Redi Controls, Inc.

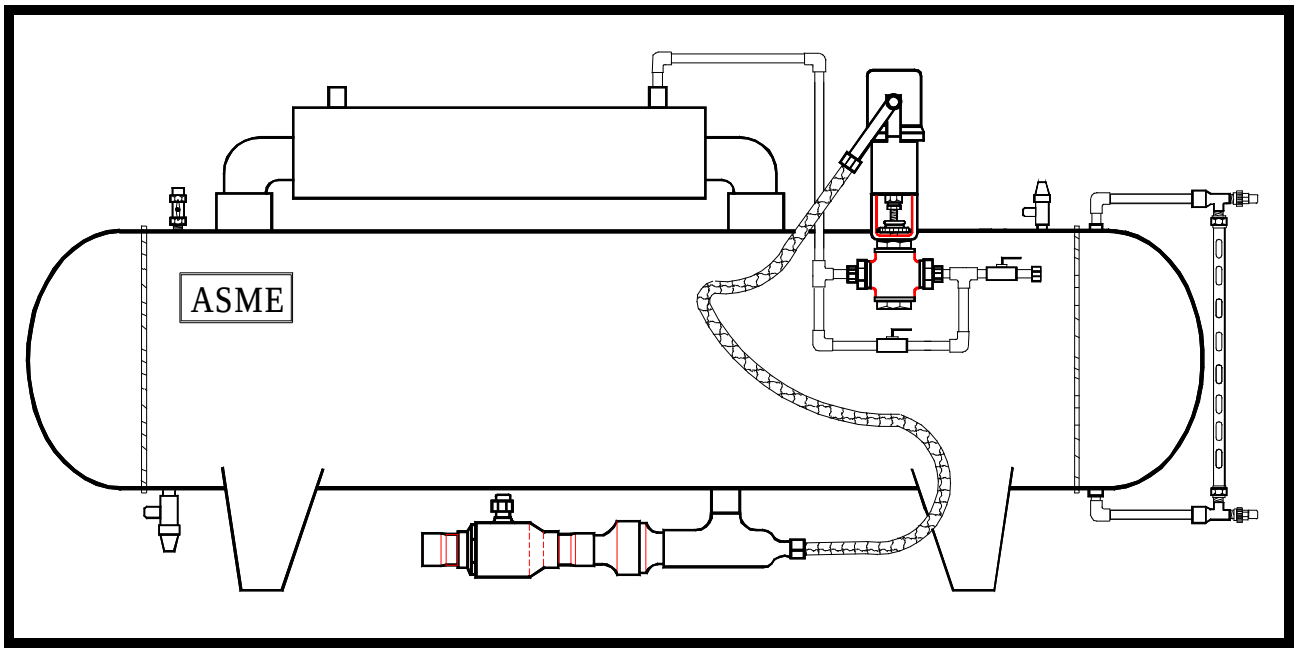
Installation Operation & Maintenance Manual

Literature No. 1061-01

SavAll™

Models SAV- 2500 thru 5000

Refrigerant Charge
Protection System and
On-Line Refrigerant Storage Vessel.....



Patent Pending

.....for use on Centrifugal Chillers

(All Refrigerants)

Vessel ASME Certified

Revised Technically as of May 1, 1996
This Copy was Printed as of January 18, 2004

Table of Contents

9 GENERAL INFORMATION 9

4 YOU ARE URGED TO READ THIS MANUAL COMPLETELY BEFORE INSTALLING AND/OR OPERATING THIS UNIT

Upon Receiving Your Unit

Inspect the unit for possible damage caused during shipping. **Contact** Equipment Servicing **before attempting to use a damaged unit.** (800) 626-8640 or (317) 865-4130.

Warnings and Cautions

NOTE: *Warnings and Cautions appear in highlighted boxes as illustrated below at appropriate points throughout this manual. Give special attention to these items.*

Warnings: are provided to alert you to potential hazards that could result in serious personal injury and damage to your equipment. Warnings may appear in this manual or on the equipment. Heed all Warnings.

Cautions: are designed to alert you to situations that may result in damage to your equipment.

Personal safety and the proper operation of your equipment require strict observance of these precautions.

EQUIPMENT SHOULD BE INSTALLED AND OPERATED ONLY BY QUALIFIED PERSONNEL

Warning: Certain servicing procedures may expose you to harmful materials and dangerous conditions. To minimize the possibility of injury, follow safety procedures and instructions described in this manual, on product labels and in material safety data sheets provided.

