MLC

MANNHEIM LABORATORY CENTER

MATERIAL TESTING LABORATORY

ARMY OIL ANALYSIS PROGRAM LABORATORY

TÜV CERT

CERTIFICATE

The TÜV CERT Certification Body of TÜV Hessen

hereby certifies in accordance with TÜV CERT-procedures that

Mannheim Laboratory Center
D-68307 Mannheim

has established and applies a quality management system for

Physical and Chemical Laboratory Analyses (Oil Analysis and Material Testing)

An audit was performed, Report No. **4098 7137**
Proof has been furnished that the requirements according to

DIN EN ISO 9001 : 2000

are fulfilled. The certificate is valid until **15. May 2006**

Certificate Registration No. **73 100 1144**

Deutscher Akkreditierungs Rat
DAR
TGA-ZM-20-96-00

TÜV HESSEN

Validity verifiable
www.tuevclub.com
Cert-GB-01/2001

Darmstadt, 16th May 2003

TÜV CERT-Certification Body
of TÜV Hessen

Mannheim Laboratory Center

Mission Statement

Provide the Army Oil Analysis Program (AOAP) and Material Testing Support for the EUCOM Area of Operation

Our Vision

Demonstrate Mannheim Laboratory Center as the Global Leader, Trainer, and Enabler, representing commitment to NATO and to the European Nations in Material Testing and AOAP support.

History of the Mannheim Laboratory Center

The Mannheim Laboratory Center dates back to 1946, when maintenance personnel of the 60th Ordnance Group provided engineer equipment repair and overhaul support for Willys-Overland MB and Ford GPW. A few years later the Ordnance Procurement Center was established, with approximately 300 local national employees employed in different branches.

In 1967, the first Oil Analysis Laboratory was established at Coleman Barracks, Mannheim. Ten Years later, in 1977, the Material Testing Laboratory and the Oil Analysis Laboratory were combined and renamed to USAREUR Materiel & Equipment Oil Analysis Laboratory (UMEOAL). This name was retained until 1998.

At the beginning, UMEOAL was under Germersheim Army Depot command and control. Later it was under the 1st Support Command. This organization was realigned to 21 TAACOM and 29th ASG. UMEOAL became part of the 29th ASG Logistics Branch and later became part of the Directorate for Materiel. In 1998, as a result of the establishment of the General Support Center - Europe, UMEOAL became part of this new organization and was renamed Mannheim Laboratory Center (MLC).

Army Oil Analysis Program

The AOAP is part of a DoD-wide effort to determine impending component failures and determine lubricant condition through periodic laboratory evaluation of used oil samples. Early detection of problems allows maintenance to be performed before more severe damage to the components occurs. In other words, AOAP helps prevent catastrophic failures before they have a chance to happen.

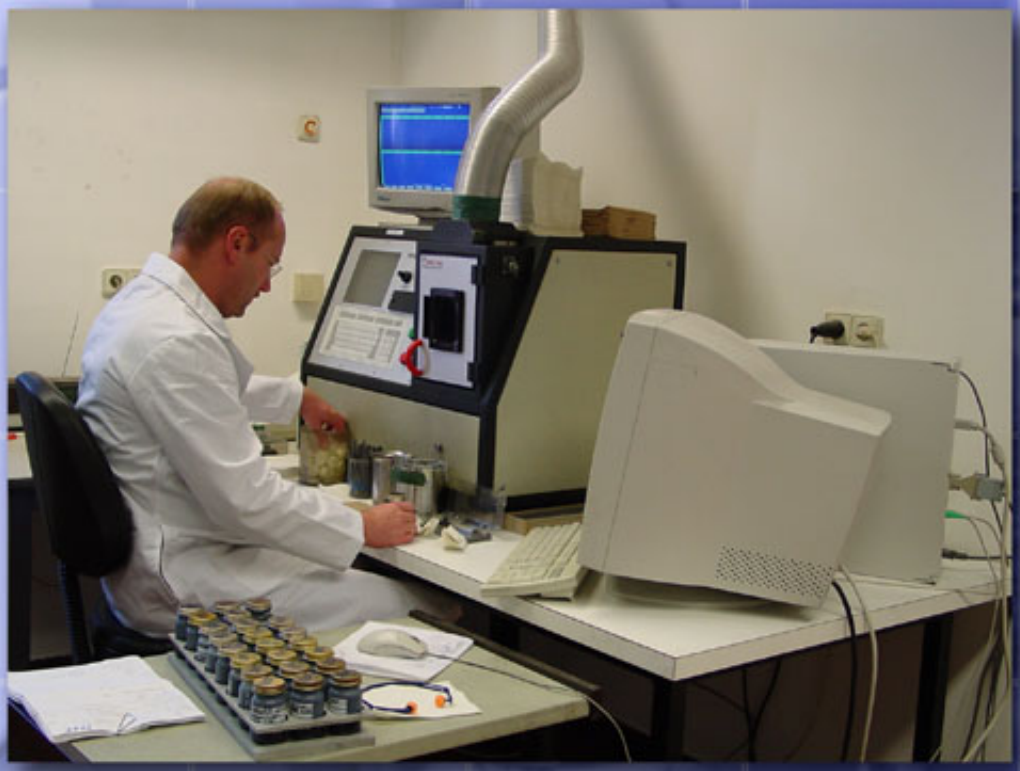
AOAP is a member of the Joint Oil Analysis Program. All services, Army, Navy, Air Force, Marines, Corps of Engineers, and Coast Guard are participating members of the DoD Program.

