

HELIUM COMPRESSOR

MODEL HC-4 MK2

TECHNICAL MANUAL

APD CRYOGENICS INC
1833 Vultee Street
Allentown, PA 18103

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GENERAL

THE HC-4 MK2 HELIUM COMPRESSOR IS DESIGNED TO OPERATE SAFELY WHEN THE INSTALLATION, OPERATION AND SERVICING ARE PERFORMED IN ACCORDANCE WITH THE INSTRUCTIONS IN THIS TECHNICAL MANUAL. CONSULT THE NEAREST APD CRYOGENICS SERVICE DEPOT WITH ANY QUESTIONS YOU MAY HAVE CONCERNING THE USE OR MAINTENANCE OF THIS COMPRESSOR. FOR SERVICE DEPOT LOCATIONS, SEE THE SERVICE SECTION OF THIS TECHNICAL MANUAL.

SPECIAL NOTICES

THREE TYPES OF SPECIAL NOTICES - WARNINGS, CAUTIONS AND NOTES - ARE USED IN THIS TECHNICAL MANUAL. THEY APPEAR AS FOLLOWS AND SERVE THE PURPOSES STATED.

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 related to the procedure or discussion presented.

WARNINGS and CAUTIONS, like other safety instructions, appear in the text where they are especially applicable. Because of their importance, they are summarized in this Safety section, the first section to be read.

WARNINGS

ALL ELECTRICAL SUPPLY EQUIPMENT MUST MEET APPLICABLE CODES AND BE INSTALLED BY QUALIFIED PERSONNEL.

DISCONNECT THE POWER SUPPLY 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 INJURY OR DEATH FROM ELECTRIC SHOCK.

THE COMPRESSOR IS CHARGED WITH HELIUM GAS. VENT THE COMPRESSOR TO ATMOSPHERIC PRESSURE BEFORE DISASSEMBLY, EXCEPT WHEN DISCONNECTING ADSORBER OR GAS LINES. UNCONTROLLED PRESSURE RELEASE CAN CAUSE INJURY TO PERSONNEL IN THE WORK AREA.

DISCONNECT GAS LINES ONLY WHEN THE COMPRESSOR IS STOPPED AND THE EXPANDER AND COMPRESSOR ARE AT ROOM TEMPERATURE. DISCONNECTING THE EXPANDER WHILE IT IS COLD MAY CREATE EXCESSIVELY HIGH INTERNAL PRESSURE AS THE GAS WARMS. MATERIAL FAILURE AND UNCONTROLLED PRESSURE RELEASE CAN CAUSE INJURY TO PERSONNEL IN THE WORK AREA.

NEVER USE COMPRESSED HELIUM GAS FROM A CYLINDER WITHOUT A PROPER REGULATOR. OVERPRESSURIZATION CAN CAUSE PERSONAL INJURY IF THE SYSTEM EQUIPMENT RUPTURES.

DURING OPERATION, SOME SURFACES UNDER THE COMPRESSOR'S COVER BECOME HOT. AVOID INJURY FROM BURNS BY ALLOWING THE COMPRESSOR TO COOL FOR 1/2 HOUR AFTER SHUTDOWN BEFORE REMOVING THE COVER FOR MAINTENANCE.

WHEN HANDLING PRESSURIZED GAS LINES AND OTHER PRESSURIZED EQUIPMENT, ALWAYS WEAR EYE PROTECTION.

NEVER APPLY HEAT TO A PRESSURIZED GAS LINE.

THE ADSORBER IS CHARGED WITH HELIUM GAS. FOLLOW THE ADSORBER VENTING PROCEDURE FOR SAFE DISPOSAL OF THE USED ADSORBER.

THE ELAPSED TIME METER CONTAINS A LITHIUM BATTERY. DO NOT REMOVE THE BATTERY. DO NOT RECHARGE, DISASSEMBLE, MUTILATE, WET OR DISPOSE OF THE METER IN FIRE.

CAUTIONS

MODIFICATION TO EQUIPMENT WITHOUT THE CONSENT OF THE MANUFACTURER WILL VOID THE WARRANTY.

CHECK THE CONDITION OF THE GASKET SEAL ON THE MALE HALF OF EACH AEROQUIP COUPLING. BE SURE THE GASKET SEAL IS IN PLACE AND THE SEALING SURFACES ON BOTH THE MALE AND FEMALE HALVES ARE CLEAN BEFORE CONNECTING. REPLACE THE GASKET SEAL IF IT IS DAMAGED.

FOLLOW CHARGING AND VENTING DISCONNECTING AND CONNECTING PROCEDURE TO PREVENT REVERSED FLOW OF SYSTEM GAS. REVERSED FLOW CAN RESULT IN CONTAMINATION OF THE SYSTEM WITH THE COMPRESSOR OIL.

**DO NOT CHARGE THROUGH THE SUPPLY COUPLING.
DO NOT VENT THROUGH THE RETURN COUPLING.**

ALWAYS THOROUGHLY DRAIN THE COOLANT FROM THE COOLING CIRCUIT IF THE COMPRESSOR IS TO BE SHIPPED OR STORED.

REPEATEDLY CHARGING THE SYSTEM WITH HELIUM GAS RATHER THAN LOCATING AND REPAIRING GAS LEAKS MAY CAUSE A MALFUNCTION. IMPURITIES ARE INTRODUCED AT AN ABNORMAL RATE AND MAY FREEZE IN THE EXPANDER.

DO NOT ALLOW AIR TO GET INTO THE SYSTEM. MOISTURE FROM THE ATMOSPHERE CAN SERIOUSLY DEGRADE EXPANDER PERFORMANCE.

A LEAKING COUPLING ON AN ADSORBER SHOULD NOT BE REPAIRED IN THE FIELD. CONSULT THE APD SERVICE DEPARTMENT. VENTING THE ADSORBER WILL INTRODUCE CONTAMINANTS TO THE SYSTEM WHICH CANNOT BE REMOVED IN THE FIELD.

KEEP THE GAS LINE COUPLING ALIGNED WHEN MAKING OR BREAKING A COUPLING CONNECTION. LEAKAGE MAY OCCUR DUE TO THE WEIGHT OF THE GAS LINE OR DUE TO A SHARP BEND NEAR THE CONNECTION.

DO NOT TIP THE COMPRESSOR GREATER THAN 5 DEGREES, TO AVOID FLOWING OIL INTO UNWANTED PLACES.

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Helium Compressor Model HC-4 MK2

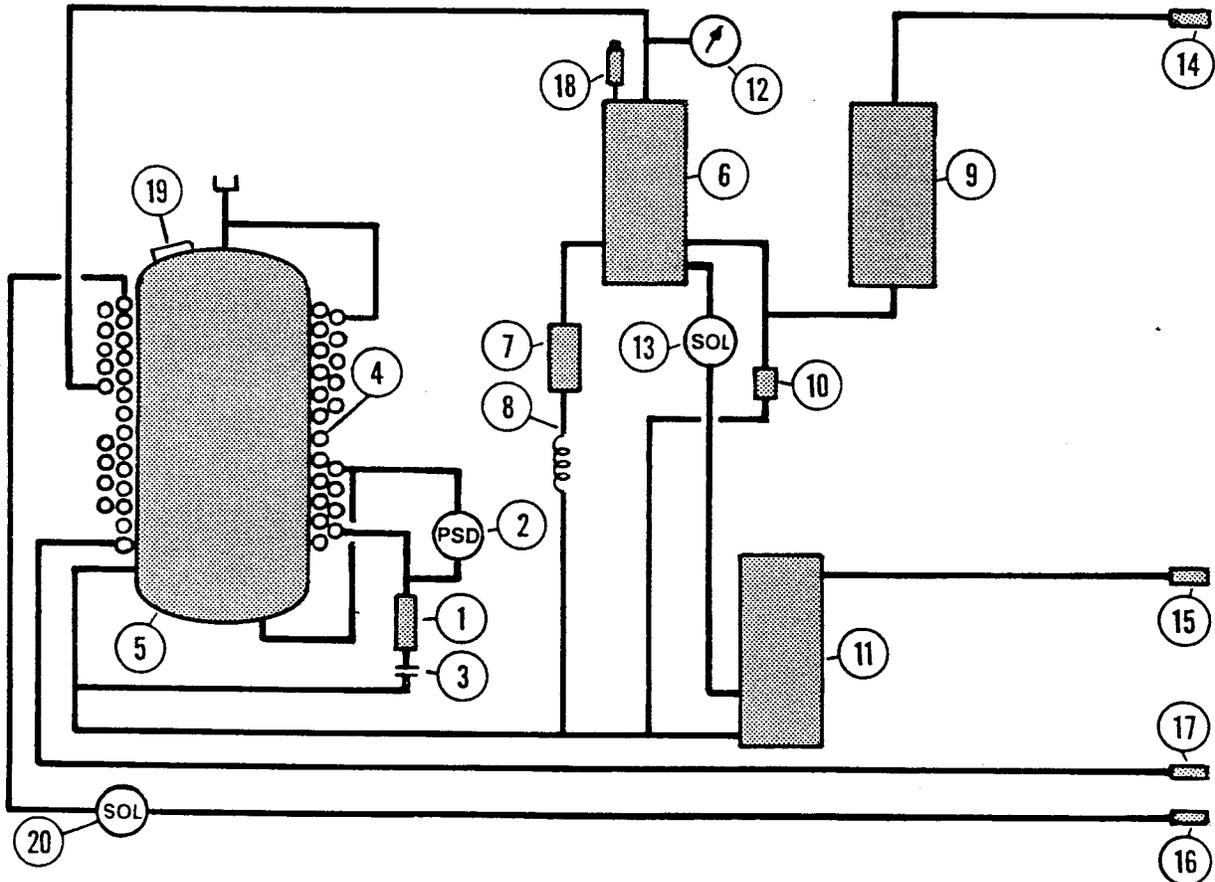
The HC-4 MK2 Compressor is a single-stage, water cooled, rotary compressor designed to deliver high pressure, oil-free helium gas to cryogenic refrigerators. The compressor is capable of operating either an M204S Expander (refrigerator) or a DE-204SL Expander. An expander cable supplies electrical power to the expander. Self-sealing couplings allow for easy connection to and disconnection from the rest of the closed-cycle cryogenic refrigeration system.

The model HC-4 Compressor designation represents a family of compressors. Each member of the family has a different part number (P/N) because electrical components are customized to match the compressor to a specific expander model and to the customer's electrical service. The nameplate attached to the compressor's rear panel identifies the part number. See Electrical Characteristics in the Specifications section of this manual.

The information in this manual pertains only to the HC-4 MK2 Compressor. Other components used with it to form an operating system are described in separate technical manuals.

PRINCIPLES OF OPERATION

The compressor continuously draws low pressure helium from the system return line. The helium gas is compressed, cooled and cleaned. High pressure oil-free helium gas is then delivered to the expander through the gas supply line. See Fig. 1.



