# The Case for Installing Centrifuge Filtration on Diesel Engines

Correlations between Soot Contamination and Engine Wear

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Shell Lubricants

T.F. HUDGINS® INCORPORATED
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# The Need

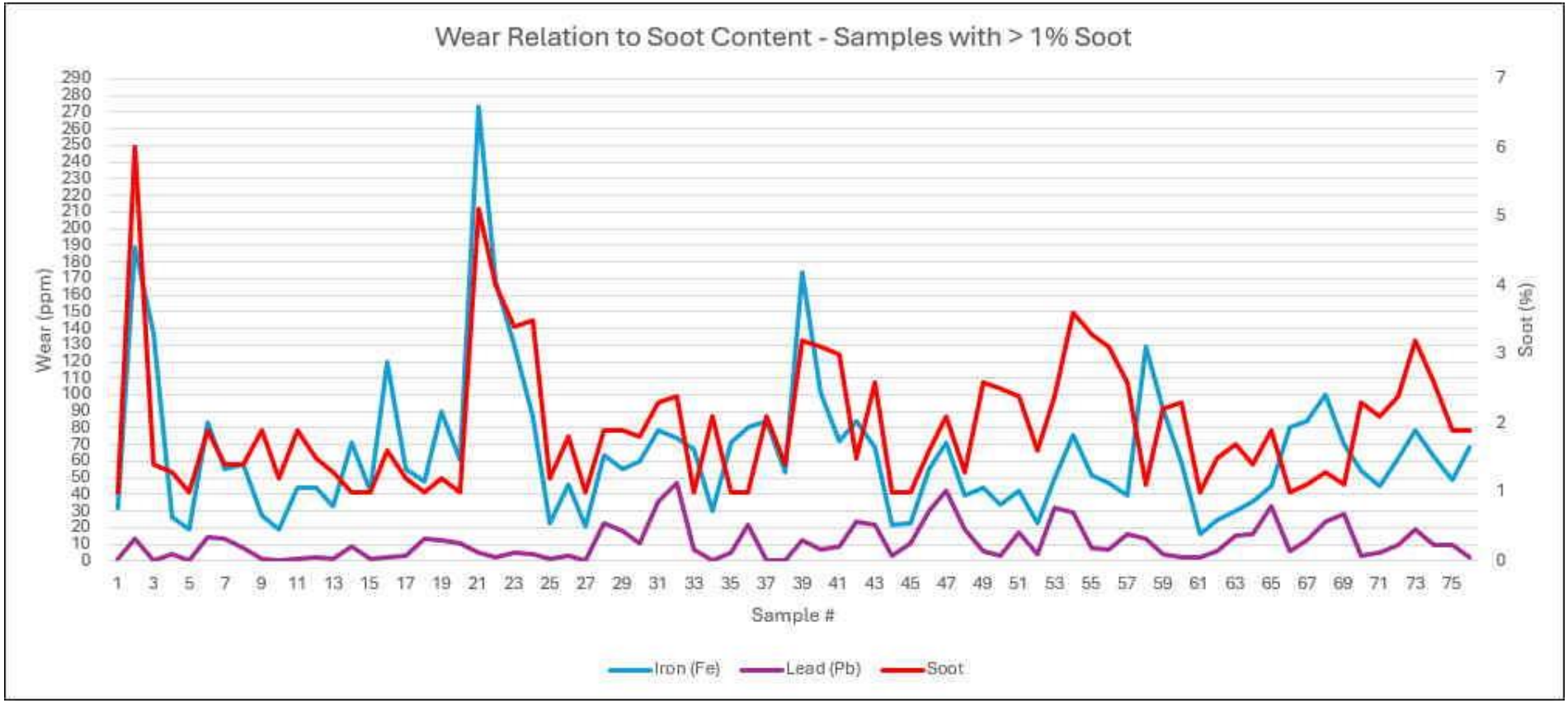
- Diesel engines operating in heavy-duty on-road, off-road, and stationary applications are subject to accelerated wear and shortened lubricant life due to high soot loading and contaminant buildup in engine oil.

- Traditional full-flow filtration offers limited protection against sub-micron particles, which are primarily responsible for abrasive wear. This leads to frequent oil changes, increased downtime, and higher maintenance costs.

