Advanced Research Systems

TECHNICAL MANUAL

MODEL ARS-4HW

WATER-COOLED HELIUM COMPRESSOR

Revision	Date	Initials
Rev 2	6/11/12	ER
Rev 3	11/15/12	ER

Conforms to UL STD 61010-1

Certified to CSA STD C22.2 No.61010-1

Table of Contents

General

ARS Inc. compressors are designed to operate safely with only original ARS Inc. parts and when the installation and servicing are performed in accordance with the instructions in this manual.

CAUTION !

Modification of the equipment without the approval of ARS Inc. will void the warranty.

These commodities, technology, or software are exported from the United States in accordance with U.S. Export Administration Regulations. Distribution and re-export to restricted countries, denied person or for end uses which are defined under EAR Part 744, or which are contrary to U.S. exported regulations, are prohibited. Diversion contrary to U.S. Law is prohibited (EAR99).

Contact ARS Inc. with any questions you have concerning the use or maintenance of this equipment:

Advanced Research Systems, Inc.

7476 Industrial Park Way

Macungie, PA 18062 USA

tel: (610) 967-2120

fax: (610) 967-2395

email: ars@arscryo.com

service email: arsservice@arscryo.com

web: www.arscryo.com

Three types of special notices are presented throughout this manual and appear on the right-hand side of text where they are especially applicable:

⚠WARNING

WARNINGS CALL ATTENTION TO ACTIONS OR CONDITIONS WHICH CAN RESULT IN INJURY OR DEATH TO PERSONNEL.

CAUTION !

Cautions call attention to actions or conditions which can result in damage to equipment or in abnormal performance.

NOTE

Notes give important additional information, explanations, or recommendations.

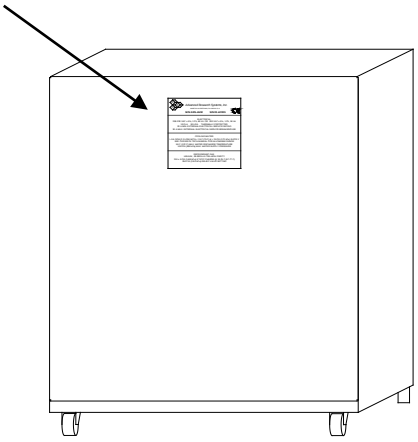
The compressor is the part of the closed cycle cryogenic refrigerator that provides the necessary helium gas flow rate at the high and low pressure for the expander to convert into the desired refrigeration capacity. The expander operates on the principle of the Gifford-McMahon refrigeration cycle.

The compressor connects to the expander by two gas lines and an electrical power cable. One of the gas lines supplies high pressure helium gas to the expander, the other gas line returns low pressure helium gas from the expander. The expander electrical power from the compressor drives the valve motor inside the expander.

The compressor requires electrical power and cooling water. The compressor is provided with a power cord for connecting to the electrical power supply. It is also provided with plastic tubing and brass fittings to connect to the cooling water supply and a drain.

The compressor is provided standard with casters so it can be easily moved. Optional glides are available for a stationary location with a reduced height.

The nameplate, model number and serial number, and other important operating information labels are located on the rear panel of the compressor:



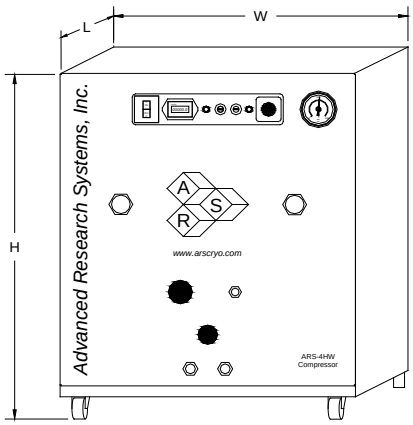
Dimensions

Width 17.1 in (434 mm)

Length 19.0 in (483 mm)

Height 20.3 in (516 mm) with casters (standard)

19.4 in (493 mm) with glides (optional)



Weight

160 lb (72.6 kg)

Mounting Position

Sitting on its casters (or glides) and level within 5°

Ambient

Operating: 12-40 C (54-104 F)

with optional air-cooled CoolPac™: < 32 C (90 F)

Storage: -20 to 60 C (-4 to 140 F) with water removed

CAUTION !

This equipment is for indoor use only.

Electrical Power Requirements

208-230 VAC ± 5%, 1 Ph, 60 Hz

200 VAC ± 5%, 1 Ph, 50 Hz

19 FLA

80 LRA

25 A MIN. external electrical service rating

30 A MAX. external electrical service circuit breaker or fuse

Nominal 3.7 kVA (3.6 kW) @ 60 Hz

Nominal 3.4 kVA (3.0 kW) @ 50 Hz

Transformers are required for voltages outside the above voltage ranges. Transformers are available from ARS Inc. Typical step-down (buck) transformers are applied as follows:

-10% for nominal 220 VAC, 50 Hz

-10% for nominal 230 VAC, 50 Hz

-15% for nominal 240 VAC, 50 Hz

-20% for nominal 250 VAC, 50 Hz

Cooling Water Requirements

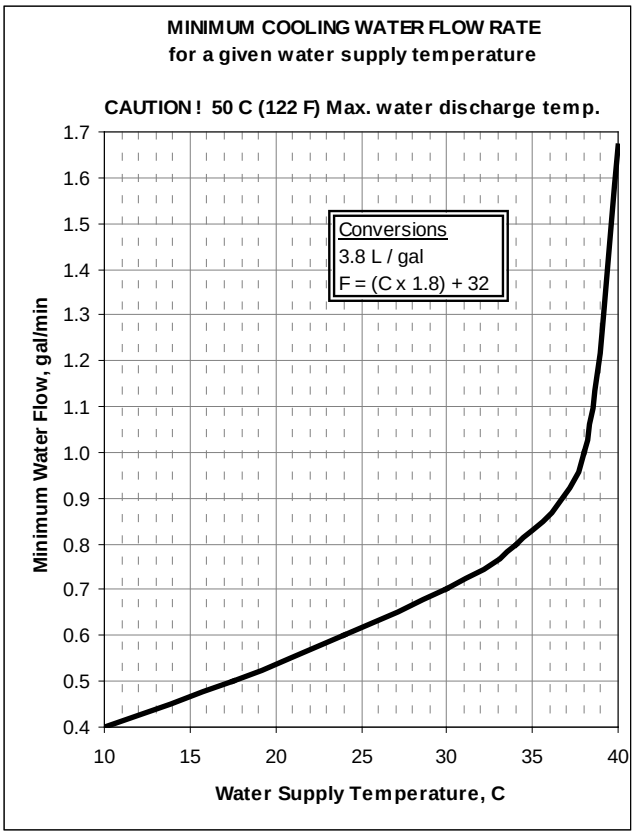
Typical: > 0.6 gal/min (2.3 L/min) with < 24 C (75 F) and > 25 psig (173 kPa) water supply, discharging to drain at < 40 C (100 F)

