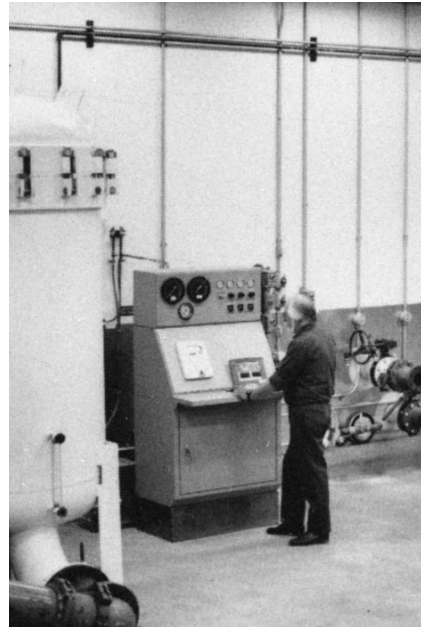




Fuel Filtration and Analytical Laboratories



Fuel Filtration Laboratory



Parker AFD aviation fuel filtration testing facility in Colorado Springs, CO

The Dinius Product Development Laboratory at Parker AFD, is one of the company's most important assets where numerous fuel filtration products are developed and qualified. A wide range of products are tested for the aviation fuel market. Located at in Colorado Springs, Colorado, the lab is the world's largest indoor jet fuel testing facility designed to achieve the following missions:

- New product development
- Qualification testing to the highly demanding requirements of civil and military aviation fuel filtration specifications
- Quality conformance testing of raw materials and finished products to support our manufacturing operations
- Analysis of customers' fluid samples to determine the best

clarification method

- Testing filter cartridges returned from the field

These functions are carried out by a well qualified Technical Services team consisting of product development engineers and test technicians. This core group is aided by other engineering and marketing functions throughout the company. Decades of cumulative experience are focused on our missions.

Fuel Filter Lab And Aviation Product Testing

To meet the critical requirements of the aviation industry, two separate computer-instrumented test loops gauge our products' ability to remove water and dirt from jet fuel. One loop is equipped for full-scale tests up to 2,500 gpm. The other loop is suitable for single element tests up to 150 gpm. These loops are designed to comply with the latest editions of jet fuel filtration and separation specifications including:

- El Publication 1581

- El 1583 Specification for Absorbent-Type Elements
- MIL-F-8901
- MIL-PRF-81380 E Fuel Monitor Specification
- MIL-PRF-52308J Filter Coalescer Element Specification
- MIL-PRF-32148 Filter Separator Elements Naval Shipboard



Two sets of clay filters, micronics filters, and filter/separators are used, along with a fuel storage capability of 45,000 gallons. Refrigerated heat exchangers, additive blending tanks, large

pumps, and a wastewater treatment system are also present. A custom, state of the art data acquisition system is included to handle the data gathering tasks.

In addition to the test loops, a separate open coalescing tank is used for visual examination of coalescing performance, and a burst chamber for determining cartridge burst and collapse strength.

Diesel Fuel Laboratory

Parker AFD is committed to



supplying the highest quality filtration technology available. Our state-of-the-art Diesel Fuel Laboratory is uniquely capable of performing full-flow single-pass efficiency testing similar to real world conditions. We also structurally challenge our products

to assure consistent performance in the most extreme conditions. At Parker AFD, we stand behind our products, as we continue to seek solutions to ensure quality fuel whenever and wherever needed.