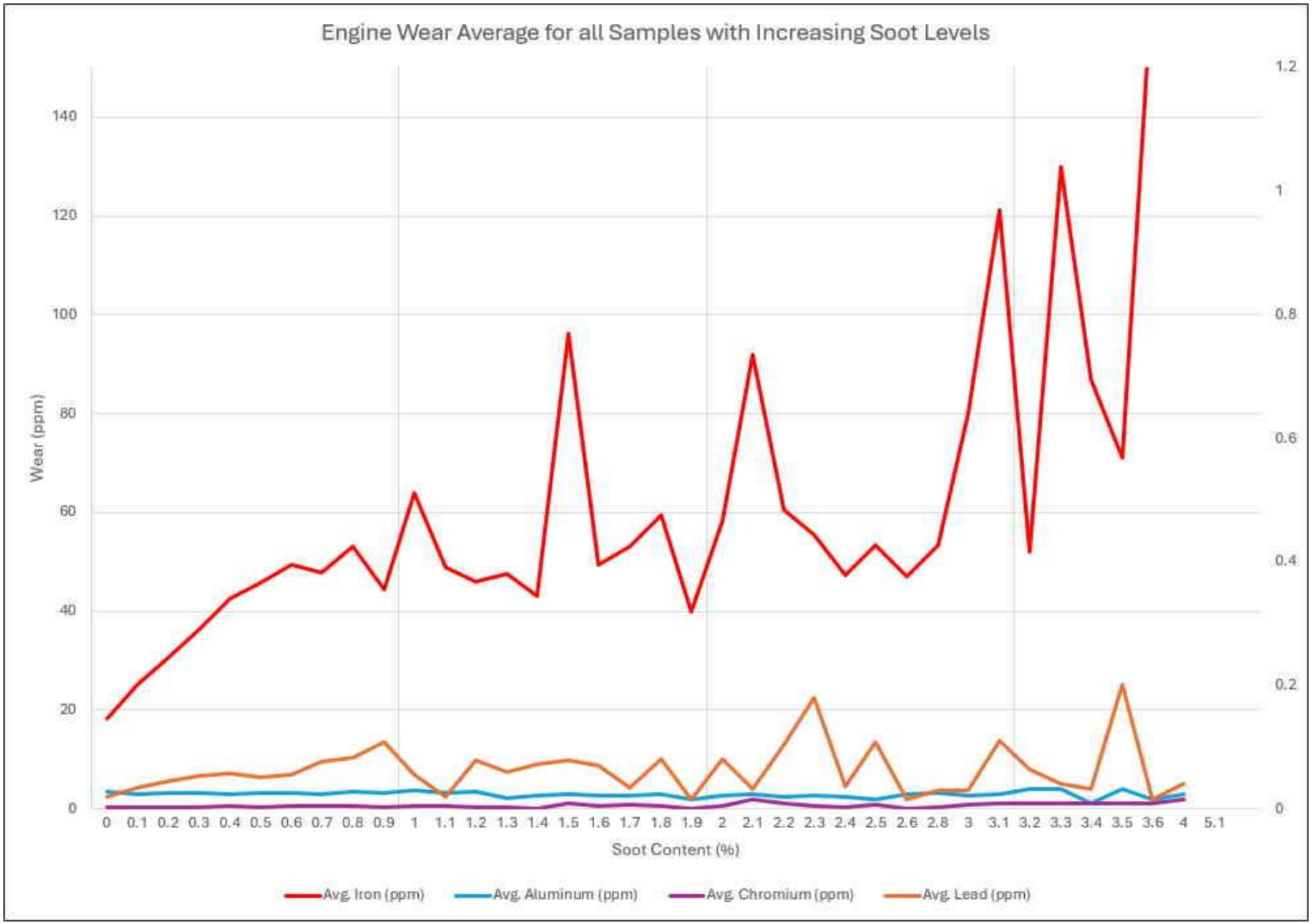
# Industry Drivers

- Tighter emissions regulations → more soot & contaminants in oil
- Rising service costs → demand for extended intervals
- Environmental pressures → reduce waste oil

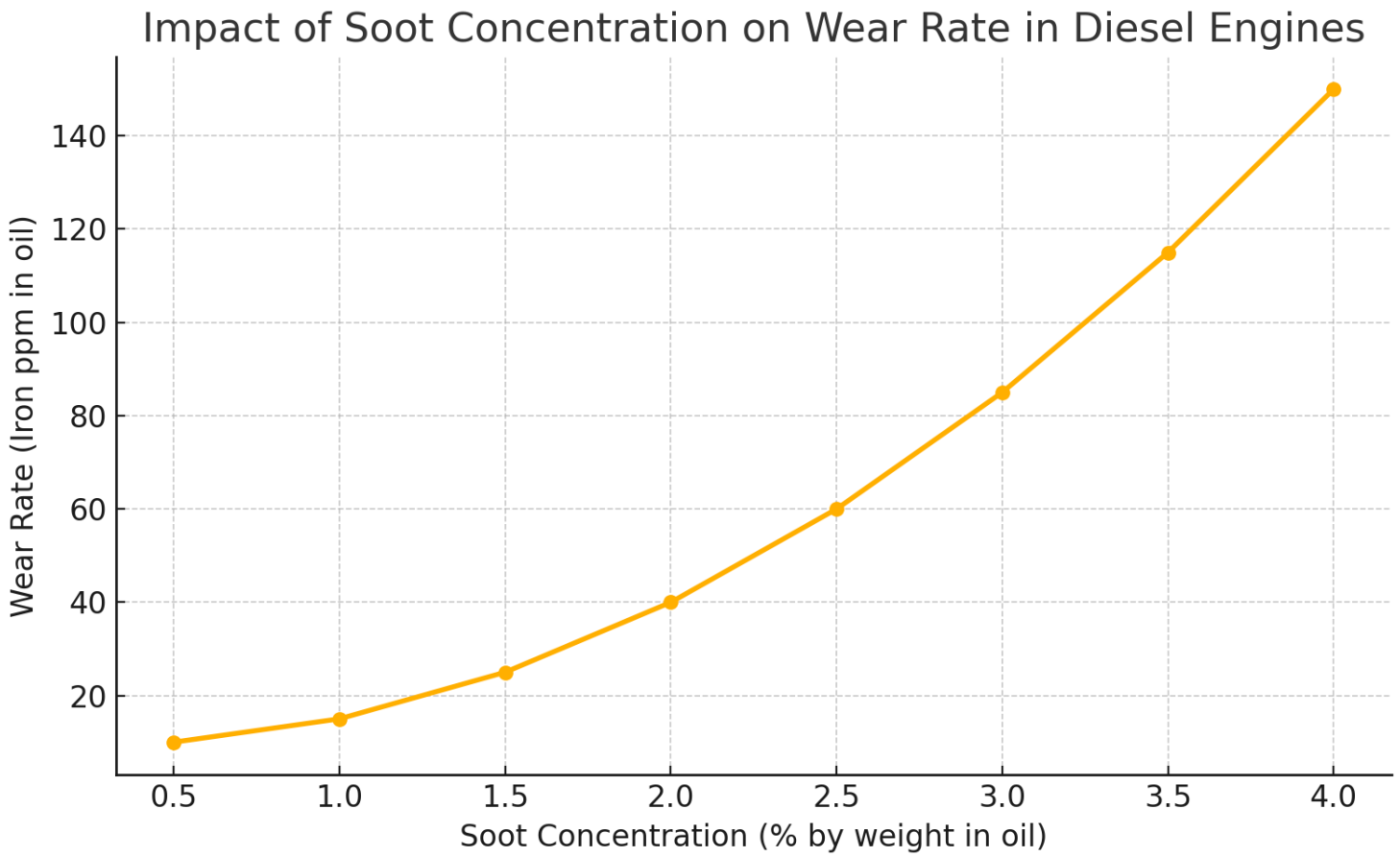
# Direct correlation of Soot Contamination to Wear Metals



