Low Viscosity HD Engine Oils and Fuel Efficiency

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Sr. Product Specialist

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Low Viscosity HD Engine Oils and Fuel Efficiency

The webinar will begin in less than 10 minutes.

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Low Viscosity HD Engine Oils and Fuel Efficiency

The webinar will begin in less than 5 minutes.

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CITGO Petroleum Corp.

Steven Bowles

- CITGO Sr. Product Specialist
- BS, Zoology
- MS, Environmental Science
- 17 Years Experience in Lubricants
- 16 Years Experience in Laboratory Supervision/Analytical Chemistry
- STLE Certified
    - Certified Lubrication Specialist
    - Oil Monitoring Analyst I

Agenda

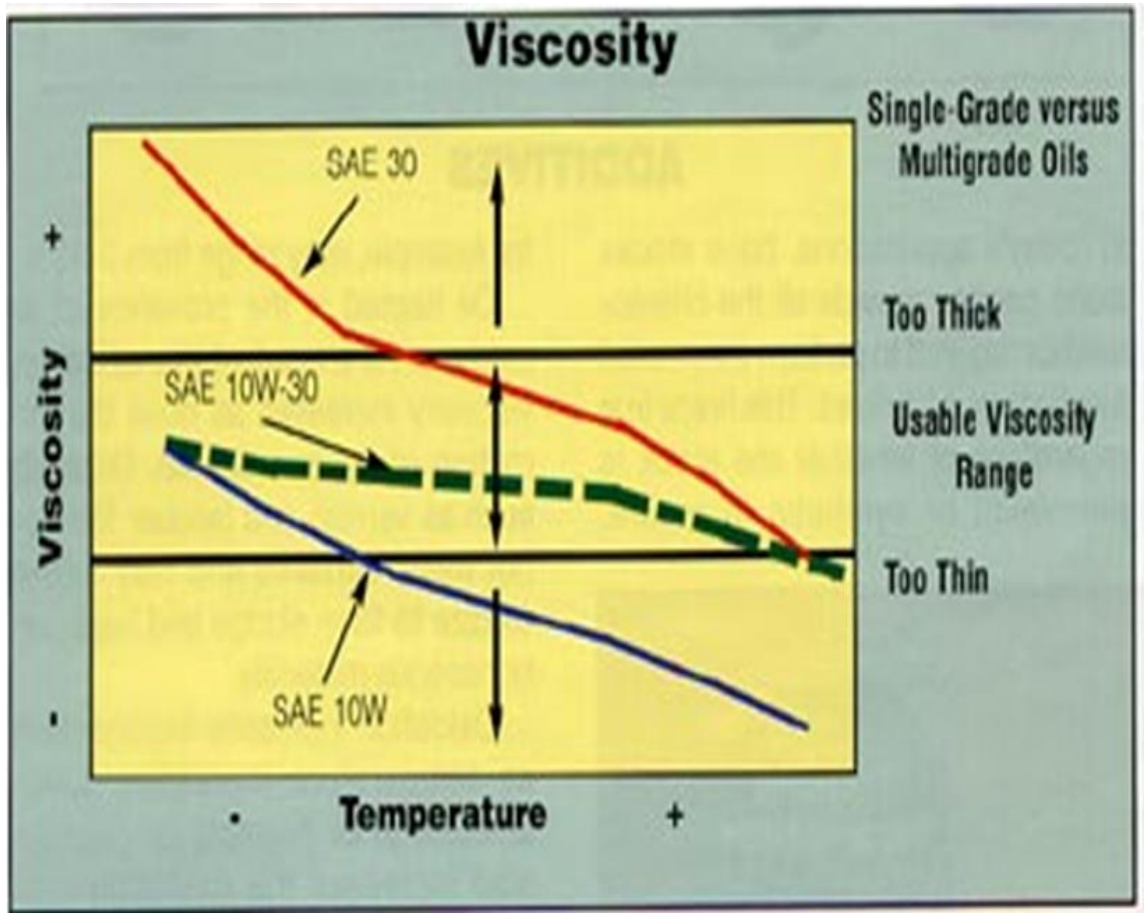
- Engine Oil Basics - Viscosity
- HDEO Viscosity Trends
- Advantages of Low Viscosity Engine Oils
- Concerns of Low Viscosity Engine Oils
- CITGO Low Viscosity HD Products
- Questions and Answers

Engine Oil Basics - Viscosity

Viscosity: the most important property

Engine Oil Basics - Viscosity

- Low enough to flow at low temperatures
- High enough to protect and perform at high temperatures



Engine Oil Basics - Viscosity

The Role of Viscosity: SAE J300

Automotive Lubricant Viscosity Grades Engine Oils – SAE J 300SEP2015					
SAE	Low Temperature Viscosities		High-Temperature Viscosities		
Viscosity Grade	Cranking (mPa.s) max at temp °C	Pumping (mPa.s) max at temp °C	Kinematic (mm^2/s) at 100°C		High Shear Rate (mPa.s) at 150°C, 10/s
			min	max	min
0W	6200 at -35	60 000 at -40	3.8	—	—
5W	6600 at -30	60 000 at -35	3.8	—	—
10W	7000 at -25	60 000 at -30	4.1	—	—
15W	7000 at -20	60 000 at -25	5.6	—	—
20W	9500 at -15	60 000 at -20	5.6	—	—
25W	13 000 at -10	60 000 at -15	9.3	—	—
8			4.0	<6.1	1.7
12			5.0	<7.1	2.0
16	---	---	6.1	<8.2	2.3
20	—	—	6.9	<9.3	2.6
30	—	—	9.3	<12.5	2.9
40	—	—	12.5	<16.3	3.5*
40	—	—	12.5	<16.3	3.7**
50	—	—	16.3	<21.9	3.7
60	—	—	21.9	<26.1	3.7

