Important Note:

**WARNING**

Read and understand operator’s manuals before using this machine.

Failure to follow operating instructions could result in serious injury

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

The following instructions have been prepared to assist in installation, operation and removal of Vilter Single 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 Corporation is not responsible for the system or the controls needed to prevent liquid carry over and as such Vilter Manufacturing Corporation cannot warrant equipment damaged by improperly protected or operating systems.

Vilter 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.

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 Corporation
Customer Service Department
5555 South Packard Ave
P.O. Box 8904
Cudahy, WI 53110-8904 USA
Telephone: 1-414-744-0111
Fax: 1-414-744-3483
e-mail: info.vilter@emerson.com

Equipment Identification Numbers:

<table>
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APPENDIXA: DANFOSS VALVE GUIDE
Long Term Storage Requirements

1. The compressor(s) must be stored in a heated building, preferably air conditioned to control moisture, to prevent corrosion of the main rotor shaft/crankshaft and (for screw comp.) The slide valve (volume ratio& capacity) motors and gears.

2. The main rotor shaft/crankshaft must be coated with light grease to prevent rusting.

3. (For Screw Compressors) The volume and capacity slide valve motor enclosures will have corrosion inhibitors installed in them and the enclosures will be sealed. On a six month basis (depending on relative humidity), check and replace inhibitors as necessary, and check for signs of corrosion.

4. Before leaving Vilter Manufacturing the compressor is evacuated and pressurized, with dry nitrogen, to 5 psig. Pressure must be monitored with the gauge (provided by Vilter) and checked on a regular basis (at least monthly).

5. The rotor shaft/crankshaft must be rotated every 3 months to prevent flat spots from developing on the bearing surfaces and to keep the shaft seal lubricated.

6. A log should be maintained indicating that the above procedures have been completed.

When the compressor is installed.

A. Look into the suction and discharge connections and inspect for any signs of corrosion on parts.

B. Prelube the compressor with the main oil pump and rotate by hand several revolutions prior to start. For reciprocating compressors this is done manually through the oil pressure gauge port.

C. Notify the Vilter Warranty Department when the compressor is started.
DOMESTIC TERMS and CONDITIONS

Exclusivity. Seller’s acceptance of Buyer’s order is expressly conditional upon Buyer’s agreement to these terms and conditions. All inconsistent or additional terms, modifications, or changes are deemed material, are expressly rejected, and do not form a part of this Agreement unless Seller agrees to such terms in writing.

Home Office Approval. Buyer understands that no agent of Seller is authorized to execute this Agreement or bind Seller unless this Agreement and any purported change are signed by a home office Officer of Seller.

Prices and Payments. Prices are exclusive of taxes and may be modified at any time prior to Seller receiving Buyer’s binding order. Upon acceptance, prices are firm for only three months and subject to reasonable escalation. Unless agreed otherwise in writing, all payments are due in full within 30 days of Seller shipping the products or providing the services. All overdue amounts will incur finance charge of the lesser of (a) 1 ½ % per month and (b) the maximum allowed by law.

Security Agreement. This Agreement shall be considered a security agreement to the maximum extent allowed by law. Seller shall have, retain, and possess a security interest in all products sold to Buyer until Seller is paid in full. Buyer grants to Seller a power of attorney to complete, sign on Buyer’s behalf, and file all forms reasonably necessary to perfect Seller’s security interest. If Buyer defaults, or Seller deems itself insecure of receiving payment, the full unpaid balance shall become immediately due and payable at the option of the Seller, and Seller may retake possession of the products without Court order.

Delivery. Seller shall not be liable for delivery delays beyond its control, including delays caused by its suppliers. All delivery dates and rates of production statements are merely good faith estimates. Unless otherwise stated on Seller’s Order Acknowledgment, all shipments are F.O.B. Seller’s factory. Seller reserves the rights to make installment deliveries.

Warranties. Seller warrants the products it manufactures to be free from defects in material and workmanship for a period of eighteen (18) months from the date of shipment from Seller’s manufacturing plant or twelve (12) months from date of installation at the initial end users location, whichever occurs first. In addition, Seller provides the following extended warranties: (a) three (3) years from the date of shipment on single screw compressor internal rotating parts, (b) two (2) years from the date of shipment on reciprocating compressors and single screw and reciprocating compressor parts, and (c) two (2) years on all other parts on a single screw compressor unit. Such warranties do not apply to ordinary wear and tear. Seller does not warrant that the product complies with any particular law or regulation not explicitly set forth in the specifications, and Buyer is responsible for ensuring that the product contains all features necessary to safely perform in Buyer’s and its customer’s plants and operations. Buyer must notify Seller of any warranty claim within ten (10) days after such claim arises, otherwise Buyer waives all rights to such claim. Products supplied by Seller which are manufactured by others are not warranted by Seller, but rather Seller merely passes through the manufacturer’s warranty to Buyer. SELLER EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Unless otherwise agreed in writing, Buyer’s sole remedy for breach of warranty is, at Seller’s option, the repair of the defect, the correction of the service, or the providing a replacement part FOB Seller’s office. Seller will not be responsible for costs of dismantling, lost refrigerant, reassembling, or transporting the product. Further, Seller will not be liable for any other direct, indirect, consequential, incidental, or special damages arising out of a breach of warranty. THESE WARRANTY REMEDIES ARE EXCLUSIVE, AND ALL OTHER WARRANTY REMEDIES ARE EXCLUDED. Products or parts for which a warranty claim is made are to be returned transportation prepaid to Seller’s factory. Any improper use, corrosion, neglect, accident, operation beyond rated capacity, substitution of parts not approved by Seller, or any alteration or repair by others which, in Seller’s judgment, adversely affects the Product, shall void all warranties and warranty obligations. Further, Seller shall not be liable under the above warranties should Buyer be in default of its payment obligations to Seller under this Agreement or any credit agreement.
Changes, Cancellations, and Returns. Buyer will pay reasonable charges and all associated costs and damages arising from canceling or changing this Agreement. No returns shall be allowed other than with Seller’s express permission, and such returns shall include a reasonable restocking charge to the extent permitted by law.

Resellers and Distributors. Should Buyer resell the product to a third party, then Buyer agrees to provide a copy of these Terms and Conditions to such third party prior to the sale, and obtain such third party’s agreement to be bound by the relevant provisions including, but not limited to, the Warranties Section and the Limitation of Liability Section. Buyer agrees to indemnify Seller against any and all claims, damages, or liability (including reasonable attorney fees) arising from Buyer’s breach of the obligations set forth in this Section.

Proprietary Rights. All designs and information provided by Seller remain its property, and Buyer shall honor all proprietary legends.

Limitation of Liability. The Seller’s price is based on the enforceability of this limitation of liability, and the Buyer understands that the price would be substantially higher without this limitation. **SELLER SHALL HAVE NO LIABILITY TO BUYER FOR LOST PROFITS OR FOR SPECIAL, CONSEQUENTIAL, EXEMPLARY OR INCIDENTAL DAMAGES OF ANY KIND, WHETHER ARISING IN CONTRACT, TORT, PRODUCT LIABILITY OR OTHERWISE, EVEN IF ADVISED OF THE POTENTIAL DAMAGES IN ADVANCE.**

**IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY DAMAGES WHATSOEVER IN EXCESS OF THE CONTRACT PRICE. IN THE EVENT THAT ANY WARRANTY OR WARRANTY REMEDY FAILS OF ITS ESSENTIAL PURPOSE, OR IS HELD TO BE INVALID OR UNENFORCEABLE FOR ANY REASON, IN CONSIDERATION OF THE OTHER PROVISIONS OF THIS AGREEMENT, THE PARTIES AGREE THAT ALL LIABILITY LIMITATIONS WILL NEVER THELESS REMAIN IN EFFECT.**

Governing Law. This Agreement shall be governed by the internal laws of the State of Wisconsin, without resort to conflicts of law analysis.

Attorney fees, Collection Costs, and Indemnification. Buyer agrees to defend and indemnify Seller against any claims, damages, or liability (including attorney fees) arising out of Buyer’s violation of any law or breach of its obligations under this Agreement including, but not limited to, personal injury, death, or property damage. In addition, Buyer shall reimburse Seller all reasonable attorney fees and collection costs incurred by Seller to enforce its rights against Buyer under this Agreement.

Manuals and Brochures. Buyer shall communicate to Seller any special needs, pictorials, labels, warning signs, instructions, or language required for the manuals and brochures used for the products. Buyer agrees to pay a reasonable surcharge for additional manuals, special manuals, and brochures.

Severability. Any legally unenforceable provision may be severed from this Agreement, and the remaining terms and conditions will be enforced as a whole as if such provision had not been inserted herein.

Waiver, Entire Agreement. No waiver by either party of a right under this Agreement shall waive any other rights. These terms and conditions and any other writing signed by Seller constitute the entire agreement, and may not be modified other than in writing signed by Seller.
**EXPORT TERMS and CONDITIONS**

Exclusivity. Seller’s acceptance of Buyer’s order is expressly conditional upon Buyer’s agreement to these terms and conditions. All inconsistent or additional terms, modifications, or changes are deemed material, are expressly rejected, and do not form a part of this Agreement unless Seller agrees to such terms in writing.

Home Office Approval. Buyer understands that no agent of Seller is authorized to execute this Agreement or bind Seller unless this Agreement and any purported change are signed by a home office Officer of Seller.

Prices and Payments. Prices are exclusive of taxes and may be modified at any time prior to Seller receiving Buyer’s binding order. Upon acceptance, prices are firm for only three months and subject to reasonable escalation. Unless agreed otherwise in writing, all payments are due in full upon receipt of order or Vilter’s receipt of an acceptable letter of credit. All overdue amounts will incur finance charge of the lesser of (a) 1 1/2% per month and (b) the maximum allowed by law.

Export Transactions. If the products provided under this Agreement are to be shipped or used outside of the United States, then the following terms apply unless otherwise agreed by Seller in writing: (1) Buyer shall be responsible for all export and import scheduling and financial arrangements, (2) Buyer shall be responsible for compliance with all export and import laws and shall comply, and shall cause its agents to comply, with the Foreign Corrupt Practices Act, (3) the United Nations Convention on the International Sale of Goods shall not apply or govern the transaction, (4) Buyer accepts all responsibility for the products complying with any non-United States based laws, regulations, and other legal requirements, and (5) Seller shall be entitled to condition any shipment upon Buyer obtaining an acceptable Letter of Credit in Seller’s favor confirmed at a United States based bank of Seller’s choosing.

Delivery. Seller shall not be liable for delivery delays beyond its control, including delays caused by its suppliers. All delivery dates and rates of production statements are merely good faith estimates. Unless otherwise stated on Seller’s Order Acknowledgment, all shipments are F.O.B. Seller’s factory. Seller reserves the rights to make installment deliveries.

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PRODUCTS or parts for which a warranty claim is made are to be returned transportation prepaid to Seller’s factory. Any improper use, corrosion, neglect, accident, operation beyond rated capacity, substitution of parts not approved by Seller, or any alteration or repair by others which, in Seller’s judgment, adversely affects the Product, shall void all warranties and warranty obligations. Further, Seller shall not be liable under the above warranties should Buyer be in default of its payment obligations to Seller under this Agreement or any credit agreement.

Changes, Cancellations, and Returns. Buyer will pay reasonable charges and all associated costs and damages arising from canceling or changing this Agreement. No returns shall be allowed other than with Seller’s express permission, and such returns shall include a reasonable restocking charge to the extent permitted by law.

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IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY DAMAGES WHATSOEVER IN EXCESS OF THE CONTRACT PRICE. IN THE EVENT THAT ANY WARRANTY OR WARRANTY REMEDY FAILS OF ITS ESSENTIAL PURPOSE, OR IS HELD TO BE INVALID OR UNENFORCEABLE FOR ANY REASON, IN CONSIDERATION OF THE OTHER PROVISIONS OF THIS AGREEMENT, THE PARTIES AGREE THAT ALL LIABILITY LIMITATIONS WILL NEVERTHELESS REMAIN IN EFFECT.

Governing Law and Dispute Resolution. This Agreement shall be governed by the internal laws of the State of Wisconsin, U.S.A. without resort to conflicts of law analysis. The parties agree the State courts located in Milwaukee, Wisconsin, U.S.A. shall have exclusive venue for any dispute concerning the enforceability, interpretation, or termination of this Agreement, and agree to bring any such action in this venue. The parties further agree to personal jurisdiction in such courts for any such dispute.

Attorney fees, Collection Costs, and Indemnification. Buyer agrees to defend and indemnify Seller against any claims, damages, or liability (including attorney fees) arising out of Buyer’s violation of any law or breach of its obligations under this Agreement including, but not limited to, personal injury, death, or property damage. In addition, Buyer shall reimburse Seller all reasonable attorney fees and collection costs incurred by Seller to enforce its rights against Buyer under this Agreement.

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STANDARD VILTER WARRANTY STATEMENT

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SELLER EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Unless otherwise agreed in writing, Buyer’s sole remedy for breach of warranty is, at Seller’s option, the repair of the defect, the correction of the service, or the providing a replacement part FOB Seller’s office. Seller will not be responsible for costs of dismantling, lost refrigerant, reasssembling, or transporting the product. Further, Seller will not be liable for any other direct, indirect, consequential, incidental, or special damages arising out of a breach of warranty. THESE WARRANTY REMEDIES ARE EXCLUSIVE AND ALL OTHER WARRANTY REMEDIES ARE EXCLUDED. Products or parts for which a warranty claim is made are to be returned transportation prepaid to Seller’s factory. Any improper use, corrosion, neglect, accident, operation beyond rated capacity, substitution of parts not approved by Seller, or any alteration or repair by others which, in Seller’s judgement, adversely affects the Product, shall void all warranties and warranty obligations. Further, Seller shall not be liable under the above warranties should Buyer be in default of its payment obligations to Seller under this Agreement or any credit agreement.
The seller extends warranty, from date of shipment, to a period of fifteen (15) years on all compressor bearings, five (5) years on all internal compressor parts and two (2) years on the remainder of the parts on single screw compressor units. If within such period any such product shall be proved to Seller’s satisfaction to be defective, such product shall be repaired or replaced at Seller’s option. Such repair or replacement shall be Seller’s sole obligation and Buyer’s exclusive remedy hereunder and shall be conditioned upon Seller’s receiving written notice of any alleged defect within ten (10) days after its discovery and, at Seller’s option, return of such parts to Seller, F.O.B., freight prepaid to Seller’s factory. Expenses incurred by Buyer in repairing or replacing any defective product or any lost refrigerant will not be allowed except by written permission of Seller. This warranty is only applicable to products properly maintained and used according to Seller’s instructions, the use of genuine Vilter replacement parts and recommended oil in all repairs and replacements has demonstrated adherence to a scheduled maintenance program as detailed in the Single Screw Compressor operating manual. This warranty does not apply to normal wear and tear, or damage caused by corrosion, misuse, overloading, neglect, improper operation, accident or alteration, as determined by Seller. Products supplied by seller hereunder, which are manufactured by someone else, are not warranted by Seller in any way, but Seller agrees to assign to Buyer any warranty rights in such products that the Seller may have from the original manufacturer. Labor and expenses for repair are not covered by warranty.

THE WARRANTY CONTAINED IN THIS SECTION IS EXCLUSIVE AND IN LIEU OF ALL OTHER REPRESENTATIONS AND WARRANTIES (EXCEPT OF TITLE), EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

Any description of the product, whether in writing or made orally by Seller or Seller’s agents, specifications, samples, models, bulletins, drawings, diagrams, engineering sheets or similar materials used in connection with Buyer’s order are for the sole purpose of identifying the products and shall not be construed as an express warranty. Any suggestions by seller or Seller’s agents regarding use, application or suitability of the products shall not be construed as an express warranty unless confirmed to be such in writing by Seller.

The 5/15 Extended Warranty shall be applicable only if the specific maintenance guidelines as outlined in the technical manual are followed. This includes the compressor inspections, completing periodic oil analysis and the change out of the oil and oil filters, and related components as required with only genuine Vilter parts. The customer is required to keep a maintenance log and receipts demonstrating the use of Genuine Vilter parts for validation of a warranty claim, if requested. The repair or replacement of parts or the performance of service under this warranty does not extend the life of this warranty beyond its original expiration date.
Warning Symbols and Meanings

Note: The symbols that appear on this page, are used throughout the manual to help identify any potential warnings, cautions or hazards and to assist in avoidance of any accidents or injuries.

Electrical Hazards

Misc. Hazards

Mechanical Hazards

Fire Hazards

Heat/Hot Hazards

Mandatory Action Sign/Verification - Communicates an action to be taken to AVOID hazard

Prohibition Symbol
Installation Instructions

DELIVERY INSPECTION

Vilter screw compressor components are thoroughly inspected at the factory, assuring the shipment of a mechanically perfect piece of equipment. Damage can occur in shipment. 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

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SEPARATOR SIZE</th>
<th>STANDARD UNIT (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSM 201</td>
<td>12”</td>
<td>2,450</td>
</tr>
<tr>
<td>VSM 301</td>
<td>12”</td>
<td>2,500</td>
</tr>
<tr>
<td>VSM 361</td>
<td>12”</td>
<td>2,500</td>
</tr>
<tr>
<td>VSM 401</td>
<td>12”</td>
<td>2,500</td>
</tr>
<tr>
<td>VSM 501</td>
<td>16”</td>
<td>3,966</td>
</tr>
<tr>
<td>VSM 601</td>
<td>16”</td>
<td>4,001</td>
</tr>
<tr>
<td>VSM 701</td>
<td>16”</td>
<td>4,036</td>
</tr>
<tr>
<td>VSM 701</td>
<td>20”</td>
<td>4,888</td>
</tr>
</tbody>
</table>

* Does not include motor.

