



MMR Technologies, Inc.

WHAT ARE THE SPECIFICATIONS FOR THE NITROGEN GAS USED IN JOULE THOMSON REFRIGERATORS?

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. Nitrogen gas can give a cooling capacity of 250 mWatts at 85K.

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

The nitrogen 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.

NITROGEN GAS SPECIFICATIONS

Gas Data

Formula:	N ₂
Molecular Weight:	28.01
Specific Volume:	3.80 ft. ³ /lb. (0.861 m ³ /kg)
CAS Registry No.:	7727-37-9

Cylinder Specifications

Nitrogen 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: NITROGEN 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 nitrogen 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 nitrogen for the vacuum chambers or for other laboratory experiments where lower pressure nitrogen is required.

Shipping Data

D.O.T. Proper Shipping Name: Nitrogen, Compressed
 Hazard Class: 2.2 (Nonflammable Gas)
 I.D. No.: UN 1066
 E.R.G. Page: 12
 Label(s): Nonflammable Gas

Summary of Nitrogen Gas Specifications

MMR Technologies, Inc. recommends that the nitrogen 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 nitrogen 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 nitrogen gas are described with respect to their contents:

TABLE 2: NITROGEN, PRE-PURIFIED, 99.998%

CYLINDER SIZE	CONTENTS			
	FT. ³	M ³	LBS	KG
1L	300	8.49	21.71	9.86
1A	255	7.22	18.48	8.38
2	81	2.29	5.87	2.66
3	32	0.91	2.32	1.05
4	11	0.31	0.15	0.07

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

CYLINDER SIZE	CONTENTS			
	FT. ³	M ³	LBS	KG
1H	341	9.66	24.71	11.21

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

CYLINDER SIZE	CONTENTS			
	FT. ³	M ³	LBS	KG
1U	485	14.30	36.59	16.60

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 nitrogen 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 nitrogen 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 NITROGEN GAS AS A FUNCTION OF THE SIZE AND PRESSURE OF THE SUPPLY TANK

TANK ID	EQUIVALENT STP VOLUME OF NITROGEN 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

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

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