The Need for 10-μ Diesel Dispenser Filters & “The Good Housekeeping Seal of Approval”

NCWM Fuels and Lubricants Subcommittee (phone conference)
Prentiss Searles, American Petroleum Institute
December 15, 2015
Fact-Finding, Fuel Quality, & Filters

• Dispenser Filter Item 237-3 July 2015 and Proposed Modification for 2016
• Fact-Finding for Good Housekeeping
  – Battelle Corrosion Study
  – EPA Corrosion Study
  – Anecdotal Evidence of Good Housekeeping Success

• Fuel Quality
  – ASTM Specifications
  – Cold Weather Concerns
  – Vehicle Impacts

• Filters – The Last Line of Defense
Voted on in July 2015

Handbook 130, Section 4.3 – Dispenser Filters

• L&R Item 237-3 (Revision to current language in **Bold Red**)

  **4.3.1. Engine Fuel Dispensers.**

  All gasoline, gasoline-alcohol blends, gasoline-ether blends, ethanol flex fuel, and M85 methanol dispensers shall have a 10 micron or smaller nominal pore-sized filter.

  All biodiesel, biodiesel blends, diesel, and kerosene dispensers shall have a $30\text{-}10$-micron or smaller nominal pore-sized filter except for dispensers with flow rates greater than 15 gallons per minute which shall have a 30-micron or smaller nominal pore size filter.

• House of Delegates Voted 50-9 in Favor of the Item at 2015 NCWM Annual Meeting but it was “Returned to Committee” Due to 16-16 Split Vote in House of Representatives at 2015 NCWM Annual Meeting.

• Based on Concerns Expressed by Some States and Marketers Regarding Cold Flow, a New Proposal is Being Made.
4.3.1. Engine Fuel Dispensers.

All gasoline, gasoline-alcohol blends, gasoline-ether blends, ethanol flex fuel, and M85 methanol dispensers shall have a 10-micron or smaller nominal pore-sized filter.

All biodiesel, biodiesel blends, diesel, and kerosene dispensers shall have a 30-micron or smaller nominal pore-sized filter with the following exceptions:

1. Dispensers with flow rates greater than 15 gallons per minute shall use a 30-micron or smaller nominal pore size filter.

2. Dispensers with flow rates less than or equal to 15 gallons per minute in the following states may use a 30-micron or smaller nominal pore size filter during the months of December through March. These states include: Nevada, Idaho, Montana, Wyoming, Colorado, North Dakota, South Dakota, Nebraska, Minnesota, Iowa, Wisconsin, Michigan, Illinois, Pennsylvania, New York, Vermont, New Hampshire, Maine. This exception has a sunset date of April 2020.

3. Dispensers with flow rates less than or equal to 15 gallons per minute in North Dakota may use a 30-micron or smaller nominal pore size filter during the months of November through March. This exception has a sunset date of April 2020.
Fact-Finding – Retail Diesel System

Ambient Temp
Filters plugged due to cold ambient temp will be freed by warmer fuel from tank

Water enters fill container

Water vapor enters through vent

Water enters droplet into tank

Diesel filter
Condensation
Pump
Fuel
Fill Pipe

Loose fittings allow ground water to enter

Fuel stored underground is 50-55°F

Water vapor enters through vent
Fact-Finding – Examples of Corrosion
Fact-Finding – Examples of Corrosion

Vapor Phase – No Contact with Fuel

Submerged STP Tube – Fuel Phase
Fact-Finding – Battelle ULSD Corrosion

• Clean Diesel Alliance Project Conclusions in 2012
  – Additives Not Involved in Corrosion
  – Ethanol and Acetic Acid Observed in Diesel Tanks
  – Acetic Acid is the Suspected Aggressive Species Initiating the Corrosion
  – Acetic Acid Likely from the Bacteria Family Acetobacteraceae
    [Link](http://www.clean-diesel.org/pdf/ULSDStoringSystemCorrosion.pdf)

• USEPA Presentation During 25\textsuperscript{th} National Tanks Conference
  – MIC is Likely Responsible for Corrosion
  – Ethanol/Glycerol Suspected Food Sources
  – Acid Production from Breakdown of Alcohols
  – Water Elimination Considered Key to Controlling

