



Agilent Certified Reference Materials

# HIGH QUALITY INORGANIC AND METALLO-ORGANIC STANDARDS FOR ATOMIC SPECTROSCOPY

The Measure of Confidence



**Agilent Technologies**

# SPECTROSCOPY

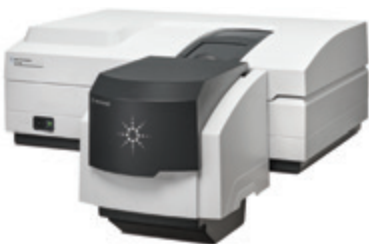
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Agilent 5100 Series ICP-OES



Agilent 7900 ICP-MS



Agilent Cary 7000  
Universal Measurement Spectrophotometer

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The Agilent atomic spectroscopy family features our unique MP-AES and ICP-QQQ technologies, which can deliver new possibilities for your lab.

For example, the Agilent 5100 Synchronous Vertical Dual View (SVDV) ICP-OES features unique Dichroic Spectral Combiner (DSC) technology that selects and combines axial and radial light from the robust vertical plasma in a single measurement. Combined with a high speed, zero gas consumption VistaChip II CCD detector, the 5100 SVDV ICP-OES runs even your toughest samples faster, with less argon.

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The Agilent Cary 7000 Universal Measurement Spectrophotometer (UMS) will satisfy all your solid sampling needs. Measure virtually any sample or measure absolute reflectance and transmission at any angle. Collect hundreds of UV-Vis-NIR spectra overnight, or characterize optical components or thin films in minutes. The Cary 7000 UMS delivers a turn-key solution that can advance your materials analysis.

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[www.agilent.com/chem/spectroscopy](http://www.agilent.com/chem/spectroscopy)

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# Why you need Agilent Certified Reference Materials

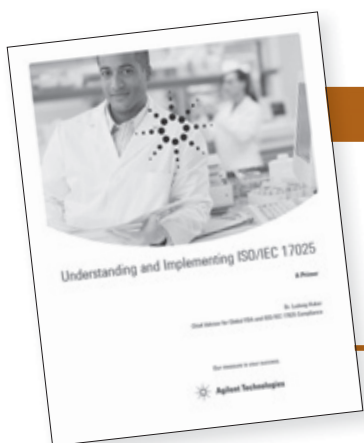
## Agilent Standards – The Right Choice for Your Laboratory

All Agilent Chemical Standards shown in this catalog are Certified Reference Materials (CRMs).

ISO/IEC 17025 is the global quality standard for the management and technical requirements of testing laboratories. Establishing and maintaining this quality system can be daunting and time-consuming. Manufacturers of standards that are accredited to ISO/IEC 17025 must demonstrate that they are technically competent, use documented and validated methods, and are able to produce precise and accurate test and calibration data with known uncertainties. Agilent certified reference materials meet all these demanding requirements.

Because all sample measurements are made with reference to the initial calibration, the accuracy of the analysis is dependent on the accuracy of the calibration standards. The calibration standards must be free of contaminants, and most importantly, must be certified using the most rigorous and robust techniques, with evidence to prove it. Using certified reference materials for preparation of calibration standards improves accuracy, establishes traceability, and allows quantification of the measurement of uncertainty. Agilent now offers a complete line of spectroscopy CRMs, manufactured under ISO 17025 and ISO Guide 34, for AA, MP-AES, ICP-OES, and ICP-MS applications.

With Agilent CRMs, your laboratory is assured of quality, purity, and consistency.



### TIPS & TOOLS

Need to know more about ISO/IEC 17025 requirements? Dr Ludwig Huber wrote an excellent introduction to ISO/IEC 17025 as the global standard for laboratory accreditation. His primer, titled *Understanding and Implementing ISO/IEC 17025*, is available from Agilent (publication 5990-4540EN), [www.chem.agilent.com/Library/primers/Public/5990-4540EN.pdf](http://www.chem.agilent.com/Library/primers/Public/5990-4540EN.pdf)

### NIST Methods for Accuracy and Traceability

All Agilent spectroscopy CRMs are certified using the high performance spectroscopy protocol<sup>1</sup> developed by the National Institute of Standards and Technology (NIST). Both the certified concentration and uncertainty values are traceable to NIST Standard Reference Materials (SRM) to ensure the highest accuracy and complete traceability. NIST uses high performance ICP-OES to certify its SRM 3100 series of spectrometric single element solution standards. NIST recommends that all manufacturers of standards use this technique to certify single element standards with high accuracy, low uncertainty, and direct traceability to the NIST SRM 3100 series.

**Figure 1** shows a typical Certificate of Analysis (CoA) for an Agilent spectroscopy CRM. This CoA highlights some of the features of our CRMs that improve quality and productivity. Agilent CRMs are manufactured in an ISO 9001, ISO Guide 34 facility and certified in an ISO/IEC 17025 testing laboratory. The certified concentrations are reported as both weight/volume ( $\mu\text{g}/\text{mL}$ ) and weight/weight ( $\mu\text{g}/\text{g}$ ) on the CoA.

Trace impurities are assayed using an Agilent ICP-MS and reported on the CoA for ICP-OES/ICP-MS standards (trace impurities are not reported for the atomic absorption standards because AA is a single element technique). The standards have a long shelf life, up to 18 months, supported by long-term stability studies performed as part of the requirements for Guide 34 accreditation.

Agilent AA, ICP-OES, and ICP-MS standards are made from high-purity raw materials, high-purity acids, and 18-M $\Omega$  deionized water. They are packed in precleaned, high-purity high-density polyethylene (HDPE) bottles before being shipped in poly-sealed bags with tamper-evident seals.

<sup>1</sup>Salit, M. *et al.* Anal. Chem. **2001**, 73, 4821-4829.

# WHY YOU NEED AGILENT CERTIFIED REFERENCE MATERIALS

## The Improved Agilent Certificate of Analysis: Discover why our standards are the highest quality in the industry

**Agilent Technologies**

### CERTIFICATE OF ANALYSIS

**Agilent Product Name:** Copper Standard: 1000 µg/mL Cu in 5% HNO<sub>3</sub>  
**Agilent Part No:** 5190-8348  
**Lot No:** Sample

Product Specifications				
Analyte	Starting Material	CAS #	Matrix	Certified Concentration
Cu	Cu	7440-50-8	5% HNO <sub>3</sub>	994 ± 2 µg/mL (w/v)
				984 ± 2 µg/g (w/w)

**Intended Use:** This solution is intended for use as a certified reference material or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma atomic emission spectroscopy (MP-AES), x-ray fluorescence spectroscopy (XRF), and other techniques for elemental analysis.

**Certification & Traceability:** This CRM was manufactured under a quality management system that is accredited to ISO Guide 34, ISO/IEC 17025, and registered to ISO 9001. This CRM was prepared to a nominal concentration of 1000 µg/mL by gravimetric methods using 99.999% pure copper (Cu) metal dissolved in high purity nitric acid (HNO<sub>3</sub>) and diluted with ASTM Type I Water. The balances used in the preparation of this CRM are calibrated regularly with traceability to NIST. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentration and uncertainty were determined using the "High Performance ICP-OES" protocol developed by NIST and both the certified concentration and uncertainty values are traceable to NIST SRM 3114, lot #011017. The uncertainty associated with the certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

**Uncertified Values:** Agilent ICP-MS was used to determine trace metal concentrations for this product (nd = not determined).

Trace Concentrations (µg/L)															
Ag	<0.5	Ce	<0.2	Gd	<0.2	Lu	<0.2	Pb	<1	Se	<2	Tl	<0.5		
Al	<2	Co	<1	Ge	0.989	Mg	<5	Pd	<0.5	Si	<100	Tm	<0.2		
As	<2	Cs	<0.5	Hf	<0.2	Mn	<1	Pr	<0.2	Sm	<0.2	U	<0.5		
Au	<0.5	Cr	<0.5	Hg	<0.5	Mo	<0.5	Pt	<0.5	Sr	<0.5	V	<1		
B	<5	Cu	Major	Ho	<0.2	Na	<25	Rb	<0.5	Sr	<1	W	<0.5		
Ba	<1	Dy	<0.2	In	nd	Nb	<0.5	Re	<0.2	Ta	<0.5	Y	<0.5		
Be	<0.5	Er	<0.2	Ir	<0.2	Nd	<0.2	Rh	<5	Tb	<0.5	Yb	<0.2		
Bi	<0.2	Eu	<0.2	K	<25	Ni	9	Ru	<0.5	Te	<1	Zn	<2		
Ca	<25	Fe	<10	La	<0.5	Os	<0.5	Sb	<0.5	Th	<0.5	Zr	<0.5		
Cd	<0.5	Ga	<0.5	Li	<2	P	<100	Sc	<5	Ti	<2				

**Instructions for Use:** Agilent Technologies recommends that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy the analyst should: (1) use only pre-cleaned containers and transferrware, (2) avoid pipetting directly from the CRM's original container, (3) use a minimum sub-sample size of 500 µL, (4) make dilutions using calibrated balances or certified volumetric class A flasks and pipettes, (5) dilute to volume using the same matrix as the original CRM, and (6) never pour used product back into the original container. The solution should be kept tightly capped. Store at controlled room temperature per USP 35 (10.30.60). Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

**Period of Validity:** Agilent Technologies ensures the accuracy of this solution until the expiration date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

**Date of release:** 9 February 2015  
**Date of expiration:** 31 August 2016

**Sample lot approver:**  
*Janice H. MacArthur*  
 QA Manager

\*Impurities in wear metal, metallo-organic and biodiesel standards assayed using ICP-OES, XRF or other elemental analysis techniques

Figure 1. Certificate of Analysis for an Agilent CRM, depicting the additional levels of quality control that are applied during the manufacture of the spectroscopy CRM.

## Single Element Standards

Agilent aqueous single element standards for AA are certified by high performance ICP-OES (HP-ICP-OES), a technique developed by the National Institute of Standards and Technology (NIST). NIST uses HP-ICP-OES to certify their SRM 3100 series of spectrometric single element solution standards. NIST recommends that all standards manufacturers use this technique to certify single element standards with high accuracy, low uncertainty, and direct traceability of both the certified concentration and the uncertainty to the NIST SRM 3100 series.

