



Environmental Gases and Equipment



Spectra Gases, Inc.

Customer Focused Technological Leader

Spectra was founded in 1980 to meet the needs of researchers for excimer laser gas mixtures and quickly grew as excimer laser applications became widespread and generally accepted. Over the years the company has continued to expand and has become a leading worldwide supplier of specialty gases for the environmental market, semiconductor industry, stable isotopes, labeled biochemicals and gas handling equipment. Despite such growth, Spectra remains focused on providing cutting-edge solutions to meet our customers' ever-changing needs.

Finding Solutions

Over forty percent of Spectra employees are dedicated to our Engineering, Research & Development, and Customer Service groups. With this extensive commitment to solving challenging applications, it is no surprise that we gain and retain a high level of customer loyalty. This integrated team effort to meet our customers' requirements is the coherence of purpose that sets Spectra apart.

Whether a customer needs a gas with a customized purity, high-speed gas delivery equipment for a new application, an uncommon gas mixture with exacting tolerances, a specifically labeled amino acid or complex analytical support, Spectra can be relied upon to provide solutions that support customer needs.

Quality Improvement

In order to remain a market leader, Spectra aggressively pursues a continuous improvement process. All of our employees have the authority to initiate process improvements and, with support from their managers, take ownership of the improvement process. The Quality Assurance Team provides all of our employees with the tools, training and authority to act decisively, a fundamental need for a "fast response" organization. Spectra is also very proud of having attained ISO 9002 registration in 1995 and our successful transition to the revised ISO 9001:2000 standard in May 2003. This innovative approach to both ISO adherence and continuous improvement results in the highest quality product for you.



Spectra Environmental Division

Pre-Eminent Manufacturer of Calibration Gas Standards

The Spectra Environmental Division is recognized around the world as the pre-eminent manufacturer of calibration gas standards for the environmental monitoring community.

The dedicated research and development professionals of Spectra allow us to routinely provide you with the leading edge products that you require. Whether it is providing a parts per trillion (ppt) mercury standard, a 100 component @ 100 parts per billion (ppb) VOC standard, a stable ppm HCl standard, or many other unique standards, analysts know that they can rely upon Spectra.

Your needs may be at the percent (%) level or at the part-per-trillion (ppt) level. You may be monitoring stack emissions, auto emissions or ambient air. In all cases, the Spectra proprietary cylinder passivation processes, combined with the highest quality manufacturing techniques and the latest in analytical analysis, provides you with the standards you require.

Spectra quality and accuracy is a culmination of decades of experience and personnel training resulting in a multi-step manufacturing and analysis process.

- *Spectra Shield™*, the unique Spectra cylinder cleaning, conditioning, and passivation processes insure our customers that the standards they purchase from Spectra are uncontaminated and that the cylinder's contents will be stable for the certified shelf life.
- All environmental standards at Spectra are produced utilizing the highest quality raw materials.
- Only the most sensitive gravimetric filling techniques are employed by Spectra. All of the weights, balances, and scales are calibrated directly to NIST (National Institute of Standards and Technology).
- All standards supplied by Spectra's Environmental Division, including air and nitrogen, are analyzed before shipping. The laboratory uses the latest state-of-the-art equipment and analytical techniques such as:
 - NDIR (non-dispersive infra-red)
 - FTIR (Fourier transform infra-red)
 - GC (gas chromatography)
 - MS (mass spectrometer)
 - CVAA (cold vapor atomic absorbance)
 - Chemiluminescence
 - Paramagnetic
 - Electrochemical.

It is readily apparent why governmental agencies, private laboratories, and industrial facilities around the world choose Spectra as their supplier of environmental standards.



Quality

Quality Management System founded on ISO Standards

Spectra Gases is the leading supplier of specialty gases, fine chemicals, and advanced gas technologies throughout the world. We have continually taken pride in the high quality of our people, products and service. The actions of our extraordinary team of professionals who are dedicated to excellence by demonstrating a passionate focus on promptness, integrity, and courtesy in every relationship ensures our continued commitment to quality and the long-term vitality of our company

Quality begins with our executive management team and is enthusiastically embraced by all of our employees. Everyone understands not only our customer's requirements and supplier's capabilities but receives intensive product and process training to provide for consistent reliable products and service.

To demonstrate this pride and assure our continued improvement, we have adopted the ISO 9000 standards as our formal Quality Management System.

Spectra Gases is proud to say that in October 1995, we attained ISO 9002 registration and in January of 1998, received ISO 9001 certification. Our most recent accomplishment, in May 2003 was our successful transition to the revised ISO 9001: 2000 standard.

The quality program of Spectra Environmental Division has been audited and certified as a qualified supplier of gaseous calibration standards for the nuclear industry.

Spectra continues to embark on new quality initiatives; ISO registration is just the beginning.



General Information: Cylinder Information

To insure the highest product quality and long term stability, Spectra Gases Environmental Division supplies its calibration standards and gases in high pressure aluminum cylinders. All new cylinders are thoroughly inspected and cleaned before going through the proprietary *Spectra Shield™* passivation process.

To maintain product integrity returned cylinders are inspected and refilled only with similar components.

In addition, aluminum cylinders have the added feature of being up to 40% lighter than steel thus lowering shipping costs and making cylinder handling easier.

All cylinders meet or exceed US DOT CFR 49 regulations.

The table below provides information on the various cylinders that Spectra utilizes for its environmental calibration gases.

Cylinder Size		2A	3A	4A	5A	6A
Diameter	In.	8	7.2	7	3.2	3.2
	cm.	20	18.4	18	8.1	8.1
Length	in.	47.5	35	16	12	9.4
	cm.	121	88.9	41	30.5	24
Tare Weight	lbs.	50	33	15	2	1.5
	kg.	23	15	7	0.9	0.7
Internal Volume	ft ³	1.06	0.55	0.25	0.04	0.03
	liters	30.0	15.7	7.0	1.32	0.9
Pressure Rating	PSIG	2015	2216	2015	2015	1800
	BAR	139.9	153.8	139.9	139.9	125.1
Approximate Contents (full pressure)	ft ³	141	84.0	35	5.6	3.7
	liters	4000	2367	979	170	104



Absolute Pressure – A quantity of pressure measured in comparison to zero pressure (total vacuum). As gauge pressure is measured with respect to that of the atmosphere, absolute pressure equals a pressure gauge reading plus atmospheric pressure (760 mm Hg at sea level)

Absolute Zero – The temperature at which molecular motion is predicted to cease: 0° Kelvin, -273.6°C, or -459.69°F.

Anhydrous – Without water.

Accuracy – The closeness of agreement between a test result and the accepted reference value [ISO 5725-1]. The closeness of agreement between the result of a measurement and a true value of measurement. Accuracy is a qualitative concept. It is typically documented at the 95% confidence interval for specialty gas calibration mixtures.

Analytical Tolerance – The maximum and minimum certification value relative range that an end user's calibration standard is certified to by a specialty gas producer. It is typically expressed as a percent (i.e. $\pm 1\%$, $\pm 2\%$, $\pm 5\%$ relative).

NOTE: It is important to ensure that the sum of the blend tolerance and the analytical tolerance, when combined, do not exceed the concentration needed for a given calibration point.

Blend Tolerance – The maximum and minimum preparation tolerance relative range that an end user's calibration standard is blended to as compared to the nominal concentration ordered. It is typically expressed as a plus or minus percent (i.e. $\pm 2\%$, $\pm 5\%$, $\pm 10\%$ relative).

NOTE: It is important to ensure that the sum of the blend tolerance and the analytical tolerance, when combined, do not exceed the concentration needed for a given calibration point.

Calibration Gas – A specialty gas mixture with a known pedigree specifying the 1) certified gas concentration, 2) traceability, 3) blend tolerance, 4) analytical certification accuracy, and 5) certification period (shelf life) used to zero or calibrate an analytical instrument. It is used as a

comparative standard for analytical instrumentation. A calibration gas may also be referred to as a Certified Standard. The decision for the pedigree of the standard is based on company quality and legal (i.e. environmental regulation) requirements.

CAS (Chemical Abstract Services) Number – An internationally recognized unique number identifying a chemical compound thus avoiding potential errors associated with chemical nomenclature.

CEM – Continuous emissions monitor. A CEM is typically an integrated system made up of analytical instruments and equipment required to continuously sample, condition, and analyze the concentration of specific gases in the sample of gases removed from or in the source (stack or duct) and also record data for compliance with environmental monitoring requirements.

Certificate of Analysis (COA) – A written document that states the certified concentration of a component of a mixture. (See Reference Material Certificate of Analysis.)

Certification Period – The time (in months) specified by the US EPA or by the specialty gas manufacturer that provides assurance that with proper handling, the calibration gas mixture retains its certified concentration. While each individual specialty gas manufacturer may state the stability/shelf life, EPA, as part of the "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards," September 1997, EPA-600/R-97/121., has provided the maximum certification period for mixtures, prepared in aluminum cylinders, for the specific components listed in the document.

Certificate of Analysis – See Reference Material Certificate of Analysis.

Certified Reference Material (CRM) – A calibration product issued by NIST that is certified for specific chemical or physical properties. The CRM is issued by NIST, with a certificate that reports the results of the characterization and indicates the intended use



of the material. It is typically known as a Standard Reference Material (SRM) or a Research Gas Mixture (RGM).

NOTE: The term Certified Reference Material (pre-1997) originally was the precursor to the NTRM standard. In some legislative documents the CRM product is still used as an acceptable standard to establish NIST traceability.

Certified Standard – A specialty gas calibration mixture with a known pedigree specifying the 1) certified gas concentration, 2) traceability, 3) blend tolerance, 4) analytical certification accuracy, and 5) certification period (shelf life) used to zero or calibrate an analytical instrument.

A certified standard gas is used as a comparative standard to calibrate analytical instrumentation.

NOTE: It is important to determine and document the pedigree of the calibration standard you should use, based on your company's quality and legal (i.e., environmental regulation) requirements.

Examples of certified standards include NIST Traceable Certified Standard, EPA Protocol Standard, or the more generic term, certified standard.

CGA Number – Cylinder/Container valve outlet connection assigned by the Compressed Gas Association (CGA) Numbers are detailed in CGA Standard V-1 and are generally followed by all specialty gas manufacturers. The CGA regime ensures that incompatible products (e.g., flammable or oxidizer) are not cross connected.

NOTE: Adapters should not be used to circumvent the CGA outlet connection on any cylinder, manifold or regulator.

Compressed Gas* - Any material or mixture that fulfills any of the following conditions:

- In the container there is an absolute pressure exceeding 40 psia at +70°F (2.76 bar at +21.1°C.)
- Regardless of the pressure at +70°F, the material or mixture has an absolute pressure exceeding 104 psia at +130°F (7.17 bar at +54.4°C).
- The material is any flammable liquid having a vapor pressure exceeding 40 psia at +100°F (2.76 bar at +37.74°C) as determined by ASTM Test D-323.

Concentration – The amount-of-substance (SI unit: moles) of the subject compound within the cylinder. This is usually described as the amount-of-substance fraction (SI unit mol/mol) and reported by specialty gas manufacturers as micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), parts per trillion (ppt), parts per billion (ppb), parts per million (ppm) or percent (%) of a given gas component in a specified balance gas matrix.

Department of Transportation (DOT) – The United States government agency that regulates the shipping of hazardous materials.

Environmental Protection Agency (EPA) – The United States government agency responsible for promulgating environmental regulations under the Clean Air Act and its amendments.

EPA Protocol Gas Standard – A calibration mixture that is produced according to the “EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards,” September 1997, EPA-600/R-97/121 or the most current version. The gas is typically certified to 1% or 2% (minimum of 2% at a 95% confidence interval) relative accuracy. It is used to ensure EPA regulatory compliance or when required by EPA for a specific application or test method.

