800mm.
Output:............................ 4-20mA, reversible. Load max 500ohm at 24V.
Digital output:................ DO1 Min. 4%=ON, DO2 Max. 98%=ON, +/- 1%
Resolution:...................... Endless.
Linearity:........................ Better than 0.3% FS (typ.0.1%).
Temp. range:................. -20 to +80degr.C.
Temp. Coeff. :............... Better than 0.05%FS/degr.C (typ.0.02)
Vibration:........................ IEC 68-2-6, 2-500Hz, 4G.
Pressure:........................ Max 100bar.



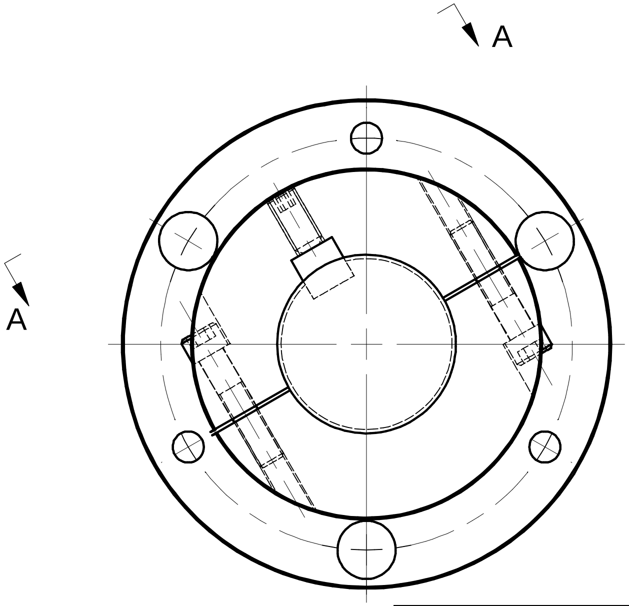

LPI wiring for 2895
keypad micro
install Jumper on channel P6
-
470 ohm
resistor
6
LPI 4-20ma
output signal
+
+24vDC
24v DC power
supply.
DC Common
120v AC
3
2
1
LPI Connector
on end of Howden
compressor

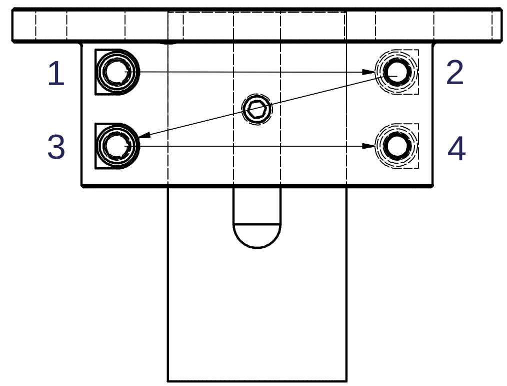
FORM 1354

# Form-Flex BPU

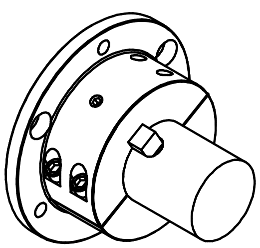
## Installation and Maintenance Manual

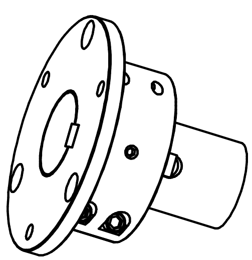
TB Wood's Incorporated
Chambersburg, Pennsylvania
Phone: 888-TBWOODS
www.TBWOODS.com




SECTION A-A





## BH CLAMP HUB INSTALLATION:

THESE INSTRUCTIONS ARE PROVIDED AS AN ADDENDUM TO THE STANDARD FORM-FLEX INSTALLATION AND MAINTENANCE INSTRUCTIONS PROVIDED WITH THE COUPLING. ALL INSTALLATION STEPS NOT DETAILED HERE ARE DEFERRED TO THE STANDARD BULLETIN.

**1)** INSPECT SHAFTS AND HUBS TO MAKE SURE THEY ARE FREE FROM BURRS.
**2)** FIT THE KEY TO THE SHAFT.

**NOTE:** NEVER TIGHTEN THE CLAMP BOLTS WITHOUT THE HUB MOUNTED ONTO THE APPROPRIATELY SIZED SHAFT. ALSO, DO NOT TIGHTEN THE SETSCREW BEFORE THE CLAMP BOLTS, MAKE SURE IT IS NOT ENGAGING THE TOP OF THE KEY BEFORE PROCEEDING TO STEP 3.

**3)** WITH CLAMP BOLTS LOOSE, SLIDE THE HUB ONTO THE SHAFT UNTIL THE HUB FLANGE FACE IS FLUSH WITH THE SHAFT END. THE HUB SHOULD SLIDE ONTO THE SHAFT EASILY WITH NO BINDING. THE KEY SHOULD BE FLUSH WITH THE END OF THE SHAFT AS WELL.
**4)** TIGHTEN THE CLAMP SCREWS IN 3 STAGES. WITH EACH STAGE, FOLLOW THE TIGHTENING SEQUENCE PATTERN SHOWN IN THE SECTION A-A ILLUSTRATION.
*STAGE 1:* HAND TIGHTEN WITH AN ALLEN WRENCH.
*STAGE 2:* TIGHTEN TO HALF OF THE CLAMP SCREW TIGHTENING TORQUE VALUE SHOWN IN TABLE 1, ACCORDING TO THE COUPLING SIZE.
*STAGE 3:* TIGHTEN TO THE FULL CLAMP SCREW TIGHTENING TORQUE VALUE SHOWN IN TABLE 1, ACCORDING TO THE COUPLING SIZE. CONTINUALLY REPEAT THE TIGHTENING SEQUENCE OF SECTION A-A UNTIL ALL BOLTS ARE COMPLETELY TIGHTENED.
**5)** TIGHTEN THE SET SCREW PER THE APPROPRIATE VALUE SHOWN IN TABLE 1 ACCORDING TO THE COUPLING SIZE.
**6)** PROCEED PER THE STANDARD FORM-FLEX INSTALLATION AND MAINTENANCE INSTRUCTIONS PROVIDED WITH THE COUPLING.

