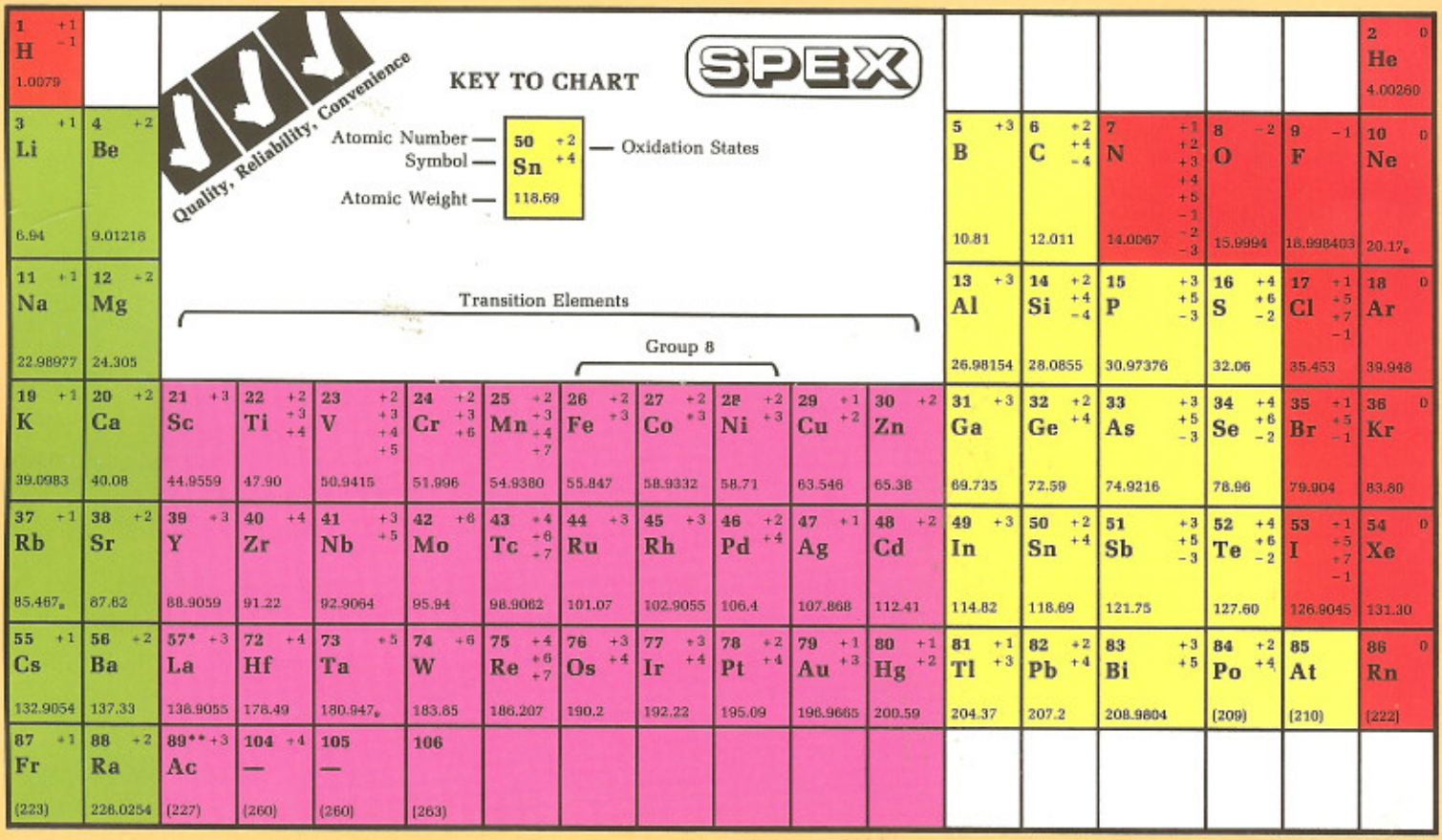

Standards
SPEX Multi-Element
Plasma Standard
Triple Checked...for Quality
CALMIX3-500
500 ml
Instrument Check Std.
100 ug/ml P, K, S
20 ug/ml As, La, Li, Mn, Mo, Ni, Sc, Na
3-65-NK
2% HCl
10/89
SPEX
Certificate of Analysis
Catalog Number: CALMIX3-500
Description: Instrument Check Std.
Lot Number: 3-65-NK
ICP CHECK:
Element Labeled (ug/ml) Measured (ug/ml)
SPEX
Standards
and Compounds
for Inorganic Spectroscopy

PERIODIC TABLE OF THE ELEMENTS



Ordering Information

Telephone: 1-908-549-7144
1-800-LAB-SPEX
(1-800-522-7739)

FAX: 1-908-603-9647

Address: SPEX Industries, Inc.
Chemical Sales Department
3880 Park Avenue
Edison, NJ 08820
USA

Telex: 178341 SPEX UT

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.

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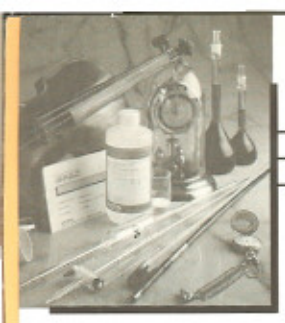


QUALITY, RELIABILITY, AND CONVENIENCE

For over 30 years SPEX Industries has been your source for specialty inorganic standards. 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. We have made Spectroscopy our business AND our reputation . . . with **Quality, Reliability** and **Convenience**. And we know you have come to expect nothing less from us.

Quality: We provide our customers with QUALITY solution standards for ICP, DCP or AA, powder blends for OES, pellements, 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 singles and multi-element solution standards are your assurances of quality.

Reliability: For over three decades spectroscopists have relied on SPEX. All of our plasma standards are triple checked, starting with a semi-quantitative trace impurity analysis via DC arc through gravimetric "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). Analysis certificates are 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 1,000µg/ml or 10,000µg/ml concentrations, single-element solutions or prepackaged multi-element blends — or have a standard customized just for your particular needs. We offer off-the-shelf delivery on prepackaged items and an unbeatable turnaround on custom standards.

Quality, Reliability, Convenience
You write the label at SPEX!

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

Our order department and chemical sales staff are waiting to assist you. Let us put over 30 years of knowledge to work for your laboratory. If you have a standardization or purity problem, call us for advice, recommendations and reliable SPEX products to solve that problem.

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 and ICP documentation and certification**

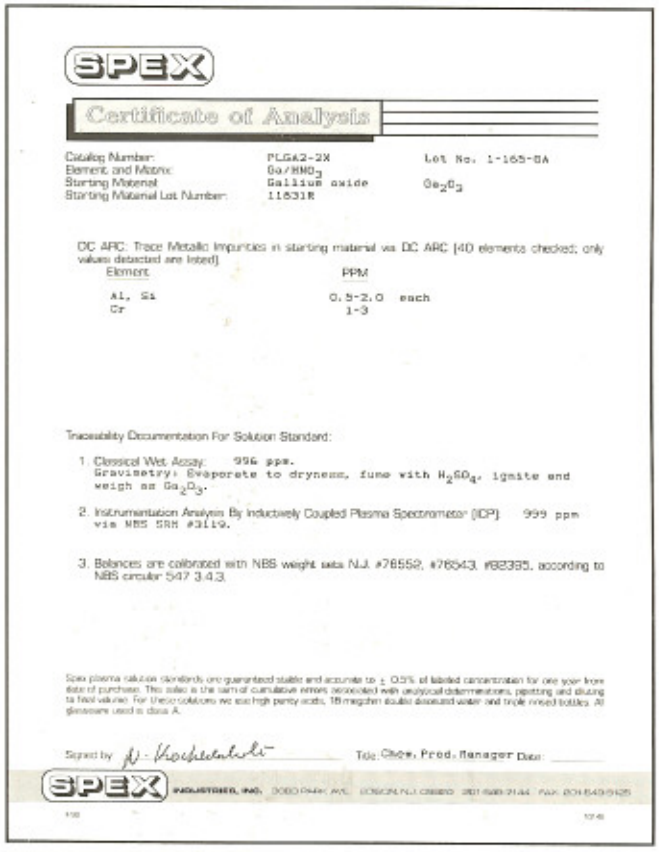
Over the last fifteen years plasma emission spectroscopy which includes the techniques of ICP, DCP, and ICP-MS, has emerged as a major analytical method in the field of elemental analysis.

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 promises to drive 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 matrixes 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 analysis certificates 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 (formerly NBS) documentation information. Our one-year stability and accuracy guarantee is included on all plasma grade single and multi-element standards too.



SPEX

Certificate of Analysis

Catalog Number: PLGA2-2X Lot No. 1-165-8A
Element and Matrix: Ga/HNO_3
Starting Material: Gallium oxide Ge_2O_3
Starting Material Lot Number: 11631R

DC ARC: Trace Metallic Impurities in starting material via DC ARC (40 elements checked; only values detected are listed)

Element	PPM
Al, Si	0.5-2.0 each
Cr	1-3

Traceability Documentation For Solution Standard:

1. Classical Wet Assay: 996 ppm.
   Gravimetry: Evaporate to dryness, fume with H_2SO_4, ignite and weigh as Ga_2O_3.
2. Instrumentation Analysis By Inductively Coupled Plasma Spectrometer (ICP) 999 ppm via NBS SRM #3119.
3. Balances are calibrated with NBS weight sets NJI #76552, #76543, #82385, according to NBS circular 547 3.4.3.

