AIR PRODUCTS

VI NA INDUSTRIAL GASES

Key Environmental markets:

Stationary Source Emissions Monitoring

- CEM Manufacturers
- Utilities
- Co-generation
- Pulp and Paper Plants
- Petrochemical
- Natural Gas Turbine Pumping Stations
- Incinerators, including Waste to Energy Plants
- Sewage Plants
- Boilers and Industrial Furnaces
- Cement Kilns
- Steel Mills
- Environmental Testers
- Independent Stack Testing

Mobile Sources

- Motor Vehicle Manufacturers (emissions certification)
- State Vehicle Inspection and Maintenance (I/M) Testing
- Aircraft Engine Testing
- Catalyst Manufacturers
- Independent Testing Laboratories
- Ambient Monitoring (air, soil, and water)
- Environmental Laboratories
- Air Quality

Component	Balance	Concentration Range	Certification Period
Carbon Dioxide	Air/Nitrogen	0.3% - 50%	6 mo < 300 ppm 36 mo ≥ 300 ppm
Carbon Monoxide	Air/Nitrogen	5 ppm - 50%	6 mo < 8 ppm 36 mo ≥ 8 ppm
Hydrogen Sulfide	Air	4 ppm - 300 ppm	6 mo ≥ 4 ppm
	Nitrogen	4 ppm - 200 ppm	6 mo < 4 ppm 12 mo ≥ 4 ppm
Methane	Air/Nitrogen	1 ppm - 1000 ppm	36 mo ≥ 1 ppm
Nitric Oxide	Nitrogen	2.5 ppm - 2.9%	6 mo < 4 ppm 24 mo ≥ 4 ppm
Nitrogen Dioxide	Air	10 ppm - 500 ppm	6 mo < 80 ppm 24 mo ≥ 80 ppm
	Nitrogen	2.5 ppm - 1%	6 mo < 80 ppm 24 mo ≥ 80 ppm
Oxygen	Nitrogen	0.6% - 50%	6 mo < .8% 36 mo ≥ .8%
Propane	Air/Nitrogen	1 ppm - 13%	36 mo ≥ 1 ppm
Sulfur Dioxide	Air	25 ppm - 4%	6 mo ≤ 39 ppm 24 mo = 40-499 ppm 36 mo ≥ 500 ppm
	Nitrogen	2.5 ppm - 4%	6 mo ≤ 39 ppm 24 mo = 40-499 ppm 36 mo ≥ 500 ppm

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EPA Protocol Methods

EPA No.	Method Determination	EPA Protocol Mixtures	Zero Gas
3A	Oxygen and carbon dioxide concentrations in emissions from stationary sources (Instrumental Analyzer Procedure)	Oxygen in N_2 ; carbon dioxide in N_2 or air; carbon dioxide and sulfur dioxide or oxygen and sulfur dioxide in N_2	CEM zero nitrogen, CEM zero air
6C	Sulfur emissions from stationary sources (Instrumental Analyzer Procedure)	Sulfur dioxide in N_2 or air; sulfur dioxide or carbon dioxide or carbon dioxide and oxygen in N_2 multi-component	CEM zero air
7E	Nitrogen oxides from stationary sources (Instrumental Analyzer Procedure)	Nitric oxide in N_2	CEM zero air
10	Carbon monoxide emissions from stationary sources	Carbon monoxide in N_2	CEM zero nitrogen
10A	Carbon monoxide emissions in certifying Continuous Emissions Monitoring Systems (CEMS) at petroleum refineries	Carbon monoxide in N_2; NIST-traceable mixture	
10B	Carbon monoxide emissions from stationary sources	Carbon monoxide in N_2	Zero air, helium zero, hydrogen zero
11	Hydrogen sulfide content of fuel gas stream in petroleum refineries	Hydrogen sulfide in N_2	CEM zero air, zero oxygen zero nitrogen
15	Total Reduced Sulfur (TRS) emissions from sulfur recovery plants in petroleum refineries	Hydrogen sulfide in N_2	CEM zero air, zero oxygen, zero nitrogen
15A	TRS emissions from sulfur recovery plants in petroleum refineries	Carbonyl sulfide in N_2 low TRS*	
16	Semicontinuous – sulfur emissions from stationary sources	Hydrogen sulfide in N_2	Zero hydrogen, zero oxygen
16A	TRS emissions from stationary sources (Impinger Technique)	Hydrogen sulfide in N_2	
16B	TRS emissions from stationary sources	Sulfur dioxide in N_2	Zero hydrogen, zero oxygen
18	Measurement of gaseous organic compound emissions by gas chromatography	VOC's in N_2 NIST-traceable	Zero air VOC-free, VOC-free nitrogen
20	Nitrogen oxides, sulfur dioxide and dilute emissions from stationary gas turbines	Nitric oxide in N_2; oxygen in N_2 ; carbon dioxide in air	CEM zero air, VOC-free nitrogen
21	Volatile Organic Compound (VOC) leaks	VOC's in N_2 * methane in air, hexane in air; VOC in air	Zero air, VOC-free air VOC-free nitrogen
25	Total gaseous nonmethane organic emissions as carbon	Methane in air; propane in air, carbon monoxide and methane* (multi-component mix); hexane in air, toulene in air	Zero oxygen
25A	Total gaseous organic concentration using Flame Ionization Analyzer	Propane in air or N_2	Zero air
25B	Total gaseous organic concentration using a Nondispersive Infrared Analyzer	Propane in air or N_2	Zero air
25C	Nonmethane Organic Compounds (NMOC) in MSW landfill gases	See Method 25 above	
25D	VOC of waste samples	1,1 Dichloroethylene*, propane in N_2	Zero nitrogen, zero hydrogen
25E	Vapor phase organic concentration in waste samples	Propane in N_2 or air, NIST-traceable mixture	Zero air, zero oxygen