TABLE 1.

**BOLT SIZES & TORQUES**

| COUPLING SERIES/SIZE | DISC PACK [REF] | | | CLAMP BOLT | | | SETSCREW | |
|---|---|---|---|---|---|---|---|---|
| | # BOLTS | SIZE - PITCH | TORQUE (lbf*ft) | # BOLTS | SIZE - PITCH | TORQUE (lbf*ft) | SIZE | TORQUE (lbf*ft) |
| BH33 | UNDER REVIEW | | | | | | | |
| BH38 | 6 | 5/16-24 | 17 | 2 | 1/4-28 | 120 | 3/8 | 10 |
| BH43 | 6 | 7/16-20 | 40 | 2 | 3/8-24 | 49 | 3/8 | 10 |
| BH48 | 6 | 7/16-20 | 40 | 4 | 3/8-24 | 49 | 1/2 | 20 |
| BH53 | 6 | 1/2-20 | 60 | 4 | 7/16-20 | 78 | 1/2 | 20 |
| BH58 | 6 | 5/8-18 | 120 | 4 | 1/2-20 | 120 | 1/2 | 20 |
| BH63 | 6 | 5/8-18 | 120 | 4 | 1/2-20 | 120 | 5/8 | 40 |
| BH68 | 6 | 3/4-16 | 200 | 4 | 5/8-18 | 240 | 3/4 | 80 |
| BH38U | 6 | 5/16-24 | 22 | 4 | 1/4-28 | 12 | 3/8 | 10 |
| BH41U | 6 | 7/16-20 | 55 | 4 | 5/16--24 | 23 | 3/8 | 10 |
| BH47U | 6 | 9/16-18 | 120 | 4 | 3/8-24 | 49 | 1/2 | 20 |
| BH54U | 6 | 9/16-18 | 120 | 4 | 7/16-20 | 78 | 1/2 | 20 |
| BP56U | 6 | 9/16-18 | 120 | 4 | 1/2-20 | 120 | 5/8 | 40 |
| DP42 | 8 | 5/8-18 | 125 | 4 | 1/2-20 | 120 | 1/2 | 20 |



8. FINISH ON MACHINED SURFACES
   TOLERANCES LESS THAN OR EQUAL TO .005" 63 Ra
   OTHER MACHINED SURFACES 125 Ra MAX.
7. TURNED SURFACES MUST RUN TRUE (CONCENTRIC, PERPENDICULAR, PARALLEL, ETC.) WITHIN .005 TIR
6. 3 PLACE DECIMALS ± .010
5. 2 PLACE DECIMALS ± .015
4. REMOVE ALL SHARP CORNERS AND BURRS
3. TAPER ON GROUND SURFACES NOT TO EXCEED .0002 PER INCH
2. GROUND SURFACES MUST RUN TRUE (CONCENTRIC, PERPENDICULAR, PARALLEL, ETC.) WITHIN .001 TIR
1. LIMIT ON ANGULAR DIMENSIONS, ± 1', CHAMFERS ± 5'

UNLESS OTHERWISE SPECIFIED

MATERIAL:

HEAT TREAT:

| REV | REVISIONS | ECN NO. | BY | CHK BY | DATE |
|---|---|---|---|---|---|
| F | | | | | |
| E | | | | | |
| D | | | | | |
| C | | | | | |
| B | | | | | |
| A | ORIGINAL RELEASE | | TDL | TDL | 7/19/07 |

THIRD ANGLE PROJECTION

CUSTOMER:
CUST. P/N:
DRAWN: TDLSM DATE: 7/19/07
APPRVD: TDL DATE: 7/19/07
SHEET: 1 OF 1 SCALE: NTS

TB Wood's
TB WOOD'S INCORPORATED
MECHANICAL DIVISION

DESCRIPTION: BH CLAMP HUB INSTALLATION INSTRUCTIONS
COMP.: ASSEMBLY
WR2-LBS. IN $^2$
PART NO.: N/A
FINISH WT.-LBS.
DRAWING NUMBER S00445
REV. LEVEL A

**WARNING:**
**Rotating equipment must be properly guarded.**
**It is the responsibility of the user to properly guard all rotating equipment to comply with OSHA or any applicable regulations. Failure to properly guard may contribute to severe injury should someone come in contact with the rotating parts or should the rotating part fail.**

**WARNING:**
**DO NOT use Wood's products on any primary aircraft drive or any other drive which could endanger human life should a drive component fail.**

Proper care with installation and alignment of couplings and equipment will permit a coupling to operate to full capacity, compensate for angular misalignment, and provide long service life.

