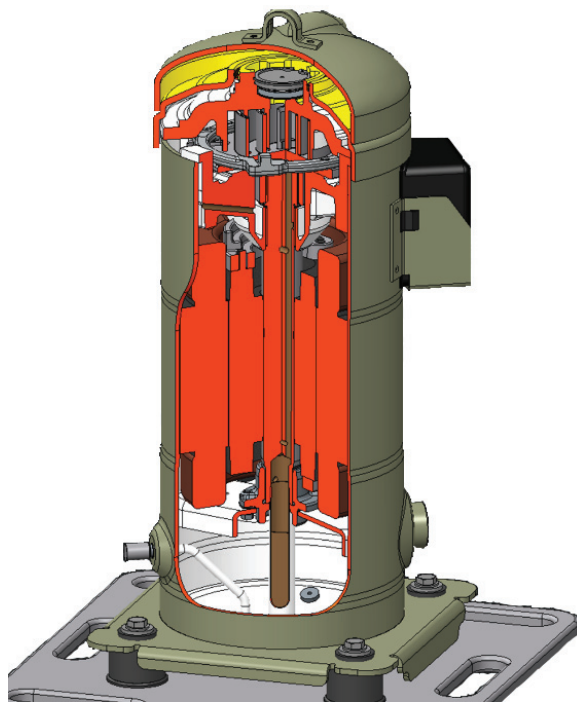




# Installation Instructions

## **CSHW Compressors**

### Installation and Service



#### **⚠ SAFETY WARNING**

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.



# Introduction

Read this manual thoroughly before operating or servicing this unit.

## Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

**⚠ WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**⚠ CAUTION** Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.

**NOTICE** Indicates a situation that could result in equipment or property-damage only accidents.

## Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

## Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

### ⚠ WARNING

#### Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring **MUST** be performed by qualified personnel. Improperly installed and grounded field wiring poses **FIRE** and **ELECTROCUTION** hazards. To avoid these hazards, you **MUST** follow requirements for field wiring installation and grounding as described in **NEC** and your local/state electrical codes.

### ⚠ WARNING

#### Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, **MUST** follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- Before installing/servicing this unit, technicians **MUST** put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). **ALWAYS** refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.
- When working with or around hazardous chemicals, **ALWAYS** refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labeling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.
- If there is a risk of energized electrical contact, arc, or flash, technicians **MUST** put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, **PRIOR** to servicing the unit. **NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

**⚠ WARNING****R-410A Refrigerant under Higher Pressure than R-22**

Failure to use proper equipment or components as described below, could result in equipment failing and possibly exploding, which could result in death, serious injury, or equipment damage. The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22. Use **ONLY** R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane representative.

**⚠ WARNING****Hazard of Explosion and Deadly Gases!**

Never solder, braze or weld on refrigerant lines or any unit components that are above atmospheric pressure or where refrigerant may be present. Always remove refrigerant by following the guidelines established by the EPA Federal Clean Air Act or other state or local codes as appropriate. After refrigerant removal, use dry nitrogen to bring system back to atmospheric pressure before opening system for repairs. mixtures of refrigerants and air under pressure may become combustible in the presence of an ignition source leading to an explosion. Excessive heat from soldering, brazing or welding with refrigerant vapors present can form highly toxic gases and extremely corrosive acids. Failure to follow all proper safe refrigerant handling practices could result in death or serious injury.

**⚠ WARNING****Hazard of Explosion!**

Use only dry nitrogen with a pressure regulator for pressurizing unit. Do not use acetylene, oxygen or compressed air or mixtures containing them for pressure testing. Do not use mixtures of a hydrogen containing refrigerant and air above atmospheric pressure for pressure testing as they may become flammable and could result in an explosion. Refrigerant, when used as a trace gas should only be mixed with dry nitrogen for pressurizing units. Failure to follow these instructions could result in death or serious injury or equipment or property-only damage.

**⚠ WARNING****Hazardous Service Procedures!**

The maintenance and troubleshooting procedures recommended in this section of the manual could result in exposure to electrical, mechanical or other potential safety hazards. Always refer to the safety warnings provided throughout this manual concerning these procedures. When possible, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tag out procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks. Failure to follow all of the safety warnings provided could result in death or serious injury.

**⚠ WARNING****Hazardous Conditions!**

Observe and follow the "Warning" and "Notices" labels on the compressor. Failure to follow these instructions could result in death or serious injury or damage to the equipment.

**NOTICE****Use Proper Charging and Crankcase Heater Operation Procedures!**

Failure to utilize proper charging and crankcase heater procedure will result in compressor failure. Refer to unit IOM or "[Charging the System](#)," p. 16 and "[Verification Before Start-Up](#)," p. 16 in this manual for the proper procedures.

**⚠ WARNING****Follow EHS Policies!**

Failure to follow instructions below could result in death or serious injury.

- All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.
- Non-Trane personnel should always follow local regulations.



## Introduction

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### Revision History

- Added 047 to Non-Loading CSHW values in Model Number Description chapter.
- Running edits.



