S3 Engines
Study Group Meeting

September 21, 2011

2011 Fall Meeting & SuperTech11
Raleigh Convention Center, Raleigh, NC

Attention Please

- In accordance with TMC Board Policy, all portable phones and pagers without a silent feature must be turned off during business sessions.
- If you must use your phone — please leave the room!

Attention Please

- This is an open meeting of the Technology & Maintenance Council.
- Audio or video recordings are not permitted at this session. However, photography is permissible.
- The opinions expressed in this meeting are those of the individual and not necessarily the opinion of his/her company nor of TMC unless stated otherwise.

Constructive Comments Are Always Appreciated!

- TMC welcomes your comments, but please make certain that they are constructive and appropriate before you turn in your evaluation sheet!

Thank You for Your Cooperation!

TMC Study Group Session

- Prior Minutes Approval
- Old Business
- Task Force Reports
- New Business/Task Force Creation
- Mini-Technical Session
- Questions & Answers

Fuel Efficient Engine Oils

S.3 MINI-TECHNICAL SESSION

September 21, 2011

TMC 2011 Fall Meeting & SuperTech11

Raleigh Convention Center, Raleigh, NC

Fuel Economy

Background

- Freight transportation is invaluable to businesses, consumers, and the economy, but is not without costs:
  - Of all energy consumed in the transportation sector, moving freight accounts for 20% of all energy consumed
  - Together, rail and truck transport consume over 35 billion gallons of diesel fuel per year . . . Representing over 350 million metric tons of carbon dioxide annually
  - Based on current trends, by 2012 ground freight transportation will consume over 45 billion gallons of diesel fuel, and is expected to produce over 450 million metric tons of carbon dioxide – a 25% increase over today's levels

http://www.epa.gov/smartwaylogistics/transport/basic-information/index.htm

Smartway

- To address these trends, the EPA developed SmartWay Transport—an innovative collaboration between the freight industry and government to reduce air pollution and greenhouse gas emissions, improve fuel efficiency, and strengthen the freight sector
- SmartWay Transport's goals are to reduce the impact of freight transport on the environment, and to help trucking partners see the rewards to their business. The programs goal is to reduce:
  - Fuel consumption from trucks and rail delivering freight
  - Operating costs associated with freight delivery
  - Emissions of CO2
  - Emissions of NOx, PM, and air toxics
- EPA projected savings of between 3.3 and 6.6 billion gallons of diesel fuel annually.

http://www.epa.gov/smartwaylogistics/transport/basic-information/index.htm

Growth of Sustainability as a Key Corporate Value

- SmartWay Partners are recognized for commitment to reducing emissions in their fleets, and these classifications make companies more attractive to prospective shipping partners

- Trucking companies have clearly taken leadership role in "Environmental Sustainability" by adopting significant technologies and practices like Smartway ground freight more efficient and cleaner for the environment
  - ***We thank you all for your commitment and accomplishments!***

SmartWay Transport Partnership: Innovative Carrier Strategies

- The following technologies have been recognized by the EPA as innovative carrier strategies to help reduce fuel consumption and emissions from freight trucks(*):
  - Idle Reduction
  - Improved Aerodynamics
  - Improved Freight Logistics
  - Automatic Tire Inflation Systems
  - Wide-base Tires
  - Driver Training
  - Weight Reduction
  - Intermodal Shipping
  - Hybrid Powertrain Technology
  - ***Low-Viscosity Lubricants***

(*) EPA SmartWay Transport Partnership, Overview of Carrier Strategies

Rob Banas

- Applications Engineer - Commercial Vehicle Lubricants, ExxonMobil Lubricants & Specialties Company
  - Certified as a Lubrication Specialist and Level II Oil Monitoring Analyst by the Society of Tribologists and Lubrication Engineers (STLE)
- Technical and field engineering support coordinator for a portfolio of national and regional fleet accounts
  - Maintenance interval optimization
  - Lubricant/equipment performance monitoring
  - Oil analysis program design and implementation
  - Equipment inspections
- Technical trainer
- Field trial coordinator in conjunction with research activities
  - Fuel economy studies
  - Durability testing
  - OEM/industry specification approvals

John Loop

- Technology Manager, The Lubrizol Corporation
  - Bachelor of Chemistry, University of Illinois (1988)
  - Ethyl Corporation. Baton Rouge, LA (1989 to 1994)
    - Lubricant Additive Synthesis
    - Lubricant Additive Bench Test Development
  - Ethyl Corporation. Richmond, VA (1994 to 2001)
    - Viscosity Modifiers
    - Heavy-Duty Diesel Formulator
  - The Lubrizol Corporation (2001 to 2011)
    - Technology Manager (Heavy Duty Engine Oil Formulator)
    - Heavy-Duty Diesel Field Test Coordinator

Larry Eckhardt

- Manager, Fleet and Field Evaluations, Fuels and Lubricants Research Division, Southwest Research Institute
- Directs fleet testing projects to evaluate the beneficial effects of fuel additives and driveline lubricants for light- and heavy-duty vehicles
- Actively involved in truck fuel economy evaluations using TMC/SAE industry–accepted test procedures
- Managed EPA SmartWay projects for EPA and commercial clients to verify performance for SmartWay
- Department specializes in planning and conducting test protocols designed specifically to generate marketing proof of performance data
- Since 1986, he has managed hundreds of SAE J1321 Type II heavy-duty truck fuel economy tests to evaluate new technologies intended to provide better fuel economy for the trucking industry

Greg Shank

- Manager Structures and Materials Coordinator, Coordinator Fluids Technology, Volvo Powertrain N.A.
- 33 Years in Fluids Technology Development Engine Oil Performance Test T6 through T13
- Chairman of Engine Manufacturers/Truck Manufacturers Lubricants Committee
- Co-Chairman American Petroleum Institute Diesel Engine Oil Advisory Panel
- ASTM Test Monitoring Board – ASTM Heavy Duty Engine Oil Panel
- SAE Fuels & Lubricants

Greg Goodson

- 1983 – 1990 Mechanic / Welder, Jack Cooper Transport
- 1990 -1994 Shop Foreman, Central Detroit Diesel
- 1994 - 1997 Shop Foreman, Jack Cooper Transport
- 1997 - 2002 Shop Superintendent, Jack Cooper Transport
- 2002 - Present Director of Maintenance & Shop Operations, Jack Cooper Transport

Rob Banas
Application Engineer
ExxonMobil

Mobil Delvac 1

Types of Fuel Efficient Lubricants

- Fuel efficient lubricants can include:
  - Synthetic transmission oils
  - Synthetic differential oils
  - Synthetic engine oils
  - Low viscosity oils

Lubricant Base Oils

Finished engine oil typically contains:

- **~75% base oil**
- **~25% additives**

- ***Base stock quality contributes significantly to finished engine oil performance!***

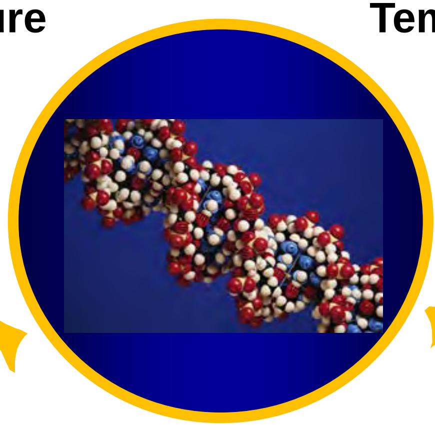
Lubricant Base Oils

How are they made?

PAO Base Oils – Polymerized at Chemical Plants

Pressure

Temperature



Controlled Ratio of Component Elements

Petrochemical Feed Stock (ethylene gas)

Mineral Oils - A Distilled Product from Crude Oil

Asphalts

Sulfur

Waxes

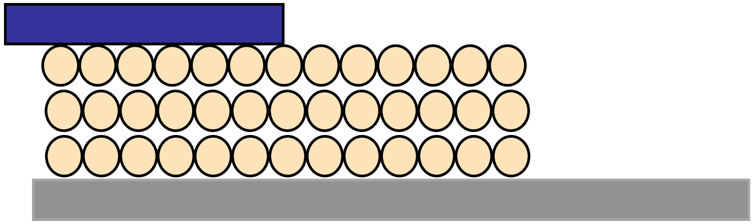
Nitrogen

Organic Compounds

Oxygen

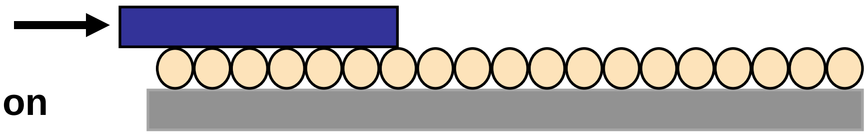
Friction and Traction

Friction is the natural resistance objects encounter when sliding against each other. A very thin layer of oil will create boundary lubrication, which still allows some surface interaction.

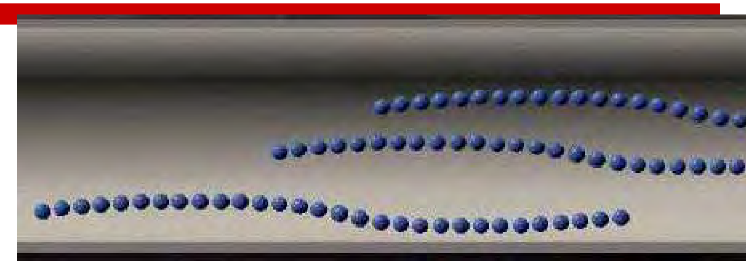


Traction arises from the oil film's internal molecular resistance to the shearing force caused by the moving object.

Friction: Synthetics vs. Mineral Oil

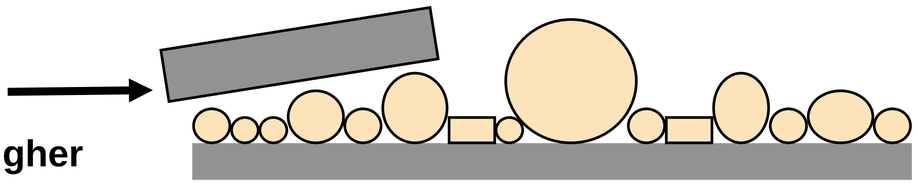


Friction Forces



Synthetic Oil

molecular structures



Higher Friction Forces

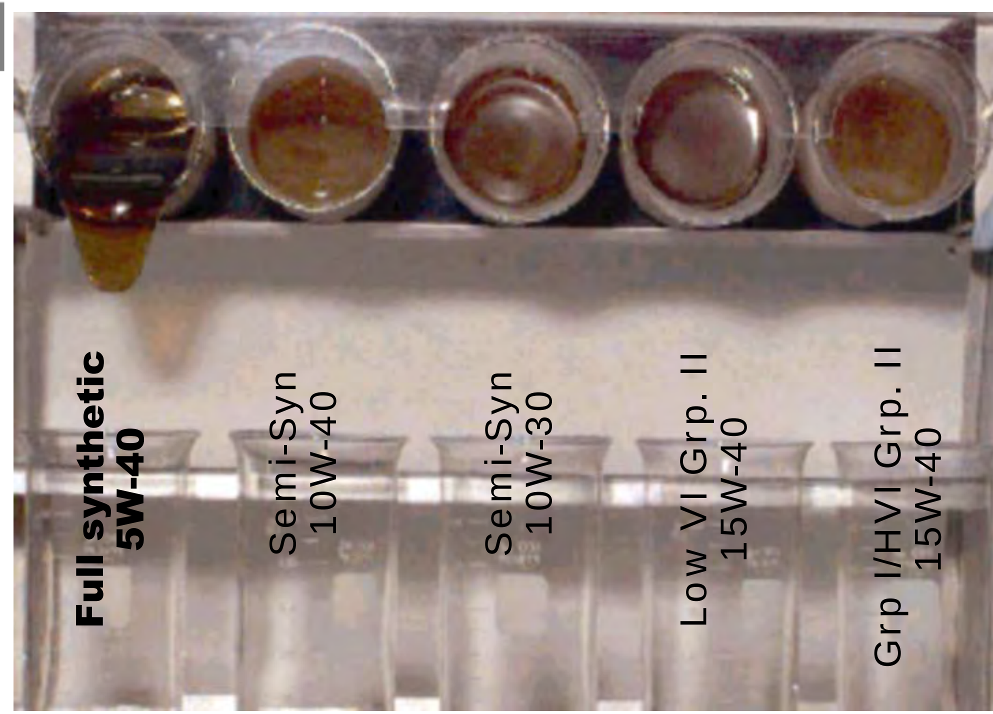
Mineral Oil

Because of their molecular structures, synthetics have a lower coefficient of friction than mineral oil.

Synthetic Advantage: Low Pour Point

- **Oils cooled to - 40ºF**
- **Tilted at 90º**
- **Photos at equal intervals**
- **The sample on the far left, 5W-40 (full synthetic) shows a distinct advantage against conventional mineral oils and even part synthetics**

1



Synthetic Advantage: Low Pour Point

- At low temperatures, synthetic fluids remain more fluid (have lower viscosity)

2

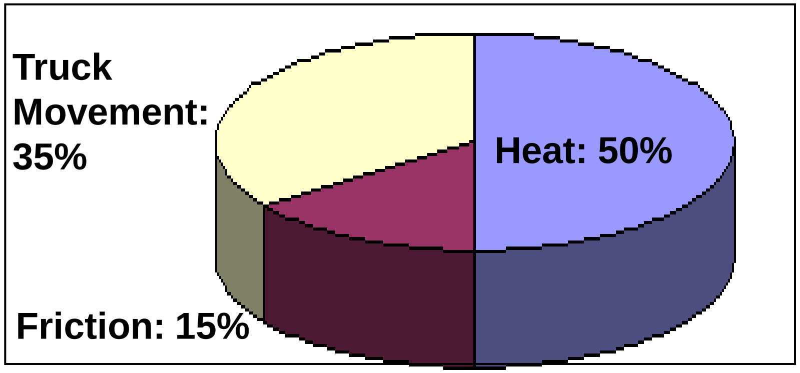
3

How do Polyalphaolefin (PAO) Based Lubricants Help Improve Fuel Economy?

