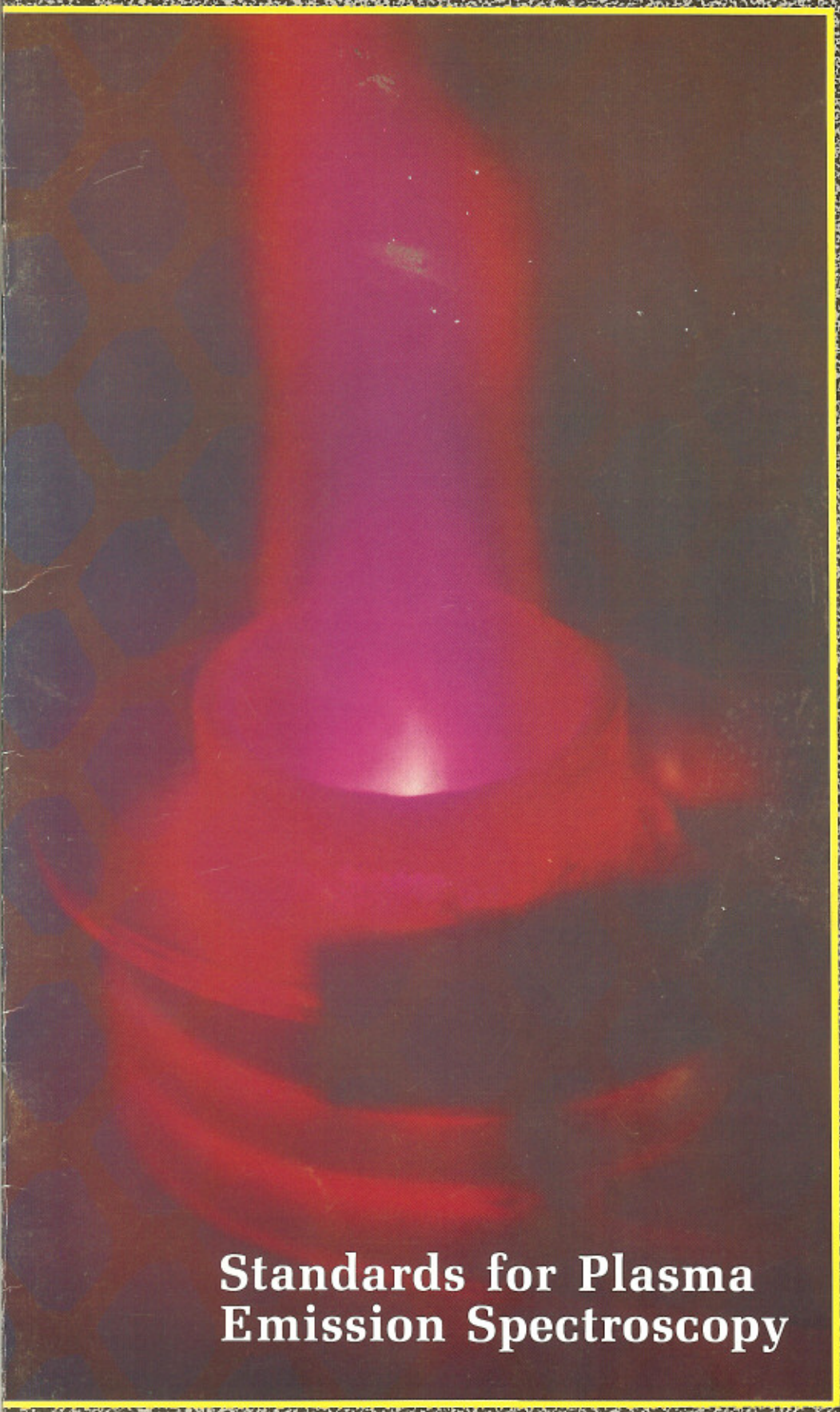


Standards for Plasma Emission Spectroscopy

Standards

Plasma Standards

SPEX

QUALITY, RELIABILITY, AND CONVENIENCE

For over 30 years SPEX Industries has been your source for speciality 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 or DCP 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, and high-purity compound 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 PL singles and multi-element solution standards are your assurances of quality.

