Sumitomo
(SHI) CRYOGENICS OF AMERICA, INC.

Gas Lines

Technical Manual

Sumitomo (SHI) Cryogenics of America, Inc.
1833 Vultee Street
Allentown, PA 18103-4783
U.S.A.

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SJM P/N261320A

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DESCRIPTION

Gas lines are needed to connect compressors to cold heads (expanders) to complete the system. Gas lines are constructed from helically corrugated stainless steel tubing covered with metal braid or from soft copper tubing. All gas lines are equipped with Aeroquip self-sealing couplings and are furnished cleaned, charged with helium gas and leak checked.

Each cryogenic system includes interconnecting gas lines to carry helium gas refrigerant to and from the components. A gas line carries high-pressure gas from the compressor to the cold head and another gas line returns lower pressure gas to the compressor.

Flexible gas lines simplify installation. The self-sealing couplings maintain the gas charge and purity by minimizing gas loss when connections are being made or broken and by preventing the entrance of contaminants. Dust plugs protect the coupling threads from damage and also help to maintain cleanliness.

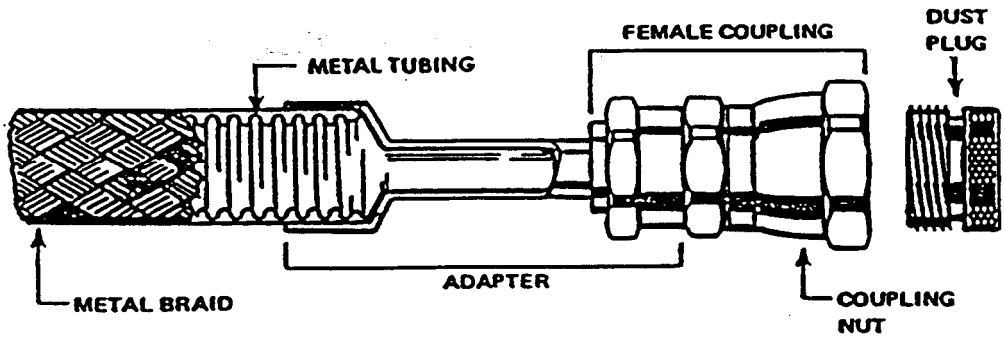

Figure 1 Typical Helically Corrugated Gas Line Construction

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SPECIFICATIONS

Minimum Bend Radius

Gas Line Type	Diameter mm (inches)	Minimum bend radius mm (inches)
Helically corrugated stainless steel	19 (3/4) I.D.	230 (9)
Helically corrugated stainless steel	13 (1/2) I.D.	180 (7)
Copper tubing using a tube bender	17 (5/8) O.D.	57 (2 ¼)
Copper tubing without using a tube bender	17 (5/8) O.D.	460 (18)

Pressure and Temperature Ratings

Pressure and Temperature Ratings	Stainless Steel and Copper
Design pressure, max.	2760 kPa (400 psig)
Operating pressure, max.	2410 kPa (350 psig)
Charge pressure, max.	1860 kPa (270 psig)
Operating temperature, max.	49º C (120º F)
Operating temperature, min.	4º C (40º F)

Identification Labels

Labels on the gas lines identify their function in the system as follows:

SUPPLY (color coded red)	Helium gas supply to the cold head from the compressor.
RETURN (color coded green)	Helium gas return from the cold head to the compressor.

Separate labels are furnished by SCAI with standard gas lines for the customer to attach to the gas lines. See the Installation section in the System manual.

Installation Tools

Properly sized open-end wrenches are needed to install and remove gas lines. SCAI can furnish (optional) one each:

Wrench, 1" open end x 3/4" open end	P/N SK30017C3
Wrench, 1 1/8" open end x 5/8" open end	P/N SK30017C2
Wrench, 1 3/16" open end x 1 3/16" ratchet	P/N SK30017C1

For MRI systems with an RF shield, gas feedthroughs may be furnished for gas line installation through the shield. Special wrenches may be required to fit the feedthroughs.

