Ultra Low Sulfur Diesel

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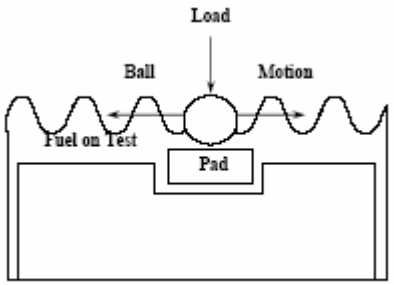
ULSD & Lubricity

- Natural lubricating property in fuels
  - Sulfur is a natural lubricant
  - ULSD regulations a major concern with diesel engine performance
- ASTM Lubricity requirement effective Jan 1, 2005 for **diesel fuels**
  - High Frequency Reciprocating Rig (HFRR)
  - 520 micron max scar



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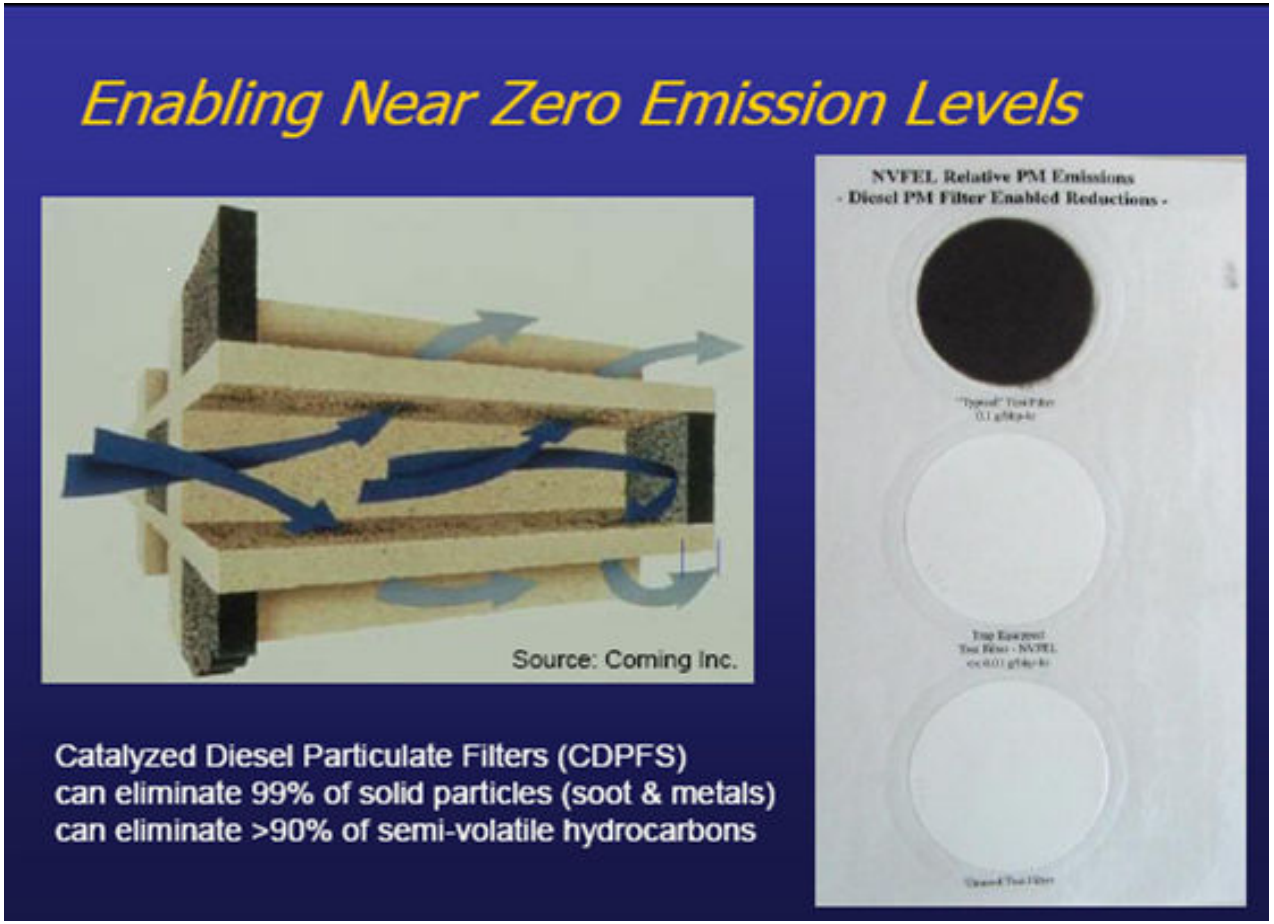
2007 Model Year Engines