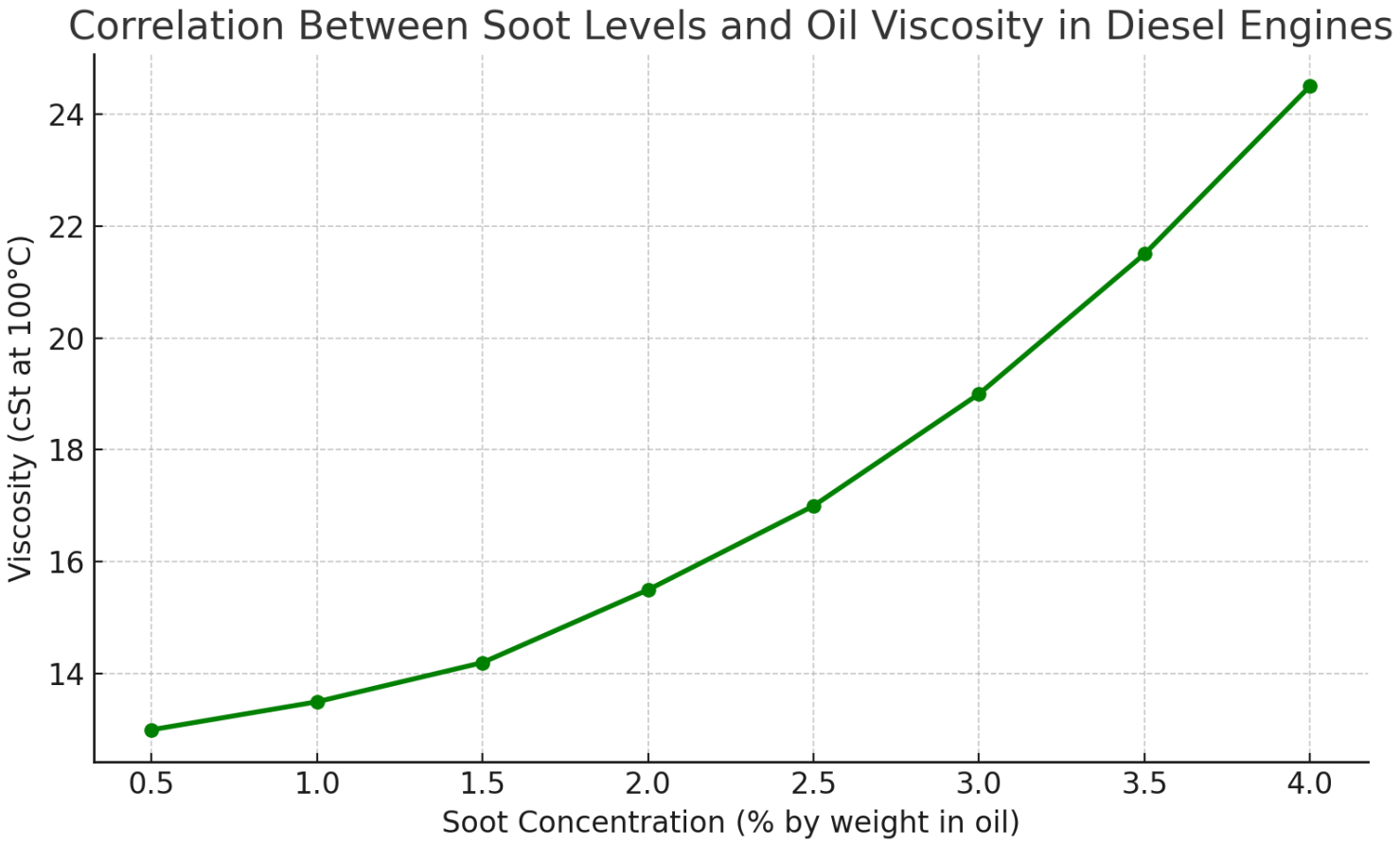
# Wear Increases in Proportion to Contamination Levels



