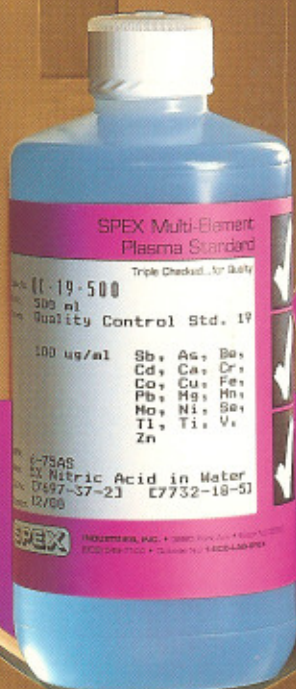


*Time Honored Quality*

**SPEX®**

**40**



**SPEX**  
ISO 9001  
NO. A1572



Accredited by Raad voor de Certificatie  
the Dutch Council for Certification

**SPEX®**

**Standards  
and  
Products  
for Inorganic  
Spectroscopy**



**Underwriters Laboratories Inc.®**  
SYSTEM FOR THE REGISTRATION OF FIRMS OF ASSESSED CAPABILITY

# ***Certificate of Registration***

File Number: A1572      Vol.: 1      Issue Date: 7-Jan-94

Underwriters Laboratories Inc. (hereinafter referred to as UL)  
hereby grants to

***Spex Industries, Inc.***  
***3880 Park Avenue***  
***Edison, NJ 08820***

(hereinafter called the Firm) the right to be listed as a UL Registered Firm of Assessed Capability in respect of the goods or services particularly described in the Appendix hereto, bearing the same number as this Certificate. Goods shall be produced by the Firm at, or services shall be offered at or from, only the address(es) given above, all in accordance with

***ISO 9001:1987 : EN 29001:1987 : BS 5750 PART 1:1987 :  
ANSI/ASQC Q91:1987***

The Certificate of Registration is granted subject to the Regulations governing the Registration referred to above.



Issued by:

**Underwriters Laboratories Inc.®**

Authorized by:

*Robert H. Levine*

Robert H. Levine  
Vice President



Accredited by Raad voor de Certificatie  
the Dutch Council for Certification



## TABLE OF CONTENTS

Introduction .....	2-3
--------------------	-----

Organometallic Oil Standards .....	4
------------------------------------	---

Single-Element Organometallic Oil Standards .....	5-6
---------------------------------------------------	-----

Sulfur Oil Standard for Diesel Fuel Analysis .....	7
----------------------------------------------------	---

SPEX Base Oils, Kerosene Blank, and STA-SOL .....	7
---------------------------------------------------	---

Stock Multi-Element Organometallic Oil Standards .....	8
--------------------------------------------------------	---

Solution Standards for Plasma Emission Spectroscopy .....	9
-----------------------------------------------------------	---

Single-Element Solution Standards for Plasma Emission Spectroscopy .....	10-13
--------------------------------------------------------------------------	-------

Plasma Emission Solution Standards Kit .....	14
----------------------------------------------	----

High-Purity Compound Kits for Custom Solution Preparation .....	14-15
Dilution Calculator .....	15

Custom Multi-Element Solution Standards for Plasma Emission Spectroscopy .....	16
--------------------------------------------------------------------------------	----

Stock Multi-Element Solution Standards for the Superfund Contract Laboratory Program (CLP) .....	17
Instrument Calibration .....	18
Initial Calibration Verification .....	18
Initial Calibration Verification II .....	18-19
Contract Required Detection Limits (CRDL) .....	19
Calibration Blanks and Matrix Blanks .....	19
Interference Checks .....	20
Spike Sample Analysis .....	20-21
Furnace AA Calibration and Spiking .....	21
Contract Laboratory Program (CLP) Set .....	22
Standards for the Contract Laboratory Program .....	22
Typical set-up for standards, samples, and blanks .....	22

Stock Multi-Element Solution Standards for Environmental Analysis .....	23
Calibration Blanks and Matrix Blanks .....	23
Mixed Multi-Element Calibration Standards .....	24
Mixed Calibration Standard Solutions .....	24
Plasma Solution .....	25
Tuning Solution II .....	25
Laboratory Performance Check (LPC) Standard .....	25
Spectral Interference Check (SIC) Standards .....	25
Laboratory Fortifying Stock (LFS) Solution .....	25-26
Instrument Check Standards .....	26
ICP-MS Calibration Standards .....	26-27
ICP-MS Internal Standards Stock Solution .....	27
ICP-MS Tuning Solution .....	28

Interference Check Standards .....	28
Environmental EPA Set .....	28
Toxicity Characteristic Leachate Procedure (TCLP) Standard .....	28
Quality Control Standards .....	28-29
Drinking Water Pollutant Standards .....	29
Trace Metals in Fish .....	29
Groundwater and Wastewater Pollution Control Check Standards .....	29-30
Alternate Water Pollution and Wastewater Standards for ICP and AA .....	30

PLASMA SHOTS™ Quality Control and Calibration Standards .....	30
SHOT-19 .....	30
SHOT-ICAL .....	30

Cyanide Standard .....	30
------------------------	----

Solution Standards for Ion Chromatography .....	31
-------------------------------------------------	----

Ion Chromatography Instrument Check Standards .....	31
-----------------------------------------------------	----

Matrix Modifiers .....	32
------------------------	----

Optical Emission and X-Ray Spectroscopy Standards .....	33
SPEX-Mixes .....	33
Element Kits .....	33
Diluted Powder Standards .....	34
Pellements .....	34

Complete Ordering Information .....	inside back cover
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Conversion Table .....	inside back cover
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## ORDERING INFORMATION

Orders may be phoned in from 8:00 a.m. - 5:30 p.m. EST, or faxed 24 hours a day. For technical information and custom orders, please call between 8:30 a.m. - 5:00 p.m. EST.

**Telephone:**  
1-908-549-7144

**Toll Free:**  
**1-800-LAB-SPEX**  
(1-800-522-7739)

**FAX:**  
1-908-603-9647

**Address:**  
SPEX Chemical Sales Department  
203 Norcross Avenue  
Metuchen, NJ 08840  
USA



## Precautions:

SPEX products are not for any cosmetic, drug or household application. Our acceptance of a purchase order is with the assumption that only qualified individuals, trained and familiar with procedures suitable to the products ordered, will handle them. On our clients must rest the entire burden of safe storage, handling, and application of all products ordered from this catalog.



## TIME HONORED QUALITY

SPEX Industries, Inc. celebrates 40 years of "Time Honored Quality". SPEX has been your source for specialty inorganic standards. We have made Spectroscopy our business and our reputation by providing the inorganic and environmental communities with Quality, Reliability, and Convenience. The SPEX Commitment to quality continues... with our ISO 9001 registration.

The SPEX facility has been Registered by Underwriter's Laboratories Inc. to the International Organization for Standardization ISO 9000 Series Standards for quality.

**Our Scope of Registration:** The design and manufacture of Multi-element standard solutions and manufacture of aqueous/oil base/powder reference standards, fusion fluxes, and quality control samples for ICP, DCP, AA, XRF spectroscopy and ion chromatography.

Also included is the resale of high-purity inorganic solid/compounds.

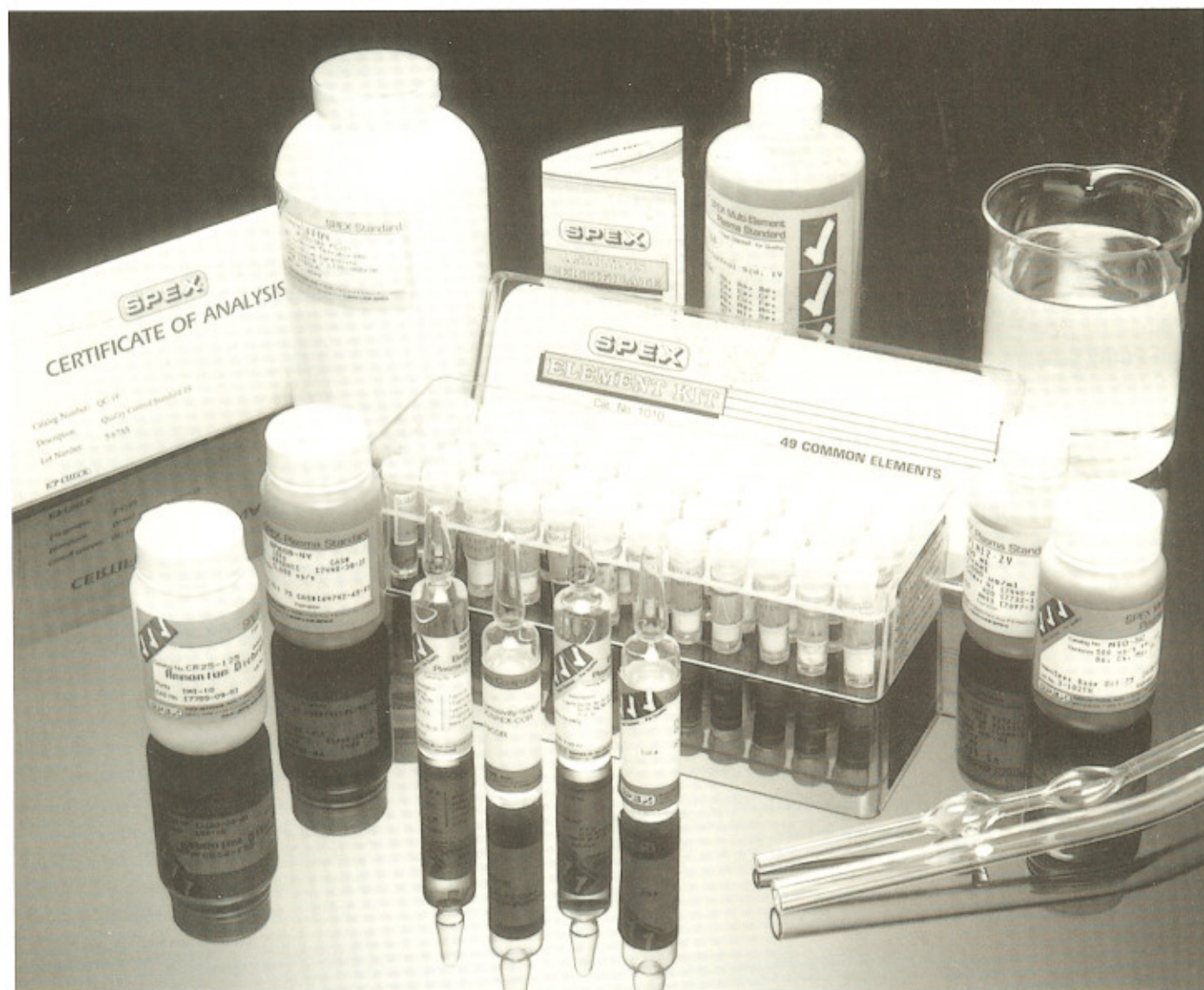
**Our Quality Policy:** The management of SPEX Industries, Inc. and the SPEX Chemical Division recognizes that commitment to quality is the key element to the success of the business. The SPEX Chemical Division is committed to providing products which meet or exceed the required specifications and are delivered on time and at the contracted price. By maintaining highly skilled, trained, and motivated employees, by having a thorough understanding of our customers' needs, and with the implementation of a documented quality system, we will continuously advance professional standards and improve our services.

The standard is often the limiting factor in the success of an analytical method, whether for characterizing a pure material

or performing the elemental analysis of a mixture. Presenting equal challenges at opposite extremes are unknowns of two types. One is a pure material, the elemental contaminants of which are to be identified and quantified; the other is a complete unknown — organic residues, minerals, pollutants... the problems are universal and unpredictable. What you first require is a reliable, known starting point — THE STANDARD!!!

No matter what your application, if you are performing ICP, DCP, AA, or XRF analysis, SPEX has the standard to suit your needs.

**Quality:** We provide our customers with QUALITY aqueous and organometallic solution standards for ICP, DCP, or AA, Inorganic Quality Control samples for environmental analysis, powder blends for OES, pellets, fluxes for XRF, and high-purity compounds and kits. Since





plasma emission spectroscopy is an emission technique, all elements emit at once. Therefore, trace impurities can interfere with the element being analyzed, giving an incorrect result. The starting materials, water and acids used, are all critical. SPEX not only uses the highest quality materials available; we analyze and report trace impurities in our standards as well as the major elements. We stand behind our quality: a one-year guarantee and our certificates of analysis on all plasma single and multi-element solution standards are your assurances of quality.

**Reliability:** For four decades spectroscopists have relied on SPEX. All of our plasma standards are triple-checked,

provided to our customers on all of our ICP grade standards showing the results of all three analyses.

**Convenience:** We make it CONVENIENT. Save time, money and man-hours. Our standards are packaged to fit your needs. Choose from a wide range of concentrations for single-element solutions or prepackaged multi-element blends — or have a standard

exact specifications, that our in-house quality control chemists monitor every phase of manufacturing, and that our standards are triple-checked using classical and instrumental techniques. We check it every step of the way. The result — standards to fit your needs, compound kits you can trust, mixes formulated to save you time.

**Total Customer Satisfaction:** We are committed to "Serving our Customers" and striving for "Total Customer Satisfaction". Our order department, technical application support, and chemical sales staff are waiting to assist you. Let us put our 40 years of knowledge to work for your laboratory. If you have a standardization, quality control or purity problem, call us for advice, recommendations,



starting with a semi-quantitative trace impurity analysis via DC ARC, classical "wet" assay for major constituent, and finally ICP analysis performed on all ICP solution standards. All titrants, balances and calibrants are certified against United States National Institute of Standards and Technology (where available). Certificates of analysis are

customized just for your particular needs. We provide off-the-shelf delivery on prepackaged items and an unbeatable turnaround on custom standards.

If you are performing inorganic spectroscopy, we have the standards to suit your specialties. Be assured that our standards and compounds meet

and reliable SPEX products to solve your problem.

**TOTAL  
CUSTOMER  
SATISFACTION**





- High-Pure Organometallic Salts
- Base Oil 20, Base Oil 75, Kerosene, STA-SOL
- ICP Documentation and Certification
- Single and Multi-Element Standards

SPEX organometallic standards in oil are used for a variety of different applications such as wear metal analysis, environmental monitoring, petrochemical testing, food processing or quality control of organic solvents.

The determination of wear metals in oils can be applied to many different types of engines such as those in automobiles, aircraft, heavy equipment, trucks, military vehicles . . . the examples are endless. By tracking specific metals suspended in the used oil, engineers and mechanics can determine the breakdown of specific engine parts. Specific elements present in the used oils have been found to be directly related to specific engine problems (see table). Engine failures as well as expensive repairs can be avoided if oils from the same engine are analyzed on a periodic trend basis for the different wear metals.

SPEX offers several different lines of quality oil standards for ICP, DCP, AA, XRF, rotrode, DC ARC or atomic fluorescence. Products range from 1,000 and 5,000ug/g (ppm) single-element standards to off-the-shelf multi-element standards to custom multi-element standards to oil concentrates. In addition, SPEX provides SPEX Base Oil 20, SPEX Base Oil 75, SPEX Kerosene Blank, and STA-SOL, Stabilizer/Solubilizer for your convenience.

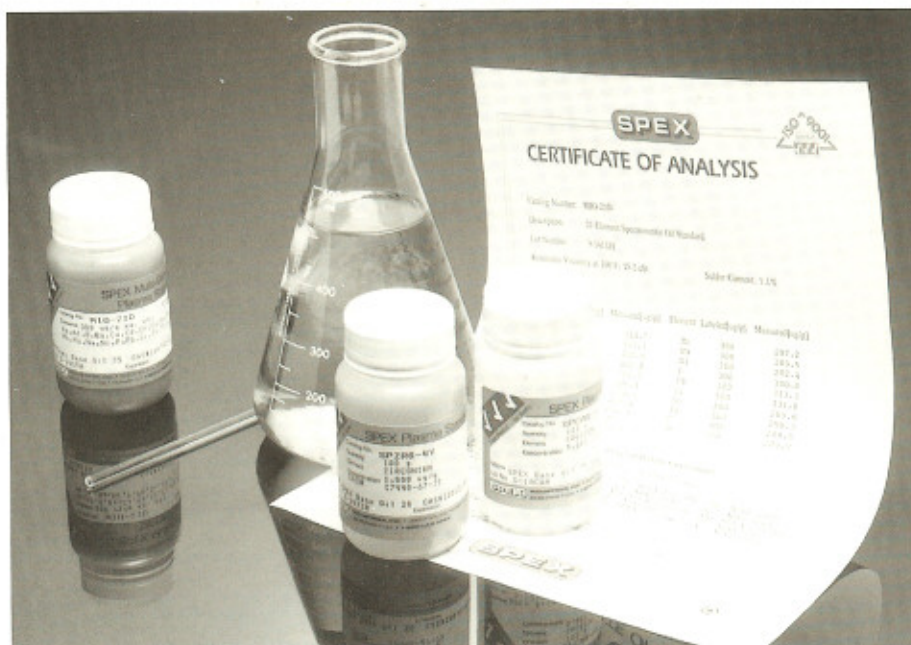
SPEX oil standards are clear, transparent solutions made directly from SPEX manufactured high-pure organometallic salts. Every standard is accompanied by a certificate of analysis. You'll receive a trace metal impurity analysis of the solid starting material and the base oil via DC ARC, a titrimetric or gravimetric assay for the major element in the starting material, sulfur content, viscosity, ICP check of the final solution, and traceability information to United States National Institute of Standards and Technology SRM's (Standard Reference Materials) where available.

## Engine Wear as Indicated by Specific Elements Found in Engine Oil

Element	Indicated Engine Wear
Aluminum (Al)	Pistons, bearings, spacers, shims and washers
Boron (B)	Coolant leaks using borate inhibitors or airborne dust
Chromium (Cr)	Rings, valves, or coolant leaks using chromate inhibitors
Copper (Cu)	Bearings and bushings, valve guides, injector shields, connecting rods and piston pins or coolant from copper radiators
Iron (Fe)	Engine shafts (camshaft or crankshaft), cylinder walls, engine block, rings, wrist pins and oil pump
Lead (Pb)	Lead additive in gear oil, seals, solder, paint, bearing metal and fuel blowby is suspected. In diesels, bearing wear

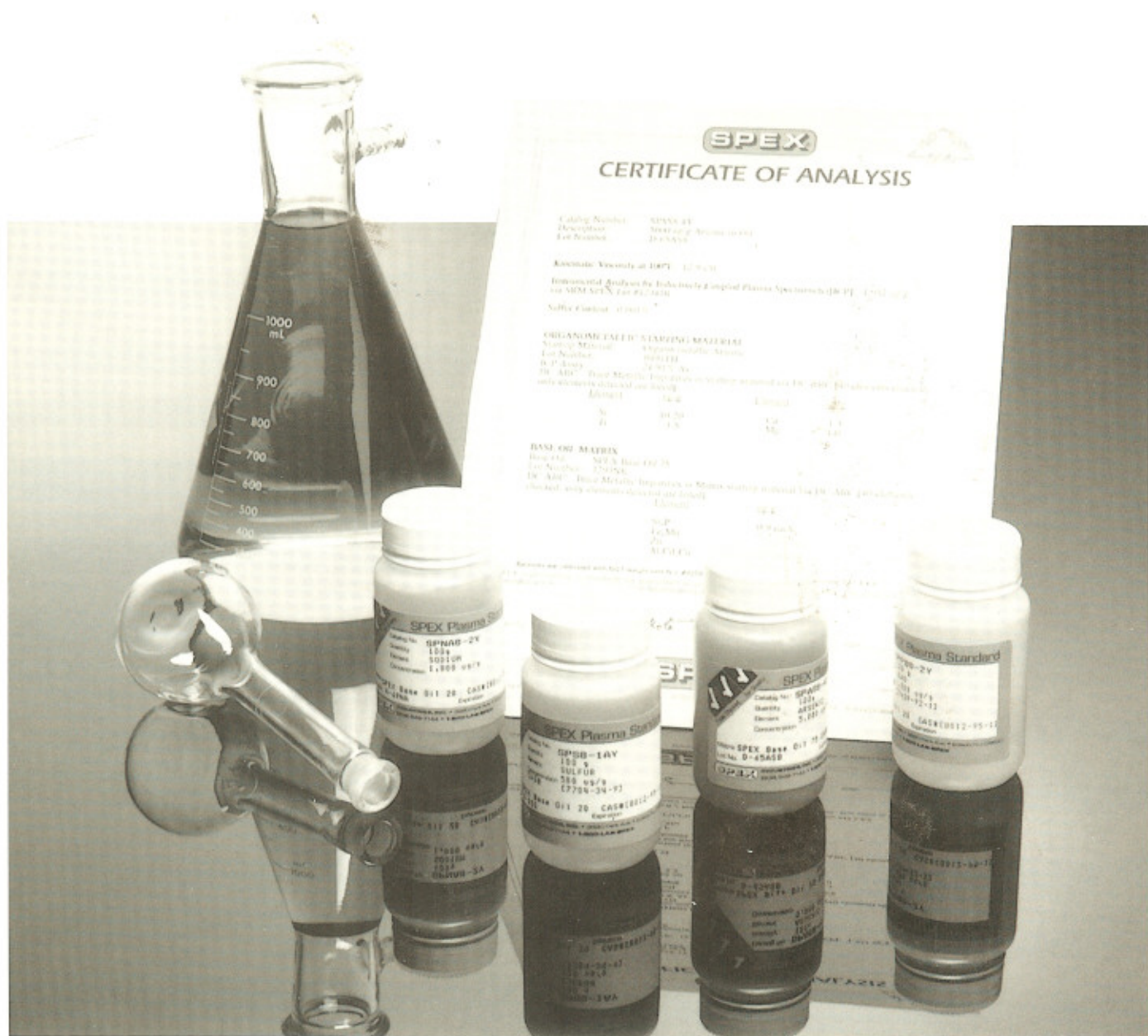
Element	Indicated Engine Wear
Magnesium (Mg)	Gear box housing and oil pump
Molybdenum (Mo)	Oil coolers and bearing alloys
Nickel (Ni)	Bearings, turbo blades, shafts and gears
Silicon (Si)	Dirt and/or dust in air cleaner system, casting sand in new engines, grinding compound
Silver (Ag)	Puddle pumps, piping with silver solder joints, bearing cages
Sodium (Na)	Coolant leak (antifreeze leakage) or oil additive
Tin (Sn)	Rod and piston coatings, bushing thrust metal and bearings
Titanium (Ti)	Turbine blades, compressor discs and bearing hub wear

Na, Cr, B, P, Ca, Ba and Mo often indicate coolant leakage as these elements are frequently used for coolants as rust or corrosion inhibitors.





