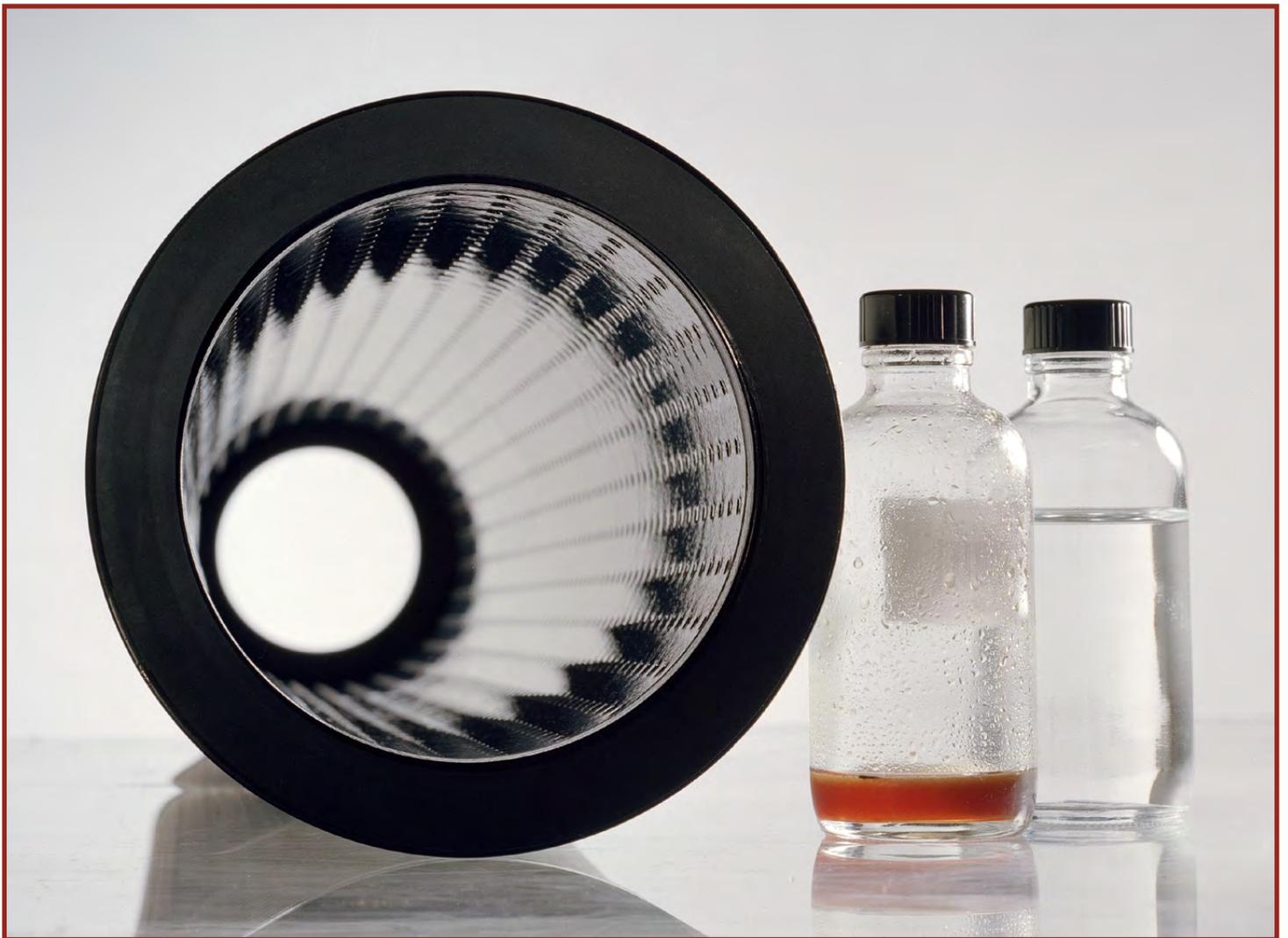


Filtration Technology Capabilities



Southwest Research Institute®
San Antonio, Texas

Southwest Research Institute®

Founded in 1947 as an independent, nonprofit research and development organization, Southwest Research Institute provides a significant research, engineering and testing resource for industry, business and government. SwRI's 11 technical divisions, ranging from automobile research and space science to bioengineering and intelligent systems, use a multidisciplinary, integrated approach to solve complex problems in science and applied technology. As part of a long-held tradition, patent rights arising from sponsored research at the Institute are often assigned to the client. SwRI generally retains the rights to Institute-funded advancements.

