Advanced Research Systems, Inc.

HELIUM GAS LINES

TECHNICAL MANUAL

Revision	Date	Initials
Rev 1	3/26/13	ER

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General

ARS Inc. gas lines are designed to operate safely 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.

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

Advanced Research Systems, Inc.

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WARNINGS, Cautions, NOTES

Three types of special notices are presented throughout this manual:

⚠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 the equipment or in abnormal performance.

NOTE

NOTES GIVE IMPORTANT ADDITIONAL INFORMATION, EXPLANATIONS, OR RECOMMENDATIONS.

All warnings, cautions, and notes appear in the text where they are especially applicable. Because of their importance, they are summarized on the following pages:

WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

WARNING

NEVER APPLY HEAT TO ANY PRESSURIZED EQUIPMENT.

WARNING

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

WARNING

DISCONNECT GAS LINES ONLY WHEN THE COMPRESSOR IS STOPPED AND THE EXPANDER HAS WARMED TO ROOM TEMPERATURE. COLD GAS, IF TRAPPED IN THE EXPANDER, CAN REACH DANGEROUSLY HIGH PRESSURE IF ALLOWED TO WARM.

WARNING

USE 2 WRENCHES TO DISCONNECT GAS LINES FROM THE EXPANDER OR COMPRESSOR TO AVOID LOOSENING THE EXPANDER OR COMPRESSOR COUPLING.

CAUTION !

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

CAUTION !

Do not get contaminants (particulates, moisture, oils or solvents, etc.) inside the gas line.

CAUTION !

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

NOTE

KEEP THE DUST CAPS OR PLUGS ON UNUSED GAS COUPLINGS.

NOTE

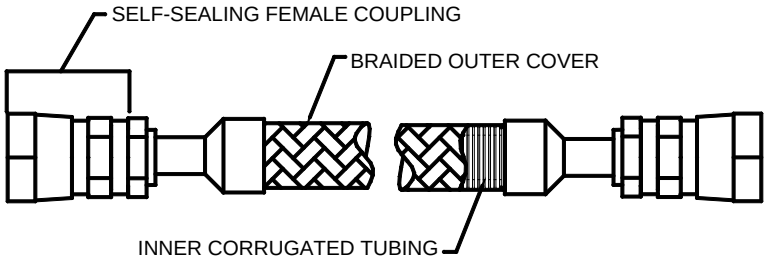
DO NOT DISASSEMBLE THE GAS LINE COUPLINGS UNLESS THE PROPER HELIUM GAS AND RE-FILLING EQUIPMENT ARE AVAILABLE. USE ONLY 99.999% ULTRA-PURE HELIUM GAS WITH A DEW POINT LESS THAN -50 C (-58 F) AT 300 psig (2069 kPa).

Introduction

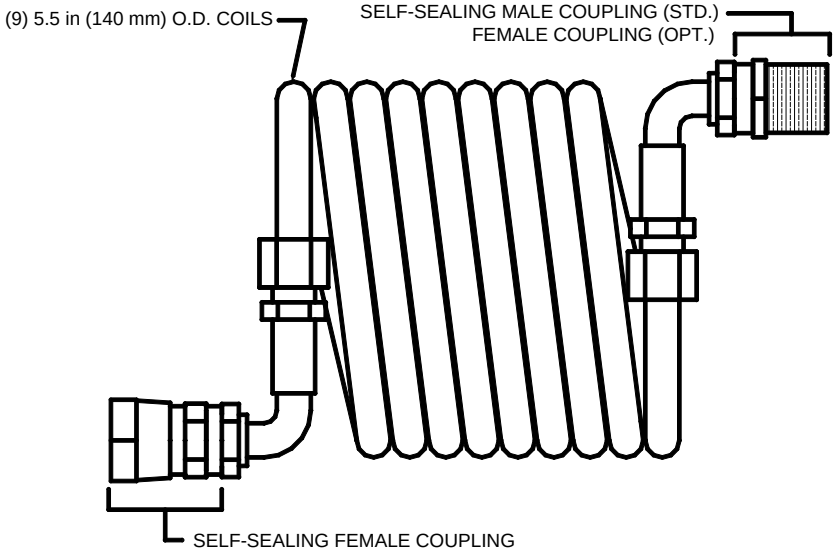
Gas lines connect the compressor to the expander. They supply the high pressure helium gas from the compressor to the expander and return the low pressure helium gas from the expander back to the compressor.

