

Prelude and Fughetta.

VI.

TOOLS OF THE TRADE

SPEX CERTIFICATE OF ANALYSIS


Catalog Number: QC-19
Description: Quality Control Standard 19
Lot Number: 1-179-AS
ICP CHECK:



SPEX

Standards and Products
for Inorganic Spectroscopy

Periodic Table of the Elements

1 +1 -1 H 1.0079		<div><p>Quality, Reliability, Convenience</p></div> <div><p>KEY TO CHART</p><p>Atomic Number — 50 — Oxidation States</p><p>Symbol — Sn</p><p>Atomic Weight — 118.69</p></div>																2 0 He 4.00260															
3 +1 Li 6.94	4 +2 Be 9.01218																	5 +3 B 10.81	6 +2 +4 -4 C 12.011	7 +1 +2 +3 +4 +5 -1 -2 N 14.0067	8 -2 O 15.9994	9 -1 F 18.998403	10 0 Ne 20.179										
11 +1 Na 22.98977	12 +2 Mg 24.305	Transition Elements																13 +3 Al 26.98154	14 +2 +4 -4 Si 28.0855	15 +3 +5 -3 P 30.97376	16 +4 +6 -2 S 32.06	17 +1 +5 +7 -1 Cl 35.453	18 0 Ar 39.948										
																		Group 8															
19 +1 K 39.0983	20 +2 Ca 40.08	21 +3 Sc 44.9559	22 +2 +3 +4 Ti 47.90	23 +2 +3 +4 +5 V 50.9415	24 +2 +3 +6 Cr 51.996	25 +2 +3 +4 +7 Mn 54.9380	26 +2 +3 Fe 55.847	27 +2 +3 Co 58.9332	28 +2 +3 Ni 58.71	29 +1 +2 Cu 63.546	30 +2 Zn 65.38	31 +3 Ga 69.723	32 +2 +4 Ge 72.59	33 +3 +5 -3 As 74.9216	34 +4 +6 -2 Se 78.96	35 +1 +5 -1 Br 79.904	36 0 Kr 83.80																
37 +1 Rb 85.4678	38 +2 Sr 87.62	39 +3 Y 88.9059	40 +4 Zr 91.22	41 +3 +5 Nb 92.9064	42 +5 Mo 95.94	43 +4 +6 +7 Tc 98.9062	44 +3 Ru 101.07	45 +3 Rh 102.9055	46 +2 +4 Pd 106.4	47 +1 Ag 107.868	48 +2 Cd 112.41	49 +3 In 114.82	50 +2 +4 Sn 118.69	51 +2 +4 -3 Sb 121.75	52 +4 +6 -2 Te 127.60	53 +1 +5 +7 -1 I 126.9045	54 0 Xe 131.30																
55 +1 Cs 132.9054	56 +2 Ba 137.33	57* +3 La 138.9055	72 +4 Hf 178.49	73 +5 Ta 180.9478	74 +5 W 183.85	75 +4 +5 +7 Re 186.207	76 +3 +4 Os 190.2	77 +3 +4 Ir 192.22	78 +2 +4 Pt 195.09	79 +1 +3 Au 196.9665	80 +1 +2 Hg 200.59	81 +1 +3 Tl 204.37	82 +2 +4 Pb 207.2	83 +3 +5 Bi 208.9804	84 +2 +4 Po (209)	85 At (210)	86 0 Rn (222)																
87 +1 Fr (223)	88 +2 Ra 226.0254	89** +3 Ac (227)	104 +4 — (260)	105 — (260)	106 — (263)																												

*Lanthanides	58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.9254	66 Dy 162.50	67 Ho 164.9304	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967 ± 0.003
**Actinides	90 Th 232.0381	91 Pa 231.0369	92 U 238.029	93 Np 237.0482	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Table of Contents

■ Introduction	2	■ Stock Multi-Element Solution Standards for Environmental Analysis	17
■ Solution Standards for Plasma Emission Spectroscopy	3	Calibration Blanks and Matrix Blanks	17
■ Single-Element Solution Standards for Plasma Emission Spectroscopy	4-7	Mixed Multi-Element Calibration Standards.....	18
■ Plasma Emission Solution Standard Kit.....	8	Instrument Check Standards	18-19
■ High-Purity Compound Kits for Custom Solution Standard Preparation	8-9	ICP-MS Calibration Standards.....	19-20
Dilution Calculator.....	9	ICP-MS Internal Standards Stock Solution.....	20
■ Custom Multi-Element Solution Standards for Plasma Emission Spectroscopy	10	ICP-MS Tuning Solution	20
■ Stock Multi-Element Solution Standards for the Superfund Contract Laboratory Program (CLP)	11	Interference Check Standards	21
Instrument Calibration.....	12	Environmental EPA Set	21
Initial Calibration Verification.....	12	Toxicity Characteristic Leachate Procedure (TCLP).....	21
Initial Calibration Verification II.....	12-13	Quality Control Standards.....	22
Contract Required Detection Limits (CRDL).....	13	Drinking Water Pollutant Standards.....	22
Calibration Blanks and Matrix Blanks	13	Trace Metals in Fish.....	22
Interference Checks.....	14	Groundwater and Wastewater Pollution Control Check Standards.....	23
Spike Sample Analysis	14-15	Alternate Water Pollution and Wastewater Standards for ICP and AA	23
Furnace AA Calibration and Spiking.....	15	■ Solution Standards for Ion Chromatography	24
Contract Laboratory Program (CLP) Set.....	16	■ Ion Chromatography Instrument Check Standards.....	24
Standards for the Contract Laboratory Program	16	■ Matrix Modifiers	inside back cover
Typical set-up for standards, samples, and blanks.....	16		

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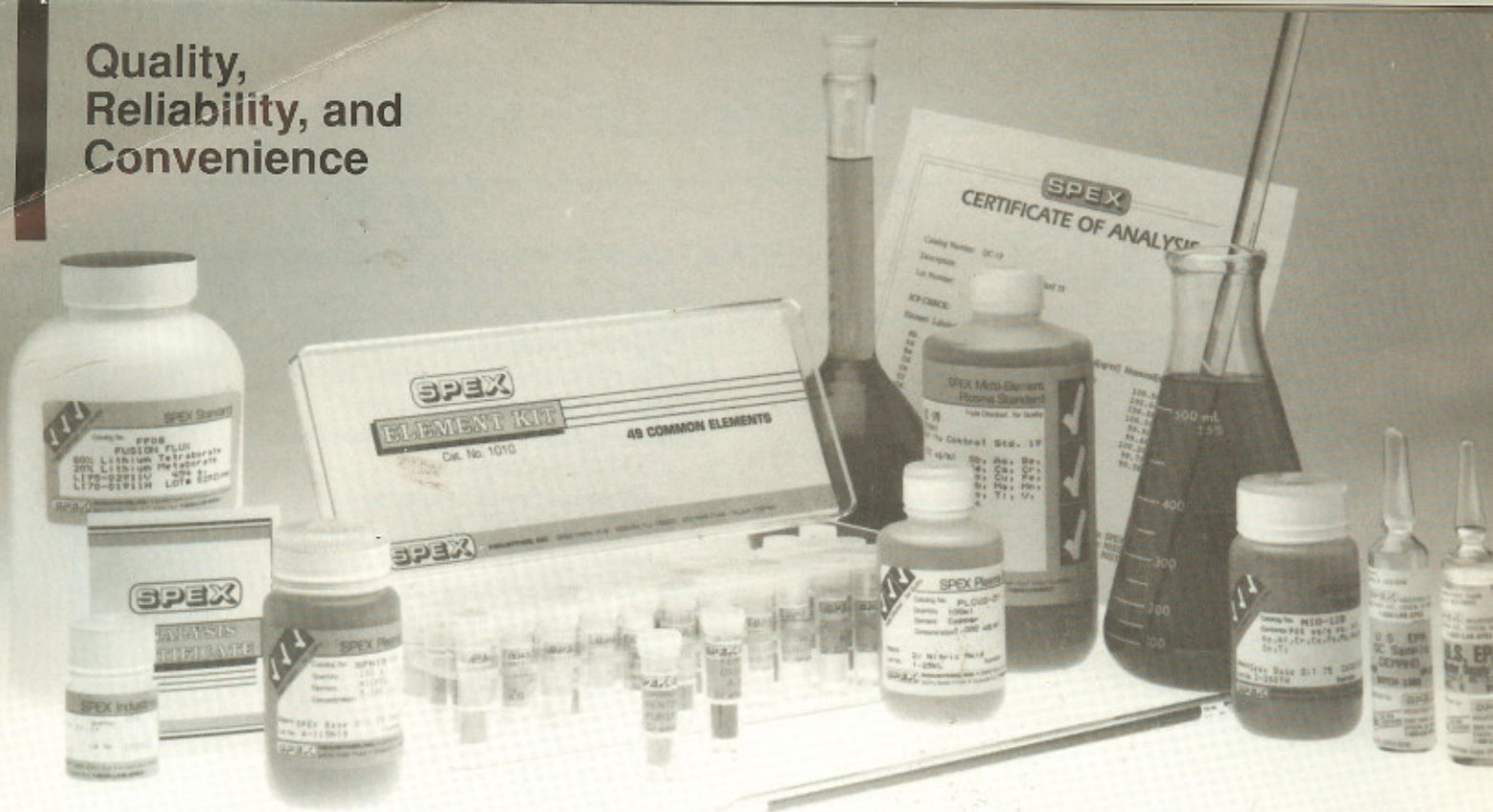
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Quality, Reliability, and Convenience



For over 35 years SPEX Industries, Inc. 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** aqueous and organometallic solution standards for ICP, DCP, or AA, US EPA Certified Inorganic Quality Control samples for environmental analysis, powder blends for OES, pellets, fluxes for XRF, and high-purity compounds and kits. Since plasma emission spectroscopy is an emission technique, all elements emit at once. Therefore, trace impurities can interfere with the element being analyzed, giving an incorrect result. The starting materials, water and acids used, are all critical. SPEX not only uses the highest quality materials available; we analyze and report trace impurities in our standards as well as the major elements. We stand behind our quality: a one-year guarantee and our certificates of analysis on all plasma single and multi-element solution standards are your assurances of quality.