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Filtration Technology Capabilities

Vehicles and equipment frequently encounter contamination that may cause excessive wear, unreliable operation or complete failure. These harmful contaminants include particulate debris from ingested dust, water, microbiological growth, lubricating oil soot and wear. Filtration products minimize exposure to these contaminants, reducing equipment maintenance costs and downtime.

Southwest Research Institute® (SwRI®) evaluates filtration performance, solves filtration-related problems and assists in defining filtration requirements. With broad capabilities in material sciences, engine design and development, and fuel and lubricant technologies, the Institute provides a significant, single resource to filtration manufacturers, suppliers and users. SwRI staff members participate in professional societies and industry groups that promulgate filtration standards and specifications. Because of its independent and impartial status, SwRI frequently offers opportunities to participate in cooperative research and development programs. SwRI technical divisions supporting filtration technology have achieved certification to ISO 9001 or 9002, ensuring compliance with stringent quality control procedures in design, development and testing.



DO17528-9533

Using advanced small particle and filtration test equipment, Institute engineers provide a significant, single resource to filtration manufacturers, suppliers and users by evaluating filtration performance, solving filtration-related problems and developing improved filters.

Using a particle counter and analyzer, SwRI staff members measure the size and number of particulates in a hydraulic fluid sample. Particulates affect the degree of engine and pump wear.



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Areas of Focus

Automotive System and Component Contamination Sensitivity

- Contaminant characterization
- Accelerated life testing (key-life testing)
- Material compatibility
- Modeling and simulation
- Test procedure development
- Environmental evaluation
- Filtration
- Emissions and safety
- Component and systems development

