

# 'It's not Your Father's Fuel'



A look at the real world problems caused by the use of Ethanol, Bio-diesel, and Ultra-Low Sulfur Diesel

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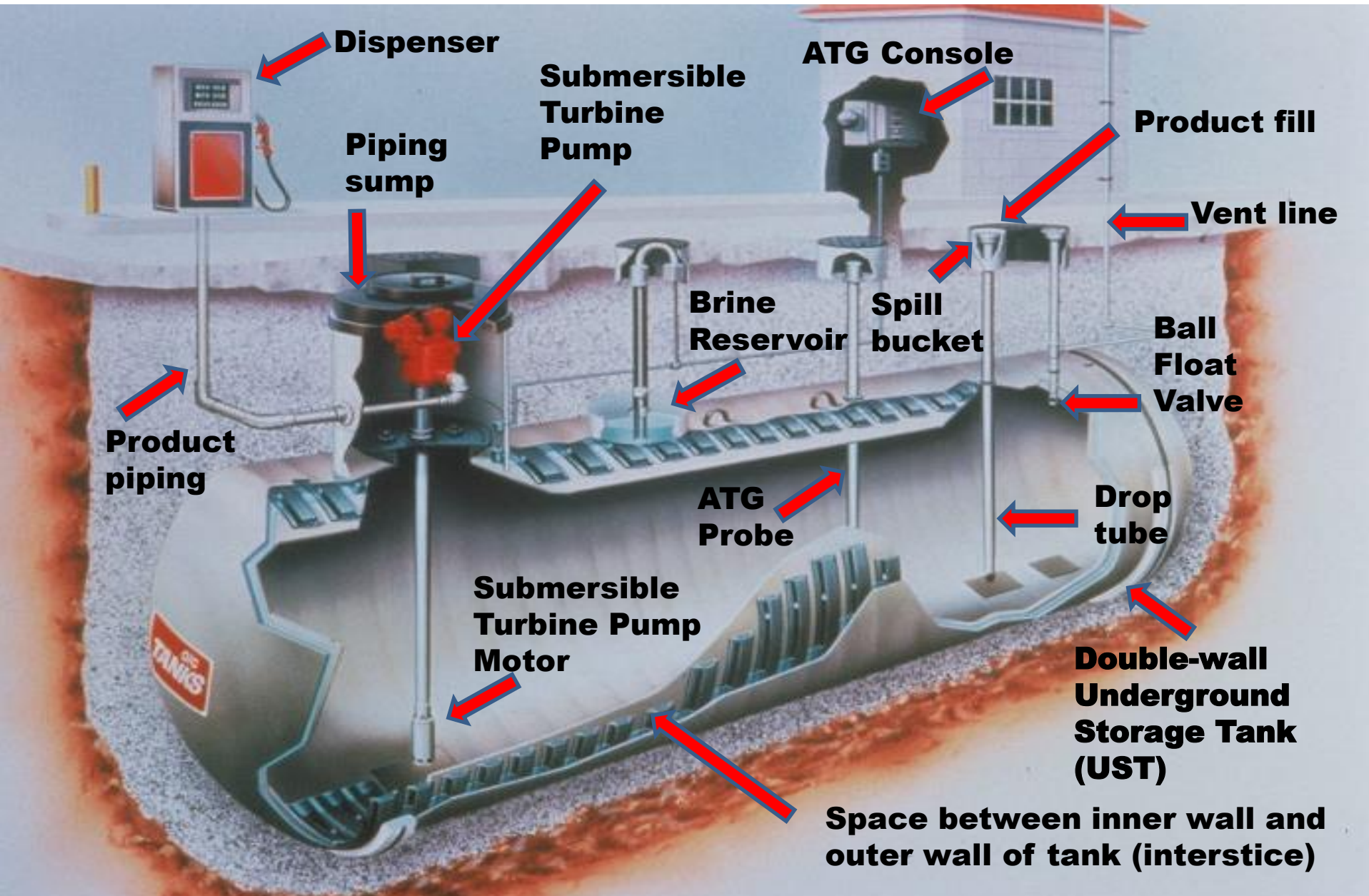
850-391-9835

850-766-1562 cell

850-591-1434 cell



# An Underground Storage Tank System



# Alternative Fuels



- E-10 Ethanol
- E-15 Ethanol
- E-85 Ethanol
- B-20 Bio-diesel
- ULSD – Ultra-Low Sulfur Diesel



## CAUTION!

This fuel contains 15% ethanol maximum

Use only in:

2007 and newer gasoline cars  
2007 and newer light-duty trucks  
Flex-fuel vehicles

This fuel might damage other vehicles.  
Federal law *prohibits* its use in other  
vehicles and engines.

**ULTRA-LOW SULFUR  
HIGHWAY DIESEL FUEL**  
(15 ppm Sulfur Maximum)

*Required* for use in all model year  
2007 and later highway diesel  
vehicles and engines.

Recommended for use in all diesel  
vehicles and engines.

