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WHAT ARE THE SPECIFICATIONS FOR THE ARGON GAS OPTION USED IN JOULE THOMSON THERMAL STAGES?

Joule Thomson refrigerators operate using high pressure gas to cool a sample stage with high temperature precision and very low noise. The most commonly used gas is nitrogen gas. There are times when argon is preferred - specifically when higher cooling capacity is necessary. Nitrogen gas gives a cooling capacity of 250 mWatts at 85K. Argon gas gives a cooling capacity of 500 mWatts at 90K.

In order to ensure maximum performance of the Joule Thomson refrigerator, with minimum operational problems, the type of argon gas used is very important.

The argon gas should be "Pre-purified Grade" purity and should be delivered in a tank at an initial pressure of at least 2640 psi. This gas can be obtained from local sources. It cannot be supplied by MMR Technologies. Shipment of high pressure gas cylinders is so highly regulated that shipment by air is not possible and shipment over long distances by truck is not economically viable.

The user should order a supply of this gas well in advance of receiving delivery of the cryogenic cooling system.

ARGON GAS SPECIFICATIONS

Gas Data

Formula:	Ar
Molecular Weight:	39.95
Specific Volume:	9.70 ft. ³ /lb. (0.60 m ³ /kg)
CAS Registry No.:	7440-37-1

Cylinder Specifications

Argon gas can come in a variety of sizes and pressures. Table 1 gives some specifications for some of the more commonly used cylinders. This is by all means not a comprehensive list.

TABLE 1: ARGON GAS CYLINDER SPECIFICATIONS

CYLINDER SIZE	VALVE OUTLET	PRESSURE AT 70F (21.1 C)
1A	CGA Number 580	2,490 psi (17, 180 kPa)
1L	CGA Number 580	2,640 psi (18, 216 kPa)
1H	CGA Number 680	3,500 psi (24, 130 kPa)
1U	CGA Number 677	6, 000 psi (41, 370 kPa)
2, 3, & 4	CGA Number 580	2,000 psi (13, 800 kPa)

► **NOTE**

Joule Thomson refrigerators require a minimum tank pressure of 1800 psi to operate. It is recommended that the minimum delivered tank pressure is 2640 psi.

► **NOTE**

When the argon tank being used for the Joule Thomson refrigerators gets below 1800 psi the tank can still be used for other applications, including acting as a back fill source of argon for the vacuum chambers or for other laboratory experiments where lower pressure argon is required.

Shipping Data

D.O.T. Proper Shipping Name: Argon, Compressed
 Hazard Class: 2.2 (Nonflammable Gas)
 I.D. No.: UN 1006
 E.R.G. Page: 12
 Label(s): Nonflammable Gas

Summary of Argon Gas Specifications

MMR Technologies, Inc. recommends that the argon gas used with the Joule-Thomson refrigerators meets the following criteria:

- Pre-purified Grade
- 99.998% minimum purity
- 1800 psi supplied pressure from the tank
- Tank pressure recommended to be at least 2640 psi
- The argon gas must go through a filter/dryer apparatus prior to going into the Joule Thomson refrigerator (There are three available kits from MMR Technolo-

gies. For further information, please refer to the Technical Support Bulletin on the Importance of Using Filter/Dryers with your Joule Thomson Refrigerators.)

There are several basic tanks that meet this qualifications. Consider the following three tables, where different tank pressures of 99.998% pure argon gas are described with respect to their contents:

TABLE 2: ARGON, PRE-PURIFIED, 99.998%

CYLINDER SIZE	CONTENTS			
	FT.³	M³	LBS	KG
1L	331	9.37	34.13	15.49
1A	280	7.93	28.86	13.09
2	88	2.49	9.07	4.11
3	35	0.99	3.61	1.64
4	12	0.34	1.24	0.56

TABLE 3: ARGON, 3500 PSI, 99.998% MIN.

