

LAB-X5000



The LAB-X5000 benchtop analyzers present many advantages:

- | **Compact and robust:** ideally suited in a busy lab
- | **Easy to use:** reliable results for all operators with minimum training
- | **Sample preparation to results in minutes:** fast decision making for consistent product quality
- | **Conforms to international standard test methods**

LAB-X5000 for the rapid determination of sulfur and metals in petroleum products

INTRODUCTION

There is a continuing and increasing demand for a rapid, simple and cost-effective measurement of sulfur and metals in a wide range of petroleum products including automotive, marine and aviation fuels. Benchtop energy-dispersive X-ray fluorescence (EDXRF) analyzers such as Hitachi's LAB-X5000 can be found in many refinery laboratories and petrochemical testing laboratories, with the instruments often operated by production staff on a 24/7 basis, providing accurate results conforming to globally accepted test norms.

EDXRF is well regarded for its excellent performance, ease of use, versatility, speed and cost effectiveness. Within the oil supply system from crude oil to refinery output, distribution, storage and usage, quality control and assurance is required at almost every stage of the process.

The LAB-X5000 can measure sulfur and other elements from the parts per million (ppm) range to high percent, covering all analytical requirements in a refinery laboratory, on a ship, or in a testing laboratory, including a mobile one.

CONFORM TO ASTM, ISO, IP, JIS, GB METHODS AND STANDARDS

Analysis with the LAB-X5000 conforms to sulfur test methods and standards including ASTM D4294, ISO 8754, ISO 20847, IP 336, IP 496, JIS K 2541-4 and GB/T 17040.

For the determination of metals, the LAB-X5000's performance conforms to ASTM D8252-19 (Ni and V in crude and residual fuel oil), and ASTM D5059-20 (Mn in gasoline) while meeting the method's precision requirements for Pb.

OILS AND FUELS ANALYSIS MADE EASY

The Hitachi LAB-X5000 benchtop EDXRF analyzer makes fuels analysis easy. This rugged, compact analyzer is designed to provide reliable and reproducible results in laboratories, production environments and mobile inspection operations. The intuitive interface is displayed on a large, industrial touch screen. Streamlined software and one-touch measurement start function are inspired by our line of point-and-shoot handheld analysers so any operator can get high quality results. Built-in atmospheric compensation allows analysis without the need for helium or vacuum purge, minimizing the cost per analysis. The analytical method parameters have been optimized by applications engineers and include automatic compensation for changes in sample density due to varying carbon/hydrogen (C/H) ratios, enabling the measurement of multiple types of oils and fuels with a single calibration, simplifying analyzer setup and operation.

Calibrations can be created by the user directly on the instrument or pre-loaded in the factory following stringent quality and performance criteria. Calibration maintenance is performed using the provided setting up samples (SUSs), which can also be used for tracking calibration stability.

The LAB-X includes several features that help protect against potential damage caused by sample spills or leaks, minimizing downtime and preventing costly repairs: sample cups fit inside a secondary safety window that will contain accidental leaks from the cup. These windows are re-usable and removable and do not require tools for assembly. The sample is inserted into an automatic turntable that positions it for analysis then moves the sample away from the X-ray tube and detector when the measurement is complete. While the risk of a leak escaping both the sample cup and secondary containment is small, should it occur it would happen away from the analytical components. To remind users that a sample should be removed after a measurement, an audible alert is generated when the analysis is complete.

With up to 100,000 results stored on the analyzer itself, operators can view new and old results easily on the built-in screen, print them on the optional integrated printer for a hard-copy record, download them on a USB memory device as a CSV file, and upload them to our ExTOPE Connect cloud service or a local server via Wi-Fi for real-time access to the data anytime, anywhere.

The LAB-X brand has been trusted by the petroleum industry for decades for its reliability, ease of use, stability and ruggedness.

SAMPLE PREPARATION

The sample preparation is very simple and only takes a few seconds: operators pour the oil to be tested into a sample cup fitted with Poly-M film, place the cup in a safety window (also fitted with Poly-M film) in the LAB-X5000's analysis port, and press the Start button.

PERFORMANCE AND RESULTS

Tables 1 to 7 show the typical performance the LAB-X delivers for the determination of sulfur and other elements in petroleum products.

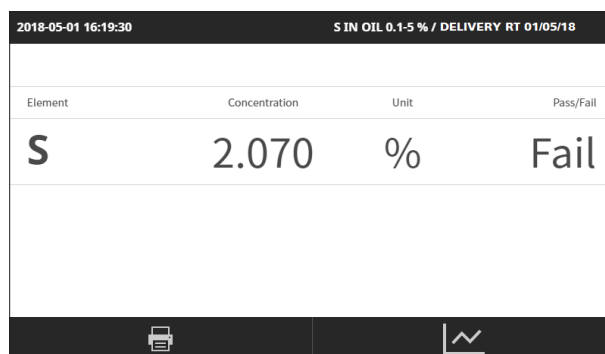
The limits of detection (LOD) are calculated from the results of 10 repeat measurements of a base mineral oil sample and the precision from 10 repeats of a sample containing the elements of interest.



Sample introduction



Starting the analysis



Element	Concentration	Unit	Pass/Fail
S	2.070	%	Fail

Results screen

Table 1: Typical calibration performance for sulfur in oils and fuels. Calibrations were created using mineral oil standards.