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# Model Number Descriptions

## Digits 1, 2, 3, 4 – Model Type

CSHW = 3.9 – 7.4 tons

## Digits 5, 6, 7 – Nominal Capacity in MBh

CSHW (Non-Unloading)	CSHW (Unloading)
047	052
050	060
052	065
056	082
058	089
060	
073	
082	
089	

## Digit 8 – Voltage

- J = 200–230/60/3
- K = 460/60/3, 380–415/50/3
- D = 575/60/3
- X = 380/60/3

## Digit 9 – Unloading

- 0 = No Unloading
- 2 = Unloading (1 step Unloading with solenoid not energized)

## Digit 10 – Design Sequence

Factory Assigned

## Digit 11 – Motor Protection Type

- 0 = Internal Line Break

## Digit 12 – Compressor

### Connections Variation

- 0 = Standard Compressor
- A = Standard Compressor, with Oil Equalizer and Sight Glass
- B = Combination Baseplate, with Oil Equalizer and Sight Glass

## Digit 13 - 17 – Reserved for Future Use



# General Information

## Overview

The purpose of this document is to provide installation and service information for Trane CSHW compressors.

This document is not meant to be provide a step-by-step procedure, but is intended to identify procedures or precautions that may be unique to a Trane compressor and should be taken into account to properly and safely remove, install, and troubleshoot the compressor.

Each installation has its unique set of circumstances which also must be taken into account by the service technician.

## POE Oil

**Table 1. Oil charge factory**

Model	Pints	Liters
CSHW047 - CSHW073	3.2	1.5
CSHW082 - CSHW089	3.8	1.8

**Notes:**

1. Oil amount and type is also printed on the nameplate.
2. Use only Trane-approved oils and do not mix oils.

## Oil Handling

POE oil is very hygroscopic, which means it absorbs moisture very readily. Therefore, it is important to properly handle the oil.

### POE Oil Handling Guidelines

- Always use the smallest container size required for the job requirements.
- Always leave the oil container tightly sealed until time of use.
- Do not reuse oil that has been opened.

## Oil Level

**Single compressor:** The oil level should be stable in the sightglass.

**Tandem and trio compressors:**

- **Operation** – The oil level will vary depending on the operating condition. Some conditions will result in oil levels below the sight glass.
- **Off** – After several minutes, the oil levels should be the same in each compressor and should be visible in the sightglass. This is the best method to determine if the system has sufficient oil.

Units overcharged with oil will operate with degraded performance and could lead to compressor damage.

## Operating Envelope

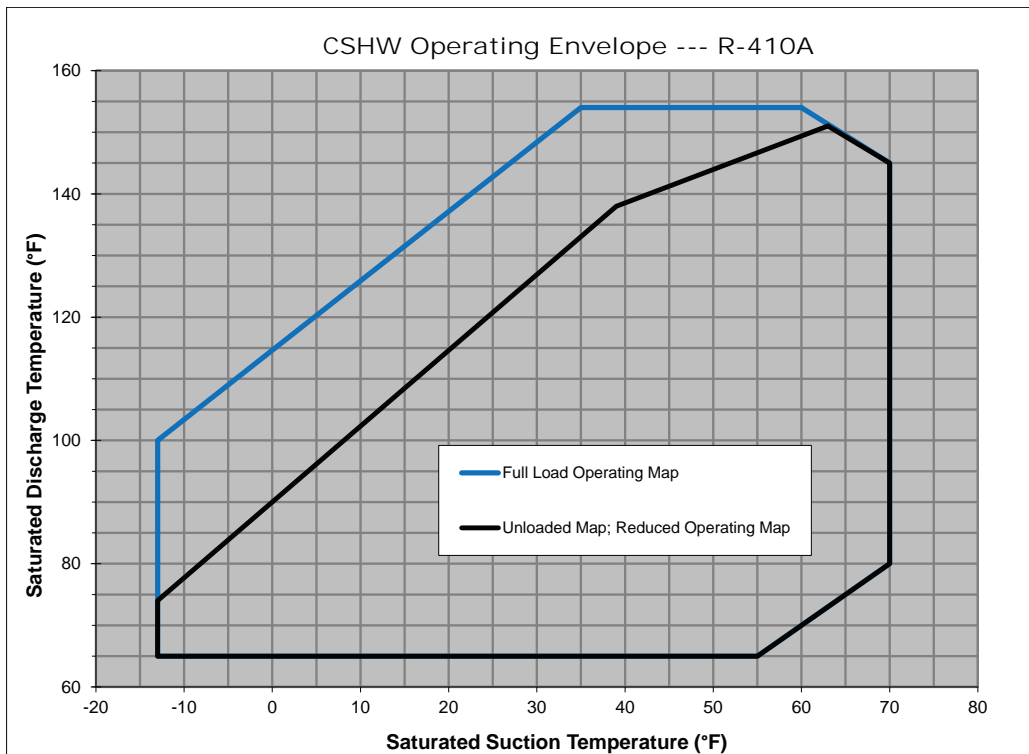
The compressor must be operated within the published operating envelope.