NOTE: *The manufacturer has a continuous equipment improvement policy and reserves the right to change specifications and design of its products without notice.*

Containment Vessel Specifications

- **Containment Vessel - Steel Construction ASME Certified**
- **Vessel capacity - 2500, 3000, 4000 & 5000 lbs.**
- **Condenser water inlet & outlet - 3/4" FNPT**
- **Relief valve size - 1" FNPT**
- **Relief valve set point - 400 psig**
- **Condenser water valve - non-electric temperature actuated**
- **Maximum working pressure - 400 psi**
- **Models SAV-2500 thru 5000: Refrigerant transfer line size = 1 5/8" O.D. Refrigerant transfer rate @ 10 PSIG evaporator pressure = 1000 lbs/minute**
- **For use on Centrifugal Chillers (all refrigerants)**
- RuptureSeal™ **Back-up relief valve (furnished with** SavAll™ **System)**

Contents of the SavAll™ Installation Kit

Each "kit" includes: One SavAll™ Unit
One RuptureSeal™ Valve
One 1 5/8" Ball Valve
One Valve "Warning" Tag

Field-Provided Items

Furnished by installer: 1 5/8" O.D. copper tube and fittings (Transfer Line)
3/4" O.D. copper tube and fittings (City Water Supply and Drain)

General Overview

The **Primary Function** of the **SavAll™** Refrigerant Containment System is to provide fully automatic emergency transfer of liquid refrigerant from the evaporator of a centrifugal chiller to a safe storage vessel for temporary containment in the event of an evaporator over-pressure condition. Once the over-pressure condition subsides, or is restored to normal, the liquid refrigerant automatically returns to the evaporator.

Because operation of the **SavAll™ System** is completely automatic, and does not require operator interaction to function, chiller down time and potential catastrophic loss of refrigerant, due to evaporator over-pressurization, are virtually eliminated.

Operation of the **SavAll™ System** is completely passive, relying solely upon pressure differential and gravity to function. The system is totally non-electric, which means there are no electronic controls, sensors, motorized valves or pumps to fail. Because the system is non-electric, it will continue to protect the chiller's refrigerant charge during periods of power outage.

As a **Secondary Function**, the **SavAll™ System** serves as a permanent on-line refrigerant storage vessel for use during chiller servicing and repair.

Theory of Operation

The most effective way to prevent catastrophic loss of refrigerant due to chiller over-pressurization is to prevent over-pressurization from occurring in the first place. The most effective way to accomplish this is to separate the liquid refrigerant from the potential cause of over-pressurization as early and rapidly as possible. This is what the **SavAll™ System** is designed to do. (Refer to Figures 1 thru 3 below for explanation of how the **SavAll™ System** functions.

Figure 1 depicts an idle centrifugal chiller at normal saturated pressure corresponding to prevailing ambient conditions. Note that the uppermost liquid refrigerant level in the chiller evaporator is below the bottom of the **SavAll™** containment vessel. This is absolutely essential for proper operation of the **SavAll™ System**. As depicted, pressures between the evaporator and containment vessel are equalized. Thus, the liquid refrigerant seeking its own level, remains in the evaporator.

