CERTIFICATE OF ANALYSIS

Agilent Product Name: Ruthenium Standard: 10000 µg/mL Ru in 20% HCl

Agilent Part No: 5190-8443

Lot No: 0010606528

Product Specifications

Analyte	Starting Material	CAS #	Matrix	Certified Concentration
Ru	$RuCl_3$	10049-08-8	20% HCl	9993 ± 50 µg/mL (w/v)
				9549 ± 50 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 17034**, **ISO/IEC 17025**, and registered to **ISO 9001**. This CRM was prepared to a nominal concentration of 10000 µg/mL by gravimetric methods using 99.9% pure ruthenium chloride ($RuCl_3$) dissolved in high purity hydrochloric acid (HCl) 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 was determined based upon gravimetric procedures. Secondary verification of the certified concentration was performed using ICP-OES. 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	7	Co	<10	Ge	<5	Lu	<2	P	<1000	Sb	<5	Te	<10
Al	62	Cs	<5	Hf	<2	Mg	<50	Pb	<10	Sc	<50	Ti	94
As	<20	Cr	37	Hg	<5	Mn	<10	Pd	40	Se	<20	Tl	<5
Au	6	Cu	<10	Ho	<2	Mo	<5	Pr	<2	Si	<1000	Tm	<2
B	<50	Dy	<2	In	nd	Na	286	Pt	21	Sm	4	V	19
Ba	60	Er	<2	Ir	41	Nb	<5	Rb	<5	Sn	305	W	<5
Bi	<2	Eu	<2	K	<250	Nd	<2	Re	<2	Sr	<10	Y	<5
Ca	<250	Fe	920	La	<5	Ni	50	Rh	273	Ta	<5	Yb	<2
Cd	<5	Ga	<5	Li	<20	Os	127	Ru	MAJOR	Tb	<5	Zn	48
Ce	<2	Gd	<2										

Instructions for Use: Agilent 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 transferware, (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 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.

Sample lot approver:

Date of release: 5 March 2020
Date of expiration: 10 November 2022

Chuck Goudreau, Certifying Officer

Hazard Information: Refer to the Safety Data Sheet (SDS), which can be obtained at www.agilent.com/chem/sds.

Homogeneity: This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with QSP 6-13 Assessment of Homogeneity and Stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.

Further Information: Please contact Agilent for further information about this CRM.

Quality Certifications: This CRM was prepared under a quality management system that is:

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. Reg. No. 44 100 16560231)
- Accredited to ISO 17034– General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2848.02)
    - ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 35.
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (A2LA Cert. No. 2848.01)
- LGC Standards, 276 Abby Road, Manchester, NH 03103