Diesel Engine Oil Technology Insights and Opportunities

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Diesel Engine-Efficiency and Emissions Research Conference

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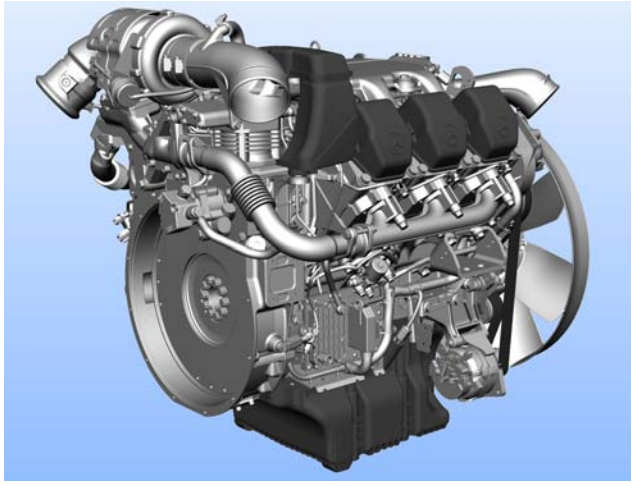
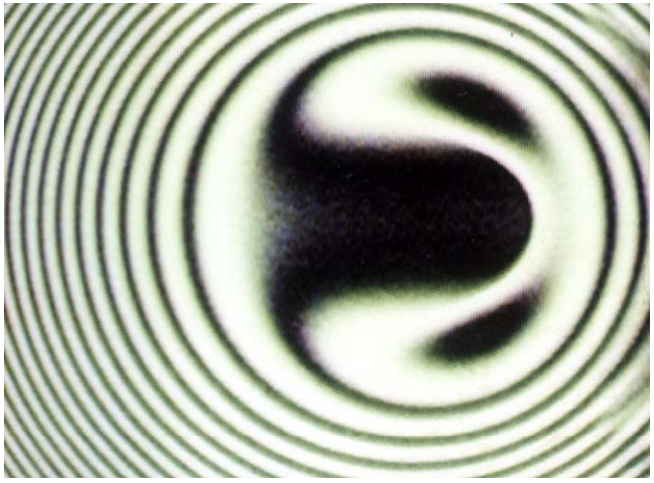
Where we are Today

- Fuel Composition and Quality



- Engine and Vehicle Development



- Innovative Lubricant Solutions

CJ-4 Technology Update

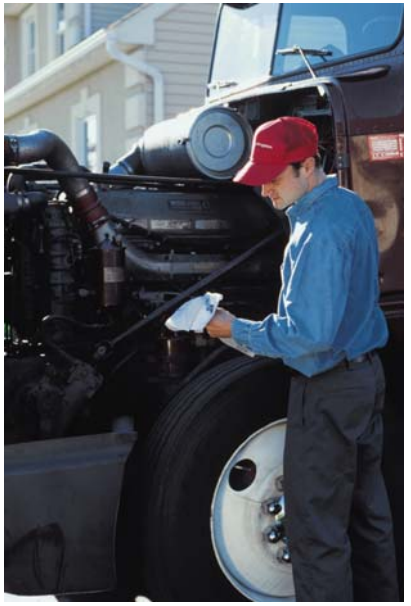
Challenge of API CJ-4 Oils

- CJ-4 oils must be below
  - 1.0% Sulfated Ash
  - 0.4% Sulfur
  - 0.12% Phosphorus