Shafts may become misaligned as a result of many natural and unavoidable causes. Heat, vibration, bearing wear, settling of foundations, etc., all tend to alter initial alignment. To ensure long life, recheck alignment after a short period of actual equipment running time.

Flexible couplings are intended to accommodate misalignment between connected equipment while minimizing loads that affect bearing and seal life and overall performance of that equipment. All couplings exert reaction forces on the connected equipment when they are misaligned. While these forces are small, they can be minimized by holding the alignment TIR at or near zero. If significant thermal growth or other movements can be measured under operating conditions, we recommend that the coupling alignment be done so that these growths move the equipment toward a zero operating misalignment.

| ITEM | DESCRIPTION | QTY. |
|---|---|---|
| 1 | FLANGE LOCKNUT | 12 |
| 2 | FLANGE HD BOLT | 12 |
| 3 | UNITIZED FLEX DISC | 2 |
| 4 | SET SCREW | 4 |
| 5 | KEY (NOT INCLUDED) | 1 |
| 6 | SPACER | 1 |
| 7 | HUB | 2 |

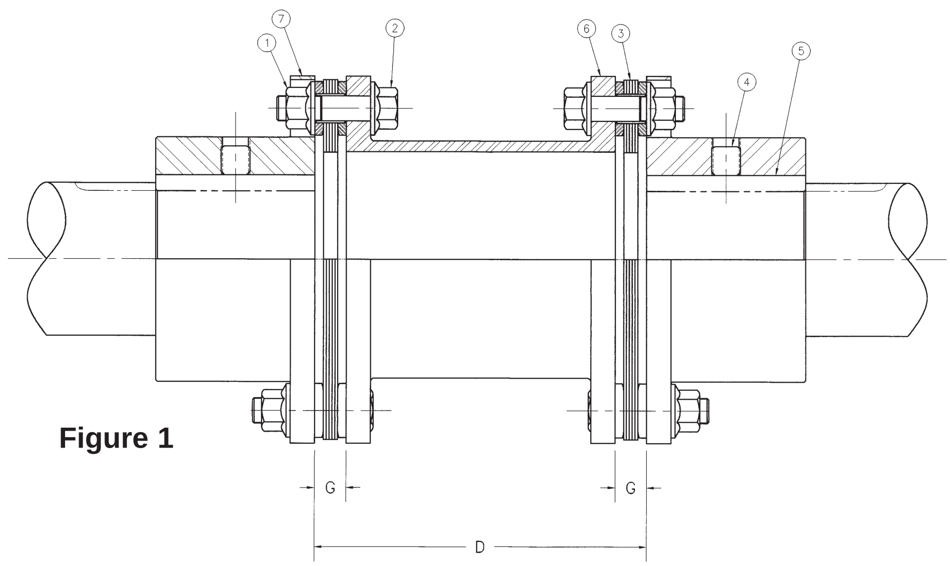



Figure 1

# INSTALLATION

### Preparation

Check that the coupling bores and the shaft separation are correct. Inspect the shafts and hubs making sure they are clean and free from burrs. If the bore is straight, measure the bore and shaft to ensure a proper fit. Check for proper fit of the keys to the shafts and hubs. If the bore is tapered, check for a good contact pattern.

### Hubs

BPU coupling hubs are normally bored for an interference fit according to ANSI/AGMA 9002-A86, unless otherwise specified.

### Straight Bored Hubs

If the hub was specified with a clearance fit and set screws are used, install the coupling hubs so that they are in the correct position and tighten the set screw(s). If the hub is bored for an interference fit, the hub should be heated to expand the bore until it is sufficiently larger than the shaft. A hub temperature of approximately 300˚ F is sufficient for most interference fits. **DO NOT EXCEED 600˚ F.** *DO NOT SPOT HEAT THE HUB AS IT MAY CAUSE DISTORTION.* After the hub has been heated a sufficient amount, quickly position the hub onto the shaft to the desired axial location. Hold the hub in place as it cools.

**Taper Bored Hubs**
Carefully mount the hub on the shaft without key(s), O-ring and back-up rings (if applicable), and tap lightly with a soft mallet to establish a metal to metal fit. This is the initial position for starting the hub advance. Measure this position, shaft end to hub flange face, with a depth gauge and record this value. Hub draw must be monitored during installation. This may be done using a dial indicator or by use of a shaft stop ring. The method of monitoring the hub draw must be established prior to removing the hub after the initial starting position has been determined. The amount of hub draw is dependent upon the desired interference and taper angle. Heat the hub to expand the bore until it is sufficiently larger than the shaft. **DO NOT EXCEED 600 DEG. F.** *DO NOT SPOT HEAT THE HUB AS IT MAY CAUSE DISTORTION.* Place the hub on the shaft the required distance to achieve the level of interference desired. Use a dial indicator or shaft stop as a guide only to determine the axial location of the hub. Hold the hub in place as it cools. Check the final results of the hub advance with a depth gauge, and install the shaft-retaining device provided with the shaft to hold the hub in place.

