OPERATION MANUAL

VILTER®

Since 1867

Manufacturers of Industrial Refrigeration
and Gas Compression Equipment

Air Unit

SC, BF, & LP Type Series Evaporators

VPN-35391AU
January 2005 Rev-0
Price $30.00

Note:

Information in this manual is for general purposes only, therefore contents may differ from one unit to another.

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Warranty

Warranty for Air Units Manufactured by Vilter Manufacturing Corporation.

Seller warrants air units manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of eighteen (18) months from the date of shipment or twelve (12) months from the date of installation which ever occurs first. The seller extends to a period of five (5) years from the date of shipment its warranty on hot dipped galvanized coils against rust through. 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. 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, AND SELLER EXPRESSLY DISCLAIMS AND EXCLUDES ANY 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.

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 finances 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.

DOMESTIC TERMS and CONDITIONS

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 NEVERTHELESS 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 be 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

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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.

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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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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.

Operation

VILTER AIR UNITS

VILTER Air Units are manufactured using the highest quality materials and workmanship. The hot dip galvanized steel coils and framework provide excellent durability and corrosion resistance for most environments.

VILTER Air Units are designed for a wide variety of applications. They can be circuited for all common refrigerants using direct expansion, liquid recirculated, or flooded feed. The defrost methods, if required, can be air, hot gas, water or electric depending on the plant configuration and application.

RECEIVING

When receiving Air Units, all packages and crates should be checked against the bill of lading. If any components are missing or damaged, have the freight agent make the proper notations on the freight bill, and enter a claim to recover the loss. Also take pictures of the damage to help identify the condition of the unit when received.

RIGGING AND HANDLING

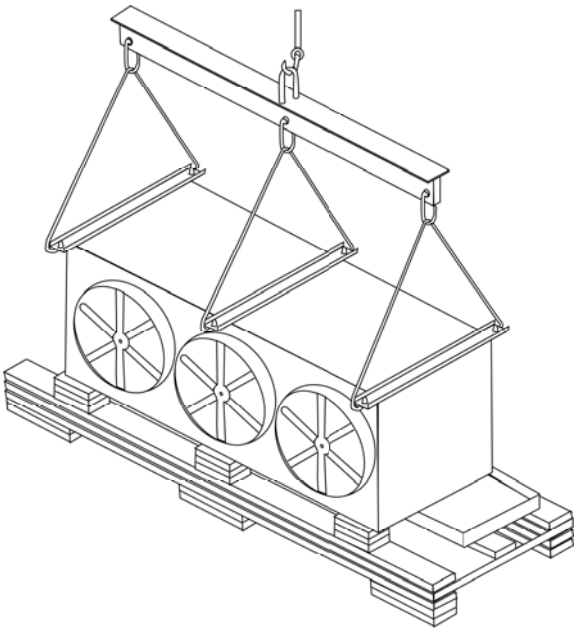
VILTER Air Units are shipped completely assembled and mounted on wooden skids or shipping legs. The services of a qualified rigger should be obtained to lift and position the Air Unit. They have the required equipment and know-how to do the job properly.

The Air Units are designed to be lifted using either a fork-truck or crane. For fork-truck lifting, the removable cross channels or the wooden runners that are mounted between the Air Unit legs should be used. Fork extensions may be required to span the distance between front and back legs. Overhead cranes can utilize the ceiling mounting channels for lifting. A spreader bar is recommended. The channels located 1” from each end should be used for lifting.

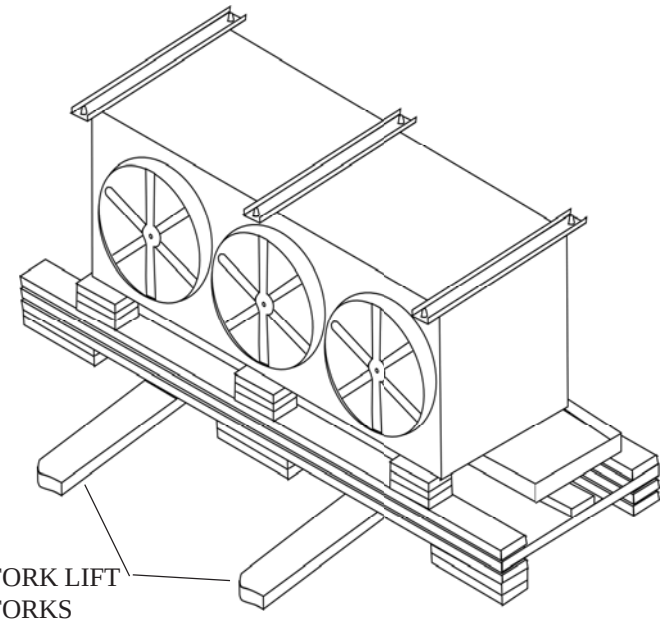
DO NOT ATTEMPT TO LIFT BY THE DRAIN PAN. DAMAGE WILL RESULT ! !

See following illustrations for handling procedures:

OVERHEAD LIFTING: Lifting by eyebolts using a spreader bar.



FORK TRUCK LIFTING: Lift by lifting channels or skid provided.



Installation

FOUNDATION AND HANGER SUPPORTS

Floors, stands, and ceiling supports must be adequately designed for supporting the weight of the Air Units.

The Air Units can be designed to be either ceiling hung or mounted on a support stand. The top channels can be used for ceiling suspension and the mounting legs are to be used for floor or stand mounting. The Air Units must be secured in position using safe and acceptable methods.

AIR UNIT LOCATION

Be sure there is sufficient free and unobstructed space around the Air Unit for proper servicing. Make certain there is free and unobstructed airflow to the evaporator's air inlet.

PIPING AND CONNECTIONS

Follow industrial refrigeration piping procedures to install and pipe the Air Unit. Refer to ANSI/ASHRAE handbooks.

VALVES AND ACCESSORIES

For units that have factory mounted valves or other accessories, servicing information is provided in the Vendor section of this manual.

Although not provided with the Air Units, all industrial refrigeration systems should have adequate filters and strainers. For start up, the use of additional filter bags in the strainers are a must. See the Vendor sections for an example of suitable suction, liquid and hot gas line strainers.

SAFETY DEVICES

Safety devices installed in plants vary according to the requirements of the local ordinances. See ANSI/ASHRAE standard 15. In case any doubt exists on this point, check local codes on the subject before installation is initiated. Make all arrangements for installation of electric power and inspection services by the local authorities so all this work will be performed, inspected, and passed in ample time to prevent any delay in starting up the plant for operation.

SYSTEM EVACUATION

As any refrigeration system will operate best when only refrigerant is present in the system, steps must be taken to remove all air, water vapor and all other non-condensibles from it before charging it with refrigerant. If air, non-condensibles, or water vapor are left in the system, various operating difficulties may be encountered. The moisture will react with the oil in the system forming sludge, which can clog passageways and lead to lubrication problems. Air and non-condensibles will tend to lodge in the condenser, decreasing the space for condensing liquid and cause the head pressure to rise. A combination of moisture and refrigerant, along with any free oxygen in the system, can cause formation of acids or other corrosive compounds which could corrode the internal parts of the system. For these reasons, it is imperative that as much of the aforementioned foreign materials be removed from the system as possible before it is placed into operation.

BASIC WIRING DIAGRAM

The wiring diagram shown is suitable for most installations. Refer to Drawings on the following two pages. (pages 12 & 13)

INSPECTION

Prior to start up, the following services must be performed:

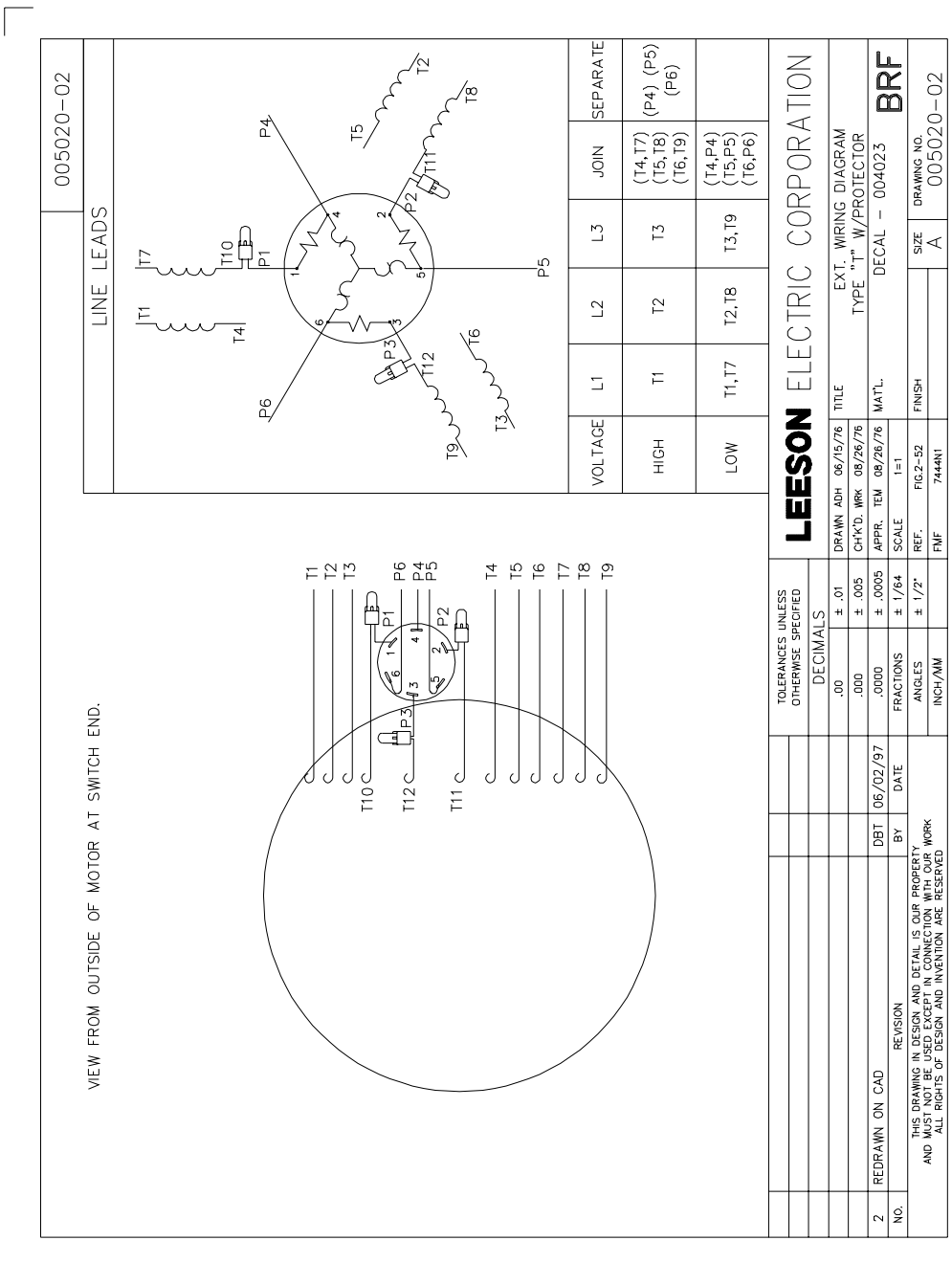
Inspect general condition of unit.

Inspect fans, motors, bearings, drives, locking collars, and belts for condition and alignment.

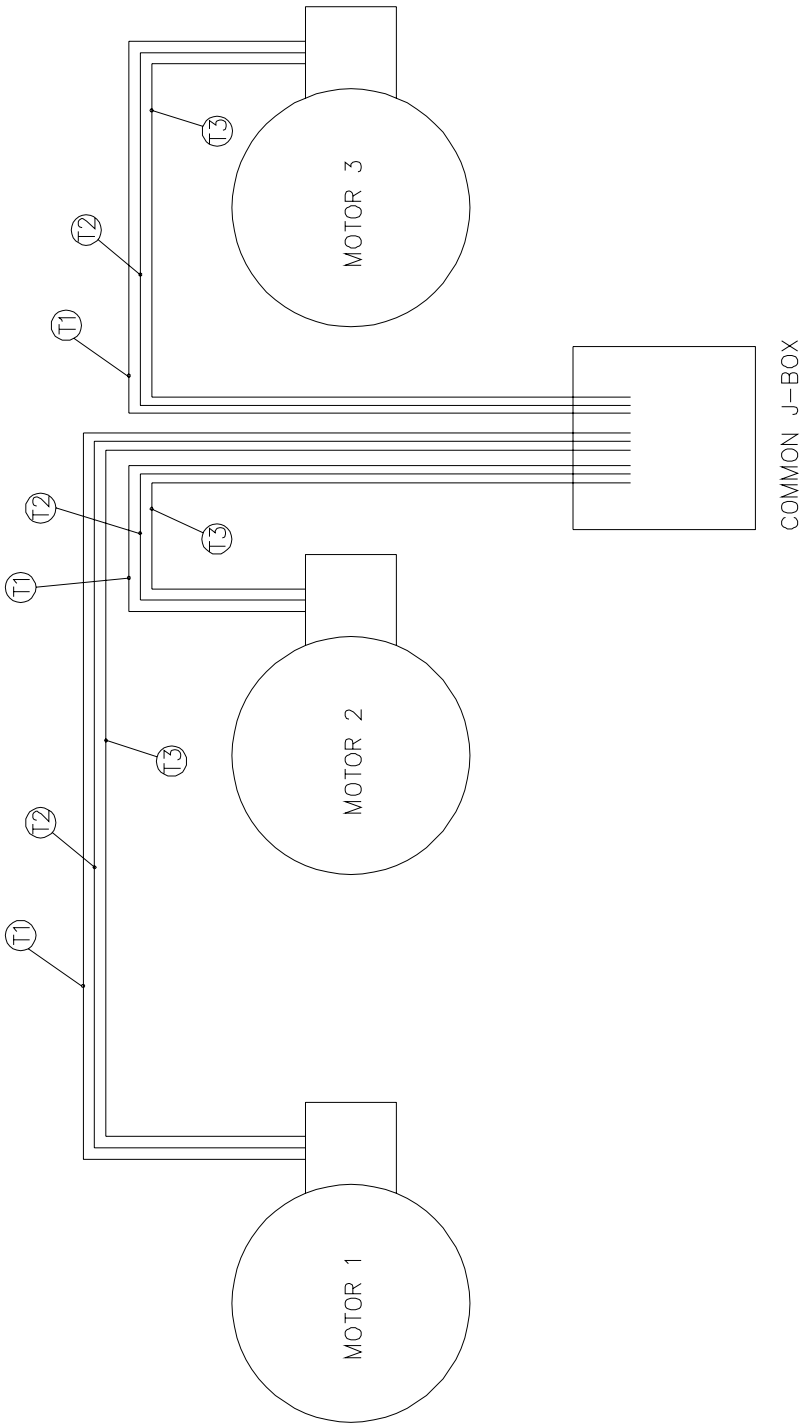
Check fans.

Proper start-up procedures and scheduled periodic maintenance will prolong the life of the equipment and ensure trouble-free performance.

Typical Air Unit Motor Wiring



Typical Air Unit Motor Wiring



Maintenance

MAINTENANCE

VILTER Air Units contain few moving parts and are nearly maintenance free. Periodic cleaning of the coil maintains cooling efficiency.

PERIODIC MAINTENANCE

It is highly recommended that a regular schedule of periodic maintenance be established and strictly adhered to. Following is a list of major check points and the approximate frequency of attention. However, the intervals are subject to adjustment as they are minimums and if operating conditions are severe, the frequency should be increased.

Once every month:

1.Check bearings (on summer operating jobs, repeat same at start and end of the season) and lubricate if necessary.

2.Clean and flush the drain pan.

3.Clean strainer (if atmosphere is extremely dusty, weekly cleaning may be necessary).

4.Check fan blades overall condition. Clean if necessary.

5.Check over the unit carefully and if any other work is necessary, complete at once.

Once every year:

1.Repeat monthly procedure.

2.Check fan shaft locking collar on the bearings.

MOTOR MAINTENANCE

When lubricating the motors of the Air Unit, follow the recommendations of the motor manufacturer. This data is provided on the following pages. Keep in mind that more motor damage has been caused by over greasing than by not greasing often enough. Motors smaller than 1½ hp generally have sealed bearings. The motor data provided must be looked over by the customer to determine if this applies to this particular unit.

FLUSHING THE DRAIN PAN

The drain pan should be flushed out to remove accumulated dirt and impurities once a month, or as conditions require.

STORAGE OF EQUIPMENT

FANS

If a fan is not installed immediately upon receipt, it is the responsibility of the purchaser/user to see that proper procedures are followed to minimize deterioration which may result from idle storage. These simple steps should be adhered to in order to protect the equipment.

1.Machined parts that are exposed to the elements should be covered with a protective coating of grease (Chesterton Heavy Duty Rustguard #740, Sprayon #322, or equivalent).

2.For fans equipped with access panels, vane section access panels, or core end covers, these can be removed to gain adequate access to the interior. These panels/covers should be reattached for storage, but fastened with a minimum of assembly hardware to facilitate access. The remaining hardware should be bagged and attached to the fan to prevent loss of these items, along with a tag indicating that all hardware should be reinstalled prior to putting the fan into service.