- | | |
|-------------------------------------|-------------------------------------|
| 1. Oil Line Filter | 11. Surge Bottle |
| 2. Oil Differential Pressure Switch | 12. Pressure Gauge |
| 3. Oil Injection Orifice | 13. Gas Equalization Solenoid Valve |
| 4. Heat Exchanger | 14. Gas Supply Coupling |
| 5. Compressor | 15. Gas Return Coupling |
| 6. Oil Separator | 16. Water Supply Fitting |
| 7. Oil Capillary Filter | 17. Water Return Fitting |
| 8. Oil Capillary | 18. Pressure Relief Valve |
| 9. Adsorber | 19. Temperature Overload Switch |
| 10. Internal Bypass Valve | 20. Water Solenoid Valve |

Fig. 1 HC-4 MK2 Flow Diagram

Gas leaving the compressor contains heat and compressor lubricant. Both must be removed. From the compressor, the hot gas with entrained oil flows over the motor winding, where the gas loses some suspended oil. The gas then flows out of the shell and through one circuit of a three circuit heat exchanger, where the gas is cooled. Next, the gas passes through the oil separator and the adsorber for oil and moisture removal. From the adsorber, the high pressure gas is supplied to the expander.

Through the system gas return line, low pressure gas from the expander flows into the compressor.

A gas line containing an internal bypass valve connects the high pressure line to the low pressure line. The bypass valve will open to prevent overloading the motor when the system gas lines are not connected to the compressor.

Oil is separated from the gas in three stages. The first stage is by precipitation when the gas passes over the motor windings. The second stage is the oil separator; oil mist from the gas is collected, agglomerated and returned to the compressor. The third stage is the adsorber which removes any remaining oil the gas is carrying.

Oil collected in the separator flows back to the compressor through a capillary tube. The differential gas pressure across the system is the moving force, and the capillary size limits the amount of gas bypassed. The small amount of oil collected in the adsorber remains there and is removed only by replacing the adsorber.

Oil in the compressor housing also collects heat. The shell-wrapped heat exchanger removes heat from the compressor motor and the warm oil by direct conduction through the compressor shell. Gas pressure pushes oil through the heat exchanger's outer tubes which cool the warm oil from the compressor. This cooled oil is then reinjected into the gas return line, which returns the oil to the compressor to reabsorb heat and lubricate the compressor.

The components of the HC-4 MK2 Compressor are identified schematically in Fig. 1. Figures 2, 3 and 4 identify the parts pictorially. Features and functions of individual components are described in the following paragraphs.

Components

Gas Supply and Return Couplings - Both are self-sealing bulkhead couplings and are the points of connection on the rear panel for the rest of the system.

Water Supply and Return Fittings - Both fittings are compression type bulkhead fittings mounted on the rear panel, for 3/8" tubing.

Compressor Power Cord - Terminating with a 3-prong plug, this power cord supplies electrical power to the compressor.

Elapsed Time Meter - The battery-operated LCD elapsed time meter shows the compressor's cumulative running time in hours up to a total of 99,999 hours.

WARNING

THE ELAPSED TIME METER CONTAINS A LITHIUM BATTERY.
DO NOT REMOVE THE BATTERY. DO NOT RECHARGE, DIS-
ASSEMBLE, MUTILATE, WET OR DISPOSE OF THE METER
IN FIRE.

Power Switch - This on/off switch starts and stops the compressor. The switch lights to indicate that power is on to the compressor.

Pressure Gauge - A pressure gauge indicates gas supply pressure. When the compressor is not running, the gauge shows the equalization pressure.

Expander (Displacer) Receptacle and Optional Cable - A 28-socket receptacle mounted on the rear panel and an expander cable supply electrical power from the compressor to the expander. The compressor can be supplied with one of two types of cables: a cable for operating an M204S Expander or a cable for operating a DE-204SL Expander.

Accessory Receptacle and Optional Cables - The accessory receptacle mounted on the rear panel is a 14-socket connector for supplying auxiliary power or remote on/off control. The remote on/off and auxiliary power cables are available as options.

Circuit Breaker - A panel mounted circuit breaker in the main power supply protects the compressor module from electrical overload.

Fuses - Two 0.6 ampere fuses in the expander circuit and one 0.6 ampere fuse in the primary of the control transformer are accessible in the rear panel. Two 5 ampere fuses in the auxiliary power circuit (from the accessory receptacle) are located in the electrical chassis.

DESCRIPTION

Electrical Chassis Box - The electrical box contains electrical components and connections and distributes power to all system circuits. It is accessible by removing the top cover of the compressor.

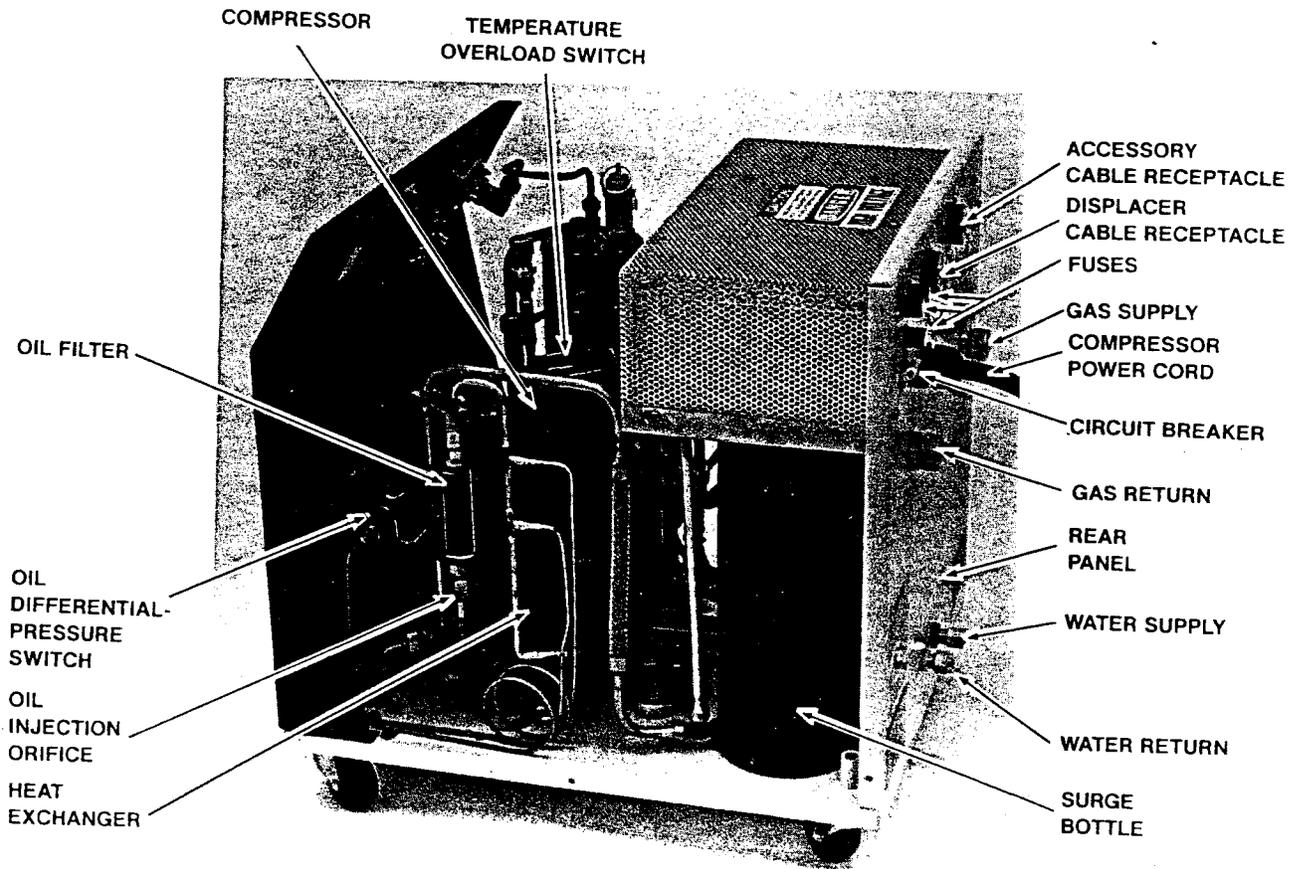


Fig. 2 Parts Identification

Compressor - The rotary, positive displacement compressor is hermetically sealed. Electrical connections to the motor are made at terminals under a protective cover on top of the housing.

The lubricant is a synthetic oil put in the compressor at the factory. Thereafter, oil is not changed or added. The oil fill fitting on the top of the compressor housing must not be opened.

Heat Exchanger - The heat exchanger consists of three coils wrapped around the compressor. One cools helium, another cools the compressor shell and another cools oil in the oil injection circuit. This circuit cools oil that has absorbed heat from the compressor and reinjects the cooled oil, which continues to absorb heat from the compressor.

Temperature Overload Switch - Installed under the electrical terminal box cover on top of the compressor, this switch senses compressor temperature through contact with the housing. The switch opens the control circuit at a predetermined temperature and resets automatically upon cooling.

Gas Equalization Solenoid Valve - This solenoid valve opens when the compressor is stopped. The valve allows the helium gas pressure across the compressor to equalize, to prevent oil from being blown out of the compressor into the low pressure gas line.

Oil Separator - The bottom of the oil separator serves as a sump. A retainer plate above the sump supports fibrous material that acts as the separating agent. Entrained oil coalesces on it, forming large droplets which drain into the sump. This unit needs no servicing or replacement.

Oil Capillary - The capillary returns oil collected in the separator sump to the low pressure side of the compressor for recycling.

Adsorber - The adsorber removes any oil and moisture the gas is carrying which did not drop out in the separator. This vessel contains activated charcoal for oil adsorption. The adsorber has a finite life and must be replaced every 10,000 operating hours.

Pressure Relief Valve - The relief valve prevents the compressor from operating at an unsafe pressure.

Oil Filters - There are two oil filters. One filter in the oil separator drain line protects the return oil capillary. The other filter in the oil injection circuit protects the compressor.

Oil Injection Orifice - This orifice is installed downstream of the oil filter in the oil injection line and controls the flow rate of oil into the compressor's gas return line.

Surge Bottle - The surge bottle located in the return gas line dampens the pressure pulsations.