- **Lower Traction Coefficient**
  - Lower traction coefficient minimizes internal friction
  - Lower viscous friction helps improve fuel economy
- **Improved Cold Flow**
  - Less thickening and improved flow in cold climate conditions results in reduced wear during cold start-ups
  - Lower contact and viscous friction helps improve fuel economy
  - Improves battery and starter motor life
- **Improved Oil Film Thickness at Operating Temperature**
  - Results in reduced "Contact Friction" and longer equipment life

How Can Low-Viscosity Lubricants Impact My Fuel Economy?

- Only a small percentage of the fuel used actually moves the truck:

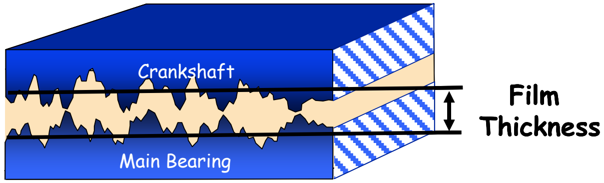


- Although friction cannot be completely eliminated, there are ways to reduce friction and increase fuel economy

- Within an engine, there are two types of friction:

  1. ***Viscous friction:*** related to the thickness of the oil and includes energy losses related to pumping the oil through the engine.

  2. ***Contact friction:*** results from contact between metal surfaces; can lead to both engine wear and a reduction in fuel economy.



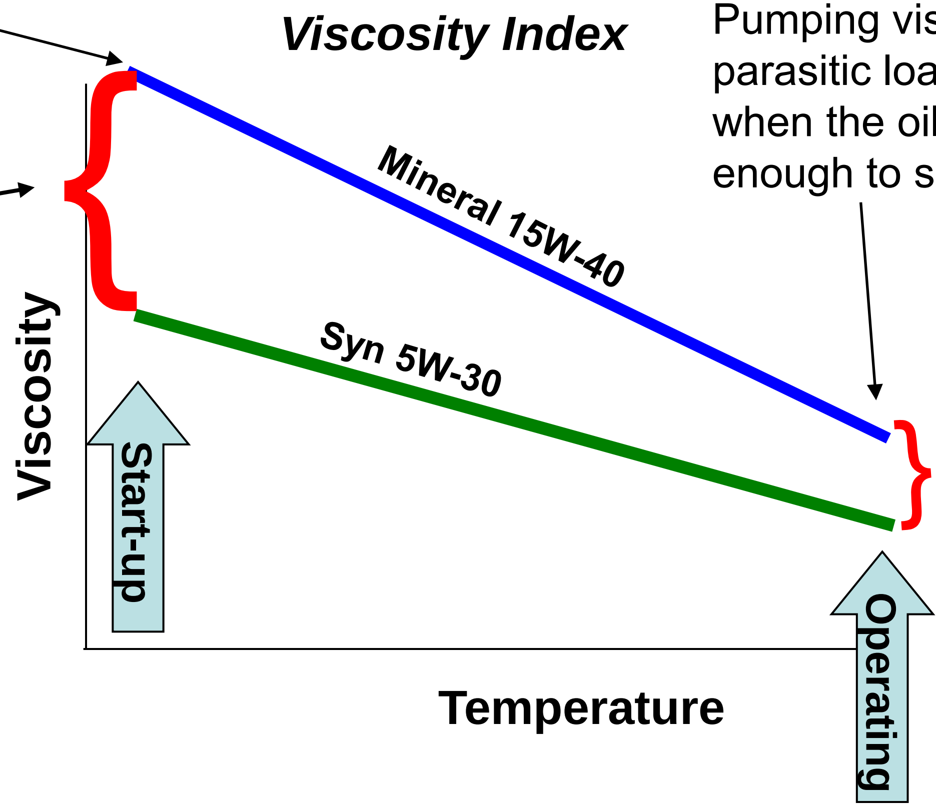
Friction Impacts on Fuel Economy

- Viscous friction is highest during cold engine start-up and stop-and-go driving
- The oil is the most viscous and the result is reduced fuel economy

Contact and viscous friction can reduce fuel economy at operating temperatures

Pumping viscous oils place higher parasitic loads on the engine and/or when the oil film isn't strong enough to separate moving parts

- The potential exists for up to a 5% improvement in fuel economy from a multi-grade lubricant with a lower "W" grade, i.e. **5**W-XX VS **15**W-XX



- The potential exists for up to a 2% improvement in fuel economy from a multi-grade lubricant with a lower, high-temperature viscosity grade, i.e. XW-**30** VS XW-**40**

Heavy Duty Engine Oil Fuel Economy

Three key operating regimes

- Measured / observed fuel economy contribution from engine oil is a complex composite of a number of different factors
- Full understanding of the engine oil fuel economy contribution requires us to "de-construct" fuel economy:

Description	Size	Oil's Impact	Measure by	Influenced by
1 Fuel Economy at Normal Operating Conditions	Small (0.5 to 2%)	Major	- Engine Stand -SAE Type II	-- High Temp Viscometrics -- Additive (including FMs)
2 Fuel Economy at Low Temperature Operation	Large (up to 5%)	Moderate	- Low Temp Test - Modified SAE	-- Low Temp Properties
3 Fuel Economy Retention	Large (up to 5%)	Potentially Major	Field or Special Lab Testing	-- Oil Stability -- Shear Characteristics

- The ultimate fuel economy improvement potential of the oil becomes the total of its contributions in each of the three distinct areas shown above weighted by the impact that each area has on a given trucking operation
  - This will be unique to each fleet
- The complexity of the fuel economy equation creates significant challenges
  - Selection of measurement tools and criteria
  - Lubricant design considerations; mineral vs. synthetic, standard vs. non-conventional, etc.

Fuel Economy Testing

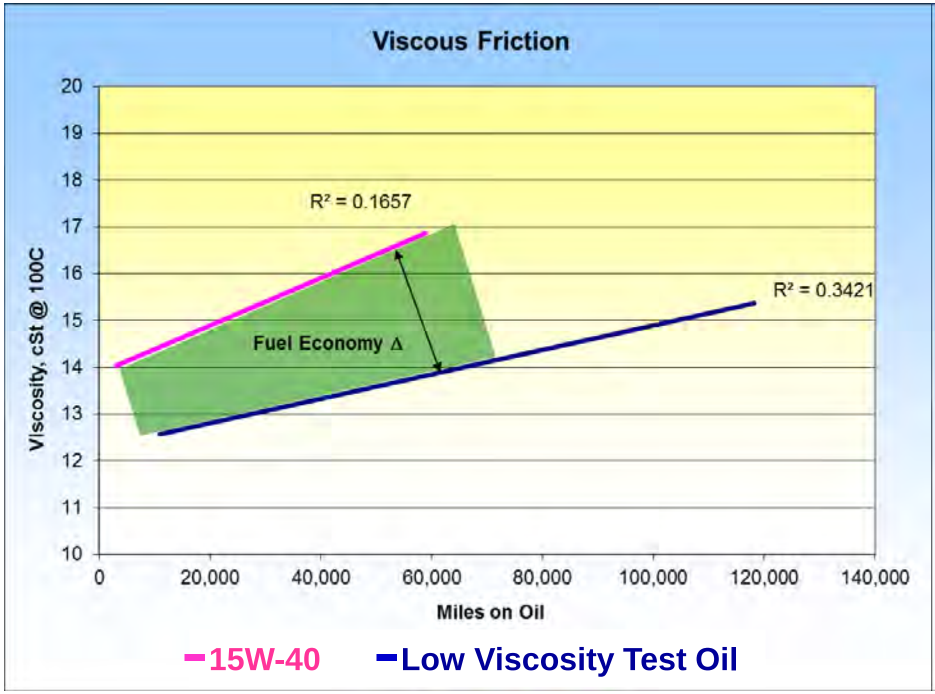
Three types of testing programs

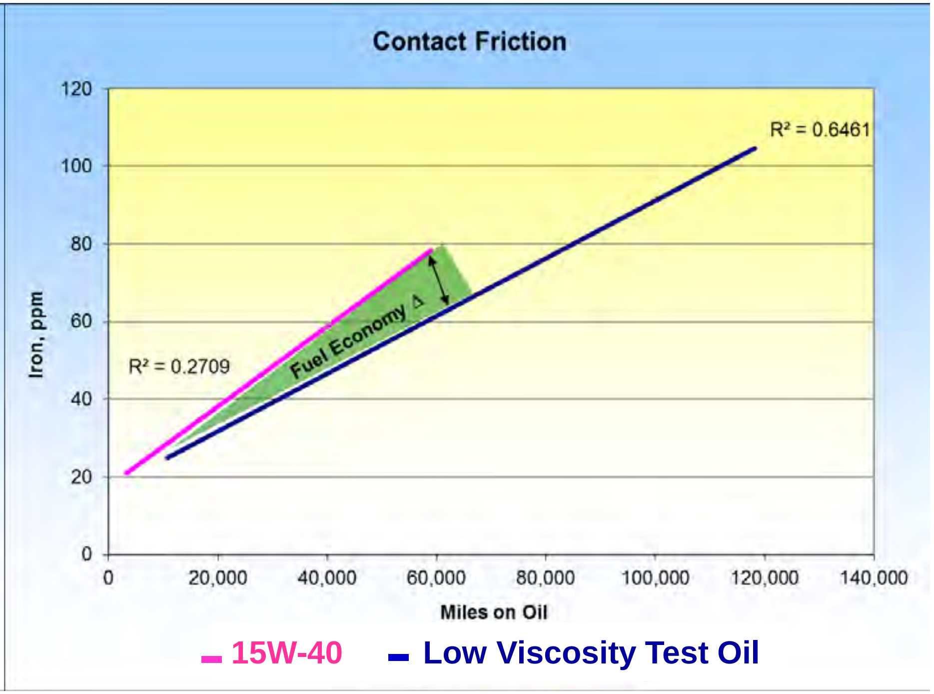
An extensive testing program needs to be undertaken in order to understand the fuel economy potential of a lubricant to include:

1. **Laboratory bench rig testing**
   - Primary Focus: Fresh oil in both steady-state & transient operating conditions
   - Confirms the wear protection performance as well as the fuel economy potential of the lubricant
2. **SAE "Joint TMC/SAE Fuel Consumption Test Procedure, Type II & Type IV**
   - Primary Focus: Fresh oil and transient condition impacts on fuel economy
3. **Longer term Field evaluation in revenue generating trucks**
   - Primary Focus: Fuel economy retention as well as fuel economy of fresh oil
   - Encompasses performance variations during cold and hot climates
   - Better includes other total cost impacts such as optimization of maintenance interval capabilities and operational simplification (Re-greasing intervals, oil filters, APU's, etc.)

Fuel Economy Retention Field Test Results

Long Term Evaluation in Customer Revenue Generating Trucks





- Fuel economy for a low viscosity synthetic engine oil is **retained** throughout service interval
  - Reduces ***Viscous*** friction (left-hand graph)
  - Reduced ***Contact*** friction (right-hand graph)

Thank You For Your Time and Attention

Rob Banas
Phone: 678-493-3930
email: rob.a.banas@exxonmobil.com

Mobil Delvac 1

John Loop
Technology Manager
The Lubrizol Corporation

Formulating Fuel Efficient Lubricants

- Base Stock (Liquid Phase)
  - What is “Synthetic”?
- Lubricant Additives
  - “Living on the Edge” (Surface Active Agents)
- Fully Formulated Lubricant
  - Primary Lubricant Function
  - Added Benefit
- 5W-40 vs 15W-40
  - Real World Data

Base Stocks

What is a SYNTHETIC (crankcase) lubricant?

A lubricating formulation where the base stock (liquid phase) is partly or completely comprised of highly refined (API Group III) or man-made (API Group IV or V) base stocks so that the overall formulation is advantaged with the better properties (low volatility, good low temperature flow, stronger resistance to oxidation, higher base viscosity) provided by the premium base stock.

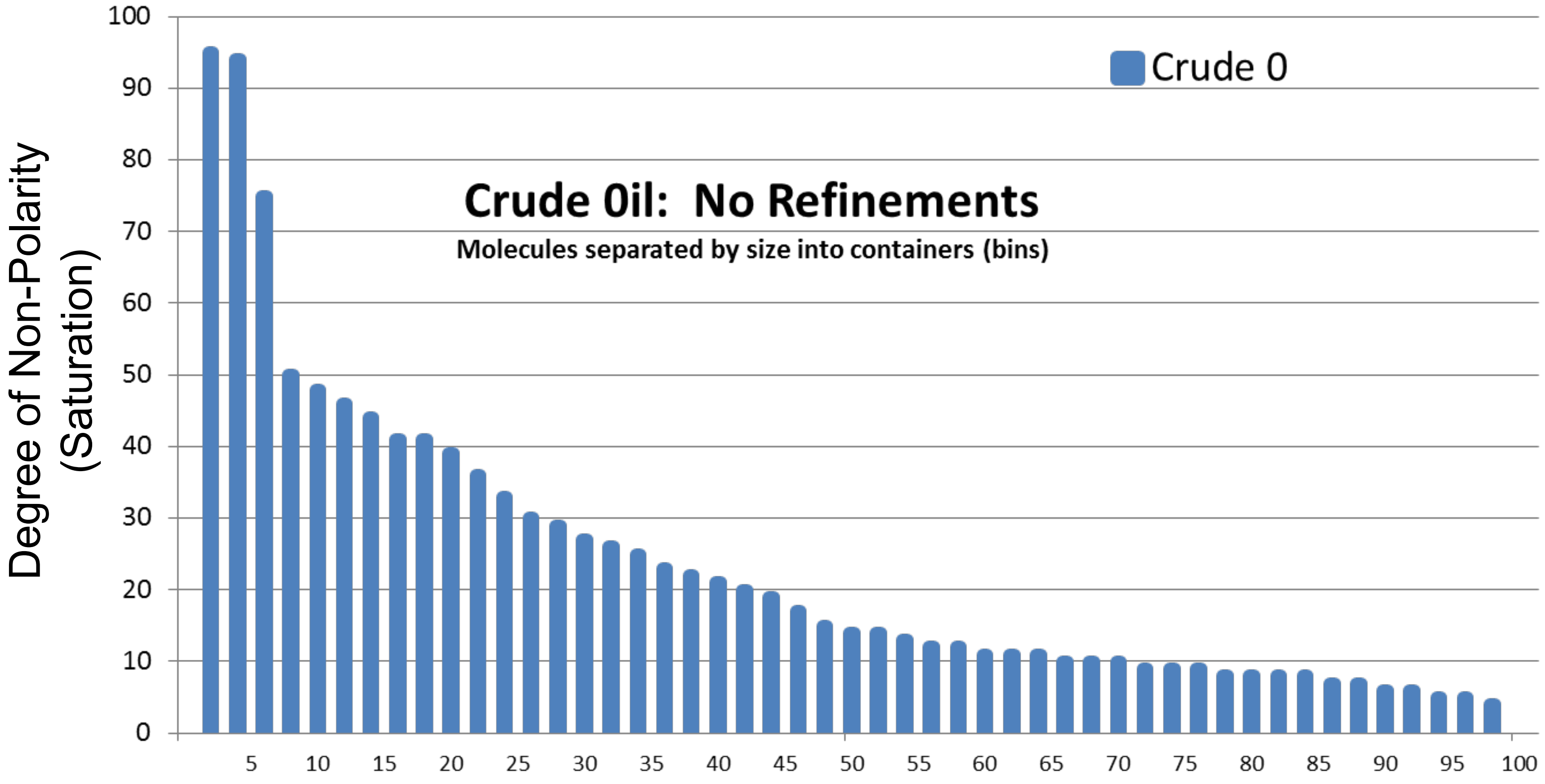
Typical viscosity grades for synthetic diesel lubricants

SAE 0W-30; 0W-40; 5W-30; 5W-40

What is a SYNTHETIC Base Stock?

