

A SMARTER APPROACH to OIL ANALYSIS

METHODS, CHALLENGES,
AND MODERN SOLUTIONS
FOR ICP LABORATORIES



Traditional oil analysis methods can introduce challenges related to solvent handling, standard stability, and contamination control. This guide explores practical approaches to elemental analysis and demonstrates how **ASOSolv™** supports safer, more flexible workflows for wear metals, additive elements, and edible oils.

TRUSTED BY LABS WORLDWIDE SINCE 1985



Elemental analysis of oil samples presents a unique set of analytical challenges. Unlike traditional aqueous samples, materials such as lubricating oils and edible oils require specialized preparation techniques to ensure accurate and reliable ICP measurements. The combination of high organic content, viscosity differences, carbon buildup, and the need for stable calibration standards can introduce significant complications during analysis.

Historically, laboratories have relied on hydrocarbon petroleum-based organic solvents and commercially available oil analysis diluents to prepare calibration standards and dilute samples for elemental testing. While effective, these solvents often introduce concerns related to analyst safety, odor, volatility, and environmental impact. Additionally, the preparation of stable multi-element calibration standards in these matrices can be time-consuming.

Meet ASOSolv™

ASOSolv™ was developed to provide laboratories with a modern alternative for elemental analysis of oil samples.



Designed for compatibility with ICP workflows, ASOSolv™ supports the preparation of calibration standards and samples for applications including wear metals, additive metals, contaminant testing, and edible oil analysis. The solvent system was engineered to simplify sample preparation while maintaining the analytical performance required for accurate analysis.

This guide is designed to help laboratories better understand the analytical considerations associated with oil-based ICP methods while introducing practical workflows using ASOSolv™.

The following pages will cover common analytical challenges, calibration strategies, sample preparation considerations, contamination risks, and best practices for generating reliable elemental data in complex organic matrices. Whether your laboratory is testing industrial lubricants, edible oils, biodiesel products, or related organic materials, this guide will provide practical information to help streamline workflows and improve confidence in analytical results. ASOSolv™ builds upon Inorganic Ventures' continued focus on developing safer, practical, and performance-driven solutions for ICP laboratories.



ASTM D5185



Standard Test Method for Multielement Determination of Used and Unused Lubricating Oils and Base Oils by ICP-OES

This method is commonly performed using direct dilution of oil samples with an organic solvent prior to ICP analysis, making it one of the primary workflows applicable to ASOSolv™ for wear metals, additives, and contaminant testing.

ASTM D4951



Standard Test Method for Determination of Additive Elements in Lubricating Oils by ICP-OES

This method focuses on additive elements such as zinc, calcium, magnesium, and phosphorus in unused oils.

ASTM D5708



Standard Test Method for Determination of Nickel, Vanadium, and Iron in Crude Oils and Residual Fuels by ICP-OES

This method utilizes dilution of crude oil or residual fuel samples into an organic solvent system for direct ICP introduction, reducing the need for extensive digestion procedures.

ISO 21033



Determination of Trace Elements by ICP-OES in Animal and Vegetable Fats and Oils

This method supports elemental analysis of edible oils and fats and may be adapted for ASOSolv™ dilution workflows to allow direct analysis of diluted oil samples by ICP-OES.

ISO 10540-3



Determination of Phosphorus Content in Animal and Vegetable Fats and Oils

This method is commonly applied to edible oils and may utilize solvent dilution techniques for direct elemental analysis of phosphorus-containing additives and naturally occurring phosphorus species.

FDA EAM 4.4



FDA Elemental Analysis Manual; Guidance Method for Elemental Analysis in Food Products Using ICP-OES Techniques

While many food workflows involve digestion, edible oil samples may also be prepared through direct solvent dilution approaches for rapid screening and routine elemental monitoring applications.

NEW METHOD FOR TESTING WEAR AND ADDITIVE METALS IN OILS

Traditional elemental analysis of oils has required the use of traditional organometallic standards and petroleum-based solvents for calibration standard preparation and sample dilution. While effective, these workflows can introduce challenges related to safety, solvent handling, contamination control, and long-term standard stability.