# Soot & Contamination increases Wear Rates



# High Soot Levels Lead to Increased Viscosity



# Test Program

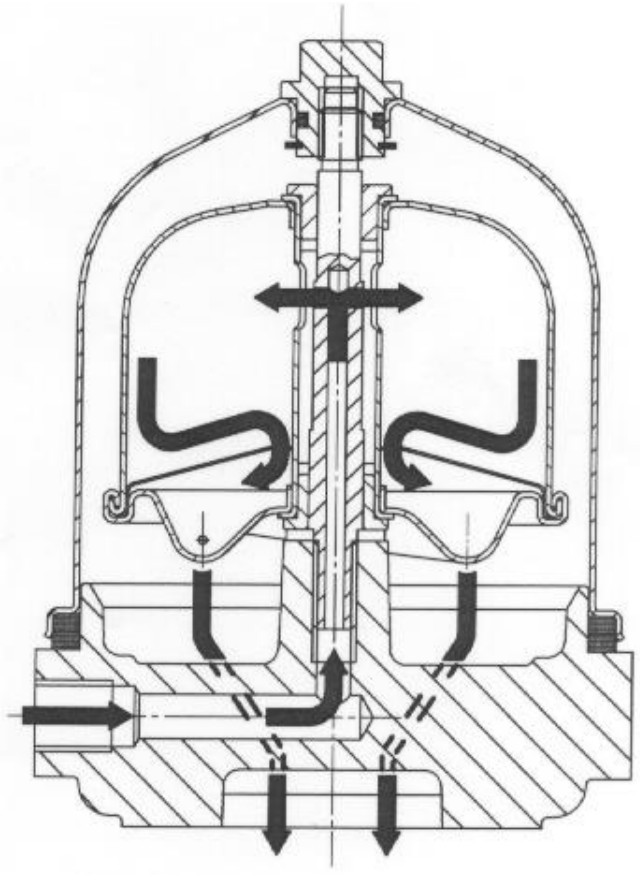
- 2,100 hours test duration
- Identical 8L diesel engines
- 15W40 CJ4 oil
- Data collected: oil analysis, sludge removal, teardown results

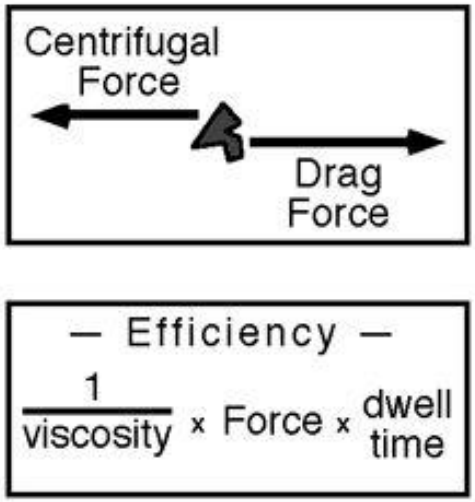
# Oil Analysis Program (Critical)

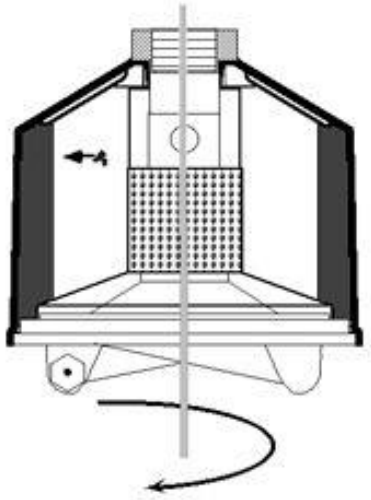
- Regularly used oil sampling and lab analysis are the most important tools.
- Check for:
- Viscosity breakdown
- Fuel dilution
- Soot levels
- Metal wear particles
- Total Base Number (TBN)
- Oxidation/nitration

# Spinner II Centrifuge Operation

- Removes contaminants based on density
- Removes sub-micron particles missed by traditional filters
- Reduces oil contamination, wear, and maintenance





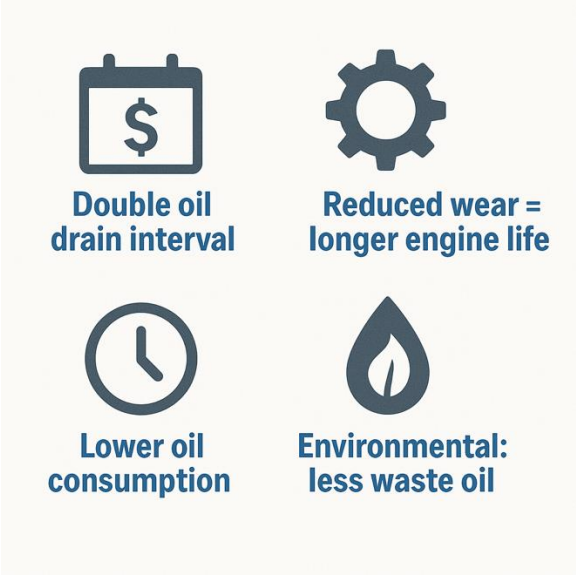



**Note - That as the cleaning chamber collects contaminants:**

- **The flow rate remains constant.**
- **There is virtually no decrease in instantaneous (single pass) efficiency.**