Material Testing Laboratory

We are the Army's only laboratory in Europe performing material testing. We test all Army material with the exception of medical items and food. The goal of material testing is to ensure serviceability and usability of supplies, avoidance of procurement cost, enhancing readiness and protecting the environment.

OUR SERVICES

ARMY OIL ANALYSIS PROGRAM



What AOAP Can Do For You

AOAP provides detailed analysis of engine, transmission and hydraulic oils, enabling you to identify potential problems before a major repair is necessary.

An oil analysis tells you a lot about how the equipment was used and what condition it's in. Oil that has been inside any moving mechanical apparatus for some time reflects the exact condition of that assembly. As moving parts make contact, wear occurs and introduces minute metal particles to the oil. These particles are so small that they remain in suspension. Many products of the combustion process also become trapped in the circulating oil. In addition, the oil may be exposed to external contamination. Thus, the oil becomes a working history of the machine. An oil analysis also suggests methods to reduce accelerated wear and contamination.

MLC's analytical processes provide customers with early detection of contaminants present in the oil, as well if you are using the appropriate lubricants. MLC is equipped with instruments to detect fuel dilution of lubrication oil, dirt contamination in the oil, antifreeze in the oil, and excessive internal component wear.

By pinpointing problems early, oil analysis ENHANCES flight safety, IMPROVES equipment readiness, EXTENDS component life, REDUCES operating cost and maintenance downtime.

Another important purpose of AOAP is to conserve petroleum resources by extending oil life. This is done by on-condition oil changes. This means oil is changed only when directed by the lab, rather than according to lube orders.

The AOAP database contains the following information: UIC, End Item Model, End Item Serial Number, Model Number, Component Serial Number, and Usage Information. This information can be used to track trends in internal component wear, location, owning unit, owning unit POC, and other information, which can aid Commanders and Senior Maintenance Leaders with maintenance availability.

ANALYTICAL TEST

AOAP Laboratory Test

Crackle Test:
Determines the presence of free water when one or two drops of oil are placed onto a laboratory hot plate heated to150 to 175 degrees Celsius. Results: A positive test for coolant or water is indicted by splattering and an audible cracking of the oil. A positive indication of fuel contamination is an audible sizzling sound of the oil.

Fourier Transform Infrared Spectrometry (FTIR):
The FTIR Spectrometry Oil Analyzer replaces 15 year old Army physical property analytical laboratory instruments and tests such as, Crackle Test (water/fuel presence); Viscosity (nametre viscometer for presence of fuel and antifreeze); and Millipore Blotter Test (antifreeze and soot). It determines quantitatively the presence of water, soot, fuel, coolant, oxidation, nitration, and sulfate products formed during system operations as well as the oil additives depletion levels in synthetic and mineral lubricants servicing aeronautical and nonaeronautical components.