Development and Testing of Aviation Fuel Filters

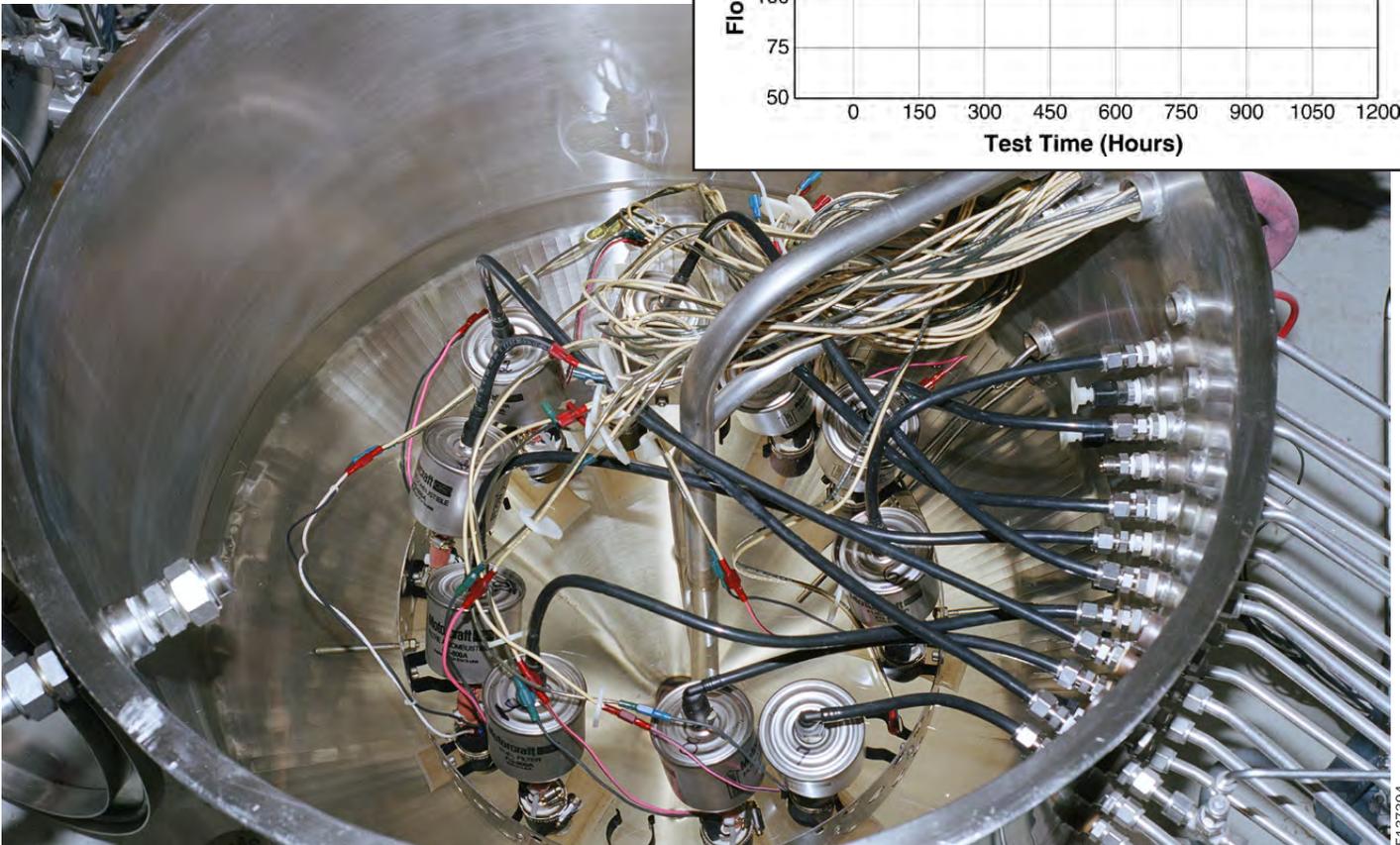
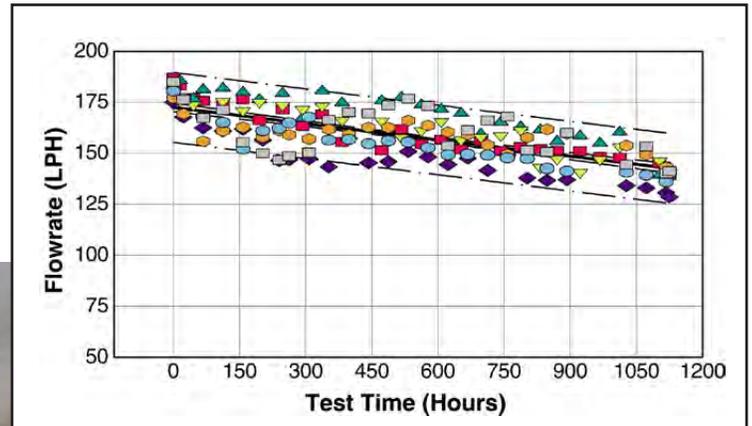
- Research and development
- Technical services
- Qualification testing
- Field analysis and contamination assessment
- Laboratory support

Filtration and Fine Particle Technology

- Filtration systems development and evaluation
- Fine particle technology
- Air filter laboratory and test stand design, development and fabrication
- Equipment calibration

Filtration Testing and Development

- Fuel and lubricant filtration testing
- Fuel filtration tests
- Lubricant filtration tests
- Particle counting and surface chemistry evaluation
- Performance and durability assessment
- Filtration test method development
- Field analysis and contamination assessment



In this contamination sensitivity evaluation, staff members introduce controlled amounts of contaminant into the fuel delivery subsystem assemblies as they undergo stringent laboratory testing.

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Automotive System and Component Contamination Sensitivity

SwRI evaluates vehicle contamination problems that can cause excessive wear and malfunctions in vehicle systems. The Institute's areas of focus include:

Contaminant Characterization

- Functionality testing
- Contamination sensitivity and durability testing
- Contaminant chemical composition determination
- Contaminant particle size evaluation

Accelerated-Life Testing (Key-Life Testing)

- Use pre- and post-test boundary analyses to identify and evaluate critical parameters
- Apply classical or modern accelerated-life assessment methodologies
- Interrogate machine performance through introduction of controlled contaminants
- Evaluate component and systems design and construction to determine vulnerability