Base Stock Evolution

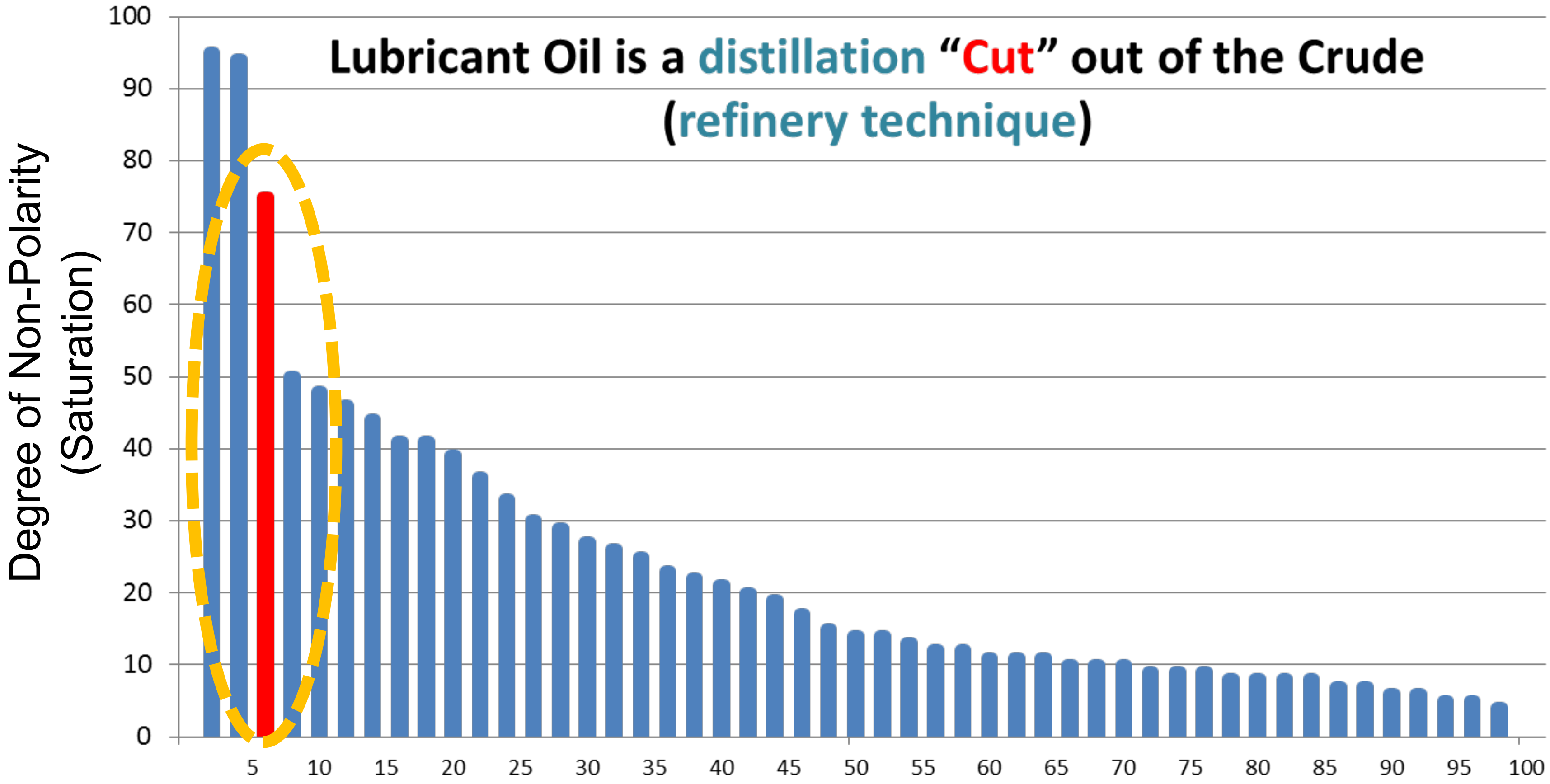
Raw Material



← Small Molecules ------------------------- Large Molecules Oil →

Base Stock Evolution

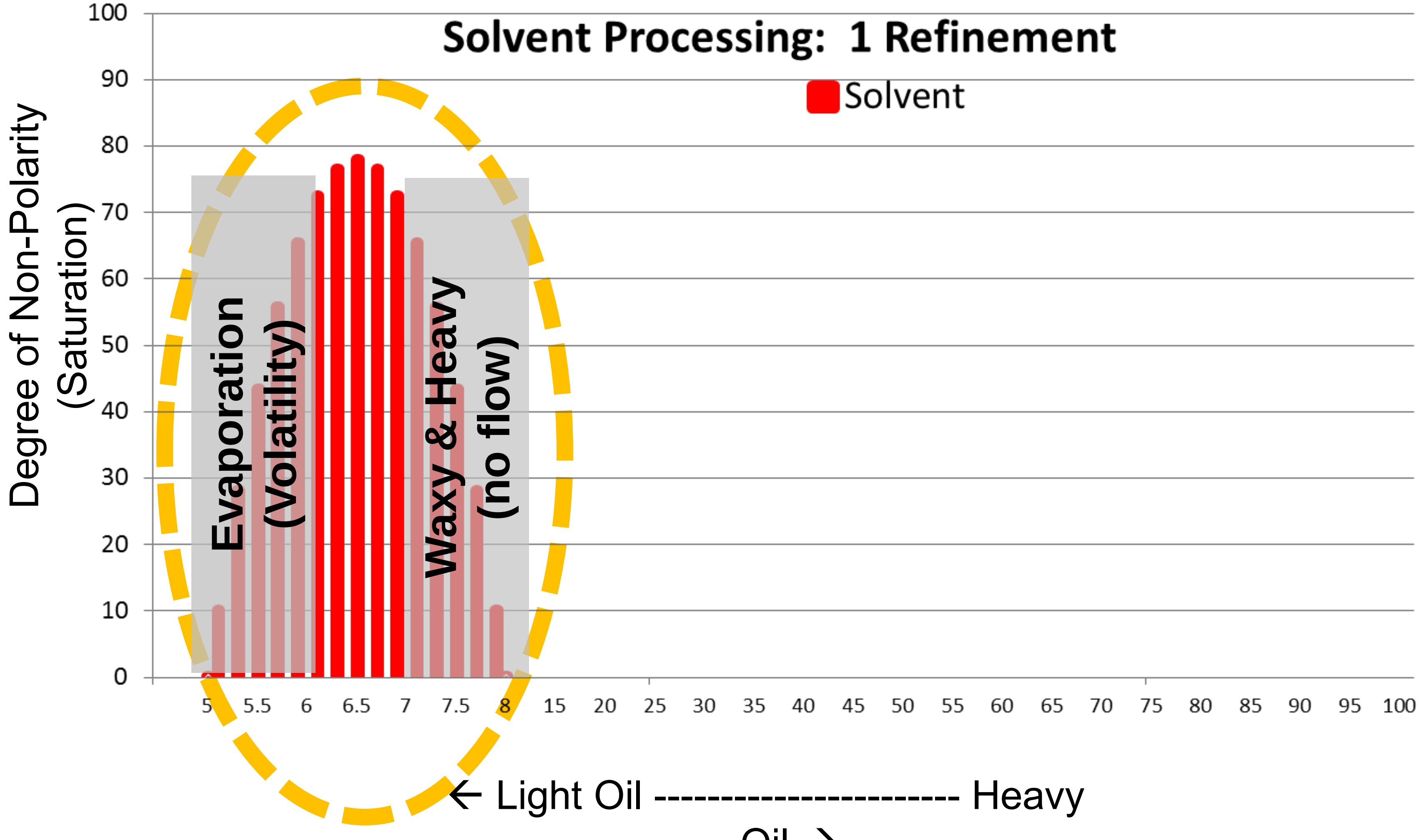
Lube Oil Region



← Small Molecules ------------------------- Large Molecules Oil →

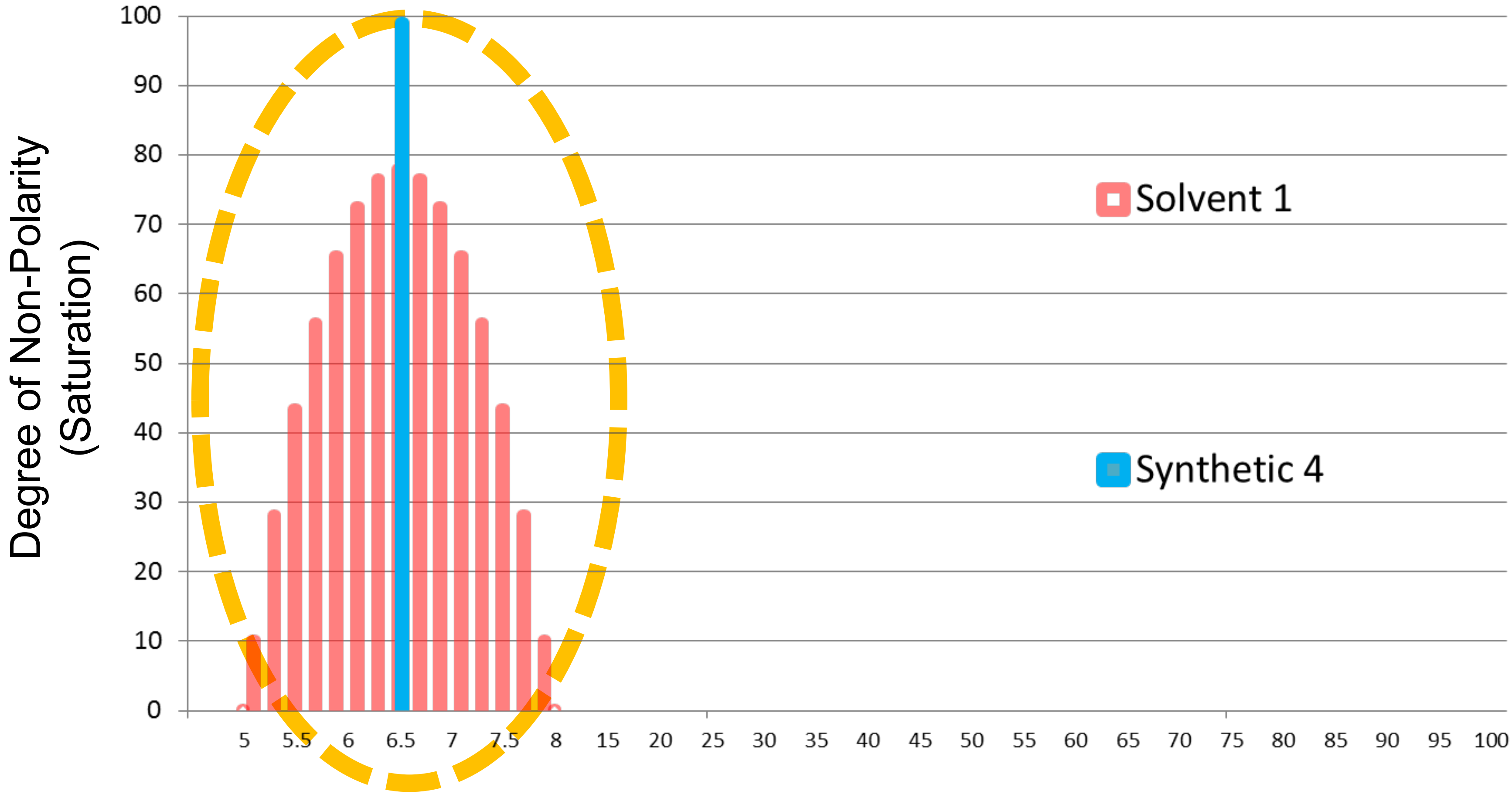
Base Stock Evolution

Zoom into Lube Oil Region



Base Stock Evolution

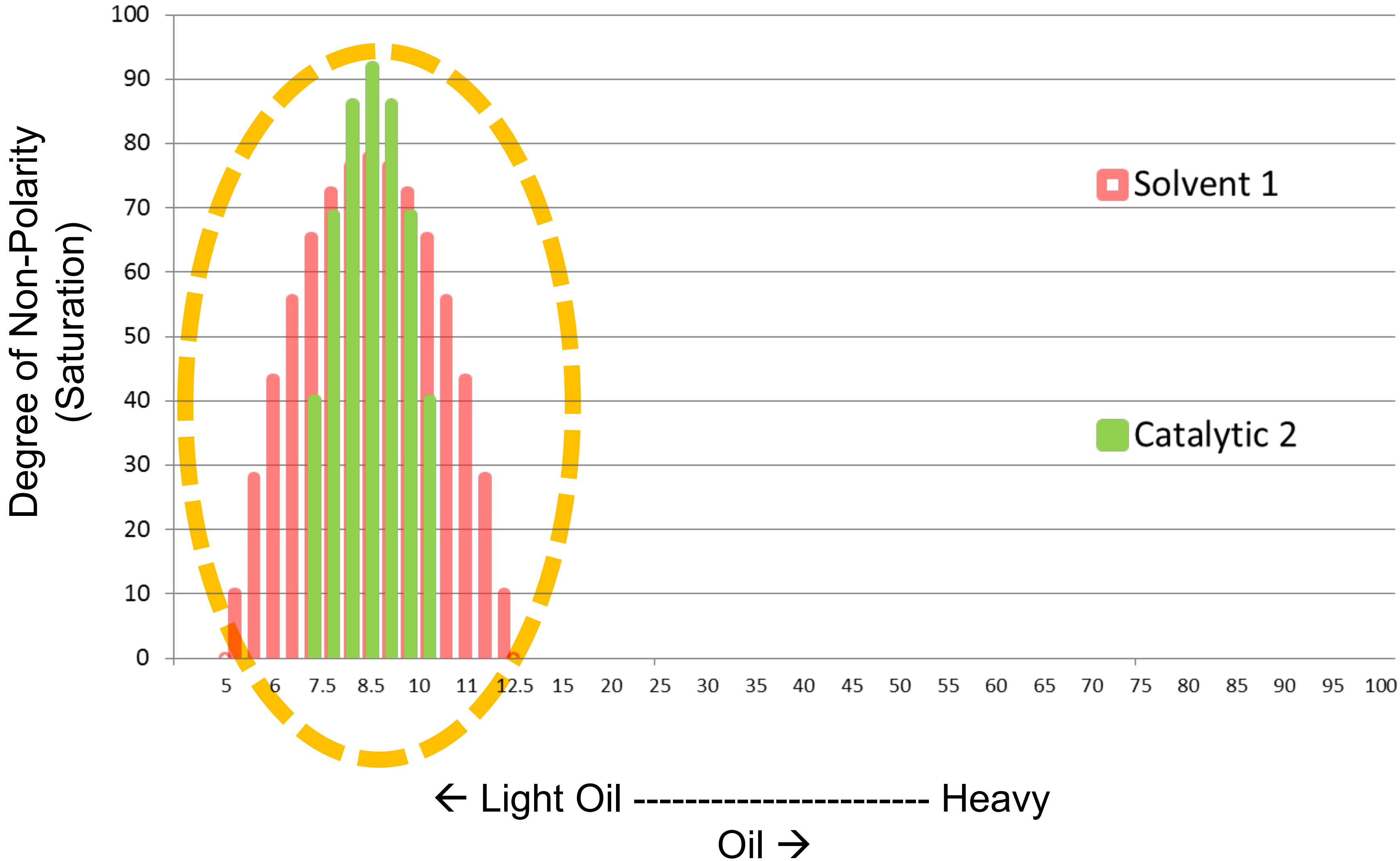
Synthetics Are More Homogenous



← Light Oil --------------------- Heavy Oil →

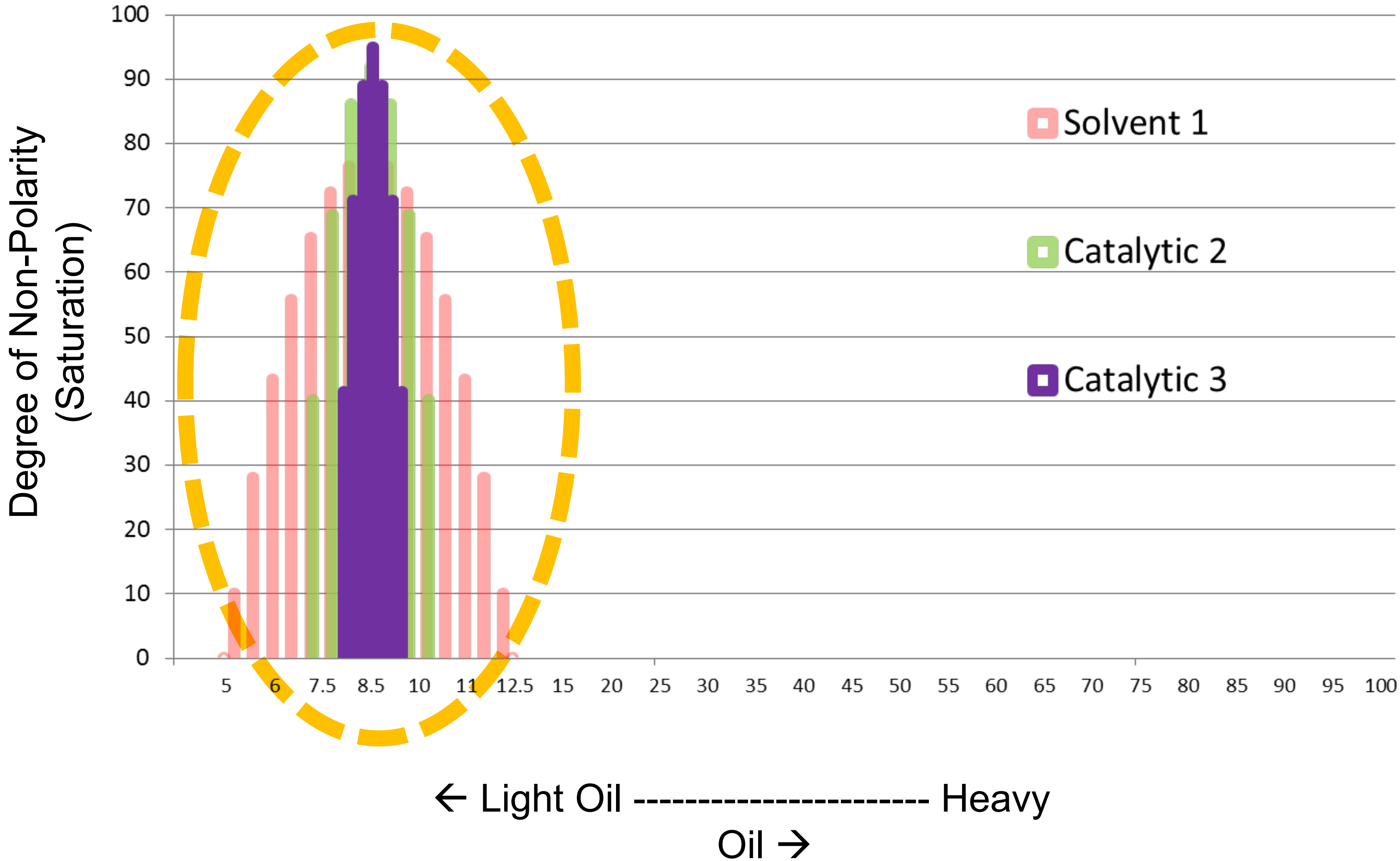
Base Stock Evolution