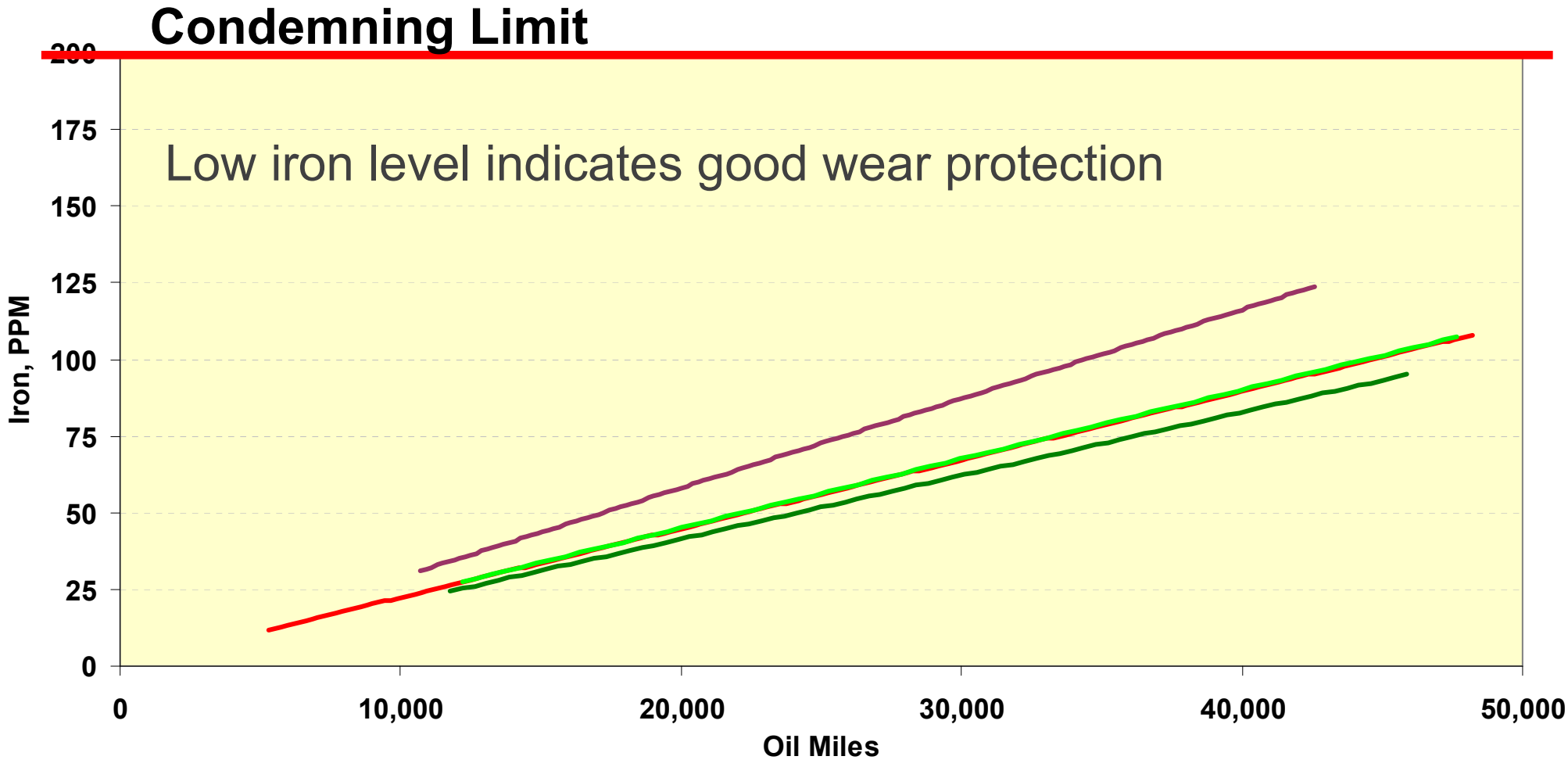
- CJ-4 Oil were designed to provide:
  - Improved High Temp. Oxidation Control
  - Improved Wear Resistance
  - Improved Soot Handling
  - Improved Deposit Control
  - Compatibility w/After Treatment Devices