FOUNDATIONS

Vilter single 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 weight).

PLACEMENT OF UNIT

The single 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.

The coupling center section is shipped loose to allow a check of proper electrical phasing, direction of rotation of the motor.

Do not check for motor rotation without having coupling disconnected from compressor.

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. 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 lint free 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.

Hangers and supports pipe lines should receive careful attention. The hangers must have ample strength and be securely anchored to withstand the vibration from the compressor and adequately support the pipe lines.

After installation, pipe hangers and supports may become loose due to seasonal changes or the building settling. This will lead to vibrations being transmitted through the pipe to the compressor unit. To avoid piping transmitted vibration, hangers and supports should be periodically checked and adjusted.

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 single 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 on 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 single 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 of 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. Second, 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.

**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-pressur-
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 an ammonia system. This will cause ammonium carbonate to precipitate when the CO₂ and ammonia are combined. If heavy enough, this precipitate will 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 leak test 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 overnight. A small drop in pressure 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 flow 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 with dry nitrogen 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.

**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-condensibles 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-condensibles, 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 60°F 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-condensibles, 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. Again break the vacuum with dry nitrogen and allow the pressure in the system to rise slightly above zero pounds (psig). 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-condensibles. 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. The reading from the gauge(s) indicates when the system has reached the low absolute pressure required for complete system evacuation.
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.

The oil level must be checked with the unit off and without any liquid ammonia inside of the separator. During normal operation, one will observe the liquid ammonia/oil mixture in the bottom sight glass, not the actual oil level.

To remove the liquid from the separator, manually close off the liquid supply line to the compressor while running. The liquid ammonia level will slowly drop and the superheat will increase. The compressor will automatically unload and once the superheat reaches 25°F, it will shutdown. Wait 30 minutes to allow the oil in the compressor and pipelines to drain into the separator to check the level of oil in the sight glass. Oil may now be added to the unit to bring it up to the operating level. (See Table Below) for approximate (full) oil charge requirements.

Oil For Single Screw Compressors Units

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 initially 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:

**Low Side Equipment**

1. Fans on air handling equipment running.
2. Pumps on water cooling equipment running.
3. Proper location and attachment of all thermostatic expansion valve bulbs to their respective suction lines.
4. Correct fan and pump rotation.
5. Evaporator pressure regulators and solenoid valves open.
6. Water pumps and motors correctly aligned and drive couplings correctly positioned and tight.
7. Belt drives correctly aligned and tightened.
8. Proper voltage to motors.

When the unit is in operation, there will be some drop in the oil level as the compressor 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.

**OIL CHARGE**

<table>
<thead>
<tr>
<th>Oil Separator Size</th>
<th>Approximate Oil Charge – Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSM 12”</td>
<td>7</td>
</tr>
<tr>
<td>VSM 12” w/oil sump</td>
<td>8</td>
</tr>
<tr>
<td>VSM 16” short (68”)</td>
<td>9</td>
</tr>
<tr>
<td>VSM 16” long (86”)</td>
<td>10.5</td>
</tr>
<tr>
<td>VSM 20”</td>
<td>12.5</td>
</tr>
</tbody>
</table>

**Do not mix oils. Never check the oil level when the unit is running.** See Separator Oil Level on page 34 for proper level.
Compressors

1. Proper oil level.
2. Voltage agrees with motor characteristics.
3. Properly sized motor fuses and heaters.
4. Direct drive couplings correctly positioned and assembled.
5. All suction and discharge stop/check or separated stop valves in their respective automatic or open mode.
6. All transducers and RTD’s calibrated and reading correctly.

Condensers and Cooling Towers

1. Water available at water cooled condensers or cooling towers and supply line valve open.
2. Water in remote water tank or sump of evaporative condenser or cooling tower and make-up water available.
3. Correct rotation of pump and fan motors.
4. Belt drives aligned and tightened correctly.
5. Direct drive couplings correctly positioned and tight.
6. Pump, fans and motors lubricated.

Controls

Controls should be at the initial set points. See Vission/Vantage manual for further information.

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. Leak check charging line and connections before charging with liquid.
3. Charge liquid refrigerant from the drum. If the drum is not equipped with “Liquid” and “Vapor” valves, place the drum in a position recommended by the refrigerant supplier so that liquid refrigerant only can enter the system. Close the liquid line or king valve, if it is not already closed. Open the charging valve slowly to allow liquid 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 water cooled condensers and 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 condenser or 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.
4. After some refrigerant has entered the system, the compressor unit starting procedure may be followed. See Start-Up and Operation Section of this manual.
5. 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 should be a liquid seal in the receiver. If these two conditions are not satisfied, additional refrigerant must be added.
6. When sufficient refrigerant has been charged into the system, close the charging and drum valves. Then remove the drum from the system.

7. During the charging period, observe the gauges carefully to insure there are 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 step 6, then start back at step 1 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”.

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**SLIDE VALVE ACTUATOR INSTALLATIONS INSTRUCTIONS**

**CAUTION**

*WHEN INSTALLING THE OPTICAL SLIDE MOTOR, LOOSEN LOCKING COLLAR BEFORE SLIDING THE COLLAR DOWN ON THE SHAFT. DO NOT USE A SCREWDRIVER TO PRY LOCKING COLLAR INTO POSITION.*

**OVERVIEW**

Calibration of an optical slide valve actuator is a two step process that must be done for each actuator installed of the compressor. Briefly, the steps are as follows.

1) The actuator motor control module, located inside the actuator housing, is calibrated so that it knows the minimum and maximum rotational positions of the slide valve it controls. The calibrated actuator will output 0 VDC at the minimum position and 5 VDC at the maximum position.

2) After the actuator motor control module has been calibrated for 0-5 Volts, the controlling channel corresponding to the actuator motor (either the capacity or volume) has to be calibrated. This instructs the Vission/ Vantage control panel to learn the rotational 0% position & rotational 100% position of the slide valve travel.

**PLEASE NOTE:  
Because there is an optical sensor on this motor, do not attempt calibration in direct sunlight.**

**ACTUATOR MOTOR CONTROL MODULE CALIBRATION PROCEDURE**

1. Disable the Slide Non-Movement Alarm by going to the “Setup” menu on the Vission/ Vantage and choosing “Alarm Disable” for the Slide Non-Movement Option.

2. Completely shut off the power to the Vission/ Vantage control panel completely.

3. If not already done, mount the slide valve actuator per (“Vilter Actuator set up for Capacity and Volume Slide Motors”). Next, wire the actuator per the attached wiring diagrams, using the already installed electrical conduit to run the cables. The old wiring can be used to pull the new cables through the conduit to the control panel. The cables may also be externally tie-wrapped to the conduit. Run the yellow AC power cable(s) and the gray DC position transmitter cable(s) in different conduit. This prevents the DC position transmitter cable from picking up electrical noise from the AC power cable. **Do not connect either of the cables to the actuators yet.**

In addition, if the actuators are replacing old gearmotors on early Vission/Vantage units, **you must remove the capacitors and associated wiring from inside the control panel.** This is necessary to prevent electrical damage to the new actuator motor.

4. When completing the calibration of the new actuators, the motors are signaled to move to below 5%. This may not completely occur when exiting the calibration screen due to a “program timer”. HOWEVER, when the compressor actually starts, the motors will travel below 5% and function correctly. The user may see that
the actuators are not below 5% after calibration and try to find the reason. If the calibration screen is re-entered right away and then exited, the timer will allow the actuator to go below the 5% on the screen. This may be perceived as a problem; in reality, it is not.

5. Note: The 0 to 5V-position transmitter output of the actuator will fluctuate wildly during the calibration process. To prevent damage to the actuators, do not connect the yellow power cable or the gray position transmitter cable until instructed to do so later on.

6. Open the plastic cover of the capacity motor by removing the four #10 screws. Caution: there are wires attached to the connector on the plastic cover. Handling the cover too aggressively could break the wires.

7. Gently lift the cover and tilt it toward the Turck connectors. Raise the cover enough to be able to press the blue calibrate button and be able to see the red LED on the top of assembly.

8. Press “Menu” on the main screen and then press the “Slide Calibration” button, to enter the slide calibration screen. (Note: you must be in this slide calibration screen before attaching the yellow power cable or gray position transmitter cable.)

9. Now connect the yellow power cable and the gray position transmitter cable to the actuator.

10. Press INC and DEC to move the slide valve and check for the correct rotation. See Table 1 for Actuator/command shaft rotation specifications.

11. Note: If the increase and decrease buttons do not correspond to increase or decrease shaft rotation, swap the blue and brown wires of the “yellow power cable”. This will reverse the rotation of the actuator/command shaft.

12. Quickly press and release the blue push button on the actuator one time. This places the actuator in calibration mode. The red LED will begin flashing rapidly.

13. Note: When the actuator is in calibration mode, it outputs 0V when the actuator is running and 5V when it is still. Thus, as stated earlier, the actuator voltage will fluctuate during calibration. After the actuator has been calibrated, 0V output will correspond to the minimum position and 5V to the maximum position.

14. Note: The “Slide calibration” screen on the Vission/Vantage has a “Current” window, which displays twice the actuator output voltage. This value, (the % volume and the % capacity) displayed in the “Current Vol” and Current Cap” Windows are meaningless until calibration has been completed.

15. Use the DEC button on the Vission/Vantage panel to drive the slide valve to its minimum “mechanical stop” position. Do not continue to run the actuator in this direction after the slide valve has reached the stop. Doing so may cause damage to the actuator or the slide valve. When the slide has reached the mechanical stop position, use the INC button to pulse the actuator to where the slide is just off of the mechanical stop and there is no tension on the motor shaft.

16. Quickly press and release the blue button on the actuator again. The red LED will now flash at a slower rate, indication that the minimum slide valve position (0V position) has been set.

17. Use the INC button on the Vission/Vantage panel to drive the slide to its maximum “mechanical stop” position. Do not continue to run the actuator in this direction after the slide valve has reached the stop. Doing so may cause damage to the actuator or the slide valve. When the slide valve has reached the mechanical stop position, use the DEC button to pulse the actuator to where the slide is just off of its mechanical stop and there is no tension on the motor shaft.

18. Quickly press and release the blue button on
the actuator one more time. The red LED will stop flashing. The actuator is now calibrated and knows the minimum and maximum positions of the slide valve it controls. Now the capacity or volume channel of the Vision/Vantage can be calibrated.

19. Use the Dec button to move the actuator towards its minimum position while watching the millivolt readout on the Vision/Vantage screen. Discontinue pressing the DEC button when the millivolt reading the “Current” window above the “Set Min” button is approximately 500 millivolts.

20. Now use the DEC and INC buttons to position the slide valve until a value close to 300 millivolts is on the screen. Then, press the “Set Min” button in the capacity or volume slide valve window to tell the controller that this is the minimum millivolt position. Note: The value in the “Current Cap” or “Current Vol” window has no meaning right now.

21. Use the INC button to rotate the actuator towards its maximum position while watching the millivolt readout on the controller screen. Discontinue pressing the INC button when the millivolt reading in the “Current” window is approximately 9200 millivolts (7900 millivolts for the 2783J qualified analog boards). You are nearing the mechanical stop position.

22. Pulse the INC button to carefully move the slide valve until the millivolt readout “saturates”, or stops increasing. This is around 9500 millivolts (8400 millivolts for 2783 qualified analog boards).

23. Pulse the DEC button until the millivolts just start to decrease. (This is the point where the channel drops out of saturation).

24. Press the “Set Max” button.

25. Press the “Main” button to complete calibration and exit the “Slide Calibration” screen. The controller will automatically energize the actuator and drive it back to its minimum position (below 5%) for pre-start-up.

26. Note: Now the “Current Cap” or the “Current Vol” value will be displayed in the window on the “Main” screen and the “Slide Calibration” screen.

27. Gently lower the plastic cover over the top of the actuator to where it contacts the base and O-ring seal. After making sure the cover is seated properly, gently tighten the four #10 screws. Caution: The plastic cover will crack if the screws are over tightened.

28. Enable the “Slide Non-Movement Alarm” by going to the “Setup” menu and choosing “Alarm Enable” for the “Slide Non-Movement Option”.

29. This completes the calibration for this channel either capacity or volume. Repeat the same procedure to the other channel.

**Slide Valve Actuator Theory of Operation**

The slide valve actuator is a gear-motor with a position sensor. The motor is powered in the forward and reverse directions from the main computer in the control panel. The position sensor tells the main computer the position of the slide valve. The main computer uses the position and process information to decide where to move the slide valve next.

The position sensors works by optically counting motor turns. On the shaft of the motor is a small aluminum “photochopper”. It has a 180 degree fence that passes through the slots of two slotted optocouplers. The optocouplers have an infrared light emitting diode (LED) on one side of the slot and a photo transistor on the other. The photo transistor behaves as a light controlled switch. When the photochopper fence is blocking the slot, light from the LED is prevented from reaching the photo transistor and the switch is open. When photochopper fence is not blocking the slot, the switch is closed.

As the motor turns, the photochopper fence alternately blocks and opens the optocoupler slots, generating a sequence that the position sensor microcontroller can use to determine motor position by counting. Because the motor is connected to the slide valve by gears, knowing the motor position
means knowing the slide valve position.

During calibration, the position sensor records the high and low count of motor turns. The operator tells the position sensor when the actuator is at the high or low position with the push button. Refer to the calibration instructions for the detailed calibration procedure.

The position sensor can get “lost” if the motor is moved while the position sensor is not powered. To prevent this, the motor can only be moved electrically while the position sensor is powered. When the position sensor loses power, power is cut to the motor. A capacitor stores enough energy to keep the position sensor circuitry alive long enough for the motor to come to a complete stop and then save the motor position to nonvolatile EEPROM memory. When power is restored, the saved motor position is read from EEPROM memory and the actuators resumes normal function

This scheme is not foolproof. If the motor is moved manually while the power is off or the motor brake has failed, allowing the motor to free wheel for too long after the position sensor looses power, the actuator will become lost.

A brake failure can sometimes be detected by the position sensor. If the motor never stops turning after a power loss, the position sensor detects this, knows it will be lost, and goes immediately into calibrate mode when power is restored.

**Slide Valve Actuator Troubleshooting next 2 pages.**
Slide Valve Actuator Troubleshooting Guide

The actuator cannot be calibrated

- Dirt or debris is blocking one or both optocoupler slots
  - Clean the optocoupler slots with a Q-Tip and rubbing alcohol.
- The photochopper fence extends less than about half way into the optocoupler slots
  - Adjust the photochopper so that the fence extends further into the optocoupler slots. Make sure the motor brake operates freely and the photochopper will not contact the optocouplers when the shaft is pressed down.
- The white calibrate wire in the grey Turck cable is grounded
  - Tape the end of the white wire in the panel and make sure that it cannot touch metal.
- Dirt and/or condensation on the position sensor boards are causing it to malfunction
  - Clean the boards with an electronics cleaner or compressed air.
- The calibrate button is stuck down
  - Try to free the stuck button.
- The position sensor has failed
  - Replace the actuator.
- Push button is being held down for more than ¾ second when going through the calibration procedure
  - Tape the end of the white wire in the panel and make sure that it cannot touch metal.
  - Depress the button quickly and then let go. Each ¾ second the button is held down counts as another press.
  - Increase the distance between the EMI source and the actuator.
  - Install additional metal shielding material between the EMI source and the actuator or cable.
  - Replace the actuator.
- The motor brake is not working properly (see theory section above.)
  - Replace the actuator.

The actuator goes into calibration mode spontaneously

- The white calibrate wire in the grey Turck cable is grounding intermittently
  - Increase the distance between the EMI source and the actuator.
- A very strong source of electromagnetic interference (EMI), such as a contactor, is in the vicinity of the actuator or grey cable
  - Install additional metal shielding material between the EMI source and the actuator or cable.
- There is an intermittent failure of the position sensor
  - Get the motor brake to where it operates freely and recalibrate.

The actuator goes into calibration mode every time power is restored after a power loss

- The motor brake is not working properly (see theory section above.)
  - Replace the actuator.
## Slide Valve Actuator Troubleshooting Guide

### The actuator does not transmit the correct position after a power loss
- The motor was manually moved while the position sensor was not powered. **Recalibrate.**
- The motor brake is not working properly. **Get the motor brake to where it operates freely and then recalibrate.**
- The position sensor’s EEPROM memory has failed. **Replace the actuator.**

### There is a rapid clicking noise when the motor is operating
- The photochopper is misaligned with the slotted optocouplers. **Try to realign or replace the actuator.**
- The photochopper is positioned too low on the motor shaft. **Adjust the photochopper so that the fence extends further into the optocoupler slots.**
- A motor bearing has failed. **Replace the actuator.**

### The motor operates in one direction only
- There is a loose connection in the screw terminal blocks. **Tighten.**
- There is a loose or dirty connection in the yellow Turck cable. **Clean and tighten.**
- The position sensor has failed. **Replace the actuator.**
- There is a broken motor lead or winding. **Replace the actuator.**

### The motor will not move in either direction
- The thermal switch has tripped because the motor is overheated. **The motor will resume operation when it cools. This could be caused by a malfunctioning control panel. Consult the factory.**
- Any of the reasons listed in “The motor operates in one direction only.” **See above.**
- The command shaft is jammed. **Free the command shaft.**
- Broken gears in the gearmotor. **Replace the actuator.**

### The motor runs intermittently, several minutes on, several minutes off
- Motor is overheating and the thermal switch is tripping. **This could be caused by a malfunctioning control panel. Consult the factory.**
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 all pressure and temperature readings.
2. Check oil pressures for excessive pressure drop. Clean filter when pressure drop exceeds 10 psi. For proper procedure to change the oil filter and charge oil into the system. (See Operation Section).
3. Check compressor sound for abnormal noises.
4. Check shaft seals for excessive oil leakage. A small amount of oil leakage (approximately 10 drops/min) is normal. This allows lubrication of the seal faces.