10W-30

Engine Oil Basics - Viscosity

API CK-4 and API FA-4 at a Glance

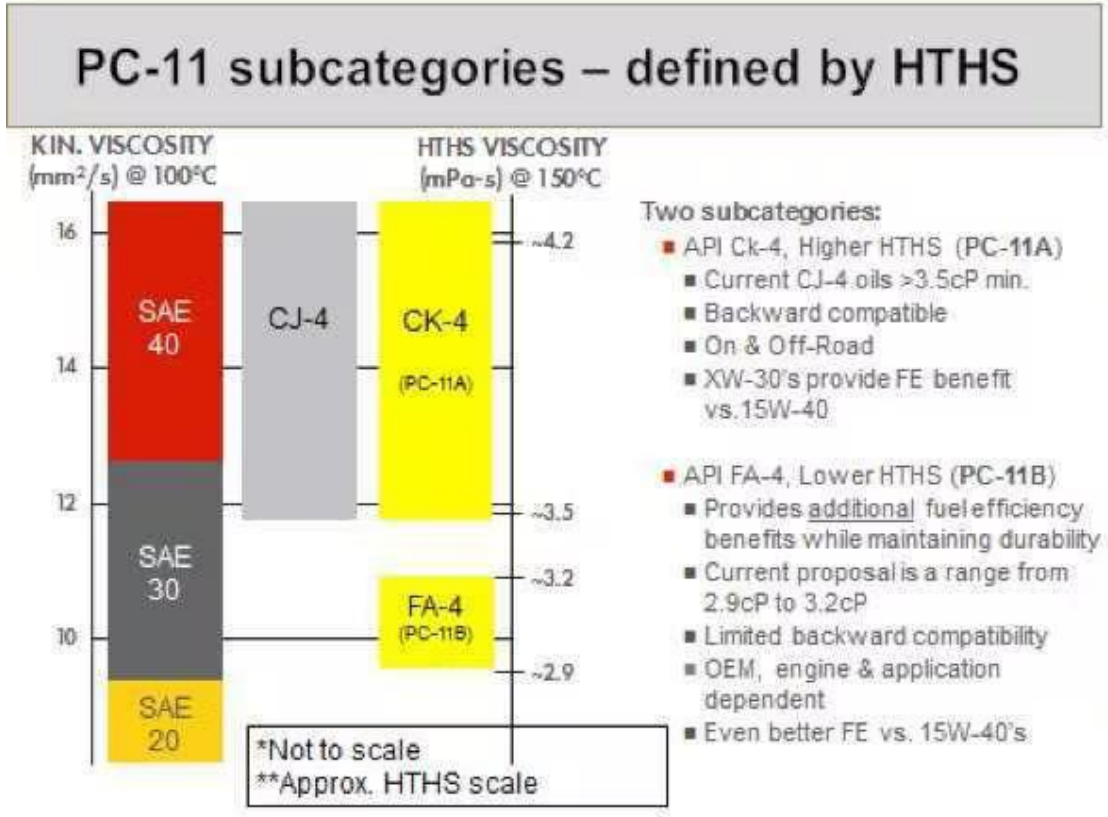
CK-4

- For current and older engines*
- Backward compatible with CJ-4, CI-4 with CI-4 PLUS, CI-4, and CH-4 oils
- Superior wear and oxidation protection compared with CJ-4 oils
- Improved shear stability
- Minimum HTHS viscosity, 3.5 cp
- Available in typical diesel viscosity grades SAE 15W-40, 10W-40, and 10W-30 (may even be offered in lighter viscosity grades)
- On-highway and non-road use

FA-4

- For newer designs of engines (late 2016 and beyond)*
- NOT backward compatible with API CK-4, CJ-4, CI-4 with CI-4 PLUS, CI-4, and CH-4 oils because of lower HTHS viscosity
- Same benefits as CK-4, plus potential to reduce emissions thanks to lower HTHS viscosity (2.9–3.2 cP)
- Available in SAE 10W-30, 5W-30, and 0W-30
- On-highway use; check with engine manufacturer regarding non-road use

* Check with engine manufacturer to verify use and any suggested maintenance changes.

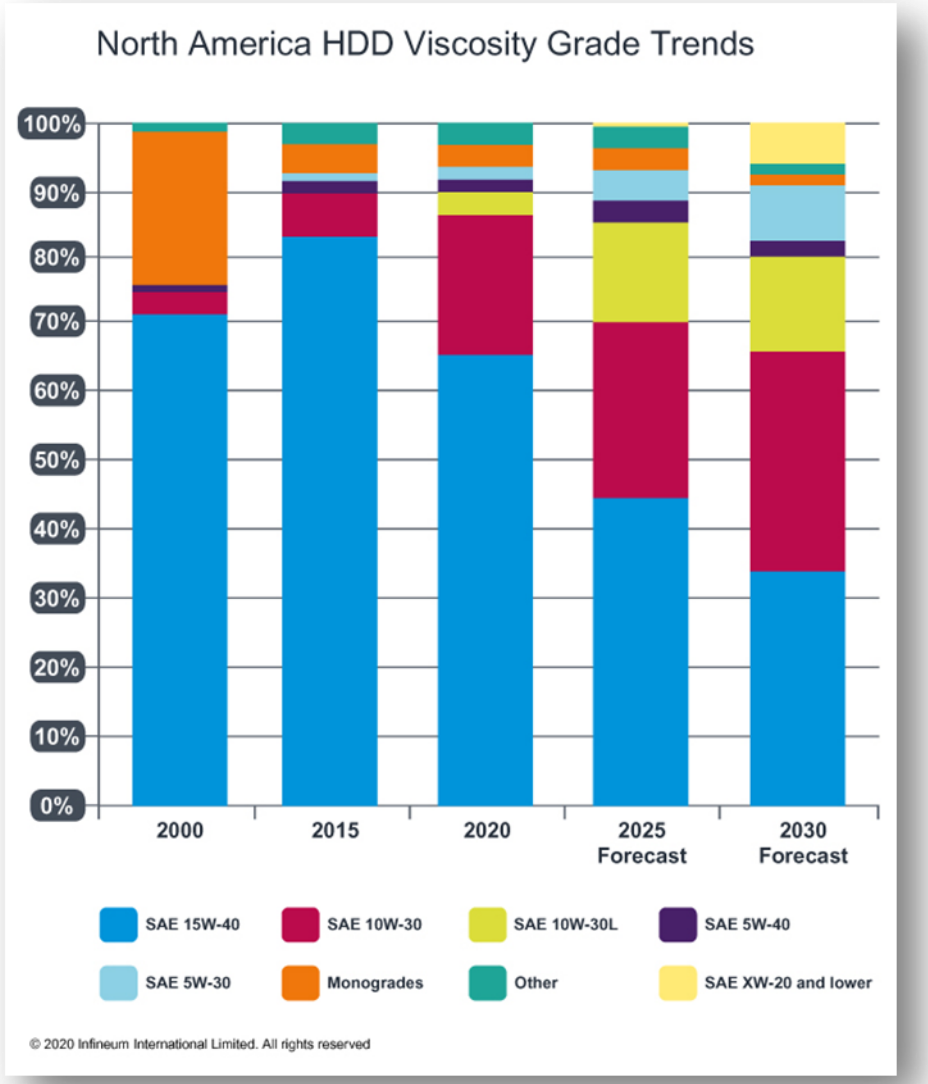


Special report: Final PC-11 picture emerges, next-gen oil offers improvements for engines old and new: Commercial Carrier Journal

Heavy Duty Diesel Engine Oil Viscosity Trends

Viscosity grades are changing....