- Backward compatible

Field Performance of API CJ-4 Oils

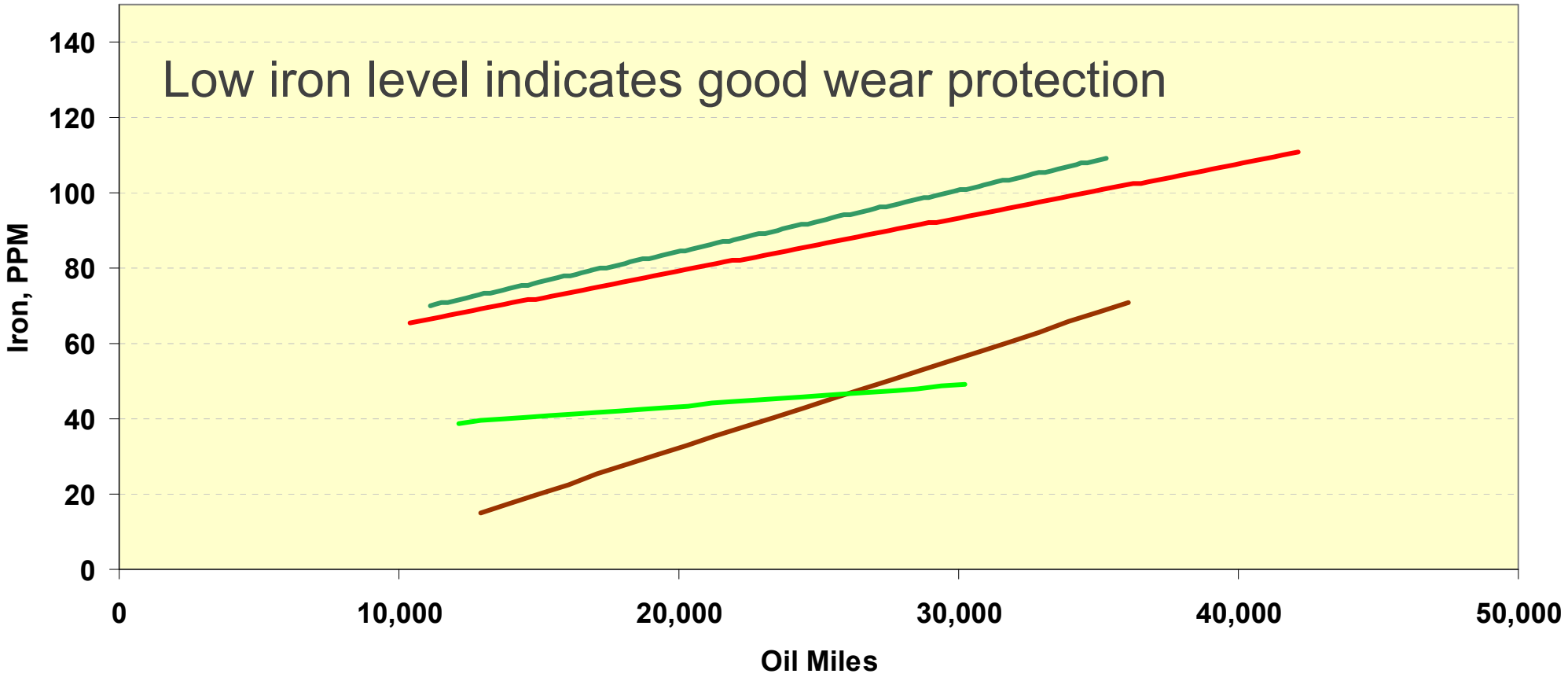


Fleet #1 – Wear performance - Iron Wear



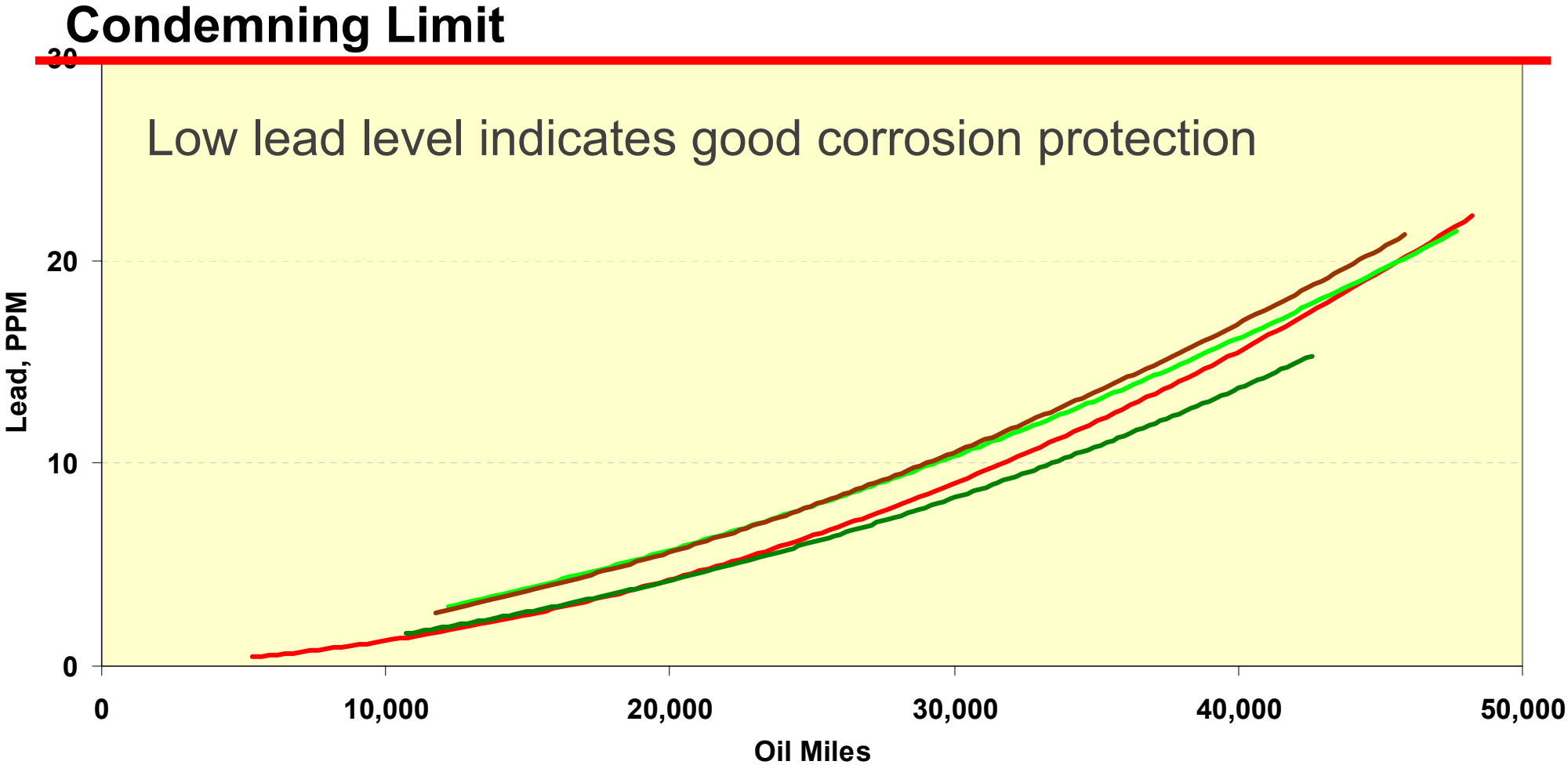