## SINGLE-ELEMENT ORGANOMETALLIC OIL STANDARDS



- Choice of 37 Elements
- 1,000ug/g (ppm), Matrix-Base Oil 20
- 5,000ug/g (ppm), Matrix-Base Oil 75
- Sold in 100g Quantities
- Certificate of Analysis with Every Solution
- Single-Element Concentrates Upon Request
- Halogens in Oil Available on a Custom Basis

SPEX Single-Element Organometallic Standards are specifically designed to meet the accuracy and purity requirements for all end user needs. The starting materials are high-pure organometallic salts manufactured by SPEX with purities ranging from 99.99% to 99.9999%. Preparing the standard from the solid salt results in elimination of unwanted starting materials, by-products and impurities. All SPEX oil standards are made with Base Oil 20, which is low in sulfur, or Base Oil 75, which has a higher sulfur content.

SPEX single-element oil standards are certified by our unique Triple-Checked Quality Assurance Program: (1) DC ARC for trace metal impurities in solid

starting materials and Base Oils; (2) classical "wet" assay of the solid starting material; (3) ICP check for major element. All of these results are then reported directly on the corresponding Certificate of Analysis. Also listed are the viscosity and sulfur content. SPEX standards are certified against United States National Institute of Standards and Technology SRM's (where available). The actual found values are right on the certificate . . . your assurance of the highest quality standards available.

Single-element oil standards are available in concentrations of 1,000 and 5,000ug/g (ppm), in matrices of Base Oil 20 and Base Oil 75, respectively.



Element Cat. #	Matrix	Concentration (ug/g)
<b>Aluminum</b>		
SPAL8-2Y	Al in Base Oil 20	1,000ug/g
SPAL8-4Y	Al in Base Oil 75	5,000ug/g
<b>Antimony</b>		
SPSB8-2Y	Sb in Base Oil 20	1,000ug/g
SPSB8-4Y	Sb in Base Oil 75	5,000ug/g
<b>Arsenic</b>		
SPAS8-2Y	As in Base Oil 20	1,000ug/g
SPAS8-4Y	As in Base Oil 75	5,000ug/g
<b>Barium</b>		
SPBA8-2Y	Ba in Base Oil 20	1,000ug/g
SPBA8-4Y	Ba in Base Oil 75	5,000ug/g
<b>Beryllium</b>		
SPBE8-2Y	Be in Base Oil 20	1,000ug/g
SPBE8-4Y	Be in Base Oil 75	5,000ug/g
<b>Bismuth</b>		
SPBI8-2Y	Bi in Base Oil 20	1,000ug/g
SPBI8-4Y	Bi in Base Oil 75	5,000ug/g
<b>Boron</b>		
SPB8-2Y	B in Base Oil 20	1,000ug/g
SPB8-4Y	B in Base Oil 75	5,000ug/g
<b>Cadmium</b>		
SPCD8-2Y	Cd in Base Oil 20	1,000ug/g
SPCD8-4Y	Cd in Base Oil 75	5,000ug/g
<b>Calcium</b>		
SPCA8-2Y	Ca in Base Oil 20	1,000ug/g
SPCA8-4Y	Ca in Base Oil 75	5,000ug/g
<b>Chromium</b>		
SPCR8-2Y	Cr in Base Oil 20	1,000ug/g
SPCR8-4Y	Cr in Base Oil 75	5,000ug/g
<b>Cobalt</b>		
SPCO8-2Y	Co in Base Oil 20	1,000ug/g
SPCO8-4Y	Co in Base Oil 75	5,000ug/g
<b>Copper</b>		
SPCU8-2Y	Cu in Base Oil 20	1,000ug/g
SPCU8-4Y	Cu in Base Oil 75	5,000ug/g
<b>Iron</b>		
SPFE8-2Y	Fe in Base Oil 20	1,000ug/g
SPFE8-4Y	Fe in Base Oil 75	5,000ug/g
<b>Lanthanum</b>		
SPLA8-2Y	La in Base Oil 20	1,000ug/g
<b>Lead</b>		
SPPB8-2Y	Pb in Base Oil 20	1,000ug/g
SPPB8-4Y	Pb in Base Oil 75	5,000ug/g
<b>Lithium</b>		
SPLI8-2Y	Li in Base Oil 20	1,000ug/g
SPLI8-4Y	Li in Base Oil 75	5,000ug/g
<b>Magnesium</b>		
SPMG8-2Y	Mg in Base Oil 20	1,000ug/g
SPMG8-4Y	Mg in Base Oil 75	5,000ug/g
<b>Manganese</b>		
SPMN8-2Y	Mn in Base Oil 20	1,000ug/g
SPMN8-4Y	Mn in Base Oil 75	5,000ug/g
<b>Mercury</b>		
SPHG8-2Y	Hg in Base Oil 20	1,000ug/g

Element Cat. #	Matrix	Concentration (ug/g)
<b>Molybdenum</b>		
SPMO8-2Y	Mo in Base Oil 20	1,000ug/g
SPMO8-4Y	Mo in Base Oil 75	5,000ug/g
<b>Nickel</b>		
SPNI8-2Y	Ni in Base Oil 20	1,000ug/g
SPNI8-4Y	Ni in Base Oil 75	5,000ug/g
<b>Phosphorus</b>		
SPP8-2Y	P in Base Oil 20	1,000ug/g
SPP8-4Y	P in Base Oil 75	5,000ug/g
<b>Potassium</b>		
SPK8-2Y	K in Base Oil 20	1,000ug/g
SPK8-4Y	K in Base Oil 75	5,000ug/g
<b>Scandium</b>		
SPSC8-2Y	Sc in Base Oil 20	1,000ug/g
<b>Selenium</b>		
SPSE8-2Y	Se in Base Oil 20	1,000ug/g
SPSE8-4Y	Se in Base Oil 75	5,000ug/g
<b>Silicon</b>		
SPSI8-2Y	Si in Base Oil 20	1,000ug/g
SPSI8-4Y	Si in Base Oil 75	5,000ug/g
<b>Silver</b>		
SPAG8-2Y	Ag in Base Oil 20	1,000ug/g
SPAG8-4Y	Ag in Base Oil 75	5,000ug/g
<b>Sodium</b>		
SPNA8-2Y	Na in Base Oil 20	1,000ug/g
SPNA8-4Y	Na in Base Oil 75	5,000ug/g
<b>Strontium</b>		
SPSR8-2Y	Sr in Base Oil 20	1,000ug/g
SPSR8-4Y	Sr in Base Oil 75	5,000ug/g
<b>Sulfur</b>		
SPS8-1AY	S in Base Oil 20	500ug/g
SPS8-2Y	S in Base Oil 20	1,000ug/g
SPS8-4Y	S in Base Oil 20	5,000ug/g
<b>Thallium</b>		
SPTL8-2Y	Tl in Base Oil 20	1,000ug/g
<b>Tin</b>		
SPSN8-2Y	Sn in Base Oil 20	1,000ug/g
SPSN8-4Y	Sn in Base Oil 75	5,000ug/g
<b>Titanium</b>		
SPTI8-2Y	Ti in Base Oil 20	1,000ug/g
SPTI8-4Y	Ti in Base Oil 75	5,000ug/g
<b>Vanadium</b>		
SPV8-2Y	V in Base Oil 20	1,000ug/g
SPV8-4Y	V in Base Oil 75	5,000ug/g
<b>Yttrium</b>		
SPY8-2Y	Y in Base Oil 20	1,000ug/g
SPY8-4Y	Y in Base Oil 75	5,000ug/g
<b>Zinc</b>		
SPZN8-2Y	Zn in Base Oil 20	1,000ug/g
SPZN8-4Y	Zn in Base Oil 75	5,000ug/g
<b>Zirconium</b>		
SPZR8-2Y	Zr in Base Oil 20	1,000ug/g
SPZR8-4Y	Zr in Base Oil 75	5,000ug/g

The standards above are sold in 100g quantities.



**NEW**

- Di-normal Butyl Sulfide
- Matrix-SPEX Base Oil 20
- Sold in 100g Quantities
- XRF Documentation and Certification
- For Use with ASTM Method D2622, Standard Test Method for Sulfur in Petroleum Products

## SULFUR OIL STANDARD FOR DIESEL FUEL ANALYSIS

Catalog #	Sulfur Concentration
DSS8-AY	50ug/g
DSS8-1Y	100ug/g
DSS8-BY	150ug/g
DSS8-CY	300ug/g
DSS8-1AY	500ug/g
DSS8-1BY	750ug/g
DSS8-2Y	1,000ug/g

### DSS8-SET

Includes one of each:

DSS8-AY  
DSS8-1Y  
DSS8-BY  
DSS8-CY  
DSS8-1AY  
DSS8-1BY  
DSS8-2Y  
Base 20

## SPEX BASE OILS, KEROSENE BLANK, AND STA-SOL

**NEW**

### SPEX Kerosene Blank

SPEX Kerosene Blank can be used to dilute organometallic oil standards. A Certificate of Analysis is included with each bottle which reports the inorganic impurities found by ICP analysis.

SPBLK-KER SPEX Kerosene .....500ml

### SPEX Base Oils

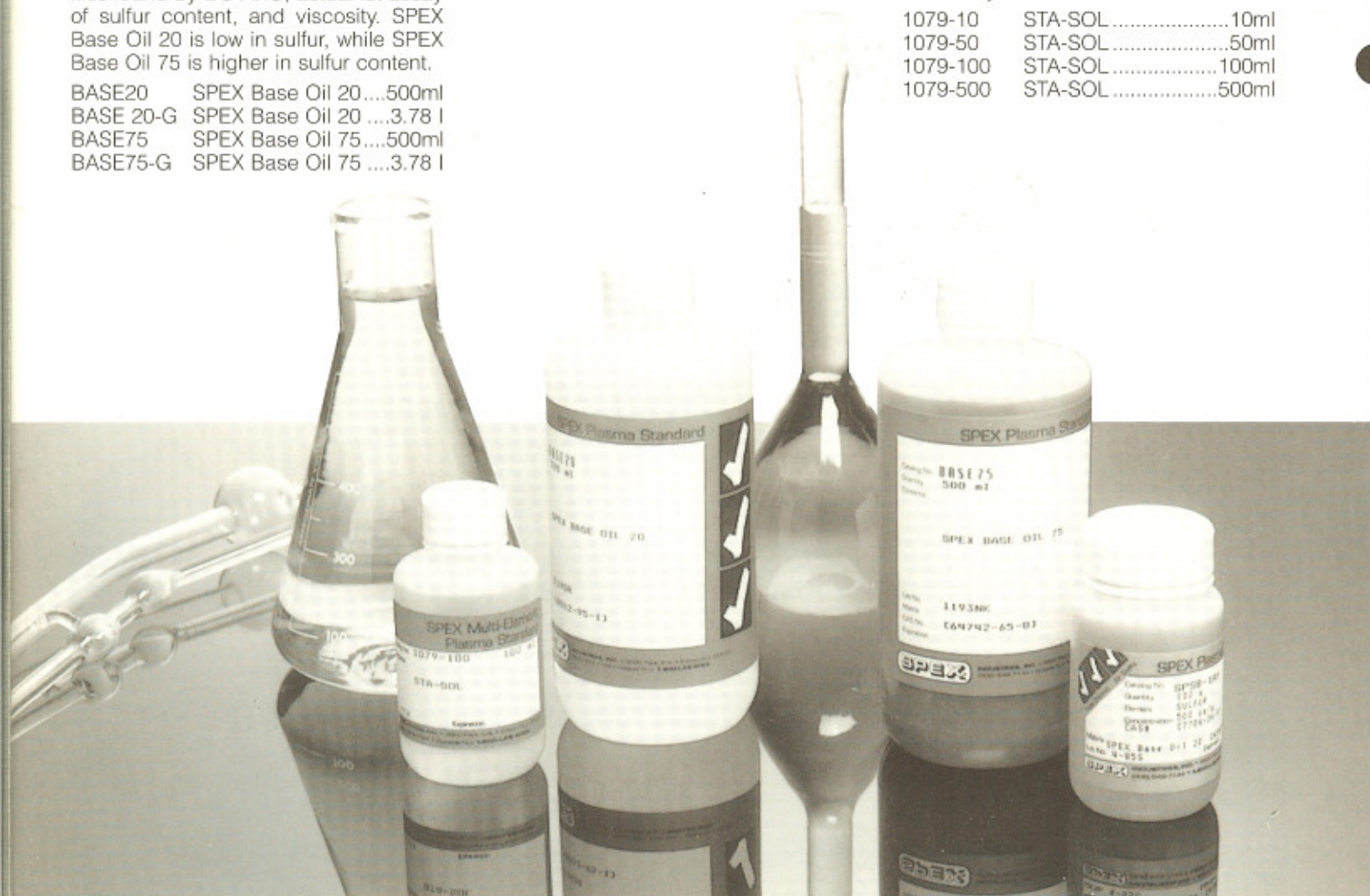
SPEX Base Oil 20 and 75 are the same certified base oils that are used in our single and multi-element blends. The Certificate of Analysis included with each bottle reports the inorganic impurities found by DC ARC, actual lot assay of sulfur content, and viscosity. SPEX Base Oil 20 is low in sulfur, while SPEX Base Oil 75 is higher in sulfur content.

BASE20 SPEX Base Oil 20.....500ml  
BASE 20-G SPEX Base Oil 20 .....3.78 l  
BASE75 SPEX Base Oil 75.....500ml  
BASE75-G SPEX Base Oil 75 .....3.78 l

### STA-SOL Stabilizer/Solubilizer

This unique blend of organic solubilizing agents and metal-ion stabilizers is a universal stabilizer/solubilizer which enables preparation of stable organometallic standards in your own laboratory.

1079-10 STA-SOL .....10ml  
1079-50 STA-SOL .....50ml  
1079-100 STA-SOL .....100ml  
1079-500 STA-SOL .....500ml





## STOCK MULTI-ELEMENT ORGANOMETALLIC OIL STANDARDS

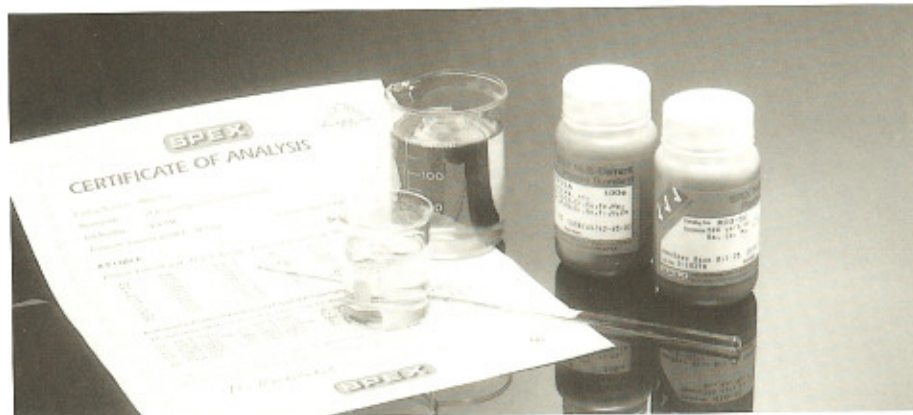
- 21, 12, 5, Element Combinations
- MIO-4A and MIO-18A for Crude Oil Analysis
- Matrix—SPEX Base Oil 75
- Sold in 100g Quantities
- Certificate of Analysis with Every Solution
- Custom Multi-Element Standards Available

SPEX Industries provides off-the-shelf, mixed multi-element oil standards formulated with combinations of elements and concentrations for the most common applications. The stock organometallic multi-element standards are designed with each element at 100, 300, 500 or 900ug/g (ppm) concentrations. All are prepared in Base Oil 75. Off-the-shelf multi-element standards decrease the time spent preparing multies from single-element standards and at the same time eliminate dilution and mixing errors.

As with all SPEX organometallic oil standards, every multi-element standard is prepared under the unique SPEX Triple-Checked Quality Assurance Program. This program guarantees the purity and concentration of your standard. Only SPEX organometallic standards are checked three ways: (1) DC ARC trace metal analysis of starting materials and Base Oil; (2) Classical "wet" assay of solid starting material; (3) Final ICP check for major element.

Every SPEX multi-element organometallic standard comes with a Certificate of Analysis that provides the end user with the actual found values as well as the labeled values. All standards are certified against United States Institute of Standards and Technology SRM's (where available). SRM's are listed directly on the Certificate of Analysis.

NEW	<b>Multi-Standard 4A</b>	
	MIO-4A	Matrix: SPEX Base Oil 75 100ug/g each: Sb, As, Hg, Se
	<b>Multi-Standard 5A</b>	
	MIO-5A	Matrix: SPEX Base Oil 75 100ug/g each: Ba, Ca, Mg, P, Zn
	<b>Multi-Standard 5B</b>	
	MIO-5B	Matrix: SPEX Base Oil 75 900ug/g each: Ba, Ca, Mg, P, Zn
	<b>Multi-Standard 5C</b>	
	MIO-5C	Matrix: SPEX Base Oil 75 500ug/g each: Ba, Ca, Mg, P, Zn
	<b>Multi-Standard 5D</b>	
	MIO-5D	Matrix: SPEX Base Oil 75 300ug/g each: Ba, Ca, Mg, P, Zn
	<b>Multi-Standard 12A</b>	
	MIO-12A	Matrix: SPEX Base Oil 75 100ug/g each: Al, Cr, Cu, Fe, Pb, Mg, Ni, Si, Ag, Na, Sn, Ti
	<b>Multi-Standard 12B</b>	
	MIO-12B	Matrix: SPEX Base Oil 75 900ug/g each: Al, Cr, Cu, Fe, Pb, Mg, Ni, Si, Ag, Na, Sn, Ti
	<b>Multi-Standard 12C</b>	
	MIO-12C	Matrix: SPEX Base Oil 75 500ug/g each: Al, Cr, Cu, Fe, Pb, Mg, Ni, Si, Ag, Na, Sn, Ti
	<b>Multi-Standard 12D</b>	
	MIO-12D	Matrix: SPEX Base Oil 75 300ug/g each: Al, Cr, Cu, Fe, Pb, Mg, Ni, Si, Ag, Na, Sn, Ti
NEW	<b>Multi-Standard 18A</b>	
	MIO-18A	Matrix: SPEX Base Oil 75 100ug/g each: Sb, As, Ba, Ca, Cr, Cu, Fe, Pb, Mg, Hg, Mo, Ni, P, Se, Sn, Ti, V, Zn
	<b>Multi-Standard 21A</b>	
	MIO-21A	Matrix: SPEX Base Oil 75 100ug/g each: Al, Ba, B, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, Si, Ag, Na, Sn, Ti, V, Zn
	<b>Multi-Standard 21C</b>	
	MIO-21C	Matrix: SPEX Base Oil 75 500ug/g each: Al, Ba, B, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, Si, Ag, Na, Sn, Ti, V, Zn
	<b>Multi-Standard 21D</b>	
	MIO-21D	Matrix: SPEX Base Oil 75 300ug/g each: Al, Ba, B, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, Si, Ag, Na, Sn, Ti, V, Zn





## SOLUTION STANDARDS FOR PLASMA EMISSION SPECTROSCOPY

- High-purity Starting Materials
- 18 Megohm (ASTM Type I) Filtered Water
- High-purity Acids
- Pre-cleaned and Leached Bottles
- Wet Assay & ICP Documentation and Certification

Plasma emission spectroscopy, which includes the techniques of ICP, DCP, and ICP-MS, has emerged as a major analytical method in the field of elemental analysis.

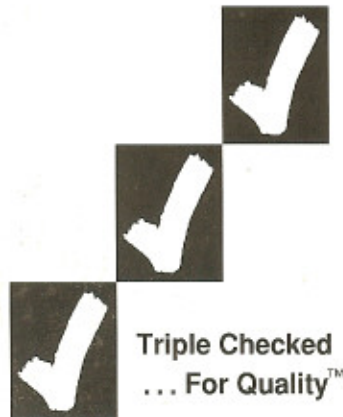
Capable of performing rapid simultaneous or sequential determinations of many elements, plasma systems are constantly revising our notions of what is detectable. Like the hyphenated techniques for gas and liquid chromatography, ICP-MS drives current detection limits even lower by perhaps two orders of magnitude, especially for elements where interference exists in the emission spectrum. The extremely high temperature of the plasma excites even refractory elements, and eliminates or minimizes many matrix effects.

SPEX offers several different lines of quality standards for plasma emission spectroscopy. Ranging from Plasma

Grade Single-Element solutions, off-the-shelf Mixed Multi-Element standards and Custom Multi-Element solutions in custom matrices to certified, high-purity inorganic compounds for starting materials in user prepared standards, SPEX has the "solutions" to your standardization problems.

SPEX certified high-purity standards are assayed for their metal content by wet chemical analysis. Semi-micro analytical balances and Class A volumetric labware are used exclusively. Our ASTM Type I filtered water minimizes cations, anions and colloids; resistivity is maintained in the 18 megohm range. Acids are the highest purity, and plastic bottles are subjected to a leaching/cleaning process. Each operation is conducted in all-plastic hoods.

We back up our quality by providing a Certificate of Analysis for every plasma grade standard we manufacture. You'll receive an actual lot assay on our starting material plus a trace impurity check, as well as verification in our state-of-the-art ICP facility and United States National Institute of Standards and Technology documentation information (where available). Our one-year stability and accuracy guarantee is included on all plasma grade single and multi-element standards.



Triple Checked  
... For Quality™





## SINGLE-ELEMENT SOLUTION STANDARDS FOR PLASMA EMISSION SPECTROSCOPY

- Choice of 70 Elements
- 1,000 or 10,000ug/ml (ppm) Concentrations
- Sold in 100ml and 500ml Quantities
- Certification with Every Solution
- Alternate Matrices for Most Elements

Plasma emission spectroscopy has become a popular and well accepted method for elemental analysis in diverse areas such as potable water testing, hazardous waste analysis, alloy and ceramics analysis.

SPEX Single-Element Plasma Solution Standards are specifically designed to meet the accuracy and purity requirements of inductively coupled and direct current plasma emission spectroscopy. The starting materials are inorganic compounds or metals with purities ranging from 99.99% to 99.9999%. All SPEX plasma standards are made with high-purity acids and ASTM Type I water (18 megohm).