- EPA regulations require reduced sulfur in diesel fuel for 2007 model year engines



Source: EPA

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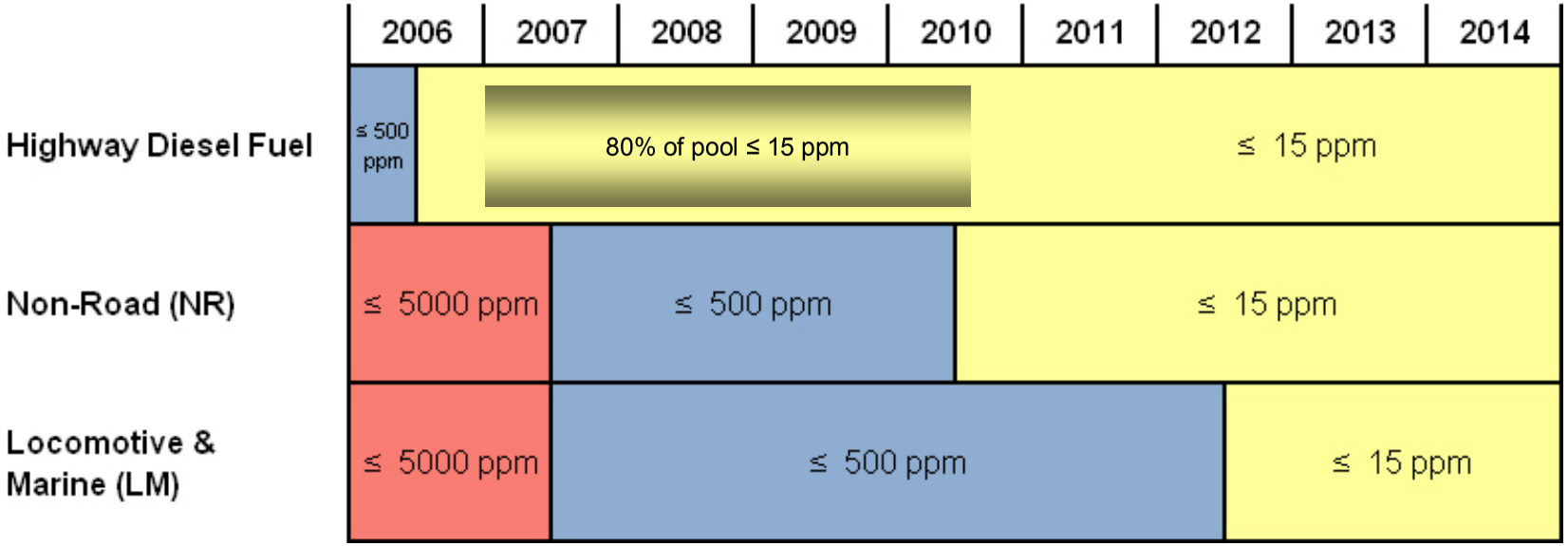
ULSD Timeline



≤ 15 ppm = ULSD

≤ 500 ppm = LSD

≤ 5000 ppm = HSD

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U.S. Supply & Demand

- "Real" demand for ULSD
  - Government Fleets
  - Special applications
  - Mandated retrofits
  - New 2007 + engines
- Little "real" demand for ULSD in 2006
- EPA mandated 80% of on-road diesel supply be ULSD by June 2006
- "Real" demand projected to be ~25% of all on-road diesel by 2010 and ~50% by 2015

*Results of Turner, Mason & Company industry survey

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Refiners Have Few Alternatives

- Heating oil is a viable alternative in PADD I
- Off-road diesel, which EPA will lower to 500 ppm in 2007 and 15 ppm in 2010, is the dominate HS distillate outside PADD I
- Nature of supply chain dictates that some off-road markets will be supplied “on-road quality”
- Loss of fungibility between heating oil and off-road diesel will limit or eliminate HS diesel supply in certain regions

*Results of Turner, Mason & Company industry survey

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Current Status of Industry ULSD Preparations

- U.S. Refineries are well along with plans/implementation to produce ULSD by 2006
- Supply capabilities will be greater than forecasted demand in 2006-2010
- Major pipeline systems have been working with shippers and terminal operators to define distribution system over last two years.