Note: Clean the system strainers each time the oil line filter element is cleaned.

B. Weekly

(Items 1 thru 4 above plus 5 thru 7)

5. Check oil levels with unit off and liquid removed from separator.

6. Check oil pressure and review microprocessor logs and log sheets.
7. Check refrigerant levels in vessels.

C. Monthly

(Items 1 thru 7 above plus 8 thru 10)

8. Lubricate all motors and bearings. Follow manufacturer’s instructions on lubrication.
9. Check calibration and operation of all controls, particularly safety controls.
10. Operate compressor capacity and volume ratio controls through their range both automatically and manually. (Recalibrate if necessary).

D. Trimonthly

(About 2000 operating hours)

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

E. Yearly

(Items 1 thru 10 and “D” above plus 11 thru 19)

11. Check entire system thoroughly for leaks.
12. Remove all rust from equipment, clean and paint.
13. Clean all oil strainers.
15. Check motors and fans for shaft wear and end play.
16. Check operation and general condition of Microcontroller and other electrical controls.
17. Drain and clean entire oil system through the separator drain. Recharge with new clean moisture free oil. For proper procedure for changing the strainer element and charging oil into the system, see Start-Up and Operation section.
18. Check the calibration of the microprocessor pressure transducers and RTD’s for accuracy.
19. Check mounting bolts for compressor and motor.

F. System Leaks

There are any number of reasons why leaks develop in a refrigeration system (i.e. 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 over-emphasized. 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.
4. 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.
The following service intervals are based on the usage of Vilter Manufacturing Corporation Premium Grade refrigeration oil in VSM Single Screw Cool Compression Compressor units.

<table>
<thead>
<tr>
<th>Group</th>
<th>Inspection/Maintenance Item</th>
<th>SERVICE INTERVAL (HOURS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>25 (4) 50 200 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</td>
</tr>
<tr>
<td></td>
<td>OIL CIRCUIT</td>
<td>R R R R R R R R R R R R</td>
</tr>
<tr>
<td></td>
<td>Oil Change (1)</td>
<td>R R R R R R R R R R R R</td>
</tr>
<tr>
<td></td>
<td>Oil Analysis (2)</td>
<td>R R R R R R R R R R R R</td>
</tr>
<tr>
<td></td>
<td>Oil Filters (3)</td>
<td>R C R C R C R C R C R C R</td>
</tr>
<tr>
<td></td>
<td>Oil Strainer</td>
<td>R C R C R C R C R C R C R</td>
</tr>
<tr>
<td></td>
<td>Suction Screen</td>
<td>R C R C R C R C R C R C R</td>
</tr>
<tr>
<td></td>
<td>Liquid Line Strainers</td>
<td>R C R C R C R C R C R C R</td>
</tr>
<tr>
<td></td>
<td>Coupling Alignment and Integrity</td>
<td>R C R C R C R C R C R C R</td>
</tr>
<tr>
<td></td>
<td>CONTROL CALIBRATION</td>
<td>I I I I I I I I I I I I</td>
</tr>
<tr>
<td></td>
<td>Transducers</td>
<td>I I I I I I I I I I I I</td>
</tr>
<tr>
<td></td>
<td>RTD's</td>
<td>I I I I I I I I I I I I</td>
</tr>
<tr>
<td></td>
<td>Inspect Compressor</td>
<td>I I I I I I I I I I I I</td>
</tr>
<tr>
<td></td>
<td>Bearings</td>
<td>I I I I I I I I I I I I</td>
</tr>
</tbody>
</table>

Key
- I Inspect.
- C Clean
- 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 20 psi or oil analysis requires it.
4. Initially the oil charge on existing system may need to be changed after 25 hours dependent on the amount of contaminates in the system.
UNIT DESCRIPTION

Description of Operation

The Cool Compression operation is similar to the standard single screw packages, except that there is no external cooler to the unit. A blanket of liquid ammonia lies on top of the oil. The cooling occurs through the entire compression and separation process. The compressor package is greatly simplified whereas there is no oil pump. Instead, the Cool Compression compressors utilize Suction Oil Injection for start-up. The following sections describe the start-up and operation of a Cool Compression unit and refer to the figure above.
Start Up

When the Cool Compression unit is initiated for start-up, Micro-controller returns the slide valves to their minimum positions. The suction oil injection solenoid (SV-2) is actuated. The compressor (C100) now starts. There is an initial pressure drop in the suction chamber of the compressor and a corresponding increase in pressure on the discharge of the compressor. This creates a pressure differential that forces the oil and liquid ammonia mixture through the suction oil injection line into the suction chamber of the compressor. This oil and liquid provides lubrication and cooling until full pressure differential lubrication is attained.

As the differential pressure increases, the oil and liquid ammonia is now injected into the screw during the compression process and the (SV2) will close.

Gas Flow

The low-pressure refrigerant enters the compressor through a combination stop/check valve and suction tee, into the suction of the compressor. The upstream pressure is measured by Pressure Transducer (PT1). The temperature of the refrigerant is measured by resistance temperature detector (RTD1). The refrigerant gas flows into the compressor where a mixture of oil and liquid refrigerant is added to the gas through the compression process. The compressed gas entrained with liquid ammonia and oil droplets discharges the compressor. The discharge pressure and temperature are monitored by pressure transducer (PT2) and resistance temperature detector (RTD2). The mixture discharges into the separator where the ammonia and oil droplets are separated from the gas. The high-pressure gas discharges from the separator, through the discharge flange on the end of the separator.

Liquid Ammonia Supply

High-pressure liquid Ammonia is supplied to the compressor package by the main liquid supply line. Provisions must be made to allow an adequate liquid supply to provide a source of liquid for cooling the compressor, while the compressor is running at operating conditions. The liquid supply line is connected to the in-line strainer to ensure that no debris enters the solenoid (SV1) and level master control valves located downstream of the strainer. The solenoid valve (SV1), is open during start-up and operation to allow the high pressure liquid ammonia to be fed to the Level Master Control Valve. The Level Master Control valve controls the amount of liquid refrigerant entering the compressor based on level of the liquid refrigerant in the separator.

The Level Master Control sensing bulb and heater are installed in the end of the separator. The sensing bulb monitors the height of ammonia in the separator. If the ammonia level in the separator is low, the sensing bulb is heated by the heater H2, which opens the Level Master Control Valve. When the liquid level is high in the separator, the heater H2 cannot heat the sensing bulb and the Level Master Control Valve will close until the liquid level drops in the separator. The outlet of the Level Master Control is connected and allows liquid to be injected into the compressor. Depending on the operating conditions and model of the compressor, the liquid injection could be through either SV3 and or SV4.

Separation

The mixture of compressed gas, liquid ammonia and oil droplets is discharged from the compressor into the separator. As the mixture moves through the separator, the oil and liquid refrigerant droplets separate out and fall to the bottom of the separator. A liquid blanket of ammonia, of approximately 2 inches in depth, remains on top of the oil within the separator.

The last stage of oil separation is completed with a wire mesh element. This element does not require maintenance and is not a serviceable item. A drain line from the final stage of separation is attached to the discharge end of the separator. A sight glass and adjustment valve is provided to visually and physically monitor the flow. The drain line is connected to
the compressor to allow reinjection of the oil/ammonia mixture.

The dry compressed gas is discharged from the separator at 0º to 2º above the saturated discharge temperature. The oil temperature in the separator is monitored by RTD3.

**Liquid and Oil Level Monitoring**

The level of oil within the separator is monitored by a float mounted within the separator, (LSL3). If the level of oil falls below that level of (LSL3), an alarm is displayed on the Vision/Vantage. When the level returns to a normal level above (LSL3), the alarm will automatically be rest.

Should the level remain below (LSL3) for an extended period of time, the compressor will eventually fail on a LO OIL Level failure.

If the ammonia level within the separator is too high, the Liquid Switch (LSH1) will open. If the liquid switch remains open for an extended period, the compressor will eventually fail on HI LIQ Ammonia Level failure. The compressor failure can not be rest until the HI LIQ Ammonia Level returns to normal operating level. In the case that an excess amount of liquid ammonia is injected into the separator, the separator will also automatically carry the liquid in droplet form out of the separator and into the system.

Note: The Liquid Switch (LSH1) has been removed on the new models. (After August 2004)

There are two or three (depending on the size of the separator) sight glasses in the end of the separator. True oil level will only be seen while the unit is shutdown and all liquid is removed from separator. During operation, a mixture of oil and liquid ammonia will be viewed in the bottom sight glass. The Vision/Vantage will monitor for low oil level during operation of the unit.

The Vision/Vantage monitors the compressor while operating. During start-up, the initial superheat may be high. As long as the superheat continues to decrease, indicating that there is liquid ammonia being added to the separator the unit will continue to operate and load.

If the superheat on the discharge of the compressor during normal operation reaches 5º F, this signifies there is not enough liquid ammonia being fed to the system. Solenoid SV3 (see note below) will then open allowing an increased amount of liquid ammonia to be injected into the compressor system. If the superheat reaches 8º F, the unit begins to unload. If the superheat continues to increase and reaches 20ºF, the unit will activate an alarm. At 25ºF, the unit will shutdown.

Note: The solenoid (SV3) has been removed on the new models. (After August 2004)

**Compressor Lubrication and Cooling**

While the unit is running a mixture of oil and liquid ammonia is injected into the compressor during the compression process. This mixture not only supplies the necessary lubrication, but it cools the internal components during the entire compression process. The mixture is injected from the separator, through a strainer and Flow Switch FS1 to assure liquid flow, into the bottom of the compressor. The connection for Suction Oil Injection is also branched off this line supplying liquid to the suction of the compressor for startup.

**Compressor Shut Down**

When the CC compressor unit shuts down, the CC unit compressor unit has been designed to remain at discharge pressure and not bleed down to suction. This will allow the liquid blanket to remain within the separator under normal circumstances.

**OIL SYSTEM**

**Checking The Oil Level**

The oil level must be checked with the unit off for at least 30 minutes and without any liquid ammonia inside of the separator. During normal operation, one will observe the liquid ammonia mixture in the bottom sight glass, not the actual oil level.

To remove the liquid from the separator, manually close off the liquid supply line to the compressor while
running. The liquid ammonia level will slowly drop and the superheat will increase. The compressor will automatically unload and once the superheat reaches 25ºF, will shutdown. The user can now visually observe the level of oil in the sight glass. The normal operating level of the oil is observed in the lower sight glass on all CC units.

**Separator Oil Level**

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Initial filling of separator</th>
</tr>
</thead>
<tbody>
<tr>
<td>12”</td>
<td>1/3 of bottom sight glass</td>
</tr>
<tr>
<td>16”</td>
<td>1/2 of bottom sight glass</td>
</tr>
<tr>
<td>16” w/3 sight glasses</td>
<td>1/3 of the middle sight glass</td>
</tr>
<tr>
<td>20”</td>
<td>1/3 of bottom sight glass</td>
</tr>
</tbody>
</table>

**Please Note:** that during the initial oil fill prior to starting the unit for the first time, the oil level will be slightly higher. Checking the oil level after a few hours, some of the oil will remain in the compressor on shutdown thus reducing the height of the oil in the separator.

**Adding Oil**

The unit must be shutdown and should have the liquid ammonia removed prior to adding oil.

During shut down, the unit will be at discharge pressure. If this pressure is too high, causing an issue regarding the addition of oil, the pressure should be bled down to suction-SLOWLY.

**Note:** If you bled the separator to suction pressure too fast you might carry oil with it.

Use the valve at the bottom of the separator to connect the line to add oil. Start to add the oil and monitor the level as you are adding.

**Note:** If the oil level is below the normal operating level, fill to the initial filling level of the separator. (See: Separator Oil Level Table)

**CAUTION**

If the unit is equipped with a heater in the separator, it is imperative you charge the oil into the separator prior to energizing the control panel to prevent burning out the immersion heater.

During the operation of the compressor the oil level may not show in the bottom sight glass. This is normal during operation. The package is equipped with high and low oil level safeties to prevent the unit from operating with too high or low of an oil level. The oil level should be checked with the unit off; the oil level should be half way up the bottom sight glass.
Operating Instructions

CHANGING AND CLEANING FILTER

See page 61 for instructions on changing oil and filters.

Oil Filter Element

The earlier style dual filter (Figure “B”) design allows for operation of either filter independently. This will allow changing/cleaning of the filters without shutting down the compressor by closing the appropriate valves.

Figure “A” is the current version of the dual filter assembly, which incorporates a selector level to choose either or both filters for use. Figure “B” is the earlier style filter assembly that utilized two single filters assembled back to back.

When servicing any of these filters, isolate the assembly. Be sure to “Vent” the filter tank then drain the oil from the canister using the drain plug on the bottom of the assembly. Remove the tank and element, use all appropriate refrigeration handling and ventilation procedures. In order to isolate (Figure “A”) either filter, you must turn handle either CW to close the left side filter and CCW to close the right side filter. Note: the pin must be properly seated in the hole. Although the selector lever on the current (Figure “A”) filter assembly can isolate one filter for service, if an o-ring leak occurs on the valve, the system may need to have all liquid removed for service/cleaning of filter. The o-rings on the lever should be changed, if this occurs.

In order to isolate (Figure “B”) you must close both inlet and outlet valves for that filter by turning the handles CW.

Clean the oil filter element as needed during the first 25 hours, depending on the cleanliness of the system and after the first 50 and 200 hours of operation. This is noted on the microprocessor hour meter. Thereafter, clean the filter every three months or when the oil pressure drops (see: Vision/ Vantage Manual set point section), whichever occurs first.

Remove the filter element from the tank. Clean it thoroughly with “brake cleaning” fluid or similar. Before reassembling, clean the tank to lengthen the
life span of the element. Strainer element end caps, and attached gaskets and springs can be re-used (with new strainer canister gasket).

Replace canister gasket before reassembling strainer tank. Place end caps on strainer element and place inside tank with spring side to bottom of tank. Refill the tank about 3/4 full of oil, attach it to the head and tighten the (4) bolts.

Liquid Injection Oil Cooling

The units are furnished with liquid injection for a typical system. The liquid solenoid valve opens whenever the compressor is in operation. The level master expansion valve controls the flow of liquid refrigerant to the compressor injection port in response to the liquid level in the separator. The discharge temperature is always maintained at saturation. If the discharge is superheated, refer to the Troubleshooting Section.

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 re-calibrate the pressure transducers. To use the block and bleed valves to re-calibrate the pressure transducers, the block valve is shut off at the unit and the pressure is allowed to bleed off by opening the bleed plug 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 plug.

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 transducer periodically for any drift of calibration.

Screw Compressor Control
And Operation

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 heater of the expansion valve bulb will be energized and heated for 30 seconds before the compressor is allowed to start.

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

Stopping the compressor unit can be accomplished a number of ways. Any of the safety set points will stop the compressor unit if abnormal operating conditions exists. The compressor unit “On-Off” or stop button will turn the compressor unit off as will the low pressure set point. If any of these conditions turns the compressor unit off, the slide valve motors will immediately energize to drive the slide valves back to 10% limit.

The control motors will be de-energized when the respective slide valve moves back below 10%. 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 valves must return below their respective 10% limits before the compressor unit can be restarted.

Slide Valve Control

Capacity and volume ratio control of the screw compressor is achieved by movement of the respective slide valves, actuated by electric motors.
## Operating Instructions

<table>
<thead>
<tr>
<th>Compressor Model Number</th>
<th>Command Shaft Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacity</td>
</tr>
<tr>
<td></td>
<td>INC</td>
</tr>
<tr>
<td>VSM 201</td>
<td>CW</td>
</tr>
<tr>
<td>VSM 301</td>
<td>CW</td>
</tr>
<tr>
<td>VSM 361</td>
<td>CW</td>
</tr>
<tr>
<td>VSM 401</td>
<td>CW</td>
</tr>
<tr>
<td>VSM 501</td>
<td>CCW</td>
</tr>
<tr>
<td>VSM 601</td>
<td>CCW</td>
</tr>
<tr>
<td>VSM 701</td>
<td>CCW</td>
</tr>
</tbody>
</table>

### Actuator Location

When viewing the compressor from the discharge end (opposite of the drive end) – on VSM 201-401 capacity, is upper right and volume is lower left. On the VSM 501-701, capacity is upper left and volume is lower right. The table for command shaft rotation (above) indicates the direction of command shaft rotation required to increase or decrease the capacity or volume ratio. The range of capacity adjustment is from 10% to 100%, the range of volume ratio adjustment is from 2.0 to 7.0.

Actuation of the electric motors can be done automatically by the micro-controller or they can be manually actuated through pop-up buttons on the touch screen display when the micro-controller is put into the manual mode.

In the automatic mode, the micro-controller determines the direction that the motors will move in response to system conditions. In addition, there are on and off settings for the capacity motor that controls the increase and decrease cycles for the motor. This is done to prevent the control from overshooting and allow the system to stabilize between slide valve changes.

The Motor Amps Load Limit protects the compressor from overloading by decreasing the compressor capacity if the motor amperage is above the Full Load Amps set point. (See appropriate Vission/Vantage Operating Manual.)

### Oil Separator Heater

The oil separator heater keeps the oil in the separator from becoming too viscous. The heater is turned on only when the compressor is off. The separator heater is supplied with an integral temperature control.

### Econ-O-Mizer Controls

Econ-O-Mizer systems are of three types: direct expansion, flooded or flash. Flash systems include a back pressure regulator to control intermediate pressure. When a direct expansion system is used, a solenoid valve and thermostatic expansion valve are furnished to control the degree of subcooling. If a flooded subcooler system or flash system is supplied, it is equipped with a liquid solenoid valve and a float switch to control the liquid level in the vessel.
SAFETY SETPOINTS

A detailed explanation of all safety setpoints can be found in the Vission / Vantage Instruction Manual for the following:

Discharge Pressure

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

Suction Pressure

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

Oil Filter Differential Pressure

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

Oil Temperature

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

Discharge Temperature Superheat

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

See section Oil Instructions for instructions on adding oil to unit.

