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Confidence in knowing

# Sustainable Garage Solutions with MicroLab®

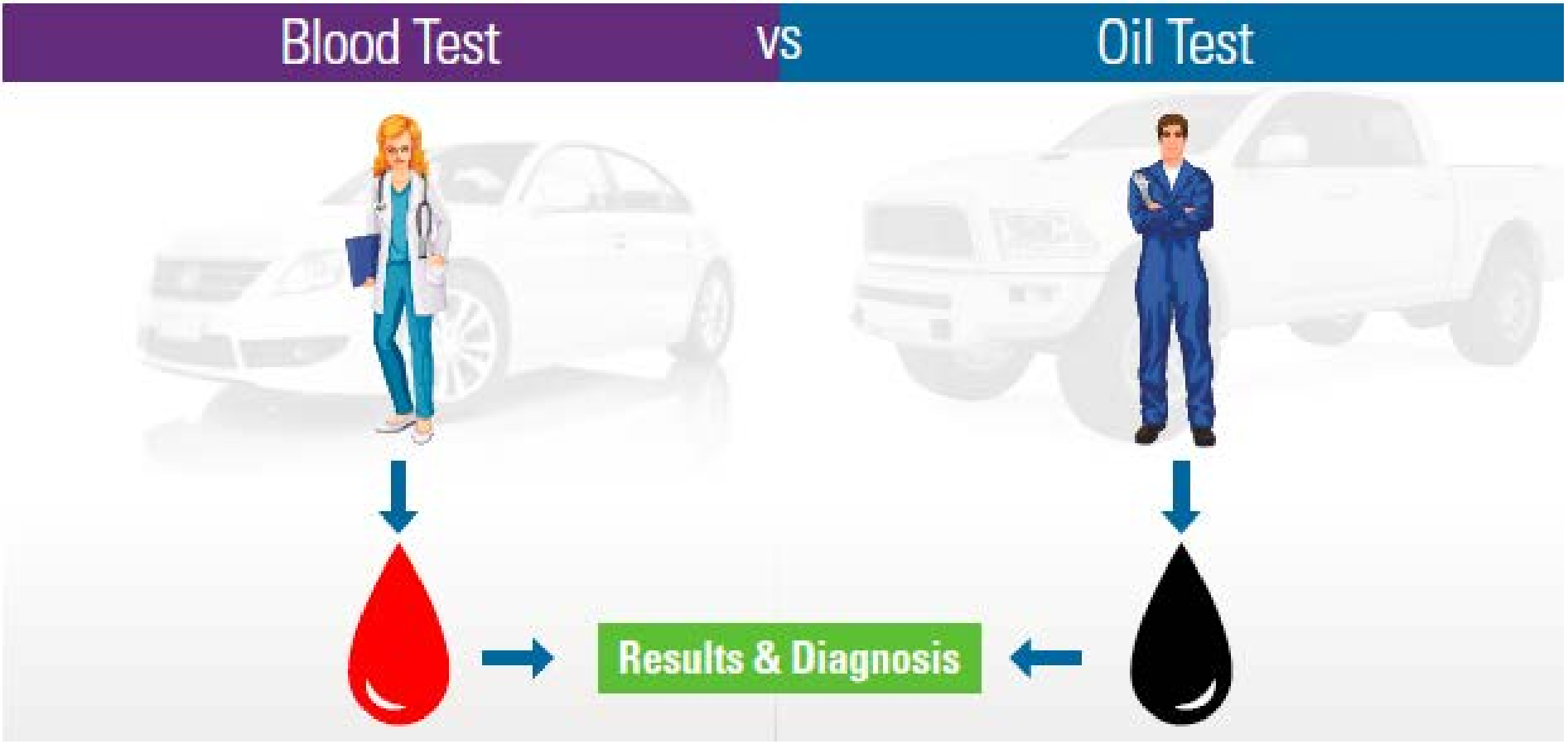
## On-site Oil Analysis


**Janet Keefe**
**Global Product Manager**
**Spectro Scientific**

*“Why would you drain perfectly good oil?”*

*Gary Lentsch, CAFM, Fleet Manager,*
*Eugene Water & Electric Board*

# Oil Analysis – The Blood Test for Vehicles




Your doctor uses a blood test to evaluate your health and diagnose the condition of your internal organs to prescribe proper treatment

Your mechanic uses an oil test to evaluate the health of the oil and diagnose the condition of internal components to determine proper maintenance actions