The trend analysis information provided by FTIR spectroscopy:

Oxidation - Organic compounds subjected to high temperatures.

Nitration - Nitro compounds due to incorrect combustion or carburetor/ injection pumps.

Soot - too rich fuel/air mixtures forming buildup which changes viscosity, and prematurely clogs component system filters.

Sulfate/sulfonate levels - internal engine by-products of diesel fuel blow-by from bad piston rings, faulty injector pump/seals, etc.

Water and acidity contamination - typically found in the presence of glycol contamination due to faulty head gaskets, water pump/seals, etc.

Fuel contamination - blow-by of the gases from piston rings or leaky fuel pump which dilute the servicing oil system.

Glycol (or other coolant) contamination - faulty water pump or leaky head gasket seals.

Base oil detergents additives - prevents welding of moving metal surfaces which results in coking effect resulting from depletion of oil inhibitors. Most common additive is zinc dialkyl phosphate (ZDP).

The Fuel Sniffer

The Fuel Sniffer employs a Surface Acoustic Wave Vapor Micro sensor to measure the concentration of fuel in used lubricating oil samples

Fourier Transform Infrared Spectrometer

The FTIR Oil Analyzer determines quantitatively the presence of water, soot, fuel, coolant, oxidation, nitration, and sulfate products formed during normal system operations as well as the oil additives depletion levels in synthetic and mineral lubricants servicing aeronautical and nonaeronautical components.

ANALYTICAL TEST

Atomic Emission Spectrometer

The Spectroil M/N measures trace quantities of elements dissolved or suspended as fine particles in natural or synthetic petroleum based products. Spectrometric oil analysis is applicable to any closed loop lubricating system, such as those found in diesel engines, diesel turbines, transmissions, gear boxes, compressors and hydraulic systems.

Analytic Ferrorgraphy

Ferrographic Analysis determines the size, shape, and type of wear-metal particles being generated by a piece of equipment and the mode of wear (e.g., spalling, rubbing, and cutting) which produces the particles. Procedure: Particles are deposited on a substrate by a magnetic gradient and analyzed with a bichromatic microscope.

Viscometer:

Tests viscosity of used lubricating oils and identifies fuel and coolant dilution problems. Lubrication fluids are affected by high temperatures and aeration during service which promotes oxidation. This oxidation, if allowed to continue indefinitely, leads to increased viscosity, varnish, and sludge.

Blotter Spot Test:

Determines insoluble contaminates and dispersive ability.
Procedure: After vigorous shaking, one drop of used oil is placed in the center of an oil filter circle and allowed to disperse for 15 minutes.

Results: The spot is evaluated for total contaminants and lubricant dispersive effectiveness.

Spectrometric Oil Analysis:

Determines the type and amount of wear metals in lubricating fluid samples. Abnormal concentrations may indicate damage wear of the equipment.

Results: Once abnormal wear is verified, the equipment may be repaired avoiding a major failure of a fluid wetted component, increased maintenance man-hours and high dollar equipment costs.

Ferrographic Analysis:

Determines the size, shape, and type of wear-metal particles being generated by a piece of equipment and the mode of wear (e.g., spalling, rubbing, and cutting) which produces the particles.

Procedure: Particles are deposited on a substrate by a magnetic gradient and analyzed with a bichromatic microscope.

This is an example of what the repairman may find when the laboratory technician alerts him to high metal wear.

Early detection and repair of this problem will result in just a gear replacement, instead of an engine failure with major damage.

This is another example of early degradation of a bearing race. Left alone, the bearing or race would eventually fail and require major repairs.

The tremendous forces at work inside of tanks and trucks will produce damage, as you see here. The rate of damage may occur at a higher rate than can be detected at normal maintenance schedules.

These are the results of a teardown and investigation of an CH-47 part identified by oil analysis as having high metal wear.