Material Compatibility

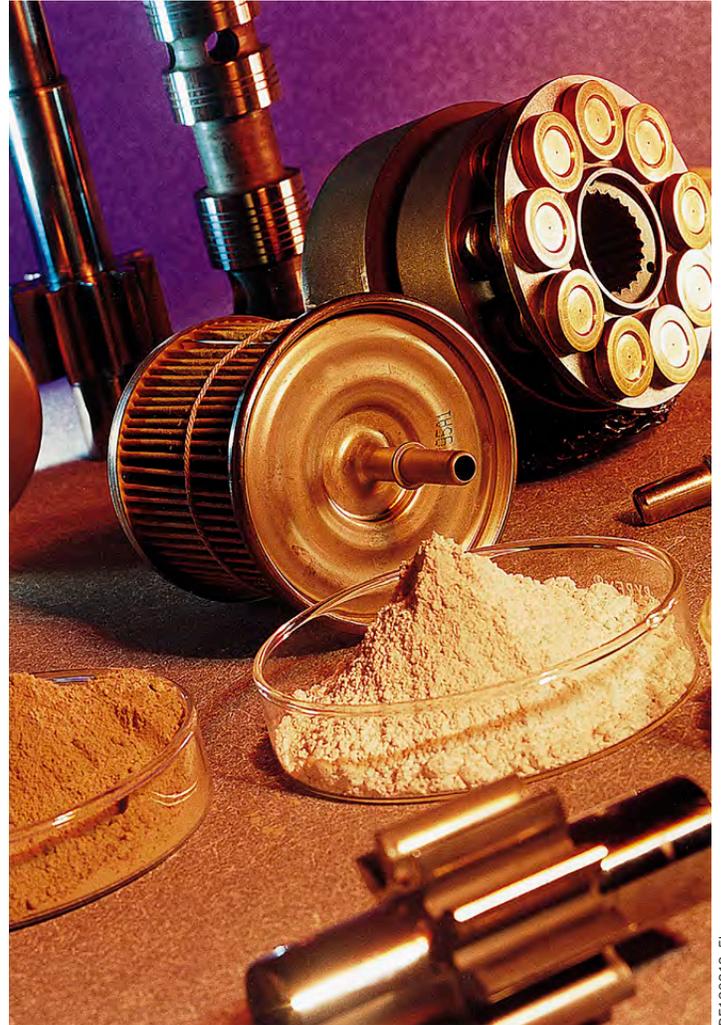
- Contamination control strategy development, implementation and evaluation
- Specialty fuel formulation
- Hot and cold soak with specialty fuel
- Scanning electron microscopy (SEM) examination
- Material and failure analyses
- Fuel property and contamination analyses
- Fuel compatibility studies
- Lubricity and wear property evaluation

Modeling and Simulation

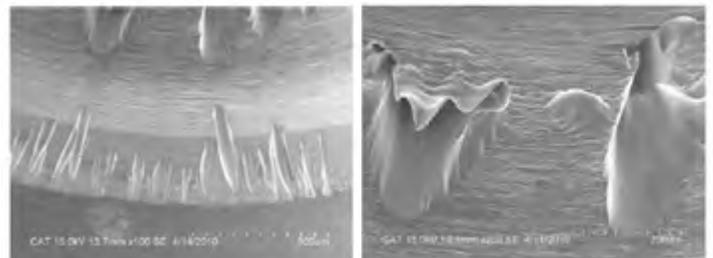
- Design components to function at given contamination levels for suitable periods of time, and with acceptable performance
- Identify contaminant-sensitive components
- Develop realistic service-life estimates
- Achieve targeted service-life for final designs

Test Procedure Development

- Fuel pumps
- Seals
- Fuel injectors
- Engines and transmissions
- Hydraulic control valves



SwRI uses contamination analysis, testing, modeling and simulation methodologies to assist industries in developing specialty test procedures that determine how contaminants affect the performance of automotive components such as filters, pumps, seals and fuel injectors.



Scanning electron microscope (SEM) images illustrate possible wear caused by solid debris in a high-pressure common rail (HPCR) fuel system.

Environmental Evaluation

- Thermal cycle testing
- Vibration and resonance evaluation
- Pressure cycle testing
- Flow cycle testing

Filtration

- Particle-loading pattern analysis
- Dust-loading pressure drop testing
- Dust-loading capacity measurement
- Filtration efficiency testing
- Media testing

Emissions and Safety Issues

- Helium- and fuel-leakage testing
- Hot-fuel handling
- Permeation testing
- Hydrocarbon compound analyses
- Upper and lower flammability limit determinations
- Electronic field measurement

Component and Systems Development

- Prototype component design
- Computational fluid dynamics analysis
- Prototyping
- Statistical analysis



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An Institute engineer calibrates a filtration vibration test stand used to evaluate the efficiency and capacity of hydraulic, aerospace and lubrication filters to current and developing industry test standards.



