



# **F-70H and F-70L Helium Compressors**

## **Service Manual**

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U.S.A.**



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SJM P/N 267056A

# SAFETY

## GENERAL

SHI equipment is designed to operate safely when the installation, operation and servicing are performed in accordance with the instructions in this technical manual. For Service Center locations, see the Service section of this manual.

## SPECIAL NOTICES

Three types of special notices -- **WARNINGS**, **CAUTIONS** and **NOTES** are used in this technical manual.



**WARNINGS** call attention to actions or conditions that can result in serious injury or death.

### CAUTION

**CAUTIONS** call attention to actions or conditions that can result in damage to the equipment or in abnormal performance.

### NOTE

**NOTES** give important, additional information, explanations or recommendations related to the appropriate topic or procedure.

**WARNINGS** and **CAUTIONS**, like other safety instructions, appear within rectangles in the text where they are applicable. Because of their importance, they are summarized in this Safety section and in the General Technical Manual, and should be read first.

### NOTE

Changes to this manual since the previous issue are identified by parallel lines (||) in the right margins.

## WARNINGS

**AVOID ELECTRIC SHOCK.** This equipment must only be connected to a supply mains switch with protective earth. All electrical supply equipment must meet applicable codes and be installed by qualified personnel.

If this equipment is modified, appropriate inspection and testing must be conducted to ensure safe use of equipment.

Disconnect the power to the compressor before troubleshooting the electrical components.

Permit only qualified electrical technicians to open electrical enclosures, to perform electrical checks or to perform tests with the power supply connected and wiring exposed. Failure to observe this warning can result in serious injury or death.

**AVOID INJURY.** Never use compressed helium gas from a cylinder without a proper regulator. Overpressure can cause serious injury if the system equipment ruptures.

During operation, some surfaces under the compressor's cover become hot. Allow the compressor to cool for 1/2 hour after shutdown before removing the cover for maintenance.

Always wear eye protection when handling pressurized gas lines and other pressurized equipment. Never apply heat to a pressurized gas line or other pressurized components.

Disconnect gas lines only when the compressor is stopped. Disconnecting the cold head while it is cold can create excessively high internal pressure as the gas warms. Material failure and uncontrolled pressure release can cause serious injury.

Use two wrenches when disconnecting a gas line coupling to avoid loosening the cold head or compressor coupling. Gas pressure can project the coupling with enough force to cause serious injury.

The compressor is charged with helium gas. Except when disconnecting the adsorber or the gas lines, vent both supply and return Aeroquip couplings to atmospheric pressure before disassembly. Uncontrolled pressure release can cause serious injury.

Always vent a gas-charged component before beginning to disassemble its couplings. Gas pressure can launch a loose coupling with enough force to cause serious injury.

The adsorber is charged with helium gas. Follow the used adsorber venting procedure for safe disposal of the used adsorber.

## CAUTIONS

**PRESERVE YOUR WARRANTY.** Modification to equipment without the consent of the manufacturer will void the warranty.

Specifications require the use of 99.999% pure helium gas. Using a lesser quality of helium can damage the system and void the warranty.

### CAUTIONS (continued)

**AVOID GAS LEAKS.** Check the condition of the gasket face seal on the male half of each Aeroquip coupling. Be sure the gasket face seal is in place and the sealing surfaces on both the male and female halves are clean before connecting. Replace the gasket face seal if it is damaged or missing.

Keep the gas line couplings aligned when making or breaking a coupling connection. Leaks can occur due to the weight of the gas line or due to a sharp bend near the connection.

### CAUTIONS (continued)

**AVOID CONTAMINATION.** When checking the compressor for shipping damage, do not connect the gas lines and the cold head. The components may become contaminated with compressor oil.

Follow the charging or venting procedures to prevent reversed flow of system gas. Do not charge through the supply coupling. Do not vent through the return coupling. Reversed flow can contaminate the system with compressor oil.

A leaking coupling on an adsorber should not be repaired in the field. Consult a Service Center. Venting the adsorber will introduce contaminants to the system, which cannot be removed in the field.

**PREVENT EQUIPMENT DAMAGE.** Damage to gas lines can result from crimping by repeated bending and repositioning.

Always thoroughly drain the coolant from the cooling circuit if the compressor is to be shipped or stored.

If the compressor is wired for 380/415 ( $\pm 10\%$ ) V3~ electrical service, connecting to a higher voltage may damage the control circuit. Similarly, if it is wired for 480 V3~, 60 Hz, it can be damaged by connecting to 380/415 V3~.

Never pull a vacuum on the compressor or on the cold head. The motors will short circuit if started.

After starting the system for the first time, to be certain that the water lines are properly connected, check that the outlet water temperature is warmer than the inlet water.

**For an installation using a water chiller or other circulating cooling system:**

Use pure ethylene glycol with water for the coolant antifreeze solution. Do not use commercial ethylene glycol sold for automotive cooling systems, which usually contains a fine grit material that can damage the cooling system.

**AVOID A MALFUNCTION.** Repeatedly charging the system with helium gas rather than locating and repairing gas leaks can cause a malfunction. Impurities are introduced at an abnormal rate and can freeze in the cold head.

Do not allow air to get into the helium gas refrigerant of the system. Moisture from the atmosphere can seriously degrade cold head performance.

**AVOID EQUIPMENT FAILURE, CONTAMINATION OR A NUISANCE SHUTDOWN.** Do not tip the compressor greater than 5 degrees from horizontal, to avoid flowing oil into unwanted places.

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# SERVICE

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# INTRODUCTION

## Helium Compressors, Models F-70H and F-70L






The compressors are designed to deliver high-pressure, oil-free, helium gas to cryogenic refrigerators. Cold head cables are used with the compressor to supply electrical power to cold heads. Self-sealing gas couplings allow for easy connection to and disconnection from the rest of the closed-cycle cryogenic refrigeration system.

The information in this manual pertains only to the F-70H (high voltage model) and the F-70L (low voltage model) Compressors. Other components used to form an operating system are described in separate technical manuals.

Pressures are stated as gauge, not absolute. Pressure units are bar and pounds per square inch (psig). For reference:

1 bar = 14.5 psig.  
1 MPa = 10 bar

Definition of Symbols used in this manual and on equipment

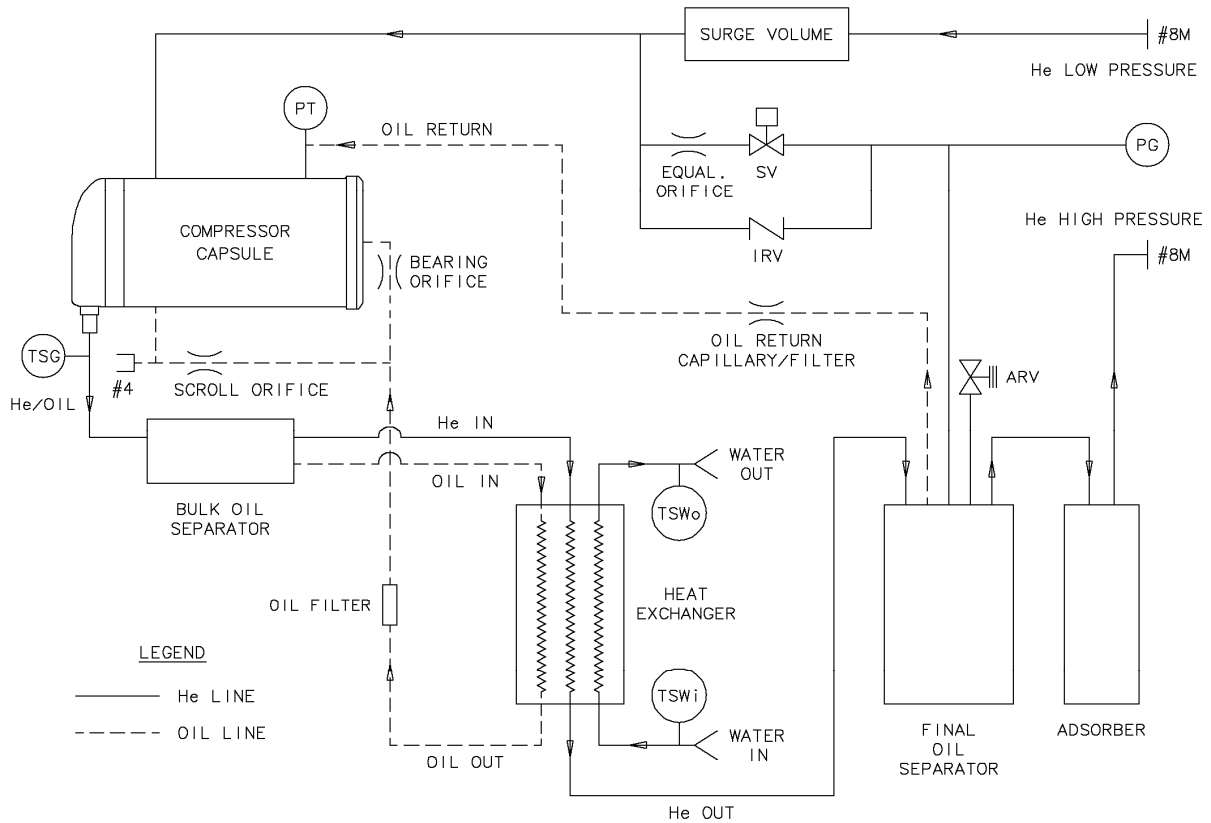
	Mains Disconnect On		Protective Earth (Ground)
	Mains Disconnect Off		Dangerous Voltage
	Refer to Manual	V3~	Volts, AC, 3 phase

Class I equipment is grounded equipment.

Reference: F-70H and F-70L Helium Compressors Operating Manual, P/N 267055A.

