Users Manual

Model 600

Helium Compressor

Austin Scientific
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OXFORD INSTRUMENTS

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How to Contact Austin Scientific Support:

For contact information and a complete listing of Direct Sales, Distributor, and Sales Representative contacts, visit the Austin Scientific Web site at:

http://www.austinscientific.com/

Austin Scientific

An Oxford Instruments Company

4114 Todd Lane

Austin, Texas 78744 USA

TEL. +1 512 441 6893

FAX +1 512 443 6665

Email: Info@austinscientific.com

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Revision History

Date	Revision	Description
September 2006	1.0.1	Conversion to new format.

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1.1 About Austin Scientific

Austin Scientific, a wholly-owned subsidiary of Oxford Instruments, specializes in the manufacture and repair of cryogenic vacuum pumps, cryocoolers (refrigerators) and helium compressors for semiconductor, optical coating, linear accelerators, medical equipment, and R&D applications.

You can find just what you need from our range of products and support services:

- New Equipment - cryopumps, compressors, cryocoolers, and cryopump controllers such as the Model 600 Helium Compressor described in this manual.
- Comprehensive range of accessories for the installation of whole systems and a complete range of spare parts to repair cryopumps and compressors.

1.2 Other Services from Austin Scientific

Austin Scientific offers a broad range of additional services:

- *Repair and refurbishment services* - Whatever brand of cryo-components you have, we offer fully warranted refurbishment, often with off-the-shelf availability.
- *Exchanges* - We offer our own quality products, as well as most makes of cryopumps and helium compressors, which are refurbished and fully warranted.
- *Technical Suppor*t - Our support engineers will help determine if your cryopump system is operating correctly so that you can get your system back to optimum efficiency as soon as possible.

  To contact Austin Scientific Technical Support:

  Email: support@austinscientific.com
- Telephone: 1-512-441-9258 or Toll Free: 1-800-404-1055
- *Installation* - On-site installation services are available to guarantee performance and save you time.
- *Training* - We offer on-site training to help you and your staff to know more about your cryopump and compressor systems. Our training will give you confidence and the ability to maintain a highest possible uptime for your system.

1.3 About this Manual

The purpose of this manual is to provide our customers using the Model 600 Helium Compressor with the information needed to safely and efficiently operate the compressor when operating as part of a cryogenic refrigeration system. Such a system is often comprised of the following equipment:

- Model 600 helium compressor unit

- Coldhead(s) or cryopump(s)
- Connecting helium lines

This manual describes the design, operation and maintenance of the M600 helium compressor unit.

1.4 Compatibility

The Austin Scientific (ASC) Model 600 Helium Compressor is compatible with running the cryopumps and coldheads from different manufacturers described in Table 1-1 and Table 1-2. Each Model 600 compressor unit can be used to run one or more such cryopumps or coldheads.

Table 1-1. M600 Helium Compressor Coldhead Compatibility

M600 Drive Unit Electrical Circuit Configuration	Coldhead Model (Manufacturer)	Number of Multiple Coldheads Allowed
Scott "T"	350CS (ASC)	3
	1020CS (ASC)	2
	1050CS (ASC)	1
	350CP (CTI)	3
	1020CP (CTI)	2
	1050CP (CTI)	1
"5/100"		
	5/80 (Leybold)	2
	5/100 (Leybold)	2

Table 1-2. M600 Helium Compressor Cryopump Compatibility

M600 Drive Unit Electrical Circuit Configuration	Cryopump Model (Manufacturer)	Number of Multiple Cryopump Allowed
Scott "T"	CP8/CP8LP (ASC)	3
	CP10 (ASC)	2
	CP16 (ASC)	1
	CT8/CT8F (CTI)	3
	CT10 (CTI)	2
	CT400	1
	CT500	1
On-Board		
	OB-8/OB-8F (CTI)	3
	OB-10 (CTI)	2
	OB-400 (CTI)	1

Additional accessories will be needed to operate multiple cryopumps or coldheads. Refer to Chapter 3, Section 3.3 for the part numbers and ordering information.

Safety Warnings 2

2.1 Standards for the Use of Warnings and Cautions

Warnings are noted when there is a possibility of injury or death to persons operating the equipment or performing specific tasks or procedures noted in this manual.

Cautions are noted when there is a possibility of damage to equipment if the caution is ignored.

2.2 Warnings Applicable to All Aspects of M600 Operations

2.2.1 High Voltage and Electrical Shock Warnings

Warning **Potentially fatal voltages are present in the compressor unit. Before beginning any work on the compressor unit, the compressor needs to be switched off then isolated from the power supply.**

Warning **Connect or disconnect the helium line joining the compressor and its load (cryopump, coldhead, etc.) only after the compressor is switched off and separated from the power source. Otherwise, there could be electrical shock hazard and may cause damage to the compressor unit and its load.**

Warning **Always provide proper grounding to the compressor unit. All electrical connection and disconnection of the unit should be done by a qualified and licensed electrician.**

Warning **High voltage is present within the system and can cause severe injury from electrical shock. Permit only qualified electrical technicians to open any electrical enclosure lo perform electrical troubleshooting**

Warning **Disconnect the compressor from its power source before carrying out any troubleshooting or maintenance activities.**

2.2.2 High Pressure Related Warnings

Warning **High gas pressure is present within the system and can cause severe injury or death from propelled panicles or pans.**

Warning **Do not recharge the system without using a pressure regulator.**

2.2.3 Helium Gas-Related Warnings

Warning **Helium gas can cause rapid asphyxiation or death if released in a confined and unvented area.**

Warning **Use a pressure reducing regulator when withdrawing helium gas from a high pressure cylinder**

Warning **Detaching the helium flexlines when the compressor load is at low temperature may cause the pressure to rise in the system beyond the permissible level therefore creating a safety hazard.**

2.2.4 Heat-Related Warnings

Warning **The compressor motor may become hot after operating. Wait for the motor to cool down before working inside the compressor.**

2.3 Operator Instructions

Follow standard Model 600 operating procedures as described in this Manual. If after reading this manual, you still have questions regarding the safe operation of the Model 600 Helium Compressor, please contact Austin Scientific Technical Support using the contact information found in Chapter 1, Section 1.2.

Introduction 3

3.1 General Information about the Model 600 Compressor

Austin Scientific offers industry-proven compressors such as the Model 600 Helium Compressor described in this manual, at highly competitive prices, and with flexible configurations. Model 600 compressors are available in high- and low-voltage configuration and in either air or water-cooled model.

3.1.1 Model 600 Features

The Model 600 compressor is designed for tens of thousands of hours of continuous operation. The main features of the Model 600 compressor are:

- Minimal maintenance requirements
- Removable adsorber cover for easy maintenance
- No front or rear panels with which to struggle
- Rack mounting available, which is ideal for vacuum coating/ion implanters, semiconductor vacuum systems, CAT scanners, MRI systems, and sputtering system applications.

3.1.2 Overview of Model 600 Compressor Design & Operation

Model 600 Helium Compressor (see Figure 3-1, water-cooled model shown) is designed to run different cryopump or coldhead models from different manufacturers (see Table 3-3 and Table 3-4 for compatibility information), for either high voltage or low-voltage and 60/50 Hz three-phase operations.