Recommended ODI 15,000 miles

Fleet #2 – Wear performance - Iron Wear



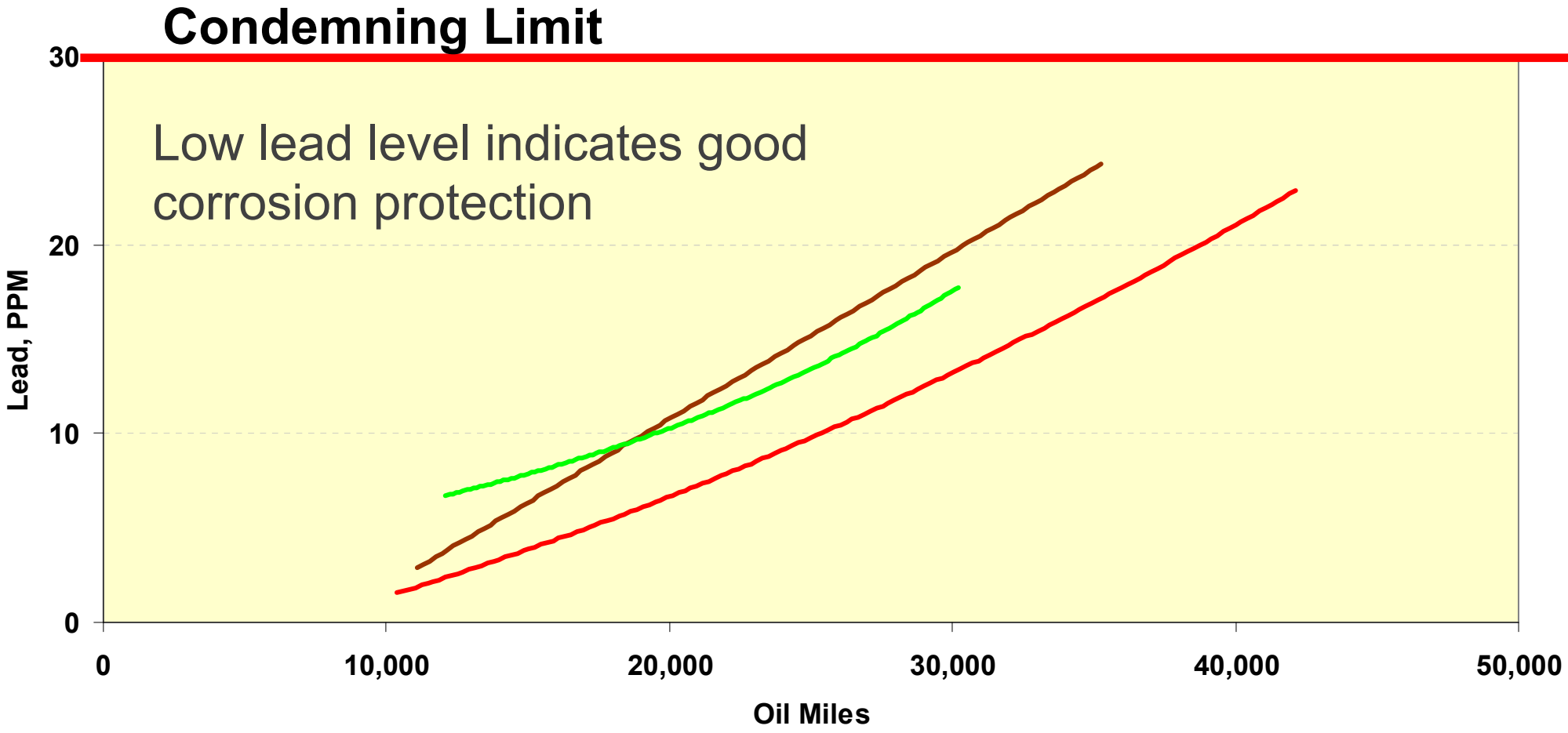
Recommended ODI 25,000 miles

Fleet #1 – Corrosion Protection - Lead level