Reliability: For 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, classical "wet" assay for major constituent, and finally ICP analysis performed on all ICP solution standards. All titrants, balances and calibrants are certified against United States National Institute of Standards and Technology (where available). Certificates of analysis are provided to our customers on all of our ICP grade standards showing the results of all three analyses.

Convenience: We make it **CONVENIENT**. Save time, money and man-hours. Our standards are packaged to fit your needs. Choose from a wide range of concentrations for single-element solutions or prepackaged multi-element blends — or have a standard customized just for your particular needs. We provide 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 35 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 & ICP documentation and certification

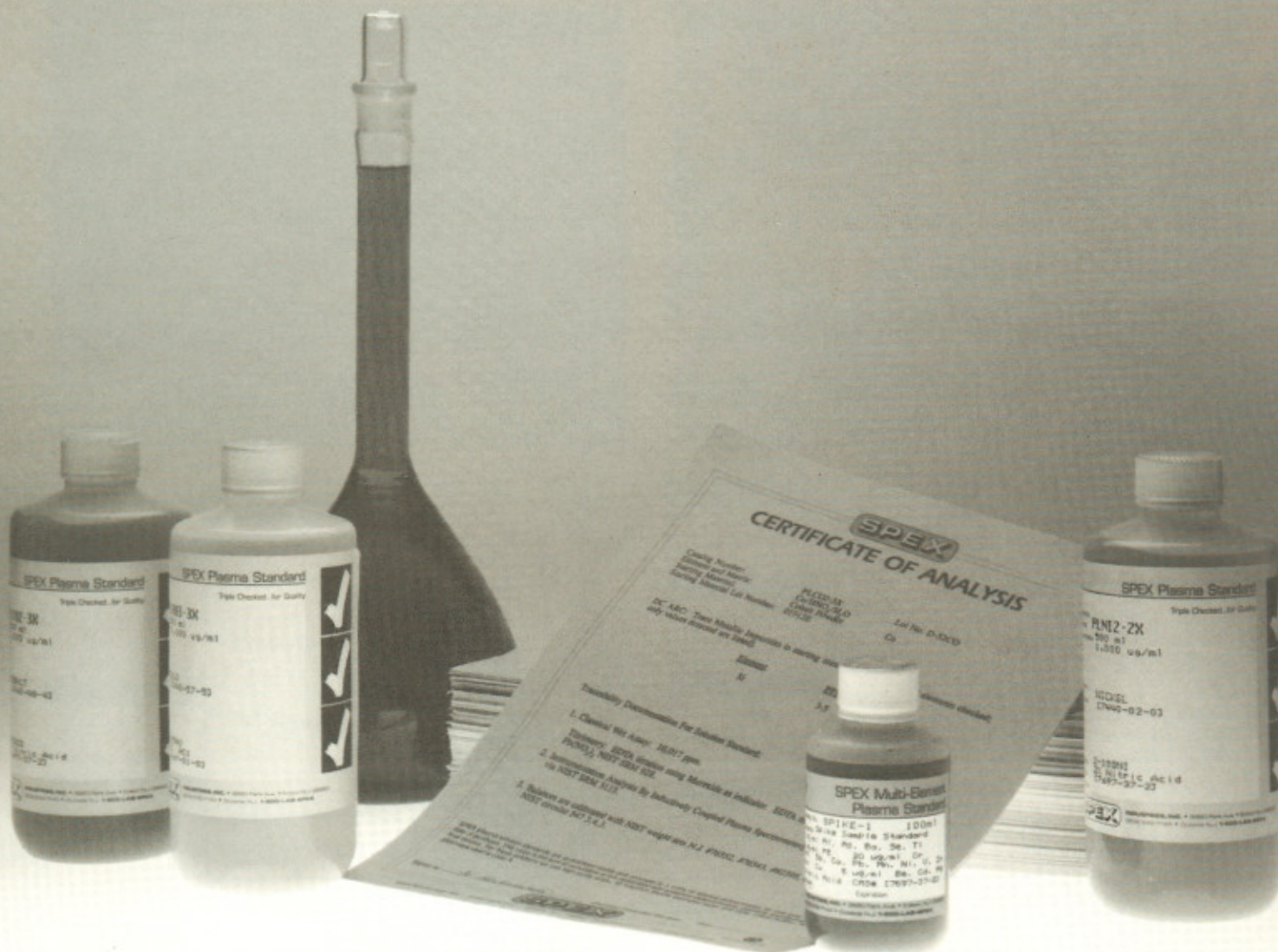
Over the last twenty years plasma emission spectroscopy, which includes the techniques of ICP, DCP, and ICP-MS, has emerged as a major analytical method in the field of elemental analysis.

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 matrices to certified, high-purity inorganic compounds for starting materials in user prepared standards, SPEX has the "solutions" to your standardization problems.

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

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



Single-Element Solution Standards For Plasma Emission Spectroscopy

- Choice of 70 elements
- 1,000 or 10,000ug/ml (ppm) concentrations
- Sold in 100 ml and 500 ml quantities
- Certification with every solution
- Alternate matrices for most elements

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

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

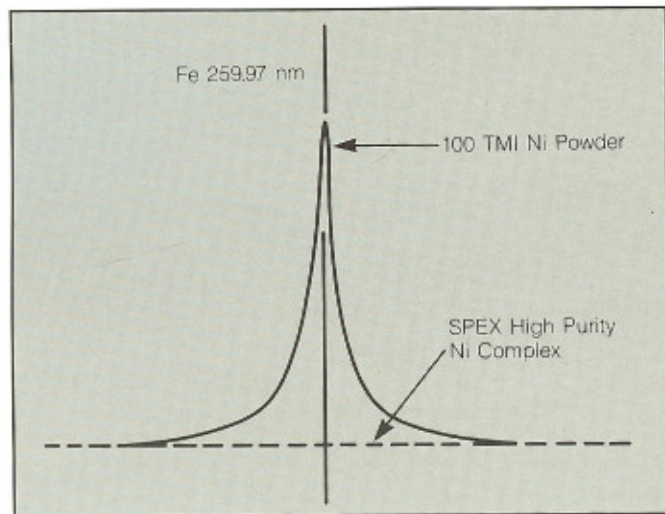
The ultra-high purity of the starting material is your assurance that detected emissions are real and are not due to unreported impurities in the calibration standard. SPEX guarantees both the purity of our solution and the

concentration of the major element to $\pm 0.5\%$ for one full year from date of shipment. Each bottle is supplied with its own certification for concentration and trace element analysis for your reference. Your standard is analyzed in the SPEX quality control laboratory by ICP, OES and wet methods. The **actual results** are reported on the SPEX certificate of analysis supplied with every bottle.