Ferrograph Findings

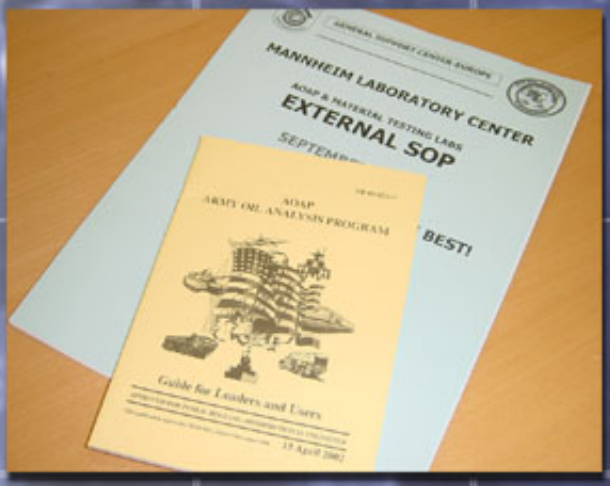
Red-oxides Particles Aligned in a Magnetic Field

Water in the Oil or Poor Lubricant Condition

Small Spheres Less Than 5 Microns in Diameter

This is an Early Warning of Rolling Bearing Failure

TRAINING PROGRAM



Certification Training Program

The Director of the Mannheim Laboratory Center (MLC) is tasked to develop and conduct AOAP training for the benefit of the USAREUR AOAP customer units.

AOAP Monitor Certification training courses have been tailored for all levels of command. Formal and informal classes are instructed throughout the year. The formal training program has been expanded to bring our "War-fighter" customer more scheduled courses.

Which "AOAP" Course is Right for You???

MLC offers two different formal courses. The AOAP Monitors must complete the course commensurate with their appointed AOAP duties. Contact your servicing laboratory to schedule personnel for AOAP Monitor Certification Training.

- Battalion and Unit-level AOAP Monitor Certification - 2 day training
- Aeronautical AOAP Monitor Certification - 4 hour training

Training Schedule

Training schedules are posted on the Mannheim Laboratory Center Web Site or email aoap.mannheim@mlc.21tsc.army. mil for information.

TRAINING PROGRAM

AOAP CUSTOMER SUPPORT

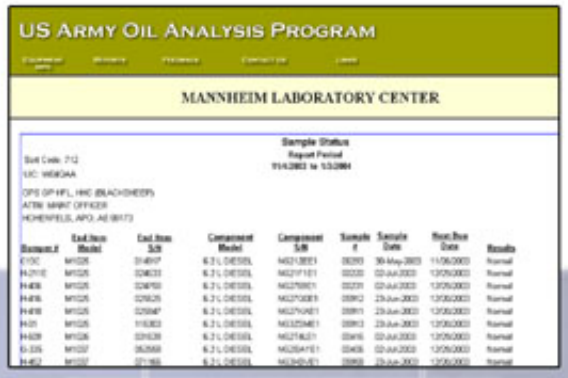
AOAP Customer Support Website

Mannheim Laboratory is striving to improve customer service and to assist in achieving our goal we now offer our AOAP customers a web site for customer support. This web site features real-time access to AOAP reports, component tracking, DA 3254-R Feedbacks and the ability to make changes to component data.

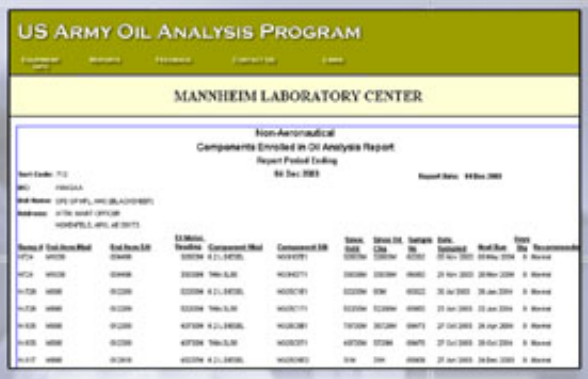
Two reports incorporated into this web site are the "Components Enrolled Report" and the "Sample Status Report". The "Components Enrolled Report" is the same report that the unit receives every month from our laboratory. The "Sample Status Report" shows component information for a two-month period, which also includes components that are delinquent. Units can track the status of a recently submitted sample by utilizing this report and it also includes which analytical tests are in process, when the sample was taken and the sample results.

This web site also includes a component search feature. Our customers can search for information by component model number, end item serial number, component serial number and end item number. Customers can also submit data changes by utilizing the "change" option on a component (Requested changes require documentation before changes are accepted). Customers can also review and close out all open DA 3254-R Feedbacks for their unit and review the component's history with this program.