## Operating Map

Below figure represents the operating map for the CSHW R-410A model compressors. For proper operation and reliability, the compressor must always be operated within the indicated limits shown in the operating map. This includes both full unit operating map conditions of the unit, and unit fault modes such as:

- Loss of evaporator air flow
- Loss of evaporator water flow
- Loss of condenser air flow
- Loss of condenser water flow
- Loss of refrigerant charge

Protection devices are required to keep the compressor within the operating envelop during operation and fault modes.

**Figure 1. R-410A operating map for CSHW at 20°F suction superheat**


### Additional basic limitations on operating conditions:

- Discharge temperature must not exceed 300°F (Measure within 6 inches from discharge port).
- Low superheat is not recommended due to risk of oil dilution of the compressor. Recommended minimums are as follows:
  - Electronic expansion valve 10°F.
  - Thermal expansion valve 18-20°F.
- Minimum oil sump superheat 20°F.
- Maximum suction gas superheat 54°F.
- Minimum of 30 psid differential between suction and discharge must be maintained.
- Voltage must be within the compression utilization voltage range.
- Minimum and maximum saturated evaporating and condensing temperatures are as shown in the operating map.
- Excess liquid refrigerant in the compressor at start up can cause Oldham coupling failure, involute breakage and damaged bearings.
- When the refrigerant system charge exceeds 3 pounds per ton, crankcase heaters are required.

- If required, heaters must be energized for a minimum of eight hours prior to starting the compressor to insure that liquid refrigerant is not in the compressor at start up.
- Under normal operation compressor shall operate for 3 minutes minimum.
- Max Amps should not exceed listing on compressor nameplate.

### Refrigerant Type

CSHW compressors are approved for use with R-410A refrigerant only. Any use of hydrocarbon refrigerants or air is strictly prohibited!

### Transportation, Handling, and Storage

The compressor must be handled in the vertical position (maximum 15° offset from vertical). Should the compressor be handled in an upside down position, its suitability for its use can not be guaranteed.



**NOTICE**

**Compressor Damage!**

Improper handling of the compressor could result on compressor damage. A compressor that has been tipped, dropped or transported in a non-upright position could contain internal damage and it is recommended that the compressor not be put into service.

Damage to compressor or packaging should be reported to the shipper immediately.

Use a proper method of lifting the compressor, both lifting ears must be used with a spreader bar.

**WARNING**

**Heavy Objects!**

Failure to follow instructions below or properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage. Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift.

For approximate compressor weight, see the below table.

**Table 2. Compressor weight without oil charge**

Model	Weight (lb)	Weight (kg)
CSHW 047, 050, 052, 056	83.8	38
CSHW 052-2	86	39
CSHW 058, 060, 073	86	39
CSHW 060-2	88.2	40
CSHW 065-2	90.4	41
CSHW 082, 089	99.2	45
CSHW 082-2, 089-2	101.4	46

The compressor and its packaging must not be exposed to rain and/or corrosive, flammable atmosphere.

The compressor must not be stored in an environment less than -31°F (-35°C) or to exceed +160°F (+71°C).

**Pre-Installation Inspections**

Check the following before using the compressor:

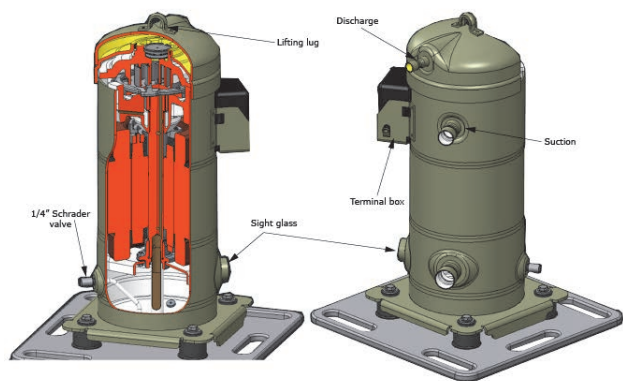
- Compressor for visible shipping damage.
- Compressor is the correct model/part number.
- Compressor is the correct voltage.

**WARNING**

**R-410A Refrigerant under Higher Pressure than R-22**

Failure to use proper equipment or components as described below, could result in equipment failing and possibly exploding, which could result in death, serious injury, or equipment damage. The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22. Use ONLY R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane representative.

Figure 2. Model CSHW



**Repair Recommendations**

**WARNING**

**Hazard of Explosion and Deadly Gases!**

Never solder, braze or weld on refrigerant lines or any unit components that are above atmospheric pressure or where refrigerant may be present. Always remove refrigerant by following the guidelines established by the EPA Federal Clean Air Act or other state or local codes as appropriate. After refrigerant removal, use dry nitrogen to bring system back to atmospheric pressure before opening system for repairs. Mixtures of refrigerants and air under pressure may become combustible in the presence of an ignition source leading to an explosion. Excessive heat from soldering, brazing or welding with refrigerant vapors present can form highly toxic gases and extremely corrosive acids. Failure to follow all proper safe refrigerant handling practices could result in death or serious injury.