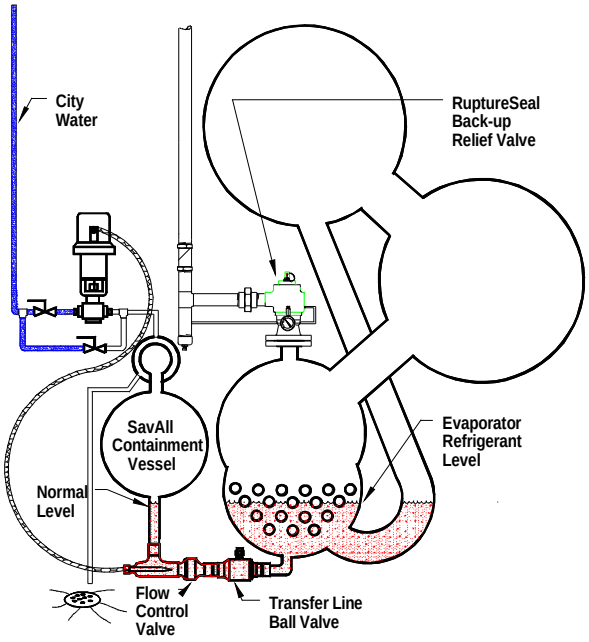


Figure 1. - *Chiller Idle, Pressure Normal*

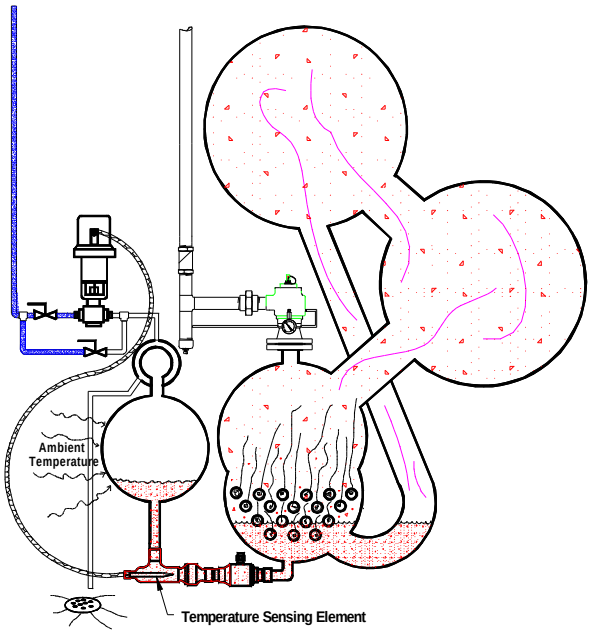
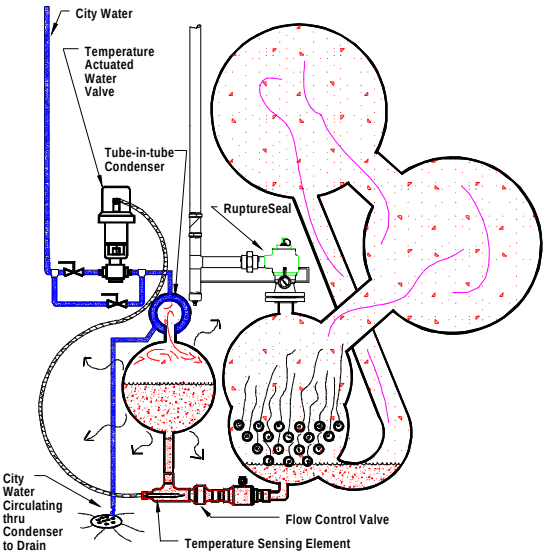


Figure 2 depicts the same centrifugal chiller in which heated water has been inadvertently introduced into the evaporator tube bundle. (Note, the result is the same, regardless of source of over-pressurization). This sudden influx of heat causes a portion of the liquid refrigerant to vaporize, thus raising the pressure in the evaporator (and likewise, throughout the entire chiller). However, because a liquid barrier exists within the interconnecting transfer line piping, a pressure differential will develop. When this happens, the higher pressure within the evaporator instantaneously begins to push the liquid refrigerant over into the lower pressure **SavAll™** containment vessel for safe storage.

Figure 2. - *Hot water introduced into evaporator*



As illustrated in Figure 3., This very rapid transfer of liquid refrigerant continues until either all of the liquid refrigerant has been transferred to the containment vessel, or until sufficient liquid refrigerant has been removed from exposure to the heat source (evaporator tube bundle) to neutralize its effect, thereby allowing evaporator pressure to stabilize at a predetermined maximum allowable level, as controlled by the temperature actuated water valve. Typically, this would be approximately 90° F for most refrigerants. Thus, depending upon the severity of the condition, a state of equilibrium will develop, which may or may not result in the entire refrigerant charge being transferred to the containment vessel.

Figure 3. - *Liquid Refrigerant being transferred to Containment Vessel*

Once the potential cause of over-pressurization has been removed, and system pressure returns to normal, any refrigerant in the containment vessel will automatically flow by gravity back to the chiller evaporator.

Flow Control Valve

The purpose of the SavAll™ System's unique (Patent Pending) Flow Control Valve (see Figure 3.) is to filter out normal pressure gradients that occur during chiller operation, such as when the chiller loads and unloads capacity. Thus, liquid refrigerant is inhibited from flowing into the containment vessel under these conditions. However, when pressure differential across the Flow Control Valve exceeds a predetermined norm, the valve will begin to open, allowing free flow of liquid refrigerant from the evaporator to the containment vessel. Once the pressure across the Flow Control Valve again equalizes, indicating a return to normal, any liquid refrigerant within the containment vessel is allowed to free flow back to the evaporator.

RuptureSeal™ Back-up Safety Relief Valve

The purpose of the RuptureSeal™ back-up relief valve is to provide protection against loss of refrigerant in the event a momentary pressure spike should burst the rupture disk. If the rupture disk should burst, the back-up relief valve maintains the necessary pressure differential required to continue pushing the liquid refrigerant over into the SavAll™ containment vessel. Therefore, the RuptureSeal™ back-up relief valve is vital to the operation of the SavAll™ refrigerant charge protection system.

INSTALLATION

Warning: ALL WELDING done to HIGH PRESSURE CENTRIFUGAL CHILLER ASME Code Vessels, i.e. R-12, R-22, R-134a, R-500, R-114, etc., MUST be done by a CERTIFIED welder and MUST be "R" Stamped per code requirements. (Certification and "R" stamp not necessary on LOW PRESSURE CENTRIFUGAL CHILLERS.)