- Manufactured from high-purity raw materials
- Higher accuracy and lower uncertainty
- Comprehensive range
- Directly traceable to NIST Standard Reference Materials
- Packaged in precleaned HDPE bottles

### 1,000 µg/mL Single Element Standards for AA and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Aluminum (Al)	5% HCl	5190-8256	5190-8257
Antimony (Sb)	30% HCl	5190-8258	5190-8259
Arsenic (As)	5% HNO <sub>3</sub>	5190-8260	5190-8261
Barium (Ba)	5% HNO <sub>3</sub>	5190-8262	5190-8263
Beryllium (Be)	5% HNO <sub>3</sub>	5190-8264	5190-8265
Bismuth (Bi)	5% HNO <sub>3</sub>	5190-8266	5190-8267
Boron (B)	H <sub>2</sub> O	5190-8268	5190-8269
Cadmium (Cd)	5% HNO <sub>3</sub>	5190-8270	5190-8271
Calcium (Ca)	5% HNO <sub>3</sub>	5190-8272	5190-8273
Cesium (Ce)	5% HNO <sub>3</sub>	5190-8274	
Chromium (Cr)	5% HCl	5190-8275	5190-8276
Cobalt (Co)	5% HNO <sub>3</sub>	5190-8277	5190-8278
Copper (Cu)	5% HNO <sub>3</sub>	5190-8279	5190-8280
Gold (Au)	20% HCl	5190-8282	5190-8283



Copper (Cu) standard, 5190-8280

(Continued)

## SINGLE ELEMENT STANDARDS

### TIPS & TOOLS

Store CRMs at controlled room temperature per USP 35 (10.30.60). Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

### 1,000 µg/mL Single Element Standards for AA and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Indium (In)	5% HNO <sub>3</sub>	5190-8284	
Iron (Fe)	5% HNO <sub>3</sub>	5190-8285	5190-8286
Lead (Pb)	5% HNO <sub>3</sub>	5190-8287	5190-8288
Lithium (Li)	5% HNO <sub>3</sub>	5190-8289	5190-8290
Magnesium (Mg)	5% HNO <sub>3</sub>	5190-8291	5190-8292
Manganese (Mn)	5% HNO <sub>3</sub>	5190-8293	5190-8294
Mercury (Hg)	5% HNO <sub>3</sub>	5190-8295	5190-8296
Molybdenum (Mo)	1% NH <sub>4</sub> OH	5190-8297	
Nickel (Ni)	5% HNO <sub>3</sub>	5190-8298	5190-8299
Palladium (Pd)	20% HCl	5190-8300	5190-8301
Platinum (Pt)	20% HCl	5190-8302	5190-8303
Potassium (K)	5% HNO <sub>3</sub>	5190-8304	5190-8305
Selenium (Se)	5% HNO <sub>3</sub>	5190-8306	5190-8307
Silicon (Si)	H <sub>2</sub> O	5190-8308	
Silver (Ag)	5% HNO <sub>3</sub>	5190-8309	5190-8310
Sodium (Na)	5% HNO <sub>3</sub>	5190-8311	5190-8312
Strontium (Sr)	5% HNO <sub>3</sub>	5190-8313	5190-8314
Tellurium (Te)	5% HNO <sub>3</sub>	5190-8315	
Thallium (Tl)	5% HNO <sub>3</sub>	5190-8316	5190-8317
Tin (Sn)	20% HCl	5190-8318	5190-8319
Titanium (Ti)	H <sub>2</sub> O	5190-8320	5190-8321
Vanadium (V)	5% HNO <sub>3</sub>	5190-8323	5190-8324
Zinc (Zn)	5% HNO <sub>3</sub>	5190-8325	5190-8326
Zirconium (Zr)	5% HNO <sub>3</sub>	5190-8327	



## 1,000 µg/mL Single Element Standards for ICP-OES and MP-AES

- Manufactured in an ISO 9001, ISO Guide 34 facility, and certified to ISO/IEC 17025
- Assayed by NIST HP-ICP-OES method and purity confirmed by ICP-MS
- Directly traceable to NIST Standard Reference Materials

### TIPS & TOOLS

The shelf life defines the time that the standard can be stored without undergoing physical or chemical change. The chemical stability and transpiration losses (water loss) determine shelf life.

Replace standards well before the expiry date to ensure accuracy and minimize contamination risks.

### 1,000 µg/mL Single Element Standards for ICP-OES and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Aluminum (Al)	5% HNO <sub>3</sub>	5190-8242	5190-8243
Antimony (Sb)	1% HNO <sub>3</sub> , trace tartaric acid	5190-8244	5190-8245
Arsenic (As)	5% HNO <sub>3</sub>	5190-8246	5190-8247
Barium (Ba)	5% HNO <sub>3</sub>	5190-8248	5190-8249
Beryllium (Be)	5% HNO <sub>3</sub>	5190-8250	5190-8251
Bismuth (Bi)	5% HNO <sub>3</sub>	5190-8252	5190-8253
Boron (B)	H <sub>2</sub> O	5190-8254	5190-8255
Cadmium (Cd)	5% HNO <sub>3</sub>	5190-9414	5190-8328
Calcium (Ca)	5% HNO <sub>3</sub>	5190-8329	5190-8330
Cerium (Ce)	5% HNO <sub>3</sub>	5190-8331	5190-8332
Cesium (Cs)	5% HNO <sub>3</sub>	5190-8333	5190-8334
Chromium (Cr)	5% HNO <sub>3</sub>	5190-8344	5190-8345
Cobalt (Co)	5% HNO <sub>3</sub>	5190-8346	5190-8347
Copper (Cu)	5% HNO <sub>3</sub>	5190-8348	5190-8349
Dysprosium (Dy)	5% HNO <sub>3</sub>	5190-8350	5190-8351
Erbium (Er)	5% HNO <sub>3</sub>	5190-8237	5190-8238
Europium (Eu)	5% HNO <sub>3</sub>	5190-8239	5190-8240
Gadolinium (Gd)	5% HNO <sub>3</sub>	5190-8241	5190-8456
Gallium (Ga)	5% HNO <sub>3</sub> , 0.5% HCl	5190-8457	5190-8458
Germanium (Ge)	5% HNO <sub>3</sub> , trace HF	5190-8459	5190-8460
Gold (Au)	20% HCl	5190-8461	5190-8462
Hafnium (Hf)	5% HCl	5190-8463	5190-8464
Holmium (Ho)	5% HNO <sub>3</sub>	5190-8465	5190-8466

(Continued)

## SINGLE ELEMENT STANDARDS

### TIPS & TOOLS

When working with osmium, only mix the standard with water and HCl. Do not use nitric acid. Nitric acid will slowly oxidize the Os to OsO<sub>4</sub>, which is volatile and very toxic.

### 1,000 µg/mL Single Element Standards for ICP-OES and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Indium (In)	5% HNO <sub>3</sub>	5190-8467	5190-8468
Iridium (Ir)	20% HCl	5190-8469	5190-8470
Iron (Fe)	5% HNO <sub>3</sub>	5190-8471	5190-8472
Lanthanum (La)	5% HNO <sub>3</sub>	5190-8473	5190-8474
Lead (Pb)	5% HNO <sub>3</sub>	5190-8475	5190-8476
Lithium (Li)	5% HNO <sub>3</sub>	5190-8477	5190-8478
Lutetium (Lu)	5% HNO <sub>3</sub>	5190-8479	5190-8480
Magnesium (Mg)	5% HNO <sub>3</sub>	5190-8481	5190-8482
Manganese (Mn)	5% HNO <sub>3</sub>	5190-8483	5190-8484
Mercury (Hg)	5% HNO <sub>3</sub>	5190-8485	5190-8486
Molybdenum (Mb)	1% NH <sub>4</sub> OH	5190-8487	5190-8488
Neodymium (Nd)	5% HNO <sub>3</sub>	5190-8489	5190-8490
Nickel (Ni)	5% HNO <sub>3</sub>	5190-8491	5190-8492
Niobium (Nb)	2% HF	5190-8493	5190-8494
Osmium (Os)	20% HCl	5190-8495	5190-8496
Palladium (Pd)	5% HNO <sub>3</sub>	5190-8497	5190-8498
Phosphorus (P)	5% HNO <sub>3</sub>	5190-8499	5190-8500
Platinum (Pt)	20% HCl	5190-8501	5190-8502
Potassium (K)	5% HNO <sub>3</sub>	5190-8503	5190-8504
Praseodymium (Pr)	5% HNO <sub>3</sub>	5190-8505	5190-8506
Rhenium (Re)	5% HNO <sub>3</sub>	5190-8507	5190-8508
Rhodium (Rh)	20% HCl	5190-8509	5190-8510
Rubidium (Rb)	5% HNO <sub>3</sub>	5190-8511	5190-8512
Ruthenium (Ru)	20% HCl	5190-8513	5190-8514
Samarium (Sm)	5% HNO <sub>3</sub>	5190-8515	5190-8516
Scandium (Sc)	5% HNO <sub>3</sub>	5190-8517	5190-8518
Selenium (Se)	5% HNO <sub>3</sub>	5190-8519	5190-8520
Silicon (Si)	H <sub>2</sub> O	5190-8521	5190-8522
Silver (Ag)	5% HNO <sub>3</sub>	5190-8523	5190-8524
Sodium (Na)	5% HNO <sub>3</sub>	5190-8525	5190-8526

(Continued)

## SINGLE ELEMENT STANDARDS

### TIPS & TOOLS

“Trace HF” refers to a small amount of hydrofluoric acid (HF) added to stabilize some elements that require it. Concentrations are usually below 0.5%. “F<sup>-</sup>” refers to fluoride as part of a raw material compound. These have F<sup>-</sup> at similarly low, dilute levels with no additional fluoride added.