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# PRINCIPLES of OPERATION



**Figure 1 Compressor Flow Diagram**

Key	
TSG	Gas temperature thermistor
TSWi	Water-in temperature thermistor
TSWo	Water-out temperature thermistor
ARV	Atmospheric relief valve
IRV	Internal relief valve
SV	Solenoid valve
PT	Pressure transducer
PG	Pressure gauge

The compressor continuously draws low-pressure helium from the system's helium low pressure (return) line. It compresses, cools and cleans the gas, then delivers it through the system's helium high pressure (supply) line to the cold head. See Figure 1.

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# DESCRIPTION

## Components

**Adsorber** - The adsorber removes any oil and moisture the gas is carrying which did not drop out in the separator. The adsorber has a finite life and must be replaced every 30,000 operating hours.

**Atmosphere Relief Valve [ARV]** – The pressure relief valve prevents the compressor from operating at an unsafe pressure by venting to the atmosphere.

**Bulk Oil Separator** - Removes much of the entrained oil from the gas stream. This unit needs no servicing or replacement.

**Cold Head Power Receptacle** - Mounted on the front panel for connecting a cable to supply electrical power from the compressor to the cold head.

**Compressor Capsule** - Helium, scroll compressor with a hermetically sealed motor.

**Compressor High Temperature Motor Protector Switch** - Located inside the compressor motor, the switch senses compressor motor temperature and stops the motor if the temperature is too high. The switch resets after cool down.

**Electrical Chassis** - The electrical box contains electrical components and connections and distributes power to all system circuits.

**Final Oil Separator** - Removes most of the remaining entrained oil from the gas stream. This unit needs no servicing or replacement.

**Fuses** – Three (3) time delay, class CC fuses, located inside the electrical chassis box, protect the transformer. Three (3) time delay, 5x20 mm, IEC Type T fuses, located on the printed circuit board inside the electrical chassis box, protect the cold head supply circuit.

**Heat Exchanger** - Uses water to cool the high-pressure helium refrigerant and the compressor's lubricating oil.

**Helium Charge** - A size 4, male (4M), Aeroquip coupling located on the front of the compressor is used for charging or venting helium gas refrigerant.

**Helium Supply and Helium Return Pressure Couplings** – Both supply (high pressure) and return (low pressure) are self-sealing, size 8, male (8M), Aeroquip, bulkhead couplings and are the points of connection on the front panel for the gas lines.

**Internal Relief Valve [IRV]** - The internal relief valve opens to allow the compressor to be operated in the stand-alone mode or when the system gas lines are disconnected, to avoid overloading the motor.

**Mains Power Switch** - Mounted on the front panel, it provides a means to disconnect power and it protects the compressor from electrical overload. This device is labeled Main Power.

**Oil Capillary** - The capillary returns oil collected in the oil separator sump to the compressor for recycling.

**Oil Filter** - Filters in the oil lines protect the oil return capillary and the orifices.

**Oil Injection Orifices** - These orifices are installed in the oil return lines and control the flow rate of oil returned to the compressor.

**Pressure Gauge** - Indicates gas pressure in the supply line. When the compressor is not running, the gauge located on the compressor's front panel shows the equalization pressure.

**Supply Gas High Temperature Thermistor** - Senses discharge gas temperature. It causes the compressor to shut down if the temperature of the high-pressure helium from the compressor is too high.

**Water High Temperature Thermistors** - Sense water temperature. One each is located in the "water in" line and in the "water out" line. They provide a warning if the inlet or the outlet water temperature is too high. High outlet water temperature indicates low water flow.

**Water In and Out Fittings** – F-70H is fitted with two (2) ½" MNPT and F-70L is fitted with two (2) ½" Serto elbows mounted on the front panel.



## MAINTENANCE

### **WARNING**

**AVOID EXPOSURE.** People with pacemakers, defibrillators or ferrous implants should avoid exposure to strong magnetic fields. The long-term effects of high magnetic fields are not well understood. Keep personal exposure to a minimum.

### **WARNING**

**AVOID INJURY.** When released in a high magnetic field, ferrous tools and parts can become hazardous projectiles.

### **CAUTION**

**PREVENT DEGRADED PERFORMANCE.** Failure to replace the adsorber can result in oil carryover to the cold head, degraded performance and difficult oil cleanup.

### **CAUTION**

**AVOID CONTAMINATION.** A leaking coupling on an adsorber should not be repaired in the field. Consult a Service Center. Venting the adsorber will introduce contaminants to the system that cannot be removed in the field.

### **CAUTION**

**PRESERVE YOUR WARRANTY.** Modification to equipment without the consent of the manufacturer will void the warranty.

Specifications require the use of 99.999% pure helium gas. Using a lesser quality of helium can damage the system and void the warranty.

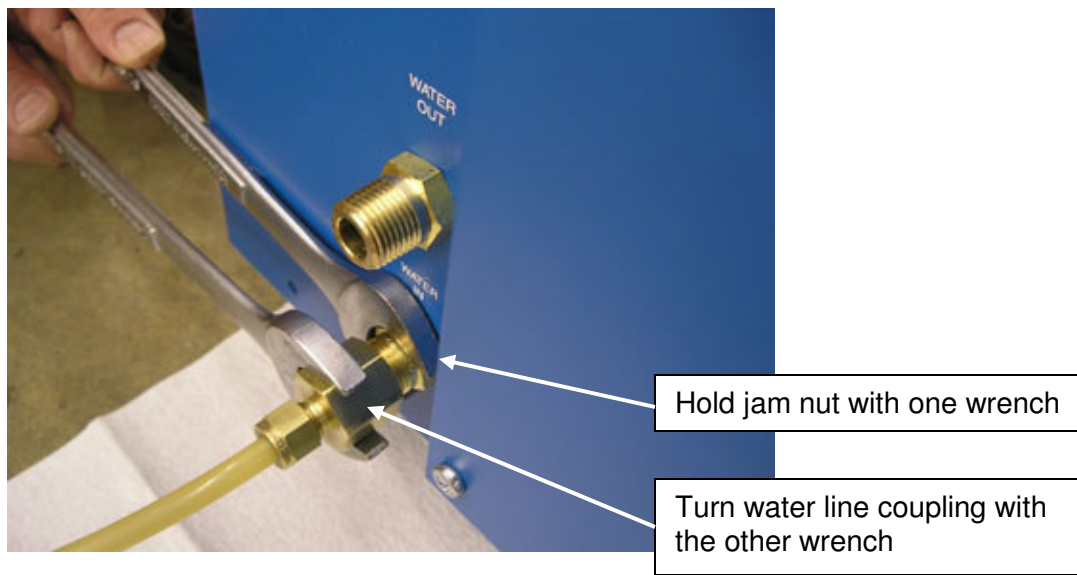
### **Connect and Remove the Water Lines**

Tools required: Open-end wrench, 15/16"

Open-end wrench to suit customer's water lines fittings

1. Using two wrenches, connect coolant supply and return lines to the water in and water out fittings on the front of the compressor. See Figure 2. Ensure that the Water In connection is connected to the supply line from the user's cooling water or coolant supply. Turn on the coolant and check the water lines for leaks. Tighten the fittings if necessary.

See Specifications in the F-70 Operating Manual for cooling requirements.



**Figure 2 Connect and Remove the Water Lines**

### **Adsorber Replacement**

Part required: Adsorber, P/N F300138A

Tools required: #2 Phillips screwdriver  
Open-end wrenches, 1", 1 1/8", 1 3/16"  
Snoop®

## **CAUTION**

**AVOID EQUIPMENT FAILURE OR CONTAMINATION.** Use SHIG adsorber P/N F300138A only. Use of non-SHIG spare parts will void the warranty.

The compressor's adsorber should be replaced every 30,000 operating hours (40 months). The used adsorber has no salvage or repair value. Venting the compressor is not required when replacing the adsorber because the gas couplings are self-sealing.

### **Adsorber Removal**

1. Stop the compressor and disconnect the power to the compressor.
2. Disconnect the high pressure (supply) gas line from the helium high pressure coupling on the compressor. Screw a dust plug into the disconnected gas line. Use two wrenches.

#### **NOTE**

Always hold the stationary nut on the gas line coupling with one wrench while turning the moveable coupling with the other wrench.

3. Remove the compressor's cover panel.
4. Disconnect the self-sealing coupling on the inlet side of the adsorber. Use two wrenches.

5. Use a Phillips screwdriver to remove the two screws holding the adsorber to the base.
6. Remove the locknut on the Aeroquip supply coupling on the front panel.
7. Pull the adsorber back until the supply coupling clears the front panel. Remove the adsorber. Remove the lockwasher from the Aeroquip supply coupling. Retain all hardware to reuse with the new adsorber.

 **WARNING**

**AVOID INJURY.** The adsorber is charged with helium gas. Follow the used adsorber venting procedure for safe disposal of the used adsorber.

**Adsorber Installation**

1. Remove the caps from the gas lines of the new adsorber. **Do not vent the new adsorber.**
2. Install the lock washer on to the supply coupling of the new adsorber. Insert the supply coupling through the front panel and position the adsorber.
3. Insert and tighten the screws to secure the new adsorber to the base.
4. Install the Nylon washer and the locknut on the supply coupling. Torque the locknut to 54 Nm (40-ft. lbs.).
5. Connect the adsorber's self-sealing coupling on its inlet side to the oil separator's outlet coupling. With two wrenches, torque the Aeroquip coupling to  $47 \pm 7$  Nm ( $35 \pm 5$  ft. lbs.).
6. Reconnect the supply (red) gas line to the supply coupling on the compressor. Torque the coupling to  $47 \pm 7$  Nm ( $35 \pm 5$ -ft. lbs.).
7. Using Snoop<sup>®</sup>, leak check all Aeroquip couplings just completed. Wipe off the Snoop<sup>®</sup> to prevent rusting. See the Leak Check procedure in Maintenance in this manual.
8. Check the equalization pressure. See Specifications in the Operating Manual.
9. Reinstall the compressor's cover panel.