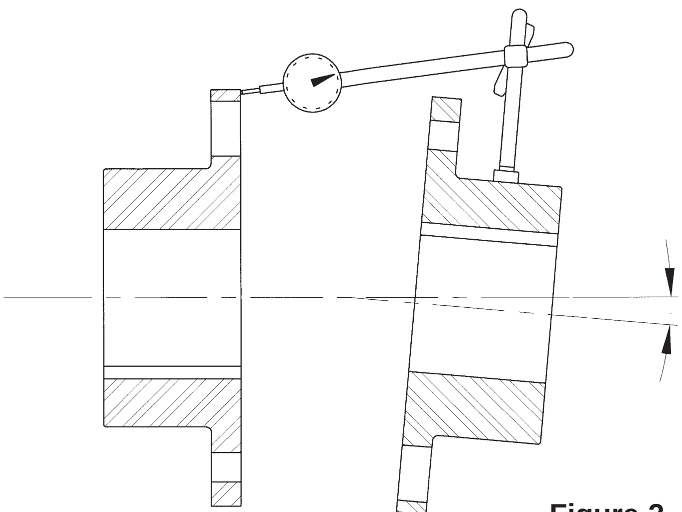


**Figure 2**

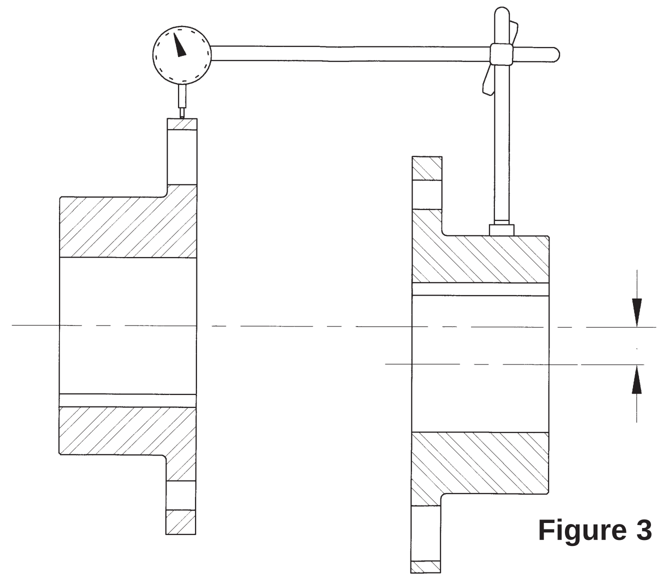


**Figure 3**

## ALIGNMENT

### Axial Spacing
The equipment must sit flat on its base. Any soft foot must be corrected now. Bring the equipment into approximate position. Measure the length of the spacer and the thickness of the two unitized flex discs from washer face to washer face to determine the “D” dimension shown in Figure 1. Measure the separation between the hub flanges and adjust the equipment until the axial hub separation equals the sum of the spacer length and the thickness of the two flex discs.

### Angular Alignment
Rigidly mount a dial indicator to one of the hubs (or shaft) and place the pointer on the flange face of the opposite hub, as shown in Figure 2. Rotate both shafts at the same time making sure the axial spacing remains constant. Adjust the equipment by shimming and/or moving so that the indicator reading is within 0.001 inch per inch of coupling flange diameter. See Table 1.

### Parallel Offset
Rigidly mount a dial indicator to one of the hubs (or shaft) and place the pointer on the flange diameter of the opposite hub, as shown in Figure 3. Compensate for indicator set-up sag. Rotate both shafts at the same time. Adjust the equipment by shimming and/or moving so that the indicator reading is within 0.001 inch per inch of the axial spacing between flex discs. See Table 1.

| Coupling Size | Total Indicator Reading (T.I.R.) | |
|---|---|---|
| | Angular | Parallel |
| BP38U | 0.005 | 0.001 Inch per Inch of “D” dim. |
| BP41U | 0.006 | |
| BP47U | 0.007 | |
| BP54U | 0.008 | |
| BP56U | 0.009 | |

**Table 1**

After securely tightening the foundation bolts, the hub separation and alignment should be re-checked and adjusted if necessary.

**NOTE:** If the driver or driven equipment alignment specification calls for closer tolerances than these recommendations, then those manufacturer's specifications should be used. In addition verify any thermal growth, which may occur during normal equipment operation, and compensate for differences.

## ASSEMBLY

With the hubs mounted and the axial spacing set, proceed to place the spacer between the two hub flanges. Care should be taken when handling the spacer. Be sure the spacer is fully supported at this time. **Damage to the unitized flex discs may result after they have been installed if the spacer is not fully supported.**

Once the spacer is in place between the two hubs, rotate the hub or spacer so that the bolt holes in the spacer line up with the clearance holes in the hub. Install the unitized flex disc at this time. Start a bolt through a bolt hole in the spacer. Put the unitized flex disc between the hub and spacer until a bushing hole in the unitized flex disc lines up with the bolt. Slide the bolt through the bushing hole in the unitized flex disc. Install the locknut until it is snug. Make sure that all bolt threads are clean and lightly oiled. Do not torque any locknuts at this time. Now pivot the unitized flex disc until the other bushing holes in the flex disc are in line with the bolt holes in the spacer. Install the rest of the spacer bolts at this time. The remaining bolts for this end of the coupling can be installed through the hub bolt holes and flex disc bushing holes.

Install the unitized flex disc in the other end of the coupling using the method as described in paragraph 2. The unitized flex disc as installed should look flat and parallel with the mating hub and spacer flanges. For reference, the flange to flange distance, dimension "G" in Figure 1, for each coupling size can be found in Table 2.