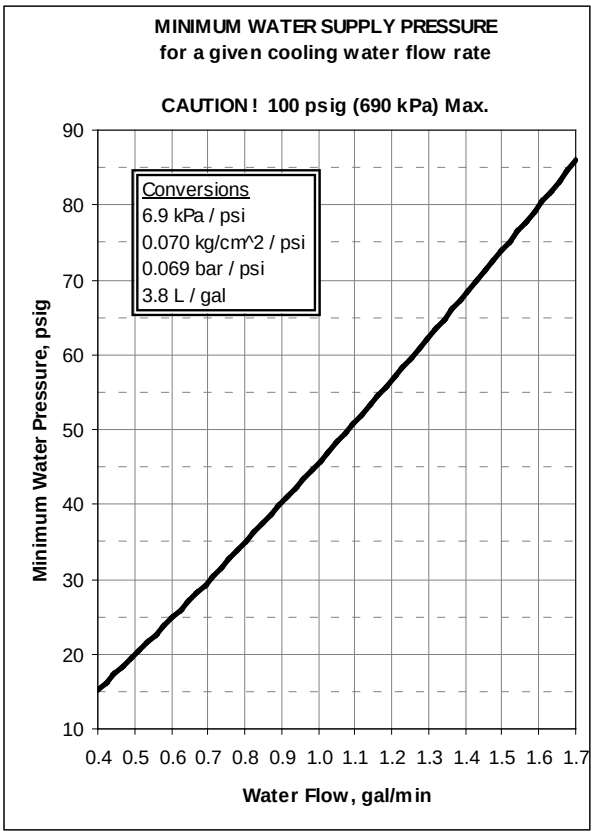
See charts below for minimum flow and pressure requirements:

CAUTION !

Do not exceed 50 C (122 F) MAX. water discharge temperature at compressor.

Do not exceed 100 psig (690 kPa) MAX. water supply pressure.





Water Quality

Typical municipal drinking water quality is recommended:

pH of 6-8 and total hardness < 85 ppm (5 grains/gal) $CaCO_3$

Air Cooling (optional)

Use ARS, Inc. CoolPac™

Refrigerant Gas

Helium, 99.999% ultra-high purity, with a dew point < -50 C (-58 F) at 300 psig (2069 kPa)

Static pressure: 200-205 psig (1379 -1413 kPa) @ 19-25 C (67-77 F)

Operating supply pressure range: 270 ± 20 psig (1862 ± 138 kPa)

Interfaces

- Expander power receptacle: Mates with ARS Inc. standard expander power cable.
- Compressor input power cord: Standard 10 ft (3.0 m) long; universal rated, 300 V, 30 A, 10/3 SJT and HO5VVF3G6; EU-harmonized color code.
- Compressor input power cord plug (for USA and Canada): NEMA L6-30P twist-lock.
- Helium connections: Male self-sealing gas couplings to mate with ARS Inc. flexible gas lines. Valve and 1/4 in (6.4 mm) o.d. tube compression fitting for gas fill/vent.
- Water connections: 3/8 in (9.5 mm) o.d. tube compression fittings (polyethylene tubing provided: 40 ft (12 m) length, 190 psi (1310 kPa) working pressure rating @ 24 C (75 F)).
- Elapsed Time Meter (ETM): Displays total time unit has operated when power is applied.

Safety

- 22-25 A On/Off Switch-Circuit Breaker, with green indicator light
- Fused controls circuit (F1): 2 A, 250 V, type 3AG (¼ in o.d. x 1¼ in long), quick-acting
- Fused expander power (F2): 1 A, 250 V, type 3AG (¼ in o.d. x 1¼ in long), quick-acting, with green indicator light on front panel
- High Temperature Switch (HTS) with red Over Temp indicator light on front panel; automatically resets
- Compressor motor internal over-current/temperature switch; automatically resets
- Gas supply pressure gauge
- Gas bypass Internal Relief Valve (IRV) and Equalization Solenoid Valve (ESV)
- Atmospheric Relief Valve (ARV) set at 350 psig (2410 kPa), ASME certified ± 3%
- Pressure vessels designed to ASME code Section VIII Division I (although exempt from requiring ASME stamp due to size), and PED 97/23/EC (Group 2 gas, Category I, Module A); 400 psi (2760 kPa) design pressure, 500 psi (3450 kPa) pneumatic proof pressure
- Electrical components rated UL, CSA, CE; Wiring designed to NFPA 79 and LVD 73/23/EEC; Insulation co-ordination per EN61010-1 (Pollution degree 1, Installation category II)
- Enclosure is ~ NEMA/UL/CSA Type 1 (indoor use, protection against contact with internals) and ~ IEC/IP21 (protected from intrusion of solid objects > 12 mm and vertical falling water)

Scheduled Maintenance

- Replace adsorber after 12,000 hours of operation

1. Unpack the equipment and inspect it for shipping damage. Check the Tip-N-Tell indicator on the carton or rear panel of the compressor to determine if the package was tilted too much.

CAUTION !

Do not tilt compressor more than 5° from level to maintain proper lubricating oil levels.

2. The compressor, expander, and gas lines are shipped separately and pressurized with helium gas at the static pressure of the compressor. Check the compressor gas supply pressure gauge. Refer to the Specifications section of this manual for the proper Refrigerant Gas static pressure (page 5).

   2.1. If the pressure is only slightly low, it may indicate shipping damage. In that case, let the unit set at room temperature for an hour and re-check.

      2.1.1. If the pressure remains low, but is stable, then add gas per the Maintenance, Adding Helium Gas, section of this manual. Monitor the gauge for any further pressure loss.

      2.1.2. If the pressure continues to decrease, then contact ARS Inc. for service.

3. Locate the compressor near the expander where it will be used. Refer to the Specifications section of this manual for the proper Mounting Position (page 3). Install the expander per its manual.

4. Connect the gas lines to the compressor and expander:

   4.1. Connect one gas line to the supply gas couplings at the compressor and expander (red).

   4.2. Connect the other gas line to the return gas couplings at the compressor and expander (green).

   4.3. Use two wrenches (provided with the gas lines or the expander installation tool kit) to hold and turn the gas line coupling (female) where shown. Turn until tight.

⚠WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

⚠WARNING

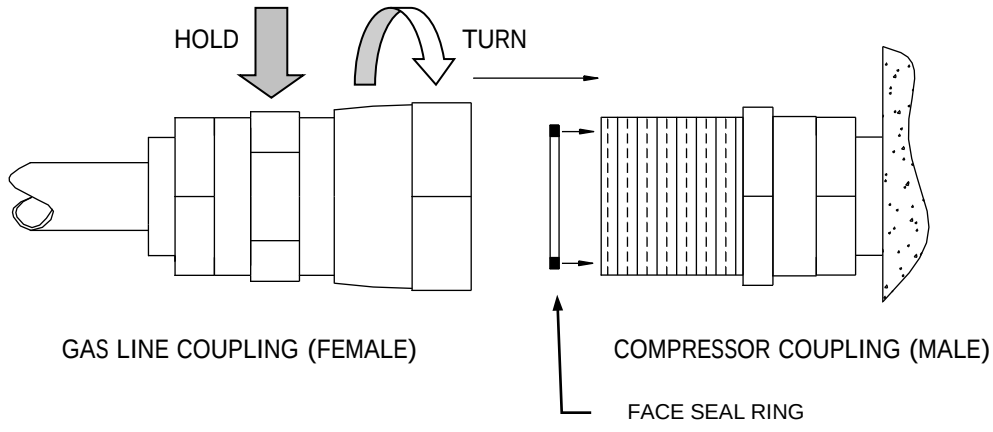
NEVER APPLY HEAT TO ANY PRESSURIZED EQUIPMENT.