This completes the procedure for replacing an adsorber.

**Register New Adsorber (30,000 hour life) (for firmware versions 1.7 or later)**

When a new adsorber is installed, the adsorber timer must be reset to 30,000 hours so that the correct remaining adsorber life will be displayed on the LCD.

The timer can be reset either through the front panel control buttons or through the RS232 terminal interface.

Through the front panel control buttons:

1. With the Main Power switch turned off, press and hold all four control buttons below the LCD window.
2. Keep these buttons held and turn the Main Power Switch ON to enter "Service Level" mode. Release the buttons.
3. Scroll using the arrow control buttons until display shows "NEW ADS? ON=Yes."

4. Press the ON control button. Display will show "SAVE? Y-ON N-OFF."
5. Press the ON control button again to complete. (Press the OFF control button to back out of the function.) When ON is pressed, display will show: "Saving New ADS". When function is complete, display will again show "NEW ADS? ON=Yes."
6. Turn the main power switch to OFF to leave Service Level.

Through the RS232 Terminal Communication Interface

1. Turn the compressor main power switch ON.
2. Connect the terminal interface computer to the compressor serial port .
3. Send a "g" to the compressor to register a new adsorber (or, alternately, send an "m" to the compressor to return the menu of available functions and then send a "g").
4. Compressor will return "Are you sure? Y/N" Send a "Y" to complete the function. ("N" will back out of the function with compressor returning "Aborted".)
5. When the function is complete, the compressor will return "Adsorber change registered."
6. Turn the compressor main power switch OFF, if desired.

### **Used Adsorber Venting and Disposal**

For safe disposal of the used adsorber:

1. A venting adapter fitting is included with the new adsorber. Attach it to one of the self-sealing couplings on the **used** adsorber. Vent the **used** adsorber to atmospheric pressure.
2. Discard the used adsorber with the venting adapter fitting connected.

### **Charging or Venting**

Tools required: Charge and vent tool with valve, #4Fx1/4" Swagelok, P/N 267191A.  
Bleed adapter, P/N 267192A  
Open-end wrenches, 5/8", 3/4"  
Helium gas cylinder with pressure regulator and charge line

Charging or venting is required whenever the equalization pressure of the system is outside the range as stated in the Specifications. See Specifications in the F-70 Operating Manual. Venting a component to atmospheric pressure is required if the component needs to be disassembled for repairs or maintenance, including repairs to its self-sealing couplings.

#### **WARNING**

**AVOID INJURY.** Never use compressed helium gas from a cylinder without a proper regulator. Overpressure can cause serious injury if the system equipment ruptures.

**CAUTION**

**AVOID CONTAMINATION.** Follow the charging and venting procedure to prevent reversed flow of system gas. Do not charge through the supply coupling. Do not vent through the return coupling. Reversed flow can contaminate the system with compressor oil.

**NOTE**

Adapter fittings for charging and venting are available as optional service tools. See the Parts section of this manual.

**Charging Procedure****CAUTION**

**PRESERVE YOUR WARRANTY.** Specifications require the use of 99.999% pure helium gas. Using a lesser quality of helium can damage the system and void the warranty.

**CAUTION**

**AVOID A MALFUNCTION.** Repeatedly charging the system with helium gas rather than locating and repairing gas leaks can cause a malfunction. Impurities are introduced at an abnormal rate and can freeze in the shield cooler.

To charge helium gas to the system:

1. Stop the compressor.
2. Locate charge and vent tool, P/N 267191A, and bleed adapter, P/N 267192A. Screw bleed adapter into charge and vent tool.
3. Connect the charge line from the pressure regulator of a helium gas cylinder containing 99.999% pure helium with a dew point less than  $-62^{\circ}\text{C}$  ( $-80^{\circ}\text{F}$ ) at 20.7 bar (300 psig) to Swagelok connector on charge and vent tool, P/N 267191A.
4. Slightly open charge and vent tool's valve and thoroughly purge the charge line from the regulator. It is important to remove all air contaminants to prevent them from entering the system.
5. Unscrew the self-sealing coupling on the bleed adapter, P/N 267192A, from the charge and vent tool, P/N 267191A. Close the valve.
6. Use two wrenches to attach the charge and vent tool to the 4M Aeroquip helium charge port on the front of the compressor.
7. Adjust the regulator to the required equalization pressure. See the Specifications section in the F-70 Operating Manual. **Slowly** open the valve on the charge and vent tool. Charge the system with helium gas to the equalization pressure.
8. Close the valves on the charge and vent tool and on the gas cylinder.
9. Disconnect the charge line from the charge and vent tool. Using two wrenches, remove the charge and vent tool. Store the charge line to keep it clean.

10. Leak check the Aeroquip couplings using the Leak Check procedure in this manual  
This completes the charging procedure.

**Venting Procedure to Adjust the Equalization Pressure**

**NOTE**

This venting procedure is not to be used for gas cleanup of the compressor.

To vent helium gas from the system:

1. Stop the compressor.
2. Be sure the valve on the charge and vent tool, P/N 267191A, is closed. Using two wrenches, install this tool on the 4M Aeroquip helium charge port.
3. **Slowly** open the valve on the charge and vent tool. Vent the system until the required equalization pressure is attained. See Specifications in the F-70 Operating Manual. Close the valve on the tool.
4. Using two wrenches, remove the charge and vent tool from the compressor.

This completes the venting procedure to adjust the equalization pressure.

**Gas Cleanup**

Tools required: 2 adapter fittings with valve, 8F Aeroquip, 255919B2.

Open-end wrenches, 1", 1 1/8" and 1 3/16".

Helium gas cylinder with pressure regulator and charge line.

If the equalization pressure shown by the compressor's pressure gauge is less than 1.4 bar (20 psig), gas cleanup of the compressor is required. Look for and repair helium leaks. Perform gas cleanup.

If system components are connected and the equalization pressure of the system is less than 1.4 bar (20 psig), check for leaks. Repair leaks. Perform gas cleanup of the system.

**CAUTION**

**PREVENT EQUIPMENT DAMAGE.** Never pull a vacuum on the compressor or on the cold head. The motors will short circuit if started.

 **WARNING**

**AVOID INJURY.** Extreme cold can cause frostbite. When handling system components, be careful not to touch any frosted parts.

 **WARNING**

**AVOID INJURY.** Do not splash cryogenic liquids on any areas of clothing or exposed skin. Damage to skin tissue will result. Always wear eye protection.

 **WARNING**

**AVOID ASPHYXIATION.** Be sure the work area is well ventilated.

 **WARNING**

**AVOID INJURY.** Disconnect gas lines only when the compressor is stopped. Disconnecting the cold head while it is cold can create excessively high internal pressure as the gas warms. Material failure and uncontrolled pressure release can cause serious injury.

Gas cleanup is required if the compressor's interior has been opened to the atmosphere or the equalization pressure is 1.4 bar (20 psig) or lower. Gas cleanup is performed with the compressor disconnected from the other system components.

**NOTE**

If the compressor's interior has been exposed to the atmosphere for an extended period, gas cleanup may not suffice to guarantee system gas purity. Contact a Service Center.

1. Disconnect the gas lines from the compressor. Plug the disconnected gas line couplings.
2. Locate two adapter fittings P/N 255919B2. Be sure their valves are closed. Attach them to the supply and return Aeroquip couplings on the compressor.
3. Connect a charge line to the pressure regulator of a helium gas cylinder containing 99.999% pure helium gas with a dew point less than -62° C (-80° F) at 20.7 bar (300 psig). Adjust the gas cylinder pressure regulator to 0.35 bar (5 psig).
4. While connecting the charge line to the adapter fitting on the compressor's return coupling, thoroughly purge the charge line from the regulator. It is important to remove all air contaminants to prevent them from entering the system.
5. Adjust the pressure regulator to 15.2 bar (220 psig). Open the valve on the adapter fitting and charge the compressor to 15.2 bar (220 psig).
6. Close the valve on the adapter fitting used for charging.
7. Run the compressor for at least 30 minutes to heat the oil to operating temperature. Stop the compressor.
8. Open the vent valve on the supply coupling of the compressor. Watch the compressor's pressure gauge. When the pressure falls to 0.35 to 0.7 bar (5 to 10 psig), close the vent valve. Open the charge valve to increase the pressure to 15.2 bar (220 psig). Close the charge valve.
9. Start the compressor
10. After running 30 to 45 seconds, stop the compressor. Open the vent valve and vent the compressor to 0.35 to 0.70 bar (5 to 10 psig). Close the vent valve.
11. Repeat steps 8, 9 and 10 ten (10) times, and then go to Step 12.
12. Open the charge valve on the adapter fitting. Charge the compressor to the equalization pressure. Close the charge valve.

13. Allow the compressor to cool. Read the pressure gauge with the compressor at 20° C (68° F). Adjust the equalization pressure by charging or venting to conform to the Specifications.
14. Close the gas cylinder valve and adjust the pressure regulator to zero psig.
15. Disconnect the charge line from the adapter fitting. Store the charge line to keep it clean.
16. Remove both adapter fittings.
17. If other components need cleaning, perform the appropriate procedures in their manuals. Otherwise, reconnect the supply and return gas lines. Torque the gas line couplings to  $47 \pm 7$  Nm ( $35 \pm 5$  ft. lbs.).
18. Leak check the Aeroquip couplings. See the Leak Check section.

This completes the gas cleanup procedure for the compressor.

### **Cold Head Gas Cleanup**

For running the cold head only to perform a maintenance procedure, the cold head receptacle can be energized without running the compressor by:

1. While the system is off, scrolling the display until “Cold Head Run” is shown
2. While “Cold Head Run” is displayed, press the ON button.

The cold head will run until the OFF button is pressed or until 30 minutes of running has occurred.

### **Leak Check**

In addition to identifying suspected leaks, check the compressor for helium leaks each time it has undergone any amount of disassembly. Use a helium mass spectrometer leak detector if available. Follow its manufacturer’s instructions.