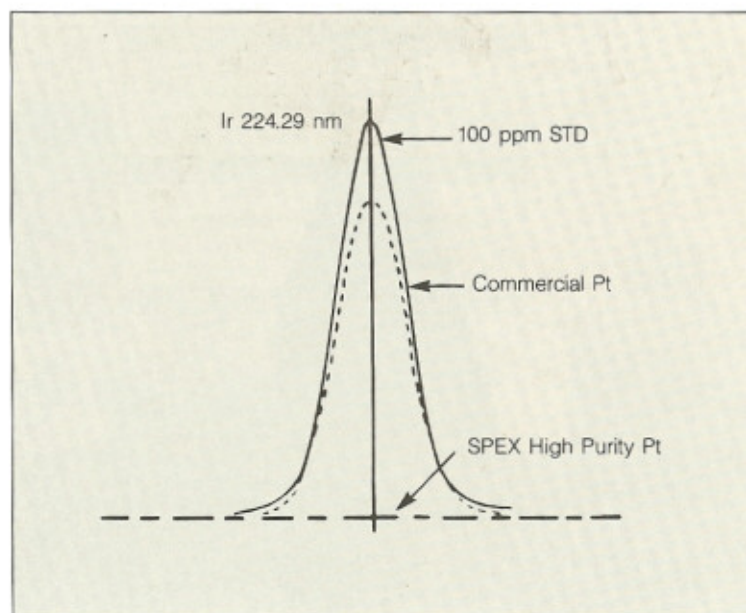
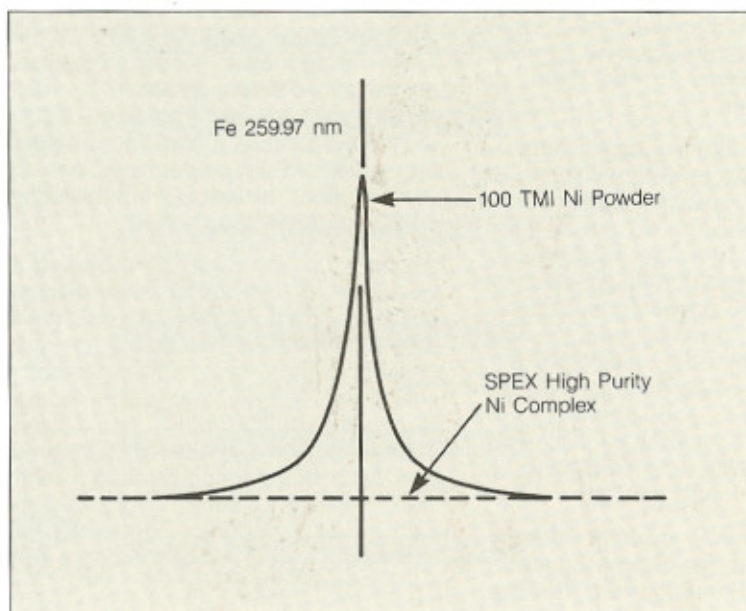
The ultra-high purity of the starting material is your assurance that detected emissions are real and are not due to unreported impurities in the calibration standard. SPEX guarantees both the purity of our solution and the concentration of the major element to  $\pm 0.5\%$  for one full year from date of shipment. Each bottle is supplied with its own certification for concentration and trace element analysis for your reference. Your standard is analyzed in the SPEX quality control laboratory by ICP, OES and wet methods. The **actual results** are reported on the SPEX certificate of analysis supplied with every bottle.

SPEX single-element solution standards are certified by our unique **Triple-Checked Quality Assurance** program: (1) DC ARC for trace metal impurities in solid starting material; (2) classical "wet" assay for major element; (3) final ICP check for major element. **All of these results are then reported directly on the corresponding certificate of analysis.**

Every precaution is taken to maintain the highest possible accuracy. We carefully consider the required element and matrix demands. Stability is assured by custom chosen matrices which avoid formation of precipitates and prevent hydrolysis. Our certification of the results is your assurance that these standards will optimize the performance level of your equipment.

Single-element plasma calibration standards are available in concentrations of 1,000 and 10,000ug/ml (ppm), most in two different matrices for your convenience.

ICP determination of Fe in 5% aqueous solution of Ni prepared from SPEX 4-9s Ni (100 TMI) powder and a specially purified batch of the nickel complex  $[\text{Ni}(\text{NH}_3)_6](\text{NO}_3)_2$ . The concentration of Fe in the 100 TMI sample is estimated at 20 ppm and therefore is less than 1 ppm in the starting material.



ICP determination of Ir in 1% aqueous solutions of Pt prepared from commercial grade Pt, and SPEX Pt sponge. A solution of 100 ppm of Ir is shown for comparison. The commercial Pt contains around .6% Ir while that in the SPEX compound is undetectable.



Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Aluminum			
PLAL2-2X	Al (NO <sub>3</sub> ) <sub>3</sub> •9H <sub>2</sub> O in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLAL2-2Y		1,000ug/ml	100ml
PLAL2-3X		10,000ug/ml	500ml
PLAL2-3Y		10,000ug/ml	100ml
PLAL1-2X	Al in 2-5% HCl	1,000ug/ml	500ml
PLAL1-3X		10,000ug/ml	500ml
Antimony			
PLSB7-2X	Sb in H <sub>2</sub> O + 6% Tartaric Acid + tr HNO <sub>3</sub>	1,000ug/ml	500ml
PLSB7-2Y		1,000ug/ml	100ml
PLSB7-3X		10,000ug/ml	500ml
PLSB7-3Y		10,000ug/ml	100ml
PLSB5-2X	Sb <sub>2</sub> O <sub>3</sub> in 20% HCl (in Teflon)	1,000ug/ml	500ml
PLSB5-3X		10,000ug/ml	500ml
Arsenic			
PLAS2-2X	H <sub>3</sub> AsO <sub>4</sub> •1/2H <sub>2</sub> O in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLAS2-2Y		1,000ug/ml	100ml
PLAS2-3X		10,000ug/ml	500ml
PLAS2-3Y		10,000ug/ml	100ml
PLAS1-2X	As <sub>2</sub> O <sub>3</sub> in 2-5% HCl	1,000ug/ml	500ml
PLAS1-3X		10,000ug/ml	500ml
Barium			
PLBA2-2X	BaCO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLBA2-2Y		1,000ug/ml	100ml
PLBA2-3X		10,000ug/ml	500ml
PLBA2-3Y		10,000ug/ml	100ml
PLBA1-2X	BaCO <sub>3</sub> in 2-5% HCl	1,000ug/ml	500ml
PLBA1-3X		10,000ug/ml	500ml
Beryllium			
PLBE2-2X	Be <sub>4</sub> O(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>6</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLBE2-2Y		1,000ug/ml	100ml
PLBE2-3X		10,000ug/ml	500ml
PLBE2-3Y		10,000ug/ml	100ml
Bismuth			
PLBI4-2X	Bi in 10% HNO <sub>3</sub>	1,000ug/ml	500ml
PLBI4-2Y		1,000ug/ml	100ml
PLBI4-3X		10,000ug/ml	500ml
PLBI4-3Y		10,000ug/ml	100ml
Boron			
PLB9-2X	(NH <sub>4</sub> ) <sub>2</sub> B <sub>4</sub> O <sub>7</sub> •4H <sub>2</sub> O in H <sub>2</sub> O	1,000ug/ml	500ml
PLB9-2Y		1,000ug/ml	100ml
PLB9-3X		10,000ug/ml	500ml
PLB9-3Y		10,000ug/ml	100ml
Cadmium			
PLCD2-2X	Cd in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLCD2-2Y		1,000ug/ml	100ml
PLCD2-3X		10,000ug/ml	500ml
PLCD2-3Y		10,000ug/ml	100ml
PLCD1-2X	Cd in 2-5% HCl	1,000ug/ml	500ml
PLCD1-3X		10,000ug/ml	500ml
Calcium			
PLCA2-2X	CaCO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLCA2-2Y		1,000ug/ml	100ml
PLCA2-3X		10,000ug/ml	500ml
PLCA2-3Y		10,000ug/ml	100ml
PLCA1-2X	CaCO <sub>3</sub> in 2-5% HCl	1,000ug/ml	500ml
PLCA1-3X		10,000ug/ml	500ml
Carbon			
PLC9-2X	H <sub>2</sub> C <sub>2</sub> O <sub>4</sub> •2H <sub>2</sub> O in H <sub>2</sub> O (Oxalic Acid)	1,000ug/ml	500ml
PLC9-2Y		1,000ug/ml	100ml
PLC9-3X		10,000ug/ml	500ml
PLC9-3Y		10,000ug/ml	100ml
Cerium			
PLCE2-2X	Ce(NO <sub>3</sub> ) <sub>3</sub> •6H <sub>2</sub> O in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLCE2-2Y		1,000ug/ml	100ml
PLCE2-3X		10,000ug/ml	500ml
PLCE2-3Y		10,000ug/ml	100ml
Cesium			
PLCS2-2X	CsNO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLCS2-2Y		1,000ug/ml	100ml
PLCS2-3X		10,000ug/ml	500ml
PLCS2-3Y		10,000ug/ml	100ml

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Chromium			
PLCR2-2X	Cr(NO <sub>3</sub> ) <sub>3</sub> •9H <sub>2</sub> O in 2-5% HNO <sub>3</sub> *Cr(+3)*	1,000ug/ml	500ml
PLCR2-2Y		1,000ug/ml	100ml
PLCR2-3X		10,000ug/ml	500ml
PLCR2-3Y		10,000ug/ml	100ml
PLCR1-2X	Cr in 2-5% HCl  (NH <sub>4</sub> ) <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> in H <sub>2</sub> O *Cr(+6)*	1,000ug/ml	500ml
PLCR1-3X		10,000ug/ml	500ml
PLCR9-2X		1,000ug/ml	500ml
PLCR9-3X		10,000ug/ml	500ml
Cobalt			
PLCO2-2X	CoCO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLCO2-2Y		1,000ug/ml	100ml
PLCO2-3X		10,000ug/ml	500ml
PLCO2-3Y		10,000ug/ml	100ml
PLCO1-2X	CoCO <sub>3</sub> in 2-5% HCl	1,000ug/ml	500ml
PLCO1-3X		10,000ug/ml	500ml
Copper			
PLCU2-2X	Cu in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLCU2-2Y		1,000ug/ml	100ml
PLCU2-3X		10,000ug/ml	500ml
PLCU2-3Y		10,000ug/ml	100ml
PLCU1-2X	Cu in 2-5% HCl	1,000ug/ml	500ml
PLCU1-3X		10,000ug/ml	500ml
Dysprosium			
PLDY2-2X	Dy <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLDY2-2Y		1,000ug/ml	100ml
PLDY2-3X		10,000ug/ml	500ml
PLDY2-3Y		10,000ug/ml	100ml
Erbium			
PLER2-2X	Er <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLER2-2Y		1,000ug/ml	100ml
PLER2-3X		10,000ug/ml	500ml
PLER2-3Y		10,000ug/ml	100ml
Europium			
PLEU2-2X	Eu <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLEU2-2Y		1,000ug/ml	100ml
PLEU2-3X		10,000ug/ml	500ml
PLEU2-3Y		10,000ug/ml	100ml
Gadolinium			
PLGD2-2X	Gd <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLGD2-2Y		1,000ug/ml	100ml
PLGD2-3X		10,000ug/ml	500ml
PLGD2-3Y		10,000ug/ml	100ml
Gallium			
PLGA2-2X	Ga in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLGA2-2Y		1,000ug/ml	100ml
PLGA2-3X		10,000ug/ml	500ml
PLGA2-3Y		10,000ug/ml	100ml
Germanium			
PLGE9-2X	(NH <sub>4</sub> ) <sub>2</sub> Ge(C <sub>2</sub> O <sub>4</sub> ) <sub>3</sub> •XH <sub>2</sub> O in H <sub>2</sub> O	1,000ug/ml	500ml
PLGE9-2Y		1,000ug/ml	100ml
PLGE9-3X		10,000ug/ml	500ml
PLGE9-3Y		10,000ug/ml	100ml
Gold			
PLAU3-2X	Au in 10% HCl	1,000ug/ml	500ml
PLAU3-2Y		1,000ug/ml	100ml
PLAU3-3X		10,000ug/ml	500ml
PLAU3-3Y		10,000ug/ml	100ml
Hafnium			
PLHF1-2X	HfOCl <sub>2</sub> •8H <sub>2</sub> O in 2-5% HCl	1,000ug/ml	500ml
PLHF1-2Y		1,000ug/ml	100ml
PLHF1-3X		10,000ug/ml	500ml
PLHF1-3Y		10,000ug/ml	100ml
Holmium			
PLHO2-2X	Ho <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLHO2-2Y		1,000ug/ml	100ml
PLHO2-3X		10,000ug/ml	500ml
PLHO2-3Y		10,000ug/ml	100ml



Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Indium			
PLIN2-2X	In in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLIN2-2Y		1,000ug/ml	100ml
PLIN2-3X		10,000ug/ml	500ml
PLIN2-3Y		10,000ug/ml	100ml
Iridium			
PLIR3-2X	IrCl <sub>3</sub> •3H <sub>2</sub> O in 10% HCl	1,000ug/ml	500ml
PLIR3-2Y		1,000ug/ml	100ml
PLIR3-3X		10,000ug/ml	500ml
PLIR3-3Y		10,000ug/ml	100ml
Iron			
PLFE2-2X	Fe in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLFE2-2Y		1,000ug/ml	100ml
PLFE2-3X		10,000ug/ml	500ml
PLFE2-3Y		10,000ug/ml	100ml
PLFE1-2X	Fe in 2% HCl	1,000ug/ml	500ml
PLFE1-3X	Fe in 5% HCl / tr HNO <sub>3</sub>	10,000ug/ml	500ml
Lanthanum			
PLLA2-2X	La <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLLA2-2Y		1,000ug/ml	100ml
PLLA2-3X		10,000ug/ml	500ml
PLLA2-3Y		10,000ug/ml	100ml
Lead			
PLPB2-2X	Pb(NO <sub>3</sub> ) <sub>2</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLPB2-2Y		1,000ug/ml	100ml
PLPB2-3X		10,000ug/ml	500ml
PLPB2-3Y		10,000ug/ml	100ml
Lithium			
PLLI2-2X	Li <sub>2</sub> CO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLLI2-2Y		1,000ug/ml	100ml
PLLI2-3X		10,000ug/ml	500ml
PLLI2-3Y		10,000ug/ml	100ml
PLLI1-2X	Li <sub>2</sub> CO <sub>3</sub> in 2-5% HCl	1,000ug/ml	500ml
PLLI1-3X		10,000ug/ml	500ml
Lutetium			
PLLU2-2X	Lu <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLLU2-2Y		1,000ug/ml	100ml
PLLU2-3X		10,000ug/ml	500ml
PLLU2-3Y		10,000ug/ml	100ml
Magnesium			
PLMG2-2X	Mg in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLMG2-2Y		1,000ug/ml	100ml
PLMG2-3X		10,000ug/ml	500ml
PLMG2-3Y		10,000ug/ml	100ml
PLMG1-2X	Mg in 2-5% HCl	1,000ug/ml	500ml
PLMG1-3X		10,000ug/ml	500ml
Manganese			
PLMN2-2X	Mn(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>3</sub> •2H <sub>2</sub> O in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLMN2-2Y		1,000ug/ml	100ml
PLMN2-3X		10,000ug/ml	500ml
PLMN2-3Y		10,000ug/ml	100ml
Mercury			
PLHG4-2X	Hg in 10% HNO <sub>3</sub>	1,000ug/ml	500ml
PLHG4-2Y		1,000ug/ml	100ml
PLHG4-3X		10,000ug/ml	500ml
PLHG4-3Y		10,000ug/ml	100ml
Molybdenum			
PLMO9-2X	(NH <sub>4</sub> ) <sub>2</sub> MoO <sub>4</sub> in H <sub>2</sub> O	1,000ug/ml	500ml
PLMO9-2Y		1,000ug/ml	100ml
PLMO9-3X		10,000ug/ml	500ml
PLMO9-3Y		10,000ug/ml	100ml
Neodymium			
PLND2-2X	Nd <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLND2-2Y		1,000ug/ml	100ml
PLND2-3X		10,000ug/ml	500ml
PLND2-3Y		10,000ug/ml	100ml
Nickel			
PLNI2-2X	Ni in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLNI2-2Y		1,000ug/ml	100ml
PLNI2-3X		10,000ug/ml	500ml
PLNI2-3Y		10,000ug/ml	100ml

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Niobium			
PLNB9-2X	NH <sub>4</sub> NbF <sub>6</sub> in H <sub>2</sub> O/tr HF	1,000ug/ml	500ml
PLNB9-2Y		1,000ug/ml	100ml
PLNB9-3X		10,000ug/ml	500ml
PLNB9-3Y		10,000ug/ml	100ml
Palladium			
PLPD3-2X	Pd in 10% HCl	1,000ug/ml	500ml
PLPD3-2Y		1,000ug/ml	100ml
PLPD3-3X		10,000ug/ml	500ml
PLPD3-3Y		10,000ug/ml	100ml
Phosphorus			
PLP9-2X	NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub> in H <sub>2</sub> O	1,000ug/ml	500ml
PLP9-2Y		1,000ug/ml	100ml
PLP9-3X		10,000ug/ml	500ml
PLP9-3Y		10,000ug/ml	100ml
Platinum			
PLPT3-2X	Pt in 10% HCl	1,000ug/ml	500ml
PLPT3-2Y		1,000ug/ml	100ml
PLPT3-3X		10,000ug/ml	500ml
PLPT3-3Y		10,000ug/ml	100ml
Potassium			
PLK2-2X	KNO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLK2-2Y		1,000ug/ml	100ml
PLK2-3X		10,000ug/ml	500ml
PLK2-3Y		10,000ug/ml	100ml
PLK1-2X	KCl in 2-5% HCl	1,000ug/ml	500ml
PLK1-3X		10,000ug/ml	500ml
Praseodymium			
PLPR2-2X	Pr <sub>6</sub> O <sub>11</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLPR2-2Y		1,000ug/ml	100ml
PLPR2-3X		10,000ug/ml	500ml
PLPR2-3Y		10,000ug/ml	100ml
Rhenium			
PLRE9-2X	(NH <sub>4</sub> ) <sub>2</sub> ReO <sub>4</sub> in H <sub>2</sub> O	1,000ug/ml	500ml
PLRE9-2Y		1,000ug/ml	100ml
PLRE9-3X		10,000ug/ml	500ml
PLRE9-3Y		10,000ug/ml	100ml
Rhodium			
PLRH3-2X	RhCl <sub>3</sub> •3H <sub>2</sub> O in 10% HCl	1,000ug/ml	500ml
PLRH3-2Y		1,000ug/ml	100ml
PLRH3-3X		10,000ug/ml	500ml
PLRH3-3Y		10,000ug/ml	100ml
Rubidium			
PLRB2-2X	RbNO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLRB2-2Y		1,000ug/ml	100ml
PLRB2-3X		10,000ug/ml	500ml
PLRB2-3Y		10,000ug/ml	100ml
Ruthenium			
PLRU3-2X	RuCl <sub>3</sub> •3H <sub>2</sub> O in 10% HCl	1,000ug/ml	500ml
PLRU3-2Y		1,000ug/ml	100ml
PLRU3-3X		10,000ug/ml	500ml
PLRU3-3Y		10,000ug/ml	100ml
Samarium			
PLSM2-2X	Sm <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLSM2-2Y		1,000ug/ml	100ml
PLSM2-3X		10,000ug/ml	500ml
PLSM2-3Y		10,000ug/ml	100ml
Scandium			
PLSC2-2X	Sc <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLSC2-2Y		1,000ug/ml	100ml
PLSC2-3X		10,000ug/ml	500ml
PLSC2-3Y		10,000ug/ml	100ml
Selenium			
PLSE2-2X	Se in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLSE2-2Y		1,000ug/ml	100ml
PLSE2-3X		10,000ug/ml	500ml
PLSE2-3Y		10,000ug/ml	100ml



Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Silicon			
PLSI9-2X	(NH <sub>4</sub> ) <sub>2</sub> SiF <sub>6</sub> in H <sub>2</sub> O/tr HF	1,000ug/ml	500ml
PLSI9-2Y		1,000ug/ml	100ml
PLSI9-3X		10,000ug/ml	500ml
PLSI9-3Y		10,000ug/ml	100ml
PLSI9A-2X		1,000ug/ml	500ml
PLSI9A-3X	Na <sub>2</sub> SiO <sub>3</sub> •9H <sub>2</sub> O in H <sub>2</sub> O	10,000ug/ml	500ml
Silver			
PLAG2-2X	Ag in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLAG2-2Y		1,000ug/ml	100ml
PLAG2-3X		10,000ug/ml	500ml
PLAG2-3Y		10,000ug/ml	100ml
Sodium			
PLNA2-2X	Na <sub>2</sub> CO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLNA2-2Y		1,000ug/ml	100ml
PLNA2-3X		10,000ug/ml	500ml
PLNA2-3Y		10,000ug/ml	100ml
PLNA1-2X	NaCl in 2-5% HCl	1,000ug/ml	500ml
PLNA1-3X		10,000ug/ml	500ml
Strontium			
PLSR2-2X	SrCO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLSR2-2Y		1,000ug/ml	100ml
PLSR2-3X		10,000ug/ml	500ml
PLSR2-3Y		10,000ug/ml	100ml
PLSR1-2X	SrCO <sub>3</sub> in 2-5% HCl	1,000ug/ml	500ml
PLSR1-3X		10,000ug/ml	500ml
Sulfur			
PLS9-2X	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> in H <sub>2</sub> O	1,000ug/ml	500ml
PLS9-2Y		1,000ug/ml	100ml
PLS9-3X		10,000ug/ml	500ml
PLS9-3Y		10,000ug/ml	100ml
Tantalum			
PLTA9-2X	NH <sub>4</sub> TaF <sub>6</sub> in H <sub>2</sub> O/tr HF	1,000ug/ml	500ml
PLTA9-2Y		1,000ug/ml	100ml
PLTA9-3X		10,000ug/ml	500ml
PLTA9-3Y		10,000ug/ml	100ml
Tellurium			
PLTE2-2X	Te in 5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLTE2-2Y		1,000ug/ml	100ml
PLTE6-3X	Te in 20% HNO <sub>3</sub>	10,000ug/ml	500ml
PLTE6-3Y		10,000ug/ml	100ml
PLTE3-2X	TeO <sub>2</sub> in 10% HCl	1,000ug/ml	500ml
PLTE5-3X		30% HCl (in Teflon)	10,000ug/ml
Terbium			
PLTB2-2X	Tb <sub>4</sub> O <sub>7</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLTB2-2Y		1,000ug/ml	100ml
PLTB2-3X		10,000ug/ml	500ml
PLTB2-3Y		10,000ug/ml	100ml
Thallium			
PLTL2-2X	TlNO <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLTL2-2Y		1,000ug/ml	100ml
PLTL2-3X		10,000ug/ml	500ml
PLTL2-3Y		10,000ug/ml	100ml
Thorium			
PLTH2-2X	Th(NO <sub>3</sub> ) <sub>4</sub> •4H <sub>2</sub> O in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLTH2-2Y		1,000ug/ml	100ml
PLTH2-3X		10,000ug/ml	500ml
PLTH2-3Y		10,000ug/ml	100ml
Thulium			
PLTM2-2X	Tm <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLTM2-2Y		1,000ug/ml	100ml
PLTM2-3X		10,000ug/ml	500ml
PLTM2-3Y		10,000ug/ml	100ml

