

SPECTROINC.

Industrial Tribology Systems



Instruments for

Predictive Maintenance

by Oil and Fuel Analysis

- Wear Metals
- Fuel Contamination

www.SpectroInc.com ☎ 978.486.0123

Innovation, Quality, Support



Product Line

LaserNet Fines	
FluidScan	
Spectroil M/N-W Military Oil Analysis Spectrometer	
Spectroil M/F-W Fuel Analysis Spectrometer	
Spectroil M/C-W, Oil Analysis Spectrometer	
Double Disc Rapid Robot (D2R2)	
Rotrode Filter Spectroscopy (RFS)	
Transit Case	
Sulfur	
Spectro-Visc Semi-automatic Viscometer	
Ferrography Laboratory	
Fuel Sniffer	
Spectro FTIR Oil Analyzer	
Turnkey Oil Analysis Laboratory (ITL)	

About Spectro Incorporated

Spectro Incorporated is a high technology company that specializes in instrumentation for machine condition monitoring based on oil and fuel analysis. Our customers benefit from our products by

- Detecting potential problems before they occur
- Avoiding costly repair bills
- Reducing maintenance costs e.g. by reducing lubricant consumption or scheduled maintenance
- Cutting expensive downtime

Our primary customers are industrial and military organizations as well as laboratories that provide oil analysis services. We also serve customers who have power generation applications or marine propulsion systems and who wish to detect contaminants in gas turbine fuels.

Spectro manufactures its own instrumentation, and, when appropriate, combines them into complete oil analysis systems through integration with products manufactured by other companies. The mainstay of Spectro's product line is the Spectroil M family of optical emission spectrometers. These have become the primary wear metal analysis instruments of many commercial laboratories and most of the world's military organizations. Recently, Spectro also entered into an exclusive worldwide marketing and sales agreement with Lockheed Martin Tactical Defense Systems for their LaserNet Fines Particle Shape Classifier and Particle Counter; a cutting edge analytical instrument that brings new capabilities to the wear particle analysis market. Other Spectro products include the Spectro-Visc Semi-automatic Viscometer, the Spectro FTIR Lubricant Condition Monitor, the FluidScan Portable Fluid Condition Monitor, the T2FM Ferrography System, the Fuel Sniffer Fuel Dilution Meter, and the LabTrak used oil analysis laboratory management software.

Spectro products are unique in that they have been designed to work equally well in the field or in the laboratory. Spectro products are used throughout the world, and a major portion of sales are outside the continental USA. Spectro has technical and sales representatives in nearly every major country.

Spectro Incorporated employs a team of professionals and experts to maintain its position as a recognized and respected industry leader. Spectro upholds its commitment to provide customers with innovation in product design, products of unsurpassed quality, and exceptional customer support.

The past 26 years have demonstrated Spectro's ability to provide its markets with innovative instrumentation use to detect abnormal wear or contamination in oil-wetted machinery and fuels. Spectro continually innovates both by inventing new products and by enhancing existing ones in response to customers' needs for more capabilities or automation.



LaserNet Fines

Particle Shape Classifier and Particle Counter

The **LaserNet Fines®C (LNF-C)** is a bench-top analytical tool that combines the oil analysis techniques of particle shape classification and particle counting in one instrument. The LNF-C analyzes hydraulic and lubricating oil samples from various types of equipment and machinery that are part of a machine condition-monitoring program. The reports are based primarily on the morphological analysis and the particle size distribution of the abnormal wear particles that are created from the internal components of the machine. The operator is presented with an assessment of particles found in the fluid sample and a history of previous results for the same equipment. LNF-C can be used as a stand-alone analytical instrument or in conjunction with a full service oil analysis program.

As a particle shape classifier, the LNF provides the user with shape recognition of all particles greater than 20µm by using a neural network. An algorithm sorts particles into the following categories: cutting, fatigue, severe sliding, nonmetallic and fibers. The shape recognition software also does a test for circularity so that bubbles and droplets greater than 20µm are eliminated from the particle counting results.