CAUTION !

Before connecting gas lines to compressor or expander, check that face seal ring on male gas coupling is in good condition, and that faces of both mating couplings are clean.

NOTE

Keep dust caps or plugs on unused gas couplings.



5. Connect the expander electrical power cable to the compressor and expander receptacles.

6. Verify the compressor on/off switch is turned off.

7. Connect the proper electrical power to the compressor power cord via a suitable connector or disconnect box. Refer to the Specifications section of this manual for the Electrical Power Requirements (page 3). A plug is provided for USA and Canada sales (refer to Interfaces in the Specifications section of this manual). Only qualified electrical service personnel familiar with applicable codes should perform this work.

8. Connect the proper cooling water supply and drain to the compressor in and out connections. Use two wrenches. Cooling water tubing is supplied with the compressor. Refer to the Specifications section of this manual for the Cooling Water Requirements (page 4). Verify the water connections do not leak. A water leak coming from within the compressor enclosure may indicate shipping damage.

⚠WARNING

EXTERNAL ELECTRICAL SERVICE MUST BE INSTALLED PER APPLICABLE LOCAL CODES. AN UNINTERRUPTED EARTH GROUND MUST BE CONNECTED TO COMPRESSOR POWER CORD/PLUG AT EXTERNAL ELECTRICAL SERVICE.

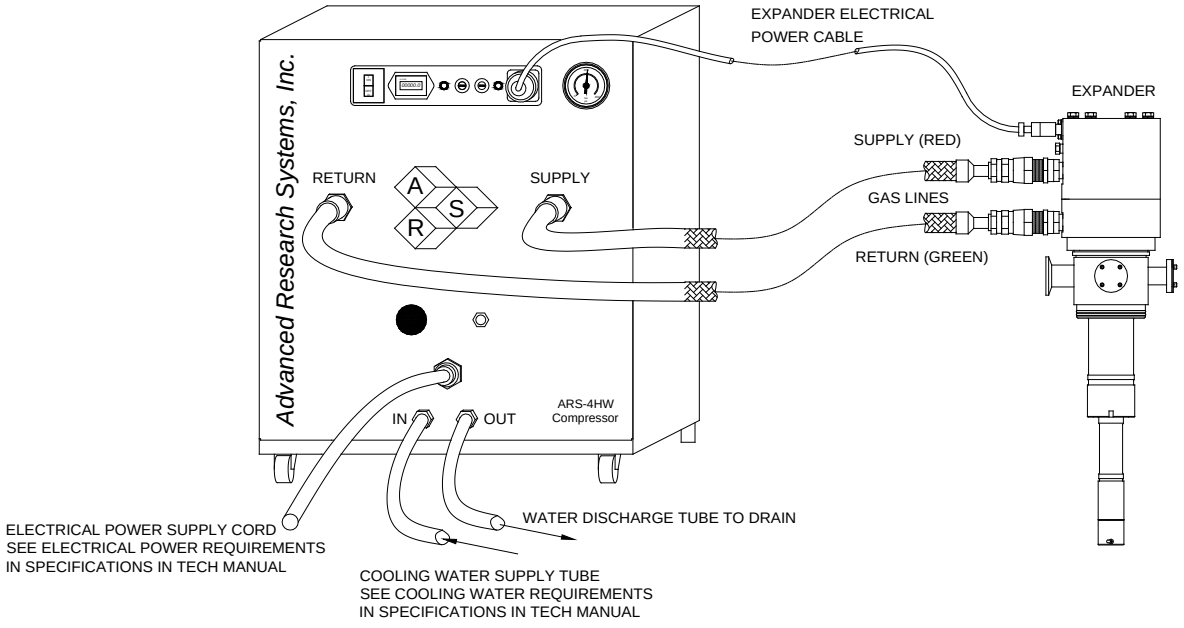
CAUTION !

Verify electrical supply frequency matches frequency on expander label.

Expander is set at factory for operation at either 50 Hz or 60 Hz.

CAUTION !

Do not exceed 100 psig (690 kPa) MAX. water supply pressure.



1. Verify the assembled system of the compressor, expander and gas lines, is at the proper static pressure. Check the compressor gas supply pressure gauge. Refer to the Specifications section of this manual for the proper Refrigerant Gas static pressure (page 5). If the pressure is below the minimum, then add gas per the Maintenance, Adding Helium Gas, section of this manual.

NOTE

Compressor has an internal relief valve (IRV) which allows it to be operated acceptably without being connected to the expander.

2. Prepare the expander for operation per its manual.

3. When ready, turn on the compressor at the on/off switch. The expander will also start and begin to cooldown.

⚠WARNING

OPERATE WITH ELECTRICAL AND ENCLOSURE PANELS IN PLACE TO AVOID ELECTRICAL SHOCK, UNCONTROLLED PRESSURE RELEASE, OR HOT SURFACES.

4. Promptly turn on the cooling water flow. Refer to the Specifications section of this manual for the Cooling Water Requirements (page 4).

5. The green light in the on/off switch should be illuminated, indicating electrical power is applied to that point. This switch is also a circuit breaker. If it trips, it will switch to the off position and the light will turn off. In the event of a power interruption (e.g. a thunderstorm) the compressor will automatically restart unless the interruption was too brief (< 1 s). In that case, the on/off switch will remain tripped and require manually restarting.

6. The expander power green light should also be illuminated, indicating fuse F2 is good and electrical power is applied to the expander power receptacle.

7. The gas supply pressure gauge should also then indicate a higher pressure. Refer to the Specifications section of this manual for the expected typical operating pressure (page 5). The pressure will fluctuate slightly if the expander is attached and operating. The pressure will be higher when the expander starts warm, and will decrease slightly as the expander cools down.

8. The elapsed time meter should also indicate an increased time as the compressor operates.

9. After 10-20 min of operation, verify the cooling water flow is adequate and that the water connections do not leak. Refer to the Specifications section of this manual for the Cooling Water Requirements (page 4).

CAUTION !

Do not exceed 50 C (122 F) MAX. water discharge temperature at compressor.

Do not exceed 100 psig (690 kPa) MAX. water supply pressure.