Flammable Gas* - A compressed gas which meets any of the following conditions:

- When 13% or less (by volume) mixed with air forms a flammable mixture at atmospheric pressure and temperature.
- The “Flammable Range” of this gas at atmospheric pressure and temperature is wider than twelve (12) percentage points, regardless of the lower limit.
- Using the Bureau of Explosives’ Flame Projection Apparatus, the flame projects more than 18 inches (45.72 cm) beyond the ignition source with the valve fully open, or, the flame flashes back and burns the valve with any degree of valve opening

* As defined by United States Department of Transportation, Bureau of Explosives Division

Gas Manufacturer Intermediate Standard

(GMIS) - A NIST traceable standard produced by the specialty gas manufacturer, then certified with an instrument calibrated through direct traceability with a NIST standard (i.e., SRM, NTRM, or RGM) in accordance with the EPA Protocol method the "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards," September 1997, EPA-600/R-97/121 or the most current version. It is used primarily by specialty gas manufacturers to provide both traceability and as a measurement anchor for certifying customer calibration standards.

Hydrostatic Test – A test of a cylinder wall elasticity by applying liquid pressure. This evaluation of cylinder wall integrity is required periodically by the United States Department of Transportation.

Inert Gas – A gas that does not react with other elements at atmospheric temperature and pressure.

Material Safety Data Sheets (MSDS) – Document required under the United States Occupational Safety and Health Administration (OSHA) rules detailing hazards, handling requirements and incident response associated with a given chemical.

Metrology – The science of weights and measures.

Mole – The amount of a substance that contains 6.023×10^{23} (Avogadro's Number) of molecules. This is the mass that is numerically equal to its molecular weight. A gram mole is the weight in grams equal to the molecular weight.

Molecular Weight – The sum of the atomic weights of all the atoms composing a molecule.

National Institute of Standards and Technology (NIST) – An agency of the United States Department of Commerce's Technology Administration. NIST's primary mission is to promote US economic growth by working with

industry to develop and apply technology, measurements, and standards. NIST is responsible for the production and certification of primary standards (Standard Reference Materials (SRM), NIST traceable Reference Materials (NTRM), and Research Gas materials (RGM) used to establish traceability to the United States metrology system.

NIST Traceable – One measurement that has been compared and certified, either directly or via not more than one intermediate standard, to a NIST primary standard such as a CRM or NTRM.

Direct Traceability – Requires that the analyzer used by the specialty gas manufacturer be calibrated with a NIST CRM standard (i.e. SRM, NTRM or RGM) within the well characterized region of the gas analyzer's calibration curve. The end user's gas cylinder is analyzed and compared with the primary standard-generated curve to determine concentration.

Indirect Traceability – Involves a multi-step analysis/certification process. First, the specialty gas manufacturer's analyzer is calibrated with a gas manufacturer's intermediate standard (i.e. GMIS). Then the customer's product cylinder is analyzed against the calibration curve to generate a certified concentration. Used in this configuration, the specialty gas manufacturer must first make the GMIS, certifying its contents using the direct traceability protocol to assign the GMIS a concentration.

NOTE: A regulatory authority (such as the US EPA) may recognize a NIST NTRM as being equivalent to a CRM (see SRM definition)

NTP – Normal temperature and pressure, +68° F (+20°C) and 760 torr.

Partial Pressure – The pressure that would be exerted by one component of a gas mixture if that one gas were alone in the volume area. The total pressure of the gas mixture is the sum of the partial pressures of each gas component.



Passivation – The treatment of a surface to create a non-reactive surface. This helps to reduce absorption, adsorption, and corrosion.

Pressure Relief Device – A safety device designed to release extreme pressure caused by an accidental exposure to fire or other extreme heat. It is also known as a Safety Relief Valve and is usually incorporated in the cylinder valve.

Pressure Relief Valve - See Pressure Relief Device

psig – Pounds per square inch gauge, meaning that the pressure is measured with respect to atmosphere.

psia – Pounds per square inch absolute, meaning that pressure is measured with respect to total vacuum.

Reference Material Certificate of Analysis (COA) – A document accompanying a calibration gas mixture stating one or more property values and their relative uncertainties, and confirming that the necessary procedures have been carried out to insure their validity and traceability.

Requested Concentration – The concentration of a gas that a customer has asked for or ordered. It is also known as the nominal value. The requested concentration is the value to which the blend and analytical tolerance are compared against to determine if the certified mixture concentration meets specifications.

Research Gas Mixture (RGM) – A gas mixture produced cooperatively by NIST and a specialty gas manufacturer. The gas mixture's concentration must be outside a current NIST Primary Standard suite or have a composition not currently supported by NIST. A RGM is designed for new gas mixtures, which have not been produced by NIST before. NIST will usually be responsible for value assignment of the mixtures and to study stability over time. The output of this process is a series of gas mixtures, which are traceable to NIST. There

may be restrictions on the gas mixtures, such as stability checkpoints, that must be met to insure continued NIST traceability. Another output of this program may be gas primaries that can be used in the NTRM or SRM programs (after any confidentiality period has expired). These standards are produced, purchased and used primarily by specialty gas manufacturers to provide both traceability and a measurement anchor for certifying customer calibration standards.

Safety Relief Device – See pressure relief device.

Safety Relief Valve - See pressure relief device.

SI Units (le Systèm International d'Unités) – Based on the 1960 General Conference of Weights and Measures, adopted the International System of units, the SI Unit. The SI base unit for gases is the mole (mol) representing "amount of substance." The SI unit for mass is the kilogram, kg.

Span Gas – Gas mixture or calibration gas used as a reference point to verify and/or set the calibration of an analytical instrument, environmental analyzer or as a method to establish NIST traceability.

Standard Reference Material (SRM) – Certified Reference Material (CRM) issued by NIST. It is certified for specific chemical or physical properties, and is issued by NIST with a certificate that reports the results of the characterization and indicates the intended use of the material. A SRM is prepared and used for two main purposes:

- a. To help develop accurate methods of analysis
- b. To calibrate measurement systems used to:
 - Facilitate exchange of goods.
 - Institute quality control.
 - Determine performance characteristics
 - Measure a property at the state-of-the-art limit.

SRMs are purchased and used primarily by specialty gas manufacturers to provide both traceability and as a measurement anchor for certifying end-user calibration standards.

STP – Standard temperature and pressure. +32°F (0°C) and 760 torr.

Tolerance – The difference between the “measured” and “expected” value. This quantity is typically presented as a percentage (i.e. ±5%) relative to the expected value (i.e., the customer’s requested concentration)

Total Hydrocarbon Content (THC) – THC is used to describe the quantity of the hydrocarbons present. It is usually expressed as methane (CH₄) or propane (C₃H₈) equivalents.

Torr – A unit of pressure equal to one (1) millimeter of mercury (mmHg)

Traceability – The property of a result of a measurement whereby it can be related to appropriate standards, generally national or international standards, through an unbroken chain of comparisons all having specified uncertainties.

NOTE: Traceability only exists when metrological evidence, appropriate for the application, is collected on a continuing basis to document the traceability chain and quantify its associated measurement uncertainties. In most cases, the ultimate stated reference for a measurement result is the SI (le Systèm International d’Unités) definition of the appropriate unit(s) [NORAMET Document No. 7 (1995-11-13)].

Uncertainty – A parameter, associated with concentration, which characterizes the dispersion of the values that are attributed to the concentration assignment. A reported concentration value must have an associated uncertainty typically at the 95% or better confidence interval.

Vapor pressure – The pressure exerted by the vapor which is in equilibrium with its associated liquid or solid at a given temperature.

Volatile organic compound (VOC)

1 - The environmental or legislated definition:

Constituents that will evaporate at their temperature of use and which, by a photochemical reaction, will cause atmospheric oxygen to be converted into potential smog-promoting tropospheric ozone under favorable climatic conditions.

2 - The scientific definition: Any hydrocarbon, except methane and ethane, with a vapor pressure equal to or greater than 0.1 mm Hg.

Zero Gas – A specialty gas that has been certified to contain less than an amount of the gas component and/or other impurities of interest. Zero gas is typically used to “zero” an analytical instrument.

NOTE: End users should always specify the components that are being measured/ monitored to ensure that the zero gas has been analyzed to certify or confirm

Warranties

Definition

Customer: As used throughout this catalog, "Customer" shall mean and include any person, partnership, corporation or other entity or organization to include all of their agents, servants, employees, heirs, successors, assigns and legal representatives. Spectra Gases: As used throughout this catalog, "Spectra Gases" shall mean and include Spectra Gases Inc. of the United States, Spectra Gases Ltd. of England, Spectra Gases GmbH of Germany, and any and all of their offices, facilities, distributors, and locations worldwide.

Warranty

Spectra Gases warrants that all products listed in this catalog and delivered to the Customer will, at the time of shipment, meet all the applicable specifications listed in this catalog or as described in other written form by Spectra Gases. If the product does not meet the listed specifications as confirmed by Spectra Gases, Spectra Gases will replace the product at no charge to the Customer. Before Spectra Gases refunds any purchase price, the Customer must give Spectra Gases a reasonable time to replace the product with one that conforms to the listed specifications. Any compensation to the Customer from Spectra Gases is limited to the purchase price of the product.

Limitation on Liability and Action

If Spectra Gases defaults in any manner under this sales contract, then Spectra Gases' sole obligation and sole liability to the Customer is to refund to the Customer all sums paid on account or replacement, not to exceed the purchase price. It is understood by all parties that Spectra Gases makes no warranty, express or implied, except as set forth in the Agreement. Under no circumstances shall Spectra Gases be liable in contract, tort, strict or absolute liability or under any other theory whatsoever for any other direct or special damages, or for any indirect or consequential damages whatsoever, notwithstanding that the loss is in the form of personal injury, pecuniary loss, increased

expense or otherwise. Under no circumstances shall any claim or suit be brought against Spectra Gases after the expiration of one (1) year from the date of the product's delivery to the Customer.

Indemnity

The Customer shall indemnify and hold harmless Spectra Gases, affiliated companies, employees, their successors and assigns from and against any and all losses, damages, liability, claim, or expense whatsoever, including reasonable attorneys' fees and costs of any kind arising out of injury to or death of persons, or damages to or destruction of property in any manner caused by, resulting from, or connected with the sale or delivery of products to the Customer.

The Customer may not extend any of Spectra Gases' warranties to a second buyer.

The Customer may never refill any of Spectra Gases' cylinders. Additionally, any products which are defective, broken, worn, corroded, or otherwise out-of-specifications, must not be used or repaired by the Customer.

Customer's Responsibilities

The Customer is responsible for the safety, warning and training of all agents, servants, employees, or any others who may be exposed to any hazards related to Spectra Gases' products. The suitability of the products ordered for the intended use is the sole responsibility of the Customer.

The Customer should not use any cylinder whose contents are not clearly and consistently marked, as such use might be dangerous. The Customer should call Spectra Gases with any questions regarding Spectra Gases' product or the safe use and storage of that product.

When cylinders are being returned prepaid or otherwise shipped by the Customer, the Customer is responsible for having the cylinders properly labeled and marked to conform to current government(s) shipping regulations within the country(ies) the returned cylinders are to be shipped within. During the return of material to



Spectra Gases any liability arising from noncompliance with any government(s) rules or regulations are the sole responsibility of the shipper (customer).

Spectra Gases' Responsibilities

When hazardous or toxic materials are involved, Spectra Gases is required to have safety recommendations available to our customers. Material Safety Data Sheets (MSDS) are available for every gas which Spectra Gases sells. Spectra Gases is responsible for the safe preparations for shipment of all products. All products should be labeled clearly and consistently.

Not by law, but by company policy, Spectra Gases' employees will treat each Customer with respect, offering the best service that we are able to provide in all cases.