# Why are we using Ethanol? (from government sources)

- Air pollution – as an oxygenate to make fuel burn cleaner and reduce air pollution
- Augment the nations fuel supply and reduce reliance on foreign fuels
- Stimulate the economy
- It's a “Green” Fuel



# Problems with Ethanol...

1. Ethanol does not burn that much cleaner than regular gasoline
2. Using Ethanol leads to an energy drop-off
3. Using Ethanol competes with food crops and increases food costs
4. Chemically-speaking, Ethanol wants to become water
5. Phase Separation
6. Some older fiberglass systems are not compatible
7. Ethanol loves to eat soft metals, rubber, and plastics
8. More frequent dispenser filter changes
9. Ethanol has a scouring effect on tank systems
10. Ethanol is destroying our petroleum pumping infrastructure

# Alternative fuels (ULSD, Ethanol and Bio-diesel)



- Have only been in widespread use nationally for about five to six years
- Growing number of problems with the integrity of storage tank system equipment

# Evidence of problems discovered from facility monthly visual inspections and State UST regulatory and fuel quality inspections



**Black “Gunk” in tank**



**Corrosion**



# Ethanol – E-10 & E-85



# Problems



Diesel sump, same facility, Georgetown, South Carolina, November 2011



Regular Unleaded gasoline sump, same facility, Georgetown, South Carolina, November 2011



Mississippi (e10)

Photo 12-09



South Carolina (e85)



Kentucky (e10)



Ohio



Idaho



Delaware (e85)

Installed 3-07 – Photo 3-08





Minnesota (e85)



Washington



California



Iowa



Florida (e10)



Florida (e10)



Florida (e10)

# How Long Does It Take For This Severe Corrosion To Occur?

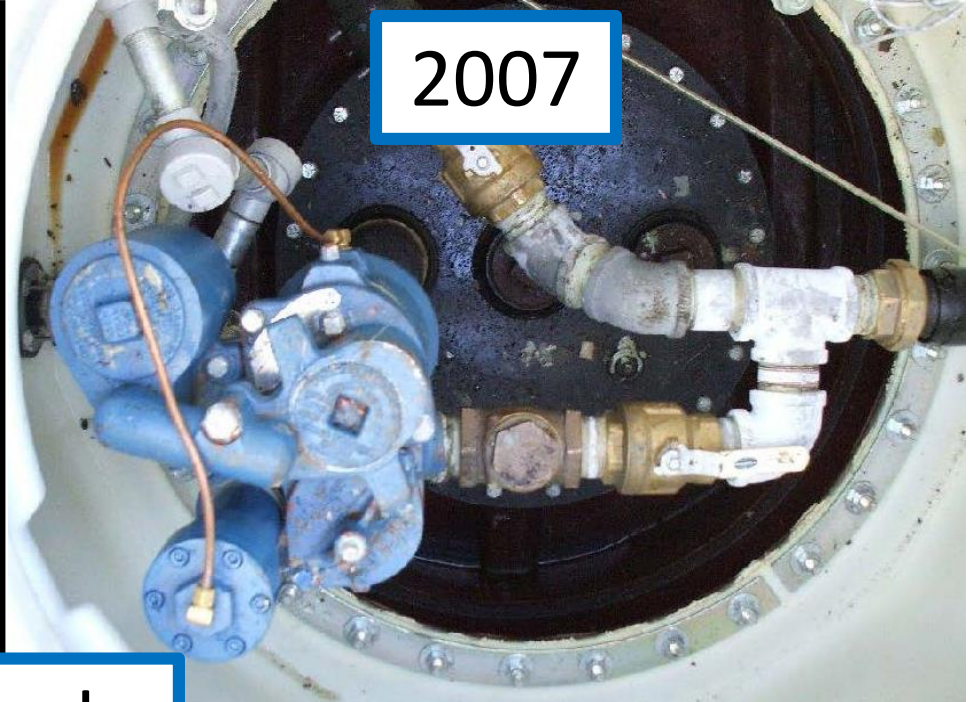
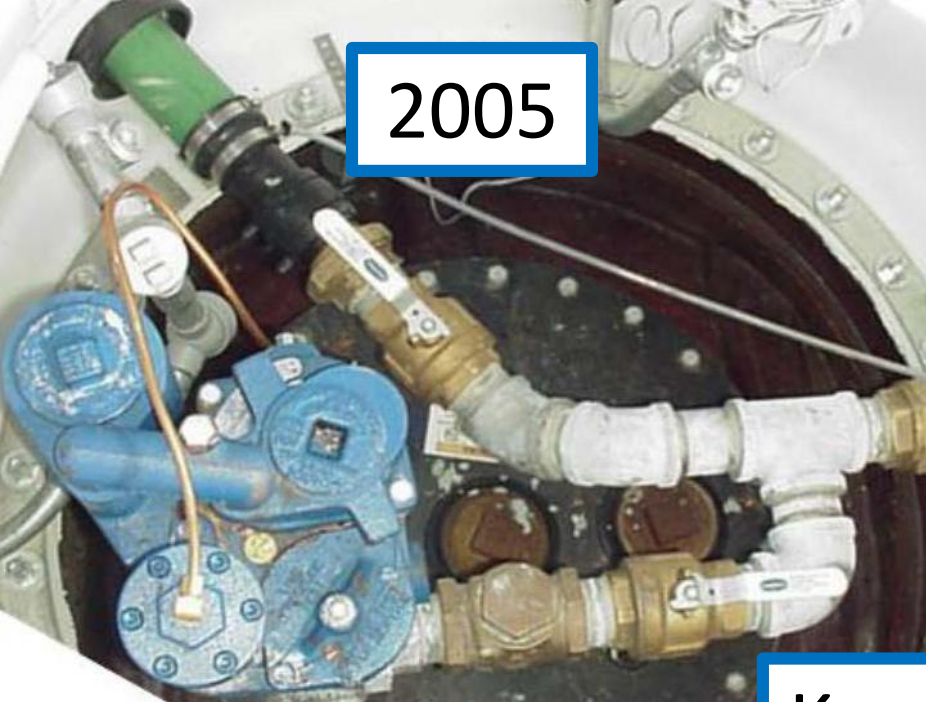


