

E15 Retailer Handbook



E15 Gasoline Blends
Industry Guidelines
Specifications and Procedures
Retail Operations



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E15 Retailer Handbook

Introduction

The U.S. Environmental Protection Agency (EPA) has approved the use of E15 ethanol fuels in light duty vehicles built since model year (MY) 2001. The EPA has specifically excluded light duty vehicles built before 2001, as well as non-automotive, marine, and other small engines.

The Renewable Fuels Association's (RFA) E15 Retailer Handbook is designed to provide fuel retailers with regulatory and technical guidance in order to legally store and sell E15 ethanol blends. The Handbook provides sample checklists and questions that all potential E15 retailers should contemplate before moving forward with offerings of E15.

About the RFA

The RFA is the leading national trade association for the domestic ethanol industry. Its mission is to advance the development, production, and use of ethanol fuel by strengthening America's ethanol industry and raising awareness about the benefits of renewable fuels. Founded in 1981, our membership includes ethanol producers and suppliers, gasoline marketers, agricultural organizations and state agencies dedicated to the continued expansion and promotion of fuel ethanol. RFA's 300-plus members are working to help America become cleaner, safer, energy independent and economically secure.

Today, the RFA focuses on legislative, regulatory, and technical issues impacting the production and use of ethanol and ethanol-blended fuels. The RFA maintains an expansive committee structure designed to meet the specific needs of ethanol producers, marketers, and retailers alike. These committees include a technical committee to address various technical issues and to assist with technical industry publications (such as this one). In addition, plant and employee safety, environmental, and co-products committees constantly monitor legislation, regulation, and enforcement activities that directly impact these critical areas of focus. All RFA committees and task forces are comprised of representatives of our member companies, staff, and, when necessary, technical consultants and other interested stakeholders.

The RFA promotes the use of fuel grade ethanol in all its legal applications.¹ Fuel ethanol is blended in nearly all of the nation's gasoline. This includes not only conventional E10 (90% gasoline/10% ethanol), reformulated gasoline (RFG) and fuels that are considered primarily gasoline, but all developing markets such as E85 and mid-level ethanol fuel blends for use in flexible fuel vehicles (FFV's). This document focuses on the product quality and integrity of fuel grade ethanol and gasoline ethanol blends containing up to 15volume % (v%) ethanol. The RFA publishes numerous resources to serve as condensed technical references for manufacturers and retailers of fuel grade ethanol and gasoline ethanol blends and other interested parties who need such information. All RFA Technical Publications and other RFA Reference materials are available on the RFA website at: www.EthanolRFA.org.

1. In October 2010 and January 2011, EPA issued partial waivers allowing E15 fuel blends for use in Model Year 2001 and newer light duty motor vehicles. This document will be updated accordingly once the information has been assessed.

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E15 Gasoline Ethanol Blends— Background

In October 2010, the U.S. Environmental Protection Agency (EPA) approved a waiver permitting the use of E15 (85v% gasoline / 15v% ethanol) in model year 2007 and newer autos and light duty motor vehicles. In January 2011, the EPA extended the waiver to permit the use of E15 in 2001 to 2006 model year autos and light duty vehicles. Of course, Flexible Fuel Vehicles (FFV) are also permitted to use E15.

E15 can only be used in 2001 and newer light duty vehicles and all FFV's.

This waiver ruling was made after many years of extensive tests, making E15 one of the most tested fuels in history prior to its permitted use.

However, EPA limited this decision to model year 2001 and newer vehicles because it is difficult to test older vehicles due to varying mileage, usage patterns, and maintenance history. EPA also excluded non-automotive engines (e.g. power equipment, marine, recreational) from the waiver because these applications often lack the sophisticated computer controls that automobile engines employ to adjust for oxygen in the fuel and other variations in fuel properties.