Installation of the **SavAll™ System** for chillers with capacities above 2000 pounds requires removal of the chiller's refrigerant charge. It will be necessary to cut a hole in the bottom of the evaporator shell in order to connect the transfer piping to the evaporator. (**The equipment manufacturer should be consulted for proper location of entry into evaporator shell**.)

The **SavAll™ System** containment vessel will be utilized as the storage means for chiller's refrigerant charge during the installation process.

Location

The **SavAll™ System** containment vessel must be installed horizontally on its base as near to the chiller as possible, preferably directly adjacent to the chiller evaporator.

It is absolutely essential that the bottom of the containment vessel be slightly higher than the highest expected liquid refrigerant level in the evaporator (see Figure 4).

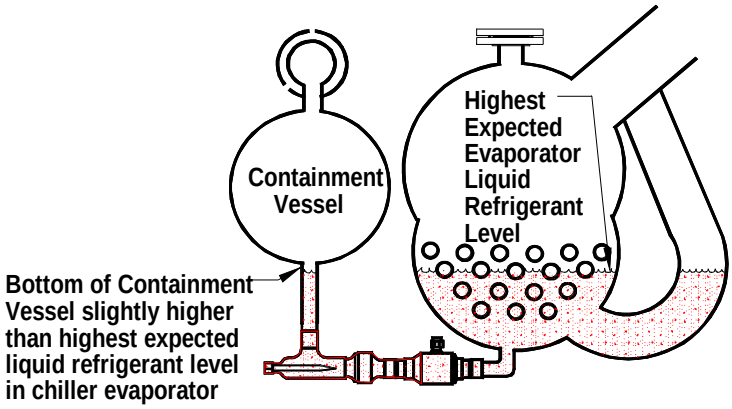


Figure 4. - *Location*

WARNING: To avoid possible injury or damage to equipment, be sure to have proper lifting and handling equipment available.

City Water Connection

1. Using 3/4" copper tubing, connect city water source to SavAll™ System water valve inlet connection (see Figure 5).
2. Using 3/4" copper tubing, run outlet drain line from Tube-in tube condenser outlet fitting to nearest floor drain or other suitable drain (see Figure 5.).

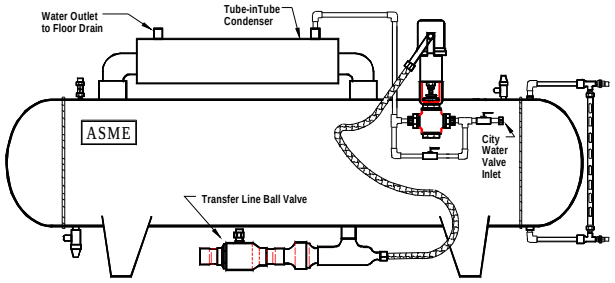


Figure 5. - *Water Connections*

Leak Testing During Installation

The **SavAll™ System** has been leak tested at the factory. However, since this is such a critical factor, it is recommended that the system be leak tested again at the time of installation. **Absolutely NO leakage can be tolerated**.

1. Close transfer line ball valve (see Figure 6).
2. Verify all other valves on containment vessel are closed.
3. Pressurize **SavAll™ System** containment vessel to a minimum of 50 psig using dry nitrogen with R-22 as a trace refrigerant.
4. At completion of leak test, relieve pressure to zero.

Evacuation of SavAll™ Containment Vessel

1. Evacuate **SavAll™ System** to 2mm/hg or less (see Figure 6).
2. It is recommended that the system be allowed to remain under a standing vacuum leak test for at least two hours to verify there are no leaks.

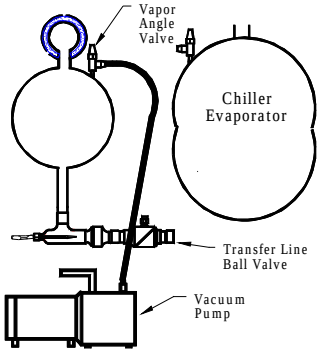


Figure 6. - *Evacuating System*

Transferring Liquid Refrigerant to Containment Vessel During Initial Installation

(See page 15 for "Manual Refrigerant Transfer to Containment Vessel when Servicing Chiller".)

With transfer line ball valve **closed**, and containment vessel under deep vacuum, i.e. 2mm/Hg:

1. Connect appropriate size refrigeration hose between the evaporator charging valve and the liquid angle valve on bottom of containment vessel (see Figure 7).
2. Open both valves and allow liquid refrigerant to transfer from the evaporator over to the containment vessel until pressures equalize.
3. If the transfer process stops before all the liquid refrigerant has transferred, it will be necessary to open the city water bypass valve (see Figure 7). This will allow cool water to flow through the tube-in-tube condenser, thereby lowering containment vessel pressure, thus inducing liquid transfer from evaporator to containment vessel.