# Benefits of Centrifugal Filtration

- Double oil drain interval
- 50% fewer oil changes
- Reduced wear = longer engine life
- Lower oil consumption
- Environmental: less waste oil



- Methods: A Spinner centrifuge, designed as a bypass oil cleaning system, was evaluated for its ability to continuously remove fine particulate matter from circulating engine oil.

- Extending diesel engine oil drain intervals with Spinner centrifuges is a proven method to reduce operating costs by lowering oil consumption, reducing labor expenses, and minimizing engine wear.

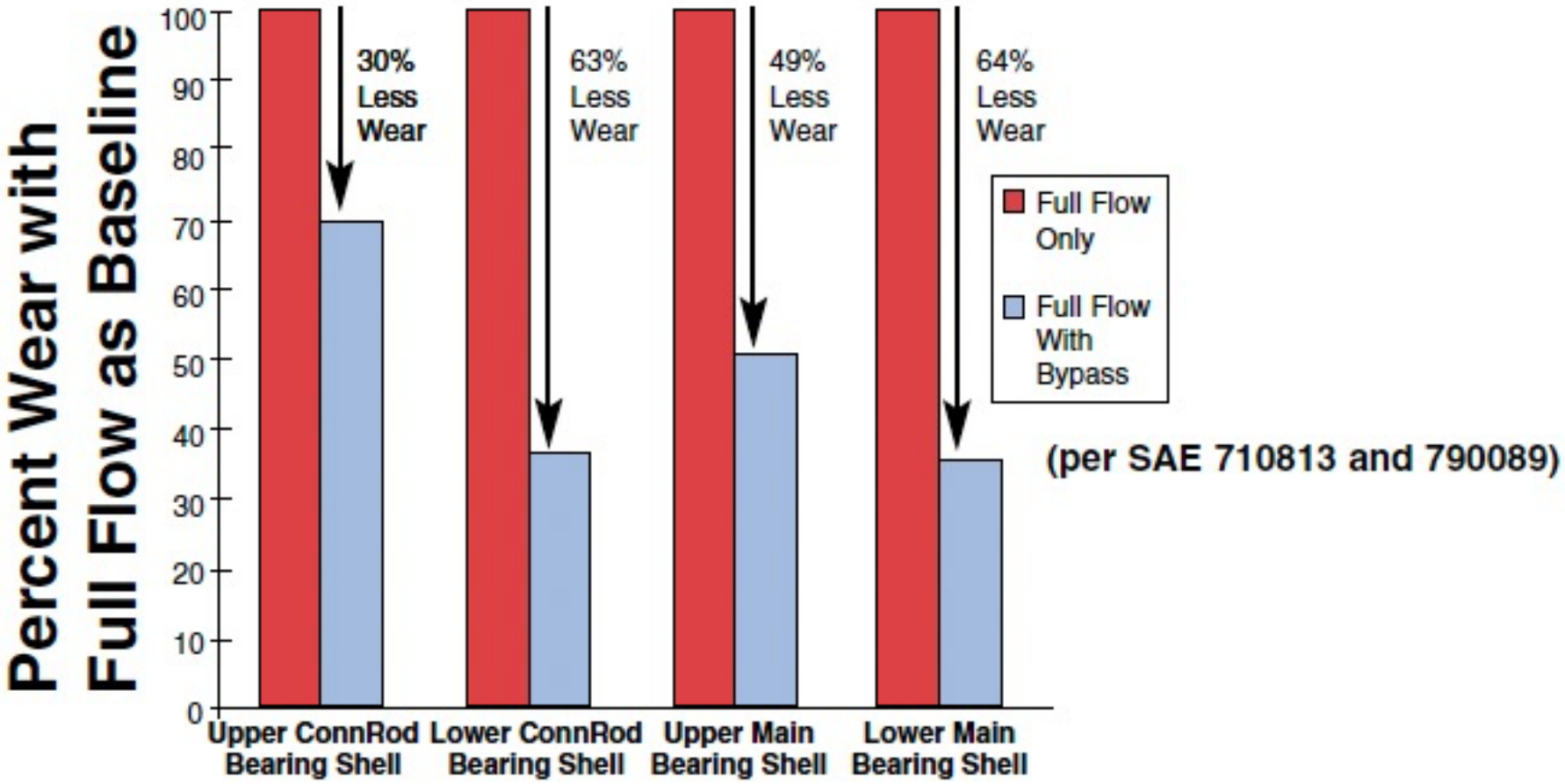
# Results

- Testing demonstrated that the Spinner centrifuge effectively extended oil life by reducing soot and insoluble content, thereby delaying the onset of viscosity increase and oxidation.
- Engines equipped with the centrifuge exhibited a 50% reduction in measured wear metal concentrations compared to baseline, as verified through oil analysis.
- Reduced contamination loading also enabled longer oil drain intervals, which in turn lowered downtime and maintenance frequency.