SwRI engineers conduct system and component contamination testing on numerous vehicle platforms, including military vehicles such as the Marine Corps Mine Resistant Ambush Protected (MRAP) vehicles deployed in support of our military operations.

U.S. Marine Corps photo by Cpl. Michael Augusto

Development and Testing of Aviation Fuel Filters

SwRI is an independent source for developing and evaluating aviation fuel filtration media systems. The Institute's comprehensive services include:

Research and Development

- Long-term materials compatibility assessments
- Component and equipment performance testing

Technical Services

- Specification 1581 for aviation jet fuel filter/separators
- Specification 1583 for aviation jet fuel monitors with absorbent-type elements
- Specification 1590 for aviation jet fuel microfilters

Qualification Testing

- Qualify products to meet national and international specifications
- Provide the aviation industry with unbiased and accurate results

Field Analysis and Contamination Assessment

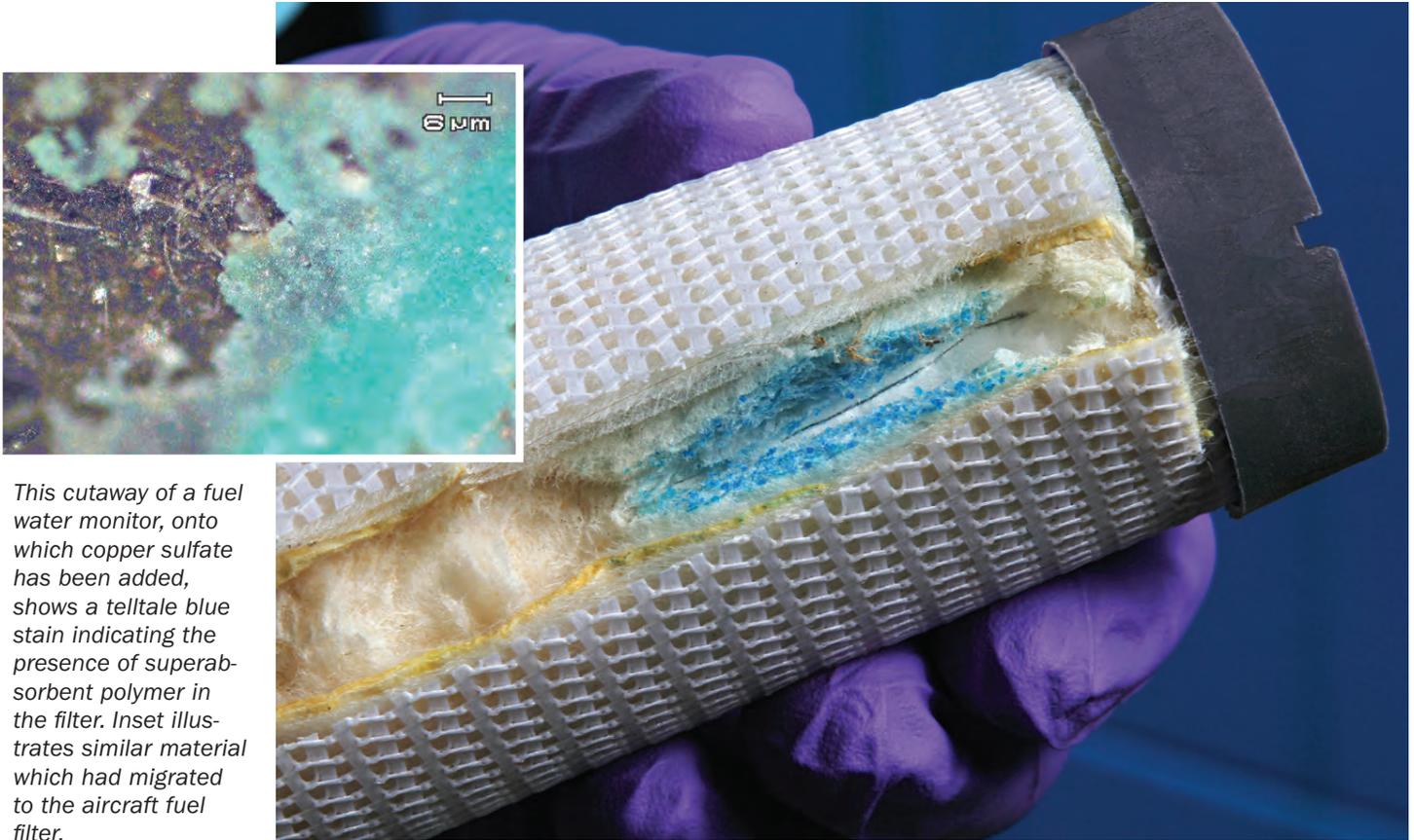
- Simulate a wide range of conditions to duplicate problems and resolve causes
- Site visits to assess conditions that may contribute to filter or component failure