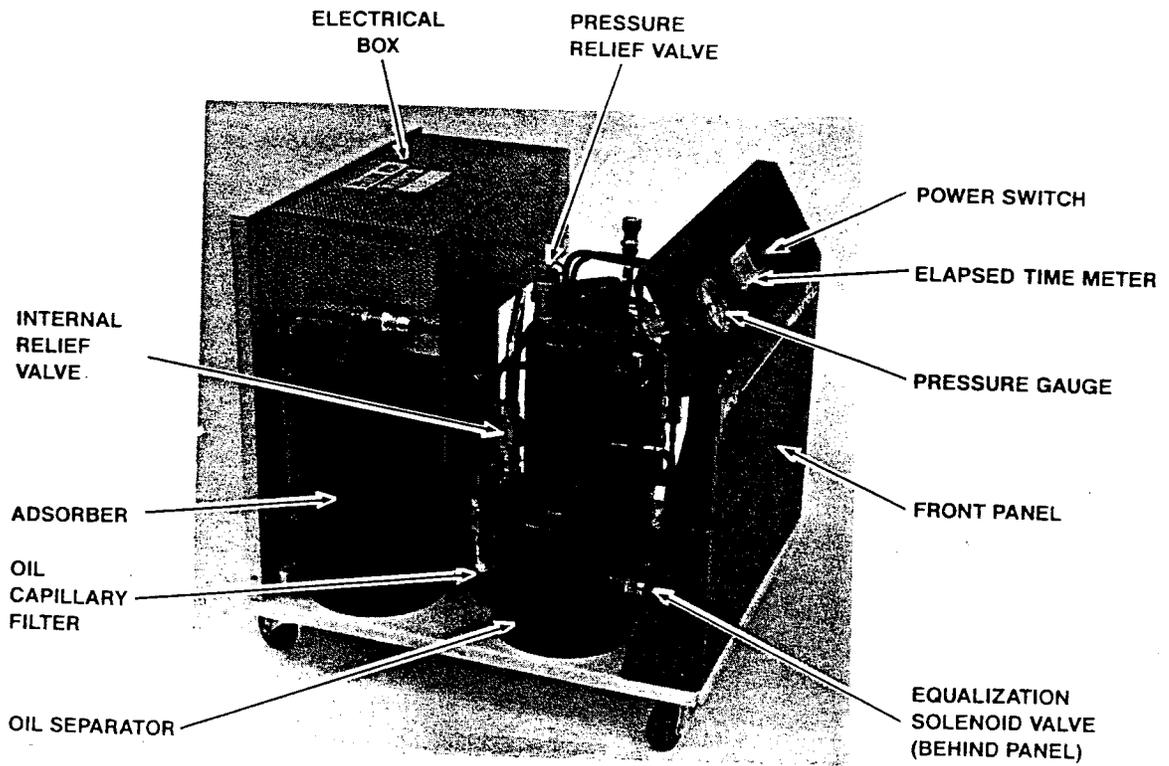


Fig. 3 Parts Identification

Oil Differential Pressure Switch - This switch shuts down the compressor if oil injection flow is too low or too warm for proper operation.

Internal Bypass (Relief) Valve - The internal bypass valve opens to allow the compressor to be run when the system gas lines are disconnected, to avoid overloading the motor.

Transformer - Some 50 Hz applications include an externally mounted transformer on the rear panel of the compressor. See Specifications.

Water Solenoid Valve - This normally closed solenoid valve opens when the compressor starts to allow cooling water to flow.

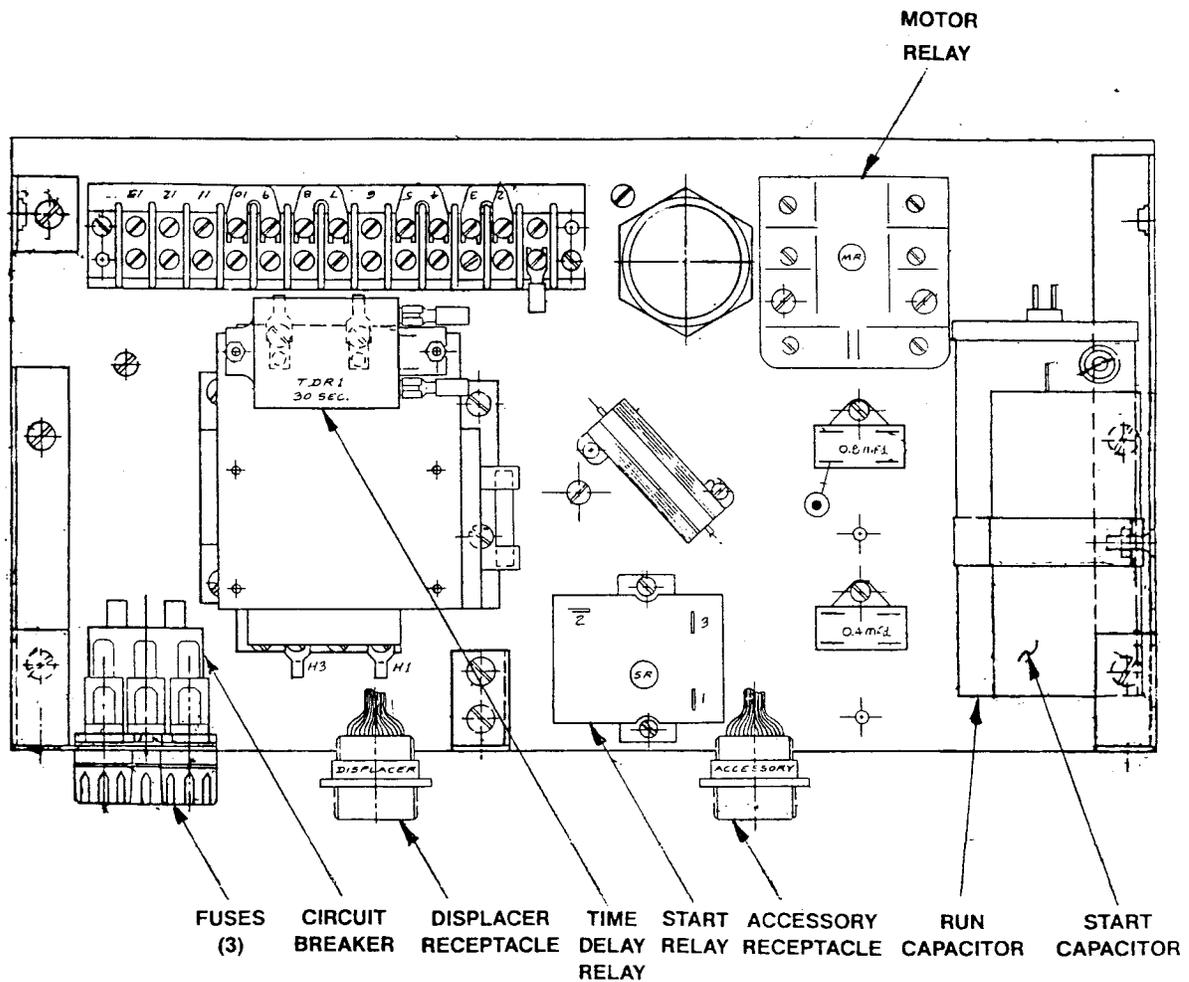


Fig. 4 Electrical Chassis Parts Identification

SPECIFICATIONS

Electrical Characteristics

<u>Compressor P/N</u>	<u>Customer's Electrical Service</u>	<u>Compressor Transformer Requirement</u>
260341E18G	208/230 VAC ($\pm 5\%$) 1 ph, 60 Hz	None
260341E18G	200 VAC ($\pm 5\%$) 1 ph, 50 Hz	None
260341E15G	220 VAC ($\pm 5\%$) 1 ph, 50 Hz	Transformer included, wired for step down to 200 VAC.
260341E16G	230/240 VAC ($\pm 5\%$) 1 ph, 50 Hz	Transformer included, wired for step down to 200/208 VAC.

Power Required: 3.0 kW, 15.5 amps full load at 208 VAC; 68 amps locked rotor.

Power Cord Connector: NEMA L6-30P (2 pole, 3 wire, 30 A, 250 VAC) male plug to connect to customer's receptacle.

Cooling Requirements

Room ambient temperature:	50°F to 100°F (10°C to 38°C)
Cooling water inlet temperature:	40°F to 80°F (4°C to 27°C)
Cooling water outlet temperature:	105°F (41°C) maximum
Cooling water pressure:	30 psig min., 100 psig maximum
Cooling water flow:	0.7 gpm minimum
Pressure drop at minimum flow:	12 psi
Water chiller cooling capacity:	11,000 BTU/hour

Helium Gas Pressures

	<u>Compressor Only</u>	<u>With DE-204SL or M204S Expander</u>
Equalization pressure at 68°F:	240-245 psig (1650-1690 kPa)	240-245 psig (1650-1690 kPa)
Operating supply pressure:	300-320 psig (2070-2210 kPa)	280-300 psig (1930-2070 kPa)

SPECIFICATIONS

Equalization pressures at different ambient temperatures:

<u>T°F</u>	<u>P psig</u>	<u>T°C</u>	<u>P kPa</u>
50	232-237	10	1600-1630
60	236-241	15.6	1630-1660
68	240-245	20	1650-1690
80	245-250	26.7	1690-1730
100	255-260	37.8	1750-1790

Pressure relief valve is set at 400 psig (2750 kPa).

Refrigerant

Quality: Refrigerant is 99.995% pure helium gas with a dew point less than -50°C (-58°F) at 300 psig.

Compressor Lubricant

Polyalkalene glycol, UCON LB-300X, specially processed by APD.

Compressor Weight 200 pounds (91 kg)

Mounting Position

Compressor must be mounted with its base down and level within 5 degrees.

Installation Kit

An installation kit, P/N 255437A, is furnished with the HC-4 MK2 Compressor. The kit contains:

<u>Item</u>	<u>Quantity</u>	<u>Description</u>	<u>Part Number</u>
1	40 feet	Polyethylene tubing, 3/8" OD	60751
2	2 sets	Swagelock front and rear ferrules for 3/8" OD tubing	17567
3	1	Adapter fitting, 8F with valve	255919B2
4	2	Swagelock nuts for 3/8" OD tubing	12341

Adapter Fittings and Cables

Available from APD. See the Service section of this manual.

Dimensions

Dimensions are in inches and (millimeters).

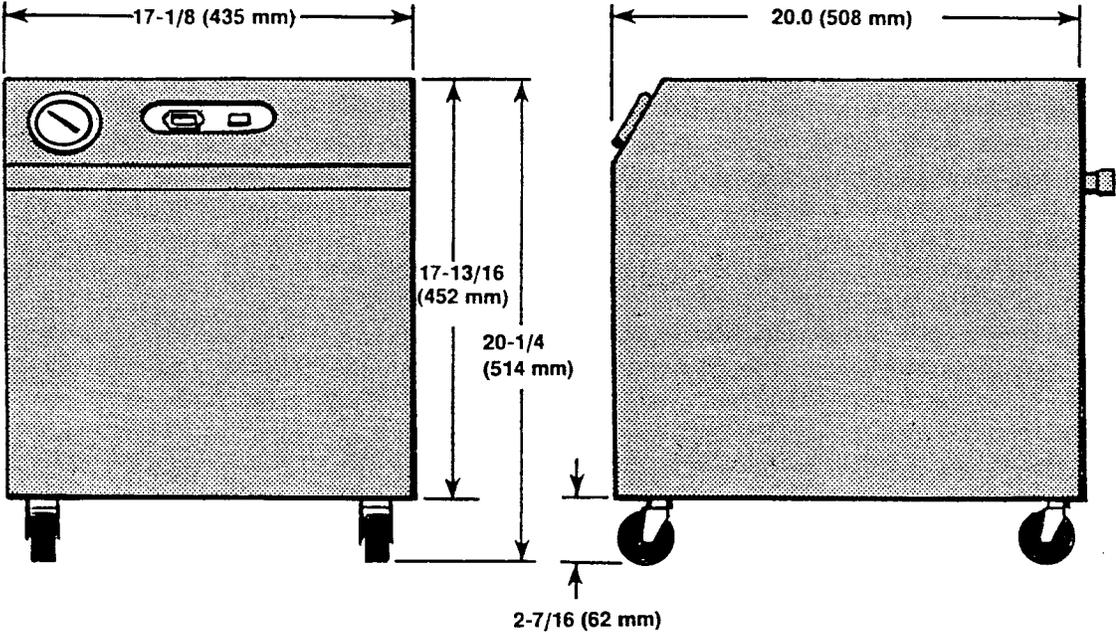


Fig. 5 HC-4 MK2 Outline Dimensions

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The HC-4 MK2 Compressor is shipped in an operable condition. Installation consists of:

- Unpacking
- Examining for damage
- Placing the compressor at its point of use
- Connecting utilities
- Checking compressor operation
- Connecting other system components.