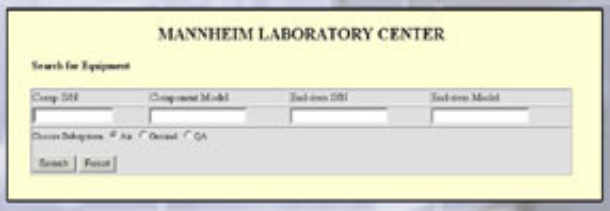
Mannheim Laboratory Center is striving to meet the needs of our customers and will continue to improve our AOAP Customer Support Web Site.



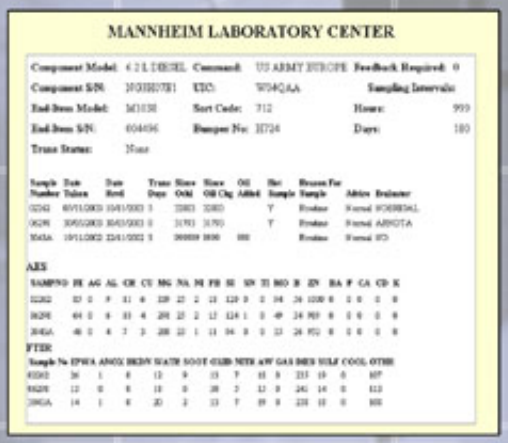
Sample Status Report



Components Enrolled Report



Component Search

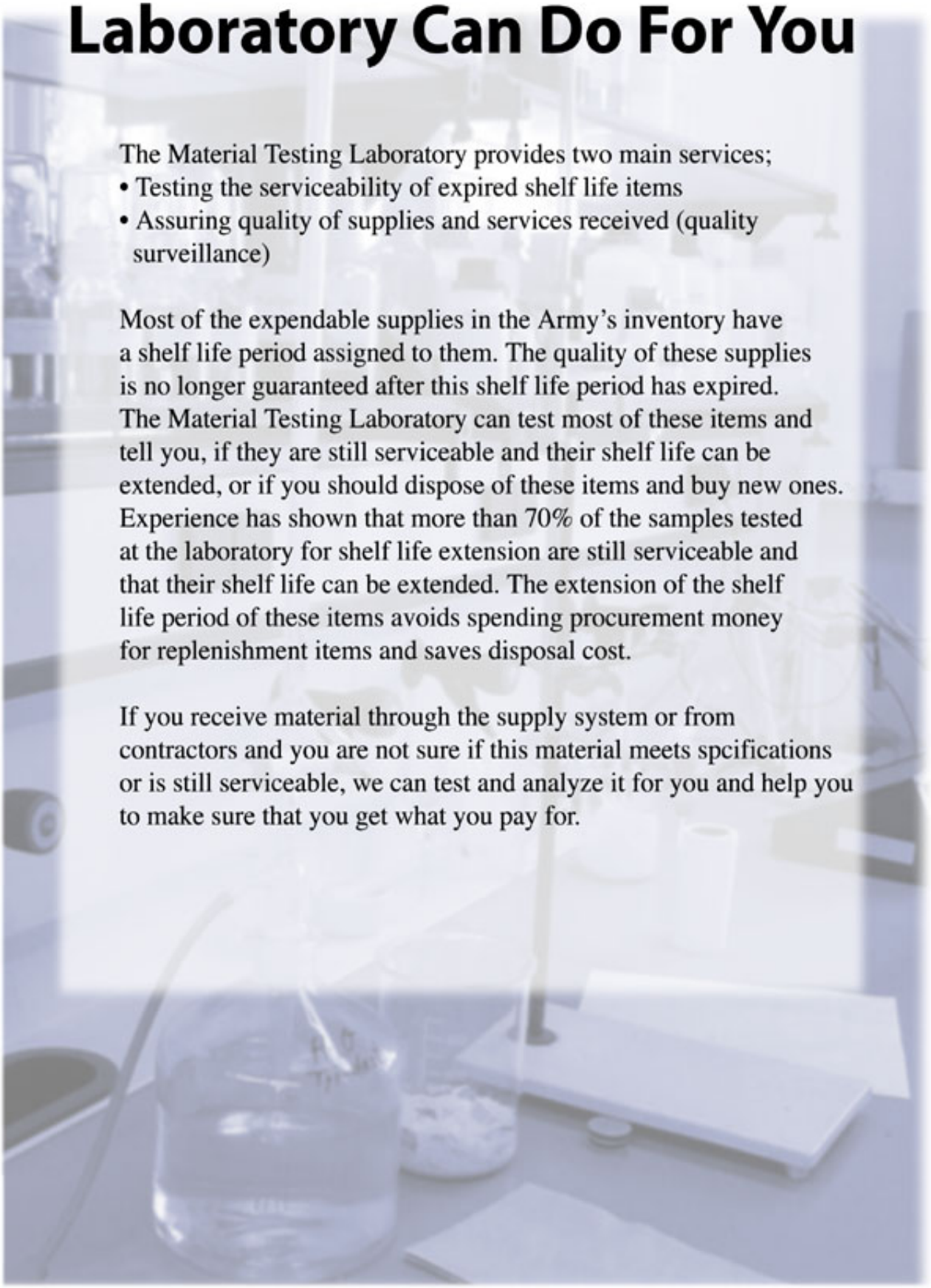


Component History

OUR SERVICES

MATERIAL TESTING LABORATORY

What the Material Testing Laboratory Can Do For You



The Material Testing Laboratory provides two main services;

- Testing the serviceability of expired shelf life items
- Assuring quality of supplies and services received (quality surveillance)

Most of the expendable supplies in the Army's inventory have a shelf life period assigned to them. The quality of these supplies is no longer guaranteed after this shelf life period has expired. The Material Testing Laboratory can test most of these items and tell you, if they are still serviceable and their shelf life can be extended, or if you should dispose of these items and buy new ones. Experience has shown that more than 70% of the samples tested at the laboratory for shelf life extension are still serviceable and that their shelf life can be extended. The extension of the shelf life period of these items avoids spending procurement money for replenishment items and saves disposal cost.

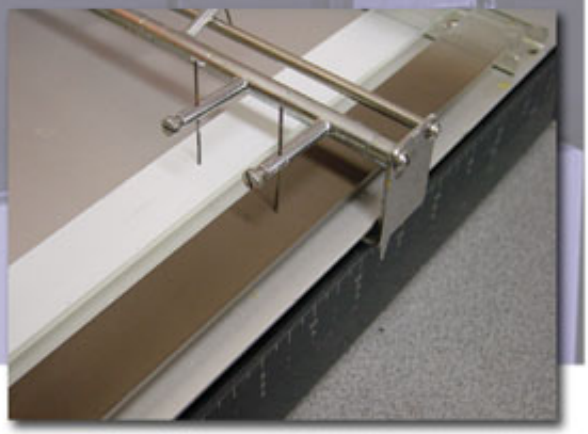
If you receive material through the supply system or from contractors and you are not sure if this material meets spcifications or is still serviceable, we can test and analyze it for you and help you to make sure that you get what you pay for.

ANALYTICAL TEST

Paint

Testing and analysis of paint, enamels, varnishes, corrosion preventive compounds etc. Coatings are applied to a material for mainly two reasons. First, to protect the coated material from the environment, and second, to change the optical properties of the coated material (walls are painted for beautification, markings are applied to danger zones, tactical equipment is painted for camouflage). The requirements for coating materials very often are outlined in Military, Federal and Industrial specifications. At the laboratory we can test paint and other coating material for compliance with these specifications. We can test for application properties and workmanship (e.g. has the material the correct viscosity for application, can it be sprayed or brushed properly, does it dry or cure properly, how good does the paint adhere to the coated base material), for optical properties (does the paint have the right color, how is the light reflectance of the coating material, how good is its hiding power), for its ability to protect the coated material (resistance of the coating to water, fuel and other liquids, protection of the base material from corrosion and weathering), and for chemical composition (which pigment is used in the coating formulation, which solvent, is the material VOC compliant).