Offering a fuel that is legal for use in less than 100% of spark ignition engines presents unique marketing considerations, as well as additional regulatory compliance procedures. Presently 2001 and newer vehicles represent nearly 70% of the fleet and a larger percentage of vehicle miles traveled (and therefore a larger percentage of the gasoline market). As such, there are special labeling requirements to mitigate the potential for misfueling of vehicles and equipment for which the use of E15 has not been approved.

Another issue is that most vehicles on the road were introduced before EPA waived E15 into use for 2001 and later light duty vehicles. The owner manuals of 2012/2013 and later model year vehicles will likely provide guidance on the use of E15 in those vehicles. However, older vehicle owner manuals provide no such guidance. In those cases it may be necessary for consumers to consult their vehicle manufacturer's website or an authorized dealership, to determine recommendations on the use of E15 in their vehicle.

Additionally, not all gasoline storage and dispensing equipment has been tested to determine its suitability with E15. This necessitates a compatibility investigation before conversion to E15 and may also require approval under state regulations or by the Authority Having Jurisdiction (AHJ).

In short, since E15 is a new, recently approved fuel, there are new considerations and more regulatory burdens to offering it. Notwithstanding the regulatory challenges, the physical handling of E15 is not all that different than handling E10.

The intent of this guide is to offer step-by-step guidance in converting to and offering E15 blends. As with any new fuel some information is still being developed. Research and testing will no doubt continue, just as it continues for improving more established fuels. Therefore, the reader is advised to check the RFA website at: www.EthanolRFA.org for the latest information.

E15 Federal Regulatory Compliance

E15

The sale of E15 necessitates compliance with several fuel-related Federal Regulations, as well as those that apply specifically to E15. Compliance with these regulations is discussed below.

E15 Waiver Conditions

When EPA approved the E15 waiver it granted a “conditional waiver” meaning the fuel could be sold providing certain conditions are met. Those conditions are as follows:

- Fuel can only be used in 2001 and newer light duty vehicles, and all FFV’s.
- The ethanol used to make E15 must meet the specifications as outlined in ASTM D4806-10 – Standard Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel.
- E15 may not exceed a maximum RVP of 9.0 psi during the summer volatility seasons (June 1 – September 15).
- EPA requires adoption of a “misfueling mitigation” strategy including:
 1. The EPA approved label.
 2. Identification of the v% ethanol in the fuel on Product Transfer Documents (PTD’s).
 3. Confirmation of proper labeling, ethanol content and fuel vapor pressure by conducting sampling surveys.
 4. While not mandatory, EPA encouraged industry to develop a public outreach and education program.

These requirements, as well as other issues, are covered in greater detail below.

Fuel Registration

Like all fuels, E15 must be registered with EPA per Title 40, Chapter 79 of the Code of Federal Regulations. Fuel and fuel additive manufacturers, in this case gasoline and ethanol producers and importers, are required to notify EPA through the submittal of an application that includes all of the information set forth in §79.11. The RFA has completed the health effects information required for the registration process for this fuel so that marketers of E15 can use the RFA registration. In applying for this registration the RFA relied, in part, on data from the American Petroleum Institute (API) 211b Research Consortium. Blenders of E10 may already be included in the Consortium. If your supplier is not a blender of E10 they should contact RFA Technical Staff for additional information on the API 211b Consortium.

Blender Registration

Oxygenate (ethanol) blenders, who are not also gasoline and ethanol producers or importers, are not considered fuel manufacturers for registration requirements under §79,

however the E15 Misfueling Mitigation requirements and other registration requirements may apply. Registration information can be found at: www.epa.gov/otaq/fuels/registrationfuels/index.htm.

Fuel Rating (Octane Posting)

E15 is subject to the Federal Trade Commission (FTC) fuel rating and octane posting requirements, as described in 16CFR306. Octane posting regulations require that the minimum octane number (Antiknock Index) of the fuel dispensed must be posted on the fuel dispenser based upon determination by appropriate testing standards. A more detailed discussion of Antiknock Index (AKI) is included in the Appendix.