- SAE 15W-40 dominant grade, but trending down
- Lower viscosities continue to grow
- Significant growth for 10W-30, both the API CK-4 (red) and API FA-4 (Yellow)
- SAE 5W-30 continues to be a very niche grade but expected to have future growth

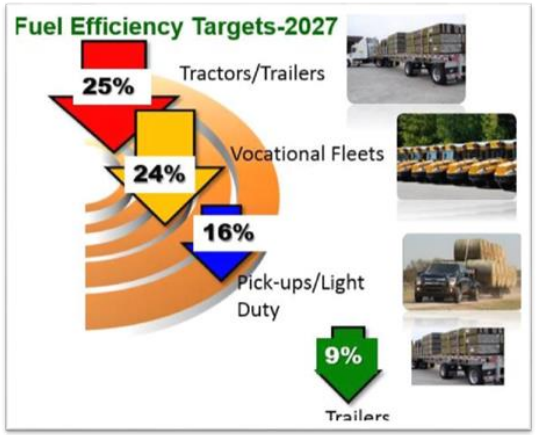


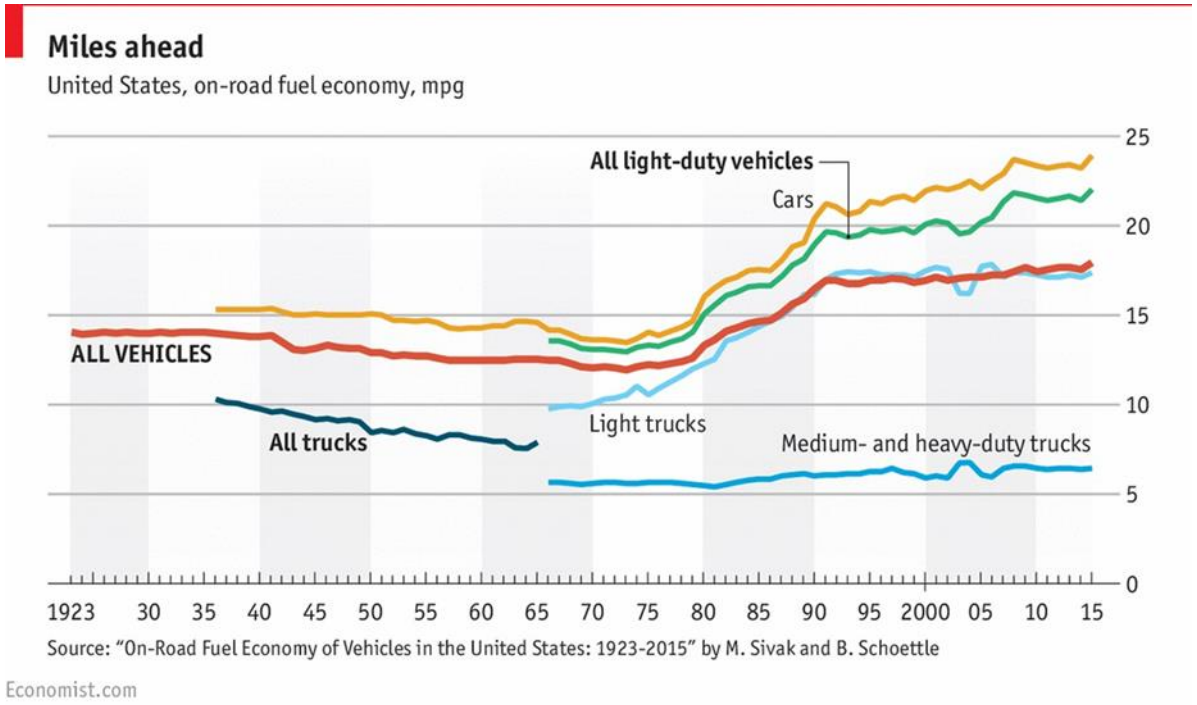
Heavy Duty Diesel Engine Oil Viscosity Trends

What's Driving Lower Viscosity Engine Oil Trends?

Government Green House Gas (GHG) Regulations.

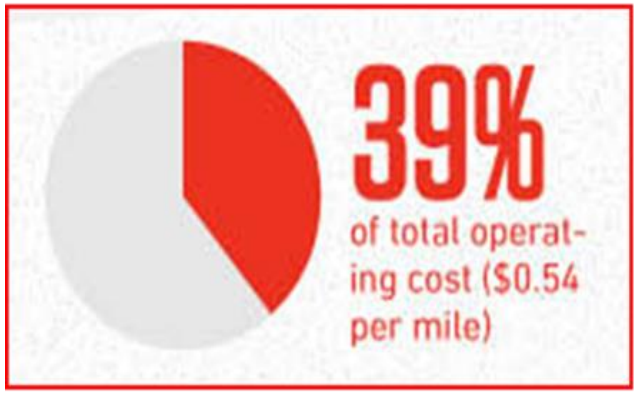
- GHG regulations to lower CO2
- The only way to lower CO2 is to improve fuel economy (burn less gas/diesel)
- Lower viscosity engine oil = better fuel economy



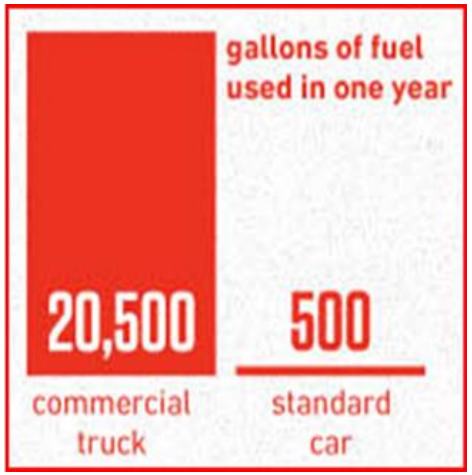


Advantages of Low Viscosity Engine Oils

- Less Pollution – lower CO2 levels
- Fuel savings – going from 15W-40 to 10W-30 can result in up to 3% fuel savings



A commercial truck can easily consume more than $70,000 of diesel fuel per year.