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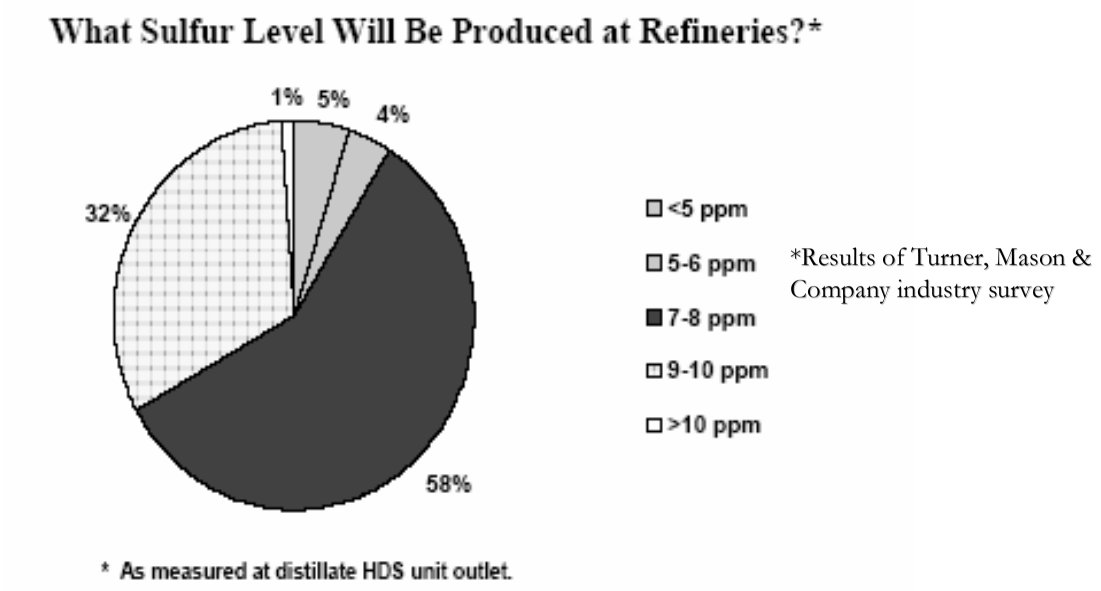
U.S. Refining Industry Plans

- Planned ULSD capacity by June 2006 of

  >2.5 million BPD*

- 90% of refineries surveyed have designed units to produce ULSD with 7-10 ppm sulfur*



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2006 EPA Transitional Flexibility

	Original	Direct Final Rule Effective 1/06/2006*
	15 ppm	15 ppm
Refineries	June 1	June 1
Pipelines & Terminals	July 15	Sept 1
Retail	Sept 1	Oct 15

* EPA will temporarily allow diesel fuel at a sulfur level of 22 ppm to be distributed downstream as ULSD during this extend transition period.

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2004 ULSD Transportation Tests

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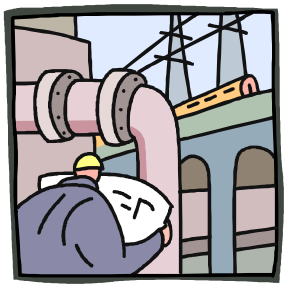
MAP 2004 ULSD Testing

- Sulfur in ULSD increases as it moves through each part of the transportation system
- To meet the 15-ppm spec when the fuel reaches the customer, pipeline and terminal operators will not allow ULSD that contains sulfur above a specified amount
- Receipt specs may be different at different facilities
  - Pipelines 7 to 9 ppm
  - Terminals 12 to 13 ppm
  - Refineries will need to produce in 5 to 7 ppm range.