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VI NA INDUSTRIAL GASES

EPA Protocol Gases

Two-Component

Calibration Standard

Carbon Dioxide in Air
100 – 9999 ppm †
1 – 20%

Carbon Dioxide in N_2
100 – 9999 ppm †
1 – 20%

Carbon Monoxide in Air
0.5 – 9.9 ppm †
10 – 99 ppm
100 – 9999 ppm**
1 – 3%

Carbon Monoxide in N_2
0.5 – 9.9 ppm †
10 – 99 ppm
100 – 9999 ppm**
1 – 10%**

Hydrogen Sulfide in Air
1 – 9.9 ppm
10 – 99 ppm
100 – 999 ppm

Hydrogen Sulfide in N_2
1 – 9.9 ppm †
10 – 99 ppm
100 – 999 ppm

Methane in Air
1 – 49 ppm
50 – 999 ppm

Nitric Oxide in N_2
0.1 – 0.9 ppm
1 – 4.9 ppm †
5 – 9.9 ppm
10 – 29.9 ppm
30 – 99 ppm
100 – 4999 ppm
5000 ppm – 1%

Nitrogen Dioxide in Air
1 – 4.9 ppm
5 – 29.9 ppm
30 – 99 ppm †
100 – 499 ppm
500 – 5000 ppm**

Oxygen in N_2
0.4 – 23% †
23.6 – 49%

Propane in Air
1 – 99 ppm
100 – 999 ppm
1000 – 6000 ppm**

Propane in N_2
1 – 99 ppm
100 – 999 ppm
0.1 – 1%

Sulfur Dioxide in Air
10 – 99 ppm †
100 – 4999 ppm †

Sulfur Dioxide in N_2
10 – 99 ppm †
100 – 4999 ppm †

Three-Component

Calibration Standard

Carbon Dioxide and Nitric Oxide in N_2
CO_2 100 – 9999 ppm, NO 1 – 4.9 ppm †
CO_2 100 ppm – 20%, NO 5 – 29.9 ppm †
CO_2 100 ppm – 20%, NO 30 – 99 ppm †
CO_2 100 ppm – 20%, NO 100 – 4999 ppm †
CO_2 100 ppm – 20%, NO 5000 ppm – 1% †

Carbon Dioxide and Oxygen in N_2
CO_2 100 ppm – 20%, 0.4 – 23.5% O_2 †
CO_2 100 ppm – 20%, 23.6 – 49% O_2 †

Carbon Dioxide and Sulfur Dioxide in N_2
CO_2 100 – 9999 ppm, SO_2 10 – 4999 ppm †
CO_2 1 – 20%, SO_2 10 – 4999 ppm †