Tennessee - March 2010

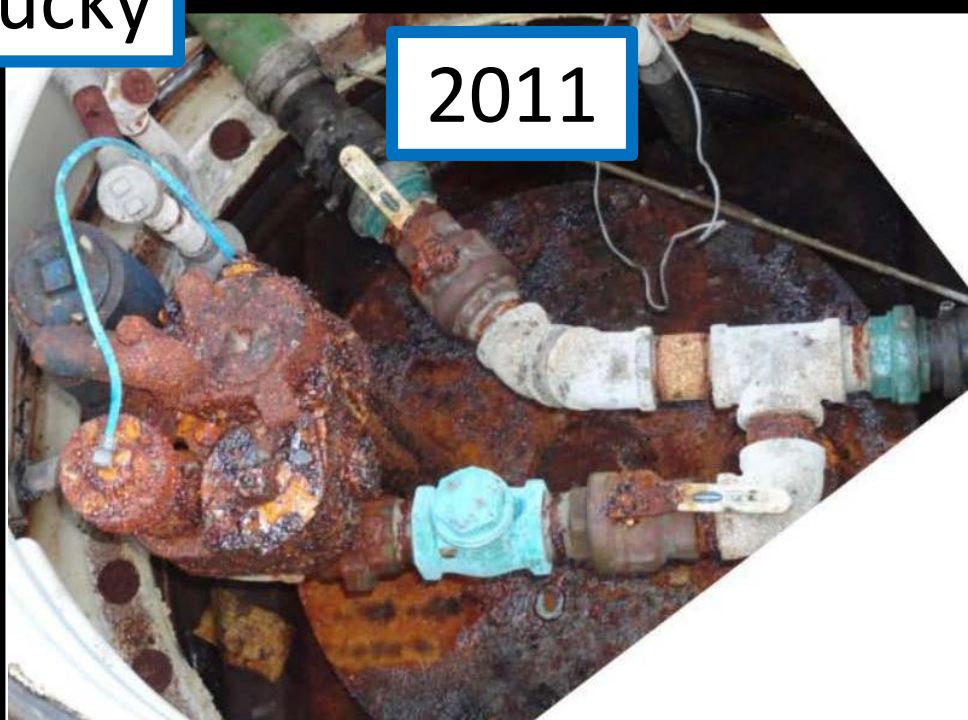


Tennessee - August 2010





Kentucky



# Diesel vs. Gasoline

## Mississippi



Installed 8-07 - Photos 3-12

Same Facility - Same Equipment – Same Day- Different Sumps

**What's this "whirlybird" doing here with the tank vents?**



Kentucky

# What's this open pipe doing here?



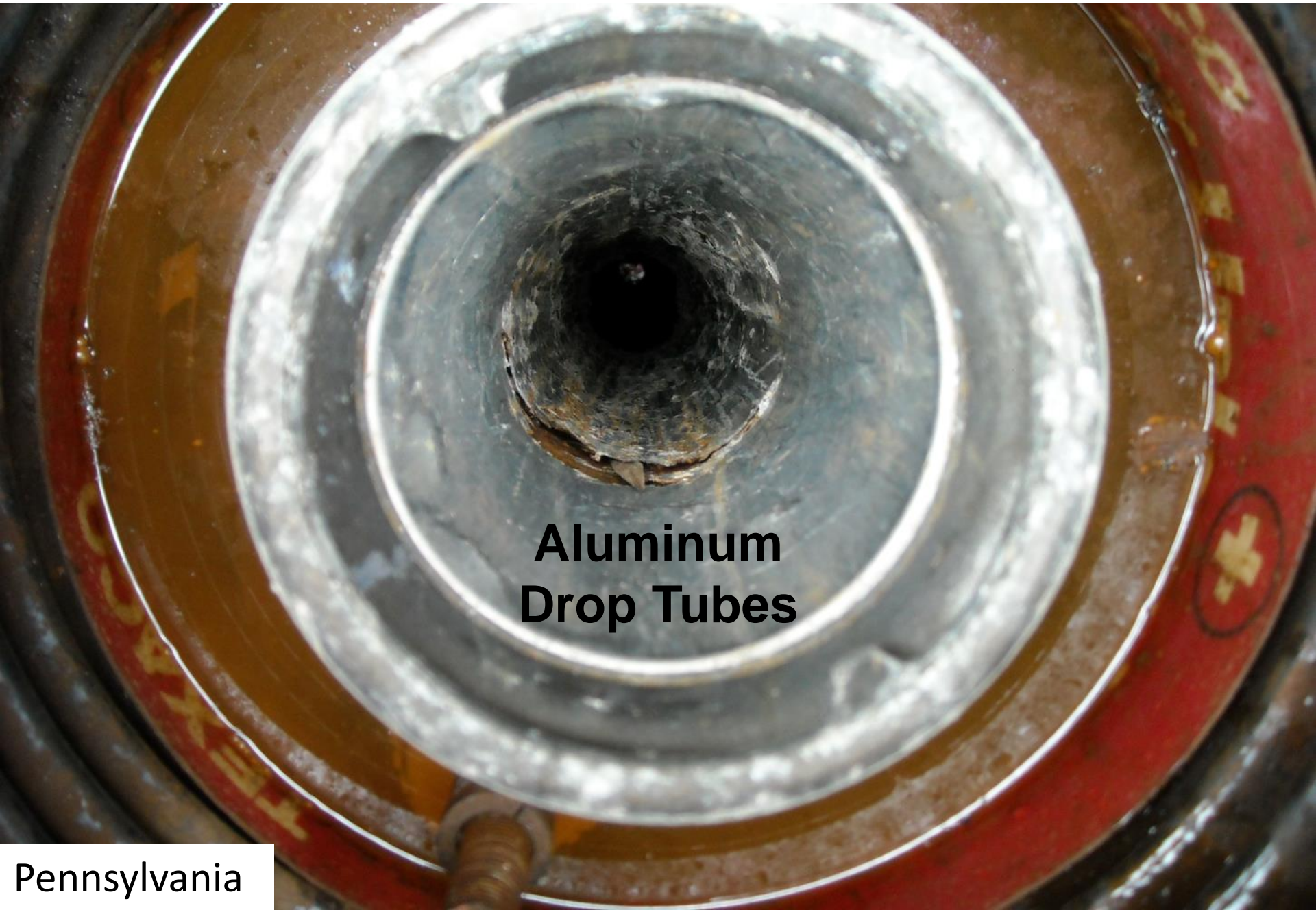
Kentucky

# Other Problem Areas – ATG Equipment



Evidence of vapor leaks

What other components could be affected by corrosion?



