MATHESON

THE MATHESON COMPANY, INC.

P. O. Box 85 / East Rutherford / N. J. 07073

Phone—(201) 933-2400/TWX—710 485-7690

June 26, 1967

Mr. W. C. Oelke
Mactlac Physical Chemistry Manual
1427 Tenth Avenue
Grinnell, Iowa 50112

Dear Mr. Oelke:

Please excuse the delay in replying to your letter of June 5th concerning safety precautions to be followed on oxygen equipment.

Oxygen may react vigorously with combustible materials such as oil and ignition may cause the melting of surrounding materials. Even a small amount of oil or organic material may cause a sudden ignition of oxygen which could possibly lead to an explosion or severe fire.

Oxygen equipment should therefore be left only in oxygen service and never adapted for use on other compressed gases. Nitrous oxide behaves similarly to oxygen, and should be treated in the same manner.

If we can provide you with any additional information concerning these gases, please contact us and we will be most happy to answer your questions.

Thank you for your interest in our products.

Very truly yours,

THE MATHESON COMPANY INC.

Paul Sennett

Paul Sennett
Technical Service Department

PS:as

Data sheets enclosed.

For prompt service on gas needs contact these offices:

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Form No. 501-GR

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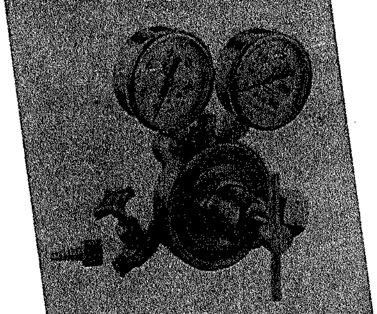


OPERATION OF YOUR NEW MATHESON GAS REGULATOR

THE MATHESON COMPANY, INC.
East Rutherford, N. J.

(Full list of Matheson Plants and Sales Offices on Back Cover)

INTRODUCTION

This manual contains a wealth of information about gas regulators. It will enable you to handle gases in the safest possible manner and help you to obtain maximum value from your new regulator.

All Matheson Regulators are precision instruments. When properly used and maintained they give excellent service for many years.

Before using your new regulator, be sure to read over the standard steps for installation, operation and shutdown – on pages 8, 9, 10 and 11.

CONTENTS

PURPOSE OF A REGULATOR

Your new gas pressure regulator is a precision instrument designed to reduce high source pressures (cylinders or compression systems) to a safe value, one consistent with a system's design. Each regulator will control a chosen delivery pressure within the bounds of the regulator's delivery pressure range.

This constant delivery pressure prevents the "overpressurization" of any apparatus downstream of the regulator and permits stable flow rates to be established according to requirements.

NOTE: See next two pages for information on the performance of regulators.

PERFORMANCE OF YOUR REGULATOR

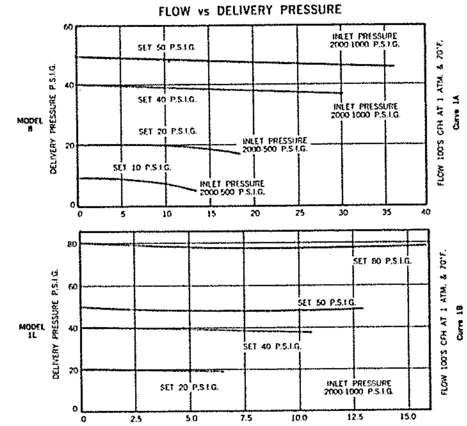
Three criteria are used by Matheson to measure the performance of a regulator:

(1) The regulator's ability to maintain a constant delivery pressure, regardless of the rate of gas discharge. All regulators will show a drop in delivery pressure with increased flow. The smaller the drop, the better the regulator performance. Curves 1A and 1B show the pressure-flow relationships of Matheson No. 8 and 1L regulators.

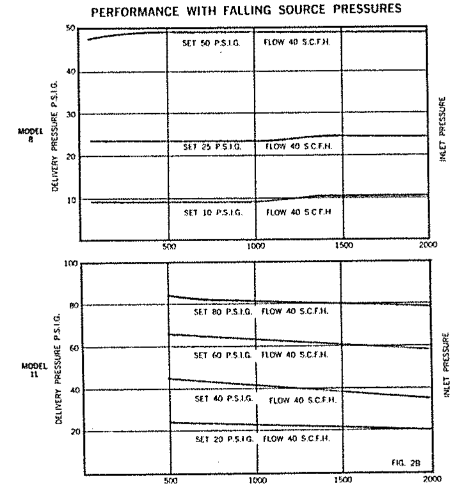
(2) The regulator's ability to maintain a constant delivery pressure as source pressure varies. This is very important. Curves 2A and 2B show the performance of Matheson No. 8 and 1L regulators with falling source pressures.