Spex plasma solution standards are guaranteed stable and accurate to ± 0.5% of labeled concentration for one year from date of purchase. This value is the sum of cumulative errors associated with analytical determinations, pipetting and diluting to final volumes. For these solutions we use high purity acids, 18 megohm double deionized water and triple rinsed bottles. All glassware used is class A.

Signed by _____ Title: Chem. Prod. Manager Date: _____

SPEX INDUSTRIES, INC. 3880 Park Ave. Edison, N.J. 08820 201-549-7144 FAX: 201-549-5125

Single-Element Solution Standards For Plasma Emission Spectroscopy

- **Choice of 70 elements**
- **1,000 or 10,000 ppm concentrations**
- **Sold in 500 ml bottles**
- **Certification with every solution**
- **Alternate matrixes 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.

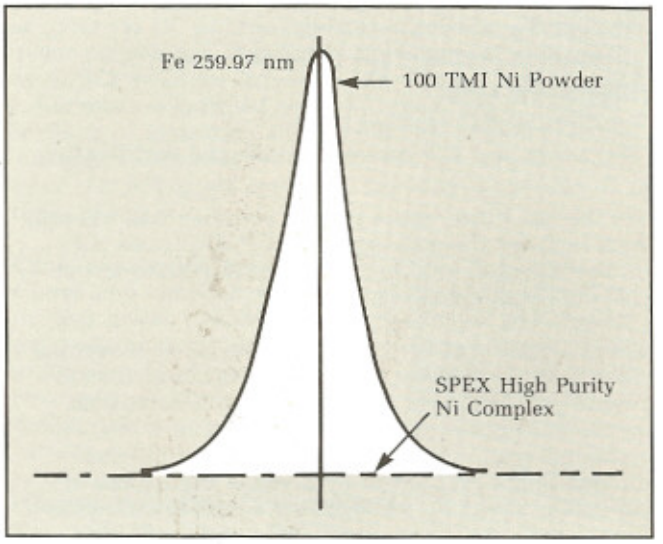
SPEX Single-Element Plasma Solution Standards are specifically designed to meet the accuracy and purity requirements of inductively coupled and direct current plasma emission spectroscopy. The starting materials are inorganic compounds or metals with purities ranging from 99.99% to 99.9999%. All SPEX 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 +/– 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 and the **actual results** reported on the SPEX certificate of analysis supplied with every bottle.

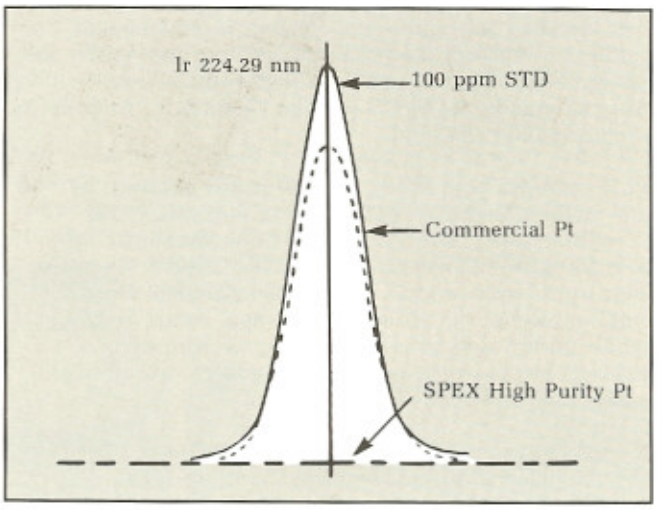
SPEX single-element solution standards are certified by our unique **triple-checked Quality Assurance** program: (1) DC ARC for trace metal impurities in solid starting material (2) classical "wet" assay for major element (3) ICP check for major element. **All of these results are then reported directly 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 matrixes 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, most in two different matrixes 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 $[Ni(NH_3)_6](NO_3)_2$. 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
Aluminum		
PLAL2-2X	Al $(NO_3)_3.9H_2O$ in	1,000ug/ml
PLAL2-3X	2-5% HNO_3	10,000ug/ml
PLAL1-2X	Al in 2-5% HCl	1,000ug/ml
PLAL1-3X		10,000ug/ml
Antimony		
PLSB2-2X	Sb_2O_3 in 2-5% HNO_3	1,000ug/ml
PLSB2-3X		10,000ug/ml
Arsenic		
PLAS2-2X	$H_3AsO_4.1/2H_2O$	1,000ug/ml
PLAS2-3X	in 2-5% HNO_3	10,000ug/ml
PLAS1-2X	As_2O_3 in 2-5% HCl	1,000ug/ml
PLAS1-3X		10,000ug/ml
Barium		
PLBA2-2X	$BaCO_3$ in 2-5% HNO_3	1,000ug/ml
PLBA2-3X		10,000ug/ml
PLBA1-2X	$BaCO_3$ in 2-5% HCl	1,000ug/ml
PLBA1-3X		10,000ug/ml
Beryllium		
PLBE2-2X	$Be_4O(C_2H_3O_2)_6$	1,000ug/ml
PLBE2-3X	in 2-5% HNO_3	10,000ug/ml
Bismuth		
PLBI4-2X	Bi in 10% HNO_3	1,000ug/ml
PLBI4-3X		10,000ug/ml
Boron		
PLB9-2X	$(NH_4)_2B_4O_7.4H_2O$	1,000ug/ml
PLB9-3X	in H_2O	10,000ug/ml
Cadmium		
PLCD2-2X	Cd in 2-5% HNO_3	1,000ug/ml
PLCD2-3X		10,000ug/ml
PLCD1-2X	Cd in 2-5% HCl	1,000ug/ml
PLCD1-3X		10,000ug/ml
Calcium		
PLCA2-2X	$CaCO_3$ in 2-5% HNO_3	1,000ug/ml
PLCA2-3X		10,000ug/ml
PLCA1-2X	$CaCO_3$ in 2-5% HCl	1,000ug/ml
PLCA1-3X		10,000ug/ml
Carbon		
PLC9-2X	$H_2C_2O_4.2H_2O$ in H_2O	1,000ug/ml
PLC9-3X		10,000ug/ml
Cerium		
PLCE4-2X	$Ce(NO_3)_3.6H_2O$ in	1,000ug/ml
PLCE4-3X	10% HNO_3	10,000ug/ml
Cesium		
PLCS2-2X	$CsNO_3$ in 2-5% HNO_3	1,000ug/ml
PLCS2-3X		10,000ug/ml

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Chromium		
PLCR2-2X	$Cr(NO_3)_3.9H_2O$ in	1,000ug/ml
PLCR2-3X	2-5% HNO_3	10,000ug/ml
PLCR1-2X	Cr in 2-5% HCl	1,000ug/ml
PLCR1-3X		10,000ug/ml
Cobalt		
PLCO2-2X	$CoCO_3$ in 2-5% HNO_3	1,000ug/ml
PLCO2-3X		10,000ug/ml
PLCO1-2X	$CoCO_3$ in 2-5% HCl	1,000ug/ml
PLCO1-3X		10,000ug/ml
Copper		
PLCU2-2X	Cu in 2-5% HNO_3	1,000ug/ml
PLCU2-3X		10,000ug/ml
PLCU1-2X	Cu in 2-5% HCl	1,000ug/ml
PLCU1-3X		10,000ug/ml
Dysprosium		
PLDY2-2X	Dy_2O_3 in 2-5% HNO_3	1,000ug/ml
PLDY2-3X		10,000ug/ml
Erbium		
PLER2-2X	Er_2O_3 in 2-5% HNO_3	1,000ug/ml
PLER2-3X		10,000ug/ml
Europium		
PLEU2-2X	Eu_2O_3 in 2-5% HNO_3	1,000ug/ml
PLEU2-3X		10,000ug/ml
Gadolinium		
PLGD2-2X	Gd_2O_3 in 2-5% HNO_3	1,000ug/ml
PLGD2-3X		10,000ug/ml
Gallium		
PLGA2-2X	Ga in 2-5% HNO_3	1,000ug/ml
PLGA2-3X		10,000ug/ml
Germanium		
PLGE9-2X	$(NH_4)_2Ge(C_2O_4)_3.xH_2O$	1,000ug/ml
PLGE9-3X	in H_2O	10,000ug/ml
Gold		
PLAU3-2X	Au in 10% HCl	1,000ug/ml
PLAU3-3X		10,000ug/ml
Hafnium		
PLHF1-2X	$HfOCl_2.8H_2O$ in	1,000ug/ml
PLHF1-3X	2-5% HCl	10,000ug/ml
Holmium		
PLHO2-2X	Ho_20_3 in 2-5% HNO_3	1,000ug/ml
PLHO2-3X		10,000ug/ml
Indium		
PLIN2-2X	In in 2-5% HNO_3	1,000ug/ml
PLIN2-3X		10,000ug/ml