### 1,000 µg/mL Single Element Standards for ICP-OES and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Strontium (Sr)	5% HNO <sub>3</sub>	5190-8527	5190-8528
Sulfur (S)	H <sub>2</sub> O	5190-8529	5190-8530
Tantalum (Ta)	2% HF	5190-8531	5190-8532
Tellurium (Te)	30% HCl	5190-8533	5190-8534
Terbium (Tb)	5% HNO <sub>3</sub>	5190-8535	5190-8536
Thallium (Tl)	5% HNO <sub>3</sub>	5190-8537	5190-8538
Thorium (Th)	5% HNO <sub>3</sub>	5190-8539	5190-8540
Thulium (Tm)	5% HNO <sub>3</sub>	5190-8541	5190-8542
Tin (Sn)	20% HCl	5190-8543	5190-8544
Titanium (Ti)	H <sub>2</sub> O	5190-8545	5190-8546
Tungsten (W)	5% HNO <sub>3</sub> , trace HF	5190-8547	5190-8548
Uranium (U)	5% HNO <sub>3</sub>	5190-8549	5190-8550
Vanadium (V)	5% HNO <sub>3</sub>	5190-8551	5190-8552
Ytterbium (Yb)	5% HNO <sub>3</sub>	5190-8553	5190-8554
Yttrium (Y)	5% HNO <sub>3</sub>	5190-8555	5190-8556
Zinc (Zn)	5% HNO <sub>3</sub>	5190-8557	5190-8558
Zirconium (Zr)	5% HCl	5190-8559	5190-8560

## SINGLE ELEMENT STANDARDS

### 10,000 µg/mL Single Element Standards for ICP-OES and MP-AES

- Manufactured in an ISO 9001, ISO Guide 34 facility, and certified to ISO/IEC 17025
- Assayed by NIST HP-ICP-OES method and purity confirmed by ICP-MS

#### TIPS & TOOLS

“Matrix matching” of major sample components can be valuable with many spectrometric techniques. Our 1% (10,000 µg/mL) standards work well as stock materials for matrix matching.

#### 10,000 µg/mL Single Element Standards for ICP-OES and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Aluminum (Al)	5% HNO <sub>3</sub>	5190-8352	5190-8353
Antimony (Sb)	1% HNO <sub>3</sub> , 1% tartaric acid	5190-8354	5190-8355
Arsenic (As)	5% HNO <sub>3</sub>	5190-8356	5190-8357
Barium (Ba)	5% HNO <sub>3</sub>	5190-8358	5190-8359
Beryllium (Be)	5% HNO <sub>3</sub>	5190-8360	5190-8361
Bismuth (Bi)	5% HNO <sub>3</sub>	5190-8362	5190-8363
Boron (B)	1% NH <sub>4</sub> OH	5190-8364	5190-8365
Cadmium (Cd)	5% HNO <sub>3</sub>	5190-8366	5190-8367
Calcium (Ca)	5% HNO <sub>3</sub>	5190-8368	5190-8369
Cerium (Ce)	5% HNO <sub>3</sub>	5190-8370	5190-8371
Cesium (Cs)	5% HNO <sub>3</sub>	5190-8372	5190-8373
Chromium (Cr)	5% HNO <sub>3</sub>	5190-8374	5190-8375
Cobalt (Co)	5% HNO <sub>3</sub>	5190-8376	5190-8377
Copper (Cu)	5% HNO <sub>3</sub>	5190-8378	5190-8379
Dysprosium (Dy)	5% HNO <sub>3</sub>	5190-8380	5190-8381
Erbium (Er)	5% HNO <sub>3</sub>	5190-8382	5190-8383
Europium (Eu)	5% HNO <sub>3</sub>	5190-8384	5190-8385
Gadolinium (Gd)	5% HNO <sub>3</sub>	5190-8386	5190-8387
Gallium (Ga)	5% HNO <sub>3</sub> , 0.5% HCl	5190-8388	5190-8389
Germanium (Ge)	5% HNO <sub>3</sub> , trace HF	5190-8390	5190-8391
Gold (Au)	20% HCl	5190-8392	5190-8393

(Continued)

## SINGLE ELEMENT STANDARDS

### TIPS & TOOLS

Minimize blockage in the sample introduction system by ensuring sample digestion is complete and checking there are no particles in solution. Filter or centrifuge if necessary.

### 10,000 µg/mL Single Element Standards for ICP-OES and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Hafnium (Hf)	5% HCl	5190-8394	5190-8395
Holmium (Ho)	5% HNO <sub>3</sub>	5190-8396	5190-8397
Indium (In)	5% HNO <sub>3</sub>	5190-8398	5190-8399
Iridium (Ir)	20% HCl	5190-8400	5190-8401
Iron (Fe)	5% HNO <sub>3</sub>	5190-8402	5190-8403
Lanthanum (La)	5% HNO <sub>3</sub>	5190-8404	5190-8405
Lead (Pb)	5% HNO <sub>3</sub>	5190-8406	5190-8407
Lithium (Li)	5% HNO <sub>3</sub>	5190-8408	5190-8409
Lutetium (Lu)	5% HNO <sub>3</sub>	5190-8410	5190-8411
Magnesium (Mg)	5% HNO <sub>3</sub>	5190-8412	5190-8413
Manganese (Mn)	5% HNO <sub>3</sub>	5190-8414	5190-8415
Mercury (Hg)	5% HNO <sub>3</sub>	5190-8416	5190-8417
Molybdenum (Mb)	1% NH <sub>4</sub> OH	5190-8418	5190-8419
Neodymium (Nd)	5% HNO <sub>3</sub>	5190-8420	5190-8421
Nickel (Ni)	5% HNO <sub>3</sub>	5190-8422	5190-8423
Niobium (Nb)	2% HF	5190-8424	5190-8425
Palladium (Pd)	10% HNO <sub>3</sub>	5190-8426	5190-8427
Phosphorus (P)	5% HNO <sub>3</sub>	5190-8428	5190-8429
Platinum (Pt)	20% HCl	5190-8430	5190-8431
Potassium (K)	5% HNO <sub>3</sub>	5190-8432	5190-8433
Praseodymium (Pr)	5% HNO <sub>3</sub>	5190-8434	5190-8435
Rhenium (Re)	5% HNO <sub>3</sub>	5190-8436	5190-8437
Rhodium (Rh)	20% HCl	5190-8438	5190-8439
Rubidium (Rb)	5% HNO <sub>3</sub>	5190-8440	5190-8441
Ruthenium (Ru)	20% HCl	5190-8442	5190-8443

(Continued)

## SINGLE ELEMENT STANDARDS

### TIPS & TOOLS

If you need to prepare your standards in an HCl matrix, remember silver is stable in HCl up to 100 mg/L. To prepare solutions in HCl, add Ag concentrate to concentrated HCl to effect complexation, then bring to volume with dilute HCl.

### 10,000 µg/mL Single Element Standards for ICP-OES and MP-AES

Description	Matrix	Part No. 100 mL	Part No. 500 mL
Samarium (Sm)	5% HNO <sub>3</sub>	5190-8444	5190-8445
Scandium (Sc)	5% HNO <sub>3</sub>	5190-8446	5190-8447
Selenium (Se)	5% HNO <sub>3</sub>	5190-8448	5190-8449
Silicon (Si)	H <sub>2</sub> O	5190-8450	5190-8451
Silver (Ag)	5% HNO <sub>3</sub>	5190-8452	5190-8453
Sodium (Na)	5% HNO <sub>3</sub>	5190-8454	5190-8206
Strontium (Sr)	5% HNO <sub>3</sub>	5190-8207	5190-8208
Sulfur (S)	H <sub>2</sub> O	5190-8209	5190-8210
Tantalum (Ta)	2% HF	5190-8211	5190-8212
Tellurium (Te)	30% HCl	5190-8213	5190-8214
Terbium (Tb)	5% HNO <sub>3</sub>	5190-8215	5190-8216
Thallium (Tl)	5% HNO <sub>3</sub>	5190-8217	5190-8218
Thulium (Tm)	5% HNO <sub>3</sub>	5190-8219	5190-8220
Tin (Sn)	20% HCl	5190-8221	5190-8222
Titanium (Ti)	5% HNO <sub>3</sub> , trace HF	5190-8223	
Titanium (Ti)	H <sub>2</sub> O	5190-8224	5190-8225
Tungsten (W)	5% HNO <sub>3</sub> , trace HF	5190-8226	5190-8227
Vanadium (V)	5% HNO <sub>3</sub>	5190-8228	5190-8229
Ytterbium (Yb)	5% HNO <sub>3</sub>	5190-8230	5190-8231
Yttrium (Y)	5% HNO <sub>3</sub>	5190-8232	5190-8233
Zinc (Zn)	5% HNO <sub>3</sub>	5190-8234	5190-8235
Zirconium (Zr)	5% HNO <sub>3</sub>	5190-8236	

## 10 and 100 µg/mL Single Element Standards for ICP-OES and ICP-MS

- Directly traceable to NIST Standard Reference Materials
- Convenient concentrations for sample dilution to working solutions
- Use as the stock blend for automated addition of internal standards

### 10 and 100 µg/mL Single Element Standards for ICP-OES and ICP-MS

#### Supplied in 100 mL bottles

Description	Matrix	Part No.
Bismuth (Bi), 10 µg/mL	2% HNO <sub>3</sub>	8500-6936
Cobalt (Co), 10 µg/mL	2% HNO <sub>3</sub>	8500-6947
Gold (Au), 100 µg/mL	2% HCl	8500-7000
Indium (In), 10 µg/mL	2% HNO <sub>3</sub>	8500-6946
Mercury (Hg), 10 µg/mL	5% HNO <sub>3</sub>	8500-6941
Rhodium (Rh), 10 µg/mL	2% HCl	8500-6945

#### TIPS & TOOLS

Ideal for ICP-MS, GFAA or other trace level elemental techniques

### 10 µg/mL Single Element Standards for ICP-MS

- Purity confirmed by ICP-MS; trace impurities reported on CoA
- Packed in acid-leached, triple-rinsed HDPE bottles and shipped in poly-sealed bags
- Directly traceable to NIST Standard Reference Materials

### 10 µg/mL Single Element Standards for ICP-MS

#### Supplied in 100 mL bottles

Description	Matrix	Part No.
Aluminum (Al)	5% HNO <sub>3</sub>	5190-8561
Antimony (Sb)	1% HNO <sub>3</sub> , trace tartaric acid	5190-8562
Arsenic (As)	2% HNO <sub>3</sub>	5190-8563

(Continued)

## SINGLE ELEMENT STANDARDS

### TIPS & TOOLS

Use balances, not pipettes, for diluting  
Try to dilute on a weight/weight  
basis using calibrated balances;  
the uncertainty of a balance is much  
lower than a pipette.