The standard gas line is constructed from flexible, corrugated stainless steel tubing covered with metal braid. See illustration below. ARS Inc. gas lines are equipped with self-sealing couplings and are furnished cleaned, pressurized with ultra-high-purity helium gas, and mass spectrometer leak-checked.

Optional nylon Nycoil hoses are available for those customers who need additional flexibility or a non-metallic gas line. See illustration below. They too are equipped with self-sealing couplings and are furnished cleaned, pressurized with helium gas, and leak-checked. However, the nylon tubing wall is permeable to gases. The loss of helium will reduce the system's equalization pressure to an unacceptable level (by 10 psig (69 kPa)) in as short a time as two months. Air will also diffuse into the gas line and contaminate the system's helium gas, primarily with water vapor. As a result, system performance and adsorber life will be less than that of a system using stainless steel gas lines, the system warranty may be different, and additional maintenance is required.



STANDARD STAINLESS STEEL FLEXIBLE GAS LINE



STANDARD NYCOIL HOSE

Specifications

Gas Line Size (Working Length X I.D.)	Material	Coupling Size	Min. Bend Radius	Max. Working Pressure	Max. Working Temperature
10 ft x $^1/_2$ in (3 m x 13 mm)	SS	#8 F	4 in (100 mm)	400 psig (2.76 MPa)	80 C
10 ft x $^3/_4$ in (3 m x 19 mm)	SS	#8 F	6 in (150 mm)	400 psig (2.76 MPa)	80 C
20 ft x $^1/_2$ in (3 m x 13 mm)	SS	#8 F	4 in (100 mm)	400 psig (2.76 MPa)	80 C
20 ft x $^3/_4$ in (3 m x 19 mm)	SS	#8 F	6 in (150 mm)	400 psig (2.76 MPa)	80 C
10 ft x $^3/_8$ in (3.6 m x 9.5 mm)	Nycoil	#8 F x #8 M	½ in axially (13 mm axially)	280 psig (1.93 MPa)	80 C

Installation

1. Unpack the equipment and inspect it for shipping damage. The expander, compressor, and gas lines are shipped pressurized with helium gas at the equalization pressure of the compressor.

2. When ready, connect the gas lines to the compressor and expander:

⚠WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

⚠WARNING

NEVER APPLY HEAT TO ANY PRESSURIZED EQUIPMENT.

CAUTION !

