

## **GAS SPECIFICATIONS**

The following specifications for medical grade gases were taken from the January 1, 2000 issue of the United States Pharmacopeia (USP) and National Formulary (NF) and represent the minimum acceptable purity and “official” testing methods. For details in performing the various tests listed, please refer to the USP 24/NF 19 \*.

Compressed gas manufacturers commonly set higher assay specifications than those listed or employ different testing methods. If your minimum acceptable purity or maximum impurity specifications are more stringent than those listed, your written Standard Operating Procedures should reflect this.

Also, if your testing methodology differs from the methods stated, you will need to prove, by validation, that your method is equivalent to the “official” method.

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<b>Oxygen, USP</b>	<b>Specification</b>	<b>Method</b>
Identification	Oxygen	a. See "assay" b. Detector tube (carbon dioxide)
Odor	none	
Carbon dioxide	$\leq 0.03\%$ **	Gas detector tube
Carbon monoxide	$\leq 0.001\%$ **	Gas detector tube *
Assay	$\geq 99.0\%$ , vol	Liquid chemistry

\* Tests for carbon dioxide and carbon monoxide are not required provided the oxygen was produced by the "air liquefaction" process. Cylinder labels must indicate whether the oxygen was produced by air liquefaction. Also, a written statement from the oxygen vendor certifying that the oxygen was produced by air liquefaction should be maintained (this can be satisfied by a statement on the bulk Certificate of Analysis).

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<b>Helium, USP</b>	<b>Specification</b>	<b>Method</b>
Identification	Helium	Wood splinter test Balloon test
Odor	None	
Carbon monoxide	$\leq 0.001\%$	Detector tube
Air	$\leq 1.0\%$	Gas chromatograph
Assay	$\geq 99.0\%$ , vol	Gas chromatograph

<b>Medical Air</b>	<b>Specification</b>	<b>Method</b>
Water & oil	No liquid discernable on mirror.	Invert 1 container for 5 minutes. Vent onto stainless steel mirror.
Odor	None	
Carbon dioxide	≤ 0.05%	Detector tube
Carbon monoxide	≤ 0.001%	Detector tube
Nitric oxide and nitrogen dioxide	≤ 2.5 ppm	Detector tube
Sulfur dioxide	≤ 5.0 ppm	Detector tube
Assay	19.5-23.5% oxygen, vol	Electrochemical cell analyzer

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<b>Nitrogen, NF</b>	<b>Specification</b>	<b>Method</b>
Identification	Helium	Wood splinter test
Odor	None	
Carbon monoxide	≤ 0.001%	Detector tube
Oxygen	≤ 1.0%	Gas chromatograph
Assay	≥ 99.0%, vol	Gas chromatograph

<b>Carbon Dioxide</b>	<b>Specification</b>	<b>Method *</b>
Identification	Carbon dioxide	Detector tube
Water	≤150 mg per cubic meter	Detector tube
Ammonia	≤0.0025%	Detector tube
Hydrogen sulfide	≤1 ppm	Detector tube
Nitric oxide	≤2.5 ppm	Detector tube
Carbon monoxide	≤0.001%	Detector tube
Nitrogen dioxide	≤2.5 ppm	Detector tube
Sulfur dioxide	≤5 ppm	Detector tube
Assay	≥99.0%, vol	Liquid chemistry

\* Perform tests in the sequence listed.

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<b>Nitrous Oxide</b>	<b>Specification</b>	<b>Method *</b>
Identification	Nitrous oxide	a. Comparison with Certified Std. b. Detector tube c. Liquid chemistry
Water	≤150 mg per cubic meter	Detector tube
Ammonia	≤ 0.0025%	Detector tube
Nitric oxide	≤ 1ppm	Detector tube
Carbon monoxide	≤ 0.001%	Detector tube

Nitrogen dioxide	≤ 1ppm	Detector tube
Halogens	≤ 1ppm	Detector tube
Carbon dioxide	≤ 0.03%	Detector tube
Air	≤ 1%	Gas chromatograph
Assay	≥ 99.0%	Gas chromatograph

\* Perform tests in the sequence listed.

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# Engineering Technical Notes

## Transfilling Evacuation Limits at Various Elevations

For example: A person transfilling cylinders at 7,000 feet above sea level would only have to draw a vacuum of 19 in. Hg on the system to achieve the same level of vacuum as a person drawing a vacuum of 25 in. Hg at sea level.

Below is a chart listing the approximate vacuum levels that would have to be achieved at different altitudes during the cylinder evacuation process to equate to 25 in. Hg at sea level.

A perfect vacuum at sea level is considered to be 29.92 in. Hg. As elevation increases, the equivalent gauge value in inches of mercury to obtain the same level of vacuum at sea level decreases.

The accompanying graph depicts the effect of altitude on atmospheric pressure.

### Altitude Pressure Transfilling Table

Altitude Feet	Pressure In. Hg
0	25.00
500	24.56
1,000	24.11
1,500	23.68
2,000	23.25
2,500	22.83
3,000	22.41
3,500	22.00
4,000	21.59
4,500	21.20
5,000	20.81
5,500	20.42
6,000	20.04
6,500	19.66
7,000	19.29
7,500	18.93
8,000	18.57
8,500	18.22
9,000	17.87
9,500	17.53
10,000	17.20

### Effect of Altitude on Atmospheric Pressure