If a leak detector is not available, use a commercial leak detection solution such as Snoop®. However, small leaks may not be detected. Also, it is important to:

- fully coat the joint being tested;
- allow time for bubbles to form at a small leak;
- look carefully for the smallest bubble formations.

After solution testing is completed, use water to wash all residues from joints and couplings.

In either method of testing, do not assume that the first found leak is the only one. Check all joints.

Leak detection by instruments can be misleading. Leaking gas can form patterns that indicate leaks at sound joints. Large leaks or a high gas concentration can make isolation difficult.

Leaks occur most frequently at threaded joints. However, they can occur also at brazed and welded joints.



The flat gasket in the face of the Aeroquip male coupling seals the joint. A leak at this gasket face seal can be detected only when a gas line is connected. A leak here can be caused by:

- the coupling not fully tightened;
- a worn, damaged, or missing gasket seal;
- dirt on or under the gasket seal;
- dirt on the female coupling's mating surface;
- damaged parts on either coupling which prevent proper mating or sealing.

### **Leak Repair**

Leaks in flexible metal tubing cannot be repaired. Discard the damaged gas line and install a new one.

Leaks at welded joints require special skills to repair. Consult a Service Center.

Replacing worn or damaged parts can repair leaks at the self-sealing couplings. Vent the compressor before beginning to disassemble it.

Tightening the coupling frequently stops leaks at threaded joints. Continued leakage after tightening requires coupling repair. Install new O-rings or Teflon tape as required.

### **Self-Sealing Couplings**

From repeated connecting and disconnecting Aeroquip couplings, the gasket seal just inside the face of the cold head gas supply and return male couplings may begin to leak and require replacement. Damaged threads, leaking seals or a leaking poppet may require replacement of coupling parts or of the complete coupling.

### **Replace the Gasket Seal**

Part required: Gasket face seal, P/N 77002

Tools required: Needle or a narrow, flat blade screwdriver  
Cotton swabs  
Isopropyl alcohol

The gasket face seal on a self-sealing coupling is replaced while the gas line is disconnected from the compressor or the cold head.

1. Carefully pierce or pry the old gasket face seal and pull it from its recessed ring in the body of the coupling. Discard the face seal.
2. Using isopropyl alcohol on a clean, cotton swab, carefully remove any remaining adhesive from the coupling's recess. Avoid getting alcohol on the face of the poppet valve assembly.
3. Dry the recessed surface with a clean, lint free cloth.
4. Do not apply any adhesive. Press a new gasket seal into the recessed ring.

**Replace a Nylon Slide Rail**

Part Required: Slide rail, P/N 267033B

Tool required: #2 Phillips screwdriver

**NOTE**

This procedure assumes that the compressor's casters have been removed.

1. Elevate the compressor for access to its bottom. Do not tip the compressor more than 10 degrees.
2. Using a Phillips screwdriver, remove the three screws and lock washers that attach the slide rail to the bottom panel of the compressor. Retain the screws and washers.
3. Install a replacement slide rail using the hardware previously removed.
4. Lower the compressor to rest on its slide rails.

**Replace the Front Locator Plate**

Part required: Front locator plate, P/N 300050C

Tool required: #2 Phillips screwdriver

1. Using a Phillips screwdriver, remove the three screws and washers holding the front locator plate to the compressor's front panel. Remove the locator plate.
2. Attach a new locator plate to the front panel using the previously removed screws and washers.

**Remove or Replace a Caster**

Part required: Caster, P/N 49137

Tool required: Open-end wrench, 7 mm

**CAUTION**

**AVOID EQUIPMENT FAILURE, CONTAMINATION OR A NUISANCE SHUTDOWN.** Do not tip the compressor greater than 10 degrees from horizontal to avoid flowing oil into unwanted places.

1. Stop the compressor and disconnect the power to the compressor. It is not necessary to remove the compressor's cover.
2. Elevate and support the compressor base about 3 ½" to 4" (90 to 100 mm) above the work surface. Do not tip the compressor more than 10 degrees.
3. Using a 7 mm open-end wrench on the flat of the caster's stem, turn the stem to remove it from the nut inside the compressor's base. Continue to remove the other casters.
4. Install new casters if required, using the 7 mm wrench.
5. Lower the compressor to rest on either its casters or its Nylon slide rails.
6. Reconnect the power to the compressor.

**Replace a Lifting Eyebolt**

Part required: Eyebolt, P/N 73216

Tool required: Screwdriver or wrench extension, if required

1. Use a tool through the eyebolt for removal if it is too tight to turn by hand.
2. Inert a replacement eyebolt. Tighten it hand tight or slightly more by use of a tool to turn it.

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## TROUBLESHOOTING

### **WARNING**

**AVOID ELECTRIC SHOCK.** Permit only qualified electrical technicians to open electrical enclosures, to perform electrical checks or to perform tests with the power supply connected and wiring exposed. Failure to observe this warning can result in serious injury or death.

### **WARNING**

**AVOID ELECTRIC SHOCK.** Disconnect the power to the compressor before troubleshooting the electrical components.

### **WARNING**

**AVOID INJURY FROM BURNS.** During operation, some surfaces under the compressor's cover become hot. Allow the compressor to cool for ½ hour after shutdown before removing the cover for maintenance.

### **CAUTION**

**PRESERVE YOUR WARRANTY.** Modification to equipment without the consent of the manufacturer will void the warranty.

### Compressor Capsule

Compressor motor checks for winding continuity, resistance and grounding will isolate most motor electrical problems. When the checks indicate a faulty compressor, a replacement is needed. Contact a Service Center.

### Winding Continuity, Grounding and Resistance Checks

Tools required: Ohmmeter or multimeter  
#2 Phillips screwdriver

The following electrical measurements to check the compressor motor may be made either at the compressor terminals or at the motor contactor.

1. Disconnect the power to the compressor.
2. Remove the cover, side panels and rear panel from the compressor.
3. Remove the terminal box cover from the side of the compressor motor to expose the three terminals T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. It is not necessary to remove the wires from their terminals.
4. With an ohmmeter, check the resistance across pairs of compressor terminals. Line to line motor resistance for the F-70H compressor capsule should be about  $2.27 \pm 10\%$  ohms, at room temperature. Line to line motor resistance for the F-70L compressor capsule should be about  $0.56 \pm 10\%$  ohms at room temperature. If there is no continuity, there is an open circuit in the motor windings. Consult a Service Center. If the resistance is less, there is a short circuit in the motor. Consult a Service Center.
5. With the ohmmeter, check for continuity between the motor windings and one of the unpainted tubes entering the compressor capsule. Use the three compressor terminals and one of the copper tubes from the compressor. If there is continuity, there is a short circuit to ground in the motor windings. Consult a Service Center.

6. If the motor passes these electrical checks, replace the terminal box cover and the compressor's cover.

### Replace Fuses

Parts required: Internal fuse kit, F-70H (high volt only), P/N 267127A, including  
(3) Power fuses, 1.0 ampere, 600 V, class CC, P/N 34162  
(3) Control board fuses, 0.63 ampere, 250 V, IEC Type T, P/N 34687  
Internal Fuse Kit, F-70L (low volt only), P/N 267128A, including  
(3) Power fuses, 2.0 ampere, 600 V, class CC, P/N 34164  
(3) Control board fuses, 0.63 ampere, 250 V, IEC Type T, P/N 34687

Tool required: #2 Phillips screwdriver.

#### **WARNING**

**AVOID ELECTRIC SHOCK.** Permit only qualified electrical technicians to open electrical enclosures, to perform electrical checks or to perform tests with the power supply connected and wiring exposed. Failure to observe this warning can result in serious injury or death.

#### **WARNING**

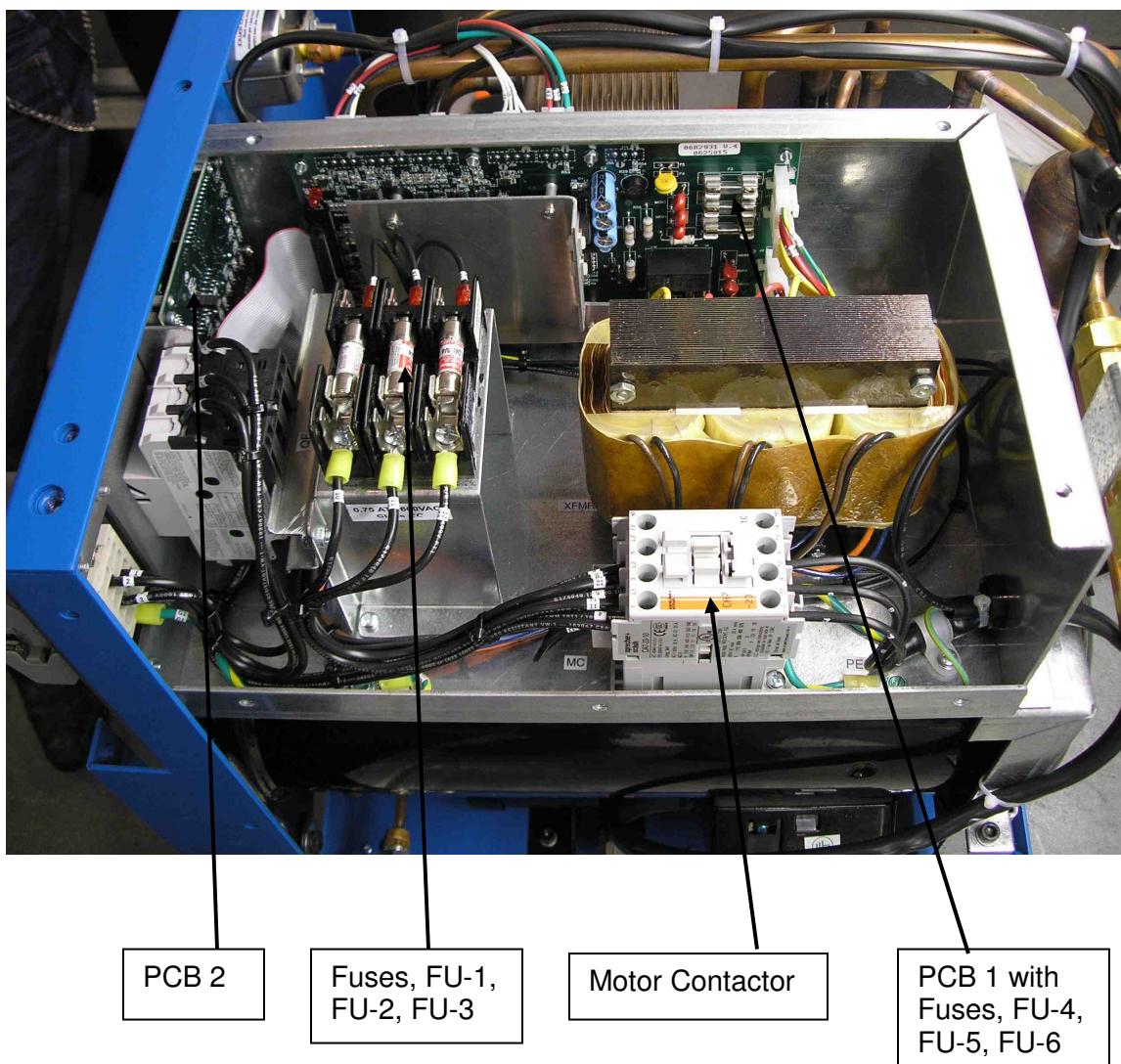
**AVOID ELECTRIC SHOCK.** Disconnect the power to the compressor before troubleshooting the electrical components.