High Liquid Level

High liquid level alarm goes on when the liquid ammonia level in the separator is too high.

SETTING OF CONTROLS

Refer to the Vission / Vantage 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 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.

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

4. Open the oil return valve from oil separator 3/4 turn.
Initial Start Up

COMPRESSOR PRE START-UP CHECK LISTS

Before proceeding with the actual starting of the compressor, the items listed on the “Pre Start-Up Check Lists (next 2 pages) must be verified. Time and money will be saved if the items on the pre start-up check lists are completed before the Vilter Technician arrives.
Pre Start-Up Check List
Field Piping and Mechanical Requirements
(Cool Compression)

Note: If start-up service has been purchased to save time and money the following items should be completed before the start-up person arrives.

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 (if used) 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 that the Stop/Check valve be located to minimize the quantity of liquid that can accumulate downstream of the valve.

4. **The Discharge and Suction Stop/Check valve must be set to the automatic position. Failure to do so could damage the compressor during the stop.** (Reverse rotation)

5. Piping for oil cooling:

   A properly sized high-pressure liquid source (preferably a dedicated line) must be piped to the stop valve at the inlet of the thermostatic expansion valve.

6. Initial Oil Charge:

   - 12” Separator – 7 gallons – ½ bottom sight glass
   - 16” Separator (short 68”)– 9 gallons – 1/2 bottom sight glass*
   - 16” Separator (long 86”)–10.5 gallons –1/2 bottom sight glass*
   *
   * note: when using three sight glasses the oil level should be 1/3 of middle glass
   - 20” Separator 12.5 gallons – 1/3 bottom sight glass

7. Before installing the center member, the motor directional rotation should be checked. Then, verify the motor hub is properly spaced to accommodate the center member.

8. The unit should be pressure tested. **Care should be taken to not pressurize excessively from the suction end of the compressor, as this will drive the compressor in a forward motion without lubrication and may cause damage.**

9. Proper ammonia refrigerant charge should be in the system. Necessary equipment for installation of any additional refrigerant should be present at the job-site prior to the startup person’s arrival. In addition, any refrigerant handling equipment necessary to comply with local ordinances should also be at the job-site.

10. **Have a qualified electrician present to verify wiring during startup.**

11. A system load should be available at the time of the startup.

12. Liquid Ammonia Supply (see Liquid Supply Section of manual).
Pre Start-Up Check List
Field Wiring Requirements
(Cool Compression)

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

Note: Units with factory-wired microprocessor. The necessary field wiring is listed as below.

Vission
_____ 1. Control power of 115 VAC 50/60 HZ must be wired to the connector. L1 is brought to connector 5, terminal 1 and L2 is brought to connector 5, terminal 5. The fuses are part of the relay board. The neutral can be connected to any of the “N’s” located on the board.

Vission
_____ 2. A dry contact from control relay K-22 must be wired to the compressor motor coil. This dry contact is wired to connector 7, terminal 1 and connector 7, terminal 2. Control power for this coil should come from a source that will be de-energized with the compressor disconnect.

Vission
_____ 3. A dry contact from control relay K-19 must be wired to the suction oil injection solenoid. This dry contact is wired to connector 6, terminal 1 and connector 6, terminal 2. Control power for this coil should come from a source that will be de-energized with the compressor disconnect.

Vission
_____ 4. An auxiliary safety cutout is available to shut down the compressor package. A dry contact must be supplied and wired to L and connector 1, terminal 2. The jumper on the terminal strip between L and connector 1, terminal 2 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.

Vantage
_____ 1. Control power of 115 VAC 50/60 HZ must be wired to the connector. L1 is brought to connector 8, terminal 8 and L2 is brought to connector 8, terminal 8. The fuses are part of the combo board. The neutral can be connected to any of the “N’s” located on the board.

Vantage
_____ 2. A dry contact from control relay K-3 must be wired to the compressor motor coil. This dry contact is wired to connector 9, terminal 2 and connector 9, terminal 3. Control power for this coil should come from a source that will be de-energized with the compressor disconnect.

Vantage
_____ 3. A dry contact from control relay K-5 must be wired to the suction oil injection solenoid. This dry contact is wired to connector 8, terminal 1 and connector 8, terminal 1 and connector 8, terminal 2. Control power for this coil should come from a source that will be de-energized with the compressor disconnect.

Vantage
_____ 4. An auxiliary safety cutout is available to shut down the compressor package. A dry contact must be supplied and wired to L and connector 12, terminal 2. The jumper on the terminal strip between L and connector 12 terminal 2 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.

Note: Vission has separate alarm and trip contact, Vantage has a combined trip and alarm contact.

Vission and Vantage
_____ 5. Indication of the compressors’ alarm or shutdown status is also available. To monitor the alarm status, wire to the alarm relay on the board. It will have a 0 VAC potential when the compressor is operating normally, and go to 115 VAC when in an alarm condition. To monitor the shutdown status, wire to trip relay on board. It will have a 0 VAC potential when the compressor is operating normally, and go to 115 VAC when in a shutdown condition.

Vission and Vantage
_____ 6. The current transformer supplied in the compressor motor conduit box should be checked to insure the motor leads of one leg are pulled through the transformer. However, this should always be checked as different motors and starting methods will require different leads to be used.
GENERAL COMMENTS

When working on the compressor, care must be taken to ensure that contaminants (i.e. water from melting ice, dirt and dust) do not enter the compressor while it is being serviced. It is essential that all dust, oil or ice that has accumulated on the outside of the compressor be removed before servicing the compressor.

When servicing the compressor, all gaskets, O-rings, roll pins and lock washers must be replaced when reassembling the compressor.

PREPARATION OF UNIT FOR SERVICING

A) On Cool Compression units, while the unit is running, close the main liquid ammonia line (located before the thermostatic expansion valve) and wait for the unit to stop by itself. This operation will remove all the liquid ammonia from the separator. The compressor will stop when the superheat at discharge reaches 25°F.

B) Shut down the unit, open the electrical disconnect switch and pull the fuses for the compressor motor to prevent the unit from starting. Put a lock on the disconnect switch and tag the switch to indicate that maintenance is being performed.

C) Isolate the unit by manually closing the discharge Stop/Check valve. If the unit is equipped with a V-PLUS® or liquid injection cooling system, close the liquid supply valves and open all solenoid valves to prevent liquid refrigerant from being trapped between the stop valves and solenoid valves. Allow the unit to equalize to suction pressure before closing the Suction Bypass or Stop/Check valve. After the unit has equalized to suction pressure and suction valves closed. Use an acceptable means to depressurize the unit that complies with all Local, State and Federal Ordinances.

D) Remove drain plugs from the bottom of compressor housing and the discharge manifold. On units equipped with Suction Oil Injection (SOI) manually open the SOI solenoid valve below the compressor. Drain the oil into appropriate containers.

REMOVAL OF COMPRESSOR FROM THE UNIT

After Preparing the unit for service the following steps should be followed when removing the compressor from the unit:

A) Disconnect the motor drive coupling from the compressor input shaft.

B) Disconnect all gas and oil piping which is attached to the compressor. When removing the suction strainer on VSM units, the suction line should be supported to prevent it from sagging.

C) Replace oil drain plug in compressor housing and discharge manifold after oil has stopped draining.

D) Remove all electrical connections to the compressor.

All Oil must be removed from unit.
On VSM with C-flange the motor/C-flange/compressor assembly must be supported with a chain fall or other lifting device, before the bolts holding the compressor to the C-flange adapter can be removed.

F) Install appropriate lifting eye into a threaded hole on the top of the compressor.

Verify unit is properly secured to avoid compressor from falling. Re-verify all piping and electrical are properly disconnected prior to lifting unit.

G) Remove compressor from the unit, verify adequate amount of room needed for clearance and weight of the bare compressor when the compressor is removed from the unit.

INSTALLATION OF THE COMPRESSOR

A) After the work has been completed, reinstall the compressor on the base or C-flange adapter (dependent upon compressor model).

B) On VSM units, the compressor should be bolted onto the C-flange adapter and the coupling reinstalled.

C) Replace all electrical, gas, liquid and oil connections removed when servicing the compressor.

LEAK CHECKING UNIT

Note: Unit must be leak checked before evacuation.

CAUTION

Slowly pressurize the unit 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.

A) Use a vacuum pump to evacuate the unit.

B) Break the vacuum on the unit using refrigerant or dry nitrogen and check for leaks. Concentrate on areas where work was done.

C) If no leaks are found, the unit can be returned to service if refrigerant was used for the leak detection gas.

If dry nitrogen was used for the leak detection gas, the nitrogen must be purged from the unit and step A and B should be repeated, this time breaking the vacuum with refrigerant. The unit may now be returned to service.
ANNUAL INSPECTION

The Vilter Single Screw Compressor is designed for long periods of trouble free operation with a minimum of maintenance. However, a yearly inspection is recommended so any irregular wear is noted and rectified. At this time, the bearing float is measured for the main rotor and gate rotors.

The following are the procedures used in measuring the main rotor and gate rotor bearing float.

**CAUTION**

When taking the measurements, do not exceed 300 to 500 Lbs. of force at point of contact or damage may result to the bearings.

A) Shut down and de-pressurize the unit, as outlined in section 0.01.

B) Main rotor bearing float.

1) Remove the coupling guard, then remove the center member from the coupling.

2) Attach a dial indicator to the compressor frame as shown and zero indicator. Place a lever arm and fulcrum behind the compressor coupling half and push the coupling towards the motor (note measurement).

C) Gate rotor bearing float.

3) Re-Zero indicator, now position the fulcrum on the motor and use the lever arm to push the input shaft towards the compressor (note measurement).

4) Add both readings, the total indicator movement is the bearing float and this should not exceed 0.003”.

**TABLE 0.1 MAXIMUM BEARING FLOAT**

<table>
<thead>
<tr>
<th>Bearing Float</th>
<th>MAIN</th>
<th>GATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Force</td>
<td>300-500</td>
<td>200-300</td>
</tr>
<tr>
<td>Lbs.</td>
<td>Lbs.</td>
<td></td>
</tr>
</tbody>
</table>

- 0.003”
- 0.002”
C) Gate rotor bearing float.

1) Remove the side covers (see: Gaterotor Removal Section) and position a dial indicator on the gate rotor.
2) Use a lever arm pivoting on a bolt with a small block of wood against the gate rotor blade to protect the blade.
3) The maximum amount of bearing float should not exceed 0.002”.

D) Measure the gate rotor to blade float. Some movement between blade and support is necessary to prevent damage to the compressor blade, however at no time should the blade uncover the support.

1) Position the blade with the gate rotor damper pin and 90º to the main rotor.
2) Position a dial indicator at the tip of the support. The total movement of the damper pin in the bushing is the gate rotor float. Refer to table 0.2 to find the maximum blade to support float (on new compressor parts).

**TABLE 0.2. GATE ROTOR FLOAT**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>FLOAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSM 71 THRU 401</td>
<td>0.045”</td>
</tr>
<tr>
<td>VSM 501 THRU 701</td>
<td>0.045”</td>
</tr>
</tbody>
</table>

E) Readings could be higher than 0.2. If readings is greater than 0.30 on table contact Vilter’s home office.

F) Inspect the main and gate rotors for signs of abnormal wear due to dirt or other contaminants from the system.

G) After the inspection is complete, the covers, coupling center member and guard can be reinstalled and the unit can then be evacuated and leak checked before starting.

A) Nord-Lock® lock washer sets are used in many areas on the Single Screw Compressor that requires a vibration proof lock washer.

B) The lock washer set is assembled so the course serrations that resemble ramps are mated together.

C) Once the lock washer set is tightened down, it takes more force to loosen the bolt then it did to tighten it. This is caused by the washers riding up the opposing serrations.
GATE ROTOR ASSEMBLY

GATE ROTOR REMOVAL

Note: The thrust bearing outer races are not secured in a stationary bearing housing on the compressors. On VSM compressors the thrust bearings are located in the gate rotor support and rotate with the support when the compressor is in operation. The inner races are secured to the stationary bearing spindle.

A) Prepare the compressor for servicing as outlined in section: Preparation of Unit.

B) Remove the upper bolt from the side cover and install a guide stud in the hole. Remove the remaining bolts and side cover. There will be some oil drainage when the cover is removed.

C) The side cover that contains the suction strainer should have the suction line properly supported before the bolts securing the line to the cover can be removed. After the line is removed, the cover can be removed per paragraph B.

D) Turn the main rotor so the driving edge of the groove is between the top of the shelf or slightly below the back of the gate rotor support. At this point install the gate rotor stabilizing tool.

E) Remove plug on the thrust bearing housing. Loosen the socket head cap screw that is located underneath the plug. This secures the inner races of the thrust bearings to the spindle.

F) Remove bolts that hold the thrust bearing housing to the compressor. Insert two of the bolts into the threaded jacking holes to assist in removing the bearing housing from the compressor. When the housing is removed, there will be shims between the spindle and thrust bearings. These control the clearance between the shelf and gate rotor blades. These must be kept with their respective parts for that side of the compressor.

G) Remove the bolts from the roller bearing housing. After the bolts have been removed, the housing can be removed from the compressor.

H) To remove the gate rotor support tool, carefully move the support opposite the direction of rotation and tilt the roller bearing end towards the suction end of the compressor. The compressor input shaft may have to be turned to facilitate the removal of the gate rotor support. On dual gate versions, repeat the procedure for the remaining gate rotor support assembly.
GATE ROTOR INSTALLATION

A) Install the gate rotor support. Carefully tilt the roller bearing end of the gate rotor support towards the suction end of the compressor. The compressor input shaft may have to be rotated to facilitate the installation of the gate rotor support.

B) Install the roller bearing housing with a new O-ring. Tighten the bolts to the recommended torque value.

C) Install the spindle with shims, tighten the bolts to the recommended torque value, measure the clearance between the shelf and blade.

D) Check the clearance between the entire gate rotor blade and the shelf, rotate the gate rotor to find the tightest spot. It should be between 0.003”-0.004”. Make adjustments, if necessary. It is preferable to shim the gate rotor blade looser rather than tighter against the shelf.

E) Once the clearance is set remove the spindle. Install new o-ring, apply Loctite 242 thread locker to the socket head cap screw clamping the thrust bearings to the spindle. Torque all bolts to the recommended torque values.

F) Install side covers and or remove suction tee with new gaskets. Tighten bolts to the recommended torque value. The unit can now be evacuated and leak checked as outlined in section 0.03.

GATE ROTOR BLADE REMOVAL

A) Remove the gate rotor assembly. Refer to section: Gate Rotor Removal.

B) Remove the snap ring and washer from the gate rotor assembly. Lift gate rotor blade assembly off the gate rotor support.

C) Check damper pin and dampener bushing for excessive wear. Replace if necessary.
Service Section

GATE ROTOR BLADE REMOVAL

A) Install damper bushing (120) in gate rotor blade (111) from the back side of the blade. Be sure the bushing is fully seated.

B) Place the blade assembly on the gate rotor support. Locating damper over bushing pin.

C) Install washer (119) and snap ring (130) on gate rotor assembly. The bevel on the snap ring must face away from the gate rotor blade. After the gate rotor blade and support are assembled, there should be a small amount of rotational movement between the gate rotor and support.

D) For installation of the gate rotor assembly and setting of gate rotor clearance, refer to section 1.02.

GATE ROTOR THRUST BEARING REMOVAL

1) Remove retaining ring that holds thrust bearings in gate rotor support.

2) Remove bearings from support.

3) Remove bearing retainer from inner race.

GATE ROTOR THRUST BEARING INSTALLATION

1) Install retainer in the back of the inner race of one of the thrust bearings. The back of the inner race is the narrower of the two sides.

2) The bearing with the retainer should be placed in the housing first, retainer towards the support. Install the second bearing. The bearings should be positioned face to face. This means that the larger sides of the inner races are placed together. A light application of clean compressor lubricating oil should be used to ease the installation of the bearings into the gate rotor support.
3) Install the bearing retaining snap ring.

4) For installation of the bearing housing and the setting of the gate rotor blade clearance, refer to section: Gate Rotor Installation.

GATE ROTOR ROLLER BEARING REMOVAL

A) Refer to section: Removal of the Gate Rotor Bearing housings and gate rotor supports.

B) Remove the snap ring (131), which retains the roller bearing in the bearing housing.

C) Remove the roller bearing (125) from the bearing housing (112).

D) Use a bearing puller to remove the roller bearing race (125) from the gate rotor support (110).

GATE ROTOR ROLLER BEARING INSTALLATION

A) Match up the part numbers on the inner race to the part numbers outer race, first install shim (155) on support. Press the bearing race (numbers visible) onto the gate rotor support.

B) Install the outer bearing into the bearing housing so the numbers match the numbers on the inner race. Install the snap ring retainer in the housing. The bevel on the snap ring must face away from the roller bearing.

C) For installation of the bearing housing, refer to section Gate Rotor Installation.
INPUT SHAFT SEAL REPLACEMENT

On Vilter VSM compressors the type of seal utilized has a stationary carbon and a rotating mirror face.

INPUT SHAFT SEAL REMOVAL

A) Prepare the compressor for servicing as outlined in section 0.01.

B) Remove bolts (281) holding the shaft seal cover (218). Insert two of the bolts into the threaded jacking holes to assist in removing the cover. There will be a small amount of oil drainage as the cover is removed.

C) Remove the rotating portion of the shaft seal (219C) off shaft.

D) Remove oil seal (230) from cover.