3.Equipment must be protected from construction debris. Ideally, equipment should be stored in a dry, well-sheltered, vibration-free location.

4.Each impeller blade should be numbered in sequence with a marker.

5.A plastic cover should be spread over the equipment.

FAN BEARINGS

Since bearings tend to “breathe” on equipment stored in areas with other than a constant temperature, moisture will condense internally. It becomes necessary to keep the bearings completely full of grease and periodically rotated to make certain that all internal parts are coated with grease. Even a full bearing will eventually pick up moisture and therefore, must be periodically purged with new grease.

Grease should be purged from bearings to remove condensed moisture, and fan wheel rotated by hand every thirty (30) days. This practice should be done more often if weather is severe or if there is a wide variation in temperature.

CAUTION IN PURGING:

THE FAN SHOULD BE ROTATED WHILE GREASING, AND HIGH PRESSURE PNEUMATIC GREASERS SHOULD BE AVOIDED. SEE SECTION ON LUBRICATION INSTRUCTIONS FOR FAN BALL BEARINGS.

For rotating, follow the procedure listed below:
The blade marked number 1 should be rotated to top center. The blade number and date should be recorded in a log book which is to be stored in a protective pouch attached to the fan.

During storage, the fan impeller should be rotated by hand at least ten (10) revolutions every thirty (30) days to circulate the lubricant in the bearings in the motor or on the fan shaft. After the tenth revolution, stop with a blade at top center which is not the same one as listed for the previous date in the log book.

Fans which are V-belt driven should be prepared for storage as follows. Carefully remove the belts, coil them (without kinks) in matched sets, and place them in a heavy carton. Mark carton with fan identification and store carton in a dry, well-ventilated area. Belts must not be left exposed to sunlight or subjected to storage ambient conditions exceeding 85°F / 70% relative humidity. Belts which show signs of deterioration should be replaced prior to start-up. Before reinstalling belts, review section on belt tension.

NOTE:
Procedures for storage of aerovent equipment as outlined above are intended as a general guide only. Storage conditions will vary depending on the location. Common sense and practical experience should determine to what extent the above procedures will be followed.

MOTORS

Motors must be stored under cover in a clean, dry, vibration-free location. Remove sufficient packaging material to allow circulation of air around motor. Maintain the temperature of the windings a few degrees above that of the surrounding air to protect against condensation. If the motor is equipped with internal heaters, the heaters should be energized throughout the storage period to prevent this condensation. If the motor does not have internal heaters, this can be accomplished using any other safe, reliable method of heating. Measure and record monthly the ambient air temperature and winding temperature.

In the event the motor is not equipped with internal heaters and space heating equipment is unavailable, wrap the motor as tightly as possible with heavy-duty polyethylene. Enclose bags of desiccant (such as Silicagel) with the motor to minimize moisture problems. Check the desiccant regularly and replace it periodically as dictated by climate requirements.

To prevent rusting of bearing parts, the rotor must be rotated at regular intervals (30 days) to assure these parts are well covered with oil or grease.

Prior to energizing the motor, it is to be inspected and meggered by a motor manufacturer's field service engineer. The charges for this service to the customer will be in accordance with manufacturer's published service rates in effect at the time of inspection.

In addition, it is strongly recommended the motor manufacturer be contacted for specific long term storage instructions.

Replacement Parts

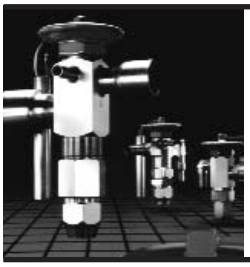
REPLACEMENT PARTS LIST

Following is a list of items that, over time, may require replacement. Contact VILTER MANUFACTURING CORPORATION for current price confirmation before placing an order. Please have the unit serial identification number on hand when placing an order for parts. Other replacement parts may be supplied as required. Consult home office for further information.

- Fan Motor
- Propeller Fan
- Fan Guard
- Pan Coil Defrost Check Valve (if applicable)
- Drain Pan (if applicable)
- Drain Pan Coil (if applicable)
- Louvers (if applicable)
- Long throw Adapters (if applicable)

Vendor Section

Sporlan
Hansen
Leeson
Baldor
Lincoln



Thermostatic Expansion Valves

Installation, Field Service, and Assembly

SPORLAN

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■ Installation

For peak performance, it is important to select a Sporlan Thermostatic Expansion Valve (TEV) with correct capacity, selective charge, external or internal equalizer, etc. See Bulletins 10-9 and 10-10 for complete application information. Equally important is the proper installation, which can determine the success or failure of the entire system.

Valve Location

TEVs may be mounted in any position, but they should be installed as close to the evaporator as possible. If a refrigerant distributor is used with the expansion valve, best performance is obtained if the distributor is mounted directly to the valve outlet. If the distributor cannot be mounted directly to the valve outlet, the distance between the valve outlet and distributor should not exceed 24 inches or refrigerant distribution problems may occur. Also, the tube connecting the valve outlet and distributor can be sized smaller to maintain refrigerant velocity and better distribution. Elbows located between the expansion valve and distributor will hinder proper distribution and therefore, are not recommended.

Best distribution is usually obtained if the expansion valve feeds vertically up or down into the distributor. System manufacturers, however, have successfully applied distributors in other orientations. See Bulletin 20-10 for application and selection information on refrigerant distributors.

While not always convenient or possible, valve Types BI, F, FB, and O are easier to service if mounted in a vertical and upright position. If mounted in a horizontal position, the internal parts must be carefully reassembled to prevent damage to them. Also, some consideration should be taken in mounting larger sized expansion valves. They must be adequately supported since system vibration and the weight of the valve may cause valve connections to fracture.

If a hand valve is located on the outlet side of the TEV it should have a full sized port. No restrictions should appear between the TEV and the evaporator, except a refrigerant distributor if one is used.

Sporlan TEVs having Selective Charges C, Z, L, or X may be installed and operated in most locations. The amount of thermostatic charge and the bulb size are such that the bulb retains control despite a colder valve body or diaphragm case. The exception is when the element is subjected to sub-zero temperatures for extended periods of time during an off-cycle. In this case, start-up may be prolonged until the bulb and element are warmed sufficiently to open the valve.

To minimize the possibility of charge migration, the Sporlan MOP type charges (CP series, ZP series, and VGA) should be installed so the diaphragm case is warmer than the bulb. Special non-condensable charges without MOP and double diaphragm hydraulic elements with MOP are available for system manufacturers to overcome this potential problem.

Occasionally, TEVs are located in corrosive atmospheric conditions that can damage the valve and/or the element assembly. Due to this possibility, the valve must be protected with appropriate materials to prevent premature failure. Consult specialists in protective coatings.

Precautions:

When the evaporator and TEV are located above the receiver, there is a static pressure loss in the liquid line. This is due to the weight of the column of liquid refrigerant, and this weight may be interpreted in terms of pressure loss in pounds per square inch as shown in Table 3, Bulletin 10-9. If the vertical lift is great enough, vapor or ***flash gas*** will form in the liquid line causing a serious reduction in the capacity of the TEV.

When an appreciable vertical lift is unavoidable, precautions should be taken to prevent the accompanying pressure loss from producing liquid line vapor. This can be accomplished by providing enough subcooling to the liquid refrigerant, either in the condenser or after the liquid leaves the receiver. Subcooling is determined by subtracting the actual liquid temperature from the condensing temperature (corresponding to the condensing pressure). A subcooling calculation example is provided in the "subcooling" section of Bulletin 10-9.

Bulletin 10-11, October 2003 Supersedes Bulletin 10-11, September 1996 and all prior publications.

Liquid subcooling is provided by the following methods:

1. ***In the condenser***
2. ***Suction – liquid heat exchanger***
3. ***Special devices***

Method 1 – will provide sufficient subcooling for the simple short-coupled system that has only moderate liquid line pressure drop.

Method 2 – will usually not provide more than 20°F subcooling on air conditioning systems operating at normal head pressures. The amount of subcooling will depend on the design and size of the heat exchanger and on the operating suction and discharge pressures.

Method 3 – may be used to provide considerable subcooling required for systems with excessive vertical lift. The following special devices are the most commonly used methods:

- Water coils in heat exchange relationship with the liquid line.
- Separate refrigeration system.
- Special heat exchanger which uses a portion of the refrigerant to cool the main body of liquid. See Figure 1.

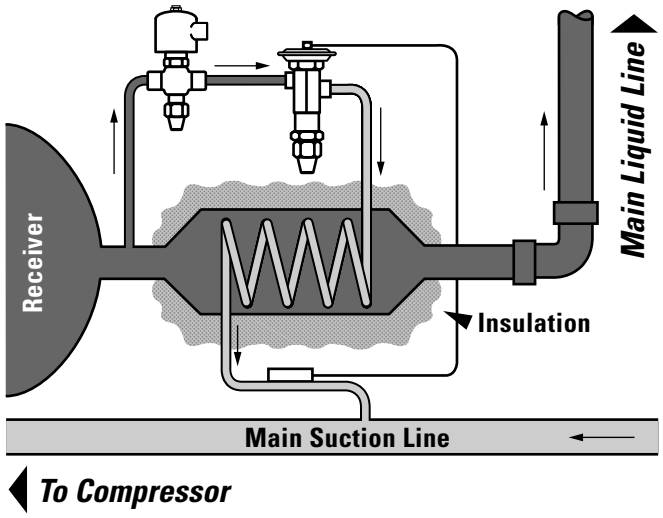


Figure 1

Ordinarily the conventional suction-liquid heat exchanger is installed near the evaporator, where the suction vapor is the coldest, to re-condense any vapor in the liquid line. When the primary purpose of the heat exchanger is to prevent the formation of flash gas – particularly on systems that have a long liquid line or excessive vertical lift – install the heat exchanger near the receiver ***before the vertical lift occurs***. (This also applies to the special devices described in Method 3). Because vapor in the liquid line considerably increases friction losses, the total pressure drop available across the expansion device on these types of systems is reduced. Also, the suction line and liquid line should be carefully insulated to minimize heat gain if subcooled below ambient temperature.

Important

Preventing the formation of vapor in liquid lines having high pressure losses does not eliminate the requirement that an adequate pressure drop must be available across the TEV. The capacity tables show valve capacities at pressure drops lower than normal. For TEV application data and capacities at pressure drops below those listed, ***consult Sporlan Valve Company***.

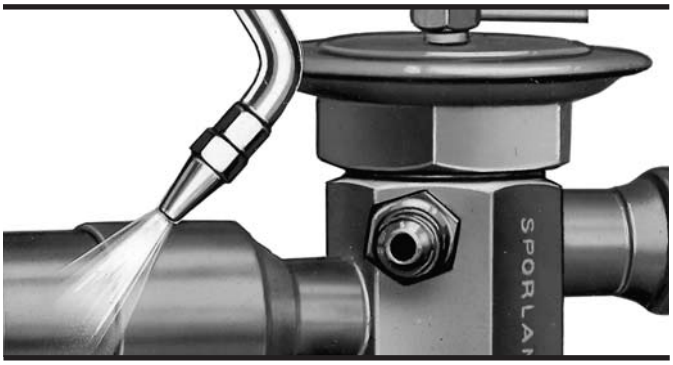


Figure 2

Solder Techniques

It is not necessary to disassemble solder type valves when soldering to the connecting lines. Any of the commonly used types of solders, e.g., 95-5, Sil-Fos, Easy-Flo, Phos-Copper, Stay Brite 8 or equivalents may be used for copper to copper connections. When soldering a brass refrigerant distributor to the valve, appropriate solders for these connections, such as 95-5, Easy-Flo, Stay Brite 8 or equivalents must be used. It is important however, regardless of the solder used, to direct the flame away from the valve body and avoid excessive heat on the diaphragm, Figure 2. As an extra precaution, a wet cloth may be wrapped around the body and element during the soldering operation.

This precaution will prevent overheating the valve body which could damage the superheat spring and result in flood back problems. In addition, the Type O, EBF/SBF, and EBS valve contain synthetic parts which can be damaged due to overheating, resulting in poor valve performance.

Bulb Location and Installation

The location and installation of the bulb is extremely important to the proper performance of the system and care should be taken with its final location.

Accepted principles of good suction line piping should be followed to provide a bulb location that will give the best possible valve control. When system manufacturers have piping recommendations that differ from the general industry recommendations and Sporlan's suggestions shown in this section, those recommendations should be used. When specific recommendations are not available, the suggestions below should be used.

The bulb should be attached to a horizontal suction line at the evaporator outlet (See Figures 3, 4, and 5) If the bulb cannot be located in that manner, it may be located on a ***descending*** vertical line only (as shown in Figure 5 for "pumpdown control"). The bulb should never be located in a trap or downstream of a trap in the suction line. Liquid refrigerant or mixture of liquid refrigerant and oil boiling out of the trap will falsely influence the temperature of the bulb and result in poor valve control.

On suction lines 7/8" OD and larger, the surface temperature may vary slightly around the circumference of the line. On these lines, it is generally recommended that the bulb be installed at 4 or 8 o'clock on the side of the horizontal line, and parallel with respect to the direction of flow. On smaller lines the bulb may be mounted at any point around the circumference, however locating the bulb on the bottom of the line is not recommended as an oil-refrigerant mixture is generally present at that point. Certain conditions peculiar to a particular system may require a different bulb location than normally

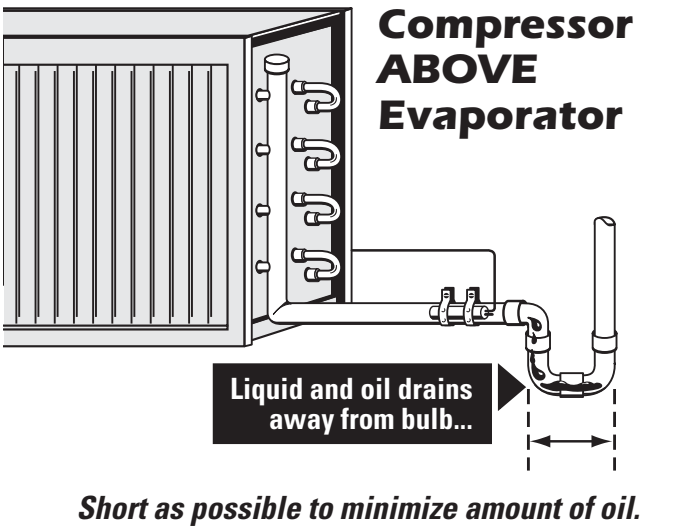


Figure 3

recommended. In these cases the proper bulb location may be determined by trial.

For satisfactory expansion valve control, ***good thermal contact*** between the bulb and suction line is essential. The bulb should be securely fastened with two bulb straps, supplied with each expansion valve, to a clean straight section of the suction line.

Recommended suction line piping usually includes a horizontal line leaving the evaporator to which the TEV bulb is attached. This line is pitched slightly downward, and when a vertical riser follows, a short trap is placed immediately ahead of the vertical line, see Figure 3. The trap will collect any liquid refrigerant or oil passing through the suction line and prevent it from influencing the bulb temperature.

On multiple evaporator installations the piping should be arranged so that the flow from any valve cannot affect the bulb of another. Approved piping practices including the proper use of traps insures individual control for each valve without the influence of refrigerant and oil flow from other evaporators.

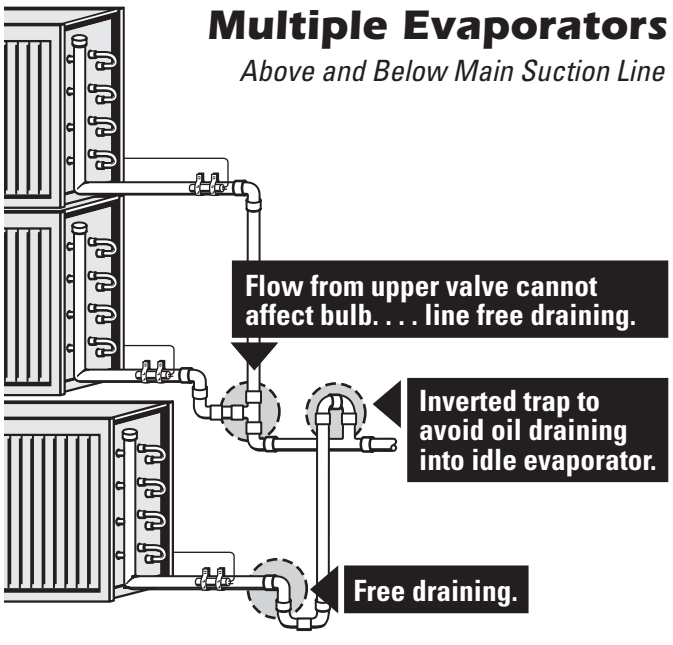


Figure 4

For recommended suction line piping when the compressor is located below the evaporator see Figure 5. The vertical riser extending to the height of the evaporator prevents refrigerant from draining by gravity into the compressor during the off-cycle. When a pumpdown control is used the suction line may turn immediately down without a trap.

On commercial and low temperature applications requiring Sporlan Selective Charges C, Z, or X the bulb should be clamped on the suction line at a point where the bulb temperature will be the same as the evaporator temperature during the off-cycle. This will insure tight closing of the valve when the compressor stops. If bulb insulation is used on lines operating below 32°F, use non-water absorbing insulation to prevent water from freezing around the bulb.