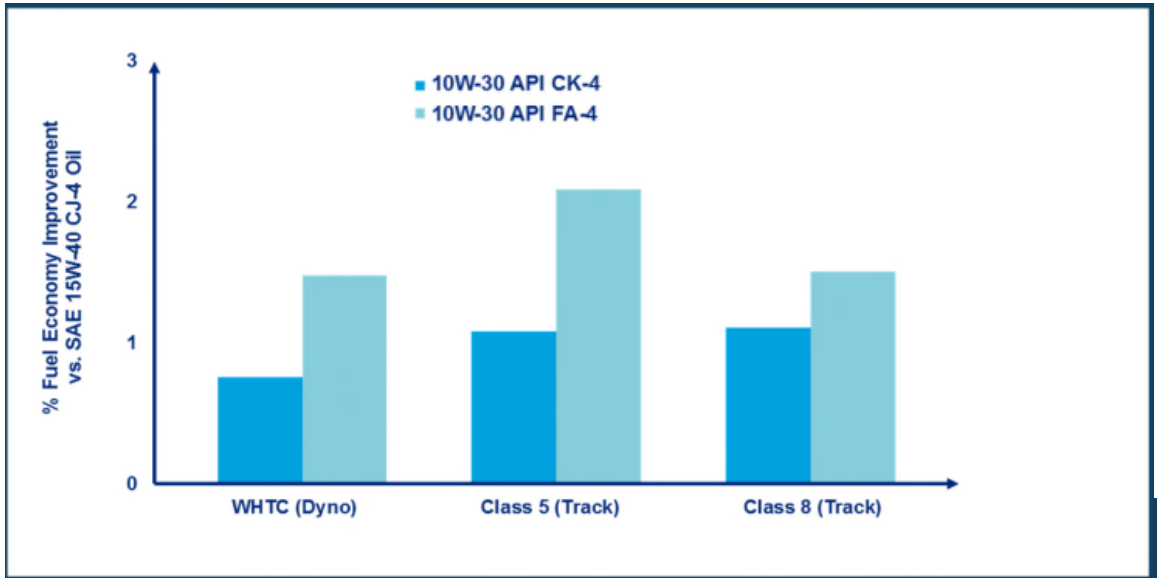
Advantages of Low Viscosity Engine Oils

HD Engine Oil Savings Calculator

Advantages of Low Viscosity Engine Oils

Fuel economy advantages of:

- 10W-30 CK-4 and 10W-30 FA-4
- vs CJ-4 15W-40



	Class 5 Dynamometer	Class 5 Track	Class 8 Track
Engine	Ford 6.7 L Power Stroke	Ford 6.7 L Power Stroke	Detroit Diesel DD15
Cycle	Federal Test Procedure (HDFTP) World Harmonized Transient Cycle (WHTC) Non-Road Test Cycle (NRTC) Ramped Mode Cycle (RMC)	Stop & Go SAE J1321	Line Haul SAE J1321

Advantages of Low Viscosity Engine Oils

Guaranteed Efficiency Program (GEP) Fleet Report

CITGO Fleet	# Power Units	FE-Results
A	40	3.2%
B	49	1.8%
C	28	1.6%
D	330	3.2%
E	494	2.2%
F	425	2.8%
Average	**228**	**2.5%**

Brundage-Bone Saves Up To 2.5% In Fuel Cost After Switching to CITGARD 700 10W-30 Heavy Duty Engine Oil

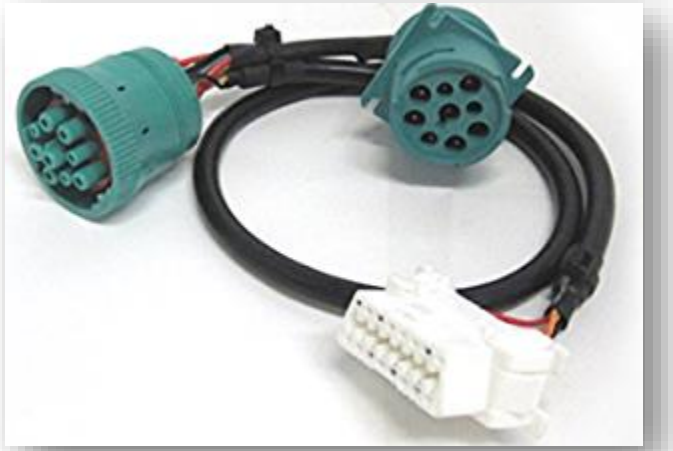
Reducing fuel costs and improving overall maintenance are top priorities for Brundage-Bone. They switched their 450-fleet operation to CITGARD 700 heavy-duty engine oil after reviewing performance insights. Independent reports from a third-party telematics provider showed a 2.5% saving in fuel costs among other benefits.

Learn more about how CITGO helped Brundage-Bone switch their fleet.

Advantages of Low Viscosity Engine Oils

Guaranteed Efficiency Program

- Complimentary Drum of Product
- 30 Days
- ECM Devices Deployed
- Data Collected
- Report Provided
- Decision Made