• Final Report Expected in Winter 2015
Fact-Finding – CRC Report No. 667

• Prepared by Consortium that Included Engine and Equipment Manufacturers, Automakers, Petroleum Refining/Distribution, Additive Companies, Microbial, and Fuel Subject Matter Experts

• Document provides:
  – Guidance for Diesel Fuel Storage and Handling
  – Focuses on Maintaining Clean Distribution System
  – Discusses Importance of Filters
Fact-Finding - CRC Report No. 667

• Significant sources of tank contamination are accumulated water and sludge that promote corrosion of fuel tank bottoms

• Water is the most common contaminant:
  – Rain, ship/barge ballast, condensation in tanks, refining process
  – Dissolved in fuel or suspended as tiny droplets

• Water is more soluble in biodiesel and biodiesel blends
Fact Finding - CRC Report No. 667

• Increased Water Content Can Lead to:
  – Accelerated corrosion/increased wear of metal surfaces that generate particulates
  – Ice formation during cold weather (vehicle)
  – Plugged filters
  – Fuel degradation
  – Microbial growth
  – Dissolved inorganic salts (ice melt), acids, and other contaminants that can increase metal corrosion and harm engines
Fact-Finding – CRC Report No. 667
Fact Finding – Anecdotal Success

Speedway: ~2,750 Retail Locations

• ~1,500 Locations in Midwest U.S.
  – No Acute Corrosion Issues for a Decade
  – Extensive and Aggressive Housekeeping Programs
    • Developed from Experience
    • Cooperation with MPC Subject Matter Experts
Fact Finding – Anecdotal Success

• Water Contamination
  – Tank Bottom Sampling
  – Corrective Action at 1-inch in Diesel Tank Bottoms
  – Dispenser Sample Bright & Clear

• Microbial Mitigation
  – Visual Observations (Photographs)
  – Inspection and Evidence of Corrosion (Photographs)
  – Testing
  – Treatment (if necessary)

• Particulate and Debris
  – Tank Bottom Sampling
  – Corrective Action is Dependent Upon Level, Filter Change Frequency, Etc.
  – Dispenser Sample Bright & Clear
Fact Finding – Anecdotal Success

• Dispenser Filters
  – 10-Micron, 95% Efficient, Water Absorbing Required
  – Flow Rate Monitoring (State-of-the-Art)
  – Routine Change-Out

• Intangibles
  – Quick to Respond to Quality Issues
  – Company-Owned: More Control
  – More Restrictive Hauler Requirements
  – In-House Maintenance Personnel
  – Tank Conversion Procedures
Fuel Quality - ASTM

From ASTM D975:

• **X8.4 Water and Sediment Controls**
  
  X8.4.1 Several strategies may be used separately or in combination to control the amount of water and sediment that are ultimately delivered to the end user’s fuel tank.

  X8.4.2 *One potential method for ensuring that clean and dry fuel is delivered to the vehicle or equipment is to use high volume particulate filtration*, combined with either water coalescing or water absorbing capability. Such a system should be designed based upon expected local fuel quality, operating conditions, and the customer’s needs. Factors to be considered may include:

  X8.4.2.1 The flow rating for the filtration, coalescer, or absorber being at least as high as the maximum expected fuel transfer rate;....
Fuel Quality – Marketers’ Concerns

• Marketers Claim – Can’t Use 10-Micron Filters in Cold Weather or with Biodiesel Blends

• PMAA Cold Temperature Testing Program Used as Example to Support Claim
  – Cooled Entire Fuel Sample to Test Temperature Before Filtering
    • Concluded above 30°F fuel temperature, both 10- and 30-micron filters perform similarly
    • Concluded at -10°F fuel temperature, significant filter plugging issues with both filters, 10-micron plugged in minutes

• Fallacy with Testing Approach
  – Fuel at Retail is stored in UST is at much higher (warmer) temperature
  – Measured wax formation, not inorganic particulate removal efficiency
  – Cold flow properties of diesel tested were NOT provided
  – Results of testing, as conducted, were not surprising