Catalysts Re-Arrange Molecules

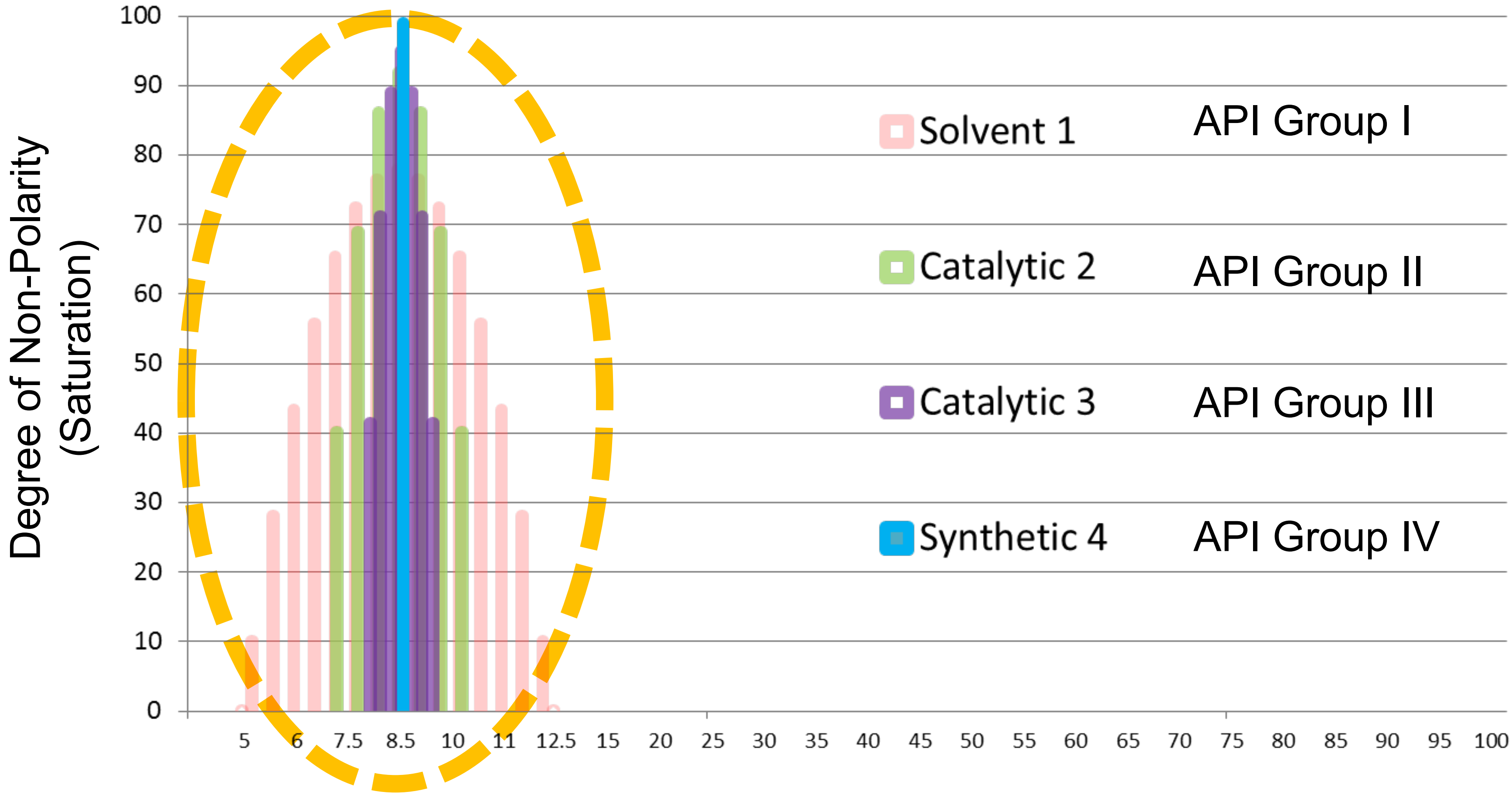


Base Stock Evolution

More Refining = More Synthetic Like

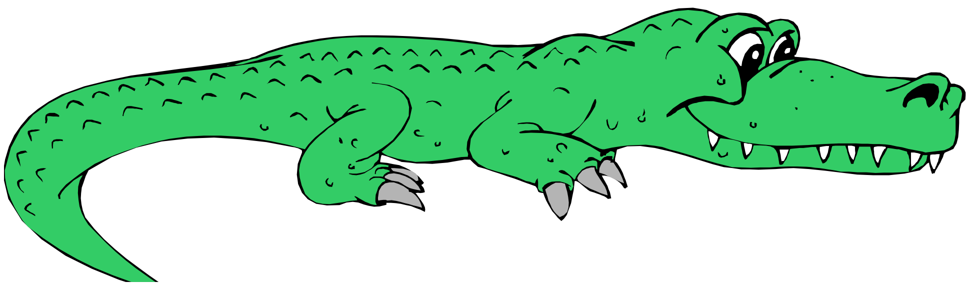


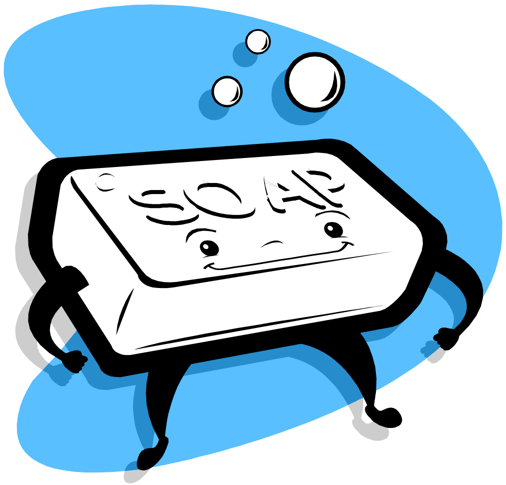
“Synthetic”: Group III/IV Base Stocks



← Light Oil ---------------------- Heavy Oil →

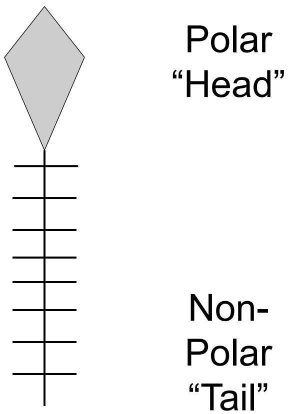
Lubricant Additives

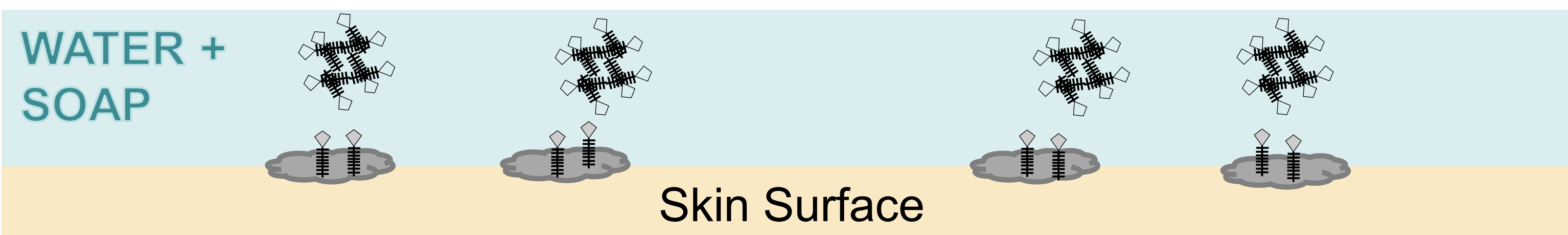




"Living on the Edge": Surfactants

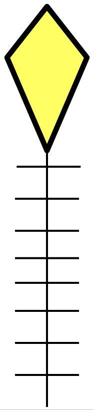
- How would you formulate a skin cleanser?
  - Liquid Phase: **WATER**
  - Additive: SOAP