The compressor itself consists of four main components:

- Compressor capsule
- Heat exchanger
- Oil mist (vapor) separator
- Volume tank
- Adsorber

The *compressor unit* and the coldhead are connected by way of helium gas flexlines. The compressor unit, coldhead and helium lines are fitted with self-sealing couplings, and are charged with ultra high-purity (99.999%) helium gas.

The *heat exchanger* removes the heat generated from the process of compressing helium in the capsule. The heat generated by the capsule must be removed from the oil and the helium gas.

To remove heat from the compressor capsule, oil is used as lubrication and cooling medium. The helium gas as well as oil, are then pumped by way of differential pressure, out of the capsule through the water-cooled or air-cooled heat exchanger. The cooled oil returns to the capsule to lubricate and cool the capsule.

The *volume tank* is an holding tank that provides additional helium gas volume on the low pressure side of the compressor system. This prevents the low-side pressure from going too low when the compressor is running.

The helium gas purifying occurs after the heat removal and cooling process. Helium gas purification must occur because the heat exchanger still has a small amount of oil vapor mixed with the gas. If this helium gas gets to the cryopump with oil vapor in it, the oil will freeze and foul the cryopump. The function of the *oil mist (vapor) separator* is to rid the helium gas stream of this oil vapor. The condensate from the oil is then returned to the capsule. The helium gas still contains a small quantity of oil vapor at this point.

The *adsorber* then filters out the remaining oil vapor from the helium gas stream. Overtime, the *adsorber* may become saturated from the oil vapor. Thus, it is important the adsorber be replaced according to the recommended replacement interval.

Figure 3-1. Model 600 Helium Compressor (water-cooled model shown)

3.1.3 Description of Subsystems

Along with the five main components, Table 3-1 describes the subsystems that serve to monitor the operating condition of the compressor unit and to ensure its safe operation.

Table 3-1. Model 600 Helium Compressor Subsystems

Subsystem Name	Function
Phase rotation monitor	*Purpose*: Monitors the phase of the input power. Will not allow operation if the phase is incorrect.
Overload relay	*Purpose*: Monitors system current. Will turn off the compressor if the current level exceeds the preset value.
Thermal switch (TS1)	*Purpose:* Monitors helium temperature upstream of the heat exchanger. *Safety Function:* Will turn off the compressor if the helium temperature gets too high.
Thermal Switch (TS2)	*Purpose:* Monitors helium temperature downstream of the heat exchanger. *Safety Function:* Will turn off the compressor if the helium temperature gets too high.
Bypass valve	*Purpose and Safety Function:* Equalizes pressure within the compressor unit upon power interruption.
Oil valve	*Purpose and Safety Function*: Prevents oil migration when power is off.
Cooling water flow meter (water-cooled model only)	*Purpose*: Allows a visual reference as to the current flow rate of the cooling water.
Fuses: • Fuses for the coldhead drive circuit • Fuses for the main input power • Fuses for the control voltage • Fuses for the fan motors	*Safety Function:* Over-current protection
Internal relief valve	*Purpose and Safety Function:* Opens a shunt between the high and low-pressure helium gas circuits. *Safety Function:* If the differential pressure exceeds a preset value, this valve opens to allow safe operation.
External relief valve	*Purpose and Safety Function:* Opens the helium gas circuit to atmosphere if the helium gas pressure exceeds 375 psi.

3.1.4 Operational Flow

The work flow of helium gas within the compressor follows these steps:

1. High-pressure helium gas is delivered from the compressor to the coldhead through the "Supply" helium flexline at 250~260 psi.
2. The helium gas is then compressed during the compression stroke of the cryopump.
3. The cryopump then expands the helium gas during its expansion stroke. During this cycle of compression and expansion of the cryopump, the helium gas is forced through regeneration materials to increase the thermodynamic efficiency of the cycle.
4. With each successive cycle, the regeneration material becomes colder and colder. Eventually, the cryopump temperatures comes down to cryogenic range.
5. After expansion, the helium gas returns to the compressor through the "Return" helium flexline at 50~100 psi to begin the cycle again.

The helium flow between the Model 600 compressor's components is illustrated in Figure 3-2and Figure 3-3, for the water-cooled and air-cooled version of the Model 600 compressor, respectively.