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Iridium		
PLIR3-2X	$IrCl_3.3H_2O$ in	1,000ug/ml
PLIR3-3X	10% HCl	10,000ug/ml
Iron		
PLFE2-2X	Fe in 2-5% HNO_3	1,000ug/ml
PLFE2-3X		10,000ug/ml
PLFE1-2X	Fe in 2-5% HCl	1,000ug/ml
PLFE1-3X		10,000ug/ml
Lanthanum		
PLLA2-2X	La_2O_3 in 2-5% HNO_3	1,000ug/ml
PLLA2-3X		10,000ug/ml
Lead		
PLPB2-2X	Pb in 2-5% HNO_3	1,000ug/ml
PLPB2-3X		10,000ug/ml
Lithium		
PLLI2-2X	Li_2CO_3 in 2-5% HNO_3	1,000ug/ml
PLLI2-3X		10,000ug/ml
PLLI1-2X	Li_2CO_3 in 2-5% HCl	1,000ug/ml
PLLI1-3X		10,000ug/ml
Lutetium		
PLLU2-2X	Lu_2O_3 in 2-5% HNO_3	1,000ug/ml
PLLU2-3X		10,000ug/ml
Magnesium		
PLMG2-2X	Mg in 2-5% HNO_3	1,000ug/ml
PLMG2-3X		10,000ug/ml
PLMG1-2X	Mg in 2-5% HCl	1,000ug/ml
PLMG1-3X		10,000ug/ml
Manganese		
PLMN2-2X	$Mn(C_2H_3O_2)_3.2H_2O$ in	1,000ug/ml
PLMN2-3X	2-5% HNO_3	10,000ug/ml
Mercury		
PLHG4-2X	Hg in 10% HNO_3	1,000ug/ml
PLHG4-3X		10,000ug/ml
Molybdenum		
PLMO9-2X	$(NH_4)_2MoO_4$ in H_2O	1,000ug/ml
PLMO9-3X		10,000ug/ml
Neodymium		
PLND2-2X	Nd_2O_3 in 2-5% HNO_3	1,000ug/ml
PLND2-3X		10,000ug/ml
Nickel		
PLNI2-2X	Ni in 2-5% HNO_3	1,000ug/ml
PLNI2-3X		10,000ug/ml
Niobium		
PLNB9-2X	NH_4NbF_6 in	1,000ug/ml
PLNB9-3X	H_2O/tr HF	10,000ug/ml
Palladium		
PLPD3-2X	Pd in 10% HCl	1,000ug/ml
PLPD3-3X		10,000ug/ml
Phosphorus		
PLP9-2X	$NH_4H_2PO_4$ in H_2O	1,000ug/ml
PLP9-3X		10,000ug/ml

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Platinum		
PLPT3-2X	Pt in 10% HCl	1,000ug/ml
PLPT3-3X		10,000ug/ml
Potassium		
PLK2-2X	KNO_3 in 2-5% HNO_3	1,000ug/ml
PLK2-3X		10,000ug/ml
PLK1-2X	KCl in 2-5% HCl	1,000ug/ml
PLK1-3X		10,000ug/ml
Praseodymium		
PLPR2-2X	Pr_6O_{11} in 2-5% HNO_3	1,000ug/ml
PLPR2-3X		10,000ug/ml
Rhenium		
PLRE2-2X	Re in 2-5% HNO_3	1,000ug/ml
PLRE2-3X		10,000ug/ml
Rhodium		
PLRH3-2X	$RhCl_3.3H_2O$	1,000ug/ml
PLRH3-3X	in 10% HCl	10,000ug/ml
Rubidium		
PLRB2-2X	$RbNO_3$ in 2-5% HNO_3	1,000ug/ml
PLRB2-3X		10,000ug/ml
Ruthenium		
PLRU3-2X	$RuCl_3.3H_2O$ in	1,000ug/ml
PLRU3-3X	10% HCl	10,000ug/ml
Samarium		
PLSM2-2X	Sm_2O_3 in 2-5% HNO_3	1,000ug/ml
PLSM2-3X		10,000ug/ml
Scandium		
PLSC2-2X	Sc_2O_3 in 2-5% HNO_3	1,000ug/ml
PLSC2-3X		10,000ug/ml
Selenium		
PLSE2-2X	Se in 2-5% HNO_3	1,000ug/ml
PLSE2-3X		10,000ug/ml
Silicon		
PLSI9-2X	$(NH_4)_2SiF_6$	1,000ug/ml
PLSI9-3X	in H_2O/tr HF	10,000ug/ml
Silver		
PLAG2-2X	Ag in 2-5% HNO_3	1,000ug/ml
PLAG2-3X		10,000ug/ml
Sodium		
PLNA2-2X	Na_2CO_3 in 2-5% HNO_3	1,000ug/ml
PLNA2-3X		10,000ug/ml
PLNA1-2X	NaCl	1,000ug/ml
PLNA1-3X	in 2-5% HCl	10,000ug/ml
Strontium		
PLSR2-2X	$Sr(NO_3)_2$	1,000ug/ml
PLSR2-3X	in 2-5% HNO_3	10,000ug/ml
PLSR1-2X	$SrCO_3$ in 2-5% HCl	1,000ug/ml
PLSR1-3X		10,000ug/ml
Sulfur		
PLS9-2X	$(NH_4)_2SO_4$ in H_2O	1,000ug/ml
PLS9-3X		10,000ug/ml

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Tantalum		
PLTA9-2X	NH_4TaF_6 in	1,000ug/ml
PLTA9-3X	H_2O/tr HF	10,000ug/ml
Tellurium		
PLTE3-2X	TeO_2 in 10% HCl	1,000ug/ml
PLTE3-3X		10,000ug/ml
PLTE2-2X	Te in 2-5% HNO_3	1,000ug/ml
PLTE2-3X		10,000ug/ml
Terbium		
PLTB2-2X	Tb_4O_7 in 2-5% HNO_3	1,000ug/ml
PLTB2-3X		10,000ug/ml
Thallium		
PLTL2-2X	$TlNO_3$ in 2-5% HNO_3	1,000ug/ml
PLTL2-3X		10,000ug/ml
Thorium		
PLTH4-2X	$Th(NO_3)_4.4H_2O$	1,000ug/ml
PLTH4-3X	in 10% HNO_3	10,000ug/ml
Thulium		
PLTM2-2X	Tm_2O_3 in 2-5% HNO_3	1,000ug/ml
PLTM2-3X		10,000ug/ml
Tin		
PLSN5-2X	Sn in 20% HCl	1,000ug/ml
PLSN5-3X	(in Teflon)	10,000ug/ml
Titanium		
PLTI9-2X	$(NH_4)_2TiF_6$ in H_2O	1,000ug/ml
PLTI9-3X	tr HF	10,000ug/ml
PLTI5-2X	$TiCl_4$ in 20% HCl	1,000ug/ml
PLTI5-3X	(in Teflon)	10,000ug/ml
Tungsten		
PLW9-2X	$(NH_4)_2WO_4$ in H_2O	1,000ug/ml
PLW9-3X		10,000ug/ml

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Uranium		
PLU2-2X	U_3O_8 in 2-5% HNO_3	1,000ug/ml
PLU2-3X		10,000ug/ml
Vanadium		
PLV2-2X	NH_4VO_3 in 2-5%	1,000ug/ml
PLV2-3X	HNO_3	10,000ug/ml
PLV1-2X	NH_4VO_3 in 2-5% HCl	1,000ug/ml
PLV1-3X		10,000ug/ml
Ytterbium		
PLYB2-2X	Yb_2O_3 in	1,000ug/ml
PLYB2-3X	2-5% HNO_3	10,000ug/ml
Yttrium		
PLY2-2X	Y_2O_3 in 2-5% HNO_3	1,000ug/ml
PLY2-3X		10,000ug/ml
Zinc		
PLZN2-2X	Zn in 2-5% HNO_3	1,000ug/ml
PLZN2-3X		10,000ug/ml
PLZN1-2X	Zn in 2-5% HCl	1,000ug/ml
PLZN1-3X		10,000ug/ml
Zirconium		
PLZR4-2X	$ZrO(NO_3)_2$ in	1,000ug/ml
PLZR4-3X	10% HNO_3	10,000ug/ml
PLZR3-2X	$ZrOCl_2.8H_2O$ in	1,000ug/ml
PLZR3-3X	10% HCl	10,000ug/ml
Matrix Blanks:		
PLBLK-HNO3	2-5% HNO_3	
PLBLK-HCL	2-5% HCl	
PLBLK-H2O	H_2O	

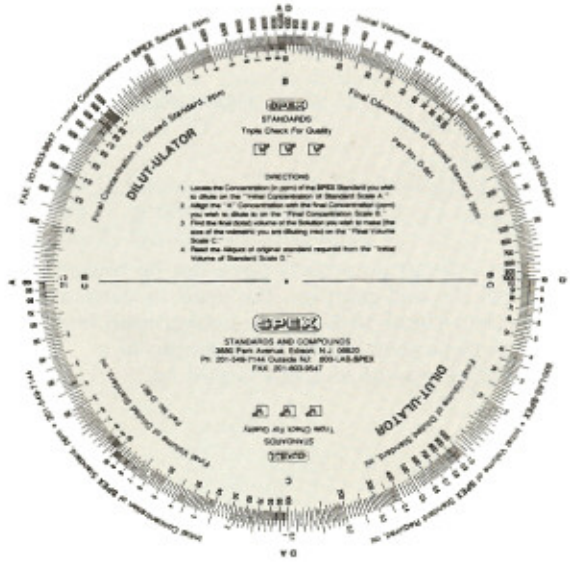
HCl, KCN, KOH, NaCN, HF, HNO_3/HCl, H_2O, Oil Matrixes are also available on a custom basis. Please call our sales office for quotations and information.