(3) The "lock-up" of the regulator. This is defined as the final pressure attained by a system when all flow is stopped. It is usually slightly above the delivery pressure when set at flowing conditions. All Matheson regulators are chosen to give the best possible "lock-up" performance possible, with but slight deviation from delivery pressure.

FLOW vs DELIVERY PRESSURE



PERFORMANCE WITH FALLING SOURCE PRESSURES



HOW YOUR REGULATOR WORKS

Figure 1 on the opposite page will help you understand how a regulator works. A regulator reduces gas pressure by the counteraction of gas pressure on a diaphragm against the compression of a spring which can be adjusted externally with the pressure adjusting screw.

In operation the pressure adjusting screw is turned to exert force on the spring and diaphragm. This force is transmitted to the valve assembly, pushing the valve away from the seat. The high pressure gas will flow past the valve into the low pressure chamber. When the force of gas pressure on the diaphragm equals the force of the spring, the valve and seat assembly close, preventing the flow of additional gas into the low pressure chamber.

Removal of gas from the low pressure chamber will permit downward deflection of the diaphragm, opening the valve assembly, and thereby permitting a pressure increase in the low pressure chamber. This constant throttling action permits a pressure balance in the regulator's low pressure chamber, thus yielding a steady delivery pressure relatively independent of normal flow fluctuations and falling cylinder pressure.

PRESSURE REDUCTION "STAGES"

Controlled pressure reduction, as explained on the preceding page, constitutes a "stage" of pressure reduction. Two stages of reduction constitute the same action in series, with the delivery pressure from one stage becoming the source pressure for the second stage.

Most gas regulators employed for use on high pressure cylinders are of the single or two stage variety.

Generally, the reduction of pressure in two stages permits a closer control of the delivery pressure over a wider range of inlet pressures.

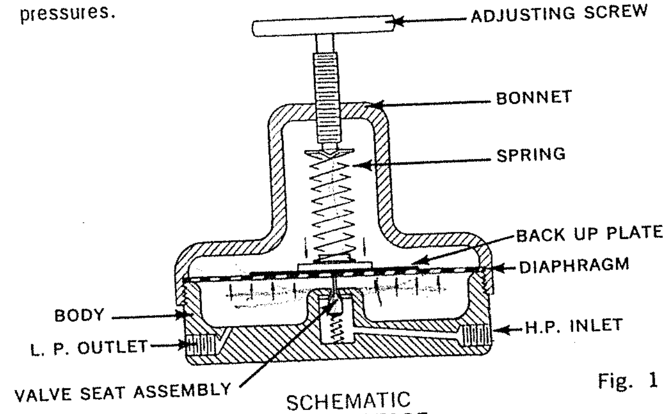


Fig. 1

SCHEMATIC
SINGLE STAGE
TYPICAL CONSTRUCTION

INSTALLATION – in 5 steps

(Refer to Fig. 2 for identification of Regulator parts)

1. Before connecting the regulator to the cylinder valve outlet, be sure the regulator has the proper CGA connection to fit the cylinder valve. If there is some doubt about the connection being correct, check the Matheson Gas Catalog for valve outlet designation and description. Inspect the regulator inlet and cylinder valve outlet for foreign matter. Remove foreign matter with a clean cloth *except in the case of Oxygen*. In the case of Oxygen, open the cylinder valve slightly, to blow any dirt out of the outlet. A dirty Oxygen regulator inlet can be rinsed clean in fresh carbon tetrachloride and blown dry with oil free Nitrogen.

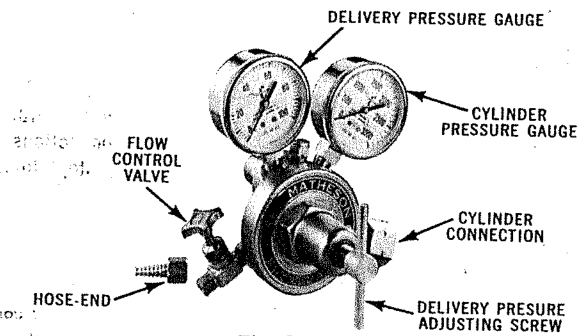


Fig. 2

'at faced wrench tighten the regulator inlet connection ·ylinder valve outlet. (Depending on gas service, the regulator inlet may be a right hand thread or a left hand thread. Make sure that proper identification of the mating connections has been made.) Do not force the threads. Some regulator connections require the use of a flat gasket to provide a leak tight seal between the regulator and valve outlet. In this instance, gaskets are supplied with the regulator and should be replaced when they become worn. When utilizing Teflon gaskets, do not exert excessive force in tightening the connection or the gasket may force its way into the valve opening and impede the discharge of gas.