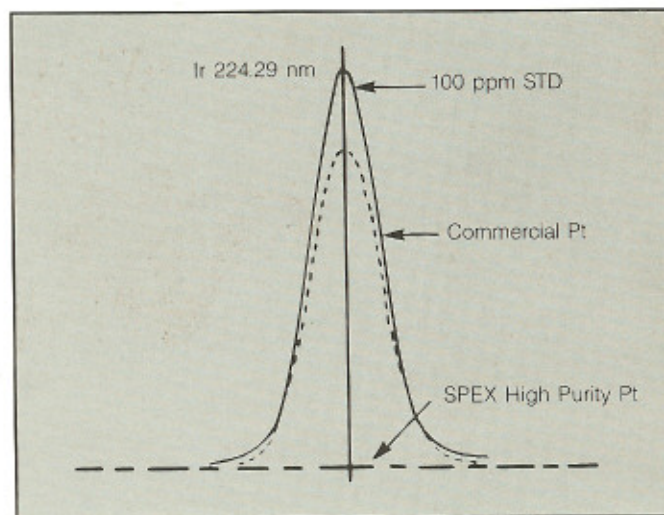
SPEX single-element solution standards are certified by our unique **Triple-Checked Quality Assurance** program: (1) DC ARC for trace metal impurities in solid starting material; (2) classical "wet" assay for major element; (3) final ICP check for major element. **All of these results are then reported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

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

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



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



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

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Aluminum			
PLAL2-2X	Al (NO ₃) ₃ •9H ₂ O in 2-5% HNO ₃	1,000ug/ml	500ml
PLAL2-2Y		1,000ug/ml	100ml
PLAL2-3X	Al in 2-5% HCl	10,000ug/ml	500ml
PLAL1-2X		1,000ug/ml	500ml
PLAL1-3X		10,000ug/ml	500ml
Antimony			
PLSB7-2X	Sb ₂ O ₃ in H ₂ O + 6% Tartaric Acid + tr HNO ₃	1,000ug/ml	500ml
PLSB7-2Y		1,000ug/ml	100ml
PLSB7-3X	Sb ₂ O ₃ in 20% HCl (in Teflon)	10,000ug/ml	500ml
PLSB5-2X		1,000ug/ml	500ml
PLSB5-3X		10,000ug/ml	500ml
Arsenic			
PLAS2-2X	H ₃ AsO ₄ •1/2H ₂ O in 2-5% HNO ₃	1,000ug/ml	500ml
PLAS2-2Y		1,000ug/ml	100ml
PLAS2-3X	As ₂ O ₃ in 2-5% HCl	10,000ug/ml	500ml
PLAS1-2X		1,000ug/ml	500ml
PLAS1-3X		10,000ug/ml	500ml
Barium			
PLBA2-2X	BaCO ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLBA2-2Y		1,000ug/ml	100ml
PLBA2-3X	BaCO ₃ in 2-5% HCl	10,000ug/ml	500ml
PLBA1-2X		1,000ug/ml	500ml
PLBA1-3X		10,000ug/ml	500ml
Beryllium			
PLBE2-2X	Be ₄ O(C ₂ H ₃ O ₂) ₆ in 2-5% HNO ₃	1,000ug/ml	500ml
PLBE2-2Y		1,000ug/ml	100ml
PLBE2-3X		10,000ug/ml	500ml
Bismuth			
PLBI4-2X	Bi in 10% HNO ₃	1,000ug/ml	500ml
PLBI4-2Y		1,000ug/ml	100ml
PLBI4-3X		10,000ug/ml	500ml
Boron			
PLB9-2X	(NH ₄) ₂ B ₄ O ₇ •4H ₂ O in H ₂ O	1,000ug/ml	500ml
PLB9-2Y		1,000ug/ml	100ml
PLB9-3X		10,000ug/ml	500ml
Cadmium			
PLCD2-2X	Cd in 2-5% HNO ₃	1,000ug/ml	500ml
PLCD2-2Y		1,000ug/ml	100ml
PLCD2-3X	Cd in 2-5% HCl	10,000ug/ml	500ml
PLCD1-2X		1,000ug/ml	500ml
PLCD1-3X		10,000ug/ml	500ml
Calcium			
PLCA2-2X	CaCO ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLCA2-2Y		1,000ug/ml	100ml
PLCA2-3X	CaCO ₃ in 2-5% HCl	10,000ug/ml	500ml
PLCA1-2X		1,000ug/ml	500ml
PLCA1-3X		10,000ug/ml	500ml
Carbon			
PLC9-2X	H ₂ C ₂ O ₄ •2H ₂ O in H ₂ O	1,000ug/ml	500ml
PLC9-2Y		1,000ug/ml	100ml
PLC9-3X	CH ₃ COOH in H ₂ O	10,000ug/ml	500ml
PLC9A-2X		1,000ug/ml	500ml
PLC9A-3X		10,000ug/ml	500ml
Cerium			
PLCE2-2X	Ce(NO ₃) ₃ •6H ₂ O in 2-5% HNO ₃	1,000ug/ml	500ml
PLCE2-2Y		1,000ug/ml	100ml
PLCE2-3X		10,000ug/ml	500ml
Cesium			
PLCS2-2X	CsNO ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLCS2-2Y		1,000ug/ml	100ml
PLCS2-3X		10,000ug/ml	500ml

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Chromium			
PLCR2-2X	Cr(NO ₃) ₃ •9H ₂ O in 2-5% HNO ₃	1,000ug/ml	500ml
PLCR2-2Y		1,000ug/ml	100ml
PLCR2-3X	Cr in 2-5% HCl	10,000ug/ml	500ml
PLCR1-2X		1,000ug/ml	500ml
PLCR1-3X		10,000ug/ml	500ml
PLCR9-2X	(NH ₄) ₂ Cr ₂ O ₇ in H ₂ O	1,000ug/ml	500ml
PLCR9-3X		10,000ug/ml	500ml
Cobalt			
PLCO2-2X	CoCO ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLCO2-2Y		1,000ug/ml	100ml
PLCO2-3X	CoCO ₃ in 2-5% HCl	10,000ug/ml	500ml
PLCO1-2X		1,000ug/ml	500ml
PLCO1-3X		10,000ug/ml	500ml
Copper			
PLCU2-2X	Cu in 2-5% HNO ₃	1,000ug/ml	500ml
PLCU2-2Y		1,000ug/ml	100ml
PLCU2-3X	Cu in 2-5% HCl	10,000ug/ml	500ml
PLCU1-2X		1,000ug/ml	500ml
PLCU1-3X		10,000ug/ml	500ml
Dysprosium			
PLDY2-2X	Dy ₂ O ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLDY2-2Y		1,000ug/ml	100ml
PLDY2-3X		10,000ug/ml	500ml
Erbium			
PLER2-2X	Er ₂ O ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLER2-2Y		1,000ug/ml	100ml
PLER2-3X		10,000ug/ml	500ml
Europium			
PLEU2-2X	Eu ₂ O ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLEU2-2Y		1,000ug/ml	100ml
PLEU2-3X		10,000ug/ml	500ml
Gadolinium			
PLGD2-2X	Gd ₂ O ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLGD2-2Y		1,000ug/ml	100ml
PLGD2-3X		10,000ug/ml	500ml
Gallium			
PLGA2-2X	Ga in 2-5% HNO ₃	1,000ug/ml	500ml
PLGA2-2Y		1,000ug/ml	100ml
PLGA2-3X		10,000ug/ml	500ml
Germanium			
PLGE9-2X	(NH ₄) ₂ Ge(C ₂ O ₄) ₃ •XH ₂ O in H ₂ O	1,000ug/ml	500ml
PLGE9-2Y		1,000ug/ml	100ml
PLGE9-3X		10,000ug/ml	500ml
Gold			
PLAU3-2X	Au in 10% HCl	1,000ug/ml	500ml
PLAU3-2Y		1,000ug/ml	100ml
PLAU3-3X		10,000ug/ml	500ml
Hafnium			
PLHF1-2X	HfOCl ₂ •8H ₂ O in 2-5% HCl	1,000ug/ml	500ml
PLHF1-2Y		1,000ug/ml	100ml
PLHF1-3X		10,000ug/ml	500ml
Holmium			
PLHO2-2X	Ho ₂ O ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLHO2-2Y		1,000ug/ml	100ml
PLHO2-3X		10,000ug/ml	500ml
Indium			
PLIN2-2X	In in 2-5% HNO ₃	1,000ug/ml	500ml
PLIN2-2Y		1,000ug/ml	100ml
PLIN2-3X		10,000ug/ml	500ml