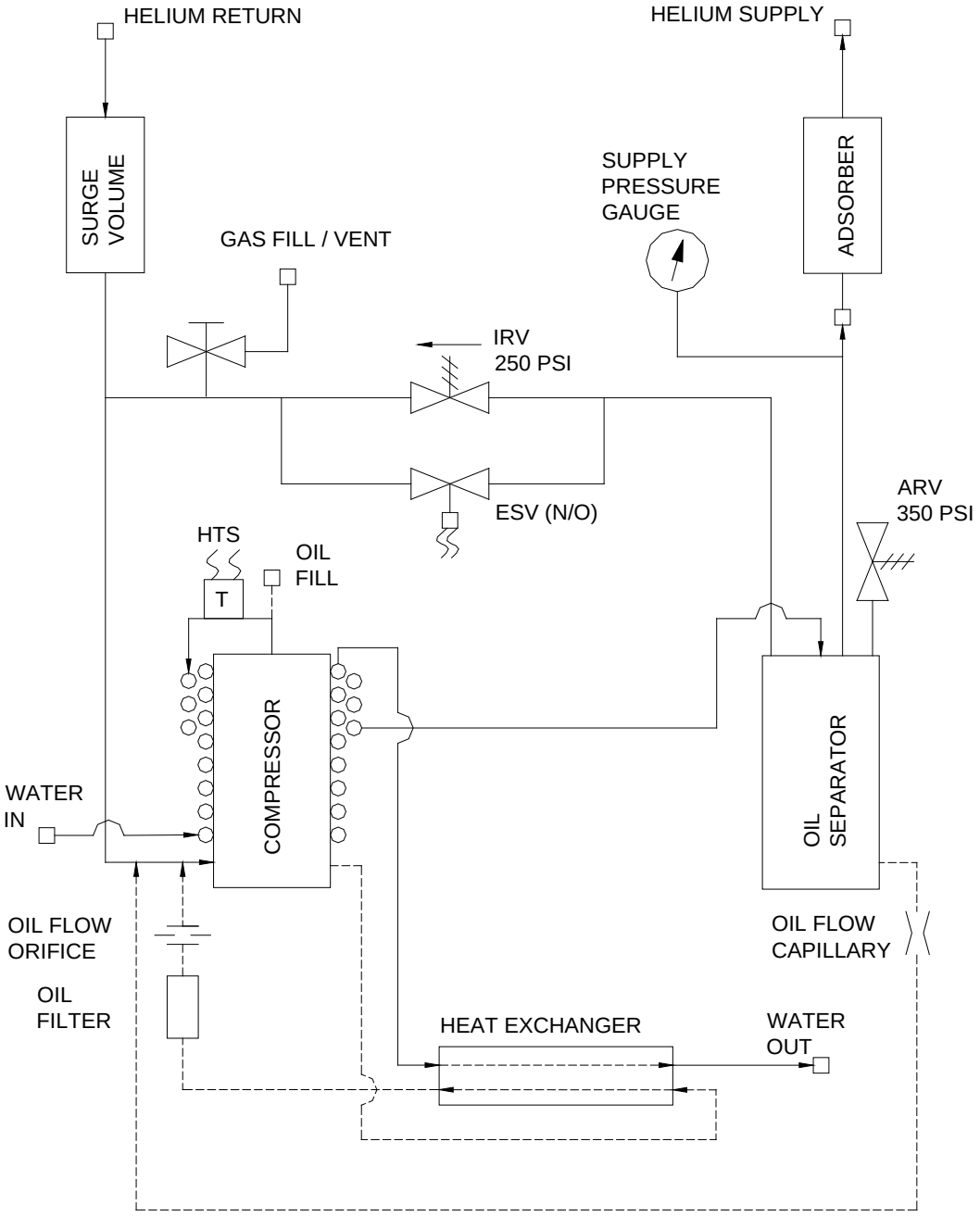
10. When finished, turn off the compressor at the on/off switch. The expander will also stop.

11. To conserve water, always shut off the cooling water when the compressor is not operating.

NOTE

Before storing compressor long-term or shipping compressor, drain all water from it.

ARS-4HW Flow Diagram



The compressor normally requires no maintenance until it has been operated for 12,000 hours. By that time the adsorber should be replaced. Depending on the performance you need, this maintenance interval can be extended. However, in order to not damage the compressor or expander, you must then monitor the expander performance for the slightest degradation in low temperature performance which would indicate the need to replace the adsorber.

Contact ARS Inc. for parts, tools, service, or any questions you have concerning the use or maintenance of this equipment. When ordering parts or tools, you must supply the model number and serial number (M/N and S/N) of the compressor as marked on the nameplate affixed to the rear panel. Contact:

Advanced Research Systems, Inc.

7476 Industrial Park Way

Macungie, PA 18062 USA

tel: (610) 967-2120

fax: (610) 967-2395

email: ars@arscryo.com

service email: arsservice@arscryo.com

web: www.arscryo.com

The compressor is designed to operate safely with only original ARS Inc. parts and when the installation and servicing are performed in accordance with the instructions in this manual.

⚠WARNING

HIGH VOLTAGE IS PRESENT WITHIN SYSTEM. AVOID ELECTRICAL SHOCK. DISCONNECT COMPRESSOR FROM ALL SOURCES OF ELECTRICAL POWER BEFORE SERVICING. PERMIT ONLY QUALIFIED PERSONS TO PERFORM SERVICE.

⚠WARNING

HIGH GAS PRESSURE IS PRESENT WITHIN SYSTEM. AVOID UNCONTROLLED PRESSURE RELEASE. VENT COMPRESSOR BEFORE DISASSEMBLING ANY INTERNAL PLUMBING PARTS, EXCEPT WHEN DISCONNECTING GAS LINES OR ADSORBER WHICH HAVE SELF-SEALING GAS COUPLINGS.

⚠WARNING

COMPRESSOR MOTOR AND HEAT EXCHANGERS ARE HOT AFTER OPERATING. LET THEM COOL DOWN BEFORE WORKING ON INSIDE OF ENCLOSURE.

Adsorber Replacement

After 12,000 hours of operation, the adsorber should be replaced. Depending on the performance you need, this maintenance interval can be extended. However, in order to not damage the compressor or expander, you must then monitor the expander performance for the slightest degradation in low temperature performance which would indicate the need to replace the adsorber.

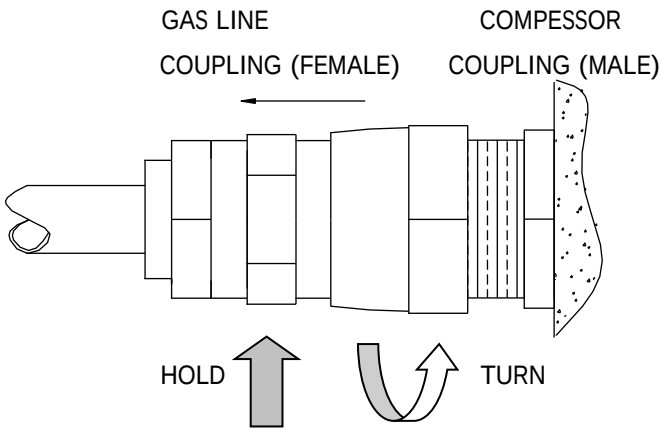
To remove the adsorber:

1. Turn off the compressor and cooling water.

2. Refer to the warnings on the first page of the Maintenance section of this manual.

3. Disconnect only the supply gas line at the compressor.

   3.1. Use two wrenches (provided with the gas lines or the expander installation tool kit) to hold and turn the gas line coupling (female) where shown:



⚠WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

⚠WARNING

NEVER APPLY HEAT TO ANY PRESSURIZED EQUIPMENT.