Unpacking

Open the shipping container, loosen the shipping restraints, and remove its contents. The container also includes the compressor technical manual.

Examination

Examine the compressor module for external damage. If there is any sign of external damage, remove the covers and check for internal damage.

Check the Tip-N-Tell sensor mounted inside the shipping crate. If it indicates mishandling during shipment, contact the carrier and the APD Service Department. Do not run the compressor. Do not connect it into the system.

Allow the compressor to reach room temperature. Read the pressure gauge. With the factory refrigerant charge intact, it will show 240-245 psig (1650-1690 kPa) at 68°F (20°C). Lower readings indicate that some of the gas charge has been lost. Refer to the Maintenance section for instructions on recharging, cleaning and leak checking.

Positioning

Place the compressor module in a location --

- that is protected from the elements
- where the ambient temperature will always be within the range of 50°F to 100°F (10°C to 38°C).

CAUTION

ALWAYS THOROUGHLY DRAIN THE COOLANT FROM THE COOLING CIRCUIT IF THE COMPRESSOR IS TO BE SHIPPED OR STORED.

It must be installed base down, within 5 degrees of level, and preferably at a height convenient for making connections and reading the gauge. Be sure the compressor cannot inadvertently roll from its location, particularly if it is elevated.

Allow at least 24" clearance from the back and from both sides of the compressor for maintenance.

Compressor Checkout

WARNING

ALL ELECTRICAL SUPPLY EQUIPMENT MUST MEET APPLICABLE CODES AND BE INSTALLED BY QUALIFIED PERSONNEL.

The compressor should be operated before being connected to the system.

1. Locate the installation kit P/N 255437A. Using 3/8" OD polyethylene tubing, connect coolant supply and return lines to the compression fittings on the rear of the compressor. Connect the supply line to the supply valve furnished and installed by customer. Turn on the coolant.
2. Be sure the power switch on the compressor is off. Plug the power cable into customer's electrical receptacle. Switch on the power supply to the compressor. Check that the circuit breaker on the rear panel is closed (handle is up).
3. Press the top of the power switch on the front of the compressor. Power switch indicator will light and the compressor will start. The water solenoid valve will open. Check water lines for leaks. Tighten the fittings if necessary. See Specifications for cooling requirements.

NOTE

An internal bypass valve will open to prevent overloading the motor when the system gas lines are not connected to the compressor.

4. When the pressures stabilize, read the pressure gauge. The pressure should match the operating supply pressure (compressor only) in the Specifications.
5. Run the compressor for 10 minutes, then stop.

This completes the checkout of the compressor

Interconnections

WARNING

WHEN HANDLING PRESSURIZED GAS LINES AND OTHER PRESSURIZED EQUIPMENT, ALWAYS WEAR EYE PROTECTION.

WARNING

NEVER APPLY HEAT TO A PRESSURIZED GAS LINE.

CAUTION

CHECK THE CONDITION OF THE GASKET SEAL ON THE MALE HALF OF EACH AEROQUIP COUPLING. BE SURE THE GASKET SEAL IS IN PLACE AND THE SEALING SURFACES ON BOTH THE MALE AND FEMALE HALVES ARE CLEAN BEFORE CONNECTING. REPLACE THE GASKET SEAL IF IT IS DAMAGED.

NOTE

See Fig. 7 for location of the gasket seal.

CAUTION

KEEP THE GAS LINE COUPLING ALIGNED WHEN MAKING OR BREAKING A COUPLING CONNECTION. LEAKAGE MAY OCCUR DUE TO THE WEIGHT OF THE GAS LINE OR DUE TO A SHARP BEND NEAR THE CONNECTION.

NOTE

Retain the threaded dust caps and plugs to recover the couplings when they are not in use. They protect the couplings from damage and prevent entry of contaminants.

1. Arrange the system components so that the gas lines will be protected from stress and traffic.
2. Remove the dust caps from the compressor supply and return gas couplings.
3. Remove the dust plugs from the couplings on one end of each of the supply and return gas lines.
4. Connect the supply gas line to the supply coupling on the compressor. Use two wrenches to tighten the coupling to 35 \pm 5 ft.lbs. See Fig. 6.

Tighten each coupling before proceeding to the next one.

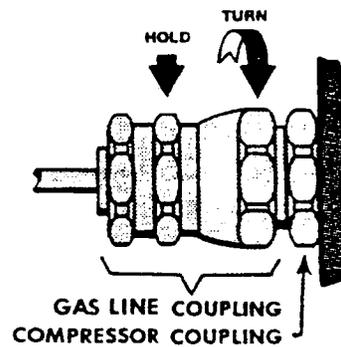


Fig. 6 Connect Gas Line to Compressor

5. Connect the return gas line to the return coupling on the compressor. Tighten the coupling to 35 ± 5 ft.lbs.
6. Leak check all Aeroquip couplings. See Leak Checking procedure.
7. Read the equalization pressure. Compare it to the equalization pressure stated in the Specifications section of the system manual.
8. Connect the other system components according to the instructions supplied for them. Connect the expander cable to the expander receptacle.

After the installation procedures for all system components have been completed, startup can begin.

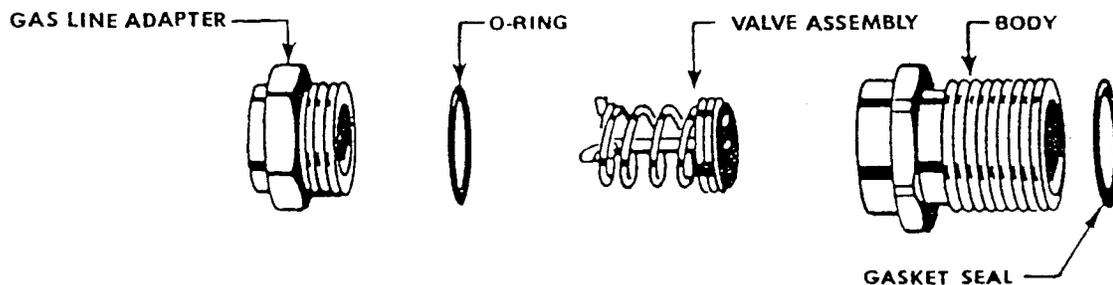


Fig. 7 Aeroquip Male Coupling Parts

Remote On/Off Cable (Accessory)

A remote on/off cable, P/N 256319C1, can be furnished as an accessory.

1. Disconnect the compressor from its power source.
2. Remove the heat shrink cap from one end of the remote on/off cable. Connect the cable to customer's remote switch. Use the green conductor to ground the switch box. Switch voltage will be 110 volts. See Fig. 10, Compressor Electrical Schematic.
3. Connect the other end of the cable to the accessory receptacle on the compressor.
4. Reconnect the compressor to its power source.

The system can now be operated from the compressor or from customer's remote switch. When using the remote switch, the power switch on the compressor must be in the stop position.

5. To verify that cable installation is correct, close customer's remote switch. Run the system for one minute, then stop.

NOTE

When the compressor is started by the remote on/off switch, it cannot be stopped by the compressor's switch. Open the compressor's circuit breaker to stop it locally. When the compressor is started at the compressor power switch, it cannot be stopped at the remote on/off switch.

Operation

Starting and stopping are the only operating procedures performed at the compressor.

Prestart Check

Before starting the compressor, be sure that all other system components to be used are properly connected and ready for operation. Refer to the instructions supplied with the other components.

When the compressor is at room temperature, 68°F (20°C), the pressure gauge should indicate 240-245 psig (1650-1690 kPa). Higher or lower temperatures will result in correspondingly higher or lower pressures, but these pressure changes are normal. Abnormally lower readings indicate that some of the gas charge has been lost. Refer to the Maintenance section for instructions on recharging, cleaning and leak checking.

Starting

At the compressor, press the top of the power switch.

The indicator in the switch will light. The compressor will start. Any items drawing power from the compressor will start.

Stopping

At the compressor, press the bottom of the power switch.

The indicator light in the switch will go out. The compressor will stop. Any items drawing power from the compressor will stop.

Automatic Restarting after a Shutdown

The HC-4 MK2 Compressor is designed to restart immediately if it is shut down by a power interruption. If the compressor stops for other reasons, refer to the Troubleshooting section of this manual.

WARNING

DISCONNECT GAS LINES ONLY WHEN THE COMPRESSOR IS STOPPED AND THE EXPANDER AND COMPRESSOR ARE AT ROOM TEMPERATURE. DISCONNECTING THE EXPANDER WHILE IT IS COLD MAY CREATE EXCESSIVELY HIGH INTERNAL PRESSURE AS THE GAS WARMS. MATERIAL FAILURE AND UNCONTROLLED PRESSURE RELEASE CAN CAUSE INJURY TO PERSONNEL IN THE WORK AREA.

WARNING

THE COMPRESSOR IS CHARGED WITH HELIUM GAS. VENT THE COMPRESSOR TO ATMOSPHERIC PRESSURE BEFORE DISASSEMBLY, EXCEPT WHEN DISCONNECTING ADSORBER OR GAS LINES. UNCONTROLLED PRESSURE RELEASE CAN CAUSE INJURY TO PERSONNEL IN THE WORK AREA.

WARNING

NEVER USE COMPRESSED HELIUM GAS FROM A CYLINDER WITHOUT A PROPER REGULATOR. OVERPRESSURIZATION CAN CAUSE PERSONAL INJURY IF THE SYSTEM EQUIPMENT RUPTURES.

WARNING

DURING OPERATION, SOME SURFACES UNDER THE COMPRESSOR'S COVER BECOME HOT. AVOID INJURY FROM BURNS BY ALLOWING THE COMPRESSOR TO COOL FOR 1/2 HOUR AFTER SHUTDOWN BEFORE REMOVING THE COVER FOR MAINTENANCE.

WARNING

WHEN HANDLING PRESSURIZED GAS LINES AND OTHER PRESSURIZED EQUIPMENT, ALWAYS WEAR EYE PROTECTION.

WARNING

NEVER APPLY HEAT TO A PRESSURIZED GAS LINE.

CAUTION

MODIFICATION TO EQUIPMENT WITHOUT THE CONSENT OF THE MANUFACTURER WILL VOID THE WARRANTY.

CAUTION

FOLLOW CHARGING AND VENTING DISCONNECTING AND CONNECTING PROCEDURE TO PREVENT REVERSED FLOW OF SYSTEM GAS. REVERSED FLOW CAN RESULT IN CONTAMINATION OF THE SYSTEM WITH THE COMPRESSOR OIL.