3. Close the regulator by releasing the pressure adjusting screw—turn counterclockwise until screw turns freely without tension.

4. Check to see that the needle valve on the regulator outlet is closed.

5. Attach tubing or piping to the regulator valve outlet. Except for high pressure regulators a hose end is provided with the regulator. Regulators supplied with "Tylok" conne[illegible] ; accept standard 1/4" O.D. copper or stainless s[illegible] ubing.

Caution: Regulators and valves used with Oxygen must not [illegible] into contact with oil and grease. In case of such contamina[illegible] not connect the regulator – this problem must be referr[illegible] sonnel trained in handling this situation.

OPERATION – in 3 steps

1. Slowly open the cylinder valve until full cylinder pressure is registered on the tank gauge. (In the case of liquefied gases a tank gauge is not usually provided.) It is recommended that the cylinder valve be fully opened to prevent limiting of flow to the regulator which would result in the failure of the regulator to maintain required delivery pressure.

2. Adjust the delivery pressure to the desired pressure setting by turning the pressure adjusting screw clockwise and noting the delivery pressure as registered on the delivery pressure gauge.

3. The flow may now be regulated by proper adjustment of the outlet needle valve.

SHUTDOWN – in 4 steps

1. Close cylinder valve.

2. Relieve all the pressure from the regulator through needle valve, until both gauges register 0.

3. Turn the adjusting screw counterclockwise until screw turns freely without tension.

4. Close regulator outlet needle valve.

DISMANTLING

1. If the regulator will not be used for a while, store in a clean, dry location, free of corrosive fumes.

2. Regulators used with corrosive or flammable gases should be flushed with dry Nitrogen. This can be done by screwing in the pressure adjusting screw (clockwise), opening the outlet valve, and directing a stream of dry Nitrogen into the regulator inlet by means of a flexible tube or rubber hose. After flushing turn out adjusting screw and close the cylinder valve.

3. Capping or sealing the regulator inlet or simply storing in the original plastic bag will prevent dirt from clogging the regulator inlet and extend the life of the regulator.

PROPER FUNCTIONING

Check your regulator periodically to see that it is functioning properly. This procedure is covered in the "Trouble Shooting" Section on pages 12 and 13.

TROUBLE SHOOTING

Regulators should be checked periodically to insure proper and safe operation. This periodic check will vary depending on gas service and usage.

Regulators in non-corrosive gas service such as Nitrogen, Hydrogen and Helium require relatively little maintenance, and a quick check on a monthly basis is usually adequate. Regulators in "corrosive" gas service such as Hydrogen Chloride, Chlorine and Hydrogen Sulfide require considerably more checking – once a week is recommended.

The procedure for checking out any regulator is as follows:

1. Gauges should read zero when all pressure is drained from system.

2. With cylinder valve open and adjusting screw turned counterclockwise, the high pressure gauge should read the cylinder pressure.

3. With the regulator outlet needle valve closed and waiting 5 to 10 minutes in check point #2, the delivery pressure gauge should not indicate a pressure increase. The pressure increase would indicate leakage across the internal valve system.

4. Next, turn the adjusting screw clockwise until a nominal delivery pressure is indicated. Inability to attain a proper

delivery pressure setting or abnormal adjustment of the screw indicated improper operation which may be attributed to blockage of the gas passage or a leak in the low pressure side of the regulator. Continued wear on a regulator valve and seat assembly will cause a rise above a set delivery pressure, termed as "crawl". A regulator exhibiting "crawl" should not be used.

5. Close cylinder valve and observe pressure both on inlet and delivery side of the regulator after 5 or 10 minutes. A drop in the pressure reading after this period of time may indicate a leak in the system, possibly at the inlet or through the needle valve, safety devices or diaphragm.

6. An excessive fall in delivery pressure under operating conditions and normal flows, indicates an internal blockage.

Any deviation from the normal in the above check out will require servicing by reputable repairmen. See "Repairs" on next page.

WARNING – A regulator, valve, or other equipment that has been used with another gas should never be used with Oxygen. A regulator or control should never be used on more than one gas, unless the user is fully familiar with the properties of the gases involved, or has obtained assurance from the gas supplier that the interchange is permissible and there is no safety hazard.

REPAIR OF REGULATORS

Matheson maintains a well equipped repair department capable of providing excellent and rapid servicing of worn regulators.