E) Remove the carbon cartridge portion of the shaft seal (219B) from the seal cover using a brass drift and hammer to tap it out from the back side of the seal cover.

SHAFT SEAL INSTALLATION

A) Install new oil seal in clean cover.

CAUTION

Care must be taken when handling the shaft seal and mirror face so it is not damaged. Do not touch the carbon or mirror face as body oil and sweat will cause the mirror face to corrode.

B) To install the carbon cartridge part of the seal in
the seal cover; remove protective wrap from the carbon cartridge, do not wipe or touch the carbon face. Lubricate the sealing O-ring with clean compressor lubricating oil. Install cartridge using seal installation tool or similar.

C) Wipe clean, the compressor input shaft and the shaft seal cavity in the compressor housing. Apply clean compressor oil to the shaft seal seating area on input shaft.

D) Lubricate the inside area of the rotating seal with clean compressor lubricating oil, do not wipe or touch the face of the rotating portion of the seal. Align the slot in the rotating seal with the drive pin on the compressor input shaft. Carefully push the seal on, holding onto the outside area of the seal until the seal seats against the shoulder on the input shaft. Make sure the seal is seated against the shoulder. If the seal is not fully seated against the shoulder, the shaft seal carbon will be damaged when the seal cover is installed.

Maintenance Suggestion:
A spray bottle filled with clean compressor oil may be used to lubricate the faces of the seals without touching the seal.

E) Install a new O-ring on the seal cover, making sure the O-ring is placed in the proper O-ring groove and not the oil gallery groove. Lubricate both seal faces with clean compressor lubricating oil.

F) Carefully install the seal cover on the compressor shaft, evenly tightening the bolts to the recommended torque values.

G) Install the coupling and coupling guard. The unit can then be evacuated and leak checked, as outlined in section 0.03.

MAIN ROTOR ASSEMBLY

Due to the procedures and tools involved in the disassembly and reassembly, the main rotor assembly must be performed by qualified individuals. Please consult the factory if maintenance is required.
CAPACITY AND VARIABLE VOLUME RATIO CONTROL ASSEMBLY

A) The following instructions are applicable for most units equipped with optical gear motors built after 11-1-01.

B) On VSS units and dual gate VSM units, each pair of volume or capacity slide valves are mechanically connected and actuated to move as a balanced pair.

Note: Models VSM 501-701 capacity and volume motor location is opposite.

OPTICAL SLIDE VALVE ACTUATOR REMOVAL

A) Follow appropriate lock out tag out procedures to shut off the electricity to the microprocessor. Disconnect cables from actuator.

B) Remove the side covers from the bracket to gain access to the shaft collar.

C) Loosen shaft collar locking screw. Slide the collar onto the actuator shaft. Lightly tighten locking screw to hold it in place.

D) Remove the (4) #10 socket head cap screws holding the bracket to the base plate.

E) Remove slide valve actuator from the unit. Remove key from command shaft.
OPTICAL SLIDE VALVE
ACTUATOR INSTALLATION

A) Install the key in the command shaft keyway.

B) Slide the actuator assembly onto the command shaft. While aligning one of the two key slots in the actuator shaft with the key on the command shaft. Make sure that the collar remained on the actuator shaft. Due to the position of the slide valve in the compressor, use of the other key slot may be required to align the bracket holes with the threaded mounting plate holes.

C) Slide the collar until it is flush with the end of the actuator shaft. Check to make sure the key is fully inserted in the actuator shaft. The key should be flush with the end of the actuator shaft.

D) Tighten the shaft collar ¼" socket head cap screw to 16 ft/lbs. (192 in/lbs.). Failure to correctly torque the locking screw may result in a failure of the actuator.

E) Install the side covers to the bracket with hex washer head self tapping screws.
OPTICAL SLIDE ACTUATOR INSTALLATION

A) Remove the four self tapping screws that secure the side covers to the actuator bracket. This will allow access to the actuator shaft.

B) Install the key in the command shaft keyway.

C) Slide the actuator assembly on to the command shaft. Align one of the two key slots in the actuator shaft with the key on the command shaft. Make sure that the collar remained on the actuator shaft. Due to the position of the slide valve in the compressor, use of the other key slot may be required to align the bracket holes with the threaded mounting plate holes.

D) Slide the collar until it is flush with the end of the actuator shaft. Check to make sure the key is fully inserted in the actuator shaft. The key should be flush with the end of the actuator shaft.

E) Tighten the shaft collar ¼” socket head cap screw to 16 ft/lbs. (192 in/lbs.). Failure to correctly torque the locking screw may result in a failure of the actuator.

F) Install the side covers to the bracket with hex washer head self tapping screws.

G) Refer to the slide valve actuator calibration instructions in the Vission/Vantage manual or the instructions packed with actuators on calibration procedures.

COMMAND SHAFT ASSEMBLY REMOVAL

The following steps can be used to remove or install either the capacity or volume command shaft assemblies.

A) Prepare the compressor for servicing as outlined in section: Preparation of Unit for Service.

B) Follow the appropriate instructions to remove control actuator as outlined in sections: Capacity and Variable Ratio Control Assembly.

C) Remove four socket head cap screws (457) and Nord-Lock washers (477) securing mounting plate (415) to manifold.

D) The command shaft and mounting plate may now be removed from the compressor.

COMMAND SHAFT ASSEMBLY INSTALLATION

A) Install the command shaft assembly with a new o-ring (446) on the manifold. Make sure that the command shaft tongue is engaged in the cross shaft slot. Rotate the bearing housing so the vent holes point down, this will prevent water and dust from entering the vents.

B) Install the actuator mounting plate with the four socket head cap screws and Nord-Lock washers securing it with proper torque.
C) The unit can now be leak checked as outlined in section: Leak Check Unit.

**COMMAND SHAFT BEARING AND O-RING SEAL REPLACEMENT**

A) Remove command shaft assembly as outlined in section 4.05.

B) Remove snap ring retainer (451) from command shaft housing (412). Push the command shaft assembly out of the housing.

C) The command shaft bearing (435) is a press fit on the command shaft (413). Remove the command shaft bearing with a suitable press.

D) Remove the O-ring seal (445) from the command shaft housing. The command shaft bushing (433 and 436) might have to be removed to gain access to o-rings. Replace bushing if the bore is deeply scored or excessively worn, using bushing (VPN 25853B).

**COMMAND SHAFT BEARING AND O-RING SEAL REASSEMBLY**

A) Install new O-ring seal in housing and lubricate the O-ring with clean compressor oil. A vent hole is provided in the command shaft bearing housing to allow any refrigerant and oil that may leak past the O-ring seal to vent to atmosphere and not into the slide valve motor housing.

B) Remove any burrs from the command shaft to prevent damage to the O-ring when assembling. Install snap ring retainer and washer on the command shaft. Press the command shaft bearing onto the command shaft. Insert the command shaft into the housing applying pressure on outer race of bearing. Make sure the bearing is fully seated in the command shaft housing. Install the snap ring retainer (451) in the command shaft housing.

C) Install command shaft assembly as outlined in section: Optical Slide Actuator Installation.

**DISCHARGE MANIFOLD REMOVAL**

A) Remove both control actuators and command shaft assemblies as outlined in sections: Optical Actuator Removal and Command Shaft Removal.

Note: Manifold has dowel pins to locate it on the compressor housing. Therefore, remove manifold straight back approximately 1” as not to break dowel pins.
NOTE:
When removing the discharge manifold on VSM compressor the compressor must be properly supported to keep the compressor from moving when the manifold is removed.

B) On VSM compressors unbolt the discharge flange from the discharge manifold.

C) Remove one bolt from each side of the discharge manifold and install (2) guide rods approximately 6” long, to support the manifold. Remove the remaining bolts (note length and location of bolts) and take off the discharge manifold.

DISCHARGE MANIFOLD INSTALLATION

A) Install (2) guide rods to position the discharge manifold. Install a new manifold gasket and the discharge manifold. Align the dowel pins and bolts, tighten manifold bolts to the recommended torque value.

B) On VSM compressors install the bolts in the discharge flange. Install the drain plug in the bottom of the discharge manifold.

C) Install both command shaft assemblies and control actuators as outlined in sections; Optical Slide Valve Actuator Removal and Command Shaft Removal.

SLIDE VALVE GEAR AND RACK INSPECTION

A) Remove the discharge manifold as outlined in section: Discharge Manifold Removal.

B) Check rack to rack clamp and rack clamp spacer clearance on slide valves.

Note Models 501-701 DO NOT have Rack Clamps.

RACK CLEARANCE VALUES

<table>
<thead>
<tr>
<th>MEASUREMENT</th>
<th>CLEARANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack to clamp.</td>
<td>0.005 to 0.010”</td>
</tr>
<tr>
<td>Rack to clamp spacer.</td>
<td>0.003 to 0.005”</td>
</tr>
</tbody>
</table>

C) Check torque of socket heat cap screws.

D) Check for excessive movement between the slide valve rack shafts and the rack. The jam nuts on the end of the slide valve rack shaft should be tight.

E) Check for loose or broken roll pins in gears.

F) Look for any excessive wear on all moving parts and replace the worn parts.

G) Reassemble the manifold and discharge elbow as outlined in section: Discharge Manifold Installation.

REMOVAL OF CAPACITY OR VOLUME CROSS SHAFTS

A) Remove the discharge manifold as outlined in section: Discharge Manifold Removal.

B) To remove the capacity or volume ratio slide valve racks, remove the two jam nuts and lock washers (361) securing the rack (316) to the slide valve shafts. The racks can now be pulled off the slide valve shafts. Repeat the procedure for the remaining pair of slide valve racks.
C) To remove the cross shafts, remove socket head bolts, clamp and spacers from both sides.

D) Loosen either set-screws (297 or 298) to be able to remove roll-pins. Drive the roll pins from pinion gear from one side. Remove pinion gear. Slide the cross shaft with the remaining pinion gear or spacers out from the opposite side. Repeat the procedure for the remaining cross shaft.

VSM compressors cross shafts.

INSTALLATION OF CAPACITY OR VOLUME CROSS SHAFTS

A) To reassemble either set of capacity or volume ratio slide valve racks, install the cross shaft with the pinion gear onto the end plate, place the remaining pinion gear on the shaft and drive in the roll pins. Install clamps, spacers and bolts on both sides. Tighten the bolts to the recommended torque values.

B) The slide valve sets must be synchronized on dual gate VSM units. Both slide valve racks for either the volume ratio or capacity slide valves must engage the cross shaft gears at the same time. Push the slides all the way towards the suction end of the compressor until they stop. Engage matching slide racks with gears for either capacity or volume and install them completely on slide valve shafts. Install washers and jam nuts on the slide valve shafts. Repeat the procedure for the remaining set of slide valve racks.

C) Install (2) guide rods to position the discharge manifold. Install a new manifold gasket and the discharge manifold. Install the dowel pins and bolts, tighten manifold bolts to the recommended torque value.

D) Install the discharge as outlined in section: Slide Valve Gear and Rack Inspection.
## Trouble Shooting Guide

**Overheating / Discharge**  
**superheat too high.**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not enough liquid before the expansion valve.</td>
<td>Check the sight glass to see if this is full of liquid. If there is no or foamy liquid in sight glass check for proper liquid supply.</td>
</tr>
</tbody>
</table>
| Solenoid before the expansion valve will not open.                  | 1. Check if solenoid coil is energized. If there is voltage being supplied to the coil, replace solenoid coil.  
2. If there is no voltage being supplied to the coil, check output module of Microprocessor.  
3. Manually open solenoid to check for proper operation of solenoid. |
| Expansion valve is not supplying enough liquid.                     | Change the superheat adjustment of the valve by turning the superheat-adjusting stem on the valve. |
| Heater in the expansion valve bulb does not work.                   | Remove the heater from the bulb to check if it is warm. (Make sure to insert it back to the end of the bulb bore)  
Check the heater for continuity with Ohmmeter. If reading is infinite or shorted, replace coil. Heater resistance should be between 960 and 1000 ohms. |
| Heater in the expansion valve bulb in not inserted deep enough into the well. | Check the position of heater in well and readjust it accordingly. |
| Too much oil in the separator.                                      | See: Checking Oil Level Instructions                                                          |
| Oil injection strainer                                              | Remove and clean strainer, reinstall.                                                        |
| Liquid injection strainers dirty.                                  | Remove and clean expansion valve and liquid line strainers, reinstall.                       |
| Discharge temperature RTD off calibration.                          | Recalibrate discharge RTD.                                                                  |
| Main oil injection filter / strainer clogged.                       | When this filter is clogged, the compressor will overheat only when the liquid expansion valve is closed. As soon as the valve reopens the compressor will run normally. If you have this intermittent overheating problems stop the compressor immediately and clean the filter/strainer. |
Trouble Shooting Guide

**High liquid level.**
- Expansion valve not set up properly.
- Too much, oil in the separator.
- Liquid level too high at low ratio, waves in the separator are too high causing a false indication.

Adjust the superheat setting of the expansion valve to maintain proper liquid level.

The oil will cover the bulb and the expansion valve will stay open.

Reset the valve to drop the level (1/4") of liquid in the separator.

Check for proper operation of the expansion valve.

Observe the liquid flow in the sight glass before the expansion valve on the liquid line. If there is no apparent flow, rapidly close and open the hand service valve to check if the liquid is flowing to the compressor.

Adjust the expansion valve superheat setting to maintain proper liquid level.

**Low liquid level.**
- High superheat adjustment of the expansion valve.
- Heater malfunctioning.
- Liquid line strainer plugged.
- Expansion valve power head or sensor bulb faulty.

Adjust the superheat setting of the expansion valve to maintain proper liquid level.

Check resistance of heater. Heater resistance should be between 960 and 1000 ohms.

Liquid line strainer plugged.

Replace expansion valve power head assembly.

The running oil level is below the sight glass. Check oil level after unit has been shut down at least 30 minutes with the suction oil injection valve on. This allows the oil in the compressor to migrate back to the separator.

6 hours after displaying a low oil level alarm the unit will shut down, if no oil is added during this time

Low oil level alarm due to large volume of oil being supplied to compressor at start, alarm should end within a few minutes when the oil level stabilizes.

Excessive amounts of liquid will allow the separator to operate inefficiently. Lower liquid level by adjusting expansion valve superheat setting.

Foaming of liquid and oil in separator.

Foaming of liquid and oil in separator.

Large variations in discharge pressure will allow flashing of the liquid in the separator.

Adjust head pressure controls to maintain a more stable head pressure.

**Low oil level.**
- Checking oil while unit is running.
- Unit shuts down.
- Low oil level alarm at start.
- Too much liquid being supplied to separator.
- Foaming of liquid and oil in separator.

Checking oil while unit is running.

Unit shuts down.

Low oil level alarm at start.

Too much liquid being supplied to separator.

Foaming of liquid and oil in separator.

Replace expansion valve power head assembly.

The running oil level is below the sight glass. Check oil level after unit has been shut down at least 30 minutes with the suction oil injection valve on. This allows the oil in the compressor to migrate back to the separator.

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Foaming of liquid and oil in separator.

Large variations in discharge pressure will allow flashing of the liquid in the separator.

Adjust head pressure controls to maintain a more stable head pressure.
Trouble Shooting Guide

Low oil level (Continued).

- ¼” drain line from separator not open enough.
- Not enough oil in separator.

Depending on operating conditions, the line may need to be fully open.

Check for proper level in the separator.

Excessive oil foam.

Liquid line overheating to compressor.

- Not enough liquid being supplied to the separator.
- Loss of or low liquid supply from expansion valve
- Loss of or low liquid supply from expansion valve

1. Check if expansion valve is operating, observe the sight glass.
2. Check the adjustment of the expansion valve.
3. Check the heater.
4. Check the liquid line and expansion valve strainers.
5. Replace the expansion valve power head assembly.
6. Check if expansion valve is operating, observe the sight glass.
7. Check the adjustment of the expansion valve.
8. Check the heater.
9. Check the liquid line and expansion valve strainers.
10. Replace the expansion valve power head assembly.
INSTRUCTIONS FOR CHANGING FILTERS AND OIL IN 3150DX

INSTRUCTIONS:
1. TURN HANDLE(1) TO POINT TOWARDS FILTER THAT IS TO CONTINUE TO OPERATE (SEE FIG.1)
2. CLOSE VALVE(2)
3. RELEASE PRESSURE ON SIDE BEING CHANGED BY OPENING THE CORRESPONDING VALVE(3)
4. LOOSEN AND REMOVE BOLTS(×4) ON CANISTER OF FILTER TO BE CHANGED
5. REPLACE ELEMENT AND GASKETS
6. REFILL CANISTER WITH OIL
7. REATTACH THE CANISTER TO FILTER COVER AND TIGHTEN BOLTS(×4)
8. CLOSE VALVE(3)
9. OPEN VALVE(2)
10. REPEAT ON OTHER SIDE OR SET HANDLE(1) TO DESIRED RUNNING POSITION

FIG. 1
Dual Filter Valve Seal Replacement

INSTRUCTIONS – VALVE SEAL REPLACEMENT

Follow these step by step instructions when valve seal replacement becomes necessary. Warranty on the valve will be voided, if these instructions are not followed.

WARNING: DO NOT TWIST THE VALVE PLUG DURING REMOVAL OR INSTALLATION. THIS WILL CAUSE PERMANENT DAMAGE TO THE VALVE PLUG AND/OR VALVE BODY MACHINED SURFACES.

DISASSEMBLY:

1. Bring the handle to the center (down) position.
2. Clean the front and back of the valve assembly of all possible contaminants.

CAUTION: THE RETAINING RINGS ARE IN A HONED VALVE BODY AND REQUIRE SPECIAL CARE WHILE REMOVING. IMPROPER HANDLING COULD CAUSE PERMANENT DAMAGE TO THE VALVE BODY AND COULD VOID THE WARRANTY.