**⚠ WARNING****Hazard of Explosion!**

Failure to follow instructions below could result in death or serious injury or equipment or property-only damage. Use only dry nitrogen with a pressure regulator for pressurizing unit. Do not use acetylene, oxygen or compressed air or mixtures containing them for pressure testing. Do not use mixtures of a hydrogen containing refrigerant and air above atmospheric pressure for pressure testing as they may become flammable and could result in an explosion. Refrigerant, when used as a trace gas should only be mixed with dry nitrogen for pressurizing units.

**Mechanical Failure**

Replace only the failed compressor in a tandem or trio set.

**Important:** *On tandem or trio assemblies, the suction and discharge lines must NOT be modified, except for the use of slip joint couplings. Other modification may cause oil return issues and lead to compressor failure. Cut the lines in a convenient place, remove the compressor, and then unbrazed the lines from the compressor. On re-installation, reinstall lines to compressor and reassemble the cut lines utilizing a slip coupling.*

Minimize system and compressor open times to avoid excessive moisture absorption by the POE oil. Maximum suggested open time is 15 minutes.

Drain and replace oil in all the non-failed compressors.

The CSHW compressor has an oil drain with a Schrader® valve that can be used to remove the oil (see [Figure 2, p. 9](#)).

Replace unit liquid line filter-drier. This is a very important part of controlling moisture in R-410A POE oil systems.

Reuse the compressors mounting isolators or mounting spacers that are used with the existing compressor assembly.

Braze the compressor into the system. Compressor connections are copper-plated steel. Use BA<sub>g</sub>-28, 40% silver, with paste flux to make the copper tube connections to the compressor.

Proceed with the following as described in the following sections:

- [“Leak Detection,” p. 15](#)
- [“Vacuum Testing and Evacuation,” p. 15](#)
- [“Charging the System,” p. 16](#)
- [“Verification Before Start-Up,” p. 16](#)

**Electrical Failure**

Follow the mechanical failure guidelines. In addition to the Mechanical Failure Guidelines, check for acid in the system.

Test the acid condition of the oil in the compressors using an acid test kit. Use Trane Part Numbers CHM00414 and 45006.

**Two Types of Motor Failures**

**Light** - If oil test kit is negative and oil is only slightly discolored, treat in the same manner as a mechanical failure.

**Severe** - If oil test kit is positive with strong pungent odor and dark oil, drain and replace oil in all of the non-failed compressors.

Reuse the compressor mounting isolators or mounting spacers that are used with the existing compressor assembly.

This type of failure requires changing both the suction and liquid line filter-driers. Use replaceable filter-drier cores to facilitate changing filter-driers, if required.

Install the suction filters no closer than the distance listed in the following table. The distance is measured from the centerline of the suction inlet tee.

1. Use acid removal type filter-drier cores in both the suction filter and liquid line filter drier.
2. Change when the pressure drop exceeds 4 psig.

Test oil after 24 hours of operation. Change filter-drier again if required. If oil is still acid, drain and replace oil in all the non-failed compressors.

After system is clean, test kit indicates okay, remove the suction clean up filter-drier and replace the liquid line drier with standard filter drier cores.



# Removal and Installation

## ⚠ WARNING

### Refrigerant under High Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage. System contains oil and refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

## ⚠ WARNING

### Hazard of Explosion and Deadly Gases!

Failure to follow all proper refrigerant handling practices could result in death or serious injury. Never solder, braze or weld on refrigerant lines or any unit components that are above atmospheric pressure or where refrigerant may be present. Always remove refrigerant by following the guidelines established by the EPA Federal Clean Air Act or other state or local codes as appropriate. After refrigerant removal, use dry nitrogen to bring system back to atmospheric pressure before opening system for repairs. Mixtures of refrigerants and air under pressure may become combustible in the presence of an ignition source leading to an explosion. Excessive heat from soldering, brazing or welding with refrigerant vapors present can form highly toxic gases and extremely corrosive acids.

Only qualified personnel should install or repair refrigeration systems. If you are not qualified, seek the services of qualified personnel. The steps listed below are not meant to be an exact step-by-step procedure, but are intended to identify procedures or precautions that may be unique to a Trane compressor and should be taken into account to properly and safely remove and install the compressor. Each installation has its unique set of circumstances which must be considered by the service technician to perform a safe and successful compressor replacement.

## Removal

## ⚠ WARNING

### Pressurized Burning Fluid!

Failure to follow these instructions could result in death or serious injury. Before opening a system, you must remove refrigerant from both the high and low sides of the system. If the pressure is not removed from both sides of the system, pressure could still exist in the system. If a torch is used to unbrazed the tubing the refrigerant and oil mixture could ignite.

## ⚠ WARNING

### Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.

- Prior to removing the compressor, open the unit disconnect and place a lock on the disconnect to prevent someone else from accidentally applying power to the unit while it is under repair.
- Completely recover the refrigerant from the refrigerant circuit being repaired. Do not release refrigerant to the atmosphere! Use Responsible Refrigerant Practices. If adding or removing refrigerant, the service technician must comply with all Federal, State, and local laws.
- Before removing the electrical connections on the compressor, use a voltmeter to check for the absence of power on the compressor power terminals.
- After confirming the absence of power, remove the electrical connections.
- Remove and measure oil from failed compressor prior to compressor removal:
  - CSHW compressors have an oil drain valve (see [Figure 2, p. 9](#)) that allows oil to be drained out of the compressor. After the refrigerant has been recovered, pressurize the system with nitrogen to help remove oil from the compressor.
  - Record the amount of oil removed from the failed compressor. The replacement compressor oil charge should be adjusted to ensure that the equivalent amount of oil remains in the unit.