When a regulator shows signs of wear it should only be serviced by reputable repairmen. Detailed drawings on all regulators and recommended parts lists are available for those equipped to do their own repairs. We strongly recommend that Matheson regulators be returned to us for reconditioning and/or repair. All Matheson regulators sent to us for repair are returned to you in first class condition meeting all original factory specifications. Any new revisions in design are automatically incorporated in all Matheson regulators repaired in our own shop.

Regulators should be sent to: Manager, Service Repair Dept., East Rutherford, N.J. (*parcel post*–P.O. Box 85, *freight address*–932 Paterson Plank Road). An explanation of the problems encountered in using the worn regulator should be included on returning the regulator to us. Quotes can be supplied before repairs are made. Please issue full instructions with regulator concerning quotations, or issue order for repair, so that quick service may be provided.

A complete overhaul for regulators in non-corrosive gas service is recommended once a year, and for regulators in corrosive gas service every 3–6 months.

Regulators in corrosive gas service (Hydrogen Chloride, Chlorine, etc.) which are used only intermittently should be adequately flushed with dry Nitrogen and stored in a dry area at room temperature to prevent excessive corrosion of the metal parts.

CHOOSING A REGULATOR

Matheson has the world's most complete line of gas regulators, covering two stage and single stage regulators, high and low pressure regulators, regulators for corrosive service, special purpose regulators, diffusion resistant metal diaphragm regulators, and regulator-flowmeter combinations.

Complete details of these regulators and other equipment for the safe handling of gases are contained in the Matheson Compressed Gas Catalog – free for the asking. Opposite each gas listing you will find the recommended regulators and valves.

Typical of Matheson's superiority in gas regulators are the many models designed for the various corrosive gases. One style is constructed of materials to withstand the corrosive effects of gases that normally attack copper bearing alloys. Another type is made to resist attack from strongly acid forming gases such as the halogens.

All of Matheson's regulators are designed with strength in reserve for recommended pressure ratings. They are also individually tested before shipment.

You will find that the Matheson Compressed Gas Catalog is a "must" when it comes to the intelligent selection of the proper gas regulators and other gas handling equipment.

OXYGEN

[Formula: O_2]

PHYSICAL CONSTANTS

Molecular Weight	32.00
Specific Volume, 70°F. 1 atm.	12.1 cu. ft./lb.
Boiling Point @ 1 atm.	–297.4°F. (–183°C.)
Freezing Point @ 1 atm.	–361.9°F. (–218.83°C.)
Specific Gravity (Air=1)	1.1053
Density, Liquid @ b.p.	1.1415 g./ml.
Density, Gas, 20°C. 1 atm.	1.429 g./l.
Critical Temperature	–181.1°F. (–118.4°C.)
Critical Pressure	736.5 p.s.i.a. (50.1 atm.)
Critical Density	0.41 g./cc.
Latent Heat of Vaporization @ b.p.	51.0 cal./g.
Latent Heat of Fusion @ m.p.	3.3 cal./g.
Specific Heat, Gas, *Cp*, 15°C., 1 atm.	0.2177 cal./(g.) (°C.)
Specific Heat, Gas, *Cv*, 15°C., 1 atm.	0.1554 cal./(g.) (°C.)
Specific Heat Ratio, *Cp/Cv*, 15°C., 1 atm.	1.401
Thermal Conductivity, Gas, @ 32°F.	0.0142 BTU/(hr.) (sq. ft.) (°F./ft.)
Viscosity, Gas, 20°C.	0.0206 centipoise
Solubility in Water @ 32°F.	1 volume/32 volumes

DESCRIPTION – Oxygen is a colorless, odorless, and tasteless gas. Its outstanding properties are its ability to sustain animal life and to support combustion. It is somewhat soluble in water, a fact responsible for aquatic life. Gaseous oxygen is about 1.1 times as heavy as air. It is usually shipped as a nonliquefied gas at 2200 p.s.i.g. at 70°F. About 1/5 of the earth's atmosphere is oxygen (20.99% by volume).

SPECIFICATIONS – The Matheson Company supplies three grades of oxygen.

1. Research Grade

This grade of oxygen has a minimum purity of 99.99 mole %. It is supplied in small cylinders containing up to 100 liters, and in Pyrex liter flasks. Either an Assayed Reagent Grade or a regular Research Grade can be supplied. The former is accompanied by a mass spectrometer analysis of the container contents. The latter is shipped with a guarantee on the maximum limits of possible impurities For Research Grade oxygen these limits are as follows:

COMPONENT	MAX. LIMITS (p.p.m. by vol.)
Argon	20
Nitrogen	20
Krypton	15
Carbon dioxide	10
Xenon	5
Nitrous oxide	5
Total hydrocarbons (as methane)	20
Moisture	5

A typical analysis of Research Grade oxygen is as follows:

COMPONENT	AMOUNT
Oxygen	99.995+%
Argon	<1 p.p.m.
Nitrogen	8 p.p.m.
Krypton	13 p.p.m.
Carbon dioxide	4 p.p.m.
Xenon	<1 p.p.m.
Nitrous oxide	<1 p.p.m.
Total hydrocarbons (as methane)	16 p.p.m.
Moisture	5 p.p.m.