CAUTION

REPEATEDLY CHARGING THE SYSTEM WITH HELIUM GAS RATHER THAN LOCATING AND REPAIRING GAS LEAKS MAY CAUSE A MALFUNCTION. IMPURITIES ARE INTRODUCED AT AN ABNORMAL RATE AND MAY FREEZE IN THE EXPANDER.

CAUTION

CHECK THE CONDITION OF THE GASKET SEAL ON THE MALE HALF OF EACH AEROQUIP COUPLING. BE SURE THE GASKET SEAL IS IN PLACE AND THE SEALING SURFACES ON BOTH THE MALE AND FEMALE HALVES ARE CLEAN BEFORE CONNECTING. REPLACE THE GASKET SEAL IF IT IS DAMAGED.

CAUTION

DO NOT ALLOW AIR TO GET INTO THE SYSTEM. MOISTURE FROM THE ATMOSPHERE CAN SERIOUSLY DEGRADE EXPANDER PERFORMANCE.

Adsorber Replacement

The adsorber must be replaced every 10,000 operating hours. There is no salvage or repair value of the adsorber. Venting of the compressor is not required when replacing the adsorber, because the couplings are self-sealing.

Adsorber Removal

1. Stop the compressor and switch off the power supply to the compressor.

2. Disconnect the supply gas line from the supply coupling on the compressor. Screw a dust plug into the disconnected gas line coupling.

NOTE

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

3. Remove the compressor's cover.
4. Disconnect the self-sealing coupling on the tube from the oil separator to the inlet side of the adsorber.

NOTE

Trace the outline of the adsorber on the compressor base, to help locate the proper position of the new adsorber.

5. Elevate the compressor to gain access underneath the bottom panel. Use a 9/16" wrench to remove the 3/8" bolt holding the adsorber to the base.

CAUTION

DO NOT TIP THE COMPRESSOR GREATER THAN 5 DEGREES, TO AVOID FLOWING OIL INTO UNWANTED PLACES.

6. Remove the lock nut and nylon washer on the supply coupling on the rear panel.
7. Pull the adsorber back until the supply coupling clears the rear panel. Remove the adsorber. Remove the lock washer from the Aeroquip supply coupling. Retain all hardware to use with the new adsorber.

WARNING

THE ADSORBER IS CHARGED WITH HELIUM GAS. FOLLOW THE 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. Position the adsorber on the base within the traced line and insert the supply coupling through the rear panel. Be sure the lock washer is installed on the coupling prior to inserting it through the rear panel.

3. Install the bolt to connect the adsorber to the base. Torque the bolt to 25 ft.lbs. Lower the elevated compressor to the floor.
4. Install the nylon washer and the locknut on the supply coupling. Torque the locknut to 40 ft. lbs.
5. Connect the adsorber's self-sealing coupling on its inlet side to the oil separator's outlet coupling. With wrenches, torque the size 4 Aeroquip coupling to 10 to 15 ft. lbs.
6. Reconnect the supply gas line to the supply coupling on the compressor. Torque the coupling to 35 \pm 5 ft. lbs.
7. Leak check all Aeroquip couplings just completed.
8. Check the equalization pressure. See Specifications.
9. Reinstall the compressor's cover.

This completes the procedure for replacing an adsorber.

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. Adapter fitting P/N 255919B2 is an alternate venting tool. Vent the used adsorber to atmospheric pressure.
2. Remove but do not discard adapter fitting P/N 255919B2. Discard the used adsorber.

Charging and Venting

Charging or venting is required whenever the equalization pressure of the system is outside the range as stated in the Specifications. See Specifications for equalization pressures at different ambient temperatures.

See also the section Gas Cleanup.

Venting is required if leaking self-sealing couplings need to be disassembled for repairs.

CAUTION

DO NOT CHARGE THROUGH THE SUPPLY COUPLING.
DO NOT VENT THROUGH THE RETURN COUPLING.

Charging Procedure

To charge helium gas to the system:

1. Stop the compressor.
2. Disconnect the return gas line from the return coupling on the compressor. Screw a dust plug into the disconnected hose coupling.
3. Locate adapter fitting P/N 255919B2. Be sure the valve is closed. Attach it to the return coupling on the compressor.
4. Connect a charge line to the pressure regulator of a helium gas cylinder containing 99.995% pure helium with a dew point less than -50°C at 300 psig. Adjust the pressure regulator to 5 psig.
5. While connecting the charge line to the adapter fitting, thoroughly purge the charge line from the regulator. It is important to remove all air contaminants to prevent them from entering the system.
6. Adjust the pressure regulator to the equalization pressure. See Specifications. Slowly open the valve on the adapter fitting. Charge the system with helium gas to the required equalization pressure.
7. Close the valves on the adapter fitting and on the gas cylinder.
8. Disconnect the charge line from the adapter fitting. Remove the adapter fitting.
9. Reconnect the return gas line to the return coupling on the compressor. Torque the coupling to 35 \pm 5 ft. lbs.
10. Leak check the Aeroquip coupling.

This completes the charging procedure.

Venting Procedure to Adjust Equalization Pressure

1. Stop the compressor and switch off the power supply to the compressor.
2. Disconnect the supply gas line from the compressor. Screw a dust plug into the disconnected gas line coupling.
3. Locate adapter fitting P/N 255919B2. Be sure the valve is closed. Attach it to the supply coupling on the compressor.

4. Slowly open the valve on the adapter fitting. Vent the compressor until the required equalization pressure is attained. See Specifications. Close the valve on the adapter fitting.
5. Remove the adapter fitting.
6. Reconnect the supply gas line to the compressor. Torque the coupling to 35 \pm 5 ft. lbs.

This completes the procedure for venting to adjust the equalization pressure.

Venting Procedure to Vent to Atmospheric Pressure

This procedure includes disconnecting the adsorber to prevent venting it.

1. Stop the compressor and switch off the power supply to the compressor.
2. Disconnect both the supply and return gas lines from the couplings on the compressor. Screw dust plugs into the disconnected gas line couplings.
3. Remove the compressor's cover.
4. With wrenches, disconnect the Aeroquip coupling in the supply line between the oil separator and the inlet side of the adsorber.
5. Locate adapter fitting P/N 257246C2. Also locate adapter fitting P/N SK8217A2 and be sure its valve is closed. Move the part of the supply line fastened to the adsorber out of the way. Connect the adapter fittings to the female Aeroquip coupling on the supply line from the oil separator.
6. Slowly open the valve on the adapter fitting. Vent the system to atmospheric pressure. Close the valve on the adapter fitting.
7. Remove the adapter fittings.
8. Perform the required maintenance.

NOTE

Do not reconnect the adsorber if the compressor has been vented to atmospheric pressure.

This completes the procedure to vent the compressor to atmospheric pressure.

Gas Cleanup

Gas cleanup is required if the compressor's interior has been opened to the atmosphere or the equalization pressure is 20 psig or lower. Gas cleanup is performed with the compressor disconnected from the other system components. The adsorber must be disconnected unless it also has been opened to the atmosphere or its charge pressure is less than 20 psig.

NOTE

If the compressor's interior has been exposed to the atmosphere for an extended period, gas cleanup may not suffice to guarantee a suitable interior and adsorber replacement will be required.

1. Run the compressor for at least 30 minutes to heat the oil to operating temperature. Stop the compressor.
2. Disconnect the gas lines from the compressor. Screw dust plugs into the disconnected gas line couplings.
3. 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.

NOTE

If the adsorber has been disconnected, connect adapter fittings P/N 257246C2 and P/N SK8217A2 to the supply line from the oil separator, for venting the compressor during this procedure.

4. 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 -50°C at 300 psig. Adjust the gas cylinder pressure regulator to 5 psig.
5. 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.
6. Adjust the pressure regulator to 100 psig. Open the valve on the adapter fitting and charge the compressor to 100 psig.
7. Close the valve on the helium gas cylinder.

8. Open the vent valve on the supply coupling of the compressor. Watch the compressor's pressure gauge. When the pressure falls to 5 to 10 psig, close the vent valve. Open the gas cylinder valve to build the pressure back up to 100 psig. Close the gas cylinder valve.
9. Repeat step 8 five times.
10. Open the cylinder valve. Adjust the pressure regulator to the equalization pressure of the system. See Specifications.
11. Open the valve on the adapter fitting and charge the compressor to the equalization pressure. Close the charge valve on the adapter fitting. Start the compressor.
12. After running 30 to 45 seconds, stop the compressor. Open the vent valve and vent the compressor to 5 to 10 psig. Close the vent valve.
13. Repeat steps 11 and 12 five times, then go to step 14.
14. Open the charge valve on the adapter fitting. Charge the compressor to the equalization pressure. Close the charge valve.
15. Allow the compressor to cool. Read the pressure gauge with the compressor at 68°F. Adjust the equalization pressure by charging or venting to conform to the Specifications.
16. Close the gas cylinder valve.
17. Disconnect the charge line from the adapter fitting.
18. Remove both adapter fittings.

NOTE

Reconnect the adsorber if it has been disconnected prior to gas cleanup. Torque the Aeroquip coupling to 10 to 15 ft.lbs.

19. If other components need cleaning, refer to the procedure in their technical manuals. Otherwise, reconnect the supply and return gas lines. Torque the couplings to 35 ±5 ft.lbs.
20. Leak check the Aeroquip couplings.

This completes the procedure for gas cleanup of the compressor.

Leak Checking

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. However, small leaks may not be detected. Also, it is important to:

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

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

In either method of testing, do not assume that one 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 seal can be detected only when a gas line is connected. A leak here can be caused by:

- o the coupling not fully tightened
- o a worn, damaged or missing gasket seal
- o dirt on or under the gasket seal
- o dirt on the female coupling's mating surface
- o 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 the APD Service Department.

Leaks at the self-sealing couplings can be repaired by replacing worn or damaged parts. Vent the compressor before beginning to disassemble it.

Leaks at threaded joints are frequently stopped by tightening the coupling. Continued leakage after tightening requires coupling repair. Install new O-rings or Teflon tape as required.

To repair a coupling:

1. Stop the compressor and switch off the power supply to the compressor.
2. Disconnect the gas line from the compressor coupling to be repaired.
3. Install dust caps on all disconnected gas couplings except the one to be repaired.
4. Remove the compressor's cover.
5. Use the Venting Procedure to Vent to Atmospheric Pressure to discharge all gas from the compressor.
6. At the coupling to be repaired, hold the stationary part with one wrench. Use a second wrench to disassemble the coupling.
7. Remove the old O-ring.
8. Wipe the O-ring groove to be sure it is clean. Lightly coat a new O-ring with vacuum grease. Install the new O-ring.
9. For a threaded joint sealed with Teflon tape, remove all old tape and apply new tape.
10. Reassemble the coupling using two wrenches.
11. Perform the Gas Cleanup procedure.

CAUTION

A LEAKING COUPLING ON AN ADSORBER SHOULD NOT BE REPAIRED IN THE FIELD. CONSULT THE APD SERVICE DEPARTMENT. VENTING THE ADSORBER WILL INTRODUCE CONTAMINANTS TO THE SYSTEM WHICH CANNOT BE REMOVED IN THE FIELD.

Replace Temperature Overload Switch

The overload switch fits in a depression on top of the compressor housing under the terminal box cover.