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Tin			
PLSN2-2X	Sn in 1% HNO <sub>3</sub> +1% HF Sn in 2% HNO <sub>3</sub> +2% HF Sn in 20% HCl (in Teflon)	1,000ug/ml	500ml
PLSN2-3X		10,000ug/ml	500ml
PLSN5-2X		1,000ug/ml	500ml
PLSN5-2Y		1,000ug/ml	100ml
PLSN5-3X		10,000ug/ml	500ml
PLSN5-3Y		10,000ug/ml	100ml
Titanium			
PLTI9-2X	(NH <sub>4</sub> ) <sub>2</sub> TiF <sub>6</sub> in H <sub>2</sub> O tr HF	1,000ug/ml	500ml
PLTI9-2Y		1,000ug/ml	100ml
PLTI9-3X		10,000ug/ml	500ml
PLTI9-3Y		10,000ug/ml	100ml
PLTI5-2X	TiCl <sub>4</sub> in 20% HCl 40% HCl (in Teflon)	1,000ug/ml	500ml
PLTI5-3X		10,000ug/ml	500ml
Tungsten			
PLW9-2X	(NH <sub>4</sub> ) <sub>2</sub> WO <sub>4</sub> in H <sub>2</sub> O	1,000ug/ml	500ml
PLW9-2Y		1,000ug/ml	100ml
PLW9-3X		10,000ug/ml	500ml
PLW9-3Y		10,000ug/ml	100ml
PLW2-2X	W in 1% HNO <sub>3</sub> +2% HF W in 2% HNO <sub>3</sub> +5% HF	1,000ug/ml	500ml
PLW2-3X		10,000ug/ml	500ml
Uranium			
PLU2-2X	U <sub>3</sub> O <sub>8</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLU2-2Y		1,000ug/ml	100ml
PLU2-3X		10,000ug/ml	500ml
PLU2-3Y		10,000ug/ml	100ml
Vanadium			
PLV2-2X	NH <sub>4</sub> VO <sub>3</sub> in 2% HNO <sub>3</sub>	1,000ug/ml	500ml
PLV2-2Y		1,000ug/ml	100ml
PLV4-3X	NH <sub>4</sub> VO <sub>3</sub> in 15% HNO <sub>3</sub>  NH <sub>4</sub> VO <sub>3</sub> in 2% HCl NH <sub>4</sub> VO <sub>3</sub> in 15% HCl	10,000ug/ml	500ml
PLV4-3Y		10,000ug/ml	100ml
PLV1-2X		1,000ug/ml	500ml
PLV3-3X		10,000ug/ml	500ml
Ytterbium			
PLYB2-2X	Yb <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLYB2-2Y		1,000ug/ml	100ml
PLYB2-3X		10,000ug/ml	500ml
PLYB2-3Y		10,000ug/ml	100ml
Yttrium			
PLY2-2X	Y <sub>2</sub> O <sub>3</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLY2-2Y		1,000ug/ml	100ml
PLY2-3X		10,000ug/ml	500ml
PLY2-3Y		10,000ug/ml	100ml
Zinc			
PLZN2-2X	Zn in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLZN2-2Y		1,000ug/ml	100ml
PLZN2-3X		10,000ug/ml	500ml
PLZN2-3Y		10,000ug/ml	100ml
PLZN1-2X	Zn in 2-5% HCl	1,000ug/ml	500ml
PLZN1-3X		10,000ug/ml	500ml
Zirconium			
PLZR2-2X	ZrO(NO <sub>3</sub> ) <sub>2</sub> in 2-5% HNO <sub>3</sub>	1,000ug/ml	500ml
PLZR2-2Y		1,000ug/ml	100ml
PLZR2-3X		10,000ug/ml	500ml
PLZR2-3Y		10,000ug/ml	100ml
PLZR3-2X	ZrOCl <sub>2</sub> •8H <sub>2</sub> O in 10% HCl	1,000ug/ml	500ml
PLZR3-3X		10,000ug/ml	500ml
Matrix Blanks:			
PLBLK-HNO3	5% HNO <sub>3</sub> 5% HCl H <sub>2</sub> O		500ml
PLBLK-HCL			500ml
PLBLK-H2O			500ml
PLBLK-H2O-1L			1L
PLBLK-H2O-2L			2L
PLBLK-H2O-4L			3.78L

HCl, KCN, KOH, NaCN, HF, HNO<sub>3</sub>/HCl, H<sub>2</sub>O, Oil Matrices are also available on a custom basis. Please call our sales office for quotations and information.



## PLASMA EMISSION SOLUTION STANDARDS KIT



**Triple Checked  
... For Quality™**

The SPEX Plasma Emission Standards Kit is designed to provide the ICP laboratory with a convenient set of single-element standards covering the most common elements for the most common applications. All of the elements of environmental concern on the **Toxic Analyte List** have been included.

Thirty eight single-element standards are supplied, each at 1,000ug/ml concentrations and in 100ml quantities. Elements are supplied in the most common matrices to enable mixing of compatible elements. As always, each SPEX Plasma Grade Standard comes with its own certificate of analysis showing trace metal analysis and traceability documentation.

Since every laboratory has its specific applications, the SPEX ICP Kit cannot fill every need. It can be easily supplemented with SPEX single and multi-element plasma standards that are manufactured under the same unique SPEX Triple-Checked Quality Assurance program to fill out your requirements.

### ICP-KIT-1: Plasma Emission Standards Kit 1

Contains **100ml of each** of the following 38 elements at 1,000ug/ml concentrations in the matrix specified:

**Matrix 2% HNO<sub>3</sub>:**

Al, As, Ba, Be, Cd, Ca, Cr, Co,  
Cu, Fe, Pb, Li, Mg, Mn, Ni, K, Sc,  
Se, Ag, Na, Sr, Ti, V, Y, Zn and Zr

**Matrix H<sub>2</sub>O:**

Sb, B, Mo, Nb, P, Si, S, Ti and W

**Matrix 20% HCl (in Teflon):**

Sn

**Matrix 10% HNO<sub>3</sub>:**

Bi, Hg

## HIGH-PURITY COMPOUND KITS FOR CUSTOM SOLUTION PREPARATION

- 6 Kits — 72 Elements
- Highest Purity, Non-hygroscopic Compounds
- Prepare Single or Multi-Element Standards
- Stable in HCl and/or HNO<sub>3</sub>
- Rapid Dissolution — Interelement Compatibility
- Certified Assay — Trace Metals Analysis

If your laboratory cannot predict analysis problems week-to-week or even day-to-day, then you need even more flexibility than offered by SPEX custom solution standards. SPEX High-Purity Compound Kits are the ideal solution. Single or multi-element standards can be made on the spot in response to specific problems. Your custom preparation will ensure the maximum sample-to-standard compatibility. The compound kits can also provide

back-up to your custom solutions for those off-the-wall applications, or where you simply need a second matrix or higher concentration.

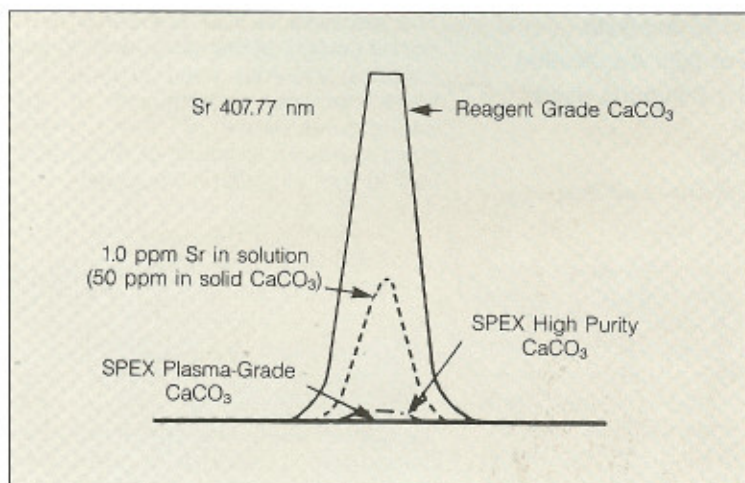
SPEX High-Purity Compound Kits offer a positive alternative to solution standards for your ICP/DCP laboratory. Plasma-grade starting materials for solution standards are available in six convenient kits comprised of seventy-two spectroscopically pure compounds. All seventy-two compounds are readily soluble and stable in aqueous HCl and/or HNO<sub>3</sub> solutions, and carefully chosen for multi-element compatibility. Each kit contains complete dissolution and handling instructions as well as pertinent information about inter-element incompatibilities. The highly stable, non-hygroscopic kit compounds offer the added advantages of extended shelf life and reduced storage space.

SPEX Compound Kits consist of high-purity materials that have been carefully selected and further processed to plasma-grade purity. Each compound is accompanied by an analysis certificate that specifies the assayed metal content and the results of a semi-quantitative spectrographic analysis for total metallic impurities. Each compound is checked for 40 elemental impurities via DC ARC and/or ICP. Elements which are detected are listed on the certificate in parts per million. These are then added to determine total metallic impurity.



Extreme high purity is critical for plasma-grade starting materials. In a multi-element solution standard, impurities present in the various starting materials can add up cumulatively to significant element concentration errors. Detectable impurities in single-element solution standards may be mistaken for true spectral interferences.

The accompanying ICP determinations graphically represent the successive stages of purification necessary to transform reagent-grade  $\text{CaCO}_3$  into a plasma-grade material. Compounds of this purity, prepared expressly for ICP-DCP Standards, are available only from SPEX.



ICP determination of Sr in 2% solutions of  $\text{CaCO}_3$  prepared from reagent grade, high-purity and plasma-grade materials. The 1 ppm aqueous Sr solution standard, corresponding to 50 ppm in the solid, indicates the following concentrations of Sr in each material:

Reagent Grade	200 ppm
High-Purity Grade	3 ppm
Plasma-Grade	1 ppm

<b>PL-K10:</b>	<b>Main Group Elements Kit:</b> Contains 2 gram equivalents of each of the following twenty-five elements: Li, Be, B, Na, Mg, Al, Si, P, K, Ca, Ga, Ge, As, Se, Rb, Sr, In, Sn, Sb, Te, Cs, Ba, Tl, Pb, Bi.
<b>PL-K20:</b>	<b>Transition Elements/Non-Metals Elements Kit:</b> Contains 2 gram equivalents of each of the following twenty-three elements: Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Zr, Nb, Mo, Cd, Hf, Ta, W, Re, Hg, Th, U, C, I, S.
<b>PL-K30:</b>	<b>Rare Earth Elements Kit:</b> Contains 2 gram equivalents of each of the following sixteen elements: Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu.
<b>PL-K40:</b>	<b>Precious Metals Kit:</b> Contains 1 gram equivalent of each of the following seven elements: Ru, Rh, Pd, Ag, Ir, Pt, Au. Os available only upon request. Due to the hazardous nature of Osmium, an Indemnification Certificate must be signed before ordering.
<b>PL-K50:</b>	<b>Inter-element Correction Kit:</b> Contains 2 gram equivalents of each of the following eleven elements: Al, Fe, Ca, Mg, Ti, Mo, Cu, Zn, Cr, Si, Zr.
<b>PL-K60:</b>	<b>Inorganic Priority Pollutant Kit:</b> Contains 2 gram equivalents of each of the following ten elements: Ag, Be, Cd, Cr, Cu, Ni, Pb, Sb, As, Zn.

#### Replacement Vials:

Containing 1 or 2 gram equivalents of the specified element.

PLK10-xx	(specify element), 2 gram equivalents.
PLK20-xx	(specify element), 2 gram equivalents.
PLK30-xx	(specify element), 2 gram equivalents.
PLK40-xx	(specify element), 1 gram equivalent.

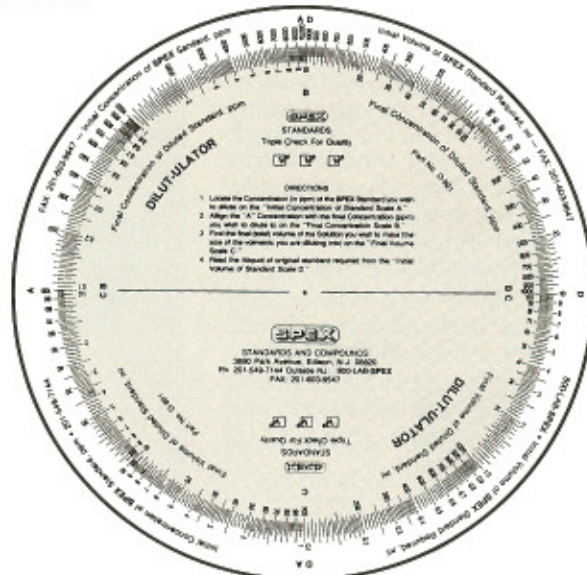
## Dilution Calculator

SPEX wants to make your job easier and your results more reliable. You can take the guesswork out of your standards with certified SPEX standards. Now you can take the guesswork out of your dilutions with the **SPEX DILUTULATOR**. The **DILUTULATOR** is a circular calculator that tells you what aliquot is required when diluting your SPEX standard to the working concentration.

Knowing the initial concentration of SPEX standard, the final desired concentration of standard you need, and the total volume of standard you wish to prepare, the **DILUTULATOR** will tell you what aliquot of SPEX standard to use. **NO MORE GUESSWORK.**

#### Catalog# D-901 SPEX DILUTULATOR

Printed on two color, heavy gauge, wear resistant plastic, 6" diameter.





## CUSTOM MULTI-ELEMENT SOLUTION STANDARDS FOR PLASMA EMISSION SPECTROSCOPY

- **Certified ICP/OES Analysis**
- **Customized For Your Application**
- **Highest Quality Reagents Used in Preparation**
- **Guaranteed For One Full Year**

**NEW** 500ml Quantities

No two plasma labs face exactly the same samples and problems, or have precisely the same requirements. In the real world you have trace element determinations in the presence of one or several major constituents, varying inter-element effects, matrix effects...the list goes on and on. These problems become increasingly important as you strive for greater reproducibility, as you go for lower limits of detection, as you push your technique to the limit.

A SPEX multi-element solution standard can remove some of these variables. We will be happy to discuss your concerns, combination of elements, their concentrations, and preferred matrices. We can then customize the most compatible, shelf-stable mixtures from our comprehensive supply of plasma grade metals, oxides and salts in the matrix of your choice.

High-purity starting materials are especially important when preparing multi-element standards. A particular element in a multi-element standard can be contaminated with that element from impurities in the starting materials of the other elements in the blend. SPEX certified inorganics are ideal for this application due to their low level of impurities.

As always, we will guarantee your custom solution standard for one year from date of shipment and supply your standard with certified concentration and impurity analysis.

All 70 elements listed in the previous single-element section are available as components in a multi-element standard prepared to your specifications. Although guidelines for defining a multi-element solution standard may vary depending on the elements involved, the following maximums can be used as a starting point when considering your multi-element standard requirements.

Element Concentration	Maximum Number of Elements
Up to 100ug/ml Each	20
101-1,000ug/ml Each	15
Over 1,000ug/ml Each	5

The elements in your standards need not be present at the same level. In real samples, you may need to determine trace elements present with a high background level of some major component. An example of a standard for this type of analysis would be:

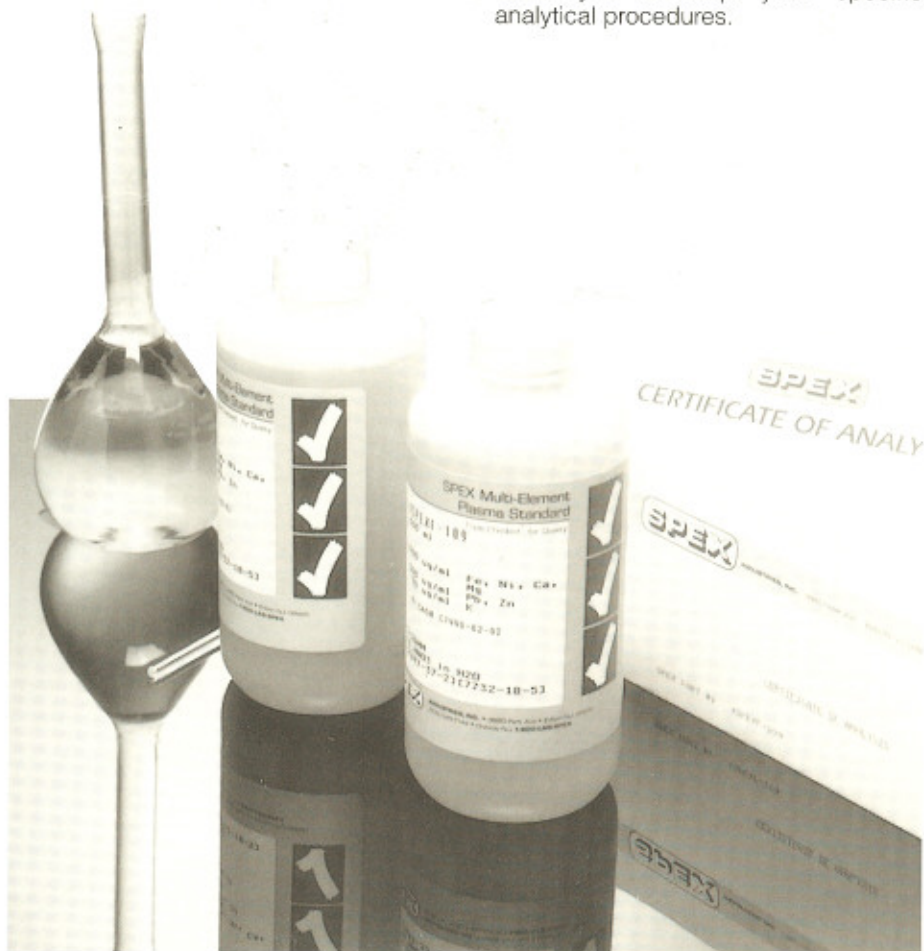
10,000ug/ml	Iron
1,500ug/ml	Manganese
1,000ug/ml	Each Nickel, Copper
750ug/ml	Each Chromium, Cobalt
430ug/ml	Phosphorus
50ug/ml	Tin

Standards are ordered initially by describing the elements required, their levels and your preferred matrix. We will then review the composition requested for interelement compatibility, solubility and matrix requirements. You will be given a unique part number which corresponds to your particular standard and a firm price quotation.

SPEX custom multi-element standards are prepared from single-element concentrates. These concentrates are tested in the same manner that the plasma single-element solution standards are. The **Triple-Checked** Quality Control procedure is performed: (1) DC ARC for trace metal impurities in solid starting material; (2) classical "wet" assay for major element; (3) ICP check for major element. A **final** quantitative ICP check is performed before the custom multi-element standard is shipped. This is your **stamp of assurance** that you are receiving the highest quality product available.

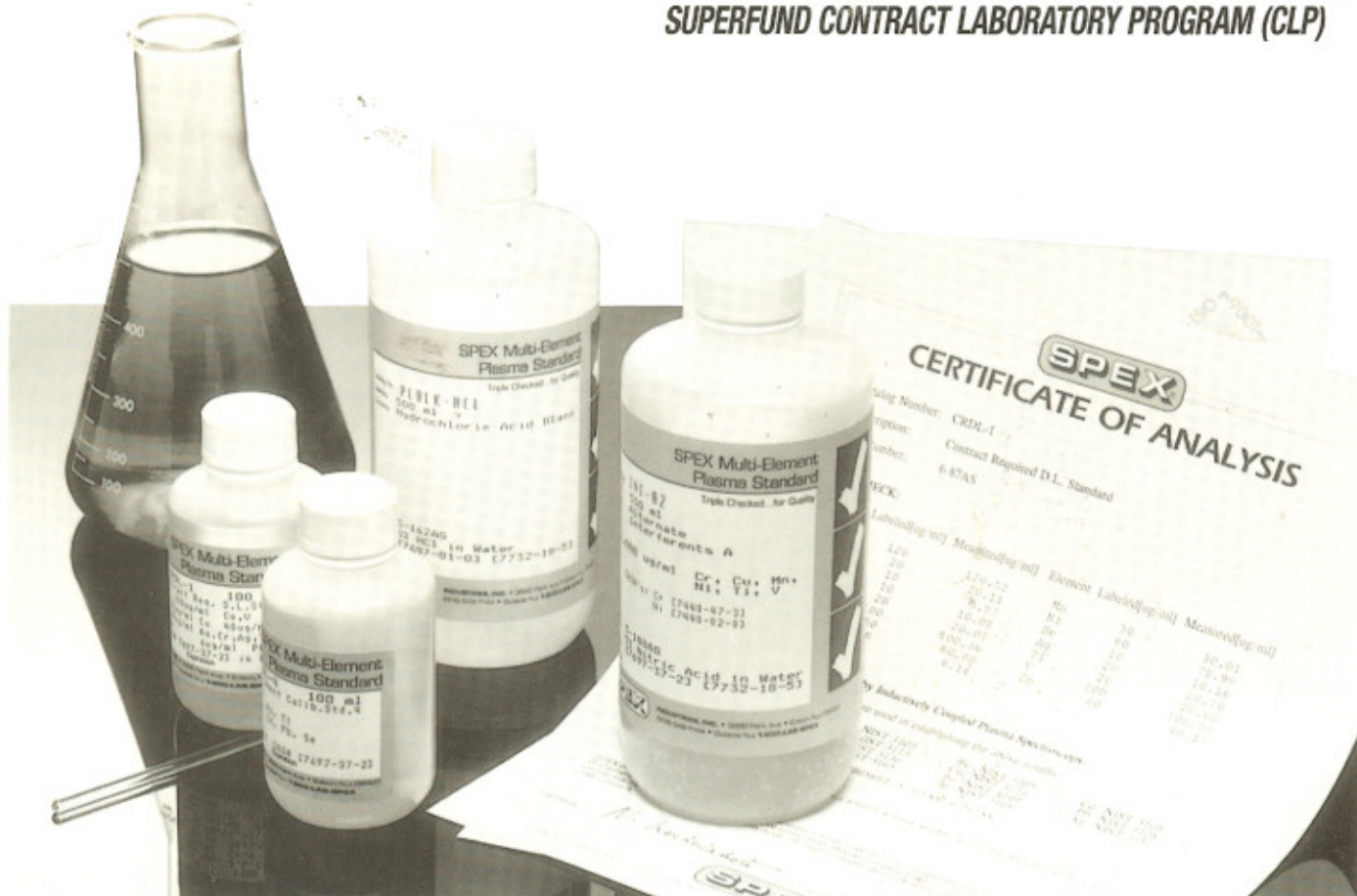
Certificates of Analysis with traceability documentation are provided on all custom single and multi-element standards.