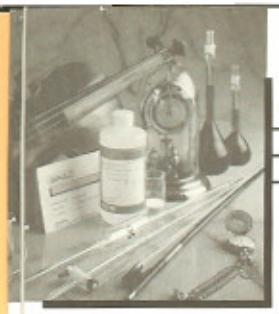
Dilution Calculator

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..... each
Printed on two colored, heavy guage, 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**

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 matrixes. 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 the result 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.

Elemental Concentration	Maximum Number Of Elements
Up to 100ug/ml Each	15
101-1,000ug/ml Each	10
Over 1,000ug/ml Each	5

The elements in your standards need not be present at the same level. In real samples, the need to determine trace elements present with a high background level of some major component arises. 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 inter-elemental 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. A **triple-checked** Quality Control check 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 one liter minimum 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.

Multi-Element Solution Standards for the Superfund Contract Laboratory Program (CLP)

SPEX Industries introduces 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, SOW.7/88. 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. A **triple-checked** Quality Control check 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 matrixes 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.7/88 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.7/88 in the following sections:

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

Instrument Calibration

The series of solutions below 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_3

Ca 5,000ug/ml
Mg 5,000ug/ml
K 5,000ug/ml
Na 5,000ug/ml

Instrument Calibration Standard 2

ICAL-2 . . . . . 100ml
Matrix 5% HNO_3

Ag 100ug/ml
Cr 100ug/ml
Mn 150ug/ml
Ni 400ug/ml
Zn 200ug/ml

Instrument Calibration Standard 3

ICAL-3 . . . . . 100ml
Matrix 5% HNO_3

Al 2,000ug/ml
Ba 2,000ug/ml
Be 50ug/ml
Co 500ug/ml
Cu 250ug/ml
Fe 1,000ug/ml
V 500ug/ml

Instrument Calibration Standard 4

ICAL-4 . . . . . 100ml
ICAL-4-500 . . . . . 500ml
Matrix 5% HNO_3

As 100ug/ml
Cd 50ug/ml
Pb 50ug/ml
Se 50ug/ml
Tl 100ug/ml

Instrument Calibration Standard 5

ICAL-5 . . . . . 100ml
ICAL-5-500 . . . . . 500ml
Matrix 2% HNO_3

Sb 600ug/ml

Instrument Calibration Standard 6

ICAL-6 . . . . . 100ml
Matrix 2% HNO_3

Hg 100ug/ml

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_3

Al 200ug/ml
Sb 60ug/ml
As 10ug/ml
Ba 200ug/ml
Be 5ug/ml
Cd 5ug/ml
Ca 5,000ug/ml
Cr 10ug/ml
Co 50ug/ml
Cu 25ug/ml
Fe 100ug/ml
Pb 5ug/ml
Mg 5,000ug/ml
Mn 15ug/ml
Ni 40ug/ml
K 5,000ug/ml
Se 5ug/ml
Ag 10ug/ml
Na 5,000ug/ml
Tl 10ug/ml
V 50ug/ml
Zn 20ug/ml

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_3

Sb 120ug/ml	Co 100ug/ml	Se 10ug/ml
As 20ug/ml	Cu 50ug/ml	Ag 20ug/ml
Be 10ug/ml	Pb 6ug/ml	Tl 20ug/ml
Cd 10ug/ml	Mn 30ug/ml	V 100ug/ml
Cr 20ug/ml	Ni 80ug/ml	Zn 40ug/ml

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 four parts hydrochloric acid blank.

Nitric Acid Blank

PLBLK-HNO3 ..... 500ml
Matrix 5% HNO_3 in ASTM Type I Water

Hydrochloric Acid Blank

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

Water Blank

PLBLK-H2O 500ml
Matrix ASTM Type I Water, 18 megohm

Interference Checks

Interelement 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 interferents alone, solution A, and the combination of interferents 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_3

Al 5,000ug/ml
Ca 5,000ug/ml
Fe 2,000ug/ml
Mg 5,000ug/ml

Analytes B

INT-B1 ..... 100ml
Matrix 5% HNO_3

Ag 100ug/ml	Cu 50ug/ml
Ba 50ug/ml	Mn 50ug/ml
Be 50ug/ml	Ni 100ug/ml
Cd 100ug/ml	Pb 100ug/ml
Co 50ug/ml	V 50ug/ml
Cr 50ug/ml	Zn 100ug/ml

In addition to the four interferents contained in INT-A1, the EPA SOW.7/88 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 SOW.7/88.

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 interferent 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_3

Cr 1,000ug/ml
Cu 1,000ug/ml
Mn 1,000ug/ml
Ni 1,000ug/ml
Ti 1,000ug/ml
V 1,000ug/ml

Alternate Analytes B

INT-B2 ..... 100ml
Matrix 5% HNO_3

Al 100ug/ml	Mo 100ug/ml
As 100ug/ml	Na 100ug/ml
B 100ug/ml	Sb 100ug/ml
Ca 10ug/ml	Se 100ug/ml
Fe 10ug/ml	Si 10ug/ml
Mg 10ug/ml	Tl 100ug/ml

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
Matrix 5% HNO_3

Al 200ug/ml	Cr 20ug/ml	Ni 50ug/ml
Sb 50ug/ml	Co 50ug/ml	Se 200ug/ml
As 200ug/ml	Cu 25ug/ml	Ag 5ug/ml
Ba 200ug/ml	Fe 100ug/ml	Tl 200ug/ml
Be 5ug/ml	Pb 50ug/ml	V 50ug/ml
Cd 5ug/ml	Mn 50ug/ml	Zn 50ug/ml

Furnace AA Calibration and Spiking

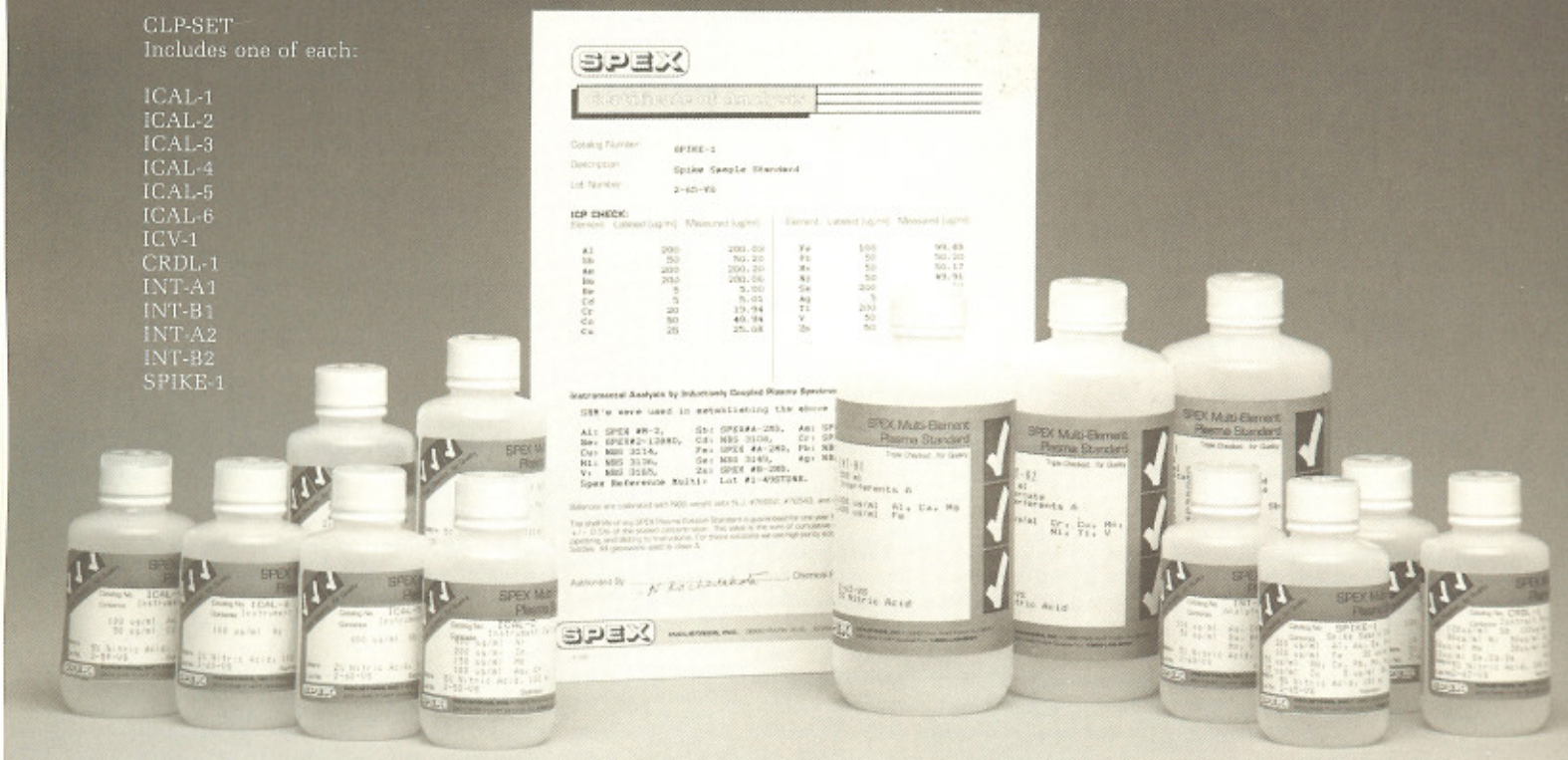
Furnace AA requires calibration standards and spikes containing only six elements: Sb, As, Cd, Pb, Se, and Tl. These solutions are easily prepared by diluting **Instrument Calibration Standard 4,** ICAL-4-500 or **Instrument Calibration Standard 5,** ICAL-5-500 to the required concentrations.