On brine tanks and water coolers, the bulb should be below the liquid surface where it will be at the same temperature as the evaporator during the off-cycle. When locating the bulb in a brine tank, paint it and the capillary tubing with pitch or other corrosion resistant paint.

If, for practical reasons, the bulb must be located where its temperature will be higher than the evaporator during the off-cycle, a solenoid valve must be used ahead of the TEV.

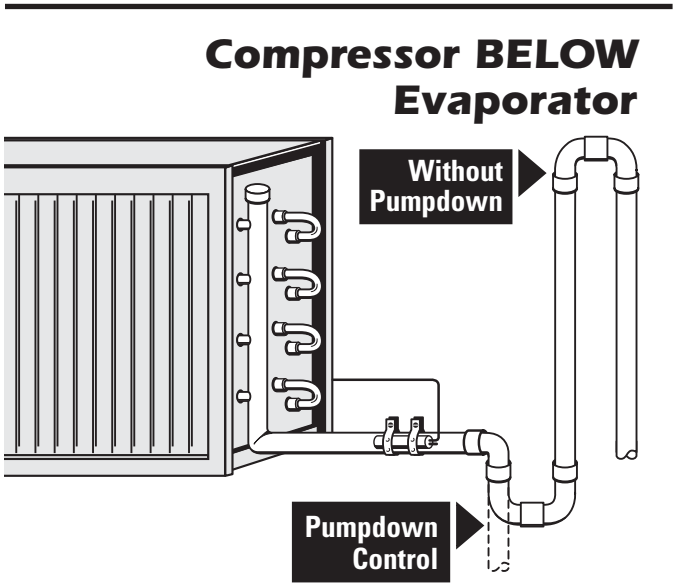


Figure 5

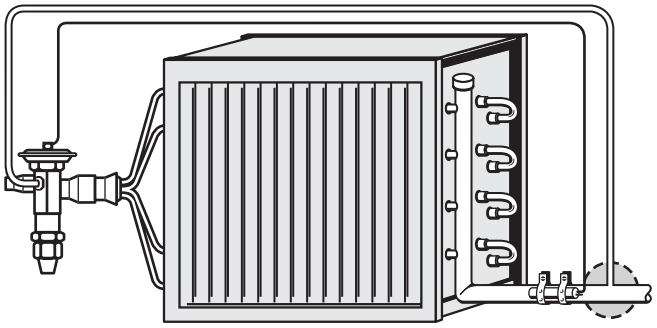
On air conditioning applications having TEVs equipped with VCP100 or VGA elements, the bulb may be located inside or outside the cooled space or duct. The valve body should not be located in the air stream leaving the evaporator. Avoid locating the bulb in the return air stream unless it is well insulated.

External Equalizer Connection

For a complete explanation of when an externally equalized valve should be used, refer to "equalization method," Bulletin 10-9. Valves supplied with an external equalizer ***will not operate*** unless this connection is made.

The equalizer connection should be made at a point that will most accurately reflect the pressure existing in the suction line at the bulb location. See Figure 6. Generally, the connection is immediately downstream of the bulb. However, equipment manufacturers sometimes locate them in return bends or suction headers that are

External Equalizer Connection



It must be connected - NEVER CAPPED!
Must be free of crimps, solder, etc.

Figure 6

compatible with their specific design requirements. The difference between the pressure at the equalizer connection and the suction pressure at the bulb location should not exceed reasonable pressure drop values. The values shown in Table 1 of Bulletin 10-9 can be used as a guide in determining the value.

If any evaporator pressure or temperature control valves are located in the suction line at or near the evaporator outlet, the equalizer must be connected on the evaporator side of these valves.

Driers, Strainers, and Accessories

Most Sporlan TEVs are equipped with built-in screens of varying mesh sizes depending on the valve size and type. These strainers are effective only in removing particles of scale, solder, etc. which could obstruct the closure of the pin and seat.

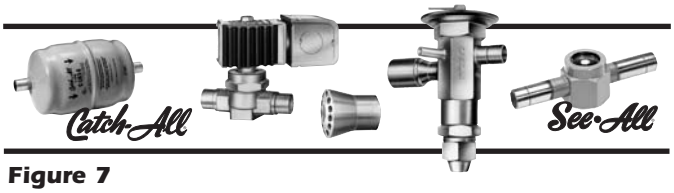


Figure 7

Moisture and smaller particles of foreign materials are equally harmful to the system and must be removed for peak system performance. Field experience has proven that, without a doubt, most expansion valve failures are due to the presence of dirt, sludge, and moisture in the system. Furthermore, the performance and life of other system components are also seriously affected by these foreign materials. The Sporlan **Catch-All Filter-Drier®** removes dirt, moisture, acids, and sludge, and insures the circulation of clean, dry refrigerant through the system at all times.

For all refrigeration and air conditioning applications we recommend that a Sporlan Catch-All Filter-Drier be installed in the liquid line ahead of the TEV. See Bulletin 40-10 for complete Catch-All Filter-Drier specifications.

Further system protection is easily and inexpensively provided with the installation of a Sporlan **See-All®**. The See-All is a combination liquid and moisture indicator that visually indicates if there is a shortage of refrigerant in the liquid line, or if the moisture content of the refrigerant is at a dangerous level. See Bulletin 70-10 for complete See-All specifications.

Test Pressures and Dehydration Temperatures

Inert dry gases such as nitrogen, helium or CO_2 are often used for leak detection.

CAUTION: Inert gases must be added to the system carefully through a pressure regulator. Unregulated gas pressure can seriously damage the system and endanger human life. Never use oxygen or explosive gases.

Excessive test pressures can shorten the life of the TEV diaphragm. Table 1 lists the maximum pressure that can safely be applied with the expansion valve connected to the evaporator. These maximum pressures are well above the minimum field leak test pressures for low sides, listed by the ANSI/ASHRAE Standard 15-2001 or latest revision.

The external equalizer line should be disconnected if there is any possibility of exceeding the recommended maximum pressures listed below.

If elevated temperatures are used to assist in dehydrating the system, the TEV should not be exposed to temperatures exceeding those shown in Table 2.

Table 2 refers to the maximum dehydration temperatures when the bulb and valve body are subjected to the same temperature. On L, C, Z, and X charges, 250°F maximum valve body temperature is permissible ***if the bulb temperature*** does not exceed those shown in the table.

Table 1
Maximum Low Side Test Pressures

Valve Type	psig
(B)I, X, NI, F, FB, (E)BF/SBF, RI, G, EG, C, S, EBS, Small O	450
D, P, H, Large O	425
A, M, V, W	400

Table 2
Maximum Dehydration Temperatures – Degrees F

Refrigerant	Thermostatic Charge					
	L	C	Z	X	VGA	P Type, ZP Series
12, 134a	190	190	250	210	---	250
22	160	160	185		250	
404A, 502, 507	150	150	170		---	
717 (Ammonia)	150	190	235	---	---	---

Expansion Valve Adjustment

Each Sporlan TEV is thoroughly tested and set at the factory before shipment. This factory superheat setting will be correct and no further adjustment is required for the majority of applications. However, there are many factors which can affect the performance of a TEV. These factors are independently variable and all of them cannot be compensated for in the design of a valve. When the application or operating conditions require a different valve setting due to one or more of the factors listed below, the valve may be adjusted to obtain the required operating superheat. Therefore, an adjusting stem is provided on all standard valves. The valve should be set with the system as near as possible to design conditions.

Factors which affect valve performance and may make it necessary to adjust the valve are:

1. Low temperature difference (TDs) between the refrigerant and the air
2. TEV bulb location
3. Balance between compressor and evaporator
4. Ratio of load to TEV capacity
5. Condenser capacity
6. Operation of several fixtures on multiple installation
7. Seasonal variation in head pressure caused by extreme changes in ambient air temperature.

Note: Valve Types F, (E)BF/SBF, Q, A, M, V, K, and W have non-rising adjusting stems and a change in adjustment does not change the stem position.

When setting valves on multi-evaporator refrigeration systems with pressure or temperature sensitive evaporator control valves, the following procedure is recommended:

1. Evaporator Pressure Regulating Valve (ORI Type): the ORI valve is set first at the minimum load condition. Then, if necessary, the expansion valve is adjusted to the desired superheat setting while under the normal operating load condition.
2. Temperature Sensitive Evaporator Regulating Valves (CDS Type): The CDS valve is forced into a fully open position first. Then the expansion valve is adjusted to the desired superheat setting at full load condition. Finally, the controller for the CDS is set to the desired temperature. Contact Sporlan Valve Company, or the case manufacturer, for additional details on setting the CDS controller.

When the adjustment is completed on the TEV, always tighten the adjusting stem packing nut and replace the seal cap tightly.

Many expansion valves are made ***non-adjustable*** for use on Original Equipment Manufacturer's units, particularly those valves used on residential air conditioning and heat pump systems. These valves are set at a superheat predetermined by the manufacturer's laboratory tests and cannot be adjusted in the field.

Some ***non-adjustable*** models are modifications of standard adjustable type valves. This is done by using a solid bottom cap instead of one equipped with an adjusting stem and seal cap. These valves can be identified by an **N** preceding the standard valve designation. Adjustable bottom cap assemblies are available for converting most non-adjustable valves to the adjustable type. However, this is rarely required. If symptoms indicate that a valve adjustment is needed, carefully check the other possible causes of incorrect superheat, pages 6 through 10, before attempting an adjustment.

How to Determine Superheat Correctly

1. Measure the temperature of the suction line at the bulb location.
2. Obtain the suction pressure that exists in the suction line at the bulb location by **either** of the following methods:
   - **a.** If the valve is externally equalized, a gauge in the external equalizer line will indicate the desired pressure directly and accurately.
   - **b.** Read the gauge pressure at the suction valve of the compressor. To the pressure add the estimated pressure drop through the suction line between bulb location and compressor suction valve. The sum of the gauge reading and the estimated pressure drop will equal the approximate suction line pressure at the bulb.
3. Convert the pressure obtained in **2a** or **2b** above to saturated evaporator temperature by using a temperature-pressure chart.
4. Subtract the two temperatures obtained in **1** and **3** – the difference is superheat.

Figure 8 illustrates a typical example of superheat measurement on an air conditioning system using Refrigerant 22. The temperature of the suction line at the bulb location is read at 52°F. The suction pressure at the compressor is 66 psig and the estimated suction line pressure drop is 2 psi …66 psig + 2 psig = 68 psig at the bulb, which is equivalent to a 40°F saturation temperature. (Use dew point temperature for refrigerant blends.) 40°F subtracted from 52°F = 12°F superheat.

Note: Refrigerated case manufacturers frequently use a "temperature difference" method to approximate superheat. This procedure consists of measuring the temperature of a location on the evaporator which is representative of saturated vapor temperature; and, then subtracting that temperature from the outlet evaporator temperature which is measured at the bulb location.

While this method of reading "superheat" is acceptable on those manufacturer's cases where the pressure drop through the evaporator is low, Sporlan does not recommend the "temperature difference" method for other types of systems.

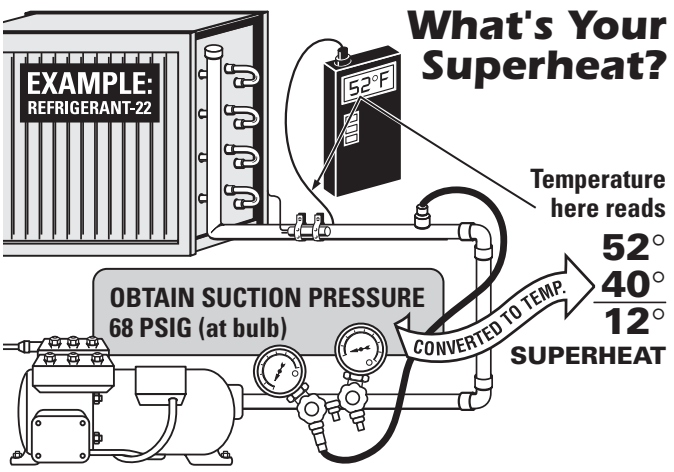


Figure 8

How to Change the Superheat Setting

Note: There are some valve bodies (G, EG, C, S, EBS and EMC) that have a packing nut around the adjustment stem. It may be necessary to loosen the packing nut slightly to turn the adjusting stem. Do not forget to retighten the nut after the superheat is set.

To reduce the superheat, turn the adjusting stem **counterclockwise**. To increase the superheat, turn the adjusting stem **clockwise**. When adjusting the valve, make no more than one turn of the stem at a time and observe the change in superheat closely to prevent ***over-shooting*** the desired setting. As much as 30 minutes may be required for the new balance to take place after an adjustment is made.

If in doubt about the correct superheat setting for a particular system, consult the equipment manufacturer. As a general rule, the proper superheat setting will depend on the amount of temperature difference **(TD)** between refrigerant temperature and the temperature of the air or other substance being cooled. Where high **TD's** exist, such as on air conditioning applications, the superheat setting can be made as high as 15°F without noticeable loss in evaporator capacity. Where low **TD's** exist, such as in low temperature blower coil applications, a superheat setting of 10°F or below is usually recommended for maximum evaporator capacity. It is these applications that the TEV will more than likely need to be adjusted.

For the correct valve setting on factory built equipment, manufacturers' recommendations should be followed. Some manufacturers specify the superheat directly; others may recommend valve adjustment to a given suction pressure at certain operating conditions, or until a certain frost line is observed. Such recommendations, however they are stated, represent the results of extensive laboratory testing to determine the best possible operation.

■ *Field Servicing*

The TEV is erroneously considered by some to be a mysterious and complex device. As a result, many valves are needlessly replaced when the cause of the system malfunction is not immediately recognized.

Actually the TEV performs only one very simple function – **it keeps the evaporator supplied with enough refrigerant to satisfy all load conditions**. It is not a temperature control, suction pressure control, a control to vary the compressor's running time, or a humidity control.

How effective the valve performs is easily determined by measuring the superheat as outlined in Figure 8. Observing the frost on the suction line, or considering only the suction pressure may be misleading. **Checking the superheat is the first step in a simple and systematic analysis of TEV performance.**

- **If not enough refrigerant is being fed to the evaporator — the superheat will be high.**
- **If too much refrigerant is being fed to the evaporator — the superheat will be low.**

Although these symptoms may be attributed to improper TEV control, more frequently the origin of the trouble lies elsewhere.

Note: TEVs with permanent bleed ports **(BP)** or Rapid Pressure Balancer **(RPB)** construction are applied on many air conditioning and refrigeration systems by original equipment manufacturers. Each application is tested and approved by the manufacturer. The primary function of these devices is to equalize high-to-low side pressures during the off cycle on systems equipped with low starting torque compressors.

However, some BP type valves are applied to allow small amounts of liquid refrigerant to pass for compressor motor cooling. The specific function of the feature on a given unit must be determined from the system manufacturer. Once that is determined, it is easier to troubleshoot the system.

The primary cause of difficulty with either the BP or RPB feature is dirt and other foreign materials that restrict or plug them. And if the system purpose intended for either feature is not being satisfied, the valve probably needs cleaning or replacing.

As stated in Bulletin 10-9, the RPB type valve is not to be applied on systems using high starting torque compressors or "hard-start" electrical components, on outdoor coils of heat pumps, or on any refrigeration system, and it should ***not*** be used to replace BP type valves that are applied on those types of systems. On systems other than those described above, the RPB type valve can replace the BP type valve when necessary. Usually it is advisable to replace a valve with one of the same specification unless advised differently. Consult with the system manufacturer for assistance.

Complaint "A"

"Valve does not feed enough refrigerant."

SYMPTOMS:

- ***Load temperature (air or water leaving evaporator) too high.***
- ***Superheat too high.***
- ***Suction pressure lower than normal with compressor unloaders locked out or hot gas bypass shut off.****

THE CAUSE MAY BE:

1. ***Moisture*** — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation. This is a common source of trouble on expansion valves. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is frozen in the intermediate position so that flow is restricted, the superheat will be high.

   Remedy — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

   To determine a safe level of moisture in the system, install a Sporlan See•All Moisture and Liquid Indicator. See Bulletin 70-10.

   Excessive moisture has a damaging effect on all system components regardless of the evaporating temperature. Moisture must be removed for trouble-free performance.

2. ***Dirt or foreign material*** — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. will restrict the flow of refrigerant when it collects in strainers or other liquid line accessories. This produces a shortage of refrigerant at the TEV port. Conventional strainers frequently allow the material to pass through the screen and obstruct the flow at the valve port. If a See•All is installed downstream of the restriction, bubbles will be visible. This should not be confused, however, with a refrigerant shortage or excessive liquid line pressure loss which are also indicated by bubbles in the See•All.

   Remedy — Locate and remove the foreign material creating the restriction. Install a Sporlan Catch-All Filter-Drier to provide effective filtration of the refrigerant. See Bulletin 40-10.

* When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.

3. ***Wax*** — Certain systems are contaminated with small amounts of wax which will precipitate at low temperatures in systems with Refrigerants 22 or 502. Since the TEV represents the first cold point in the refrigeration cycle, wax is most likely to form at the valve port.