Spectra Gases has the right to:

- Refuse to sell any product to a Customer, particularly if we believe that the product will not be handled safely or used appropriately.
- Refuse to refill a Customer owned cylinder
- Charge a preparation fee without notice when Customer owned cylinders do not meet Spectra Gases' standards before being filled. For the same reason, Spectra Gases has the right to replace cylinder valves at the Customer's expense.
- Hold shipment of product until an authorized purchase order number has been received from the Customer

Cylinder & Equipment Terms

Cylinder Rental Options*

Option #1: Deposit /Rental Options

- a. A cylinder deposit (dependent on the cylinder size) is first sent to Spectra Gases.
- b. The customer returns the cylinder to Spectra Gases when it is empty.
- c. The cylinder deposit, less outstanding invoices and freight bills, is then sent in the form of a credit memo by Spectra Gases to

the Customer's billing address, minus rental charges.

Option #2: Rental System (Demurrage)

Rental charges are invoiced each month. Charges are discontinued after the cylinder is received at a Spectra Gases plant location.

Note: Unless otherwise arranged with Spectra Gases, empty cylinders must be returned prepaid to any of the following locations: (Customers who send cylinders back not prepaid will be billed for the amount of freight.)

USA East Coast
Spectra Gases, Inc
80 Industrial Drive
Alpha, NJ 08865 USA

USA West Coast
Spectra Gases, Inc.
1261 Activity Drive
Vista, CA 92083 USA

Germany
Spectra Gases GmbH
Im Riemen 12
64832 Babenhausen

United Kingdom
Spectra Gases Ltd.
e-Space North
Wisbech Road Littleport
Cambridgeshire, England
PE18 6XY

**Prices are subject to change without notice.*

General Return Information

Return of Cylinders

Before and during any transportation, all compressed gas cylinders must have all valve openings tightly closed, and all dust caps and dust plugs/fittings securely tightened. Cylinders must be returned freight prepaid only to the nearest Spectra Gases facility.

Collect returns will **not** be accepted by Spectra Gases' receiving department.

Compressed gas cylinders that are full, partially full or empty that are being returned to any Spectra Gases facility, "may not be offered for transportation unless offered in the same manner as required when it previously contained a greater quantity of hazardous material," (CFR 43, 173.29). Shipping paperwork (Bill of Lading) must include the proper shipping name preceded by the words, "RESIDUE: Last Contained".

Do not remove the hazard class labels before returning empty cylinders.

Return of Equipment

Equipment must be returned freight prepaid to the nearest Spectra Gases facility. All equipment used with hazardous gases must be thoroughly purged with an inert gas prior to return to Spectra Gases.

Return Authorization for Gases

Do not return any material in question without prior approval from Spectra Gases. Spectra Gases' customer service department will initiate a RETURN AUTHORIZATION (RA) for any product that must be evaluated by Spectra Gases. An "RA" number will be supplied for proper identification by Spectra Gases. Please contact Spectra Gases' customer service department for specific information regarding the return of any and all material to Spectra Gases.

Returned Goods Restocking Charge

Customers desiring to return unused standard equipment for credit will be charged a restocking fee. Custom or specially modified components or systems will be accepted at Spectra Gases' sole discretion.

Refilling Customer Owned Cylinders

Federal law in the U.S.A. prohibits refilling of Spectra Gases or any other vendor owned cylinders without prior permission from the owner. Call the nearest Spectra Gases facility for additional information on refilling Customer owned cylinders.

Method of Shipment From Spectra Gases Facilities

USA Facilities

1. All orders will ship Freight On Board (F.O.B.) shipping point. Freight charges are to be prepaid and added to the customer's invoice unless arranged otherwise with Spectra Gases.
2. Some shipments made within a fifty (50) mile radius of Spectra Gases' facilities in the U.S.A. can be made via Spectra Gases

truck. Please contact Spectra Gases' customer service department for details.

3. Common carrier is the standard method of transportation for shipments over seventy (70) pounds. Please specify the preferred common carrier or Spectra Gases shipping department will use the common carrier that best services the customer's area.
4. Air freight shipments can be arranged through a number of carriers. There are several types of air shipments; for example: next day, second day, deferred air. Spectra Gases customer service department can help the customer decide which method of shipment is necessary for the customer's specific requirement. Cost is dependent upon the type of service, weight and material to be shipped.
Note: Some hazardous materials cannot be offered for air shipment.
5. Ocean freight shipments can be arranged through a number of carriers. Spectra Gases customer service department can help the customer decide which is the best carrier for the customer's specific requirements.

United Kingdom and Germany Facilities

1. All orders will ship Freight On Board (F.O.B.) shipping point. Freight charges are to be prepaid and added to the customer's invoice unless arranged otherwise with Spectra Gases.
2. Freight carrier is the standard method of transportation within most countries. Please specify the preferred freight carrier of choice or Spectra Gases shipping department will use the freight carrier that best services the customer's area.
3. Air freight shipments can be arranged through a number of carriers. There are several types of air shipments; for example: next day, second day, deferred air. Spectra Gases customer service department can help the customer decide which method of shipment is necessary for the customer's specific requirement. Cost is dependent upon the type of service, weight and material to be shipped.

Note: Some hazardous materials cannot be offered for air shipment.



4. Ocean freight shipments can be arranged through a number of carriers. Spectra Gases customer service department can help the customer decide which is the best carrier for the customer's specific requirements.

Inspection and Receipt of Goods

Customer shall examine and check each shipment upon receipt and unless a written claim is delivered to Spectra Gases within ten (10) days upon receipt of delivery, all claims with respect to said shipment or the products contained herein shall be conclusively deemed waived and the customer shall be conclusively.

deemed to have accepted delivery of such product from Spectra Gases. Ten (10) days after the customer has received said shipment, Spectra Gases is said to have complied with all obligations to the customer with respect to said product(s).

Material Safety Data Sheets

"MATERIAL SAFETY DATA SHEETS (MSDS) ARE SUPPLIED EACH TIME A NEW GAS PRODUCT IS ORDERED AS SPECIFIED BY OSHA'S COMMUNICATION STANDARD 29 CRF 1910.1200."

U.S. Environmental Protection Agency Protocol Gas Standards For Compliance With 40CFR Parts 50, 58, 60, and 75.

Parts 50, 58, 60, and 75 of 40CFR specify that gaseous pollutant concentration standards used for calibration and audit of continuous emission monitors (CEM) and ambient air quality analyzers be analyzed according to **EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS (EPA-600/R-97/121)** revised September 1997.

Spectra's Protocol Gas Standards are manufactured, analyzed, and certified to meet or exceed all of the requirements of EPA-600/R-97/121.

The following components and concentrations are covered by EPA-600/R-97/121 and are available from Spectra Gases as US EPA Protocol Gas Standards either singularly or in multi-component blends.

Component	Balance	Available Concentrations
CO ₂	Air	2000 ppm to 20%
CO ₂	N ₂	2000 ppm to 20%
CO	Air	0.5 ppm to 6.25% ¹
CO	N ₂	0.5 ppm to 6.25%
H ₂ S	Air	25 ppm to 200 ppm
H ₂ S	N ₂	5 ppm to 200 ppm
CH ₄	Air	1 ppm to 1000 ppm
CH ₄	N ₂	1 ppm to 1000 ppm
NO	N ₂	0.5 ppm to 1%
NO ₂	Air/N ₂	25 ppm to 3250 ppm ²
O ₂	N ₂	1% to 23%
C ₃ H ₈	Air	1 ppm to 2% ¹
C ₃ H ₈	N ₂	1 ppm to 2%
SO ₂	Air	5 ppm to 4550 ppm
SO ₂	N ₂	0.5 ppm to 1%

¹ Flam/ox restricted at elevated concentrations

² VP restricted at concentrations above 1650 ppm



Certified Environmental Calibration Standards

Certified and primary calibration gas standards are used for instrument calibration and other monitoring and measurement applications where either use of an EPA Protocol calibration standard is not required or an EPA Protocol standard is not available.

As with all Spectra environmental standards, Certified Environmental Calibration Standards are produced gravimetrically directly traceable to NIST standards in cylinders that have been individually passivated by the proprietary Spectrashield™ process.

In addition, where NIST or comparable international standards are available, analysis are performed utilizing these international standards. Where standards are not available from international metrology organizations, Spectra employs in-house developed analysis technology and standards to provide you with the most accurate and reliable standards available.

Each cylinder is individually analyzed and supplied with a Certificate of Analysis (C of A).

TYPICAL SPECIFICATIONS

Concentration Range	CERTIFIED STANDARDS		PRIMARY STANDARDS	
	Blend Tolerance	Analysis	Blend Tolerance	Analysis
< 100 ppb	Consult factory	Consult factory	Consult factory	Consult factory
100 ppb to 999 ppb	± 20%	± 10%	± 10%	± 5%
1 ppm TO 9999 ppm	± 10%	± 5%	± 5%	± 1%
> 1%	± 5%	± 2%	± 1%	± 0.02% absolute

Certified and primary calibration gas standards are available in size 2A, 3A, and 4A aluminum cylinders and where appropriate in size 2, 3, and 4 internally polished and passivated steel cylinders.

All certified and primary calibration gas standards are filled to the maximum pressure and volume as determined by the cylinder, the vapor pressure of the mixture, or restrictions due to flammable-oxidizer (flam-ox) requirements.

(Continued)



Component	Balance	Available Concentrations
Ammonia (NH ₃)	Zero Air	25 ppm to 6% ²
Ammonia (NH ₃)	N ₂	1 ppm to 10% ²
Benzene (C ₆ H ₆)	Zero Air	1 ppm to 1000 ppm ^{1,2}
Benzene (C ₆ H ₆)	N ₂	10 ppb to 1000 ppm ¹
Carbon Dioxide (CO ₂)	Zero Air	1 ppm to 20%
Carbon Dioxide (CO ₂)	N ₂	1 ppm to 20%
Carbon Monoxide (CO)	Zero Air	500 ppb to 3% ²
Carbon Monoxide (CO)	N ₂	500 ppb to 20%
Ethylene Oxide (C ₂ H ₂ O)	N ₂	1 ppm to 1% ¹
Hexane (C ₆ H ₁₄)	Zero Air	100 ppb to 5000 ppm ²
Hexane (C ₆ H ₁₄)	N ₂	10 ppb to 5000 ppm ¹
Hydrogen Chloride (HCl)	N ₂	10 ppm to 1%
Hydrogen Sulfide (H ₂ S)	Zero Air	5 ppm to 1000 ppm
Hydrogen Sulfide (H ₂ S)	N ₂	1 ppm to 3%
Mercury (Hg)	N ₂	2 µg/m ³ to 60 µg/m ³
Methane (CH ₄)	Zero Air / N ₂	1 ppm to 2.5% ²
Methane (CH ₄)	N ₂	1 ppm to 10%
Nitric Oxide (NO)	N ₂	500 ppb to 2%
Nitrogen Dioxide (NO ₂)	Zero Air	25 ppm to 0.5%
Phosphine (PH ₃)	N ₂	100 ppb to 1000 ppm
Propane (C ₃ H ₈)	Zero Air	10 ppb to 1% ^{1,2}
Propane (C ₃ H ₈)	N ₂	10 ppb to 25%
Sulfur Dioxide (SO ₂)	Zero Air	5 ppm to 2%
Sulfur Dioxide (SO ₂)	N ₂	500 ppb to 2%
Sulfur Hexafluoride (SF ₆)	Zero Air	100 ppb to 1%
Sulfur Hexafluoride (SF ₆)	N ₂	100 ppb to 1%
Toluene (C ₆ H ₅ CH ₃)	Zero Air	1 ppm to 100 ppm ¹
Toluene (C ₆ H ₅ CH ₃)	N ₂	25 ppb to 100 ppm ¹
Vinyl chloride (C ₂ H ₃ Cl)	Zero Air	100 ppb to 2000 ppm ¹
Vinyl chloride (C ₂ H ₃ Cl)	N ₂	100 ppb to 2000 ppm ¹

¹ Vapor pressure constraints will limit fill pressure/volume at higher concentrations of this standard

² Flam/ox constraints will limit fill pressure/volume at higher concentrations of this standard.