**Tip:** Before removing the existing tubing from the compressor, apply flux to the joint. This will aid in the flow of the braze material and help keep the joint clean for rebrazing. After fluxing, heat the joint evenly to slightly higher temperature than the melting temperature of the filler material. At this point, the two parts of the assembly should be easily separated.

- Refrigerant Connection Removal  
Single compressor—Cut the refrigerant lines in a convenient location that allows reassembly with slip couplings. Then, unbrazed the line from the compressor and reuse it when the replacement is installed.



## Removal and Installation

### Compressor Replacement—Tandem and Trio Compressor Sets

Definitions:

- **Tandem**—Two compressors on a single refrigerant circuit.
- **Trio**—Three compressors on a single refrigerant circuit.

There are special considerations that are unique to replacing compressors in a tandem or trio set:

1. Only replace the failed compressor.
2. On tandem or trio assemblies, the suction and discharge lines must not be modified, except for the use of slip-joint couplings. Other modifications may cause oil return issues and lead to compressor failure. Cut the lines in a convenient place, remove the compressor, and then unbrazed the lines from the compressor. On re-installation, reinstall lines to compressor and reassemble the cut lines using a slip coupling.
3. Change oil in all compressors in the tandem or trio compressors whenever there is a failure.
  - Use the oil charging valve on the compressor.
  - Ensure that the same amount of oil that was removed from the compressors is replaced with new oil.

### Installation

#### **⚠ WARNING**

##### **Hazardous Voltage w/Capacitors!**

**Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.*

#### **⚠ WARNING**

##### **Hazard of Explosion and Deadly Gases!**

**Failure to follow all proper refrigerant handling practices could result in death or serious injury. Never solder, braze or weld on refrigerant lines or any unit components that are above atmospheric pressure or where refrigerant may be present. Always remove refrigerant by following the guidelines established by the EPA Federal Clean Air Act or other state or local codes as appropriate. After refrigerant removal, use dry nitrogen to bring system back to atmospheric pressure before opening system for repairs. Mixtures of refrigerants and air under pressure may become combustible in the presence of an ignition source leading to an explosion. Excessive heat from soldering, brazing or welding with refrigerant vapors present can form highly toxic gases and extremely corrosive acids.**

- Only qualified personnel should install or repair refrigeration systems. If you are not qualified, seek the services of qualified personnel.
- Pressure tests must be performed by qualified personnel.
- The replacement compressor contains a nitrogen charge of 5 psig.
- Remove the suction plug before the discharge plug to avoid oil spray while opening the compressor.
- Keep exposure to the atmosphere at a minimum due to POE oil. Remove the rubber plugs only when ready to install the compressor. Plug other compressor on tandem or trio compressors.

CSHW compressors are shipped with oil; the level should be equal with the bottom of the equalizer port.

Recommendations for installation are as follows:

Single compressor circuit:

- All replacement CSHW compressors have an equalizer port (closed with a rubber plug for storage and shipping). For single applications, this equalizer port will need to be brazed shut with a 1.125" tube and cap.
- If the replacement compressor requires a full oil charge, then the compressor can be tipped away from equalizer port while the port is brazed shut. The as-shipped oil charge can remain in the compressor.
- If the oil charge in the replacement compressor needs to be reduced, oil can be poured out of the equalizer prior to brazing shut.
- Ensure that the same amount of oil that was removed with the failed compressor is replaced with new oil.

Tandem or Trio compressor circuit:

- Remove and measure oil from failed compressor and from existing manifolded compressor(s).

- Remove equalizer rubber plug and drain oil from replacement compressor.
- Install replacement compressor in unit using slip couplings on suction and/or discharge tubing, as necessary.
- Equalizer tubes that remain full diameter (1.125") between compressors can also be reassembled with slip couplings.
- Equalizer tubes which reduce to 0.25" tubes should not be modified. If the 1.125" adapter tube is damaged during removal from the failed compressor, replace with new tube and cap.
- Recharge oil to compressors as necessary to equally replace the oil amount that was removed.

### a. Removal Instructions

**Tip:** Before removing the existing tubing from the compressor, apply flux to the joint. This will aid in the flow of the braze material and help keep the joint clean for rebrazing. After fluxing, heat the joint evenly to slightly higher temperature than the melting temperature of the filler material. At this point, the two parts of the assembly should be easily separated.