Custom plasma solutions are supplied in 500ml or one liter volumes. SPEX off-the-shelf multi-element standards, described in the next section have been formulated with element combinations and concentrates for the most common applications. Check them against your requirements. One or more of them may closely match your specifications, or may be close enough to fit your needs while you develop your specific analytical procedures.





## STOCK MULTI-ELEMENT SOLUTION STANDARDS FOR THE SUPERFUND CONTRACT LABORATORY PROGRAM (CLP)



SPEX Industries offers a complete series of multi-element standards and blanks designed for use in the U.S. Environmental Protection Agency's Contract Laboratory Program (CLP). These off-the-shelf solutions provide everything you need for:

- Instrument Calibrations
- Calibration Verifications
- Interference Checks
- Calibration Blanks
- Sample Spikes

As with all SPEX Plasma-Grade Standards, every CLP standard is prepared under the unique **SPEX Triple-Checked Quality Assurance Program**. This program guarantees the purity and concentration of your standards for one full year. Only SPEX plasma-grade standards are checked three ways:

- DC ARC Trace Metal Analysis of Starting Materials
- Classical "Wet" Assay of Major Elements
- ICP Check of the Final Solution

The following standards and solutions have been designed by SPEX Industries for use in conjunction with the U.S. Environmental Protection Agency's Contract Laboratory Program (CLP). They are to be used in conjunction with the Statement of Work for Inorganic Analysis; Multi-Media/Multi-Concentration Document Number ILM02.0. Dilutions that determine the final concentrations of the various elements are suggested for each solution. The analyst may, however, choose to modify these dilution factors since the absolute concentration, to some extent, may be determined by the sample to be analyzed and the instrumentation used.

SPEX off-the-shelf multi-element standards for CLP are prepared from single-element concentrates. These concentrates are tested in the exact manner that the plasma single-element solution standards are. The **Triple-Checked Quality Control** procedure is performed: (1) DC ARC for trace metal impurities; (2) classical "wet" assay for major element; (3) ICP check for major element.

**The final ICP check**, performed in our own laboratories, is your **stamp of assurance**. We calibrate our instruments with **traceable reference materials** and

show you the **actual found value** of the solution you receive — not just an ideal, calculated number. The sections that follow contain multi-element standards referenced to their application. The combinations of elements, concentrations, and matrices listed have been designed by SPEX for both convenience of use and stability.

Please refer to the appropriate section of this catalog for additional single and multi-element standards that can also be used in these studies. SPEX also offers a complete line of custom standards for special applications.

The US EPA SOW, ILM02.0 gives specific procedures for the methods of analysis, elements to be analyzed for, and concentration levels. Standards are specified not only by the elements present and their relative concentrations, but also the order and frequency of running standards, blanks and samples. Details of these specifications may be found in the US EPA SOW, ILM02.0 in the following sections:

- Exhibit C, Inorganic Target Analyte List (TAL)
- Exhibit D, Analytical Methods
- Exhibit E, QA/QC Requirements



## Instrument Calibration

This series of solutions may be used separately or mixed together for calibration of the instrument and preparation of the analytical curve. When mixed these solutions will yield a standard containing all the elements in the Target Analyte List. Instruments must be calibrated daily, every 24 hours or each time the instrument is set up. Calibration standards must be prepared fresh for each analysis and discarded after use. A dilution of 100-fold is suggested for ICAL-2, ICAL-3, and ICAL-4, and a dilution of 10-fold for ICAL-1. Antimony and mercury can be diluted as required.

### Instrument Calibration Standard 1

ICAL-1 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Ca	5000ug/ml	317.933nm
Mg	5000ug/ml	279.553nm
K	5000ug/ml	766.490nm
Na	5000ug/ml	589.592nm

### Instrument Calibration Standard 2

ICAL-2 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Ag	100ug/ml	328.068nm
Cr	100ug/ml	205.552nm
Mn	150ug/ml	257.610nm
Ni	400ug/ml	231.604nm
Zn	200ug/ml	213.856nm

### Instrument Calibration Standard 3

ICAL-3 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al	2000ug/ml	396.152nm
Ba	2000ug/ml	233.527nm
Be	50ug/ml	313.042nm
Co	500ug/ml	228.616nm
Cu	250ug/ml	324.754nm
Fe	1000ug/ml	259.940nm
V	500ug/ml	292.402nm

### Instrument Calibration Standard 4

ICAL-4 ..... 100ml  
ICAL-4-500 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
As	100ug/ml	189.042nm
Cd	50ug/ml	214.438nm
Pb	50ug/ml	220.353nm
Se	50ug/ml	196.090nm
Tl	100ug/ml	351.924nm

### Instrument Calibration Standard 5

ICAL-5 ..... 100ml  
ICAL-5-500 ..... 500ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	600ug/ml	217.581nm

### Instrument Calibration Standard 6

ICAL-6 ..... 100ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Hg	100ug/ml	194.232nm

## Initial Calibration Verification

After the instrument is calibrated, the calibration must be verified, at each wavelength to be used for analysis, with an independent standard. SPEX verification standard, ICV-1, contains all the elements on the TAL in one solution. You need only select those wavelengths (elements) for verification that are to be subsequently analyzed. A dilution of 10-fold is recommended prior to use.

### Initial Calibration Verification Standard

ICV-1 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al	200ug/ml	396.152nm
Sb	600ug/ml	217.581nm
As	100ug/ml	189.042nm
Ba	2000ug/ml	233.527nm
Be	50ug/ml	313.042nm
Cd	50ug/ml	214.438nm
Ca	5000ug/ml	317.933nm
Cr	100ug/ml	205.552nm
Co	500ug/ml	228.616nm
Cu	250ug/ml	324.754nm
Fe	1000ug/ml	259.940nm
Pb	50ug/ml	220.353nm
Mg	5000ug/ml	279.553nm
Mn	150ug/ml	257.610nm
Ni	400ug/ml	231.604nm
K	5000ug/ml	766.490nm
Se	50ug/ml	196.090nm
Ag	100ug/ml	328.068nm
Na	5000ug/ml	589.592nm
Tl	100ug/ml	351.924nm
V	500ug/ml	292.402nm
Zn	200ug/ml	213.856nm

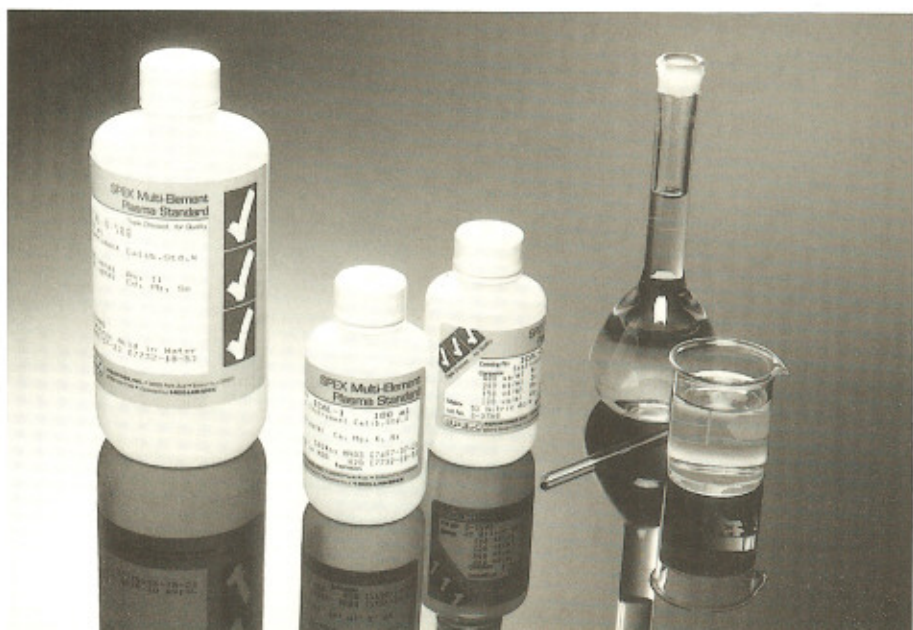
## Initial Calibration Verification II

SPEX Second Source Initial Calibration Verification Standard, ICV-2, is used to meet CLP QA second source requirements. ICV-2 is sold only as a set of three standards (ICV-2A, ICV-2B, and ICV-2C) containing all the TAL elements. You need only select those wavelengths (elements) for verification that are to be subsequently analyzed. A dilution of 100-fold is recommended for all three standards prior to use.

### Initial Calibration Verification Standard II

ICV-2A ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al	1000ug/ml	396.152nm
Ba	1000ug/ml	233.527nm
Be	100ug/ml	313.042nm
Ca	2000ug/ml	317.933nm
Cr	200ug/ml	205.552nm
Co	500ug/ml	228.616nm
Cu	200ug/ml	324.754nm
Fe	1000ug/ml	259.940nm
Mg	2000ug/ml	279.553nm
Mn	100ug/ml	257.610nm
Ni	500ug/ml	231.604nm
K	2000ug/ml	766.490nm
Ag	100ug/ml	328.068nm
Na	2000ug/ml	589.592nm
V	500ug/ml	292.402nm
Zn	100ug/ml	213.856nm





## Initial Calibration Verification II (cont'd.)

The same Instrument Calibration Standards, ICAL-1 through ICAL-6, can be used with ICV-2. The following dilutions are suggested: A dilution of 250-fold for ICAL-1; a dilution of 20-fold for ICAL-4; a dilution of 100-fold for ICAL-2 and ICAL-3. Antimony and mercury can be diluted as required.

ICV-2B.....500ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	1000 ug/ml	217.581nm

ICV-2C.....500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
As	500ug/ml	189.042nm
Cd	100ug/ml	214.438nm
Pb	500ug/ml	220.353nm
Se	500ug/ml	196.090nm
Tl	500ug/ml	351.924nm

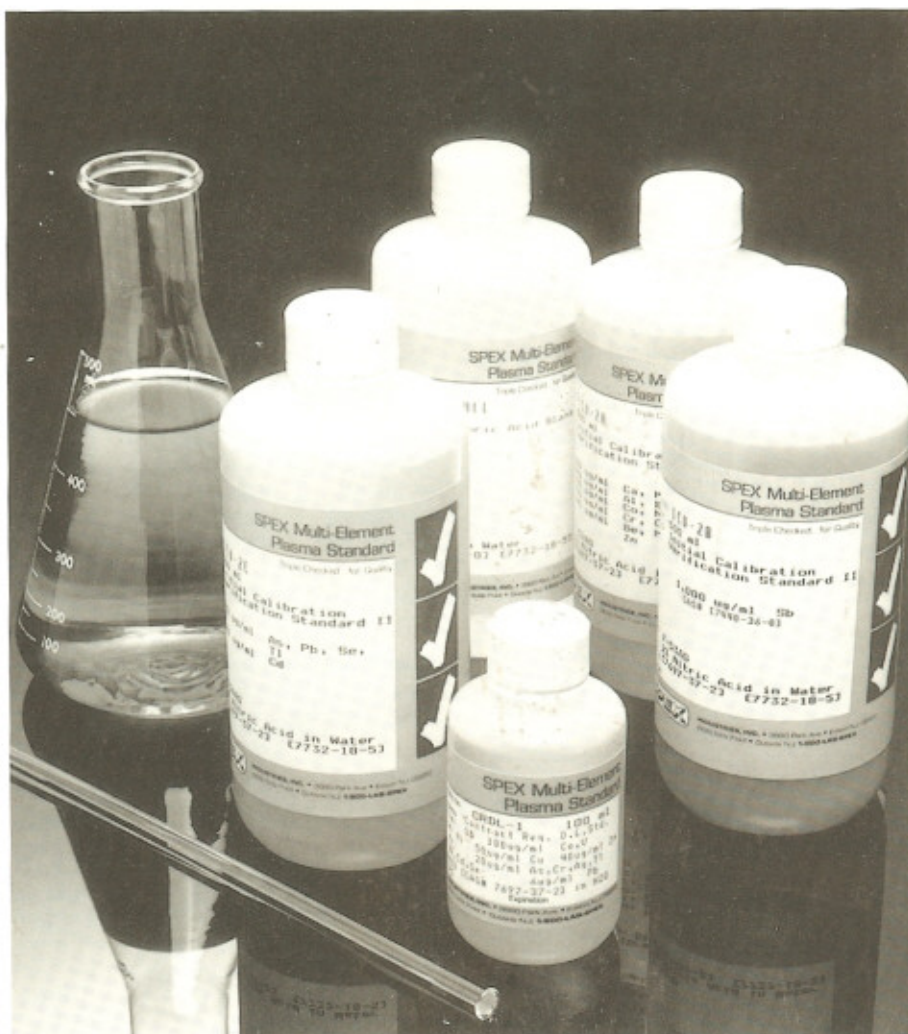
ICV-2  
Includes one of each:  
ICV-2A  
ICV-2B  
ICV-2C

Above standards are not sold separately.

## Contract Required Detection Limits, CRDL

A standard must be run at two times the Contract Required Detection Limits, CRDL, or at two times the Instrument Detection Limits, IDL, whichever is greater. This standardization must be performed at the start and the end of each sample analysis or at least twice in an 8 hour shift. All elements to be analyzed must be run except Al, Ba, Ca, Fe, Mg, Na, and K.

The CRDL-1 standard contains all the required elements on the TAL, in their appropriate concentration ratios. CRDL-1 should be diluted by a factor of 1000 prior to use in the "two times CRDL" run for ICP analysis. For analysis by atomic absorption, CRDL-1 should be diluted by a factor of 2000 prior to use in the "one times CRDL" run. The elements arsenic and lead should be run at two times the Instrument Detection Limit, IDL. The concentrations of these elements may be adjusted with the corresponding SPEX single-element standards for arsenic, PLAS2-2X and lead, PLPB2-2X. This standard may also be used as an IDL standard or alternatively the Instrument Calibration Standards can be mixed and diluted accordingly.



## Contract Required Detection Limits Standard

CRDL-1.....100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	120ug/ml	217.581
As	20ug/ml	189.042
Be	10ug/ml	313.042
Cd	10ug/ml	214.438
Cr	20ug/ml	205.552
Co	100ug/ml	228.616
Cu	50ug/ml	324.754
Pb	6ug/ml	220.353
Mn	30ug/ml	257.610
Ni	80ug/ml	231.604
Se	10ug/ml	196.090
Ag	20ug/ml	328.068
Tl	20ug/ml	351.924
V	100ug/ml	292.402
Zn	40ug/ml	213.856

## Calibration Blanks and Matrix Blanks

All SPEX blank solutions are prepared with the same high-purity acids and ASTM Type I water as that used in our

plasma-grade standards. SPEX matrix blanks can be used to dilute standards or can be run directly as blanks to establish base lines. The calibration blank is prepared by mixing one part nitric acid blank with three parts hydrochloric acid blank.

### Nitric Acid Blank

PLBLK-HNO<sub>3</sub>.....500ml  
Matrix 5% HNO<sub>3</sub> in ASTM Type I Water

### Hydrochloric Acid Blank

PLBLK-HCL.....500ml  
Matrix 5% HCl in ASTM Type I Water

### Water Blank

PLBLK-H<sub>2</sub>O.....500ml  
PLBLK-H<sub>2</sub>O-1L.....1L  
PLBLK-H<sub>2</sub>O-2L.....2L  
PLBLK-H<sub>2</sub>O-4L.....3.78L  
Matrix ASTM Type I Water, 18 megohm



## Interference Checks

Inter-element and background correction factors must be verified at the beginning and the end of each analysis run or at least twice in an 8 hour shift. Two solutions are required for the interference check: the interferences alone, solution A, and the combination of interferences and analytes, solution AB. Solution A is prepared by diluting INT-A1 by a factor of 10. Solution AB is prepared by diluting (together) solution A by a factor of 10 and solution B by a factor of 100; for example diluting 10ml of solution A plus 1.0ml of solution B to 100ml with calibration blank.

### Interferents A

INT-A1 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al	5000ug/ml	396.152nm
Ca	5000ug/ml	317.933nm
Fe	2000ug/ml	259.940nm
Mg	5000ug/ml	279.553nm

### Analytes B

INT-B1 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Ag	100ug/ml	328.068nm
Ba	50ug/ml	233.527nm
Be	50ug/ml	313.042nm
Cd	100ug/ml	214.438nm
Co	50ug/ml	228.616nm
Cr	50ug/ml	205.552nm
Cu	50ug/ml	324.754nm
Mn	50ug/ml	257.610nm
Ni	100ug/ml	231.604nm
Pb	100ug/ml	220.353nm
V	50ug/ml	292.402nm
Zn	100ug/ml	213.856nm

In addition to the four interferences contained in INT-A1, the US EPA ILM02.0 lists six more elements that can interfere with analysis of the elements on the TAL. SPEX also provides a set of alternate interference samples that may be used in conjunction with the standards above. Together they enable the analyst to check and correct for all the interferences listed in ILM02.0.

Again two solutions are required. The first solution, A\*, is prepared by combining and diluting INT-A1 and INT-A2 by a factor of ten: 10ml of INT-A1 plus 10ml of INT-A2 diluted to 100ml with calibration blank. The second solution, AB\*, requires both interference standards diluted by a factor of 10 and both the analytes diluted by a factor of 100: 10ml of INT-A1, plus 10ml of INT-A2, plus 1.0ml of INT-B1, plus 1.0ml of INT-B2, diluted to 100ml with calibration blank.

### Alternate Interferents A

INT-A2 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Cr	1000ug/ml	205.552nm
Cu	1000ug/ml	324.754nm
Mn	1000ug/ml	257.610nm
Ni	1000ug/ml	231.604nm
Ti	1000ug/ml	334.941nm
V	1000ug/ml	292.402nm

### Alternate Analytes B

INT-B2 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al	100ug/ml	396.152nm
Sb	100ug/ml	217.581nm
As	100ug/ml	189.042nm
B	100ug/ml	249.773nm
Ca	10ug/ml	317.933nm
Fe	10ug/ml	238.204nm
Mg	10ug/ml	279.553nm
Mo	100ug/ml	202.030nm
Se	100ug/ml	196.090nm
Si	10ug/ml	251.611nm
Na	100ug/ml	589.592nm
Ti	100ug/ml	351.924nm

## Spike Sample Analysis

In the spike sample analysis a spike containing the required elements, in their respective required amounts, is added to the sample prior to addition of any reagents, digestion, distillation, etc. Information is then provided on the effects of the sample matrix and the entire methodology. The SPEX spike standard, SPIKE-1, provides all the analytes required for the ICP and the AA spike. Add 1.0ml of SPIKE-1 to aqueous samples and 2.0ml of SPIKE-1 to solid samples prior to digestion.

### Spike Sample Standard

SPIKE-1 ..... 100ml  
SPIKE-1-500 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al	200ug/ml	396.152nm
Sb	50ug/ml	217.581nm
As	200ug/ml	189.042nm
Ba	200ug/ml	233.527nm
Be	5ug/ml	313.042nm
Cd	5ug/ml	214.438nm
Cr	20ug/ml	205.552nm
Co	50ug/ml	228.616nm
Cu	25ug/ml	324.754nm
Fe	100ug/ml	259.940nm
Pb	50ug/ml	220.353nm
Mn	50ug/ml	257.610nm
Ni	50ug/ml	231.604nm
Se	200ug/ml	196.090nm
Ag	5ug/ml	328.068nm
Ti	200ug/ml	351.924nm
V	50ug/ml	292.402nm
Zn	50ug/ml	213.856nm





## Spike Sample Analysis (cont'd.)

In addition to SPIKE-1, the US EPA SOW ILM02.0 lists two more standards for Spike Sample Analysis. SPIKE-2, spike for water, consists of a set of three standards (SPIKE-2A, SPIKE-2B, SPIKE-2C). SPIKE-3, spike for soil, is available in one solution. Add appropriate amounts of these to the samples prior to addition of any reagents, digestion, distillation, etc.

### Spike Sample Standard II (Water)

SPIKE-2A ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al	2000ug/ml	396.152nm
Ba	2000ug/ml	233.527nm
Be	50ug/ml	313.042nm
Cr	200ug/ml	205.552nm
Co	500ug/ml	228.616nm
Cu	250ug/ml	324.754nm
Fe	1000ug/ml	259.940nm
Mn	500ug/ml	257.610nm
Ni	500ug/ml	231.604nm
Ag	50ug/ml	328.068nm
V	500ug/ml	292.402nm
Zn	500ug/ml	213.856nm

SPIKE-2B ..... 100ml  
Matrix 1% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	500ug/ml	217.581nm

SPIKE-2C ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
As	2000ug/ml	189.042nm
Cd	50ug/ml	214.438nm
Pb	500ug/ml	220.353nm
Se	2000ug/ml	196.090nm
Tl	2000ug/ml	351.924nm

### SPIKE-2

Includes one of each:

- SPIKE-2A
- SPIKE-2B
- SPIKE-2C

Above standards are not sold separately.