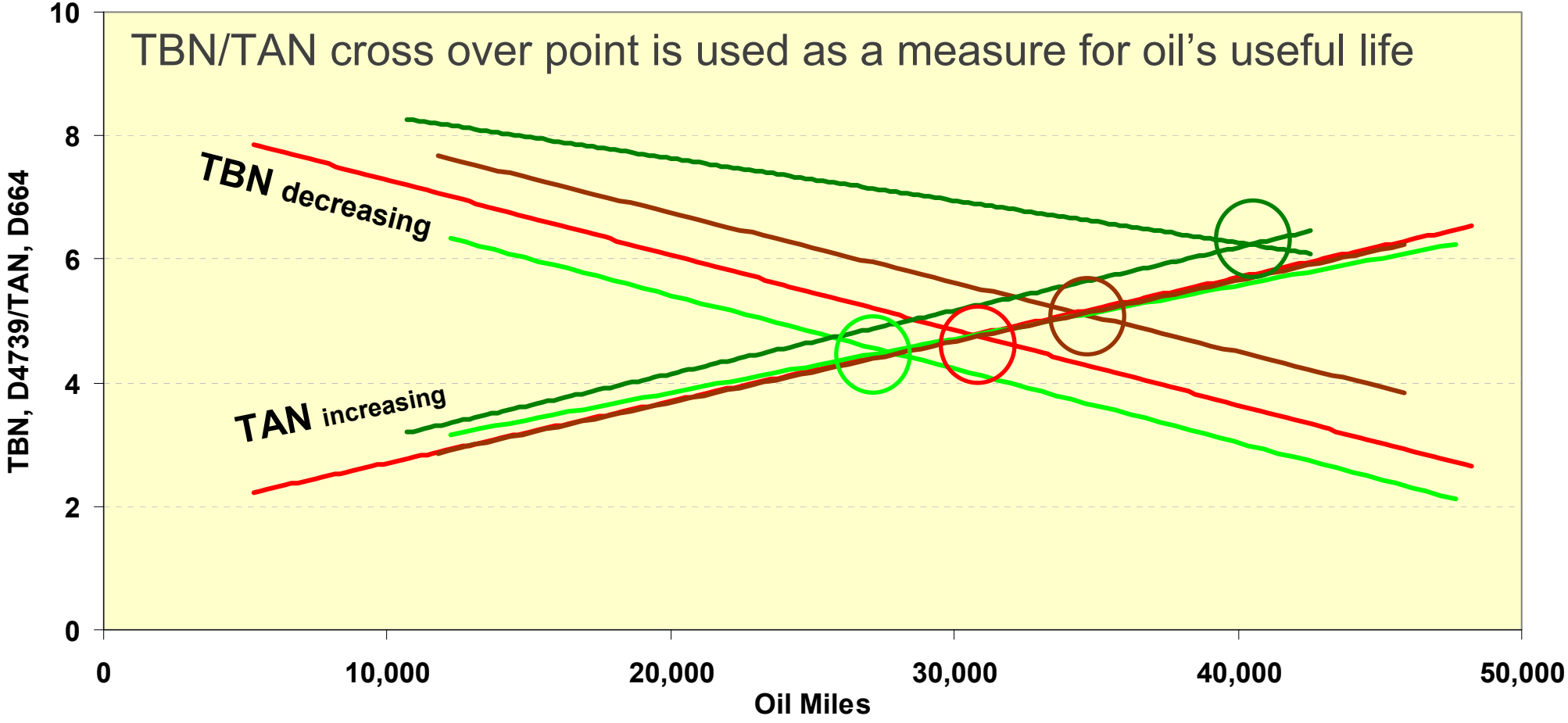
Recommended ODI 15,000 miles

Fleet #2 – Corrosion Protection - Lead level



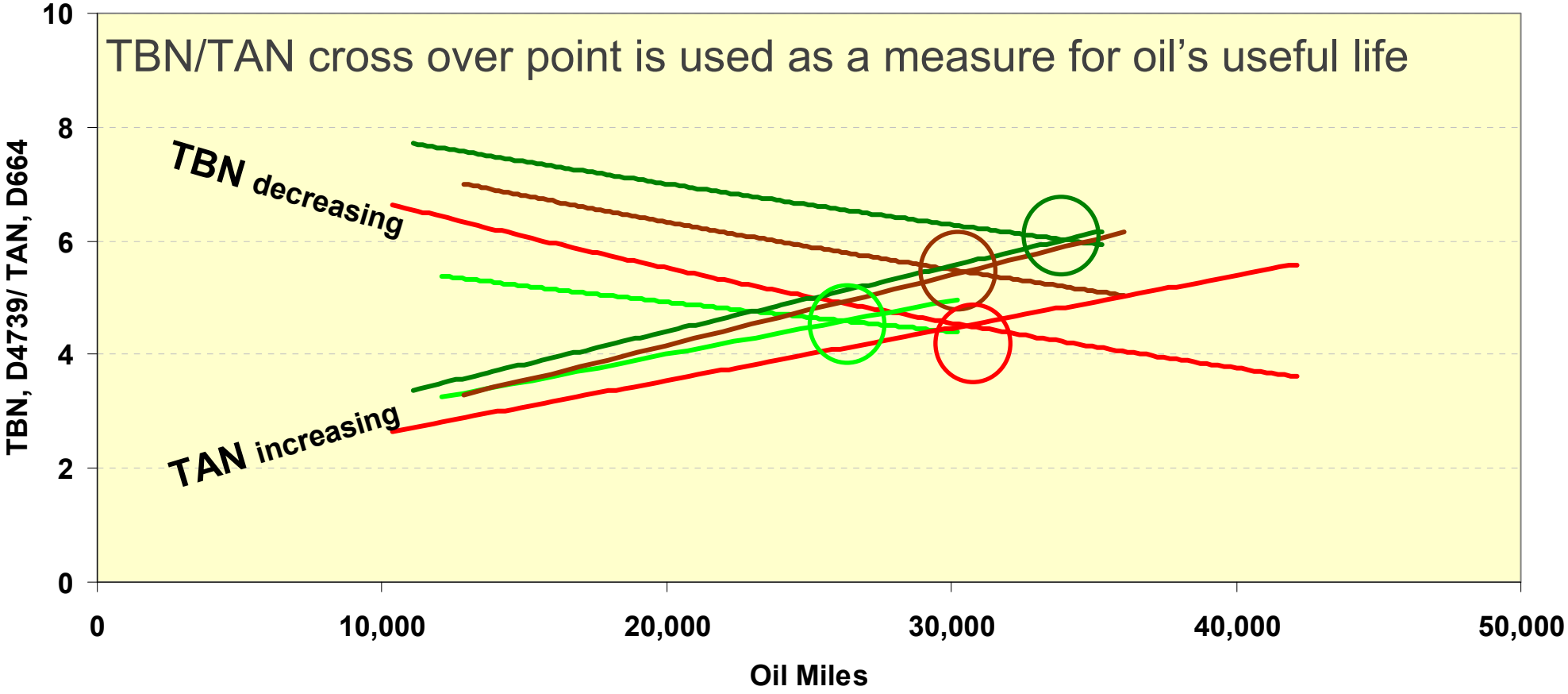
Recommended ODI 25,000 miles