Testing sponsored by API² indicates that the (R+M)/2 blending value of 112.5 used for the ethanol in E10 blending is also the approximate blending octane value for the ethanol in E15. Thus, an 84 octane base fuel would increase to approximately 87 octane with a 10 volume % (v%) ethanol addition, while the same base fuel with 15v% ethanol would yield an octane of approximately 88.3. ASTM International is currently updating the precision statements to include blends above E10 in the current octane test methods. As of Fall 2011, the test work has been completed. However, the statistical analysis has not yet been completed. Blenders and marketers should check the RFA website for any updates on octane posting requirements.

Conventional and Reformulated Gasoline

The E15 waiver discusses various issues from the perspective of conventional gasoline. Reformulated gasoline (RFG) can also contain 15v% ethanol providing the fuel is in compliance with all requirements that apply to RFG. In areas requiring reformulated gasoline (RFG, roughly one-third of US gasoline) E15 may have to meet an even lower RVP maximum.

Misfueling Mitigation / Labeling

Because E15 is only approved for use in 2001 model year and newer cars / light duty vehicles, the retail dispenser must display a notice to prevent introduction of E15 into non-approved vehicles and equipment. EPA's guidance is listed below.

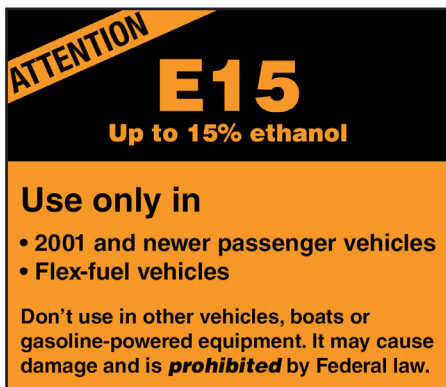
The retail dispenser must display a notice to prevent introduction of E15 into non-approved vehicles and equipment.

Misfueling Mitigation Conditions

- Labels must be placed on E15 retail dispensers indicating that E15 use is only for 2001 and newer motor vehicles.
- Product Transfer Documents (PTD's) must accompany all transfers of fuels for E15 use.
- Parties involved in the manufacture of E15 must participate in a survey of compliance at fuel retail dispensing facilities to ensure proper labeling of dispensers.
- Parties must submit a plan addressing conditions to EPA for approval.

2. Determination of the Potential Property Ranges of Mid-Level Ethanol Blends, American Petroleum Institute, April 23, 2010.

What is EPA doing to address Potential Misfueling?



E15 Label

On June 23, 2011, EPA finalized regulations to help prevent misfueling of vehicles, engines and equipment not covered by the partial waiver decisions. These regulations require all E15 fuel dispensers to have a label that informs consumers about what vehicles can, and what vehicles and equipment cannot, use E15. The rule prohibits the use of gasoline containing greater than 10v% ethanol in the vehicles, engines and equipment not approved by EPA. Many insurance companies provide misfueling liability insurance. Check with your insurance provider to verify your coverage.

The rule also requires PTD's specifying ethanol content and Reid Vapor Pressure (RVP) to accompany the transfer of gasoline blended with ethanol and a survey of retail stations to help ensure compliance with labeling and ethanol content requirements.

This rule complements the E15 partial waiver decisions and does not replace or remove any conditions of the waiver decisions. The rule is expected to facilitate effective implementation of the waiver conditions and further reduce the potential for misfueling.

Other Waiver Requirements: The EPA also placed certain "fuel quality conditions" on E15 as follows:

- Ethanol used for E15 must meet ASTM International D4806-10.
- The Reid Vapor Pressure for E15 is limited to 9.0 psi during the summertime.

Detergent Requirements: EPA regulations require that gasoline and gasoline / ethanol blends (up to E15) be treated with a registered detergent additive (40CFR79). EPA requires additive manufacturers to conduct tests before a detergent can be registered and maintains a list of certified detergents (www.epa.gov/otaq/regs/fuels/additive/detergnt/web-dtrg.htm). EPA officials have told the U.S. Government Accountability Office (GAO) that "the agency has no plans to revise its regulations for certifying detergents for E15 because it currently has not determined any detergent-related issues different from E10." As such, the detergent treat rate used for E10 can also be used for E15.