Testing Capabilities

FUEL

- Ultra Low Sulfur Diesel (ULSD) red dyed
- All tests can be performed with various blend concentrations of biodiesel

RESISTANCE-TO-FLOW TEST

- Flow rates up to 60 USGPM.
- Typical product testing from 20% to 120% of rated flow

RETENTION TEST

- ISO codes - through influent and effluent particle counts
- Efficiency (single pass)
- Beta ratios

SOLIDS CAPACITY TEST

- Contamination loading conducted to maximum rated differential pressure

COLLAPSE TEST

- Maximum product differential pressure to component and product failure
- Assures structural integrity beyond element solids capacity

MEDIA MIGRATION TEST

- Effluent filtration media migration test to assure product cleanliness

SOLIDS AND WATER TEST - ENVIRONMENTAL CONDITIONS

- Retention testing in single pass mode with a slurry combination of both solids and water
- Cartridge capacity is measured at terminal pressure

SPIN-ON SEAL TEST

- Maximum product seal pressure

EMULSIFIED WATER COALESCING TEST

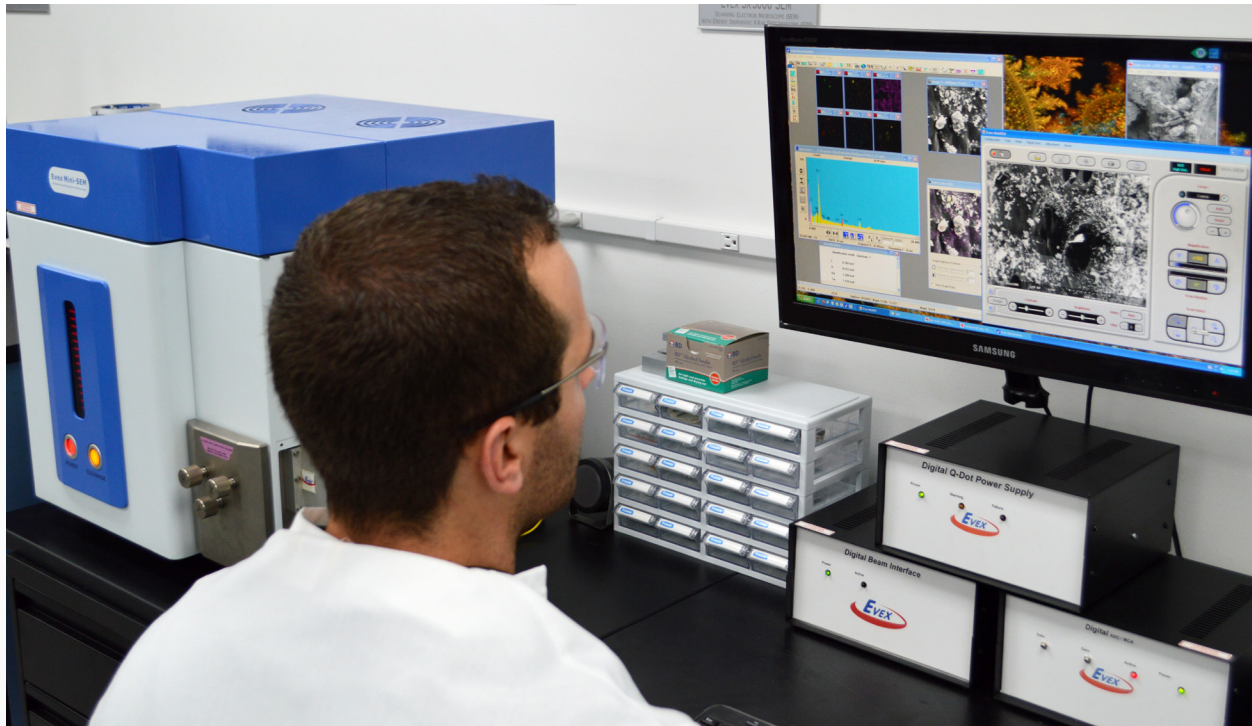
- Water injected before system pump
- Testing to assure a product affectivity to remove emulsified water from diesel fluids

