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... the variable temperature solid state characterization experts!*

WHAT ARE THE SPECIFICATIONS FOR THE VACUUM PUMPS NEEDED TO OPERATE THE JOULE THOMSON REFRIGERATORS?

INTRODUCTION TO VACUUM PUMP USAGE

Joule Thomson refrigerators have a wide temperature range to operate over, ranging from 70K to 730K. In order to reach these temperatures, there are two types of vacuum requirements:

- (1) For general temperature control, the Joule Thomson refrigerator must be in a vacuum chamber with a vacuum of no less than 8 milliTorr. This can be accomplished using a two stage roughing pump. This pump will be described in the section "Vacuum Chamber Pump Specifications" on page 1.

► **NOTE**

Turbo pumps can be used only with the MMR Technologies' Variable Temperature Microprobe System, to achieve much higher vacuum. These pumps will not be described in this technical support bulletin. For further information, please contact MMR Technologies.

- (2) For temperatures below 80K, a second pump is required to provide a constant, reliable vacuum pressure to assist the cooling down to temperatures as low as 68K. MMR Technologies has a vacuum pump kit specifically recommended for this usage. Information on this kit will be described in the section "Vacuum Assist Pump Specifications to Reach 68K" on page 4.

VACUUM CHAMBER PUMP SPECIFICATIONS

A vacuum chamber pressure of 8 milliTorr or better is ideal for the operation of the MMR Technologies' Joule-Thomson (J-T) cryogenic cooling system and thermal isolation of the device under analysis. A two stage roughing pump with a pumping speed of at least 90 liters per minute (3.18 cfm, 5.3 cmm) is suggested for this application. This pump should be operated with no air injection or bleed.

Recommended Pumps

MMR Technologies' recommends the Alcatel 2005 pumps, and specifically the model 2010SD Pascal Series Rotary Vane pump as a good pump, meeting the minimum

specification. This pump is available from MMR Technologies (part number C1800). The 2010SD pump has several highly desirable traits:

- Quiet
- Excellent water vapor pumping
- Low temperature
- Very low ultimate pressure
- Continuous operation at all pressures
- Easy maintenance

Dimensions of the Alcatel 2005 Pumps

There are several versions of this pump available, depending on the electrical rating required:

| ELECTRICAL RATING | | | DIMENSIONS IN MM | | |
|--------------------------|-------------|----------|-------------------------|----------|----------|
| | | | L | D | H |
| 1 phase | 115 - 230 V | 50/60 Hz | 250 | 155 | 133 |
| 3 phase | 230 - 460 V | 50/60 Hz | 240 | 155 | 78 |
| 1 phase | 220 V | 50 Hz | 167 | 162 | 126 |
| 3 phase | 220 - 380 V | 50 Hz | 184 | 140 | 100 |
| 1 phase | 240 V | 50 Hz | 236 | 162 | 126 |
| 3 phase | 240 - 415 V | 50 Hz | 184 | 140 | 100 |

Technical Characteristics of the Alcatel 2005 Pumps

| TECHNICAL CHARACTERISTICS | UNITS | 50 Hz | 60 Hz |
|----------------------------------|----------------------------|------------------------|------------------------|
| Free air displacement | m ³ /h (cfm) | 5.4 | 6.5 (3.8) |
| Pneurop pumping speed | m ³ /h (cfm) | 4.8 | 6.5 (3.4) |
| Ultimate Pressure | | | |
| no air injection | mbar | < 10 ⁻⁴ | < 10 ⁻⁴ |
| with partial air injection | mbar | < 2 x 10 ⁻³ | < 2 x 10 ⁻³ |
| with total air injection | mbar | < 10 ⁻² | < 10 ⁻² |

| TECHNICAL CHARACTERISTICS | UNITS | 50 Hz | 60 Hz |
|---------------------------------------|--------------|--------------|--------------|
| Inlet and exhaust flanges | NW | 25 | 25 |
| Max. permissible water vapor pressure | mbar | 35 | 25 |
| Water vapor absorption capacity | g/h | 120 | 110 |
| Weight | kg (lbs) | 22.4 (52) | 23 (51) |
| Motor | kW (h.p.) | 0.375 | 0.5 (1/2) |
| Oil capacity | l | 0.825 | 0.825 |
| Recommended oil | | Alcatel 100 | Alcatel 100 |
| Noise level (as per Pneurop) | dBa | 50 | 52 |

The Windsor Series from Stokes Vacuum

All Stokes Windsor Series pumps are a two-stage design. A gas ballast is standard to prevent condensation, an especially useful feature for applications involving high concentrations of water vapor or other condensable gases.