Tighten all of the locknuts evenly and in an alternating fashion to the values shown in Table 2.

**Table 2**

| Coupling Size | Locknut Size | Tightening Torque (as supplied) | | "G" |
|---|---|---|---|---|
| | | FT-LBS | Nm | |
| BP38U | 5/16-24 | 22 | 30 | .40 |
| BP41U | 7/16-20 | 55 | 75 | .55 |
| BP47U | 9/16-18 | 120 | 163 | .62 |
| BP54U | 9/16-18 | 120 | 163 | .62 |
| BP56U | 9/16-18 | 120 | 163 | .62 |

**IMPORTANT:** To ensure long life, recheck alignment after a short period (one to two hours) of actual equipment running time. It is recommended that all locknuts be retightened at this time to the values shown in Table 2.

## UNITIZED FLEX DISC REPLACEMENT

If it becomes necessary to replace the unitized flex disc, it can be done as follows:

At one end of the coupling remove all of the locknuts. Ensure that the spacer is supported at this time. Back out and remove all but one of the bolts. Pivot the unitized flex disc out. Remove the last bolt and slide the unitized flex disc out supporting the spacer at this end of the coupling.

Disassemble the other end of the coupling per the above paragraph, being sure to support the spacer when taking out the last bolt. Remove the spacer.

Replace parts as necessary. Recheck alignment and reassemble per the previous pages.

**Repair Kits**

Replacement parts are available from TB Wood's Incorporated through your local distributor.

| Coupling Size | Repair Kits |
|---|---|
| BP38U | B038URKA |
| BP41U | B041URKA |
| BP47U | B047URKA |
| BP54U | B054URKA |
| BP56U | B056URKA |

**ATEX** — In order for this coupling to meet the ATEX requirements, it is mandatory to precisely follow these installation instructions along with the included supplement form 0005-08-49-01. This supplement outlines the ATEX requirements. If the operator does not adhere to these instructions, conformity is immediately invalidated.

***WARNING:*** *Because of the possible danger to person(s) or property from accidents which may result from improper use or installations of products, it is extremely important to follow the selection, installation, maintenance and operational procedures. All rotating power transmission products are potentially dangerous and can cause serious injury. They must be properly guarded in compliance with OSHA, ANSI, and any other local or governmental standards for the speeds and applications in which they are used. It is the responsibility of the user to provide proper guarding. For ATEX requirements the guard must have a minimum of ½ inch (12.7 mm) radial clearance to the coupling major diameter "A" (See Figure 1) and allow for good ventilation.*

1. **Purpose** — These instructions are intended to help you to install, align, and maintain your THOMAS coupling.
2. **Scope** — Covered here will be general information, hub mounting, alignment, assembly, locknut tightening, disc pack replacement, and part numbers.
3. **General Information** — The coupling, as received, may or may not be assembled. If assembled, the locknuts are not fully tightened. Examine the parts to assure there is no visible damage. If coupling is assembled, remove the bolts, locknuts, and washers that attach the hubs to the disc packs. Remove both hubs. Leave the disc packs attached to the center member assembly.
4. **Hub Mounting**
   A. **General** — Clean hub bores and shafts. Remove any nicks orClean hub bores and shafts. Remove any nicks or burrs. If bore is tapered, check for good contact pattern. If the bore is straight, measure the bore and shaft diameters to assure proper fit. The key(s) should have a snug side-to-side fit with a small clearance over the top.

      **NOTE**: If the DBZ hub position on the shaft does not allow enough room to install the short bolts in the hub after hub mounting, install the bolts and disc pack before mounting hub on shaft. See Section 6A & B.

   B. **Straight Bore** — Install the key(s) in the shaft. If the hub is an interference fit, heat the hub in an oil bath or oven until bore is sufficiently larger than the shaft. 350ºF is usually sufficient. An open flame is not recommended. However, if flame heating is necessary, use a very large rose bud tip to give even heat distribution. A thermal heat stick will help determine hub temperature. **DO NOT SPOT HEAT THE HUB OR DISTORTION MAY OCCUR**. With the hub expanded, slide it up the shaft to the desired axial position. A pre-set axial stop device can be helpful.

      **NOTE**: All DBZ hubs have pressed in bushings. Make sure the bushings are facing the disc pack.

   C. **Straight Bore Slip Fit** — Install the key(s) in the shaft. Install the set screw(s) in the hub making sure they do not protrude into the keyway or the bore. Now slide the hub up the shaft to the desired axial position. The set screw(s) which hold the hub in place are tightened, using a torque wrench, to the