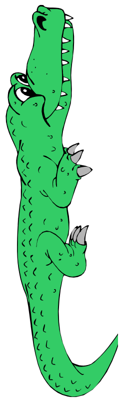


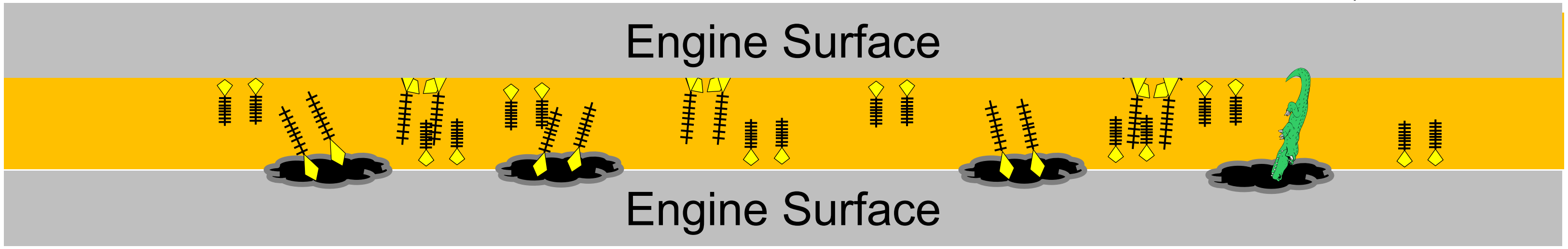


"Living on the Edge": Surfactants

- How to formulate a Crankcase Lubricant!
  - Liquid Phase: Oil
  - Additive: SOAP

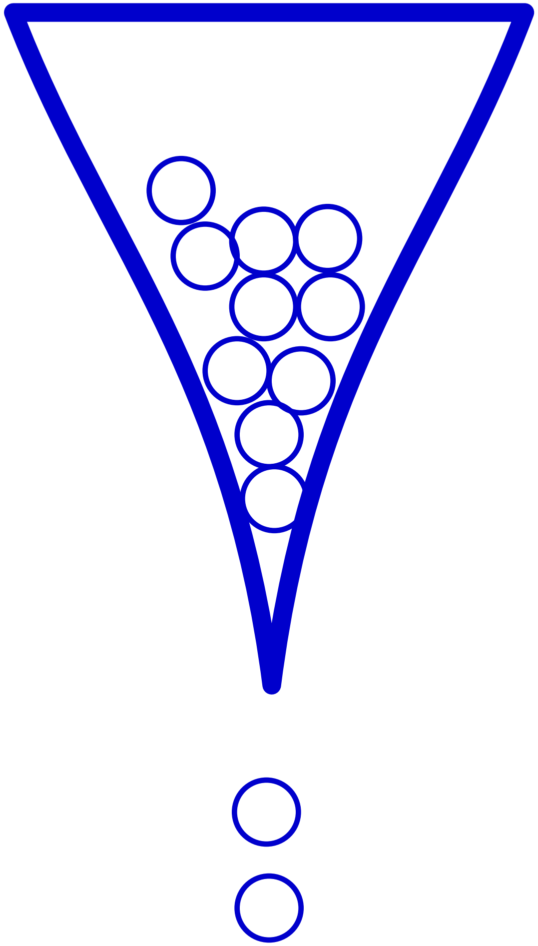




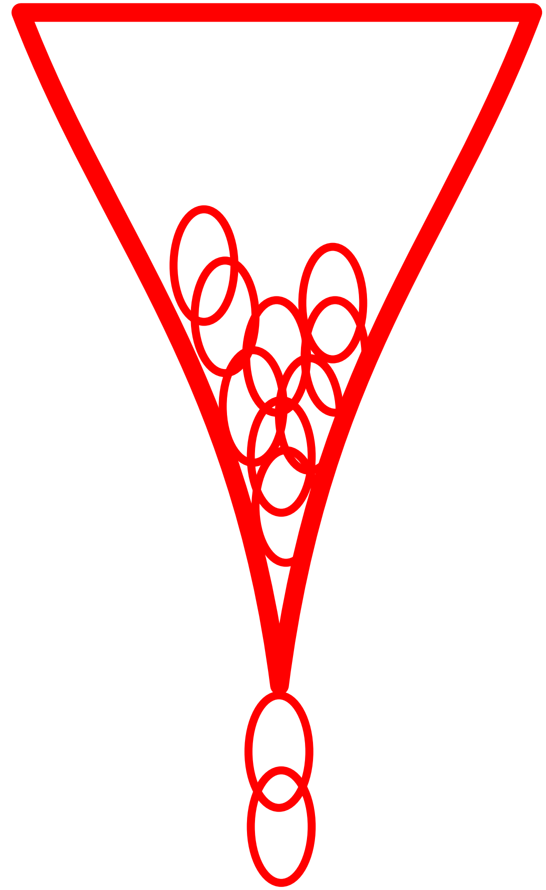


Kinematic vs HTHS* Viscosities

* HTHS: High-Temperature/ High-Shear



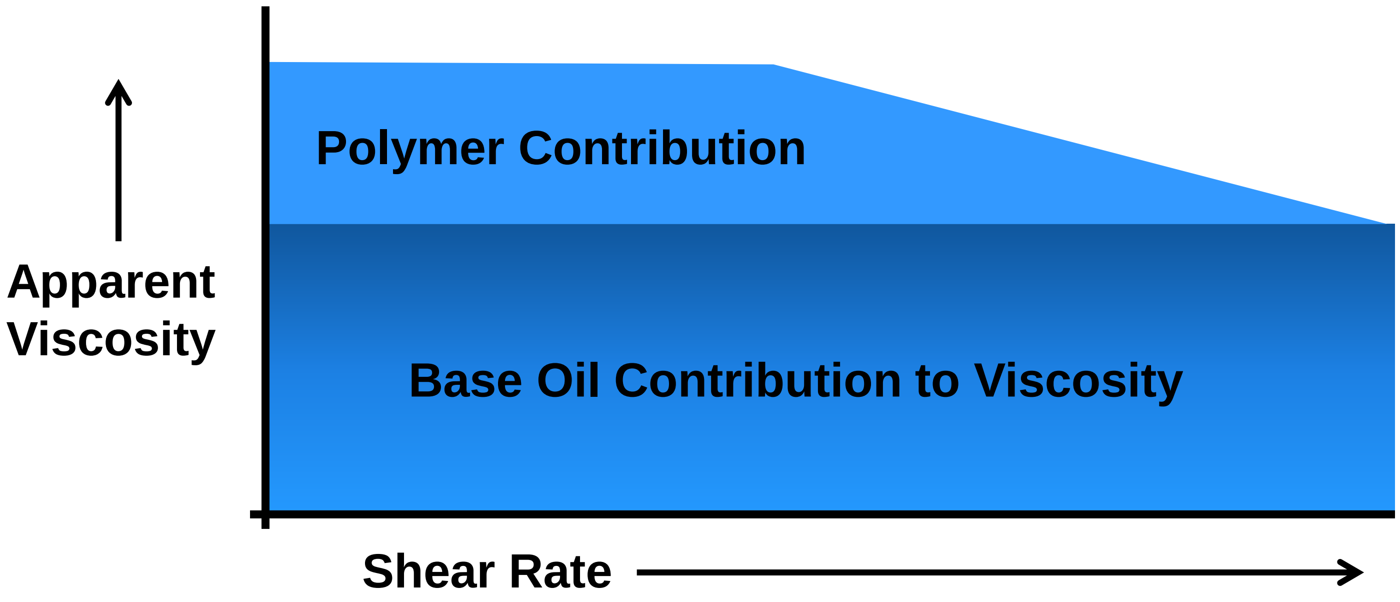
GRAVITY ONLY



SHEAR FORCE

High-Temperature/High-Shear (HTHS)

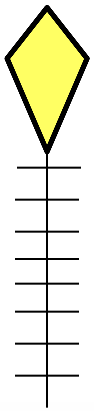
- Viscosity of lubricant depends on the shear rate applied to the fluid
- Viscosity loss is temporary if the shear force or energy applied is low
- However, high temperature and/or energy situations (thin film lubrication at high sliding speeds in oil pumps, gearboxes, valve gear and piston rings) will result in permanent viscosity loss

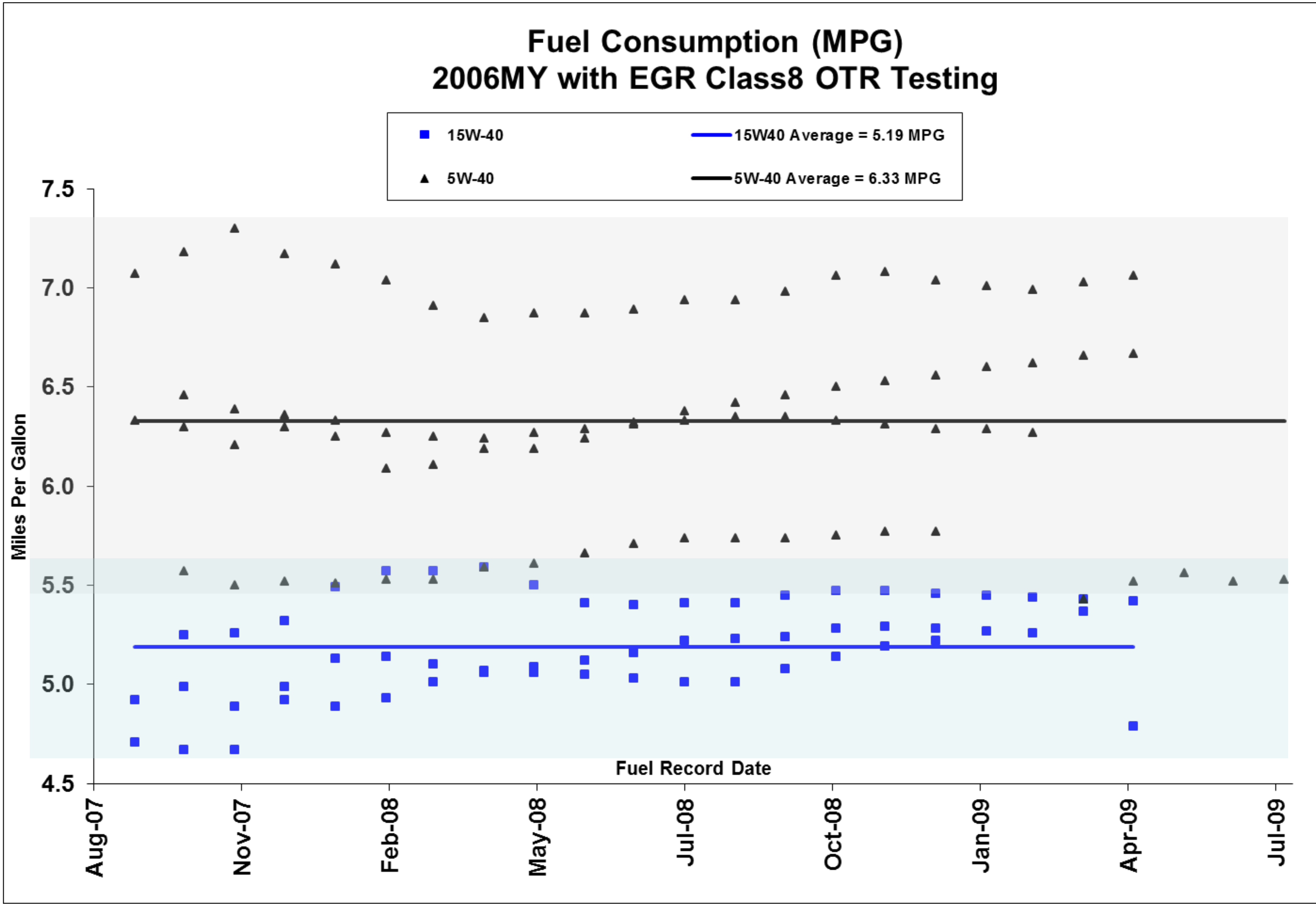


Fully Formulated Lubricant

- Primary Lubricant Function: Protect the Engine
  - Additive / Lubricant Manufacturers work together to deliver products that protect the engine.
    - Fuel Efficient Engine Lubricants will continue to protect

- Added Benefit: Delivering Fuel Efficiency
  - A Correct **Balance** of the….
    - Base Stocks
    - Additives
    - Viscosity & Friction Modifiers