**Aluminum  
Drop Tubes**

# Corrosion on Aluminum Drop Tubes



Minnesota



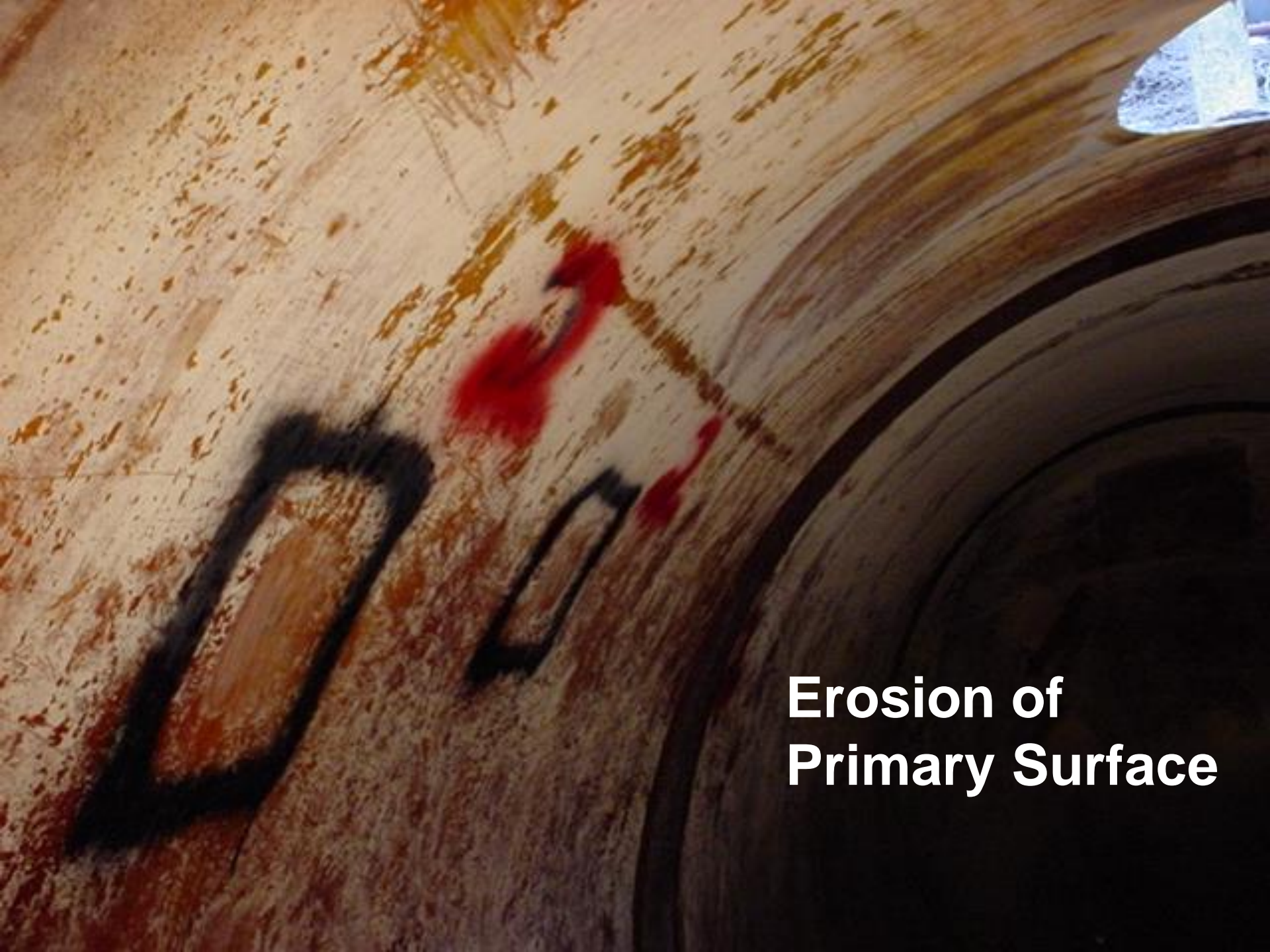


# Corrosion on Ball Float Valve Overfill