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

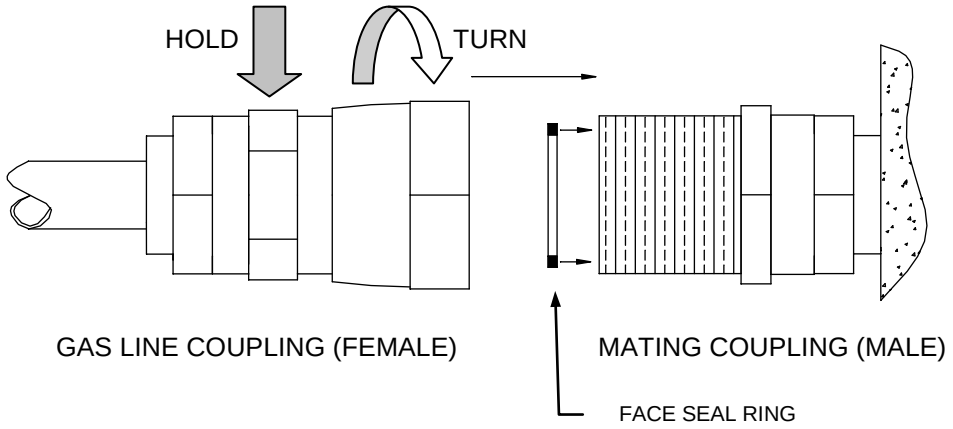
NOTE

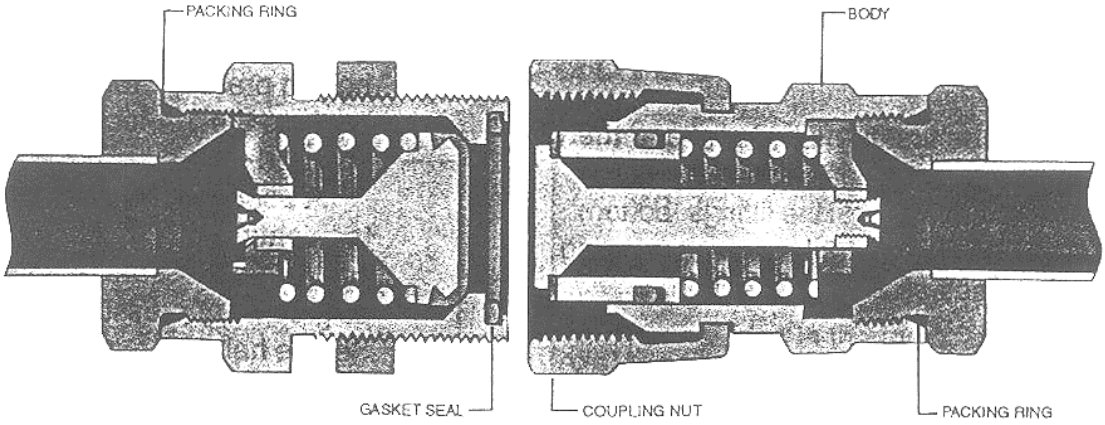
KEEP THE DUST CAPS OR PLUGS ON UNUSED GAS COUPLINGS.

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

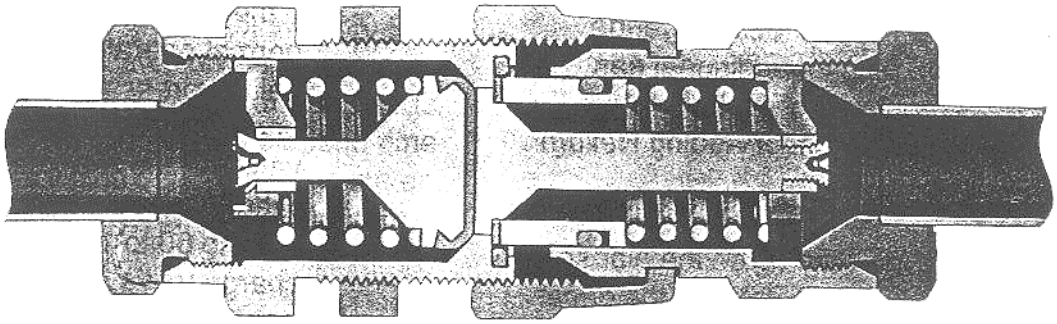
2.2. Connect the other gas line to the return gas couplings (green) at the compressor and expander.

2.3. Use two wrenches (provided with the expander) to hold and turn the gas line coupling (female) where shown. Turn until tight. See also illustrations on next page.