Figure 3-2. Flow Diagram for Air-Cooled Model 600 Helium Compressor

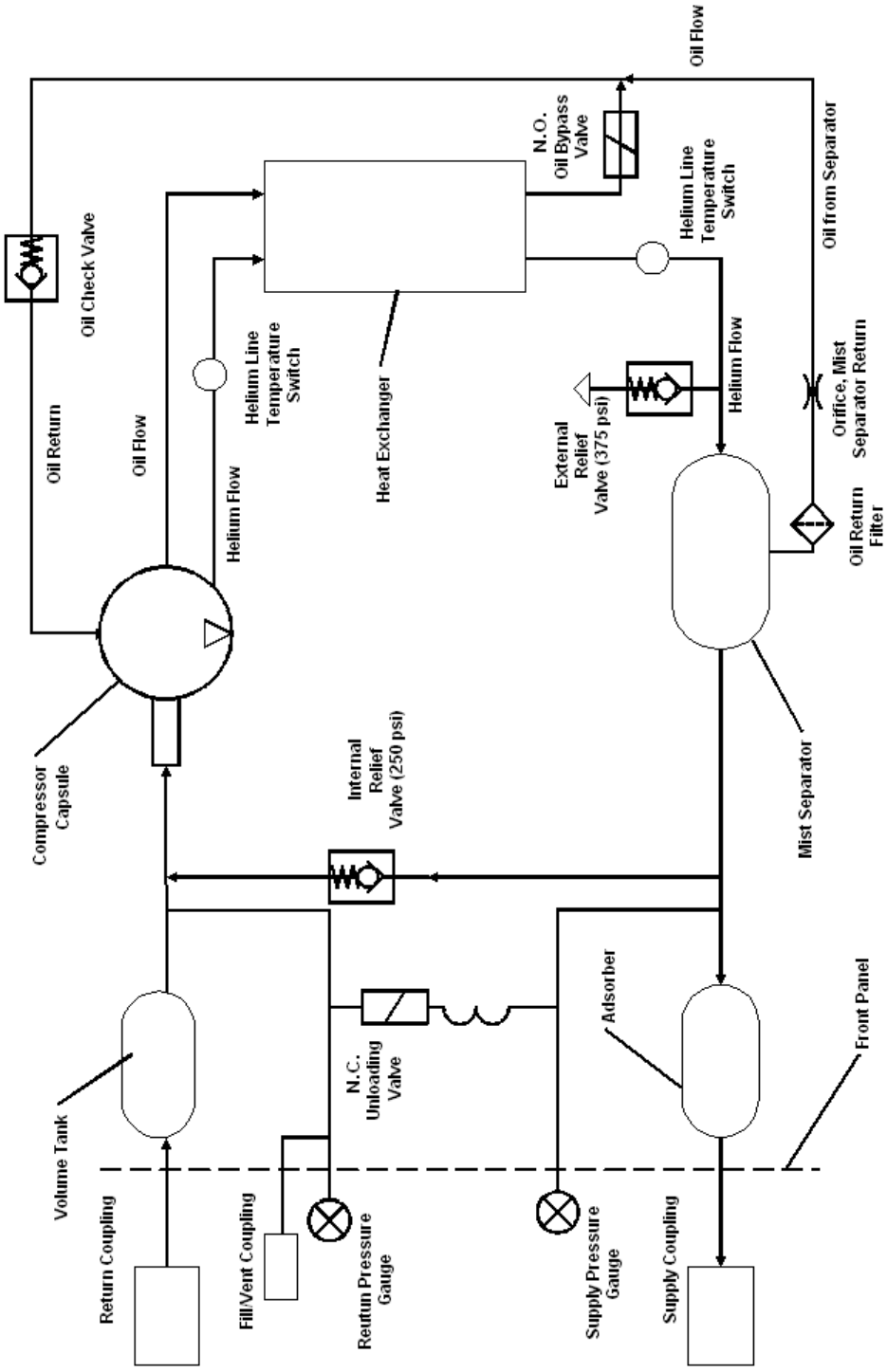
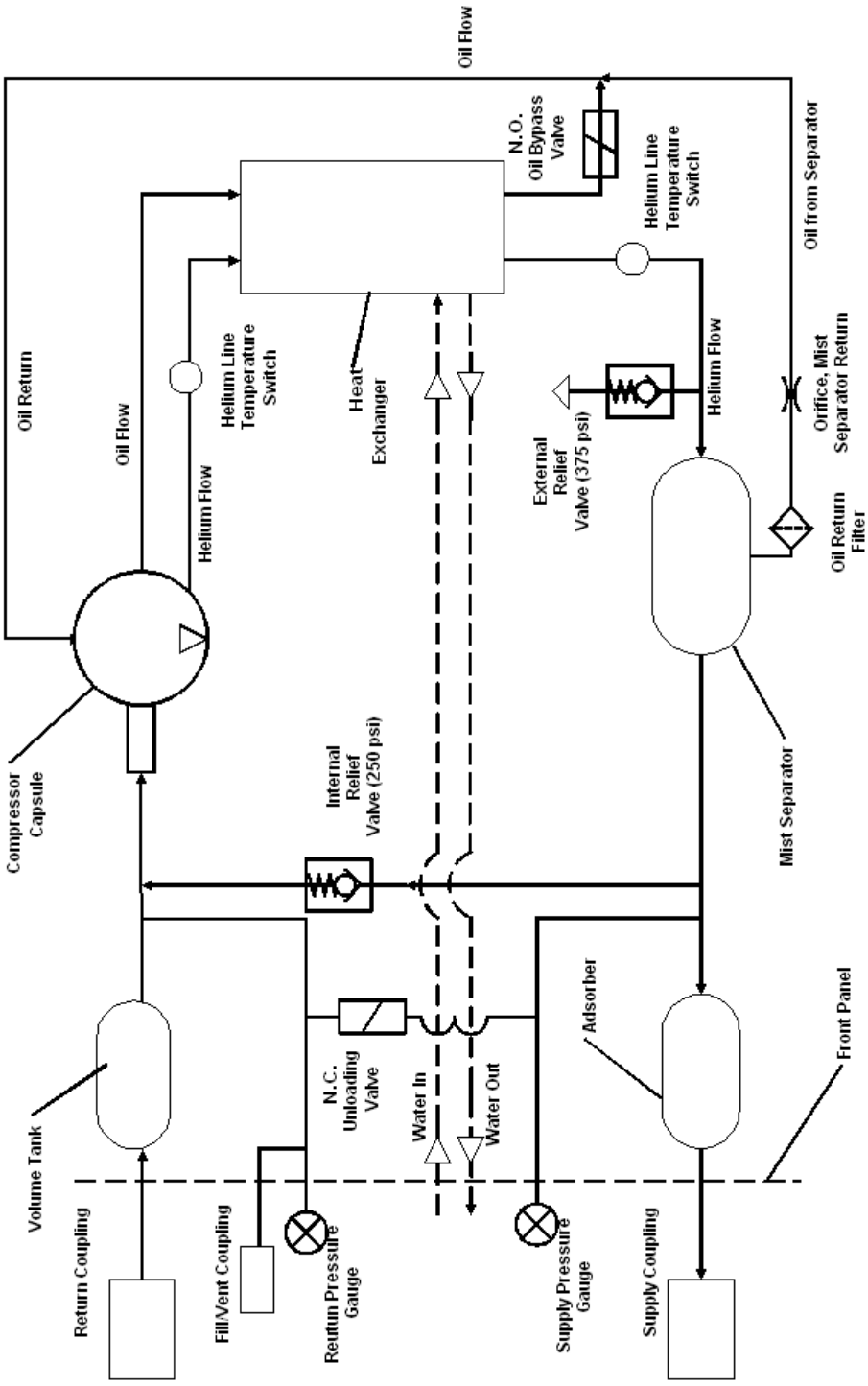


Figure 3-3. Flow Diagram for Water-Cooled Model 600 Helium Compressor



3.2 Specifications

The Model 600 Helium Compressor specifications are listed in Table 3-2 and Table 3-3.

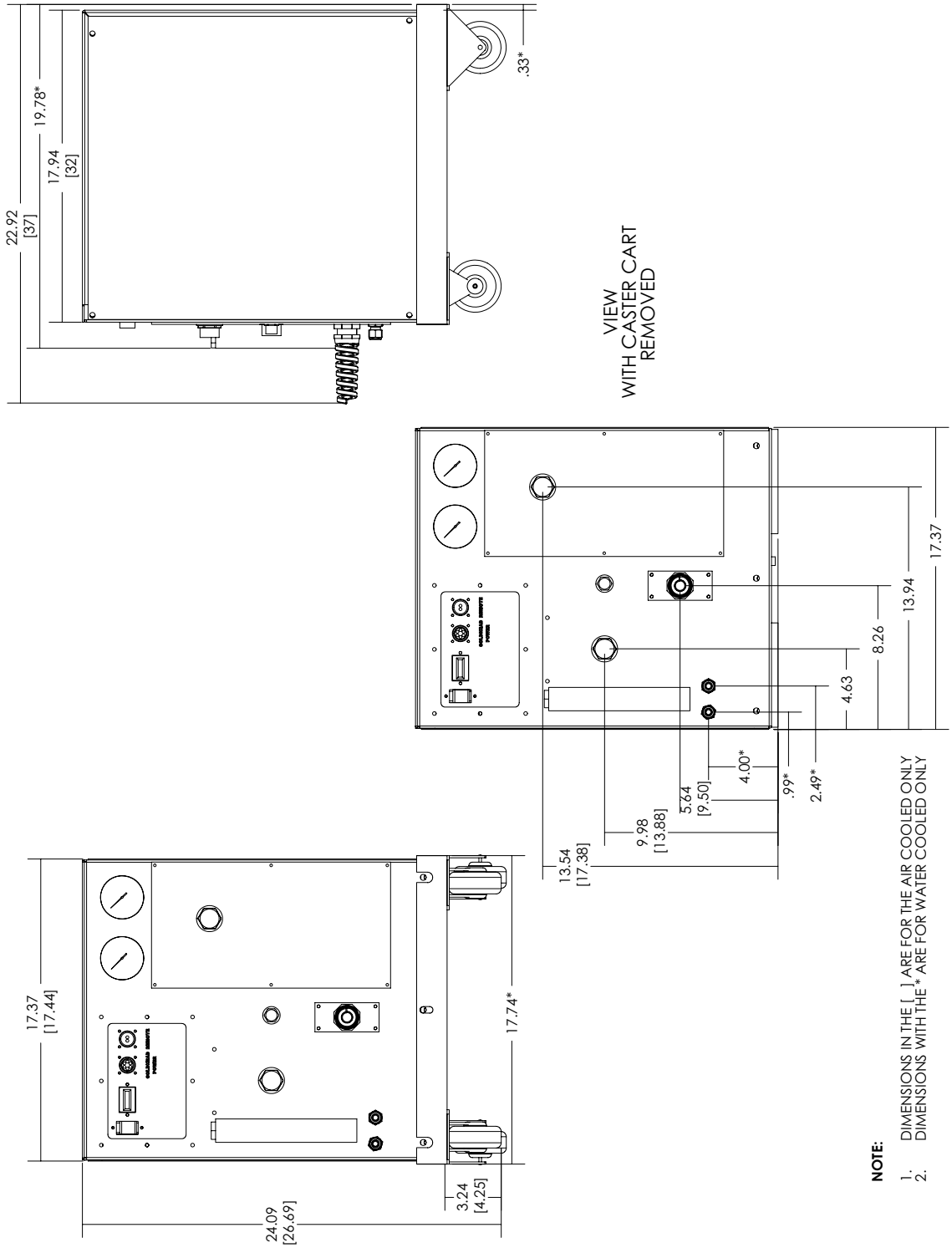
Table 3-2.Power Requirements for Model 600 Helium Compressor