### Spike Sample Standard III (Soil)

SPIKE-3 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	100ug/ml	217.581nm
As	400ug/ml	189.042nm
Ba	400ug/ml	233.527nm
Be	10ug/ml	313.042nm
Cd	10ug/ml	214.438nm
Cr	40ug/ml	205.552nm
Co	100ug/ml	228.616nm
Cu	50ug/ml	324.754nm
Pb	100ug/ml	220.353nm
Mn	100ug/ml	257.610nm
Ni	100ug/ml	231.604nm
Se	400ug/ml	196.090nm
Ag	10ug/ml	328.068nm
Tl	400ug/ml	351.924nm
V	100ug/ml	292.402nm
Zn	100ug/ml	213.856nm



## Furnace AA Calibration and Spiking

Furnace AA requires calibration standards and spikes containing only six elements: Sb, As, Cd, Pb, Se, and Tl. The following Graphite AA standards are available for the QA/QC furnace AA protocols.

### GFAA Calibration Standard

GFAA-ICAL ..... 50ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	50ug/ml	217.581nm
As	20ug/ml	189.042nm
Cd	15ug/ml	214.438nm
Pb	10ug/ml	220.353nm
Se	15ug/ml	196.090nm
Tl	20ug/ml	351.924nm

### GFAA Initial Calibration Verification Standard (Second Source)

GFAA-ICV ..... 50ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	25ug/ml	217.581nm
As	10ug/ml	189.042nm
Cd	10ug/ml	214.438nm
Pb	5ug/ml	220.353nm
Se	10ug/ml	196.090nm
Tl	10ug/ml	351.924nm

### GFAA Spike Standard

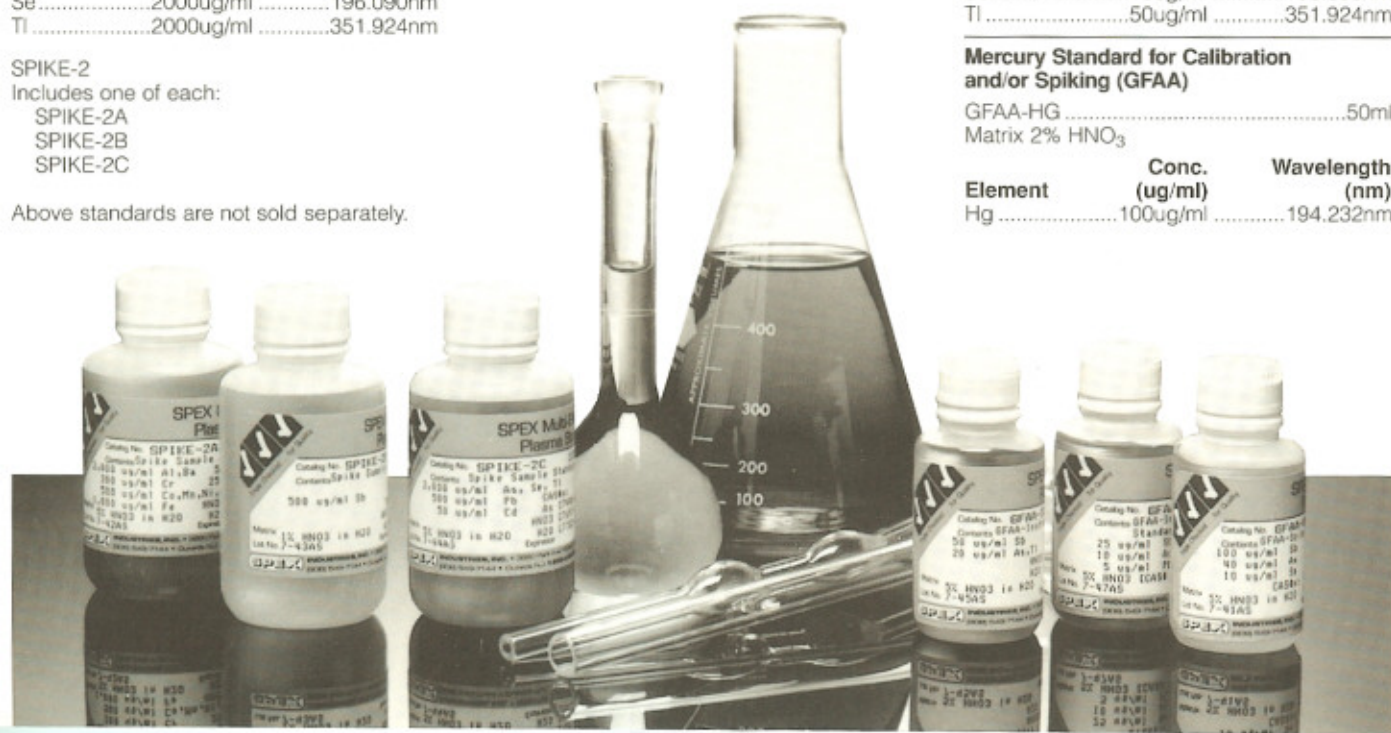
GFAA-SPIKE ..... 50ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	100ug/ml	217.581nm
As	40ug/ml	189.042nm
Cd	5ug/ml	214.438nm
Pb	20ug/ml	220.353nm
Se	10ug/ml	196.090nm
Tl	50ug/ml	351.924nm

### Mercury Standard for Calibration and/or Spiking (GFAA)

GFAA-HG ..... 50ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Hg	100ug/ml	194.232nm





## Contract Laboratory Program (CLP) Set

Set of 13 standards for use in the Contract Laboratory Program

### CLP-SET

Includes one of each:

ICAL-1	ICAL-6	INT-B1
ICAL-2	ICV-1	INT-A2
ICAL-3	CRDL-1	INT-B2
ICAL-4	INT-A1	SPIKE-1
ICAL-5		

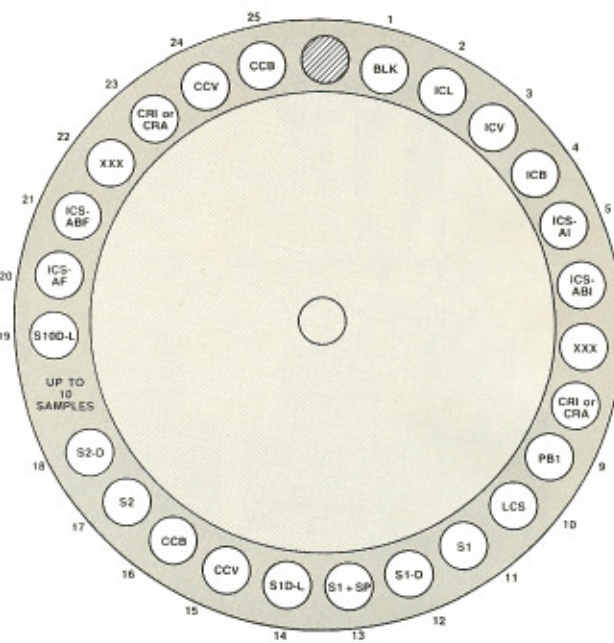


## Standards For The Contract Laboratory Program

Following is a list of samples, standards, and blanks in a possible running sequence as suggested by the Contract Laboratory Program protocols. Also listed are the SPEX standards and solutions to be used in preparing the blanks, standards, and spikes.

1.	BLK	Blank: SPEX PLBLK's
2.	ICL	Initial calibration solution: mixture of SPEX ICAL's
3.	ICV	Initial calibration verification: SPEX ICV-1
4.	ICB	Initial calibration blank (not digested): SPEX PLBLK's
5.	ICS-A1	Initial interferences, A: SPEX INT-A1 and INT-A2
6.	ICS-AB1	Initial interferences and analytes AB: SPEX INT-A1, INT-A2, INT-B1, INT-B2
7.	XXX	"Throw-away" sample; used to clear torch of high levels of interferences: SPEX PLBLK's
8.	CRI (ICP)	or CRA (AA)-2 x Contract required detection limits: SPEX CRDL-1
9.	PB1	Preparation blank: Digested water or soil blank
10.	LCS	Laboratory control sample (digested): SPEX ICV-1
11.	S1	Sample #1
12.	S1-D	Sample #1 duplicate
13.	S1+SP	Sample #1 with spike: SPEX SPIKE-1
14.	S1D-L	Sample #1 diluted five fold
15.	CCV	Continuing calibration verification (50% ICV): SPEX ICV-1
16.	CCB	Continuing calibration blank: SPEX PLBLK's (If results of CCV and CCB are within limits, proceed to next sample, if not stop run)
17.	S2	Sample #2
18.	S2-D	Sample #2 duplicate Up to 10 samples may be run as long as CCV and CCB tests are within accepted limits
19.	S10D-L	Sample #10 diluted five fold
20.	ICS-AF	Final interferences, A: SPEX INT-A1 and INT-A2
21.	ICS-ABF	Final interferences and analytes, AB: SPEX INT-A1, INT-A2, INT-B1, INT-B2
22.	XXX	"Throw-away" sample; used to clean torch of high levels of interferences: SPEX PLBLK's
23.	CRI (ICP)	or CRA (AA)-2 x Contract required detection limits: SPEX CRDL-1
24.	CCV	Continuing calibration verification (50% ICV): SPEX ICV-1
25.	CCB	Continuing calibration blank: SPEX PLBLK's

Typical set-up for standards, samples, and blanks to be run for CLP analysis





## STOCK MULTI-ELEMENT SOLUTION STANDARDS FOR ENVIRONMENTAL ANALYSIS

- Matrix Blanks
- Calibration Test Solutions for ICP Spectrometers
- Calibration Test Solutions for ICP-MS
- ICP Interference Check Standards
- Toxicity Characteristics Leachate Procedure (TCLP)
- Quality Control Standards
- Primary and Secondary Drinking Water Metals
- Extracted Metal Pollutants from Solid Wastes
- Metal Pollutants in Groundwater
- Trace Metals in Fish

SPEX Industries offers off-the-shelf, mixed multi-element standards formulated with element combinations and concentrations for the most common applications. Included are a number of blends containing those metals of concern in the pollution of groundwater, drinking water and solid wastes.

Each standard is backed up by our unique **Triple-Checked Quality Assurance Program**: assuring the shelf life of your standards for one full year. And every SPEX plasma grade standard is supplied with the **SPEX Certificate of Analysis**, outlining the analytical methods and standard reference materials used. No other supplier provides you with this kind of back-up.

The purity of the starting material is especially important when preparing multi-element standards. For example, a 20-element standard that includes iron is likely to be contaminated with iron from the remaining 19 elements, resulting in significantly higher iron concentrations than the calculated

value. All SPEX plasma standards are made from high-purity acids, ASTM Type I water (18 megohm), and SPEX certified metals and inorganic compounds. Since we know exactly how much of each element is contributed by each component, a build-up of impurities resulting from undetected contamination in individual starting materials will not occur.

SPEX off-the-shelf multi-element standards are prepared from single-element concentrates. These concentrates are tested in the exact manner that the plasma single-element solution standards are. The **Triple-Checked Quality Control** procedure is performed: (1) DC ARC for trace metal impurities; (2) classical "wet" assay for major element; (3) ICP check for major element.

The final ICP check, performed in our own laboratories, is your stamp of assurance. We calibrate our instruments with traceable reference materials and show you the actual found value of the solution you receive — not just an ideal, calculated number.

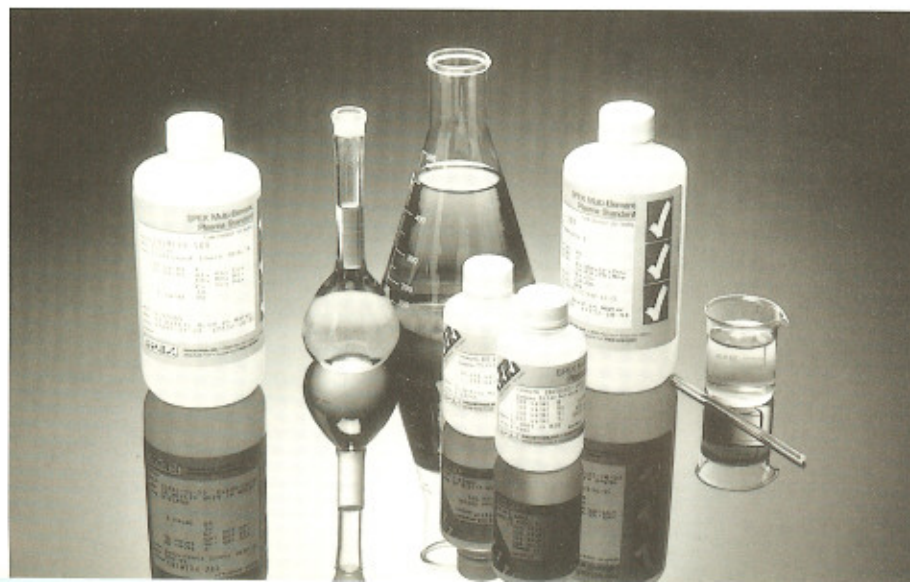
The sections that follow contain multi-element standards referenced to their application. The combinations of elements, concentrations, and matrices listed have been designed by SPEX for both convenience of use and stability.

Standards may be diluted in the same matrix as that specified; however, caution must be exercised in the choice of the source for your diluents. Diluting the matrix may cause some standards to precipitate. Also, an impure or unknown diluent turns your standard into an unknown. We recommend using SPEX Matrix Blanks when diluting your standards unless you are certain of the purities of diluents obtained from another source.

### Calibration Blanks and Matrix Blanks

SPEX blank solutions are prepared with high-purity acids and ASTM Type I water as are our plasma-grade standards. SPEX matrix blanks can be used to dilute your multi-element standards or can be run directly as a blank to establish your base line. An aqua regia blank can be prepared by mixing one part nitric acid blank with three parts hydrochloric acid blank. Do not use any acid or water as a diluent if you are not certain of its purity. For use in US EPA SW-846, Method 6010 and also Method 200.7.

Nitric Acid Blank	
PLBLK-HNO3 Matrix 5% HNO <sub>3</sub> in ASTM Type I Water	500ml
Hydrochloric Acid Blank	
PLBLK-HCL Matrix 5% HCl in ASTM Type I Water	500ml
Water Blank	
PLBLK-H2O	500ml
PLBLK-H2O-1L	1L
PLBLK-H2O-2L	2L
PLBLK-H2O-4L	3.78L
Matrix ASTM Type I Water, 18 megohm	







### Mixed Multi-Element Calibration Standards

The following series of five calibration standards are provided for routine instrument calibration. The concentrations and matrices have been selected for both convenience of use and stability. You can also prepare these multi-element standards yourself from individual SPEX plasma-grade, single-element solution standards. For use in US EPA SW-846, Method 6010 and also Method 200.7.

#### Mixed Calibration Standard 1

MIXSTD1-100	100ml
MIXSTD1-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Be	50	313.042
Cd	150	214.438
Pb	500	220.353
Mn	100	257.610
Se	200	196.090
Zn	150	213.856

#### Mixed Calibration Standard 2

MIXSTD2-100	100ml
MIXSTD2-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Ba	100	233.527
Co	100	228.616
Cu	100	324.754
Fe	10,000	259.940
V	100	292.402

#### Mixed Calibration Standard 3

MIXSTD3-100	100ml
MIXSTD3-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
As	500	189.042
Mo	100	202.030
Si	100	251.611

#### Mixed Calibration Standard 4

MIXSTD4-100	100ml
MIXSTD4-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	200	396.152
Ca	1000	317.933
Cr	20	205.552
Ni	20	231.604
K	400	766.490
Na	200	589.592

#### Mixed Calibration Standard 5

MIXSTD5-100	100ml
MIXSTD5-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	200	217.581
B	100	249.773
Mg	1000	279.553
Ag	50	328.068
Tl	200	351.924

#### Set of 5 Mixed Calibration Standards

MIXSTD-SET  
Includes one of each:

- MIXSTD1-100
- MIXSTD2-100
- MIXSTD3-100
- MIXSTD4-100
- MIXSTD5-100

**NEW**

### Mixed Calibration Standard Solutions

The Calibration Standards are used to calibrate the instrument response with respect to analyte concentrations. For use in US EPA Method 200.7 (Revision 3.3 April 1991) and SW-846, Method 6010 (Third Edition).

#### CAL Solution 1

MIXSTD1A-100	100ml
MIXSTD1A-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	50	217.581
As	100	189.042
Ba	10	223.527
B	20	249.773
Cd	20	214.438
Ca	100	317.933
Cu	20	324.754
Mn	20	257.610
Se	50	196.090
Ag	5	328.068

#### CAL Solution 2

MIXSTD2A-100	100ml
MIXSTD2A-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Li	50	670.784
Mo	100	202.030
K	200	766.490
Na	100	589.592
Sr	10	407.771

#### CAL Solution 3

MIXSTD3A-100	100ml
MIXSTD3A-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Co	20	228.616
P	100	213.618
V	20	292.402

#### CAL Solution 4

MIXSTD4A-100	100ml
MIXSTD4A-500	500ml
Matrix 5% HNO <sub>3</sub> tr HF	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	100	396.152
Cr	50	205.552
**Hg	20	194.232
SiO <sub>2</sub>	100	251.611
Sn	40	189.980
Zn	50	213.856

\*\* Mercury is supplied as a separate solution due to incompatibility with other elements.

#### CAL Solution 5

MIXSTD5A-100	100ml
MIXSTD5A-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Be	10	313.042
Fe	100	259.940
Pb	100	220.353
Mg	100	279.553
Ni	20	231.604
Tl	50	351.924

#### Set of 5 Calibration Standards

MIXSTD-SETA  
Includes one of each:

- MIXSTD1A-100
- MIXSTD2A-100
- MIXSTD3A-100
- MIXSTD4A-100
- MIXSTD5A-100



NEW

## Plasma Solution

The Plasma Solution is used for determining the optimum viewing height of the plasma above the work coil prior to plasma optimization. For use in US EPA Method 200.7 (Revision 3.3 April 1991) and SW-846, Method 6010 (Third Edition).

### Plasma Solution 1

PLASMA-1-100	100ml
PLASMA-1-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
As	10	189.042
Pb	10	220.353
Se	10	196.090
Tl	10	351.924

NEW

## Tuning Solution II

The Tuning Solution is used for adjusting the aerosol argon gas flow prior to calibration and analysis.

### Tuning Solution 2

TUNING-2	100ml
TUNING-2-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Cu	10	324.754
Pb	10	220.353

NEW

## Laboratory Performance Check (LPC) Standard

The Laboratory Performance Check (LPC) Standard is a solution of method analytes used to evaluate the performance of the instrument. The LPC Standard is used immediately following calibration, after every tenth sample, and at the end of the sample run. The analyzed value of each analyte in the LPC solution should be within 95% to 105% of its expected value. If the analyte value is outside the interval, reanalyze the LPC. If the analyte is again outside the +/- 5% limit, the instrument should be recalibrated and all samples following the last acceptable LPC solution should be reanalyzed. For use in US EPA Method 200.7 (Revision 3.3 April 1991) and SW-846, Method 6010 (Third Edition).

### LPC Standard 1

LPC-1-100	100ml
LPC-1-500	500ml
Matrix 5% HNO <sub>3</sub> tr HF	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	20	396.152
Sb	20	217.581
As	20	189.042
Ba	20	223.527
Be	20	313.042

B	20	249.773
Cd	20	214.438
Ca	20	317.933
Cr	20	205.552
Co	20	228.616
Cu	20	324.754
Fe	20	259.940
Pb	20	220.353
Li	20	670.784
Mg	20	279.553
Mn	20	257.610
**Hg	20	194.232
Mo	20	202.030
Ni	20	231.604
P	100	213.618
K	100	766.490
Se	20	196.090
SiO <sub>2</sub>	100	251.611
Ag	5	328.068
Na	20	589.592
Sr	20	421.552
Tl	20	351.924
Sn	20	189.980
V	20	292.402
Zn	20	213.856

\*\* Mercury is supplied as a separate solution due to incompatibility with other elements.

NEW

## Spectral Interference Check (SIC) Standards

The Spectral Interference Check (SIC) Standards are used to set or confirm that the correct background correction intervals have been set for sequential ICP spectrometers and that the proper inter-element correction factors have been set for simultaneous ICP spectrometer systems. For use in US EPA Method 200.7 (Revision 3.3 April 1991) and SW-846, Method 6010 (Third Edition).

### SIC Solution Standard 1

SIC-1-100	100ml
SIC-1-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)
Mo	50

SIC Solution Standard 1 is used for evaluating the Mo interelement spectral correction factors on the following analytes:

Analyte	Wavelength (nm)
Al	308.215
Sb	206.833
Se	196.099
Sn	189.980
V	292.402

### SIC Solution Standard 2

SIC-2-100	100ml
SIC-2-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)
Cr	20
Co	10
Cu	40
Mn	20
V	20

SIC Solution Standard 2 is used for evaluating interelement spectral correction factor for the following analytes:

Analyte	Interferent	Wavelength (nm)
Sb	Cr	206.833
Pb	Co	220.353
Zn	Cu	213.856
Mo	Mn	203.844
As	V	193.696
Be	V	313.043

### SIC Solution Standard 3

SIC-3-100	100ml
SIC-3-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)
Al	30
Fe	150
Ni	20

SIC Solution Standard 3 is used for evaluating interelement spectral correction factor for the following analytes:

Analyte	Interferent	Wavelength (nm)
As	Al	193.696
Cr	Fe	205.552
Mn	Fe	257.610
Ag	Fe	328.068
V	Fe	292.402
Sb	Ni	206.833
Zn	Ni	213.856

### Set of 3 Spectral Interference Check Standards

SIC-SET  
Includes one of each:  
SIC-1-100  
SIC-2-100  
SIC-3-100

NEW

## Laboratory Fortifying Stock (LFS) Solution

The Laboratory Fortifying Stock (LFS) Solution is used for spiking the laboratory fortified blank and the laboratory fortified sample matrix. 2ml of the Laboratory Fortifying Stock Solution must be added to a 100 ml aliquot of the laboratory fortified blank. The laboratory fortified blank must be carried through the entire sample preparation procedure and analysis scheme. For use in US EPA Method 200.7 (Revision 3.3 April 1991) and SW-846, Method 6010 (Third Edition).

Ca, K, Mg, and Na are not included in this solution because their concentrations vary from one environmental sample to the other.