3. Remove front retaining ring and pull out the valve plug assembly. If required, lightly push or tap on the back at the center of the plug.

DO NOT twist the plug while removing (see above warning). Caution must be observed while removing the plug assembly to avoid losing the ball and spring they will become loose items.

4. Check for any damage to the valve plug and valve body. Do not attempt to repair any parts without consulting the factory. These parts are machined to close tolerances.

5. Remove the (seals) two O-Rings(1) from the plug and one O-Ring(2) from the valve bore rear.

CLEANLINESS:

Cleanliness is important for proper sealing and long seal life. Every precaution must be taken to insure that all parts are clean prior to assembly. Foreign particles, dirt, metal chips, etc. in the valve may cause leakage and can damage the seals, thus reducing their life.
# VSM Cool Compression Spare Parts List

<table>
<thead>
<tr>
<th>ITEM DESCRIPTION</th>
<th>Separator Size</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>12&quot;</td>
</tr>
<tr>
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<td>QTY</td>
</tr>
<tr>
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<tr>
<td>Pressure Transducer</td>
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<tr>
<td>Heater</td>
<td>1</td>
</tr>
<tr>
<td>RTD Transducer cordset</td>
<td>1</td>
</tr>
<tr>
<td>Oil Filter strainer basket</td>
<td></td>
</tr>
<tr>
<td>(20&quot; canister) inc’s all gaskets</td>
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</tr>
<tr>
<td><strong>Single Filter Assembly</strong></td>
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</tr>
<tr>
<td><strong>DUPLEX Canister Kit</strong></td>
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<tr>
<td>Oil Filter strainer basket assembly</td>
<td></td>
</tr>
<tr>
<td>with magnets for 20&quot; canister</td>
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</tr>
<tr>
<td>Filter Canister Gasket (Only)</td>
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<tr>
<td>Pleated Filter 10 micron</td>
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<tr>
<td>Pleater Filter 20 micron</td>
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<tr>
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<tr>
<td>208/230V</td>
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</tr>
<tr>
<td>Replacement solenoid coil - 115V</td>
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<tr>
<td>Replacement solenoid coil</td>
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<td>Suction Oil Strainer ¾” FPT</td>
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<td>High Liquid Level Switch</td>
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<tr>
<td>30 Ton</td>
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<td>50 Ton</td>
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<td>75 Ton</td>
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<td>100 Ton</td>
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<tr>
<td>LMC Heater Assembly 120 v/15watt</td>
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<tr>
<td>LMC Powerhead assy 20-100TR</td>
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<tr>
<td>20 Ton - Liquid Injection strainer</td>
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<td>30 Ton – 100 Ton</td>
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<td>Liquid Injection Solenoid 120V</td>
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<td>120V – Replacement Coil</td>
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<td>240V – Replacement Coil</td>
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<td>Oil, Vilter R717, 5 gal.</td>
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<tr>
<td>Oil, Vilter R717, 55 gal.</td>
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<tr>
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<tr>
<td>201 thru 401</td>
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<tr>
<td>Disch. manifold to Sep. flg. gskt.</td>
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<tr>
<td>501 thru 701</td>
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<tr>
<td>Suction Tee to Comp. gskt.</td>
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<tr>
<td>201 thru 401</td>
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</tr>
<tr>
<td>Suction Tee to Comp. gskt.</td>
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</tr>
<tr>
<td>501 thru 701</td>
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<tr>
<td>Economizer 1” flg. gasket</td>
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<tr>
<td>Economizer comp. flg. gskt.</td>
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Gate Rotor Assembly
Part totals indicated are for one gate rotor assembly, dual gate machines will require double the components.

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<td>GATE ROTOR &amp; DAMPER KIT.</td>
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<td>GATE ROTOR SUPPORT ASM. 120 and 111</td>
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<tr>
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<td>GATE ROTOR.</td>
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<td>SHIM 0.003&quot;.</td>
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<td>176</td>
<td>PIPE PLUG.</td>
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NOTE: * Not pictured

Replacement Parts
Gate Rotor Assembly
### Replacement Parts

#### Shaft Seal

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<thead>
<tr>
<th>ITEM</th>
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<th>ALL VSM 501 THROUGH 701</th>
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<td>VPN</td>
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<td>HEX HEAD CAP SCREW.</td>
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**NOTE**

* Not pictured.

Seal sold only as a kit. Cool Compression is ammonia only.
Replacement Parts
Actuating Motor with
Optical Sensor and Command Shaft

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<th>ITEM</th>
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<th>VSM 501 THROUGH 701</th>
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<td>VPN</td>
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Note: There are two slide valve actuators per compressor. One each for the control of the Volume Ratio and Capacity slide valves. If both actuators or parts are to be replaced double the quantities above.
Replacement Parts
Slide Valve Carriage Assembly

Volume Ratio Slide Valve Components

Capacity Slide Valve Components

Slide Valve Carriage Assembly
# Replacement Parts
## Slide Valve Carriage Assembly

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<td>ALL VSM 201</td>
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<tr>
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<td>THROUGH 401</td>
</tr>
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<td></td>
<td>340, 341, 350 &amp; 355.</td>
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<td>340, 342, 350 &amp; 355</td>
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<td>VOLUME PISTON SHAFT.</td>
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<td>PISTON RING SET.</td>
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<td>EXPANSION PIN.</td>
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<td>374</td>
<td>LOCK WASHER (PAIR).</td>
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Note: There are two slide valve carriages per gaterotor. Each one each has its own Volume Ratio and Capacity slide valves. The above totals are per side of the compressor, double the quantities if both slide valve carriages are being worked on. *Not Pictured.
# Replacement Parts

## Micellaneous Frame Components

**201-401 Only**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>MODEL NUMBER</th>
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<td>240 mm DISCHARGE MANIFOLD WITH HORIZONTAL DISCHARGE</td>
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<td>KEY</td>
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<td>522</td>
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**Note:** * Not Pictured.
Replacement Parts
Micellaneous Frame Components
501-701 Only
## Replacement Parts

### Miscellaneous Frame Components

**501-701 Only**

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**Note:** *Not Pictured.*
Replacement Parts
Main Rotor, Slide Valve Cross Shafts and End Plate
(Counter Clockwise Rotation)
201-401 ONLY

INSTALL PIN WITH TOOL RF5085AT
# Replacement Parts

## Main Rotor, Slide Valve Cross Shafts and End Plate

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**NOTE:**
* * Not pictured.
A As required.
Replacement Parts
Main Rotor, Slide Valve Cross Shafts and End Plate
(Clockwise Rotation)
501-701 Only
# Replacement Parts

## Main Rotor, Slide Valve Cross Shafts and End Plate

**501-701 Only**

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**NOTE:**

- * Not pictured.
- A As required.
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## Replacement Parts

### C-Flange Assembly

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### Contact Information

A. Contact Home Office for part number.
## Replacement Parts Tools

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Item 902 is used to set the stainless steel seal "cup" into the seal housing without touching the carbon "seal nose."
Complete Control Valve and Element:

1. Liquid Injection Assembly parts are found in the SPARE PARTS LISTS (page 39).

2. Connection sizes and tubing lengths, if other than standard, contact Vilter Manufacturing.

ELECTRICAL SPECIFICATION

Standard 15 watt, 120v.

STANDARD CAPILLARY TUBING LENGTH —- 10 FEET

HEATER ELEMENT ASSEMBLY

Consists of heater element lead wire, protective thermostatic switch, and moisture proof seal. The standard lead wire length is two feet.
Sporlan Thermostatic Expansion Valve

HOW THE THERMOSTATIC EXPANSION VALVE WORKS

Basically, Thermostatic Expansion Valve Operation determined by three fundamental pressures:

\[ P_1 \] Bulb pressure acts on one side of the diaphragm, tends to open the valve.

\[ P_2 \] Evaporator pressure acts on the opposite side, tends to close the valve.

\[ P_3 \] Spring pressure — which also assists in the closing action — is applied to the pin carrier and is transmitted through push rods to a buffer plate on the evaporator side of the diaphragm.

When the valve is modulating, bulb pressure is balanced by the evaporator pressure plus the spring pressure:

\[ P_1 = P_2 + P_3 \]

Since the bulb contains both vapor and liquid refrigerant (not superheated vapor alone as in the suction line) its temperature and pressure increases. This higher bulb pressure acting on the top (bulb side) of the diaphragm is greater than the opposing evaporator pressure plus spring pressure, causing the valve pin to be moved away from the seat. The valve is opened until the spring pressure — combined with the evaporator pressure — is sufficient to balance the bulb pressure. Figure-i illustrates a system with the same refrigerant in both the bulb and evaporator. Bulb pressure is shown in red, evaporator pressure in blue, and spring pressure in black. The total closing pressure (evaporator plus spring) is shown by a blue and black dash curve.

If the valve does not feed enough refrigerant, the evaporator pressure drops or the bulb temperature is increased by the warmer vapor leaving the evaporator (or both) and the valve opens, admitting more refrigerant until the three pressures are again in balance. Conversely, if the valve feeds too much refrigerant, the bulb temperature is decreased, or the evaporator pressure increases (or both) and the spring pressure tends to close the valve until the three pressures are in balance.

With an increase in evaporator load, the liquid refrigerant evaporates at a faster rate — moving the point of complete vaporization further from the outlet of the coil. This action leaves more coil surface for superheating the refrigerant which increases the bulb temperature AND pressure. With the increased pressure exerted on top of the diaphragm, the valve moves to a more open position to handle the new load condition with a slight change in superheat.

The thermostatic expansion valve will maintain a fully active evaporator under all load conditions.

Fixed restrictions and other expansion devices can offer only a corn promise in system performance when operating conditions change.

SPORLAN SELECTIVE CHARGES

For the most efficient system performance, Sporlan introduced Selective Charges for thermostatic expansion valves over 40 years ago. Their present universal acceptance throughout the refrigeration industry is evidence of the many operational advantages not possible with conventional charges.

An explanation of the characteristics, design features, and advantages of each selective charge follows:
Sporlan Thermostatic Expansion Valve

Design Characteristics:

1. Employs same refrigerant in thermostatic element as used within system.

2. Bulb volume and amount of charge it contains is such that sufficient liquid will remain in the bulb under all temperature conditions of the diaphragm case and capillary tubing.

Advantages:

Bulb will always control refrigerant flow despite a colder valve or diaphragm case.

Disadvantages:

1. When the compressor is started, the suction and evaporator pressures drop. But since the valve bulb is not immediately cooled, the comparatively high bulb pressure opens the valve too much resulting in:
   a. Low superheat and possible floodback to the compressor.
   b. Delayed suction pressure pulldown and possible overloading of the compressor motor.

2. With the same valve adjustment, the superheat increases at lower evaporator temperatures where high superheats are more detrimental to system capacity.

3. During off-cycle, if bulb is in a comparatively warm location, the bulb pressure may be great enough to open the valve, filling the evaporator with liquid. This is another possible cause of flood-back at start-up.

4. Conventional liquid charged valves have no inherent anti-hunt features.

Application:

Because of definite operating advantages obtained with the use of other Selective Charges, the use of the Type L charge is generally confined to large capacity ammonia systems and a few unusual application.

Design Characteristics:

1. Pressure limit or maximum operating pressure (MOP) feature. The Sporlan P charge is a patented modification of the conventional limited liquid charge (gas charge). The constituents of this charge are such that at a predetermined valve bulb temperature a maximum bulb pressure is reached. Any increase in bulb temperature above this point also results in virtually no increase in bulb pressure, causing the valve to throttle.

2. Sporlan Type P air conditioning charge makes use of the Flow-Master element originally patented by Sporlan which is effective in stabilizing valve control and in materially reducing system hunt.
Sporlan Thermostatic Expansion Valve

Type L liquid charges are also available for most commonly used refrigerants in most element sizes.

**THERMOSTATIC EXPANSION VALVE with RAPID PRESSURE BALANCER FEATURE**

Sporlan developed and patented a totally new type of “bleed valve” for use with air conditioning PSC (Permanent split capacitor — low starting torque) motor compressors. This development was prompted by requests from manufacturers of air conditioning equipment for a thermostatic expansion valve which would equalize high and low side pressures more rapidly than a conventional permanent bleed design. The RPB valve presents a major breakthrough in the design of thermostatic expansion valves. These valves generally reduce the equalization time by about 50% over that obtained with the permanent bleed type.

The RPB feature should allow the system pressures to equalize in about two minutes; however, the amount of system charge and high side volume can affect this time. As shown in Figure-7 the RPB bleed is actuated only on the off cycle. Immediately after shut down the evaporator pressure rises and the pin carrier moves to the closed position as in a conventional valve. However, with the RPB design the pin carrier continues its motion and opens the secondary spring loaded bleed port allowing rapid equalization of high and low side pressures. Upon restarting the compressor the secondary bleed port closes and the valve functions in the normal manner.

The RPB feature is currently available in valve Types C and S up to and including 4 tons Refrigerant 22 nominal capacity for air conditioning and heat pump (indoor coil only) applications.

For proper operation, foreign material must be kept out of the valve. A *Catch-All Filter-Drier* should be installed as close as possible to the valve inlet.

On systems utilizing compressors that have starting torques higher than the PSC motor, on outdoor coils of heat pumps, or on refrigeration systems, the RPB should not be used because of possible start-up problems. When a “bleed valve” is required on one of these systems, the permanent bleed type valve is available. To determine the proper bleed port size, sufficient testing must be done by the manufacturer.

Normally, it is advisable to replace a valve with one of the same specification. However, a valve with the RPB feature can replace a permanent bleed type except on outdoor coils of heat pumps or on refrigeration systems. If electrical “hard-start” components have been added to the system, it is not necessary nor advisable to use the bleed port or RPB type thermostatic expansion valve.
Sporlan Thermostatic Expansion Valve

THE EXTERNAL EQUALIZER

The operation of the thermostatic expansion valve is dependent upon the relationship of the three fundamental pressures. See Figure-1. Bulb pressure acting on top of the diaphragm must always equal the sum of evaporator (or suction pressure) and spring pressure applied to the under-side of the diaphragm.

On an internally equalized valve, the pressure at the valve outlet (or evaporator inlet) is transmitted to the under-side of the diaphragm via a passageway within the valve or through clearance around the push rods. On an externally equalized valve the under-side of the diaphragm is isolated from valve outlet pressure by packing around the push rods or by closely fitted rods making a metal-to-metal seal. See Figure-8. Suction pressure is transmitted to the under-side of the diaphragm by a line usually connected between the suction line near the evaporator outlet (generally downstream of the bulb) and an external fitting on the valve.

Figure-9 shows an internally equalized valve feeding an evaporator — which, for purpose of illustration, has no pressure drop. The pressure at the valve outlet and at the bulb location is 27 psig. So, the under-side of the valve diaphragm senses the evaporator pressure of 27 psig — which acts to close the valve. A spring pressure of 7 psi also assists the evaporator pressure in attempting to close the valve. The valve consequently adjusts its flow rate until the suction line vapor becomes sufficiently superheated to create a bulb temperature of 37 F. which develops a pressure of 34 psi — assuming the same refrigerant in the bulb as in the system — balancing the evaporator and spring pressure. The resulting superheat is 90 F.

While internally equalized valves may be used with evaporators that have a low pressure drop, valves with an external equalizer must be used when there is an appreciable pressure drop between the valve outlet and bulb location. This is illustrated in Figures-9, 10, and 11. The refrigerant in the system is assumed to be R12.
If this same internally equalized valve with the same spring adjustment is installed on an evaporator of equivalent nominal capacity but with a 6 psi pressure drop, the operating superheat will increase to 15°F as shown in Figure-b. Now the valve senses a comparatively high pressure of 33 psig at the valve outlet. The total closing pressure is 33 + 7 or 40 psig. Since the bulb pressure must equal the total closing pressure, the valve reduces its flow rate to create the necessary superheat and bulb pressure. Consequently, excessive evaporator pressure drop causes an internally equalized valve to operate at abnormally high superheat, and serious loss of evaporator capacity results.

The problem of improper valve control illustrated in Figure-b may be corrected by applying a thermostatic valve with an external equalizer. Figure-li shows the same system, but with an externally equalized valve. The suction pressure at the bulb location is transmitted to the under-side of the diaphragm via the external equalizer line. Valve operation is now identical to that shown in Figure-9, and the superheat returns to 9°F.

### WHEN TO USE THE EXTERNAL EQUALIZER

As evaporating temperature drops the maximum pressure drop that can be tolerated between the valve outlet and the bulb location without serious capacity loss for an internally equalized valve also decreases. This is shown in Table 1 below. There are, of course, applications which may satisfactorily employ the internal equalizer when higher pressure drop is present, but this should usually be verified by laboratory tests. The general recommendations given in Table 1 are suitable for most field installed systems. Use External Equalizer when pressure drop between valve outlet and bulb location exceeds values shown in Table 1.

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Evaporating Temperature Degress F.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Pressure Drop-psi</td>
<td></td>
</tr>
<tr>
<td>12,500</td>
<td>2</td>
</tr>
<tr>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td>502</td>
<td>3</td>
</tr>
<tr>
<td>717 Ammonia</td>
<td>3</td>
</tr>
</tbody>
</table>

When the expansion valve is equipped with an External Equalizer, it must be connected—never capped—or the valve may flood, starve, or regulate erratically.

There is no operational disadvantage in using an External Equalizer even if the evaporator has a low pressure drop.
“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 Position”, 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.