Laboratory Support

- Automated tensiometer
- Microseparatometer
- Particle counters and other electronic sensors
- Karl Fisher titrator



SwRI staff members use state-of-the-art testing facilities and equipment to evaluate aviation fuel filtration components and systems. In addition to performing industry-specified tests and procedures, Institute engineers develop custom tests to meet specific client requirements.



This cutaway of a fuel water monitor, onto which copper sulfate has been added, shows a telltale blue stain indicating the presence of superabsorbent polymer in the filter. Inset illustrates similar material which had migrated to the aircraft fuel filter.

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Since 1957, SwRI has conducted aviation fuel research and testing ranging from fundamental investigations to field validation testing and rapid response problem solving.

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SwRI staff members disassemble filter cartridges to evaluate individual components of the contaminant and determine cause of filter failure.

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Filtration and Fine Particle Technology

SwRI performs filtration and fine particle research from particle mechanics and aerosol science to qualification testing for industry, commercial and military specifications. SwRI services include:

Filtration Systems Development and Evaluation

Laboratory and Field Program Support

- Performing qualification and third-party comparative evaluations
- Providing component and systems research and development
- Aiding in developing strategies for demonstrating specific levels of performance
- Performing standardized tests to manufacturer, industry, government and military specifications
- Providing filtration efficiency, dust capacity and life measurement

Qualification Testing to Specifications

- Automotive and heavy-duty vehicles: ISO 5011 SAE J726 and JIS D 1612 plus OEM specifications and standards
- Nuclear
- Power plant
- Gas turbine
- Railroad
- Military

Fine Particle Technology

- Ultrasonic nucleation and agglomeration of bubbles in liquids and agglomeration of particles in gases
- Particle transport and deposition in piping systems and near-field open spaces
- Engine wear as a function of concentration and size distribution of ingested dust
- Component operability in adverse environments
- System and component failure mode analysis
- Particle transport, deposition and multi-phase flows
- Particle sizing and analysis
- Specification development
- Off-highway and severe dust evaluations
- Filter failure analysis
- Environmental testing and evaluations
- Dust and small particle analysis
- Small particle interactions and mass transfer
- Condensation
- Low and zero gravity separations

Air Filter Laboratory and Test Stand Design, Development and Fabrication

- Semi-automatic operation with real-time display
- Closed loop control of dust feeding and airflow management
- Post-test report generation
- Emphasis on real-world operation and real-life laboratory simulation

Equipment Calibration

- Four primary test stands with capability to 4,500 scfm
- Isokinetic sampling
- Optical particle counting (0.3–10 μm)
- Air cleaners, elements, flat sheets and components
- Multi- and single-stage systems
- Radiator/heat exchanger test loop



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SwRI engineers conduct detailed laboratory testing of novel air filtration technologies.



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Using up-to-date instrumentation and laboratory facilities, Institute staff members design and test air filtration systems and components.



SwRI developed a new test cell to evaluate, under a variety of conditions, vehicle radiators, coolants and related components and fluids from vehicles ranging in size from compact cars to Class 8 trucks and military vehicles.