Protection Equipment





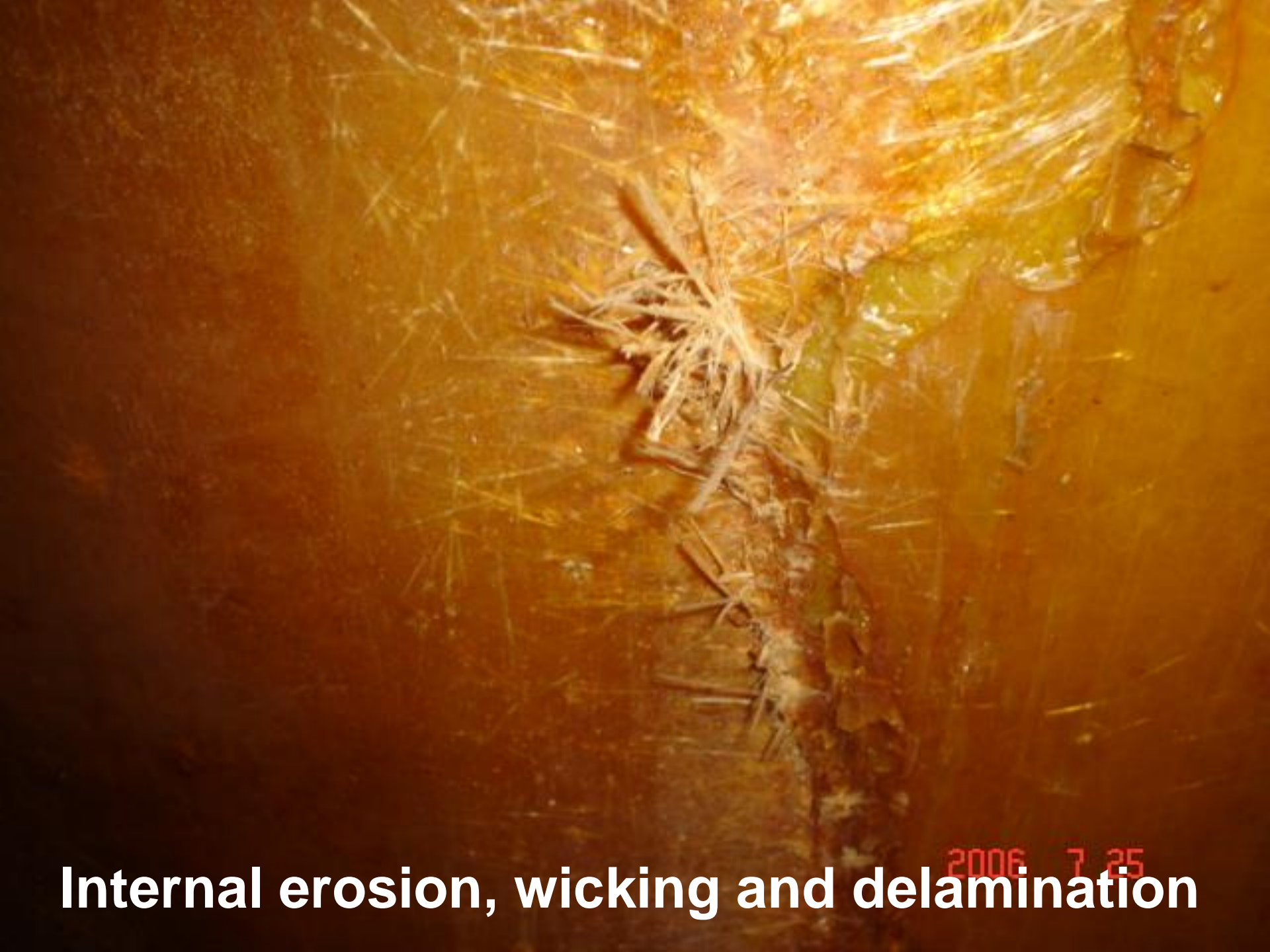
**Observations with Older Single-wall  
Fiberglass Tanks in E-10 Service for  
less than Two Years**