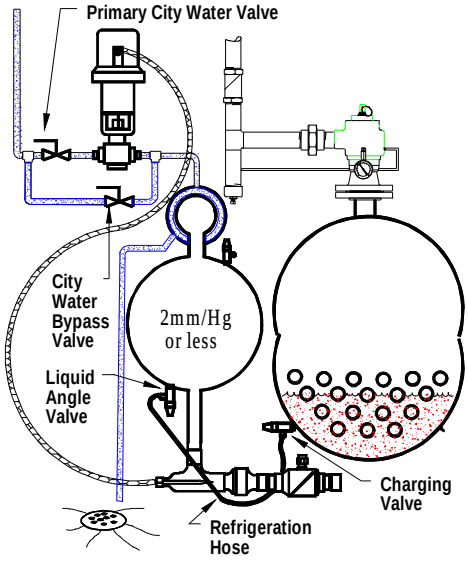
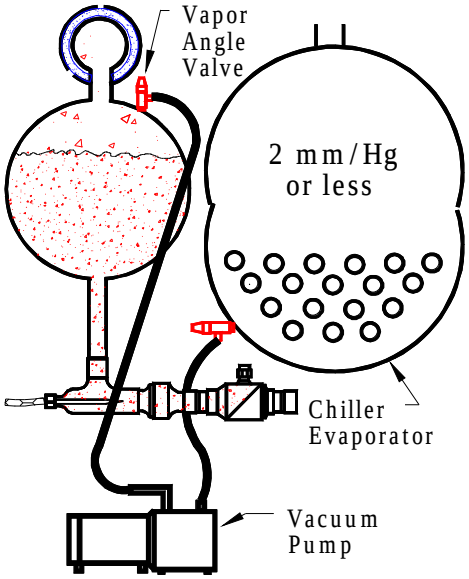


Figure 7. - *Liquid Refrigerant being transferred to Containment Vessel*

4. Once liquid refrigerant transfer has been completed, close both the evaporator charging valve and liquid angle valve on containment vessel.
5. Close city water bypass

Recovering Vapor from Chiller to Containment Vessel



1. Connect vacuum pump to chiller (see Figure 8).
2. Connect discharge of vacuum pump to vapor angle valve on top of containment vessel (see Figure 8).
3. Open both valves and start vacuum pump.
4. Crack open city water bypass valve just enough to maintain steady pressure in containment vessel.
5. Allow vacuum pump to run until proper vacuum has been achieved in chiller.
6. Turn off vacuum pump.
7. Close chiller valve and containment vessel valve
8. Close city water bypass valve.
9. Refrigerant recovery is now complete, and **final piping connection to evaporator shell can be completed**.

Figure 8. - *Recovering Vapor*

Transfer Line Piping

Warning: ALL WELDING done to HIGH PRESSURE CENTRIFUGAL CHILLER ASME Code Vessels, i.e. R-12, R-22, R-134a, R-500, R-114, etc., MUST be done by a CERTIFIED welder and MUST be "R" Stamped per code requirements. (Certification and "R" stamp not necessary on LOW PRESSURE CENTRIFUGAL CHILLERS.)

1. Cut proper size hole in bottom (or as near as possible to the bottom) of evaporator shell (see Figure 9) at location previously selected per equipment manufacturer's recommendation. Hole size must be equal to transfer line piping size. **DO NOT RESTRICT OPENING!**
2. **Weld appropriate fitting to evaporator shell over hole.**
3. Run transfer line piping (using refrigeration grade copper tubing of the same tubing size as the transfer line ball valve) between the evaporator connection and the containment vessel (see Figure 9). **DO NOT REDUCE PIPE SIZE!**
4. Pressurize chiller and leak test all piping connections and weld joints. **Be absolutely sure there are no leaks!**
5. Insulate transfer line between evaporator and bottom of containment vessel.

NOTE: *DO NOT INSULATE* ***SavAll™*** *VESSEL.*

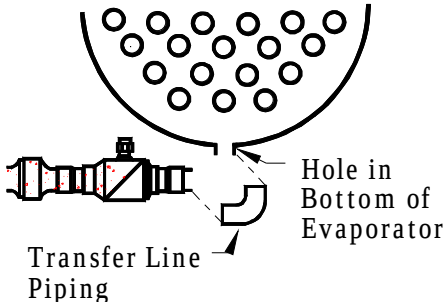


Figure 9. - *Connecting*

6. Evacuate chiller.
7. Connect refrigeration hose between chiller charging valve and containment vessel vapor angle valve (see Figure 10).
8. Open chiller charging valve.
9. Open containment vessel vapor valve and break vacuum in chiller to a pressure above 32° degrees saturation temperature for the refrigerant that is being used. (Read Warning Below.)