To help address these challenges, Inorganic Ventures developed a new direct dilution workflow for ICP analysis of wear metals and additive elements in oils using ASOSolv™ spiked with cobalt and yttrium internal standards. This approach supports the preparation of calibration standards and diluted oil samples for rapid elemental analysis.

This white paper demonstrates the application of this workflow for the analysis of wear metals and additive elements in oil matrices while discussing:

- Direct dilution sample preparation
- ICP-OES method considerations
- Internal standardization using Co and Y
- Calibration strategies
- Detection capability for routine oil analysis
- Improved laboratory safety and workflow simplification

[Click here to access the full technical white paper and learn more about implementing direct dilution ICP workflows using ASOSolv™.](#)

ASOSolv™ was developed to provide laboratories with a safer and more flexible alternative to traditional petroleum-based solvents used for elemental analysis of oils. Unlike many conventional oil analysis solvents, ASOSolv™ supports the preparation of calibration standards using both aqueous certified reference materials and traditional organometallic standards, giving laboratories greater flexibility when designing calibration workflows.



Designed for applications including wear metals, additive metals, edible oils, and other organic matrices, ASOSolv™ combines analytical performance with improved compatibility for modern direct dilution ICP workflows. The solvent system was engineered to support stable working standards, low trace metallic impurities (TMI), and reduced analytical challenges associated with traditional hydrocarbon-based solvents.

WHY LABORATORIES ARE EVALUATING ASOSOLV™

- Compatible with aqueous CRMs *and* traditional organometallic standards
- Uses renewable, bio-based starting materials
- Low trace metallic impurity background
- Supports direct dilution ICP workflows and low-level trace metals testing
- Excellent working standard stability
- Reduced carbon buildup during ICP analysis

SULFUR COMPATIBILITY

Traditional organometallic oil standards frequently contain sulfur originating from the starting materials used during manufacturing. This can create elevated sulfur backgrounds that complicate low-level sulfur analysis and may require laboratories to dedicate separate instrumentation specifically for sulfur testing. ASOSolv™ supports the preparation of calibration standards using aqueous CRMs, helping reduce unwanted sulfur background contributions from traditional organometallic materials.

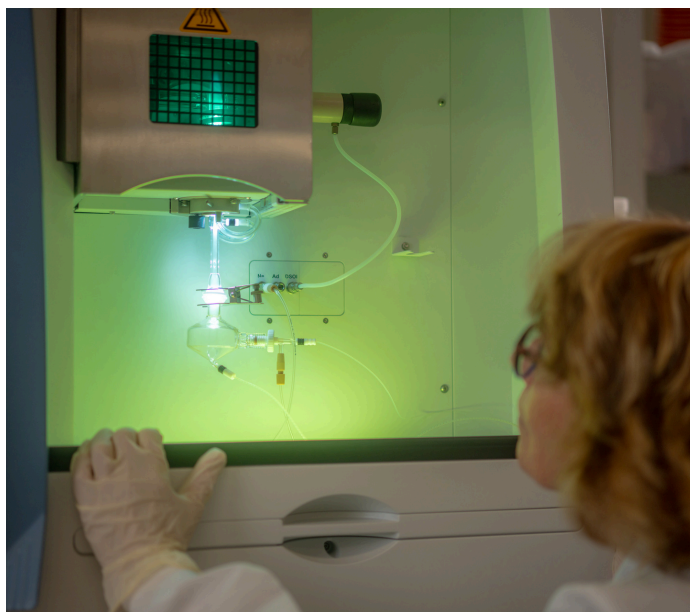
HIGH PURITY FOR TRACE METALS ANALYSIS

ASOSolv™ undergoes trace metallic impurity characterization to support demanding elemental analysis applications involving lubricating oils, edible oils, and other organic matrices. Low background contamination levels help improve blank performance and support lower detection limits for trace elemental measurements. Trace metallic impurity information is reported for 65 elements, including sulfur.

APPLICATIONS

ASOSolv™ is well-suited for:

- Edible oils
- Industrial oils
- Wear and additive metals in lubricating oils
- Direct dilution ICP-OES and workflows
- Methods aligned with ASTM D5185, ASTM D4951, ASTM D5708, ISO 21033, ISO 10540-3, and FDA elemental analysis guidance



33-Element Standards

Each concentration level kit is separated into two separate solutions for optimized compatibility, stability, and interference reduction.