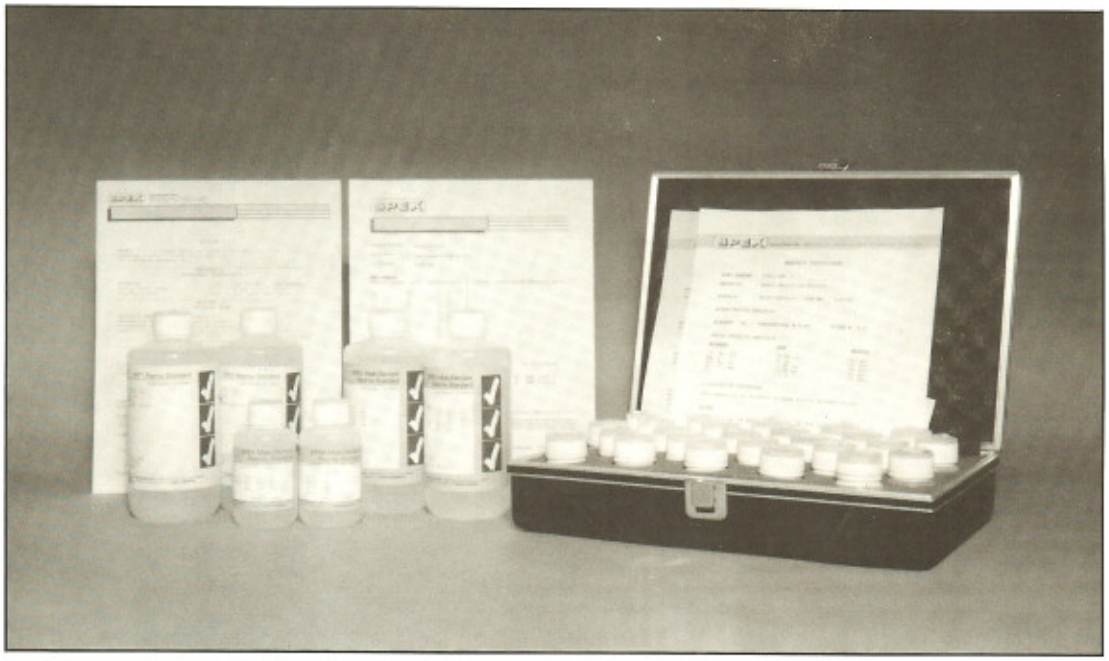
Reliability: For over three decades spectroscopists have relied on SPEX. All of our standards are triple checked, starting with a semi-quantitative trace impurity analysis via DC arc through gravimetric "wet" assay for major constituent, and finally ICP analysis performed on all solution standards. All titrants, balances and calibrants are traceable to the United States National Bureau of Standards 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 solution 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 ICP/DCP spectroscopy, we have 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 manufacture, 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.



Standards For Plasma Emission Spectroscopy

- High-purity starting materials
- 18 megohm/filtered water
- High-purity acids
- Pre-cleaned and leached bottles
- Wet assay, DCP and ICP documentation and certification

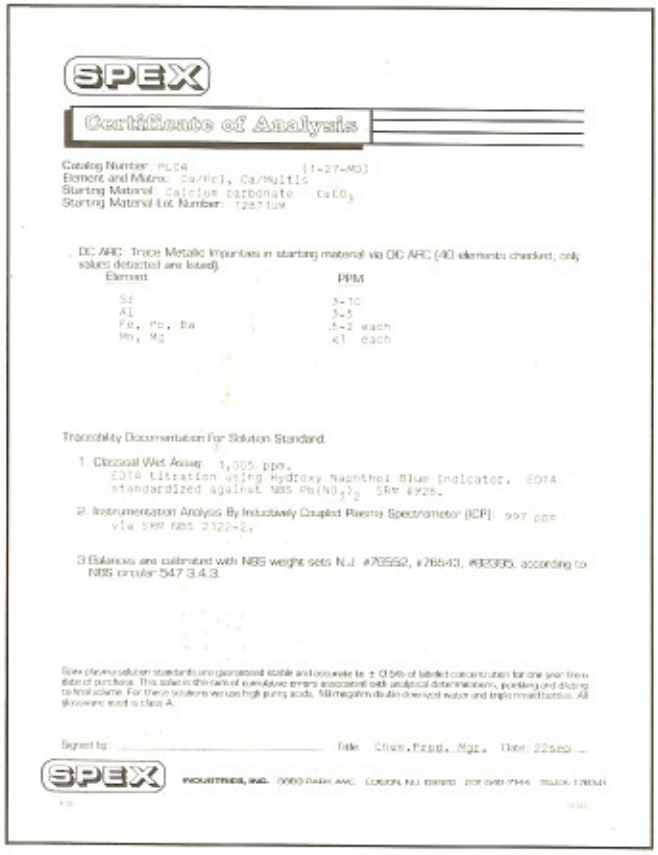
Over the last fifteen years plasma emission spectroscopy which includes the techniques of ICP, DCP, and ICP-MS, has emerged as a major analytical method in the field of elemental analysis.