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Iridium			
PLIR3-2X PLIR3-2Y PLIR3-3X	$\text{IrCl}_3 \cdot 3\text{H}_2\text{O}$ in 10% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Iron			
PLFE2-2X PLFE2-2Y PLFE2-3X PLFE1-2X PLFE1-3X	Fe in 2-5% HNO_3 Fe in 2-5% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml 500ml 500ml
Lanthanum			
PLLA2-2X PLLA2-2Y PLLA2-3X	La_2O_3 in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Lead			
PLPB2-2X PLPB2-2Y PLPB2-3X	$\text{Pb}(\text{NO}_3)_2$ in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Lithium			
PLLI2-2X PLLI2-2Y PLLI2-3X PLLI1-2X PLLI1-3X	Li_2CO_3 in 2-5% HNO_3 Li_2CO_3 in 2-5% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml 500ml 500ml
Lutetium			
PLLU2-2X PLLU2-2Y PLLU2-3X	Lu_2O_3 in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Magnesium			
PLMG2-2X PLMG2-2Y PLMG2-3X PLMG1-2X PLMG1-3X	Mg in 2-5% HNO_3 Mg in 2-5% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml 500ml 500ml
Manganese			
PLMN2-2X PLMN2-2Y PLMN2-3X	$\text{Mn}(\text{C}_2\text{H}_3\text{O}_2)_3 \cdot 2\text{H}_2\text{O}$ in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Mercury			
PLHG4-2X PLHG4-2Y PLHG4-3X	Hg in 10% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Molybdenum			
PLMO9-2X PLMO9-2Y PLMO9-3X	$(\text{NH}_4)_2\text{MoO}_4$ in H_2O	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Neodymium			
PLND2-2X PLND2-2Y PLND2-3X	Nd_2O_3 in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Nickel			
PLNI2-2X PLNI2-2Y PLNI2-3X	Ni in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Niobium			
PLNB9-2X PLNB9-2Y PLNB9-3X	NH_4NbF_6 in $\text{H}_2\text{O}/\text{tr HF}$	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Palladium			
PLPD3-2X PLPD3-2Y PLPD3-3X	Pd in 10% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Phosphorus			
PLP9-2X PLP9-2Y PLP9-3X	$\text{NH}_4\text{H}_2\text{PO}_4$ in H_2O	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Platinum			
PLPT3-2X PLPT3-2Y PLPT3-3X	Pt in 10% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Potassium			
PLK2-2X PLK2-2Y PLK2-3X PLK1-2X PLK1-3X	KNO_3 in 2-5% HNO_3 KCl in 2-5% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml 500ml 500ml
Praseodymium			
PLPR2-2X PLPR2-2Y PLPR2-3X	Pr_6O_{11} in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Rhenium			
PLRE9-2X PLRE9-2Y PLRE9-3X	$(\text{NH}_4)_2\text{ReO}_4$ in H_2O	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Rhodium			
PLRH3-2X PLRH3-2Y PLRH3-3X	$\text{RhCl}_3 \cdot 3\text{H}_2\text{O}$ in 10% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Rubidium			
PLRB2-2X PLRB2-2Y PLRB2-3X	RbNO_3 in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Ruthenium			
PLRU3-2X PLRU3-2Y PLRU3-3X	$\text{RuCl}_3 \cdot 3\text{H}_2\text{O}$ in 10% HCl	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Samarium			
PLSM2-2X PLSM2-2Y PLSM2-3X	Sm_2O_3 in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Scandium			
PLSC2-2X PLSC2-2Y PLSC2-3X	Sc_2O_3 in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Selenium			
PLSE2-2X PLSE2-2Y PLSE2-3X	Se in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml
Silicon			
PLSI9-2X PLSI9-2Y PLSI9-3X PLSI9A-2X PLSI9A-3X	$(\text{NH}_4)_2\text{SiF}_6$ in $\text{H}_2\text{O}/\text{tr HF}$ $\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$ in H_2O	1,000ug/ml 1,000ug/ml 10,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml 500ml 500ml
Silver			
PLAG2-2X PLAG2-2Y PLAG2-3X	Ag in 2-5% HNO_3	1,000ug/ml 1,000ug/ml 10,000ug/ml	500ml 100ml 500ml

Element Cat. #	Matrix	Conc. ug/ml	Qty. ml
Sodium			
PLNA2-2X	Na ₂ CO ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLNA2-2Y		1,000ug/ml	100ml
PLNA2-3X	NaCl in 2-5% HCl	10,000ug/ml	500ml
PLNA1-2X		1,000ug/ml	500ml
PLNA1-3X		10,000ug/ml	500ml
Strontium			
PLSR2-2X	Sr(NO ₃) ₂ in 2-5% HNO ₃	1,000ug/ml	500ml
PLSR2-2Y		1,000ug/ml	100ml
PLSR2-3X	SrCO ₃ in 2-5% HCl	10,000ug/ml	500ml
PLSR1-2X		1,000ug/ml	500ml
PLSR1-3X		10,000ug/ml	500ml
Sulfur			
PLS9-2X	(NH ₄) ₂ SO ₄ in H ₂ O	1,000ug/ml	500ml
PLS9-2Y		1,000ug/ml	100ml
PLS9-3X		10,000ug/ml	500ml
Tantalum			
PLTA9-2X	NH ₄ TaF ₆ in H ₂ O/tr HF	1,000ug/ml	500ml
PLTA9-2Y		1,000ug/ml	100ml
PLTA9-3X		10,000ug/ml	500ml
Tellurium			
PLTE2-2X	Te in 5% HNO ₃	1,000ug/ml	500ml
PLTE2-2Y		1,000ug/ml	100ml
PLTE6-3X	Te in 20% HNO ₃ TeO ₂ in 10% HCl TeO ₂ in 40% HCl	10,000ug/ml	500ml
PLTE3-2X		1,000ug/ml	500ml
PLTE5-3X		10,000ug/ml	500ml
Terbium			
PLTB2-2X	Tb ₄ O ₇ in 2-5% HNO ₃	1,000ug/ml	500ml
PLTB2-2Y		1,000ug/ml	100ml
PLTB2-3X		10,000ug/ml	500ml
Thallium			
PLTL2-2X	TlNO ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLTL2-2Y		1,000ug/ml	100ml
PLTL2-3X		10,000ug/ml	500ml
Thorium			
PLTH2-2X	Th(NO ₃) ₄ •4H ₂ O in 2-5% HNO ₃	1,000ug/ml	500ml
PLTH2-2Y		1,000ug/ml	100ml
PLTH2-3X		10,000ug/ml	500ml
Thulium			
PLTM2-2X	Tm ₂ O ₃ in 2-5% HNO ₃	1,000ug/ml	500ml
PLTM2-2Y		1,000ug/ml	100ml
PLTM2-3X		10,000ug/ml	500ml
Tin			
PLSN2-2X	Sn in 1% HNO ₃ +1% HF Sn in 2% HNO ₃ +2% HF Sn in 20% HCl (in Teflon)	1,000ug/ml	500ml
PLSN2-3X		10,000ug/ml	500ml
PLSN5-2X		1,000ug/ml	500ml
PLSN5-2Y		1,000ug/ml	100ml
PLSN5-3X		10,000ug/ml	500ml

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

HCl, KCN, KOH, NaCN, HF, HNO₃/HCl, H₂O, Oil Matrices are also available on a custom basis. Please call our sales office for quotations and information.

Plasma Emission Solution Standards 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 concentrations and in 100ml quantities. Elements are supplied in the most common matrices to enable mixing of compatible elements. As always, each SPEX Plasma Grade Standard comes with its own certificate of analysis showing trace metal analysis and traceability documentation.

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

ICP-KIT-1: Plasma Emission Standards Kit 1

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

Matrix 2% HNO_3 : Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Ni, K, Sc, Se, Ag, Na, Sr, Ti, V, Y, Zn and Zr

Matrix H_2O : Sb, B, Mo, Nb, P, Si, S, Ti and W

Matrix 20% HCl (in Teflon): Sn

Matrix 10% HNO_3 : Bi, 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 — Interelement Compatibility
- Certified Assay — Trace Metals Analysis

If your laboratory cannot predict analysis problems week-to-week or even day-to-day, then you need even more flexibility than offered by SPEX custom solution standards. SPEX High-Purity Compound Kits are the ideal solution. Single or multi-element standards can be made on the spot in response to specific problems. Your custom preparation will ensure the maximum sample-to-standard compatibility. The compound kits can also provide back-up to your custom solutions for those off-the-wall applications, or where you simply need a second matrix or higher concentration.

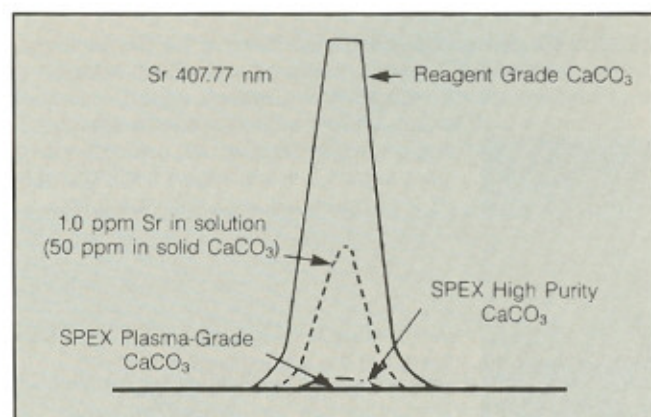
SPEX High-Purity Compound Kits offer a positive alternative to solution standards for your ICP/DCP laboratory. Plasma-grade starting materials for solution standards are available in six convenient kits comprised of seventy-two spectroscopically pure compounds. All seventy-two compounds are readily soluble and stable in aqueous HCl and/or HNO_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 Elements 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 seven elements: Ru, Rh, Pd, Ag, Ir, Pt, Au. Os available only upon request. Due to the hazardous nature of Osmium, an Indemnification Certificate must be signed before ordering.

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 equivalent.