MAINTENANCE

Disconnect Gas Lines

WARNING

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

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 injury.

WARNING

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

CAUTION

AVOID GAS LEAKS. 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. Crimping from repeated bending and repositioning can cause damage to gas lines.

CAUTION

PREVENT EQUIPMENT DAMAGE. Do not use a clamp over hose section of flex gas line.

Disconnect from the Compressor

Tools required: Open-end wrenches

1. Always use two wrenches. Use one wrench to hold the compressor coupling. Use the second wrench on the gas line coupling nut to break the connection. See Figure 2.
2. After breaking the connection, hold the coupling adapter with one wrench. Remove the gas line coupling from the compressor coupling with the second wrench. See Figure 3.
3. Screw a dust cap finger tight on to the compressor coupling.

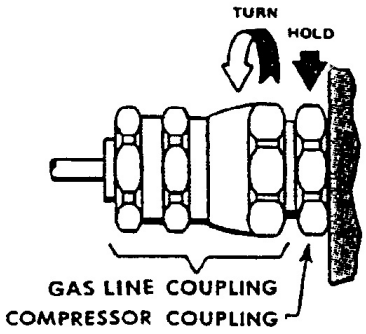

Figure 2 Break Gas Line Connection from Compressor

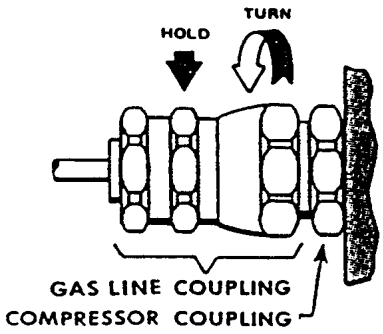

Figure 3 Disconnect Gas Line from Compressor

Disconnect from the Cold Head

Tools required: Open-end wrenches

1. Always use two wrenches. Use one wrench to hold the cold head coupling. Use the second wrench on the gas line coupling nut to break the connection. See Figure 4.
2. After breaking the connection, hold the coupling adapter with one wrench. Remove the gas line coupling from the cold head coupling with the second wrench. See Figure 5.
3. Screw a dust cap finger tight on to the cold head coupling.

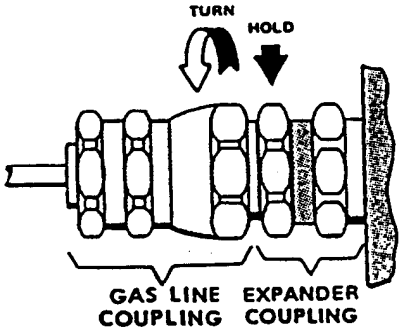

Figure 4 Break Gas Line Connection from Cold Head

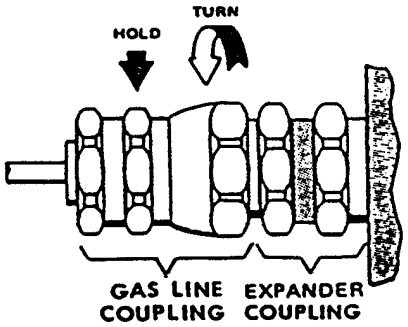

Figure 5 Disconnect Gas Line from Cold Head

Leak Check

Leakage of helium gas is the only likely problem to originate on a gas line. Use of a helium mass spectrometer leak detector is recommended. If no mass spectrometer is available, a liquid leak detector solution may be used on the coupling joints.

With the gas lines connected to the compressor and to the cold head, leak check the connected coupling joints.

The flat gasket in the face of the male coupling seals the joint. A leak at this gasket 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

Gas Line Repair

Leaks in the helically corrugated 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 an SCAI Service Center.

Leaks at the self-sealing couplings can be repaired by replacing worn or damaged parts. Vent the gas line before beginning to disassemble it except when replacing a gasket seal.