Model	Operating AC Voltage [V] (Factory Setting)	Frequency [Hz]	Phase	Max Current Drawn [A]
Model 600 low voltage (all models)	200~230 +/-10% (230)	60/50	3	25
Model 600 high voltage (all models)	400~480 +/-10% (480)	60/50	3	13

Table 3-3. Model 600 Helium Compressor Specifications

Feature/Component	Specification Description
Physical Dimensions	• See Fig. 3.xx for water-cooled model • See Fig. 3.xx for air-cooled model
Weight	• 260 lbs for water-cooled model • 300 lbs for air-cooled model
Helium Pressure	• Static: 240 +/- 5 psig • Operating: 280 +/- 10 psig (supply)
Interface	• Cold head power connector mates with ASC and CTI drive cables • Helium connections: 1/2 inch male Aeroquip couplings
Adsorber Replacement Schedule	10,000 Hours (per elapsed time meter on the compressor)
Cooling Water (for water-cooled models)	• 1.5 gpm minimum flow rate • 80° F maximum inlet water temperature • Recommended chiller capacity: 2.5 ton/per unit • Water line connector: 3/8 inch Swagelok
Air Cooling (for air-cooled models)	• Air-cooled units must maintain a minimum clearance of at least 12 inches at both the front and rear grills • Maximum ambient temperature should not exceed 104° F

Figure 3-4. Model 600 Dimensions (Larger Print Attached at the End of This Manual)



3.3 Ordering Information

Table 3-4 contains the ordering information for the Model 600 compressor unit.

Table 3-4. Model 600 Helium Compressor Ordering Information

Compressor Configuration	Part Number
M600 water-cooled, low voltage, standard drive circuit	91-00001-0LW
M600 water-cooled, high voltage, standard drive circuit	91-00001-0HW
M600 air-cooled, low voltage, standard drive circuit	91-00001-0LA
M600 air-cooled, high voltage, standard drive circuit	91-00001-0HA
M600 water-cooled, low voltage, Onboard drive circuit	91-00001-LWB
M600 water-cooled, high voltage, Onboard drive circuit	91-00001-HWB
M600 water-cooled, high voltage, 5/100 drive circuit	91-00001-1HW

Customers can also order the optional accessories and replacement parts listed in Table 3-5.

Table 3-5. Optional Accessories and Replacement Parts

Accessories/Replacement Parts	Part Number
Adsorber	80-00005-000
Helium charge line (10ft.*), with bleeder fitting	94-01006-010
Helium lines (10ft.*)	10418-10
Helium regulator	HR-580
Helium tee, for connecting two cryopumps	T-MMF
Three-port manifold, for connecting three cryopumps	80075
Splitter box, supplies power to up to three cryopumps	10359
Onboard splitter box, supplies power to up to three Onboard cryopumps	10366
Maintenance manifold, for helium clean up process on compressors and cryopumps	10134
Cryopump drive cable (10ft.*), sends power to the cryopump motor from the compressor	10144-10

*Custom length available.

Installation 4

4.1 Safety Warnings

Review the safety warnings in Chapter 2 before beginning any installation activities.

4.2 Installation Steps

4.2.1 Unpacking and Inspection

Once the equipment is received, inspect the exterior of the shipping carton for any signs of damage. Report any damage to the shipping company immediately.

Remove the straps and packaging materials on the compressor unit, then lift or roll the unit out of the carton carefully. Inspect the exterior of the unit. If any damage is observed, inform the shipping company. Keep the original packaging materials in case the unit needs to be returned to the factory for service or other reasons.

Most shipping companies have a certain grace period for reporting damages due to shipping in order to process the insurance information in a timely manner. Therefore it is highly recommended that shipping carton be opened and the unit inspected whether or not it will be put into operation right away.

Caution: ***When transporting or storing the compressor unit, make certain it is not tilted by more than 45 degrees to avoid the unit been tipped over.***

4.2.2 Mounting the Compressor

It is highly recommended that the compressor unit be installed on a level and steady surface.

If the unit must be installed in a tilted manner, the maximum tilting angle is 10 degrees. Tilting the unit more than this maximum allowable angle could result in damage and contamination in the system, and may void the warranty on the unit.

4.2.3 Preparing the Compressor for Operation

1. Check the voltage of the power source before connecting the main power cable to a suitable connector or disconnect box, making sure that the compressor switch is off. *If the voltage of the power source is different from the factory default setting (see Chapter 3,Table 3-2), it may be necessary to change the tap settings on the 24VAC control transformer located inside the electrical box of the compressor. Follow the steps described in Section 4.2.5 to make the change.*
2. For water-cooled Model 600 units, connect the cooling water:

a. Typical municipal drinking water is recommended.

b. Minimum water flow rate of 1.5 gpm is required to achieve a maximum discharge temperature of 100 °F (with 80°F considered ideal)

3. For air-cooled Model 600 units, make sure the front and rear grills have at least 12 inches of clearance from the nearest objects.
4. Verify that helium pressure is between 240 +/- 5 psig. If pressure is low, refer to Chapter 7, Section 7.4.1 for charging procedures.
5. Start the compressor and run for about 15 minutes to stabilize the compressor oil inventory.
6. The compressor is now ready to be connected to the cryopump or coldhead.

4.2.4 Installation

4.2.4.1 Ambient Conditions and Coolant Connection

Ambient Conditions:

When the compressor is in operation, the ambient temperature should be between 5°C to 40°C (40°F to 104°F). The compressor unit should be set up in a non-condensing environment.

Coolant Connection:

Caution: ***For water-cooled compressor models, the water used in the unit operation must meet the specifications indicated in Chapter 3, Section 3.2.***

Caution: ***Failure to comply with the coolant specifications may result in serious damage to the compressor and may void the warranty on the unit.***

Identify the inlet and outlet connection ports first before connecting the hoses. The water supply line should be connected to the inlet port on the compressor.