# Achieving Sustainability Goals with On-site Oil Analysis

**Reduce disposal** of waste oil

**Reduce consumption** of new oil

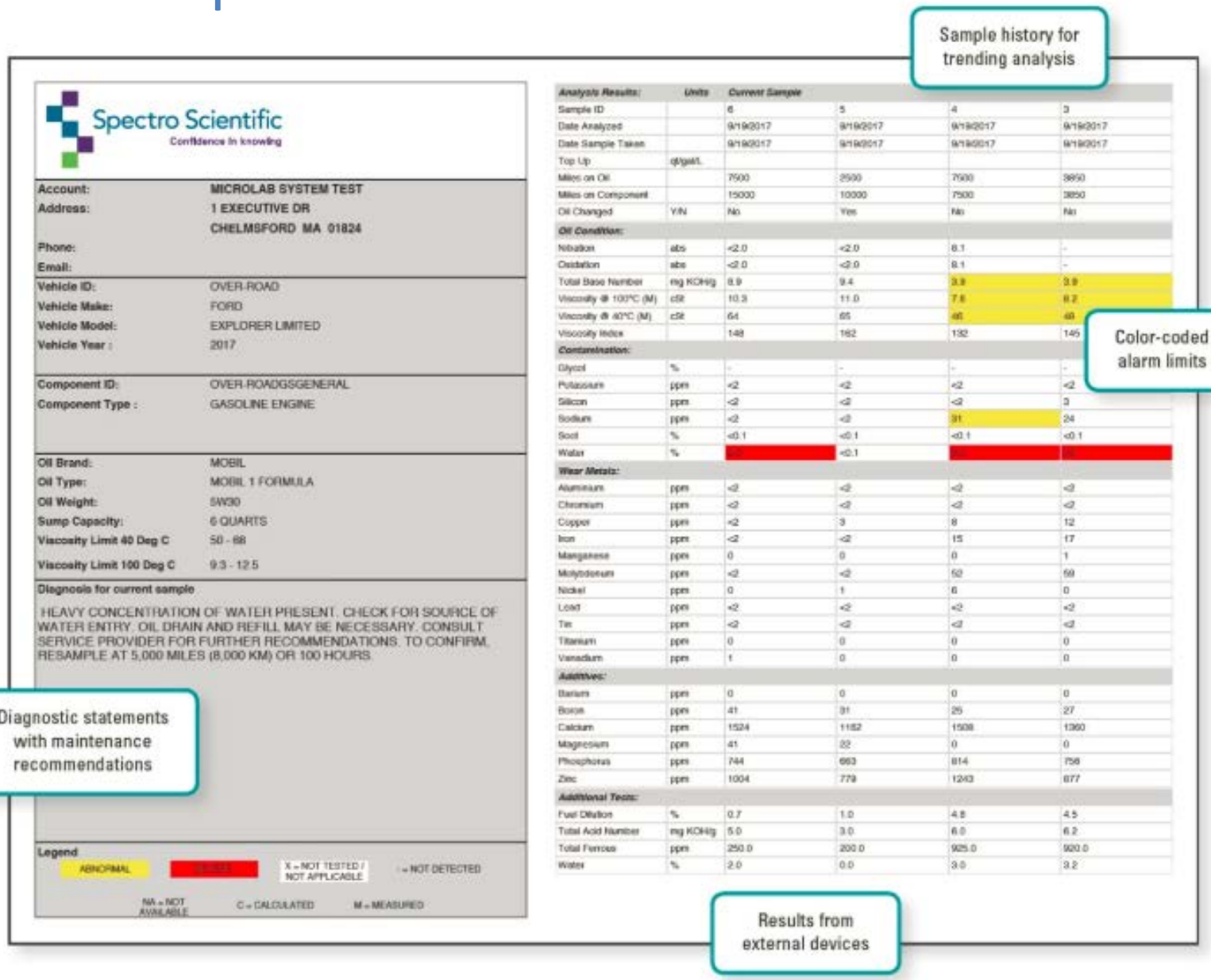
# Conditioned based maintenance


- Replace something only when condition indicates need
- Condition based maintenance practices are used for vehicle parts – Gauges used for evaluating tire and brake pad condition
- Oil analysis is the gauge for oil condition

# Key parameters for conditioned-based oil drains

- **Additives**
  - TBN decreases as stabilizer additives deplete and cause acidic buildup in oil
  - Ca, Zn and P will deplete over time
- **Oil condition**
  - Oxidation & Nitration increase as oil breaks down
- **Viscosity**
  - Increases as oil becomes over-extended with varnish & sludge buildup
  - Decreases with contamination like fuel, coolant and water
- **Contamination & mechanical breakdown**
  - Water
  - Soot
  - Fuel
  - Particulates
  - Glycol
  - Dirt
  - Wear metals

# MicroLab report



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| | |
|---|---|
| Account: | MICROLAB SYSTEM TEST |
| Address: | 1 EXECUTIVE DR |
| | CHELMSFORD MA 01824 |
| Phone: | |
| Email: | |
| Vehicle ID: | OVER-ROAD |
| Vehicle Make: | FORD |
| Vehicle Model: | EXPLORER LIMITED |
| Vehicle Year : | 2017 |
| Component ID: | OVER-ROADGSGENERAL |
| Component Type : | GASOLINE ENGINE |
| Oil Brand: | MOBIL |
| Oil Type: | MOBIL 1 FORMULA |
| Oil Weight: | 5W30 |
| Sump Capacity: | 6 QUARTS |
| Viscosity Limit 40 Deg C | 50 - 68 |
| Viscosity Limit 100 Deg C | 9.3 - 12.5 |

Diagnosis for current sample

HEAVY CONCENTRATION OF WATER PRESENT. CHECK FOR SOURCE OF WATER ENTRY. OIL DRAIN AND REFILL MAY BE NECESSARY. CONSULT SERVICE PROVIDER FOR FURTHER RECOMMENDATIONS. TO CONFIRM, RESAMPLE AT 5,000 MILES (8,000 KM) OR 100 HOURS.