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Contamination Concerns

7,500 Gallons 15ppm ULSD contaminated with:	<500 ppm Diesel Fuel	<3000 ppm Jet/Diesel Fuel	<5000 ppm Heating Oil
7 Gallons or .1%	**+ 0.5 ppm**	**+ 3 ppm**	**+ 5 ppm**
37 Gallons or .5%	**+ 2.5 ppm**	**+ 15 ppm**	**+ 25 ppm**
75 Gallons or 1%	**+ 5 ppm**	**+ 30 ppm**	**+ 50 ppm**

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Terminals and Bulk Plants

- Sulfur increased as it moved through dead leg piping that contained higher sulfur products
- Product layering occurred when ULSD was put into above ground storage tanks
- A single tank sample did not represent the overall product sulfur level of the tank
- Due to product layering, heel mixing may not be effective for converting tanks to on-spec ULSD
- Tanks should be completely emptied, two or more times.

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Transports

- Sloped-bottom transports
  - should contribute little, if any, sulfur contamination to ULSD
- Flat-bottom transports
  - can cause significant sulfur contamination to ULSD
  - Sulfur contamination can be reduced by draining compartments prior to loading ULSD
- All transports need to be completely drained when switching from higher sulfur products to ULSD
- Flushing compartments with ULSD prior to loading helps remove sulfur left from other products

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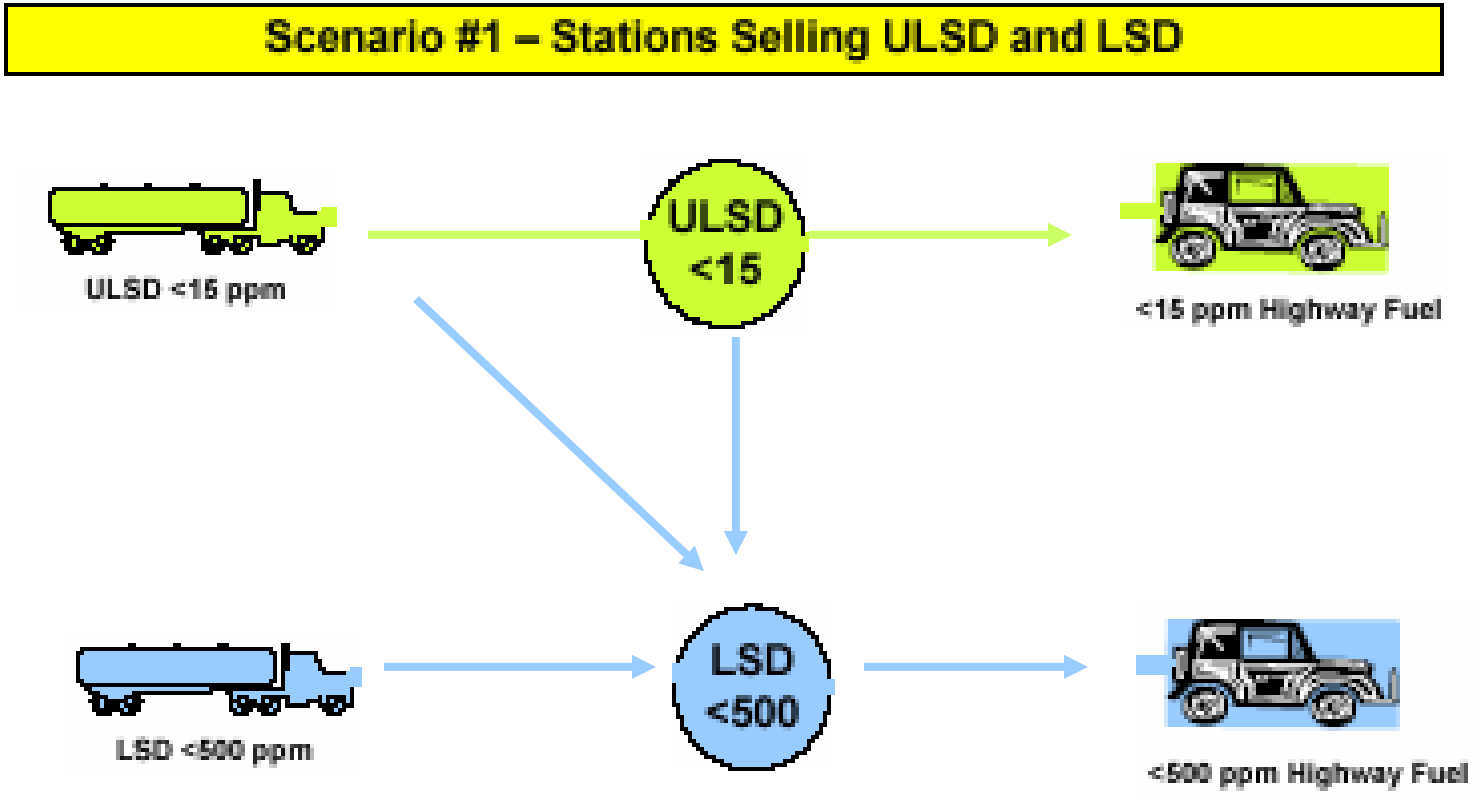
Retail Marketing / Jobbers