### 10 µg/mL Single Element Standards for ICP-MS

#### Supplied in 100 mL bottles

Description	Matrix	Part No.
Barium (Ba)	2% HNO <sub>3</sub>	5190-8564
Beryllium (Be)	2% HNO <sub>3</sub>	5190-8565
Boron (B)	H <sub>2</sub> O	5190-8566
Cadmium (Cd)	2% HNO <sub>3</sub>	5190-8567
Chromium (Cr)	2% HNO <sub>3</sub>	5190-8568
Copper (Cu)	2% HNO <sub>3</sub>	5190-8569
Iridium (Ir)	2% HCl	5190-8570
Lead (Pb)	2% HNO <sub>3</sub>	5190-8571
Lithium (Li)	2% HNO <sub>3</sub>	5190-8572
Lutetium (Lu)	2% HNO <sub>3</sub>	5190-8573
Manganese (Mn)	2% HNO <sub>3</sub>	5190-8574
Mercury (Hg)	5% HNO <sub>3</sub>	5190-8575
Nickel (Ni)	2% HNO <sub>3</sub>	5190-8576
Platinum (Pt)	5% HCl	5190-8577
Scandium (Sc)	2% HNO <sub>3</sub>	5190-8578
Selenium (Se)	2% HNO <sub>3</sub>	5190-8579
Silver (Ag)	2% HNO <sub>3</sub>	5190-8580
Strontium (Sr)	2% HNO <sub>3</sub>	5190-8581
Terbium (Tb)	2% HNO <sub>3</sub>	5190-8582
Tin (Sn)	5% HCl	5190-8583
Uranium (U)	2% HNO <sub>3</sub>	5190-8584
Vanadium (V)	5% HNO <sub>3</sub>	5190-8585
Yttrium (Y)	2% HNO <sub>3</sub>	5190-8586
Zinc (Zn)	2% HNO <sub>3</sub>	5190-8587



## Matrix Modifiers and Buffers for AA

- Certified in an ISO/IEC 17025 testing laboratory by HP-ICP-OES
- Directly traceable to NIST Standard Reference Materials

### TIPS & TOOLS

To determine the mass of matrix modifier added to the furnace, multiply the concentration of the modifier by 0.005 for 5  $\mu\text{L}$  aliquots or 0.02 for 20  $\mu\text{L}$  aliquots.



Palladium nitrate, 190024300



Mixed palladium nitrate/magnesium nitrate, 5190-8340

### Matrix Modifiers for Graphite Furnace AA

#### Supplied in 100 mL bottles

Description	Matrix	Part No.
Palladium nitrate Contains 0.1% Pd	5% HNO <sub>3</sub>	5190-8335
Palladium nitrate Contains 2,000 $\mu\text{g}/\text{mL}$ Pd	5% HNO <sub>3</sub>	190024300
Palladium nitrate Contains 1% Pd	10% HNO <sub>3</sub>	5190-8336
Ammonium phosphate Contains 10% NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub>	2% HNO <sub>3</sub>	5190-8337
Ammonium phosphate Contains 40% NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub>	H <sub>2</sub> O	190024100
Magnesium nitrate Contains 1% Mg(NO <sub>3</sub> ) <sub>2</sub>	2% HNO <sub>3</sub>	5190-8338
Nickel nitrate Contains 1% Ni(NO <sub>3</sub> ) <sub>2</sub>	2% HNO <sub>3</sub>	5190-8339
Nickel nitrate Contains 5,000 $\mu\text{g}/\text{mL}$ Ni	5% HNO <sub>3</sub>	190024200
Mixed palladium nitrate/magnesium nitrate Contains 750 $\mu\text{g}/\text{mL}$ Pd, 500 $\mu\text{g}/\text{mL}$ Mg	2% HNO <sub>3</sub>	5190-8340
Mixed palladium nitrate/magnesium nitrate Contains 1,000 $\mu\text{g}/\text{mL}$ Pd, 600 $\mu\text{g}/\text{mL}$ Mg	2% HNO <sub>3</sub>	5190-8341
Mixed, ammonium phosphate/magnesium nitrate Contains 10 $\mu\text{g}/\text{mL}$ ammonium phosphate, 600 $\mu\text{g}/\text{mL}$ Mg	2% HNO <sub>3</sub>	5190-8342
Ammonium nitrate Contains 5% NH <sub>4</sub> NO <sub>3</sub>	2% HNO <sub>3</sub>	190024000
Triton X-100 surfactant		CP3418

## MATRIX MODIFIERS AND BUFFERS FOR AA



Cesium buffer solution – 1%, 190064500

### Buffers/Ionization Suppressant for Flame AA

#### Supplied in 500 mL bottles

Description	Matrix	Part No.
Cesium buffer solution Contains 1% 10,000 µg/mL Cs	5% HNO <sub>3</sub>	190064500
Lanthanum buffer solution Contains 10% 100,000 µg/mL La	5% HNO <sub>3</sub>	8200206901
Potassium buffer solution Contains 10% 100,000 µg/mL K	5% HNO <sub>3</sub>	8200206801
Strontium buffer solution Contains 10% 100,000 µg/mL Sr	5% HNO <sub>3</sub>	8200207001
Cesium nitrate ionization buffer Contains 1% Cs (from carbonate)	5% HNO <sub>3</sub>	5190-8343

## Multi-Element Standards

### Multi-Element Standards for ICP-OES, MP-AES, and ICP-MS

#### TIPS & TOOLS

As a rule, the total concentration of all elements (metals) in a multi-element mixture should be kept below 20,000 µg/mL (2%).

- General environmental spiking solutions
- QC check samples for water and trace metals
- Use for international environmental standards

#### Multi-Element Calibration Standards for ICP-OES & MP-AES

##### Supplied in 125 mL bottles

Description	Matrix	Part No.
Calibration mix 1 Contains 100 µg/mL Sb, Mo, Sn, Tl	2% HNO <sub>3</sub> + 0.5% HF	6610030500
Calibration mix 2 Contains 100 µg/mL Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Ni, Pb, Se, Ti, Th, U, V, Zn	5% HNO <sub>3</sub>	6610030600
Calibration mix majors Contains 500 µg/mL Ca, Fe, K, Mg, Na	5% HNO <sub>3</sub>	6610030700

#### Multi-Element Calibration Standards for ICP-MS

Description	Matrix	Part No.
Multi-element calibration standard-1, 100 mL Contains 10 µg/mL Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sc, Sm, Tb, Th, Tm, Y, Yb	5% HNO <sub>3</sub>	8500-6944
Multi-element calibration standard-2A, 2 x 100 mL Bottle 1 contains 10 µg/mL Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ga, K, Li, Mg, Mn, Na, Ni, Pb, Rb, Se, Sr, Tl, U, V, Zn Bottle 2 contains 10 µg/mL Hg	5% HNO <sub>3</sub>	8500-6940
Multi-element calibration standard-3, 100 mL Contains 10 µg/mL Sb, Au, Hf, Ir, Pd, Pt, Rh, Ru, Te, Sn	10% HCl/1% HNO <sub>3</sub>	8500-6948
Multi-Element Calibration Standard-4, 100 mL Contains 10 µg/mL B, Ge, Mo, Nb, P, Re, S, Si, Ta, Ti, W, Zr	H <sub>2</sub> O, trace HF	8500-6942

# MULTI-ELEMENT STANDARDS FOR ICP-OES AND ICP-MS

## TIPS & TOOLS

Don't underestimate the importance of good mixing when preparing standards. A simple swirl is not enough. Make a habit of inverting and shaking the container several times.



ICP-MS semi-quant standard I, 5190-8594

## Environmental Standards for ICP-MS

### Supplied in 100 mL bottles

Description	Matrix	Part No.
Environmental calibration standard Contains 1,000 µg/mL Fe, K, Ca, Na, Mg, 10 µg/mL Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Ti, V, Zn, Th, U	10% HNO <sub>3</sub>	5183-4688
Initial calibration verification standard Contains 1,000 µg/mL Fe, K, Ca, Na, Mg, Sr, 10 µg/mL Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Ti, V, Zn, Th, U	5% HNO <sub>3</sub>	5183-4682
Internal standard mix Contains 100 µg/mL <sup>6</sup> Li, Sc, Ge, Rh, In, Tb, Lu, Bi	10% HNO <sub>3</sub>	5188-6525
Internal standard mix Contains 10 µg/mL <sup>6</sup> Li, Sc, Ge, Y, In, Tb, Bi	5-10% HNO <sub>3</sub>	5183-4681
Environmental spike mix Contains 1,000 µg/mL Fe, K, Ca, Na, Mg, 100 µg/mL Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Ti, V, Zn, U	5% HNO <sub>3</sub>	5183-4687

## Semi-Quant Standards for ICP-MS

### Supplied in 100 mL bottles

Description	Matrix	Part No.
ICP-MS semi-quant standard I Contains 10 µg/mL Ag, Al, As, Ba, Bi, Ca, Cd, Ce, Dy, Er, Eu, Ga, Gd, Ho, La, Lu, Mg, Na, Nd, P, Pb, Pr, Rb, Sc, Se, Sm, Sr, Tb, Th, Tl, Tm, U, Y, Yb	40% aqua regia	5190-8594
ICP-MS semi-quant standard II Contains 10 µg/mL Au, B, Be, Co, Cr, Cu, Fe, Ge, Hf, Ir, K, Li, Mn, Mo, Nb, Ni, Os, Pd, Pt, Re, Rh, Ru, Sb, Si, Sn, Ta, Te, Ti, V, W, Zn, Zr	40% aqua regia, trace HF	5190-8595