# Results: Wear and Oil Condition

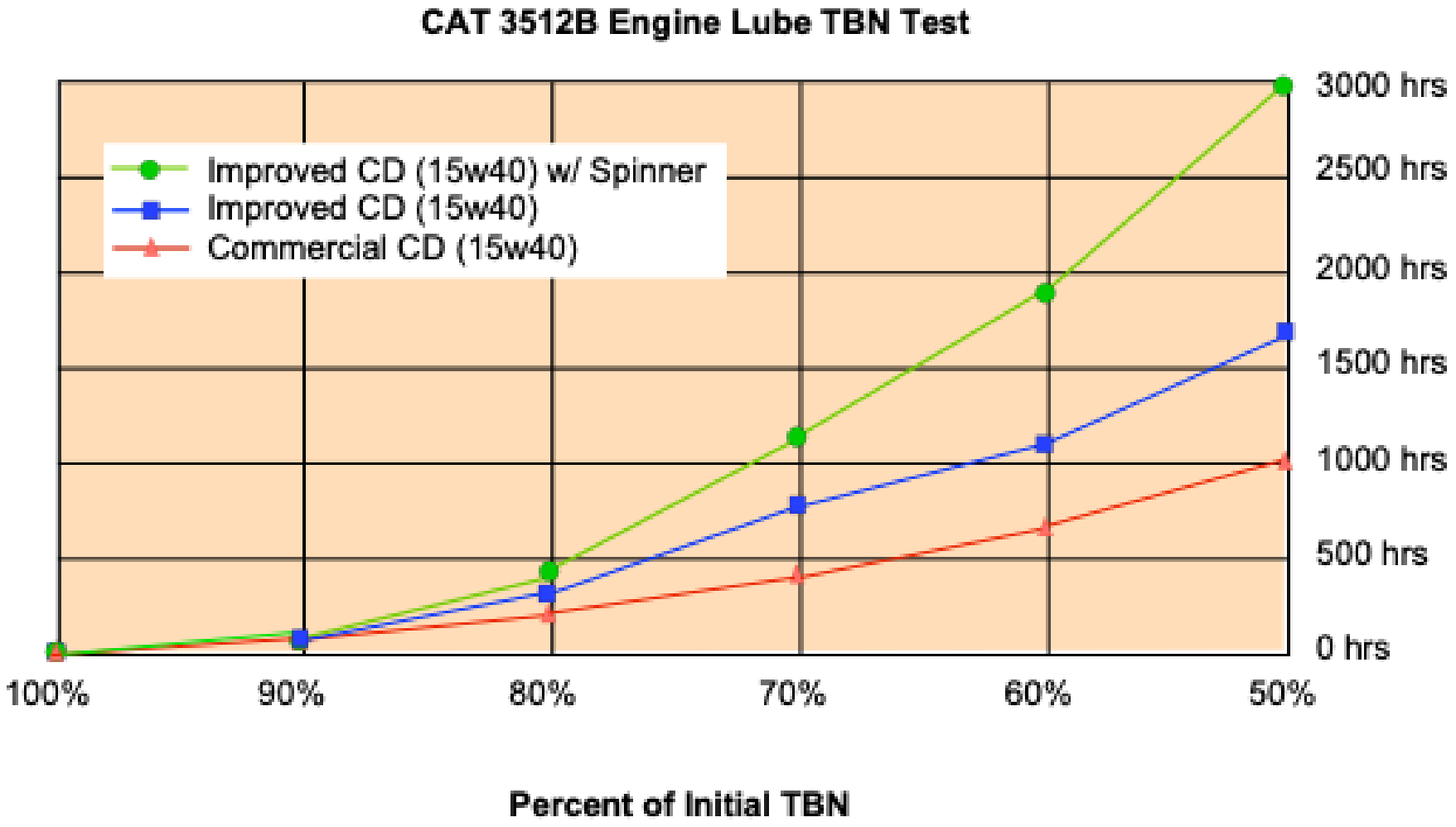
- Lower iron wear particles
- Slower viscosity increase
- Better TBN retention
- Lower total insolubles