COARSE WATER COALESCING TEST

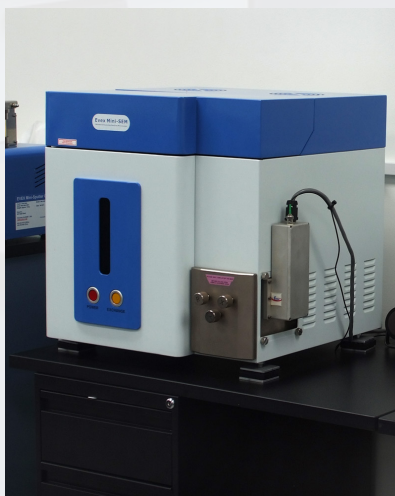
- Water injected after system pump
- Testing to assure a product affectivity to remove bulk water from diesel fluids

Analytical Laboratory

The Analytical Laboratory houses a wide range of capabilities to support the development of filtration products. These capabilities include the testing of filters, in-house quality control testing, and the analysis of customer fluid samples. Using our broad range of cutting edge technology and diagnostic equipment, Parker AFD is committed to manufacturing quality products and providing industry leading filtration. Equipment and testing is performed within the guidelines of ASTM, ISO, SAE, and ANSI standards. At Parker AFD, we stand behind our products, as we continue to seek solutions to ensure quality fuel whenever, and wherever, it's needed.



Laboratory Capabilities and Equipments



30 KEV SEM SCANNING ELECTRON MICROSCOPE (SEM) WITH ENERGY DISPERSIVE X-RAY SPECTROSCOPY (EDS)

- Analyze both liquid and solid samples up to 120,000X magnification using a high energy beam of electrons in a raster scan pattern in order to determine topography, composition, and electrical conductivity.
- Determines the elemental composition or chemical characterization of a sample, or discriminate particulate.
- Particularly useful in assessing the composition of individual particles, or granules, from various sources for quality control and failure analysis. Returned cartridge contamination can be isolated on the scale of micrometers and individually analyzed. Root cause analysis of the contamination source can then be performed.

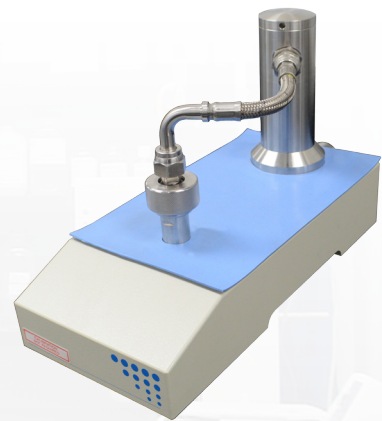
FOURIER TRANSFORM INFRARED (FT-IR) SPECTROMETER

- Analyzes both liquid and solid materials, using infrared light to determine molecular composition.
- Measures the amount of absorbance and reflectance through a material sample across the infrared spectrum.
- Results of the spectral analysis are compared against a database of patterns in order to determine particulate contamination of organic compounds on filter media.
- The FT-IR analysis is helpful in determining particulate contamination on various filter media, as well as additional sources. Once a contaminant is identified, possible sources can be traced to alleviate the downstream filtration issues.



POROMETER

- Determines the following characteristics of flow porometry for media and filter samples:
 - Pore Size Distribution
 - Bubble Point Measurement
 - Air Permeability
- Accurately measures the characteristics of filter media for new product development.
- Allows for benchmark testing of Parker Velcon media against competitor cartridges.



PARTICLE COUNTER AND AUTOMATIC BOTTLE SAMPLER

- Determine both the particle sizing characteristics and the particle distribution of a liquid sample with the single and multi-pass filter method within the guidelines of ASTM and ISO standards.
- Uses hydraulic fluid as a baseline for bottle sampling.
- 8 Channel Particle Counter reports results down to 1 μ m levels.
- Results of an analysis are characterized as ISO Codes, Beta Ratios, and Efficiency Ratings.
- Particle size distribution analyses are helpful in determining the most efficient and effective filtration cartridges for use in various applications. A large accumulation of 1 μ m particulate in a sample will require specific filtration, as opposed to an accumulation of 25 μ m $>$ particles.



icountBSplus
Bottle Sampler



icountACM20
Portable Particle Counter



HIAC
Liquid Particle Counter

INTERFACIAL TENSIOMETER (IFT)

- Measures the surface tension, or energy per unit area, of a liquid sample using the Du Noüy Ring method.
- Interfacial tension measurements are used to determine the addition of surfactants within a fluid sample, which will decrease the surface tension. A higher IFT value indicates lower surfactant levels.
- Surfactants within fuel can disarm coalescer elements, which could allow water to bypass filtration, and migrate downstream to an aircraft. Surfactants are also known as detergents, emulsifiers, or wetting agents.
- Important to identify the emulsification characteristics of fluid samples.