## MULTI-ELEMENT STANDARDS FOR ICP-OES AND ICP-MS

### Environmental Standards for ICP-OES

#### Supplied in 500 mL bottles

Description	Application	Part No.
INTF-A quality control standard Contains 5,000 µg/mL Al, Ca, Mg, 2,000 µg/mL Fe	Interference check standard, for preparation of US EPA CLP standards ICSA and ICSAB	190064800
ICV-7 quality control standard Contains 5,000 µg/mL Ca, Mg, K, Na, 200 µg/mL Al, Ba, 100 µg/mL Fe, 60 µg/mL Sb, 50 µg/mL Co, V, 40 µg/mL Ni, 25 µg/mL Cu, 20 µg/mL Zn, 15 µg/mL Mn, 10 µg/mL As, Cr, Ag, Tl, 5 µg/mL Be, Cd, Pb, Se	Initial/continuing calibration verification standard, for US EPA CLP analyses	190064900
QCSTD-27 quality control standard Contains 100 µg/mL Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Sr, Na, Ti, V, Zn	Quality control standard, for environmental analyses	190065000
ANALT-B quality control standard Contains 100 µg/mL Cd, Ni, Pb, Ag, Zn, 50 µg/mL Ba, Be, Co, Cr, Cu, Mn, V	Interference check standard, for preparation of US EPA CLP standard ICSAB	190065100

### Initial Calibration Verification Standards

Description	Matrix	Volume (mL)	Similar to PerkinElmer Part No.	Part No.
Alternate trace metal drinking pollution and wastewater standards I for ICP and AA Contains 20 µg/mL Al, Fe, V, 10 µg/mL Co, Cu, Mn, Ni, Zn, 5 µg/mL Sb, Be, Tl	2% HNO <sub>3</sub>	100	N9300214	5190-9406
Alternate trace metal drinking pollution and wastewater standards II for ICP and AA Contains 500 µg/mL Ca, Na, 100 µg/mL Mg, K	2% HNO <sub>3</sub>	100	N9300215	5190-9407
Initial calibration verification for ICP, AA, or GFAA Contains 500 µg/mL Ca, K, Mg, Na, 200 µg/mL Al, Ba, 100 µg/mL Fe, 60 µg/mL Sb, 50 µg/mL Co, V, 40 µg/mL Ni, 25 µg/mL Cu, 20 µg/mL Zn, 15 µg/mL Mn, 10 µg/mL Ag, As, Cr, Tl, 5 µg/mL Be, Cd, Se, 3 µg/mL Pb	5% HNO <sub>3</sub> , trace tartaric acid	500	N9300224	5190-9408

## MULTI-ELEMENT STANDARDS FOR ICP-OES AND ICP-MS

### EPA Method Standards

- Formulated for EPA methods 6010 and CLP for ICP-OES
- Use for CLP interference checks – ICS
- Supplied with safety data sheet and CoA for complete assurance

#### EPA Method Standards

Description	Matrix	Volume (mL)	Similar to PerkinElmer Part No.	Part No.
ICS interference A for EPA 200.7 Contains 5,000 µg/mL Al, Ca, Mg, 2,000 µg/mL Fe	20% HCl	500		5190-8599
CLP instrument calibration solution 1 Contains 5,000 µg/mL Ca, Mg, K, Na	5% HNO <sub>3</sub>	125	N9300218	5190-9409
CLP instrument calibration mix 4 Contains 100 µg/mL As, Ti, 50 µg/mL Cd, Se, 30 µg/mL Pb	5% HNO <sub>3</sub>	125	N9300221	5190-9412

#### Interference Check Mixes

##### Supplied in 100 mL bottles

Description	Matrix	Part No.
6020 Interference check solution A Contains 20,000 µg/mL Cl, 3,000 µg/mL Ca, 2,500 µg/mL Fe, Na, 2,000 µg/mL C, 1,000 µg/mL Al, Mg, P, K, S, 20 µg/mL Ti, Mo	5% HNO <sub>3</sub> , trace HF	5188-6526
6020 Interference check solution B Contains 20 µg/mL Cr, Co, Cu, Mn, Ni, V, 10 µg/mL As, Cd, Se, Zn, 5 µg/mL Ag	5% HNO <sub>3</sub>	5188-6527

## Wear Metal and Metallo-organic Standards

### TIPS & TOOLS

Thorough mixing is especially important when using oil-based standards. Due to their viscosity they are difficult to homogenize. For best results, always mix the standard by vigorously shaking the container for at least a few minutes. Alternately, shake the container and sonicate the standard in an ultrasonic bath for a few minutes.

- Highest quality metallo-organic mixes in the industry manufactured in accordance with the requirements of ISO Guide 34 and ISO 17025
- Accuracy ensured by quality testing with NIST Standard Reference Materials
- CoA shows certified, not nominal, concentrations
- For use in blending and preparation of calibration standards for spectrometric analysis of metals in hydrocarbon/petrochemical samples

### Wear Metal and Metallo-organic Standards

#### 100 g

Description	Nominal Conc. (µg/g)	Matrix	Part No.
A21 Wear metal standards Contains Ag, Al, B, Ba, Ca, Cd, Cr, Cu, Fe, Mg, Mn, Mo, Na, Ni, P, Pb, Si, Sn, Ti, V, Zn	100	75 cSt hydrocarbon oil	5190-8603
	300	75 cSt hydrocarbon oil	5190-8604
	500	75 cSt hydrocarbon oil	5190-8605
	900	75 cSt hydrocarbon oil	5190-8706
A21+K Wear metal standards Contains all A21 elements plus K	100	75 cSt hydrocarbon oil	5190-8710
	300	75 cSt hydrocarbon oil	5190-8711
	500	75 cSt hydrocarbon oil	5190-8712
	900	75 cSt hydrocarbon oil	5190-8713

# WEAR METAL AND METALLO-ORGANIC STANDARDS

## Single Element Oil Standards

- Highest quality metallo-organic mixes in the industry manufactured in accordance with the requirements of ISO Guide 34 and ISO 17025
- Accuracy ensured by quality testing with NIST Standard Reference Materials
- CoA includes trace metal concentrations confirmed by ICP-OES

### TIPS & TOOLS

Many of these compounds are sulfonate-based, and therefore contain high levels of sulfur. If absence of sulfur is important for your application, use sulfur-free standards.

### Single Element Standards in Hydrocarbon Oil

#### 50 g

Description	Matrix	Conc. (µg/g)	Part No.
Aluminum (Al)	75 cSt hydrocarbon oil	1,000	5190-8731
		5,000	5190-8732
Antimony (Sb)	75 cSt hydrocarbon oil	1,000	5190-8733
		5,000	5190-8734
Arsenic (As)	75 cSt hydrocarbon oil	1,000	5190-8735
Barium (Ba)	75 cSt hydrocarbon oil	1,000	5190-8736
		5,000	5190-8737
Beryllium (Be)	75 cSt hydrocarbon oil	1,000	5190-8738
Bismuth (Bi)	75 cSt hydrocarbon oil	1,000	5190-8739
Boron (B)	75 cSt hydrocarbon oil	1,000	5190-8740
		5,000	5190-8741
Cadmium (Cd)	75 cSt hydrocarbon oil	1,000	5190-8742
		5,000	5190-8743
Calcium (Ca)	75 cSt hydrocarbon oil	1,000	5190-8744
		5,000	5190-8745
Cerium (Ce)	75 cSt hydrocarbon oil	1,000	5190-8746
		5,000	5190-8747
Chromium (Cr)	75 cSt hydrocarbon oil	1,000	5190-8748
		5,000	5190-8749
Cobalt (Co)	75 cSt hydrocarbon oil	1,000	5190-8750
		5,000	5190-8751
Copper (Cu)	75 cSt hydrocarbon oil	1,000	5190-8752
		5,000	5190-8753
Iron (Fe)	75 cSt hydrocarbon oil	1,000	5190-8754
		5,000	5190-8755
Lanthanum (La)	75 cSt hydrocarbon oil	1,000	5190-8756
		5,000	5190-8757
Lead (Pb)	75 cSt hydrocarbon oil	1,000	5190-8758
		5,000	5190-8759
Lithium (Li)	75 cSt hydrocarbon oil	1,000	5190-8760
		5,000	5190-8761
Magnesium (Mg)	75 cSt hydrocarbon oil	1,000	5190-8762
		5,000	5190-8763

(Continued)



## WEAR METAL AND METALLO-ORGANIC STANDARDS

### TIPS & TOOLS

Store metallo-organic standards in a cool, dry place away from moisture.

### Single Element Standards in Hydrocarbon Oil

50 g			
Description	Matrix	Conc. (µg/g)	Part No.
Manganese (Mn)	75 cSt hydrocarbon oil	1,000	5190-8764
		5,000	5190-8765
Mercury (Hg)	75 cSt hydrocarbon oil	1,000	5190-8766
Molybdenum (Mo)	75 cSt hydrocarbon oil	1,000	5190-8767
		5,000	5190-8768
Nickel (Ni)	75 cSt hydrocarbon oil	1,000	5190-8769
		5,000	5190-8770
Phosphorus (P)	75 cSt hydrocarbon oil	1,000	5190-8771
		5,000	5190-8772
Potassium (K)	75 cSt hydrocarbon oil	1,000	5190-8773
		5,000	5190-8774
Scandium (Sc)	75 cSt hydrocarbon oil	1,000	5190-8775
Selenium (Se)	75 cSt hydrocarbon oil	1,000	5190-8776
Silicon (Si)	75 cSt hydrocarbon oil	1,000	5190-8777
		5,000	5190-8778
Silver (Ag)	75 cSt hydrocarbon oil	1,000	5190-8779
		5,000	5190-8780
Sodium (Na)	75 cSt hydrocarbon oil	1,000	5190-8781
		5,000	5190-8782
Strontium (Sr)	75 cSt hydrocarbon oil	1,000	5190-8783
Sulfur (S)	75 cSt hydrocarbon oil	1,000	5190-8784
		5,000	5190-8785
Thallium (Tl)	75 cSt hydrocarbon oil	1,000	5190-8786
Tin (Sn)	75 cSt hydrocarbon oil	1,000	5190-8787
		5,000	5190-8788
Titanium (Ti)	75 cSt hydrocarbon oil	1,000	5190-8789
		5,000	5190-8790
Tungsten (W)	75 cSt hydrocarbon oil	1,000	5190-8791
		5,000	5190-8792
Vanadium (V)	75 cSt hydrocarbon oil	1,000	5190-8793
		5,000	5190-8794
Yttrium (Y)	75 cSt hydrocarbon oil	1,000	5190-8795
		5,000	5190-8796
Zinc (Zn)	75 cSt hydrocarbon oil	1,000	5190-8797
		5,000	5190-8798
Zirconium (Zr)	75 cSt hydrocarbon oil	1,000	5190-8799
		5,000	5190-8800