<table>
<thead>
<tr>
<th>Valve Size</th>
<th>1.5”</th>
<th>2”</th>
<th>2.5”</th>
<th>3”</th>
<th>4”</th>
<th>5”</th>
<th>6”</th>
<th>8”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Turns</td>
<td>2</td>
<td>2.25</td>
<td>2.75</td>
<td>3.25</td>
<td>4.5</td>
<td>3.75</td>
<td>5.75</td>
<td>7.75</td>
</tr>
</tbody>
</table>
“Stop Check” Installation

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 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.
HANSEN TECHNOLOGIES
CORPORATION

HS8A with Close-Coupled STO5O Strainer

INTRODUCTION
The redesigned, heavy-duty HS8A refrigeration solenoid valve is flanged, compact, and pilot-operated. It is now more dirt resistant, erosion resistant, and corrosion resistant. A dirt controlling Teflon piston seal prevents sticking. The valve body has improved, erosion resistant flow passages. And a proprietary coating on the valve body gives unmatched corrosion protection. The HS8A is used to provide on-off control of refrigerant flow. When the coil is energized, a pressure difference across the piston opens the valve seat. When the coil is de-energized, a spring closes the main Teflon seat to stop all flow.

APPLICATIONS
The HS8A is ideal as a liquid line solenoid valve. While primarily for ammonia, this valve is also suitable for R22, R134a, and other compatible refrigerants. The most common use of this valve is to control flow to: expansion devices, recirculating liquid overfeed evaporators, hot gas defrost, and small capacity evaporator suction. In addition, the HS8A makes an ideal noncondensible gas (air) purge point solenoid valve, and is recommended for use with Hansen AUTO-PURGERS.

MAXIMUM RATINGS, AMMONIA
Liquid, Receiver Pressure: 110 Tons (387 kW)
Recirculation, 4 to 1: 36 Tons (127 kW)
Hot Gas: 10 Tons (35 kW)
Suction: 5.0 Tons (18 kW)
Flow Factor: Cv = 3.3 (2.9 Kv)

ADDITIONAL FEATURES
Dimensionally replaces RIS S8F and Hansen HS8
Low-wattage coil
300 psig (20.7 bar) MOPD
Teflon main & pilot seats
Close-couples to STO5O (100 mesh) strainer
Heavy-duty construction
CSA certified

MATERIAL SPECIFICATIONS
Body: Cast ductile iron, corrosion-resistant coated
Bonnet Cartridge: Steel, plated
Piston: Stainless steel, Teflon seal
Plunger: Stainless steel
Pilot Orifice: Stainless Steel
Seats: Teflon, pilot and main
MOPD: 300 psig (20.7 bar) AC coils only
Safe Working Pressure: 400 psig (27 bar)
Operating Temperature: -600°F to +2400°F (-50°C to +115°C)
ELECTRICAL
The solenoid is a normally-closed (NC) device. One standard coil fits all Hansen valves. The coil draws 16 watts and operates properly between 85% and 110% of rated voltage (24V coil draws 19 watts). The standard coil connection is a 1/2" fitting (NPSM) for conduit. DIN plug, quick disconnect, and junction box coils are available. Pilot lights are also available. Contact the factory for details. Coils have a rustproofed steel housing which meets NEMA 3R (rainproof) and NEMA 4 (splashproof) requirements. The junction box version is considered NEMA 1.

The coil should only be energized while installed on the solenoid tube. Otherwise, the coil may quickly burn-out. To avoid bending the solenoid tube, remove the coil from the valve before tightening any flexible conduit connection.

INSTALLATION
Protect the interior of the valve from dirt before and during installation. A close-coupled inlet strainer is normally installed and recommended. Allow 2" (50 mm) above the valve for coil removal and 3" (76 mm) below the strainer for screen removal. The arrow on the valve body must point in the direction of system flow. If a pressure reversal can occur use a check valve on the outlet side of the HS8A. The check valve can be close coupled directly to the HS8A outlet.

INSTALLATION DIMENSIONS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QNTY</th>
<th>PRT#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. Coil Kit (11 5V) 1/2&quot; Fitting</td>
<td>70-0271</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Coil Kit (230V) 1/2&quot; Fitting</td>
<td>70-0286</td>
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<tr>
<td>Std. Coil Kit (24V) 1/2&quot; Fitting</td>
<td>70-0284</td>
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<tr>
<td>DIN Plug Coil Kits</td>
<td>FACTORY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Disconnect Coil Kits</td>
<td>FACTORY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coil with Junction Box Kits</td>
<td>FACTORY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above Std. Coil Kits Consist of:</td>
<td></td>
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</tr>
<tr>
<td>Bare Coil, 1 5V 50/60Hz, wire leads</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Bare Coil, 230V 50/60Hz, wire leads</td>
<td>1</td>
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<td></td>
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<tr>
<td>Bare Coil, 24V 50/60Hz, wire leads</td>
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<tr>
<td>Other Voltage Coils</td>
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<tr>
<td>Coil Housing Assembly Kit</td>
<td>70-1060</td>
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<tr>
<td>Coil Washer</td>
<td>70-0289</td>
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</tr>
<tr>
<td>Coil Nut</td>
<td>70-0281</td>
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<tr>
<td>Gasket Kit Consists of:</td>
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<tr>
<td>Solenoid Tube Gasket</td>
<td>70-1005</td>
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<tr>
<td>Upper Body 0-ring</td>
<td>70-0001</td>
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<tr>
<td>Lower Body 0-ring</td>
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<tr>
<td>Flange Gasket</td>
<td>70-0010</td>
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<tr>
<td>Stem O-ring</td>
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<tr>
<td>Packing</td>
<td>70-0016</td>
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<tr>
<td>Seal Cap Gasket (prior to 1998)</td>
<td>70-0011</td>
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<tr>
<td>Seal Cap O-ring</td>
<td>70-0019</td>
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<td>Packing Washer</td>
<td>70-0026</td>
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<tr>
<td>Packing Nut</td>
<td>70-1001</td>
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<tr>
<td>Bonnet Cartridge Kit</td>
<td>70-0144</td>
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<td>Above Kit Consists of:</td>
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<tr>
<td>Cartridge Assembly</td>
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<td>Gasket Kit</td>
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<td>Solenoid Tube/Plunger Kit</td>
<td>70-1059</td>
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<td>Piston Assembly Kit</td>
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<td>Above Kit Consists of:</td>
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<td>Piston Assembly</td>
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<td>Closing Spring</td>
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<td>Gasket Kit</td>
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<td>Stem Kit Consists of:</td>
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<td>Stem</td>
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<td>Piston Assembly Kit</td>
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<td>Above Kit Consists of:</td>
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<tr>
<td>Piston Assembly</td>
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<td>Screen Assembly, 100 mesh</td>
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<td>Strainer Cap Gasket</td>
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<td>Bolt and Nut Kit</td>
<td>70-1007</td>
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<tr>
<td>For HS8A less Strainer (a)</td>
<td>78-1-001</td>
<td></td>
<td></td>
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<tr>
<td>For HS8A with Strainer (b)</td>
<td>78-0005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consists of:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Nut 7/16-14</td>
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<tr>
<td>Bolt, 7/16—14 x 33/4</td>
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<td></td>
</tr>
<tr>
<td>Bolt, 7/16—14 x 51/2</td>
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<td></td>
<td></td>
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<tr>
<td>Strainer Cap</td>
<td>78-0002</td>
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<tr>
<td>Assembled Body</td>
<td>HSSAII</td>
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<tr>
<td>Replacement Kit</td>
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<tr>
<td>Complete Valve less Coil Kit and Flanges</td>
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<tr>
<td>Assembled Strainer</td>
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</tr>
<tr>
<td>Replacement Kit</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Flange Kit (FPT, SW, WN, ODS)</td>
<td>FACTORY</td>
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<tr>
<td>Includes (2) Flanges only; Specify Style and Size</td>
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</tbody>
</table>

*NOTE: All parts also fit HS8.

91
Standard 1/2" Coil Fitting shown above. Other coil options also available are:

- DIN Plug Coil
- Quick Disconnect Coil
- Coil Junction With Box
SERVICE AND MAINTENANCE

Failure to open: Wrong coil voltage; low line voltage; electric controlling device is not switching; coil is burned-out; inlet/outlet pressure differential is too high; piston or solenoid coil plunger is jammed closed with dirt.

Failure to close: Electric controlling device is not switching; manual-opening stem is turned in; piston or solenoid coil plunger is jammed open by dirt; damage or dirt at main valve seat or pilot valve seat.

Before opening the valve for service, be sure it is isolated from the system and all refrigerant is pumped out to zero pressure. Disconnect electrical power from the coil (1). To remove the coil (1), unscrew the coil nut (4) and remove the washer (3). Then, remove the coil (1) from the solenoid tube (6). To remove internal parts, use a large wrench to slowly unscrew the bonnet cartridge (15), proceeding cautiously to detect any remaining refrigerant inside the valve. Then, remove the closing spring (17) and piston (16). Check for dirt on the piston (16), Teflon piston seal, and seat. Clean and reinstall or install new parts. Check the upper (9) and lower (10) body 0-rings and replace if necessary. Use refrigerant oil or grease when installing the 0-rings.

To check the pilot section of the valve, first loosen the four solenoid tube screws (8). Then, break the seal between the solenoid tube (6) and bonnet cartridge (15), being careful to avoid any refrigerant which may remain. Check the face of the Teflon seat in the plunger (5), the plunger spring, and the pilot seat orifice on the bonnet cartridge (15). Clean, polish, or replace parts as necessary. The pilot seat is integral with the bonnet cartridge. Install a new solenoid tube gasket (7) and oil lightly. Reassemble the bonnet cartridge (15) to the valve body (27), using 75 ft-lbs (102 N·m) torque to tighten the secondary, metal, knife-edge seal. Carefully check the valve for leaks before restoring to service.

CAUTION

Hansen valves are for refrigeration systems only. These instructions 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. Bonnets, solenoid tubes, etc., should not be removed from 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 product. Escaping refrigerant can cause injury, especially to the eyes and lungs.

WARRANTY

Hansen valves are warranted against defects in workmanship and materials for a period of one year F.O.B. our plant. No consequential damages or field labor is included.

ORDERING INFORMATION,
HS8A SOLENOID VALVE

<table>
<thead>
<tr>
<th>FLANGE CONNECTION STYLE &amp; SIZES</th>
<th>FPT, SW, WN</th>
<th>ODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD</td>
<td>ALSO</td>
<td>STD</td>
</tr>
<tr>
<td>1/2 3/4&quot;, 3/8&quot;</td>
<td>5/8&quot;</td>
<td></td>
</tr>
</tbody>
</table>

FPT: Female Pipe Thread (American National Standard)
SW: Socket Weld to accommodate American and API pipe
WN: Weld Neck to match American pipe ODS:
Outside Diameter Sweat, for American copper tubes

Standard encapsulated solenoid coil is included for 115V, 230V, or 24V; 50/60Hz; other voltages are available. Standard coil connection is a 1/2" fitting (NPSM). Coils with DIN plug, quick disconnect, or junction box are available. Pilot lights are also available. Contact the factory.

TO ORDER: Specify type, connection style and size, volts, and strainer if required. Unless otherwise specified, the standard coil with ½” fitting will be supplied.

TYPICAL SPECIFICATIONS

“Refrigerant solenoid valves shall have encapsulated, watertight coils, Teflon seats, ductile iron or steel bodies, stainless steel pistons, spring closing pilot and main valve seats, and must be suitable for a safe working pressure of 400 psig (27 bar), as manufactured by Hansen Technologies Corporation or approved equal.”

OTHER PRODUCTS

Modular Pressure Regulators
Solenoid Valves
Gas-Powered Valves
Shut-Off Valves, 3/½” to 16”
Hand Expansion Valves (Regulators)
Level Pulse Control Systems (Pulse Width Valves)
Thermostatic Expansion Valves (TXV)
Inline and Piston-Type Check Valves
Gauge, Purge, and Needle Valves
Strainers and Filter Systems
AUTO-PURGER®s
Liquid Refrigerant Pumps
Float Drain Regulators
Van-Level® Adjustable Level Controls
Techni-Level®Transducer Probes
Float Switches
SEE-LEVEL® Liquid Indicators
Frost Master® Defrost Controllers
Pressure-Relief Valves
Rupture Disc Assemblies

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
If service is required, first contact your equipment distributor or contact A Vilter Technical Service Representative at:

Vilter Manufacturing Corporation
5555 South Packard Ave.
PO Box 8904
Cudahy, WI 53110-8904
Telephone: 414-744-0111
Fax: 414-744-1769
e-mail: info.vilter@emerson.com

*Note:* It will be necessary to have your Vilter order number available when contacting Vilter Manufacturing Corporation for service support.
The following items need to be setup in order for the valve to operate properly.

1. Press the “Circle” button on the valve. A value of “01” should be shown on the screen.
2. Press the “Circle” button. There should be a value of “1” shown. If not use the up/down arrows to change it to the correct value. Press the “Circle” button when done.
3. Press the “Up” arrow button. A value of ”02” should be shown on the screen.
4. Press the “Circle” button. There should be a value of “1” shown. If not use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
5. Press the “Up” arrow button. A value of “03” should be shown on the screen.
6. Press the “Circle” button. There should be a value of “2” shown. If not, use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
7. Press the “Up” arrow button until a value of “04” is shown on the screen.
8. Press the “Circle” button. There should be a value of “50” shown. If not, use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
9. Press the “Up” arrow button until a value of “07” is shown on the screen.
10. Press the “Circle” button. There should be a value of “1” shown. If not, use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
11. Press the “Up” arrow button until a value of “10” is shown on the screen.
12. Press the “Circle” button. Press the up/down arrow button to change the value to “11”. Press the “Circle” button.
13. Press the “Up” arrow button until a value of “26” is shown on the screen.
14. Press the “Circle” button. Press the up/down arrow buttons to change the value to the correct valve that is on the unit. The value number is listed on the valve. The values and valves are as follows:
   - 0: No valve selected. Alarm A1 will become active.
   - 1: ICM20 with ICAD 600
   - 2: ICM25 with ICAD 600
   - 3: ICM32 with ICAD 600
   - 4: ICM40 with ICAD 900
   - 5: ICM50 with ICAD 900
   - 6: ICM65 with ICAD 900
15. Press the “Circle” button.

The valve is now ready to be used.
ICM/ICAD Motorized Valve
Installation, Programming, and Trouble-shooting
Contents

Installation .................................................................3
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Troubleshooting
  The Manual Tool .....................................................10
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1. The ICM valve and ICAD motor actuator must be installed in horizontal pipelines with the motor actuator pointing upwards.

2. To prevent damage to O-rings and the valve seat, remove the one-piece ICM bonnet and function module from the valve body prior to welding the valve body in the line. For ICM 20 (3/4” size) the valve seat is not integrated with the valve bonnet and must be separately removed from the valve body with a 12 mm hex key prior to welding (see diagrams below).

Removing ICM 25 to 65 bonnets
1) Remove the 4 bolts
2) Rotate the bonnet as shown
3) Pry the bonnet out of the valve body by using screw drivers between the bonnet and valve body as shown

<table>
<thead>
<tr>
<th>No.</th>
<th>Part description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ICM body (housing)</td>
</tr>
<tr>
<td>2</td>
<td>ICM bonnet/function module</td>
</tr>
<tr>
<td>2a</td>
<td>O-ring for bonnet/function module</td>
</tr>
<tr>
<td>2b</td>
<td>O-ring for bonnet/function module</td>
</tr>
<tr>
<td>2c</td>
<td>O-ring for sealing ICAD motor with ICM valve</td>
</tr>
<tr>
<td>3</td>
<td>ICM adapter/valve stem</td>
</tr>
<tr>
<td>4</td>
<td>ICM bonnet gasket</td>
</tr>
<tr>
<td>5</td>
<td>Bolts for ICM</td>
</tr>
<tr>
<td>11</td>
<td>ICAD motor actuator</td>
</tr>
<tr>
<td>12</td>
<td>O-ring for ICM 20 seat orifice</td>
</tr>
<tr>
<td>13</td>
<td>ICAD screws</td>
</tr>
<tr>
<td>14</td>
<td>Guide ring</td>
</tr>
<tr>
<td>15</td>
<td>ICM 20 valve seat orifice</td>
</tr>
</tbody>
</table>
Care should be taken to protect the ICM function module while it is removed from the valve body.

3. Weld the valve body in line making sure the arrow on the valve body is pointing in the direction of flow.
4. Remove all debris from the valve body before re-installing the bonnet.
5. Install the bonnet/function module into the valve body.
   a. For ICM 0, make sure that the removable orifice seat is installed in the valve body with the small O-ring between the orifice seat and body. Make sure the bonnet gasket is installed and in good condition.
   b. For ICM 5 through ICM 65, check that the two O-rings on the bonnet and gasket located between the bonnet and valve body are installed and in good condition. A light coating of refrigerant oil on the bonnet O-rings will facilitate installation of the bonnet.
6. Install the four bolts and torque to the following specifications:

<table>
<thead>
<tr>
<th>Valve body</th>
<th>Nm</th>
<th>ft lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICM 0</td>
<td>50</td>
<td>37</td>
</tr>
<tr>
<td>ICM 25</td>
<td>80</td>
<td>59</td>
</tr>
<tr>
<td>ICM 32</td>
<td>80</td>
<td>59</td>
</tr>
<tr>
<td>ICM 40</td>
<td>90</td>
<td>66</td>
</tr>
<tr>
<td>ICM 50</td>
<td>100</td>
<td>74</td>
</tr>
<tr>
<td>ICM 65</td>
<td>110</td>
<td>81</td>
</tr>
</tbody>
</table>

7. Install the ICAD motor actuator on the ICM valve:
   a. The ICM valve must not be in its fully opened position while the ICAD motor is calibrated with the valve at a later step. Therefore, if the opening degree of the ICM valve was changed from the factory setting, it should be set to an opening degree between 0% and 75% using the manual magnet tool. To easily ensure correct positioning, turn the manual tool counter-clockwise until it is clear that it cannot be turned further.
   b. Make sure that the ICM adapter/valve stem and inner ICAD motor magnets are completely dry and free from any debris.
   c. For applications below freezing, the ICM adapter O-ring (position 2c in the diagram on page 3) must be removed, and Molycote G 4500 grease (supplied with ICAD motor) needs to be applied in the O-ring groove on the adapter and on the O-ring before it is re-installed on the ICM adapter. The Molycote grease ensures a good seal between the ICAD motor and the ICM adapter to prevent moisture from entering the ICAD magnets.
   d. Place the ICAD motor on the valve stem.
   e. Push the ICAD motor completely down to the identification ring on the valve stem and use a 2.5 mm hex key to tighten the set screws evenly so the ICAD motor is centered on the ICM adapter (torque: 3 Nm/ 2.5 lb-ft).
Wiring the ICAD

Note: The ICAD is powered by a 24 Volt DC power source.