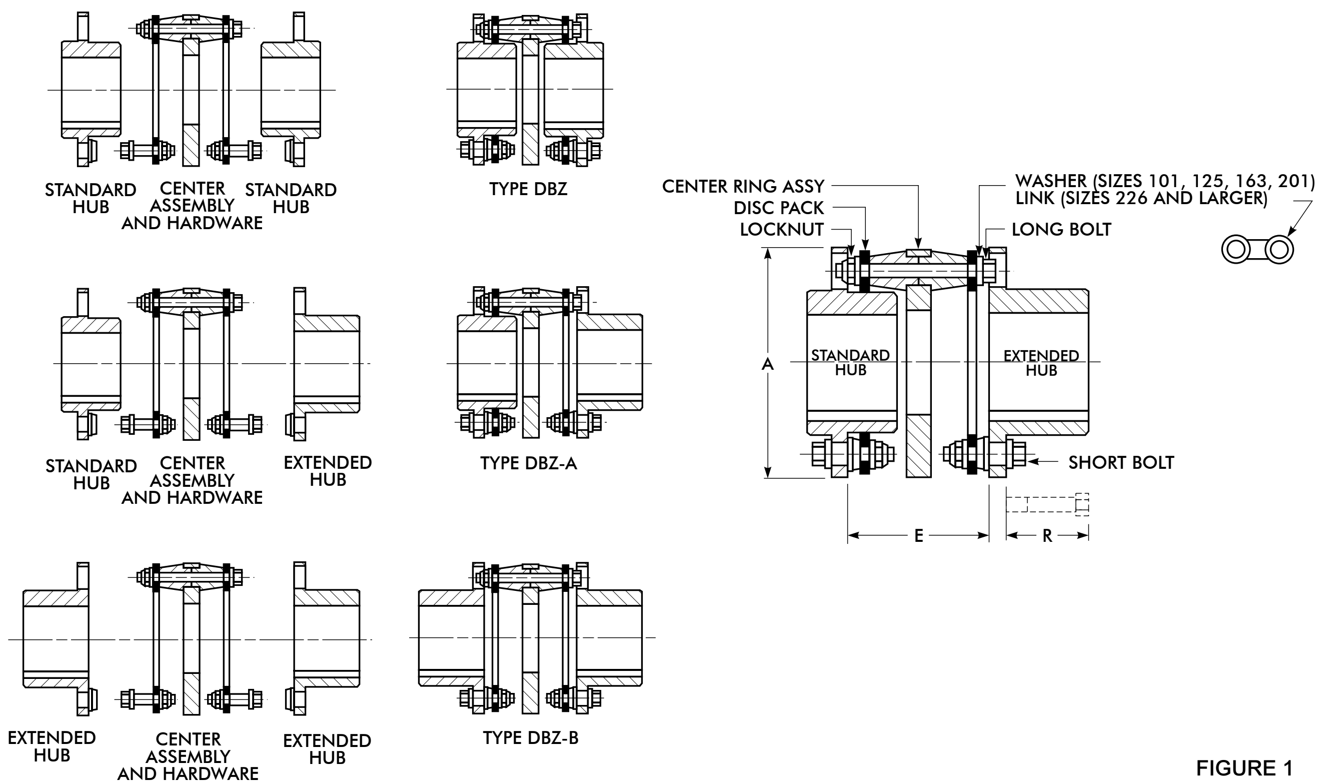



FIGURE 1

values shown in Table 1A.

**NOTE: Never use two set screws one on top of the other.**

D. **Taper Bore** — Put the hub on the shaft without the key(s) in place. Lightly tap the hub on the shaft with a soft hammer. This will assure a metal-to-metal fit between shaft and hub. This is the starting point for the axial draw. Record the position between shaft end and hub face with a depth micrometer. Mount a dial indicator to read axial hub movement. Set the indicator to "0." Remove the hub and install the key(s). Heat the hub in an oil bath or oven until the bore is sufficiently larger than the shaft. 350°F is usually sufficient. An open flame is not recommended. However, if flame heating is necessary, use a very large rose bud tip to give even heat distribution. A thermal heat stick will help determine the hub temperature. **DO NOT SPOT HEAT THE HUB OR DISTORTION MAY OCCUR.** With the hub expanded, slide it quickly up the shaft to the "0" set point. Continue to advance the hub up the taper to the desired axial position. Use the indicator as a guide only. A pre-set axial stop device can be helpful. Check the final results with a depth micrometer. Install the hub shaft end retention device to hold the hub in place.

5. **Shaft Alignment** — Move equipment into place.

A. **Soft Foot** — The equipment must sit flat on its base. Any soft foot must now be corrected.

B. **Axial Spacing** — The axial spacing of the shafts should be positioned so that the disc packs (flexing elements) are not distorted when the equipment is running under normal operating conditions. This means there is a minimal amount of waviness in the disc pack when viewed from the side. This will result in a flexing element that is centered and parallel to its mating flange faces. Move the connected equipment to accomplish the above.

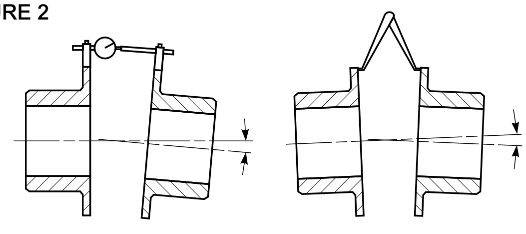
**NOTE**: The disc pack is designed to an optimal thickness and is not to be used for axial adjustments by removing or adding individual discs.

As a guide, maximum and minimum values for dimension "E" are given. These dimensions are suggested for initial installation. Additional capacity is available to compensate for thermal and structural movement. Maximum axial capacity values for these couplings are also given. See Table 1 and Figure 1.