The detergent treat rate used for E10 can also be used for E15.

Labeling and Ethanol Content Surveys

As with other EPA-regulated programs (e.g. RFG Program) EPA is requiring a labeling and ethanol content survey program for use in its enforcement and compliance efforts.

Specifically, EPA is requiring:

Any fuel or fuel additive manufacturer using this partial waiver must participate in a survey, approved by EPA, of compliance at fuel retail facilities conducted by an independent surveyor. An EPA-approved survey plan is to be in place prior to introduction of E15 into the marketplace and the results of the survey

EPA is requiring an ethanol content survey program. Two survey options are available.

must be provided to EPA for use in its enforcement and compliance assurance activities.

One of two options may be utilized to meet this condition of this partial waiver decision:

For Survey Option 1, a fuel or fuel additive manufacturer may individually survey labels and ethanol content at retail stations wherever its gasoline, ethanol, or ethanol blend may be distributed if it may be blended as E15. EPA must approve this survey plan before it is conducted by the fuel or fuel additive manufacturer.

For Survey Option 2, a fuel or fuel additive manufacturer may choose to conduct the survey through a nationwide program of sampling and testing designed to provide oversight of all retail stations that sell gasoline. Details of the survey requirements are similar to those included in the ULSD and RFG programs. A fuel or fuel additive manufacturer may conduct this survey as part of a consortium, as discussed in the proposed rule.

Fuel Survey Compliance Assistance

In the EPA final rule entitled “Regulation To Mitigate the Misfueling of Vehicles and Engines With Gasoline Containing Greater Than Ten Volume Percent Ethanol and Modifications to the Reformulated and Conventional Gasoline Programs” obligated parties are required to conduct a retail survey program to evaluate E15 content and labeling requirements under the regulations.

The RFA recognized the challenge with the development of resources to meet the fuel survey regulatory requirement and has partnered with the RFG Survey Association (RFGSA) to develop an efficient compliance option to fulfill this requirement. The RFGSA is a not-for-profit organization, which since 1995, has provided independent, high quality, efficient programs and services to satisfy the fuel compliance requirements of industry and government.

The RFGSA, in conjunction with and on behalf of all obligated parties under these regulations, has developed a comprehensive E15 retail survey sampling and testing program that will meet all the requirements of the regulations outlined in 40 CFR Part 80 §1502. The proposed program design will focus on E15 distribution by source terminal, examining both the likely areas of distribution and its surrounding trade area. The Program to be implemented by the RFGSA will be EPA approved and funded jointly by the oil and ethanol industries. The survey program must be fully funded and operating prior to the introduction of E15 into commerce. The RFGSA working closely with the obligated parties and EPA will provide assistance in the development of an orderly process for interested program participants to satisfy their E15 survey requirements under the regulations. For more information on the E15 fuel survey, please see www.rfgsa.org.

Public Education and Outreach

The RFA, in cooperation with numerous stakeholders, has developed an ongoing public education and outreach effort. The stakeholder group

**E15 information can be found
at www.E15Fuel.org**

has an E15 information website at www.E15Fuel.org which provides E15 information and FAQ's for various fuel use categories. Those preparing to sell E15 may find it useful to utilize materials found on the website.

UST Systems and EPA Guidance

Some Underground Storage Tank (UST) systems and related underground equipment may not be compatible with E15 blends. In addition, some systems that are compatible may not be listed as such by Underwriter Laboratories (UL) since they were manufactured prior to the introduction of E15. Demonstrating compatibility is very important because failure to do so would not only violate EPA's UST regulations, but may also violate fire codes and conditions of UST insurance. EPA has issued a guideline document entitled "Guidance on Compatibility of UST Systems with Ethanol Blends Greater than 10 Percent and Biodiesel Blends Greater than 20 Percent", which is included in the Appendix.