Please consult factory for other components and concentrations

Methods 26, 26A & 321 Calibration Gas Standards

HCl and HCl/SF₆ Calibration Gas Standards

US EPA Methods 26 and 26A are utilized for the determination of HCl emissions from combustions stacks, primarily waste incinerators. US EPA Method 321 is utilized for HCl emissions from Portland cement plants.

In particular, US EPA Method 321, ***Gaseous HCl Emissions at Portland Cement Kilns by Fourier Transform Infrared (FTIR) Spectroscopy***, states in paragraph 9.1.1 that:

“An HCl standard of approximately 50 ppm in a balance of ultra pure nitrogen is recommended. The SF₆ (tracer) concentration shall be 2 to 5 ppm depending upon the measurement path length. The spike ratio (spike flow/total flow) shall be no greater than 1:10, and an ideal spike concentration should approximate the native effluent concentration.”

Spectra Gases supplies both HCl in nitrogen and HCl spiked with SF₆ in nitrogen for use as a calibration standard for US EPA Methods 26, 26A and 321. HCl concentrations below 1000 ppm are supplied in aluminum cylinders that have been passivated by the proprietary SpectraShield™ process. HCl concentrations above 1000 ppm are supplied in steel cylinders which have been highly polished then passivated by the proprietary SpectraShield™ process. Whether supplied in aluminum or steel cylinders these HCl and HCl/SF₆ standards have guaranteed stability periods of 12 months.

Component	Concentration	Blend	Analytical	CGA
HCl balance N ₂	10 ppm to 100 ppm	10%	5%	330
HCl balance N ₂	100 ppm to 1%	10%	5%	330
HCl / SF ₆ balance N ₂	10 ppm HCl / 2 ppm SF ₆	10%	5%	330
HCl / SF ₆ balance N ₂	50 ppm HCl / 2 ppm SF ₆	10%	5%	330



Gaseous Mercury (Hg⁰) Calibration Standards

With current and proposed worldwide regulations mandating the monitoring and/or control of mercury emissions, it is extremely important to have a reliable standard for required periodic calibration of the monitoring equipment. Through the efforts of the Research and Development Program of Spectra Gases, and our propriety cylinder passivation procedures, a stable gaseous mercury calibration gas standard is now available.

Spectra supplies mercury calibration gas in high pressure, high volume cylinders. The mercury is present in the metallic state, Hg⁰, in a balance gas of research grade air.

Cylinder Size	2A
Cylinder Dimensions	8.0" dia. x 47.5" high (20 cm x 120 cm)
Cylinder Weight	50 pounds (23 kg)
Cylinder Internal Volume	1.06 ft ³ (30 liters)
Cylinder Gas Volume	141 ft ³ (4000 liters)
Cylinder Pressure	2000 psig (140 bar)
Concentration Range	up to 60 µg/m ³
Stability Guarantee	(six) 6 months
Cylinder Outlet	CGA 660
Recommended Regulator	SGI Model 7622 (see below)

Spectra recommends that only a pre-conditioned, low internal volume regulator be utilized for mercury calibration gases.

Our SGI Model 7622 Miniature Regulator is well suited for use with mercury standards, providing a low flow rate with accurate pressure control. A metal diaphragm and KEL-F seat, along with pre-conditioning, make this regulator ideally suited for mercury calibration standards.



MERCAL™

Mercury Calibration System for CEMS

The patented MerCal™ is designed to provide a stable source of oxidized mercury, Hg⁺², as well as, elemental mercury, Hg⁰, to allow complete calibration of mercury continuous emissions monitoring systems (CEMS). Most mercury analyzers measure only Hg⁰ and incorporate a converter to reduce the oxidized form to the elemental state. Hg⁺² is required to allow the converter's efficiency to be checked on a regular basis.

MerCal™ eliminates the need for complicated liquid standards and the potential for producing secondary environmental problems



In operation a high pressure source of NIST traceable elemental mercury and a high pressure source of chlorine are reacted in the stack mounted MerCal™. Mercury flow is set by the user's mercury protocol gas regulator to match the continuous emissions monitoring system requirements. MerCal™ incorporates a flow restrictor to establish a few cc/min chlorine flow, thus eliminating the need to correct the concentration of the Hg⁰ when it is reacted to HgCl₂

The CEMS controller automatically initiates flow of either the Hg⁰, or the Hg⁰ and Cl₂. In the Hg⁰ only mode, the outlet of the MerCal™ unit will be elemental mercury which can be used to check the calibration and drift of the CEMS. In the Hg⁰ and Cl₂ mode the outlet of the MerCal™ will be HgCl₂ which will allow for the monitoring of the efficiency of the Hg⁺² to Hg⁰ converter in the CEMS.

MerCal™ is engineered to be maintenance free. The replacement of the mercury will be determined by the frequency and the length of calibration cycles. The replacement of the chlorine cylinder will be much less frequent and in normal operation it is estimated to be over two years.



Zero Grade Gases

Spectra's zero grade air and nitrogen are the products of choice when you require high quality, cost effective, non-regulatory zero gases. Every cylinder is supplied with an individual certificate of analysis to insure the quality that you require.

CEM Zero Grade Gases

Federal, state, and local air pollution control regulations require daily zero and span calibrations for CEMS (continuous emissions monitoring systems). A CEMS must be zeroed with a pure gas that is free of the pollutants being measured. Spectra's CEM zero grade air and nitrogen are analyzed for SO₂, NO_x, CO, CO₂, H₂O, and total hydrocarbons. With each individual cylinder being analyzed the quality of CEM zero grade gases is consistent from cylinder to cylinder insuring that the performance of the gas meets and/or exceeds the requirements of all applicable regulations.

VOC Zero Grade Gases

Spectra's VOC zero grade gases are the ideal choice for support gas, zero gas, or purging gas for all VOC/THC analysis. This includes EPA ambient methods (TO-14, TO-15, and TO-17) as well as vehicle emission zero gas and CEM THC zero gas.

SPECIFICATIONS

(all concentrations in ppm except where noted)

	NITROGEN				AIR		
	ZERO	CEM ZERO	VOC ZERO		ZERO	CEM ZERO	VOC ZERO
CO	2	0.5	<0.05	CO	1	0.5	<0.05
CO ₂	2	1	<0.5	CO ₂	1	1	<0.3
H ₂ O	1	4	<0.5	H ₂ O	5	5	<1.0
Nox		0.1		NO _x		0.1	
SO ₂		0.1		SO ₂		0.1	
THC (as CH ₄)	1	0.1	<0.05	THC (as CH ₄)	1	0.1	<0.05
O ₂	1	0.5	<0.5	O ₂	20-21%	20-21%	20-21%



VOC Standards Make vs. Buy

Occasionally we receive questions about the advisability and practicality of an air toxics laboratory producing their own VOC standards. In order to provide accurate guidance we queried many laboratories. Both governmental and private laboratory personnel were asked for their opinions on the pros and cons of manufacturing and then utilizing VOC standards for air toxics analysis.

All of the respondents voiced concern over a laboratory being able to produce accurate, uniform, and stable standards. Including:

- **Training of Personnel** – Where and how were the personnel trained?
- **Experience of Personnel** – How many years of experience do the personnel have in VOC standards preparation and analysis? One commentator indicated that the minimum experience level should be five years.
- **Quality Concerns** – Is the facility audited to ISO 9000 standards? Is the laboratory's production of VOC standards incorporated in their QA procedures?
- **Proper Reagents** – Highest available purity VOCs and VOC free N₂ exclusively utilized. The availability of two discrete batches of reagent was indicated to be desirable.
- **Proper Equipment** – These include such items as compressors, heated vessels and transfer equipment, N₂ clean-up equipment, gauges, balances, etc. All measurement devices should be NIST traceable and be within current validation period.
- **Availability of Standards** – Both liquid and gaseous.
- **Stability Testing** – What studies has the laboratory conducted to indicate that the prepared standard is stable for an hour, day, week, month, or year? Several comments were received stating that in their opinion the use of a liquid injection into a Summa canister followed by N₂ pressurization was not an acceptable method of standard preparation.

A number of governmental agency laboratories indicated that they would have potential problems in accepting data obtained utilizing self-made standards unless the standards were analyzed, and the accuracy was certified by an independent laboratory. Alternately the use of commercially produced standards to verify the self-made standards was also indicated to be viable.

100% of the respondents indicated that at first thought the primary reason for producing VOC standards internally was as a cost saving measure. However, they all concluded that in actuality this is not the case. In the words of one laboratory manager:

“As a production laboratory, we make money by running samples, lots of them, and time spent on standards prep is time taken away from something else.... running the instrument, crunching data, spitting out reports. It (producing our own standards) would cost us more in the long run!”

There was uniform consensus that once all factors are considered there is no compelling reason for a laboratory to manufacture VOC standards in lieu of purchasing them from a qualified vendor.



BTEX Calibration Standards

Environmental regulations require accurate, traceable low concentration organic gas calibration standards to calibrate instruments used in:

- Ambient air monitoring
- Infiltration studies
- Measurement of incinerator emissions
- Measurement of fugitive emissions from chemical processing equipment
- Measurement of industrial stationary sources
- Measurement of landfill gases

Spectra offers a four (4) component, BTEX Standard -1, a six (6) component, BTEX Standard - 2, and a seven (7) component, BTEX Standard - 3, calibration standards in concentrations from 100 ppb to 10 ppm in a balance gas of VOC zero grade nitrogen (N₂). All concentrations are directly traceable to NIST gravimetrically and analytically by comparison with NIST certified standards.

BTEX standards are available in a variety of cylinders; most common are the size 6A, 104 liters at 1800 psig and the 2A, 4000 liters at 2000 psig.

BTEX STANDARD - 1

Benzene [71-43-2]	Toluene [108-88-3]
Ethyl Benzene [100-41-4]	o-Xylene [95-47-6]

BTEX STANDARD - 2

Benzene [71-43-2]	m-Xylene [108-38-3]
Ethyl Benzene [100-41-4]	o-Xylene [95-47-6]
Toluene [108-88-3]	p-Xylene [106-42-3]

BTEX STANDARD - 3

Benzene [71-43-2]	m-Xylene [108-38-3]
Ethyl Benzene [100-41-4]	-Xylene [95-47-6]
Toluene [108-88-3]	p-Xylene [106-42-3]
Tert-butyl methyl ether	(MTBE) [1634-04-4]

NOTE: CAS numbers are in square brackets, i.e. [00-00-0]

SPECIFICATIONS

Blend Tolerance:	100 ppb to 1 ppm +/- 10%
	> 1 ppm to 10 ppm +/- 5%
Analytical Accuracy	100 ppb to 1 ppm +/- 5%
	> 1 ppm to 10 ppm +/- 2%
Stability	12 months

Please contact Spectra Environmental Division for information on other concentrations, tolerances, and cylinder sizes.



Method TO-14A Calibration Standards

US EPA's Compendium Method TO-14A, "Determination of Volatile Organic Compounds (VOCs) In Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography" is used extensively by analysts for both ambient air studies and indoor air quality (IAQ) studies.

Spectra's TO-14A calibration standards are manufactured using exacting gravimetric techniques with all gravimetric measurements directly traceable to NIST (National Institute of Standards and Technology). Furthermore Spectra's 39 component mix is directly traceable analytically to NIST.

Spectra's base TO-14A calibration standard consists of 39 components at concentrations of either one (1) ppm or one hundred (100) ppb in a balance of VOC free nitrogen (N₂) with other concentrations available as custom mixtures. All TO-14A standards have one year stability. In addition Spectra supplies 41 and 43 component TO-14A standards, as well as, a variety of subsets.