As a particle counter, the LNF processes and stores thousands of images to obtain good counting statistics. Particles are sized directly and results can be displayed by ISO 4406 Code (>4µm, >6µm, and >14µm), or several military codes. The direct imaging capability of this instrument totally eliminates the need for calibration with a test dust. Air bubbles greater than

20µm are ignored and the laser is powerful enough to process heavily sooted (black) oils.

Benefits and Features

- Magnification is set at factory. Recalibration is never required.
- Particle count is an indication of a fluid's cleanliness.
- Data outputs include particle type identification, image maps, size trends and ISO, NAS, and NAVAIR cleanliness codes.
- Algorithms to perform shape analysis, wear particle identification and machine condition assessment.
- Large particles are classed by a neural network as "cutting, fatigue, severe sliding, nonmetallic, free water droplets or fibers".
- Provides image maps of all particles greater than 20 µm.
- Automatic adjustment for fluid darkness; sees through black diesel lubricating oils.
- Built-in data-base for machine condition trending.



ASP, Automatic Sample Processor for the LaserNet Fines





FluidScan



The **FluidScan** is a handheld condition based maintenance system that protects machinery by determining when a lubricant needs to be changed due to excessive contamination or degradation. It detects lubricant contamination and degradation at the point of use by measuring key oil condition parameters in both synthetic and petroleum based lubricants and fluids.

The FluidScan analyzes lubricants and fluids using infrared spectroscopy, a technique that has found wide acceptance as a primary test for contamination and degradation. It performs the analyses with the same accuracy as laboratory instruments, but does so on-site in a handheld version. The FluidScan thus reports and stores information on lubricant condition at the point of use.

The FluidScan features: small, handheld rugged mid-infrared spectrometer; sensitivity comparable to high-end laboratory FTIR spectrometers; on-site analysis; patented optical waveguide technology; reliable performance self-calibrating reference, under 1 minute analysis time; and key oil condition measurements. The FluidScan measures: total base number (TBN), oxidation, nitration, sulfation, incorrect lubricant, additive depletion, soot, glycol/antifreeze, water fuel dilution. It stores over 10,000 records.

Features and Benefits

- Provides an early warning of lubricant degradation and contamination
- Extended oil change intervals
- No delay in waiting for laboratory analysis
- Reduced operational and maintenance costs
- Reduction of unscheduled maintenance outages
- Prevention of catastrophic failures
- Reduction of hazardous waste

Spectroil Family of Oil & Fuel Analysis Spectrometers



Features and Benefits

- Provides an early warning of abnormal wear.
- Conforms to ASTM Standard Test Method D6595 and D6728 requirements
- No sample preparation
- 30 second analysis time
- Bench-top and transportable
- Analyzes all elements simultaneously
- Always ready to analyze samples
- Simple to operate without special training or background
- Standard and readily available consumables
- Requires no special utilities or gases, only AC power
- Meets stringent Department of Defense requirements (JOAP)
- Optional large particle analysis capability
- Optional sulfur analysis capability
- Optional turbine cleaning water and injector analysis program

The Spectroil family of oil analysis spectrometers consists of the Spectroil M/C-W for commercial oil analysis, the Spectroil M/N-W for military applications and the Spectroil M/F-W for gas turbine and diesel engine fuel analysis. All versions of the Spectroil M family are identical in hardware and differ only in their application and the way they are calibrated. Spectroils are compact, rugged, transportable and easy to use spectrometers designed specifically for the analysis of wear metals, contaminants and additives in lubricants, hydraulic fluids, coolants and fuels. They use the time-tested and reliable rotating disc electrode (RDE) technique to measure quantities of dissolved and suspended fine particles in natural or synthetic petroleum based products and coolants. Spectroils can be configured to detect up to 32 elements simultaneously.

Spectroil M/N-W Oil Analysis Spectrometer

The Spectroil M/N-W is the military version of the Spectroil M family of oil and fuel analysis spectrometers. The Spectroil M/N-W is the second generation of the original Spectroil M that was designed from the ground up specifically for oil analysis for military applications. It was tested and selected by the U.S. Government Department of Defense Joint Oil Analysis Program (JOAP) as their "next generation" oil analysis spectrometer.