2. Ultra High Purity Grade (Gold Label)

The specifications and typical analysis are shown in the following table:

COMPONENT	SPECIFICATIONS	TYPICAL ANALYSIS
Oxygen	99.95% min.	99.986%
Argon	<300 p.p.m.	60 p.p.m.
Nitrogen	<100 p.p.m.	25 p.p.m.
Krypton	< 20 p.p.m.	13 p.p.m.
Carbon dioxide	< 10 p.p.m.	7 p.p.m.
Xenon	< 5 p.p.m.	4 p.p.m.
Nitrous oxide	< 5 p.p.m.	2 p.p.m.
Total hydrocarbons (as methane)	< 20 p.p.m.	16 p.p.m.
Moisture	< 10 p.p.m.	6 p.p.m.

3. Extra Dry Grade

The specifications and typical analysis are shown in the threads per inch, female outlet.

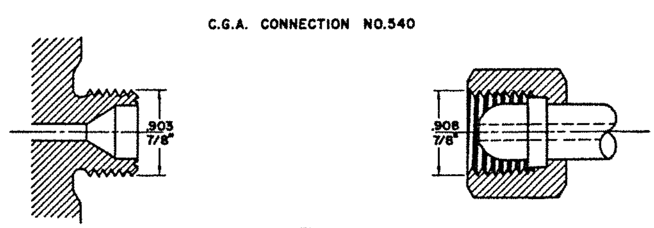


FIG. I

SAFETY DEVICES – Cylinders containing oxygen have safety devices of either the frangible disc type or frangible disc type backed up with fusible metal, melting at approximately 212°F. Cylinders pressurized 10% in excess of their marked service pressure in accordance with present I.C.C. regulations must be equipped only with safety devices of the unbacked frangible disc type. These safety devices are usually an integral part of the cylinder valve, situated opposite the valve outlet.

RECOMMENDED CONTROLS–In order to reduce the high cylinder pressure of oxygen to a safe working value consistent with a system's design, the following types of controls are recommended.

Automatic Pressure Regulators

1. *SINGLE STAGE REGULATORS*

A single stage regulator will reduce cylinder pressure in one stage to a delivery pressure in a particular range depending upon the design of the regulator and its spring load. A single stage regulator will show a slight variation in delivery pressure as cylinder pressure falls. The following single stage regulators are available from The Matheson Company:

MODEL NO.	DELIVERY PRESSURE RANGE, p.s.i.g.
1L-540	3-80
1H-540	5-180
2-540	25-650
3-540	50-1500
4-540	100-2500
36 (for lecture bottles)	5-75

2. *TWO STAGE REGULATORS*

This type of regulator performs the same function as single stage regulators. However, greater accuracy and control of delivery pressure is maintained, and the delivery pressure does not vary as cylinder pressure falls. The following two stage regulators are available from The Matheson Company:

MODEL NO.	DELIVERY PRESSURE RANGE, p.s.i.g.
8-540	5-50
9-540	5-250

3. *LOW PRESSURE REGULATOR*

The above regulators are not satisfactory for accurate delivery pressures below 5 p.s.i.g. Therefore an auxiliary regulator specifically designed for low pressures is recommended to be used in series with any of the standard regulators having delivery pressures to 50 p.s.i.g. The Matheson Company has various models known as the type 70 regulator which may be obtained with delivery pressures ranging from 3 inches water column to 10 p.s.i.g., as follows:

MODEL NO.	DELIVERY PRESSURE RANGE
70B	3 – 15 inches water column
70A	5 – 10 p.s.i.g.
70	8 oz. – 4 p.s.i.g.

When this regulator is supplied to be used in conjunction with a standard regulator, an extra heavy hose is supplied to connect to the standard regulator. All Matheson regulators are provided with needle valves so that accurate flow control can be maintained.

Manual Valves

Manual needle valves for direct attachment to the cylinder valve outlet are available. These types of controls are used mainly where intermittent flows are necessary, or where it is desired to control the flow of gas directly from the cylinder. This type of a needle valve will allow control of extremely small flow rates on up to relatively large flow rates. However, pressures cannot be controlled with such a valve and, if a line or system becomes plugged, dangerous pressures can build up. The following manual type valves are recommended for use with oxygen: No. 50-540 and No. 52-540 with tank gauge. These valves are supplied with serrated hose ends, ¼" Tylok compression fittings, or ¼" NPT male or female outlets. Needle valve No. 31 is recommended for use with lecture bottles.