Periodically check the coolant flow rate and temperature to ensure the proper operation of the compressor unit.

4.2.4.2 Connecting the Helium Flexlines

Caution: ***Attach or detach the helium flexlines only when the power to the compressor unit is switched off. Never twist the helium flexlines during the installation process.***

Before connecting the helium flexlines, follow these steps:

1. Identify the helium “Return” (low pressure) and “Supply” (high pressure) ports on the compressor front panel.
2. Clearly mark the helium flexline that will be used to connect to the corresponding “Supply” and “Return” port on the cryopump or coldhead,

Note: The helium flexlines are equipped with self-sealing couplings which can be attached and detached without helium escaping.

Follow these steps to connect the helium flexlines:

1. Unscrew the protective caps from the couplings and keep the caps for future use.

2. Check the connectors for cleanness. When necessary, use lint-free clean cloth or soft brush to clean the connectors.
3. Check the flat seals on the male couplings and make sure they are properly placed. Replace any missing or defective seals.
4. Use only the open-wrenches supplied with the installation kit. For a ½" coupling, tighten with a 1-3/16" wrench and stabilize with a 1" wrench.
5. Tighten down all couplings as far as possible and then back off by one quarter turn to relieve strain.

If the flexlines need to be bent to a radii of less than 8" (20 cm), then a 90 degree helium elbow needs to be installed (see Chapter 3, Section 3.3 for the part number).

4.2.4.3 Filling the Compressor with Helium Gas

Caution: ***All safety regulations related to handling pressurized gas cylinders must be observed. Only use helium with 99.999% or better purity when performing refill operation.***

Required tools:

- Helium gas cylinder filled with ultra-high-purity (UHP) helium (99.999% Minimum)
- 8" crescent wrench
- 10" crescent wrench
- Helium regulator (P/N HR-580)
- Helium charge line (10'), with bleeder fitting (P/N 94-01006-010)

Follow these steps:

1. If the compressor was running, turn off the compressor. Allow the compressor to cool down for at least one hour.
2. Look at the two pressure gauges and determine whether or not helium needs to added or vented from the system. The proper static pressure for the M600 series compressor is 240 ± 5 psi.
3. Attach the helium regulator to the UHP helium bottle. Open the valve on the UHP helium bottle.
4. Attach the helium charge line to the regulator.
5. Set the regulator to 240 psi. Open the regulator.
6. Attach the ¼" male bleeder fitting that comes with the helium charge line to the ¼" female Aeroquip fitting on the helium charge line. Slowly tighten the bleeder fitting to the ¼" female Aeroquip fitting on the helium charge line until gas starts to vent. Vent the helium charge line for at least 15 seconds.
7. Remove the bleeder fitting from the helium charge line. Attach the helium charge line to the ¼" vent/fill Aeroquip on the M600 compressor.
8. Fill the compressor with UHP helium until the pressure gauges read 240 ± 5 psi.
9. Remove the helium charge line from the compressor.
10. Close the regulator.
11. Close the valve on the UHP helium bottle.
12. Remove the helium regulator from the UHP helium bottle.

13. Seal the helium gas charge/vent valve on the compressor unit by properly securing with a protective cap.

4.2.4.4 Adjusting Helium Gas Pressure

Refer to Chapter 3, Table 3-3 for the required pressure specification of the compressor unit. If the pressure falls below that level, the helium gas refill procedure described in Section 4.2.4.3 needs to be performed. On the other hand, if the pressure is too high, then the helium gas needs to be released in order to maintain the proper level.

4.2.5 Electrical Connection

Caution: ***Before connecting power to the compressor unit, make sure the factory setting of the operating voltage matches that of the power supply where the unit is being installed. Failure to do so will result in performance degradation of the system.***

If the voltage of the power source is different from the factory default setting (see Chapter 3, Table 3-2), it may be necessary to change the tap settings on the 24VAC control transformer located inside the electrical box of the compressor. Follow the steps described below to make the change:

1. Unscrew the two side panels of the compressor
2. Unscrew the top (wrap-around) cover of the unit
3. Unscrew the electrical box cover
4. Change taps on the 24VAC control transformer to the setting that is closest to that of the power source (illustrated in Figure Figure 4-1)
5. Put back and screw down the electrical box cover
6. Put back and screw down the panels and top cover of the compressor

Electrical connections are to be made in accordance with the diagram in Figure 4-2 for high voltage M600 compressor models, and the diagram in Figure 4-3 for low voltage models.

Figure 4-1. Model 600 Helium Compressor Control Voltage Transformer Tap Settings

208/220V Setting

208/220V Setting
(Factory setting for low voltage models)

380/400V Setting

460/480V Setting
(Factory setting for high voltage models)

Figure 4-2. M600 High Voltage Model Electrical Schematics (Larger Print at the End of This Manual)