Basically EPA has stated that:

"Owners and operators of underground storage tanks (UST's) regulated under 40 CFR part 280 can demonstrate compliance with EPA's compatibility requirement (40 CFR 280.32) when storing gasoline containing greater than 10 percent ethanol or diesel containing greater than 20 percent biodiesel. In 1988, EPA promulgated the compatibility requirement (and other UST requirements) under the authority of Subtitle I of the Solid Waste Disposal Act, as amended."

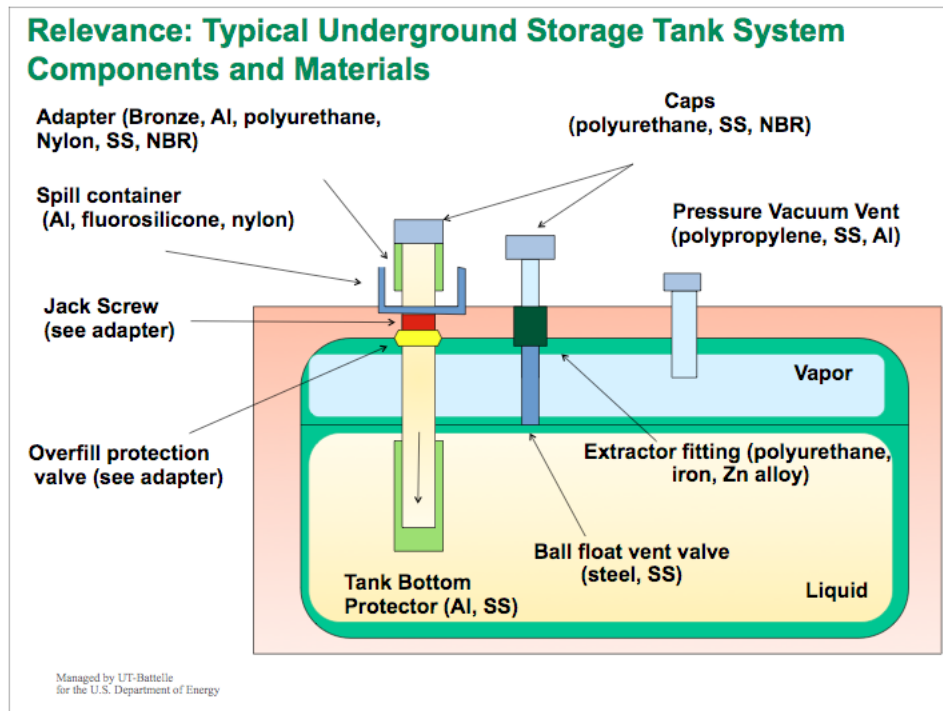
EPA's partial waiver of E15 under the Clean Air Act has no legal bearing on a UST owner or operator's requirement to comply with all applicable Federal UST regulations, including the UST compatibility requirement in 40 CFR 280.32 and other sections of 40 CFR 280. Specifically, in order to ensure the safe storage of higher ethanol and biodiesel blends, or any other regulated substance, owners and operators must meet the existing compatibility requirement for UST systems.

The UST compatibility requirement in 40 CFR 280.32 states, "Owners and Operators must use a UST system made of, or lined, with materials that are compatible with the substance stored in the UST system." Because the chemical and physical properties of ethanol and biodiesel blends may make them more aggressive to certain UST system materials than petroleum, it is important that all UST system components in contact with ethanol or biodiesel blends are materially compatible with that fuel.

RFA encourages UST owners to make improvements to the required documentation on installed equipment at their retail fuel stations. Improved requisite information for UST and fuel handling equipment is necessary for the introduction of all new fuels and fuel blends.

"Owners and Operators must use a UST system made of, or lined, with materials that are compatible with the substance stored in the UST system."

The diagram below displays a typical UST System and its components.