39 COMPONENT TO-14A

Benzene [71-43-2]	Dichlorodifluoromethane [75-71-8] (Halocarbon 12)
Bromomethane [74-83-9]	1,1,2 Trichlorotrifluoroethane [76-13-1] (Halocarbon 113)
Carbon Tetrachloride [56-23-5]	Dichlorotetrafluoroethane [76-14-2] (Halocarbon 114)
Chlorobenzene [108-90-7]	Hexachloro-1,3 Butadiene [87-68-3]
Chloroform [67-66-3]	Methylene Chloride [75-09-2]
Chloromethane [74-87-3]	Styrene [100-42-5]
1,2-Dibromoethane [106-93-4]	1,1,2,2-Tetrachloroethane [79-34-5]
1,3 Dichlorobenzene [95-50-1]	Tetrachloroethylene [127-18-4]
1,4 Dichlorobenzene [541-73-1]	Toluene [108-88-3]
p-Dichlorobenzene [106-46-7]	1,2,4-Trichlorobenzene [120-82-1]
1,1-Dichloroethane [75-34-3]	1,1,1-Trichloroethane [71-55-6]
1,2-Dichloroethane [107-06-2]	1,1,2-Trichloroethane [79-00-5]
1,1-Dichloroethene [75-35-4]	Trichloroethene [79-01-6]
cis-1,2-Dichloroethene [156-59-2]	1,2,4-Trimethylbenzene [95-63-6]
1,2-Dichloropropane [78-87-5]	1,3,5-Trimethylbenzene [108-67-8]
cis-1,3-Dichloropropene [10061-01-5]	Vinyl Chloride [75-01-4]
trans-1,3-Dichloropropene [10061-02-6]	o-Xylene [95-47-6]
Chloroethane [75-00-3]	m-Xylene [108-38-3]
Ethyl Benzene [100-41-4]	p-Xylene [106-42-3]
Trichlorofluoromethane [75-69-4] (Halocarbon 11)	

NOTE: CAS numbers are in square brackets, i.e. [00-00-0]

To enhance your QA/QC procedures, Spectra stocks at least two (2) individual batches of each VOC raw material. This allows you to order two (2) independent **TO-14A Calibration Standards** from Spectra.

41 Component TO-14A

39 component plus 1,3-Butadiene [106-99-0] and Acrylonitrile [107-13-1]

43 Component TO-14A

41 component plus 3-Chloropropene [107-05-1] and 4-Ethyltoluene [622-96-8]

(Continued)



Method TO-14A Calibration Standards Subsets

All are available at standard concentrations of one (1) ppm and one hundred (100) ppb in a balance gas of VOC free nitrogen (N₂). Other concentration are available as custom mixtures.

TO-14 A Subset 1 (1 year stability)

Benzene [71-43-2]	1,3-Dichlorobenzene [541-73-1]
Benzyl Chloride * [100-44-7]	Toluene [108-88-3]
Chlorobenzene [108-90-7]	o-Xylene [95-47-6]

* stability is not guaranteed

TO-14 A Subset 2 (1 year stability)

Acetonitrile [75-05-8]	Chloroform [67-66-3]
1,3-Butadiene [106-99-0]	Methylene Chloride [75-09-2]
Carbon Tetrachloride [56-23-5]	Trichlorofluoromethane [75-69-4]

TO 14A CFC/HFC Standard (1 year stability)

Trichlorofluoromethane (Halocarbon 11) [75-69-4]	1,1,2-Trichloro-1, 2,2-Trifluoroethane (Halocarbon 113) [76-13-1]
Dichlorodifluoromethane(Halocarbon 12) [75-71-8]	1,2-Dichlorotetrafluoroethane (Halocarbon 114) [76-14-2]

TO 14A Internal Standard (1 year stability)

Bromochlormethane[74-97-5]	1,4-Difluorobenzene[540-36-3]
Chlorobenzene-d5[3114-55-4]	

TO 14A Internal Standard/Tuning Standard (1 year stability)

Bromochlormethane [74-97-5]	Chlorobenzene-d5 [3114-55-4]
1-Bromo-4-Fluorobenzene (4-Bromofluorobenzene) [460-00-4]	1,4-Difluorobenzene [540-36-3]

Regulator Recommendation

Various independent and Agency laboratories have indicated that to ensure repeatability with low level calibration gases it is best to utilize the same regulator for initial assay and for daily usage, thus minimizing the sources for potential variances and possible cross contamination. If a regulator is purchased along with the TO-14A standard, Spectra Gases will perform the initial assay and certification analysis utilizing the regulator and cylinder as a matched set.

Spectra Gases' model 7621 regulator is ideal for use with the TO-14A component standard. Please see the equipment section for information on this and other gas handling equipment.

Standard Available Cylinders

CYLINDER SIZE	VOLUME	PRESSURE	CGA
2A	4000 liters	2000 psig	350
6A	104 liters	1800 psig	180

Method TO-15 / TO-17 Calibration Standard

The TO-15 / TO-17 Calibration Standard consists of 62 components at standard concentrations of one (1) ppm or one hundred (100) ppb in a balance gas of VOC free nitrogen (N₂). Other concentrations are available as custom mixtures. Stability of a TO-15 standard is 12 months.

Whether you are performing Compendium Method TO-15; “**Determination of Volatile Organic Compounds (VOCs) In Air Collected in Specially Prepared Canisters And Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)**” or Compendium Method TO-17; “**Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes**”, Spectra’s Calibration Standard is the standard of choice.

Acetone [67-64-1]	4-Ethyltoluene [622-96-8]
Benzene [71-43-2]	Halocarbon 11 (Trichlorofluoromethane) [75-69-4]
Benzyl Chloride* [100-44-7]	Halocarbon 12 (Dichlorodifluoromethane) [75-71-8]
Bromoform [75-25-2]	Halocarbon 113(1,1,2-Trichlorotrifluoroethane) [76-13-1]
Bromomethane [74-83-9]	Halocarbon 114 (1,2-Dichlorotetrafluoroethane) [76-14-2]
Bromodichloromethane [75-27-4]	Heptane [142-82-5]
1,3-Butadiene [106-99-0]	Hexachloro-1,3-butadiene [87-68-3]
2-Butanone (MEK) [78-93-3]	Hexane [110-54-3]
Carbon Disulfide* [75-15-0]	2-Hexanone (MBK) [591-78-6]
Carbon Tetrachloride [56-23-5]	4-Methyl-2-Pentanone (MIBK) [108-10-1]
Chlorobenzene [108-90-7]	Methylene Chloride [75-09-2]
Chlorethane [75-00-3]	Methyl-tert-Butylether (MTBE) [1634-04-4]
Chloroform [67-66-3]	2-Propanol [67-63-0]
Cyclohexane [110-82-7]	Propylene [115-07-1]
Chloromethane [74-87-3]	Styrene [100-42-5]
Dibromochloromethane [124-48-1]	1,1,2,2-Tetrachloroethane [79-34-5]
1,2-Dichlorobenzene [95-50-1]	Tetrachloroethene [127-18-4]
1,3-Dichlorobenzene [541-73-1]	Tetrahydrofuran [109-99-9]
1,4-Dichlorobenzene [106-46-7]	Toluene [108-88-3]
1,1-Dichloroethane [75-34-3]	1,1,1-Trichloroethane [71-55-6]
1,2-Dichloroethane [107-06-2]	1,1,2-Trichloroethane [79-00-5]
1,1-Dichloroethene [75-35-4]	Trichloroethene [79-01-6]
cis-1,2-Dichloroethene [156-59-2]	1,2,4-Trichlorobenzene [120-82-1]
trans-1,2-Dichloroethene [156-60-5]	1,2,4-Trimethylbenzene [95-63-6]
1,2-Dichloropropane [78-87-5]	1,3,5-Trimethylbenzene [108-67-8]
cis-1,3-Dichloropropene [10061-01-5]	Vinyl Acetate [108-05-4]
trans-1,3-Dichloropropene [10061-02-6]	Vinyl Chloride [75-01-4]
1,4-Dioxane [123-91-1]	o-Xylene [95-47-6]
Ethanol* [64-17-5]	m-Xylene [108-38-3]
Ethyl Acetate [141-78-6]	p-Xylene [106-42-3]
Ethyl Benzene [100-41-4]	
1,2 Dibromoethane [106-93-4]	

*No stability guarantee on these compounds.

NOTE: CAS numbers are in square brackets, i.e. [00-00-0]

To enhance your QA/QC procedures, Spectra stocks at least two (2) individual batches of each VOC raw material allowing you to order two (2) independent TO-15 / TO-17 Calibration Standards.

(Continued)



TO-15 / TO-17 Subset Calibration Standard

The TO-15 / TO-17 Subset Calibration Standard consists of 25 components which are not contained in the TO-14 Calibration Standard. It is available from stock at standard concentrations of one (1) ppm or one hundred (100) ppb in a balance gas of VOC free nitrogen (N₂). Other concentrations are available as custom mixtures.

Stability of 1 ppm TO-15 standard in a size 2A cylinder is 12 months. All other concentrations or cylinder sizes are 6 months.

Acetone [67-64-1]	4-Ethyltoluene [622-96-8]
Allyl Chloride [107-05-1]	n-Heptane [142-82-5]
Benzyl Chloride* [100-44-7]	n-Hexane [110-54-3]
Bromodichloromethane [75-27-4]	2-Hexanone (MBK) [591-78-6]
Bromoform [75-25-2]	4-Methyl-2-Pentanone (MIBK) [108-10-1]
1,3-Butadiene [106-99-0]	Methyl-tert-Butylether (MTBE) [1634-04-4]
2-Butanone (MEK) [78-93-3]	2-Propanol [67-63-0]
Carbon Disulfide* [75-15-0]	Propylene [115-07-1]
Cyclohexane [110-82-7]	Tetrahydrofuran [109-99-9]
Dibromochloromethane [124-48-1]	Vinyl Acetate [108-05-4]
trans-1,2-Dichloroethene [156-60-5]	Vinyl Bromide [593-60-2]
1,4-Dioxane [123-91-1]	2,2,4-Trimethylpentane [540-84-1]
Ethyl Acetate [141-78-6]	

* No stability guarantee on these components

2A, 1 ppm 1 year. All other concentrations, six months.

Regulator Recommendation

Various independent and Agency laboratories have indicated that to ensure repeatability with low level calibration gases it is best to utilize the same regulator for initial assay and for daily usage, thus minimizing the sources for potential variances and possible cross contamination. If a regulator is purchased along with the TO-15 / TO-17 Calibration Standard, Spectra Gas will perform the initial assay and certification of analysis utilizing regulator and cylinder as a matched set.

Spectra Gases' Model 7621 regulator is ideal for use with TO-15 / TO-17 Calibration Standards please see equipment section for further information on this and other gas handling equipment.

Standard Available Cylinders

Cylinder Size	Volume	Pressure	CGA
2A	4000 liters	2000 psig	350
6A	104 liters	1800 psig	180

Stability of one (1) ppm standard in a size 2A cylinder is guaranteed for a minimum of 12 months, all other concentrations and cylinder sizes are guaranteed for a minimum of six (6) months.

Massachusetts APH Calibration Standards

In February 2000, The Massachusetts Department of Environmental Protection, (MADEP) published the "Method For The Determination Of Air-Phase Petroleum Hydrocarbons (APH)." This method is designed to measure the gaseous-phase concentrations of volatile aliphatic and aromatic petroleum hydrocarbons in air and soil gas.

This method, based on the collection of whole air samples in SUMMA[®] passivated stainless steel canisters, with subsequent analysis by gas chromatography/mass spectrometry (GC/MS), is designed to complement and support the toxicological approach developed by the MADEP to evaluate human health hazards that may result from exposure to petroleum hydrocarbons (MADEP, 1994).