**Erosion of  
Primary Surface**

**Cracking**





**Internal erosion, wicking and delamination**

2006 7 25



**Delamination of gel coat**

2006 7 25

BLISTERS  
↓ T-3

**Blisters on sidewall**

# Ethanol-Free Gasoline Has Become a Marketing Tool





# Advertising Ethanol-Free Fuels





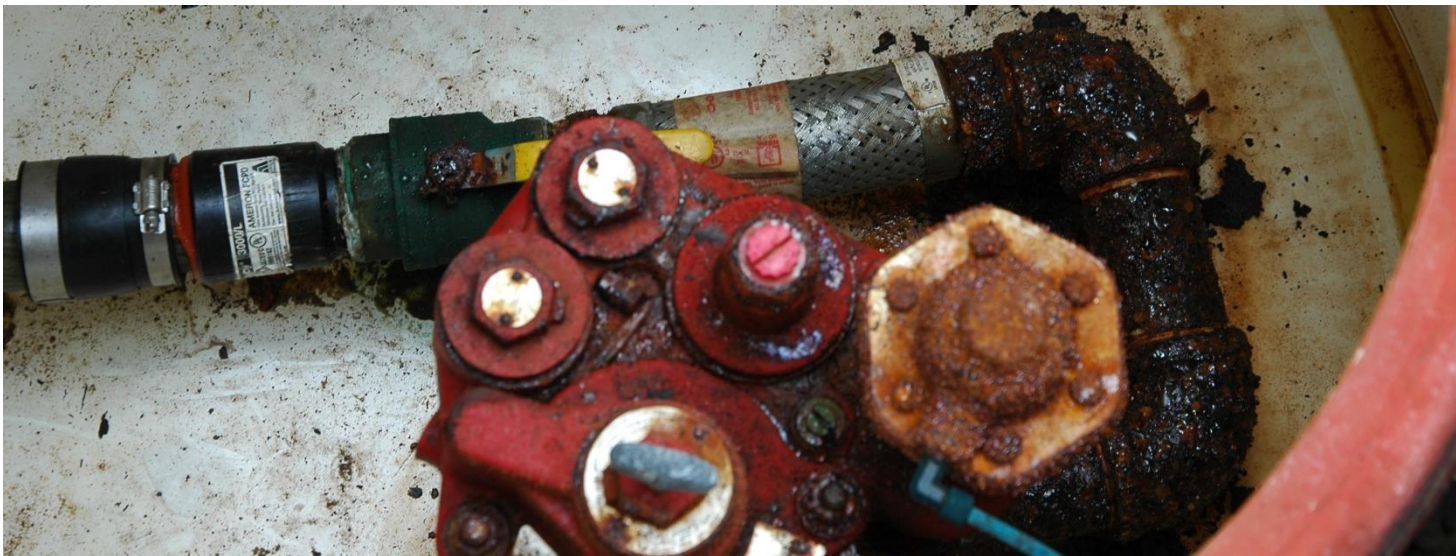
# Recent National EPA/State Regulator Field Study with Ethanol Corrosion

- EPA provided sampling kits
- Passive diffusion samplers were placed in piping sumps to measure the concentrations of ethanol and acetic acid
- Data came from Florida (35), Tennessee (13), Illinois (6), Wisconsin (4), California (2), and Iowa (1)
- 27 RUL, 2 MUL, 26 PUL, 5 E-85, and One Diesel



# Findings

- Many sumps had high concentrations of Ethanol or Acetic Acid
- No significant difference between RUL & PUL
- Corrosion worse in sumps with high concentrations
- Corrosion worse in sumps with water
- For Ethanol to cause corrosion in a sump, there must be ethanol, bacteria, and water
- Eliminating one of these could prevent corrosion?



# Other Problems

- Warranties for UST and AST Fuel System Components
- Vehicle Warranties
- Concerns with traditional problems from ethanol fuel use such phase separation, degradation of soft metals, increased filter replacement, and the scouring effect on fuel tanks
- UST & AST owner acceptance
- Consumer confidence



# Ultra-Low Sulfur Diesel

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*Required* for use in all model year  
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# Ultra Low Sulfur Diesel

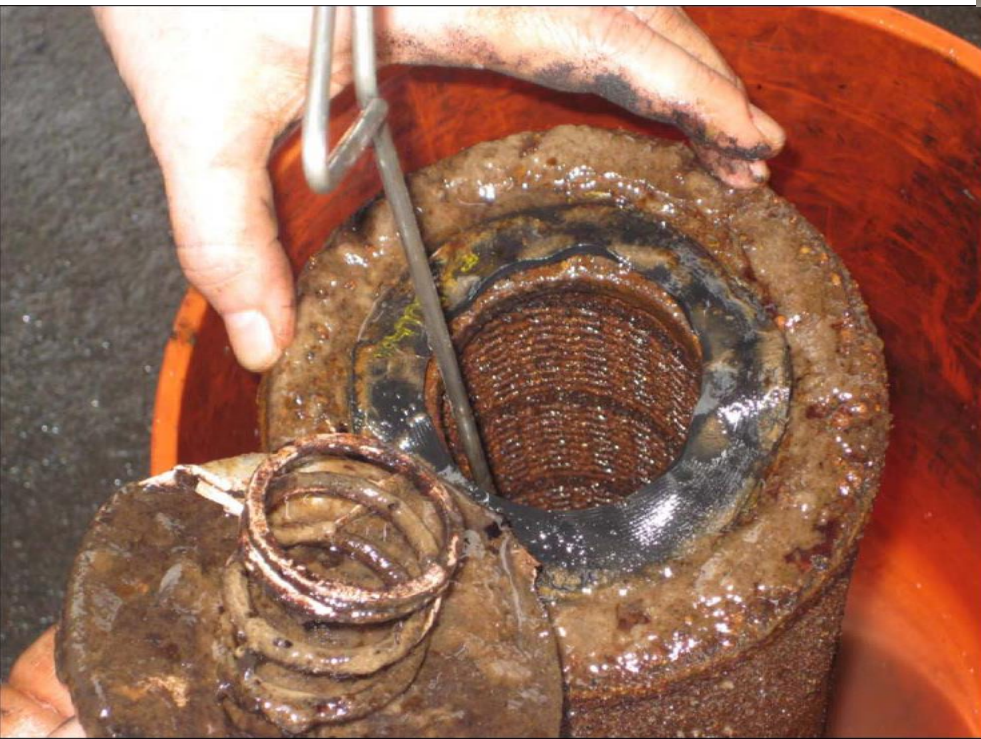


Submersible Pump & Riser  
(Left hand side is aluminum;  
Right hand side is steel)



Submersible Pump Head  
(in vapor space -- never  
contacts fuel)