Source: Oak Ridge National Laboratory

EPA considers the following parts of the UST system to be critical for demonstrating compatibility:

- Tank or internal tank lining
- Piping
- Line leak detector
- Flexible connectors
- Drop tube
- Spill and overfill prevention equipment
- Submersible turbine pump and components
- Product shear valve
- Sealants (including pipe dope and thread sealant), fittings, gaskets, o-rings, bushings, couplings, and boots
- Containment sumps (including submersible turbine sumps and under dispenser containment)
- Release detection floats, sensors, and probes
- Fill and riser caps

For newly installed equipment comprised of multiple individual components such as submersible turbine pump assemblies, UST system owners and operators may obtain a certification from the equipment manufacturer documenting compatibility for the entire assembly. Unless the overall system has otherwise demonstrated E15 compatibility, manufacturer approval of replacement components does not extend material compatibility to the overall system.

Options for Meeting the Compatibility Requirement

Acceptable methods for owners and operators of UST systems storing ethanol-blended fuels greater than 10 percent ethanol to demonstrate compatibility under 40 CFR 280.32 are:

- Use components that are certified or listed by a nationally recognized, independent testing laboratory (for example, Underwriters Laboratories) for use with the fuel stored.
- Use components approved by the manufacturer to be compatible with the fuel stored. EPA considers the acceptable forms of manufacturer approvals to:
 1. Be in writing
 2. Indicate an affirmative statement of compatibility
 3. Specify the range of biofuel blends the component is compatible with; and
 4. Be from the equipment manufacturer, not another entity (such as the installer or distributor); or
- Use another method determined by the implementing agency to sufficiently protect human health and the environment. EPA will work with states as they evaluate other acceptable methods.

Currently, a note in 40 CFR 280.32 allows owners and operators to use the American Petroleum Institute's (API) Recommended Practice 1626, an industry code of practice, to meet the compatibility requirement for ethanol-blended fuels. The original version of API 1626 (1st ed. 1985, reaffirmed in 2000) applies to up to 10 percent ethanol blended with gasoline and is not applicable to meet the compatibility requirement for ethanol blends greater than 10 percent. In August 2010, API published a second edition of API 1626. The second edition addresses ethanol blends greater than 10 percent and may be used to demonstrate compatibility for UST systems storing ethanol blends.

OSHA

There are Occupational Safety and Health Administration (OSHA) Standards that apply to retail gasoline outlets. In particular, OSHA Standard 1910.106 should be reviewed. This standard covers employee hazards, fuel storage, and delivery, as well as numerous other items. Currently, OSHA 1910.106 requires that fuel tanks and dispensing equipment be listed with an organization such as UL. OSHA has told GAO that it "is re-evaluating its plan to explore ways to allow fuel retailers, under certain conditions, to use existing dispensing equipment for intermediate blends."

At present, OSHA has not issued any additional guidance. OSHA 1910.106 and other OSHA Standards can be found on OSHA's website at: www.osha.gov.

OSHA Standard 1910.106 applies to retail gas outlets and should be reviewed.

E15 State and Local Requirements

State Regulations on Conversions

A number of states, and even a few municipalities, have regulations or have issued guidance on converting UST systems and above ground equipment to E10, blends greater than E10, and other biofuels. A few have even developed conversion checklists. Some of the more detailed guidelines include: Colorado, Iowa, North Carolina, South Carolina, Tennessee, the City of Tucson, and Wisconsin. Links to each of these are provided below.