### LFS Solution 1

LFS-1-100	100ml
LFS-1-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)
Al	25
Sb	25
As	25



## Laboratory Fortifying Stock Solution (cont'd)

Element	Conc. (ug/ml)
Ba	25
Be	5
B	25
Cd	10
Cr	25
Co	10
Cu	25
Fe	25
Pb	25
Li	25
Mn	25
**Hg	5
Mo	10
Ni	25
P	50
Se	25
SiO <sub>2</sub>	25
Ag	2.5
Sr	25
Ti	25
Sn	10
V	10
Zn	25

\*\* Mercury is supplied as a separate solution due to incompatibility with other elements.



## Instrument Check Standards

Instrument Check Standards are used to calibrate and verify wavelength accuracy and stability in sequential and simultaneous ICP units. Each CAL-MIX is designed to give the user wavelength ranges from 160nm to 790nm. Every ICP manufacturer has a specific group of elements at varying concentrations which is used as a guideline to determine instrument accuracy and reliability. Each element is run at a specific wavelength and, depending on the result, an instrument is calibrated and fine-tuned. Some manufacturers have special calibration programs incorporated into their software package; others give you this information in their manuals. These standards are also useful as training tools for technicians or in methods development. Check your ICP manual or service guide for further information.

### Instrument Check Standard 1

CALMIX1-100	100ml
CALMIX1-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	10ug/ml	396.152nm
Ba	1ug/ml	233.527nm
Be	1ug/ml	313.042nm
B	10ug/ml	249.773nm
Ca	1ug/ml	317.933nm
Ni	10ug/ml	231.604nm
P	100ug/ml	213.618nm
Sc	1ug/ml	361.384nm
Zn	10ug/ml	213.856nm

### Instrument Check Standard 2

CALMIX2-100	100ml
CALMIX2-500	500ml
Matrix 2% HCl	

Element	Conc. (ug/ml)	Wavelength (nm)
Ba	50ug/ml	233.527nm
Be	20ug/ml	313.042nm
La	20ug/ml	379.478nm
Mn	20ug/ml	257.610nm
Ni	20ug/ml	231.604nm
Sc	20ug/ml	361.384nm
Zn	20ug/ml	213.856nm

### Instrument Check Standard 3

CALMIX3-100	100ml
CALMIX3-500	500ml
Matrix 2% HCl	

Element	Conc. (ug/ml)	Wavelength (nm)
As	20ug/ml	189.042nm
La	20ug/ml	379.083nm
Li	20ug/ml	670.784nm
Mn	20ug/ml	257.610nm
Mo	20ug/ml	202.030nm
Ni	20ug/ml	231.604nm
P	100ug/ml	213.618nm
K	100ug/ml	766.490nm
Sc	20ug/ml	361.384nm
Na	20ug/ml	589.592nm
S	100ug/ml	180.731nm

### Instrument Check Standard 4

CALMIX4-100	100ml
CALMIX4-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	10ug/ml	396.152nm
As	10ug/ml	189.042nm
Ba	1ug/ml	233.527nm
Cu	10ug/ml	324.754nm
Pb	10ug/ml	220.353nm
Mn	10ug/ml	257.610nm
Ni	10ug/ml	231.604nm
P	10ug/ml	213.618nm
K	50ug/ml	766.490nm
Sc	10ug/ml	361.384nm
Na	10ug/ml	589.592nm
Zn	10ug/ml	213.856nm

### Instrument Check Standard 7

CALMIX7-100	100ml
CALMIX7-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	100ug/ml	396.152nm
As	100ug/ml	189.042nm
Cd	100ug/ml	214.438nm
Cr	100ug/ml	205.552nm
Co	100ug/ml	228.616nm
Cu	100ug/ml	324.754nm
Fe	100ug/ml	259.940nm
Pb	100ug/ml	220.353nm
Mg	100ug/ml	279.553nm
Mn	100ug/ml	257.610nm
Ni	100ug/ml	231.604nm
K	100ug/ml	766.490nm
Na	100ug/ml	589.592nm
Zn	100ug/ml	213.856nm
Y	600ug/ml	320.332nm

### Instrument Check Standard 8

CALMIX8-100	100ml
CALMIX8-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	50ug/ml	396.152nm
As	50ug/ml	189.042nm
Cr	50ug/ml	205.552nm
Co	50ug/ml	228.616nm
Cu	50ug/ml	324.754nm
Pb	50ug/ml	220.353nm
P	50ug/ml	213.618nm
K	50ug/ml	766.490nm
Na	50ug/ml	589.592nm

### Instrument Check Standard 10

CALMIX10-100	100ml
CALMIX10-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	50ug/ml	396.152nm
Ba	50ug/ml	233.527nm
Cd	50ug/ml	214.438nm
Cu	50ug/ml	324.754nm
Mn	50ug/ml	257.610nm
K	500ug/ml	766.490nm
Zn	50ug/ml	213.856nm

## ICP-MS Calibration Standards

The newly emerging technique of ICP-MS requires a multi-element calibration standard to be constructed differently from an ICP calibration standard. Here elements are chosen so that their atomic weights are spread across the mass spectrum. This multi-element standard is designed to assist the operator in verification of the mass range.

ICPMS-100	100ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)
Be	10ug/ml
Bi	10ug/ml
Ce	10ug/ml
Co	10ug/ml
In	10ug/ml
Pb	10ug/ml
Mg	10ug/ml
Ni	10ug/ml
U	10ug/ml



## ICP-MS Calibration Standards (cont'd)

The following multi-element standards were designed to assist the ICP-MS operator with concentration verification checks. This group of multi-element standards contains virtually every element in the mass spectrum at 10ug/ml each.

ICPMS-1 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Ce	10ug/ml
Dy	10ug/ml
Er	10ug/ml
Eu	10ug/ml
Gd	10ug/ml
Ho	10ug/ml
La	10ug/ml
Lu	10ug/ml
Nd	10ug/ml
Pr	10ug/ml
Sm	10ug/ml
Sc	10ug/ml
Tb	10ug/ml
Th	10ug/ml
Tm	10ug/ml
Y	10ug/ml
Yb	10ug/ml

ICPMS-1A ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Ce	10ug/ml
Dy	10ug/ml
Er	10ug/ml
Eu	10ug/ml
Gd	10ug/ml
Ho	10ug/ml
La	10ug/ml
Lu	10ug/ml
Nd	10ug/ml
Pr	10ug/ml
Sm	10ug/ml
Th	10ug/ml
Tm	10ug/ml
Yb	10ug/ml

ICPMS-2 ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Al	10ug/ml
As	10ug/ml
Ba	10ug/ml
Be	10ug/ml
Bi	10ug/ml
Ca	10ug/ml
Cd	10ug/ml
Cr	10ug/ml
Co	10ug/ml
Cs	10ug/ml
Cu	10ug/ml
Fe	10ug/ml
Ga	10ug/ml
In	10ug/ml
Pb	10ug/ml
Li	10ug/ml
Mg	10ug/ml
Mn	10ug/ml
**Hg	10ug/ml
Ni	10ug/ml

K	10ug/ml
Rb	10ug/ml
Se	10ug/ml
Ag	10ug/ml
Na	10ug/ml
Sr	10ug/ml
Ti	10ug/ml
V	10ug/ml
U	10ug/ml
Zn	10ug/ml

ICPMS-2A ..... 100ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Al	10ug/ml
As	10ug/ml
Ba	10ug/ml
Be	10ug/ml
Ca	10ug/ml
Cd	10ug/ml
Cr	10ug/ml
Co	10ug/ml
Cs	10ug/ml
Cu	10ug/ml
Fe	10ug/ml
Ga	10ug/ml
Pb	10ug/ml
Li	10ug/ml
Mg	10ug/ml
Mn	10ug/ml
**Hg	10ug/ml
Ni	10ug/ml
K	10ug/ml
Rb	10ug/ml
Se	10ug/ml
Na	10ug/ml
Ag	10ug/ml
Sr	10ug/ml
Ti	10ug/ml
V	10ug/ml
U	10ug/ml
Zn	10ug/ml

\*\*Mercury is supplied as a separate solution due to incompatibility with other elements.

ICPMS-3 ..... 100ml  
Matrix 10% HCl

Element	Conc. (ug/ml)
Sb	10ug/ml
Au	10ug/ml
Hf	10ug/ml
Ir	10ug/ml
Pd	10ug/ml
Pt	10ug/ml
Rh	10ug/ml
Ru	10ug/ml
Te	10ug/ml
Sn	10ug/ml

ICPMS-4 ..... 100ml  
Matrix H<sub>2</sub>O with a trace of HF

Element	Conc. (ug/ml)
B	10ug/ml
Ge	10ug/ml
Mo	10ug/ml
Nb	10ug/ml
P	10ug/ml
Re	10ug/ml
S	10ug/ml
Si	10ug/ml
Ta	10ug/ml
Ti	10ug/ml
W	10ug/ml
Zr	10ug/ml

ICPMS-SET  
Includes one of each:

- ICPMS-1
- ICPMS-2
- ICPMS-3
- ICPMS-4
- \*ICPMS-H<sub>2</sub>O
- \*ICPMS-HNO<sub>3</sub>
- \*ICPMS-HCl

\*Blanks are the same lots as the set matrices.



## ICP-MS Internal Standards Stock Solution

The Internal Standard Stock Solutions are used for addition to blanks, calibration standards and samples for internal standardization. Dilute 10ml to 100ml. For use in US EPA SW-846 Method 200.8.

### Internal Standard Stock Solution — Bismuth

ICPMS-BI ..... 100ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Bi	100ug/ml

### Internal Standard Stock Solution — Indium

ICPMS-IN ..... 100ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)
In	100ug/ml

### Internal Standard Stock Solution — Scandium

ICPMS-SC ..... 100ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Sc	100ug/ml

### Internal Standard Stock Solution — Terbium

ICPMS-TB ..... 100ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Tb	100ug/ml

### Internal Standard Stock Solution — Yttrium

ICPMS-Y ..... 100ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Y	100ug/ml



## ICP-MS Tuning Solution

The Tuning Solution is used for instrument tuning and mass calibration prior to analysis. A dilution of 100-fold is suggested giving the solution concentration of 100ug/L (ppb) in 1% HNO<sub>3</sub>. Internal standards are not added to this solution. For use in US EPA SW-846 Method 200.8.

### Tuning Solution 1

TUNING-1 ..... 100ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Be.....	10ug/ml
Co.....	10ug/ml
In.....	10ug/ml
Pb.....	10ug/ml
Mg.....	10ug/ml

## Interference Check Standards

The Interference Check Standards are used to set or confirm that the correct background correction intervals have been set for sequential ICP spectrometers and that the proper inter-element correction factors are set for simultaneous ICP spectrometer systems. For use in US EPA SW-846, Method 6010 and Method 200.7.

### Interference Check Standard, 18

INTER18-100 ..... 100ml  
INTER18-500 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
As.....	1000ug/ml	189.042nm
Ba.....	300ug/ml	233.527nm
Be.....	100ug/ml	313.042nm
Cd.....	300ug/ml	214.438nm
Cr.....	300ug/ml	205.552nm
Co.....	300ug/ml	228.616nm
Cu.....	300ug/ml	324.754nm
Pb.....	1000ug/ml	220.353nm
Mn.....	200ug/ml	257.610nm
Hg.....	50ug/ml	194.232nm
Ni.....	300ug/ml	231.604nm
K.....	20,000ug/ml	766.490nm
Se.....	500ug/ml	196.090nm
Ag.....	300ug/ml	328.068nm
Ti.....	1000ug/ml	351.924nm
V.....	300ug/ml	292.402nm
Zn.....	300ug/ml	213.856nm

### Interference Check Standard, 3

INTER3-100 ..... 100ml  
INTER3-500 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
B.....	500ug/ml	249.773nm
Mo.....	300ug/ml	202.030nm
Si.....	230ug/ml	251.611nm
Ti.....	1000ug/ml	334.941nm

### Interference Check Standard, 1

INTER1-100 ..... 100ml  
INTER1-500 ..... 500ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Sb.....	1000ug/ml	217.581nm

### Interference Check Standard, 5

INTER5-100 ..... 100ml  
INTER5-500 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Al.....	1200ug/ml	396.152nm
Ca.....	6000ug/ml	317.933nm
Fe.....	5000ug/ml	259.940nm
Mg.....	3000ug/ml	279.553nm
Na.....	1000ug/ml	589.592nm

### Set of 4 Interference Check Standards

INTER-SET  
Includes one of each:  
INTER18-100  
INTER3-100  
INTER1-100  
INTER5-100

## Environmental EPA Set

Set of 9 standards and 2 matrix blanks for use in US EPA Methods 6010 and 200.7 for analysis of trace metals by ICP.

### EPA-SET

Includes one each of:  
MIXSTD1-100 ..... INTER3-100  
MIXSTD2-100 ..... INTER5-100  
MIXSTD3-100 ..... INTER1-100  
MIXSTD4-100 ..... PLBLK-HNO<sub>3</sub>  
MIXSTD5-100 ..... PLBLK-HCL  
INTER18-100

## Toxicity Characteristic Leachate Procedure (TCLP) Standard

The Toxicity Characteristic Leachate Procedure (TCLP) is designed to determine the mobility of both organic and inorganic contaminants present in liquid, solid, and multi-phase wastes. To simplify, TCLP is designed to determine the hazardous contaminants that are actually entering into the environment. For use in accordance with the Toxicity Characteristic rule regulatory levels issued in the Federal Register 55, 11846 March 1990; Method 1311.

In addition to the SPEX TCLP Standard designed with all elements in one solution, the Toxicity Characteristic rule separates the elements according to specific instrumentation: ICP, GFAA, and Cold Vapor AA.

### TCLP Standard 1

TCLP-100 ..... 100ml  
TCLP-500 ..... 500ml  
Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
As.....	25ug/ml	189.042nm
Ba.....	500ug/ml	233.527nm
Cd.....	5ug/ml	214.438nm
Cr.....	25ug/ml	205.552nm
Pb.....	25ug/ml	220.353nm
Se.....	5ug/ml	196.090nm
Ag.....	25ug/ml	328.068nm
**Hg.....	20ug/ml	194.232nm

\*\*Mercury is supplied as a separate solution due to incompatibility with other elements.

### TCLP Standard for GFAA

TCLP-GFAA ..... 100ml  
TCLP-GFAA-500 ..... 500ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
As.....	25ug/ml	189.042nm
Pb.....	25ug/ml	220.353nm
Se.....	5ug/ml	196.090nm

### TCLP Standard for Cold Vapor AA

TCLP-AA ..... 100ml  
TCLP-AA-500 ..... 500ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Hg.....	20ug/ml	194.232nm

### TCLP Standard for ICP

TCLP-ICP ..... 100ml  
TCLP-ICP-500 ..... 500ml  
Matrix 2% HNO<sub>3</sub>

Element	Conc. (ug/ml)	Wavelength (nm)
Ba.....	500ug/ml	233.527nm
Cd.....	5ug/ml	214.438nm
Cr.....	25ug/ml	205.552nm
Ag.....	25ug/ml	328.068nm

## Quality Control Standards

Quality Control Standards for trace metal analysis. These standards can be used to check the standard curve, the procedure for interelement correction and other spectral interferences.

The laboratory performance for carrying out the Method 200.7 is tested in the beginning and on a quarterly basis using the Quality Control Standards. These standards are carried through the entire analytical operation of the method. If the determined concentration is not within +/- 5.0% of 1 mg/L, the laboratory performance is unacceptable. The source of the problem should be identified and corrected before continuing the analysis.

For use in US EPA Method 200.7 (Revision 3.3 April 1991) and SW-846, Method 6010 (Third Edition).



## Quality Control Standards (cont'd)

### Quality Control Standard 19

QC-19	100ml
QC-19-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	100ug/ml	217.581nm
As	100ug/ml	189.042nm
Be	100ug/ml	313.042nm
Cd	100ug/ml	214.438nm
Ca	100ug/ml	317.933nm
Cr	100ug/ml	205.552nm
Co	100ug/ml	228.616nm
Cu	100ug/ml	221.810nm
Fe	100ug/ml	259.940nm
Pb	100ug/ml	220.353nm
Mg	100ug/ml	279.553nm
Mn	100ug/ml	257.610nm
Mo	100ug/ml	202.030nm
Ni	100ug/ml	231.604nm
Se	100ug/ml	196.090nm
Ti	100ug/ml	351.924nm
V	100ug/ml	292.402nm
Zn	100ug/ml	213.856nm

### Quality Control Standard 7

QC-7	100ml
QC-7-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	100ug/ml	396.152nm
Ba	100ug/ml	233.527nm
B	100ug/ml	249.773nm
K	100ug/ml	766.490nm
Si	50ug/ml	251.611nm
Ag	100ug/ml	328.068nm
Na	100ug/ml	589.592nm

### Set of 2 Quality Control Standards

QC-SET	Includes one of each:
QC-19	
QC-7	

### Quality Control Standard 21

QC-21	100ml
QC-21-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	100	217.581
As	100	189.042
Be	100	313.042
Cd	100	214.438
Ca	100	317.933
Cr	100	205.552
Co	100	228.616
Cu	100	221.810
Fe	100	259.940
Pb	100	220.353
Li	100	670.784
Mg	100	279.553
Mn	100	257.610
Mo	100	202.030
Ni	100	231.604
Se	100	196.090
Sr	100	421.552
Ti	100	351.924
V	100	292.402
Zn	100	213.856

### Quality Control Standard 7A

QC-7A	100ml
QC-7A-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	100	396.152
Ba	100	233.527
B	100	249.773
K	1000	766.490
Si	500	251.611
Ag	50	328.068
Na	100	589.592

### QC-SET A

Includes one of each:

- QC-21
- QC-7A

## Drinking Water Pollutant Standards

These standards are for use with procedures for compliance monitoring of drinking water and for analysis of ground and surface water where determination at the drinking water contaminant levels are required. Refer to US EPA SW-846, Method 1310 and US National Primary Drinking Water Regulations 40 CFR Part 141.

Secondary metals from US Appendix to 200.7 are used in the analysis of drinking water by ICP.

### Primary Drinking Water Metals

EP-8	100ml
EP-8-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
As	10ug/ml	189.042nm
Ba	100ug/ml	233.527nm
Cd	5ug/ml	214.438nm
Cr	10ug/ml	205.552nm
Pb	10ug/ml	220.353nm
Se	5ug/ml	196.090nm
Ag	10ug/ml	328.068nm
**Hg	10ug/ml	194.232nm

\*\*Mercury is supplied as a separate solution due to incompatibility with other elements.

### Secondary Drinking Water Metals

EP-4	100ml
EP-4-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Cu	100ug/ml	221.810nm
Fe	30ug/ml	259.940nm
Mn	5ug/ml	257.610nm
Zn	500ug/ml	213.856nm

### Set of 2 Drinking Water Standards

DW-SET	Includes one of each:
EP-8	
EP-4	

## Trace Metals in Fish

For use in methods for the sampling and analysis of priority pollutants in sediments and fish tissue. Refer to the US EPA methods manuals 600/4-79-020 and 600/4-81-055.

### Trace Metals in Fish

WP-9	100ml
WP-9-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
As	100ug/ml	189.042nm
Cd	5ug/ml	214.438nm
Cr	20ug/ml	205.552nm
Cu	50ug/ml	324.754nm
Pb	10ug/ml	220.353nm
Hg	100ug/ml	194.232nm
Ni	20ug/ml	231.604nm
Se	10ug/ml	196.090nm
Zn	1000ug/ml	213.856nm

## Groundwater and Wastewater Pollution Control Check Standards

The water pollution control check standards may be used either as standards or as means to check the individual analyst's accuracy and precision. Refer to US EPA methods manual 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes"; Trace metals 21I, 21II and 21III methods.

### Trace Metals I

WP-15	100ml
WP-15-500	500ml
Matrix 5% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	500ug/ml	396.152nm
As	100ug/ml	189.042nm
Be	100ug/ml	313.042nm
Cd	25ug/ml	214.438nm
Cr	100ug/ml	205.552nm
Co	100ug/ml	228.616nm
Cu	100ug/ml	324.754nm
Fe	100ug/ml	259.940nm
Pb	100ug/ml	220.353nm
Mn	100ug/ml	257.610nm
Hg	5ug/ml	194.232nm
Ni	100ug/ml	231.604nm
Se	25ug/ml	196.090nm
V	250ug/ml	292.402nm
Zn	100ug/ml	213.856nm

### Trace Metals II

WP-3	100ml
WP-3-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Sb	20ug/ml	217.581nm
Ag	10ug/ml	328.068nm
Ti	20ug/ml	351.924nm

continued on page 30



**NEW PLASMA SHOTS™**  
Quality Control and Calibration Standards

**Groundwater and Waste-water Pollution Control Check Standards (cont'd)**

**Trace Metals III**

MN-6	100ml
MN-6-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Ba	500ug/ml	233.527nm
Ca	500ug/ml	317.933nm
Mg	100ug/ml	279.553nm
Mo	500ug/ml	202.030nm
K	100ug/ml	766.490nm
Na	500ug/ml	589.592nm

**Set of 3 Trace Metals**

TM-SET

Includes one of each:

WP-15 WP-3 MN-6

**Alternate Water Pollution and Wastewater Standards for ICP and AA**

**Alternate Metals I**

WP-11	100ml
WP-11-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Al	20ug/ml	396.152nm
Sb	5ug/ml	217.581nm
Be	5ug/ml	313.042nm
Co	10ug/ml	228.616nm
Cu	10ug/ml	324.754nm
Fe	20ug/ml	259.940nm
Mn	10ug/ml	257.610nm
Ni	10ug/ml	231.604nm
Ti	5ug/ml	351.924nm
V	20ug/ml	292.402nm
Zn	10ug/ml	213.856nm

**Alternate Metals III**

MN-4	100ml
MN-4-500	500ml
Matrix 2% HNO <sub>3</sub>	

Element	Conc. (ug/ml)	Wavelength (nm)
Ca	500ug/ml	317.933nm
Mg	100ug/ml	279.553nm
K	100ug/ml	766.490nm
Na	500ug/ml	589.592nm

AM-SET

Includes one of each:

WP-11

MN-4

- Pre-diluted Solutions
- Certificate of Analysis
- Sold in 25ml Ampules

**SHOT-19**

SHOT-19

Set includes three of each:

SHOT 19-1

SHOT 19-10

SHOT-HNO<sub>3</sub>

**SHOT 19-1**

Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Sb	1
As	1
Be	1
Cd	1
Ca	1
Cr	1
Co	1
Cu	1
Fe	1
Pb	1
Mg	1
Mn	1
Mo	1
Ni	1
Se	1
Ti	1
V	1
Zn	1

**SHOT 19-10**

Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Sb	10
As	10
Be	10
Cd	10
Ca	10
Cr	10
Co	10
Cu	10
Fe	10
Pb	10
Mg	10
Mn	10
Mo	10
Ni	10
Se	10
Ti	10
V	10
Zn	10

**SHOT-HNO<sub>3</sub>**

5% Nitric Acid Blank

**SHOT-ICAL**

SHOT-ICAL

Set includes five of each:

SHOT ICAL-A

SHOT-HNO<sub>3</sub>

**SHOT ICAL-A**

Matrix 5% HNO<sub>3</sub>

Element	Conc. (ug/ml)
Al	20
Sb	10
As	5
Ba	20
Be	0.5
Cd	2.5
Ca	20
Cr	1
Co	5
Cu	2.5
Fe	10
Pb	2.5
Mg	20
Mn	1.5
Ni	4
K	20
Se	2.5
Ag	1
Na	20
Ti	5
V	5
Zn	2

**SHOT-HNO<sub>3</sub>**

5% Nitric Acid Blank

**NEW**

**Cyanide Standard**

- Certified Wet Assay
- Stability Guarantee

RSCN9-2X	500ml
Matrix H <sub>2</sub> O	

Analyte	Conc. (ug/ml)
Cyanide	1000ug/ml





## SOLUTION STANDARDS FOR ION CHROMATOGRAPHY

- High-purity Starting Materials
- 18 Megohm (ASTM Type I) Water
- Pre-cleaned and Leached Bottles
- Triple-Checked for Reliability
- Custom Solutions Upon Request

SPEX Industries offers a complete line of anion standards for Ion Chromatography (IC) which includes SPEX-ION standards, off-the-shelf instrument check standards, and custom anion solution standards (available upon request). These SPEX-ION standards can be used in conjunction with US EPA Test Method 300.0 (August 1991) and ASTM Method D4327 for analysis of drinking water, surface water, mixed domestic and industrial wastewater, groundwater, reagent water, solids (after extraction), and leachates (when no acetic acid is used).