A specially designed oil pump within the pump module supplies a constant and consistent positive pressure to lubricate components, seal vacuum, dissipate heat, and flush away contaminants. This results in cooler operation with minimal friction and a longer service life.

Anti-suckback protection is standard to protect the vacuum chamber when the pump is shut off. Other features of the Stock Windsor Series include conveniently located sight glass windows, easily accessible oil drain and fill ports, and standard ISO flanges to simplify connection to any vacuum system.

Model 56 Specifications

| | |
|----------------------------|---|
| Nominal Pumping Speed: | 5.6 cfm (160 L/min.) |
| Ultimate Pressure: | 6.0×10^{-4} Torr |
| Motor Horsepower: | 1/2 h.p. |
| Oil Capacity: | 1.4 qt. (1.3 L) |
| Tubing Needed: | 13/16 inch I.D. |
| Intake/Exhaust Connection: | ISO NW 25 |
| Electrical Requirements | 115/230V, 50/60 Hz, single phase |
| Weight: | 58.5 lbs (26.6 kg) |
| Overall Dimensions: | 20.75" L x 7.18" W x 10.75" H (528 mm x 179 mm x 272 mm) |

VACUUM ASSIST PUMP SPECIFICATIONS TO REACH 68K

There are two main low end temperatures for the Joule-Thomson refrigerators: 68K or 77K. If you are operating a refrigerator that only goes down to 77K, you may skip this pump requirement. If however, the refrigerator is stated to have the capacity to go down to 68K, a vacuum assist pump is required.

MMR Technologies has three versions of the Vacuum Pump Kit for Gas Outlet, or the Vacuum Assist Pump, depending on the voltage requirements:

- C1813 for 115V, 60 Hz
- C1816 for 220 - 240V, 50 Hz
- C1817 for 100 V, 50/60Hz

The Vacuum Pump Kit for Gas Outlet

This vacuum pump kit provides a consistent, reliable vacuum at the gas outlet of the refrigerator permitting the vacuum assisted Joule-Thomson refrigerator to operate at temperatures as low as 68K when using nitrogen gas as the refrigerant. The vacuum pump kit provides a flexible gas coupling hose from the exhaust port of the vacuum assisted Joule-Thomson refrigerator to the vacuum pump, an over-pressure relief valve for protection of the refrigerator in the event the vacuum pump is turned off while the refrigerator is operating, a vacuum pump to maintain a vacuum in the liquid cryogen storage area of the refrigerator while the refrigerator is operating, and an oil mist filter on the pump exhaust to prevent contamination of the laboratory area with oil vapor from the pump exhaust.

Features of the Vacuum Pump Kit

Several unique features of the Model C1813, C1816, or C1817 vacuum pump kits simplify operation, provide improved performance, and extend the operating temperature range of the refrigerator.

- A complete, tested vacuum line between the mechanical pump and the MMR refrigerator exhaust port.
- Over pressurization protection using a pressure relief valve which opens when the pressure of the gas in the vacuum line exceeds atmospheric pressure by more than one pound per square inch.
- Exhaust filter/mist eliminator to trap any oil in the mechanical pump exhaust. This prevent oil contamination of the laboratory environment

Specifications of the Vacuum Pump Kit

| | |
|--|---|
| Connection to the Refrigerator Exhaust | Flexible Tygon Tubing |
| Connection to Vacuum Pump | Flexible Vacuum Tubing |
| Vacuum Pump | Modified Dayton Pump Model 4Z577 |
| Pump Exhaust System: | Balston High Efficiently Coalescing Filter |

| | |
|--------------------|---|
| WEight: | 30 pounds |
| Size: | 5.75" x 13.125" x 9.5" (150 mm x 337 mm x 242 mm) |
| Power Requirements | 120 V, 60 Hz (C1813) 220 to 240V/50Hz (C1816) 100 V, 50/60 Hz (C1817) |

FURTHER QUESTIONS

If you have further questions, please do not hesitate to contact MMR Technologies, Inc.:

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