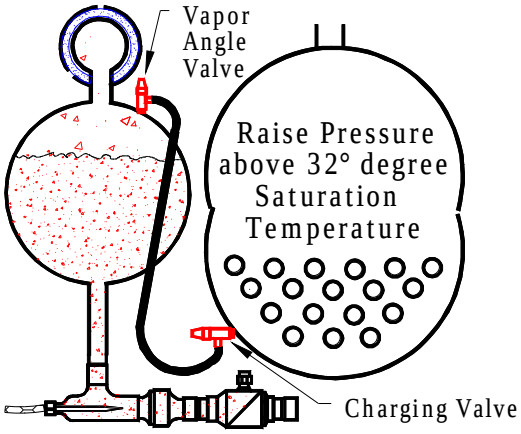


Figure 10. - *Breaking Vacuum in chiller*

Warning: DO NOT OPEN transfer line ball valve until the chiller has reached a pressure corresponding to a saturated temperature above FREEZING (32° F), otherwise the chiller may be damaged due to freezing.

10. Once proper pressure has been reached in chiller, close both the evaporator charging valve and containment vessel vapor angle valve.

NOTE: *When transferring liquid refrigerant back to chiller, it is recommended that when possible, start the chiller water pump to circulate water thru evaporator tubes while transferring refrigerant.*

Warning: DO NOT OPEN transfer line ball valve until the chiller has reached a pressure corresponding to a saturated temperature above FREEZING (32° F), otherwise the chiller may be damaged due to freezing.

11. Open transfer line ball valve and allow liquid refrigerant to flow by gravity back to the evaporator.
12. Attach valve "WARNING" Tag to transfer line ball valve (see Figure 12 on page 14).

Installation of the containment part of the **SavAll™ System** is now complete. (Read Warning below!)

Warning: <u>THE TRANSFER LINE BALL VALVE MUST REMAIN OPEN AT ALL TIMES</u>, except when SavAll™ is being used as on-line refrigerant storage vessel during chiller servicing or repair. The SavAll™ System will not function and therefore <u>CANNOT</u> protect the chiller's refrigerant charge if the Transfer Line Ball Valve is closed.

Water Valve Calibration

The condenser water valve opening temperature has been preset to 90° F at the factory and no further adjustment should be necessary. However, should a different operating temperature be required, such as when there is abnormally high ambient temperature conditions, refer to the Maintenance Section of this manual, beginning on page 17, for calibration instructions.

Rupture Disk Back-up Relief Valve

The evaporator rupture disk relief MUST be retrofitted with one of the various RuptureSeal™ valves (see Figure 11). If such a valve is already installed, no further action is required.

Refer to installation instructions accompanying valve when installing.

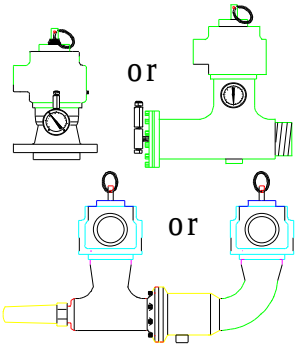


Figure 11. - RuptureSeal™ *Back-up Relief Valves*

Chiller Control Set-up

Chillers having start-up ramp loading control "Soft Loading" capability should be set-up to ramp load slowly over several minutes to allow sufficient time for any liquid refrigerant that may have accumulated in the containment vessel during the "Off" cycle to return to the evaporator.

Chillers that do not have "Soft Loading" capability should be modified to include a time delay circuit to delay loading at start-up for at least one to two minutes.

OPERATION

Basic Operating Instructions

1. **THE REFRIGERANT TRANSFER LINE BALL VALVE MUST REMAIN OPEN AT ALL TIMES** (except when manually transferring refrigerant from chiller to **SavAll™** containment vessel during chiller servicing or repair).