CYLINDER SIZE	CONTENTS			
	FT.³	M³	LBS	KG
1H	386	10.93	39.79	18.06

TABLE 4: ARGON, 6000 PSI, 99.998% MIN.

CYLINDER SIZE	CONTENTS			
	FT.³	M³	LBS	KG
1U	570	16.14	58.76	26.66

Several types of cylinders have been described in this technical support bulletin. In order to determine the best type of cylinder for your applications and requirements, some further information on these basic cylinder types can be seen in Table 5 on page 4.

TABLE 5: DIMENSION, WEIGHT AND CAPACITY INFORMATION ON COMMON CYLINDERS

CYLINDER SIZE	NOMINAL DIMENSIONS (DIAMETER X LENGTH)		TARE WEIGHT		WATER CAPACITY		INTERNAL VOLUME	
	INCHES	CM	LBS	KG	LBS	KG	CU. FT.	LITERS
1A	9 x 51	23 x 130	122	55	96	43.5	43.8	1.55
1L	10 x 55	24 x 140	138	63	108	49.0	49.0	1.73
1H	9 x 51	23 x 130	188	85	96	43.5	43.8	1.55
1U	10 x 51	25 x 120	312	141	93	42.2	42.4	1.50
2	9 x 26	22 x 65	64	29	36.8	16.7	16.7	0.59

MMR TECHNOLOGIES CRYOCOOLER OPERATING TIME AS A FUNCTION OF STORAGE TANK SIZE AND PRESSURE

Another important consideration when deciding which argon gas tank to use with your cooling system is the length of time the experiments are expected to take, and how long the tank of argon gas will last. There are several variables that are important in this:

- Tank Size
- Tank Pressure
- The usage rate of the refrigerator

While the first two variables are intuitive, the usage rate of the refrigerator can vary from system to system, and from experiment to experiment, depending on the types of samples being cooled, the experimental conditions, the cooling requirements on the system, and the vacuum pressure within the chamber housing the Joule Thomson refrigerator. There are also slight variations from refrigerator to refrigerator. With that in mind, Table 6 will suggest some typical usage times that can be expected.

TABLE 6: OPERATING TIME FOR A TANK OF ARGON GAS AS A FUNCTION OF THE SIZE AND PRESSURE OF THE SUPPLY TANK

TANK ID	EQUIVALENT STP VOLUME OF ARGON IN THE TANK AT DELIVERY PRESSURE	STP VOLUME AVAILABLE FOR REFRIGERATOR USE	USAGE RATE OF REFRIGERATOR	OPERATING TIME AS A FUNCTION OF TANK
1L	211.0 cu. ft.	98.5 cu. ft.	2 cu. ft. / hr.	49 hours
			3 cu. ft. / hr.	33 hours
			4 cu. ft. / hr.	25 hours
			5 cu. ft. / hr.	20 hours
1A	189.0cu ft.	72.5 cu. ft.	2 cu. ft. / hr.	36 hours
			3 cu. ft. / hr.	24 hours
			4 cu. ft. / hr.	18 hours
			5 cu. ft. / hr.	15 hours
1H	189.0 cu. ft.	178.5 cu. ft.	2 cu. ft. / hr.	89 hours
			3 cu. ft. / hr.	60 hours
			4 cu. ft. / hr.	45 hours
			5 cu. ft. / hr.	36 hours
1U	183.0 cu. ft.	426.8 cu. ft.	2 cu. ft. / hr.	213 hours
			3 cu. ft. / hr.	142 hours
			4 cu. ft. / hr.	107 hours
			5 cu. ft. / hr.	85 hours
2	72.0 cu. ft.	8 cu. ft.	2 cu. ft. / hr.	4 hours
			3 cu. ft. / hr.	2.7 hours
			4 cu. ft. / hr.	2.0 hours
			5 cu. ft. / hr.	1.6 hours

FURTHER QUESTIONS

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