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Filtration Testing and Development

SwRI integrated programs provide a single resource to filtration manufacturers, suppliers and users. The Institute's filtration testing and development programs include:

Fuel and Lubricant Filtration Testing

- Particle counting and surface chemistry evaluation
- Performance and durability assessment
- Filtration test method development
- Field analysis and contamination assessment

Fuel Filtration Tests

- SAE J905 fuel filter tests
- SAE J1985 fuel filter initial single-pass efficiency test
- SAE J1488 emulsified water removal test
- SAE J1839 coarse water removal test
- Contaminant chemical and particle size analysis and ISO 19438 multipass for fuel filter sensitivity and durability lubricant filtration tests

Lubricant Filtration Tests

- ISO 4548 multipass lubricating oil filter test
- SAE HS806 oil filter test
- ISO 16889 hydraulic filters – multipass method
- Heavy-duty filter performance specifications, such as Cummins, Caterpillar and Mack
- Soot and contaminant chemical analysis

SwRI conducts fuel and lubricant filtration tests in accordance to SAE and ISO standards. Multipass filtration tests record fuel filter efficiency and life parameters.

Particle Counting and Surface Chemistry Evaluation

- Batch and on-line particle counting
 - Calibration to ISO 11171 specification
 - SAE AS 4059 (formerly NAS 1638 method)
 - ISO 4406 method
- K12 processor tensiometer
- Surface tension, including DuNoüy ring and Wilhelmy plate methods
- Interfacial tension, including DuNoüy ring and drop volume methods
- Contact angle
- Surface free energy
- Adsorption
- Critical micelle concentration



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Standardized laboratory tests, such as the Wilhelmy plate (left) and the DuNoüy ring (right) methods, establish the surface and interfacial tension of fluids such as fuels, lubricants, hydraulic fluids, and surfactant-containing fluids.

Performance and Durability Assessment

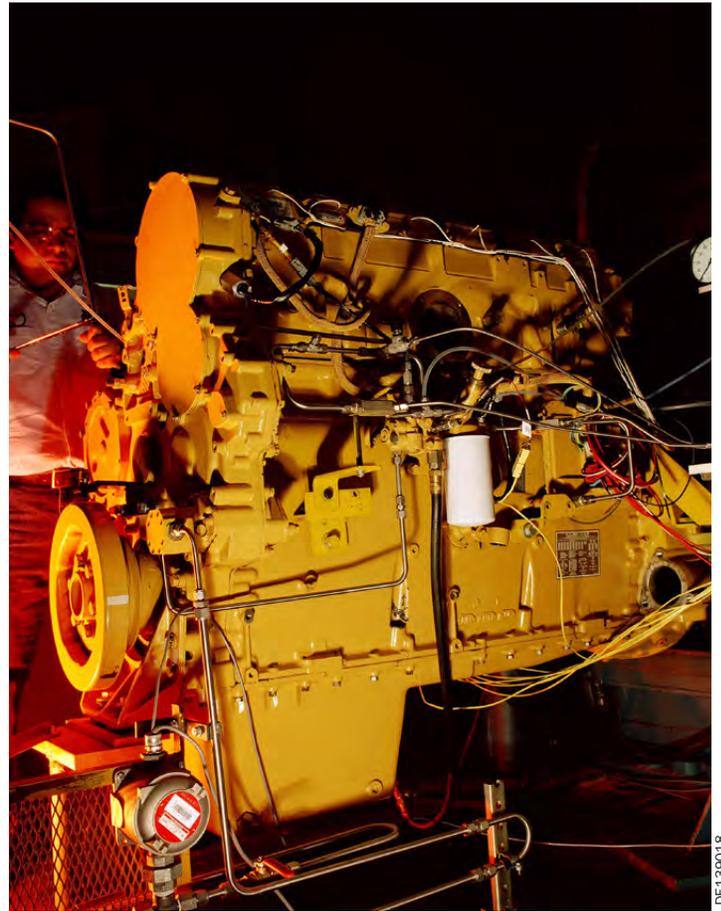
- Shock
- Vibration
- Temperature
- Fluid compatibility
- Macroscopic and microscopic examinations
- Chemical analysis
- Corrosion product determination
- Nondestructive evaluations