### b. Installation

### c. Preparation:

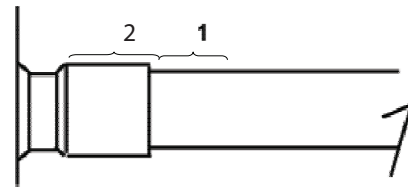
- i. For proper capillary action to occur, the tube and the fitting must be free of oil, grease, burrs, and oxide contamination. To remove the oil and grease a commercial solvent or denatured alcohol can be used. The surface may be properly cleaned by brushing with a stainless shell brush or by a stiff rubbing with emery cloth. Wipe the joint clean to remove small foreign particles such as emery dust, by wiping the surface with a clean cloth. Once the surfaces are clean, be careful not to touch them as oil from the skin will contaminate the surfaces.
- ii. Pre-fit the existing tubing into the compressor to check that it has full insertion into the compressor fitting.
- iii. Apply flux with a brush to the outside of the compressor connecting tubing, taking care to evenly apply the flux around the entire diameter. Care must also be taken not to get the flux inside of the tubing as this may result in contamination of the refrigerant system.
- iv. Reinsert the tube into the compressor connection. If the tubing does not stay fully inserted, it must be restrained to prevent it from backing out of the compressor connection during the brazing process.

### d. Brazing Technique

- i. If possible, use a double-side torch while brazing.

- ii. Use 40% silver brazing alloy with flux.
- iii. Start heating the tube first. Evenly heat the tube, location 1 (see the figure below), until it reaches a dull red color. When using flux, this color is also a good indicator of when the proper brazing temperature has been reached. Continue heating the tube until the flux passes the "bubbling" temperature range and becomes quiet, completely fluid, and transparent—it should have the appearance of clear water.
- iv. Direct the flame from the tube to the fitting, evenly heating it until the flux that may be remaining in the fitting is also completely fluid.
- v. Sweep the torch between the fitting and the tube, locations 1 and 2 (see the figure below), with most of the heat being applied to the heavier and slower-heating fitting until the tube and fitting reach and maintain a uniform heat in both parts.

**Figure 3. Brazing locations 1 and 2**



- vi. Pull the flame slightly back and feed the brazing material in between the fitting and the tube. If the joint has been properly heated, the braze material should flow around and into the joint.

**Important:** The heated base metal should melt the filler; the heat from the torch flame should not be what melts the filler.

- vii. Once the braze material has flowed around and into the joint, briefly move the torch around the fitting to ensure complete capillary action into the joint.
- viii. Check the joint to visually ensure that the braze material is completely around the joint.

### e. Post-Braze

## NOTICE

### Equipment Damage!

Flux is corrosive and could lead to long-term problems and equipment damage if not properly removed. If not cleaned off, flux could hide leaks. Quench the joint with water or a wet rag while the joint is still hot—but below 900°F—to shock off the flux.

- When brazing refrigerant connections, protect compressor body and terminal box from torch heat damage.

## Removal and Installation

- When brazing, always use a nitrogen purge to prevent the formation of copper oxide contamination that can damage the compressor.

## Electrical Connections

### ⚠ WARNING

#### Hazardous Service Procedures!

Failure to follow all instructions in this manual and on the tags, stickers, and labels could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, **MUST** follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

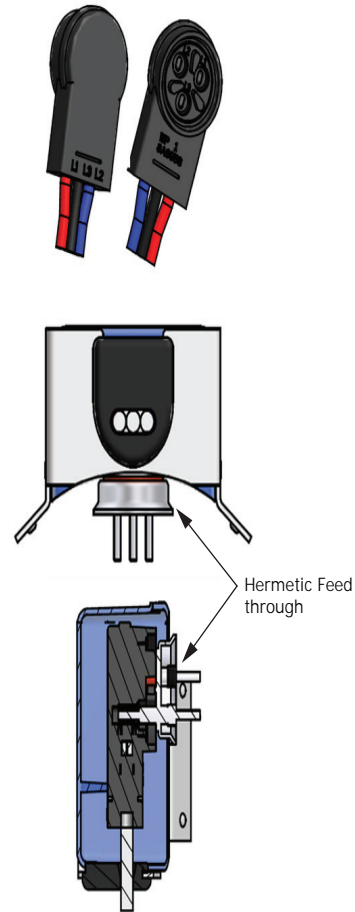
#### CSHW 047-089

The phases on the terminal block are color coded:

- Red - PhaseL1
- Blue - PhaseL2
- None - PhaseL3

The CSHW compressor is designed for use with terminal plugs.

Figure 4. Color coded compressor power plug



Before starting the compressor, check the electrical phasing with a phase sequence meter similar to an Ideal-Sperry Model 61-520.

### NOTICE

#### Compressor Damage!

Operating the compressor with improper phasing could cause compressor failure. Check phasing before starting compressor.

## Leak Detection

### ⚠ WARNING

#### Hazard of Explosion!

Failure to follow instructions below could result in death or serious injury or equipment or property-only damage. Use only dry nitrogen with a pressure regulator for pressurizing unit. Do not use acetylene, oxygen or compressed air or mixtures containing them for pressure testing. Do not use mixtures of a hydrogen containing refrigerant and air above atmospheric pressure for pressure testing as they may become flammable and could result in an explosion. Refrigerant, when used as a trace gas should only be mixed with dry nitrogen for pressurizing units.