Three (3) Class CC time delay fuses (1.0 ampere for F-70H, 2.0 amperes for F-70L), FU-1, FU-2 and FU-3, are located in the electrical chassis box. See Figure 3.

Three (3) 0.63 AT fuses, FU-4, FU-5 and FU6 are located on the printed circuit board (PCB 1) in the electrical chassis box. See Figure 3.

If the LCD display reads Phase Seq-ERR, check all fuses FU-1 through FU-6. If no phase sequence error is indicated but the diagnostic interface connection signals are behaving erratically or the compressor will not run or build pressure, check fuses FU1-FU3.

1. Disconnect the power to the compressor.
2. Remove the compressor's cover.
3. Remove the ventilated cover from the electrical chassis box.
4. Remove, inspect or check each fuse to find a blown fuse(s). Replace the defective fuse(s).
5. Reinstall the cover on the electrical box.
6. Reinstall the compressor's cover.
7. Reconnect the power to the compressor.



**Figure 3 Electrical Chassis**

**Replace the Electrical Chassis**

Parts required: P/N F267109A for F-70H  
 P/N F267097A for F-70L

Tools required: Flat blade screwdriver  
 #2 Phillips screwdriver  
 Phillips torque screwdriver, 2.0 Nm (18 in. lbs.)  
 Needle nose pliers

Failures in the electrical system may make it necessary to replace the electrical chassis box assembly or remove it to repair individual components. Perform the following steps to remove the electrical chassis assembly from the compressor.

1. Read and record the elapsed time on the LCD display of the old unit. Contact a Service Center to report the elapsed time meter reading.

 **WARNING**

**AVOID ELECTRIC SHOCK.** Disconnect the power to the compressor before troubleshooting the electrical components.

2. Stop the compressor and disconnect the power to the compressor.
3. Using a Phillips screwdriver, remove the compressor's cover. Retain the screws and lock washers for reinstallation.
4. Remove the electrical chassis ventilated cover by using a Phillips screwdriver to remove the 6 screws and lock washers. See Figure 3. Retain the screws and lock washers.
5. Using a flat blade or a Phillips screwdriver, remove the 3 wires from terminals T1, T2 and T3 on the motor contactor. Remove the wire clamp and wire tie. Remove the ground wire from the green ground screw.
6. Disconnect the solenoid wires from the printed circuit board. Connector is not visible behind the transformer in Figure 2. Remove the wire tie from the solenoid wires.
7. Disconnect from the printed circuit board the sensor connectors on the outside of the electrical chassis box
8. Remove the four screws and lock washers on the front panel of the electrical chassis. Retain the screws and washers. Remove the two screws and lock washers holding the electrical chassis to the compressor's mounting frame.
9. Pull the disconnected wires through the bushing in the rear of the electrical chassis. Carefully pull the front panel of the electrical chassis away from the front panel of the compressor. Completely remove the electrical chassis.
10. Install the new electrical chassis. Reconnect the wires, clamps and wire ties removed in steps 5, 6 and 7. Refer to the wiring schematic. Proper phasing requires connecting wire 4 to T1, wire 5 to T2 and wire 6 to T3. Using a Phillips torque screwdriver, tighten the wires to the contactor's terminals to 2.0 Nm (18 in. lbs.).
11. Replace the compressor's cover.
12. Reconnect the power to the compressor.
13. Start the compressor to check that it runs properly.

This completes the procedure for replacing the electrical chassis.

Contact SCAI Engineering for procedure on resetting time on F-70 compressor.

### **Replace the Supply Gas High Temperature Thermistor**

Part required: Gas temperature thermistor, P/N 267049A

Tools required: #0 Phillips screwdriver  
#2 Phillips screwdriver  
Needle nose pliers

1. Stop the compressor and disconnect the power to the compressor.



2. Using a Phillips screwdriver, remove the compressor's cover. Retain the screws and lock washers for reinstallation.
3. The gas temperature thermistor is fastened to the compressor discharge gas tube coming out of the compressor head (located at the rear of the entire compressor package). With the needle nose pliers, disconnect the two wires from the switch.
4. Use the #0 Philips screwdriver to remove the switch from the supply gas tube. Retain the screws and lock washers.
5. Attach a replacement thermistor, using the hardware previously removed.
6. Reattach the two wires to the terminals on the switch.
7. Replace the compressor's cover.
8. Reconnect the power to the compressor.

### **Replace the Water High Temperature Thermistors (Thermistor Cable Assembly)**

Part required: Water temperature thermistor cable, P/N 267039B

Tools required: #2 Phillips screwdriver  
Needle nose pliers  
Open-end wrenches 1", 1 1/8", 1 3/16"  
Snoop<sup>®</sup>

1. Stop the compressor and disconnect the power to the compressor.
2. Using a Phillips screwdriver, remove the compressor enclosure cover. Retain the screws and lock washers for reinstallation.
3. The water temperature thermistors are clipped to the water supply and water return copper tubes directly behind the front panel. The adsorber must be removed to gain access to the thermistors. Follow the procedure Adsorber Removal in the Maintenance section. Retain all hardware and parts for reinstallation.
4. With a marker, mark the location of the water temperature thermistors on the copper tubing.
5. Disconnect the thermistor cable assembly from the electrical chassis. Remove the cable ties and un-clip the two water temperature thermistors.
6. Install a replacement thermistor cable assembly using new cable ties to support in place.
7. Clip the water temperature thermistors to the copper tubing where marked. Connect the thermistor cable assembly to the electrical chassis.
8. Reinstall the adsorber, using the procedure Adsorber Installation in the Maintenance section. Include leak checking the Aeroquip couplings with Snoop<sup>®</sup>. See the Leak Check procedure in the Maintenance section in this manual.
9. Replace the compressor's enclosure cover.

**Automatic Restarting After a Helium High Temperature Shutdown Error**

If a helium discharge high temperature shutdown error causes a shutdown of the system, the compressor will attempt to restart itself 5 times at 20 minute intervals before a reset signal must be provided to the compressor. A reset signal or power outage will clear the shutdown error and reset the automatic restart counter.

If the system is set for DB25 Configuration Mode 2 and a helium high temperature shutdown error occurs, the system will ignore automatic resets during the first 19 minutes of the 20 minute interval to prevent rapid on-off cycling of the compressor.

**System Status Display**

Normal conditions: When all systems are operating normally, with no system errors, the following lines are displayed on the LCD in the order listed below by scrolling the display. Press the DISPLAY buttons (up and down arrows) to scroll the LCD. Scrolling past the bottom of the display will start back at the top and repeat. If the DISPLAY button is pressed and not pressed again after 30 seconds, the display will return to the first line (ET).

- Elapsed time in hours to one decimal place and control state
- Helium Temp-OK
- Water Temp-OK
- Water Flow-OK
- Motor Temp-OK
- Phase Seq (sequence)-OK
- Return Press-OK
- Ads Life XXXXX
- DB-25 Config (switch configuration)-OK
- Rtn Press (current return pressure)
- Software Version
- Cold Head Run (When in OFF state only)



Error conditions: If a system error occurs that causes an alarm or shutdown condition, the monitor point as listed above will change from “OK” to “ERR” and that monitor point will be scrolled to the top for display.

Any point that has not failed will continue to display OK if the operator manually scrolls the display.

If additional points fail before the operator resets the first error(s), the latest point to fail will change from “OK” to “ERR” and will be scrolled to the top for display. In this way, the operator will see the most recent fault displayed on the LCD and, by manually scrolling the display, can see other error conditions that lead up to the latest.

If a monitoring sensor is disconnected, the display for that monitor point will change from “OK” to “FAIL”.

**Error Conditions**

An error condition will cause either a system alarm or a shutdown. The following table lists the alarm and the shutdown errors that are monitored. Overload trip of the Mains Power switch (described below) is not monitored or reported.