In response to this method, Spectra now produces the following APH calibration standard, with all components at 1 ppmV in either size 2A or 6A cylinders:

COMPOUND [CAS#]

1,3-Butadiene [106-99-0]	m- & p- Xylenes [108-38-3] [106-42-3]
Isopentane [78-78-4]	o-Xylene [95-47-6]
Methyl-tert-Butylether [1634-04-4]	n-Nonane [111-84-2]
n-Hexane[110-54-3]	Isopropylbenzene [98-82-8]
Benzene [71-43-2]	1-Methyl-3-ethylbenzene [620-14-4]
Cyclohexane [110-82-7]	1,3,5-Trimethylbenzene [108-67-8]
2,3-Dimethylpentane [565-59-3]	n-Decane [124-18-5]
n-Heptane [142-82-5]	1,2,3-Trimethylbenzene [526-73-8]
Toluene [108-88-3]	p-Isopropyltoluene [99-87-6]
Toluene-d8 (IS) [2037-26-5]	Butylcyclohexane [1678-93-9]
n-Octane [111-65-9]	n-Undecane [1120-21-4]
Ethylbenzene [100-41-4]	n-Dodecane [112-40-3]
2,3-Dimethylheptane [3074-71-3]	

NOTE: CAS numbers are in square brackets, i.e. [00-00-0]

To enhance your QA/QC procedures, Spectra stocks at least two (2) individual batches of each VOC raw material. This allows you to order two (2) independent **MA DEP Calibration Standards** from Spectra.

Regulator Recommendation

Various independent and Agency laboratories have indicated that to ensure repeatability with low level calibration gases it is best to utilize the same regulator for initial assay and for daily usage, thus minimizing the sources for potential variances and possible cross contamination. If a regulator is purchased along with the MADEP standard, Spectra Gases will perform the initial assay and certification analysis utilizing the regulator and cylinder as a matched set.

Spectra Gases' model 7621 regulator is ideal for use with the MADEP standard. Please see the equipment section for information on this and other gas handling equipment.



U.S. EPA PAMS Calibration Standards

The United States Environmental Protection Agency's ozone precursor monitoring program known as PAMS, Photochemical Assessment Monitoring System, utilizes Spectra Gases standards for program quality assurance.

Under the 1990 Clean Air Act Amendments, EPA has required more extensive monitoring of ozone and its precursors in areas with persistently high ozone levels (mostly large metropolitan areas). In these areas, the States have established ambient air monitoring sites which collect and report detailed data for volatile organic compounds, nitrogen oxides, ozone and meteorological parameters. Analyses of these data help the EPA and the States to better understand the underlying causes of ozone pollution, to devise effective remedies and measure environmental improvement.

The standard that Spectra supplies is manufactured using exacting micro-gravimetric techniques with all measurements directly traceable to NIST (National Institute of Standards and Technology).

Spectra offers the PAMS standard at the EPA specified concentrations expressed as ppb C (parts per billion expressed as carbon) and also at 100 ppb v/v and 1 ppm v/v. The PAMS calibration standard is supplied in a size 2A cylinder with a guaranteed stability of 12 months or a size 6A cylinder with a six month stability guarantee.

To enhance your QA/QC procedures, Spectra stocks at least two (2) individual batches of each VOC raw material. This allows you to order two (2) independent **US EPA PAMS Calibration Standards** from Spectra.

Regulator Recommendation

Various independent and Agency laboratories have indicated that to ensure repeatability with low level calibration gases it is best to utilize the same regulator for initial assay and for daily usage, thus minimizing the sources for potential variances and possible cross contamination. If a regulator is purchased along with the TCEQ standard, Spectra Gases will perform the initial assay and certification analysis utilizing the regulator and cylinder as a matched set.

Spectra Gases' model 7621 regulator is ideal for use with the PAMS standard. Please see the equipment section for information on this and other gas handling equipment.

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U.S. EPA PAMS Calibration Standards

Number following the compounds is the concentration in ppb C (parts per billion expressed as carbon) as specified by the U.S. EPA.

Acetylene 40 [74-86-2]	Isopropylbenzene 40 [98-82-8]
Benzene 30 [71-43-2]	n-Octane 30 [111-65-9]
n-Butane 40 [106-97-8]	n-Pentane 25 [109-66-0]
1-Butene 30 [106-98-9]	1-Pentene 25 [109-67-1]
cis-2-Butene 35 [590-18-1]	Methylcyclohexane 30 [108-87-2]
trans-2-Butene 25 [624-64-6]	Methylcyclopentane 25 [96-37-7]
Cyclohexane 40 [110-82-7]	2-Methylheptane 25 [592-27-8]
Cyclopentane 20 [287-92-3]	3-Methylheptane 25 [589-81-1]
n-Decane 30 [124-18-5]	2-Methylhexane 25 [591-76-4]
m-Diethylbenzene 40 [141-93-5]	3-Methylhexane 25 [589-34-4]
p-Diethylbenzene 25 [105-05-5]	2-Methylpentane 20 [107-83-5]
2,2-Dimethylbutane 40 [75-83-2]	3-Methylpentane 40 [96-14-0]
2,3-Dimethylbutane 50 [79-29-8]	n-Nonane 25 [111-84-2]
2,3-Dimethylpentane 50 [565-59-3]	cis-2-Pentene 35 [627-20-3]
2,4-Dimethylpentane 40 [108-08-7]	trans-2-Pentene 25 [646-04-8]
n-Dodecane 40 [112-40-3]	Propane 40 [74-98-6]
Ethane 25 [74-84-0]	n-Propylbenzene 30 [103-65-1]
Ethyl Benzene 25 [100-41-4]	Propylene 25 [115-07-1]
Ethylene 20 [74-85-1]	Styrene 40 [100-42-5]
o-Ethyltoluene 30 [611-14-3]	Toluene 40 [108-88-3]
m-Ethyltoluene 25 [620-14-4]	1,2,3-Trimethylbenzene 25 [526-73-8]
p-Ethyltoluene 40 [622-96-8]	1,2,4-Trimethylbenzene 40 [95-63-6]
n-Heptane 25 [142-82-5]	1,3,5-Trimethylbenzene 25 [108-67-8]
n-Hexane 30 [110-54-3]	2,2,4-Trimethylpentane 30 [540-84-1]
1-Hexene 60 [592-41-6]	2,3,4-Trimethylpentane 25 [565-75-3]
Isobutane 25 [75-28-5]	n-Undecane 30 [1120-21-4]
Isopentane 40 [78-78-4]	o-Xylene 25 [95-47-6]
Isoprene 40 [78-79-5]	m/p-Xylene (combined) 40 [108-38-3 / 106-42-3]

NOTE: CAS numbers are in square brackets, i.e. [00-00-0]

EN 12619 Calibration Standard

The EU (European Union) EN 12619 standard for flame ionization detection (FID) measurement of total organic compounds (TOC) in stationary source combustion emissions including municipal and hazardous waste incinerators is a nine component mix.

Spectra Gases provides the required EN 12619 standard in a balance of research grade nitrogen.

EN 12619 Calibration Standard

2 mg/m ³ Methane [74-82-8]	
1.5 mg/m ³ Ethane [74-84-0]	
0.5 mg/m ³ Toluene [108-88-3]	
0.5mg/m ³ Benzene [71-43-2]	
0.5mg/m ³ Methylene Chloride [75-09-2]	
50 mg/m ³ Carbon Monoxide [630-08-0]	
11 % Oxygen [7782-44-7]	
10% Carbon Dioxide [124-38-9]	
Balance Nitrogen [7727-37-9]	
Blend Tolerance	+/- 10%
Analytical Tolerance	+/- 10%
Stability	12 months

NOTE: CAS numbers are in square brackets, i.e. [00-00-0]

The mixture can be supplied in a range of cylinder sizes from 7-30 litre water capacity.

To enhance your QA/QC procedures, Spectra stocks at least two (2) individual batches of each VOC raw material. This allows you to order two (2) independent EN 12619 calibration standard from Spectra.

Regulator Recommendation

Various independent and Agency laboratories have indicated that to ensure repeatability with low level calibration gases it is best to utilize the same regulator for initial assay and for daily usage, thus minimizing the sources for potential variances and possible cross contamination. If a regulator is purchased along with the EN 12619 Calibration Standard, Spectra Gases will perform the initial assay and certification analysis utilizing the regulator and cylinder as a matched set.

Spectra Gases' model 7621 regulator is ideal for use with the EN 12619 Calibration Standard. Please see the equipment section for information on this and other gas handling equipment.



T.C.E.Q. Calibration Standard

The Texas Commission on Environmental Quality (TCEQ) utilizes a 102 component calibration standard for the determination of multiple ambient air contaminants. Please see reverse side for a complete list of components.

Spectra supplies this standard to the TCEQ, formerly the TNRCC (Texas Natural Resource Commerce Commission), for their internal use. The TCEQ standard is manufactured using exacting micro-gravimetric techniques with all gravimetric measurements directly traceable to NIST (National Institute of Standards and Technology). For improved quality assurance Spectra maintains two distinct lots of raw materials allowing you to order two (2) independent calibration standards from Spectra.

Spectra offers these 102 components at the concentrations specified by the TCEQ.

The TCEQ calibration standard is supplied in a size 2A cylinder with a guaranteed stability of 12 months.

Regulator Recommendation

Various independent and Agency laboratories have indicated that to ensure repeatability with low level calibration gases it is best to utilize the same regulator for initial assay and for daily usage, thus minimizing the sources for potential variances and possible cross contamination. If a regulator is purchased along with the TCEQ standard, Spectra Gases will perform the initial assay and certification analysis utilizing the regulator and cylinder as a matched set.

Spectra Gases' model 7621 regulator is ideal for use with the TCEQ 102 component standard. Please see the equipment section for information on this and other gas handling equipment.

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T.C.E.Q. Calibration Standard

Number following the components is the concentration in ppb v/v as specified by the TCEQ.