   It is sometimes difficult to observe the wax in a valve because it may exist in solid form only at very low temperatures. By the time the valve has been taken apart, the temperature has increased enough to cause the wax to melt and thus become difficult to detect. When wax is suspected, it can usually be detected on the pin and seat by packing the valve in dry ice while disassembling.

   Remedy — Clean the valve with solvent before reassembling the valve. The Sporlan HH style Catch-All Filter-Driers have a special activated charcoal desiccant that is designed to remove wax in the liquid line before it causes trouble. Therefore, to prevent wax problems, use these HH style driers (e.g., C-415-S-HH) on all low temperature systems using Refrigerants 22 or 502.

4. ***Refrigerant shortage*** — See•All or sight glass in the liquid line will show bubbles when the system is short of refrigerant charge. Before adding more refrigerant however, be sure the bubbles are not produced by other causes (See Paragraphs **A-2** and **A-5**).

   A lack of refrigerant charge may also be detected by a hissing sound at the TEV. Some systems not equipped with a liquid line sight glass will have test cocks or other devices for checking the refrigerant level in the receiver.

   Remedy — Add enough refrigerant to obtain desired result.

5. ***Gas in the liquid line*** — As explained in Paragraphs **A-2** and **A-4**, liquid line vapor can be produced by a partially plugged strainer or drier and by a shortage of refrigerant charge. In addition, gas in the liquid line can be caused by air or other non-condensable gases in the system or by excessive pressure losses in the liquid line as a result of:

   - Long or undersized line.
   - Liquid line vertical lift.

   Remedy — Verify the correct liquid line size for the equivalent length and system tonnage. Consult liquid line sizing data published in many manufacturers' catalogs and in textbooks. If undersized, repipe with the correct size.

   Determine amount of vertical lift, and obtain the resulting pressure loss from Table 3, Bulletin 10-9. Using the subcooling calculation example provided in the "subcooling" section of Bulletin 10-9, find required subcooling necessary to prevent gasification with the existing pressure losses. Provide the necessary subcooling by using one of the methods described on Page 1.

6. ***Misapplication of internally equalized valve or incorrect location of external equalizer*** — If the pressure drop through the evaporator exceeds the predetermined values shown in Table 1, Bulletin 10-9, an externally equalized valve must be used. When an externally equalized valve is used, the equalizer connection should be made at a point in the suction line that will reflect the pressure existing in the line at the bulb location.

   Remedy — Replace internally equalized valve with one having an external equalizer.

   If external equalizer is installed incorrectly, change to correct location. See Page 3.

7. ***Insufficient pressure drop across valve*** — One of the factors that influence expansion valve capacity is the pressure drop that exists between the inlet and outlet. Anything contributing to a reduction in this pressure drop will reduce valve capacity. Abnormally low condensing pressures, excessive liquid line pressure losses (even with adequate subcooling), undersized distributor nozzle or distributor tubes may also be responsible for a very low net pressure drop across the valve port.

   Remedy — Remove source of pressure loss, or install valve with adequate capacity at the reduced pressure drop. If inlet pressure to valve is low due to low condensing pressure, raise pressure.

   If the refrigerant distributor nozzle is undersized replace with correct size. See Bulletin 20-10.

8. ***Dead thermostatic element or wrong thermostatic charge*** — If the element has partially or completely lost its thermostatic charge, the valve will be unable to feed sufficient refrigerant or will remain closed. A wrong charge may cause insufficient feed also.

   Remedy — Replace the element if it is dead. If charge is incorrect, replace with proper selective charge. See Bulletin 10-9.

9. ***Charge migration (CP series, ZP series, and VGA charges only)*** — In order for valves with these charges to maintain control at the bulb, the bulb must be kept at a lower temperature than the element (diaphragm case). If the thermostatic charge does migrate to the element because of a lower element temperature, the valve will throttle.

   Detection — Warm the element with a cloth saturated with hot water. If this produces more refrigerant feed and reduces the superheat to normal, charge migration is responsible for the starved evaporator.

   Causes —
   - Insufficient pressure drop between the valve outlet and bulb location, possibly due to an oversized distributor nozzle or no nozzle at all.
   - Excessive pushrod leakage, which allows the leaking refrigerant to cool the diaphragm case before passing into the equalizer line. This is a rare occurrence and should be carefully checked before arriving at this conclusion.
   - Cold location of TEV, or condensate drippage on the diaphragm case.

   Remedies —
   - Install distributor nozzle correctly sized in accordance with nozzle sizing procedure given in Sporlan Bulletin 20-10.
   - On valves with packed pushrod construction, remove element and tighten the pushrod packing nuts.
   - Relocate the TEV away from cold outlet air, or condensate drippage.

10. ***Undersized valve***

    Remedy — Install valve sized in accordance with procedure given in Bulletin 10-9, or Bulletin 10-10.

11. ***High Superheat adjustment***

    Remedy — Turn the adjusting stem counter clockwise until the correct superheat is indicated.

12. ***Feed-back from another valve*** — Review instructions for Bulb Location and Installation, Page 2.

    Remedy — Check the bulb temperature and calculate the superheat. If superheat is normal but too little refrigerant is

flowing through the evaporator, check the piping for possible refrigerant flow from another evaporator affecting the bulb. Re-pipe if necessary. See Figure 4.

13. *High pressure drop through evaporator*

Remedy — Check the pressure at the evaporator inlet and outlet with gauges. If pressure difference is greater than the values shown in Table 1, Bulletin 10-9, use an externally equalized valve.

14. *Restricted, plugged, or capped external equalizer* — If the pressure under the diaphragm builds up due to pushrod leakage and cannot escape through the external equalizer line, the valve will remain closed.

Remedy — Check the external equalizer line to be sure it is open or not capped.

Complaint "B"

"Valve feeds too much refrigerant."

SYMPTOMS:

- ***Liquid returns to compressor.***
- ***Superheat is low.***
- ***Suction pressure is normal or higher than normal.***

THE CAUSE MAY BE:

1. *Moisture* — Water or a mixture of water and oil frozen in the valve port or working parts of the valve will prevent proper operation. This is the most common source of trouble on TEVs. Since the valve is the first cold spot in the system, moisture will freeze and block the valve open, closed, or any position in between. If the valve is held in the open position by ice, liquid flood-back will occur.

Remedy — Install a Sporlan Catch-All Filter-Drier in the liquid line for removal of moisture from the refrigerant and oil. See Bulletin 40-10.

For additional protection, install a Sporlan See•All Moisture and Liquid Indicator for a positive indication of when a safe moisture level is reached. See Bulletin 70-10.

2. *Dirt or foreign material* — Contaminants such as copper oxide scale, metal chips, oil breakdown sludge, etc. may pass through ordinary strainers and lodge at the TEV port and prevent the valve from closing.

Remedy — Disassemble the valve and remove all foreign material from the internal parts. Install a Sporlan Catch-All Filter-Drier in the liquid line. The Catch-All filters out the smallest particles of foreign material that might interfere with the operation of any system component.

3. *Expansion valve seat leak* — When the valve port does not seat tightly, refrigerant will pass through during the off-cycle and fill the evaporator with refrigerant. If the seat leak is severe, the valve will feed too much refrigerant during the operating cycle as well. (Not applicable to valves with permanent bleed ports or RPB feature.)

Remedy — If the valve seat is leaking, a gurgling or hissing sound can usually be heard during the off-cycle. Also, a sight glass or See•All in the liquid line may indicate continued refrigerant flow for a long period after the compressor has stopped. Make certain however, that the bubbles are not the result of ***back-flow*** through a vertical liquid line.

Disassemble the valve to be certain that dirt or foreign material is not responsible (see **B-2**). If the pin and seat are worn or damaged and an internal parts kit is available, replace the parts. When parts are not available, the valve must be replaced.

4. *Oversized valve* — Check valve ratings considering all the factors which affect its capacity. See Page 16, Bulletin 10-9, or Page 3, Bulletin 10-10.

Remedy — Install correctly sized valve.

5. *Incorrect bulb installation* — The bulb should be securely fastened to a straight, clean, section of the suction line using two bulb straps for good thermal contact. Also, the temperature of the bulb should not be influenced by ambient temperature — an external heat source such as a steam pipe or heating coil.

Remedy — Install bulb correctly. See Bulb Location and Installation, Page 2.

6. *Low superheat adjustment*

Remedy — Turn the adjusting stem clockwise until the correct superheat is indicated. See Page 4.

7. *Incorrect thermostatic charge*

Remedy — Select and install the correct selective charge. See Bulletin 10-9.

8. *Incorrectly located external equalizer*

Remedy — Relocate external equalizer or the connection between evaporator and any other temperature or pressure sensitive evaporator control valve near bulb location. See Page 3 for recommendations.

9. *Inefficient compressor* — If the compressor is inefficient or for some other reason lacks capacity, the suction pressure will operate higher than normal. This may or may not be accompanied by low superheats.

Remedy — Consult with compressor manufacturer.

Complaint "C"

"Valve feeds too much refrigerant <u>at start-up only</u>."

SYMPTOMS:

- ***Liquid returns to compressor.***
- ***No superheat.***
- ***Suction pressure higher than normal.***

THE CAUSE MAY BE:

1. *Refrigerant drainage* — Drainage of refrigerant from the evaporator (during the off-cycle) when installed at a higher level than the compressor.

Remedy — Install a trap-riser to top of evaporator or use pump-down control. See Figure 5.

2. *Compressor or suction line in cold location* — During the period when the system is not in operation, liquid refrigerant will condense at the coldest point in the system. Liquid will condense in the compressor or suction line, if they are located in an ambient temperature below that of the evaporator during the off-cycle. Upon re-starting, this liquid will slug the compressor.

Remedy — Keep compressor or suction line warm during the off-cycle. Some compressors are equipped with crankcase heaters

for this purpose. Another corrective measure is to install a suction line solenoid valve that is de-energized during the off-cycle.

3. ***Restricted or plugged external equalizer*** — A momentary flood can occur when the load increases suddenly, such as at start-up because the higher suction pressure cannot reach the underside of the diaphragm and help close the valve. If the pressure under the diaphragm increases due to any pressure leakage around the pushrods, the valve will eventually throttle.

   Remedy — Remove the restriction or plugged portion of the external equalizer.

4. ***Liquid line solenoid valve seat leak or interrupted pumpdown*** — Liquid refrigerant can continue to feed the TEV and/or remain in evaporator upon shut-down causing flood-back to the compressor upon start-up.

   Remedy — Disassemble and clean solenoid valve and/or replace damaged internal parts if seat leakage is the problem. If the pumpdown cycle isn't completed before the compressor cycles off, or the thermostat calls for cooling and reopens the liquid line solenoid before the evaporator has been properly evacuated, check the low pressure cut-off setting or the electrical controls for possible causes.

Complaint "D"

"Valve doesn't feed properly."

SYMPTOMS:

- ***Poor system performance.***
- ***Superheat normal or lower than normal.***
- ***Suction pressure lower than normal with compressor unloaders locked out or hot gas bypass shut off.****

THE CAUSE MAY BE:

1. ***Unequal circuit loading (Multi-circuit evaporators and parallel evaporators connected to a single refrigerant distributor)*** — When each circuit is not subjected to the same heat load, the lightly loaded circuits will allow unevaporated refrigerant or low temperature vapor to enter the suction line and throttle the valve. This will cause normally loaded circuits to be deprived of their share of refrigerant. The net result is a loss of refrigerated evaporator surface.

   Remedy — Make necessary modifications which will allow each evaporator circuit to receive the same percentage of the total load. See Bulletin 20-10 for application information on multi-circuit evaporators using a refrigerant distributor.

2. ***Poor refrigerant distribution (Multi-circuit evaporators and parallel evaporators connected to a single refrigerant distributor)*** — If the refrigerant distribution is faulty, the circuits receiving the largest portion of refrigerant will have the controlling influence on the TEV. The result is the same as in paragraph 1 above.

   Remedy — Correct refrigerant distribution. See Bulletin 20-10 for complete information on Refrigerant Distributors.

3. ***Low load***— Low evaporator load may be caused by insufficient air over the coil as a result of an undersized blower, dirty air filters, or an obstruction in the air stream. In addition, frost formation on the coil or low entering air temperatures will reduce the evaporator load.

   Remedy — Correct the condition responsible.

4. ***Flow from one coil affecting TEV bulb of another (Multiple evaporator systems only)*** — The temperature of the bulb may be falsely influenced by flow from another evaporator usually because of incorrect piping.

   Remedy — Correct the piping. See Figure 4, Page 3.

5. ***Improper compressor-evaporator balance*** — If the compressor is too large for the load and evaporator capacity, the low suction pressure which results will cause poor system performance.

   Remedy — Consult with the manufacturer or consulting engineer, or the ASHRAE Handbook on component balancing. If necessary, change or correct the improperly sized component. Hot gas bypass may be used to balance properly.

6. ***Evaporator oil-logged*** — Poor heat transfer occurs and unpredictable performance takes place. If erratic performance is observed over a period of time, and other causes are omitted from consideration, review the amount of oil in the system. Turbulent compressor oil level with little or no return to the compressor sump indicates oil problems.

   Remedy — Remove excessive oil from evaporator and connecting piping. Many times the evaporator temperature will be too low for the oil to be removed. Therefore, the system must be allowed to warm sufficiently to get cold oil to drain. Analyze system components for possible causes of oil problem before restarting the system. Consult with the compressor manufacturer for specific details on their compressor.

Complaint "E"

"System hunts or cycles."

SYMPTOMS:

- ***Suction pressure fluctuates****
- ***Superheat fluctuates.***
- ***Valve does not feed enough, and then too much refrigerant.***

THE CAUSE MAY BE:

1. ***System characteristics*** — Certain design characteristics of the system may have an effect on the system's tendency to hunt or cycle. As an example, after the valve admits refrigerant to the evaporator inlet, there is a time delay before the bulb senses the effect at the evaporator outlet. This time delay is dependent on evaporator length, tube size, and load. Generally, there is more likelihood for hunting to occur when this time interval is long. Other influencing factors are circuit arrangement, load per circuit, and temperature difference.

   Remedy — When hunting is moderate particularly with no floodback, the effect on the system is insignificant and correc-

* When system has some form of capacity reduction — cylinder unloaders or hot gas bypass, a low suction pressure will not exist. Therefore, when checking TEV performance, a better analysis is possible when these devices are locked out or shut off so the suction pressure will respond to variations in load or valve feed.

tions are not necessary. If hunting is severe with floodback to the compressor, check the possible remedies shown in paragraphs below.

2. ***Valve size*** — An over-sized valve usually aggravates hunting. Carefully check the valve rating considering all the factors affecting its capacity. See Bulletin 10-9, or Bulletin 10-10.

   Remedy — Replace valve with one correctly sized. On multiple circuit evaporators using a refrigerant distributor, the capacity of the valve can be reduced, within certain limits, by installing a smaller distributor nozzle. See Bulletin 20-10.

3. ***Bulb location*** — If the bulb is located in a suction line trap, its temperature will be affected by liquid oil and refrigerant alternately collecting and evaporating at this point. This condition frequently results in severe hunting.

   Remedy — As a temporary measure relocate the bulb away from the trap, and any turbulent areas created by elbows, tees, etc. Also remove the bulb from the air stream or insulate. Re-pipe if necessary. Sometimes another position around the circumference of the suction line will minimize hunting. Follow the Bulb Location and Installation instructions given on Page 2 for the best TEV control.

4. ***Refrigerant and load distribution*** — In addition to the effects of poor distribution explained in paragraphs **D-1** and **D-2**, hunting also frequently results. This is caused by liquid refrigerant from the overfed circuits occasionally reaching the bulb of the valve.

   Remedy — Correct the faulty distribution.

5. ***Superheat adjustment*** — All Sporlan TEVs are preset at the factory to give the best performance on the average system. A valve should not be adjusted unnecessarily, but occasionally another setting may prove to be better.

   Remedy — Turn the adjusting stem clockwise a turn at a time. If the hunting stops or is reduced, turn the adjusting stem counter clockwise a turn at a time to obtain the lowest superheat with stable operation.

6. ***Moisture*** — As ice forms in a TEV from excessive moisture, a very erratic hunt may result.

   Remedy — Remove the moisture with the installation of a Sporlan Catch-All Filter-Drier. A safe moisture level can be determined by installing a Sporlan See•All.

Complaint "F"

"System won't perform properly."

SYMPTOM:

- ***Cannot get valve to react or regulate at all.***

THE CAUSE MAY BE:

1. ***No refrigerant being fed to evaporator***. See Section **A** on Pages 6 & 7.

2. ***Too much refrigerant being fed to evaporator***. See Section **B** on Page 8.

3. ***Too much refrigerant being fed to evaporator at start-up only***. See Section **C** on Page 8.

4. ***Refrigerant control is erratic***. See Section **D** on Page 9.

5. ***System is hunting or cycling***. See Section **E** on Page 9.

6. ***The TEV has been physically abused in an effort to make the valve work properly.*** This is usually the result of a mistaken analysis. It is frequently assumed that if a valve does not feed properly, it is stuck (either opened or closed). Beating the valve body with a hammer will only distort the body and make it impossible for the valve to work once the real cause is determined.

   If a valve "sticks," it is usually due to moisture freezing in the port, dirt and other foreign material restricting or plugging the internal parts, wax forming on the internal parts at low temperatures, or the valve has been physically abused so it **cannot** function.