• Diesel Fuel for “Winter” Use Must Meet Cold Temperature Requirements
  – Control Wax Through Blending No. 1 and/or Cold Flow Additives
  – Fuels Should Meet ASTM D975 Cold Flow Tables Appendix X5
February (coldest month) ~16” below ground -- Average Temp of 33°F

Feb 28, 2014, High 11.9°F, low -13°F 2” below ground temp was 21°F

http://www.wunderground.com/personal-weather-station/dashboard?ID=KMTCHEST1#history/s20140228/e20140228/mdaily

Montana (MST) SCAN Site Violett - NRCS National Water and Climate Center - Provisional Data - subject to revision as of Mon Sep 14 12:06:18 PDT 2015. Notes on dates - Daily sensors (e.g. TAVG.D-1) report a summary value for the previous day. Hourly sensors (e.g. TAVG.H-1) report a summary value for the previous hour. Instantaneous sensors (e.g. TOBS.I-1) report a single observation on the hour.

http://www.wcc.nrcs.usda.gov/nwcc/view
Fuel Quality – Marketers’ Concerns

Average Soil Temperature for United States Taken at 40 Inches in °F

Soil temperature change at 6 feet in depth averages +/-10°F annually.

http://www.builditsolar.com/Projects/Cooling/US-ground-temps.gif

http://www.builditsolar.com/Projects/Cooling/EarthTemperatures.htm
Fuel Quality – Vehicle Impacts

• Modern Vehicle Diesel Injection System:
  – High Pressure Common Rail (20,000+ psi)
  – Extremely Tight Injector Tolerances (2 to 4-micron)

• Microscopic Particulates Can Cause Significant Issues:
  – Loss of Power/Performance
  – Injector Erosion
  – Over-Fueling/Engine Damage
  – Vehicle Repairs May Be >$2,000

• 10-Micron Dispenser Filters Lessen Particle Loading on Vehicle Filters to Extend Vehicle Filter Life
  – GM Study Cites Up to 30% More Particles Removed from Diesel with 10-Micron vs. 30-Micron
Filters – The Last Line of Defense
Cost of Business

Claim - Filters Cost $15 Each; Change Twice Monthly

http://www.alliedelectronics.com/Fuel-Filter.html

Filter 10 Micron 1 1/2 16 UNF 1 Flow 400-10

$5.40 per Filter

Good Housekeeping at UST
Real World Experience
Shows 1 Change-Out
Annually Required
Filters – The Last Line of Defense
Tank Management Impacts Filter Life

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• Dispenser Sample Bright & Clear
Filters – The Last Line of Defense
Responsibilities Are Shared

• Different Management for Different Parts of Distribution System
• Does Not Alleviate UST Owners of Responsibility
  – Pristine Fuel Can Be Provided to Retailer, but...
  – Retail UST Environment Perfect Conditions for Corrosion to Generate Particulate
• Multiple Studies on Importance of Housekeeping at Retail USTs
  – Water and Microbial Activity Responsible for Corrosion and Particulate in USTs
  – Good Housekeeping Greatly Reduces These Concerns
  – 10-Micron Dispenser Filters Provide Last Defense Before Customer Vehicles
Proposal to Modify L&R 237-3

Approach to Proposal: To Address the Concerns Raised by Some State Regulators and Marketers Regarding the Possibility of Filters Clogging in the Winter, Exceptions Are Proposed to the 10-Micron Diesel Dispenser Filter Requirement.

• States Receiving “Winter” Exemptions Based on ASTM D975 Appendix X5
  – The 10th Percentile Minimum Ambient Air Temperatures Reaches -20°C (-4°F) or Below.
  – The Highlighted Maps Below Show These States for Each Month.
  – To Simplify Implementation, a State is Granted the Exception for the Entire Winter Season if -20°C (-4°F) Achieved During Any Single Month (December through March).
  – When Only a Portion of the State Meets the Criteria, the Entire State was Included in the Exception.
  – North Dakota is Granted the Exception for November Because it is the Only State that Reaches -20°C (-4°F) for that Month.

• April 2020 Sunset Date Allows Time for Full Implementation.
November and December
January and February
March

FIG. X5.6 March—10th Percentile Minimum Ambient Air Temperatures
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