When couplings are frequently disconnected and reconnected, it is important to wipe the mating parts (threads and faces) with a clean, lint-free tissue or cloth.

Venting

Tools required: Adapter fitting with valve, 8M Aeroquip, P/N SK8217A2.
Open-end wrenches

NOTE

Adapter fittings are available as optional accessories from SCAI.

1. Disconnect the gas line from the system. Install a dust cap on each of the male couplings of the compressor and cold head, or on the RF feedthroughs, if used in the system.

2. Be sure the valve on adapter fitting SK8217A2 is closed. If only one coupling on the gas line is to be repaired, install the adapter fitting on the good coupling. Use two wrenches.

3. Slowly open the valve on the adapter fitting to vent the entire charge of helium gas.

4. Close the adapter fitting's valve. Do not remove the adapter fitting. It will be used for gas cleanup and recharging.

NOTE

Gas cleanup and recharging of the gas line are always required if a coupling has been repaired. Instead of venting the gas line to atmospheric pressure, some operators prefer to connect an adapter fitting and a charge line to the coupling not being repaired, to purge the gas line with helium during repair. Set the helium gas regulator at 35 kPa (5 psig) or less to prevent air from entering the gas line and contaminating it.

Repair Self-sealing Couplings

WARNING

AVOID 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 personal injury.

CAUTION

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

Damaged threads, leaking seals or a leaking valve assembly may require replacement of coupling parts or replacement of the complete coupling half.

Replace the Gasket Seal

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

From repeated connecting and disconnecting the coupling, the gasket face seal just inside the face of a male coupling may begin to leak and require replacement. The gasket seal is replaced while the gas line is disconnected.

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. See Figure 6.
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.
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.

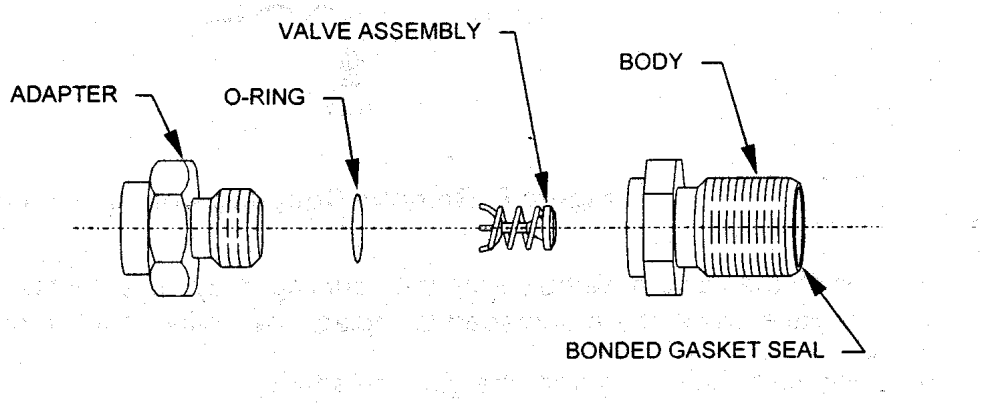

Figure 6 Aeroquip Male Coupling Parts

Repair or Replace a Coupling

Tools required: Open-end wrenches

This procedure applies to both male and female couplings on gas lines, compressor and cold head.

1. Vent the charged component using the venting procedure in this manual or in the Maintenance section of the appropriate manual.
2. If the coupling to be repaired has the venting adapter fitting attached, remove the adapter fitting. Use two wrenches.
3. Use two wrenches to disconnect the coupling body from the adapter. Hold the adapter with one wrench. Remove the coupling body with the other wrench. See Figure 7.
4. Push the valve assembly from the coupling body. It is not fastened. Examine all parts and replace any that are damaged or replace the entire coupling half. See Figures 6 or 8.