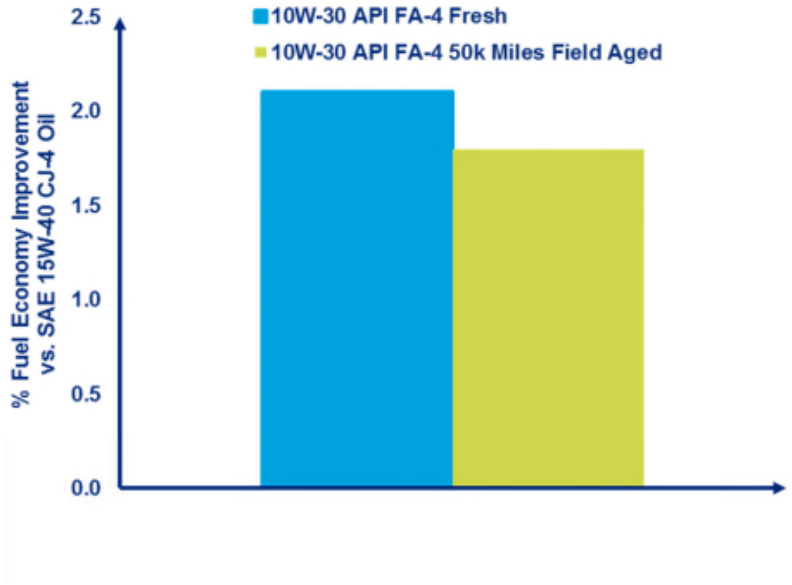


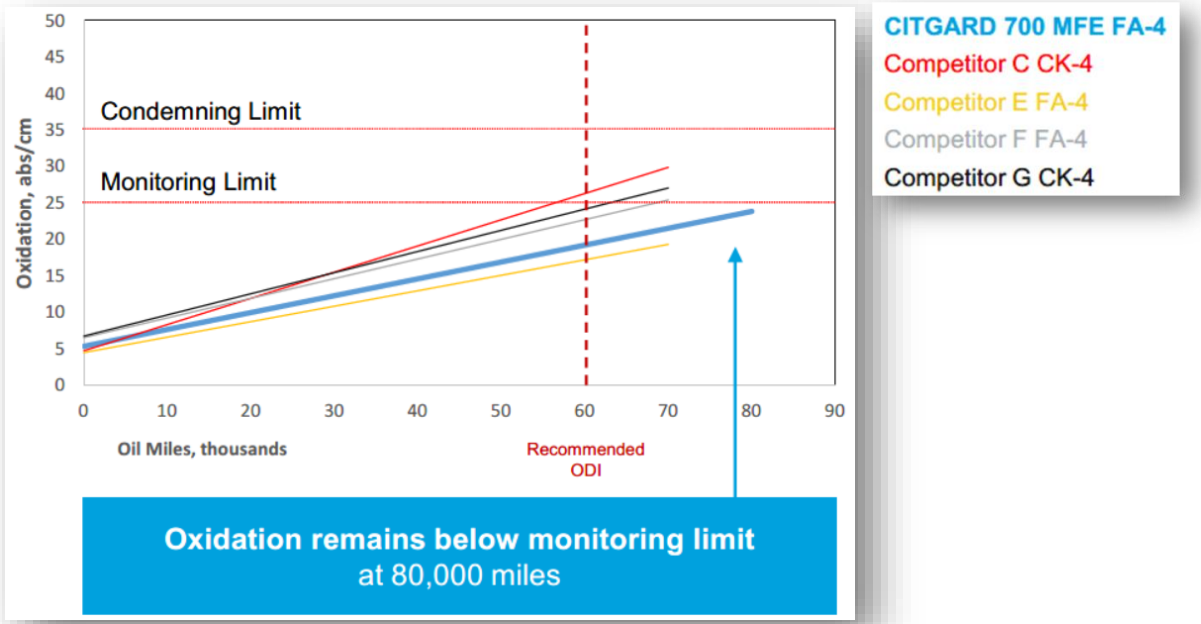
LinkeDrive

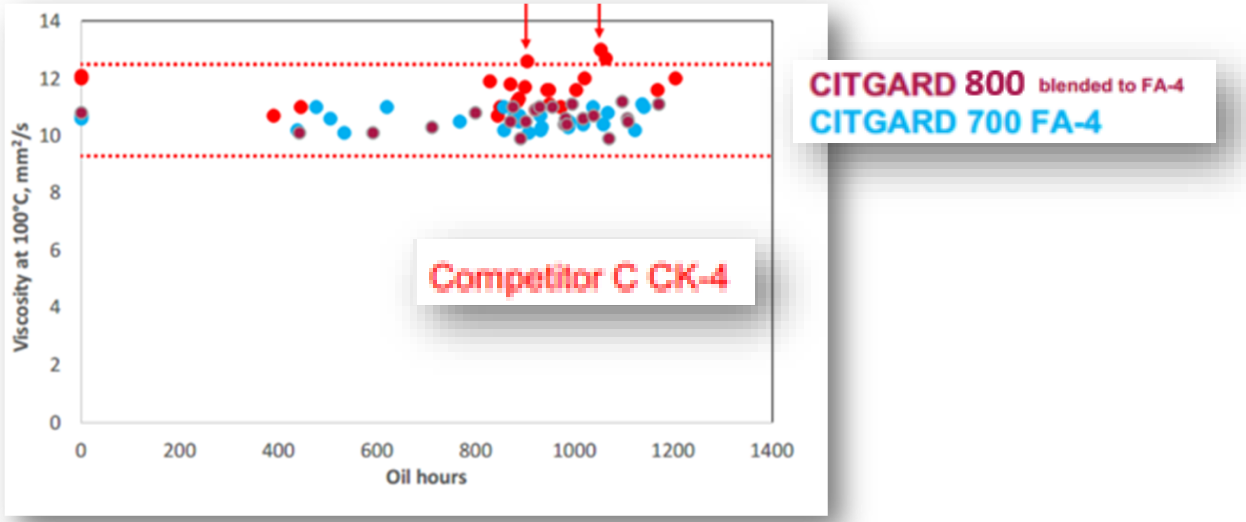
QUALIFYING ENGINE OIL TESTED
☐ CITGARD 1000 SAE 5W30
☐ CITGARD 700 SAE 10W30 API CK-4
☐ CITGARD 700 MFE SAE 10W30 API FA-4
☐ CITGARD 800 SAE 10W30

Advantages of Low Viscosity Engine Oils

Outstanding oxidation performance enables CITGARD oils to retain fuel economy throughout a drain cycle







Advantages of Low Viscosity Engine Oils

Fuel saving technologies:

An equipment investment with extended ROI?

Changing operating conditions?


Tire Pressure System


6x2 axles


Idle Reduction


Transmissions


Engine Parameters


LRR Tires

Lightweighting


Downspeeding


Maintenance Trailer


FE Aerodynamics


Tractor Aerodynamics


Lubricants


Platooning


Engine Accessories


Solar

- **No investment!**
- **No Equipment & Operational Changes**

Concerns of Low Viscosity Engine Oils

The oil is too thin!

- Customers worry about the wear protection offered by the lower viscosity oils
- API CK-4/FA-4 had two new tests added to the testing program
- Modern engine oils are designed to handle the smaller, hotter running, higher output engines common today