Fleet #1 – Oil life as indicated by Total Base Number and Total Acid Number



Recommended ODI 15,000 miles

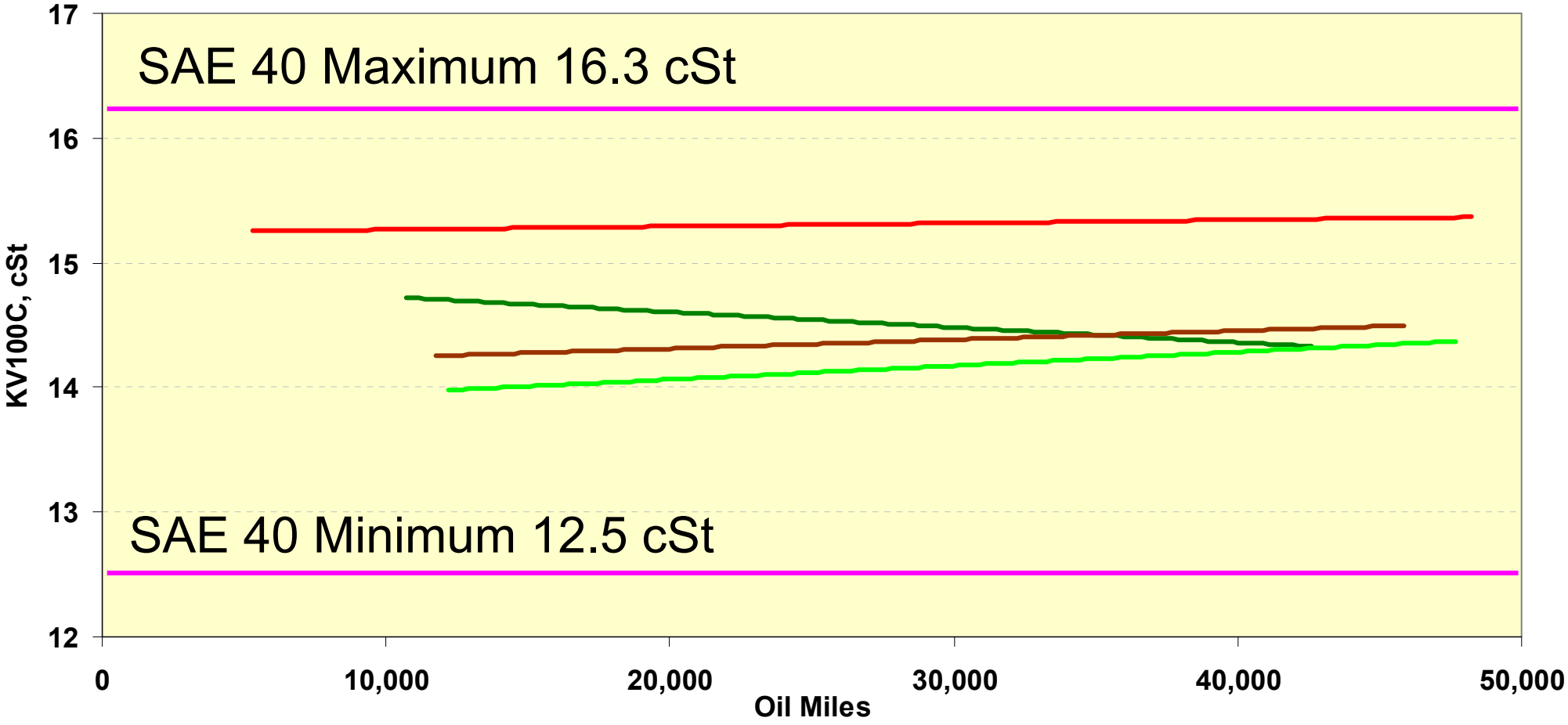
Fleet #2 – Oil life as indicated by Total Base Number and Total Acid Number