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 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. SPEX standards are labeled with actual analyzed values, not theoretical percentages. 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 Bureau of Standards 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: PLCA (1-27-MO)
Element and Matrix: Ca/HCl, Ca/Multis
Starting Material: Calcium carbonate $CaCO_3$
Starting Material Lot Number: 128710M

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

Element	PPM
Sr	5-10
Al	3-5
Fe, Pb, Ba	.5-2 each
Mn, Mg	<1 each

Traceability Documentation For Solution Standard

1. Classical Wet Assay: 1,005 ppm.
EDTA titration using Hydroxy Naphthol Blue Indicator. EDTA standardized against NBS $Pb(NO_3)_2$ SRM #928.

2. Instrumentation Analysis By Inductively Coupled Plasma Spectrometer (ICP): 997 ppm
via SRM NBS 2122-2.

3 Balances are calibrated with NBS weight sets N.J. #76552, #76543, #82365, 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 allows for the build up of cumulative errors associated with analytical determinations, pipetting and diluting to final volume. For these solutions we use high purity acids, 18 megohm double distilled water and triple rinsed bottles. All glassware used is class A.

Signed by: _____ Title: Chem. Prod. Mgr. Date: 22sep ...

SPEX INDUSTRIES, INC. 0860 PARK AVE. EDISON, NJ 08820 201 549 7144 TELEX 138341

Single-Element Standards For Plasma Emission Spectroscopy

- Choice of 70 elements
- 1,000 or 10,000 ppm concentrations
- Sold in 500ml bottles
- Certification with every solution
- Alternate matrices for most elements

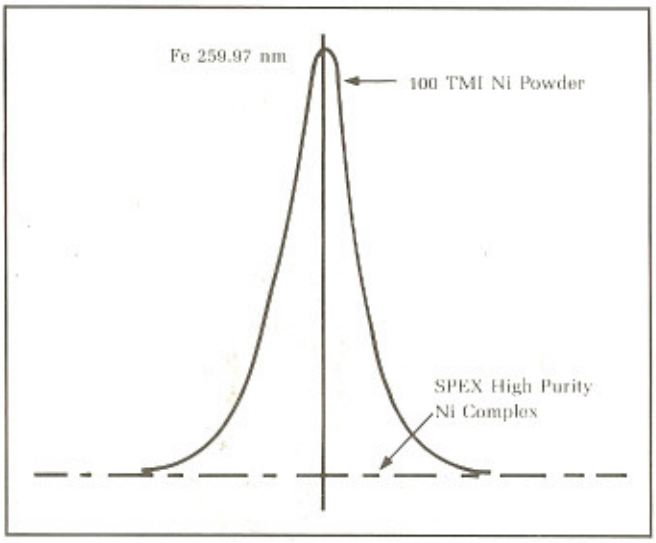
Plasma emission spectroscopy has become a popular and well accepted method for elemental analysis in diverse areas such as potable water testing, hazardous waste analysis, alloy and ceramics analysis.

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 elements 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).

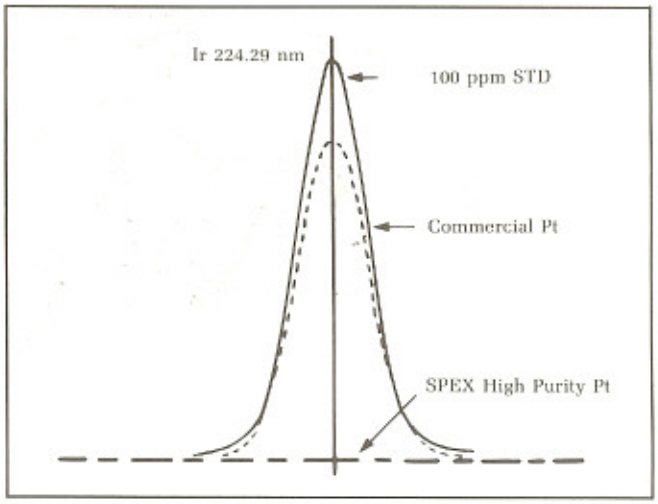
The ultra-high purity of the starting material is your assurance that detected emissions are real and are not due to unreported impurities in the calibration standard. SPEX guarantees both the purity of our solution and the concentration of the major element to +/– 0.5% for one full year from date of 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 results reported on the SPEX certificate of analysis supplied with every bottle.