As with all SPEX Plasma-Grade Standards, every SPEX-ION Standard is prepared under the unique SPEX Triple-Checked Quality Assurance Program. Only SPEX-ION standards are checked three ways:

- DC ARC Trace Metal Analysis of Starting Materials
- Classical "Wet" Assay for Major Constituents (where applicable)
- IC Check for Major Anion(s)

All of the results are then reported directly on the corresponding certificate of analysis, including traceability to the United States National Institute of Standards and Technology SRM's (where available).

Anion Catalog #	Matrix	Concentration ug/ml	Qty ml
<b>Bromide</b>			
AS-BR9-2Y AS-BR9-2X	NaBr in H <sub>2</sub> O	1,000ug/ml	100ml 500ml
<b>Chloride</b>			
AS-CL9-2Y AS-CL9-2X	NaCl in H <sub>2</sub> O	1,000ug/ml	100ml 500ml
<b>Fluoride</b>			
AS-F9-2Y AS-F9-2X	NaF in H <sub>2</sub> O	1,000ug/ml	100ml 500ml
<b>Nitrate</b>			
AS-NO39-2Y AS-NO39-2X	NaNO <sub>3</sub> in H <sub>2</sub> O	1,000ug/ml	100ml 500ml
<b>Nitrite</b>			
AS-NO29-2Y AS-NO29-2X	NaNO <sub>2</sub> in H <sub>2</sub> O	1,000ug/ml	100ml 500ml
<b>Phosphate</b>			
AS-PO49-2Y AS-PO49-2X	KH <sub>2</sub> PO <sub>4</sub> in H <sub>2</sub> O	1,000ug/ml	100ml 500ml
<b>Sulfate</b>			
AS-SO49-2Y AS-SO49-2X	K <sub>2</sub> SO <sub>4</sub> in H <sub>2</sub> O	1,000ug/ml	100ml 500ml

**Caution:** To avoid contamination, DO NOT sample directly from the SPEX-ION standard bottle. SPEX recommends first pouring an aliquot into a disposable non-contaminating container for subsequent use.

31

## ION CHROMATOGRAPHY INSTRUMENT CHECK STANDARDS

### Instrument Check Standards

Ion Chromatography Instrument Check Standards are solutions of analytes used to calibrate the instrument's response with respect to analytic concentration. The calibration curve can be required to be verified on each working day and/or whenever the anion is changed. For use in the US EPA Test Method 300.0 (August 1991) and ASTM Method D4327.

### IC Instrument Check Standard 1

ICMIX1-100 .....100ml  
Matrix H<sub>2</sub>O

Anion	Concentration (ug/ml)
Cl <sup>-</sup> .....	30ug/ml
F <sup>-</sup> .....	20ug/ml
NO <sub>3</sub> <sup>-</sup> .....	100ug/ml
HPO <sub>4</sub> <sup>2-</sup> .....	150ug/ml
SO <sub>4</sub> <sup>2-</sup> .....	150ug/ml

### IC Instrument Check Standard 2

ICMIX2-100 .....100ml  
Matrix H<sub>2</sub>O

Anion	Concentration (ug/ml)
Br <sup>-</sup> .....	400ug/ml
Cl <sup>-</sup> .....	200ug/ml
F <sup>-</sup> .....	100ug/ml
NO <sub>3</sub> <sup>-</sup> .....	400ug/ml
HPO <sub>4</sub> <sup>2-</sup> .....	600ug/ml
SO <sub>4</sub> <sup>2-</sup> .....	400ug/ml



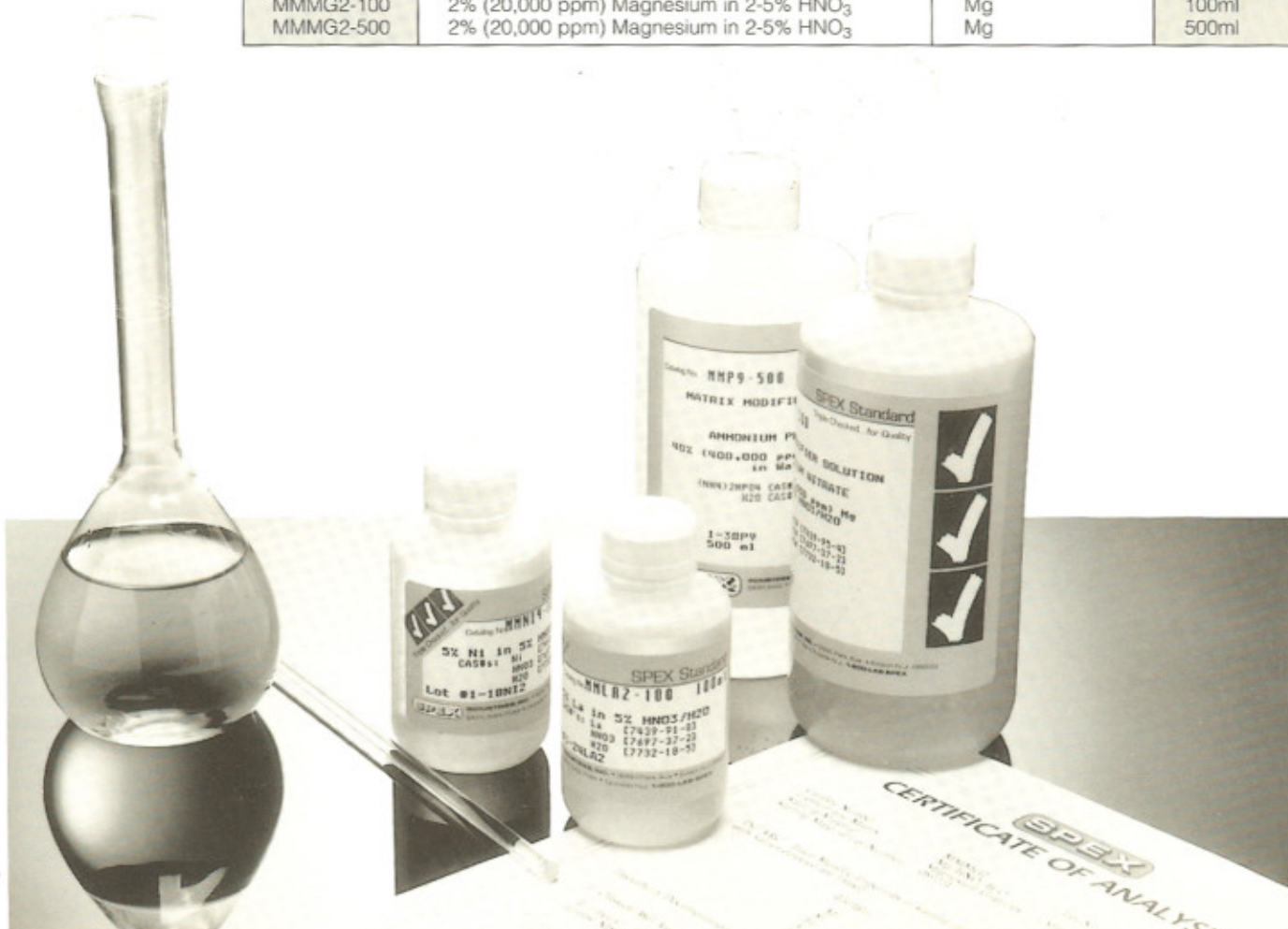


## MATRIX MODIFIERS

SPEX offers a variety of high purity matrix modifiers for Graphite Furnace Atomic Absorption (GFAA) that will change the behavior of either the analyte element or matrix in solution with respect to temperature, thus allowing a more optimum graphite furnace program to be used.

During the pyrolysis stage of graphite furnace atomic absorption (GFAA) certain elements are lost due to their high volatility. Matrix modifiers are added to a solution to prevent these losses during pyrolysis by converting the element to a less volatile form.

Catalog Number	Description	Starting Material	Quantity
MMNI4-100 MMNI4-500	Nickel Nitrate Solution 5% (50,000 ppm) Nickel in 5-10% HNO <sub>3</sub> 5% (50,000 ppm) Nickel in 5-10% HNO <sub>3</sub>	Ni Ni	100ml 500ml
MMP9-100 MMP9-500	Ammonium Phosphate Solution 40% (400,000 ppm) Ammonium Phosphate in H <sub>2</sub> O 40% (400,000 ppm) Ammonium Phosphate in H <sub>2</sub> O	(NH <sub>4</sub> ) <sub>2</sub> HPO <sub>4</sub> (NH <sub>4</sub> ) <sub>2</sub> HPO <sub>4</sub>	100ml 500ml
MMCA2-100 MMCA2-500	Calcium Nitrate Solution 2% (20,000 ppm) Calcium in 5% HNO <sub>3</sub> 2% (20,000 ppm) Calcium in 5% HNO <sub>3</sub>	Ca(NO <sub>3</sub> ) <sub>2</sub> • 4H <sub>2</sub> O Ca(NO <sub>3</sub> ) <sub>2</sub> • 4H <sub>2</sub> O	100ml 500ml
MMLA2-100 MMLA2-500	Lanthanum Nitrate Solution 5% (50,000 ppm) Lanthanum in 2-5% HNO <sub>3</sub> 5% (50,000 ppm) Lanthanum in 2-5% HNO <sub>3</sub>	La <sub>2</sub> O <sub>3</sub> La <sub>2</sub> O <sub>3</sub>	100ml 500ml
MMLA1-100 MMLA1-500	Lanthanum Chloride Solution 5% (50,000 ppm) Lanthanum in 2-5% HCl 5% (50,000 ppm) Lanthanum in 2-5% HCl	La <sub>2</sub> O <sub>3</sub> La <sub>2</sub> O <sub>3</sub>	100ml 500ml
MMNO2-100 MMNO2-500	Ammonium Nitrate Solution 5% (50,000 ppm) Ammonium Nitrate in 2% HNO <sub>3</sub> 5% (50,000 ppm) Ammonium Nitrate in 2% HNO <sub>3</sub>	NH <sub>4</sub> NO <sub>3</sub> NH <sub>4</sub> NO <sub>3</sub>	100ml 500ml
MMPD4-100 MMPD4-500	Palladium Nitrate Solution 2% (20,000 ppm) Palladium in 5-10% HNO <sub>3</sub> 2% (20,000 ppm) Palladium in 5-10% HNO <sub>3</sub>	Pd(NH <sub>3</sub> ) <sub>4</sub> (NO <sub>3</sub> ) <sub>2</sub> Pd(NH <sub>3</sub> ) <sub>4</sub> (NO <sub>3</sub> ) <sub>2</sub>	100ml 500ml
MMMG2-100 MMMG2-500	Magnesium Nitrate Solution 2% (20,000 ppm) Magnesium in 2-5% HNO <sub>3</sub> 2% (20,000 ppm) Magnesium in 2-5% HNO <sub>3</sub>	Mg Mg	100ml 500ml





## OPTICAL EMISSION AND X-RAY SPECTROSCOPY STANDARDS

- Qualitative Standards
- Semi-quantitative Standards
- OES/XRF

SPEX offers a variety of qualitative and semi-quantitative standards for emission and x-ray spectroscopy that can be used to obtain dependable results in analyses ranging from qualitative to truly quantitative.

SPEX-Mixes are mixtures of elements used as spiking standards. Spikes are added to samples so that trace elements may be determined semi-quantitatively by the method of standard additions. SPEX-Mixes are available for the 49 common elements, 16 rare earth elements and the 10 noble elements.

Our 1010 Element Kit is very useful as a spike via the method of standard additions. The kit contains separate vials of the 49 individual common elements found in our blended SPEX-Mix. Individual packaging affords greater flexibility for the spectroscopist desiring better sample control or the advantage of single-element spiking.

As a further convenience to the spectroscopist, SPEX offers a series of diluted powder standards. Here the combination of elements used in the SPEX-Mixes are supplied and pre-diluted, in either four, five or seven specific concentrations; in either graphite powder or lithium carbonate base. This series of diluted powder standards is helpful for the analysis of elements in an unknown where the levels of both the principal and contaminant elements are sought.

When analyzing common elements in an unknown, for example, a serial dilution with graphite powder followed by a comparison of the spectra with the four-step G Standard or the seven-step G-7 Standard containing 0.1% indium internal standard is recommended.

A lithium carbonate base, rather than graphite, will enhance sensitivity in the determination of rare earth containing unknowns. Dilutions performed in SPEX high-purity lithium carbonate can be burned and compared to the spectra of the seven-step Rare Earth L-7 Standard, which is diluted in  $\text{Li}_2\text{CO}_3$ .

Time-Saver Standards speed the semi-quantitative analysis of relatively pure materials. A set of Time-Saver Standards consists of a blank and five steps (a series of diluted powders) spiked with a SPEX-Mix. Optical emission and x-ray spectroscopists will appreciate the ease

and convenience of a Time-Saver. No longer will you have to tediously prepare each powder dilution in your calibration process. SPEX does it for you. You can depend on superior semi-quantitative results using our prepared standards. Choose from a select stock base, or we can customize a Time-Saver series for you.

### SPEX-Mixes

SPEX-Mix spiking standards are added to samples so that trace elements may be determined semi-quantitatively by the method of known additions.

**SPEX-Mix 1000** Series contains 1.27% each of the following 49 common elements:

Ag, Al, As, B, Ba, Be, Bi, Br, Ca, Cd, Ce, Cl, Co, Cr, Cs, Cu, F, Fe, Ga, Ge, Hg, I,

In, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Sb, Se, Si, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Zn, Zr.

CATALOG# 1000-2 SPEX-Mix, 2 grams  
CATALOG# 1000-10 SPEX-Mix, 10 grams

**Rare Earth SPEX-Mix 1030** Series contains 5.28% each of the following 16 elements:

Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sc, Sm, Tb, Tm, Y, Yb.

CATALOG# 1031-2

Rare Earth SPEX-Mix, 2 grams  
CATALOG# 1031-10

Rare Earth SPEX-Mix, 10 grams

**Noble Metal SPEX-Mix 1040** Series contains 9.32% each of the following 10 elements:

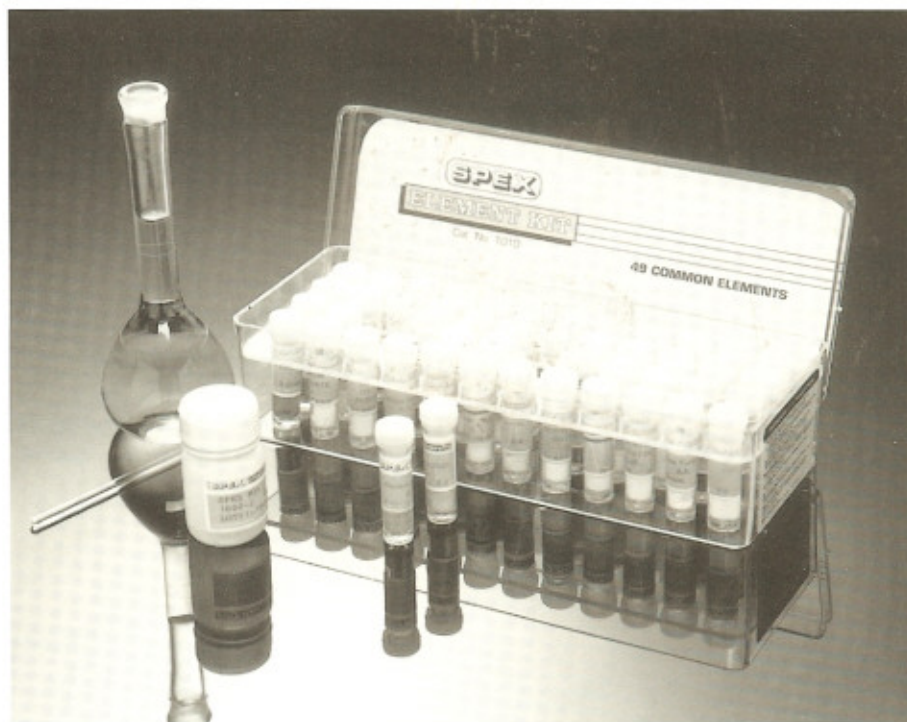
Au, Ga, Hf, In, Ir, Pd, Pt, Re, Rh, Ru.

CATALOG# 1041-1

Noble Metal SPEX-Mix, 1 gram

CATALOG# 1041-5

Noble Metal SPEX-Mix, 5 grams



### Element Kits

The 1010 and 1030 Element Kits contain separate containers of compounds included in the respective SPEX-Mix (2 grams each). Use for quantitative, semi-quantitative and qualitative spectrochemical analysis. Replacements are available as indicated.

CATALOG# 1010	Common Element Kit, 49 elements, 2 grams each
CATALOG# 1011-XX	(Specify Element) — Replacement elements for 1010 Kit
CATALOG# 1030	Rare Earth Element Kit, 16 elements, 2 grams each



## Diluted Powder Standards

### Common Element Standards

SPEX Diluted Powder Standards are useful for the semi-quantitative determination of the 49 common elements (those included in SPEX-Mix 1000) by dilution techniques. A set of diluted powders consists of 2 grams of each standard containing the given percentage of each of the 49 elements in the matrix specified.

#### CATALOG# 1002

G Standards, 2 grams each of the 4 concentrations. Steps included: 0.1%, 0.01%, 0.001%, and 0.0001% of each element in graphite powder.

#### CATALOG# 10027

G-7 Standards, 2 grams each of the 7 concentrations. Steps included: 0.1%, 0.033%, 0.01%, 0.0033%, 0.001%, 0.00033% and 0.0001% of each element in graphite; 0.1% indium internal standard added.

#### CATALOG# 10045

L-5 Standards, 2 grams each of 5 concentrations. Steps included: 0.1%, 0.033%, 0.01%, 0.0033% and 0.001% of each element in TMI 10 lithium carbonate, 0.1% indium internal standard added.

### Rare Earth Standards

Available by Special Order Only.

#### CATALOG# 10327

Rare Earth L-7 Standards, 2 grams of each of the 7 concentrations. Steps included: 0.5%, 0.167%, 0.05%, 0.0167%, 0.005%, 0.00167% and 0.0005% of each element in SPEX-Mix 1030 in TMI 10 lithium carbonate, 0.5% indium internal standard added.

### Noble Metal Standards

Available by Special Order Only.

#### CATALOG# 10427

Noble Metal G-7 Standards, 2 grams each of the 7 concentrations. Steps include: 0.5%, 0.167%, 0.05%, 0.0167%, 0.005%, 0.00167%, and 0.0005% of each element in SPEX-Mix 1040 in TMI 10 lithium carbonate, 0.5% indium internal standard added.

### Time-Saver Standards

SPEX Time-Savers speed the semi-quantitative analysis of relatively pure materials. A set consists of 2 grams of one of our high purity materials for use as a blank, and five 2-gram standards. Each standard is spiked with a SPEX-Mix at the following steps: 0.1%, 0.033%, 0.01%, 0.0033% and 0.001% of each element in the mix. The following bases are available as stock items, specify the required SPEX-Mix (1000, 1031, 1041):

#### CATALOG# TSAL

Time-Saver, Aluminum Oxide.

#### CATALOG# TSCO

Time-Saver, Cobalt (III) Oxide.

#### CATALOG# TSFE

Time Saver, Iron (III) Oxide.

#### CATALOG# TSSI

Time Saver, Silicon.

#### CATALOG# TSSID

Time Saver, Silicon Dioxide.

Other bases and custom Time-Saver Standards are available by special order only.

## Pellements

Pellements are pressed powder pellets used for calibrating x-ray and direct reading emission spectrometers. 1% of a chosen element in a graphite matrix is pressed into a SPEX-Cap for protection as well as ease of storage and handling. In this form the element can easily be introduced into the sample holder of the spectrometer and a curve can be plotted for comparison with an unknown. Choose from 73 single-element pellements or a combination multi-element grouping. Pellements are available in 31mm diameters. Specify single element reference standards from the following list:

Ag, Al, As, Au, B, Ba, Be, Bi, Br, Ca, Cd, Ce, Cl, Co, Cr, Cs, Cu, Dy, Er, Eu, F, Fe, Ga, Gd, Ge, Hf, Hg, Ho, I, In, Ir, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr.

#### CATALOG# 1015

(specify element) 31mm Pellement in 3619 SPEX-Cap

Custom multi-element pellements are also available.