LCD Display First Line	Type	Error	Indication
Helium Temp-ERR	Shutdown	High helium discharge temperature	Temperature > 93°C (200°F)
Water Temp-ERR	Alarm	High water supply temperature.	Temperature > 35°C (95°F).
Water Flow-ERR	Alarm	Low water flow	Temperature > 46°C (115°F)
Motor Temp-ERR	Shutdown	High compressor motor winding temp (internal protector open)	Return Pressure > 140 psig while compressor is commanded on.
Phase Seq-ERR	Shutdown	Phase sequence or open fuse	Monitored by microprocessor
Return Pressure-ERR	Shutdown	Loss of gas charge	Return pressure < 15 psig.
DB-25 Config1-ERR (or Config2)	Shutdown	Remote cable does not match switch setting	Monitored by microprocessor

If the compressor has been shut down by one of these interlocks, do not restart until the problem has been found and corrected. Refer to the Troubleshooting Guide to identify the problem.

In the event of a shutdown error, the compressor motor and cold head valve motor are turned off. The microprocessor will annunciate the error condition via signals at the System Diagnostics Connector and via the LCD Display. Signals are available on the 25-pin connector for output to an external device. See Figure 2 and Tables 1 and 2.

The Mains Power switch trips when steady-state current exceeds 1.2 x the front panel set point. When tripped, the switch knob locates halfway between the on and off positions.

**Clearing Error Conditions**

**NOTE**

Errors can be cleared locally only when configuration mode is set for Mode 1. When configuration mode is set for Mode 2, errors must be cleared using the DB25 diagnostic interface.

When an error is corrected, the message(s) can be cleared from the display and the system diagnostics connector by any of the following procedures:

- Apply a momentary signal to the diagnostic interface connector, or
- Press the DISPLAY UP and DISPLAY DOWN (arrow) buttons simultaneously, or
- Turn the Main Power switch to off, pause briefly, then turn back on

### **Restarting After an Error Condition**

When the shutdown is caused by helium discharge high-temperature, the compressor will be able to restart only after it has cooled enough for the thermistor to read a temperature below the cut-off point. After waiting for the compressor to cool, clear the error message then push the ON button to restart. Should the compressor fail to start, allow more cooling time. Repeat the restart procedure. Check cooling water temperature and flow. Compare with Specifications.

If the shutdown is due to a motor high temperature, the motor winding high temperature relay will automatically reset in approximately 30 minutes. To restart the compressor, clear the error message then push the ON button. If the compressor fails to start, allow more cooling time. Repeat the restart procedure.

If the motor circuit protector opens, the knob moves part way toward OFF. Reset it by turning the knob completely to OFF, then clockwise to ON. The compressor and the cold head should start automatically.

### **RS232 Terminal Communication Interface (for firmware versions 1.7 or later)**

A terminal interface is provided that allows information from the compressor to be transmitted and displayed to a separate computer running a terminal emulator program. In addition to transmitting and displaying information, the terminal interface also permits registering in the F-70 memory a new adsorber installation.

- Connect via the serial connector using a terminal emulator program such as Hyperterminal.
  - Dsub9 Pin assignment: 2=receive, 3=transmit, 5=Earth Ground (through chassis)
  - Settings: 9600 baud, 8 data bits, no parity, 1 stop bit, no flow control
  - Terminal settings: Do not send line ends with line feed.
  - Additional terminal settings as desired: e.g. echo typed characters, append line feed on line end (receive only).
- From terminal program send “m” (press “m” and then “enter”) to display command menu resident in F-70 controller.
  - Send letter corresponding to the desired command (e.g. “a” to return firmware version).
  - Note: Commands are active with or without menu displayed. Commands are case insensitive.
  - A) Software Version
  - B) Status
  - C) Run Hours
  - D) Return Pressure
  - E) Temperatures
  - F) Adsorber Life
  - G) Register New Adsorber
  - H) Last 20 Failures
  - I) Transmit Data Logs
  - A) Software Version
    - Returns installed firmware name and version (e.g. “F70 V1.7”)
  - B) Status
    - Returns whether in DB25 Configuration mode 1 or mode 2
    - Returns operating state (e.g. On; Off; Off, fault; etc.)
    - Returns active faults (e.g. Return Pressure ERR)

- C) Run Hours
  - Returns display run time (run hours since last service)
  - Returns master run time (run hours since manufacture)
- D) Return Pressure
  - Returns current return pressure in bar and psig
- E) Temperatures
  - Returns current operating temperatures
- F) Adsorber Life
  - Returns remaining adsorber life in hours
- G) Register New Adsorber
  - Resets the adsorber timer function to 30,000 hours (life of a new adsorber)
- H) Last 20 Failures
  - Returns a list of the last 20 recorded faults. Each line in the list includes:
    - An arbitrary index number to show sequence of occurrence (earliest recorded fault can occur anywhere in the list)
    - The name of the recorded fault
    - The display run time value at the time of the recorded fault
- I) Transmit Data Logs
  - Returns data log contents in raw form. **Contact SCAI for description of format of raw data.**

**Troubleshooting Guide**

<u>Problem</u>	<u>Possible Cause</u>	<u>Corrective Action</u>
Blown transformer fuse(s), FU-1, FU-2 or FU-3	Fault in 200V portion of PCB 1 Transformer short circuit	Replace PCB 1 Replace transformer.
Blown PCB 1 fuse(s), FU-4, FU-5 or FU-6	Valve motor short circuit Cold head cable short circuit Solenoid valve fault Motor contactor fault PCB 1 fault	Check motor winding resistances; replace if outside specifications. Check continuity of each conductor; replace cable if open. Replace solenoid. Check contacts; replace if defective Replace PCB 1.
Tripped MAIN POWER circuit protector  Note: See electrical drawing for specific compressor model for correct set point.	Wrong load current set value Loss of phase/low supply voltage Excessive current draw by compressor capsule Motor contactor fault Operation with compressor capsule return pressure below atmospheric pressure	Set to correct value  Check mains voltage; correct if outside specifications See above  See above Check pressure transducer setting.

<u>Problem</u>	<u>Possible Cause</u>	<u>Corrective Action</u>
<p>LCD reads Motor Temp-ERR</p> <p>Note: This fault is inferred from detection of high return pressure. Under normal conditions, high return pressure occurs only when motor is not running.</p> <p>Note: High return pressure set point is 140 psig.</p>	<p>Compressor capsule internal thermal protector open</p> <p>Low supply voltage</p> <p>Excessive helium charge pressure</p> <p>Excessive operating differential pressure</p> <p>Insufficient cooling water</p> <p>Motor internal fault</p> <p>High return pressure</p> <p>Excessive helium charge pressure</p> <p>Insufficient differential pressure</p> <p>Return pressure transducer fault</p> <p>PCB 1 fault</p> <p>Blown fuse (any)</p>	<p>Check mains voltage; correct if outside the specifications.</p> <p>See Specifications in Operating Manual</p> <p>See Specifications in Operating Manual</p> <p>Check coolant flow and temperature; see Specifications in Operating Manual</p> <p>Check motor winding resistances.</p> <p>See Specifications in Operating Manual</p> <p>See Specifications in Operating Manual</p> <p>See "Return Pressure Fault" problem</p> <p>Replace PCB 1</p> <p>Check and replace fuse(s)</p>
<p>LCD reads Helium Temp-ERR</p> <p>Note: High helium temperature set point is 93°C.</p>	<p>Insufficient cooling water</p> <p>Blocked oil circulation</p> <p>Temperature transistor fault</p> <p>PCB 1 fault</p> <p>Water flow is reversed</p>	<p>Check coolant flow and temperature</p> <p>See "Oil Level Fault" problem</p> <p>Check that oil return capillary is open; perform oil carryover test.</p> <p>Replace transistor</p> <p>Replace PCB 1</p> <p>Check installation of water lines</p>
<p>LCD reads Phase Seq-ERR</p>	<p>Reversed phase</p> <p>Loss of phase</p> <p>Blown fuse (any)</p> <p>PCB 1 fault</p>	<p>Check mains power</p> <p>Check mains power</p> <p>Check and replace fuse(s)</p> <p>Replace PCB 1</p>
<p>DB25 configuration fault</p> <p>LCD reads DB-25 Config1-ERR (or Config2-ERR)</p>	<p>Configuration selector switch is in the wrong position, or was in the wrong position when power was supplied.</p> <p>Continuity value between pins 7 and 8 is not compatible with DB25 configuration switch setting.</p> <p>PCB 1 fault</p> <p>PCB 2 fault</p>	<p>Turn off power and move the switch to the correct position.</p> <p>See Tables 1 and 2 in the Operating Manual</p> <p>Replace PCB 1</p> <p>Replace PCB 2</p>

<b><u>Problem</u></b>	<b><u>Possible Cause</u></b>	<b><u>Corrective Action</u></b>
LCD reads Return Press-ERR  Note: Low return pressure. Set point is 15 psig	Low helium gas charge  Return pressure transducer fault PCB 1 fault	See Helium Gas Pressure Specifications in the Operating Manual Replace transducer  Replace PCB 1
LCD reads Water Temp-ERR  Note: Incoming water high temperature set point is 35°C	High supply water temperature Temperature transistor fault PCB 1 fault	Check temperature; correct if out of specifications. Replace transistor Replace PCB 1
LCD reads Water Flow-ERR  Note: This warning condition is inferred from high outgoing water temperature.  Note: Outgoing water high temperature set point is 46°C	Low water flow  High supply water temperature Excessive load on compressor High helium charge pressure High differential pressure PCB 1 fault	Check flow rate; correct if outside specifications Check temperature; correct if out of specifications  See Specifications in Operating Manual See Specifications in Operating Manual Replace PCB 1

**Compressor Reset Functions**

**1. MAIN POWER circuit protector trip:**

Rotate knob fully counter-clockwise to OFF. Rotate to ON.