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



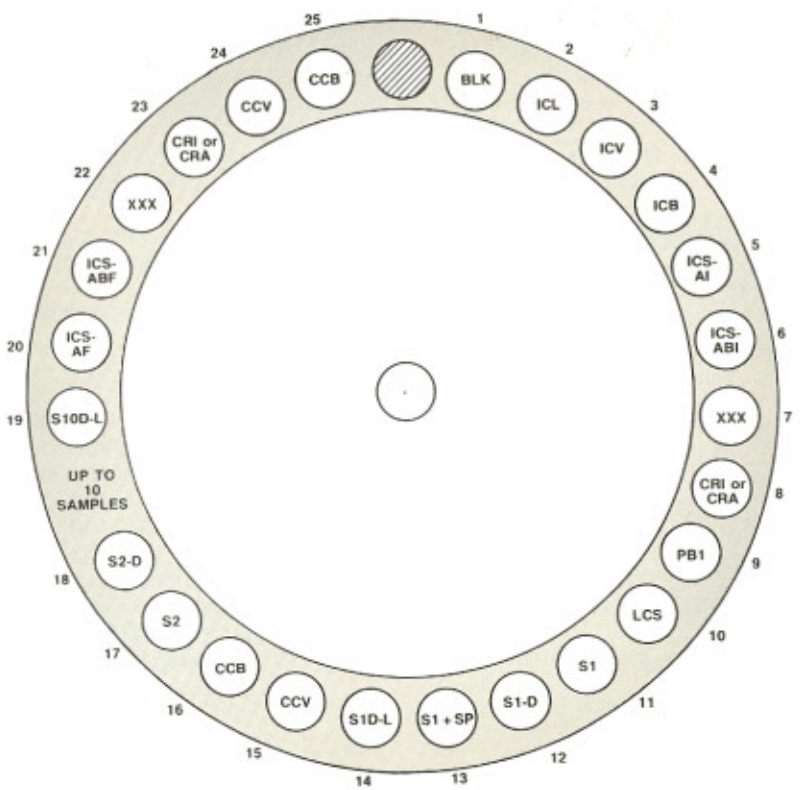
Standards For The Contract Laboratory Program

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-AI . . . . . Initial interferents, A: SPEX INT-A1 and INT-A2
6. ICS-ABI . . . . . Initial interferents 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 interferents: 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 interferents, A: SPEX INT-A1 and INT-A2
21. ICS-ABF . . . . Final interferents, and analytes, AB SPEX INTA-1, INT-A2, INTB-1, INT-B2
22. XXX . . . . . "Throw-away" sample: used to clean torch of high levels of interferents: 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

- **Calibration Test Solutions for ICP Spectrometers**
- **Primary and Secondary Drinking Water Metals**
- **Extracted Metal Pollutants from Solid Wastes**
- **Metal Pollutants in Ground Water**
- **Trace Metals in Fish**
- **ICP Interference Check Standards**
- **Matrix Blanks**
- **Quality Control Standards**

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 for CLP are prepared from single-element concentrates. These

concentrates are tested in the exact manner that the plasma single-element solution standards are. A **triple-checked Quality Control Check** is performed: (1) DC ARC for trace metal impurities (2) classical "wet" assay for major element (3) ICP check for major element.

A 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 matrixes 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 four 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 section 5.5.1 and also method 200.7 section 7.5.1.

Nitric Acid Blank
PLBLK-HNO3 . . . . . 500ml
Matrix 5% HNO_3 in ASTM Type I Water

Hydrochloric Acid Blank
PLBLK-HCL 500ml
Matrix 5% HCl in ASTM Type I Water

Water Blank
PLBLK-H2O 500ml
Matrix ASTM Type I Water

Mixed Multi-Element Calibration Standards

The following series of five calibration standards are provided for routine instrument calibration. The concentrations and matrixes 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 EPA SW-846, method 6010 section 5.4 and also method 200.7 section 7.4.

Mixed Calibration Standard 1

MIXSTD1-100 . . . . . 100ml
MIXSTD1-500 . . . . . 500ml
Matrix 2% HNO_3

Beryllium 50ug/ml
Cadmium 150ug/ml
Lead 500ug/ml
Manganese 100ug/ml
Selenium 200ug/ml
Zinc 150ug/ml

Mixed Calibration Standard 2

MIXSTD2-100 . . . . . 100ml
MIXSTD2-500 . . . . . 500ml
Matrix 5% HNO_3

Barium 100ug/ml
Cobalt 100ug/ml
Copper 100ug/ml
Iron 10,000ug/ml
Vanadium 100ug/ml

Mixed Calibration Standard 3

MIXSTD3-100 . . . . . 100ml
MIXSTD3-500 . . . . . 500ml
Matrix 2% HNO_3

Arsenic 500ug/ml
Molybdenum 100ug/ml
Silicon 100ug/ml

Mixed Calibration Standard 4

MIXSTD4-100 . . . . . 100ml
MIXSTD4-500 . . . . . 500ml
Matrix 5% HNO_3

Aluminum 200ug/ml
Calcium 1,000ug/ml
Chromium 20ug/ml
Nickel 20ug/ml
Potassium 400ug/ml
Sodium 200ug/ml

Mixed Calibration Standard 5

MIXSTD5-100 . . . . . 100ml
MIXSTD5-500 . . . . . 500ml
Matrix 5% HNO_3

Antimony 200ug/ml
Boron 100ug/ml
Magnesium 1,000ug/ml
Silver 50ug/ml
Thallium 200ug/ml

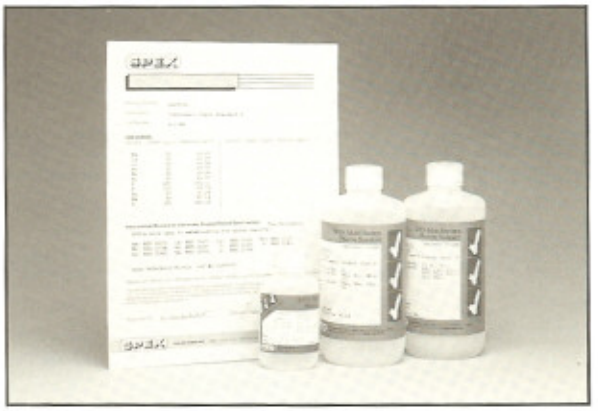
Set of 5 Mixed Calibration Standards

MIXSTD-SET
Includes one each of:

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

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. For use in EPA SW-846, Method 6010 section 5.6 and method 200.7 section 7.6.1

Instrument Check Standard 1

CALMIX1-100 . . . . . 100ml
CALMIX1-500 . . . . . 500ml
Matrix 2% HNO_3

Aluminum 10ug/ml
Barium 1ug/ml
Beryllium 1ug/ml
Boron 10ug/ml
Calcium 1ug/ml
Nickel 10ug/ml
Phosphorus 100ug/ml
Scandium 1ug/ml
Zinc 10ug/ml

Instrument Check Standard 2

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

Barium 50ug/ml
Beryllium 20ug/ml
Lanthanum 20ug/ml
Manganese 20ug/ml
Nickel 20ug/ml
Scandium 20ug/ml
Zinc 20ug/ml

Instrument Check Standard 3

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

Arsenic 20ug/ml
Lanthanum 20ug/ml
Lithium 20ug/ml
Manganese 20ug/ml
Molybdenum 20ug/ml
Nickel 20ug/ml
Phosphorus 100ug/ml
Potassium 100ug/ml
Scandium 20ug/ml
Sodium 20ug/ml
Sulfur 100ug/ml

Instrument Check Standard 4

CALMIX4-100 . . . . . 100ml
CALMIX4-500 . . . . . 500ml
Matrix 2% HNO_3

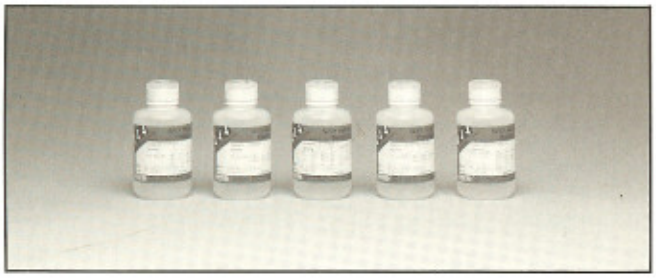
Aluminum 10ug/ml
Arsenic 10ug/ml
Barium 1ug/ml
Copper 10ug/ml
Lead 10ug/ml
Manganese 10ug/ml
Nickel 10ug/ml
Phosphorus 10ug/ml
Potassium 50ug/ml
Scandium 10ug/ml
Sodium 10ug/ml
Zinc 10ug/ml

Instrument Check Standard 7

CALMIX7-100 . . . . . 100ml
CALMIX7-500 . . . . . 500ml
Matrix 2% HNO_3

Aluminum 100ug/ml
Arsenic 100ug/ml
Cadmium 100ug/ml
Chromium 100ug/ml
Cobalt 100ug/ml
Copper 100ug/ml
Iron 100ug/ml
Lead 100ug/ml
Magnesium 100ug/ml
Manganese 100ug/ml
Nickel 100ug/ml
Potassium 100ug/ml
Sodium 100ug/ml
Zinc 100ug/ml
Yttrium 600ug/ml

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_3

Beryllium 10ug/ml
Magnesium 10ug/ml
Cobalt 10ug/ml
Nickel 10ug/ml
Indium 10ug/ml
Cerium 10ug/ml
Lead 10ug/ml
Bismuth 10ug/ml
Uranium 10ug/ml

The following group of multi-element standards was 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.