Kit Part Numbers	Calibration Level (After 10x dilution with ASOSolv)	Individual Solution Names	Concentration of Solution (u g / g)	Matrix	Elements
ASOS-1-CAL-500PPM (2) 500mL bottles per kit	50 ug/g	ASOS-1-CAL-500PPM-HNO3	500	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-500PPM-HCL	500	20% HCl / 0.3% HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-200PPM (2) 500mL bottles per kit	20 ug/g	ASOS-1-CAL-200PPM-HNO3	200	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-200PPM-HCL	200	20% HCl / tr HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-100PPM (2) 500mL bottles per kit	10 ug/g	ASOS-1-CAL-100PPM-HNO3	100	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-100PPM-HCL	100	20% HCl / tr HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-50PPM (2) 500mL bottles per kit	5 ug/g	ASOS-1-CAL-50PPM-HNO3	50	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-50PPM-HCL	50	20% HCl / tr HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-10PPM (2) 500mL bottles per kit	1 ug/g	ASOS-1-CAL-10PPM-HNO3	10	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-10PPM-HCL	10	20% HCl / tr HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-5PPM (2) 500mL bottles per kit	0.5 ug/g	ASOS-1-CAL-5PPM-HNO3	5	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-5PPM-HCL	5	20% HCl / tr HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-2.5PPM (2) 500mL bottles per kit	0.25 ug/g	ASOS-1-CAL-2.5PPM-HNO3	2.5	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-2.5PPM-HCL	2.5	20% HCl / tr HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-1PPM (2) 500mL bottles per kit	0.1 ug/g	ASOS-1-CAL-1PPM-HNO3	1	10% HNO3	Ag, Al, B, Ba, Bi, Ca, Cd, Cr3, Cu, In, K, Mg, Na, Ni, P, Pb, S, Sr
		ASOS-1-CAL-1PPM-HCL	1	20% HCl / tr HF	As, Be, Fe, Hg, Li, Mn, Mo, Sb, Se, Si, Sn, Ti, V, Zn, Zr
ASOS-1-CAL-BLANK (2) 500mL bottles per kit	0 ug/g (Blank)	ASOS-1-CAL-BLANK-HNO3	0	10% HNO3	None
		ASOS-1-CAL-BLANK-HCL	0	20% HCl	None

Transitioning from traditional organometallic workflows to aqueous hybrid standards using ASOSolv™ can significantly simplify ICP analysis of oils. To help laboratories better understand these approaches, the Inorganic Ventures team has discussed this transition in both a Bench Boost podcast episode and a technical webinar focused on direct dilution oil analysis workflows using hybrid aqueous-organic calibration strategies. **These resources share practical considerations for ICP-OES oil analysis, including:**

- Direct dilution sample preparation
- Hybrid aqueous-organic calibration standards
- Internal standard selection
- Plasma loading considerations
- Standard stability
- Wear metals and additive element analysis
- Reducing dependence on traditional petroleum-based solvents
- Real-world ICP workflow optimization

BENCH BOOST PODCAST

Listen, Learn, and Boost Your Lab Knowledge

Tune in to Bench Boost for practical insights, expert conversations, and real-world solutions covering ICP-OES, ICP-MS, sample preparation, troubleshooting, and more—bringing analytical chemistry topics from the lab bench to life.

[Listen](#)

APP NOTES

Explore ASOSolv™ in Action: Two New Application Notes

Discover how ASOSolv™ enables the use of aqueous CRMs for ICP-OES analysis across both edible and lubricating oils. Explore two application notes demonstrating streamlined approaches for testing trace metals in edible oils and wear metals.

[Wear Metals](#)[Edible Oils](#)

TECHNICAL WEBINAR

Tips for Trace Analysis by ICP-OES & ICP-MS

Discover practical strategies for improving trace metal analysis by ICP-OES and ICP-MS, from minimizing contamination and selecting the right solution matrices to resolving washout issues and reducing measurement uncertainty for reliable results.

[Watch](#)

GUIDES & PAPERS

View All Inorganic Ventures Guides & Papers

Explore Inorganic Ventures' library of technical papers, application notes, and educational guides covering ICP analysis, sample preparation, reference materials, quality management, and practical solutions for today's analytical laboratory.

[Explore](#)