   Remedy — Inspect the valve and its internal parts, including the inlet strainer. If plugged or restricted in any way, clean the parts thoroughly, oil the parts with a good grade of refrigerant oil, and reassemble the parts. Complete details on this subject are found on Pages 10 through 12.

   If the valve is beyond normal cleaning processes, or if it is physically damaged in any way, replace the valve with its proper replacement model.

■ Field Assembly Instructions

Sporlan valves my be opened easily for inspection.

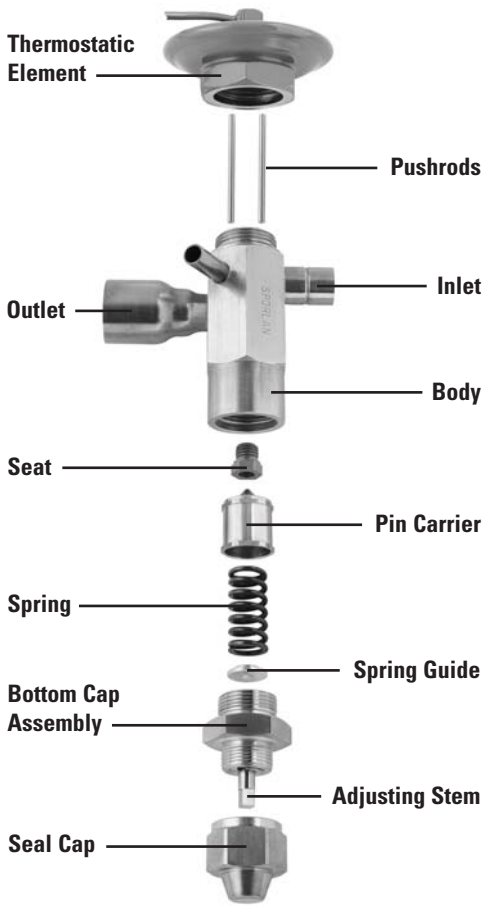


Figure 9

Note: These Field Assembly Instructions apply in part to all Sporlan TEVs. See Figure 9 for an "exploded" view of those models that can be completely disassembled. When a TEV is to be disassembled for inspection and cleaning, or for replacement of the thermostatic element or the internal parts, the following information should be reviewed for assistance.

Types F dated approximately C84 or earlier and Types I, BI, NI, RI, FB manufactured prior to 1994 do not have replaceable elements nor internal parts kits, but can be disassembled for inspection and cleaning. Type F dated D84 or later, Type S valves dated B69 or later, Type C valves dated C70 or later, and **ALL** Type G, X, (E)BF/SBF and EBS valves employ packless pushrod construction and internal parts are NOT available for use with them. However, their elements can be replaced and they can be disassembled for inspection and cleaning. Due to the single pushrod construction of the Type (E)BF/SBF and EBS valves, only the bottom cap assembly, pin guide, and superheat spring may be removed for inspection and cleaning.

Early production of the Type F valve with the replaceable element requires a 15/16" **thin jaw**, open end type element wrench such as a Bonney 1230. Subsequent production of the Type F valve and all Types (E)BF/SBF, I, BI, NI, RI, and FB valves require a 1" **thin jaw**, open end type element wrench such as the one available from Sporlan wholesalers. An open end wrench is necessary because of limited space between the body and element of these valves. Precautions must be taken in removing the KT-43 element (F) so the element, body, or connections are not damaged by the wrenches.

While standard open end or adjustable wrenches fit the other element sizes, the **thin jaw** type wrenches are also available for the other element sizes: Bonney 1236 (1-1/8") for KT-53 elements, Bonney 1240 (1-1/4") for KT-83 elements, Bonney 1248 for KT-33 elements, and Bonney 1252 for KT-63 and 7 elements.

Replaceable elements and internal parts kits are available for current valves with ***packed*** pushrod construction:
Types P, H, M, D, and A.

Replaceable elements for Types O, V, W, and U are also available. However, special field assembly instructions are included with their internal parts kits.

Assembling Instructions

The following steps are necessary in properly disassembling, inspecting, cleaning, and reassembling a TEV whether the valve is in or out of the refrigerant piping.

1. Before disassembling the valve, be sure the refrigerant pressure in the system has been reduced to a safe level **(0 psig)**.

2. Remove the seal cap and turn the adjustment stem counter-clockwise to relieve the spring force. Count and record the number of turns so adjustment can be returned to its original position.

3. Using appropriate wrenches or a vise to properly support the valve body, remove the element (if a replaceable type), the bottom cap assembly, and the internal parts. (Only remove the bottom cap, pin guide, and superheat spring on Type (E)BF/SBF and EBS valves. **DO NOT** remove the single pushrod from these valves.)

   Caution: Regardless of whether the valve is in the system or in a vise, care must be taken to prevent distorting the body by exerting too much pressure in tightening the element or in clamping the body in the vise. Also, do not use a wrench on the outer welded edge of the element.

4. Inspect parts, element, and body for any foreign materials or physical damage.

5. On valves with replaceable elements and/or internal parts, replace any items that appear damaged.

6. Clean all parts with solvent, preferably by applying and then blowing off with clean dry compressed air.

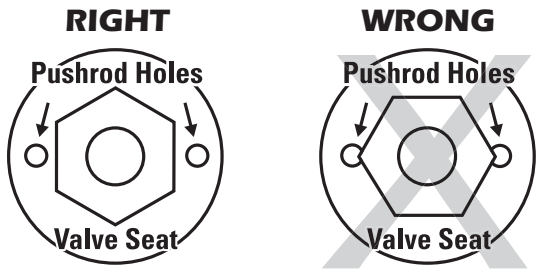


Figure 10

7. To reassemble valves with replaceable seats, screw seat into body with a fairly light pressure since it does not require a heavy pressure to make this small knife-edge joint.

   Caution: Be sure hexagon corners of seat do not protrude into pushrod holes (see Figure 10).

   For valves that do not have replaceable elements or for Type O valves, place the pushrod(s) into the body now.

8. Next, slip the pin and carrier (which have been pressed together at the factory) into the body and tap the pin into the seat to form a true seating surface. It is generally advisable, before tapping these parts together, to check the concentricity of both the pin and seat by engaging the parts by pressing them lightly together with one finger and noting that there is no tendency to stick together. This should be repeated several times after rotating the pin carrier a quarter of a turn. In assembling valves with port sizes of 1/4" and larger which use the flat disc instead of the tapered pin, **DO NOT TAP THE DISC AGAINST THE SEAT.**

9. Now place the spring guide stamping (when used), and spring, in the pin carrier, place the lower spring guide on the opposite end of the spring and screw the bottom cap in place. (Replace the pin guide, spring, and bottom cap assembly together on Type (E)BF/SBF and EBS valves.) After screwing bottom cap assembly in place, carefully tighten, preferable with two 10" wrenches, to seal the metal-to-metal knife edge joint. The sealing surfaces should be free of any foreign material or nicks that might prevent a leak-tight joint.

10. On valves with replaceable elements (except Types O, (E)BF/SBF and EBS), place the pushrods into the body and open the valve several times by pressing down on the pins with a flat metal surface. This will help seat the pin properly.

11. Check the height of the pushrod(s) above the element sealing surface with the pushrod gauge (see Figure 11). The gauge is supplied with internal parts kits or can be obtained at no charge

Table 3

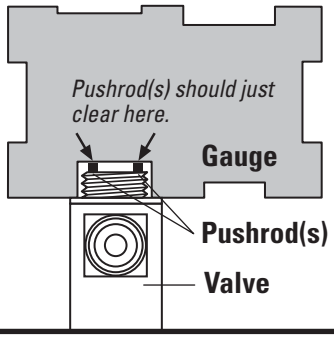
Valve Type①		Gauge Number
Current	**Obsolete**	
AA(E), LMC-AA(E)	---	1
DA(E), LMC-DA(E)	---	2
PFE or HFE-1 1/2, 3, 4, 5, 8, 12	PFE or HFE-6, 7 1/2, 10, 11	3
PVE or HVE-2 1/2, 5 1/2, 7, 11, 16, 20	PVE or HVE-2, 5, 8, 10, 12, 15, 17, 18	
PDE or HDE-5, 8, 14	PDE or HDE-6, 7 1/2, 9, 12, 13	
PRE or HRE-1 1/2, 4, 6 1/2, 9, 12	PRE or HRE-6, 7 1/2, 11, 13	
---	UFE-12, 17	
	UVE-22, 30	
	UDE-15, 21	
	URE-16, 22	
OFE-23, 32, 40	UFE-23	3A
OVE-40, 55, 70	UVE-40	
ODE-28, 40, 50	UDE-28	
ORE-30, 35, 45	URE-30	
All F Models② except FF(E)-1/8, FV(E)-1/4, FD(E)-1/8, FR(E)-1/8	---	4
All G Models except GF(E)-1/8, GV(E)-1/4, GR(E)-1/8	All small K models	5
All X Models	---	
MFE-5, 7 1/2, 11, 13, 15, 20	MFE-12, 17	6
MVE-8, 12, 18, 21, 26, 34	MVE-30	
MDE-6, 9, 13, 15, 18, 25	MDE-14, 20	
MRE-9, 15, 20, 25	---	
KFE or VFE-45, KVE or VVE-70		
KDE or VDE-55, KRE or VRE-50		
MFE-25	MFE-22	6A
MVE-42	MVE-40	
MDE-30	MDE-26	
MRE-30	---	
KFE or VFE-35, 55	VFE-50	
KVE or VVE-52, 100	VVE-90	
KDE or VDE-40, 65	VDE-42, 60	
KRE or VRE-38, 70	---	
WFE-80, 110	WFE-75, 100	7
WVE-135, 180	---	
WDE-95, 130	WDE-90, 120	
WRE-100, 130	---	
CF(E) or SF(E)-1/4, 1/2, 1, 1 1/2, 2, 2 1/2, 3	R and T Models with 83 elements	8
CV(E) or SV(E)-1/2, 1, 1 1/2, 2, 3, 4, 5		
CD(E) or SD(E)-1/4, 1/2, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2		
CR(E) or SR(E)-1/4, 1/2, 1, 1 1/2, 2, 3, 4		
CFE-5, SFE-5, 6	---	8A
CVE-8, SVE-8, 10		
CDE-6, SDE-6, 7		
CRE-6, SRE-6, 7		
OFE-6, 9, 12		
OVE-10, 15, 20		
ODE-7, 11, 14		
ORE-6, 9, 12		
OFE-16, OVE-30 ODE-20, ORE-21③	---	8B

upon request. (Since the internal parts of the Type (E)BF/SBF and EBS valves cannot be replaced, it is not necessary to check the pushrod height of these valves.)

The appropriate gauge numbers for the various TEV's are given in Table 3.

Caution: If the element-to-body joint utilizes a gasket, the gasket must be removed before checking pushrod height.

If the pushrod(s) are too long, they must be carefully ground off to the proper length. Clean the pushrod(s) of all dirt and grindings and place them into the body.



Check Height of Pushrod(s) with Gauge

Figure 11

12. *Element Replacement* — If the element is damaged or has lost its thermostatic charge, replace it with the same type.

To properly replace the element without damaging the element or the valve body on valves which utilize a gasketed joint, be sure only one gasket is used before assembling the element. In assembling gasketed elements held in place by two cap screws, be sure to pull up the cap screws evenly.

On valves which utilize the threaded type of element with metal-to-metal knife edge joints, always use an appropriate wrench (10") on the wrench flats. **DO NOT** use a wrench on the outer welded edge of the element. The sealing surfaces should be free of any foreign materials or nicks that might prevent a leak-tight joint. A few drops of refrigerant oil on the element threads will facilitate easy assembling and removal.

13. Return the superheat spring adjustment to its original position. Replace the seal cap tightly.

① Type F (internally and externally equalized) valves dated D84 or later, Type S valves dated B69 or later, Type C valves dated C70 or later, and all Type G (externally equalized only) and X valves have packless pushrod construction and internal parts kits are not available for use with them.

② Applies only to Type F valves with a replaceable element.

③ Formerly used the KT-33-8 element and gauge number 33-8 (redesignated 8B). The KT-33-8 element has been replaced by the KT-83.

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Bulletin C401d
March, 2002

HANSEN TECHNOLOGIES CORPORATION

HCK4-4 Check Valve

Specifications, Applications, Service Instructions & Parts

HCK4 IN-LINE CHECK VALVES
5/8" thru 4" PORT
(16 thru 100 mm)

Flanged
3/8" thru 4"
FPT, SW, WN, ODS
for refrigerants

INTRODUCTION

The HCK4 series of dependable, compact, rugged in-line check valves (disc type non-return valves) is ideally suited for refrigerant flow control applications. Valves open wide for flow in the arrow direction on the valve body. Valves close quickly and reliably when flow reversals occur.

Plated bodies and stainless steel seat discs and springs enable them to withstand expected industrial refrigeration conditions. Furthermore, these check valves can be mounted in any position, close-coupled to other valves, and use same flanges as Parker R/S, Frick, and Henry.

ADVANTAGES

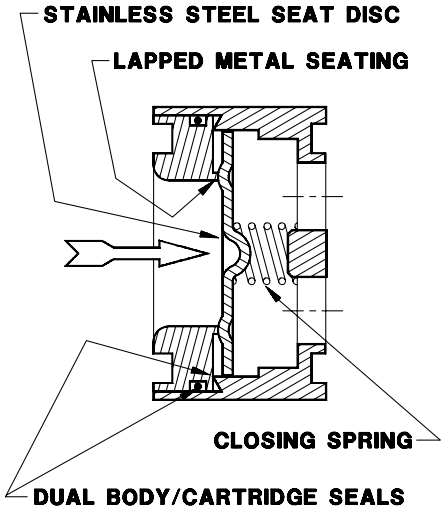
These compact check valves offer reliable operation regardless of position. Corrosion resistant stainless steel seat disc. Metal-to-metal seats facilitate durable, tight closing of valves.

APPLICATIONS

These in-line check valves are designed to provide refrigerant flow control to hot gas lines, liquid lines, compressor discharge lines, suction lines, and hot gas heated drain pans.

These valves are not recommended for use with pulsating loads such as low speed compressor discharge and screw compressor side port applications. For applications such as these, use Hansen HCK1 piston type check valves.

KEY FEATURES



ADDITIONAL FEATURES

Mounts in any position
Less than 1 PSID wide opening pressure
Can be close-coupled
Low bubble leakage tolerance
For Ammonia, R22, R134a, and other approved refrigerants
Dimensionally replaces R/S CK4A-2, -3, -4, -8, & -1
U.L. Listed

MATERIAL SPECIFICATIONS

Body:
- **⅝" thru 1¼": Steel, ASTM A108, zinc chromate plated**
- **1½" thru 4": Ductile iron, ASTM A536, zinc chromate plated**

Seat Disc: Stainless steel
Seat Cartridge:
- **⅝" thru 1¼": Stainless steel, ASTM A582**
- **1½" thru 4": Steel, ASTM A108, zinc chromate plated**

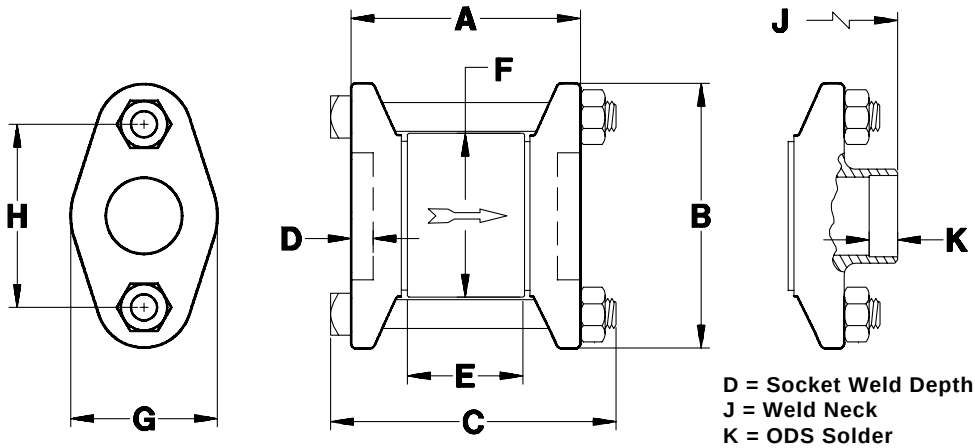
Spring: Stainless steel
Safe Working Pressure: 400 PSIG (27 bar)
Operating Temperature: -60F to 240F (-50 to 115°C)

INSTALLATION

Valve may be located in any position. Arrow on valve body should match direction of flow. Secure valve with gaskets between flanges and tighten bolts evenly. Do not use this valve or any component to align pipes or tighten gap between flanges.

Do not install on inlet side of solenoid valves or control valves with electric shut-off or shut-off valves unless a relief valve is used from therein between piping. Do not install on inlet side of outlet pressure regulators where liquid may become trapped. Instead, check valves should be located on outlet side of these valves. Check valves can be close-coupled to other matching solenoid valves, pressure regulators, or strainers by using a Male Adapter Ring and longer bolts supplied when so specified on order.