# WEAR METAL AND METALLO-ORGANIC STANDARDS

## Base Oil and Solvents

- Highest quality metallo-organic mixes in the industry manufactured in accordance with the requirements of ISO Guide 34 and ISO 17025
- Traceable to NIST SRM 1085b to ensure the highest accuracy
- CoA includes trace metal concentrations confirmed by ICP-OES
- For use in blending and preparation of calibration standards for spectrometric analysis of metals in hydrocarbon/petrochemical samples

### Base Oil and Solvents

Description	Matrix	Quantity	Part No.
Base mineral oil, <1 µg/g Used for blending and preparation of calibration standards for spectrometric analysis of metals in hydrocarbon/petrochemical samples.	75 cSt mineral oil	500 mL	5190-8715
		1/2 gal	5190-8716
A-solv solvent Used for diluting metallo-organic standards, oils and other organic solutions when preparing for spectrometric analysis of metals in hydrocarbon/petrochemical samples. Use as a matrix blank and as a diluent.	Proprietary solvent	1 gal	5190-8717
Biodiesel blank Excellent matrix match for almost all biodiesel fuels. Use as calibration blanks for analysis of metals or sulfur in biodiesel	B100 biodiesel	100 mL	5190-8718
		500 mL	5190-8719

## Internal Standard for Oil Analysis

- Corrects for wide variations in sample viscosity or oil composition
- Easy to use when added to the diluent prior to sample preparation

### Internal Standard for Oil Analysis

#### 200 g

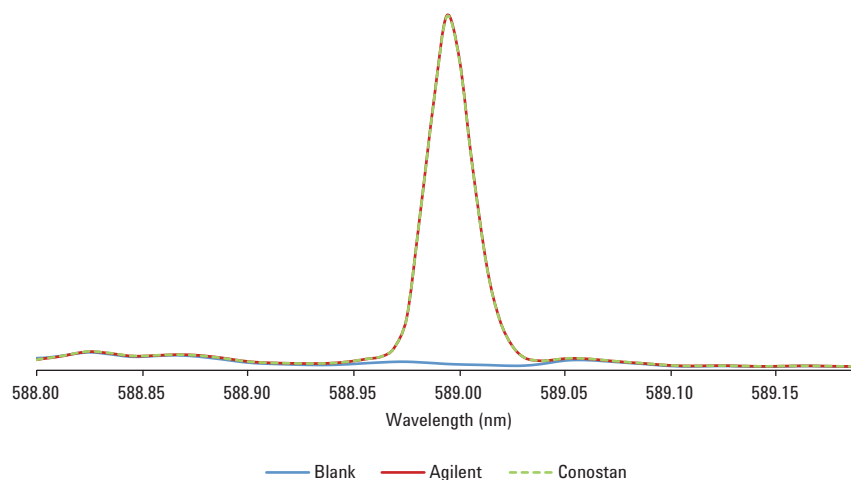
Description	Matrix	Part No.
Cobalt internal standard Contains 5,000 µg/g Co	Hydrocarbon oil	5190-8714

## Proof of Equivalency

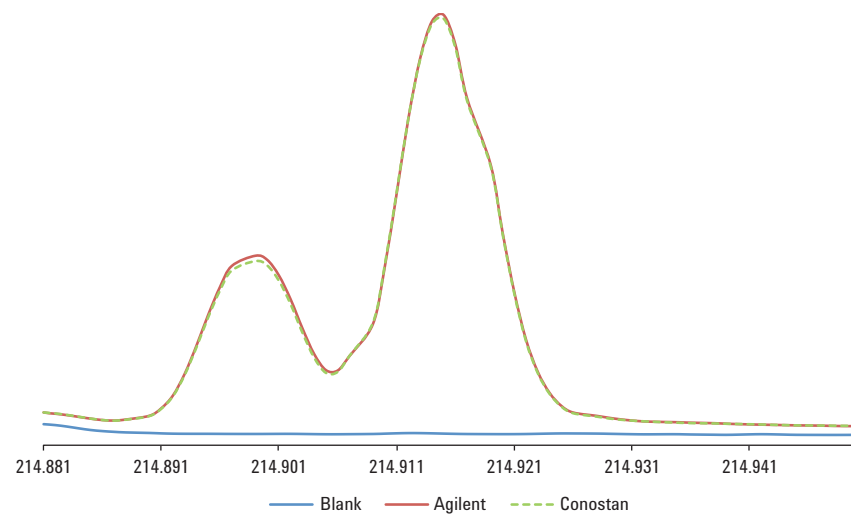
We demonstrated the quality of Agilent standards by comparing them with industry-leading Conostan metallo-organic multi-element oil and biodiesel standards. Conostan standards are the benchmark standard for metallo-organic analysis for customers performing wear metal analysis in lubricating oils and biodiesel.

The analyses were performed on an Agilent 5100 ICP-OES in radial view. The signal graphics in **Figures 2, 3, and 4** reveal an excellent match between the wear metal standards from Agilent and Conostan. We analyzed phosphorus, sodium, and boron because the industry regards these elements as more difficult to measure. There were no differences in matrix background or response when comparing Agilent A21+K and Conostan S21+K wear metal standards. In addition, there is no significant change in the emission spectrum on either side of the analytical wavelength. This baseline indicates that the standard is free of unwanted components that would increase the background. The traces in **Figures 2, 3, and 4** confirm that the Agilent standard is “clean” and analytically equivalent to the Conostan standard.

### Wear Metal and Metallo-organic Standards



**Figure 2.** Comparison of Agilent and Conostan wear metal standards for 50 µg/g sodium in hydrocarbon oil at 588.995 nm. Na is an element prone to contamination. The traces are identical, demonstrating excellent agreement (Agilent p/n 5190-8712).

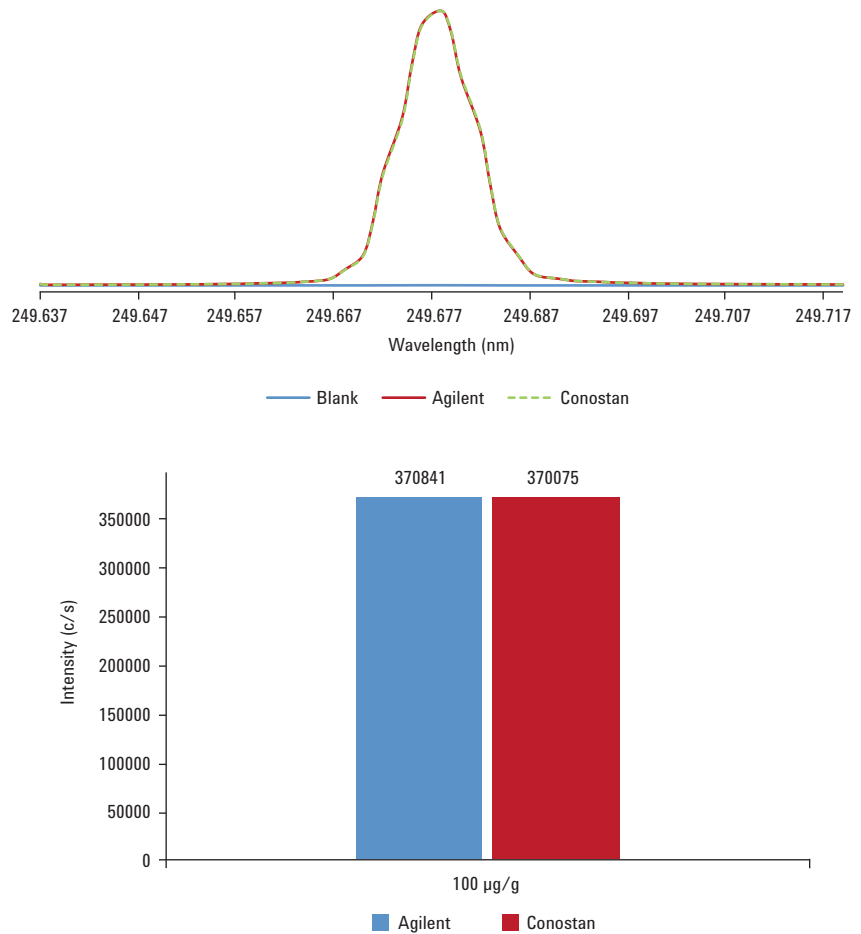


**Figure 3.** Comparison of Agilent and Conostan wear metal standards for 50 µg/g phosphorus in hydrocarbon oil at 214.914 nm. The traces are virtually identical, demonstrating excellent agreement (Agilent p/n 5190-8712).

## From Standards to Services

With their virtually identical performance, Agilent standards are excellent alternatives to Conostan standards. What's more, Agilent offers the instrument consumables, parts, and services you need to gain maximum advantage from our extensive standards portfolio.

### Single Element Oil Standards



**Figure 4.** Boron is reputed to be difficult to quantify due to its instability in hydrocarbon matrices. A comparison of Agilent and Conostan single element 100 µg/g standards for boron at 249.679 nm shows nearly identical traces with no differences in matrix background. The measured signal intensity is also comparable, confirming again that the Agilent standard is “clean” and equivalent to the Conostan standard (Agilent p/n 5190-8740).