Legend

ABNORMAL | X = NOT TESTED / NOT APPLICABLE | - = NOT DETECTED

NA = NOT AVAILABLE | C = CALCULATED | M = MEASURED

| Analysis Results: | Units | Current Sample | | | |
|---|---|---|---|---|---|
| Sample ID | | 6 | 5 | 4 | 3 |
| Date Analyzed | | 9/19/2017 | 9/19/2017 | 9/19/2017 | 9/19/2017 |
| Date Sample Taken | | 9/19/2017 | 9/19/2017 | 9/19/2017 | 9/19/2017 |
| Top Up | qt/gal/L | | | | |
| Miles on Oil | | 7500 | 2500 | 7500 | 3850 |
| Miles on Component | | 15000 | 10000 | 7500 | 3850 |
| Oil Changed | Y/N | No | Yes | No | No |
| **Oil Condition:** | | | | | |
| Nitration | abs | <2.0 | <2.0 | 6.1 | - |
| Oxidation | abs | <2.0 | <2.0 | 8.1 | - |
| Total Base Number | mg KOH/g | 8.9 | 9.4 | 3.9 | 3.9 |
| Viscosity @ 100°C (M) | cSt | 10.3 | 11.0 | 7.6 | 8.2 |
| Viscosity @ 40°C (M) | cSt | 64 | 65 | 46 | 48 |
| Viscosity Index | | 148 | 162 | 132 | 145 |
| **Contamination:** | | | | | |
| Glycol | % | - | - | - | - |
| Potassium | ppm | <2 | <2 | <2 | <2 |
| Silicon | ppm | <2 | <2 | <2 | 3 |
| Sodium | ppm | <2 | <2 | 31 | 24 |
| Soot | % | <0.1 | <0.1 | <0.1 | <0.1 |
| Water | % | [redacted] | <0.1 | [redacted] | [redacted] |
| **Wear Metals:** | | | | | |
| Aluminium | ppm | <2 | <2 | <2 | <2 |
| Chromium | ppm | <2 | <2 | <2 | <2 |
| Copper | ppm | <2 | 3 | 8 | 12 |
| Iron | ppm | <2 | <2 | 15 | 17 |
| Manganese | ppm | 0 | 0 | 0 | 1 |
| Molybdenum | ppm | <2 | <2 | 52 | 59 |
| Nickel | ppm | 0 | 1 | 6 | 0 |
| Lead | ppm | <2 | <2 | <2 | <2 |
| Tin | ppm | <2 | <2 | <2 | <2 |
| Titanium | ppm | 0 | 0 | 0 | 0 |
| Vanadium | ppm | 1 | 0 | 0 | 0 |
| **Additives:** | | | | | |
| Barium | ppm | 0 | 0 | 0 | 0 |
| Boron | ppm | 41 | 31 | 25 | 27 |
| Calcium | ppm | 1524 | 1152 | 1508 | 1360 |
| Magnesium | ppm | 41 | 22 | 0 | 0 |
| Phosphorus | ppm | 744 | 663 | 814 | 758 |
| Zinc | ppm | 1004 | 779 | 1243 | 877 |
| **Additional Tests:** | | | | | |
| Fuel Dilution | % | 0.7 | 1.0 | 4.8 | 4.5 |
| Total Acid Number | mg KOH/g | 5.0 | 3.0 | 6.0 | 6.2 |
| Total Ferrous | ppm | 250.0 | 200.0 | 925.0 | 920.0 |
| Water | % | 2.0 | 0.0 | 3.0 | 3.2 |