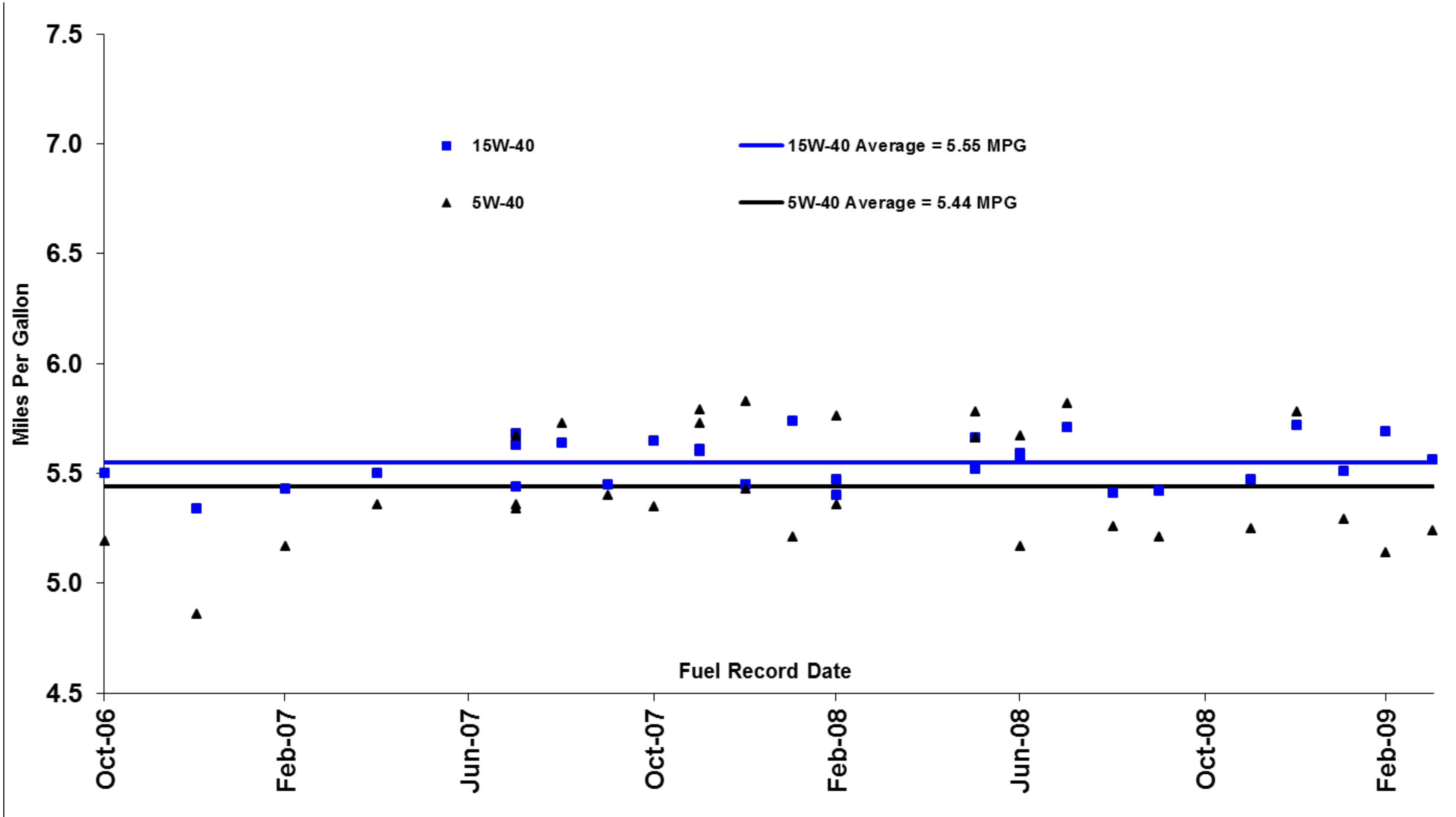




Fuel Consumption (MPG)
2006MY with EGR Class8 OTR Testing
15W-40
15W40 Average = 5.19 MPG
5W-40
5W-40 Average = 6.33 MPG
Miles Per Gallon
7.5
7.0
6.5
6.0
5.5
5.0
4.5
Fuel Record Date
Aug-07
Nov-07
Feb-08
May-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09

Fuel Consumption (mpg)

2006MY Class 8 OTR Testing



Thank You For Your Time and Attention

John Loop
Phone: (440) 347-5365
email: john.loop@lubrizol.com

Additional information on Heavy-Duty Diesel Engine Oils may be found at:
www.hddeo.com

Larry A. Eckhardt

Manager, Fleet and Field Evaluations

Southwest Research Institute

Recommended Practices

TMC Recommended Practices

- RP1101 Type 1 ***Obsolete***
- RP1102 In-service Fuel Consumption Test Procedure Type II
- RP1103 In-service Fuel Consumption Test Procedure Type III
- RP1109 Type IV Fuel Economy Test Procedure

SAE Recommended Practices

- SAE J1264 Joint RCCC/SAE Fuel Consumption Test Procedure (Short-Term In-Service Vehicle) Type 1
- SAE J1321 Joint TMC/SAE Fuel Consumption Test Procedure Type II
- SAE J1526 Joint TMC/SAE Fuel Consumption In-Service Test Procedure Type III
- SAE J1376 Fuel Economy Measurement Test (Engineering Type) for Trucks and Buses

J1321 Joint TMC/SAE Fuel Consumption Test Procedure – Type II

- This recommended practice provides a standardized test procedure for comparing the fuel consumption of two conditions of a test vehicle or of one test vehicle to another.
- An unchanging control vehicle is run in tandem with the test vehicle(s) to provide reference fuel consumption data.
- This procedure is especially suitable for testing components that require substantial time for removal and replacement or modification, such as engines, transmission, tag-axles, and body sheet metal.
- This procedure may also be used for comparison of entire vehicles and for easy-to-change components.

J1321 Joint TMC/SAE Fuel Consumption Test Procedure – Type II

- The result of a test using this procedure is the percent difference in fuel consumption between the two test vehicles or the difference in fuel consumption of one vehicle in two different test conditions

- The fuel measurement method is a key factor in determining the overall accuracy achievable with this procedure

- If the weighing method is used, overall test accuracy is best and based on test experience will be within ± 1%
  - For example, 6% measurement improvement can be from 5% - 7% actual improvement

Four Basic Rules

- The following four basic rules must be applied to this procedure to insure test result validity:
  1) The test routes and cargo weight should be representative of actual operation.
  2) A single test is inconclusive regardless of the results. A single test should be taken as an indicator. Test results must be repeatable to have validity.
  3) The more variables controlled, the more conclusive the results.
  4) All test procedures or methods are accurate within prescribed limits.

Drivers

- Drivers selected should be sufficiently skilled so that test results are not affected by the driver's technique improvement during the test period.

- Drivers should also have a strong motivation for unbiased results and excellence of test procedure conduct.

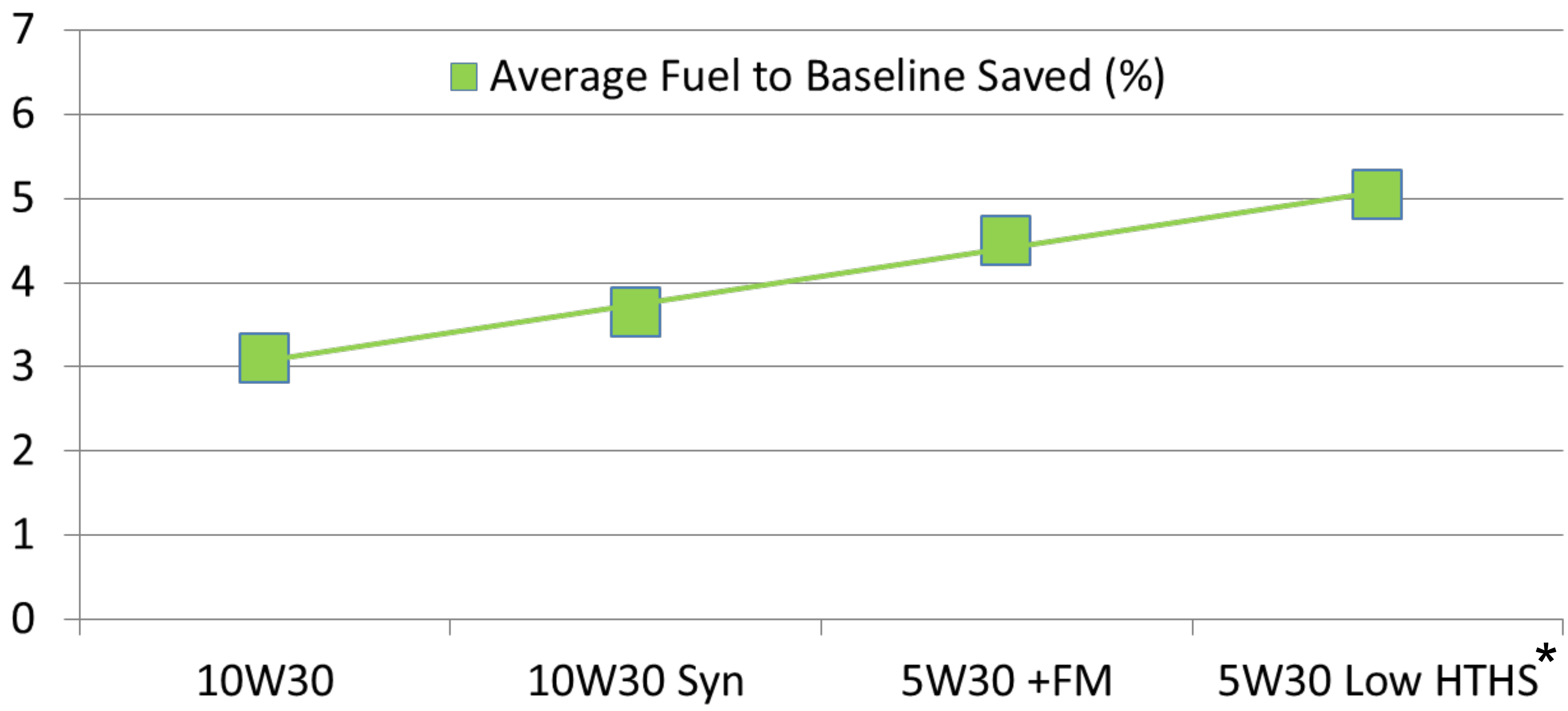
Observers

- Observers should be assigned to each vehicle.
- The observer records the data necessary.
- Complex driving cycles require observers; simple driving cycles may not require observers.

Test Accuracy

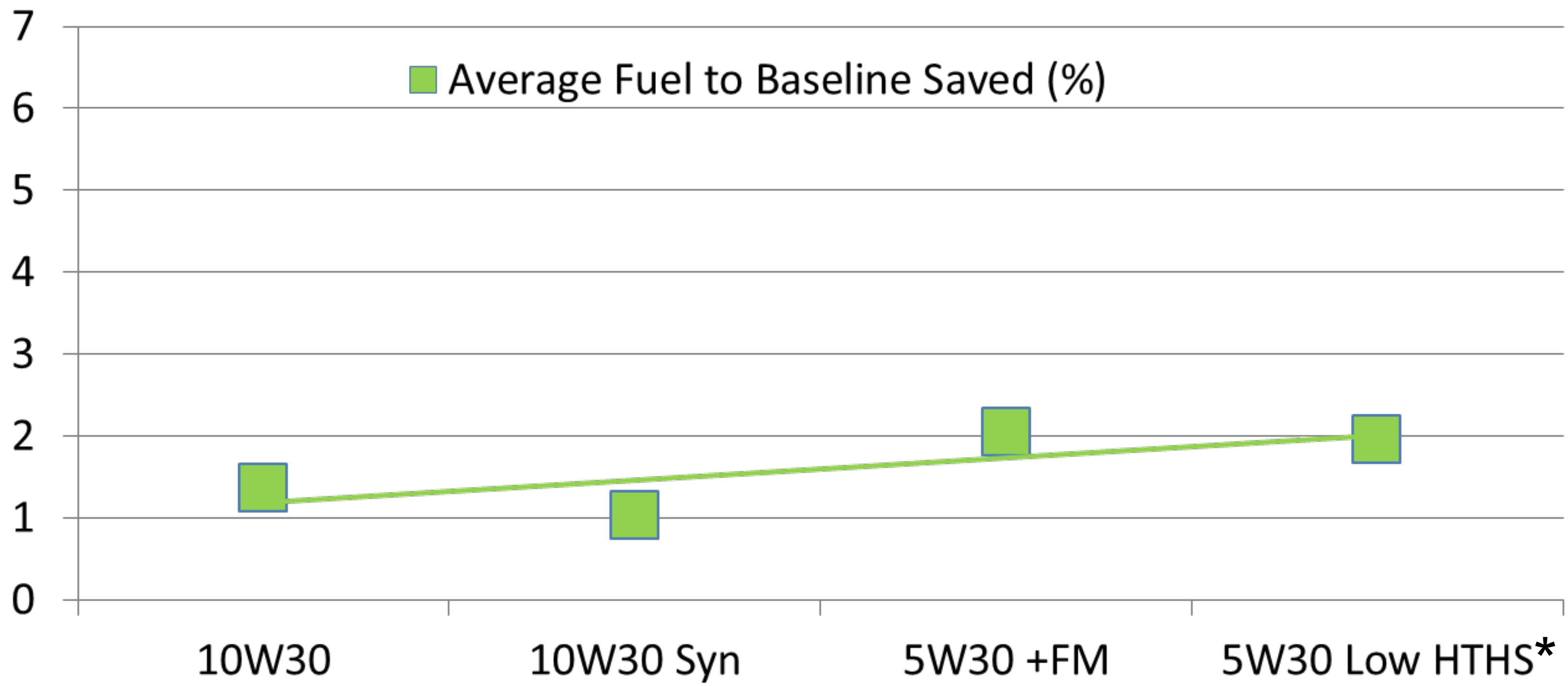
- Test accuracy for properly conducted tests using portable tank weigh methods are considered to have an overall accuracy within ±1%
  - Based upon test experience with long-haul test routes
  - Example: 6% measured difference can be from 5% - 7% actual difference.