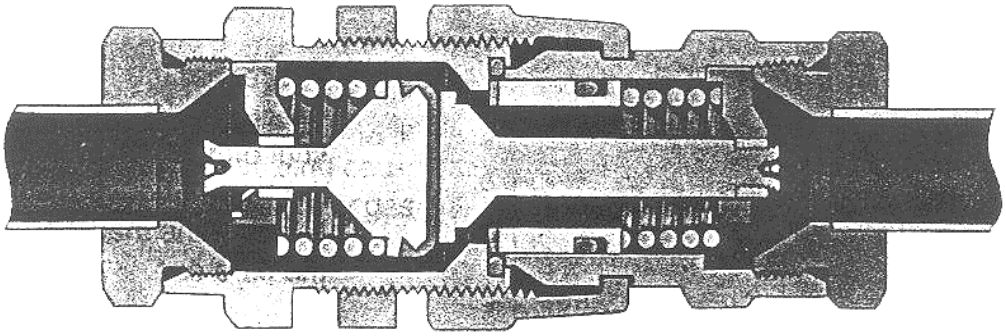




Coupling Halves Disconnected



Coupling Halves Partially Connected



Coupling Halves Fully Connected

Cross-sectional view of self-sealing couplings

Removal

1. Turn off the compressor and wait until the expander second stage has warmed to > 273 K (0 C).

2. Disconnect the gas lines from the compressor and/or expander:

WARNING

DISCONNECT GAS LINES ONLY WHEN THE COMPRESSOR IS STOPPED AND THE EXPANDER HAS WARMED TO ROOM TEMPERATURE. COLD GAS, IF TRAPPED IN THE EXPANDER, CAN REACH DANGEROUSLY HIGH PRESSURE IF ALLOWED TO WARM.

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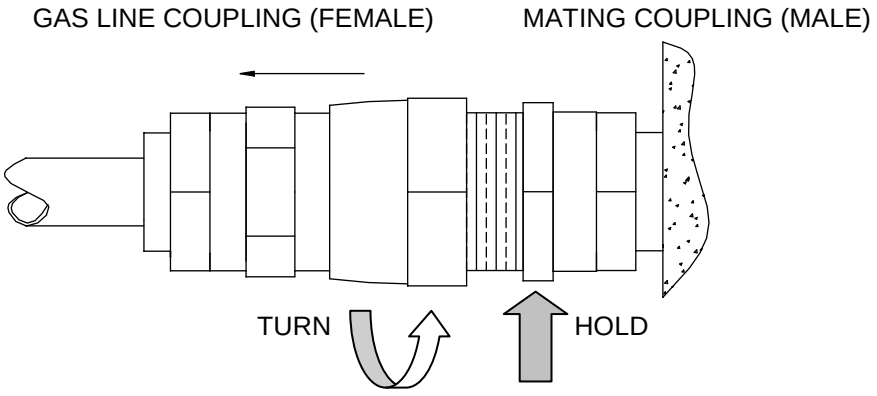
WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

NOTE

KEEP THE DUST CAPS OR PLUGS ON UNUSED GAS COUPLINGS.

2.1. Use 2 wrenches (provided with the expander) to hold and turn the gas couplings where shown. Turn until loose.



Maintenance

The stainless steel gas lines normally require no maintenance, but the Nycoil hoses do require regular maintenance. For both, the only failure modes are gas leakage and coupling thread wear. See the appropriate sections that follow.

Contact ARS Inc. for parts, tools, service, or answers to 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 and/or expander as marked on their nameplate. Contact:

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The gas line 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.

Leakage

Gas line leakage can be observed by a reduced equalization pressure at the compressor pressure gauge. First check the gas line couplings for leaks only while they are connected to the compressor and/or expander. To verify the leak is in the gas line, you must remove the gas line completely from the system to isolate it. A helium mass spectrometer and “sniffer” probe are required to find the smallest leaks. Larger leaks can be found using a commercial leak detection fluid (dilute soap solution). Leaks in the corrugated tubing cannot be repaired. Refer to the special service procedure for Nycoil hoses.

Worn Self-Sealing Couplings

When the gas line is frequently connected and disconnected from the compressor and/or expander, it is important to wipe clean the mating faces and threads before each connection. After several connects/disconnects the mating threads may become too worn and begin to gall. Then the gas line coupling, and possibly the mating compressor or expander coupling, must be replaced.

<u>To replace the face seal ring on male couplings</u>:

1. Disconnect the gas line at the appropriate end from the compressor or expander per the Removal section of this manual.
2. Carefully pry the old ring from the recess on the face of the male coupling.
3. Wipe off any debris in the recess or on the face of the coupling.
4. Press a new clean face seal ring into the recess.
5. Re-connect the gas line per the Installation section of this manual.