### ⚠ WARNING

#### Hazardous Pressures!

When using dry nitrogen cylinders for pressurizing units for leak testing, always provide a pressure regulator on the cylinder to prevent excessively high unit pressures. Never pressurize unit above the maximum recommended unit test pressure as specified in applicable unit literature. Failure to properly regulate pressure could result in a violent explosion, which could result in death or serious injury or equipment or property-only-damage. See maximum recommended unit test pressure below.

### Pressure Testing

- Use industry-standard and EPA-accepted techniques for testing.
- Pressure tests must be performed by qualified personnel.
- Use tools especially designed for leak testing.
- Do not exceed the high-side and low-side pressures listed on the unit nameplate.
- If no test pressure value is listed on the nameplate of the unit, a pressure of no more than 150 psig is acceptable.
- The CSHW compressor has an internal check valve. When pressurizing the system, it is important to never allow the low side pressure to exceed the high side pressure by more than 5 bar (72 psig). Greater pressure differential could result in compressor damage. Also slowly raise the pressure over a 2-minute time period to allow sufficient time for internal pressures in the compressor to equalize.

### NOTICE

#### Overpressure Damage!

Failure to follow these instructions could result in compressor damage. Do not pressurize the low side of the compressor by more than 5 bar (72 psig) higher than the high side of the compressor within less than two minutes.

- Pressure decay testing can be used to check for gross leaks but will not be able to detect the location of a leak.
- After pressurizing the system use an R-410A leak detection device to detect and locate leaks.

## Vacuum Testing and Evacuation

- Use the procedure as described in the unit Installation, Operation, and Maintenance manual.
- If no other information is available, use the following information.

### NOTICE

#### Compressor Motor Damage!

Failure to follow these instructions could cause compressor motor damage. Never use the compressor as a vacuum pump. Never meg-ohm test or apply power to the compressor while it is in a vacuum.

### ⚠ WARNING

#### Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged.

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.*

- Ensure that there is no voltage being applied to the compressor terminals.
- Evacuate the unit to 500 microns.
- Hold vacuum for 30 minutes.
- Rapid pressure rise indicates a leak; locate and repair the leak.
- Slow pressure rise indicates one of two possibilities:
  - A small leak, indicated by a continuous rise in pressure.
  - Moisture in the system, indicated by a slow rise in pressure and leveling-out at a pressure equivalent to the moisture level. If this occurs, break the



## Removal and Installation

vacuum with dry nitrogen and repeat evacuation process to 500 micron.

- Once system is leak-tight, connect compressor repeat the vacuum procedure, break vacuum with dry nitrogen and evacuate to 500 microns. The vacuum should be able to be maintained for four hours. Isolate the vacuum pump so that the vacuum gauge only reads the system pressure.
- Vacuum must be measured in the refrigeration system and not at the vacuum pump.

## Charging the System

### **⚠ WARNING**

#### **Hazardous Pressures!**

**Failure to follow these instructions could result in a violent explosion, which could result in death or serious injury. If a heat source is required to raise the tank pressure during removal of refrigerant from cylinders, use only warm water or heat blankets to raise the tank temperature. Do not exceed a temperature of 150°F. Do not, under any circumstances apply direct flame to any portion of the cylinder.**

Use R-410A refrigerant only! Follow the instructions in the unit Installation, Operation, and Maintenance manual for proper charging methods.

If there are no instructions available, use these guidelines:

- Evacuate the unit as described in “[Vacuum Testing and Evacuation](#),” p. 15.
- Ensure that the oil level is at least 1/2-sight glass in the compressor
- Do not use the compressor to pull refrigerant into the system.
- Charge liquid refrigerant into the high-side of the unit—either into the condenser or liquid receiver, if so equipped.
- Charge as much of the unit refrigerant charge as possible before starting the compressor.
- Do not charge liquid refrigerant into the low side of the compressor without the compressor running. Small amounts of liquid may be metered through refrigerant gauges into the suction line while the compressor is operating.
- If the unit is equipped with suction and discharge service valves, close them during the charging procedure.
- *Water chiller units*—Always operate the chilled water pumps while charging the unit to prevent freezing the evaporator.

## Verification Before Start-Up

Follow the instructions in the unit Installation, Operation, and Maintenance manual. If there are no instructions available, use these guidelines:

- Before starting the unit, verify that all service valves are open.
- Energize the crankcase heater a minimum of 8 hours before starting the compressor.

### **NOTICE:**

#### **Compressors Failure!**

**To protect compressors from premature failure the unit must be powered and crankcase heaters energized at least 8 hours BEFORE compressors are started.**

If the compressor is a replacement for a failed compressor and has been charged in accordance with either the procedures in the unit IOM or “[Charging the System](#),” p. 16 in this manual, the compressor could be immediately started after charging the system. The reason for this is that the refrigerant has not had sufficient time to migrate to the compressor and cause potential damage upon startup. The system should set for no more 8 hours or overnight with a refrigerant charge without crankcase heater operation. If the time exceeds 8 hours or the unit sits overnight, the crankcase heater must be operational for a minimum of 8 hours prior to starting the compressor.

If liquid refrigerant was charged into the suction or low side during the charging procedure, damage could still occur.