- During 2004 test program, USTs showed signs of product layering.
- Mixing ULSD among several manifold tanks can alleviate product layering
- Making multiple deliveries into different tanks promotes better mixing
- Product layering can occur if the volume of ULSD delivered is less than 60 percent of the final inventory in the UST

Unlimited Downgrading-
Station Selling ULSD and LSD



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No Downgrades-
Stations Only Selling ULSD

Scenario #2 – Stations Selling Only ULSD

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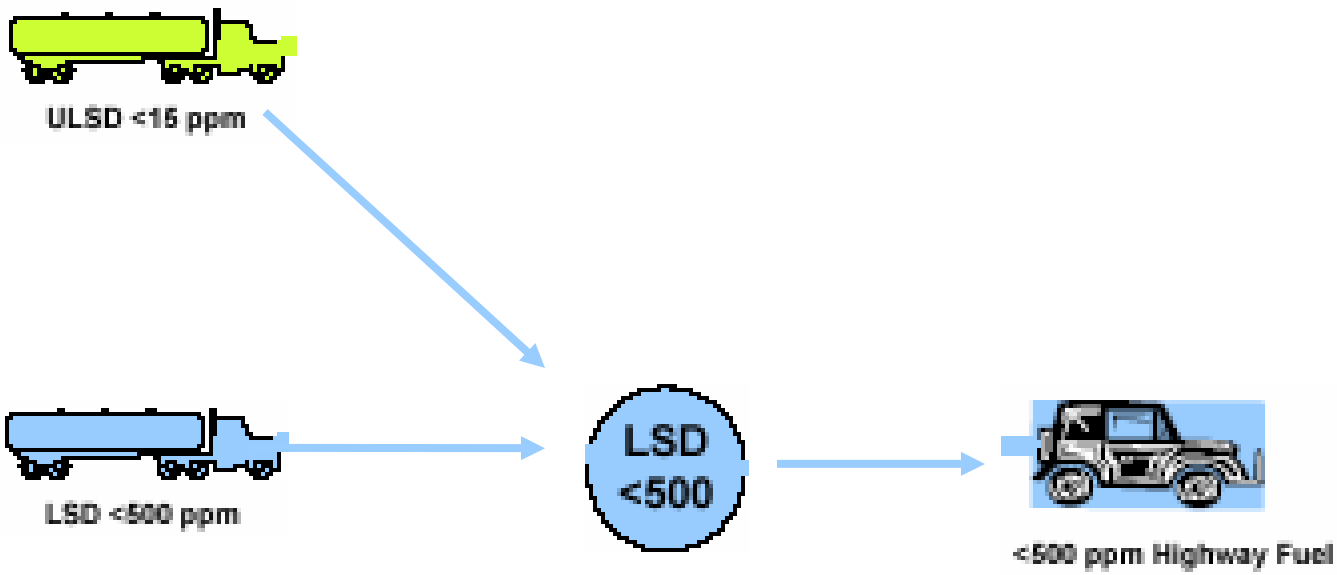
20% Downgrade Limit-
Stations Only Selling LSD

Scenario #3 – Stations Selling Only LSD



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Questions?

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