# Bypass Filtration Reduces Engine Wear

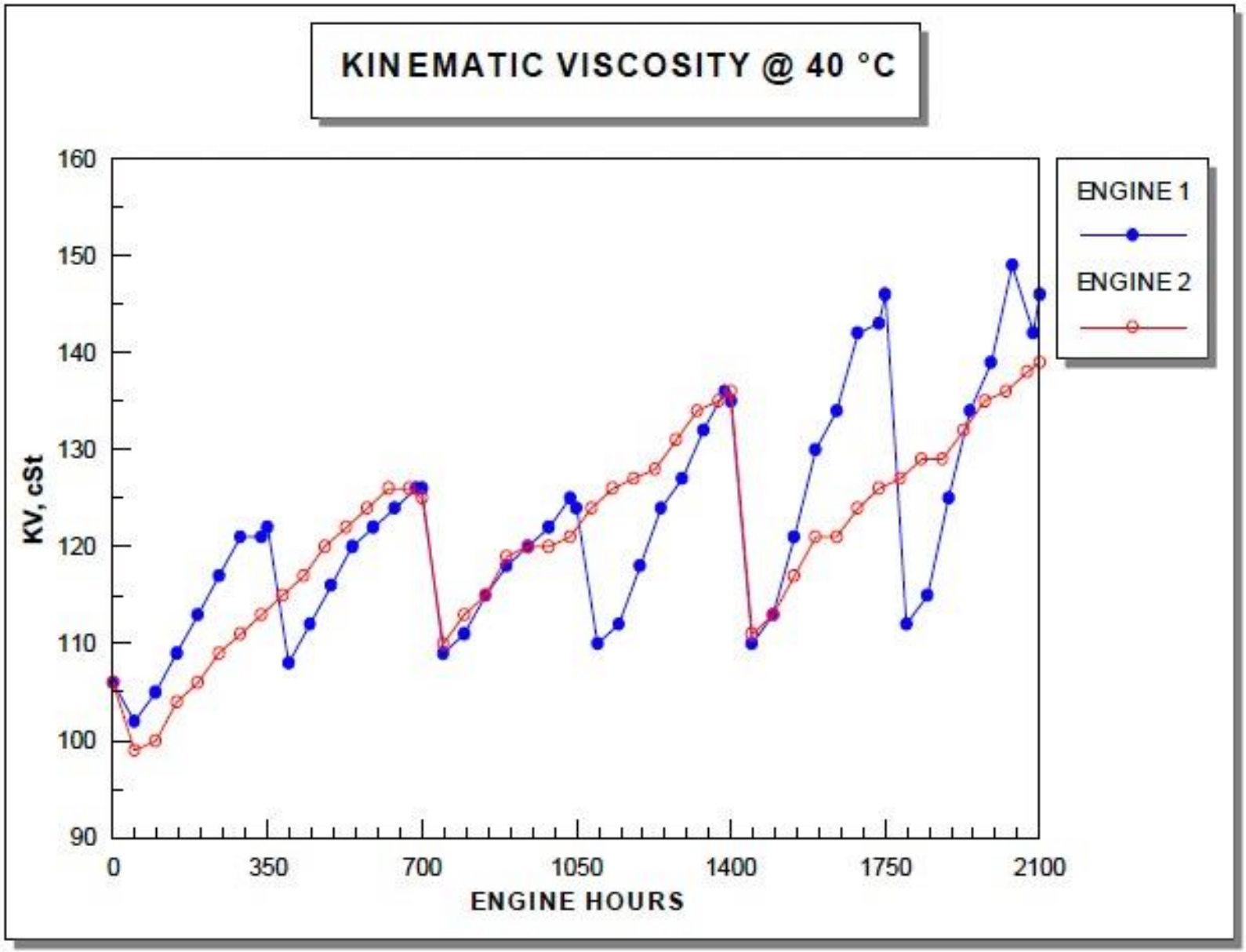



(per SAE 710813 and 790089)

# TBN Results


CAT 3512B Engine Lube TBN Test
Improved CD (15w40) w/ Spinner
Improved CD (15w40)
Commercial CD (15w40)
3000 hrs
2500 hrs
2000 hrs
1500 hrs
1000 hrs
500 hrs
0 hrs
100%
90%
80%
70%
60%
50%
Percent of Initial TBN

# Viscosity


KINEMATIC VISCOSITY @ 40 °C
KV, cSt
160
150
140
130
120
110
100
90
0
350
700
1050
1400
1750
2100
ENGINE HOURS
ENGINE 1
ENGINE 2

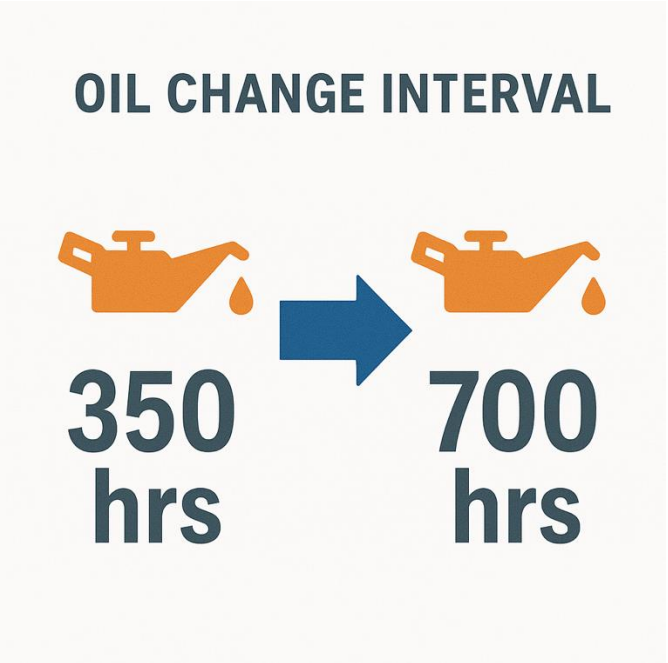
# Friction Rate

| Serial number | Oil filtration type | Dust Load Air filtration quality (G cycle$^{-1}$)* | Average friction pressure (kPa) | Wear of Fe (sleeve) |
|---|---|---|---|---|
| 9 | 10μ + centrifuge | 1.25 | 162.8 | 0.0832 |
| 10 | Standard 20μ + centrifuge | 2.5 | 164 | 0.5213 |
| 11 | HP 10M | 5.0 | 165 | 1.0097 |
| 12 | Standard 20μ | 10.0 | 166 | 3.074 |
| 13 | Standard 25μ | 20.0 | 170 | 5.9537 |
| 14 | Standard 25μ | 40.0 | 179.6 | 10.1387 |