## **Biodiesel Standards**

### **Metals in Biodiesel Standards**

- Formulated specifically for analysis of metals in biodiesel fuel to ASTM D6751 & EN14214
- Matrix is 100% biodiesel to eliminate matrix variations
- Made from soybean oil, which is an excellent matrix match for most biodiesels

#### **Metals in Biodiesel Standards**

<b>Description</b>	<b>Matrix</b>	<b>Conc. (µg/g)</b>	<b>Part No.</b>
Metals additives standard, MA5 Contains Ba, Ca, Mg, P, Zn	75 cSt hydrocarbon oil	900	5190-8720
Metals in biodiesel standard Contains Ca, K, Mg, Na, P	B100 biodiesel	5	5190-8721
		10	5190-8722
		20	5190-8723

### **Sulfur in Biodiesel Standards**

- Formulated specifically for analysis of sulfur in biodiesel fuel to ASTM D2622, D4294, D5453, D6751 and others
- Matrix is 100% biodiesel to eliminate matrix variations
- Made from soybean oil, which is an excellent matrix match for most biodiesels

#### **Sulfur in Biodiesel Standards**

##### **Supplied in 100 mL bottles**

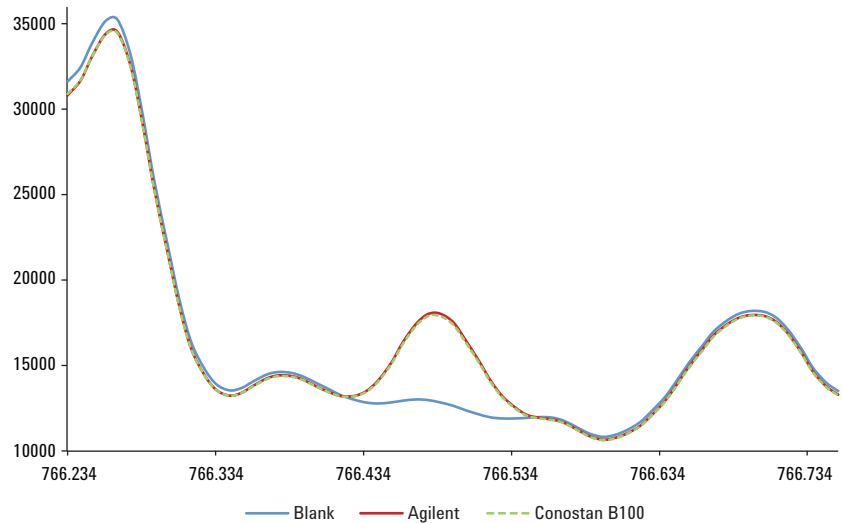
<b>Description</b>	<b>Matrix</b>	<b>Conc. (µg/g)</b>	<b>Part No.</b>
Sulfur in biodiesel standard Contains S	B100 biodiesel	10	5190-8724
		15	5190-8725
		20	5190-8726
		25	5190-8727
		50	5190-8728
		100	5190-8729
		500	5190-8730

## Proof of Equivalency

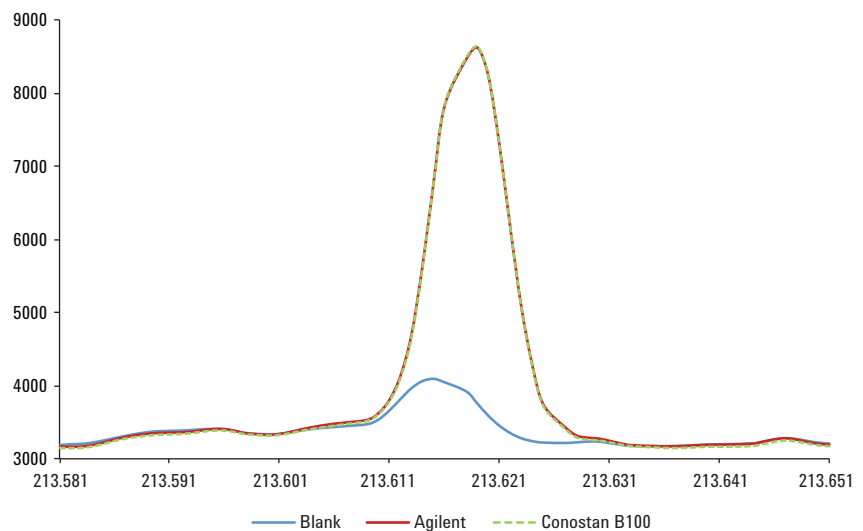
We demonstrated the quality of Agilent biodiesel standards by comparison with industry-leading Conostan biodiesel standards. The signal graphics in **Figures 5, 6, and 7** reveal an excellent match between the biodiesel standards from Agilent and Conostan. We analyzed phosphorus, sulfur, and potassium because the industry regards these elements as more difficult to measure in biodiesel.

The signal graphics for the Agilent and Conostan standards are virtually identical for the nominated elements. In addition, there is no significant change in the emission spectrum on either side of the analytical wavelength. This baseline indicates that the standard is free of unwanted components that would increase the background. The traces in **Figures 5, 6, and 7** confirm that the Agilent standard is “clean” and equivalent to the Conostan standard.

### Biodiesel Standards



**Figure 5.** Comparison of Agilent and Conostan Biodiesel B100 standards for potassium at 2 µg/g (766.491 nm) shows nearly identical traces (Agilent p/n 5190-8723).



**Figure 6.** Comparison of Agilent and Conostan Biodiesel B100 standards for phosphorus at 2 µg/g (213.618 nm) demonstrates excellent agreement (Agilent p/n 5190-8723).

Sulfur in Biodiesel Standards

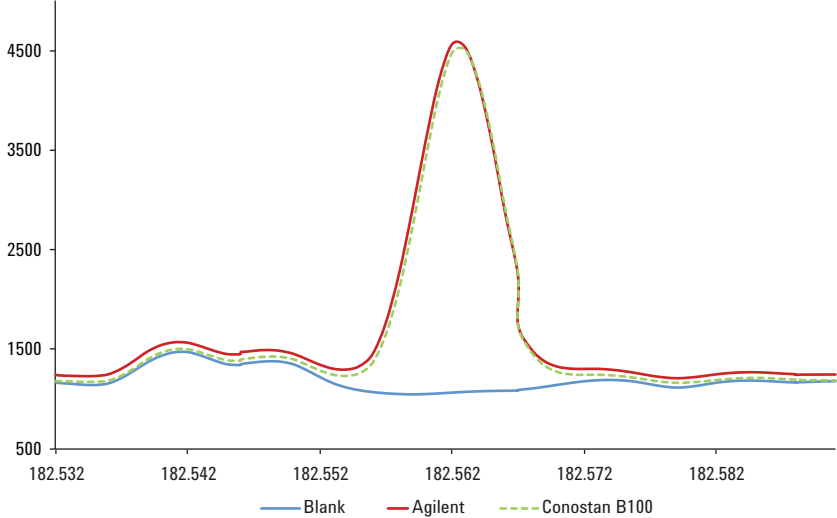


Figure 7. Comparison of Agilent and Conostan Biodiesel B100 standards for sulfur at 50 µg/g (182.562 nm) shows nearly identical traces (Agilent p/n 5190-8730).

## Agilent ICP-OES and MP-AES Instrument Standards

### Wavelength Calibration Solutions for ICP-OES and MP-AES

#### Supplied in 500 mL bottles



Wavelength calibration solution for ICP-OES and MP-AES, 6610030100

Description	Matrix	Part No.
Wavelength calibration concentrate for ICP-OES and MP-AES Contains 50 µg/mL Al, As, Ba, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sr, Zn, 500 µg/mL K Dilute 10 times prior to use	5% HNO <sub>3</sub>	6610030000
Wavelength calibration solution for ICP-OES and MP-AES Contains 5 µg/mL Al, As, Ba, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sr, Zn, 50 µg/mL K Ready to use	5% HNO <sub>3</sub>	6610030100
Calibration blank solution for ICP-OES and MP-AES: 500 mL 0 mg/L Suitable for use as a calibration blank or for dilution of the wavelength calibration concentrate. Ready to use	Pure ASTM Type 1A water with 5% HNO <sub>3</sub>	5190-7001

### Internal Standard/Ionization Suppressant

#### Supplied in 125 mL bottles

Description	Matrix	Part No.
ICP internal standard Contains 100 µg/mL <sup>6</sup> Li, Sc, Y, In, Tb, Bi	5% HNO <sub>3</sub>	6610030400



## Agilent ICP-MS Instrument Standards

### TIPS & TOOLS

When using ICP-MS, don't include an internal standard in the unknown or spike mix.

### Installation and Checkout Standards

Description	Part No.
ICP-MS checkout solutions for 7700/7900/8800 series and 7500 ce/cx/cs system installation kit Contains tuning solution, dual mode (1), dual mode (2), wash, and water blank solutions	5185-5850
ICP-MS checkout solutions for 7500s system installation kit Contains tuning solution, dual mode (1), dual mode (2), abundance sensitivity (1), abundance sensitivity (2), detection limit solution, high sensitivity tune, wash, and water blank solutions	5184-3564
ICP-MS checkout solutions for 7500a/i/c system installation kit Contains tuning solution, dual mode (1), dual mode (2), wash, and water blank solutions	5184-3565

### Aqueous Internal Standards

- Made of pure materials and free of contaminating elements
- Convenient concentrations for sample dilution to working solutions
- Use as the stock blend for automated addition of internal standards

### Aqueous Internal Standards

#### Supplied in 100 mL bottles

Description	Matrix	Part No.
Aqueous internal standard, 10 µg/mL iridium (Ir)	2% HCl	5190-8588
Aqueous internal standard, 10 µg/mL lithium ( <sup>6</sup> Li)	2% HNO <sub>3</sub>	5190-8589
Aqueous internal standard, 10 µg/mL terbium (Tb)	2% HNO <sub>3</sub>	5190-8590
Aqueous internal standard, 10 µg/mL lutetium (Lu)	2% HNO <sub>3</sub>	5190-8591
Aqueous internal standard, 10 µg/mL germanium (Ge)	2% HNO <sub>3</sub> , trace HF	5190-8592

# AGILENT ICP-MS INSTRUMENT STANDARDS



Stock tuning solution, 5188-6564

## Multi-Element Internal Standard

### Supplied in 100 mL bottles

Description	Matrix	Part No.
Multi-element internal standard (mix 4) Contains 50 µg/mL <sup>6</sup> Li, Sc, 25 µg/mL Ge, Te, 10 µg/mL Bi, In, Tb	2% HNO <sub>3</sub> , trace HF	5190-8593