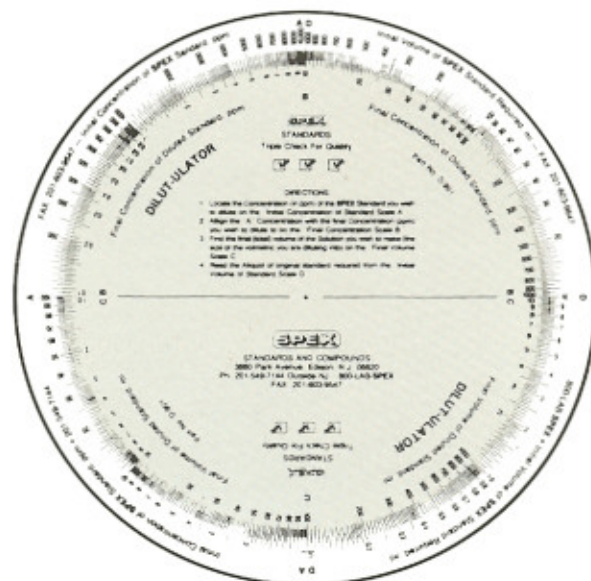
Dilution Calculator

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

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

Catalog# D-901 SPEX DILUTULATOR

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



Custom Multi-Element Solution Standards for Plasma Emission Spectroscopy

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

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

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

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

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

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

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

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

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

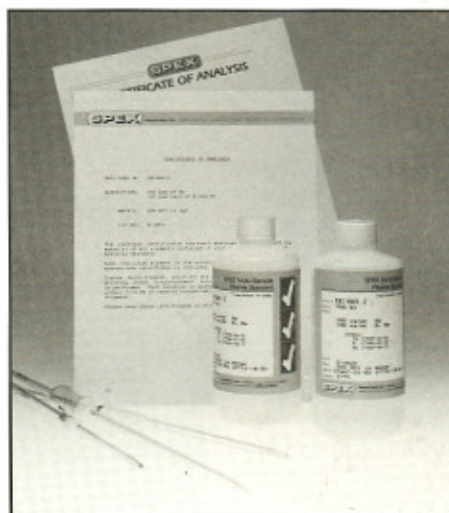
Standards are ordered initially by describing the elements required, their levels and your preferred matrix. We will then review the composition requested for interelement

compatibility, solubility and matrix requirements. You will be given a unique part number which corresponds to your particular standard and a firm price quotation.

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

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

Custom plasma solutions are supplied in 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.



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

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

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

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

- DC ARC trace metal analysis of starting materials
- Classical "wet" assay of major elements
- ICP check of the final solution

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

concentration, to some extent, may be determined by the sample to be analyzed and the instrumentation used.

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

The final ICP check, performed in our own laboratories, is your **stamp of assurance**. We calibrate our instruments with **traceable reference materials** and show you the **actual found value** of the solution you receive — not just an ideal, calculated number. The sections that follow contain multi-element standards referenced to their application. The combinations of elements, concentrations, and matrices listed have been designed by SPEX for both convenience of use and stability.

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

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

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

SPEX CERTIFICATE OF ANALYSIS

Catalog Number: RCV-1
Description: Initial Calibration Verification Standard
Lot Number: 3-151A3

ICP CHECK

Element	Labeled (ppm)	Measured (ppm)	Element	Labeled (ppm)	Measured (ppm)
Al	200	200.54	Pb	5	4.95
Ba	50	50.81	Rb	5,000	5,001.31
Ca	10	9.97	Se	15	15.02
Co	200	199.82	Si	40	40.04
Cu	5	4.92	Sr	5,000	5,003.25
Cr	5	5.01	Te	5	4.90
Fe	5,000	5,002.40	V	10	10.05
K	10	9.99	Zn	5,000	4,991.93
Mg	50	50.01			
Mn	25	25.03			
Ni	100	100.38			

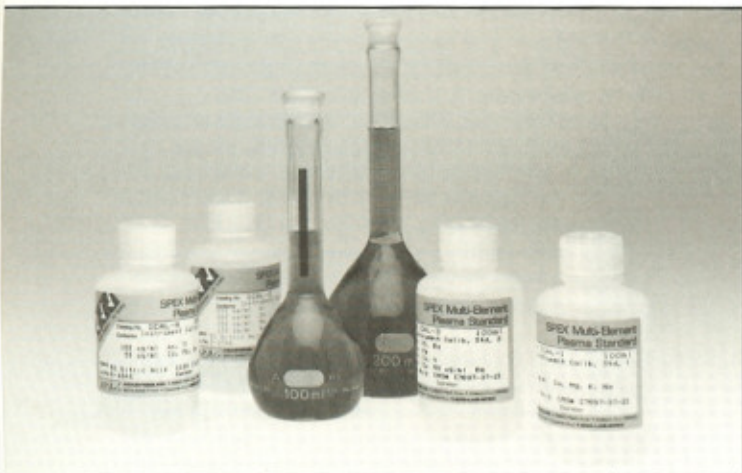
Instrumental Analysis by Inductively Coupled Plasma Spectroscopy:
The following ICP-MS was used in establishing the above results:
Al: SPEX #1-13V, Ba: SPEX #1-7M0, Ag: SPEX #1-17IV, Bi: SPEX #1-18IV,
Be: SPEX #1-14H, Cd: NIST 3108, Co: SPEX #1-13V, Cr: SPEX #1-13IV,
Cu: NIST 3113, Fe: NIST 3114, Hg: SPEX #1-13V, Pb: NIST 3120, Mg: SPEX #1-13V,
Mn: NIST 3115, Ni: NIST 3116, K: SPEX #1-13V, Se: NIST 3145, Ag: NIST 3151,
Na: SPEX #1-13V, Te: NIST 3155, V: NIST 3165, Zn: SPEX #1-13V.

SPEX Reference Matrix: Lot #1-75T0RD & 3-34AS.

SPEX Industries, Inc. 3500 N. 10th St. P.O. Box 10000, Milwaukee, WI 53210-1000

Instrument Calibration

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



Instrument Calibration Standard 1

ICAL-1 100ml
Matrix 5% HNO₃

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

Instrument Calibration Standard 2

ICAL-2 100ml
Matrix 5% HNO₃

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

Instrument Calibration Standard 3

ICAL-3 100ml
Matrix 5% HNO₃

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

Instrument Calibration Standard 4

ICAL-4 100ml
ICAL-4-500 500ml
Matrix 5% HNO₃

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

Instrument Calibration Standard 5

ICAL-5 100ml
ICAL-5-500 500ml
Matrix 2% HNO₃

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

Instrument Calibration Standard 6

ICAL-6 100ml
Matrix 2% HNO₃

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

Initial Calibration Verification

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

Initial Calibration Verification Standard

ICV-1 500ml
Matrix 5% HNO₃

Element	Conc. (ug/ml)	Wavelength (nm)
Al	200ug/ml	396.152nm
Sb	60ug/ml	217.581nm
As	10ug/ml	189.042nm
Ba	200ug/ml	233.527nm
Be	5ug/ml	313.042nm
Cd	5ug/ml	214.438nm
Ca	5000ug/ml	317.933nm
Cr	10ug/ml	205.552nm

Co	50ug/ml	228.616nm
Cu	25ug/ml	324.754nm
Fe	100ug/ml	259.940nm
Pb	5ug/ml	220.353nm
Mg	5000ug/ml	279.553nm
Mn	15ug/ml	257.610nm
Ni	40ug/ml	231.604nm
K	5000ug/ml	766.490nm
Se	5ug/ml	196.090nm
Ag	10ug/ml	328.068nm
Na	5000ug/ml	589.592nm
Tl	10ug/ml	351.924nm
V	50ug/ml	292.402nm
Zn	20ug/ml	213.856nm

Initial Calibration Verification II

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

Initial Calibration Verification Standard II

ICV-2A 500ml
Matrix 5% HNO₃

Element	Conc. (ug/ml)	Wavelength (nm)
Al	1000ug/ml	396.152nm
Ba	1000ug/ml	233.527nm
Be	100ug/ml	313.042nm
Ca	2000ug/ml	317.933nm
Cr	200ug/ml	205.552nm

Co	500ug/ml	228.616nm
Cu	200ug/ml	324.754nm
Fe	1000ug/ml	259.940nm
Mg	2000ug/ml	279.553nm
Mn	100ug/ml	257.610nm
Ni	500ug/ml	231.604nm
K	2000ug/ml	766.490nm
Ag	100ug/ml	328.068nm
Na	2000ug/ml	589.592nm
V	500ug/ml	292.402nm
Zn	100ug/ml	213.856nm

Initial Calibration Verification II (cont'd.)

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

ICV-2B500ml
Matrix 2% HNO₃

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

ICV-2C500ml
Matrix 5% HNO₃

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

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

Above standards are not sold separately.

Contract Required Detection Limits, CRDL

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

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

Contract Required Detection Limits Standard

CRDL-1100ml
Matrix 5% HNO₃

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

Calibration Blanks and Matrix Blanks

All SPEX blank solutions are prepared with the same high-purity acids and ASTM Type I water as that used in our plasma-grade standards. SPEX matrix blanks can be used to dilute standards or can be run directly as blanks to establish base lines. The calibration blank is prepared by mixing one part nitric acid blank with three parts hydrochloric acid blank.