Flowmeters

Flowmeters of the rotameter type such as Matheson series 600 laboratory flowmeters are recommended where definite flow rates must be known.

SHIPPING REGULATIONS–Oxygen is shipped in high pressure steel cylinders as a nonflammable compressed gas, taking an I.C.C. "Green Label". They are usually filled to the marked service pressure of the cylinder or to a maximum of 10% in excess of the marked service pressure in accordance with present I.C.C. regulations.

Table 1. THERMODYNAMIC PROPERTIES OF SATURATED OXYGEN[1]

Temp. °K.	Absolute Pressure atm.	Specific Volume Liquid cc./g. mole	Specific Volume Vapor cc./g. mole	Enthalpy cal./g. mole Liquid	Enthalpy cal./g. mole Vapor	Latent Heat cal./g. mole	Entropy cal./(g. mole) (°K.) Liquid	Entropy cal./(g. mole) (°K.) Vapor	Temp. °K.
90.15	1.00	27.9	7223	158	1788	1630	1.90	19.99	90.15
95	1.60	28.6	4508	219	1800	1581	2.55	19.21	95
100	2.50	29.3	3028	284	1816	1532	3.23	18.55	100
105	3.73	30.1	2000	351	1831	1480	3.86	17.96	105
110	5.38	31.0	1456	420	1844	1424	4.48	17.43	110
115	7.51	32.0	1045	489	1854	1365	5.08	16.95	115
120	10.20	33.1	784	557	1861	1304	5.61	16.47	120
125	13.51	34.3	592	626	1864	1238	6.13	16.02	125
130	17.52	35.7	460	700	1863	1163	6.63	15.58	130
135	22.23	37.4	363	776	1854	1078	7.19	15.18	135
140	27.9	39.4	286	860	1833	973	7.78	14.73	140
145	34.4	42.3	220	954	1783	829	8.41	14.13	145
150	42.2	47.9	157	1081	1682	601	9.24	13.25	150
154.27	49.7	74.5	74.5	1393	1393	0	11.25	11.25	154.27

Table 2. THERMODYNAMIC PROPERTIES OF SUPERHEATED OXYGEN[1]

v, volume, cc./g. mole; **h,** enthalpy, cal./g. mole; **s,** entropy, cal./(g. mole) °K.

(Saturation Temperatures in Parentheses)

Atm.		100°K.	120°K.	140°K.	160°K.	180°K.	200°K.	220°K.	240°K.	260°K.	280°K.
1 (90.15°K.)	v	8,050	9,730	11,400	13,070	14,740	16,390	18,030	19,680	21,330	22,970
	h	1,861	2,005	2,146	2,286	2,426	2,565	2,700	2,834	2,971	3,111
	s	20.76	22.07	23.16	24.10	24.92	25.66	26.30	26.88	27.43	27.93
5 (108.9°K.)	v		1,790	2,210	2,590	2,940	3,280	3,610	3,940	4,260	4,590
	h		1,947	2,113	2,262	2,406	2,547	2,684	2,822	2,962	3,102
	s		18.48	19.76	20.76	21.61	22.36	23.01	23.61	24.17	24.68
10 (119.7°K.)	v		805	1,040	1,250	1,450	1,625	1,800	1,960	2,130	2,290
	h		1,865	2,069	2,230	2,381	2,523	2,664	2,806	2,948	3,090
	s		16.53	18.13	19.20	20.09	20.84	21.51	22.13	22.70	23.22
20 (132.7°K.)	v			455	572	677	722	864	956	1,046	1,136
	h			1,961	2,163	2,328	2,479	2,627	2,775	2,922	3,068
	s			16.10	17.45	18.42	19.22	19.93	20.57	21.44	21.70
40 (148.7°K.)	v				228	298	356	408	460	532	556
	h				1,993	2,219	2,397	2,558	2,717	2,952	3,028
	s				15.28	16.62	17.56	18.32	19.01	19.93	20.21
60	v					168	220	264	303	353	367
	h				1,570	2,093	2,322	2,493	2,661	2,910	2,991
	s				12.25	15.37	16.59	17.40	18.13	19.11	19.40

NITROUS OXIDE

(Synonyms: Dinitrogen Monoxide; Laughing Gas)
[Formula: N_2O]