### Tuning Solutions

Description	Matrix	Part No.
PA tuning solution kit, 2 x 100 mL Tuning 1 contains 20 µg/mL Zn, Be, Cd, As, 10 µg/mL Ni, Pb, Mg, 5 µg/mL Ti, Na, Al, U, Cu, Th, Ba, Co, Sr, V, Cr, Mn, <sup>6</sup> Li, Sc, In, Lu, Bi, 2.5 µg/mL Y, Yb Tuning 2 contains 10 µg/mL Mo, Sb, Sn, Ge, Ru, Pd, 5 µg/mL Ti, Ir	Tuning 1: 5% HNO <sub>3</sub>  Tuning 2: 10% HCl/1% HNO <sub>3</sub> , trace HF	5188-6524
Stock tuning solution, 100 mL Contains 10 µg/mL Li, Y, Ce, Ti, Co	2% HNO <sub>3</sub>	5188-6564
Stock tuning solution, 100 mL Contains 10 µg/mL Li, Mg, Y, Ce, Ti, Co	2% HNO <sub>3</sub>	5190-0465
Tuning solution, 2 x 500 mL Contains 10 µg/L Li, Y, Ce, Ti, Co	2% HNO <sub>3</sub>	5184-3566
Tuning solution, 2 x 500 mL Contains 1 µg/L Li, Mg, Y, Ce, Ti, Co	2% HNO <sub>3</sub>	5185-5959

## Tune and Calibration Standard 6020

- Designed for US EPA methods, 200.8, and ILM05.2
- Packed in pre-leached HDPE bottles with tamper-evident seal

### Tune and Calibration Standard 6020

#### Supplied in 100 mL bottles

Description	Matrix	Part No.
Tune and calibration standard 6020 Contains 10 µg/mL Co, In, Li, Tl	5% HNO <sub>3</sub>	5190-8597

### Tuning and Calibration Standard 6020 for EPA 200.8

#### Supplied in 100 mL bottles

Description	Matrix	Part No.
Tuning and calibration standard 6020 for EPA 200.8 Contains 10 µg/mL Be, Co, In, Mg, Pb	5% HNO <sub>3</sub>	5190-8596



Cobalt tuning solution, 5190-8598

### Cobalt Tuning Solution

#### Supplied in 500 mL bottles

Description	Matrix	Part No.
Cobalt tuning solution Contains 1 µg/L Co	2% HCl	5190-8598

## PerkinElmer ICP-OES Instrument Standards

- Performance validated directly on PerkinElmer systems
- Supplied with Safety Data Sheet and Certificate of Analysis for complete assurance
- Packed in pre-leached HDPE bottles, secured with tamper-evident seal

### Wavecal Calibration Solutions

Description	Matrix	Volume (mL)	Similar to PerkinElmer Part No.	Part No.
UV Wavecal calibration solution Contains 100 µg/mL K, P, S, 20 µg/mL As, La, Li, Mn, Mo, Na, Ni, Sc, 1 µg/mL Ca	5% HCl	500	N0582152	5190-9410
Vis Wavecal calibration solution Contains 50 µg/mL K, 10 µg/mL La, Li, Mn, Na, Sr, 1 µg/mL Ba, Ca	2% HNO <sub>3</sub>	250	N9302946	5190-9411

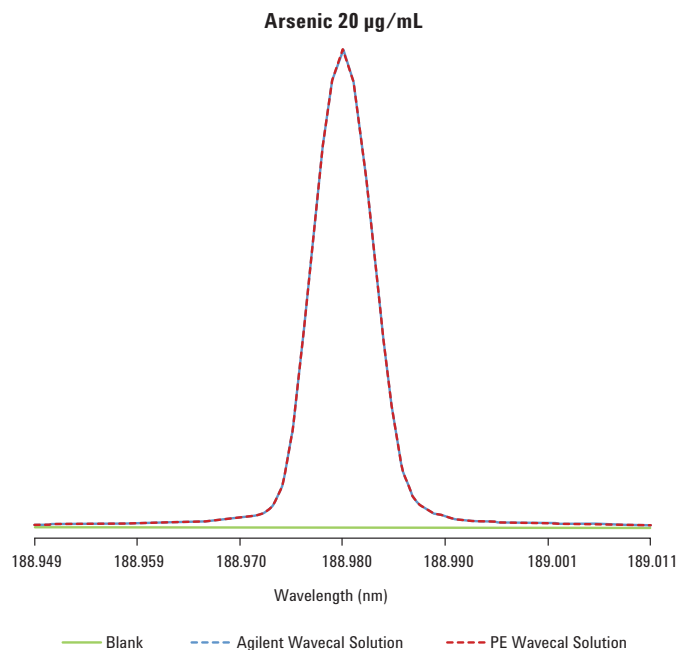
### Mixed Calibration Standard

Description	Matrix	Volume (mL)	Similar to PerkinElmer Part No.	Part No.
Mixed calibration standard for ICP-OES Contains 50 µg/mL As, K, 10 µg/mL La, Li, Mn, Ni, Sr, Zn, 1 µg/mL Ba, Mg	2% HNO <sub>3</sub>	500	N0691579	5190-9413

## Proof of Equivalency

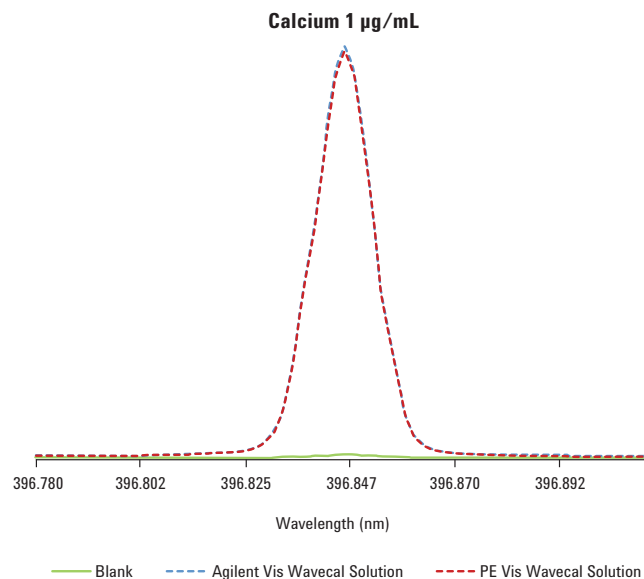
We demonstrated equivalency between Agilent and PerkinElmer Wavecal Calibration Standards required to complete wavelength calibration on the PerkinElmer Optima Series ICP-OES. The analysis was performed on an Agilent 5100 ICP-OES in axial/radial view and aims to show equivalence in concentration (instrument response) and sample matrix (instrument signal). The graphics show that the signal for the selected element in the Agilent and PerkinElmer standards is virtually identical and the baseline is free from unwanted components. This confirms that the Agilent standard is “clean” and equivalent to the PerkinElmer OEM Wavecal standard.

### UV Wavecal Calibration Solution



**Figure 8.** Comparison of Agilent and PerkinElmer UV Wavecal calibration solution for arsenic at 1 mg/mL (396.847 nm) shows nearly identical traces (Agilent p/n 5190-9410).

### Vis Wavecal Calibration Solution



**Figure 8.** Comparison of Agilent and PerkinElmer Vis Wavecal calibration solution for calcium at 1 mg/mL (396.847 nm) shows nearly identical traces (Agilent p/n 5190-9411).

### Recommendations

Standard solutions are manufactured following strict procedures and they must be handled with care as they are highly valuable assets when kept in good condition. Observing the following recommendations will help save considerable time, money, and troubleshooting.

1. Use only deionized water and high purity acids/reagents to prepare calibration standards and samples. Your data is only as good as your lowest blank.
2. Avoid pipetting directly from the CRM's original container – always pour a small amount into a different clean container and take your aliquot from there.
3. Never return unused standard to the original Agilent container.
4. Don't neglect preventative or routine maintenance. Most instrument problems are preventable.
5. Replace pump tubing frequently to ensure consistent reliable data.
6. Pre-clean all labware and avoid use of glassware where possible, especially for trace-level applications.
7. At the end of the day, always rinse the sample delivery lines and the sample introduction system thoroughly before shutting off the instrument. The rinse solution should be prepared in the same solvent as the samples being analyzed.
8. If at all possible, include both nitric acid ( $\text{HNO}_3$ ) and hydrochloric acid (HCl) in standards and samples. The oxidizing power of  $\text{HNO}_3$  will help decompose your samples while the complexing power of HCl will minimize carryover and help solubilize many analytes, such as Hg and Sn.
9. Run as many blanks as possible (at least two to three) to establish the lowest possible background.
10. Use aseptic techniques to prevent contamination. Remember, some gloves contain a high concentration of Zn.
11. Always run daily instrument performance checks using the appropriate instrument tuning solution.
12. When in doubt, consult your Agilent application engineer regarding any analytical questions that you may have.

### Operational Tips

1. Always prepare your calibration standards from Certified Reference Materials manufactured in an ISO 9001, Guide 34 facility and certified in an ISO/IEC 17025 testing lab. Certification ensures the highest levels of purity and quality with known uncertainties for precise, accurate calibration data and consistent performance, leading to greater productivity.
2. Always try to matrix match your calibration standards to your samples. Matrix matching is easier if you use 1% (10,000  $\mu\text{g}/\text{mL}$ ) standards as stock materials for major sample components and keep the total concentration of all elements below 20,000  $\mu\text{g}/\text{mL}$  (2%).
3. Verify instrument performance before analysis.
4. Do not overtighten the pressure bar on the peristaltic pump tubing.
5. Always detach the peristaltic pump tubing from the holder after use.
6. Always rinse between samples and after analysis.
7. Routinely clean the nebulizer by reverse-flushing.
8. Soak the spray chamber overnight in 25% detergent to restore performance.
9. Clean the torch by soaking in aqua regia and rinse afterwards.
10. Ensure the torch is dry before re-installing.



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