Ca rbon Monoxide and Nitric Oxide in N_2
CO 0.5 – 9.9 ppm, NO 1 – 4.9 ppm †
CO 0.5 – 9.9 ppm, NO 5 – 29.9 ppm †
CO 0.5 – 9.9 ppm, NO 30 – 99 ppm †
CO 0.5 – 9.9 ppm, NO 100 – 4999 ppm †
CO 0.5 – 9.9 ppm, NO 5000 ppm – 1% †
CO 10 – 99 ppm, NO 1 – 4.9 ppm †
CO 10 ppm – 10%, NO 5 – 29.9 ppm
CO 10 ppm – 10%, NO 30 – 99 ppm
CO 10 ppm – 10%, NO 100 – 4999 ppm
CO 10 ppm – 10%, NO 5000 ppm – 1%

Carbon Monoxide and Oxygen in N_2
CO 0.5 – 9.9 ppm, O_2 0.4 – 49% †
CO 10 – 99 ppm, O_2 0.4 – 49% †
CO 100 ppm – 9.5%, O_2 0.4 – 49% †**

Carbon Monoxide and Sulfur Dioxide in N_2
CO 0.5 – 9.9 ppm, SO_2 10 – 4999 ppm †
CO 10 ppm – 10%, SO_2 10 – 99 ppm †
CO 10 ppm – 10%, SO_2 100 – 4999 ppm †

Nitric Oxide and Sulfur Dioxide in N_2
NO 1 – 4.9 ppm, SO_2 10 – 99 ppm †
NO 1 – 4.9 ppm, SO_2 100 – 4999 ppm †
NO 5 – 29.9 ppm, SO_2 10 – 4999 ppm †
NO 30 – 99 ppm, SO_2 10 – 4999 ppm †
NO 100 – 4999 ppm, SO_2 10 – 4999 ppm †
NO 5000 ppm – 1%, SO_2 10 – 4999 ppm †

Oxygen and Propane in N2
O_2 0.4 – 49%, C_3H_8 1 ppm – 1.6% †

Oxygen and Sulfur Dioxide in N_2
O_2 0.4 – 49%, SO_2 10 – 4999 ppm †

Four-Component

Calibration Standard

Carbon Dioxide, Carbon Monoxide, Nitric Oxide in N_2
CO_2 100 – 9999 ppm, CO 0.5 – 9.9 ppm, NO 1 – 4.9 ppm †
CO_2 100 ppm – 20%, CO 0.5 – 9.9 ppm, NO 5 – 29.9 ppm †
CO_2 100 ppm – 20%, CO 0.5 – 9.9 ppm, NO 30 – 4999 ppm †
CO_2 100 ppm – 20%, CO 0.5 – 9.9 ppm, NO 5000 ppm – 1% †
CO_2 100 – 9999 ppm, CO 10 – 9999 ppm, NO 1 – 4.9 ppm †
CO_2 100 ppm – 20%, CO 10 ppm – 10%, NO 5 – 29.9 ppm †
CO_2 100 ppm – 20%, CO 10 ppm – 10%, NO 30 – 4999 ppm †
CO_2 100 ppm – 20%, CO 10 ppm – 10%, NO 5000 ppm – 1% †
CO_2 100 – 9999 ppm, CO 1 – 10%, NO 1 – 4.9 ppm †
CO_2 1 – 20%, CO 0.5 ppm – 10%, NO 1 – 4.9 ppm †
CO_2 1 – 20%, CO 0.5 – 9.9 ppm, NO 5 – 29.9 ppm †

Carbon Dioxide, Carbon Monoxide, Oxygen in N_2
CO_2 100 – 9999 ppm, CO 0.5 – 9.9 ppm, O_2 0.4 – 49% †
CO_2 100 ppm – 20% , CO 10 ppm – 9.5%, O_2 0.4 – 49% †

Carbon Dioxide, Carbon Monoxide, Propane in Air
CO_2 100 ppm – 20%, CO 0.5 – 9.9 ppm, C_3H_8 1 ppm – 1.6% †**
CO_2 100 ppm – 20%, CO 10 – 99 ppm, C_3H_8 1 ppm – 1.6% †
CO_2 100 ppm – 20%, CO 100 ppm – 8%, C_3H_8 1 ppm – 0.6% †

Carbon Dioxide, Carbon Monoxide, Propane in N_2
CO_2 100 ppm – 20%, CO 0.5 – 9.9 ppm, C_3H_8 1 ppm – 2.9% †
CO_2 100 ppm – 20%, CO 10 – 99 ppm, C_3H_8 1 ppm – 2.9% †
CO_2 100 ppm – 20%, CO 100 ppm – 10%, C_3H_8 1 ppm – 2.9% †