ICPMS-1 . . . . . 100ml
Matrix 5% HNO_3

Cerium 10ug/ml
Dysprosium 10ug/ml
Erbium 10ug/ml
Europium 10ug/ml
Gadolinium 10ug/ml
Holmium 10ug/ml
Lanthanum 10ug/ml
Lutetium 10ug/ml
Neodymium 10ug/ml
Praseodymium 10ug/ml
Samarium 10ug/ml
Scandium 10ug/ml
Terbium 10ug/ml
Thorium 10ug/ml
Thulium 10ug/ml
Yttrium 10ug/ml
Ytterbium 10ug/ml

ICPMS-2 . . . . . 100ml
Matrix 5% HNO_3

Silver 10ug/ml
Aluminum 10ug/ml
Arsenic 10ug/ml
Barium 10ug/ml
Beryllium 10ug/ml
Bismuth 10ug/ml
Calcium 10ug/ml
Cadmium 10ug/ml
Cobalt 10ug/ml
Chromium 10ug/ml
Cesium 10ug/ml
Copper 10ug/ml
Iron 10ug/ml
Gallium 10ug/ml
Mercury 10ug/ml
Indium 10ug/ml
Potassium 10ug/ml
Lithium 10ug/ml
Magnesium 10ug/ml
Manganese 10ug/ml
Sodium 10ug/ml
Nickel 10ug/ml
Lead 10ug/ml
Rubidium 10ug/ml
Selenium 10ug/ml
Strontium 10ug/ml
Thallium 10ug/ml
Vanadium 10ug/ml
Uranium 10ug/ml
Zinc 10ug/ml
** Mercury is supplied as a seperate solution due to incompatability with other elements.

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

Gold 10ug/ml
Iridium 10ug/ml
Palladium 10ug/ml
Platinum 10ug/ml
Rhodium 10ug/ml
Ruthenium 10ug/ml
Tin 10ug/ml
Tellurium 10ug/ml
Hafnium 10ug/ml
Antimony 10ug/ml

ICPMS-4 . . . . . 100ml
Matrix H_20 with a trace of HF

Boron 10ug/ml
Germanium 10ug/ml
Molybdenum 10ug/ml
Niobium 10ug/ml
Phosphorus 10ug/ml
Rhenium 10ug/ml
Sulfur 10ug/ml
Silicon 10ug/ml
Tantalum 10ug/ml
Titanium 10ug/ml
Tungsten 10ug/ml
Zirconium 10ug/ml

ICPMS-SET
Includes one each of:

ICPMS-1 ICPMS-3
ICPMS-2 ICPMS-4
*ICPMS-H2O *ICPMS-HCL
*ICPMS-HNO3
*Blanks are the same lots as the set matrixes.

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 section 5.7 and method 200.7 section 7.6.2.

Interference Check Standard, 18

INTER18-100 ..... 100ml
INTER18-500 ..... 500ml
Matrix 5% HNO_3

Arsenic 1,000ug/ml
Barium 300ug/ml
Beryllium 100ug/ml
Cadmium 300ug/ml
Chromium 300ug/ml
Cobalt 300ug/ml
Copper 300ug/ml
Lead 1,000ug/ml
Manganese 200ug/ml
Mercury 50ug/ml
Nickel 300ug/ml
Potassium 20,000ug/ml
Selenium 500ug/ml
Silver 300ug/ml
Thallium 1,000ug/ml
Vanadium 300ug/ml
Zinc 300ug/ml

Interference Check Standard, 3

INTER3-100 ..... 100ml
INTER3-500 ..... 500ml
Matrix 5% HNO_3

Boron 500ug/ml
Molybdenum 300ug/ml
Silicon 230ug/ml
Titanium 1,000ug/ml

Interference Check Standard, 1

INTER1-100 ..... 100ml
INTER1-500 ..... 500ml
Matrix 2% HNO_3

Antimony 1,000ug/ml

Interference Check Standard, 5

INTER5-100 ..... 100ml
INTER5-500 ..... 500ml
Matrix 5% HNO_3

Aluminum 1,200ug/ml
Calcium 6,000ug/ml
Iron 5,000ug/ml
Magnesium 3,000ug/ml
Sodium 1,000ug/ml

Set of 4 Interference Check Standards

INTER-SET
Includes 1 each of:

INTER18-100
INTER3-100
INTER1-100
INTER5-100

Environmental EPA Set

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

EPA-SET
Includes one each of:

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

INTER18-100
INTER3-100
INTER5-100
INTER1-100

PLBLK-HNO3
PLBLK-HCL

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_3

Arsenic 100ug/ml
Cadmium 5ug/ml
Chromium 20ug/ml
Copper 50ug/ml
Lead 10ug/ml
Mercury 100ug/ml
Nickel 20ug/ml
Selenium 10ug/ml
Zinc 1,000ug/ml

Quality Control Standards

Quality control standards for trace metal analysis. These standards can be used to check the standard curve, the procedure for inter-element correction and other spectral interferences.

For US EPA method 200.7 and EPA methods manual 600/482-055 "Technical Additions to Methods for Chemical Analysis of Water and Wastes."

Quality Control Standard, 19

QC-19 . . . . 100ml
QC-19-500 . . . . 500ml
Matrix 5% HNO_3

Antimony 100ug/ml
Arsenic 100ug/ml
Beryllium 100ug/ml
Cadmium 100ug/ml
Calcium 100ug/ml
Chromium 100ug/ml
Cobalt 100ug/ml
Copper 100ug/ml
Iron 100ug/ml
Lead 100ug/ml
Magnesium 100ug/ml
Manganese 100ug/ml
Molybdenum 100ug/ml
Nickel 100ug/ml
Selenium 100ug/ml
Thallium 100ug/ml
Titanium 100ug/ml
Vanadium 100ug/ml
Zinc 100ug/ml

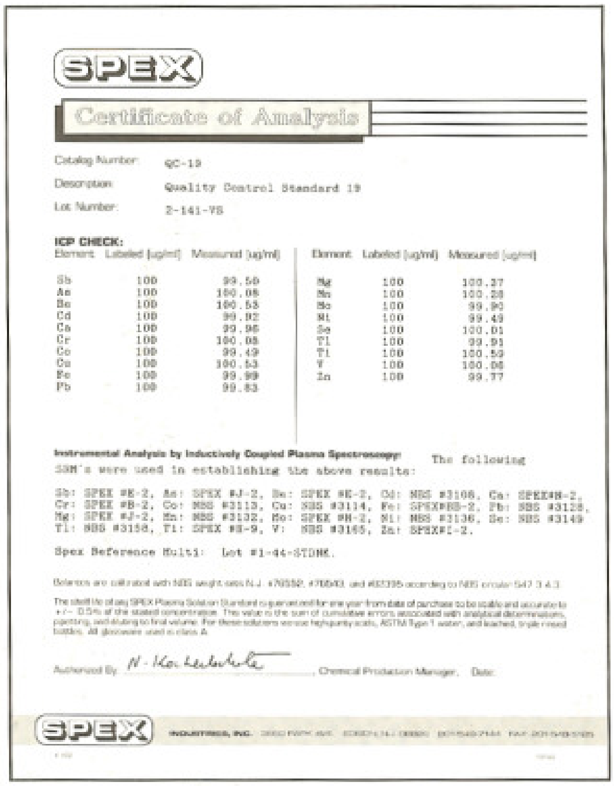
Quality Control Standard 7

QC-7 . . . . 100ml
QC-7-500 . . . . 500ml
Matrix 5% HNO_3

Aluminum 100ug/ml
Barium 100ug/ml
Boron 100ug/ml
Potassium 1,000ug/ml
Silicon 50ug/ml
Silver 100ug/ml
Sodium 100ug/ml

Set of 2 Quality Control Standards

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



SPEX

Certificate of Analysis

Catalog Number: QC-19
Description: Quality Control Standard 19
Lot Number: 2-141-VS

ICP CHECK:

Element	Labeled (ug/ml)	Measured (ug/ml)	Element	Labeled (ug/ml)	Measured (ug/ml)
Sb	100	99.50	Mg	100	100.27
As	100	100.08	Mn	100	100.28
Be	100	100.53	Mo	100	99.90
Cd	100	99.92	Ni	100	99.49
Ca	100	99.96	Se	100	100.01
Cr	100	100.08	Tl	100	99.91
Co	100	99.49	Ti	100	100.59
Cu	100	100.53	V	100	100.06
Fe	100	99.99	Zn	100	99.77
Pb	100	99.83			

Instrumental Analysis by Inductively Coupled Plasma Spectroscopy: The following SRM's were used in establishing the above results:

Sb: SPEX #E-2, As: SPEX #J-2, Be: SPEX #E-2, Cd: NBS #3108, Ca: SPEX#H-2, Cr: SPEX #B-2, Co: NBS #3113, Cu: NBS #3114, Fe: SPEX#BB-2, Pb: NBS #3128, Mg: SPEX #J-2, Mn: NBS #3132, Mo: SPEX #H-2, Ni: NBS #3136, Se: NBS #3149 Tl: NBS #3158, Ti: SPEX #E-9, V: NBS #3165, Zn: SPEX#I-2.