Acetylene 200 [74-86-2]	trans-2-Hexene 100 [4050-45-7]
Benzene 100 [71-43-2]	Isobutane 100 [75-28-5]
1-Butene 100 [106-98-9]	Isopentane 100 [78-78-4]
2-Butanone (MEK) 500 [78-93-3]	Isopropylbenzene (Cumene) 100 [98-82-8]
Bromomethane 100 [74-83-9]	Isooctane 100 [540-84-1]
1,3-Butadiene 100 [106-99-0]	2 Methyl 1,3 Butadiene (isoprene) 100 [78-79-5]
cis-2-Butene 100 [590-18-1]	3-Methyl-1-Butene 100 [563-45-1]
n-Butane 100 [106-97-8]	2-Methyl-2-Butene 100 [513-35-9]
trans-2-Butene 100 [624-64-6]	Methyl tert-Butyl Ether (MTBE) 100 [1634-04-4]
Butyl Acetate 500 [123-86-4]	Methylcyclohexane 100 [108-87-2]
Butyl Aldehyde 500 [123-72-8]	Methylcyclopentane 100 [96-37-7]
Carbon Tetrachloride 100 [56-23-5]	2-Methylheptane 100 [592-27-8]
Chlorobenzene 100 [108-90-7]	3-Methylheptane 100 [589-81-1]
Chloroform 100 [67-66-3]	2-Methylhexane 100 [591-76-4]
Chloromethane 100 [74-87-3]	3-Methylhexane 100 [589-34-4]
2-Chloropentane 100 [625-29-6]	2-Methyl-3-Hexanone 500 [7379-12-6]
2-Chloroprene 100 [126-99-8]	5-Methyl-2-Hexanone 500 [110-12-3]
Cyclohexane 100 [110-82-7]	Methyl Isobutyl Ketone (MIBK) 500 [108-10-1]
Cyclopentane 100 [287-92-3]	2-Methylpentane 100 [107-83-5]
Cyclopentene 100 [142-29-0]	3-Methylpentane 100 [96-14-0]
n-Decane 100 [124-18-5]	2-Methyl-1-Pentene 100 [763-29-1]
1,2-Dibromoethane (Ethylene Dibromide) 100 [106-93-4]	4-Methyl-1-Pentene 100 [691-37-2]
1,1-Dichloroethane 100 [75-34-3]	2-Methylpropanal 500 [78-84-2]
1,2-Dichloroethane (Ethylene Dichloride) 100 [107-06-2]	n-Nonane 100 [111-84-2]
1,1-Dichloroethylene 100 [75-35-4]	n-Octane 100 [111-65-9]
1,2-Dichloropropane 100 [78-87-5]	n-Pentane 200 [109-66-0]
cis-1,3-Dichloropropene 100 [10061-01-5]	1-Pentene 100 [109-67-1]
trans-1,3-Dichloropropene 100 [10061-02-6]	cis-2-Pentene 100 [627-20-3]
Dichlorodifluoromethane (Halocarbon 12) 100 [75-71-8]	trans-2-Pentene 100 [646-04-8]
Dichloromethane 100 [75-09-2]	3-Pentanone 500 [96-22-0]
p-Diethylbenzene 100 [105-05-5]	Propane 200 [74-98-6]
2,2-Dimethylbutane 100 [75-83-2]	Propene 200 [115-07-1]
2,3-Dimethylbutane 100 [79-29-8]	Propyl Acetate 500 [109-60-4]
2,3-Dimethylpentane 100 [565-59-3]	n-Propylbenzene 100 [103-65-1]
2,4-Dimethylpentane 100 [108-08-7]	Styrene 100 [100-42-5]
Dodecane 100 [112-40-3]	1,1,2,2-Tetrachloroethane 100 [79-34-5]
Ethane 200 [74-84-0]	Tetrachloroethylene 100 [127-18-4]
Ethyl Acetate 500 [141-78-6]	Toluene 100 [108-88-3]
Ethyl Benzene 100 [100-41-4]	1,1,1-Trichloroethane 100 [71-55-6]
m-Diethylbenzene 100 [141-93-5]	1,1,2-Trichloroethane 100 [79-00-5]
Ethylene 200 [74-85-1]	Trichloroethylene 100 [79-01-6]
o-Ethyltoluene 100 [611-14-3]	Trichlorofluoromethane (Freon 11) 100 [75-69-4]
m-Ethyltoluene 100 [620-14-4]	1,2,3-Trimethylbenzene 100 [526-73-8]
p-Ethyltoluene 100 [622-96-8]	1,2,4-Trimethylbenzene 100 [95-93-6]
n-Heptane 100 [142-82-5]	1,3,5-Trimethylbenzene 100 [108-67-8]
3-Heptanone 500 [106-35-4]	2,3,4-Trimethylpentane 100 [565-75-3]
n-Hexane 100 [110-54-3]	n-Undecane 100 [821-95-4]
2-Hexanone 500 [591-78-6]	Vinyl Chloride 100 [75-01-4]
3-Hexanone 500 [589-38-8]	o-Xylene 100 [95-47-6]
1-Hexene 100 [592-41-6]	m-Xylene 100 [108-38-3]
cis-2-Hexene 100 [592-43-8]	p-Xylene 100 [106-42-3]

NOTE: CAS numbers are in square brackets, i.e. [00-00-0]

EPA Methods 25, 25A, 25B, 25C, 25D and 25E Calibration Standards and Support Gases

US EPA Method 25, Determination of Total Gaseous Nonmethane Organic Emissions as Carbon; Method 25A, Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer; Method 25B, Determination of Total Gaseous Organic Concentration Using a Nondispersive Infrared Analyzer; Method 25C, Determination of Nonmethane Organic Concentration (NMOC) in Landfill Gases; Method 25D, Determination of the Volatile Organic Concentration of Waste Samples; and Method 25E, Determination of Vapor Phase Organic Concentration in Waste Samples all have specific requirements for gaseous calibration standards and support gases.

Spectra provides all of the following as required by the various methods:

	25	25A	25B	25C	25D	25E
1% CH ₄ in Air	X			X		
20 ppm C ₃ H ₈ in Air	X			X		
200 ppm C ₃ H ₈ in Air	X			X		
3000 ppm C ₃ H ₈ in Air	X			X		
50 ppm CO ₂ in Air	X					
500 ppm CO ₂ in Air	X					
1% CO ₂ in Air	X					
50 ppm CO / 50 ppm CH ₄ / 20 ppm C ₃ H ₈ / 1% CO ₂ in Air	X			X		
50 ppm Hexane in Air	X					
20 ppm Toluene in Air	X					
100 ppm Methanol in Air	X					
VOC free He	X					
VOC free O ₂	X				X	X
VOC free H ₂	X				X	X
VOC free Air	X	X	X	X	X	X
VOC free N ₂					X	
FID fuel 40% H ₂ / 60% He or 40% H ₂ / 60% N ₂		X		X		
Low level calibration gas (25-35% of span value)		X	X	X		
Mid level calibration gas (45-55% of span value)		X	X	X		
High level calibration gas (80-90% of span value)		X	X	X		
10% C ₃ H ₈ / 1% 1,1-Dichloroethylene balance N ₂ *					X	
100% C ₃ H ₈						X

* VP restricted

Please contact Spectra Environmental Division for information on other standards and concentrations



Vapor Intrusion Calibration Standard

With the increasing focus on vapor intrusion issues Spectra Gases is offering the PIANO (Paraffinic, Isoparaffinic, Aromatic, Napthenic, and Olefinic) calibration standard. The forensic requirements for vapor intrusion (VI) studies requires this multi-component standard to allow analysts to correctly identify and quantify the compounds of interest. The 80 component volatile/semi-volatile Vapor Intrusion standard is manufactured using exacting micro-grav techniques with all measurements directly traceable to NIST (National Institute of Standards and Technology).

The standard is available in concentrations of either 100 ppb or 1 ppm, and is supplied in our Spectra Shield® size 2A cylinder (4000 liters @ 2000 psig).

For improved quality assurance procedures, Spectra maintains two distinct lots of raw materials allowing you to order two (2) independent calibration standards from Spectra.

Please see reverse side for a complete list of components.

Regulator Recommendation

Various independent and Agency laboratories have indicated that to ensure repeatability with low level calibration gases it is best to utilize the same regulator for initial assay and for daily usage, thus minimizing the sources for potential variances and possible cross contamination. If a regulator is purchased along with the PIANO standard, Spectra Gases will perform the initial assay and certification analysis utilizing the regulator and cylinder as a matched set.

Spectra Gases' model 7621 regulator is ideal for use with the PIANO 80 component standard. Please see the equipment section for information on this and other gas handling equipment.

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Vapor Intrusion Calibration Standard

PARRAFINIC

Pentane [109-66-0]
Hexane [110-54-3]
Heptane [142-82-5]
Octane [11-65-9]
Nonane [111-84-2]
Decane [124-18-5]
Undecane [1120-21-4]
Dodecane [112-40-3]

ISOPARRAFINIC

Isopentane [78-78-4]
2-Methylpentane [107-83-5]
3-Methylpentane [96-14-0]
2,3-Dimethylbutane [79-29-8]
2,3-Dimethylpentane [565-59-3]
2,2-Dimethylpentane [590-35-2]
2,4-Dimethylpentane [108-08-7]
2-Methylhexane [591-76-4]
3-Methylhexane [589-34-4]
2,3,3-Trimethylpentane [560-21-4]
2,3-Dimethylhexane [584-94-1]
3-Ethylhexane [619-99-8]
2,4-Dimethylhexane [589-43-5]
2,2,3-Trimethylpentane [564-02-3]
2,5-Dimethylhexane [592-13-2]
2,2,4-Trimethylpentane (isooctane) [540-84-1]
2,3,4-Trimethylpentane [565-75-3]
2-Methylheptane [592-27-8]
3-Methylheptane [589-81-1]

AROMATIC

Benzene [71-43-2]
Toluene [108-88-3]
Ethyl Benzene [100-41-4]
m + p-Xylene [108-38-3][106-42-3]
o-Xylene [95-47-6]
Styrene [100-42-5]
Isopropylbenzene [98-82-8]
n-Propylbenzene [103-65-1]
1-Methyl-3-ethylbenzene [620-14-4]
1-Methyl-4-ethylbenzene [622-96-8]
1,3,5-Trimethylbenzene [108-67-8]
1-Methyl-2-ethylbenzene [611-14-3]
1,2,4-Trimethylbenzene [95-63-6]
1,2,4,5-Tetramethylbenzene [95-93-2]

AROMATIC (cont)

1,2-Diethylbenzene [135-01-3]
1-Methyl-2-isopropylbenzene [527-84-4]
1-Methyl-3-n-propylbenzene [1074-43-7]
1-Methyl-4-n-propylbenzene [1074-55-1]
1-Methyl-2-n-propylbenzene [1074-17-5]
1,4-Dimethyl-2-ethylbenzene [1758-89-9]
1,3-Dimethyl-5-ethylbenzene [934-74-7]
1,2-Dimethyl-4-ethylbenzene [934-80-5]
1,2-Dimethyl-3-ethylbenzene [933-98-2]
1,3-Dimethyl-4-ethylbenzene [874-41-9]
1-Methyl-3-isopropylbenzene [535-77-3]
1,3-Dimethyl-2-ethylbenzene [2870-04-4]
sec-Butyl benzene [135-98-8]
1-Methyl-4-isopropylbenzene [99-87-6]
n-Butylbenzene [104-51-8]
n-Pentylbenzene [538-68-1]
Naphthalene [91-20-3] *

NAPHTHENIC

Cyclopentane [287-92-3]
Methylocyclopentane [96-37-7]
Cyclohexane [110-82-7]
Methylocyclohexane [108-87-2]

OLEFINIC

1-Pentene [109-67-1]
2-Methyl-1-Butene [563-46-2]
trans-2-Pentene [646-04-8]
cis-2-Pentene [627-20-3]
1-Hexene [592-41-6]
1-Heptene [592-76-7]
1-Octene [111-66-0]
1-Nonene [124-11-8]
1-Decene [872-05-9]

THIOPHENE & FUEL ADDITIVES

1,2-Dichloroethane [107-06-2]
1,2-Dibromoethane [106-93-4]
tert-amyl methyl ether [994-05-8]
Diisopropyl ether [108-20-3]
tert-butyl ethyl ether [637-92-3]
tert-butyl methyl ether [1634-04-4]
tertiary butanol [75-65-0] *
Ethanol [64-17-5] *

NOTE * No stability guarantee on these components CAS #s are in square brackets, i.e. [CAS#].

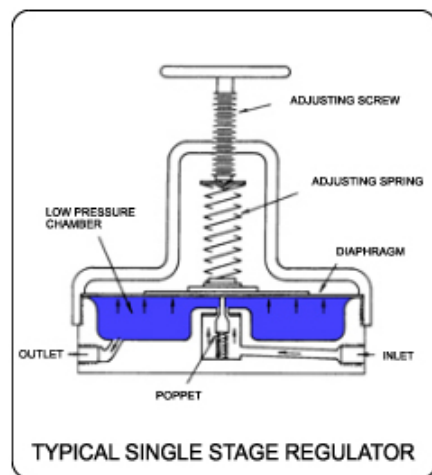
Pressure Regulators

Principle of Operation

Compressed gases are generally not useable until a pressure regulator is incorporated into the delivery system to reduce the gas pressure to a workable level that can be safely utilized in equipment and instruments. The basic design and construction materials differ according to the composition and pressure of the gas as well as the specific application requirements.