# Start-Up

Follow the instructions in the unit Installation, Operation, and Maintenance manual. If there are no instructions available, use these guidelines:

## **NOTICE**

### **Equipment Damage!**

**Failure to follow guidelines below could result in equipment damage.**

- Never start the compressor without refrigerant in the system.
- Never bypass the low pressure switch to start the unit.
- Monitor oil level for 60 minutes to ensure that oil returns from the system.
- Check system pressures and temperatures to ensure they are in line with unit design pressures. Refer to the unit Installation, Operation, and Maintenance manual for this information.
- To top off the unit, charge liquid refrigerant may added by slowly throttling it into the suction line. This must be done only when the compressor is operating.
- Do not overcharge the unit.
- Recommended system full load superheats—unless specified differently in the unit Installation, Operation, and Maintenance manual—is 16°F–20°F.
- Measure the oil sump superheat. Oil sump superheat should be greater than 20°F. Oil sump superheat is calculated as follows:  
$$\text{Oil Sump Superheat} = \text{Oil Sump Temperature} - \text{Saturated Suction Temperature}$$
- Measure the oil sump temperature by placing a thermocouple on the bottom of the compressor, preferably in the center, and insulate it. Calculate sump superheat. If less than 20°F, recheck the expansion valve superheat and increase it. Low sump superheat is indicated by foaming compressor oil.
- After fully charging the unit, recheck all pressure, temperatures, and electrical readings.



# Maintenance

Check the unit Installation, Operation, and Maintenance manual for specific instructions.

Operating conditions must always remain within the operating range of the compressor. This includes:

- Operating pressures (suction and discharge pressure).
- Operating temperatures (suction, discharge, and liquid).
- Operating parameters (compressor superheat, sub-cooling, oil sump superheat, voltage, and amperage).
- Check all of the following on a regular basis:
  - System operating conditions.
  - System refrigerant charge level.
  - Oil levels and oil color.

## **⚠ WARNING**

### **Hazardous Voltage!**

**Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.**

- Check electrical connections (prior to startup each season).
- Check unit operating controls.



# Troubleshooting

**Important:** Check the unit Installation, Operation, and Maintenance manual for additional information regarding diagnosis and causes.

## ⚠ WARNING

### Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, **MUST** follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

### Compressor will not start

- Refer to the unit Installation, Operation, and Maintenance manual for possible diagnostics codes and corrective action.
- Verify:
  - Compressor voltage is correct.
  - All safety switches are closed.
  - All the contacts on the contactor are pulled in.
  - The internal motor overloads may be open. Disconnect power to the unit and disconnect the wires from the compressor terminals. With an ohm meter, check to ensure that there is resistance between T1-T2 and T3.

### Compressor will not build up pressure

- Compressor is wired incorrectly—It will be noisy and draw 1/2 the expected amps. Shut the compressor off immediately. Running in this condition for more than 5 seconds may damage the compressor.
- Check to ensure that any bypass valves in the system are not open.
- Four-way reversing valve may be stuck and not switched properly bypassing from the high side to the low side of the system; this situation is indicated by an extremely warm suction inlet to the compressor.

### Abnormal running noise

- Compressor is running backwards—Immediately shut off the compressor and check wiring and proper phasing.

- Excessive floodback—The superheat should be a minimum of 16°F at full load and oil sump temperature should be at least 20°F above the saturated suction temperature. Measure the sump temperature at the bottom center of the compressor. Chillers with electronic expansion valves may operate with lower superheats; check the unit Installation, Operation, and Maintenance manual for proper operating superheats.
- Compressor is full of liquid on startup—The crankcase heater either was not energized for a minimum of eight hours, or it is defective.
- Mechanical damage to the compressor has occurred—Check compressor amperage. It may also trip the compressor motor protection module or other unit electrical protection devices such as circuit breakers.

### High-pressure control opens

- Check the unit Installation, Operation, and Maintenance manual for possible diagnostics codes and corrective action.
- Also check for:
  - Defective condenser fan motors or controls.
  - Dirty air-cooled or water-cooled condensers.
  - Restricted air flow.
  - Insufficient water flow.
  - System overcharged with refrigerant. Check superheat and system sub-cooling.
  - Non-condensables in the system.

### Low-pressure control opens

- Check the unit Installation, Operation, and Maintenance manual for possible diagnostics codes and corrective action.
- Also check for:
  - Defective evaporator fan motors, belts, or controls.
  - Defective TXV valve.
  - Plugged liquid line filter.
  - Liquid line solenoid valve does not open (if so equipped).
  - Dirty evaporators, either air-to-air or water-to-air.
  - Restricted airflow.
  - Insufficient evaporator water flow.
  - System undercharged with refrigerant. Check system superheat and sub-cooling.



## Troubleshooting

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### Compressor short cycling

- Check the unit Installation, Operation, and Maintenance manual for possible diagnostics codes and corrective action.
- Also check for:
  - Defective unit controls—maximum 12 starts per hour.
  - Compressors cycling on safety controls.
  - Unit oversized.
  - Building load is light—this is likely to occur prior to building occupancy.







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