OVERCOME "VISCOSITY FEAR SYNDROME

Concerns of Low Viscosity Engine Oils

All major OEM's factory fill with 10W-30

OEM Diesel Engine Oil Recommendation Summary

Infineum

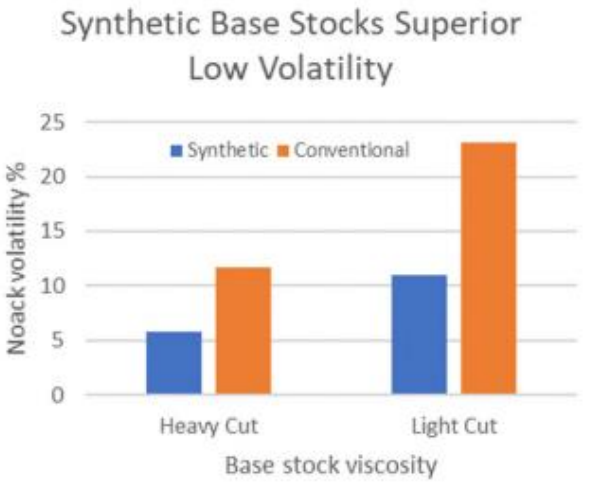
OEM	API CJ-4 Legacy spec and Factory Fill grade	API CK-4 (2016-present)	Service	API CK-4 OEM Oil Drains
Cummins	**CES 20081** SAE 10W-30	**CES 20086** **SAE** 10W-30	Light (> 7.0 MPG)	75,000 (up to 100,000 with OilGuard)
			Normal (6.0 – 6.9 MPG)	60,000
			Short Haul (5.0 - 5.9 MPG)	50,000
			Severe (< 5.0 MPG)	25,000
Detroit Diesel	**DFS 93K218** SAE 10W-30	**DFS 93K222** **SAE 10W-30 API FA-4**	Efficient Long Haul (> 7.0 MPG)	75,000 (DD15) / 65,000 (DD13)
			Long Haul (> 6.0 MPG)	60,000 (DD15) / 55,000 (DD13)
			Short Haul (5.1-5.9 MPG)	45,000 (DD15) / 40,000 (DD13)
			Severe (< 5.0 MPG)	35,000
Mack/ Volvo	**Mack EO-O PP / Volvo VDS-4** SAE 10W-30	**Mack EOS-4.5 / Volvo VDS-4.5** SAE 10W-30	Normal Duty(> 6.0 MPG)	55,000**
			Heavy Duty (5.0 – 5.9 MPG)	40,000**
			Severe Duty (<5.0 MPG)	30,000
Caterpillar	**ECF 3** SAE 10W-30 and SAE 15W-40	**API CK-41** SAE 10W-30 and SAE 15W-40		Application Specific
Navistar	**API CJ-4** SAE 10W-30	**API CK-4** SAE 10W-30	Light (> 6.5 MPG)	50,000 (up to 75,000 with oil sampling)
			Moderate (5.5 – 6.5 MPG)	30,000
			Severe (< 5.5 MPG)	20,000
PACCAR	**API CJ-4** SAE 10W-30	**API CK-4** SAE 10W-30	Normal / Line Haul, <20% Idle	75,000
			Normal / Line Haul, > 20% Idle	50,000
			Severe / Vocational	30,000
GM (Duramax 6.6L)	**API CJ-4** SAE 10W-30	**API CK-4** SAE 10W-30		7,500**
Ford (Powerstroke 6.7L)	**WSS M2C171-E** SAE 10W-30	**WSS M2C171-F1** SAE 10W-30		3,000 – 10,000**

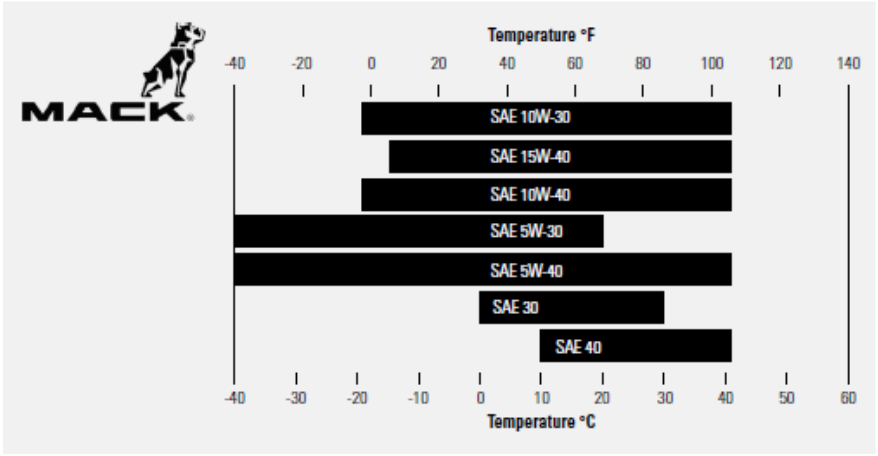
**Idle >30%, use next shorter ODI

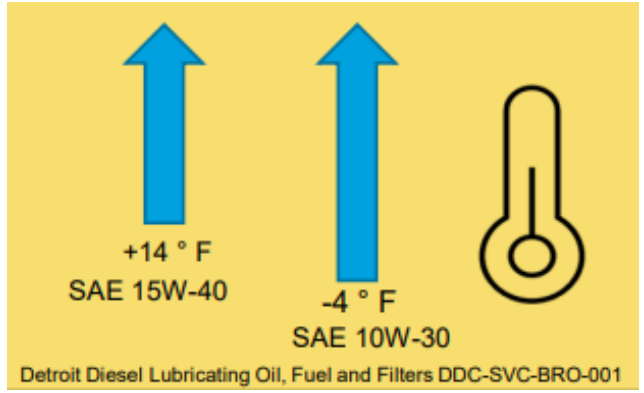
Concerns of Low Viscosity Engine Oils

Modern engines are designed to operate on SAE 10W-30 oils

- OEM Fill since ~2010
- Based on OEM design, would not expect issues with:
  - Oil consumption – should decrease with higher synthetic content
  - Low oil pressure
  - Sensor issues
- Wider vehicle operating range – improved low temp performance, less wear on start-up

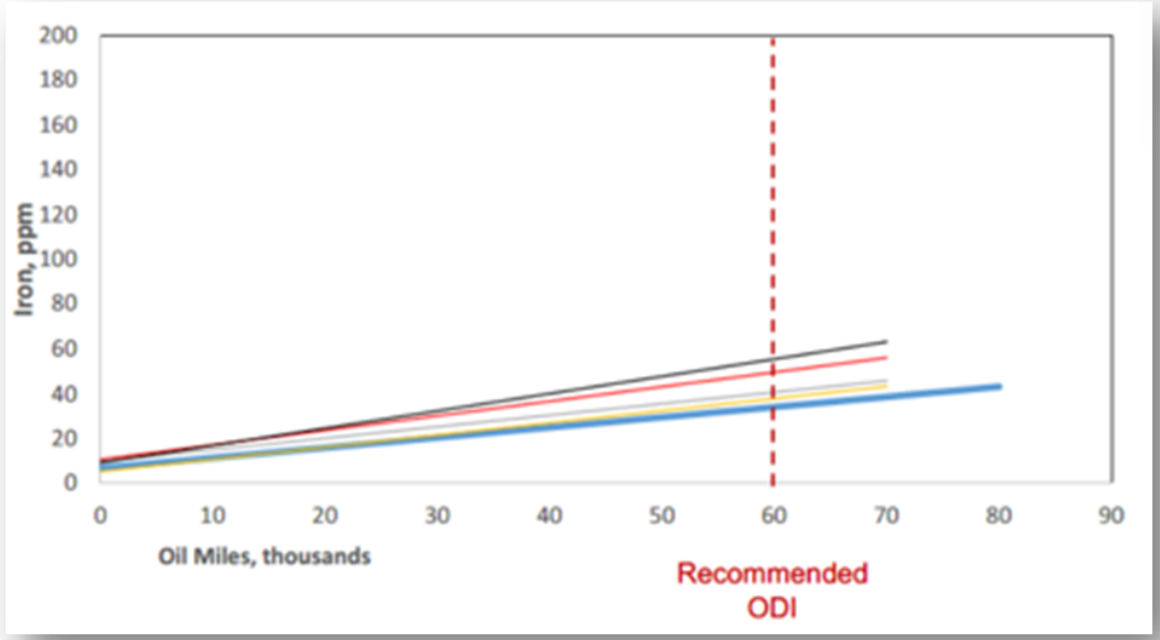






Concerns of Low Viscosity Engine Oils

Wear protection – no problem!