⚠WARNING

USE 2 WRENCHES TO DISCONNECT A GAS LINE TO AVOID LOOSENING THE COUPLING.

NOTE

Keep dust caps or plugs on unused gas couplings.

4. Remove the compressor's right side panel (the side closest to the gas supply coupling). The side panel is held on with (8) Phillips head screws (#10-32 x 3/8 truss head stainless steel). Save the screws.

5. Referring to the picture on the next page:

   5.1. Disconnect the inlet coupling. (It is a smaller gas line coupling.)

      5.1.1. Use two wrenches (3/4 in or 19 mm) to hold and turn the female inlet coupling, similarly to the figure above, until the male coupling on the adsorber is disconnected.

      5.1.2. Do not let the adsorber male coupling loosen. You may need a third wrench.

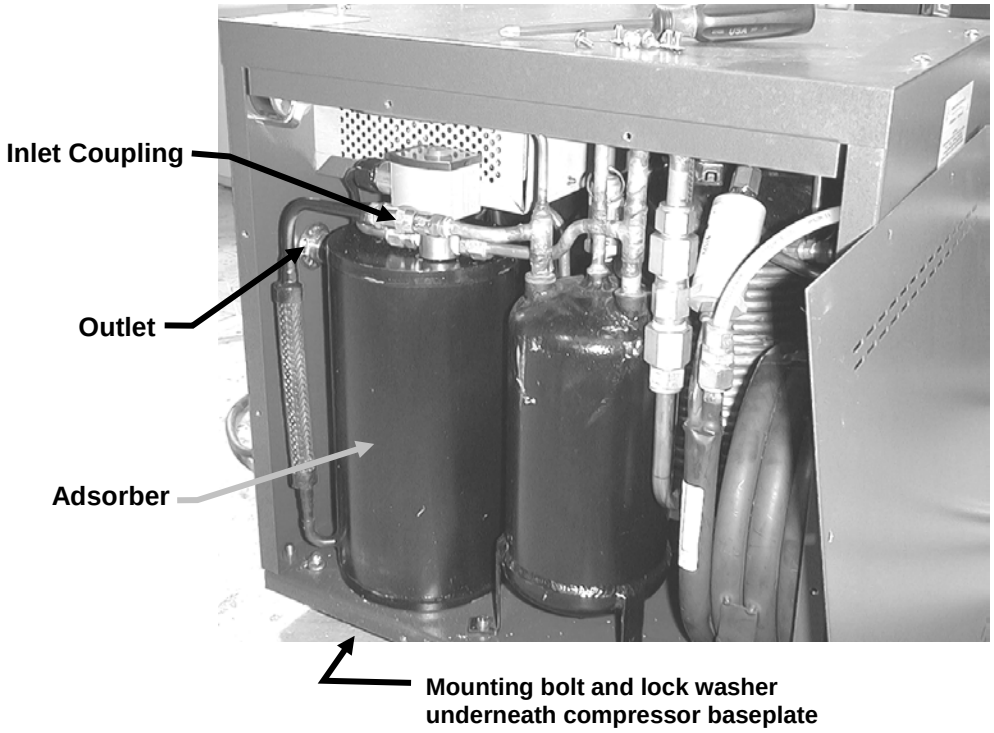
   5.2. Remove the jam nut (1 3/16 in hex) from the gas supply coupling (male) on the front of the compressor. From inside the compressor this is the adsorber outlet. There is a lock washer there.

5.3. Lift up this side of the compressor from underneath the baseplate to a height of not more than 4 in (10 cm) above the floor.

5.4. Remove the mounting bolt (9/16 in hex; 3/8-16 x 1/2 Grade 2 zinc-plated steel) and lock washer that holds the adsorber to the compressor baseplate from underneath.

CAUTION !

Do not tilt compressor more than 5° from level to maintain proper lubricating oil levels.



6. Slide the adsorber out of the compressor. Keep the panel screw's jam nut, the outlet lock washer, and the mounting bolt and lock washer.

7. Dispose of the adsorber in accordance with local codes.

⚠WARNING

DEPRESSURIZE OLD ADSORBER BEFORE DISPOSING OF IT. USE FILL/VENT FITTING, ARS P/N 001075, OR EQUIVALENT.

To install the replacement adsorber:

1. Remove the dust caps from the gas couplings (male) at each end of the replacement adsorber. The smaller coupling is the inlet.

2. Verify that a face seal ring is on each male coupling, clean and properly positioned. Refer to figure on page 6.

3. Referring to the picture above:

   3.1. Install the outlet lock washer (kept from step 6 above) on the larger male (outlet) coupling. The lock washer must be inside the front panel.

3.2. Carefully slide the adsorber into the compressor with the outlet coupling through the gas supply hole in the front panel.

3.3. Install the mounting bolt (9/16 in hex; 3/8-16 x 1/2 Grade 2 zinc-plated steel) and lock washer (kept from step 6 above) to hold the adsorber to the compressor baseplate from underneath. Torque to 22 lb-ft (30 N-m).

3.4. Lower the compressor to floor level.

3.5. Install the jam nut (1 3/16 in hex; kept from step 6 on the previous page) onto the gas supply coupling (outlet) on the front of the compressor. Tighten the jam nut until the lock washer inside begins to collapse.

3.6. Align the inlet coupling (male, on the adsorber) with the mating female coupling in the compressor.

3.6.1. Engage the first turns by hand.

3.6.2. Make the connection quickly to minimize gas leakage.

3.6.3. Firmly seal the connection using two wrenches (3/4 in or 19 mm) until the fittings "bottom."

⚠WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

⚠WARNING

NEVER APPLY HEAT TO ANY PRESSURIZED EQUIPMENT.

⚠WARNING

USE 2 WRENCHES TO DISCONNECT A GAS LINE TO AVOID LOOSENING THE COUPLING.

3.7. Install the compressor side panel with (8) Phillips head screws (from step 4 on page 11).

3.8. Reconnect the supply gas line to the compressor. Refer to step 4 on page 6.

3.9. Verify the reconnected system is again at the proper static pressure. Check the compressor gas supply pressure gauge. Refer to the Specifications section of this manual for the proper Refrigerant Gas static pressure. If the pressure is below the minimum, then add gas per the Maintenance, Adding Helium Gas, section of this manual.

3.10. Add 12,000 to the reading on the elapsed time meter. Write this total on a label and affix the label to the front of the compressor as a reminder.

Adding Helium Gas

If you need to add helium more than once every several months, check for leaks. Use a commercial leak detection or soap solution or helium mass spectrometer "sniffer" leak detector to check all gas plumbing joints with the compressor pressurized to 280-300 psig (1931-2069 kPa).

CAUTION !

If gas supply pressure gauge indicates 0, then perform Gas Cleanup procedure in Maintenance section of this manual.