To replace a gas line coupling:

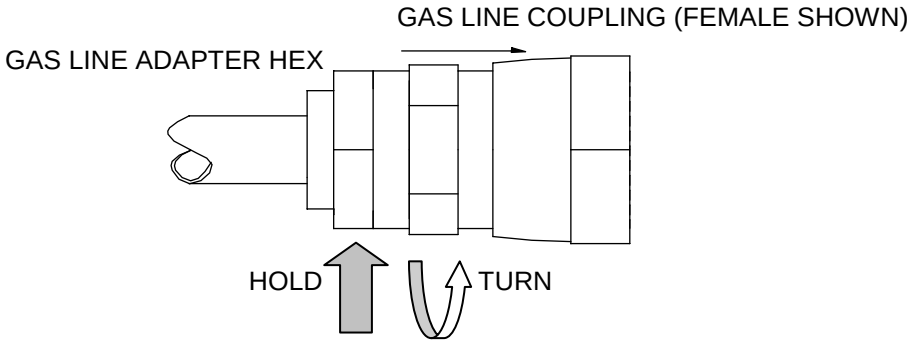
1. Purchase new self-sealing couplings, adapter o-rings, face seal rings, and at least one gas line fill/vent fitting from ARS. See Parts section.
2. Disconnect the gas line completely from the compressor and the expander per the Removal section of this manual.
3. Vent the gas from the gas line:

NOTE
DO NOT DISASSEMBLE THE GAS LINE COUPLINGS UNLESS THE PROPER HELIUM GAS AND RE-FILLING EQUIPMENT ARE AVAILABLE. USE ONLY 99.999% ULTRA-PURE HELIUM GAS WITH A DEW POINT LESS THAN -50 C (-58 F) AT 300 psig (2069 kPa).

3.1. Connect a gas line fill/vent fitting to one of the gas line couplings. Refer to Installation step 2.3 on page 5 for instructions on connecting gas couplings.

3.2. Slowly open the valve on the fill/vent fitting and vent the gas to atmospheric pressure.

4. Use 2 wrenches (provided with the expander) to hold the gas line adapter hex and turn the gas coupling where shown. Turn until loose. Discard the worn coupling.



CAUTION !
Do not get contaminants (particulates, moisture, oils or solvents, etc.) inside the gas line.

5. Promptly install the new coupling. Verify the o-ring seal on gas line adapter is clean and undamaged. Replace it if in doubt. Tighten the new coupling to the gas line adapter.
6. Perform the Gas Cleanup Procedure.

Gas Cleanup Procedure

Gas cleanup is required if the gas line's interior has been contaminated or opened to the atmosphere. It is performed with the gas line disconnected from the other system components.

1. Disconnect the gas line completely from the compressor and expander per the Removal section of this manual.
2. Locate two gas line fill/vent fittings, P/N 021025. Close the valves. Install the fittings to the couplings on opposite ends of the gas line. Refer to Installation step 2.3 on page 5. Alternately, if using only one fill/vent fitting, you will have to perform the following steps in a different sequence (i.e. steps 4., 3., 5., then detach the helium gas supply in order to repeat).

CAUTION !

Before connecting the gas fittings to the gas line, check that the face seal ring on the male coupling is in good condition, and that the faces of both mating couplings are clean.

3. Attach a regulated helium gas supply cylinder (99.999% ultra-pure helium gas with dew point less than -50 C (-58 F) at 300 psig (2069 kPa)) to one of the fill/vent fittings.

⚠WARNING

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

⚠WARNING

ALWAYS WEAR EYE PROTECTION WHEN HANDLING ANY PRESSURIZED EQUIPMENT.

4. Slowly open the valve on the other fill/vent fitting and vent the gas to atmospheric pressure. Then close the valve.
5. Fill the gas line with helium gas (99.999% ultra-pure helium gas with dew point less than -50 C (-58 F) at 300 psig (2069 kPa)) and to the equalization pressure defined on the compressor and/or in the compressor manual. Then close the valve.
6. Repeat steps 4. and 5. four (4) more times. Alternately, if using only one fill/vent fitting, you will have to attach and detach the helium supply each time. Finish this step with the gas line filled to the proper equalization pressure. Close the valve.
7. Disconnect the helium gas supply and remove the fill/vent fittings from the gas line. Refer to Removal step 2.1 on page 7.

NOTE

KEEP THE DUST CAPS OR PLUGS ON UNUSED GAS COUPLINGS.