Nitric Acid Blank

PLBLK-HNO₃500ml
Matrix 5% HNO₃ in ASTM Type I Water

Hydrochloric Acid Blank

PLBLK-HCL500ml
Matrix 5% HCl in ASTM Type I Water

Water Blank

PLBLK-H₂O500ml
PLBLK-H₂O-1L1L
PLBLK-H₂O-2L2L
PLBLK-H₂O-4L3.78L
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.

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

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

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.

Interferents A

INT-A1 500ml
Matrix 5% HNO₃

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

Analytes B

INT-B1 100ml
Matrix 5% HNO₃

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

Alternate Interferents A

INT-A2 500ml
Matrix 5% HNO₃

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

Alternate Analytes B

INT-B2 100ml
Matrix 5% HNO₃

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

Spike Sample Standard

SPIKE-1 100ml
SPIKE-1-500 500ml
Matrix 5% HNO₃

Element	Conc. (ug/ml)	Wavelength (nm)
Al	200ug/ml	396.152nm
Sb	50ug/ml	217.581nm
As	200ug/ml	189.042nm
Ba	200ug/ml	233.527nm
Be	5ug/ml	313.042nm
Cd	5ug/ml	214.438nm
Cr	20ug/ml	205.552nm

Co	50ug/ml	228.616nm
Cu	25ug/ml	324.754nm
Fe	100ug/ml	259.940nm
Pb	50ug/ml	220.353nm
Mn	50ug/ml	257.610nm
Ni	50ug/ml	231.604nm
Se	200ug/ml	196.090nm
Ag	5ug/ml	328.068nm
Ti	200ug/ml	351.924nm
V	50ug/ml	292.402nm
Zn	50ug/ml	213.856nm

Spike Sample Analysis (cont'd.)

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

Spike Sample Standard II (Water)

SPIKE-2A.....100ml
Matrix 5% HNO₃

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

SPIKE-2B.....100ml
Matrix 1% HNO₃

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

SPIKE-2C.....100ml
Matrix 5% HNO₃

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

SPIKE-2

Includes one of each:

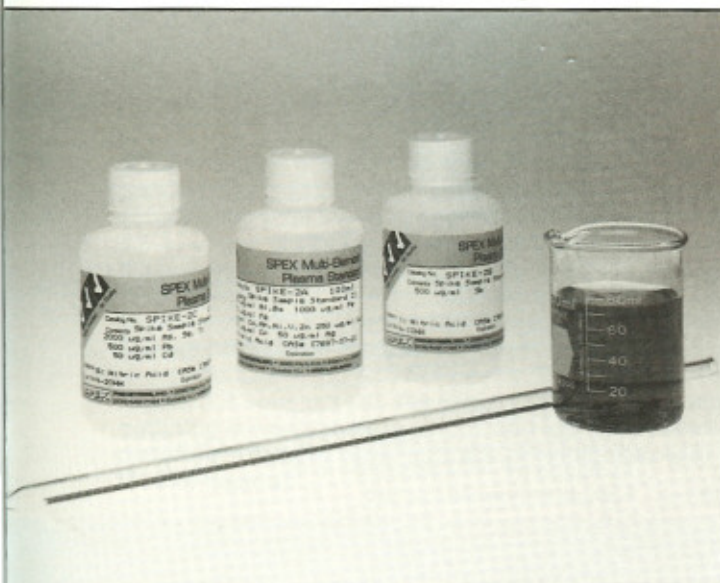
SPIKE-2A
SPIKE-2B
SPIKE-2C

Above standards are not sold separately.

Spike Sample Standard III (Soil)

SPIKE-3.....100ml
Matrix 5% HNO₃

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



Furnace AA Calibration and Spiking

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

GFAA Calibration Standard

GFAA-ICAL.....50ml
Matrix 5% HNO₃

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

GFAA Initial Calibration Verification Standard (Second Source)

GFAA-ICV.....50ml
Matrix 5% HNO₃

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

GFAA Spike Standard

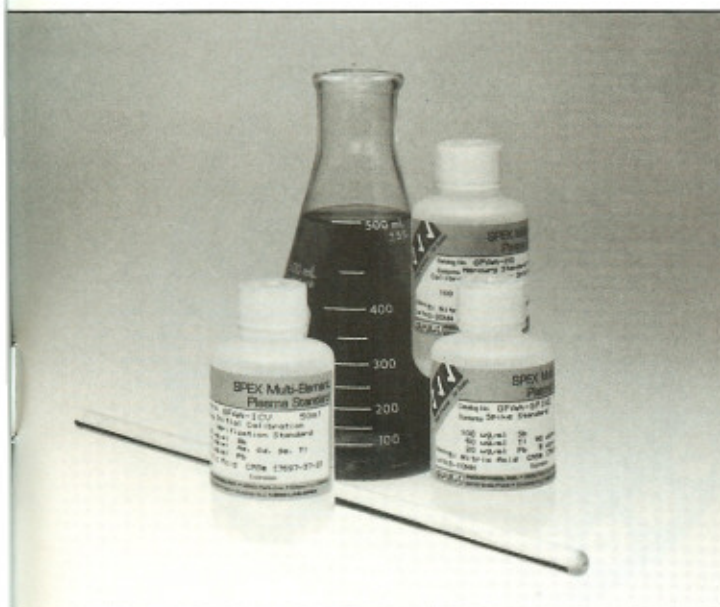
GFAA-SPIKE.....50ml
Matrix 5% HNO₃

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

Mercury Standard for Calibration and/or Spiking (GFAA)

GFAA-HG.....50ml
Matrix 2% HNO₃

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



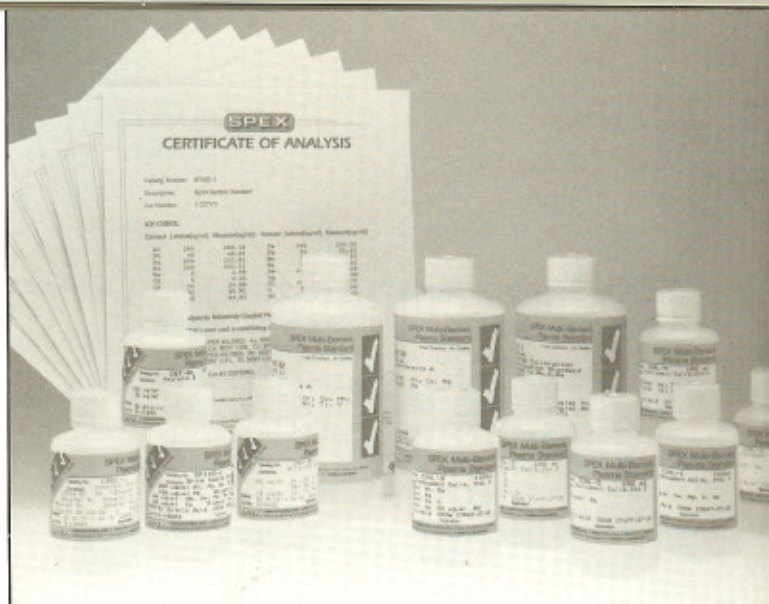
Contract Laboratory Program (CLP) Set

Set of 13 standards for use in the Contract Laboratory Program

CLP-SET

Includes one of each:

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

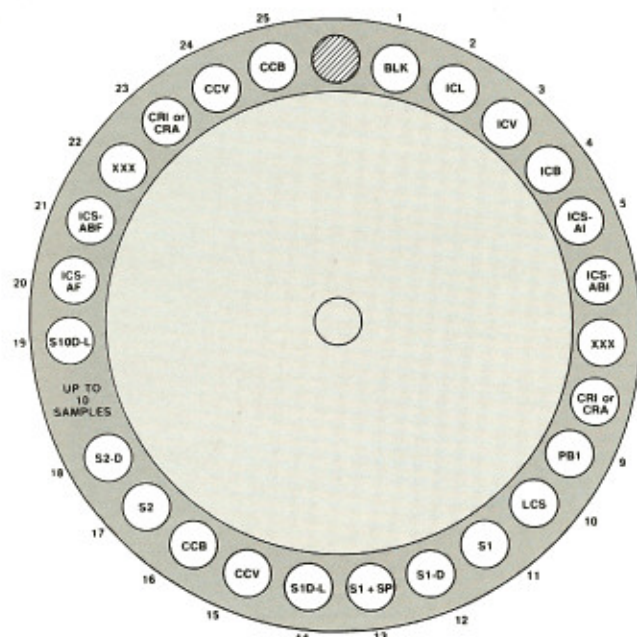


Standards For The Contract Laboratory Program

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

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

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

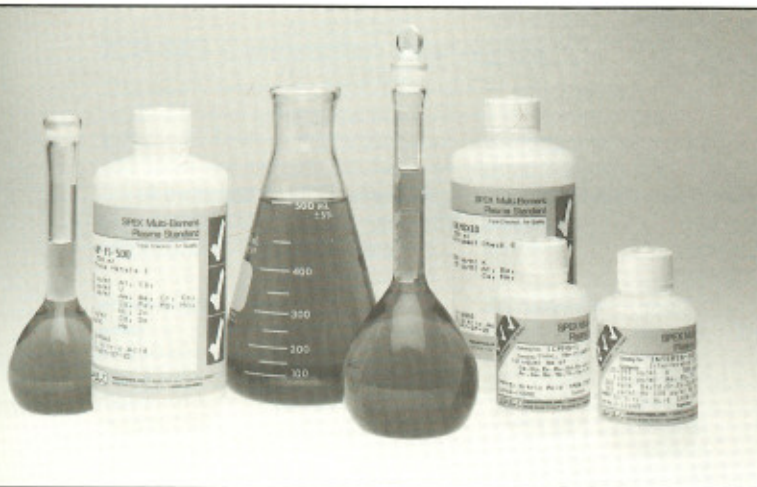


Stock Multi-Element Solution Standards for Environmental Analysis

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

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

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



Calibration Blanks and Matrix Blanks

SPEX blank solutions are prepared with high-purity acids and ASTM Type I water as are our plasma-grade standards. SPEX matrix blanks can be used to dilute your multi-element standards or can be run directly as a blank to establish your base line. An aqua regia blank can be prepared by mixing one part nitric acid blank with three parts hydrochloric acid blank. Do not use any acid or water as a diluent if you are not certain of its purity. For use in US EPA SW-846, Method 6010 section 5.5.1 and also Method 200.7 section 7.5.1.

The purity of the starting material is especially important when preparing multi-element standards. For example, a 20-element standard that includes iron is likely to be contaminated with iron from the remaining 19 elements, resulting in significantly higher iron concentrations than the calculated value. All SPEX plasma standards are made from high-purity acids, ASTM Type I water (18 megohm), and SPEX certified metals and inorganic compounds. Since we know exactly how much of each element is contributed by each component, a build-up of impurities resulting from undetected contamination in individual starting materials will not occur.

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

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

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

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

Nitric Acid Blank

PLBLK-HNO₃500ml
Matrix 5% HNO₃ in ASTM Type I Water

Hydrochloric Acid Blank

PLBLK-HCL500ml
Matrix 5% HCl in ASTM Type I Water

Water Blank

PLBLK-H₂O500ml
PLBLK-H₂O-1L1L
PLBLK-H₂O-2L2L
PLBLK-H₂O-4L3.78L
Matrix ASTM Type I Water, 18 megohm

Mixed Multi-Element Calibration Standards

The following series of five calibration standards are provided for routine instrument calibration. The concentrations and matrices have been selected for both convenience of use and stability. You can also prepare these multi-element standards yourself from individual SPEX plasma-grade, single-element solution standards. For use in US EPA SW-846, Method 6010 section 5.4 and also Method 200.7 section 7.4.



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 US EPA SW-846, Method 6010 section 5.6 and Method 200.7 section 7.6.1

Mixed Calibration Standard 1

MIXSTD1-100	100ml
MIXSTD1-500	500ml
Matrix 2% HNO ₃	

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

Mixed Calibration Standard 2

MIXSTD2-100	100ml
MIXSTD2-500	500ml
Matrix 5% HNO ₃	

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

Mixed Calibration Standard 3

MIXSTD3-100	100ml
MIXSTD3-500	500ml
Matrix 2% HNO ₃	

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

Mixed Calibration Standard 4

MIXSTD4-100	100ml
MIXSTD4-500	500ml
Matrix 5% HNO ₃	

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

Mixed Calibration Standard 5

MIXSTD5-100	100ml
MIXSTD5-500	500ml
Matrix 5% HNO ₃	

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

Set of 5 Mixed Calibration Standards

MIXSTD-SET
Includes one of each:
MIXSTD1-100
MIXSTD2-100
MIXSTD3-100
MIXSTD4-100
MIXSTD5-100

Instrument Check Standard 1

CALMIX1-100	100ml
CALMIX1-500	500ml
Matrix 2% HNO ₃	

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

Instrument Check Standard 2

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

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

Instrument Check Standard 3

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

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

Instrument Check Standards (cont'd.)

Instrument Check Standard 4

CALMIX4-100	100ml
CALMIX4-500	500ml
Matrix 2% HNO ₃	

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

Instrument Check Standard 7

CALMIX7-100	100ml
CALMIX7-500	500ml
Matrix 2% HNO ₃	

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

Instrument Check Standard 8

CALMIX8-100	100ml
CALMIX8-500	500ml
Matrix 2% HNO ₃	

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

Instrument Check Standard 10

CALMIX10-100	100ml
CALMIX10-500	500ml
Matrix 2% HNO ₃	

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

ICP-MS Calibration Standards

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

ICPMS-100	100ml
Matrix 2% HNO ₃	

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

ICPMS-1	100ml
Matrix 5% HNO ₃	

Element	Conc. (ug/ml)
Ce	10ug/ml
Dy	10ug/ml

Er	10ug/ml
Eu	10ug/ml
Gd	10ug/ml
Ho	10ug/ml
La	10ug/ml
Lu	10ug/ml
Nd	10ug/ml
Pr	10ug/ml
Sm	10ug/ml
Sc	10ug/ml
Tb	10ug/ml
Th	10ug/ml
Tm	10ug/ml
Y	10ug/ml
Yb	10ug/ml

ICPMS-1A	100ml
Matrix 5% HNO ₃	

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

ICPMS-2	100ml
Matrix 5% HNO ₃	

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

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

ICP-MS Calibration Standards (cont'd.)

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 each.

ICPMS-2A 100ml
Matrix 5% HNO₃

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

Mn.....	10ug/ml
**Hg.....	10ug/ml
Ni.....	10ug/ml
K.....	10ug/ml
Rb.....	10ug/ml
Se.....	10ug/ml
Na.....	10ug/ml
Ag.....	10ug/ml
Sr.....	10ug/ml
Ti.....	10ug/ml
V.....	10ug/ml
U.....	10ug/ml
Zn.....	10ug/ml

ICPMS-3 100ml
Matrix 10% HCl

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

ICPMS-4 100ml
Matrix H₂O with a trace of HF

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

ICPMS-SET

Includes one of each:

ICPMS-1
ICPMS-2
ICPMS-3
ICPMS-4
*ICPMS-H₂O
*ICPMS-HNO₃
*ICPMS-HCL

*Blanks are the same lots as the set matrices.

ICP-MS Internal Standards Stock Solution

The Internal Standard Stock Solutions are used for addition to blanks, calibration standards and samples for internal standardization. Dilute 10ml to 100ml. For use in US EPA SW-846 Method 200.8, revision 4.3.

Internal Standard Stock Solution — Bismuth

ICPMS-BI 100ml
Matrix 2% HNO₃

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

Internal Standard Stock Solution — Indium

ICPMS-IN..... 100ml
Matrix 2% HNO₃

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

Internal Standard Stock Solution — Scandium

ICPMS-SC 100ml
Matrix 2% HNO₃

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

Internal Standard Stock Solution — Terbium

ICPMS-TB 100ml
Matrix 2% HNO₃

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

Internal Standard Stock Solution — Yttrium

ICPMS-Y 100ml
Matrix 2% HNO₃

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

ICP-MS Tuning Solution

The Tuning Solution is used for instrument tuning and mass calibration prior to analysis. A dilution of 100-fold is suggested giving the solution concentration of 100ug/L (ppb) in 1% HNO₃. Internal standards are not added to this solution. For use in US EPA SW-846 Method 200.8, revision 4.3.

Tuning Solution 1

TUNING-1..... 100ml
Matrix 2% HNO₃

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

Interference Check Standards

The Interference Check Standards are used to set or confirm that the correct background correction intervals have been set for sequential ICP spectrometers and that the proper interelement 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	

Element	Conc. (ug/ml)	Wavelength (nm)
As	1000ug/ml	189.042nm
Ba	300ug/ml	233.527nm
Be	100ug/ml	313.042nm
Cd	300ug/ml	214.438nm
Cr	300ug/ml	205.552nm
Co	300ug/ml	228.616nm
Cu	300ug/ml	324.754nm
Pb	1000ug/ml	220.353nm
Mn	200ug/ml	257.610nm
Hg	50ug/ml	194.232nm

Ni	300ug/ml	231.604nm
K	20,000ug/ml	766.490nm
Se	500ug/ml	196.090nm
Ag	300ug/ml	328.068nm
Tl	1000ug/ml	351.924nm
V	300ug/ml	292.402nm
Zn	300ug/ml	213.856nm

Interference Check Standard, 3

INTER3-100	100ml
INTER3-500	500ml
Matrix 5% HNO ₃	

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

Interference Check Standard, 1

INTER1-100	100ml
INTER1-500	500ml
Matrix 2% HNO ₃	

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

Interference Check Standard, 5

INTER5-100	100ml
INTER5-500	500ml
Matrix 5% HNO ₃	

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

Set of 4 Interference Check Standards

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

Environmental EPA Set

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

EPA-SET

Includes one each of:

MIXSTD1-100	MIXSTD5-100	INTER1-100
MIXSTD2-100	INTER18-100	PLBLK-HNO ₃
MIXSTD3-100	INTER3-100	PLBLK-HCL
MIXSTD4-100	INTER5-100	

Toxicity Characteristic Leachate Procedure (TCLP) Standard

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

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

TCLP Standard 1

TCLP-100	100ml
TCLP-500	500ml
Matrix 5% HNO ₃	

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

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

TCLP Standard for GFAA

TCLP-GFAA	100ml
TCLP-GFAA-500	500ml
Matrix 2% HNO ₃	

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

TCLP Standard for Cold Vapor AA

TCLP-AA	100ml
TCLP-AA-500	500ml
Matrix 2% HNO ₃	

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

TCLP Standard for ICP

TCLP-ICP	100ml
TCLP-ICP-500	500ml
Matrix 2% HNO ₃	

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

Quality Control Standards

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

For US EPA Method 200.7 and US 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% HNO₃

Element	Conc. (ug/ml)	Wavelength (nm)
Sb.....	100ug/ml.....	217.581nm
As.....	100ug/ml.....	189.042nm
Be.....	100ug/ml.....	313.042nm
Cd.....	100ug/ml.....	214.438nm
Ca.....	100ug/ml.....	317.933nm
Cr.....	100ug/ml.....	205.552nm
Co.....	100ug/ml.....	228.616nm
Cu.....	100ug/ml.....	221.810nm
Fe.....	100ug/ml.....	259.940nm
Pb.....	100ug/ml.....	220.353nm
Mg.....	100ug/ml.....	279.553nm
Mn.....	100ug/ml.....	257.610nm
Mo.....	100ug/ml.....	202.030nm
Ni.....	100ug/ml.....	231.604nm
Se.....	100ug/ml.....	196.090nm
Ti.....	100ug/ml.....	351.924nm
Ti.....	100ug/ml.....	334.941nm
V.....	100ug/ml.....	292.402nm
Zn.....	100ug/ml.....	213.856nm

Quality Control Standard 7

QC-7.....100ml
QC-7-500.....500ml
Matrix 5% HNO₃

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

Set of 2 Quality Control Standards

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

Drinking Water Pollutant Standards

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

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

Primary Drinking Water Metals

EP-8.....100ml
EP-8-500.....500ml
Matrix 2% HNO₃

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

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

Secondary Drinking Water Metals

EP-4.....100ml
EP-4-500.....500ml
Matrix 2% HNO₃

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

Set of 2 Drinking Water Standards

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

Trace Metals in Fish

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

Trace Metals in Fish

WP-9.....100ml
WP-9-500.....500ml
Matrix 5% HNO₃

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

Groundwater and Wastewater Pollution Control Check Standards

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

Trace Metals I

WP-15 100ml
WP-15-500 500ml
Matrix 5% HNO₃

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

Trace Metals II

WP-3 100ml
WP-3-500 500ml
Matrix 2% HNO₃

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

Trace Metals III

MN-6 100ml
MN-6-500 500ml
Matrix 2% HNO₃

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

Set of 3 Trace Metals

TM-SET
Includes one of each:
WP-15 WP-3 MN-6

Alternate Water Pollution and Wastewater Standards for ICP and AA

Alternate Metals I

WP-11 100ml
WP-11-500 500ml
Matrix 2% HNO₃

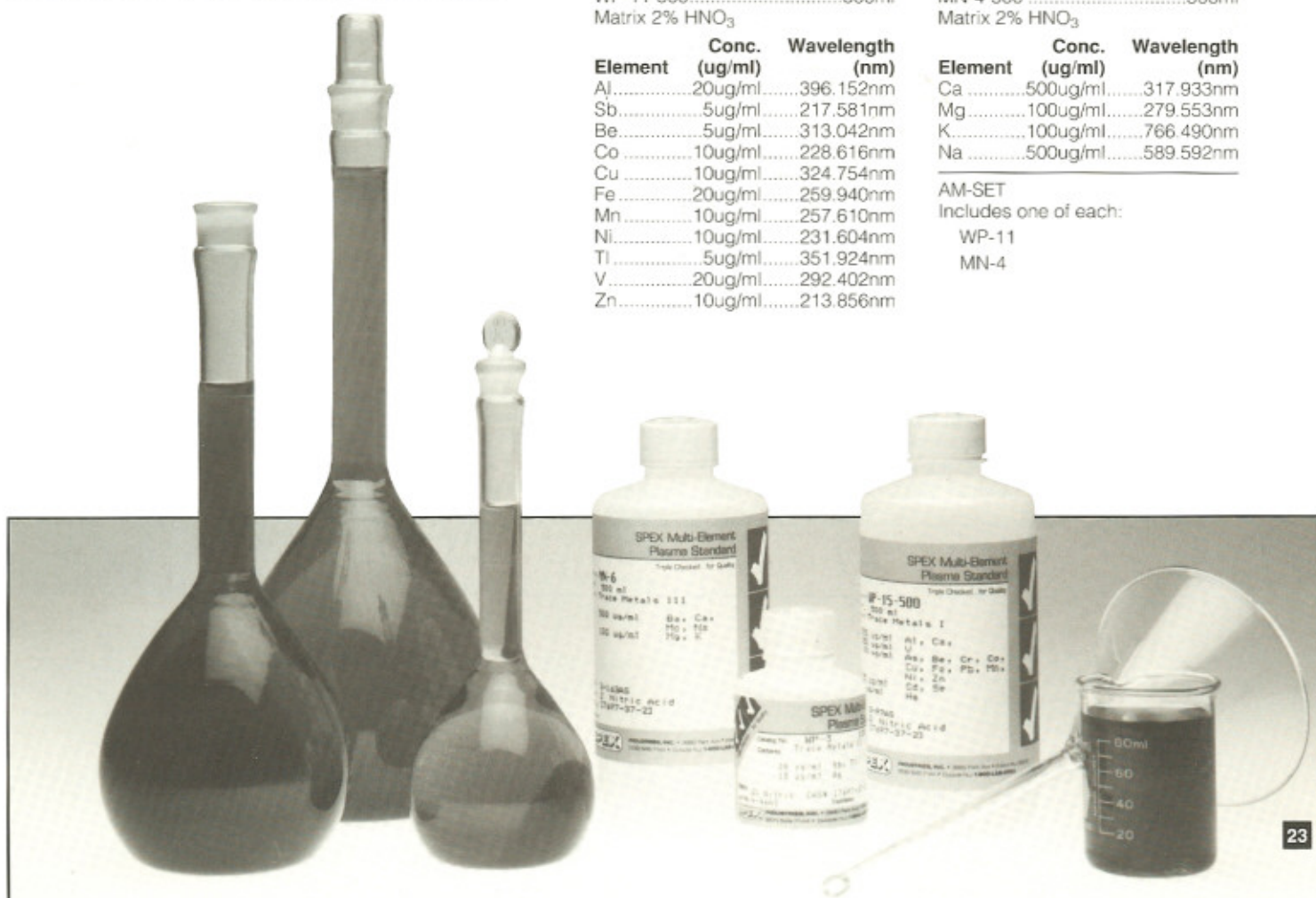
Element	Conc. (ug/ml)	Wavelength (nm)
Al	20ug/ml	396.152nm
Sb	5ug/ml	217.581nm
Be	5ug/ml	313.042nm
Co	10ug/ml	228.616nm
Cu	10ug/ml	324.754nm
Fe	20ug/ml	259.940nm
Mn	10ug/ml	257.610nm
Ni	10ug/ml	231.604nm
Tl	5ug/ml	351.924nm
V	20ug/ml	292.402nm
Zn	10ug/ml	213.856nm

Alternate Metals III

MN-4 100ml
MN-4-500 500ml
Matrix 2% HNO₃

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

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



Solution Standards for Ion Chromatography

- High-purity starting materials
- 18 Megohm (ASTM Type I) Water
- Pre-cleaned and leached bottles
- Triple-Checked for reliability
- Sold in 100 ml quantities

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

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

- DC ARC trace metal analysis of starting materials.
- Classical "wet" assay for major constituents (where applicable).
- IC check for major anion(s).

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

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

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

Ion Chromatography Instrument Check Standards

Instrument Check Standards

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

IC Instrument Check Standard 1

ICMIX1-100 100ml
Matrix H₂O

Anion	Concentration (ug/ml)
Cl ⁻	30ug/ml
F ⁻	20ug/ml
NO ₃ ⁻	100ug/ml
HPO ₄ ²⁻	150ug/ml
SO ₄ ²⁻	150ug/ml

IC Instrument Check Standard 2

ICMIX2-100 100ml
Matrix H₂O

Anion	Concentration (ug/ml)
Br ⁻	400ug/ml
Cl ⁻	200ug/ml
F ⁻	100ug/ml
NO ₃ ⁻	400ug/ml
HPO ₄ ²⁻	600ug/ml
SO ₄ ²⁻	400ug/ml

Matrix Modifiers

Matrix Modifiers

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

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

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



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