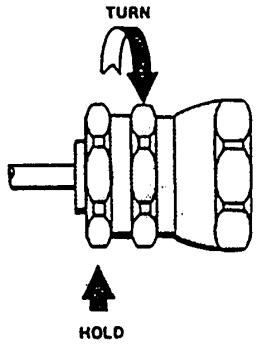

Figure 7 Remove Coupling from Gas Line

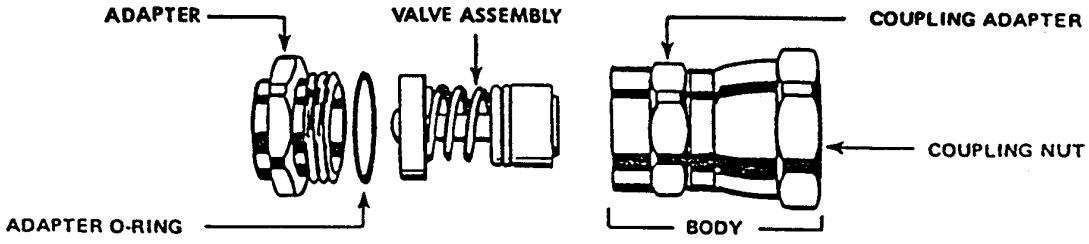

Figure 8 Aeroquip Female Coupling Parts

5. Remove the O-ring from the gas line adapter.
6. Wipe the O-ring groove to be sure it is clean. Lightly coat a new O-ring with vacuum grease. Install the O-ring in the gas line adapter.
7. Wipe the valve assembly with a clean, lint-free cloth. Insert the valve assembly into the coupling body from the rear.

8. Thoroughly degrease or apply Locquic Primer T (a degreasing agent) to the threads of the adapter and to the internal threads of the coupling body. Do not get Primer T on the O-ring or any of its seating surfaces.

9. Allow about 5 minutes for the primer to dry. Apply Loctite 242 to one full thread in the coupling adapter. Use a needle applicator. Start at the second thread from the lead thread and work toward the hexagon. Shake the Loctite before use.

10. Assemble the coupling body to the adapter. Use two wrenches. Hold the adapter with one wrench and screw the two parts together. Tighten the size 8 Aeroquip coupling parts to 4.85 – 6.25 kg_f m (35 – 45 ft. lbs.).

11. Allow at least a 6-hour curing period before applying gas pressure.

This completes the procedure for repairing or replacing a self-sealing coupling.

Charge Pressure Verification

Tools required: Tool Kit, P/N 268151A
Open-end wrenches

This procedure describes the process for checking and, if necessary, correcting the helium gas charge pressure in refrigeration system gas lines.

CAUTION

PRESERVE YOUR WARRANTY. Any helium gas used in this procedure should be of high purity. A purity level 0f 99.999% is required.

CAUTION

PREVENT EQUIPMENT DAMAGE. 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. Crimping from repeated bending and repositioning can cause damage to gas lines.

WARNING

AVOID INJURY. Use two wrenches when connecting or disconnecting a gas line coupling to avoid loosening the wrong joint. Gas pressure can project the coupling with enough force to cause injury.

1. Verify the pressure gauge tool [P/N 268150C2] has a minimum charge pressure of 20 psig.

2. If the charge pressure in the tool is too low, use the charge adapter tool [P/N 255919B2] to charge the pressure gauge tool to 50 psig. If the pressure gauge tool is completely empty, purge the pressure gauge tool with helium gas by “flushing through” with the exhaust valve open. After purging, close the exhaust valve and establish the proper charge pressure in the pressure gauge tool. Close the exhaust valve. Remove the charge adapter from the pressure gauge tool.

3. Unthread the dust cap from one end of the gas line to be checked. Be sure the valve on the pressure gauge tool is closed before it is connected. Connect the male Aeroquip end of the pressure gauge tool to the gas line using two wrenches.

4. Read the pressure.

4.1. If the pressure is low, but $\geq$ 20 psig, use the charge adapter to add helium gas to the gas line to reach the specified equalization pressure.