INSTALLATION DIMENSIONS



D = Socket Weld Depth
J = Weld Neck
K = ODS Solder

DIMENSION LETTER	HCK4-2* ⅝" PORT	HCK4-3* ¾" PORT	HCK4-4* 1" PORT	HCK4-5 1¼" PORT	HCK4-7 1½" PORT	HCK4-8* 2" PORT	HCK4-9 2½" PORT	HCK4-0 3" PORT	HCK4-1* 4" PORT
A	2.50" (64 mm)	3.25" (83 mm)	3.25" (83 mm)	3.25" (83 mm)	5.06" (129 mm)	5.06" (129 mm)	6.06" (154 mm)	6.06" (154 mm)	6.39" (162 mm)
B	3.19" (81 mm)	4.50" (114 mm)	4.50" (114 mm)	4.50" (114 mm)	4.56" (116 mm)	4.56" (116 mm)	6.00" (152 mm)	6.00" (152 mm)	7.13" (181 mm)
C	3.50" (89 mm)	4.50" (114 mm)	4.50" (114 mm)	4.50" (114 mm)	6.38" (162 mm)	6.38" (162 mm)	7.50" (191 mm)	7.50" (191 mm)	8.00" (203 mm)
D	0.38" (10 mm)	0.50" (13 mm)	0.50" (13 mm)	0.50" (13 mm)	0.75" (19 mm)	0.75" (19 mm)	1.00" (25 mm)	1.00" (25 mm)	1.00" (25 mm)
E =	1.03" (26 mm)	1.22" (31 mm)	1.22" (31 mm)	1.22" (31 mm)	2.56" (65 mm)	2.56" (65 mm)	2.92" (74 mm)	2.92" (74 mm)	3.50" (89 mm)
F	1.50" (38 mm)	2.37" (60 mm)	2.37" (60 mm)	2.37" (60 mm)	3.62" (92 mm)	3.62" (92 mm)	4.84" (123 mm)	4.84" (123 mm)	6.06" (154 mm)
G	1.56" (40 mm)	2.50" (64 mm)	2.50" (64 mm)	2.50" (64 mm)	4.56" (116 mm)	4.56" (116 mm)	6.00" (152 mm)	6.00" (152 mm)	7.13" (181 mm)
H	2.19" (56 mm)	3.12" (79 mm)	3.12" (79 mm)	3.12" (79 mm)	3.06" (78 mm)	3.06" (78 mm)	4.00" (102 mm)	4.12" (105 mm)	5.00" (127 mm)
J	3.26" (83 mm)	4" (102 mm)	4" (102 mm)	4" (102 mm)	6.06" (154 mm)	6.06" (154 mm)	7.06" (179 mm)	7.06" (179 mm)	9.89" (251 mm)
K	0.33" (8 mm)	0.49" (12 mm)	0.59" (15 mm)	0.62" (16 mm)	0.71" (18 mm)	0.87" (22 mm)	0.96" (24 mm)	1.08" (27 mm)	1.40" (36 mm)
Valve Cv (Kv)	5.8 (5)	8.2 (7)	11.7 (10)	14.0 (12)	39 (33)	50 (43)	74 (63)	93 (80)	210 (180)
Pipe Size	½", ¾"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"

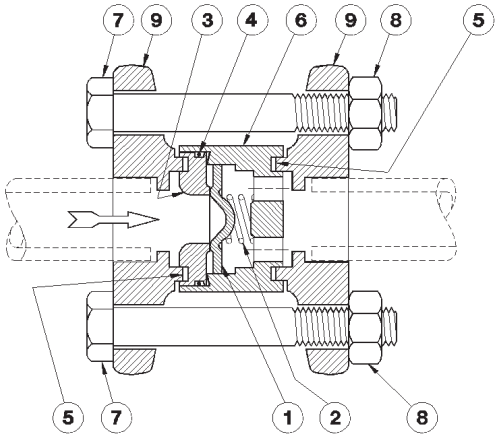
***Dimensionally replaces R/S check valve models CK4A-2, -3, -4, -8, and -1. = "E" dimension is check valve body outside edge to outside edge. Flange groove depth: nominal 0.12" each of two; gasket thickness: nominal 0.06" each of two.**

PARTS LIST

HCK4-2 (2-BOLT)

ITEM	DESCRIPTION	QTY	PART NO
	Valve Assembly Kit		
	Above Kit Consists of:		
1	Seat Disc	1	72-0069
2	Closing Spring	1	72-0070
3	Seat Cartridge	1	72-0068
4	Seat Cartridge O-ring	1	72-0071
5	Flange Gasket	2	70-0065
6	Body, HCK4-2	1	72-0067
7	Bolt ($^{7}/_{16}$" - 14 x 3.25")	2	70-0225
8	Nut ($^{7}/_{16}$" - 14)	2	70-0055
9	Flange (FPT, SW, WN, ODS)	2	FACTORY

HCK4-2 (2-BOLT)

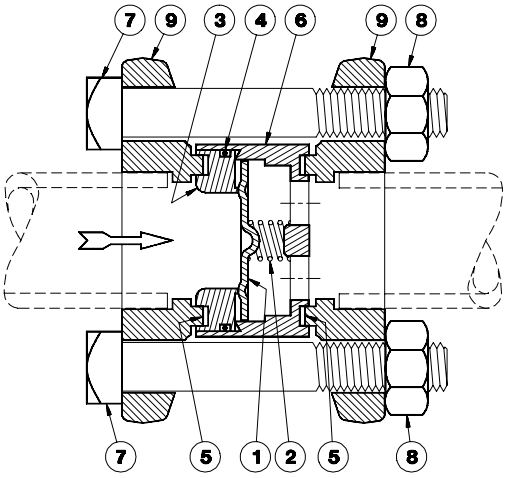


Socket weld shown. FPT, weld neck, ODS: available.

HCK4-3, -4, -5 (2-BOLT)

ITEM	DESCRIPTION	QTY	PART NO
	Valve Assembly Kit		
	Above Kit Consists of:		
1	Seat Disc	1	72-0006
2	Closing Spring	1	70-0204
3	Seat Cartridge	1	72-0002
4	Seat Cartridge O-ring	1	72-0003
5	Flange Gasket	2	70-0132
6a	Body, HCK4-3	1	72-0004
6b	Body, HCK4-4	1	72-0008
6c	Body, HCK4-5	1	72-0001
7	Bolt ($^{5}/_{8}$" -11 x 4")	2	72-0005
8	Nut ($^{5}/_{8}$" -11)	2	70-0136
9	Flange (FPT, SW, WN, ODS)	2	FACTORY

HCK4-3, -4, -5 (2-BOLT)

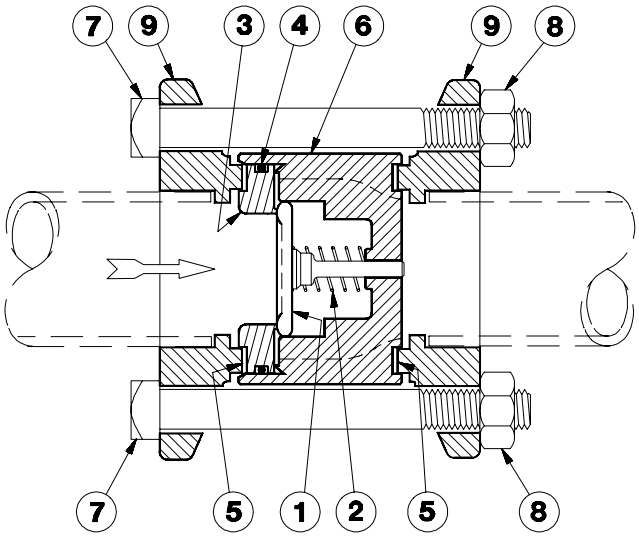


Socket weld shown. FPT, weld neck, ODS: available.

HCK4-7, -8, -9, -0, -1 (4-BOLT)

ITEM	DESCRIPTION	QTY	PART NO
1a	Seat Disc 1½", 2"	1	72-0016
1b	Seat Disc 2½", 3"	1	72-0034
1c	Seat Disc 4"	1	72-0053
2a	Closing Spring 1½", 2"	1	72-0021
2b	Closing Spring 2½", 3"	1	72-0032
2c	Closing Spring 4"	1	72-0048
3a	Seat Cartridge 1½", 2"	1	72-0020
3b	Seat Cartridge 2½"	1	72-0029
3c	Seat Cartridge 3"	1	72-0028
3d	Seat Cartridge 4"	1	72-0047
4a	Seat Cartridge O-ring 1½", 2"	1	72-0017
4b	Seat Cartridge O-ring 2½", 3"	1	72-0027
4c	Seat Cartridge O-ring 4"	1	72-0049
5a	Flange Gasket 1½", 2"	2	75-0138
5b	Flange Gasket 2½"	2	75-0125
5c	Flange Gasket 3"	2	75-0137
5d	Flange Gasket 4"	2	75-0253
6a	Body, HCK4-7	1	72-0042
6b	Body, HCK4-8	1	72-0019
6c	Body, HCK4-9	1	72-0025
6d	Body, HCK4-0	1	72-0026
6e	Body, HCK4-1	1	72-0046
7a	Bolt, HCK4-7, -8 ($^{5}/_{8}$" - 11 x 6")	4	70-0268
7b	Bolt, HCK4-9, -0 ($^{3}/_{4}$" - 10 x 7")	4	72-0033
7c	Bolt, HCK4-1 ($^{7}/_{8}$" - 9 x 7.5")	4	72-0051
8a	Nut, HCK4-7, -8 ($^{5}/_{8}$" - 11)	4	70-0136
8b	Nut, HCK4-9, -0 ($^{3}/_{4}$" - 10)	4	75-0210
8c	Nut, HCK4-1 ($^{7}/_{8}$" - 9)	4	75-0280
9	Flange (FPT, SW, WN, ODS)	2	FACTORY

HCK4-7, -8, -9, -0, -1 (4-BOLT)



Socket weld shown. Weld neck, ODS: available.

OPERATION

HCK4 check valves are normally closed valves. As inlet pressure increases, it overcomes the closing spring force. As the seat disc is pushed back and away from the seat cartridge, flow through the valve occurs. The valve will remain open until the inlet pressure drops below the closing spring force or there is a flow reversal, at which time the seat disc will close against the seat cartridge, preventing reverse flow.

SIZING

Check valves are normally selected on the basis of line size. However, for gas flow applications at low load conditions, a minimum of 1 psid across the valve is essential. This will maintain valve at full open position. Valve Cv (Kv) is listed in the installation dimension table on page 2. Factory valve sizing assistance is available.

SERVICE AND MAINTENANCE

These valves are a reliable part of a refrigeration system. However, if valve does not appear to be operating satisfactorily, isolate it from the refrigeration system. Remove all refrigerant from associated piping and valves. Follow the guidelines in the caution section. Loosen each flange nut on the check valve. Break each flange gasket seal. Carefully loosen flange bolts one at a time, being cautious to avoid any refrigerant which still may be present. Remove check valve from flanges and inspect. Lapped seating surfaces should be smooth and free of pits or scratches.

To confirm valve operation, move seat disc with eraser end of pencil. Movement should be free from friction. If not, disassemble and visually inspect for dirt in valve or burrs on seat disc. Clean or replace parts as necessary. Valve discs and seats can be restored by lapping on a flat plate.

Reassemble valve and insert between flanges. Replace and tighten bolts and nuts evenly. Carefully check for leaks before returning to service.

CAUTION

Hansen check valves are only for refrigeration systems. These instructions and related safety precautions must be completely read and understood before selecting, using, or servicing these valves. Only knowledgeable, trained refrigeration mechanics should install, operate, or service these valves. Stated temperature and pressure limits should not be exceeded. Valves should not be removed unless system has been evacuated to zero pressure. See also Safety Precautions in current List Price Bulletin and Safety Precautions Sheet supplied with product. Escaping refrigerant might cause personal injury, particularly to the eyes and lungs.

WARRANTY

Hansen valves are guaranteed against defective materials or workmanship for one year F.O.B. our plant. No consequential damages or field labor is included.

ORDERING INFORMATION, HCK4 CHECK VALVES

TYPE	PORT SIZE (mm)	FLANGE CONNECTION STYLE & SIZES		
		FPT, SW, WN		ODS
		STD	ALSO	STD
HCK4-2*	5/8" (16)	½"	3/8", ¾"	5/8"
HCK4-3*	¾" (20)	¾"	1", 1¼"	7/8"
HCK4-4*	1" (25)	1"	¾", 1¼"	1 1/8"
HCK4-5	1¼" (32)	1¼"	¾", 1"	1 3/8"
HCK4-7	1½" (40)	1½"	2"	1 5/8"
HCK4-8*	2" (50)	2"	1½"	2 1/8"
HCK4-9	2½" (65)	2½"	3"	2 5/8"
HCK4-0	3" (80)	3"	--	3 1/8"
HCK4-1*	4" (100)	4"	--	4 1/8"

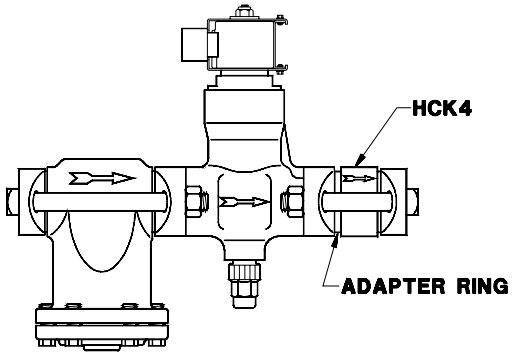
*Replaces R/S CK4A-2, CK4A-3, CK4A-4, CK4A-8, & CK4A-1.
HCK4-2 close-couples to HS6 & HS8 Solenoid Valves.
HCK4-3, -4, & -5 close-couples to HS7 Solenoid Valve.
FPT available only 3/8" to 1¼".

TO ORDER: Specify valve type, connection style and size, and close-coupling information if needed.

TYPICAL SPECIFICATIONS

"Refrigeration in-line check valves shall have steel or ductile iron bodies, stainless steel seat discs, stainless steel closing springs, and be suitable for a safe working pressure of 400 PSIG, as manufactured by Hansen Technologies Corporation type HCK4 or approved equal."

Typical close-coupling to solenoid valve.



ISO 9002
Hansen Technologies Corp.
Burr Ridge, IL Cert. # 000472
Orlando, FL Cert. # 001523

HANSEN TECHNOLOGIES CORPORATION

6827 High Grove Boulevard
Burr Ridge, Illinois 60527 U.S.A.
Telephone: (708) 325-1565 FAX: (708) 325-1572
Toll-free: 1-800-426-7368

Lubrication Instructions For Ball Bearing Motors

Lubrication
This motor is supplied with pre-lubrication ball bearings. No lubrication required before start up.

Relubrication Intervals
The following intervals are suggested as a guide:

SUGGESTED RELUBRICATION INTERVALS		
HOURS OF SERVICE PER YEAR	H.P. RANGE	RELUBE INTERVAL
5,000	Sub Fractional to 7 1/2 10 to 40 50-200	5 Years 3 Years 1 Year
Continuous Normal Applications	Sub Fractional to 7 1/2 10 to 40 50 to 200	2 Years 1 Year 9 Months
Season Service Motor Idle 6 Months or More	All	1 Year (Beginning of Season)
Continuous High Ambients Dirty or Moist Locations High Vibrations Where Shaft End is Hot (Pumps-Fans)	Sub Fractional to 40 50 to 200	6 Months 3 Months

Lubrication

Use high quality ball bearing lubricant. Use consistency of lubricant suitable for class of insulation stamped on nameplate as follows:

LUBRICATION CONSISTENCY				
INSULATION CLASS	CONSISTENCY	TYPE	TYPICAL LUBRICATION	FRAME TYPE
B & F F & H	Medium	Polyurea	Shell Dolium R and/or Chevron SR1 2	Sub Fractional to 447T All

Procedure

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215T frame and smaller. Use 2 to 3 strokes on NEMA 254T thru NEMA 365 T frame. Use 3 to 4 strokes on NEMA 404T frames and larger. On motors having drain plugs, remove drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215T frame and smaller. Insert 3 to 5 inch length on larger motors. For motors having drain plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep lubricant clean. Lubricate motors at standstill. remove and replace drain plugs at standstill. Do not mix petroleum lubricant and silicone lubricant in motor bearings.

LEESON®

ELECTRIC MOTORS, GEARMOTORS AND DRIVES

LEESON ELECTRIC
GRAFTON, WISCONSIN 53024-0241 U.S.A.
TEL (262)377-8810 FAX (262)377-9025 www.leeson.com

A Subsidiary of Regal-Beloit Corporation

Installation Maintenance Instructions
AC Induction Motors

Installation

After unpacking, check for damage. Be sure that shaft rotates freely. Before making electrical power connections, check for proper grounding of motor and application. All electrical contacts and connections must be properly insulated and enclosed. Couplings, belts, chains or other mounted devices must be in proper alignment, balance and secure to insure safe motor operation.

Electrical Wiring

Prior to connecting to the power line, check nameplate for proper voltage and rotation connection. This motor should be installed in compliance with the National Electrical Code and any other applicable codes. Voltage at motor not to exceed + or -10% of nameplate. Authorized person should make all electrical connections.

Mounting

This motor should be securely mounted to the application. Sufficient ventilation area should be provided to insure proper operation.