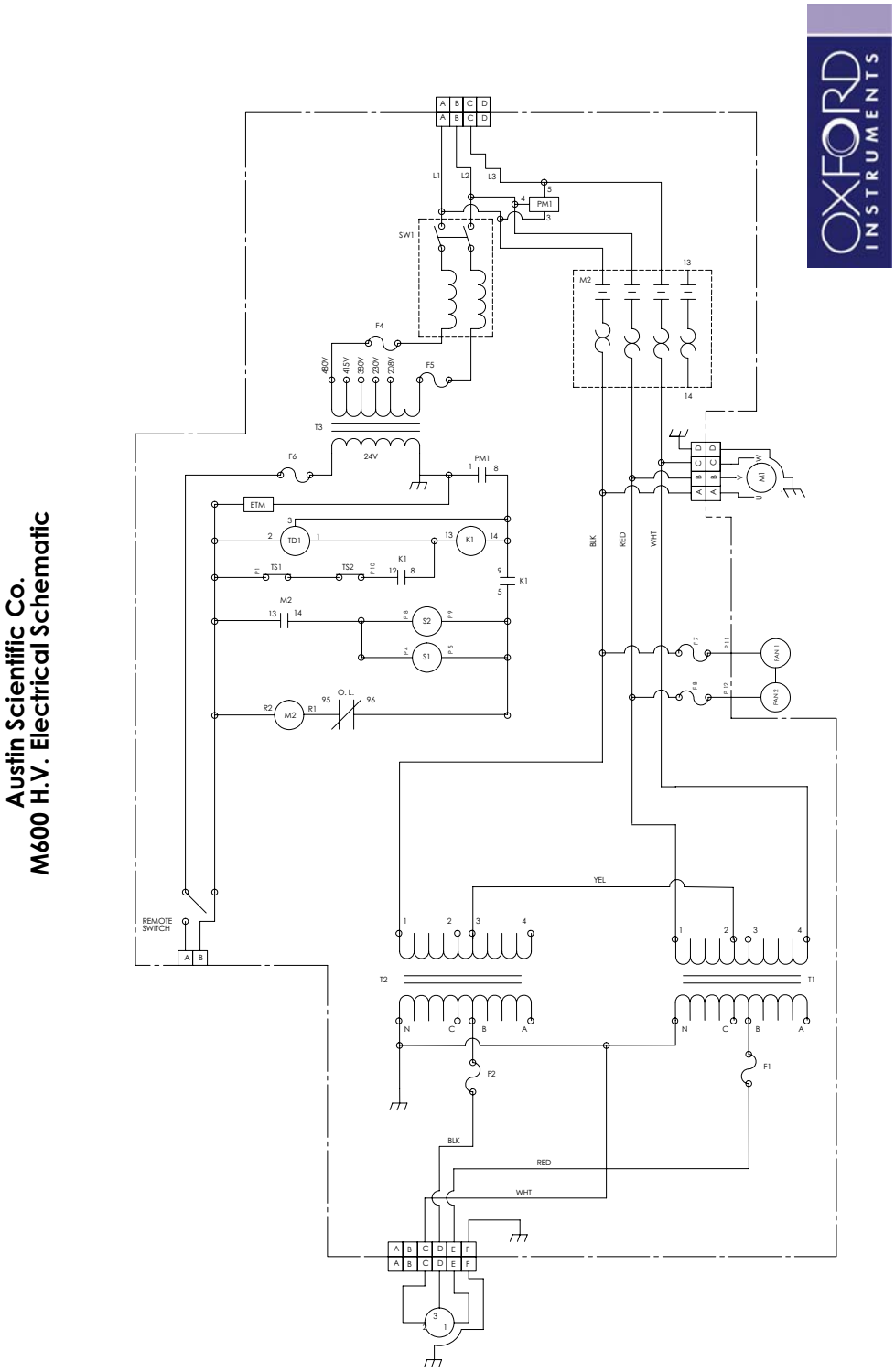
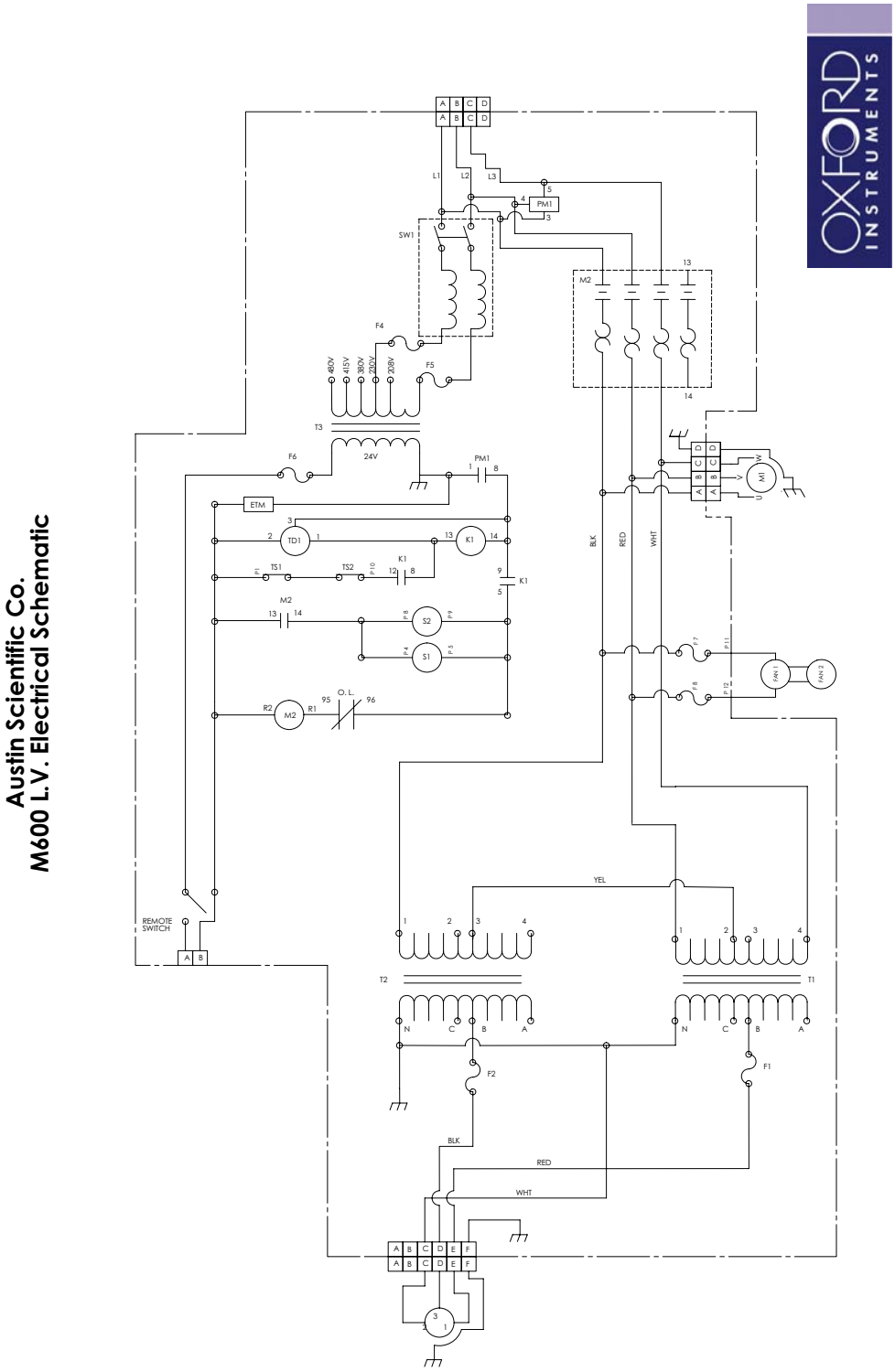


Figure 4-3. M600 Low Voltage Model Electrical Schematics (Larger Print at the End of This Manual)



Operations 5

5.1 Before Switching On the System

After the compressor unit and its load (cryopump, coldhead, etc.) are installed and connected, check the helium gas pressure as indicated by the pressure gauge mounted on the rear panel of the compressor unit. Refer to Chapter 3, Section 3.2, for the proper static pressure readings for the compressor.

If the helium pressure needs to be adjusted, refer to Chapter 7, Section 7.4.1 for procedures to release helium gas in order to reduce the pressure, or to fill the compressor with more helium gas to increase the pressure.

5.2 Normal Operation

Caution: ***Run the compressor unit continuously only when it is connected to the helium flexlines and the compressor load (cryopump, coldhead, etc.). Failure to do so may cause damage to the compressor and could void the warranty.***

The load of the compressor can be powered through the power connectors located on the front panel of the compressor. To start operation of the compressor and its load, do the following:

1. Open the coolant supply (water-cooled compressor model only)
2. Switch on the main power source
3. Press the ON button to start the compressor. Both the compressor and its load should start simultaneously

During operation, check the coolant flow rate (water-cooled models) and the operating pressure frequently. Refer to Chapter 3, Table 3-3 for required coolant flow rate. If it is too slow, make sure any problems associated with water supply or water outlet are resolved. Refer to Chapter 3, Table 3-3 for proper helium pressure level for the compressor unit. If the helium pressure is too low, switch off the compressor unit. It may be necessary to perform a helium "topping-up" maintenance procedure as described in Chapter 7, Section 7.4.1. If pressure drop-off happens frequently, there may be a substantial leak in the helium circuit of the compressor. In this case, contact Austin Scientific customer service immediately.