Filtration Test Method Development

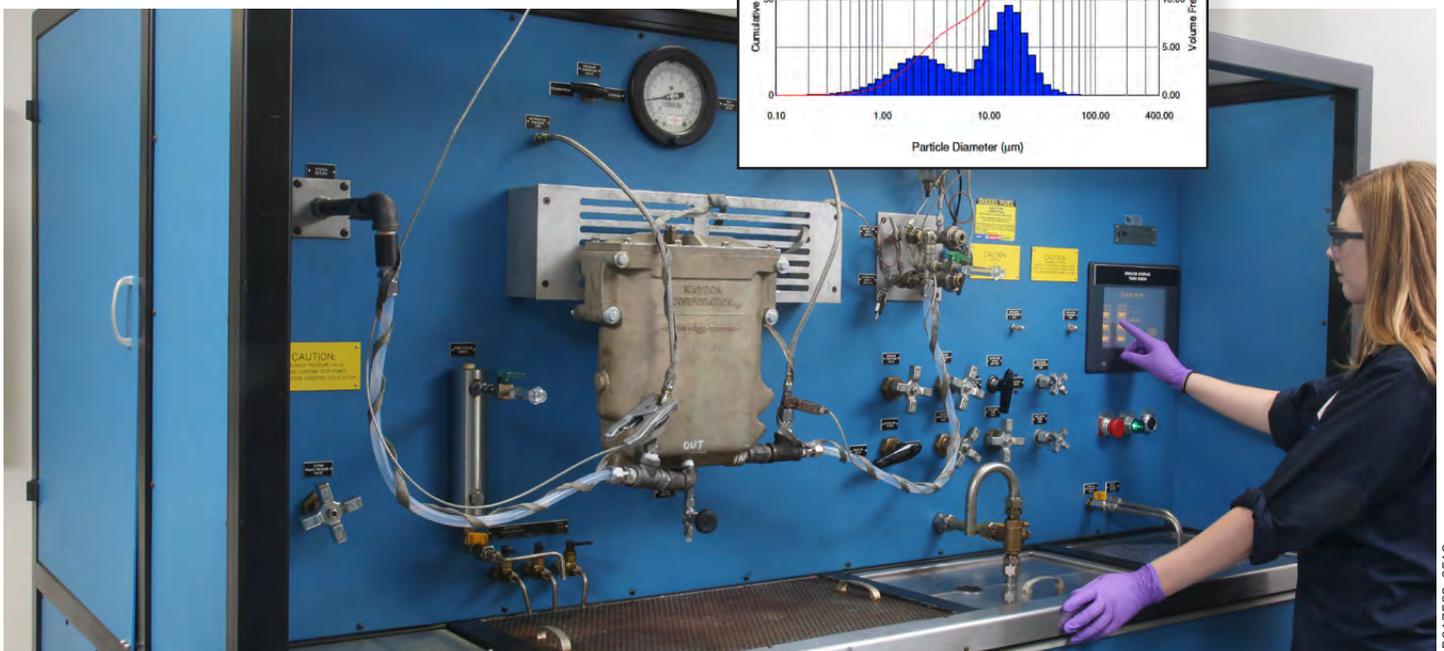
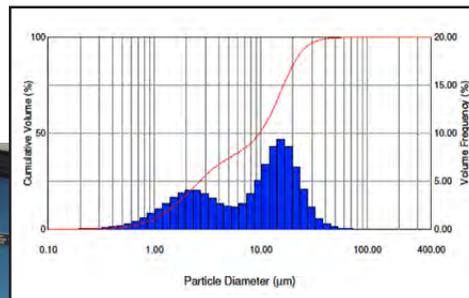
- Developing improved test methods that better simulate the fuel and lubricant filter environment
- Incorporating real-world operating parameters into test methods
- Improving repeatability and reproducibility in the laboratory
- Developing several novel filtration-related test methods and analysis techniques
 - SwRI Wear Index fuel filter and rating method
 - ISO test for lubricating-oil soot removal devices

Field Analysis and Contamination Assessment

- Scanning electron microscope
- X-ray fluorescence
- Fourier transform infrared analysis
- Microbiological analysis
- Optical microscopy
- Lubricity analysis
- Inductively coupled plasma



In an Institute-developed wear index test, engineers evaluate the ability of a filter to remove engine component wear debris under real-world conditions.



SwRI conducts standardized SAE water separation tests to determine the effects of alternative fuels on water separation performance. Water droplet size distribution is detailed in the inset graphic.

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Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies more than 1,200 acres and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for nearly 3,000 employees who perform contract work for industry and government clients.

We welcome your inquiries. For more information, please contact:



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industry and the public
through innovative science
and technology***

Scott Hutzler, Director
Fuels and Lubricants Technology Department
Fuels and Lubricants Research Division
210.522.6978 • Fax 210.522.5720
scott.hutzler@swri.org

Southwest Research Institute
6220 Culebra Road
San Antonio, Texas 78238-5166

swri.org



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