Sample history for trending analysis

Color-coded alarm limits

Diagnostic statements with maintenance recommendations

Results from external devices

# Traditional oil analysis approach



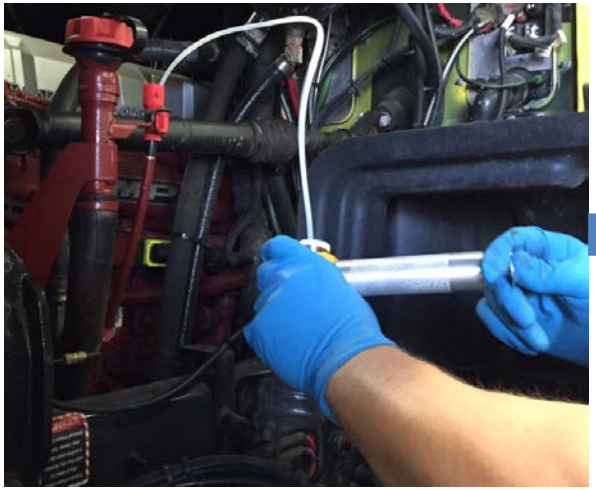






**Cycle time: 3 days to 3 weeks**

# Implementing On-site Oil Analysis

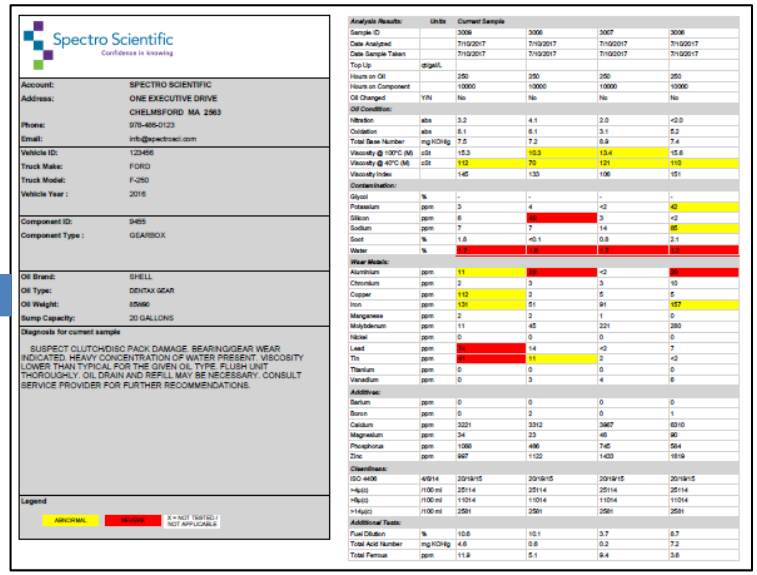


Pull oil sample

*Photo courtesy: City of Tampa*


Enter info into MicroLab & test sample

Conduct necessary maintenance



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| | |
|---|---|
| Account: | SPECTRO SCIENTIFIC |
| Address: | ONE EXECUTIVE DRIVE<br>CHELMSFORD MA 2563 |
| Phone: | 978-486-0123 |
| Email: | info@spectroscl.com |
| Vehicle ID: | 123456 |
| Truck Make: | FORD |
| Truck Model: | F-250 |
| Vehicle Year : | 2016 |
| Component ID: | 9455 |
| Component Type : | GEARBOX |
| Oil Brand: | SHELL |
| Oil Type: | DENTAX GEAR |
| Oil Weight: | 85/90 |
| Sump Capacity: | 20 GALLONS |

Diagnosis for current sample

SUSPECT CLUTCH/DISC PACK DAMAGE. BEARING/GEAR WEAR INDICATED. HEAVY CONCENTRATION OF WATER PRESENT. VISCOSITY LOWER THAN TYPICAL FOR THE GIVEN OIL TYPE. FLUSH UNIT THOROUGHLY. OIL DRAIN AND REFILL MAY BE NECESSARY. CONSULT SERVICE PROVIDER FOR FURTHER RECOMMENDATIONS.

Legend

ABNORMAL | SEVERE | X = NOT TESTED / NOT APPLICABLE

| Analysis Results: | Units | Current Sample | | | |
|---|---|---|---|---|---|
| Sample ID | | 3009 | 3008 | 3007 | 3006 |
| Date Analyzed | | 7/10/2017 | 7/10/2017 | 7/10/2017 | 7/10/2017 |
| Date Sample Taken | | 7/10/2017 | 7/10/2017 | 7/10/2017 | 7/10/2017 |
| Top Up | qt/gal/L | | | | |
| Hours on Oil | | 250 | 250 | 250 | 250 |
| Hours on Component | | 10000 | 10000 | 10000 | 10000 |
| Oil Changed | Y/N | No | No | No | No |
| **Oil Condition:** | | | | | |
| Nitration | abs | 3.2 | 4.1 | 2.0 | <2.0 |
| Oxidation | abs | 6.1 | 6.1 | 5.1 | 5.2 |
| Total Base Number | mg KOH/g | 7.5 | 7.2 | 8.9 | 7.4 |
| Viscosity @ 100°C (M) | cSt | 15.3 | 10.3 | 13.4 | 15.6 |
| Viscosity @ 40°C (M) | cSt | 112 | 70 | 121 | 110 |
| Viscosity Index | | 145 | 133 | 106 | 151 |
| **Contamination:** | | | | | |
| Glycol | % | - | - | - | - |
| Potassium | ppm | 3 | 4 | <2 | 40 |
| Silicon | ppm | 6 | 68 | 3 | <2 |
| Sodium | ppm | 7 | 7 | 14 | 85 |
| Soot | % | 1.8 | <0.1 | 0.8 | 2.1 |
| Water | % | 0.2 | 0.2 | 0.1 | 0.2 |
| **Wear Metals:** | | | | | |
| Aluminium | ppm | 11 | 28 | <2 | 30 |
| Chromium | ppm | 2 | 3 | 3 | 10 |
| Copper | ppm | 112 | 2 | 5 | 5 |
| Iron | ppm | 139 | 51 | 91 | 157 |
| Manganese | ppm | 2 | 2 | 1 | 0 |
| Molybdenum | ppm | 11 | 45 | 221 | 280 |
| Nickel | ppm | 0 | 0 | 0 | 0 |
| Lead | ppm | 24 | 14 | <2 | 7 |
| Tin | ppm | 11 | 11 | 2 | <2 |
| Titanium | ppm | 0 | 0 | 0 | 0 |
| Vanadium | ppm | 0 | 3 | 4 | 6 |
| **Additives:** | | | | | |
| Barium | ppm | 0 | 0 | 0 | 0 |
| Boron | ppm | 0 | 2 | 0 | 1 |
| Calcium | ppm | 3221 | 3312 | 3467 | 6310 |
| Magnesium | ppm | 34 | 23 | 46 | 90 |
| Phosphorus | ppm | 1066 | 486 | 745 | 584 |
| Zinc | ppm | 987 | 1122 | 1433 | 1819 |
| **Cleanliness:** | | | | | |
| ISO 4406 | 4/6/14 | 20/18/15 | 20/18/15 | 20/18/15 | 20/18/15 |
| >4µ(c) | /100 ml | 25114 | 25114 | 25114 | 25114 |
| >6µ(c) | /100 ml | 11014 | 11014 | 11014 | 11014 |
| >14µ(c) | /100 ml | 2581 | 2581 | 2581 | 2581 |
| **Additional Tests:** | | | | | |
| Fuel Dilution | % | 10.6 | 10.1 | 3.7 | 6.7 |
| Total Acid Number | mg KOH/g | 4.6 | 0.8 | 0.2 | 7.2 |
| Total Ferrous | ppm | 11.9 | 5.1 | 9.4 | 3.6 |