Recommended ODI 25,000 miles

Fleet #1 –Oil Viscosity Stability

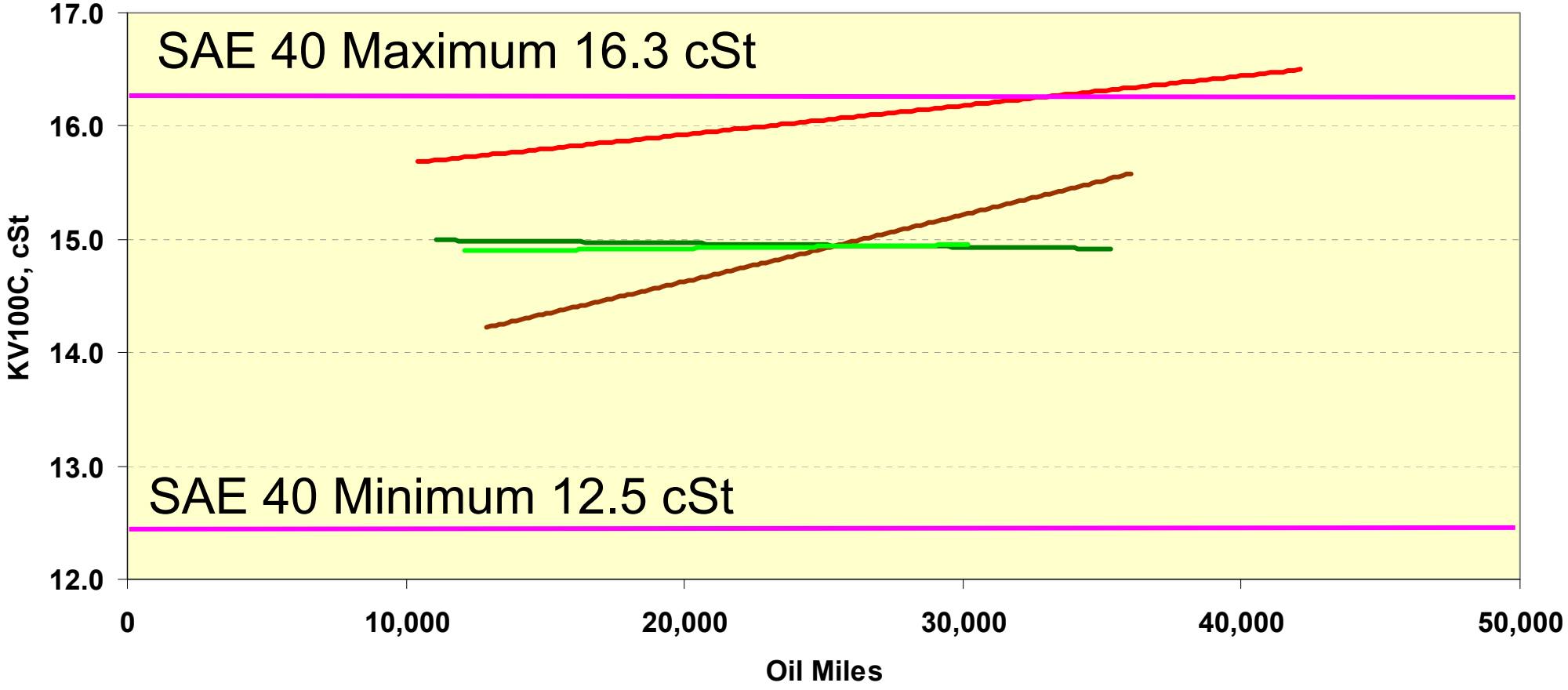
Controlled Viscosity – Resisting Thickening from Soot and Oxidation



Recommended ODI 15,000 miles

Fleet #2 – –Oil Viscosity Stability

Controlled Viscosity – Resisting Thickening from Soot and Oxidation

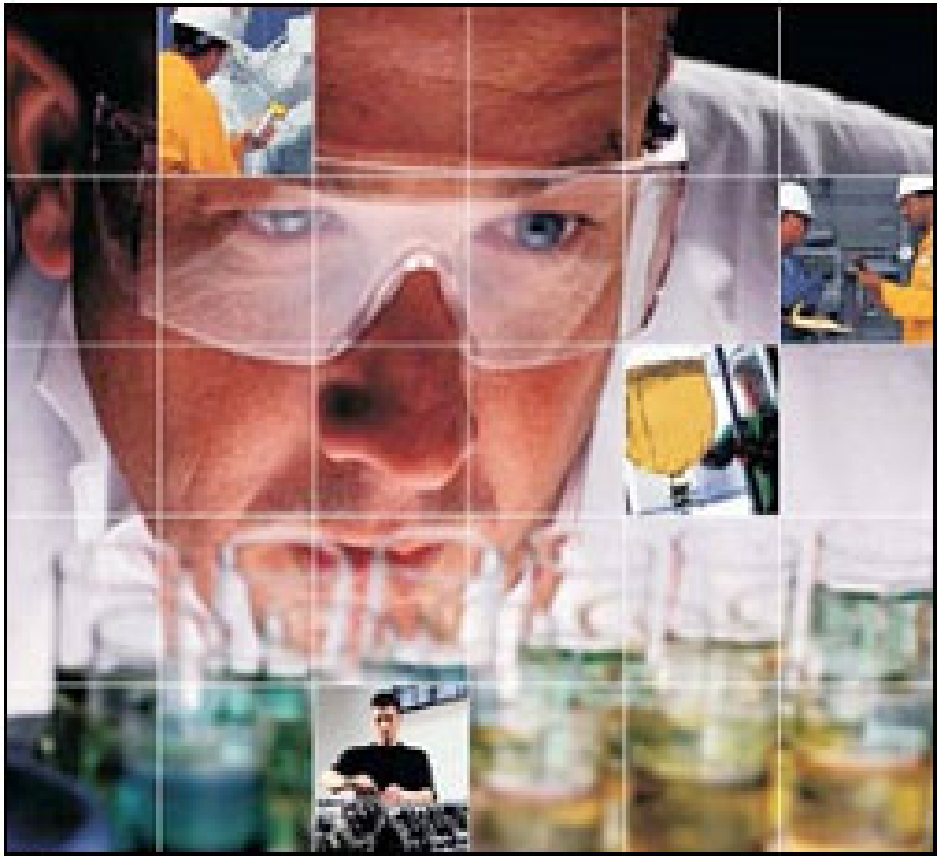


Recommended ODI 25,000 miles

Summary of Performance Data

Key findings:

- Good Wear control
- Good Corrosion control
- Good Oil Life
- Good Soot Handling and Oxidation Control



Looking at Future Diesel Lubricant Technology

Viscosity grades of oil can effect fuel economy

Europe

European FE grades available 5W-30 and 10W-40 and approved by OEMs.