The Spectroil M/N-W is still the only mobile spectrometer that has been tested and approved to meet the complete technical and performance requirements of the JOAP CID-0191 Specification for Deployable Spectrometers of 4 June 1999. It has been assigned NATO Stock Numbers for all three armed services.

Spectroil M/F-W Fuel Analysis Spectrometers

The Spectroil M/F-W has become the standard instrument when on-site and immediate fuel analysis is a necessity. It fulfills the requirements of ASTM D 6728, Standard Test Method for Determination of Contaminants in Gas Turbine and Diesel Engine Fuel by Rotating Disc Electrode Atomic Emission Spectrometry. It is designed specifically for the analysis of ash-forming contaminants in fuel such as sodium, potassium and vanadium that cause corrosion or deposits at turbine operating temperatures.

Spectroil M/C-W, Oil Analysis Spectrometer

The Spectroil M/C-W has become the standard instrument at most commercial oil analysis laboratories and machine condition monitoring programs that require the rapid analysis of wear metals, contaminants and additives in lubricants. It fulfills the requirements of ASTM D6595 Standard Method for Determination of Wear Metals and Contaminants in Used Lubricating Oils or Hydraulic Fluids by Rotating Disc Electrode Atomic Emission Spectrometry. The unit in this configuration detects 21 elements simultaneously.



Spectroil options to meet your needs

■ Double Disc Rapid Robot (D2R2)

The D2R2 is an accessory to the Spectroil M spectrometer that provides automatic operation for the analysis of used oil samples. It can be added to an existing Spectroil M spectrometer already in the field, or it can be purchased as a new complete system. The Double Disc Rapid Robot (D2R2) is an innovative design for automation that consists of two parts: a robot to exchange consumables, and an automatic sample changer for fully automatic and unattended operation. It is a robotics system that mounts to

the spectrometer sample stand and fulfills all the functions of sequentially introducing and removing oil samples and exchanging graphite electrodes. It is self-contained and works independently of the spectrometer operating software. Although operation is automatic, it also has the capability to manually sequence through each of the robotics functions.

The Double Disc Rapid Robot (D2R2) was designed specifically for oil analysis using the

RDE technique. Automation has been made possible with the innovative use of the double disc approach. The need for a sharpened rod electrode for each analysis has been eliminated, and the requirement to change graphite electrodes has been automated. The result is a simple and rapid robotics system for total automation of the Spectroil M Oil Analysis Spectrometer.



■ Rotrode Filter Spectroscopy (RFS)

Rotrode Filter Spectroscopy (RFS) is an analytical technique that enables rotating disc electrode (RDE) spectroscopy to detect and analyze large wear and contaminant particles in fluids. RFS supplements standard atomic emission spectroscopy by providing additional information that can be used to determine the mechanical condition of machinery.

With the addition of RFS analysis, the RDE

technique can analyze particles greater than 10 micrometers in used oil samples. By trending the change in the ratio between standard RDE spectroscopy and RFS results, the two methods can be used to improve the detection and analysis of progressive wear.

The Rotrode Filter Spectroscopy System is a semi automated analytical accessory to the Spectroil M Oil Analysis Spectrometer.

It consists of one stand-alone cabinet and includes a five-station disc electrode preparation fixture, vacuum/pressure pump, a reservoir for cleaning solvent, a sump for waste oil, and electrode clamp assemblies. It requires only external electrical power for operation and uses only environmentally friendly solvents. The entire system is on casters and can be easily transported.



■ Transit Case for Spectroil

The Spectroil M transit case is an oil analysis laboratory in a deployable container. The transit case is designed to accommodate the Spectroil and all necessary accessories and consumables during transport and to act as an oil analysis laboratory when on-site. It features a shock mounted cradle designed to hold and protect the Spectroil. The case is mounted on four casters; two fixed and two that swivel

and have locking brakes.