IMPORTANT: Locate source of fault and any short circuit damage prior to reset and compressor operation

**2. Normal reset: used to clear controller faults and warnings:**

Remote reset through DIAGNOSTIC INTERFACE connector

From front panel, simultaneously depress scroll up button and scroll down button

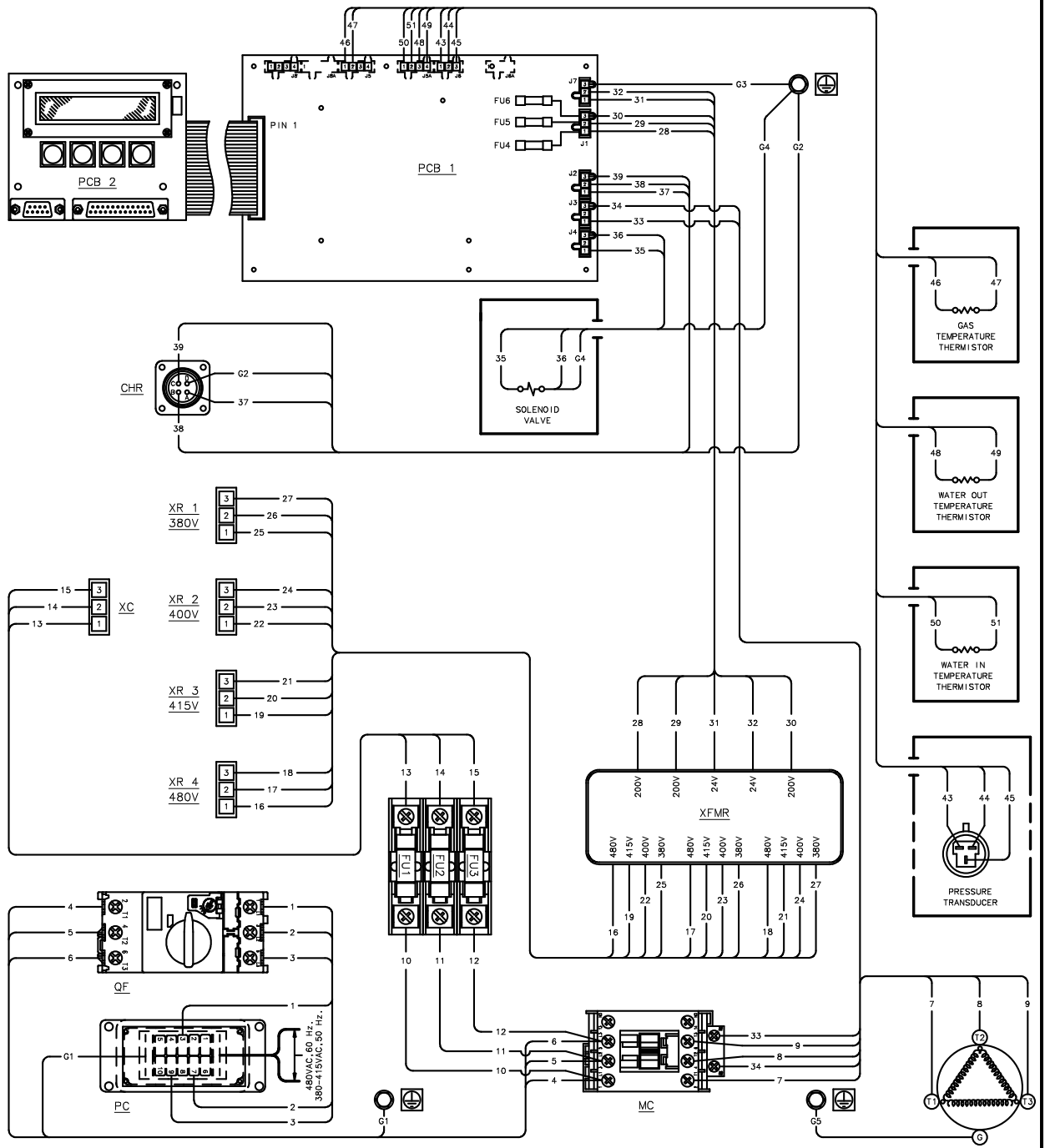


Figure 4 F-70H Compressor Wiring Diagram



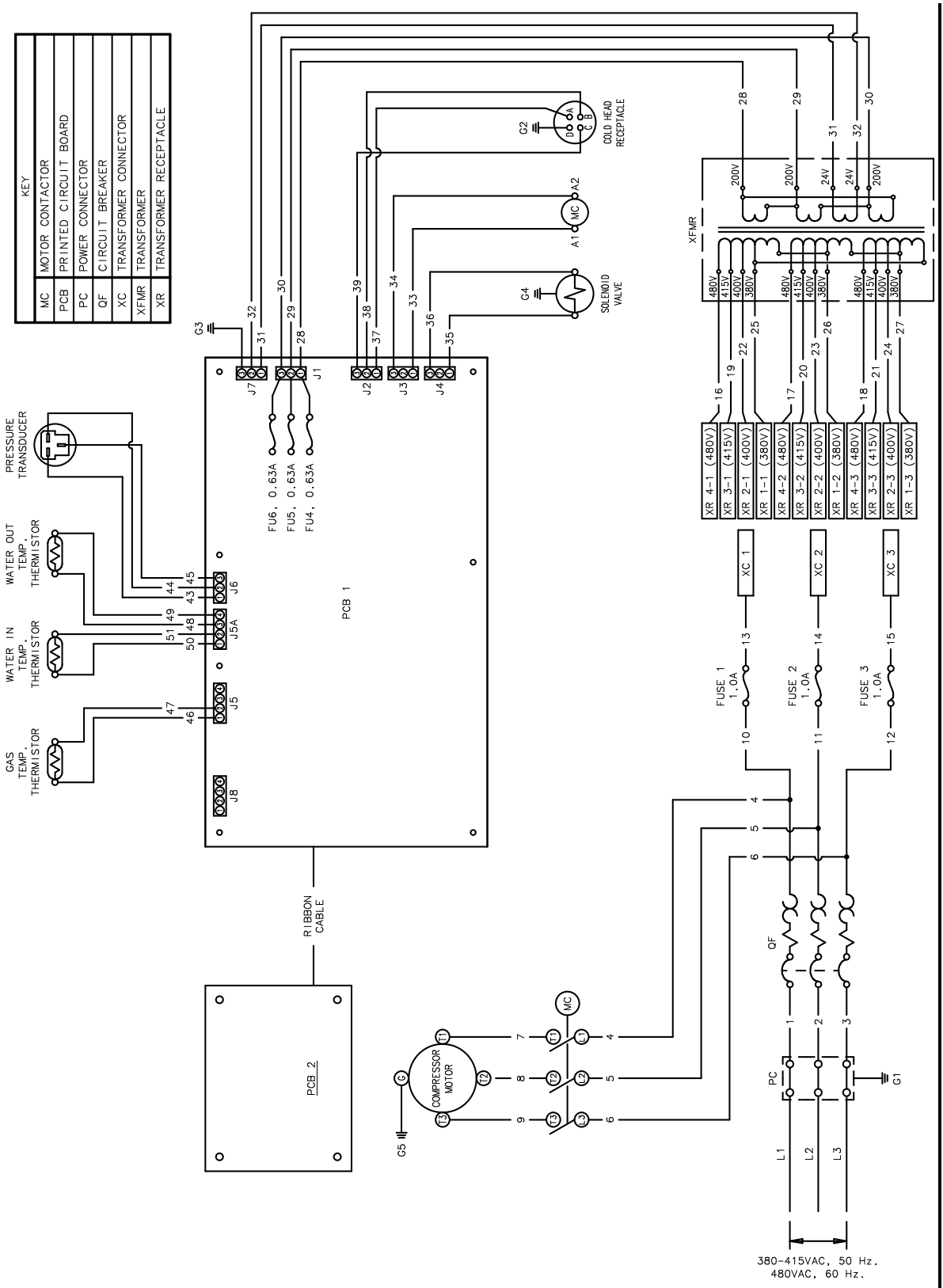


Figure 5 F-70H Compressor Wiring Schematic

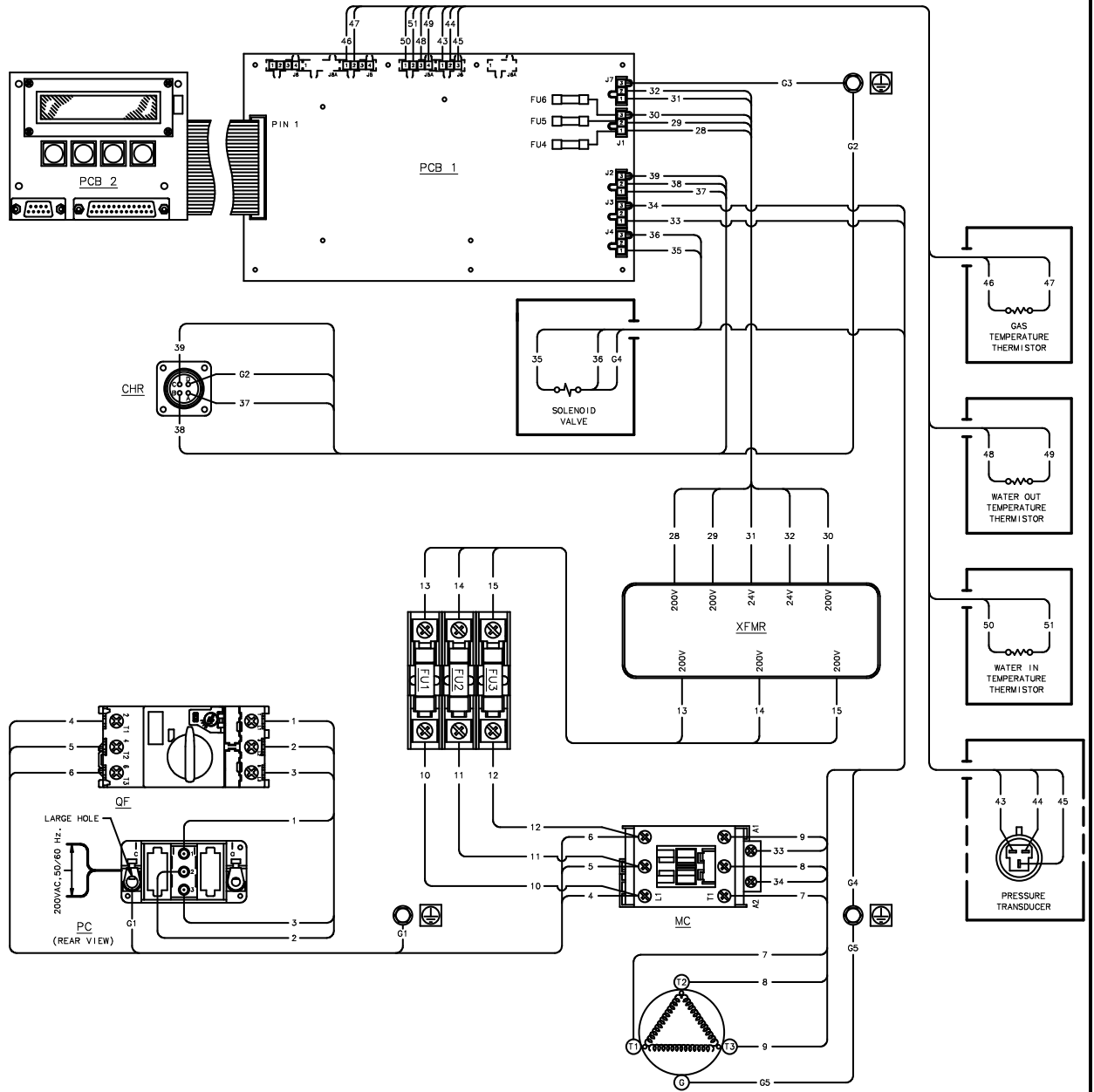


Figure 6 F-70L Compressor Wiring Diagram

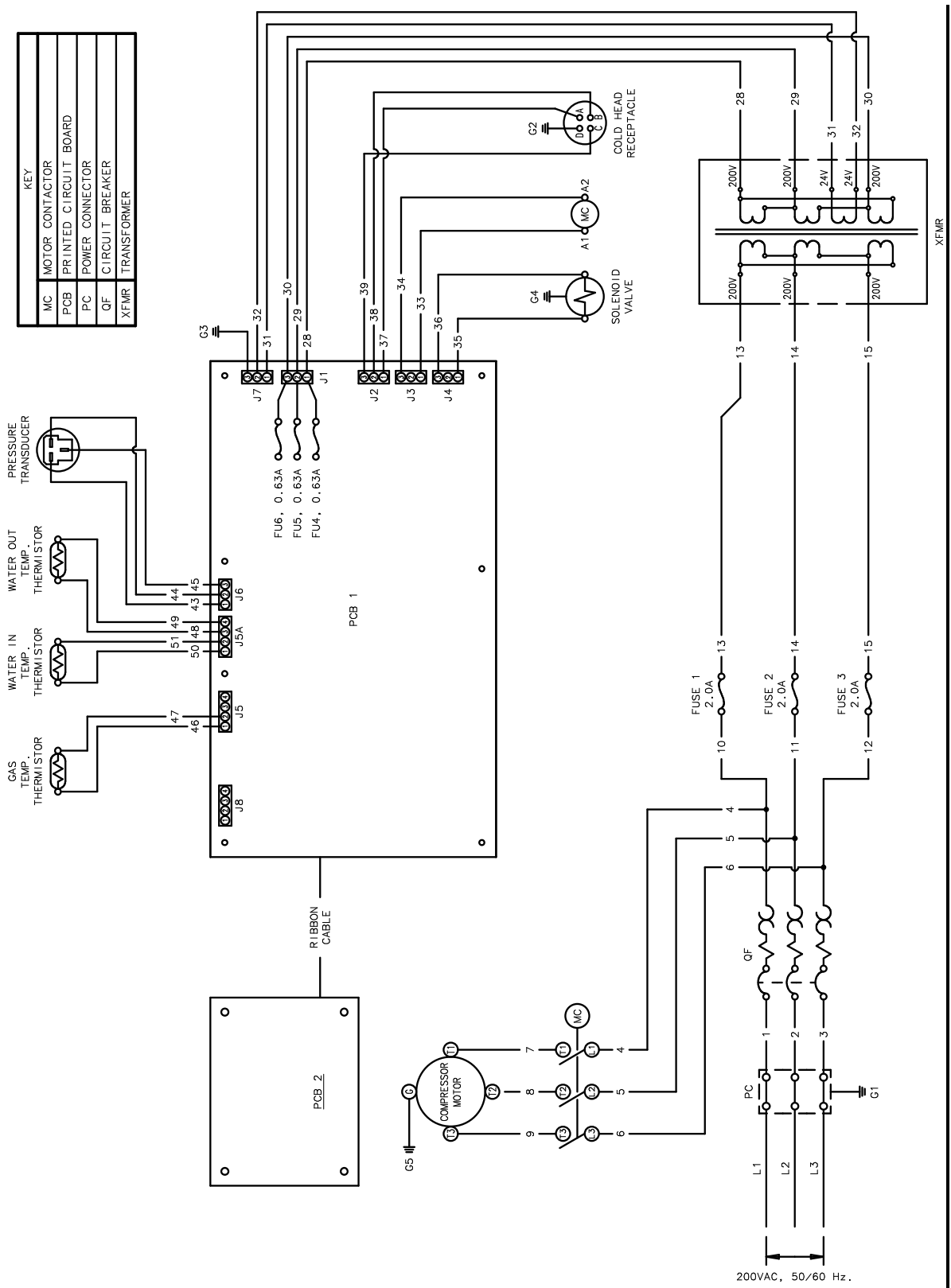


Figure 7 F-70L Compressor Wiring Schematic

# PARTS

## Ordering

The nameplate fastened to the compressor identifies the components as follows:

- Model Number
- Part Number
- Customer's Part Number (when applicable)
- Serial Number
- Date of Manufacture

Furnish this complete information when ordering parts. Also, order parts by part number and name.

### **NOTE**

Be sure to have 99.999% pure helium gas available for servicing the system.

Variations for electrical service: F-70H for 480 ( $\pm 10\%$ ) V3~, 60 Hz and  
 380/415 ( $\pm 10\%$ ) V3~, 50 Hz.  
 F-70L for 200 ( $\pm 10\%$ ) V3~, 50/60 Hz.

<b><u>F-70H Compressor Parts</u></b>			
<b><u>Item</u></b>	<b><u>Quantity</u></b>	<b><u>Part Name</u></b>	<b><u>Part Number</u></b>
1.1	1	Electrical chassis assembly for F-70H	F267109A
1.2	1	Internal fuse kit, F-70H (high volt only), including (3) Power fuses, 1 ampere, 600 V, class CC (3) Control board fuses, 0.63 ampere, 250 V	267127A 34162 34687
1.3	1	Mains Power Cord, HV, 2 m, 90° Down, Side Entry, Bootlace Terminals	267107C6

<b><u>F-70L Compressor Parts</u></b>			
<b><u>Item</u></b>	<b><u>Quantity</u></b>	<b><u>Part Name</u></b>	<b><u>Part Number</u></b>
2.1	1	Electrical chassis assembly for F-70L	F267097A
2.2	3	Fuse, 2.0 amperes, 600 V, time delay, class CC (transformer), F-70L	34164