US

- Fuel economy interest growing with high fuel prices
- Proposed legislation under review to look at FE improvement for heavy and medium duty vehicles from 2011
- US market currently predominantly 15W-40 (>90% total) with 10W-30 in colder climate (Canada) plus limited 5W-40 synthetic market segment
- Traditional concern regarding durability of xW-30 grades
- Interest growing in FE grades from OEMs as European-type engines introduced into US market (MB/DDC, Volvo/Mack, MAN/International Trucks).

Innovative Technology: Delivering Energy-Saving Performance

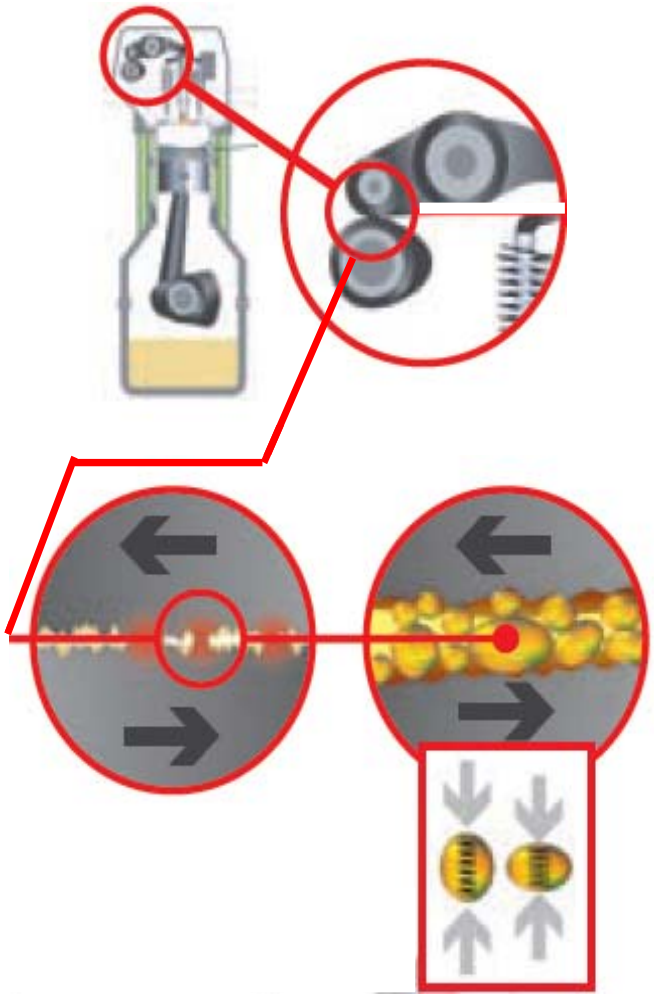
Challenge: Using low-viscosity energy-saving oils without compromising protection

- Reducing friction and oil film thickness
- Maintaining protection against wear
- No reduction in protection and durability

Solution: Energy-saving oils with exceptional durability

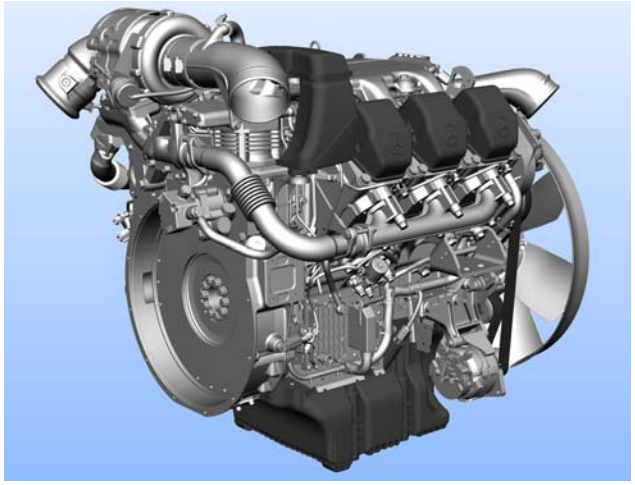
Use of synthetic technology base oils with anti-wear boosters to deliver the optimum balance between efficiency and protection

- Novel anti-wear boosters help maintain protective oil films
- Synthetic technology base oils more resistant to thinning at high temperatures



In the Future

- Fuel Composition and Quality



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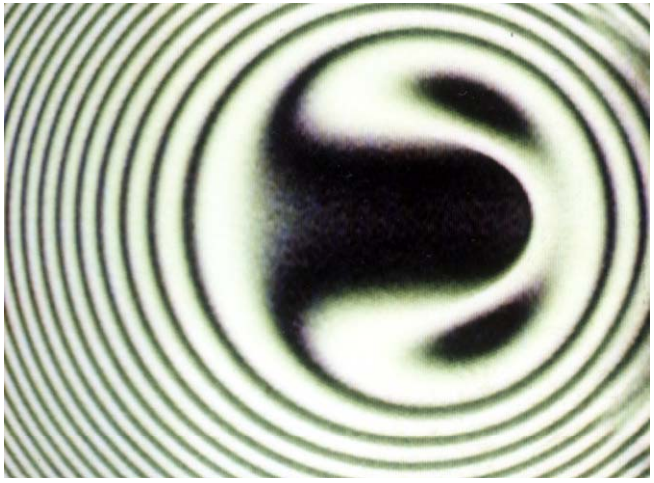

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