Get report with maintenance recommendations

**Cycle time: 10 – 15 minutes**

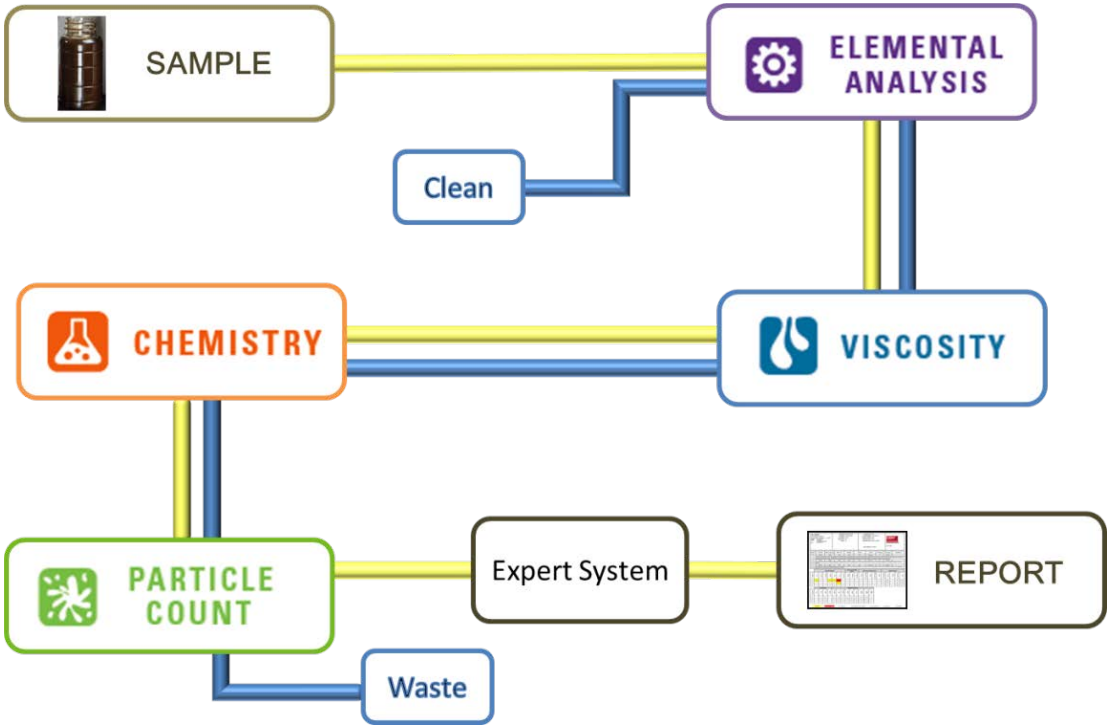
# MicroLab Module Overview

## Automation

Runs up to four independent analysis components seamlessly, with self-cleaning and reporting

## Artificial Intelligence

Translates all test data into maintenance action statements and color coded alarms