To shut down the compressor unit, press the OFF button on the front panel. After that, allow coolant to continue to circulate for at least 10 more minutes before shutting off flow (water-cooled models).

Troubleshooting 6

6.1 Troubleshooting Activities

Table 6-1 describes some problems that users might encounter while operating the Model 600 Cryopump Compressor and provides solutions to those problems.

If a compressor problem still persists after performing the corrective actions described in this section, please contact Austin Scientific Technical Support for further assistance. Refer to Chapter 1, Section 1.2 for contact information.

Table 6-1. Troubleshooting Procedures

Problem	Possible Cause	Corrective Action
The compressor On/Off switch (SW1) is in the On position but will not start.	1. No power is coming from the power source. 2. Incorrect or disconnected wiring within the compressor 3. Thermal protection switch (TS1 and/or TS2) is open. 4. High current has tripped the current overload relay.	1. Check service fuses, circuit breakers, and wiring associated with the power source. Repair as needed. 2. Check the compressor against the wiring schematic. See Chapter 4, Figure 4-2 or Figure 4-3. 3. Confirm that switch TS1 and/or TS2 is closed. 4. Reset the current overload relay.
Compressor stops after several minutes of operation and remains off.	1. High temperature of the compressor caused by insufficient cooling water (for water-cooled model), resulting in the opening of thermal protection switches (TS1 and/or TS2). For air-cooled model, the ambient temperature is too high. 2. Insufficient helium static pressure. 3. Low power source voltage. 4. Mechanical seizure.	1. Confirm that sufficient cooling water (for water-cooled model) is flowing to the compressor. For air-cooled model, provide additional cooling to the surrounding environment. 2. Add helium, using the procedures described in Chapter 7, Section 7.4.1. 3. Confirm that power source voltage is correct. 4. Contact Austin Scientific for assistance.

Maintenance 7

7.1 Maintenance Personnel Requirements

Only trained and qualified personnel should perform the maintenance procedures described in this chapter. All other maintenance work must be performed by Austin Scientific personnel in the factory. Please contact Austin Scientific to make arrangement for such work. See contact information in Chapter 1, Section 1.2

7.2 Removing the Compressor from Service: Removal, Transport, and Storage

It is recommended that the Model 600 compressor be removed from service when carrying out the maintenance duties described in Chapter 7, Section 7.3.

To remove the compressor unit from service, do the following:

1. Turn off the compressor unit by pressing the OFF button
2. Switch off the main power supply to the compressor
3. Separate the compressor unit from the main power source
4. Allow coolant to continue circulate for at least 10 more minutes (for water-cooled model)
5. Allow the compressor load (cryopump, coldhead, etc.) to warm up before detaching helium flexlines

Caution: ***Loosening or detaching helium flexlines with the compressor load at low temperature without proper warming-up can result in loss of helium and/or pressure rise in the compressor unit beyond its designed maximum pressure level.***

When transporting the compressor unit, follow these guidelines:

- Make sure the appropriate protective caps are properly secured before shipping.
- Always store the compressor unit in a dry place. Refer to Chapter 3, Table 3-3 for proper storage environment.
- If a freezing temperature environment is anticipated whether during shipping or under storage, make certain the coolant in the compressor circuit is properly drained.

Caution: ***The compressor unit should never be tilted more than 45 degrees either during shipping or in storage.***

7.3 Scheduled Preventative Maintenance Activity

The only scheduled maintenance required on the Model 600 compressor is the replacement of compressor adsorber after every 10,000 hours of operation as indicated on the compressor elapsed time meter. When the compressor is used with 50 Hz power, the actual elapsed time will be 1.2 times of that shown on the meter.

The adsorber is used to keep the oil vapor out of the helium gas in the flow circuit of compressor unit and its load. After about 10,000 hours of operation, the effectiveness of the adsorber will decrease. It then needs to be replaced. Otherwise the oil particles could accumulate on the cold surface of the compressor load, reducing the cooling performance of the overall system. In severe cases of such oil contamination, the load (cryopump, coldhead, etc.) could cease to function completely.

To remove and replace the compressor adsorber, follow the steps described in Chapter 7, Section 7.3.1 and Chapter 7, Section 7.3.2.

Caution: ***Use only Austin Scientific supplied adsorber for replacement. Refer to Chapter 3, Section 3.3 for the part number.***

7.3.1 Remove the Compressor Adsorber

To remove the compressor adsorber:

1. Turn off the compressor and separate it from the main power supply.
2. Allow sufficient time for the load of the compressor (cryopump or coldhead) to warm up before detaching the helium flexlines from the compressor. Refer to Chapter 4, Chapter 4.2 for proper procedures to detach helium flexlines.

Caution: ***Detaching helium flexlines with the compressor load at low temperature could result in loss of helium gas. It may also cause the pressure rise in the system beyond the permissible level therefore creating a safety hazard.***

3. Use the two wrenches supplied with the (optional) Installation Kit to avoid loosening the body of the coupling from its adapter. Hold one wrench tight on the coupling half attached to the rear side of the compressor. Use the other wrench to loosen the coupling to the helium supply line.
4. Unscrew the two-self sealing coupling halves quickly to minimize minor gas leakage. Figure 7-9 contains an illustration of the self-sealing couplings.
5. Detach the helium flexline from the helium supply connection located on the blue panel on the front panel. See Figure 7-1.
6. Unscrew and remove the nut and washer of the helium supply connector.
7. Unscrew the six screws holding the blue panel on the front panel, as illustrated in Figure 7-2.
8. Once the blue panel is removed, the adsorber should be in full view. Remove the two screws that hold the adsorber to the bottom of the compressor chassis, as illustrated in Figure 7-3 and Figure 7-4.
9. There is a short section of helium flexline that connects the adsorber with the oil-mist separator of the compressor. Unsrew the connection. See Figure 7-5.
10. Slightly pull the adsorber assembly towards the front. Then tilt the assembly to remove it from the chassis, as illustrated in Figure 7-6.

11. Remove the adsorber and save all nuts, bolts, and washers for installing the replacement adsorber (Figure 7-7 and Figure 7-8).
12. The removed adsorber can be returned to Austin Scientific for credit. Chapter 1, Section 1.2 provides the contact information.

7.3.2 Install Replacement Adsorber

To install the replacement adsorber:

1. Remove the dust caps from the self-sealing coupling halves at each end of the replacement adsorber.
2. Check the self-sealing connector flat rubber gasket to make sure that it is clean and properly positioned.
3. Place the adsorber back in the compressor using the nuts, bolts, and washers set aside during the removal process described in Step 5 of Chapter 7, Section 7.3.1.
4. Install the two-self sealing coupling halves quickly to minimize minor gas leakage.
5. Use the two wrenches supplied with the (optional) Installation Kit, holding one wrench tight on the coupling half attached to the rear side of the compressor. Use the other wrench to tighten the coupling to the helium supply line.
6. Make the final turns by hand and then use the wrenches until the fittings bottom out.
7. Replace the cover and the flex lines.
8. Make sure the supply pressure gauge reads 240 +/- 5 psig. If the pressure is either too high or too low, follow the instructions in Chapter 7, Section 7.4.1 to fill the helium gas to the proper pressure level.
9. Add 10,000 to the reading of the elapsed time meter and write this number on the decal provided with the replacement adsorber. This decal can be affixed to the foot of the compressor.
10. Restart the compressor.