2.3	1	Internal Fuse Kit, F-70L Compressor including: (3) Power Fuses, 2A, 600V, P/N 34164 (3) Control Board Fuses, .63A, 250V, P/N 34687	267128A

<b><u>F-70H and F-70L Compressor Parts</u></b>			
<b><u>Item</u></b>	<b><u>Quantity</u></b>	<b><u>Part Name</u></b>	<b><u>Part Number</u></b>
3.1	1	Adsorber assembly	F300138A
3.2	1	Gas temperature thermistor	267049A
3.3	1	Cable assembly with water temperature switches	267039B
3.4	1	Water Fitting Kit, including: (2) Elbow, 90° Swivel, brass, ½” hose barb to ½” BSP, Serto P/N TPD 4050, P/N 300342A	267129A
3.5	1	Cold Head Cable, F70 Compressor to SC-10, Amphenol to Amphenol connector, 13.5 m lg. (factory use only)	267053C44
3.6	1	Cold Head Cable, F70 Compressor to RDK-408L2, Amphenol to Amphenol connector, 20 m lg. (factory use only)	267017C65
3.7	1	Cold Head Cross Mix Extension Cable, 0.3 m lg., Amphenol to Harting connector and cross phased wiring, used when retrofitting F-70 in place of an Leybold CP6000 compressor and connecting to Leybold RGD-5100 CH cable.	267052C1
3.8	1	Cold Head Extension Cable, 0.15m lg., Amphenol to Harting connector, used when retrofitting F-70 in place of an HC-10 and connecting to SC-10 cable.	267064C0.5
3.9	1	Front locator plate	300050C
3.10	2	Slide rail	267033B
3.11	4	Caster	49137
3.12	3	Eyebolt	73216
3.13	2	Gasket face seal, 8M Aeroquip coupling	77002

<b><u>Service Tools</u></b>			
<b><u>Item</u></b>	<b><u>Quantity</u></b>	<b><u>Part Name</u></b>	<b><u>Part Number</u></b>
4.1	1	Charge and vent tool kit, including (1) Charge and vent tool, #4F x ¼” Swagelok (1) Bleed adapter assembly	267190A 267191A 267192A
4.2	1	Spanner Wrench Kit, including (1) Wrench, 1-3/16” open end, crowfoot, P/N SK12463C (1) Wrench, 1-1/8” open end x 5/8” open end, P/N SK30017C2 (1) Wrench, 1” open end x 3/4” open end, P/N SK30017C3	267130A

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