General Service Safety Precautions

Chapter 1

Introduction

Tecumseh Products Company has prepared this handbook to assist service personnel in safely working with refrigeration and air conditioning equipment that uses Tecumseh Products Company hermetic compressors. It is not designed to replace the training required for professional service personnel. It is also not intended to replace other information available from refrigeration and air conditioning equipment manufacturers.

Trained Personnel Only

Servicing, repairing, and troubleshooting refrigeration and air conditioning systems should be done only by those with the necessary knowledge, training, and equipment.

Terminal Venting and Electrocution

Improperly servicing, repairing, or troubleshooting a compressor can lead to electrocution or fire due to terminal venting with ignition. Follow the precautions below to avoid serious injury or death from electrocution or terminal venting with ignition.

Fire Hazard from Terminal Venting with Ignition

Oil and refrigerant can spray out of the compressor if one of the terminal pins is ejected from the hermetic terminal. This "terminal venting" can occur as a result of a ground fault (also known as a short circuit to ground) in the compressor. The oil and refrigerant spray from terminal venting can be ignited by electricity and produce flames that can lead to serious burns or death. See figures 1-1 through 1-3 for details.

⚠ WARNING ⚠

Never service, repair, or troubleshoot unless you are qualified to perform these functions. Improper servicing can lead to serious injury or death from fire, electrical shock, or explosion.

Terminal Venting and Electrocution Precautions

To reduce the risk of electrocution or serious burns or death from terminal venting with ignition:

- Be alert for sounds of arcing (sizzling, sputtering or popping) inside the compressor. IMMEDIATELY GET AWAY if you hear these sounds.
- Disconnect ALL electrical power before removing the protective terminal cover. Make sure that all power legs are open. (NOTE: The system may have more than one power supply.)
- Never energize the system unless: 1) the protective terminal cover is securely fastened, and 2) the compressor is properly connected to ground. Figures 1-4 through 1-6 illustrate the different means of fastening protective terminal covers.

- Never reset a breaker or replace a fuse without first checking for a ground fault (a short circuit to ground).

  An open fuse or tripped circuit breaker is a strong indication of a ground fault (also know as a short circuit to ground). Use only a megohmmeter ("megger") or a Hi-Potential Ground tester (Hi-Pot) to check for a ground fault. A conventional ohmmeter will not reliably detect a ground fault under certain circumstances. See the Service Handbook for more information on checking for a ground fault. Also, always follow the megger or Hi-Pot manufacturer's procedures and safety rules.

  If a ground fault does exist, keep the power off. WARNING! To avoid electric shock, electrocution, and terminal venting with ignition, do not energize a compressor that has a ground

fault. Mark and red tag the compressor to indicate that there is a ground fault. Do not reconnect the power leads. Tape and insulate each power lead separately.

- Disconnect power before servicing. Always disconnect power before servicing unless it is required for a specific troubleshooting technique. In these situations, use extreme caution to avoid electric shock.

FIGURE 1-1: Compressor with (1) protective cover and (2) bale strap removed to show (3) hermetic terminal.

FIGURE 1-2: Close up view of hermetic terminal showing individual terminal pins with power leads removed.

FIGURE 1-3: Close up view of hermetic teminal after it has vented.

FIGURE 1-4: Compressor with (1) protective cover held in place by (2) metal bale strap.

FIGURE 1-5: Compressor with (1) protective cover held in place by (2) nut.

FIGURE 1-6: Compressor with (1) snap in protective cover.

Refrigerants and Other Chemicals

Contact with refrigerant, mixtures of refrigerant and oil, or other chemicals can cause a variety of injuries including burns and frostbite. For example, if refrigerant contacts skin or eyes, it can cause severe frostbite. Also, in the event of a compressor motor failure, some refrigerant and oil mixtures can be acidic and can cause chemical burns.

To avoid injury, wear appropriate protective eye wear, gloves, and clothing when servicing an air conditioning or refrigeration system. Refer to your refrigerant supplier for more information.

If refrigerant or mixtures of refrigerant and oil come in contact with skin or eyes, flush the exposed area with water and get medical attention immediately.

Compressor Removal

Failure to properly remove the compressor can result in serious injury or death from electrocution, fire, or sudden release of refrigerant and oil.