RECOMMENDED COPPER WIRE & TRANSFORMER SIZE

SINGLE PHASE MOTORS - 230 VOLTS

H.P.	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
		100	150	200	300	500
1 1/2	3	10	8	8	6	4
2	3	10	8	8	6	4
3	5	8	8	6	4	2
5	7 1/2	6	4	4	2	0
7 1/2	10	6	4	3	1	0

THREE PHASE MOTORS - 230 & 460 VOLTS

H.P.	VOLTS	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
			100	150	200	300	500
1 1/2	230	3	12	12	12	12	10
1 1/2	460	3	12	12	12	12	12
2	230	3	12	12	12	10	8
2	460	3	12	12	12	12	12
3	230	5	12	10	10	8	6
3	460	5	12	12	12	12	10
5	230	7	10	8	8	6	4
5	460	1/2	12	12	12	10	8
7 1/2	230	7 1/2	8	6	6	4	2
7 1/2	460	10	12	12	12	10	8
10	230	10	6	4	4	4	1
10	460	15	12	12	12	10	8
15	230	15	4	4	4	2	0
15	460	20	12	10	10	8	6
20	230	20	4	2	2	1	000
20	460		10	8	8	6	4
25	230		2	2	2	0	000
25	460	Consult	8	8	6	6	4
30	230	Local	2	1	1	00	0000
30	460	Power	8	6	6	4	2
40	230	Company	1	0	00	0000	300
40	460		6	6	4	2	0
50	230		1	0	00	0000	300
50	460		4	4	2	2	0
60	230		1	00	000	250	500
60	460		4	2	2	0	00
75	230		0	000	0000	300	500
75	460		4	2	0	00	000

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ELECTRIC MOTORS
GEARMOTORS AND DRIVES

Motor Trouble-Shooting Chart

Caution:
1. Disconnect power to the motor before performing service or maintenance.
2. Discharge all capacitors before servicing motor.
3. Always keep hands and clothing away from moving parts.
4. Be sure required safety guards are in place before starting equipment.

Problem:	Like Causes:	What To Do:
Motor fails to start upon initial installation.	Motor is miswired.	Verify motor is wired correctly.
	Motor damaged and rotor is striking stator.	May be able to reassemble; otherwise, motor should be replaced.
	Fan guard bent and contacting fan.	Replace fan guard.
Motor has been running, then fails to start.	Fuse or circuit breaker tripped.	Replace fuse or reset the breaker.
	Stator is shorted or went to ground. Motor will make a humming noise and the circuit breaker or fuse will trip.	Disassemble motor and inspect windings and internal connections. A blown stator will show a burn mark. Motor must be replaced or the stator rewound.
	Motor overloaded or load jammed.	Inspect to see that the load is free. Verify amp draw of motor versus nameplate rating.
	Capacitor (on single phase motor) may have failed.	First discharge capacitor. To check capacitor, set volt-ohm meter to RX100 scale and touch its probes to capacitor terminals. If capacitor is OK, needle will jump to zero ohms, and drift back to high. Steady zero ohms indicates a short circuit; steady high ohms indicates an open circuit.
	Starting switch has failed.	Disassemble motor and inspect both the centrifugal and stationary switches. The weights of the centrifugal switch should move in and out freely. Make sure that the switch is not loose on the shaft. Inspect contacts and connections on the stationary switch. Replace switch if the contacts are burned or pitted.
Motor runs but dies down.	Voltage drop.	If voltage is less than 10% of the motor's rating contact power company or check if some other equipment is taking power away from the motor.
	Load increased.	Verify the load has not changed. Verify equipment hasn't got tighter. If fan application verify the air flow hasn't changed.
Motor takes too long to accelerate.	Defective capacitor	Test capacitor per previous instructions.
	Faulty stationary switch.	Inspect switch contacts and connections. Verify that switch reeds have some spring in them.
	Bad bearings.	Noisy or rough feeling bearings should be replaced.
	Voltage too low.	Make sure that the voltage is within 10% of the motor's name-plate rating. If not, contact power company or check if some other equipment is taking power away from the motor.
Motor runs in the wrong direction.	Incorrect wiring.	Rewire motor according to wiring schematic provided.
Motor overload protector continually trips.	Load too high.	Verify that the load is not jammed. If motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a stock motor may not be able to duplicate the performance. Remove the load from the motor and inspect the amp draw of the motor unloaded. It should be less than the full load rating stamped on the nameplate.
	Ambient temperature too high.	Verify that the motor is getting enough air for proper cooling. Most motors are designed to run in an ambient temperature of less than 40°C. (Note: A properly operating motor may be hot to the touch.)
	Protector may be defective.	Replace the motor's protector with a new one of the same rating.
	Winding shorted or grounded.	Inspect stator for defects, or loose or cut wires that may cause it to go to ground.

Motor Trouble-Shooting Chart

10/13/00 (continued)

Problem:	Like Causes:	What To Do:
Motor vibrates.	Motor misaligned to load.	Realign load.
	Load out of balance. (Direct drive application.)	Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is .001" runout per every inch of shaft length.
	Motor bearings defective.	Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Replace bearings. Add oil if a sleeve of bearing. Add grease if bearings have grease fittings.
	Rotor out of balance.	Inspect motor by itself with no load attached. If it feels rough and vibrates but the bearings are good, it may be that the rotor was improperly balanced at the factory. Rotor must be replaced or rebalanced.
	Motor may have too much endplay.	With the motor disconnected from power turned shaft. It should move but with some resistance. If the shaft moves in and out too freely, this may indicate a preload problem and the bearings may need additional shimming.
	Winding may be defective.	Test winding for shorted or open circuits. The amps may also be high. Replace motor or have stator rewound.
Bearings continuously fail.	Load to motor may be excessive or unbalanced.	Besides checking load, also inspect drive belt tension to ensure it's not too tight may be too high. An unbalanced load will also cause the bearings to fail.
	High ambient temperature.	If the motor is used in a high ambient, a different type of bearing grease may be required. You may need to consult the factory or a bearing distributor.
The motor, at start up, makes a loud rubbing or grinding noise.	Rotor may be striking stator.	Ensure that motor was not damaged in shipment. Frame damage may not be repairable. If you cannot see physical damage, inspect the motor's rotor and stator for strike marks. If signs of rubbing are present, the motor should be replaced. Sometimes simply disassembling and reassembling motor eliminates rubbing. Endbells are also sometimes knocked out of alignment during transportation.
Start capacitors continuously fail.	The motor is not coming up to speed quickly enough.	Motor may not be sized properly. Verify how long the motor takes to come up to speed, Most single phase capacitor start motors should come up to speed within three seconds. Otherwise the capacitors may fail.
	The motor is being cycled too frequently.	Verify duty cycle. Capacitor manufacturers recommend no more than 20, three-second starts per hour. Install capacitor with higher voltage rating, or add bleed resistor to the capacitor.
	Voltage to motor is too low.	Verify that voltage to the motor is within 10% of the nameplate value. If the motor is rated 208-230V, the deviation must be calculated from 230V.
	Starting switch may be defective, preventing the motor from coming out of start winding.	Replace switch.
Run capacitor fail.	Ambient temperature too high.	Verify that ambient does not exceed motor's nameplate value.
	Possible power surge to motor, caused by lightning strike or other high transient voltage.	If a common problem, install surge protector.

LEESON

ELECTRIC MOTORS
GEARMOTORS AND DRIVES

DC Motor Trouble-Shooting Chart

Caution:
1. Disconnect power to the motor before performing service or maintenance.
2. Discharge all capacitors before servicing motor.
3. Always keep hands and clothing away from moving parts.
4. Be sure required safety guards are in place before starting equipment.

Problem:	Like Causes:	What To Do:
Motor fails to start upon initial installation.	Motor is miswired.	Verify that the motor is wired correctly.
	No output power from controller.	Measure voltage coming from the controller.
	Motor damaged and the fan guard is contacting the cooling fan.	Replace fan guard.
	Motor is damaged and the armature is rubbing against the magnets.	Disassemble motor and see if the armature can be realigned by reassembly. Motor may have to be replaced.
Motor has been running, then fails to start.	Fuse or circuit breaker is tripped.	Replace the fuse or reset the breaker.
	Armature is shorted or went to ground. Motor may make a humming noise and the circuit breaker or fuse will trip.	Disassemble motor and inspect the armature for a burnt coil. Inspect the commutator for burnt bars. If this condition exists, the motor needs to be replaced. To test, set your OHM meter to the RX1 scale, touch probes to bars 180 degrees apart all around the commutator. The reading should be equal.
	The brushes may be worn down too far and no longer make contract with the commutator.	Inspect the brushes to make sure that they are still making contact with the commutator. Refer to manufacturer's recommended brush length chart.
	Controller may be defective.	Verify voltage is coming out of the controller.
Motor runs but loses power.	Load had increased.	Verify the load has not changed. Measure the amp draw of motor against the full load amp rating of the motor. If the amp draw is higher then rating, motor is undersized for application.
	Motor controller not properly set.	Check controller manual for adjustments. The torque and/or IR compensation settings may need adjustment.
	Motor may have an open connection.	Inspect the armature for an open connection.
	Brushes may not be seated properly or worn beyond their useful length.	Verify that the brushes are properly seated and measure their length against the recommended brush length chart.
Motor takes too long to accelerate.	Motor controller not properly set.	The accel trim pot of the controller should be adjusted.
	Brushes are worn.	Verify brush length.
	Bearings may be defective.	Inspect bearings for proper service. Noisy or rough bearings should be replaced.
Motor runs in the wrong direction.	Incorrect wiring.	Interchange the two motor leads.
Motor runs ok but has a clicking noise.	Suspect a burr on the commutator.	Stone the armature commutator with a commutator stone to remove burr.

LEESON ELECTRIC CORPORATION
BOX 241 GRAFTON, WISCONSIN 53024-0241 U.S.A.

Carefully read and fully understand this Owner's Manual prior to installation, operation and maintenance of your motor.

1. SAFETY DEPENDS ON YOU

Lincoln Electric motors are designed and manufactured with safety in mind. However, your overall safety can be increased by properly installing, operating and maintaining the motor. Read and observe all instructions, warnings and specific safety precautions included in this manual and THINK BEFORE YOU ACT!

2. RECEIVING AND INSPECTION

Check packing list and inspect motor to make certain no damage has occurred in shipment. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

Turn the motor shaft by hand to be certain that it rotates freely. Be careful not to cut yourself on the shaft keyway; it is razor sharp!

Check the nameplate for conformance with power supply and control equipment requirements.

3. HANDLING

⚠ WARNING

FALLING EQUIPMENT can injure.

- **Lift only with equipment of adequate lifting capacity.**
- **If so equipped, use lift ring(s) on the motor to lift ONLY the motor and accessories mounted by Lincoln Electric.**

In case of assemblies on a common base, the motor lift ring(s) CANNOT be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. In all cases, care should be taken to assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

4. STORAGE

Motor stock areas should be clean, dry, vibration free and have a relatively constant ambient temperature. For added bearing protection while the motor is in storage, turn the motor shaft every six months.

A motor stored on equipment and component equipment prior to installation should be kept dry and protected from the weather. If the equipment is exposed to the atmosphere, cover the motor with a waterproof cover. Motors should be stored in the horizontal position with drains operable and positioned in the lowest point. CAUTION: Do not completely surround the motor with the protective covering. The bottom area should be open at all times.

Windings should be checked with a megohm-meter (Megger) at the time equipment is put in storage. Upon removal from storage, the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying. Note the sensitivity of properly connected megohm-meters can deliver erroneous values. Be sure to carefully follow the megohm-meter's operating instructions when making measurements.

All external motor parts subject to corrosion, such as the shaft and other machined surfaces, must be protected by applying a corrosion-resistant coating.

5. INSTALLATION

For maximum motor life, locate the motor in a clean, dry, well ventilated place easily accessible for inspecting, cleaning and lubricating. The temperature of the surrounding air should not exceed 104°F (40°C) except for motors with nameplates indicating a higher allowable maximum ambient temperature.

⚠ WARNING

MOVING PARTS can injure.

- **BEFORE starting motor, be sure shaft key is captive.**
- **Consider application and provide guarding to protect personnel.**

5.1 INSTALLATION – MECHANICAL

Base

Mount the motor on a firm foundation or base sufficiently rigid to prevent excessive vibration. On foot-mounted motors, use appropriately sized bolts through all four mounting holes. For frames which have six or eight mounting holes, use the two closest the drive shaft and two on the end opposite the drive shaft (one on each side of the frame). If necessary, properly shim the motor to prevent undue stress on the motor frame and to precision align the unit.

Position

Standard motors may be mounted in any position. The radial and thrust load capacity of the motor's bearing system provides for this feature.

Drains

All motors have drain holes located in the end brackets. As standard, drains are in place for the horizontal with feet down mounting position. Other positions may require either rotation of the end brackets or drilling additional holes to attain proper drainage. Be sure existing drain or vent holes do not permit contaminant entry when motor is mounted in the other positions.

Additional drain holes exist near the bearing cartridge in both end brackets of 284T thru 449T steel frame motors. The drain holes are closed with a plastic plug. When the motor is vertically mounted, the plug located in the lower end bracket must be removed. To access the plug on blower end, simply remove the shroud; on some models, it is also necessary to take off the blower.

Drive – Power Transmission

The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. Do not drive the unit on the shaft as this will damage the bearings. Coat the shaft lightly with heavy oil before installing pulley.

Belt Drive: Align the pulleys so that the belt(s) will run true. Consult the belt manufacturer's catalog for recommended tension. Properly tension the belt; excessive tension will cause premature bearing failure. If possible, the lower side of the belt should be the driving side. On multiple belt installations be sure all belts are matched for length.

Chain Drive: Mount the sprocket on the shaft as close to the shaft shoulder as possible. Align the sprockets so that the chain will run true. Avoid excessive chain tension.

Gear Drive and Direct Connection: Accurate alignment is essential. Secure the motor and driven unit rigidly to the base. Shims may be needed to achieve proper alignment.

Excessive motor vibration may result if the full length of the motor shaft key is not completely engaged by the coupling or sheave. For these situations, adjustment of the key length is required.

5.2 INSTALLATION – ELECTRICAL

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Disconnect input power supply before installing or servicing motor.**
- **Motor lead connections can short and cause damage or injury if not well secured and insulated.**
- **Use washers, lock washers and the largest bolt size which will pass through the motor lead terminals in making connections.**
- **Insulate the connection, equal to or better than the insulation on the supply conductors.**
- **Properly ground the motor — see GROUNDING.**

Check power supply to make certain that voltage, frequency and current carrying capacity are in accordance with the motor nameplate.

Proper branch circuit supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and correctly sized thermal elements or overload relay protection.

Short circuit current fuses or breakers are for the protection of the branch circuit. Starter or motor controller overload relays are for the protection of the motor.

Each of these should be properly sized and installed per the National Electrical Code and local codes.

Properly ground the motor – See GROUNDING.

Terminal Box

Remove the appropriate knockout. For terminal boxes without a knockout, either a threaded power-conduit entry hole is provided or the installer is responsible for supplying a correctly sized hole.

The majority of terminal boxes can be rotated in place to allow power lead entry from the 3, 6, 9 or 12 o'clock direction.

Motor Connection

All single speed and two-speed Lincoln motors are capable of across-the-line or autotransformer starting. Reference the lead connection diagram located on the nameplate or inside of the terminal box cover.

Single speed motors have reduced voltage start capability per the following chart.

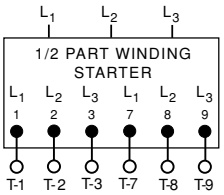
Number of Motor Leads	Number of Rated Voltages	Lead Numbers	YDS	PWS
3	Single	1-3	No	No
6	Single	1-3, 7-9	No	Yes
	Single	1-6	Yes	No
	Dual	1-6	Yes(1)	No
9	Dual	1-9	No	No
12	Single	1-12	Yes	Yes
	Dual	1-12	Yes	No(2)

(1) YDS capability on lower voltage only.
(2) PWS capability on lower voltage only, 1200 RPM, 324T-365T steel frame motors with Model Number efficiency letter of "S" or "H".

Contact Motor Customer Service at 1-800-668-6748 (phone), 1-888-536-6867 (fax) or motors@lincolnelectric.com (e-mail) for a copy of across-the-line and other reduced voltage start connection diagrams.

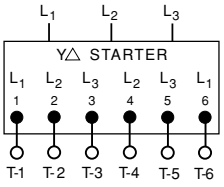
Connection Diagram 1

Single Voltage, 6 Leads
Part Winding Start Connection



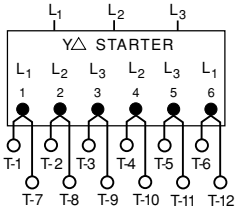
Connection Diagram 2

Single Voltage, 6 Leads
Y△ Start Connection



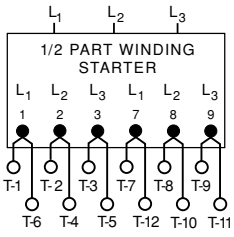
Connection Diagram 3

Single Voltage, 12 Leads
Y△ Start Connection



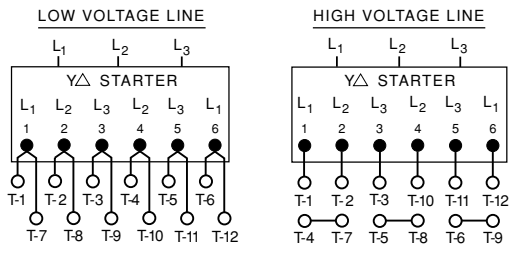
Connection Diagram 4

Single Voltage, 12 Leads
Part Winding Start Connection



Connection Diagram 5

Dual Voltage, 12 Leads
Y△ Start Connection



Space Heater (option)

Leads for space heaters are identified as H1 and H2. Heater voltage and watts are marked on the motor nameplate and should be checked prior to connection to power source.