	Limit (ppm)	CITGARD 700 MFE ppm maximum
Lead	10	0
Aluminum	50	28

CITGARD 700 MFE metal wear levels at 80,000 oil miles

Concerns of Low Viscosity Engine Oils

IWX Engine Tear Down at 850,000 Miles

CITGARD 700 MFE
SB 10W-30 FA-4

Worn Liner for comparison

Worn Liner - mirror polishing

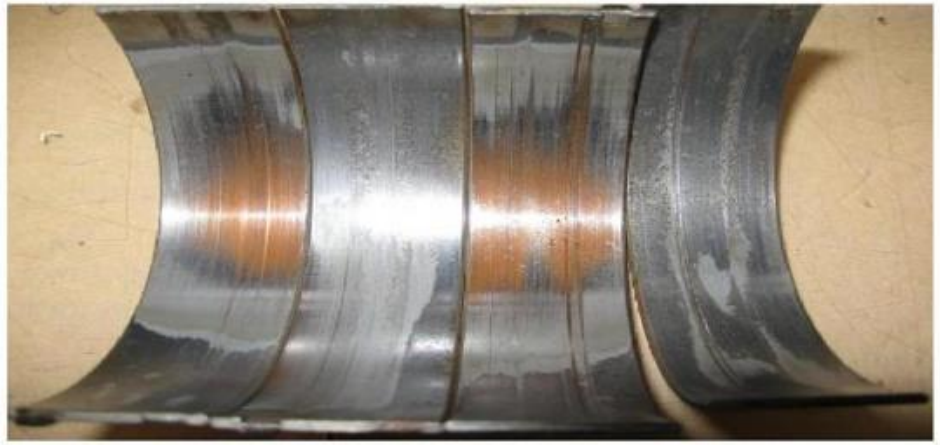
Concerns of Low Viscosity Engine Oils

CITGARD 700 MFE
SB 10W-30 FA-4

IWX Engine Tear Down at 850,000 Miles

IWX bearings

Worn bearings for comparison

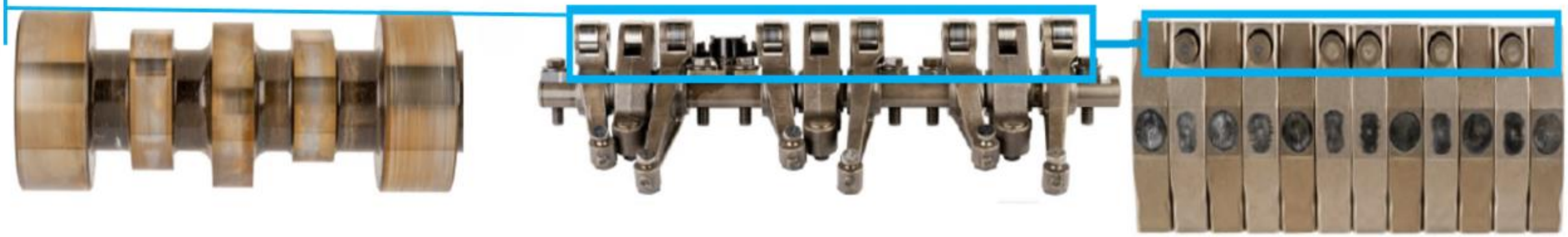


Worn bearings

Concerns of Low Viscosity Engine Oils

- **CITGARD 1000 Full Synthetic**
  - **Blended as 5W-16**
    - **No Hardware Damage**
    - **2017 Cummins ISX**

Teardown at 500,000 miles



Concerns of Low Viscosity Engine Oils

- **Four Competitors**
  - **@ Normal CK-4 Viscosity**
    - **Significant Engine Damage**
  - **2017 Cummins ISX**

Competitor A & D:

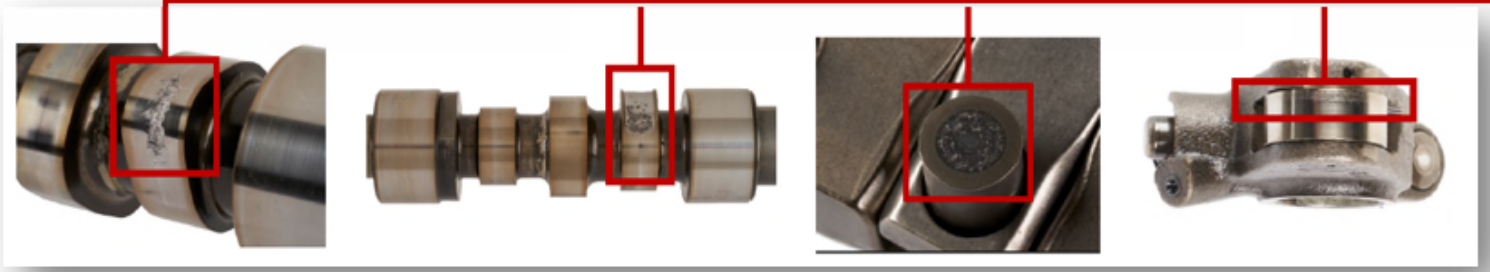
- **Abrasive Wear**
  - **Cam Lobes**
  - **Rocker Arms**

Competitor B:

- **Crosshead Pitting**

Competitor C:

- **Cam Lobe and Rocker Damage**



CITGO Low Viscosity HD Products

CITGARD 700 Synthetic Blend SAE 10W-30

- API CK-4, CJ-4, CI-4 Plus, CI-4, CH-4
- Approved for major Diesel OEM’s
- Balanced Detergent package
- Shear stable viscosity modifier

CITGARD 700 MFE Synthetic Blend SAE 10W-30

- API FA-4
- Cummins CES 20087
- Detroit Diesel 93K223
- Additional fuel savings vs CK-4 10W-30

CITGO Low Viscosity HD Products

CITGARD 800 Synthetic Blend SAE 10W-30

- Formerly CITGARD CNG/LNG Synthetic blend SAE 10W-30
- Multi-fuel capability: CNG/LNG, Diesel, Gasoline
- API CK-4/SN
- Cummins CES 20092 (CNG/LNG) and CES 20086 (Diesel) approval
- Major Diesel OEM Approvals

CITGARD 1000 Full Synthetic SAE 5W-30

- Formerly CITGARD SynDurance Plus Synthetic SAE 5W-30
- Extreme cold temperature performance
- API CK-4
- Major Diesel OEM Approvals
- Only 5W-30 approved for Ford WSS-M2C171-F1