Fuel Efficient Lubricants
Class 6: xW-30 vs 15W-40



** HTHS: High-Temperature/ High-Shear*

Fuel Efficient Lubricants
Class 8: xW-30 vs 15W-40



** HTHS: High-Temperature/ High-Shear*

Breakdown of Fuel Economy Benefits of Synthetic Oil versus Mineral Oil

Engine
1-2%

Transmission
2-3%

Gear
3-4%

Cumulative Benefit: 6 to 9%

Thank You For Your Time and Attention

Larry Eckhardt
Phone: (210) 522-2980
email: larry.eckhardt@swri.org

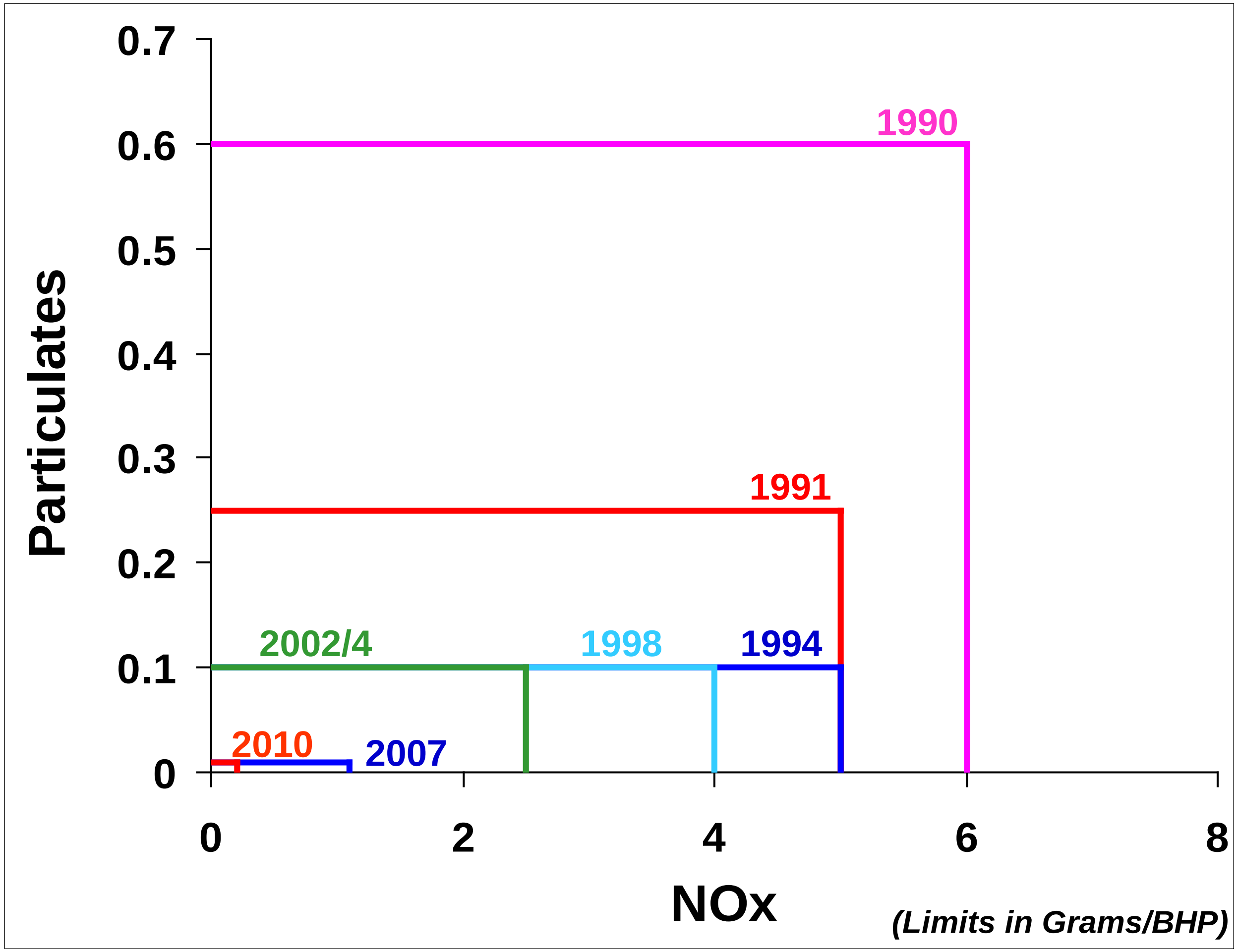
Greg Shank

Manager Structures & Materials

Volvo Powertrain, N.A.

Truck & Engine Manufacturers Association™

U.S. HD Diesel Emission Requirements



API HD Oil Specifications

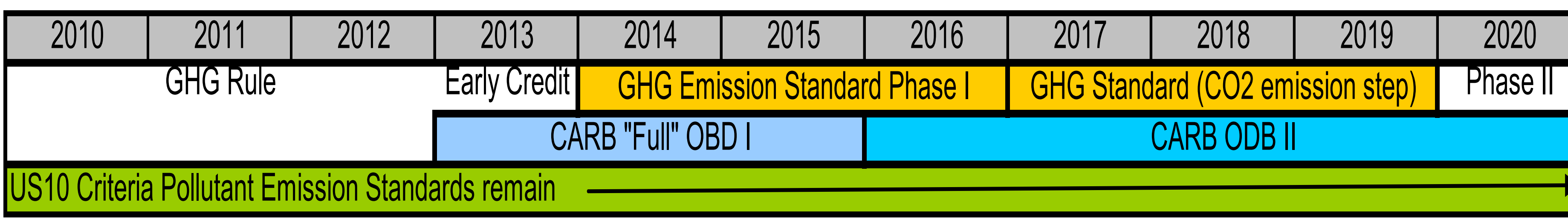
Year	Oil Category
1991	CF-4
1994	CG-4
1998	CH-4
2002/4	CI-4 (CI-4 Plus)
2007	*CJ-4*
2010	*CJ-4*

Regulation

Overview, Timeline, & Applicability

- Green House Gases (GHG) Emission Standards “Phase I” of US EPA program
- Final rule authorized by end of July 2011 (published by Fall 2011)
- Early credit generation: 2013MY (as early as 2 Jan 2012)
- GHG certification required: 2014MY
- GHG certification required (step to lower CO2 standard): 2017MY

NOTE: EPA staff have stated development on Phase II GHG rules will start in August 2011.



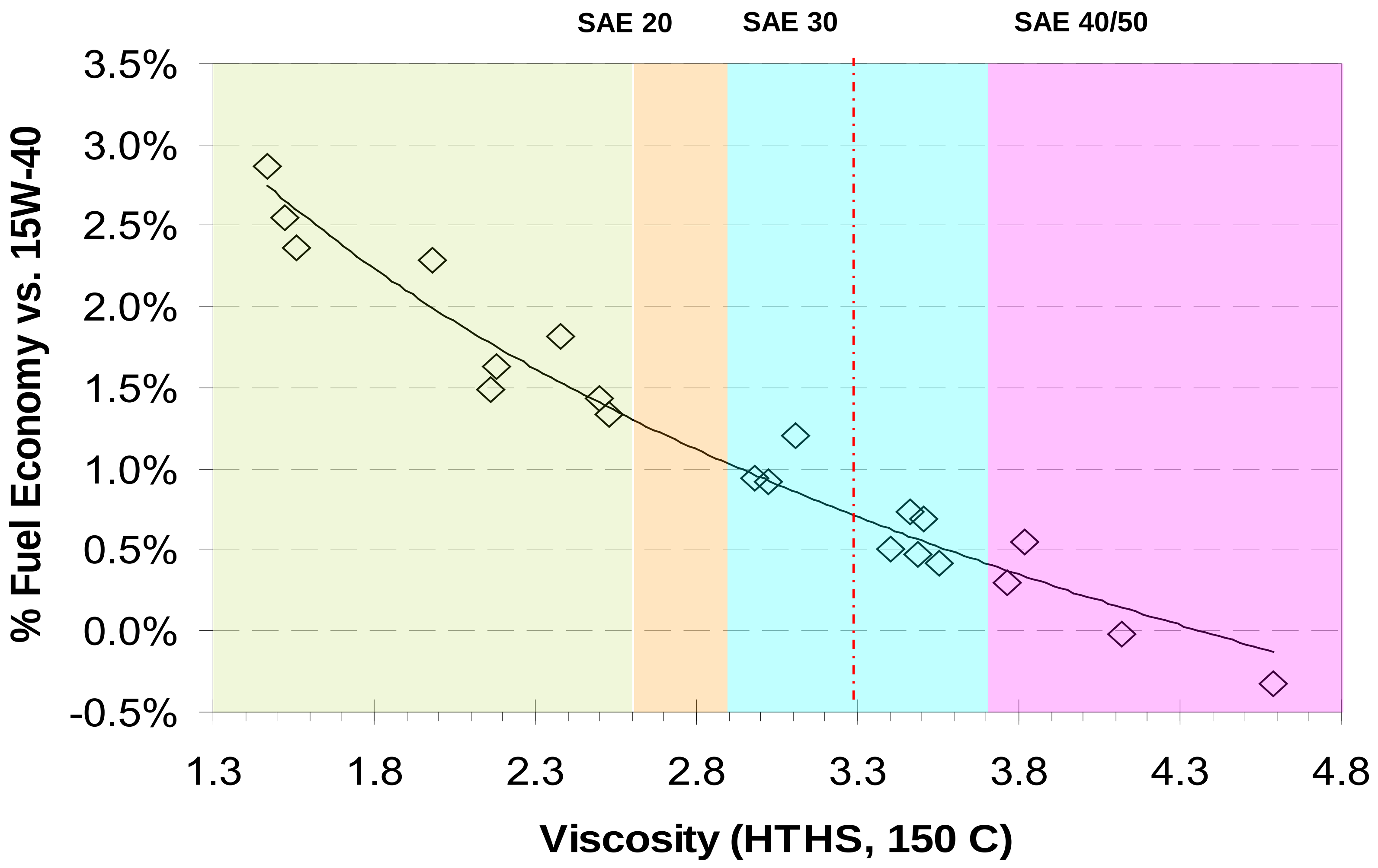
EPA Heavy-Duty Fuel Efficiency

- Engine only portion of standard requirements
  - measured as CO_2 emission levels
  - reported as percent reduction from 2013-2015 Model Year (***current engine lubricant***) baselines.

Tractors – Conventional tractor/trailer trucks
Vocational – All other non-conventional tractor/trailer trucks

Model Year	LHD Engines	MHD Engines	HHD Engines
2013 - 2015 Tractors	**NA**	**Baseline**	**Baseline**
2016 and later Tractors	**NA**	**-4.9%**	**-5.15%**
2013-2015 Vocational	**Baseline**	**Baseline**	**Baseline**
2016 and later Vocational	**-6.8%**	**-6.8%**	**-3.8%**

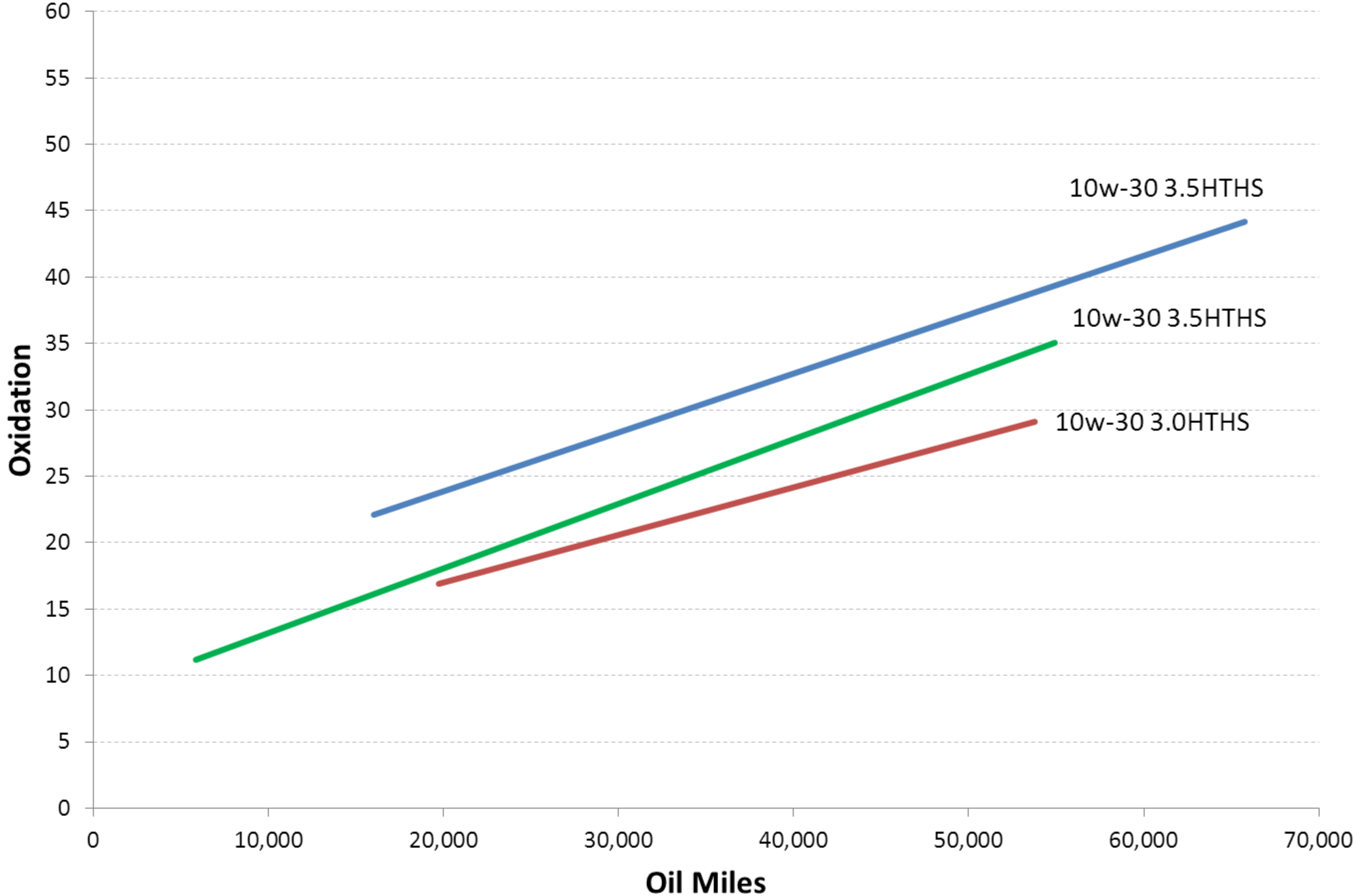
Fuel Economy & High-Temperature/ High-Shear (HTHS)