Loading the Weather O Meter with samples for accelerated weathering tests



Testing the drying properties of paint with the drying time recorder

POL

Petroleum, Oil, Lubricants

The requirements for POL products like fuel, lubricating oils, hydraulic fluids etc. are given in detailed specifications. The laboratory can test POL products for their conformance with these specifications. We can test for viscosity (shows which oil grade do we have), API and/or specific gravity (gives e.g. indication of the type of fuel under test), particulate contamination (how clean is the material), water content (too much water can lead to corrosion and to performance problems), pour and freezing point (cold weather properties of the POL), copper corrosion (gives indications about the corrosiveness of the POL), dropping point of greases, flashpoint, distillation properties. We can test for contamination or mixing of fuels, for identification of fuels and oils, and determine the gross heat value of liquid (or solid) fuel, etc.

Determination of the viscosity of hydraulic fluid

Determination of the water content of fuel with the Karl Fischer Titrator

Comparing a copper corrosion test sample with the ASTM Standard Strips

ANALYTICAL TEST

ANALYTICAL TEST

Environmental

The laboratory also has the capability to perform analyses in the area of environmental protection. We can analyze samples for contamination with POL, PAH, heavy metals and other organic and inorganic pollutants. We can analyze paint samples and other material for contamination with lead (the permissible lead content of paint is very low), we can analyze soil samples for contamination with POL (e.g. if there is a suspected oil spill), we can analyze water samples for contamination with lead, cadmium, zinc, chromium and other metals (e.g. to assure the proper operation of ion-exchange systems in a plating shop). We can identify unknown material for proper disposal.

Voltametric Analyzer used for the determination of the heavy metal content of aqueous samples

Analyzing the metal content of an aqueous sample with the atomic absorption spectrometer

Analyzing a sample for organic pollutants with a GCMS-System

Determination of the acid content of a sample

Chemical

The Material Testing Laboratory has the capability to test chemicals, cleaning compounds, solvents, disinfectants and comparable material. We can test for purity (e.g. how pure is the alcohol), acid and base numbers (indicates how corrosive the material is), pH-value, specific gravity, concentration of acids and bases (e.g. strength of battery acid), distillation range and distillation residue (indicates the purity of a solvent or liquid chemical), contamination, cleaning properties (how good does a cleaning compound remove dirt), active ingredient content (e.g. chlorine content of disinfectant, shows how effective the material is), sulfur content (the sulfur content of solid and liquid fuel is limited due to environmental concerns and corrosion problems), etc.

Performing peel strength test

Other Test

Adhesives, sealants, and locking and retaining compounds play an ever increasing role in modern manufacturing processes. We can test these materials for viscosity (a too high viscosity shows that the material already has started to cure), for pot life and cure time (these materials must allow to work with for some time, but then they must cure to their final strength), for holding power, for tensile and shear strength, for peel strength (these characteristics tell how good the material is), for electrical characteristics like dielectric breakthrough voltage and insulating properties (important for sealants used in a high voltage environment), for elongation and durometer hardness (hard and brittle sealants crack easily if the material connected or sealed expands and/or contracts during service) etc.

INDUSTRY FACTS

Industry Moving More To Lubricant Condition Monitoring As Part of Proactive Maintenance

THOMPSON-RAMO-WOOLRIDGE (TRW) Automotive Inc. - Contamination is the number one cause of bearing damage that leads to premature removal.

KAWASAKI STEEL - Implemented a contamination control program resulting in a 97% reduction in hydraulic component failures.

BRITISH HYDROMECHANICS RESEARCH ASSOCIATION - Improved oil cleanliness extends actual MTBF (Mean Time Between Failure) 10-50 times depending on cleanliness.

CATERPILAR - Dirt and contamination are by far the number one cause of hydraulic system failures.

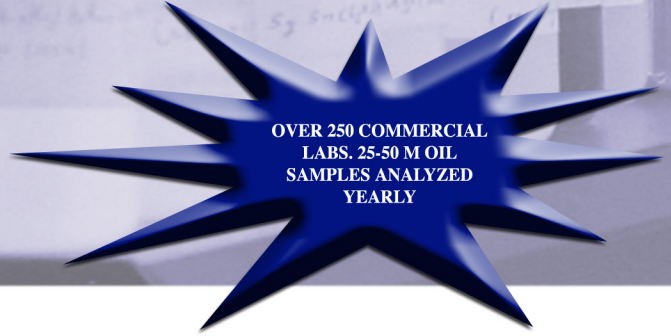
MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT) - 6-7% of the gross national product ($240B) is required just to repair the damage caused by mechanical wear as a result of contamination.