Follow these precautions when removing a compressor from a system:

- Disconnect ALL electrical power. Disconnect all electrical power supplies to the system making sure that all power legs are open. (NOTE: the system may have more than one power supply.)
- Be sure refrigerant is recovered before removing compressor. Attempting to remove the compressor before removing all refrigerant from the system can cause a sudden release of refrigerant and oil. Among other things, this can:
  - »»cause a variety of injuries including burns and frostbite.
  - »»cause a fire if a torch is used to disconnect tubing.
  - »»expose the service person to toxic gas.

- To avoid serious injury or death, be sure to remove and recover all refrigerant before removing the compressor.
- Use a tubing cutter, not a torch. Use a tubing cutter to remove the compressor. A torch can cause even trace amounts of refrigerant to decompose and release toxic fumes. In addition, using a torch to remove the compressor can cause a fire. If you ignore this recommendation and use a torch, be prepared to extinguish a fire.

System Flushing, Purging, and Pressure Testing for Leaks

Failure to properly purge or pressure test a system for leaks can result in serious injury or death from explosion, fire, or contact with acid-saturated refrigerant or oil mists.

Follow these precautions when purging or pressure testing a system for leaks:

- Tecumseh discourages the use of flushing products and recommends the use of suction line filter-drier and proper oil changes. If the use of a flushing agent is absolutely necessary, follow the flushing agent manufacturer's instructions.
- To purge a system, use only dry nitrogen.
- When pressure testing for leaks, use only regulated dry nitrogen or dry nitrogen plus trace amounts of the serial label refrigerant.
- When purging or pressure testing any refrigeration or air conditioning system for leaks, never use air, oxygen or acetylene.
  - »»Oxygen can explode on contact with oil.
  - »»Acetylene can decompose and explode when exposed to pressure greater than approximately 15 psig.
  - »»Combining an oxidizing gas such as oxygen or air, with an HCFC or HFC refrigerant under pressure can result in a fire or explosion.

- Use a pressure regulating valve and pressure gauges.

  Commercial cylinders of nitrogen contain pressures in excess of 2000 psig at 70°F. At pressures much lower than 2000 psig, compressors can explode and cause serious injury or death. To avoid over pressurizing the system, always use a pressure-regulating valve on the nitrogen cylinder discharge (see Figure 1-7). The pressure regulator must be able to reduce the pressure down to 1 or 2 psig and maintain this pressure.

  The regulating valve must be equipped with two pressure gauges:

  - one gauge to measure cylinder pressure, and
  - one gauge to measure discharge or downstream pressure.

- Use a pressure relief valve.

  In addition to a pressure regulating valve and gauges, always install a pressure relief valve. This can also be a frangible disc type pressure relief device. This device should have a discharge port of at least ½" MPT size. The valve or frangible disc device must be set to release at 175 psig (see Figure 1-7).

- Do not pressurize the system beyond 150 psig field leak test pressure.

  When field testing a system for leaks, 150 psig is adequate test pressure.

- Disconnect nitrogen cylinder and evacuate the system before connecting the refrigerant container.

  Disconnect the nitrogen cylinder and evacuate the system according to the equipment manufacturer's recommendations prior to charging the system.

System Charging

Failure to properly charge the system can result in serious injury or death from explosion or fire.

Follow these precautions when charging a system:

- Do not operate the compressor without charge in the system.

  Operating the compressor without a charge in the system can damage the hermetic terminal. As always, to avoid serious injury or death from terminal venting with ignition, never energize the compressor unless the protective terminal cover is securely fastened.

- Use proper refrigerant.

  Use only the serial label refrigerant when charging the system. Using a different refrigerant can lead to excess system pressure and an explosion. Use of a refrigerant other than the serial label refrigerant will void the compressor warranty.

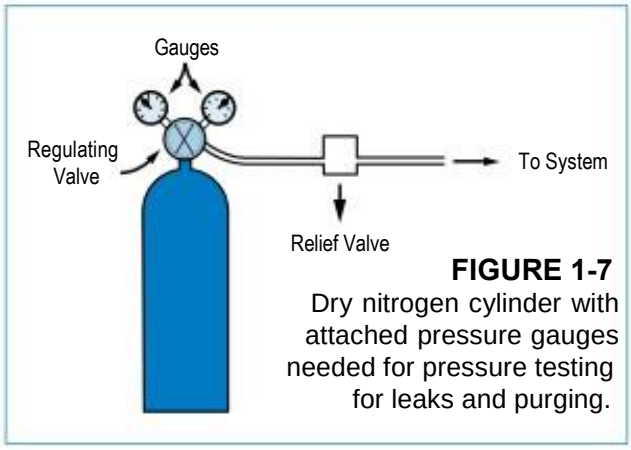

FIGURE 1-7
Dry nitrogen cylinder with attached pressure gauges needed for pressure testing for leaks and purging.