⚠WARNING

NEVER USE HELIUM GAS FROM A CYLINDER WITHOUT A PROPERLY RATED PRESSURE REGULATOR, TUBING AND FITTINGS.

⚠WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

⚠WARNING

NEVER APPLY HEAT TO ANY PRESSURIZED EQUIPMENT.

⚠WARNING

USE 2 WRENCHES TO CONNECT/DISCONNECT A GAS LINE TO AVOID LOOSENING THE COUPLING.

CAUTION !

Do not get contaminants (air, particulates, moisture, oils, solvents, etc.) inside compressor gas plumbing.

1. Use only 99.999% ultra-high purity helium gas with a dew point less than -50 C (-58 F) at 300 psig (2069 kPa).
2. You will need to provide a clean helium pressure regulator on the helium gas cylinder, a tee on the outlet of the regulator, a valve for venting to atmosphere on one branch of the tee, and a clean dry metal filling line on the other branch of the tee. All must be rated for at least 300 psig (2068 kPa).
3. Attach the filling line from the pressure regulator on the helium cylinder to the gas fill/vent fitting (1/4 in, 6.4 mm, o.d. tube compression fitting) next to the gas fill/vent valve on the front of the compressor.
4. Set the helium pressure regulator to 10 to 25 psig (69-172 kPa).
5. Loosen the filling line connection at the gas fill/vent fitting. Allow helium gas to purge the regulator, filling line and connection for 5-10 seconds to purge them of air.
6. While still purging, tighten the connection at the gas fill/vent fitting.
7. Set the helium pressure regulator to 280-300 psig (1931-2069 kPa).
8. Refer to the Specifications section of this manual for the required static pressure or typical operating pressure (page 5).
9. Slowly open the gas fill/vent valve on the front of the compressor.

    9.1. If the compressor is on and operating under normal conditions:

        9.1.1. When the gas supply pressure gauge on the compressor indicates the typical operating pressure, close the gas fill/vent valve.

    9.2. If the compressor off:

        9.2.1. When the gas supply pressure gauge on the compressor indicates the static pressure, close the gas fill/vent valve.

10. Ensure that the gas fill/vent valve on the compressor is closed. Shut off the helium pressure regulator on the helium gas cylinder. Remove the filling line from the gas fill/vent fitting.

Gas Cleanup

Gas cleanup is required if the static pressure is < 20 psig (138 kPa), or if the compressor gas plumbing has been opened to the atmosphere during a repair.

The adsorber must be disconnected before performing any repair to the compressor gas plumbing (perform steps 4 and 5.1 only on page 11 to disconnect the adsorber). The adsorber must be reconnected before running the compressor.

If you need to add helium more than once every several months, check for leaks before performing the Gas Cleanup. Use a commercial leak detection or soap solution or helium mass spectrometer "sniffer" leak detector to check all gas plumbing joints with the compressor pressurized to 280-300 psig (1931-2069 kPa).

NOTE

If adsorber has been exposed to atmosphere for > 8 hr, then it must also be replaced.

NOTE

Do not vent compressor unless proper helium and re-filling equipment are available. Use only 99.999% ultra-high purity helium, with a dew point < -50 C (-58 F) at 300 psig (2069 kPa).

NOTE

Keep dust caps or plugs on unused gas couplings.

⚠WARNING

NEVER USE HELIUM GAS FROM A CYLINDER WITHOUT A PROPERLY RATED PRESSURE REGULATOR, TUBING AND FITTINGS.

⚠WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

⚠WARNING

NEVER APPLY HEAT TO ANY PRESSURIZED EQUIPMENT.

⚠WARNING

USE 2 WRENCHES TO CONNECT/DISCONNECT A GAS LINE TO AVOID LOOSENING THE COUPLING.

CAUTION !

Do not get contaminants (air, particulates, moisture, oils, solvents, etc.) inside compressor gas plumbing.

1. Disconnect both gas lines from the compressor. Screw dust plugs into the disconnected gas line couplings.
2. Perform steps 1 through 7 of the Adding Helium Gas procedure in the Maintenance section of this manual (page 14).
3. Slowly open the gas fill/vent valve on the front of the compressor and fill the compressor to 200 psig (1379 kPa). Close the gas fill/vent valve.
5. Turn on the cooling water flow at a reduced rate, 0.2-0.4 gal/min (0.8-1.5 L/min).
6. If the adsorber is disconnected, then it must be reconnected before running the compressor. Turn on the compressor and run it for 30 minutes to heat the oil to operating temperature. Then turn off the compressor.
7. Adjust the helium pressure regulator to 0 psig (0 kPa), and close the helium gas cylinder main valve.
8. Open the vent valve that you attached to the tee on the outlet of the helium pressure regulator. Watch the compressor's pressure gauge. When the pressure falls to < 10 psig (< 69 kPa), close the vent valve.
9. Open the helium gas cylinder main valve and adjust the helium pressure regulator to > 200 psig (> 1379 kPa). Fill the compressor to 200 psig (1379 kPa).
10. Turn on the compressor and run it for 5 minutes. Then turn off the compressor.
11. Repeat Steps 7 through 10 five (5) times.