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, 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 $[Ni(NH_3)_6](NO_3)_2$. 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% HNO3	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		
PLBI2-2X	Bi in 2-5% HNO_3	1,000ug/ml
PLBI2-3X		10,000ug/ml
Boron		
PLB9-2X	$(NH_4)_2B_4O_7.4H_2O$	1,000ug/ml
PLB9-3X	in 2-5% HNO_3	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		
PLCE2-2X	$Ce(NO_3)_3.6H_20$ in	1,000ug/ml
PLCE2-3X	2-5% HNO_3	10,000ug/ml

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Cesium		
PLCS2-2X	Cs_2CO_3 in 2-5% HNO_3	1,000ug/ml
PLCS2-3X		10,000ug/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	$HfOCl_2.8H_20$ in 2-5%	1,000ug/ml
PLHF1-3X		10,000ug/ml

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Holmium		
PLHO2-2X	Ho_2O_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
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	$(NH_4)_2$ MoO_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

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Niobium		
PLNB9-2X	NH_4NbF_6 in	1,000ug/ml
PLNB9-3X	H_2O/tr HF	10,000ug/ml
Palladium		
PLPD3-2X	$(NH_4)_2PdCl_4$	1,000ug/ml
PLPD3-3X	in 10% HCl	10,000ug/ml
Phosphorus		
PLP9-2X	$NH_4H_2PO_4$ in H_2O	1,000ug/ml
PLP9-3X		10,000ug/ml
Platinum		
PLPT3-2X	$H_2PtCl_6.xH_20$	1,000ug/ml
PLPT3-3X	10% HCl	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

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Sodium		
PLNA2-2X	Na_2CO_3 in 2-5% HNO_3	1,000ug/ml
PLNA2-3X		10,000ug/ml
PLNA1-2X	Na_2CO_3	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
Sulfer		
PLS9-2X	$(NH_4)_2SO_4$ in H_2O	1,000ug/ml
PLS9-3X		10,000ug/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

ELEMENT CAT. #	MATRIX	CONC. ug/ml
Tungsten		
PLW9-2X	$(NH_4)_2WO_4$ in H_2O	1,000ug/ml
PLW9-3X		10,000ug/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	V_2O_5 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		
PLZR2-2X	$ZrO(NO_3)_2$ in	1,000ug/ml
PLZR2-3X	2-5% HNO_3	10,000ug/ml
PLZR1-2X	$ZrOCl_2.8H_2O$ in	1,000ug/ml
PLZR1-3X	2-5% 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 Matrices are also available on a custom basis. Please call our sales office for quotations and information.

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 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.

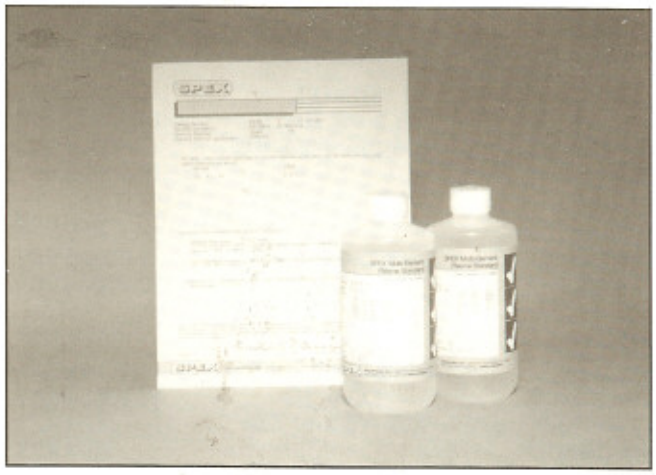
High-purity starting materials are especially important when preparing multi-element standards. A particular element in a multi-element standard can be contaminated with that element from impurities in the starting materials of the other elements in the blend. SPEX certified inorganics are ideal for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

As always, we will guarantee the result for one year from date of manufacture 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-elemental 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, solubitity and matrix requirements. You will be given a unique part number which corresponds to your particular standard and a firm price quotation.

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

Custom 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 concentrations 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 Plasma Emission Spectroscopy

- 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 ce ..fied 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.

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

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 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 five 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.