The transit case is manufactured from a formulation of polyethylene for high impact strength and has outstanding resistance to high and low temperatures. The design provides protection to fungus, water, solvents and abrasion. Handles are provided for the removal of the cover, tie downs around the perimeter facilitate

securing the case during transport, and there are openings on the bottom for movement by forklift.

The Spectroil can be operated while still in the case and a gas cylinder lift mechanism is used to raise the spectrometer to a comfortable height (variable) for operation. Storage for consumables and accessories is provided in a custom compartment which doubles as a work table.

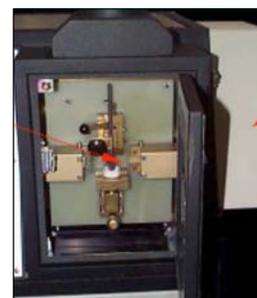


■ Sulfur in Oil or Fuel Option

On-site analysis of the element sulfur in diesel engine and gas turbine fuels has been a desire of the gas turbine manufacturer and power plant engineer for years. Until recently, on-site sulfur analysis using a fuel analysis spectrometer was not possible because the oxygen in the atmosphere absorbs the emission of sulfur produced during the analysis. With the innovation of

a compact, nitrogen purged optic mounted near the sample stand of the Spectroil M/F-W and Spectroil M/C-W, on-site analysis of sulfur can be achieved along with the routine analysis of the key sulfation and corrosion elements such as vanadium, sodium and potassium. Nitrogen consumption is minimal due to the small size of the optic and the short optical path to the

spark. It can be turned on as required to coincide with those samples that need sulfur analysis to further reduce argon consumption. The sulfur capability for the Spectroil M can be included as an accessory to new instruments, or added in the future as a retrofit.





Spectro-Visc Semi-automatic Viscometer

The Spectro-Visc is a bench-top semi-automatic kinematic temperature bath viscometer optimized for the analysis of used and new lubricants. It conforms to the requirements in ASTM D445, D446, D7279, IP 71 and ISO 3104. It is also the ideal system for used oil analysis laboratories that need to test a wide range of lubricant viscosities.

Features and Benefits

- Viscosity analysis of used oil provides an early warning of lubricant degradation and contamination
- Compliant with requirements for ASTM D 445, D 7279 and related specifications.
- High throughput – up to 60 samples per hour to ASTM precision.
- Small sample volume – 0.3 to 0.6 ml.
- Low solvent consumption – 2.5 ml per sample.
- Extremely easy to use.
- Automatic flow time measurement.
- Fully automatic cleaning and drying.
- Fast, easy tube replacement, no need to drain bath.
- Single or dual solvent injection system.
- No PC required for system to operate.
- Optional dual measurement capability.

The Spectro-Visc is a self-contained viscometer system that consists of a thermostatic bath with circular heater and a control column. The bath contains four patented viscometer tubes together with optical sensors to detect the flow of oil through the tubes. The measuring tubes function independently of each other. The control column has an LCD display that provides the user with information about the system's status and an array of LED's indicate the current status of each measuring tube. An optional external computer can also be used to control the system for applications where more extensive data handling requirements are necessary.

The user of the Spectro-Visc has the option to operate in two modes, standard viscosity determinations or measuring tube calibration. In both modes, the user chooses how many determinations have to be made for an average result. The operator also controls additional parameters such as tube constants and cleaning cycle.



Ferrography Laboratory

The Spectro Ferrography Laboratory is a complete analytical system for the separation and interpretation of wear and contaminant particles in used lubricant oils, hydraulic fluids, coolants and fuels. It consists of the Thistle Tube Ferrogram Maker, a bichromatic microscope, video camera and image capture software.

The T2FM is fast because there is no delay time as sample is pumped through plastic tubing before reaching the ferrogram surface. The T2FM delivers the entire sample and all the particles contained therein onto the ferrogram surface. A crystal clear rinse is obtained without fail for every ferrogram. There are no last minute drips of oil sample onto the ferrogram leaving distracting halos around the particles when viewed under the microscope.