Thermostat (option)

Leads for thermostats (normally closed, automatic reset contacts) are identified as P1 and P2. Connect these to a relay or signaling device. Motor line current cannot be handled by the thermostat.

Table 1 — Thermostat Contact Ratings

Voltage (60 Hz)	110V	220V
Max. Cont. Current (amps)	3.0	1.5
Min. Cont. Current (amps)	0.2	0.1

Thermistor (option)

Leads for thermistors are identified as P3 and P4. Thermistors require connection to Texas Instruments® Control Module Model 32AA or its equivalent for proper operation. This item may be purchased from Lincoln Electric.

Brake (option)

Carefully read and fully understand the instructions supplied by the brake manufacturer (see inside of brake housing or separately enclosed sheet). Contact the brake manufacturer for additional information.

GROUNDING

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Connect the motor frame to a good earth ground per the National Electrical Code and local codes to limit the potential to ground in the event of contact between live electrical parts and the metal exterior.**

Lincoln motors may be electrically connected to earth ground using a terminal box mounting screw or a separate grounding screw when provided. Both are accessible inside the mounted terminal box. When a bronze mounting screw is supplied, always use it as the grounding point. In making the ground connection, the installer should make certain that there is a good electrical connection between the grounding lead and the motor.

6. OPERATION

Three phase squirrel cage induction motors will operate successfully, but not necessarily in accordance with nameplate ratings, at voltages 10 percent above or below nameplated value at the design frequency.

⚠ WARNING

MOVING PARTS can injure.

- **Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off and causing bodily injury.**
- **Keep away from moving parts.**

ELECTRIC SHOCK can kill.

- **Do not operate with covers removed.**
- **Do not touch electrically live parts.**

After checking that the shaft key is secure, operate the motor free of load and check the direction of rotation. If the motor rotates in the wrong direction, interchange any two supply leads.

Couple the motor to its load and operate it for a minimum of one hour. During this period, check for any unusual noise or thermal conditions. Check the actual operating current to be sure that the nameplate current times service factor is not exceeded for steady continuous loads.

7. MAINTENANCE

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Internal parts of the motor may be at line potential even when it is not rotating.**
- **Disconnect all input power to the drive and motor before performing any maintenance.**

Lincoln Electric motors have been designed and manufactured with long motor life expectancy and trouble-free operation in mind.

Periodically inspect the motor for excessive dirt, friction or vibration. Dust may be blown from an inaccessible location using compressed air. Keep the ventilation openings clear to allow free passage of air. Make sure the drain holes in the motors are kept open and the shaft slinger is positioned against the end bracket. Grease or oil can be wiped by using a petroleum solvent.

Overheating of the bearings caused by excessive friction is usually caused by one of the following factors:

1. Bent shaft.
2. Excessive belt tension.
3. Excessive end or side thrust from the gearing, flexible coupling, etc.
4. Poor alignment.

Damaging vibrations can be caused by loose motor mountings, motor misalignment resulting from the settling or distortion of the foundation, or it may be transmitted from the driven machine. Vibration may also be caused by excessive belt or chain tension.

BEARING SYSTEM

Lincoln motors have a high quality, premium design bearing system. Bearing sizes and enclosures are identified on most motor nameplates. The majority are double-shielded, deep-groove ball bearings. Double-sealed ball bearings are used on some motors in frames 56 and 143T thru 145T. A drive-end cylindrical roller bearing is standard on Crusher Duty motors, frames 405T and larger.

Lubrication instructions and/or grease specifications provided on the motor supersede the following information.

In general, the motor's bearing system has sufficient grease to last indefinitely under normal service conditions. For severe or extreme service conditions, it is advisable to add one-quarter ounce of grease to each bearing per the schedule listed in Table 2. Use a good quality, moisture-resistant, polyurea-based grease such as Chevron SRI #2. Lithium based greases are not compatible with polyurea-based greases; mixing the two types may result in the loss of lubrication.

Motors designed for low ambient applications have bearings with special low temperature grease. Use Beacon 325 lithium based grease or equivalent per the appropriate interval in Table 2.

Motors designed for high ambient applications have bearings with special high temperature grease. Use Dow Corning DC44 silicone grease or equivalent per the interval in Table 2 under "Extreme".

Severe Service: Operating horizontally, 24 hours per day, vibration, dirty, dusty, high humidity, weather exposure, or ambient temperatures from 104-130°F (40-55°C).

Extreme Service: Operating vertically, heavy vibration or shock, heavy duty cycle, very dirty or ambient temperatures from 130-150°F (55-65°C).

Table 2 : Bearing Lubrication Intervals

Motor Syn Speed	Motor Horsepower	Service Conditions	
		Severe	Extreme
BALL BEARINGS			
1800 RPM and slower	1/4 to 7-1/2 HP	2 years	6 months
	10 to 40 HP	1 year	3 months
	50 HP and up	6 months	3 months
above 1800 RPM	all sizes	3 months	3 months
ROLLER BEARINGS			
all speeds	all sizes	3 months	3 months

When adding lubricant, keep all dirt out of the area. Wipe the fitting completely clean and use clean grease dispensing equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

If the motor is equipped with a relief port or tube, make certain it is open and free of caked or hardened grease. Before replacing relief plugs, allow excess grease or pressure to vent by running the motor for several minutes after lubrication.

⚠ CAUTION

- **LUBRICANT SHOULD BE ADDED AT A STEADY MODERATE PRESSURE. IF ADDED UNDER HEAVY PRESSURE BEARING SHIELD(S) MAY COLLAPSE.**
- **DO NOT OVER GREASE.**

PARTS

All parts should be ordered from Authorized Motor Warranty Stations. Call your Lincoln Electric Sales Office for location and phone number. A "Service Directory" listing all Authorized Motor Warranty Stations geographically is available; request Bulletin SD-6. These shops stock GENUINE Lincoln Electric replacement parts and have factory trained personnel to service your motor.

8. WHO TO CALL

For the location and phone number of the Lincoln Electric District Sales and Technical Support Office nearest you, check your local Yellow Pages or call 1-800-MOTOR-4-U (1-800-668-6748) or visit our web site at www.lincolnelectric.com/motors.

LINCOLN® ELECTRIC
MOTOR DIVISION

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO 44117-2525 U.S.A.
For more information call: 1-800-MOTOR-4-U

IM566-A December 1998

9. WARRANTY

The Lincoln Electric Company, the Seller, warrants all new *standard* motors and accessories thereof against defects in workmanship and material provided the equipment has been properly cared for and operated under normal conditions. All warranty periods begin on the date of shipment to the original purchaser. Warranty periods for ***low voltage (< 600 V)*** motors are defined in the following chart. The warranty period for ***medium voltage (> 600 V)*** motors is one year on sine-wave power. Contact Lincoln for warranty period on PWM power. #

Model Number Prefix	Efficiency Code(s)	Frame Sizes	Warranty Period		
			Sine-Wave Power	PWM Power	
AA, AF, AN	S, P, B	143T-286T	5 Yrs	2 Yrs*	#
CF, SD	M	143T-215T	2 Yrs	1 Yr	#
CF, CN, CS, CP	E, H, P, B	143T-449T	5 Yrs	2 Yrs*	#
		182U-449U	5 Yrs	2 Yrs*	#
C5, C6	H, P	M504-689	1 Yr	Contact Lincoln	#
MD, SE	S	284T-445T	5 Yrs	1 Yr	#
RC, RJ, SC	H	56-145T	5 Yrs	2 Yrs*	#
RD, RF	S	56-56H	5 Yrs	2 Yrs*	#
REW, SEW	S	56-256T	1 Yr	1 Yr	#
SD, SF	S, H, P, B	143T-449T	5 Yrs	2 Yrs*	#
Field Kits and Accessories			5 Yrs		

* Applies to motors with a service factor of 1.15 or higher. Motors with a 1.0 service factor have a 1 year warranty on PWM power.

If the Buyer gives the Seller written notice of any defects in equipment within any period of the warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its own factory or other place as designated by the Seller. The remedy provided the Buyer herein for breach of Seller's warranty shall be exclusive.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside of the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or its use by the Buyer, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and except as above set forth there are no guarantees or warranties with respect to accessories or equipment, either expressed or arising by option of law or trade usage or otherwise implied, including with limitation the warranty of merchantability, all such warranties being waived by the Buyer.

- indicates change since last printing.

BALDOR
MOTORS AND DRIVES

AC & DC Motor Installation – Maintenance Instructions

These instructions are intended to complement (not replace) the information in MN400 Installation and Operation manual for "Integral Horsepower AC Induction Motors ODP, TEFC, Explosion Proof" and MN605 Installation and Operation manual for "Integral Horsepower DC Motors".

Handling

The weight of the motor and shipping container will vary. Use correct material handling equipment to avoid injury.

Use caution when removing the motor from its packaging. Sharp corners may exist on motor shaft, motor key, sheet metal and other surfaces.

Receiving

Inspect the motor for damage before accepting it. The Motor shaft should rotate freely with no rubs. Report any damage immediately to the commercial carrier that delivered your motor.

Safety Notice

Only qualified personnel trained in the safe installation and operation of this equipment should install this motor. When improperly installed or used, rotating equipment can cause serious or fatal injury. Equipment must be installed in accordance with the National Electrical Code (NEC), local codes and NEMA MG2 Safety Standards for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators. Observe the following guidelines:

1. When eyebolts are provided, they must be fully tightened and are intended to lift the motor and its included accessories only.
2. Ground the motor according to NEC and local codes.
3. Provide a permanent guard to prevent accidental contact of body parts or clothing with rotating or moving parts or burns if motor is hot.
4. Shaft key must be secured before starting motor.
5. Do not apply power to the motor until the motor is securely mounted by its mounting holes.
6. This motor must only be connected to the proper line voltage, line frequency and load size.
7. Motors are not to be used for load holding or restraining unless a properly sized brake is installed. If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure.
8. Disconnect all power services, stop the motor and allow it to cool before servicing.
9. For single phase motors, discharge the start and/or run capacitors before servicing.
10. Do not by-pass or render inoperative any safety device.
11. DC series wound motors must be protected from sudden loss of load causing overspeed damage. DC shunt wound motors must be protected from loss of field voltage which can result in damage.
12. When using AC motors with frequency inverters, be certain that the motors Maximum Speed Rating is not exceeded.
13. Mounting bolts should be high tensile steel. Be sure to use a suitable locking device on each bolt (spring washer or thread lock compound).

Guarding

After motor installation is complete, a guard of suitable dimensions must be constructed and installed around the motor/gearmotor. This guard must prevent personnel from coming in contact with any moving parts of the motor or drive assembly but must allow sufficient cooling air to pass over the motor.

If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure.

Brush inspection plates and electrical connection cover plates or lids, must be installed before operating the motor.

When this motor is installed according to these instructions, it complies with the EEC Machinery Directive. Electromagnetic Compatibility (EMC) requirements for CE compliance are met when the incoming power is purely sinusoidal. For other power source types, refer to MN1383 "Recommended Practices for Installation for EC Directive 89/336/EEC Relating to EMC".

Motor Enclosure

ODP, **Open drip proof** motors are intended for use in clean, dry locations with adequate supply of cooling air. These motors should not be used in the presence of flammable or combustible materials. Open motors can emit flame and/or molten metal in the event of insulation failure.

TEFC, **totally enclosed** motors are intended for use where moisture, dirt and/or corrosive materials are present in indoor and outdoor locations.

Explosion proof motors, as indicated by the Underwriters Laboratories, Inc. label are intended for use in hazardous areas as specified by the NEC.

Mounting

Foot mounted machines should be mounted to a rigid foundation to prevent excessive vibration. Shims may be used if location is uneven.

Flange mounted machines should be properly seated and aligned. Note: If improper rotation direction is detrimental to the load, check rotation direction prior to coupling the load to the motor shaft.

For **V-belt drive,** mount the sheave pulley close to the motor housing. Allow clearance for end to end movement of the motor shaft. Do not overtighten belts as this may cause premature bearing failure or shaft breakage.

Direct coupled machines should be carefully aligned and the shaft should rotate freely without binding.

Wiring

Connect the motor as shown in the connection diagram. If this motor is installed as part of a motor control drive system, connect and protect the motor according to the control manufacturers diagrams. The wiring, fusing and grounding must comply with the National Electrical Code and local codes. When the motor is connected to the load for proper direction of rotation and started, it should start quickly and run smoothly. If not, stop the motor immediately and determine the cause. Possible causes are: low voltage at the motor, motor connections are not correct or the load is too heavy. Check the motor current after a few minutes of operation and compare the measured current with the nameplate rating.

Adjustment

The neutral is adjustable on some DC motors. AC motors have no adjustable parts.

Noise

For specific sound power or pressure level information, contact your local Baldor representative.

Vibration

This motor is balanced to NEMA MG1, Part 7 standard.

Brushes (DC Motors)

Periodically, the brushes should be inspected and all brush dust blown out of the motor. If a brush is worn $^1/_2$″ (from length specified in renewal parts data), replace the brushes. If the commutator is worn or rough, the armature should be removed. The commutator should be turned in a lathe, the mica recut and the commutator polished. Reassemble and seat the new brushes using a brush seating stone. Be sure the rocker arm is set on the neutral mark.

Lubrication

This is a ball or roller bearing motor. The bearings have been lubricated at the factory. Motors that do not have regrease capability are factory lubricated for the normal life of the bearings.

Lubricant

Baldor motors are pregreased, normally with Polyrex EM (Exxon Mobil). If other greases are preferred, check with a local Baldor Service Center for recommendations.

Relubrication Intervals (For motors with regrease capability)

New motors that have been stored for a year or more should be relubricated. Lubrication is also recommended at these intervals:

Table 1 Relubrication Interval

NEMA (IEC) Frame Size	Rated Speed (RPM)			
	3600	1800	1200	900
Up to 210 incl. (132)	5500Hrs.	12000Hrs.	18000Hrs.	22000Hrs.
Over 210 to 280 incl. (180)	3600Hrs.	9500Hrs.	15000Hrs.	18000Hrs.
Over 280 to 360 incl. (225)	*2200Hrs.	7400Hrs.	12000Hrs.	15000Hrs.
Over 360 to 5000 incl.(300)	*2200Hrs.	3500Hrs.	7400Hrs.	10500Hrs.

* Lubrication interval for 6313 or 6314 bearings that are used in 360 through 5000 frame, 2 pole motors. If roller bearings are used, bearings must be lubricated more frequently, divide the relubrication interval by 2.

Table 2 Service Conditions

Severity of Service	Ambient Temperature Maximum	Atmospheric Contamination	Type of Bearing
Standard	40° C	Clean, Little Corrosion	Deep Groove Ball Bearing
Severe	50° C	Moderate dirt, Corrosion	Ball Thrust, Roller
Extreme	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion	All Bearings
Low Temperature	<-30° C **		

* Special high temperature grease is recommended.

** Special low temperature grease is recommended.

Table 3 Lubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Table 4 Amount of Grease to Add

Frame Size NEMA (IEC)	Bearing Description (Largest bearing in each frame size)					
	Bearing	OD D mm	Width B mm	Weight of grease to add ounce (gram)	Volume of grease to add	
					inches^3	teaspoon
Up to 210 incl. (132)	6307	80	21	0.30 (8.4)	0.6	2.0
Over 210 to 280 incl. (180)	6311	120	29	0.61 (17.4)	1.2	3.9
Over 280 to 360 incl. (225)	6313	140	33	0.81 (23.1)	1.5	5.2
Over 360 to 5000 incl.(300)	NU322	240	50	2.12 (60.0)	4.1	13.4

Weight in grams = 0.005 DB

Procedure

Clean the grease fitting (or area around grease hole, if equipped with slotted grease screws). If motor has a purge plug, remove it. Motors can be regreased while stopped (at less than 80°C) or running.

Apply grease gun to fitting (or grease hole). Too much grease or injecting grease too quickly can cause premature bearing failure. Slowly apply the recommended amount of grease, taking 1 minute or so to apply. Operate motor for 20 minutes, reinstall purge plug if previously removed.

Caution: Keep grease clean. Mixing dissimilar grease is not recommended.

Sample Relubrication Determination

This sample determination is based on a NEMA 286T (IEC 180) motor operating at 1750 RPM driving an exhaust fan in an ambient of 43°C atmosphere that is moderately corrosive.

1. Table 1 list 9500 hours for standard conditions.
2. Table 2 classifies severity of service as “Severe”.
3. Table 3 lists a multiplier value of 0.5 for Severe conditions.
4. Table 4 shows that 1.2 in^3 or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

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