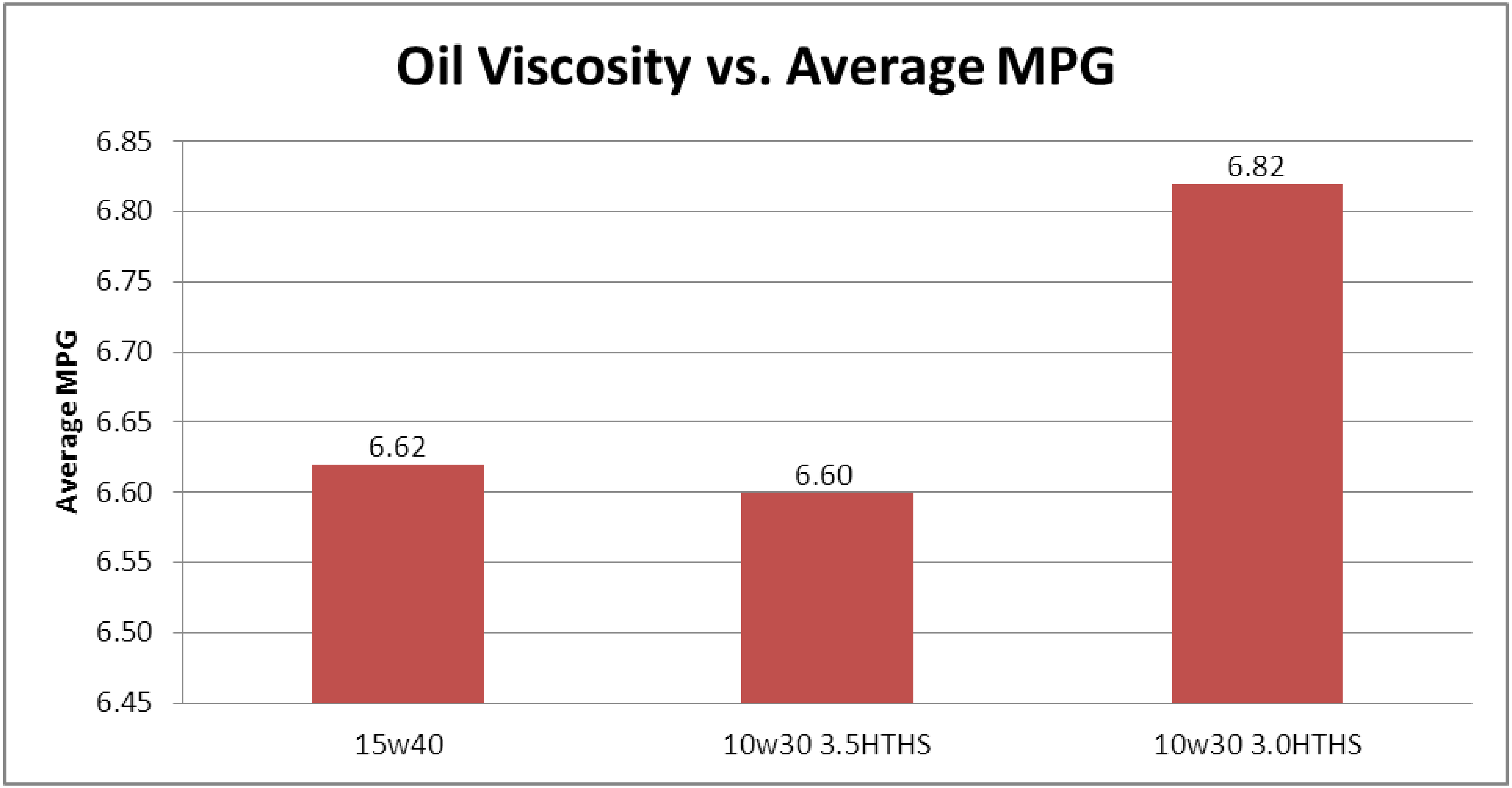



EPA 2010 Class 8
Iron vs. Oil Miles
Iron (ppm)
0
20
40
60
80
100
120
140
Oil Miles
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
10w-30 3.5HTHS
10w-30 3.5HTHS
10w-30 3.0HTHS


EPA 2010 Class 8
Lead vs. Oil Miles
Lead (ppm)
50
40
30
20
10
0
10w-30 3.0HTHS
10w-30 3.5HTHS
10w-30 3.5HTHS
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
Oil Miles

EPA 2010 Class 8
Oil Oxidation vs. Oil Miles





Comparing the 3.5 HTHS 10W-30 to the 3.0 HTHS yields an Fuel Economy gain of **3%**

New Category PC11 Needs

- ***Fuel Economy, Fuel Economy, Fuel Economy***
- Maintain Engine Durability
- Oxidation Control
- Biodiesel Compatibility
- Extended Oil Drain
- Backwards Compatibility
- Replacement of Current Engine Test

Truck & Engine Manufacturers Association™
Bringing Cleaner Power to the World Since 1968®

333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
Tel: (312) 929-1970 I Fax: (312) 929-1975
www.truckandenginemanufacturers.org

API/EMA Diesel Engine Oil Advisory Panel
c/o Steven Kennedy, Co-Chair
ExxonMobil Research & Engineering
Paulsboro Technical Center
P.O. Box 480
Paulsboro, New Jersey 08066-0480

Re: Request for New Category

Dear Steve:

In accordance with the procedures established in API 1509 Appendix D, the Engine Manufacturers Association requests that the API/EMA Diesel Engine Oil Advisory Panel (DEOAP) proceed with the development of a new heavy-duty diesel engine oil category (referred to as "PC-11"). **EMA/TMA requests that the API first license date for this new oil category be no later than January 1, 2016.**

As you are aware, the U.S. Environmental Protection Agency (EPA) is in process of adopting regulations which will mandate improvements in fuel efficiency from heavy-duty on-highway diesel engines and vehicles, beginning in 2014 with additional efficiency improvements beginning in 2017 (the "GHG Rule"). Engine lubricant performance can have a significant influence on an engine's ability to achieve EPA's fuel efficiency goals. Heavy-duty engine oil fuel efficiency is directly related to high-temperature/high-shear (HTHS) performance; however, many engines require the current HTHS level of performance to achieve acceptable engine durability.

Therefore EMA/TMA requests that the PC-11 category be split into two separate and distinct subcategories with corresponding HTHS performance levels, one that preserves historical heavy-duty oil criteria and one that provides fuel efficiency benefits.

Both subcategories should also provide improvements in oxidation stability, aeration benefits, shear stability, and compatibility with biodiesel blends. EMA/TMA looks forward to working with the API Marketing experts to determine a viable product identification system to convey to the marketplace the critical difference between the two distinct classifications of PC-11 oils.

A table outlining proposed performance requirements for PC-11 is attached as Exhibit A. As the category development process proceeds, EMA/TMA expect to provide information regarding the performance tests that may be available to evaluate the performance needs requested.

We look forward to working together again with API as we undertake this very important project.

Very truly yours,

Greg Shank

Greg Shank
Lubricants Committee Chair

Truck & Engine Manufacturers Association™
Bringing Cleaner Power to the World Since 1968®

333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
Tel: (312) 929-1970 I Fax: (312) 929-1975
www.truckandenginemanufacturers.org

Characteristic	Carryover from CJ-4	Improved for PC?11	New for PC?11
Piston Deposits, Fe and Oil Consumption	X		
Piston Deposits, Al and Oil Consumption	X		
Ring and Liner Wear (Corrosive), Bearing Corrosion	X		
Soot Valvetrain Wear (Abrasive and Rolling)	X		
Soot Valvetrain Wear (Sliding Wear)	X		
Soot / EGR Valvetrain Wear Valve Stem / Guide Wear (Abrasive and Corrosive)	X		
Piston/Liner Scuffing Wear (Adhesive)			**X (New Test)**
Thermal Stability (Oxidation)		X	
Oil Aeration		X	
Soot/Viscosity in EGR Engines	X		
Compatible with biodiesel blends			**X – Corrosion** **X – Deposits** **X – Oxidation** **X- Low Temperature Pump Ability**
Elastomer Compatibility	X		
Used Oil Viscometrics (Low Temp)	X		
High Temperature Corrosion	X		
Shear Stability			**X (New Test)**
Volatility	X		
Foaming	X		
Filter Plugging/ Sludge	X		
Ash Limit	X		
Phosphorus Limit	X		
Sulfur Limit	X		
High Temperature/High Shear Limit (Fresh Oil)	X - -3.5 cP min for non-FE oils		**X - 2.9 - 3.5 cP for FE oils**
High Temperature/High Shear Limit (After Shear Oil)			**X - for FE & non-FE Oils**

Development Time Line

- New category EMA/TMA request – May 2011
- Diesel Engine Oil Advisory Panel (DEOAP) forms
  New Category Evaluation Team (NCET) – June 2011
- NCET Meetings Aug. & Sept. 2011
- DEOAP Meeting Oct. 2011
- API Lubricants Committee Nov. 2011
- If approved by Lubes Committee forms the New Category Development Team
- API new category oils January 2016

http://www.apicj-4.org

Do your diesel right.

Performance Specification | Service Category Description | Frequently Asked Questions

If you run a diesel, your engine oil is about to change.

The new API CJ-4 oils are made for high-performance diesel engines designed to meet 2007 on-highway exhaust emission standards. API CJ-4 oils exceed previous performance requirements and are specifically designed to protect emission control systems, help comply with emission standards, reduce engine wear, and control piston deposits and oil consumption.

API CJ-4 oils are also engineered for use in previous model year engines and intended to maintain oil drain intervals when used in conjunction with Ultra-Low Sulfur Diesel Fuel (15 ppm maximum sulfur). As always, you should follow engine manufacturers' recommendations for specific application guidelines for all engine oil products.

API SERVICE CJ-4
SAE 15W-40

Developed in cooperation with

Caterpillar | Cummins | Detroit Diesel | Mack Trucks, Inc. | Volvo Trucks North America | International Truck and Engine | General Motors

Thank You For Your Time and Attention

Greg Shank
Phone: (301) 790-5817
email: greg.shank@volvo.com

Greg Goodson
Director of Maintenance
Jack Cooper Transport

Background

- Founded in 1928 by Jack Cooper
  - Started as a carrier for General Motors from the Leeds Assembly Plant in Kansas City, Missouri
- In 2009 combined with Active Transportation Company LLC of Joplin, Missouri / Spring 2001 – purchased DMT Trucking
  - Second largest auto and truck transport carrier in the nation
  - One of the few remaining transport companies with professional Teamster Union drivers
- Provide services to all of the major domestic and foreign automotive manufacturers and commercial shippers of pre-owned vehicles
  - Transport distribution services, including truck-away, yard management, rail loading, auto lease and auctions
- Operate 26 terminals throughout the U.S. and Canada
  - 24/7 central breakdown center
  - 12 complete maintenance facilities
- ***Haul over 1.6 million vehicles per year***

Fleet Overview

- Over 1,650 state of the art automotive transport carriers
- Predominant truck make and model numbers
  - Volvo WAH, Sterling LT8500, International 8100
- Predominant tires
  - Bridgestone and Michelin
- Predominant engine make and model
  - Detroit Diesel Series 60 and Mercedes MBE 4000
  - Cummins ISM
  - Caterpillar C-12
- Predominant drivetrains
  - Transmissions: Eaton
  - Differentials: Meritor
- Predominant trailers; Cottrell, Boydstun, Delevan
  - Percent electric: 75%
  - Percent hydraulic: 25%

Commitment to Sustainability

- US Environmental Protection Agency SmartWay Transport Partner
  - Jack Cooper Transport has earned an EPA SmartWay Carrier score of 1.00
  - Scores indicate the relative fuel efficiency and environmental performance of the Carrier and Logistics partners
  - A score of 1.00 represents very good environmental performance and is above the industry standard.
- Other initiatives
  - Switching to full Synthetics resulted in lowering “oil make-up” usage by 12%, lessoning the environmental impact on exhaust gasses and reduced new oil purchases!
  - Jack Cooper Transport uses only certified oil and filter recyclers

Commitment to Sustainability

Other initiatives (Continued)

- Monitor engine idle time daily by using two methods

  1. Real time data provided on GPS systems that are down loaded daily and graphed per terminal Best to Worst
     - All drivers are coached frequently if they are in the bottom half of the running report
     - Drivers are formally coached on the 3rd consecutive day of having a “Worst” rating
  2. All engine data is downloaded every PM cycle and mpg is checked and idle time is recorded

Fuel Efficiency

- JCT auto-carriers virtually no aerodynamics designed into equipment
- Vocational type duty cycles
  - 63% of the hauls are long haul trips over 500 miles
  - 37% of the hauls are short haul trips ranging between 150 - 300 miles
  - Average load factor of 73%
  - Average fuel economy is 5.0 mpg when trucks operate at 68 mph
  - Average fuel economy is 5.3 mpg when trucks operate at 63 mph
  - Fuel economy is one of the toughest areas to target

Fuel Efficient Initiatives

- Use only full synthetics (PAO) oils throughout the truck
  - Engine oils
    - Currently using a 5W-40 synthetic
    - Will be testing a 5W-30 synthetic oil this fall
  - Transmission and differential fluids
- Keeping the best rated roll resistant tire on all equipment when possible
- Maintaining 100% tire inflation check and inspection on every unit on a monthly basis
- Keeping engines at peak performance by running overheads once a year and by monitoring oil samples
- Mandate no idle zones at all locations
- Not idling trucks until ambient temperature is 5ºF or lower
- Performing proper cooling system maintenance once a year to prevent constant engine fan cycling and overheating
- Training drivers on progressive shift strategy

Fuel Efficient Engine Oils

- Jack Cooper Transport started researching how we could get over 10 years or over a million plus miles before overhaul
- With increasing lubricant prices, rising shop cost and equipment down time for PMs we needed an engine oil that would:
  - Allow us to extend our drain intervals
  - One that would handle severe duty cycles
  - Lower the “Total Cost of Ownership” to include reduce make-up oil, improve engine life and fuel economy
- Road blocks to meeting goals:
  - Severe duty cycles while operating with smaller bore engines (very weight conscious)
  - High horse power demands
  - Higher than normal thermal rating
  - Operability at sub zero temperatures
  - Total Base Number retention over the entire extended oil drain interval
  - Corrosion protection and soot control while operating at extended drains

Fuel Efficient Oils

- In 1997 Jack Cooper Transport made the decision to switch from conventional base oils to fuel efficient full synthetics (PAOs) from front to rear, Immediately saw paybacks to include
  - 14% decreased oil consumption
  - 3/10th of a mile increase in fuel economy
  - Fuel economy and oil consumption was tracked daily
  - Increased oil drain intervals from 30,000 to between 80,000 to 100,000 mile oil drain interval with great success
- Partnering up with a very good lubricant company was key to JCT achieving all it's needs
- We currently utilize a state of the art oil sampling program with an average of 45,000 oil samples per year
- We have quarterly oil analysis reviews complimented with several engine tear downs to track our success!
- ***Program has been a huge Win For Jack Cooper Transport!***

Key Components of the Program

- Know your equipment and engines - they need to be operating at top level of performance to really bench-mark fuel economy improvements
- Determine what your overall needs are before jumping into any extended oil drain interval program
- Implement a solid oil sampling program and be disciplined to look at the numbers and not just at the cautions or alerts flags
  - Know what causes these alerts

Thank You For Your Time and Attention

Greg Goodson
913-321-8500
ggoodson@jackcooper.com

Jack Cooper Transport
Pacific Motor Trucking

Questions and Answers