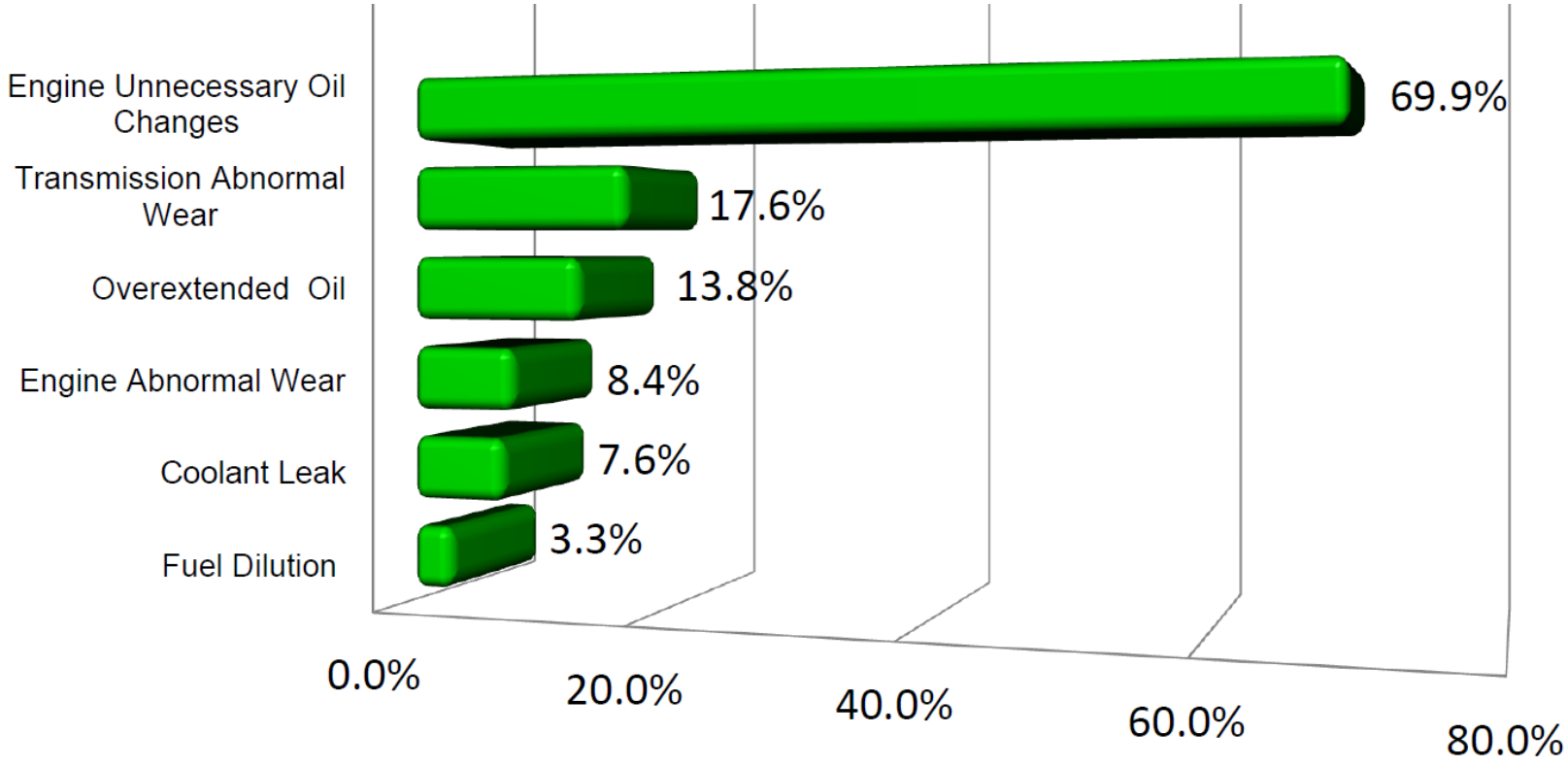




## Patented design

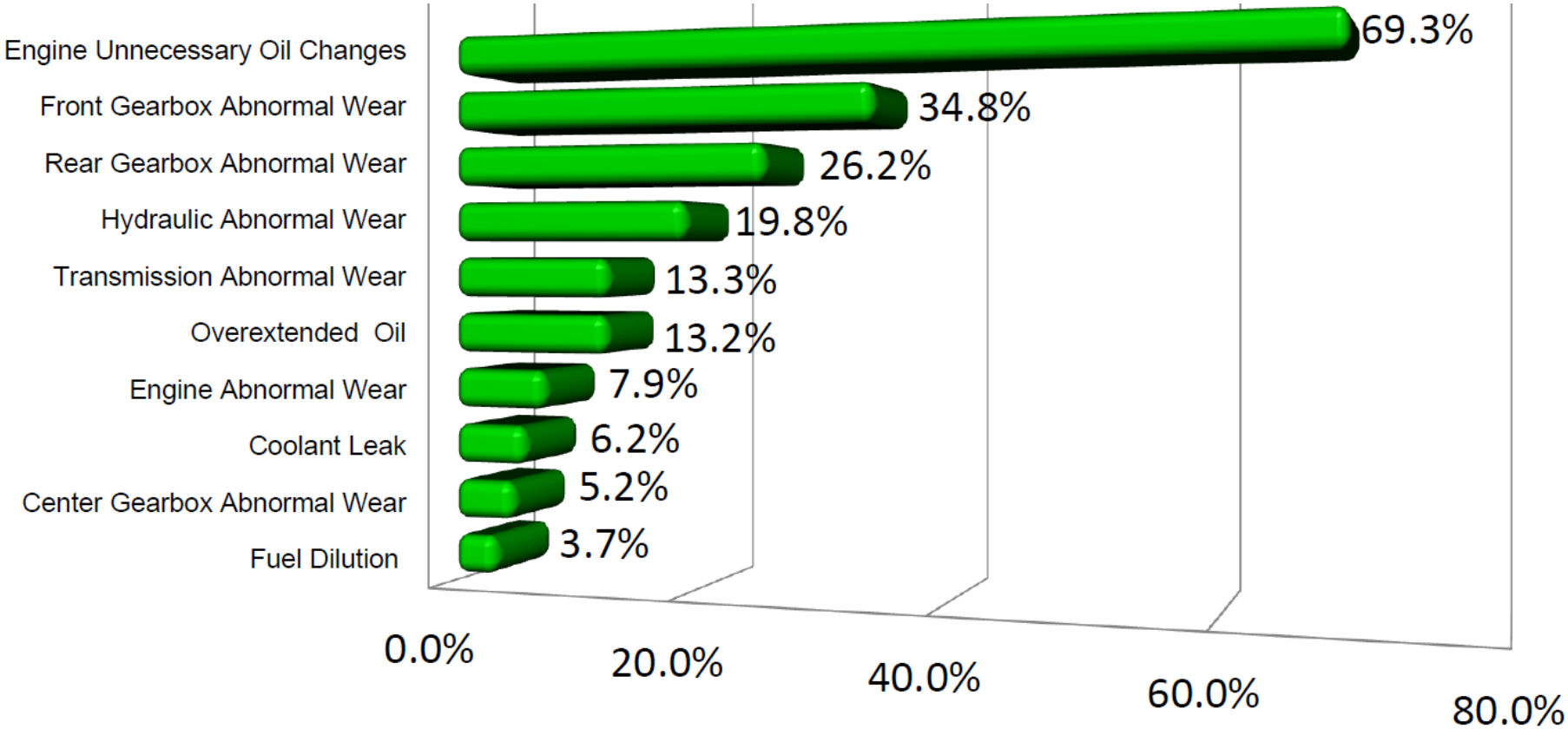
On-site analyzer, Patent No. D358105, 5537336, 5517427, 6452179, 6455850, 7237431

# Municipal Fleet Issues Identified with Oil Analysis




Municipal fleet data during a 12 month period

# Mining Fleet Issues Identified with Oil Analysis



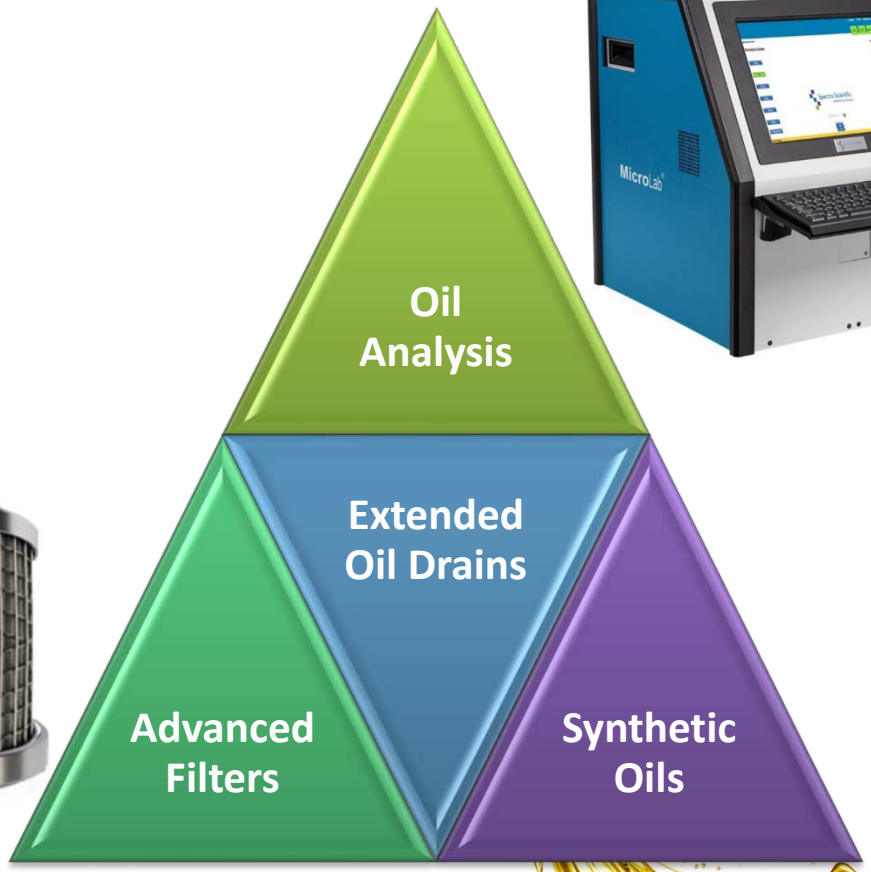

Mining fleet data during a 12 month period

# A Green Technology that Pays for Itself

**Oil drain interval extension is made possible by instant results from on-site oil analysis**

- **Green:** reduces oil use & waste oil disposal
- **Pays for itself:** savings from oil drain extension can pay for analyzer in <2 years
- **Improves asset utilization:** more significant savings from reduction in mechanical failures, increased uptime and extended asset lifetime