OKLAHOMA STATE UNIVERSITY - When fluid is maintained cleaner, hydraulic pump life can be extended by 50 times.

TRINOVA/AEROEQUIP - Abrasive wear accounts for about 90% of failures due to contamination.

NIPPON STEEL - Hydraulic system contamination control program resulted in 80% reduction of pump replacement frequencies and a 90% reduction in cumulative frequency of all tribological failures (failures related to wear and contamination).

Industry Moving More To Lubricant Condition Monitoring As Part Of Proactive Maintenance



Benefits of Using Oil Analysis

Intangible and Intuitive Benefits

-Reduced Hazardous Waste Disposal Cost
-Reduced Pipeline and Storage Cost
-Increased Life Expectancy of Components
-Early Detection of Impending Failures
-Protects the environment

On Condition Oil Change (OCOC) Program

OCOC eliminates the wasteful requirement of changing component oil based on hours, miles or calendar days as currently specified by many TMs and LOs.

USAREUR FY02 OCOC Cost Avoidance was $10,576,819
USAREUR FY03 OCOC Cost Avoidance was $7,279,722

Other Quantified Cost Avoidance - Based on Detection of Impending Failures or Presence of Contaminants in the Oil

DA FORM 3254-R Issued to Document a Problem to a Unit Which Has Cost Relevance

FY99-01 Quantified Cost Avoidance Was $7,412,557

FY03-12 Escalated Ten-year Cost Avoidance $42,189,010

Benefits of Using Material Testing

-Ensures serviceability quality of supplies
-Saves procurement cost
-Saves disposal cost
-Protects the environment
-Ensures materiel meets specifications

RESOURCES

Policy Directives

DoD: AR 700-132
Joint Oil Analysis Program (JOAP)
4140.27-M
Shelf-Life Management Manual

DA: AR 750-1
Army Material Maintenance Policy & Retail Maintenance Operations

DA: AR 700-139
Army Warranty Program Concepts and Policies

USAREUR: AE Supplement 1 to AR 750-1
Maintenance of Supplies and Equipment – Army Materiel Maintenance Policy

Program Procedural Directives

AE Regulation 710-2
Supply Policy Below the Wholesale Level

DA PAM 738-750
Functional Users Manual for the Army Maintenance Management Systems (TAMMS)
Specific Reference: Chapter 4 (Non-Aero AOAP)

DA PAM 738-751
Functional Users Manual for the Army Maintenance Management Systems--
Aviation (TAMMS)

DA PAM 750-1
Leader's Unit Maintenance Handbook

DA PAM 750-35
Guide for Motor Pool Operations

TB 43-0211
AOAP Guide for Leaders and Users

TB 43-0106
Aeronautical Equipment Army Oil Analysis Program (AOAP)

TB 43-0239
Maintenance in the Desert

Mannheim Laboratory Center-External SOP

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Operating Hours

Monday - Friday
0730 - 1600
Closed American and German
Holidays

Contact Information

Mannheim Laboratory Center
DSN 382 - 5208/5131
Commercial 0049-621-779-5208/5131
FAX: 382-4302
aoap.mannheim@mlc.21tsc.army.mil

Bamberg AOAP Laboratory
DSN 469-8424/8427
Commercial 0049-951-300-8424/8427
Fax: 469-8497
aoap.bamberg@mlc.21tsc.army.mil

Material Testing Laboratory
DSN: 382-4115
Commercial: 0049-621-779-4115
FAX: 382-5293
matlab@mlc.21tsc.army.mil

Website
www.21tsc.army.mil/gsce/mlc_default.asp

Emergency Number

AIC Office
DSN: 382-4315
Commercial: 0049-621-779-4315

Service is the lifeblood of any organization. Everything flows from it and is nourished by it. MLC knows customer service is not a department... "It's an attitude".

YOUR GOAL IS OUR GOAL!
MANNHEIM LABORATORY CENTER
MLC
ISO 9001:2000 CERTIFIED

May 2004