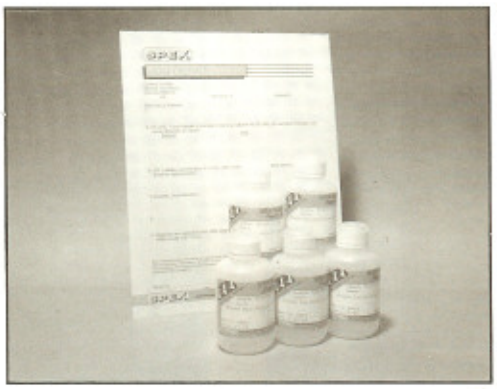
Nitric Acid Blank
PLBLK-HNO3 . . . . . 500ml
Matrix 5% HNO_3 in ASTM Type I Water

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 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 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. The internal standard (Sc) is added to enhance the color of the ICP plume as well as allow the user to perform internal reference checks or corrections.

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. Either way, a calibration check should be performed routinely on your unit.

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

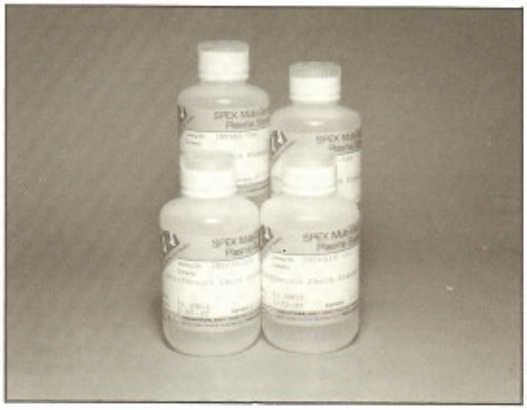
Instrument Check Standard 4

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

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 5% 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 INTER1-100
INTER3-100 INTER5-100

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
Vandium	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	1000ug/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

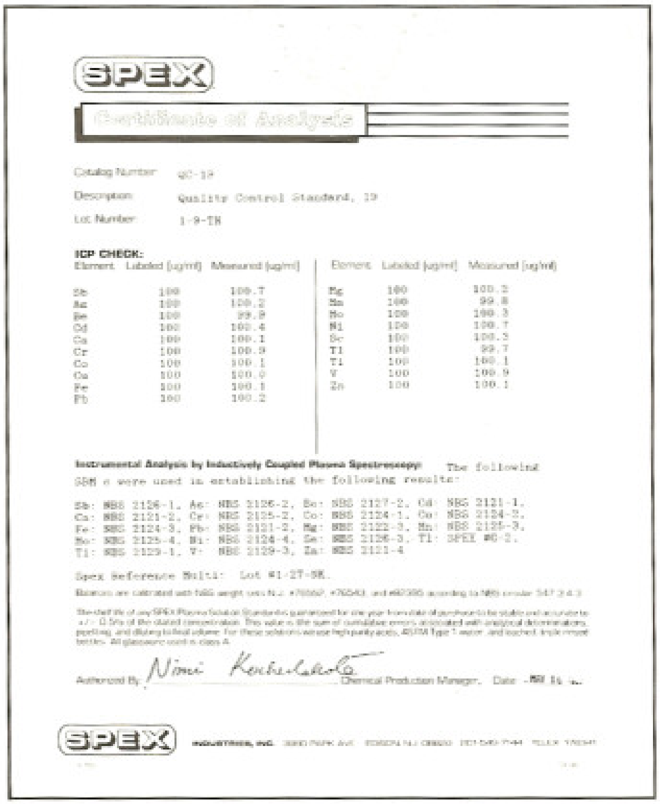
Trace Metals in Fish

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	1000ug/ml


SPEX

Certificate of Analysis

Catalog Number: QC-19
Description: Quality Control Standard, 19
Lot Number: 1-9-TH

ICP CHECK:

Element	Labeled (ug/ml)	Measured (ug/ml)	Element	Labeled (ug/ml)	Measured (ug/ml)
Sb	100	100.7	Mg	100	100.2
As	100	100.2	Mn	100	99.8
Be	100	99.9	Mo	100	100.3
Cd	100	100.4	Ni	100	100.7
Ca	100	100.1	Se	100	100.3
Cr	100	100.9	Tl	100	99.7
Co	100	100.1	Ti	100	100.1
Cu	100	100.0	V	100	100.9
Fe	100	100.1	Zn	100	100.1
Pb	100	100.2			

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

Sb: NBS 2126-1, As: NBS 2126-2, Be: NBS 2127-2, Cd: NBS 2121-1,
Ca: NBS 2121-2, Cr: NBS 2125-2, Co: NBS 2124-1, Cu: NBS 2124-2,
Fe: NBS 2124-3, Pb: NBS 2121-2, Mg: NBS 2122-3, Mn: NBS 2125-3,
Mo: NBS 2125-4, Ni: NBS 2124-4, Se: NBS 2126-3, Tl: SPEX #6-2,
Ti: NBS 2129-1, V: NBS 2129-3, Zn: NBS 2121-4

Spex Reference Multi: Lot #1-27-9K.