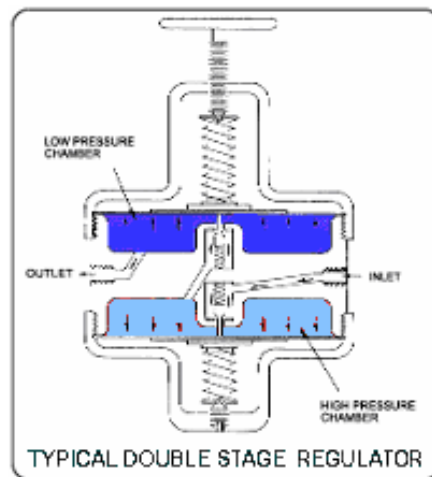
Single Stage Design

Single stage pressure regulators reduce the cylinder gas pressure to the delivery pressure in one (1) step. This one step pressure reduction results in a slight change in delivery gas pressure as the cylinder pressure decays. (In most cases, the delivery pressure will rise.) The single stage regulator is a satisfactory and cost effective selection if slight variations in delivery pressure and/or periodic adjustments are not detrimental to the application. In the case of liquefied gases the cylinder pressure is constant and single stage regulators are recommended.



Double Stage Design

Double stage pressure regulators reduce the cylinder gas pressure to a working level in two (2) steps. The cylinder gas pressure is reduced by the first stage to a preset, intermediate level which becomes the gas pressure at the second stage inlet. This allows the second stage to fine-tune the final delivery pressure. Thus, double stage regulators provide a constant delivery pressure unaffected by cylinder pressure decay.



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Regulators for Criteria Pollutant Analysis

All of the regulators offered by Spectra's Environmental Division are engineered and manufactured to provide you with the optimum unit for your application. Thus deciding which regulator to order for criteria pollutant analysis is a simple three step process. You choose

1. Single or double stage?
2. Brass or stainless steel?

Is there any helium or hydrogen in the cylinder?

You then select your desired delivery pressure (2-50 psig or 1-125 psig), outlet connection (¼" compression fitting or ¼" NPTM), and the proper CGA connection.

Regulators for VOC Analysis

Spectra's Model 7621 is the regulator of choice for VOC analysis standards. This compact, regulator is designed and manufactured to provide optimum performance as a VOC Regulator. The 7621 is a low volume single stage regulator with a low flow rate and accurate pressure control. The regulator is constructed with a metal diaphragm and a PCTFE* seat then after cleaning of all components the regulator is assembled without any hydrocarbon greases. Prior to shipment each regulator is then tested to insure that there is no hydrocarbon bleed.

The Model 7621 has delivery pressure ranges of 0-30 psig, 0-60 psig, or 0-100 psig and outlet connections of 0.0625", 0.125, 0.25 or 6.0 mm compression fitting.

Regulators for Mercury Analysis

Spectra's Model 7622 regulator is preconditioned for use with mercury calibration standards. The regulator is constructed with a metal diaphragm and a PCTFE* seat. After assembly and cleaning the unit is conditioned with mercury to insure trouble free mercury analysis in the field.

The Model 7622 has delivery pressure ranges of 0-30 psig, 0-60 psig, or 0-100 psig and outlet connections of 0.0625", 0.125, 0.25 or 6.0 mm compression fitting.

**PCTFE (PolyChloroTriFluoroEthylene) is a Fluroelastomer formerly known as Kel-F*

CEMS Protocol Station

The Spectra protocol station assembly is specifically designed for the safe and convenient wall and/ or panel mounting for all of Spectra's single and double stage brass and stainless steel gas regulators. The protocol station is suitable for all applications where cylinder change outs occur on a regular basis whether in the laboratory or in a process environment. The protocol station is a cost effective and safe method of changing out and connecting cylinders while eliminating the requirement of repeatedly handling the regulator during the cylinder "swapping".

The protocol station features:

- ***Stainless steel flex hose with an integral check valve to prevent contamination during cylinder changeover.***
- ***Gas block with a spare port for installation of a purge valve if required.***
- ***Regulator bracket assembly that provides for convenient mounting to almost any surface.***



Depending upon your requirements the Spectra protocol station can be configured with either single stage or dual stage brass or stainless steel regulators. The protocol station can be supplied with a digital contact pressure switch to provide a signal when the cylinder pressure falls below the user selected set-point.

Hydrogen (H₂) Generators

Eliminate high-pressure hydrogen cylinders from the laboratory and generate a continuous source of Ultra High Purity (UHP) hydrogen gas using de-ionized water and electricity.

Applications

- GC-FID, NPD, FPD, TCD, ELCD, HALL
- GC-carrier gas
- THA

Benefits

- **Continuous Supply** of GC purity hydrogen on demand.
- **Improved Productivity** - Hydrogen as a carrier is faster and more sensitive than helium, reducing analysis times without loss of resolution.
- **Extended Column Life** - Hydrogen, as a carrier gas, requires lower elution temperatures and thus improves the column life.
- **Safety**. Hydrogen production at low pressure eliminates the risks of explosion.
- **Economical**. No gas cylinder rental, no price inflation.
- **Increased Efficiency in the Laboratory**. No interruption of analysis due to cylinder changes

Technical Features

- Self test fault diagnosis with digital display and audible alarm: detection of internal and external H₂ leaks, H₂ overpressure, water level, water conductivity, display of H₂ product flow and total flow.
- Easy access to maintenance components (desiccant cartridge and de-ionization cartridge).
- Large capacity 5 liter water tank. Automatic water filling (optional).
- Patented filters avoid rapid degradation of water quality increasing service life.
- H₂ capacities up to 0.5 lpm.
- H₂ purity: 99.999%.

Please contact your Spectra Gases' representative for assistance in specifying a hydrogen generator for your specific application.



Nitrogen (N₂) Generators

Eliminate high-pressure nitrogen cylinders from your facility and generate a continuous source of high purity nitrogen from a compressed air supply.

Applications

- LCMS (single and multiple units) .ICP
- ELSD
- GC-carrier gas
- GC-FID, NPD, ECD, AED
- Solvent evaporation

Benefits

- **Improved Safety** - No handling high--pressure gas cylinders or liquid dewars. Nitrogen is produced at controlled low pressures
- **Simple Installation** - Only one set up operation required for reliable service over time. Installation on or below a laboratory bench top, saving space in the laboratory
- **Economy.** Quick return on investment -No gas cylinder rental bottles, no price inflation

Technical Features

- N₂ flow: 0.5 L/min to 30L/min, for larger capacities please consult Spectra Gases
- N₂ purity: 97% to 99.999%
- On-line purity monitoring capability
- Digital hour(s) counter
- Audible and visual maintenance indicator
- Economy mode option: Enables the compressor to switch off when nitrogen supply is not required
- Oil-free air compressor available
- Available with or without built-in air compressor
- Quick and easy servicing: less than 10 minutes every 6 months

Please contact your Spectra Gases' representative for assistance in specifying a nitrogen generator for your specific application.



Zero Air Generators

By simply connecting to clean, dry compressed air supply, the Spectra Zero Air Generator will remove hydrocarbons, making it ideal for use in FID applications.

Applications

- CG-FID, NPD, FPD
- THC Analyzer

Benefits

- **Improved Analytical Performance.** -The reduction of methane (CH₄) to less than 0.1 ppm reduces background noise and improves the base line stability.
- **Simple Installation** - uses clean, dry compressed air, to provide gas free from any trace of hydrocarbons. Improved Safety - Elimination of high pressure gas cylinders.
- **Consistent Gas Purity** improves instrument performance.
- **Economy** - Quick return on investment typically 1 year. No gas cylinder rental, no price inflation.
- **Increased Efficiency** - no interruption of analysis due to cylinder changes.

Technical Features

- Eliminates contaminants (hydrocarbons including CH₄) in compressed air, using a proven heated catalyst
- Quick and easy servicing: changing the filters once a year takes just a few minutes
- Capacities up to 3.5 Liters/min standard. Larger flow rates on request.
- Available with or without an air compressor.
- Impurities < 0.1 ppm (CH₄).

Please contact your Spectra Gases' representative for assistance in specifying a Zero Air Generator for your specific application.



OEM Calibration Kits

These kits are designed to provide the OEM's customers with high quality gas calibration standards in an easy to carry, easy to use format. The gas standards are supplied in light weight, high pressure, reusable aluminum cylinders containing 170 liters of gas.

Molded plastic carrying cases are available to hold either two or three cylinders with additional space for the flow control regulator and sample tubing.



Two cylinder carrying case with regulator



Three cylinder carrying case with regulator



Flow control regulator



UNITED STATES (Headquarters)

3434 Route 22 West, Branchburg, NJ 08876
tel: 1.908.252.9300 or 1.800.932.0624
fax: 1.908.252.0811

UNITED KINGDOM

Spectra Gases, Ltd.
e-Space North
Wisbech Road
Littleport, Cambridgeshire UK, CB6 1RA
tel: 44.1353.865470
fax: 44.1353.865472

GERMANY

Spectra Gases, GmbH
Im Riemen 12
64832 Babenhausen
Germany
tel: 49.6073.7262.0
fax: 49.6073.7262.200

CANADA

Spectra Gases-Canada
Gatineau, Quebec
Canada
tel: 800.932.0611
tel: 819.772.4398
fax: 819.772.4716

International Distributors

AUSTRALIA

Coherent Scientific Pty, Ltd.
116 Burbridge Road
Hilton, Australia 5033

tel: 61.8.352.2020
fax: 61.8.352.1111

CHINA

You Tai Technology, Ltd
Shenzhen High – Tech
Park South District
Building R2A, Room 508
Shenzhen, Guangdong, China
tel: 86.0755.26972867
fax: 86.0755.26737020

HONG KONG

Hong Kong Specialty Gases Co.
2B Wing Cheong Fty. Bldg..
121 King Lam Street
Cheung Sha Wan
Kowloon, Hong Kong
tel: 852.2668.738
fax: 852.2652.0401

INDIA

Modi Measurement Sys. Pvt. Ltd.
219 Hill View Industrial Estate
Off L.B.S.Marg, Amrut Nagar Road
Ghatkopar (W) Mumbai 400 086
tel: 91.55969798
fax: 91.25007335

ISRAEL

Gas Technologies OB Ltd
4 Yad Harutzim Street
Industrial Area Kfar Saba
POB 2406
Kfar Saba 44641 Israel
tel: 972.9.7687876
fax: 972.9.7687855

ITALY

Chemical Research 2000 Srl
Via Vico Viganò, 55
00133 Roma, Italia (Italy)
Tel/Fax: 39-06-20630997

JAPAN

Tomoe Shokai Co., Ltd.
1-1-25 Minami Kamata
Ohta-Ku, Tokyo 144
Japan
tel: 81.3.3.734.1111
fax: 81.3.3.739.1070

KOREA

E.O. Technics Co., Ltd
864-4, Kwanyang 2-Dong
Dongan-Gu, Anyang-Shi,
Kyoungki-Do, Korea 431-062
tel: 82.31.422.2501
fax: 82.31.422.2502

PHILIPPINES

Anaki Systems Sales
U-705 Buendia Tower
Gil Puyat Avenue
Pasay City, Philippines
tel: 632.512.2371/2372
fax: 632.512.2124

SINGAPORE

Tomoe Transtech Specialty Gases Pte. Ltd.
7 International Business Park, #04-05
Jurong East, Singapore 609919
tel: 65.6563.2083
fax: 65.6563.1945

TAIWAN

Titan Electro Optics
14 Fl., NO19-11
San-Chung Road
Taipei 115
Taiwan, ROC
tel: 88.6226.5522.00
fax: 88.6226.5522.33





Environmental Division

a Division of Spectra Gases, Inc.

3434 Route 22 West
Branchburg, New Jersey 08876 USA
tel: 1.908.252.9300 / 1.800.932.0624
fax: 1.908.252.0811

www.spectragases.com

Offices and Distributors Worldwide