4.2. If pressure in the gas line is <20 psig, perform a clean–up on the gas line.

5. When finished checking or pressurizing the gas line, make sure the gauge tool is charged to 50 psig helium gas for storage.

6. Disconnect the male Aeroquip end of the pressure gauge tool from the gas line using two wrenches.

7. Screw the dust cap finger tight on to the gas line coupling.

This completes the procedure for checking the charge pressure in a gas line.

Gas Cleanup and Recharging

Tools required: Adapter fittings (2) P/N SK8217A2 or 255919B2 and 257246C5.
Open-end wrenches

Cleaning and recharging are always required when a gas line has been vented and repaired or if the gas pressure has dropped to less than 140 kPa (20 psig). Each gas line is cleaned and charged individually using adapter fittings.

1. Locate and connect adapter fitting P/N SK8217A2 to one gas line coupling. Connect adapter fittings P/N 255919B2 and257246C5 to the other coupling. Be sure the valve on each adapter fitting is closed before it is connected.

NOTE

Adapter fittings are available as optional accessories from SCAI.

2. Connect a charge line to the pressure regulator of a helium gas cylinder containing 99.995% pure helium gas with a dew point less than -50º C (-58º F) at 2065 kPa (300 psig).

WARNING

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

3. Open the gas cylinder valve. While connecting the charge line to the valve on one of the adapter fittings, thoroughly purge the charge line from the regulator. It is important to remove all air contaminants to prevent them from entering the gas line.

4. Adjust the gas cylinder regulator to 690 kPa (100 psig). Open the valve on the adapter fitting and charge the gas line to 690 kPa (100 psig).

5. Close the valve on the helium gas cylinder (not on the regulator).

6. Open the vent valve. Watch the regulator's pressure gauge. When the pressure falls to 35 – 70 kPa (5 – 10 psig), close the vent valve. Open the gas cylinder valve to increase the pressure to 690 kPa (100 psig). Close the gas cylinder valve.

7. Repeat step 6 five (5) times.

8. Close the valve on the adapter fitting used for charging. Open the gas cylinder valve. Adjust the pressure regulator to the equalization pressure of the system. Refer to the Specifications section in the System manual.

9. Open the valve on the adapter fitting and charge the gas line to the equalization pressure.

10. Close the valve on the adapter fitting. Close the gas cylinder valve. Disconnect the charge line from the adapter fitting. Store the charge line to keep it clean.

11. Remove the adapter fittings.

This completes the procedure for gas cleanup of a gas line.

PARTS

Ordering

Order parts by part number and name. See Figure 9.

Parts Identification and Number

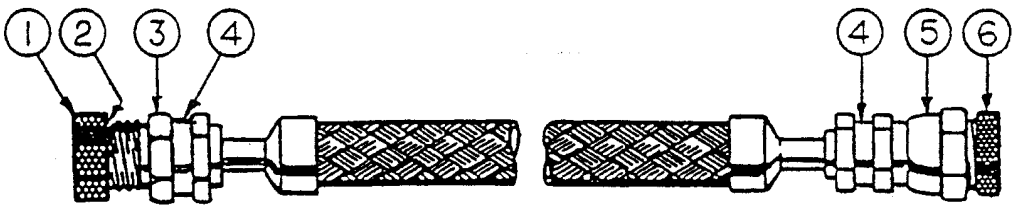

Figure 9 Parts Identification

Item	Part Name	Part Number	
		Size 4	Size 8
1.	Dust Cap	44639	44642
2.	Gasket Seal	77003	77002
3.	Coupling Half, Male	44601	44612
4.	O-ring	77005	47102
5.	Coupling Half, Female	44901	44614
6.	Dust Plug	44640	44643

NOTE

Gas lines used to carry refrigerant gas between the compressor and the cold head typically are furnished with size 8 Aeroquip couplings.