# Problems with Ultra Low Sulfur Diesel and Steel Components





# FE Petro Equipment



Old vs New  
**Corrosion, Pitting**

Leak detection equipment not functioning





**Filter  
threads**

**Strainer**



**“Coffee Grounds”**



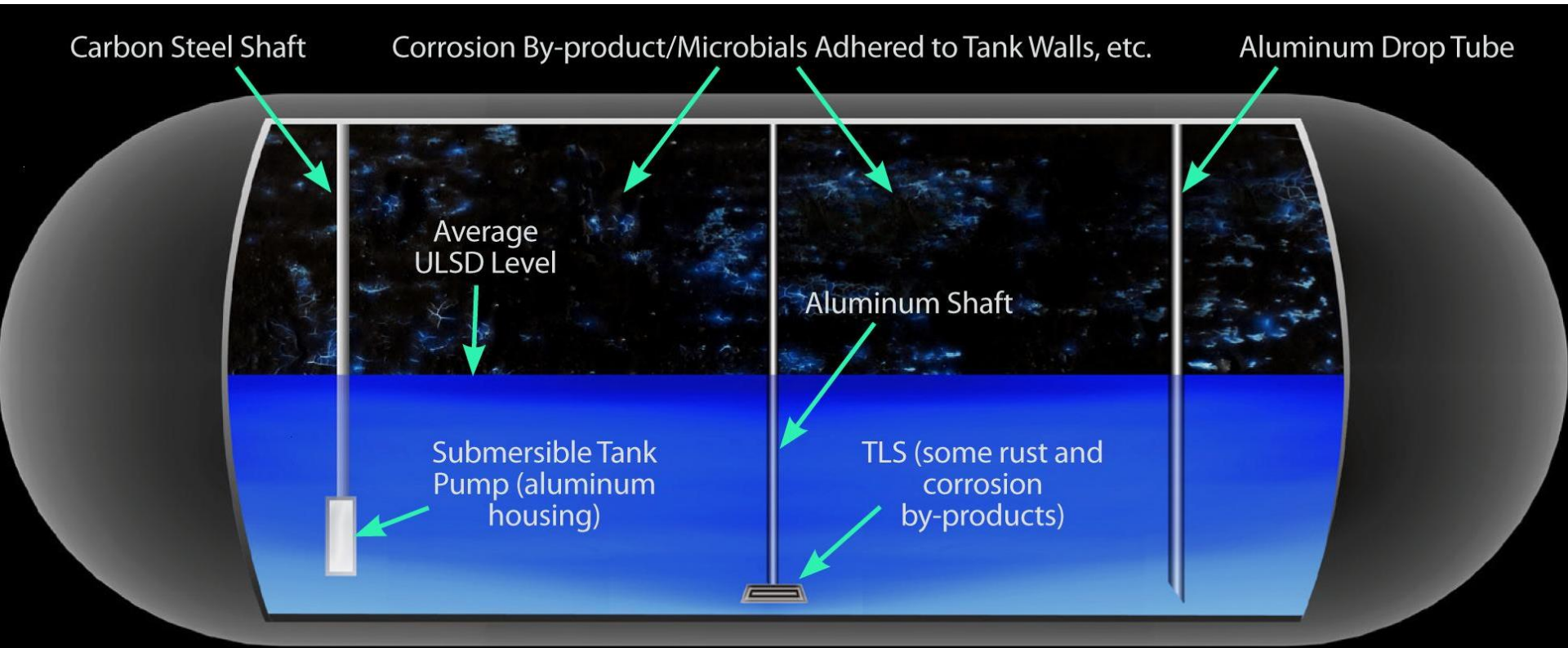
**Problems reported from all regions of the country-  
No problems reported at refineries, pipelines, not  
associated with individual supplier**



# Problems Observed

- **Filters clogging/requiring more frequent replacement**
- **Seal/Gasket/O-ring deterioration**
- **STP replacement/Column pipe wear/Motor problems**
- **Tanks rusting/leaking (includes tanks of vehicles)**
- **Meter Failure**
- **Line leak detectors damaged or broken**
- **Automatic nozzle shutoff failure/shorter lifespan**
- **Tank probes malfunctioning**
- **Check valves not seating**
- **Shear valves not sealing/failing tests**
- **Swivels failing/shorter lifespan**
- **Dispenser leaks/failures/ premature replacement**
- **Solenoid valves clogged/failing**
- **Corrosion on the riser pipe**
- **Pipe failure**

# ULSD Corrosion – UST Detail



**UST showing corrosion and possible microbial corrosion spots.**



# Likely Causes

- No one cause, but rather a mixture.....
- Microbial influence getting a lot of attention:
- Salt and other contaminants also a contributing factor?
- Corrosion inhibitor depletion (aka “soap”) theory – acidic additives form soaps if contacted with excessive tank water cations from salts or caustic:
- Poor housekeeping, no biological monitoring, improper application of biocides exacerbates problem

# The Clean Diesel Fuel Alliance

- Created in early 2006
- Participants include:
  1. Government
  2. Engine Manufacturers
  3. Marketers
  4. Refiners
  5. Marketers
  6. Equipment Producers