Links to biofuel policies:

Colorado Checklist:

www.colorado.gov/cs/Satellite?c=Page&cid=1248095303296&pagename=CDLE-OilPublicSafety%2FCDLELayout

Iowa Checklist:

www.iowadnr.gov/portals/idnr/uploads/ust/ethanolcklist.pdf

Iowa Policy:

www.iowadnr.gov/portals/idnr/uploads/ust/ethanolconv.pdf

North Carolina Checklist:

http://portal.ncdenr.org/c/journal/view_article_content?groupId=38361&articleId=1329541&version=1.0#top

South Carolina Application/Notification:

www.scdhec.gov/environment/lwm/forms/d-3885.pdf

Tennessee Checklist:

www.tn.gov/environment/ust/docs/cn1285_eecc.pdf

Tucson, AZ Checklist:

www.tucsonaz.gov/fire_prevention/Resources/EthanolChecklist.pdf

Wisconsin Application/Notification:

www.dsp.wi.gov/er/pdf/bst/Forms_FM/ER-BST-FM-9-AlternativeFuels.pdf

It is very important that federal, and where applicable, state/municipality guidelines be followed. In the event of a UST leak, the retailer's insurance, as well as state financial assurance trust funds, could be denied if one cannot demonstrate compliance.

It is very important that federal and state/municipality guidelines be followed.

Many states have fuel quality regulations and enforcement programs. In addition, states have individual OSHA departments that regulate worker's safety. In most cases, a state's fire marshal also works closely with local fire marshals who are often the Authority Having Jurisdiction (AHJ) over retail fuel sites. State and local regulations can change rapidly so retailers should determine any state or local requirements with which they must comply. A list of some of the most important topics are covered below.

Many states have fuel quality regulations and enforcement programs along with individual OSHA departments.

State Fuel Quality Regulations

Many states have fuel quality regulations and specifications, which are usually (but not always) handled by the State's Weights and Measures division. Regulations vary among states. Some may adopt all or a portion of ASTM Specification D4814 "Standard Specification for Automotive Spark-Ignition Engine Fuel" and may require any ethanol blended into gasoline meet ASTM Specification D4806 "Standard Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel."

Other states follow fuel specifications established by the National Conference on Weights & Measures (NCWM). These specifications are developed as model regulations, which are published in the National Institute of Standards and Technology (NIST) Handbook 130 "Uniform Laws and Regulations."

Still other states may simply develop and adopt their own fuel specifications by legislative or regulatory action.

Many state regulations currently limit the maximum ethanol content of gasoline to 10v% because until recently that was the maximum permitted level under Federal regulations. The RFA is in the process of working with these states and NCWM to update these regulations to coincide with federal regulations.

Note that states may also have retail dispenser labeling requirements, as well as specific product transfer document requirements.

State OSHA Requirements

Most states also have a state OSHA department. Usually states simply adopt and enforce federal OSHA standards.

National Fire Protection Association / International Code Council

Most states adopt various codes of the National Fire Protection Association (NFPA) and/or the International Code Council (ICC). These include a variety of codes relating to retail gasoline systems. Potentially applicable items are as follows:

NFPA Applicable Codes:

- NFPA 30, Flammable and Combustible Liquids Code
 - Installation of ASTs and USTs
 - Installation of Piping Systems
 - Fire Hazard Analysis
 - Proper Classification of Liquids

- NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages
 - Proper Siting of ASTs
 - Piping Systems
 - Leak Detection in Piping Systems
 - Fuel Dispensing Systems
 - Vapor Recovery Systems
 - Area Classification Around Dispensers
 - Operating Procedures

Information on NFPA codes can be found on their website: www.nfpa.org

ICC Applicable Codes:

- International Fire Code

Information on ICC codes can be found on their website: www.iccsafe.org

Authority Having Jurisdiction

Ultimately, when installing or converting a retail gasoline system, you will likely be dealing with a local authority, commonly referred to as the Authority Having Jurisdiction (AHJ). For most areas this will likely be the local fire marshal. When converting to E15 you should advise the AHJ and inquire about any specific regulations with which you must comply.

Get in touch with your local AHJ (Authority Having Jurisdiction) before installing or converting a retail gasoline system.

E15 Conversion Guidelines

Although E15 is a relatively new fuel, the industry's experience with E10 blends proves useful for E15. However, there are a few more important steps in converting to E15. The RFA recommends following various checklists and guidelines. These include investigative equipment checklists and conversion guidelines.