Figure 7-1. Remove compressor adsorber - Step 5

Figure 7-2. Remove compressor adsorber - Step 6

Figure 7-3. Remove compressor adsorber - Step 8 (a)

Figure 7-4. Remove compressor adsorber - Step 8 (b)

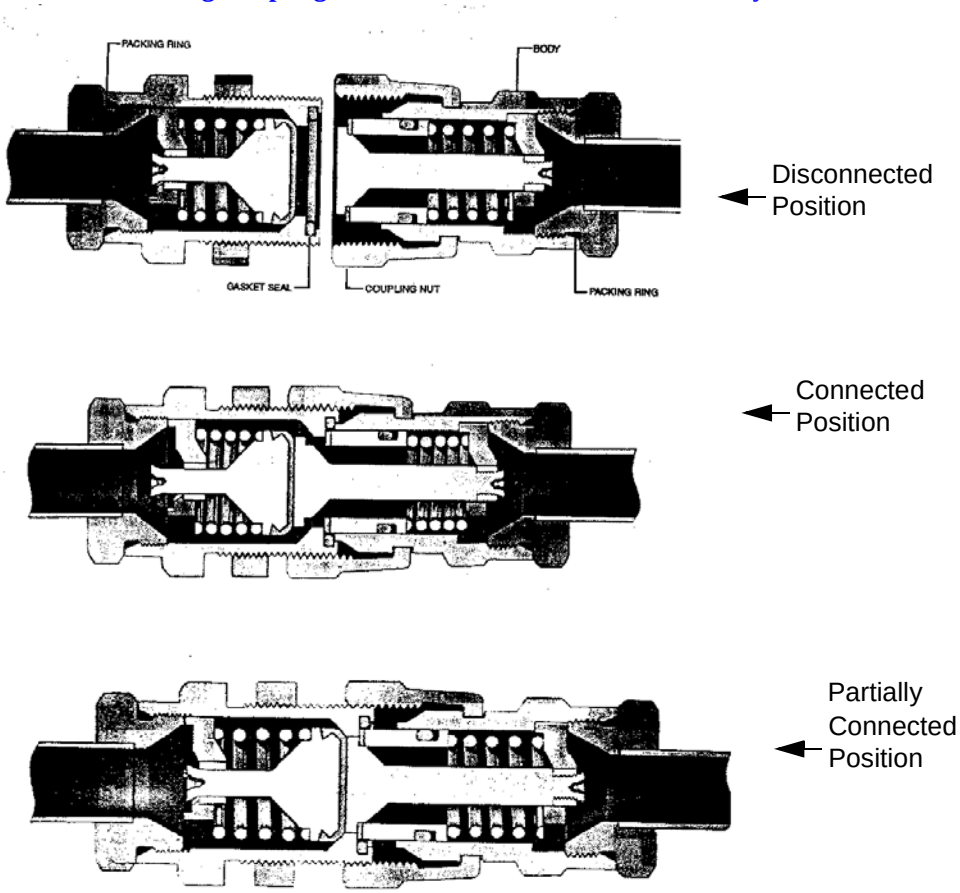
Figure 7-5. Remove compressor adsorber - Step 9

Figure 7-6. Remove compressor adsorber - Step 10

Figure 7-7. Remove compressor adsorber - Step 11 (a)

Figure 7-8. Remove compressor adsorber - Step 11 (b)

Figure 7-9. Model 600 Self-Sealing Coupling in Disconnected, Closed, and Partially Closed Positions



7.4 Unscheduled Corrective Maintenance

The following corrective maintenance activities may be necessary should the helium gas circuit of Model 600 compressor becomes contaminated.

7.4.1 Add or Vent Helium Gas

If a compressor unit needs to have helium gas added more than once every several months, check for leaks caused by improperly connected self-sealing connections or incorrectly sealed charge valve. If the compressor unit is connected to its load (cryopump, coldhead, etc.), check for leaks in the load also.

Use only 99.999% pure helium gas.

Required tools:

- Helium gas cylinder filled with ultra-high-purity (UHP) helium (99.999% Minimum)
- 8" crescent wrench
- 10" crescent wrench
- Helium regulator (P/N HR-580)
- Helium charge line (10'), with bleeder fitting (P/N 94-01006-010)

Follow these steps:

1. Turn off the compressor. Allow the compressor to cool down for at least one hour.
2. Look at the two pressure gauges and determine whether or not helium needs to added or vented from the system. The proper static pressure for the M600 series compressor is 240 ± 5 psi.
3. If the static helium charge is too high, helium should be vented. If this is not the case, skip to Step 5.
4. Use a ¼" female Aeroquip fitting, similar to the one that comes with the helium charge line to vent the helium from the compressor. Slowly tighten the bleeder fitting to the ¼" vent/fill Aeroquip until gas starts to vent. Allow the compressor to vent until the static pressure is 240 ± 5 psi.
5. If the static pressure is too low, helium needs to be added.
6. Attach the helium regulator to the UHP helium bottle. Open the valve on the UHP helium bottle.
7. Attach the helium charge line to the regulator.
8. Set the regulator to 240 psi. Open the regulator.
9. Attach the ¼" male bleeder fitting that comes with the helium charge line to the ¼" female Aeroquip fitting on the helium charge line. Slowly tighten the bleeder fitting to the ¼" female Aeroquip fitting on the helium charge line until gas starts to vent. Vent the helium charge line for at least 15 seconds.
10. Remove the bleeder fitting from the helium charge line. Attach the helium charge line to the ¼" vent/fill Aeroquip on the M600 compressor.
11. Fill the compressor with UHP helium until the pressure gauges read 240 ± 5 psi.
12. Remove the helium charge line from the compressor.
13. Close the regulator.
14. Close the valve on the UHP helium bottle.
15. Remove the helium regulator from the UHP helium bottle.
16. Restart the M600 compressor.

7.4.2 Remove Helium Contamination

Helium contamination is usually indicated by irregular, noisy or intermittent operation (ratcheting), and sometimes seizure of the cryopump drive mechanism. This is caused by accumulation of frozen contaminants within the compressor load and resulting in interference. The source of the helium contamination is due to either

- Inadvertent introduction of ambient air into the system
- Use of helium with purity of lass than 99.999%, such as helium gas used for leak detection and welding.

Steps to decontaminate the helium circuit:

Minor contamination can usually be removed by running the cold cryopump for several hours to trap contaminants in the cryopump, then shut down the compressor and immediately remove the helium lines at the compressor. Allow the cryopump to warm thoroughly, then perform the cleanup procedure as outlined in the cryopump manual.

7.5 Cleaning Equipment

Stubborn contamination involving water vapor requires decontamination of the compressor. One effective method involves supplying clean helium to the return side at appropriate pressure while venting a small amount of gas from the supply side; while the compressor is running. This is referred to as a "running purge". Contact Austin Scientific if such a procedure is needed.

Caution: ***Do not use solvents to clean the connectors. The fittings should never be greased or oiled. Otherwise the helium circuit could become contaminated.***

7.6 Returning Equipment

Before returning any equipment, contact Austin Scientific to receive special instructions and to obtain a return authorization (RMA) number. See contact information in Chapter 1, Section 1.2.