The screenshot shows the homepage of the Clean Diesel Fuel Alliance Information Center. The header features the text "Government - Industry - Consumers" above the main title "Clean Diesel Fuel Alliance" and "INFORMATION CENTER". A navigation bar includes links for "Skip Navigation", "About ULSD", "EPA Standards", "EIA", "ULSD Compliance", "Media Room", and "Contact Us". A green sidebar on the left contains a menu with the following items: "Highway ULSD Fuel", "Non-Road ULSD Fuel", "Vehicle Performance", "Environment & Health", "Frequently Asked Questions", and "Quicklinks to Member Web Sites". The main content area has a light blue background with a cloud pattern. It features a central headline: "Ultra Low Sulfur Diesel (ULSD) fuel and new engines and vehicles with advanced emissions control systems offer significant air quality improvement." Below this are four columns of text, each with a small image and a link. The first column is titled "Highway ULSD Fuel" and mentions a major reduction in sulfur content, with a link to "Highway Diesel". The second is "Non-Road ULSD Fuel", discussing EPA standards for locomotive, marine, and non-road engines, with a link to "Non-Road Diesel". The third is "New Diesel Technology", describing Ultra Low Sulfur Diesel (ULSD) as a cleaner-burning fuel with a maximum of 15 ppm sulfur, with a link to "Vehicle Performance". The fourth is "Environmental Benefits", stating that ULSD fuel and new engine technologies improve air quality and provide health benefits, with a link to "Environment and Health". At the bottom, there are links for "Para leer en español el folleto sobre diesel ultra bajo en azufre" and "Energy Tomorrow Radio Podcast on ULSD". A small graphic on the left side of the bottom section shows a "ULTRA-LOW SULFUR HIGHWAY DIESEL FUEL (15 ppm Sulfur Maximum)" label with a warning to keep pumps properly labeled.

Website: [www.clean-diesel.org](http://www.clean-diesel.org)

# Members of the Clean Diesel Fuel Alliance

- AAA
- Alliance of Automobile Manufacturers
- American Petroleum Institute
- American Trucking Associations
- Association of American Railroads
- Association of International Automobile Manufacturers
- Association of Oil Pipe Lines
- Diesel Technology Forum
- Engine Manufacturers Association
- Independent Liquid Terminals Association
- Manufacturers of Emission Controls Association
- National Automobile Dealers Association
- National Association of Convenience Stores
- National Association of Fleet Admins.
- NATSO, Inc., representing Truck Stops & Travel Plazas
- National Petrochemical & Refiners Association
- National Tank Truck Carriers, Inc.
- Petroleum Equipment Institute
- Petroleum Marketers Association of America
- Society of Independent Gasoline Marketers of America
- Steel Tank Institute
- Truck Renting and Leasing Association
- U.S. Environmental Protection Agency
- U.S. Department of Energy
- U.S. Energy Information Administration
- Western States Petroleum Association

# Clean Diesel Alliance Study

The Battelle/Tanknology proposal was chosen and funded by API, PEI, STI, NACS, PMAA, NATSO, AAR, and Ford

## *Theories to Investigate*

- **Aerobic and anaerobic microbes** are producing byproducts that are establishing a corrosive environment in ULSD systems
- **Aggressive chemical species (e.g., acetic acid)** present in ULSD systems are facilitating aggressive corrosion; and
- **Additives** in the fuel are contributing to the corrosive environment in ULSD systems

# Test Sites

- **Chose 6 sites with similar throughput and history of issue:**
  - 1 site that does not show symptoms of corrosion
  - 5 sites with history of severe, rapidly induced corrosive symptoms
- **Sites in three states**
  - 2 in California
  - 3 in NY (including no symptoms site)
  - 1 in NC



# Site Inspections

- Feb 8-23: Inspected 6 sites
- Report Completed Late Summer 2012



# Inspection Process Disassembled System



# Inspection Process Fuel Sampling



**Inspection  
Process  
Water Bottom  
Sampling**



**Inspection  
Process  
Video Inside Tank  
and Vapor  
Sampling**





# Biological Analysis to Extract DNA



# ULSD Corrosion – Assessment



New steel  
corrosion coupon



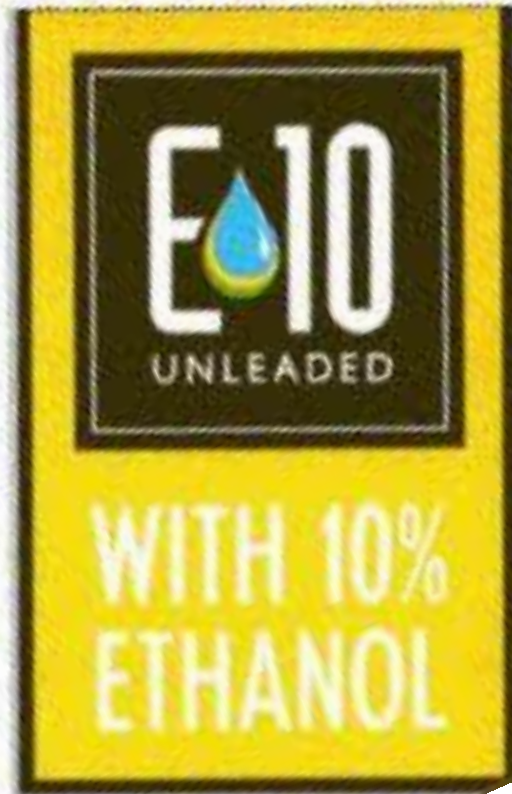
After 3 months

# So what did the Study Conclude?

- More studies are needed, but one of the causes of corrosion with ULSD systems is...



# Conclusion- The Source of the Problem...Ethanol!



# Bio-Diesel

- Many Bio-diesel plants shut down when the price dropped
- Problems with feedstocks and maintaining quality
- Problems with cold-flow and scouring effects on tanks
- Problems with “shelf-life”
- Expensive to refine
- Prone to microbial growth



# Questions?