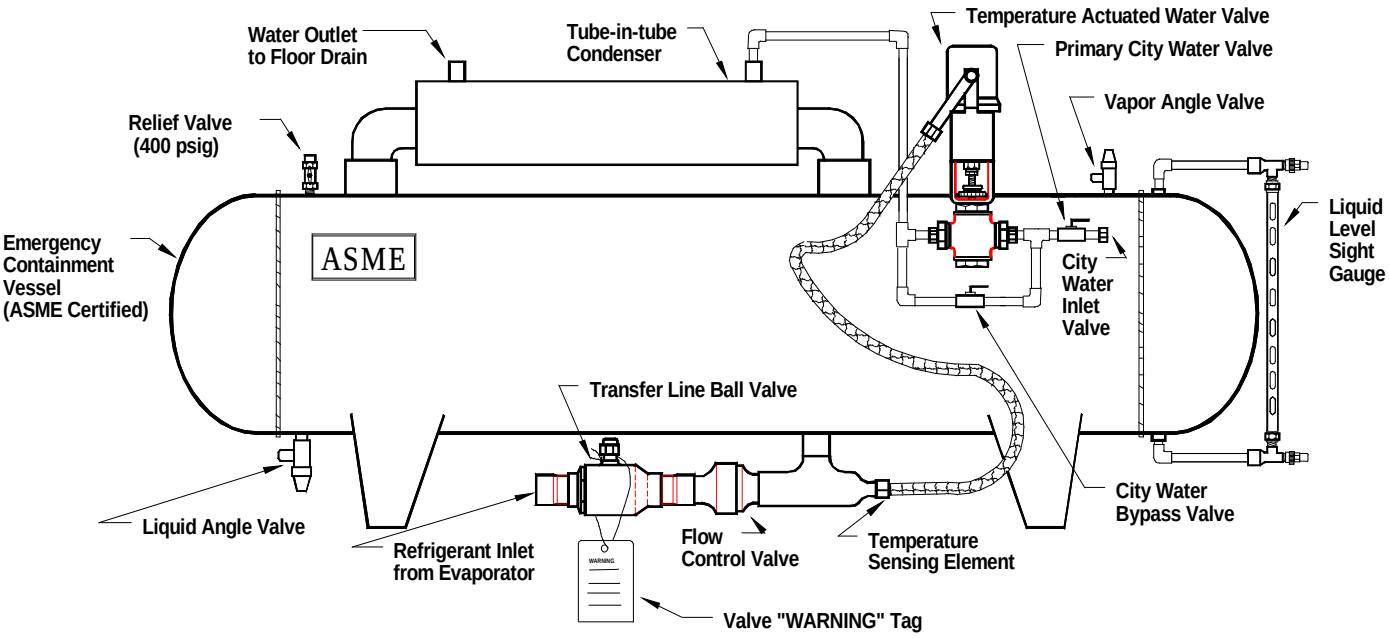


Figure 12. - *Schematic of System*

2. Both liquid level gauge valves should normally remain closed at all times and opened only when it is necessary to view liquid level, then re-closed (see Figure 12).
3. Primary city water valve MUST remain OPEN at all times (see Figure 12).
4. Bypass city water valve MUST remain CLOSED at all times except when performing manual refrigerant transfer (see Figure 12).

WARNING: During normal operation, both the primary city water valve and the transfer line ball valve must remain open at all times for system to be functional.

Pressurizing and Leak Testing Chiller

When pressurizing chiller for leak testing, it will be necessary to temporarily close the Transfer Line Ball Valve. At conclusion of leak test, be ABSOLUTELY SURE to re-open the Transfer Line Ball Valve!

Purge Operation

It is absolutely imperative, in order to assure proper operation of the **SavAll™ System** , that the chiller be completely purged free of non-condensables (air) at all times. This is especially critical for chillers that remain idle for long periods of time.

The purge unit MUST be capable of purging the chiller during OFF-CYCLE period. If the existing purge system is incapable of automatic purging during the OFF-CYCLE, it is strongly recommended that the purge system be replaced with a microprocessor controlled high efficiency unit such as the Redi-Purge™ (see Figure 13).

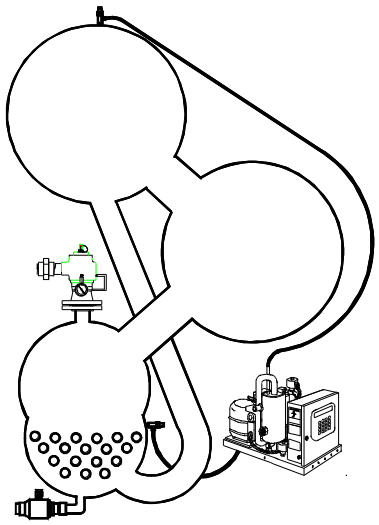


Figure 13. - *Purge Hook-up*

Caution: Failure to maintain properly purged system at all times could render the SavAll™ System inoperative.

Manual Refrigerant Transfer to Containment Vessel when Servicing Chiller

(See page 10 for "Transferring Liquid Refrigerant to Containment Vessel during Initial Installation.)

When it is necessary to remove the chiller's refrigerant charge for any reason, it can be quickly transferred over to the **SavAll™ System** containment vessel for temporary storage as follows:

1. Open the city water bypass valve. Normally the city water temperature will be cool enough to lower the containment vessel pressure sufficiently to cause liquid refrigerant to flow from the evaporator to the containment vessel. However, If the city water is too warm, it may be necessary to circulate heated water through the evaporator tube bundle in order to raise evaporator pressure sufficiently to push the remaining refrigerant into the containment vessel.
2. Once all liquid refrigerant has been transferred to the containment vessel, **CLOSE** the transfer line ball valve.