PHYSICAL CONSTANTS

Molecular Weight	44.02
Vapor Pressure @ 70°F.	745 p.s.i.g.
Specific Volume, 70°F., 1 atm.	8.7 cu. ft./lb.
Boiling Point @ 1 atm.	–129.1°F. (–89.5°C.)
Freezing Point @ 1 atm.	–152.3°F. (–102.4°C.)
Density, Liquid @ b.p.	1.266 g./cc.
Density, Gas, 0°C., 1 atm.	1.997 g./l.
Specific Gravity, Gas, 15°C. (Air = 1)	1.530
Critical Temperature	97.7°F. (36.5°C.)
Critical Pressure	1047.6 p.s.i.a. (71.2 atm.)
Critical Density	0.451 g./ml.
Latent Heat of Vaporization @ b.p.	3.958 kcal./mole
Latent Heat of Fusion @ m.p.	1.563 kcal./mole
Specific Heat, Gas, Cp, 15°C., 1 atm.	0.2004 cal./(g.) (°C.)
Specific Heat, Gas, Cv, 15°C., 1 atm.	0.1538 cal./(g.) (°C.)
Specific Heat Ratio, Gas, Cp/Cv, 15°C., 1 atm.	1.303
Thermal Conductivity, Gas, 0°C.	0.0087 BTU/(hr.) (sq. ft.) (°F./ft.)
Viscosity, Gas, 0°C.	0.01362 centipoise
Solubility in Water, 0°C.	130.52 cc./100 g. H_2O
Trouton Constant	21.4

DESCRIPTION–Nitrous Oxide is a colorless, nonflammable, nontoxic gas with a slightly sweetish taste and odor. It is shipped as a liquefied compressed gas under its own vapor pressure of about 745 p.s.i.g. at 70°F. It is somewhat soluble in water and more soluble in alcohol.

SPECIFICATIONS– Nitrous oxide has a minimum purity of 98.0%, the principal impurity being air. Average analyses show a purity of 98.5%.

USES–Nitrous oxide is used chiefly as an inhalation anesthetic and as a dispersing agent in cream whippers.

TOXICITY–Nitrous oxide is nontoxic and non-irritating and is extensively used as an anesthetic in medicine and dentistry. It is a rather weak anesthetic and must be inhaled in high concentrations, mixed with air or oxygen. When inhaled without oxygen, it is a simple asphyxiant. Inhalation of small amounts often produces a type of hysteria; hence its trivial name, laughing gas.

PRECAUTIONS IN HANDLING AND STORAGE–The following general rules should apply in the handling and storage of nitrous oxide.

1. Never drop cylinders or permit them to strike each other violently.

2. Cylinders should be assigned a definite area for storage. The area should be dry, cool, well-ventilated, and preferably fire-resistant. Keep cylinders protected from excessive temperature rise by storing them away from radiators, or other sources of heat. Storage conditions should comply with local and state regulations.

3. Cylinders may be stored in the open, but in such cases should be protected against extremes of weather and from the dampness of the ground to prevent rusting. During the summer, cylinders stored in the open should be shaded against the continuous direct rays of the sun in those localities where extreme temperatures prevail.

tors which may be obtained with delivery pressures ranging from 3 inches water column to 10 p.s.i.g. as follows:

MODEL NO.	DELIVERY PRESSURE RANGE
70	8 oz. – 4 p.s.i.g.
70A	5 – 10 p.s.i.g.
70B	3 – 15 inches water column

When any of the above regulators is to be used in conjunction with a standard regulator, an extra heavy hose is supplied to connect to the standard regulator. All Matheson regulators are provided with needle valves attached to the outlets so that accurate flow control can be maintained.

Manual Valves

Matheson needle valves No. 50-320 and No. 52-320 with tank gauge, both of brass bar stock, are available for direct attachment to the cylinder valve outlet. Either valve can be equipped with a variety of outlets, such as a serrated hose end, ¼" Tylok compression fitting, or ¼" NPT male or female pipe. These valves should be used only where manual flow control is needed and should not be used to control pressure since dangerous pressures can be built up if a system becomes clogged or if the system itself is closed. A No. 31 needle valve is recommended for use with lecture bottles.

Flowmeters

Matheson series 600 laboratory flowmeters of the rotameter type are recommended for use where definite flow rates must be known.

SHIPPING REGULATIONS–Nitrous oxide is classified by the I.C.C. as a nonflammable, compressed gas and is shipped with the required "Green Label".

COMMERCIAL PREPARATION – Nitrous oxide is obtained most commonly by the thermal decomposition of ammonium nitrate. It may also be obtained by controlled reduction of nitrites or nitrates, by the slow decomposition of hyponitrites, and by the thermal decomposition of hydroxylamine.