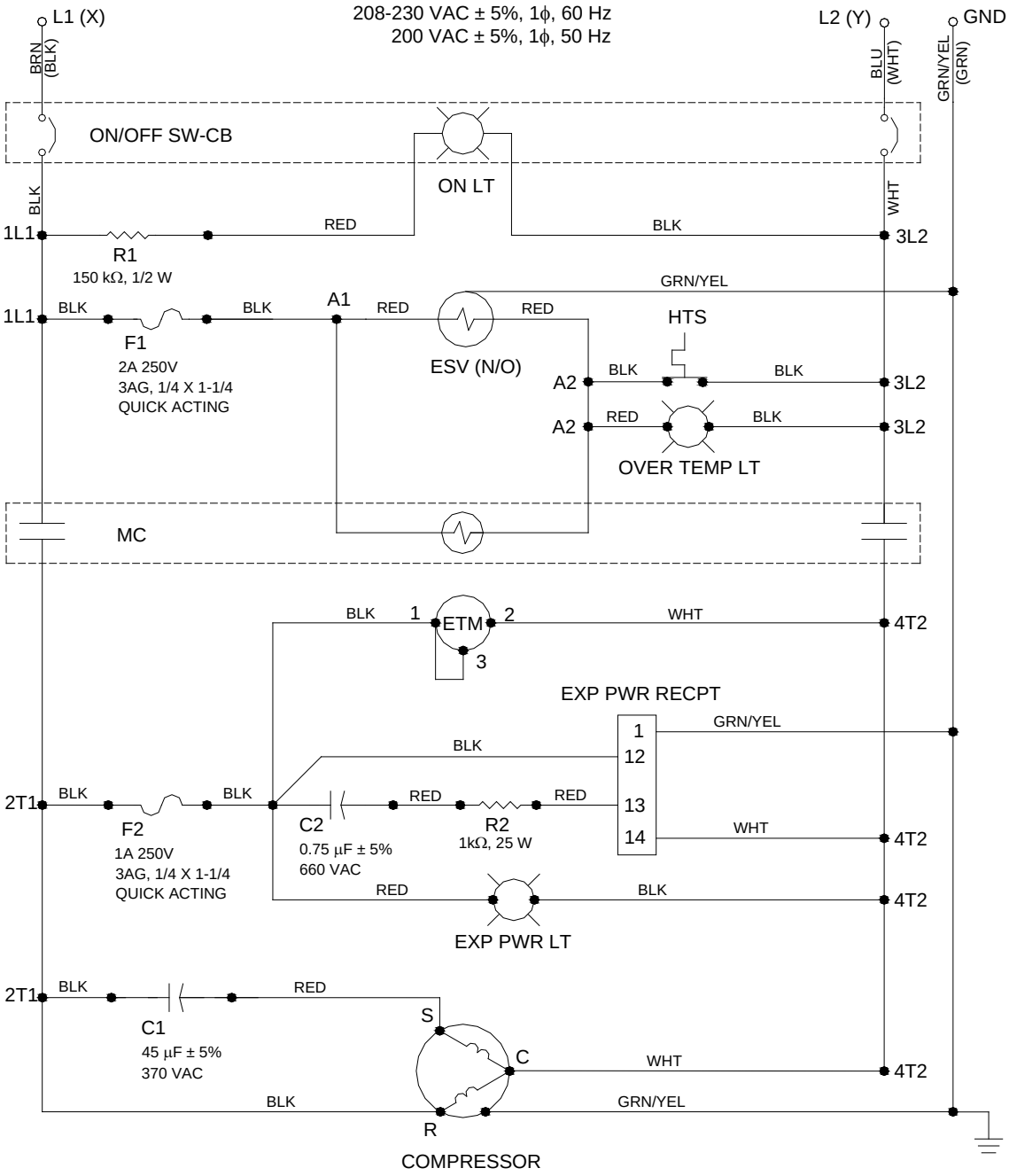
12. Allow the compressor to cool to room temperature 19-25 C (67-77 F). Adjust the static pressure by filling or venting to conform to the specification (see Refrigerant Gas static pressure, page 5).

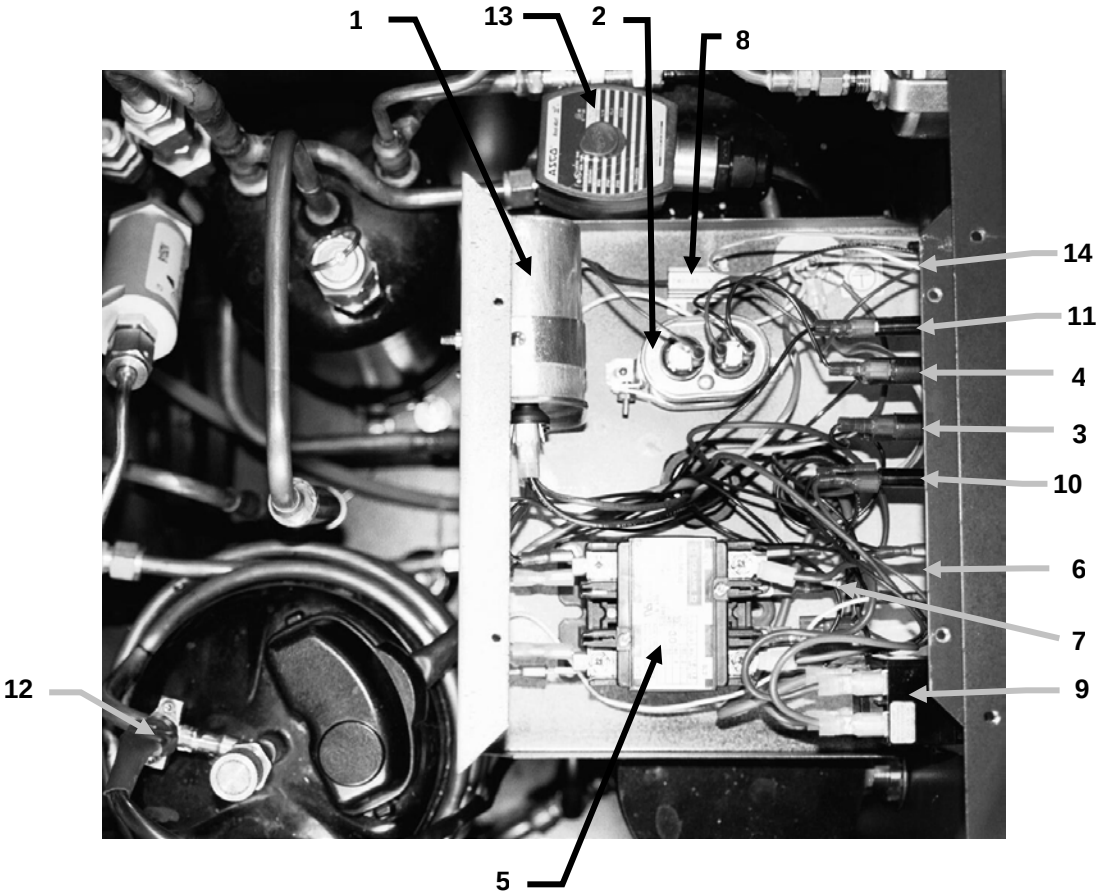
13. Ensure that the gas fill/vent valve on the compressor is closed. Shut off the helium pressure regulator on the helium gas cylinder. Remove the filling line from the gas fill/vent fitting.

14. Store the filling line with the fill/vent coupling end closed and filled with helium gas to keep it internally clean and dry.

15. If other components (gas lines or expander) need a gas cleanup, refer to the procedures in their technical manuals. Otherwise, reconnect the supply and return gas lines to the compressor.

ARS-4HW Electrical Schematic





Item	Ref.	Description
1	C1	Capacitor, Run, 45 μF ± 5% 370 VAC
2	C2	Capacitor, Expander, 0.75 μF ± 6% 370 VAC
3	F1	Fuseholder, 2 A, 250 V, Type 3AG (¼ in o.d. x 1¼ in long), Quick-Acting
4	F2	Fuseholder, 1 A, 250 V, Type 3AG (¼ in o.d. x 1¼ in long), Quick-Acting
5	MC	Motor Contactor
6	ETM	Meter, Elapsed Time
7	R1	Resistor, On Light, 150 kΩ, ½ W
8	R2	Resistor, Expander, 1 kΩ, ≥ 10 W
9	SW-CB	On-Off Switch/Circuit-Breaker, With Indicator Light
10		Over Temp Light
11		Expander Power Light
12	HTS	High Temperature Switch
13	ESV	Equalization Solenoid Valve
14		Expander Power Receptacle

⚠WARNING

HIGH VOLTAGE IS PRESENT WITHIN SYSTEM. AVOID ELECTRICAL SHOCK. DISCONNECT COMPRESSOR FROM ALL SOURCES OF ELECTRICAL POWER BEFORE SERVICING. PERMIT ONLY QUALIFIED PERSONS TO PERFORM SERVICE.