Spex Reference Multi: Lot #1-44-STDHK.

Balances are calibrated with NBS weight sets N.J. #70552, #70640, and #83395 according to NBS circular 547 3.4.3

The shelf life of any SPEX Plasma Solution Standard is guaranteed for one year from date of purchase to be stable and accurate to +/- 0.5% of the stated concentration. This value is the sum of cumulative errors associated with analytical determinations, pipetting, and diluting to final volume. For these solutions we use high purity acids, ASTM Type 1 water, and leached, triple rinsed bottles. All glassware used is class A.

Authorized By N. Kochelsheka, Chemical Production Manager, Date:

SPEX INDUSTRIES, INC.

Drinking Water Pollutant Standards

The standards below are for use procedures for compliance monitoring of drinking water and for the analysis of ground and surface water where determination at the drinking water contaminent levels are required. US EPA SW-846, method 1310 and US National Primary Drinking Water Regulations 40 CRF Part 141.

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

Primary Drinking Water Metals

EP-8 . . . . 100ml
EP-8-500 . . . . 500ml
Matrix 2% HNO_3

Arsenic 10ug/ml
Barium 100ug/ml
Cadmium 5ug/ml
Chromium 10ug/ml
Lead 10ug/ml
Selenium 5ug/ml
Silver 10ug/ml
Mercury 10ug/ml

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

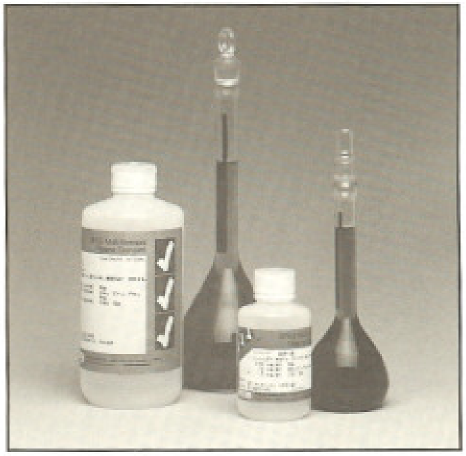
Secondary Drinking Water Metals

EP-4 . . . . 100ml
EP-4-500 . . . . 500ml
Matrix 2% HNO_3

Copper 100ug/ml
Iron 30ug/ml
Manganese 5ug/ml
Zinc 500ug/ml

Set of 2 Drinking Water Standards

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



Ground Water and Waste Water 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 I, II and III methods.

Trace Metals I

WP-15 ..... 100ml
WP-15-500 ..... 500ml
Matrix 5% HNO_3

Aluminum 500ug/ml
Arsenic 100ug/ml
Beryllium 100ug/ml
Cadmium 25ug/ml
Chromium 100ug/ml
Cobalt 100ug/ml
Copper 100ug/ml
Iron 100ug/ml
Lead 100ug/ml
Manganese 100ug/ml
Mercury 5ug/ml
Nickel 100ug/ml
Selenium 25ug/ml
Vanadium 250ug/ml
Zinc 100ug/ml

Trace Metals II

WP-3 ..... 100ml
WP-3-500 ..... 500ml
Matrix 2% HNO_3

Antimony 20ug/ml
Silver 10ug/ml
Thallium 20ug/ml

Trace Metals III

MN-6 ..... 100ml
MN-6-500 ..... 500ml
Matrix 2% HNO_3

Barium 500ug/ml
Calcium 500ug/ml
Magnesium 100ug/ml
Molybdenum 500ug/ml
Potassium 100ug/ml
Sodium 500ug/ml

Set of 3 Trace Metals

TM-SET
Includes one each of:

WP-15
WP-3
MN-6

Alternate Water Pollution and Waste Water Standards for ICP and AA

Alternate Metals I

WP-11 ..... 100ml
WP-11-500 ..... 500ml
Matrix 2% HNO_3

Aluminum 20ug/ml
Antimony 5ug/ml
Beryllium 5ug/ml
Cobalt 10ug/ml
Copper 10ug/ml
Iron 20ug/ml
Manganese 10ug/ml
Nickel 10ug/ml
Thallium 5ug/ml
Vanadium 20ug/ml
Zinc 10ug/ml

Alternate Metals III

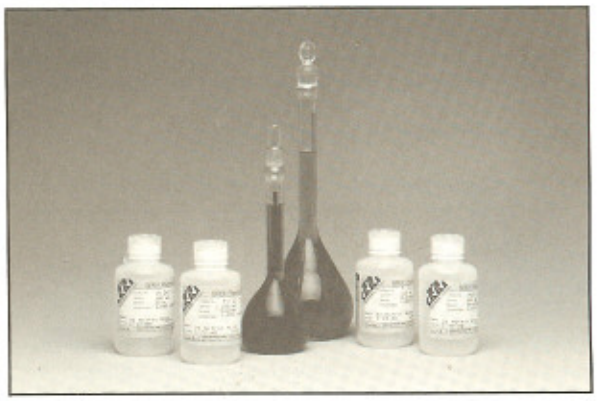
MN-4 ..... 100ml
MN-4-500 ..... 500ml
Matrix 2% HNO_3

Calcium 500ug/ml
Magnesium 100ug/ml
Potassium 100ug/ml
Sodium 500ug/ml

AM-SET
Includes one each of:

WP-11
MN-4

Plasma Emission Solution Standard Kit



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 concentration and in 100ml quantities. Elements are supplied in the most common matrixes 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, however, easily be 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 concentration in the matrix specified:

Matrix 2% HNO_3:	Al, Sb, As, Ba, Be, Bi, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Ni, K, Sc, Se, Ag, Na, Sr, Tl, V, Y, Zn and Zr
Matrix H_2O:	B, Mo, Nb, P, Si, S, Ti and W
Matrix 20% HCl (in Teflon):	Sn
Matrix 10% HNO_3:	Hg

High-Purity Compound Kits For Custom Solution Standard Preparation

- **6 Kits — 72 Elements**
- **Highest Purity, Non-hygroscopic Compounds**
- **Prepare Single or Multi-Element Standards**
- **Stable in HCl and/or HNO_3**
- **Rapid Dissolution— Inter-element Compatibility**
- **Certified Assay— Trace Metals Analysis**

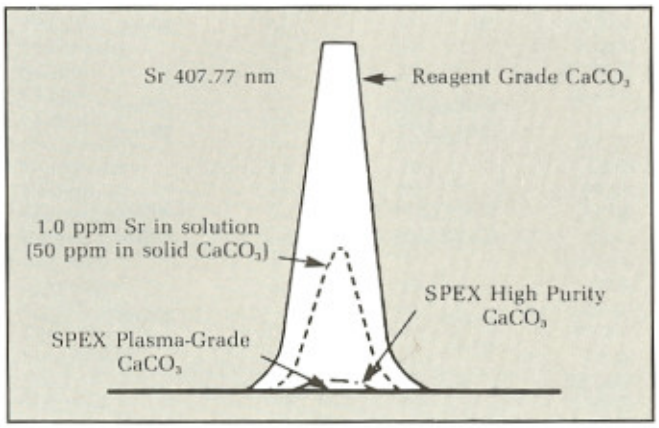
If your laboratory cannot predict analysis problems week-to-week or even day-to-day, then you need even more flexibility than offered by SPEX custom solution standards. SPEX High-Purity Compound Kits are the ideal solution. Single-element or multi-element standards can be made on the spot in response 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 comprising seventy-two spectroscopically pure compounds. All seventy-two compounds are readily soluble and stable in aqueous HCL or HNO_3 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. 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 $CaCO_3$ 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 $CaCO_3$ 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

SPEX Compound Kits are convenient and economical for shipping. The lightweight kits are securely packaged in foam-lined cases with individual compounds sealed in pre-cleaned, non-contaminating, screw-cap polyethylene bottles.

PL-K10: **Main Group Element Kit:**
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.

PL-K20: **Transition Elements/Non-Metals Elements Kit:**
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.

PL-K30: **Rare Earth Elements Kit:**
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.

PL-K40: **Precious Metals Kit:**
Contains 1 gram equivalent of each of the following eight elements: Ru, Rh, Pd, Ag, Os, Ir, Pt, Au.