Nycoil Hoses Service Procedure

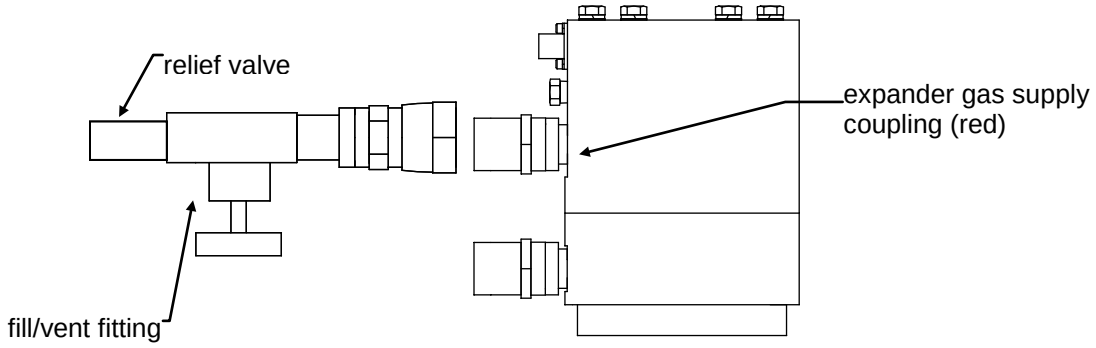
The nylon Nycoil hoses will permeate helium gas from inside the system, which will reduce the system's operating pressure and thus performance in as little time as two months, even if not operating. These hoses will also allow outside air to diffuse into the system's helium gas, which over time will contaminate it with water vapor. As a result, Nycoil hoses must be replenished with pure helium on a regular basis.

For Nycoil hoses NOT assembled into a system:

1. The Nycoil hoses should be kept in their as-received packaging until ready to be used.
2. After 30 days of storage, the gas in the Nycoil hoses must be purged immediately prior to connecting them to the expander and compressor. Use only 99.999% ultra-pure helium gas with a dew point less than -50 C (-58 F) at 300 psig (2069 kPa).
   2.1. Vent the hoses to < 5 psig (< 35 kPa).
   2.2. Fill the hoses to 200-210 psig (1380-1450 kPa).
   2.3. Repeat 2.1 and 2.2 five (5) times more, finishing with the hoses pressurized to 200-210 psig (1380-1450 kPa).
3. Promptly connect the hoses to the expander and compressor.

For Nycoil hoses assembled into a system:

1. The entire system (expander, compressor, and hoses) should be purged every 90 days (even if the system has not been operated), or sooner if either the performance has become unacceptable or if the system equalization pressure has decreased 10 psig (- 69 kPa) from the value specified in the compressor manual. Follow the procedures in the expander and compressor manuals and in section 1. above.
   1.1. It is helpful to trap contaminants in the expander. To do this, first have the expander operating at its coldest temperature. Then turn off the system power and promptly disconnect the hoses at the expander. Attach a fill/vent fitting (ARS p/n 001075) with a relief valve on the fitting's outlet onto the expander gas supply coupling (red). The relief valve must have a cracking pressure of less than 400 psig maximum.



Parts

Contact ARS Inc. for parts, tools, service, or answers to 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 and/or expander as marked on the nameplate. Contact:

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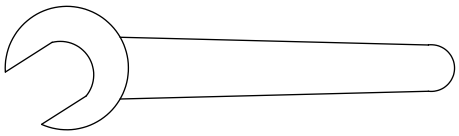
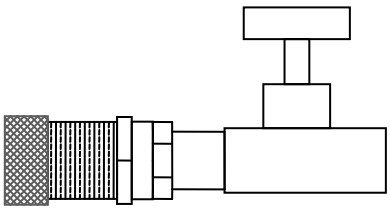
INSTALLATION TOOL KIT (provided with new expanders) –

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



GAS LINE FILL/VENT FITTING, ARS P/N 021025 –



SELF-SEALING COUPLINGS, SIZE #8 –

QTY		ARS P/N	DESCRIPTION
1		000247	FEMALE COUPLING
1		000269-8	O-RING FOR COUPLING ADAPTER
1		021026	FACE SEAL RING FOR MALE COUPLING
1		000301	MALE COUPLING
1		000248	DUST PLUG FOR FEMALE COUPLING
1		000303	DUST CAP FOR MALE COUPLING