- Do not overcharge a refrigeration or air conditioning system.

  Overcharging a refrigeration or air conditioning system can result in explosion. To avoid serious injury or death, never overcharge the system. Always use proper charging techniques. Limit charge amounts to those specified on the system equipment serial label or in the original equipment manufacturer's service information.

  Overcharging the system immerses the compressor motor, piston, connecting rods, and cylinders in liquid refrigerant. This creates a hydraulic block preventing the compressor from starting. The hydraulic block is also known as locked rotor.

  Continued supply of electricity to the system causes heat to build in the compressor. This heat will eventually vaporize the refrigerant and rapidly increase system pressure. If, for any reason, the thermal protector fails to open the electrical circuit, system pressure can rise to high enough levels to cause a compressor housing explosion.

Prevention of Water-Utilizing System Explosions

In certain water-utilizing refrigeration systems, water can leak into the refrigerant side of the system. This can lead to an explosion of system components including, but not limited to the compressor. If such an explosion occurs, the resulting blast can kill or seriously injure anyone in the vicinity.

Systems at Risk of Explosion

Water-utilizing systems that have single-wall heat exchangers may present a risk of explosion. Such systems may include:

- water source heat pump/air conditioning systems, and
- water cooling systems, such as icemakers, water coolers, and juice dispensers.

Water-utilizing systems that have single-wall heat exchangers present a risk of explosion unless they have either:

- a high pressure cut-out which interrupts power to ALL leads to the compressor, **or**
- an external pressure relief valve.

How an Explosion Occurs

If the refrigerant tubing in the heat exchanger develops a leak, water can enter the refrigerant side of the system. Water entering the refrigerant side can come in contact with live electrical connections in the compressor causing a short circuit or a path to ground. When this occurs, extremely high temperatures can result. The heat build-up creates steam vapor that can cause excessive pressure throughout the entire system. This system pressure can lead to an explosion of the compressor or other system components.

Service Procedures

In light of the risk of explosion, be especially alert for signs of water leaking into the refrigerant side of the system. Whenever servicing or troubleshooting a water-utilizing system, always check to see if it has either a pressure relief valve or a high-pressure cut out as previously described. If the system does not have at least one of these, DISCONNECT ALL ELECTRICAL POWER and look for indications that water has leaked into the refrigerant side of the system. These indications may include:

- Observation or a report of a blown fuse or tripped circuit breaker.
- Signs that water has leaked to the outside of the system.
- Reports that the system has made gurgling or percolating noises.
- A history of loss of refrigerant charge without a leak being found in the system.
  NOTE: Common leak detection methods will not detect a water-to-refrigerant leak in the system's heat exchanger(s).
- Observation of or a report of the compressor giving off an unusual amount of heat. If

ANY of these indications are present, do the following checks to determine if water has leaked into the refrigerant side:

Step 1: Check for a Ground Fault (a Short to Ground)

Use only a megohmmeter ("megger") or a Hi-Potential Ground tester ("Hi-Pot") to check for a ground fault. A conventional ohmmeter will not reliably detect a ground fault under certain circumstances. To check for a ground fault, use the procedure outlined on pages 40-41.

- If a ground fault does not exist, go to Step 2.
- If a ground fault does exist, keep the power off.

WARNING! To avoid electric shock, electrocution and terminal venting with ignition, do not energize a compressor that has a ground fault. Mark and red tag the compressor to indicate that there is a ground fault. Do not reconnect the power leads. Tape and insulate each power lead separately. Proceed to Step 2. Do not replace the compressor or energize the system before performing Step 2.

Step 2: Check for Water in the System

Once the compressor is cool to the touch, open the system process valve slightly to see if any water comes out of the system. **WARNING!** Opening the system process valve while the compressor is hot can cause severe burns from steam coming out of the valve.

If ANY water comes out of the process valve, the entire system **must** be replaced. See "replacing a Single-wall Water-utilizing System" below.

If water does not come out of the process valve, there is still a possibility that some water has leaked into the refrigerant side of the system. To address this possibility, determine if the system has a history of losing refrigerant charge without a leak being found or repaired.

If you find ANY indication of a history of losing refrigerant charge without detection of a leak, this is a sign that refrigerant has leaked in the water inside the heat exchanger. The entire system **must** be replaced. See “Replacing a Single-wall Water-utilizing System” on page 33.