There are two cables pre-mounted and connected to the ICAD motor actuator. Never try to open the ICAD motor because the special moisture seal will be damaged.

The power cable consists of 3 wires:
- Green: (-) common (ground)
- Brown: (+) positive from 24VDC power source
- White: (+) positive from UPS/battery backup (optional)

The control cable consists of 7 wires:
- Yellow: (-) common (ground)
- Gray: (+) positive 4-20mA or 0-20mA input to control ICAD motor
- Blue: (+) positive 4-20mA or 0-20mA output from ICAD for valve position feedback
- Pink: (+) positive 2-10V or 0-10V input to control ICAD motor. Also used as a digital input with the yellow wire for on/off solenoid valve operation.
- White: common alarm (digital NPN transistor output when combined with yellow wire)
- Brown: indicates ICM is fully open (digital NPN transistor output when combined with yellow wire)
- Green: indicates ICM is fully closed (digital NPN transistor output when combined with yellow wire)

Electrical Data

Supply voltage is galvanically isolated from input and output wires.

Supply voltage
24 V d.c., +10% / -15%
Load ICAD 600: 1.2 A
ICAD 900: 2.0 A

Fail safe supply
Min. 19 V d.c.
Load ICAD 600: 1.2 A
ICAD 900: 2.0 A

Analog input - Current or Voltage
Current
0/4 - 20 mA
Load: 200 Ω
Voltage
0/ - 10 V d.c.
Load: 10 kΩ

Analog output
0/4 - 20 mA
Load: ≤ 250 Ω

Digital input - Digital ON/OFF input by means of voltfree contact (Signal/Telecom relays with gold-plated contacts recommended) – Voltage input used
ON: contact impedance < 50 Ω
OFF: contact impedance > 100 kΩ

Digital output - 3 pcs. NPN transistor output
External supply: 5 - 24 V d.c. (same supply as for ICAD can be used, but please note that the galvanically isolated system will then be spoiled).
Output load: 50 Ω
Load: Max. 50 mA
Wiring diagram showing ICAD wired with a PLC or other type of third-party electronics

Note:
The ICAD supplies the power for the 4-20 mA feedback signal.

Wiring diagram with Danfoss EKC controllers

Note:
For instructions on completely wiring an EKC controller, please see the relevant EKC controller manual.
**Wiring diagram showing ICAD wired with a digital input for ON/OFF solenoid valve operation**

**Note:**
The ICAD motor can be programmed to open or close when the relay is closed. See parameter j09 in programming section.

**Terminal box is customer supplied.**

**Wiring diagram showing ICAD digital outputs wired with customer supplied auxiliary relays**

**Note:**
The same 24 V.d.c. power supply that powers the ICAD can be used with the ICAD digital outputs to power auxiliary relays (or other small load devices), but please note that the system will no longer be galvanically isolated.

**Terminal box is customer supplied.**
ICAD Overview

Before programming it is important to understand the functionality of the ICAD actuator:

1. The ICAD is a digital stepper motor. As such, it will count steps up and down from the position it believes it is in. Every time, the ICAD is powered on, it will drive itself to the closed position in order to re-establish its base point of reference. It will then move back to the position corresponding to the signal it is receiving from the control wiring.

2. The ICAD can be put into manual mode to move it (using the up and arrows) to a location different from the location that the signal is telling it to be in (see parameter j01, p. 6). When in the manual mode, the display screen will be flashing and will continue to flash flashing the % opening of the valve until the ICAD is taken out of the manual mode.

3. The ICAD can be operated in analog mode (for modulating operation) or in digital mode for solenoid operation. The ICAD can receive a variety of control signals (see parameter j03, p. 6) and can send a valve position output signal to modulate another ICAD or to a PC or PLC for monitoring. (see parameter j06, p. 6)

4. Because the ICAD is employs a digital stepper motor, its speed can be adjusted to any percentage of full speed through the parameter menu. (see parameter j04, p. 6)

5. The ICAD can be connected to a 24 VDC UPS (Uninterruptible Power Supply) and can be programmed for actions when the normal power has been cut and the ICAD is operating off of the UPS power. (see parameter j07 and j12, p. 6)

Operating the ICAD Menu

1. In order to access the menu, PRESS and HOLD the middle button (2) until the menu screen appears.

   1. Down arrow push button
   2. Enter
   3. Up arrow push button
   4. Display

2. Once you are in the menu, use the up (3) and down (1) arrow keys to move through the list of parameters.

3. To display the current setting of a parameter press the middle button.
   a. To change the value of a parameter setting, use the up or down arrow to establish the new setting while in that particular parameter’s display mode.
   b. Once the new setting for a parameter has been selected, push the center button to save the charge and return to the menu.

4. Repeat this procedure for all parameters.

5. Exit from the parameter list by pressing and holding the middle button for 2 seconds. The ICAD will automatically exit if no buttons are pushed for 20 seconds.
## ICM/ICAD Motorized Valve Installation, Programming, and Troubleshooting

### Programming the ICAD

When the ICAD motor is first powered, the ICAD display will flash an A1 alarm. This means that the ICM valve size that is being used with the ICAD motor needs to be selected in parameter \( p_{26} \). Parameter \( p_{26} \) is password protected and will not appear in the parameter list until the user enters the password in parameter \( p_{10} \). The password is “11,” and will allow the user to access parameter \( p_{26} \) where the appropriate valve size is selected. When the ICM valve size is selected, the ICAD will calibrate itself to the ICM valve and will then be ready for control by a 4-20mA signal. For most applications, this is the only programming that will need to be done if the ICAD is going to be controlled by a 4-20mA input.

### ICAD Parameters

<table>
<thead>
<tr>
<th>Description</th>
<th>Display name</th>
<th>Min.</th>
<th>Max.</th>
<th>Factory setting</th>
<th>Unit</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICM OD (Opening Degree)</td>
<td>-</td>
<td>0</td>
<td>100</td>
<td>-</td>
<td>%</td>
<td>ICM valve Opening Degree is displayed during normal operation. Running display value (see ( p_{01}, p_{05} )).</td>
</tr>
<tr>
<td>Main Switch</td>
<td>( p_{01} )</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>Internal main switch 1: Normal operation 2: Manual operation. Valve Opening Degree will be flashing. With the down arrow and the up arrow push buttons the OD can be entered manually.</td>
</tr>
<tr>
<td>Mode</td>
<td>( p_{02} )</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>Operation mode 1: Modulating – ICM positioning according to Analog Input (see ( p_{03} )) 2: ON/OFF - operating the ICM valve like an ON/OFF solenoid valve controlled via Digital Input. See also ( p_{09} ).</td>
</tr>
<tr>
<td>Analog Input signal</td>
<td>( p_{03} )</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>Type of Analog Input signal from external controller 1: 0 - 20 mA 2: 4 - 20 mA 3: 0 - 10 V 4: 2 - 10 V</td>
</tr>
<tr>
<td>Speed at ON/OFF and Modulating Mode</td>
<td>( p_{04} )</td>
<td>1</td>
<td>100</td>
<td>100</td>
<td>%</td>
<td>Speed can be decreed. Max. speed is 100 % Not active when ( p_{01} = 2 ). If ( p_{02} = 2 ) the display will indicate speed in display. Low, Med and High also means ON/OFF operation. If ( p_{04} &lt; 33 ), Low is displayed 33 &lt; ( p_{04} &lt; 66 ), Med is displayed ( p_{04} &gt; 67 ), High is displayed</td>
</tr>
<tr>
<td>Automatic calibration</td>
<td>( p_{05} )</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>-</td>
<td>Not active before ( p_{26} ) has been operated. Always auto reset to 0. CA’ will flash in the display during calibration, if Enter push button has been activated for two seconds.</td>
</tr>
<tr>
<td>Analog Output signal</td>
<td>( p_{06} )</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>Type of A0 signal for ICM valve position 0: No signal 1: 0 - 20 mA 2: 4 - 20 mA</td>
</tr>
<tr>
<td>Fail safe</td>
<td>( p_{07} )</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>Define condition at power cut when fail safe is installed. 1: Close valve 2: Open valve 3: Maintain valve position 4: Go to OD given by ( p_{12} )</td>
</tr>
<tr>
<td>Digital Input function</td>
<td>( p_{09} )</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>Define function when DI is ON (short circuited DI terminals) when ( p_{02} = 2 ) 1: Open ICM valve (DI = OFF = &gt; Close ICM valve) 2: Close ICM valve (DI = OFF = &gt; Open ICM valve)</td>
</tr>
<tr>
<td>Password</td>
<td>( p_{10} )</td>
<td>0</td>
<td>199</td>
<td>0</td>
<td>-</td>
<td>Enter number to access password protected parameters: ( p_{26} ) Password = 11</td>
</tr>
<tr>
<td>Old Alarms</td>
<td>( p_{11} )</td>
<td>A1</td>
<td>A99</td>
<td>-</td>
<td>-</td>
<td>Old alarms will be listed with the latest shown first. Alarm list can be reset by means of activating down arrow and up arrow at the same time for 2 seconds.</td>
</tr>
<tr>
<td>OD at powercut</td>
<td>( p_{12} )</td>
<td>0</td>
<td>100</td>
<td>50</td>
<td>-</td>
<td>Only active if ( p_{07} = 4 ). If fail safe supply is connected and powercut occurs ICM will go to entered OD.</td>
</tr>
<tr>
<td>ICM configuration</td>
<td>( p_{26} )</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>-</td>
<td>NB: Password protected. Password = 11 At first start up A1 will flash in display. Enter valve type 0: No valve selected. Alarm A1 will become active. 1: ICM20 with ICAD 600 2: ICM25 with ICAD 600 3: ICM32 with ICAD 600 4: ICM40 with ICAD 900 5: ICM50 with ICAD 900 6: ICM65 with ICAD 900</td>
</tr>
</tbody>
</table>
The manual tool should always be ordered with any ICM/ICAD assembly. This tool gives the user the ability to remove the ICAD actuator and manually rotate the valve in the open or close direction depending on need and application. When using the manual tool, a clockwise rotation will open the valve and a counter-clockwise rotation will close the valve.

**NOTE:**

It is very important to remember that when rotating the valve manually you are changing the position from that in the actuator’s memory. If power is removed from the actuator prior to using the manual tool, no problem will occur because, once the ICAD is powered up again, it will automatically recalibrate to the fully closed position before returning to the position in memory to which the control signal last set the valve. This recalibration will not occur if power is not removed from the ICAD prior to using the manual tool, and erroneous operation will likely occur. Always remove power before using the manual tool, and restore power afterward to ensure recalibration and trouble-free operation.

The user will be able to troubleshoot and determine many of the conditions and set points within the ICAD by accessing the Service Menu. A list of those service parameters follows below:

### Service Parameters

<table>
<thead>
<tr>
<th>Description</th>
<th>Display name</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD %</td>
<td>j50</td>
<td>0</td>
<td>100</td>
<td>%</td>
<td>ICM valve Opening Degree</td>
</tr>
<tr>
<td>AI [mA]</td>
<td>j51</td>
<td>0</td>
<td>20</td>
<td>mA</td>
<td>Analog Input signal</td>
</tr>
<tr>
<td>AI [V]</td>
<td>j52</td>
<td>0</td>
<td>10</td>
<td>V</td>
<td>Analog Input signal</td>
</tr>
<tr>
<td>AO [mA]</td>
<td>j53</td>
<td>0</td>
<td>20</td>
<td>mA</td>
<td>Analog Output signal</td>
</tr>
<tr>
<td>DI</td>
<td>j54</td>
<td>0</td>
<td>1</td>
<td>-</td>
<td>Digital Input signal</td>
</tr>
<tr>
<td>DO Close</td>
<td>j55</td>
<td>0</td>
<td>1</td>
<td>-</td>
<td>Digital Output Closed status. ON when OD &lt; 3 %</td>
</tr>
<tr>
<td>DO Open</td>
<td>j56</td>
<td>0</td>
<td>1</td>
<td>-</td>
<td>Digital Output Open status. ON when OD &gt; 97 %</td>
</tr>
<tr>
<td>DO Alarm</td>
<td>j57</td>
<td>0</td>
<td>1</td>
<td>-</td>
<td>Digital Output alarm status. ON when an alarm is detected</td>
</tr>
<tr>
<td>MAS mP SW ver.</td>
<td>j58</td>
<td>0</td>
<td>100</td>
<td>-</td>
<td>Software version for MASTER Microprocessor</td>
</tr>
<tr>
<td>SLA mP SW ver.</td>
<td>j59</td>
<td>0</td>
<td>100</td>
<td>-</td>
<td>Software version for SLAVE Microprocessor</td>
</tr>
</tbody>
</table>

It is also possible to restore the original factory settings to the ICAD by the following procedure:

**To restore factory settings:**

1. Remove the power supply.
2. Activate down arrow and up arrow push buttons at the same time.
3. While holding the up and down arrow reconnect the power supply.
4. Release down arrow and up arrow push buttons.
5. When the display on ICAD is alternating between showing: **CA** and **A1** the factory resetting is complete.
Alarms

There are a number of alarms which are excellent indicators of improper installation or set-up:

<table>
<thead>
<tr>
<th>Description</th>
<th>ICM alarm text</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>No valve type selected</td>
<td>A1</td>
<td>At start-up A1 and CA will be displayed</td>
</tr>
<tr>
<td>Controller fault</td>
<td>A2</td>
<td>Internal fault inside electronics</td>
</tr>
<tr>
<td>Input error</td>
<td>A3</td>
<td>Not applicable if $01 = 2$ or $02 = 2$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When $03 = 2$ and $AI &gt; 22$ mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When $03 = 3$ and $AI &gt; 12$ V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When $03 = 4$ and $AI &gt; 12$ V or $AI &lt; 1$ V</td>
</tr>
<tr>
<td>Low voltage of fail safe supply</td>
<td>A4</td>
<td>If 5 V d.c. &lt; Fail safe supply &lt; 18 V d.c.</td>
</tr>
<tr>
<td>Check Supply to ICAD</td>
<td>A5</td>
<td>If supply voltage &lt; 18 V d.c.</td>
</tr>
</tbody>
</table>

Troubleshooting Tips

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause and solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The valve is not working and an A1 is flashing in the display.</td>
<td>The ICM valve size was not selected in parameter $26$. See the programming section on page 9.</td>
</tr>
<tr>
<td>The valve does not appear to be opening or closing properly</td>
<td>1. The ICM was not mounted properly on the valve stem. <strong>Solution:</strong> Check to make sure that the ICM was mounted evenly on the ICM valve</td>
</tr>
<tr>
<td></td>
<td>2. The ICAD is not receiving a proper input signal. <strong>Solution:</strong> Use the service parameters ($51$ for a mA input or $52$ for a voltage input) to check the input signal that the ICAD is receiving.</td>
</tr>
<tr>
<td>The valve position feedback signal is not working when using customer supplied controller/PLC</td>
<td>1. A power supply was installed in the 4-20mA/0-20mA feedback loop. The ICAD motor actuator supplies the power for the 4-20mA/0-20mA feedback loop. <strong>Solution:</strong> Remove any power source that may be supplied to the feedback loop.</td>
</tr>
<tr>
<td></td>
<td>2. Wiring problem. <strong>Solution:</strong> Check the service parameter $53$ to see what the ICAD is outputting. If this does not reveal anything, check the current output (yellow and blue wires in ICAD control cable) with an ammeter.</td>
</tr>
<tr>
<td></td>
<td>3. The feedback output signal was turned off in parameter $56$. <strong>Solution:</strong> Check to make sure the setting in parameter $56$ is correct.</td>
</tr>
</tbody>
</table>

*For all other problems, contact Danfoss.*
Common Questions

**What happens in the event of a power failure?**

The ICAD will remain in the position it is in when power is lost. There are two ways to address this condition:

- Add a UPS (Uninterruptible Power Supply) to the power wiring. This is easily accomplished with the green and white wires in the power cable. A UPS is available from Danfoss. The UPS can provide service for up to 9 ICAD 600’s or up to 6 ICAD 900’s.

  **Note:** The UPS is not a continuous power supply. It is used to change the valve position (usually to close the valve) in the event of a power failure. Therefore, the system is not to be run in the UPS mode.

- Add a solenoid valve in front of the ICM. This is a very simple solution provided that there is no issue associated with the additional pressure drop through the solenoid valve.

**How much power do I need to supply to the ICAD?**

The total power required depends on both the ICAD size and the number of ICAD’s powered by the DC power supply. The power for each ICAD is:

- For the ICAD 600 (used on ICM 0, 5, and 3), the power requirement is approximately 30 W
- For the ICAD 900 (used on ICM 40, 50, and 65), the power requirement is approximately 50 W

**How can I monitor the valve position remotely?**

The control wiring provides for a 4 to 20 mA or 0 to 20 mA signal output (blue and yellow wires). This signal can be sent to:

- A remote display
- A PLC or PC
- Another ICAD motor to give the same opening position