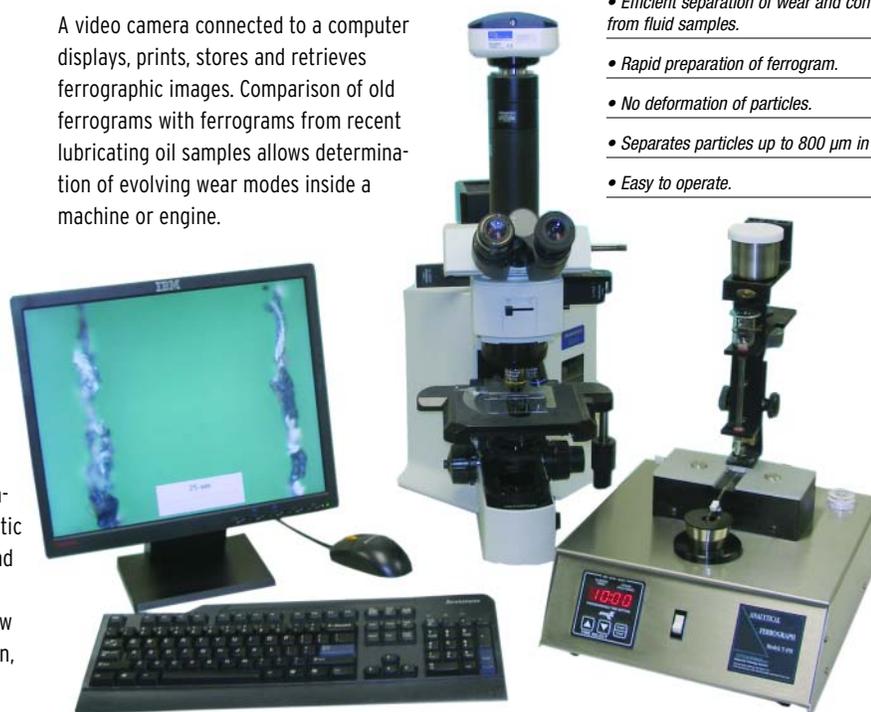
A bichromatic microscope is used to view and examine ferrograms made with the T2FM. The bichromatic microscope is equipped with both reflected (red) and transmitted (green) light sources so that the ferrogram may be illuminated from both above and below the microscope stage. With bichromatic illumination,

metal particles, which reflect light, appear bright red, whereas nonmetallic particles appear green because light transmits through them.

A video camera connected to a computer displays, prints, stores and retrieves ferrographic images. Comparison of old ferrograms with ferrograms from recent lubricating oil samples allows determination of evolving wear modes inside a machine or engine.

Features and Benefits

- Ferrography assists in the diagnosis of the origin, characteristics and distribution of wear particle debris.
- Efficient separation of wear and contaminant particles from fluid samples.
- Rapid preparation of ferrogram.
- No deformation of particles.
- Separates particles up to 800 μm in size.
- Easy to operate.



The Fuel Sniffer

The Fuel Sniffer is a portable fuel dilution meter that can be used in the laboratory or in the field to provide rapid and accurate measurements of fuel contamination in engine oil.

The Fuel Sniffer was developed in collaboration with the U.S. Navy. The Fuel Sniffer employs a Surface Acoustic Wave (SAW) Vapor Microsensor to measure the concentration of fuel in used lubricating oil samples by sampling the "head space" in the sample bottle. Based on Henry's Law, the fuel vapor concentration is directly related to the fuel present in the oil sample. A pump inside the instrument draws head-space vapors across the SAW sensor which detects absorbed hydrocarbons by a change in frequency of a surface acoustic wave (SAW).

The Fuel Sniffer takes just over 60 seconds to perform a measurement. The next sample can be introduced quickly with the specially designed "clamp and sample" bottle platform, so that 40 or more samples can be analyzed per hour. The sample bottle platform also keeps the sample bottle below the level of the instrument to prevent potential damage due to liquid sample coming in contact with the sensor.