PL-K50: **Inter-element Correction Kit:**
Contains 2 gram equivalents of each of the following eleven elements: Al, Fe, Ca, Mg, Ti, Mo, Cu, Zn, Cr, Si, Zr.

PL-K60: **Inorganic Priority Pollutant Kit:**
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 equalivants.
PLK20-xx (specify element), 2 gram equalivents.
PLK30-xx (specify element), 2 gram equalivents.
PLK40-xx (specify element), 1 gram equalivent.

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
	Nickel Nitrate Solution		
MMNI4-100	5% (50,000 ppm) Nickel in 5-10% HNO_3	Ni	100ml
MMNI4-500	5% (50,000 ppm) Nickel in 5-10% HNO_3	Ni	500ml
	Ammonium Phosphate Solution		
MMP9-100	40% (400,000 ppm) Ammonium Phosphate in H_2O	$(NH_4)_2HPO_4$	100ml
MMP9-500	40% (400,000 ppm) Ammonium Phosphate in H_2O	$(NH_4)_2HPO_4$	500ml
	Calcium Nitrate Solution		
MMCA2-100	2% (20,000 ppm) Calcium in 5% HNO_3	$Ca(NO_3)_2 \cdot 4H_2O$	100ml
MMCA2-500	2% (20,000 ppm) Calcium in 5% HNO_3	$Ca(NO_3)_2 \cdot 4H_2O$	500ml
	Lanthanum Nitrate Solution		
MMLA2-100	5% (50,000 ppm) Lanthanum in 2-5% HNO_3	La_2O_3	100ml
MMLA2-500	5% (50,000 ppm) Lanthanum in 2-5% HNO_3	La_2O_3	500ml
	Lanthanum Chloride Solution		
MMLA1-100	5% (50,000 ppm) Lanthanum in 2-5% HCL	La_2O_3	100ml
MMLA1-500	5% (50,000 ppm) Lanthanum in 2-5% HCL	La_2O_3	500ml
	Ammonium Nitrate Solution		
MMNO2-100	5% (50,000 ppm) Ammonium Nitrate in 2% HNO_3	NH_4NO_3	100ml
MMNO2-500	5% (50,000 ppm) Ammonium Nitrate in 2% HNO_3	NH_4NO_3	500ml
	Palladium Nitrate Solution		
MMPD4-100	2% (20,000 ppm) Palladium in 5-10% HNO_3	Pd	100ml
MMPD4-500	2% (20,000 ppm) Palladium in 5-10% HNO_3	Pd	500ml
	Magnesium Nitrate Solution		
MMMG2-100	2% (20,000 ppm) Magnesium in 2-5% HNO_3	Mg	100ml
MMMG2-500	2% (20,000 ppm) Magnesium in 2-5% HNO_3	Mg	500ml

Atomic Weights Based on Carbon-12

Element	Atomic Symbol	Atomic Number	Weight
Actinium	Ac	89	227.028
Aluminum	Al	13	26.9815
Americium	Am	95	(243)
Antimony	Sb	51	121.75
Argon	Ar	18	39.948
Arsenic	As	33	74.9216
Astatine	At	85	(210)
Barium	Ba	56	137.33
Berkelium	Bk	97	(247)
Beryllium	Be	4	9.0122
Bismuth	Bi	83	208.980
Boron	B	5	10.811
Bromine	Br	35	79.904
Cadmium	Cd	48	112.41
Calcium	Ca	20	40.08
Californium	Cf	98	(251)
Carbon	C	6	12.011
Cerium	Ce	58	140.12
Cesium	Cs	55	132.905
Chlorine	Cl	17	35.453
Chromium	Cr	24	51.996
Cobalt	Co	27	58.9332
Copper	Cu	29	63.546
Curium	Cm	96	(247)
Dysprosium	Dy	66	162.50
Einsteinium	Es	99	(254)
Erbium	Er	68	167.26
Europium	Eu	63	151.96
Fermium	Fm	100	(257)
Fluorine	F	9	18.9984
Francium	Fr	87	(223)
Gadolinium	Gd	64	157.25
Gallium	Ga	31	69.735
Germanium	Ge	32	72.59
Gold	Au	79	196.967
Hafnium	Hf	72	178.49
Helium	He	2	4.0026
Holmium	Ho	67	164.930
Hydrogen	H	1	1.00797
Indium	In	49	114.82
Iodine	I	53	126.9045
Iridium	Ir	77	192.22
Iron	Fe	26	55.847
Krypton	Kr	36	83.80
Lanthanum	La	57	138.905
Lawrencium	Lr	103	(260)
Lead	Pb	82	207.2
Lithium	Li	3	6.941
Lutetium	Lu	71	174.97
Magnesium	Mg	12	24.305
Manganese	Mn	25	54.9380
Mendelevium	Md	101	(258)
Mercury	Hg	80	200.59
Molybdenum	Mo	42	95.94
Neodymium	Nd	60	144.24
Neon	Ne	10	20.179
Neptunium	Np	93	237.048
Nickel	Ni	28	58.71
Niobium	Nb	41	92.906
Nitrogen	N	7	14.0067
Nobelium	No	102	(259)
Osmium	Os	76	190.2
Oxygen	O	8	15.994
Palladium	Pd	46	106.4
Phosphorus	P	15	30.9738
Platinum	Pt	78	195.09
Plutonium	Pu	94	(244)
Polonium	Po	84	(209)
Potassium	K	19	39.0983
Praseodymium	Pr	59	140.907
Promethium	Pm	61	(145)
Protactinium	Pa	91	231.036
Radium	Ra	88	226.0254
Radon	Rn	86	(222)
Rhenium	Re	75	186.207
Rhodium	Rh	45	102.905
Rubidium	Rb	37	85.467
Ruthenium	Ru	44	101.07
Samarium	Sm	62	150.4
Scandium	Sc	21	44.956
Selenium	Se	34	78.96
Silicon	Si	14	28.086
Silver	Ag	47	107.87
Sodium	Na	11	22.9898
Strontium	Sr	38	87.62
Sulfur	S	16	32.06
Tantalum	Ta	73	180.948
Technetium	Tc	43	98.9062
Tellurium	Te	52	127.60
Terbium	Tb	65	158.925
Thallium	Tl	81	204.37
Thorium	Th	90	232.038
Thulium	Tm	69	168.934
Tin	Sn	50	118.69
Titanium	Ti	22	47.90
Tungsten	W	74	183.85
Uranium	U	92	238.029
Vanadium	V	23	50.9415
Xenon	Xe	54	131.30
Ytterbium	Yb	70	173.04
Yttrium	Y	39	88.9059
Zinc	Zn	30	65.38
Zirconium	Zr	40	91.22

Conversion Table

1 microgram (ug) = 1×10^{-6} grams (g)
1 milligram (mg) = 0.001 grams (g)
1 kilogram (kg) = 1000 grams (g) = 2.2046226 lbs
1 pound (lb) = 453.59237 grams (g)

1 milliliter (ml) = 0.001 liters (l)
1 liter (l) = 1000 milliliters (ml)
1 liter (l) = 0.26417205 gallons (gal)
1 gallon (gal) = 3.7854118 liters (l)
1 ug/ml = 1 part per million (ppm) = 1ug/g*

1 ug/l = 1 part per billion (ppb)
1 mg/ml = 1000 ppm = 1mg/g*
1 mg/l = 1 ppm
1 ppm = 1000 ppb
1 ppb = .001 ppm

10,000 ppm of metal = 10g of metal/l = 1% of metal
1,000 ppm of metal = 1g of metal/l = 0.1% of metal
100 ppm of metal = 0.1g of metal/l = 0.01% of metal
*** By weight**

Now Available

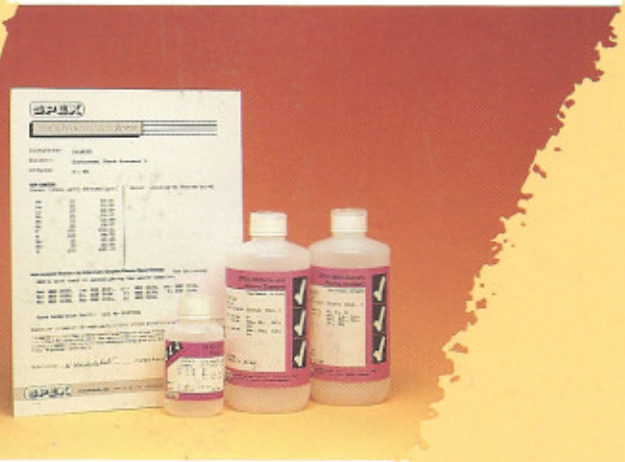
Multi-Element Environmental Standards

- CLP for Superfund, RCRA
- EPA Solid Waste, SW-846
- Clean Water Act, Method 200.7
- Primary Drinking Water Regulations

Quality
Standards for ICP, DCP, AA, OES and X-Ray Spectroscopy with the SPEX stability guarantee and certificate of analysis.

Reliability
Triple-checked by our unique quality assurance system: DC arc, wet assay and ICP analysis. NBS documentation provided.

Convenience
Save time, money and man-hours. Choose size, concentration, matrix and element. Off-the-shelf, pre-packaged or customized standards for an *exact* application match.



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