Authorized By: Nimi Kechelaelo Chemical Production Manager, Date:

SPEX INDUSTRIES, INC.

Drinking Water Pollutant Standards

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

Secondary metals from US EPA 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

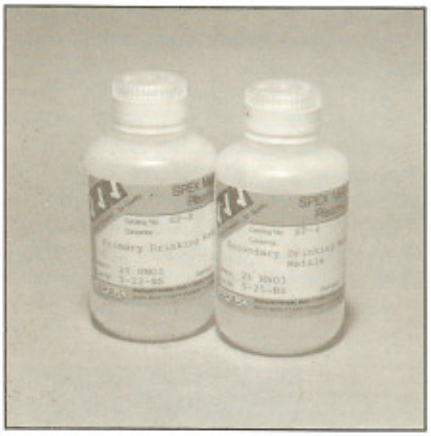
Secondary Drinking Water Metals

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 a standard or as a 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

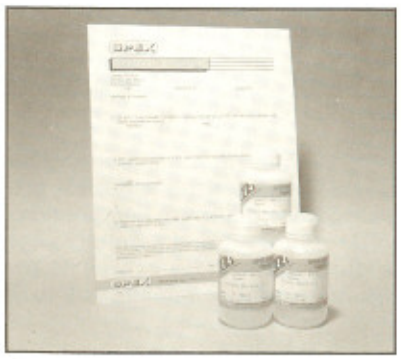
MN-6 . . . . . 100ml
MN-6-500 . . . . . 500ml
Matrix 2% HNO_3

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

Set of 2 Alternate Metal Standards

AM-SET
Includes one each of:
WP-11
MN-4

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

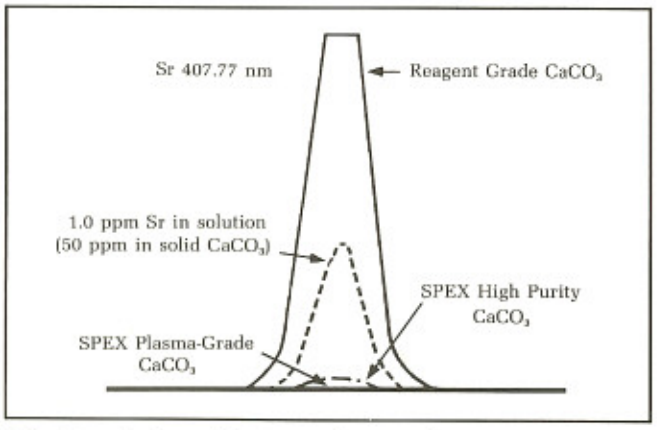
If your laboratory cannot predict analysis problems week-to-week or even day-to-day, then you need even more flexibility than offered by SPEX custom solution standards. SPEX High-Purity Compound Kits are the ideal solution. Single-element or multi-element standards can be made on the spot in response 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 HNO3 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 equivalents.
PLK20-xx	(specify element), 2 gram equivalents.
PLK30-xx	(specify element), 2 gram equivalents.
PLK40-xx	(specify element), 1 gram equivalents.

SPEX

MATERIAL

Lanthanum Carbonate

FORMULA

$La_2(CO_3)_3 \cdot XH_2O$

PURITY

LOT NUMBER

Soluble in dilute minerals acids;
Insoluble in presence of Fluorides

QUANTITATIVE ANALYSIS

Element	Theoretical %	Analyzed %
La	-	46.01

SEMIQUANTITATIVE ANALYSIS

Element	ppm
B,Mg,Si	<1 ea.
Fe,Al,Ti,Ni	<1 ea.
Mn,Ag	<1 nd ea.
Other Rare Earths	nd

SPEX INDUSTRIES, INC.
3880 PARK AVE. • EDISON, N.J. 08820
TEL: 201-549-7144 • TELEX 178341

Ordering Information

Telephone: 1-201-549-7144 or
1-800-LAB-SPEX
(1-800-522-7739)

FAX: 1-201-549-5125

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, food 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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