DIESEL MOTOR OILS MEETING FORD WSS-M2C171-F1 Page 1 of 10

Brand Name	Viscosity	Supplier
0W-40		
Mobil Delvac 1 ESP 0W-40	0W-40	ExxonMobil
5W-30		
CITGARD® SYNDURANCE® Plus Synthetic Heavy Duty Engine Oil	5W-30	CITGO Petroleum Corporation
5W-40		
Advantage HD DEO Full Synthetic	5W-40	Country Mark
Advantage Ultra Premium Plus	5W-40	Advanced Lubrication Specialt
Allied	5W-40	Allied Oil And Tire Company
AMALIE XLO Ultimate Full Synthetic Molybdenum Fortified	5W-40	AMALIE Oil Company
Archer Gold	5W-40	GROWMARK Inc
Bel-Ray® Hyperion Elite Synthetic	5W-40	Calumet Branded Products, LLC
Blue Mountain	5W-40	Old World Industries, LLC
CARQUEST	5W-40	Warren Oil Company, LLC
CITGARD® SYNDURANCE® Plus Synthetic Heavy Duty Engine Oil	5W-40	CITGO Petroleum Corporation
D-MO 5W-40 SYNTHETIC	5W-40	Federated Co-operatives Limited
Drydene DieselALL Syn™ 5W40 CK-4	5W-40	Drydene Performance Products
Duragard	5W-40	Advantage Dist. and Lubricants, LLC
Duron UHP 5W-40	5W-40	Petro-Canada Lubricants Inc.
ENHANCE Super Synthetic	5W-40	Enhance Lubricants, LLC
Fleet Pro Elite Full Synthetic	5W-40	Pinnacle Oil
International Full Synthetic	5W-40	Navistar, Inc.
KLONDIKE	5W-40	KLONDIKE Lubricants Corp.
Lubriguard Full Synthetic	5W-40	Warren Oil Company, LLC
Mag 1	5W-40	Warren Distribution
Mahindra	5W-40	Mahindra USA, Inc.
Marathon Multipower-3 Elite	5W-40	Marathon Petroleum Co LP
Maxtron Enviro Edge	5W-40	CHS Inc.
MFA OIL	5W-40	MFA OIL Company
Monolec Ultra® Syn Heavy Duty Engine Oil	5W-40	Lubrication Engineers, Inc.
Motorcraft Full Synthetic Diesel Motor Oil	5W-40	Ford Motor Company
Mystik® JT-8® Synthetic Engine Oil	5W-40	CITGO Petroleum Corporation

CITGO Low Viscosity HD Products

OEM Approved Fluids

Gear Oils

- SYNDURANCE Synthetic Gear Lubricants

Transmission Fluids

- SYNDURANCE Synthetic MTF
- SYNDURANCE 668 ATF
- Emgard MTF 7011

Available Viscosity

- 75W-90, 80W-140

Primary Specification

- Eaton PS-386
- Allison TES 668
- Daimler DT-12

CITGO Low Viscosity HD Products

Suitable For Use Fluids

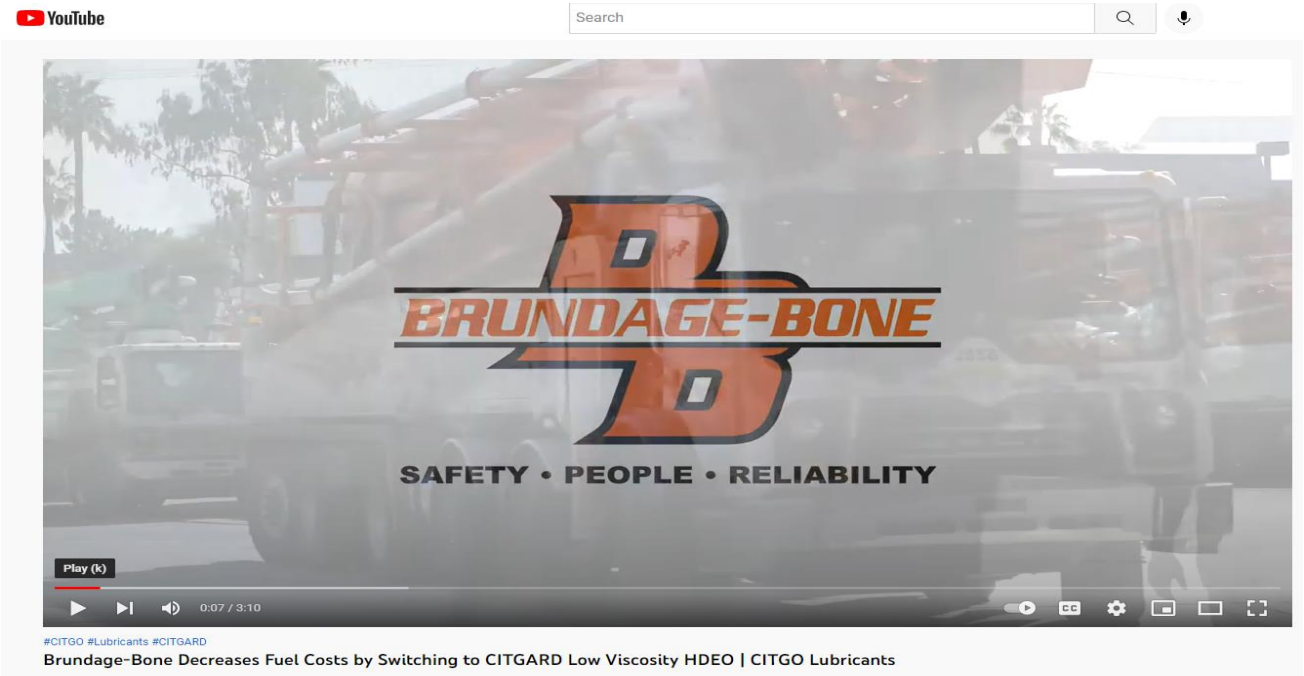
- CITGEAR Synthetic HD Gear
- CITGEAR Synthetic HD Gear
- DriveShift Synthetic AMT Transmission Fluid
- Quatrasyn Synthetic Transmission Fluid

Primary Suitable For Use Application

- SAE 50 - Eaton PS 164 Rev 7
- 75W-90, 75W-140, 80W-140
- Mack M-Drive/Volvo I-Shift, Detroit DT12
- Allison TES 295

Questions

- Any Questions?



How to Contact Us

- Lubes Answer Line

  800-248-4684

  8:00 AM - 12:00 PM, 1:00 PM – 5:00 PM CT
  Monday through Thursday

  8:00 AM - 12:00 PM, 1:00 PM – 4:30 PM CT
  Friday

  lubeshelp@citgo.com

Future Webinars

June 24, 2022	Water, Water, Everywhere - David Turner
July 8, 2022	LubeAlert Oil Monitoring – Erica McDonald
July 22, 2022	Lubricant Storage and Handling – David Turner