C. **Laser Alignment is an Option** — If not available proceed with dial indicator method.

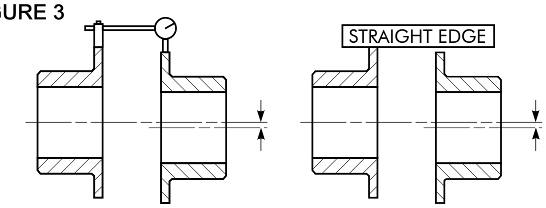
D. **Angular Alignment** — Rigidly mount a dial indicator on one hub or shaft, reading the face of the other hub flange, as shown in Figure 2. Rotate both shafts together making sure the shaft axial spacing remains constant. Adjust the equipment by shimming and/or moving so that the indicator reading is within the values shown in Chart "A".

FIGURE 2



E. **Parallel Offset** — Rigidly mount a dial indicator on one hub or shaft, reading the other hub flange outside diameter, as shown in Figure 3. Compensate for indicator set-up sag. Rotate both shafts together. Adjust the equipment by shimming and/or moving so that the indicator reading is within the values shown in Chart "A".

FIGURE 3




## CHART A — Suggested Maximum Alignment Value

| COUPLING SIZE | Total Indicator Reading (TIR) (in.) | |
|---|---|---|
| | Angular | Parallel |
| **50** | .004 | .003 |
| **62** | .005 | .003 |
| **75** | .005 | .003 |
| **101** | .006 | .004 |
| **126** | .007 | .005 |
| **163** | .009 | .005 |
| **201** | .010 | .006 |
| **226** | .012 | .007 |
| **263** | .014 | .009 |
| **301** | .016 | .010 |
| **351** | .018 | .012 |
| **401** | .020 | .013 |
| **451** | .024 | .014 |

**NOTE:** If the driver or driven equipment alignment tolerances are more stringent than our recommendations, the driver or driven equipment tolerances should be used. Also, be sure to compensate for thermal movement in the equipment. The coupling is capable of approximately four times above shaft misalignment tolerances. However, close alignment at installation will provide longer service with smoother operation.

6. **Final Assembly —** With the coupling in good alignment, the bolts will fit through the holes in the flanges and the disc packs easily.

A. If the coupling arrived assembled, the disc packs are still attached to the center ring. Before taking the disc packs off, first install one hub bolt through each disc pack and secure with a locknut. This will help when the pack is reinstalled later. If the coupling was shipped disassembled, the bolt through the pack is not required as the discs in the pack are factory-taped together.

B. Remove the long bolts. Mount disc packs on the hubs with the one bolt through the disc pack aligned with a clearance hole in the hub. Install the short



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bolts through the hub bolt holes, disc pack, bevel washers or links, and secure with locknuts. Make sure all parts pilot on the body ground part of the bolt. Remove the disc pack alignment bolt.

**NOTE**: All bolt threads should be lubricated. A clean motor oil is recommended.

C. Position one set of the short bolts in each hub on top. Now slide the center ring down into place straddling the short bolts with the center ring bushings. If coupling is dynamically balanced, the center ring match marks must line up with both hub match marks. When one bushing is in line with the hole in the disc pack, slide one long bolt through washer or link, disc pack, center ring, disc pack, washer or link, and then secure with a locknut. The long bolt requires a minimum clearance “R” for installation between back side of coupling flange and stationary equipment. See Figure 1 and Table 1 for value of “R”. On size 226 and larger a link must be put on the bolt first. Now install the rest of the long bolts in the same manner.

D. Tighten the long bolt locknuts at this time. See Table 1 for torque values.

**NOTE**: With the coupling in good alignment the bolts should easily fit through the holes in the flanges and the disc pack. It is recommended that all locknuts be retightened after several hours of initial operation when ever possible.

E. For further help with the installation or alignment, consult the Factory

7. **Disc Pack Replacement** — If it becomes necessary to replace the disc pack, it can be done as follows:

   A. Remove all the long bolts and lower the center ring by sliding it out from between the two disc packs.

   B. Remove one short bolt from the disc pack/hub connection and re-install it through a hub clearance hole and into the hole in the disc pack. Put the nut on. This will keep the discs together and maintains the disc orientation for later reinstallation. Remove the rest of the short bolts and take off the disc pack. Repeat for the second disc pack.

   C. Replace the pack(s) if required. Recheck alignment per Section 5. Reassemble per Section 6.

8. **Replacement parts** — See Table 2.

## TABLE 1 — Dimensions & Tightening Torques ★

| COUPLING SIZE | A (in.) | E (in.) | | Axial Capacity (in) | R (in.) | Thread Size ‡ | Torque | |
|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | | ft-lbs (in.-lbs) | Nm |
| **50** | 2.00 | 1.36 | 1.37 | ± .023 | 1.41 | #6-40 | (24) | 2.7 |
| **62** | 2.44 | 1.74 | 1.75 | ± .028 | 1.75 | #10-32 | (36) | 4 |
| **75** | 2.69 | 1.77 | 1.78 | ± .032 | 1.75 | #10-32 | (36) | 4 |
| **101** | 3.22 | 2.08 | 2.10 | ± .038 | 1.97 | #12-28 | (96) | 11 |
| **126** | 3.84 | 2.46 | 2.48 | ± .046 | 2.31 | 1/4-28 | (156) | 18 |
| **163** | 4.56 | 2.46 | 2.48 | ± .057 | 2.31 | 1/4-28 | (156) | 18 |
| **201** | 5.34 | 2.96 | 2.98 | ± .067 | 2.69 | 5/16-24 | 25 | 34 |
| **226** | 6.06 | 3.83 | 3.85 | ± .076 | 3.31 | 3/8-24 | 34 | 46 |
| **263** | 7.00 | 4.33 | 4.35 | ± .089 | 3.75 | 7/16-20 | 60 | 81 |
| **301** | 8.00 | 4.90 | 4.93 | ± .102 | 4.44 | 1/2-20 | 95 | 129 |
| **351** | 9.38 | 5.90 | 5.93 | ± .118 | 5.44 | 5/8-18 | 175 | 237 |
| **401** | 10.69 | 6.71 | 6.75 | ± .136 | 6.16 | 11/16-16 | 150 ✱ | 203 ✱ |
| **451** | 12.13 | 7.27 | 7.31 | ± .154 | 6.75 | 3/4-16 | 190 ✱ | 258 ✱ |