1. Disconnect the power supply to the compressor.
2. Remove the compressor's cover.

3. Lift off the cover of the terminal box on top of the compressor. See Fig. 8.
4. Disconnect wires 28 and 29 from the temperature switch terminals. Remove the retainer containing the temperature switch. Discard the temperature overload switch and its retainer.
5. Place a new temperature overload switch with retainer into the terminal box on top of the compressor housing by engaging the retainer clips into the slotted holes in the terminal box case.
6. Connect wires 28 and 29 to the terminals of the temperature switch.
7. Replace the terminal box cover.

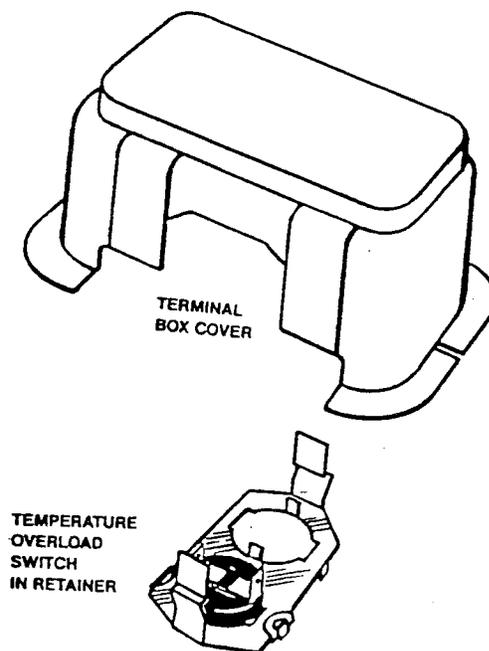


Fig. 8 Temperature Overload Switch

BLANK

Automatic Shutdown

The compressor will shut down automatically if any of the following are open:

- o the oil differential pressure switch
- o the compressor temperature overload switch
- o the motor over-current relay
- o the circuit breaker or a control circuit fuse.

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.

If the shutdown was caused by the oil differential pressure switch, wait until the pressure gauge indicates the equalization pressure. The compressor should start by turning the power switch off, then on.

If the unit shuts down again, refer to the Troubleshooting section to determine the cause and corrective action.

When the shutdown is caused by the temperature overload switch, the compressor will restart only after it has cooled enough for the switch to close. Press the power switch to off. After waiting for the compressor to cool, press the power switch to restart. Should the compressor fail to start, turn it off and allow more cooling time. Repeat the restart procedure.

The motor over-current relay automatically resets after the fault has been corrected. To restart the compressor, press the power switch to the on position.

If the circuit breaker opens, reset the breaker by pushing its lever to the up position.

If a fuse is open, switch off the compressor supply power, replace the fuse, then restart the compressor.

The Troubleshooting Guide that follows lists problems that can occur in the compressor and suggests causes and corrective actions.

WARNING

**DISCONNECT THE POWER SUPPLY TO THE COMPRESSOR
BEFORE TROUBLESHOOTING THE ELECTRICAL COMPONENTS.**

WARNING

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 INJURY OR DEATH FROM ELECTRIC SHOCK.

CAUTION

MODIFICATION TO EQUIPMENT WITHOUT THE CONSENT OF THE MANUFACTURER WILL VOID THE WARRANTY.

Troubleshooting Guide

<u>Problem</u>	<u>Possible Cause</u>	<u>Corrective Action</u>
Compressor and items powered from it do not start when start switch on compressor is closed. Run light is not on.	No electrical power.	Check that power source is on and power cord is connected.
	Tripped circuit breaker in compressor module.	Check voltage. Reset circuit breaker. Consult APD Service Department if problem persists.
	Open fuse in the control circuit.	Check for a short circuit. Replace fuse. Consult APD Service Department if problem persists.
	Faulty control circuit transformer.	Measure resistances in primary and secondary. Compare with values in chart in this section. Replace transformer if defective.

<u>Problem</u>	<u>Possible Cause</u>	<u>Corrective Action</u>	
Run light comes on for 30 seconds, then goes off, but compressor does not start.	Defective motor contactor or open circuit to motor contactor.	Measure motor relay coil resistance. Check for open circuit. Replace if defective.	
	Low voltage in primary or secondary circuit of control circuit transformer.	Measure resistances in primary and secondary. Replace transformer if defective.	
	Compressor starts, but shuts down after approximately 30 seconds of operation.	Wrong equalization or operating pressure.	Refer to Specifications and section on Charging and Venting. Leak check the system if pressure is low.
		Gas equalization solenoid valve has failed.	Replace the solenoid valve.
		Low oil flow.	Look for oil leaks in compressor module. Consult APD Service Department.
		Orifice or the oil cooling line filter is blocked.	Replace the orifice and the filter.
Compressor starts but shuts down sometime later.	Oil differential pressure switch has failed.	Replace the switch.	
	Insufficient coolant for compressor.	Check coolant flow and temperature. Refer to Specifications.	
	Circuit breaker or fuse is open.	Reset circuit breaker or replace fuse. Compare electric service with system specifications. Consult APD Service Department if problem persists.	
	Component failure in power circuit.	Check for open circuit breaker or fuse. Reset or replace if necessary. Check for a faulty component.	

<u>Problem</u>	<u>Possible Cause</u>	<u>Corrective Action</u>
	Oil differential pressure switch is open.	Recheck corrective actions for the problem "Compressor starts, but shuts down after approximately 30 seconds of operation."
	Incorrect current draw.	Measure current. Check motor winding resistances. If check reveals failed motor windings or locked rotor, consult the APD Service Department.
	Compressor overload relay opens.	If water and power checks indicate utilities are within specifications, interlocks may be faulty. Consult APD Service Department.
	Water solenoid valve is closed.	With power on, check water flow. If no water is flowing, turn off power. Disconnect wires 24 and 34 from terminals 2 and 4, respectively, on the terminal strip in the electrical chassis box. Measure the resistance of the solenoid valve coil. Compare with value on chart in this section. If coil is open, replace it or install a new valve.
System starts but gas pressures are abnormally high or low.	Wrong equalization pressure.	Refer to Specifications and section on Charging and Venting. Leak check the system if pressure is low.
	Gas line couplings are not fully engaged.	Be sure that all Aeroquip couplings are fully engaged and torqued.
	Gas lines are connected wrong	Reconnect. See Installation section.

<u>Problem</u>	<u>Possible Cause</u>	<u>Corrective Action</u>
Gradual loss of helium gas pressure.	Gas is leaking from the compressor.	Leak check the compressor and repair.
Compressor runs, but elapsed time meter does not.	Defective elapsed time meter or motor contactor.	Replace the defective component.

WARNING

THE ELAPSED TIME METER CONTAINS A LITHIUM BATTERY. DO NOT REMOVE THE BATTERY. DO NOT RECHARGE, DIS-ASSEMBLE, MUTILATE, WET OR DISPOSE OF THE METER IN FIRE.

