



Certificate of Analysis

ULTRAGrade™ Solution
Hafnium ICP Standard
1000 µg/mL

Catalog Number: ICP-072
Lot Number: H00641A
Job Number: J00007277
Lot Issue Date: 08/25/2009
Expiration Date: 09/30/2016

Starting Material: Hafnium Oxide
Starting Material Purity: 99.99%
Starting Material Lot No.: BH00742
Matrix: 1% Hydrochloric acid in low TOC water (< 50 ppb)
Atomic Weight Hf: 178.5

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentrations were verified by our ISO 17025 accredited laboratory to be within ± 2.5%, when compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP-MS) vs. NIST SRM 3122

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

| | | | |
|----------------|----------------|----------------|----------------|
| * Al <0.250 ND | * Ga <0.005 ND | n Nb | n S |
| * Sb <0.005 ND | n Ge | n Os | n Ta |
| * As <0.005 ND | n Au | * Pd <0.005 ND | n Te |
| * Ba <0.005 ND | s Hf | * P <0.005 ND | n Tb |
| * Be <0.005 ND | n Ho | * Pt <0.005 ND | n Tl <0.005 ND |
| * Bi <0.005 ND | * In <0.005 ND | * K <0.005 ND | n Th |
| * B <0.005 ND | n Ir | n Pr | n Tm |
| * Cd <0.005 ND | * Fe <0.005 ND | n Re | * Sn <0.005 ND |
| * Ca <0.005 ND | * La <0.005 ND | n Rh | n Ti <0.250 D |
| n Ce | * Pb <0.005 ND | n Rb | n W |
| n Cs | * Li <0.005 ND | n Ru | n U |
| * Cr <0.005 ND | n Lu | n Sm | * V <0.005 ND |
| * Co <0.005 ND | * Mg <0.005 ND | n Sc | n Yb |
| * Cu <0.005 ND | * Mn <0.005 ND | * Se <0.005 ND | n Y |
| n Dy | * Hg <0.005 ND | * Si <0.250 D | * Zn <0.005 ND |
| * Er <0.005 ND | * Mo <0.005 ND | * Ag <0.005 ND | * Zr <0.500 D |
| * Eu <0.005 ND | n Nd | * Na <0.005 ND | |
| * Gd <0.005 ND | * Ni <0.005 ND | * Sr <0.005 ND | |

* - element checked for
 ND - not detected

i - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 22°C ± 0.5°C): 0.999 g/mL



ISO 9001 Registered Quality System – TUV USA

William J. Leary
 Quality Assurance Manager