NOTE: *This is the only time the transfer line ball valve should ever be closed. At all other times the TRANSFER LINE BALL VALVE MUST REMAIN OPEN. The SavAll™ System will not function and therefore CANNOT protect the chillers refrigerant charge if the transfer line ball valve is closed.*

3. Connect vacuum pump between evaporator and containment vessel (see Figure 8. on page 11).
4. Open vapor angle valve on containment vessel and charging valve on evaporator.
5. Leave City Water Bypass Valve OPEN.
6. Start vacuum pump and evacuate chiller.
7. When chiller is properly evacuated, close both angle valves and turn off vacuum pump.

8. Close water valve bypass valve.
9. Transfer of refrigerant to **SavAll™ System** containment vessel is now complete.

   IMPORTANT: Before you return refrigerant to the chiller, you must read the warning below!

Warning: When Transferring refrigerant from SavAll™ containment vessel back to chiller, BE ABSOLUTELY SURE the chiller evaporator is at a pressure corresponding to a saturated temperature above FREEZING (32° F) before re-opening transfer line ball valve, otherwise the chiller may be damaged due to freezing.

Using the SavAll™ to Verify Proper Refrigerant Charge

The **SavAll™ System** can be used as a quick and accurate means of verifying the chiller's liquid refrigerant charge.

1. First, accurately trim the refrigerant charge as necessary, and only if necessary, to optimum operating charge.
2. Transfer liquid refrigerant over to the **SavAll™ System** containment vessel (see *Manual Transfer of Refrigerant Charge* on page 15).
3. Once the liquid refrigerant is completely transferred to the containment vessel, **close** the transfer line ball valve.
4. **Close** water valve bypass valve, if opened during transfer process.
5. Allow sufficient time for liquid refrigerant temperature to equalize to ambient temperature.
6. Open both liquid level gauge valves.
7. Using a permanent ink marking pin, mark the liquid level on the gauge glass and/or metal shield.
8. Also, record next to the mark both the ambient temperature and containment vessel pressure. Now you have an accurate benchmark that can be used at anytime to verify the chiller's refrigerant charge.

NOTE*: Similar markings for other temperatures and pressures may also be included as needed.*

9. **OPEN** transfer line ball valve and allow refrigerant to return to chiller..
10. Close both liquid level gauge valves.

MAINTENANCE

Because the **SavAll™ System** is a totally passive device, having few working components, virtually no maintenance is required.

Servicing Temperature Actuated Condenser Water Valve

Generally, the only system component that may ever require attention, is the Temperature Actuated Valve.

Manual Flushing: To flush valve, insert a screwdriver under each side of lower spring guide. Pry both guide and spring away from body to open valve.

Valve Adjustment: To raise valve opening temperature point, turn adjusting screw counter-clockwise; to lower valve opening temperature point, turn screw clockwise.

NOTE: *Valve closing point is not-adjustable. The valve will close 3° to 5° below opening point.*

Service: Valve seat and disc, after long periods of operation, may become worn or pitted, thus allowing leakage through valve when closed. Internal parts can be replaced.

Renewal Kits containing seats, discs, retainers, diaphragms and all additional internal parts required to recondition the Johnson Controls Series V47 valve are available from your nearest Penn-Baso wholesaler. Order **Kit # STT16A-601R**.

Servicing RuptureSeal™ Back-up Relief Valve

Refer to Maintenance section of IOM furnished for the RuptureSeal™ Back-up Relief Valve

REDI CONTROLS, INC.

SavAll™ Warranty

Within one year from date of purchase, Redi Controls will repair any **SavAll product** being used by the original purchaser, which is defective due to faulty materials or workmanship. manufacturer has the right to repair or replace a defective part or replace the entire product.

To file a Warranty claim on any system or component, return the defective item to manufacturer, or other location as manufacturer directs, freight prepaid.

This Warranty <u>does not</u> apply to or cover:

Damages beyond manufacturers' control.

Malfunctions that result from failure to properly install, operate or maintain product in accordance with instructions provided by manufacturer.

Failures of equipment due to abuse, accident or negligence.

Damages from, or part failures due to equipment not being installed per manufacturers' instructions, per applicable codes or ordinances, or in accordance with good trade practices.

Labor or other charges incurred in removing or reinstalling any product or part.

Damages resulting from use of product for any purpose other than for which it was designed and manufactured.

Any implied warranty of merchantability or fitness for any particular purpose, occurring after the Warranty Period.

Loss of use, loss of time, inconvenience, rental for substitute products, loss of business, loss of income, or any other consequential damages resulting from use or failure of any product.

Inquiries to:

Redi Controls, Inc.
Valle Vista Executive Center
755 East Main Street
Greenwood, IN 46143
(317) 865-4130 - Fax: (317) 865-4145