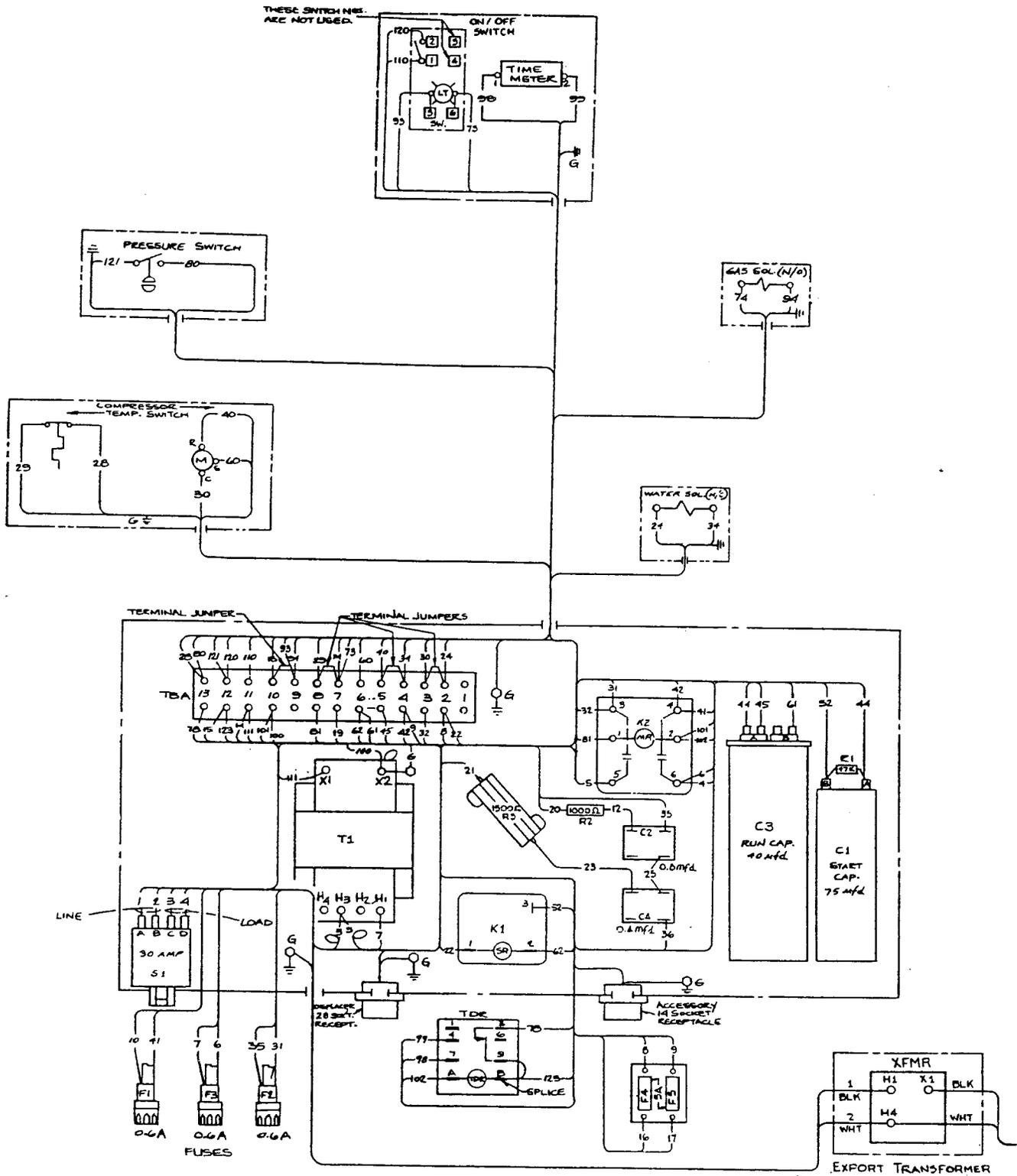


Fig. 9 HC-4 MK2 Compressor Wiring Diagram

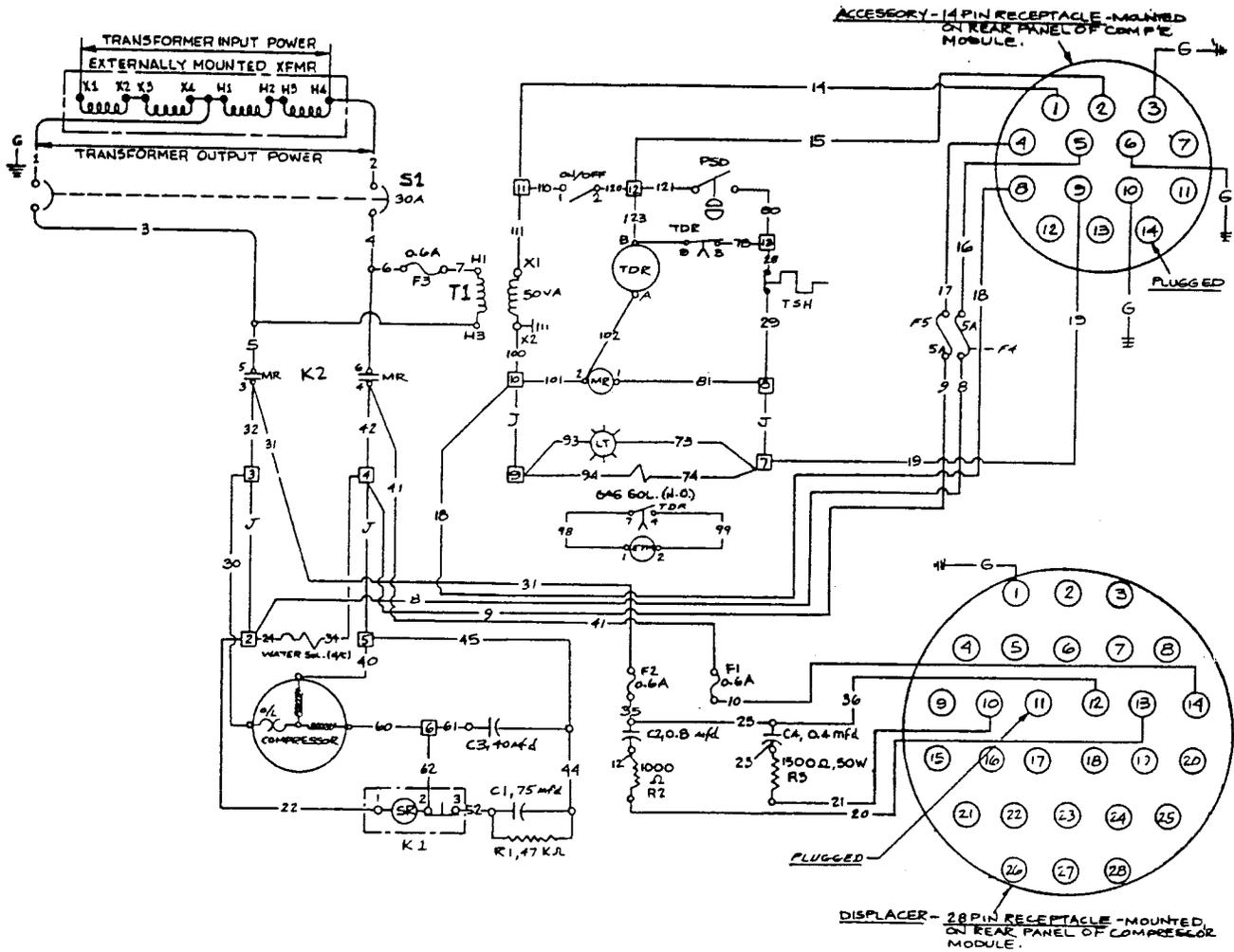


Fig. 10 HC-4 MK2 Compressor Electrical Schematic

Measure Resistance Values of Components

The values listed below are approximate and are intended to be used as guides. Disconnect any wires from the component to be checked or disconnect the component from the circuit before measuring its resistance.

<u>Component</u>	<u>Resistance</u>
Control circuit transformer primary	40 ohms
Control circuit transformer secondary	12 ohms
Motor relay coil	300 ohms
Gas equalization solenoid valve coil	94 ohms
Start relay coil	14,400 ohms
Water solenoid valve coil	380 ohms
Time delay relay coil	Solid state, normally open coil.

Compressor Motor

Compressor motor checks for winding continuity, resistance and grounding will isolate most motor electrical problems. Current measurements will separate a locked rotor condition from other electrical problems. When the checks indicate a faulty compressor, a replacement is needed. Contact the APD Service Department

WARNING

DISCONNECT THE POWER SUPPLY TO THE COMPRESSOR BEFORE TROUBLESHOOTING THE ELECTRICAL COMPONENTS.

WARNING

DURING OPERATION, SOME SURFACES UNDER THE COMPRESSOR'S COVER BECOME HOT. AVOID INJURY FROM BURNS BY ALLOWING THE COMPRESSOR TO COOL FOR 1/2 HOUR AFTER SHUTDOWN BEFORE REMOVING THE COVER FOR MAINTENANCE.

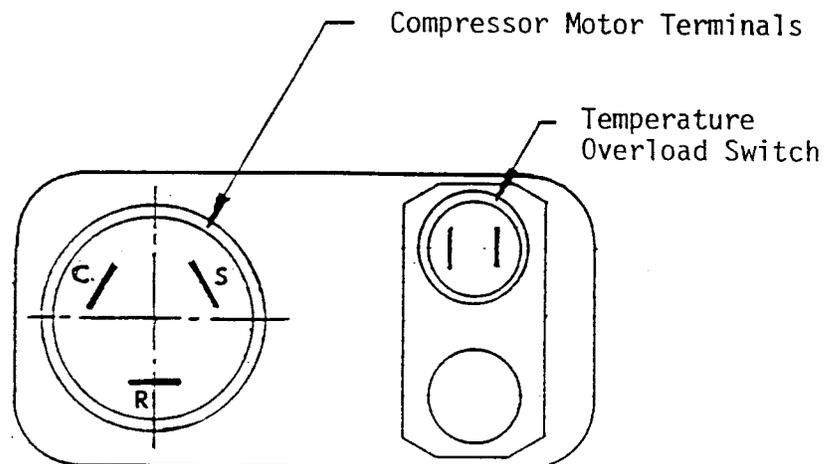
WARNING

PERMIT ONLY QUALIFIED ELECTRICAL TECHNICIANS TO OPEN ELECTRICAL ENCLOSURES, TO PERFORM ELECTRICAL CHECKS OR TO PERFORM TESTS WITH THE POWER SUPPLY CONNNECTED AND WIRING EXPOSED. FAILURE TO OBSERVE THIS WARNING CAN RESULT IN INJURY OR DEATH FROM ELECTRIC SHOCK.

Winding Continuity, Grounding and Resistance

1. Switch off the power supply to the compressor.

2. Remove the cover of the compressor module.
3. Remove the terminal box cover from the top of the compressor motor to expose the three terminals R, S and C. See Fig. 11. Disconnect wires 40, 60 and 30 from terminals R, S and C respectively.
4. With an ohmmeter, check the resistance across compressor terminals C and R. Resistance should be 0.8 to 1.2 ohms. If the resistance is outside this range, consult the APD Service Department. If there is no continuity, the winding is open. Consult the APD Service Department.
5. With an ohmmeter, check the resistance across compressor terminals C and S. Resistance should be 1.8 to 2.2 ohms. If the resistance is outside this range, consult the APD Service Department. If there is no continuity, the winding is open. Consult the APD Service Department.
6. With the ohmmeter, check for continuity between compressor terminal C and one of the copper tubes entering the compressor housing. If there is continuity, the motor is grounded. Consult the APD Service Department.
7. If the motor passes these electrical checks, reconnect wires 40, 60 and 30 to compressor terminals R, S and C respectively.
8. Replace the terminal box cover and the cover of the compressor module, unless current measurement is to be performed.



Current Measurement

1. Disconnect the power supply to the compressor.
2. Remove the cover from the electrical chassis box.
3. Clamp the ammeter onto one of the power wires on the line side of the circuit breaker. The current can range up to 70 amperes. Use a suitable scale on a clamp-on ammeter.
4. Connect the power to the compressor.
5. Start the compressor.
6. Read the ammeter, then stop the compressor.
 - o A reading of 0 amps indicates an open circuit.
 - o A reading of 14 to 20 amps is normal at steady state operating conditions.
 - o A reading of 20 to 40 amps indicates a defective relay, start-run capacitor, or bad motor windings. Check the resistance of each to detect the faulty component.
 - o A reading of 68 amps indicates a locked rotor. Consult the APD Service Department.
 - o A reading of full scale, along with a tripped circuit breaker or a blown control circuit fuse, indicates a short circuit in the chassis wiring or motor.
7. Remove the ammeter.
8. Replace the electrical chassis box cover and the compressor module cover.

Ordering

The nameplate fastened to the rear panel of the compressor housing identifies the compressor as follows:

Model number
Part number
Serial number.

Furnish this complete information when ordering parts. Also, order parts by part number and name. Refer to the next section for Parts Identification and Numbers.

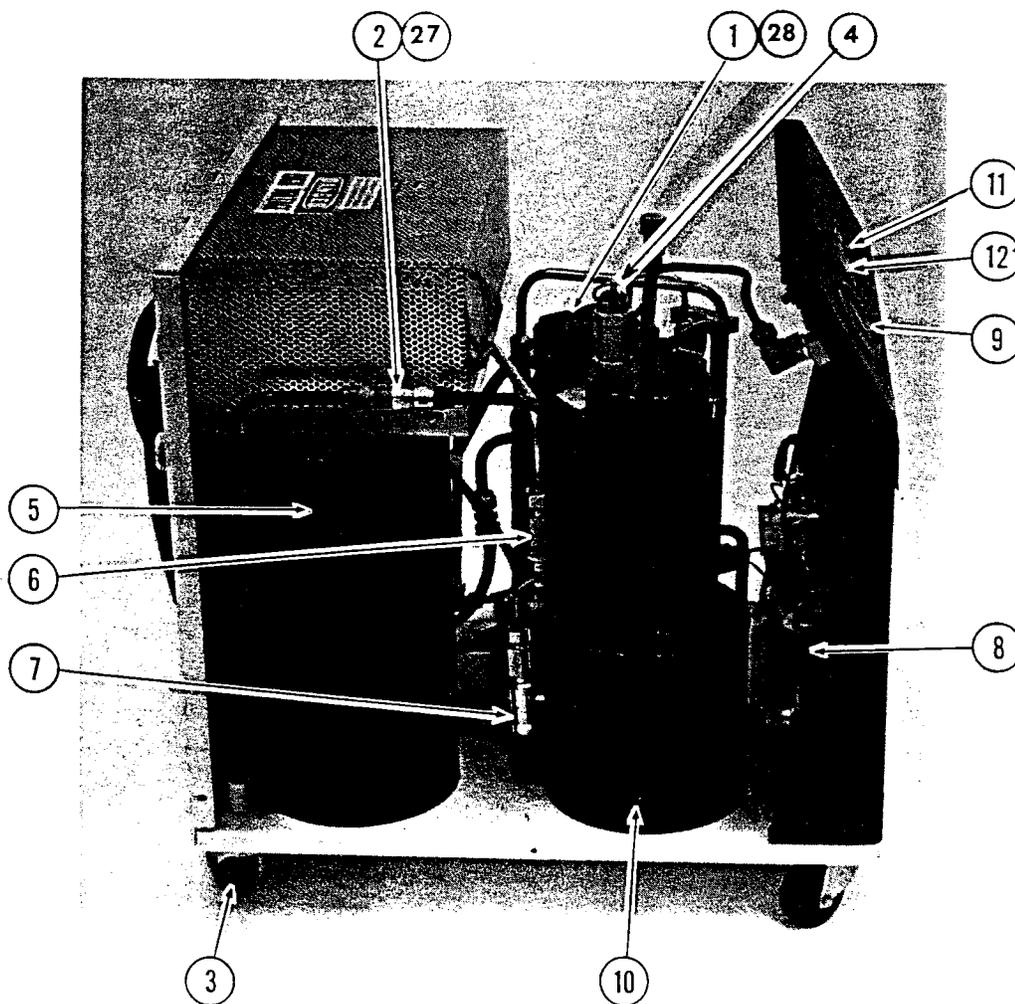


Fig. 12 Parts Identification

Parts Identification and Numbers (See Fig. 12)