ISO 5011 G-Cycle

# Oil Condition Results

- Engine oil stayed cleaner:
- Lower iron wear metals
- Stable viscosity
- Controlled insolubles
- TBN above limits at 700 hrs




Centrifuge removed 1.4 kg of soot & debris over test

Cleaner oil → reduced wear & downtime

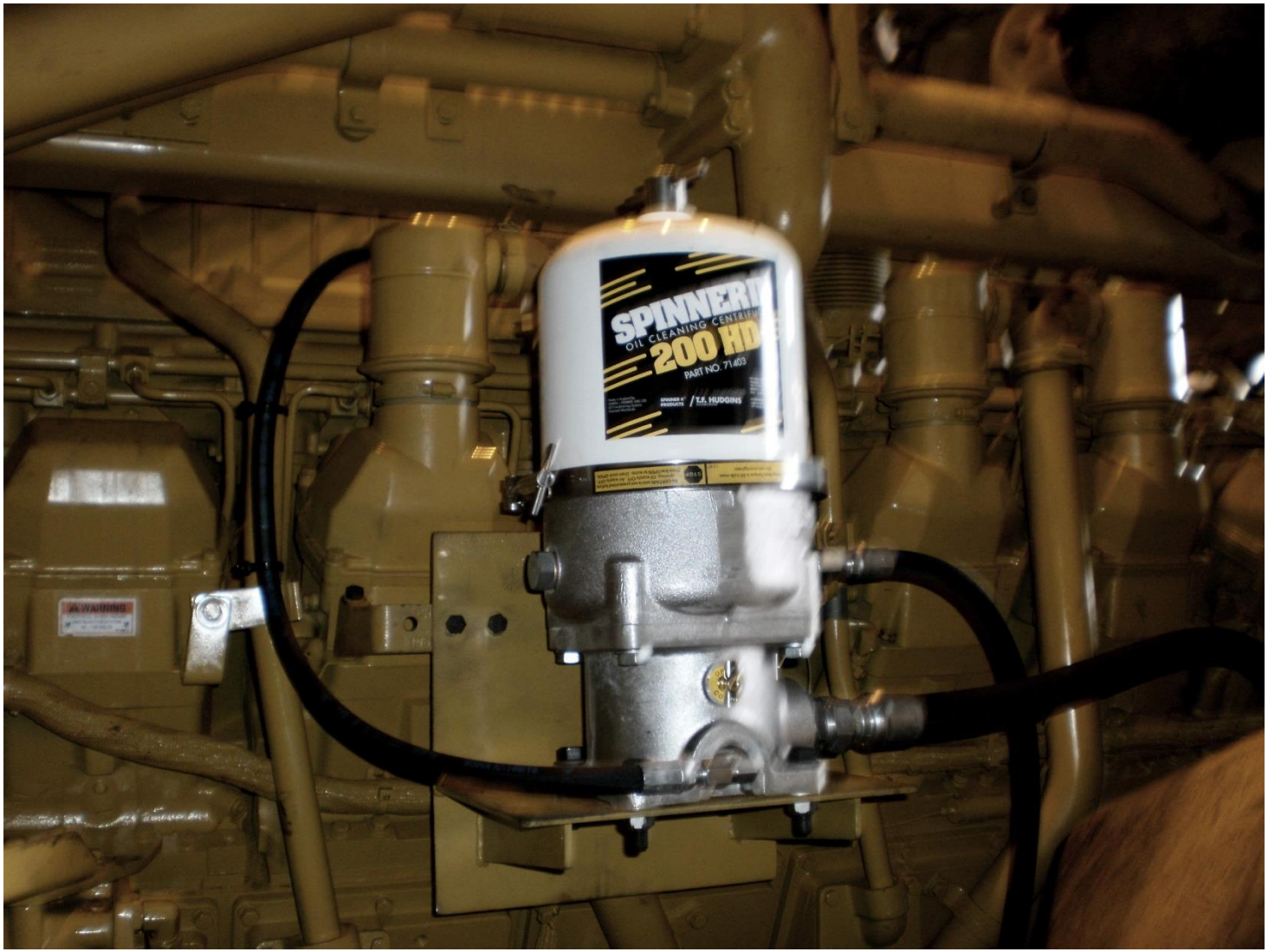
# CAT 793 Haul Truck
# Captured Contaminants 1500 Hours



Debris removed from oil stream

# Engine Mounted Spinner II on CAT Shovel


# Spinner II Mounted on the Engine in CAT 793



# CAT Haul Truck with Spinner II Centrifuge

# Genset Installation

# Contamination Captured
# Full-Flow Filter Missed


# CAT 793 Haul Truck


# SPINNER II CENTRIFUGES

Clean Oil

Longer Engine Life

Fewer Oil Changes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**Cut Maintenance Costs Today.**

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