⚠WARNING

HIGH GAS PRESSURE IS PRESENT WITHIN SYSTEM. AVOID UNCONTROLLED PRESSURE RELEASE. VENT COMPRESSOR BEFORE DISASSEMBLING ANY INTERNAL PLUMBING PARTS, EXCEPT WHEN DISCONNECTING GAS LINES OR ADSORBER WHICH HAVE SELF-SEALING GAS COUPLINGS.

⚠WARNING

COMPRESSOR MOTOR AND HEAT EXCHANGERS ARE HOT AFTER OPERATING. LET THEM COOL DOWN BEFORE WORKING ON INSIDE OF ENCLOSURE.

The following troubleshooting guide lists the most common problems that can occur. Also check the expander manual.

Problem	Possible Cause(s)	Corrective Action(s)
1. Compressor does not start, but on/off switch is ON and green indicator light is not illuminated in on/off switch.	1.1 No electrical power. 1.2 Incorrect or disconnected wiring within compressor at on/off switch, or defective on/off switch (SW-CB).	1.1 Check external power source, circuit breakers/fuses and wiring, and power cord connections. 1.2 Check wiring per electrical schematic (page 17); check SW-CB for open circuit.
2. Compressor does not start, but on/off switch is ON and green indicator light is illuminated in on/off switch.	2.1 Incorrect or disconnected wiring within compressor, or defective component, after on/off switch. 2.2 See 6.1 and 6.3 2.3 Defective motor contactor (MC).	2.1 Check wiring for open circuits (see electrical schematic on page 17). 2.2 See 6.1 and 6.3 2.3 Check MC relay coil resistance for open circuit.
3. Compressor stops shortly after starting, and on/off switch is tripped.	3.1 Cooling water or ambient too cold, causing thickened oil in compressor and high current draw.	3.1 Turn on compressor again (SW-CB requires 10 s wait between attempts); Decrease cooling water flow (see Minimum Flow vs. Water Temperature chart on page 4) or, Move compressor to warmer area (see Ambient spec on page 3).

Problem	Possible Cause(s)	Corrective Action(s)
3. (cont'd) Compressor stops shortly after starting, and on/off switch is tripped.	3.2 Low power source voltage at 60 Hz (or high voltage at 50 Hz), causing high current draw. 3.3 High static or operating pressure.	3.2 Check power source voltage (see Specifications page 3). Provide separate circuit for compressor. Add a step-up (boost) or step-down (buck) transformer. 3.3 See 7.1, 7.3 and 7.4
4. On/off switch or external electrical service breaker/fuse trips immediately on start-up.	4.1 See 3.1 4.2 Short circuit to ground. 4.3 Locked compressor rotor. 4.4 Defective on/off switch.	4.1 See 3.1 4.2 Check external power source wiring and compressor internal wiring for short circuits (see electrical schematic on page 17). 4.3 Check for very high "locked rotor" current draw. 4.4 Replace ON/OFF SW-CB
5. Compressor stops after running, and red OVER TEMP light is illuminated.	5.1 High Temperature Switch (HTS) has tripped, caused by insufficient cooling. 5.2 Defective HTS (normally closed) has failed to open. 5.3 Possible oil circuit blockage.	5.1 Verify cooling water flow is adequate and that there are no water leaks (see Cooling Water Requirements on page 4). 5.2 Check HTS at room temperature for open circuit. 5.3 Contact ARS Service.
6. Compressor stops after running, but on/off switch is ON, green indicator light is illuminated in on/off switch, and red OVER TEMP light is not illuminated.	6.1 Fuse F1 has opened. 6.2 See 2.1 and 2.3 6.3 Failed compressor motor or motor internal overload switch is tripped.	6.1 Remove fuse F1 using small blade screwdriver (1/4 turn counter-clockwise, pull fuse out of spring cap). Replace with 2A 250V 3AG ¼ x 1 ¼ quick acting fuse 312002P, reversing above procedure for installation. Check for possible short circuits in that circuit (see electrical schematic on page 17). 6.2 See 2.1 and 2.3 6.3 Check motor windings resistances for open circuits.
7. Compressor gas supply pressure is abnormally high or low.	7.1 Incorrect static pressure.	7.1 Check typical operating pressure and static pressure (see Specifications page 5). To reduce pressure, slowly open gas fill/vent valve. To increase pressure, see Adding Helium Gas on page 14.

Problem	Possible Cause(s)	Corrective Action(s)
7. (cont'd) Compressor gas supply pressure is abnormally high or low.	7.2 Defective Equalization Solenoid Valve (ESV) (normally open), has failed to close, causing low supply pressure.	7.2 Either valve has stuck open or solenoid coil has failed. Turn off compressor. Electrically disconnect solenoid coil from circuit (see electrical schematic on page 17). Check coil resistance. If low (~ 400 Ω) then coil is good and valve is stuck open. Contact ARS Service.
	7.3 Gas lines are not fully engaged at compressor and/or expander.	7.3 Verify all couplings are snug.
	7.4 Gas lines are crossed.	7.4 Verify one gas line connects to supply (red) couplings at compressor and expander. Verify other gas line connects to return (green) couplings at compressor and expander.
	7.5 Slow loss of gas due to leakage.	7.5 Check for leaks (see Adding Helium Gas on page 14).
8. Compressor cycling on/off.	8.1 Intermittent electrical power source. See also 1. and 2. above.	8.1 See 1. and 2. above.
	8.2 See 5. above.	8.2 See 5. above.
9. Expander valve motor does not start, and green expander power light on compressor is <u>not</u> illuminated.	9.1 Fuse F2 has opened.	9.1 Replace F2. See 6.1.

Contact ARS Inc. for parts, tools, service, or any questions you have concerning the use or maintenance of this equipment. When ordering parts or tools, you must supply the model number and serial number (M/N and S/N) of the compressor as marked on the nameplate affixed to the rear panel. Contact:

Advanced Research Systems, Inc.

7476 Industrial Park Way

Macungie, PA 18062 USA

tel: (610) 967-2120

fax: (610) 967-2395

email: ars@arscryo.com

service email: arsservice@arscryo.com

web: www.arscryo.com

The compressor is designed to operate safely with only original ARS Inc. parts and when the installation and servicing are performed in accordance with the instructions in this manual.

INSTALLATION TOOL KIT (provided with new expander) –

QTY	ARS P/ N	DESCRIPTION
1		1" THIN HEAD SERVICE WRENCH
1		$1^{1}/_{8}$" THIN HEAD SERVICE WRENCH
1		$1^{3}/_{16}$" THIN HEAD SERVICE WRENCH

Typical Service Wrench 

ARS-4HW 12,000 hr MAINTENANCE KIT –

QTY	ARS P/N	DESCRIPTION
1	031035	Adsorber

ARS-4HW MISCELLANEOUS PARTS–

QTY	ARS P/N	DESCRIPTION
1		Nut and ferrule set for 3/8 in o.d. tube water in and out fittings
1		Nut and ferrule set for 1/4 in o.d. tube gas fill/vent fitting