CHEMICAL PROPERTIES–Nitrous oxide is stable and comparatively unreactive at ordinary temperatures, e.g., to ozone, hydrogen, the halogens, the alkali metals, etc. At elevated temperatures N_2O decomposes into nitrogen and oxygen, the rate of decomposition being appreciable above 565°C. At elevated temperatures N_2O supports combustion and oxidizes certain organic compounds, the alkali metals, etc. N_2O is soluble in alkaline solutions but does not form hyponitrites. A crystalline hexahydrate can be obtained at low temperatures.

PHYSICAL DATA

Thermodynamic Data

See Table 1.

Vapor Pressure

For data on vapor pressures see Table 1 on Thermodynamic Properties of Saturated Nitrous Oxide, and Figure 2.

REFERENCES

[1]Extracted by permission from *ASRE Refrigerating Data Book,* 1957-58.

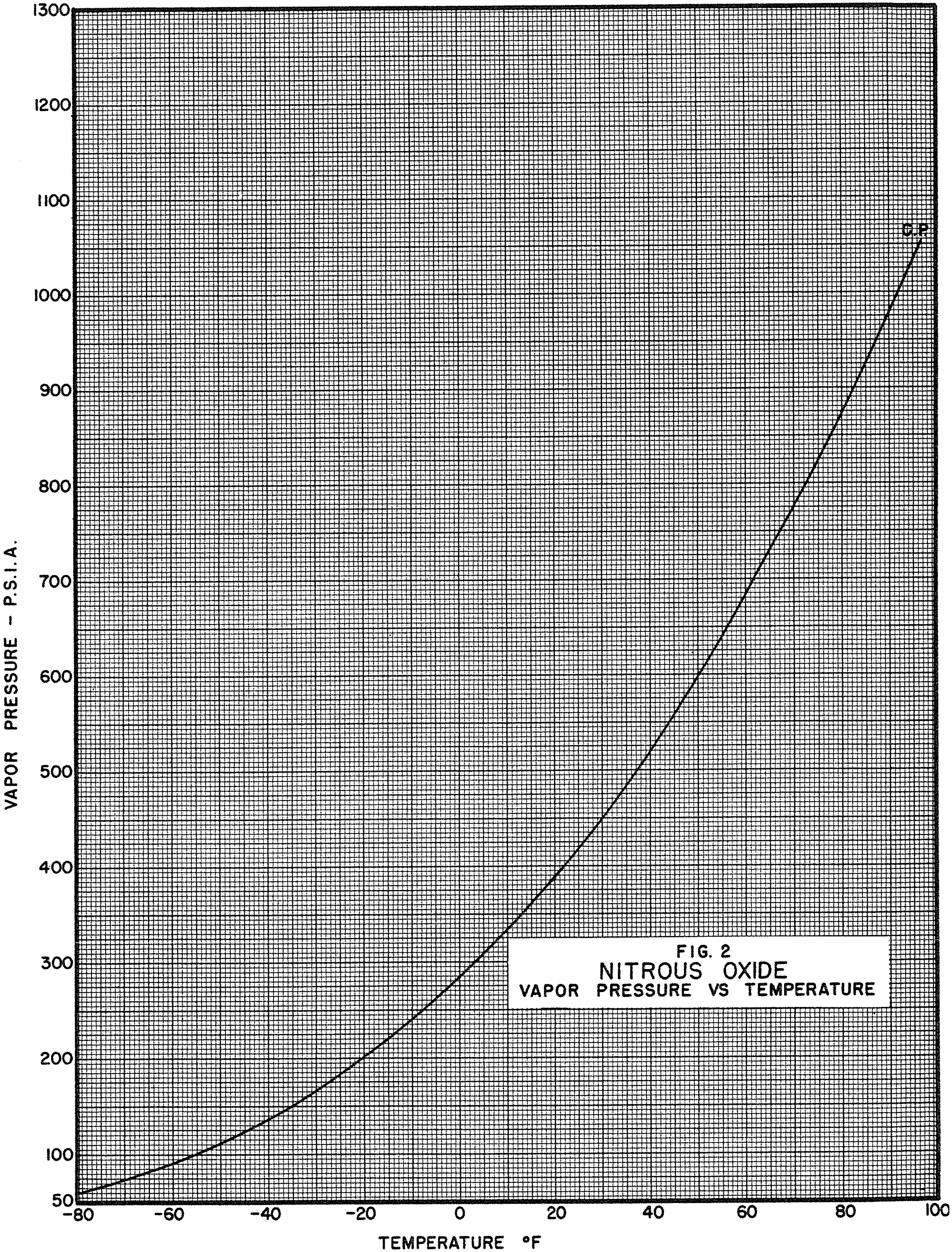


FIG. 2
NITROUS OXIDE
VAPOR PRESSURE VS TEMPERATURE