★ These torque values are approximate for steel bolts with lubricated threads. The locknuts are prevailing torque type and some resistance will be felt. If galling is suspected, immediately stop and contact the Factory. Modification will be necessary for stainless steel. For stainless steel the tightening torque must be reduced to 60% of the values shown. Stainless steel bolt and locknut threads must also be liberally coated with molybdenum disulfide grease.

‡ Bolts should be held from rotating while the locknuts are torqued to the values shown.

✱ These locknuts are cad plated.

## TABLE 1A — Set Screw Tightening Torque

| Setscrew Thread Size | Torque in-lb | Torque ft-lb | Torque Nm |
|---|---|---|---|
| **1/4-20** | 66 | 6 | 7 |
| **1/4-28** | 76 | 6 | 9 |
| **5/16-18** | 132 | 11 | 15 |
| **5/16-24** | 144 | 12 | 16 |
| **3/8-16** | 240 | 20 | 27 |
| **3/8-24** | 276 | 23 | 31 |
| **1/2-13** | 600 | 50 | 68 |
| **1/2-20** | 660 | 55 | 75 |

## TABLE 2 — Part Numbers & Quantity Required

| COUPLING SIZE OF DBZ DBZ-A DBZ-B | Std Hub | Ext Hub | Center Ring | Center Member Assembly with Hardware | | Disc Pack Two per Cplg | | Parts Kit Consists of Washers or Links, Bolts, and Locknuts for One Coupling | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Tomaloy Disc Packs | Stainless Disc Packs | Tomaloy | Stainless | Parts Kit | Washer or Link | | Long Bolt | | Short Bolt | | Locknut | |
| | Part No. | Part No. | Part No. | Part No. | Part No. | Part No. | Part No. | Part No. | Part No. | Qty | Part No. | Qty | Part No. | Qty | Part No. | Qty |
| 50 | 114401 | 514402 | 314405 | 114404 | 314404 | 710492 | 910492 | 716320 | . . . | . . . | 312659 | 2 | 210495 | 4 | 711738 | 6 |
| 62 | 414412 | 114413 | 014416 | 814415 | 914415 | 510601 | 710601 | 816320 | . . . | . . . | 112657 | 2 | 010525 | 4 | 011739 | 6 |
| 75 | 114423 | 814424 | 514427 | 314426 | 414426 | 710523 | 910523 | 816320 | . . . | . . . | 112657 | 2 | 010525 | 4 | 011739 | 6 |
| 101 | 716104 | 216105 | 814438 | 614437 | 714437 | 910619 | 310619 | 916320 | 511192 | 8 | 711162 | 2 | 411161 | 4 | 516503 | 6 |
| 126 | 116106 | 816107 | 414445 | 214444 | 314444 | 910618 | 310618 | 116320 | 002161 | 8 | 811198 | 2 | 510728 | 4 | 916504 | 6 |
| 163 | 816108 | 616109 | 016022 | 414455 | 514455 | 410954 | 610954 | 416320 | 002161 | 16 | 811198 | 4 | 510728 | 8 | 916504 | 12 |
| 201 | 416110 | 016111 | 414471 | 214470 | 314470 | 710624 | 910624 | 001950 | 002170 | 16 | 411206 | 4 | 210721 | 8 | 316505 | 12 |
| 226 | 616112 | 116113 | 614482 | 414481 | 514481 | 010689 | 210689 | 001953 | 011874 | 12 | 011250 | 4 | 010634 | 8 | 716506 | 12 |
| 263 | 716114 | 216115 | 514491 | 314490 | 414490 | 920357 | 120357 | 001956 | 211875 | 12 | 710788 | 4 | 410787 | 8 | 116507 | 12 |
| 301 | 416116 | 516117 | 414500 | 214499 | 314499 | 420359 | 620359 | 001958 | 411876 | 12 | 310656 | 4 | 010655 | 8 | 516508 | 12 |
| 351 | 616118 | 716119 | 314509 | 114508 | 214508 | 820361 | 020361 | 001960 | 711877 | 12 | 410734 | 4 | 110733 | 8 | 316510 | 12 |
| 401 | 816120 | 916121 | 914516 | 714515 | 814515 | 220363 | 420363 | 001962 | 011878 | 12 | 310241 | 4 | 110240 | 8 | 716511 ✱ | 12 |
| 451 | 016122 | 116123 | 514523 | 314522 | 414522 | 310646 | 510646 | 001964 | 311879 | 12 | 910642 | 4 | 710641 | 8 | 116512 ✱ | 12 |

✱ These locknuts are cadmium plated.



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35391R-Rev01