Features and Benefits

- Detects excessive fuel in the lubricant causes wear
- Measures fuel in oil from 0% to 10%
- Small size, ideal for field use or in the laboratory
- Single point calibration
- Easy to operate, rugged and reliable
- Fast and accurate, measurement time ~ 60 seconds.
- Inexpensive to use, requires no chemicals or consumables
- Low maintenance, self-diagnostic program



Spectro FT-IR Oil Analyzer Lubricant Oil Degradation & Contamination Measurement

The Spectro FT-IR Oil Analyzer is specifically designed for the molecular analysis of lubricating oil to determine oil degradation and contamination. It was developed and optimized for predictive maintenance programs according to JOAP and DIN standards for the rapid determination of oxidation, nitration, sulfation, water, coolant, fuel dilution, soot and wear additive depletion in used lubricating oils.

The Spectro Oil Analysis FT-IR Spectrometer is equipped with a zinc selenide transmission flow cell. The transmission cell has high infrared throughput, is optimized for used oil analysis and is easy to clean. The cell assembly is mounted in a pre-aligned base plate for fast and reproducible exchange.

When coupled with an optional auto sampler, the Spectro FT-IR Oil Analyzer is ideal for condition monitoring laboratories with large sample loads. The system is easy to use and requires little training for operation since it is optimized for one application: used oil analysis. It features continuous online diagnosis of all spectrometer components and automatic control of selected measurement parameters.

Features and Benefits

- Provides an early warning of lubricant degradation and contamination
- Instrument and software specifically designed for the analysis of used oil.
- Transmission cell optimized for the analysis of used oil.
- Fixed interferometer does not require software or manual alignment.
- Exceptional stability and reliability in harsh operating environments.
- Completely sealed and desiccated to prevent humidity interferences





Turnkey Oil Analysis Laboratory (ITL)

The Spectro Industrial Tribology Laboratory (ITL) is a turnkey system providing condition monitoring for machines and engines by oil analysis. The measurements made using the Industrial Tribology Laboratory determine lubricant and machine condition, the cornerstones of any effective predictive maintenance system. Spectro has put together an instrument package that makes the necessary measurements to effectively monitor all the oil lubricated equipment in your plant or fleet.

The instruments Spectro has chosen to accomplish this task are **1)** a Spectro M optical emission spectrometer for analysis of wear metals, additives and contaminants, **2)** a Spectro FTIR Fourier Transform Infrared spectrometer for analysis of organic components, **3)** a Spectro-Visc automatic viscometer, **4)** A LaserNet Fines for classification of wear and particle counting and **5)** a computer (or network) for data

storage, processing and retrieval. Optionally Spectro provides additional instruments to enhance the data generated by the basic instruments of the turnkey industrial tribology configuration. They include ferrography instruments, fuel dilution meter, and titrators for TAN, TBN or Karl Fisher water determinations. A local area network (LAN) version of the ITL system is also available for laboratories that process large numbers of oil samples.

Included in the ITL is a computerized expert equipment condition monitoring software program called LabTrak. It is a sophisticated, yet simple to use, LIMS which administers the routine operations associated with a condition monitoring program based on oil analysis. The analytical instruments send results to the central computer (or a network) where they are stored in a database for subsequent evaluation.

The software implements the tasks of a full function oil analysis laboratory including sample logging, analysis, data storage and retrieval, automatic evaluation and reporting.

Spectro installs and provides training for all instruments as an integrated system. Since the Industrial Tribology Laboratory is a turnkey system, supplied and installed by one vendor, the worry and learning curve errors associated with new methods and equipment are minimized during the startup process. Condition monitoring of your equipment can begin immediately after the installation of your instruments and during the initial training of your personnel.

Features and Benefits

- Turnkey system from one supplier
- Installation and training
- Optimized instrumentation and software for the customer's requirements

- A** - Spectroil M
- B** - Rotrode Filter Spectroscopy
- C** - LaserNet Fines
- D** - ASP
- E** - Spectro FT-IR
- F** - Fuel Sniffer
- G** - Data Storage
- H** - T:FM
- I** - Spectro-Visc Viscometer