MICRO-SEPAROMETER

- Measures the water separation characteristics of fuels by determining the presence of surfactants, which affect the ability to separate free water from fuel.
- A fluid sample is mechanically mixed with a water sample to achieve emulsification. The results are characterized on a scale of 1-100, with 100 being the maximum value of an unprocessed sample. A lower value on the scale, the more surfactant present in a fluid sample, hampering its ability to coalesce properly.



ULTRAVIOLET (UV) SPECTROPHOTOMETER

- Measures the amount of absorbance and reflectance through a material sample across the Ultraviolet spectrum.
- Results are measured as transmittance through a liquid sample, and then reported as absorbance.
- Determines surfactant, surface active agent, concentrations within fluid samples based on the amount of light absorbance at specific wavelengths.



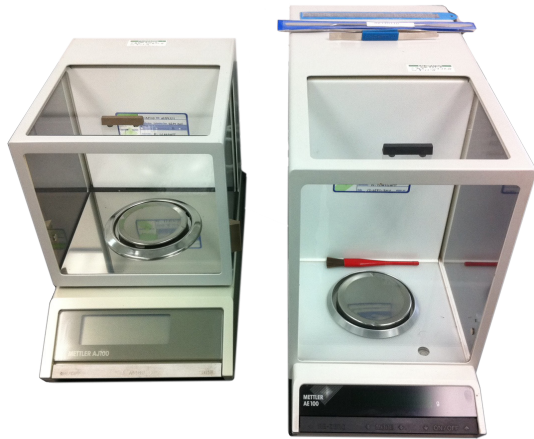
VISCOSITY & PH BALANCE STATION

- The viscosity of a liquid sample can be determined.
- The pH levels of a liquid sample can be determined.

MICROSCOPE STATION

- General spectroscopy and close-up imaging of particulate contamination for analysis.
- Allows for in-depth analysis of returned cartridges, or “filter autopsies”.
- Magnified image capturing can facilitate in particulate contamination sources.





ANALYTICAL BALANCES

- Measures the amount of gravimetric contamination.
- Allows for accurate, and efficient results of particulate analysis.
- Helpful in determining the amount of total suspended solids within a fluid sample for filter life estimation, as well as effective filtration methods.

GAS CHROMATOGRAPHY-MASS SPECTROMETRY

The Agilent 6890 Gas Chromatograph (GC) with 5793 Mass Selective (MS) Detector (GC/MS) is the latest technology we have added to our analytical laboratory. The GC/MS allows for chemical analysis of unknown compounds in liquid, gas and volatile mixtures. The GC allows us to break down mixtures into their basic components, while the MS enables us to determine the molecular weight of each of the unknowns. The results are then compared to build in libraries of compounds and allow us to identify the compounds which are unknown.

The GC/MS allows us to

- Fully characterize fuel and its components
- Detect additives in the fuel
- Measure the content of FAME in biofuel
- Determine the biofuel blends
- Perform both qualitative and quantitative analysis

For some of the compounds the sensitivity level can get down to parts per billion (ppb) levels. The GC/MS allows for faster contaminants identification and provides critical information to help solve our customers' contamination problems.



Mission

Parker AFD is committed to being the world's preferred source for the expert aviation filtration solutions we deliver to our customers.

Values

Superior customer service

Profitable growth

Meet or exceed customer expectations

Accountability

Integrity