Concentration range	Concentration unit	Standard error of calibration	Guaranteed limit of detection (3 σ)	Limit of quantification (10 σ)	Precision (95% confidence)	Measurement time
0 - 150	mg/kg	3	6	12	2.2 at 50	300 seconds
0 - 1000	mg/kg	6	6	12	5.3 at 500	300 seconds
0.1 - 5	% m/m	0.03	n/a	n/a	0.005 at 1	50 seconds

Table 2: Typical repeatability data for sulfur determination

Given sulfur concentration	Concentration unit	Precision (95% confidence) at given concentration	ASTM D4294 repeatability	ISO 20847 repeatability (diesel fuels)	Measurement time
10	mg/kg	2.7	Outside scope	Outside scope	300 seconds
50	mg/kg	2.2	5.4	9	
100	mg/kg	2.9	8.5	10	
500	mg/kg	5.3	24	17	
1000	mg/kg	7.2	37	Outside scope	
0.5	% m/m	0.003	0.011	Outside scope	50 seconds
1.0	% m/m	0.005	0.016	Outside scope	
3.0	% m/m	0.006	0.033	Outside scope	
5.0	% m/m	0.014	0.150	Outside scope	

Table 3: Typical calibration performance for sulfur and metals in fuel oil. Calibration was created using fuel oil standards

Analyte	Concentration range	Concentration unit	Standard error of calibration	Guaranteed limit of detection (3 σ)	Limit of quantification (10 σ)	Precision (95% confidence)	Measurement time
S	0 - 5.5	% m/m	0.02	n/a	n/a	0.03 at 4.5	100 seconds
V	0 - 500	mg/kg	5	1.5	4	5 at 250	
Fe	0 - 500	mg/kg	5	1.2	3	2 at 300	
Ni	0 - 100	mg/kg	1	1.0	2	1 at 50	

If you need to meet the precision requirements of ASTM D8252-19, simply increase the measurement time to 300 seconds. The LAB-X5000 repeatability at 300 seconds analysis time is shown in Table 4, and the corresponding limits of detection are in Table 5.

Table 4: LAB-X5000 repeatability at 300 s analysis time versus ASTM D8252-19 repeatability

Given concentration	Concentration unit	V repeatability		Ni repeatability	
		LAB-X5000	ASTM D8252-19	LAB-X5000	ASTM D8252-19
3	mg/kg	0.5	0.8	0.8	0.8
5	mg/kg	0.5	1.0	0.5	1.1
10	mg/kg	0.8	1.5	0.6	1.5
25	mg/kg	1.2	2.4	0.7	2.5
50	mg/kg	1.3	3.5	1.1	3.6

Table 5: Metals in fuel oil limits of detection at 300s measurement time

Analyte	Concentration unit	Guaranteed limit of detection (3 σ)	Limit of quantification (10 σ)
S	mg/kg	n/a	n/a
V	mg/kg	1.0	2.3
Fe	mg/kg	0.8	1.8
Ni	mg/kg	0.7	1.6

Table 6: Typical calibration performance for manganese in gasoline. Calibration was created using 75% isooctane/25% toluene standards.

Analyte	Concentration range	Concentration unit	Standard error of calibration	Guaranteed limit of detection (3 σ)	Limit of quantification (10 σ)	Precision (95% confidence)	Measurement time
Mn	0 - 300	mg/l	1.5	1.2	2.5	2.1 at 150	60 seconds

Table 7: Typical calibration performance for lead in gasoline. Calibration was created using 75%isooctane/25% toluene standards.

Analyte	Concentration range	Concentration unit	Standard error of calibration	Guaranteed limit of detection (3 σ)	Limit of quantification (10 σ)	Precision (95% confidence)	Measurement time
Pb	0 - 0.08	g/l	0.0008	0.0009	0.0020	0.0008 at 0.04	300 seconds
Pb	0 - 1.30	g/l	0.009	n/a	n/a	0.015 at 0.65	50 seconds

SUMMARY

Once calibrated, Hitachi High-Tech's LAB-X5000 provides cost-effective, accurate and repeatable determination of sulfur and metals in a wide variety of petroleum products, enabling operators to make process decisions fast and ensure products meet stringent specifications. The analyzer's ease of use and ruggedness make it an ideal quality control tool at the refinery and any testing facility, delivering results within minutes for maximum productivity.



ORDERING INFORMATION

The minimum required for this application is:

- LAB-X5000 Fuels package, which includes: the analyzer, user manual, pre-loaded optimized method parameters, method sheets (calibration instructions), setting-up samples, and a liquids accessories pack

Optional items:

- Factory calibrations:
 - We have a comprehensive range of factory calibrations for the determination of sulfur, and sulfur and metals in oil. Please speak with your local Hitachi High-Tech representative to discuss which calibrations meet your testing requirements
- Calibration standards sets:
 - S in mineral oil standards (0 - 150 mg/kg), part number 10003365
 - S in mineral oil standards (0 - 1000 mg/kg), part number 10003362
 - S in mineral oil standards (0 - 5 % m/m), part number 10011742
 - S, V, Fe, Ni in residual fuel oil standards, part number 10003363

Visit www.hitachi-hightech.com/hha for more information.

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