# Technologies working together to optimize oil drains


# The value of extended oil drains

**Reduce maintenance costs**

- Do fewer oil changes

**Increase equipment availability**

- Shorter PM service gets equipment back to work faster

**Reduced labor**

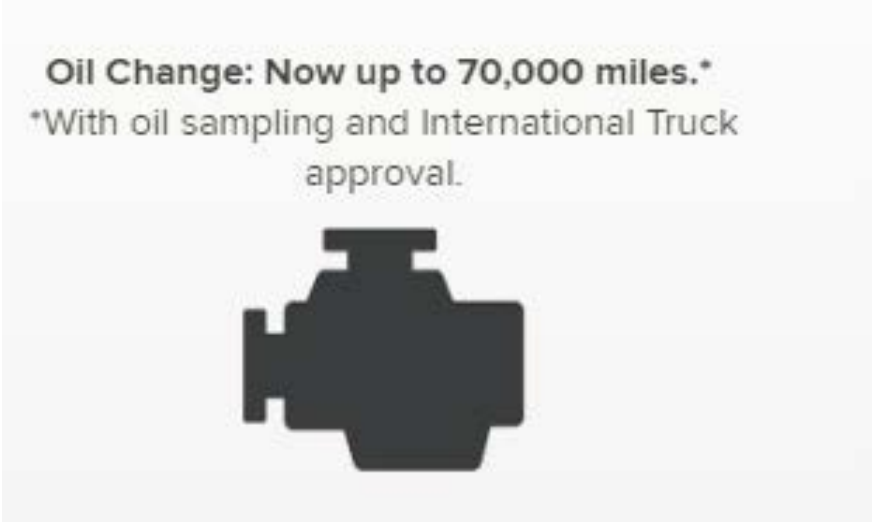
- Save time and costs by doing only the maintenance needed

# OEM offering extended oil drains with oil analysis

INTERNATIONAL

A26

**from International A26 Product Information




- Extended service intervals offered by International was a key buying decision for EWEB who uses a MicroLab 40.
- International approved their on-site oil analysis program for extended service intervals

# Eugene Water & Electric Board

- 260 vehicles including light-duty, heavy-duty and construction equipment
- Estimated $50-200 per engine oil change
- Goal to do condition-based oil change to reduce oil drains
- Reduced frequency of most oil drains by half

**Cost Savings**
$88 ave engine oil
x 391 eliminated oil changes/yr
= **$34,408 per year**

**Oil Reduction**
Average 6 gal/oil change
x 391 eliminated oil changes/yr
= **2,346 gal per year**

# Boston Central Fleet

- 380 heavy duty trucks
- Transition to condition-based oil change to:
  - reduce oil drains
  - improve shop workflow
- Identify problems before they lead to mechanical failure


*Photo courtesy: City of Boston Central Fleet*

**Cost Savings**
$150 oil change costs
x 380 eliminated oil changes/yr
= **$57,000 per year**

**Oil Reduction**
~ 10 gal/oil change
x 380 eliminated oil changes/yr
= **3,800 gal per year**

**Scott Alther | Superintendent, Repair and Maintenance | City of Boston Central Fleet**
….”It has been very beneficial for us as an organization to extend oil drain intervals for a cost savings and to schedule a better work flow. And if you do have an issue, oil analysis can find mechanical problems before they cause a failure.”

# Large City Fleet: Major Rocky Mountain City

- 500 heavy duty trucks
- Goal to go from mileage-based oil change to a condition-based oil change
- Oil drain interval increased from 2,500mi to 8,000mi

**Cost Savings**
$400 oil change costs
x 11 eliminated oil changes/yr
x 500 fleet vehicles
= **$2.2M per year**

**Oil Reduction**
Approx. 10 gal/oil change
x 11 eliminated oil changes/yr
x 500 fleet vehicles
= **55,000 gal per year**

# Who Uses the MicroLab?

## Fleet

Boston Public Works

City of Tampa, Florida

RTA

Massachusetts Bay Transportation Authority

Salt Lake City

City of Raleigh, North Carolina

Kitsap Transit — Connecting Communities

DENVER — The Mile High City

EWEB

All-Star Transportation

City of Long Beach Public Works — Strong Foundation, Strong City

City of Los Angeles — Founded 1781

LYNX

City of Oakland Public Works

City of Sacramento

City of Orlando

The Port Authority of New York & New Jersey

neuco — New England Utility Constructors Inc.

City of Richardson

## OEMs

Peterbilt

John Deere

Volvo

Kenworth

GM

Cummins

## Service Providers

SAPP BROS. — Welcome, Be Our Guest

Housby

Rush Truck Centers

B-Line Lube

speedco — Truck Lube & Tires + Repairs

Wheatley Truck Parts — Parts • Engines • Drivetrains

## Lubricant Suppliers

ExxonMobil

Chevron

Total

Shell

# Thank You!


## MicroLab ®

**All-In-One, Automated Lubricant Analysis System**

Fleet Solutions from Spectro Scientific

www.spectrosci.com