If you do not find any indication of a history of loss of charge without detection of a leak, you still need to install:

A high-pressure cut-out which interrupts power to ALL leads to the compressor, **or**

An external pressure relief valve

Also, if you found a ground fault in the compressor in Step 1, replace the compressor before applying power to the system.

Start Capacitor Overheating

An overheated start capacitor can burst and spray or splatter hot material that can cause burns. Applying voltage to a start capacitor for more than a few seconds can cause the capacitor to overheat.

Check capacitors with a capacitance meter, and never check a capacitor with the power on.

System Evacuation

Never use a compressor to evacuate a system. Instead, use a high-vacuum pump specifically designed for that purpose.

Never start the compressor while it is under deep vacuum. Always break a vacuum with a minimum 2 psig refrigerant charge before energizing the compressor.

The compressor is cooled primarily by the flow of refrigerant. Running a system that is low on charge will reduce the life of the compressor.

Failure to follow these instructions can damage the hermetic terminal. As always, to avoid serious injury or death from terminal venting with ignition, never energize the compressor unless the protective terminal cover is securely fastened.

Servicing or Troubleshooting Water-Utilizing Systems: Preventing Explosions

In certain water-utilizing refrigeration systems, water can leak into the refrigerant side of the system. This can lead to an explosion of system components, including but not limited to, the compressor. If such an explosion occurs, the resulting blast can kill or seriously injure anyone in the vicinity.

Systems at Risk of Explosion

Water-utilizing systems that have single-wall heat exchangers may present a risk of explosion. Such systems may include:

- water source heat pump/air conditioning systems, and
- water cooling systems such as icemakers, water coolers, and juice dispensers.

Water-utilizing systems that have single-wall heat exchangers present a risk of explosion unless they have either:

- a high pressure cut-out which interrupts power to ALL leads to the compressor, or
- an external pressure relief valve.

How an Explosion Occurs

If the refrigerant tubing in the heat exchanger develops a leak, water can enter the refrigerant side of the system. Water entering the refrigerant side can come in contact with live electrical connections in the compressor causing a short circuit or a path to ground. When this occurs, extremely high temperatures can result. The heat build-up creates steam vapor that can cause excessive pressure throughout the entire system. This system pressure can lead to an explosion of the compressor or other system components.

Service Procedures

In light of the risk of explosion, be especially alert for signs of water leaking into the refrigerant side of the system. Whenever servicing or troubleshooting a water-utilizing system, always check to see if it has either a pressure relief valve or a high pressure cut-out as previously described. If the system does not have at least one of these, DISCONNECT ALL ELECTRICAL POWER and look for indications that water has leaked into the refrigerant side of the system. These indications may include:

- Observation of or a report of a blown fuse or tripped circuit breaker.
- Signs that water has leaked to the outside of the system.
- Reports that the system has made gurgling or percolating noises.
- A history of loss of refrigerant charge without a leak being found in the system. NOTE: common leak detection methods will not detect a water-to-refrigerant leak in the system's heat exchanger(s).
- Observation of or a report of the compressor giving off an unusual amount of heat.

If ANY of these indications are present, do the following checks to determine if water has leaked into the refrigerant side:

Step 1: Check for a Ground Fault (a Short to Ground)

Check the compressor for a ground fault (also known as a short circuit to ground) using the procedure outlined in "Identifying Compressor Electrical Problems" on pages 40-41.

- If a ground fault does not exist, go to Step 2.
- If a ground fault does exist, keep the power off. WARNING! To avoid electric shock, electrocution or terminal venting with ignition, do not energize a compressor that has a ground fault. Mark and red tag the compressor to indicate that there is a ground fault. Do not reconnect the power leads. Tape and insulate each power lead separately. Proceed to Step 2. Do not replace the compressor or energize the system before performing Step 2.

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If you do not find any indication of a history of loss of charge without detection of a leak, you still need to install:

- a high-pressure cut-out which interrupts power to ALL leads to the compressor, or
- an external pressure relief valve.

Also, if you found a ground fault in the compressor in Step 1, replace the compressor before applying power to the system.

Replacing a Single-wall Water-utilizing System

When replacing a single-wall water-utilizing system, replace the system with one that has:

- a double-wall heat exchanger(s), or
- a high-pressure cut-out which interrupts power to ALL leads to the compressor, or
- an external pressure relief valve.