<u>Item</u>	<u>Part Name</u>	<u>Part Number</u>
1	Compressor assembly	256035E
2	O-ring (2), size 4 Aeroquip coupling	77183
3	Caster (4)	49133
4	Pressure relief valve	53028
5	Adsorber assembly	F256390A
6	Internal bypass valve	270067A
7	Oil capillary filter	50315
8	Gas equalization solenoid valve	254990C
9	Pressure gauge, panel mount, 2 inch dial	50532
10	Oil separator assembly	254732D
11	Power switch	38850
12	Elapsed time meter	35008

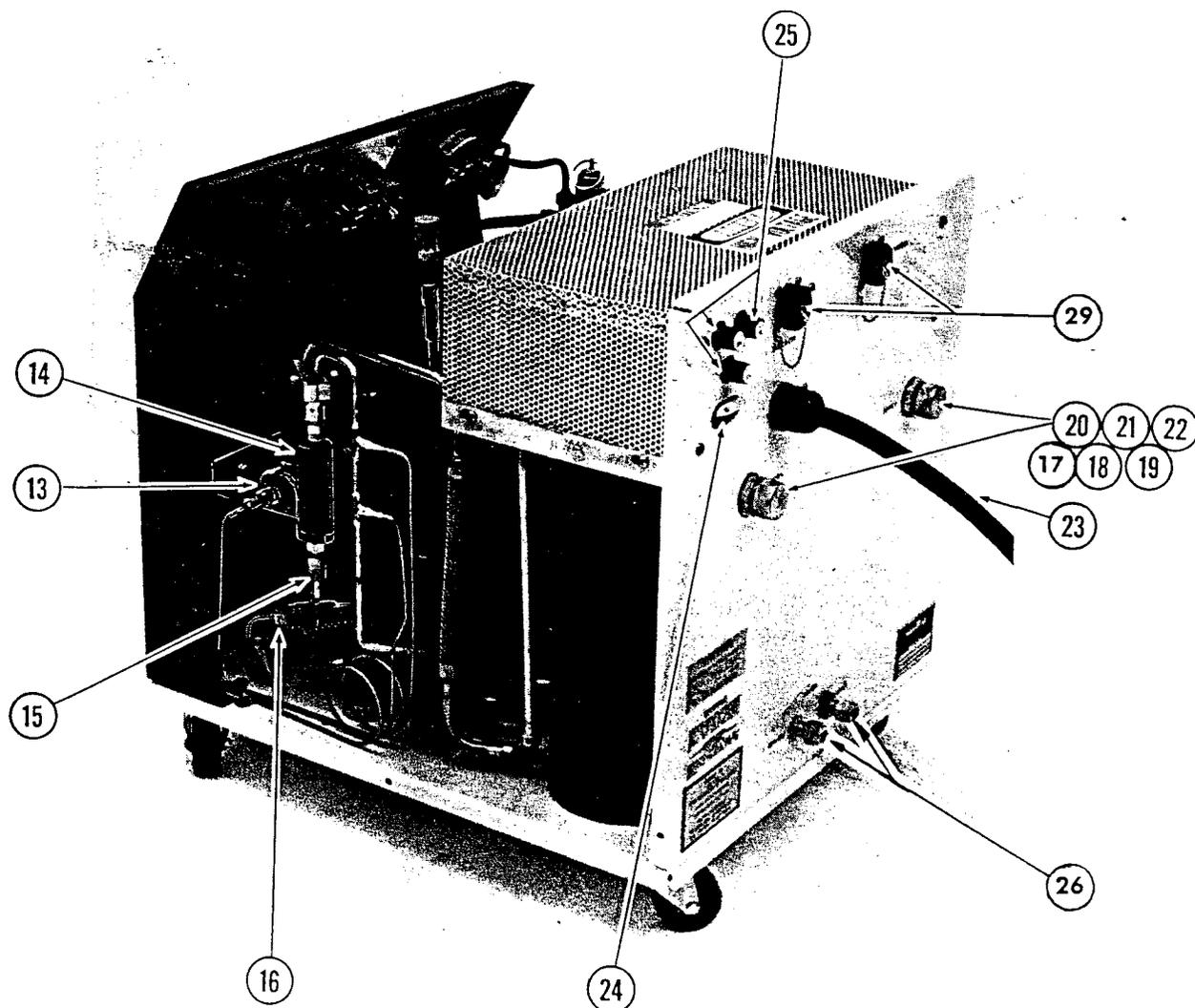


Fig. 13 Parts Identification

Parts Identification and Numbers (See Figs. 12 and 13)

<u>Item</u>	<u>Part Name</u>	<u>Part Number</u>
13	Oil differential pressure switch assembly	256089C
14	Oil injection filter assembly	255008B
15	Oil injection orifice	256066B
16	Oil capillary assembly	254763C
17	Gasket seal (2), Aeroquip coupling	77002
18	O-ring (2), Aeroquip coupling	47102
19	Nylon washer (2), Aeroquip coupling	72628
20	Lock washer (2), Aeroquip coupling	46401
21	Lock nut (2), Aeroquip coupling	46101
22	Dust cap (2), Aeroquip coupling	45301
23	Power cable	256507B
24	Circuit breaker S1, 30A/250VAC/2 pole	34668
25	Fuse F1, F2, F3, 0.6 amp.	34653
26	Fitting (2), water	14505
27	Gasket seal, size 4 Aeroquip coupling	77003
28	Temperature overload switch in retainer	256034A2
29	Receptacle cap (2)	34489

Parts Identification and Numbers (See Fig. 10)

<u>Item</u>	<u>Part Name</u>	<u>Part Number</u>
30	Transformer T1, control circuit	39409
31	Time delay relay	37414
32	Resistor R2, 1,000 ohms	37904
33	Resistor R3, 1,500 ohms	37520
34	Capacitor C1, start, 75 mfd	256034A10
35	Resistor R1, 47,000 ohms	256034A14
36	Capacitor C2, expander circuit, 0.8 mfd	32517
37	Capacitor C3, run, 40 mfd	256034A11
38	Start relay K1	256034A13
39	Motor contactor K2	37104
40	Transformer for 220 VAC, 1 ph, 50 Hz electrical service or Transformer for 230/240 VAC, 1 ph, 50 Hz electrical service	39417 39401
41	Water solenoid valve	256415C
42	Fuse F4, F5, 5 amp.	34665
43	Capacitor C4, 0.4 mfd	32522

SERVICE

SERVICE DEPOTS

Eastern USA: APD CRYOGENICS INC
 1833 Vultee Street
 Allentown, PA 18103
 Tel: (800) 525-3071
 or
 (215) 791-6750

Telex: 205528
 Fax: (215) 791-0440

Western USA: APD CRYOGENICS INC
 Suite I
 1030 E. Duane Avenue
 Sunnyvale, CA 94086
 Tel: (408) 736-4406
 Fax: (408) 736-7325

U.K.: APD CRYOGENICS INC
 IGC EUROPE, LTD.
 5 Jupiter House
 Calleva Industrial Park
 Aldermaston
 Berkshire RG7 4QW
 England
 Tel: 44 (0734) 819373
 Telex: 847629 APDUK G
 Fax: 44 (0734) 817601

France: CRYO-DIFFUSION
 49, rue de Verdun
 27690 Lery
 France
 Tel: 33 (32) 590368
 Telex: 180444 CRYODIF F
 Fax: 33 (32) 590065

Japan: NAGASE & COMPANY, LTD.
 5-1, Sionbashi-Kobunacho
 Chuo-ku, Tokyo 103
 Japan
 Tel: 81 (3) 665-3761
 Fax: 81 (3) 668-2138

HEADQUARTERS

APD CRYOGENICS INC
 1833 Vultee Street
 Allentown, PA 18103
 Tel: (800) 525-3072 (Sales and Parts)
 or
 (215) 791-6700

Tel: (800) 525-3071 (Service)
 or
 (215) 791-6750

Fax: (215) 791-0440

Adapter Fittings

The following adapter fittings, required for servicing the HC-4 MK2 Compressor, are available as accessories. 8F denotes a size 8, female Aeroquip coupling. Figure 14 shows a typical adapter fitting.

<u>Item</u>	<u>Quantity</u>	<u>Description</u>	<u>Part Number</u>
1	1	Adapter fitting, 8F with valve	255919B2
2	1	Adapter fitting, 8M with valve	SK8217A2
3	1	Adapter fitting, 4M to 8F	257246C2

Cables

The following cables for use with the HC-4 MK2 Compressor are available as accessories from APD. Only one (1) of the expander cables and one (1) of the accessory cables can be used at the same time.

<u>Item</u>	<u>Quantity</u>	<u>Description</u>	<u>Part Number</u>
1	1	Expander Cable for DE-204SL Expander, 11 ft. long	256508B1
		Expander Cable for DE-204SL Expander, 30 ft. long	256508B2
		Expander Cable for DE-204SL Expander, 20 ft. long	256508B3
		Expander Cable for DE-204SL Expander, 33 ft. long	256508B4
2	1	Expander Cable for M204S Expander, 11 ft. long	260336B1
		Expander Cable for M204S Expander, 30 ft. long	260336B2
3	1	Accessory Cable for Remote On/Off	256319C1
4	1	Accessory Cable for Power to a Cool Pak Air-to- Water Heat Exchanger	256293C

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<u>Item</u>	<u>Quantity</u>	<u>Description</u>	<u>Part Number</u>
5	1	Accessory Cable for Auxiliary 230 Volt Power	256319C2
6	1	Accessory Cable for Auxiliary 110 Volt Power	256319C3

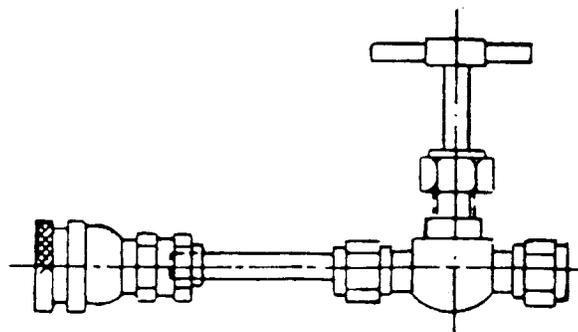


Fig. 14 Typical Adapter Fitting

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