Compatibility of Materials

As noted earlier, UST systems and above ground equipment may not be UL listed for E15. If not, the options are to either obtain new components that are UL listed or obtain manufacturer confirmation that the system component in question is E15 compatible. The following information should aid the retailer and petroleum equipment suppliers in identifying materials that are compatible with E15.

In March 2011, Oak Ridge National Laboratory (ORNL) completed testing and prepared a report³ intended to be used by material designers and users to identify potential issues and guide the selection of materials compatible for use in E15 dispensers. This report also included a literature review of previous work.

The National Renewable Energy Laboratory (NREL) also contracted with UL to harvest equipment from the field and test them. The scope of NREL's testing also included new equipment on various levels of ethanol blends. This program used an "aggressive ethanol" at 17v%, a fuel far more likely to instigate failures than ethanol found in the marketplace.

UL issued a report on this program in November 2010.⁴ The UL study focused primarily on component performance (as opposed to focusing on specific metals and elastomers). A few excerpts from the UL report conclusions are as follows:

"The overall results of the program were not conclusive insofar as no clear trends in the overall performance of all equipment could be established.

Various pieces of new and used dispensing equipment demonstrated compliant results. Shear valve and flow limiter test items produced compliant results, the submersible turbine pump performed well, and hoses generally yielded compliant results.

Some equipment, both new and used, demonstrated performance during and after the Long-Term Exposure test that indicated a reduced level of safety or performance, or both. These pieces of equipment demonstrated limited ability to safely accommodate exposure to fuels such as E15 with higher ethanol content. Responses of nonmetals to exposure – notably gaskets and seals, but also polymeric parts – were involved with these noncompliances. Dispenser meter/manifold/valve assemblies in particular demonstrated largely noncompliant results; the seal materials used in this portion of the hydraulic tree may require careful consideration if fuel blends with higher ethanol content are used."

The report noted that with regard to polymer degradation it "was caused primarily by the acid constituents of the aggressive ethanol."

3. *Intermediate Ethanol Blends Infrastructure Materials Compatibility Study: Elastomers, Metals, and Sealants*, Oak Ridge National Laboratory, March 2011.

4. *Dispensing Equipment Testing with Mid-Level Ethanol/Gasoline Test Fluid*, Underwriters Laboratories, November 2010.

The ORNL study focuses more specifically on identifying metals, elastomers, and sealants as either compatible or non-compatible. The work also used “aggressive ethanol” at 10v%, 17v%, and 25v%, as well as an all hydrocarbon (i.e. E0) fuel. Based on a review of this study, the following identifies compatible and non-compatible material.

E15 Compatibility with Various Materials

<u>Compatible</u>	<u>Metals</u>	<u>Non-Compatible</u>
1020 Solid Steel	<u>Discoloration/Mild Corrosion</u>	
1100 Aluminum	Brass	
201 Nickel	Phosphor Bronze	
304 Stainless Steel	Zinc-plated (galvanized steel)	
	Lead-plated (terne) steel	
	<u>Elastomers</u>	
<u>Compatible</u>	<u>Uncertain¹</u>	<u>Non-Compatible</u>
Fluorosilicone Rubber	Styrene Butadiene Rubber (SBR)	Silicone Rubber
Fluoroelastomers (fluorocarbons)	Nitrite Rubber (BUNS, BUNAN)	Polyurethane
		Neoprene
	<u>Sealants</u>	
<u>Compatible</u>		<u>Non-compatible²</u>
Gasoil E-Seal		E-Seal Standard PTF E-Sealant
		Rector Seal

1. SBR and NBR properties are highly dependent on material additives, processing and co-polymer concentrations. As such, some formations of SBR and NBR may not be compatible with E15 while others are.

2. Standard PTFE (Rector Seal) when combined with Teflon tape appears to be acceptable.

Manufacturer’s Compatibility Information

Many manufacturers provide information on the compatibility of their products with E15. Some industry trade associations also maintain letters of compatibility on the equipment their manufacturer members produce. These include the Steel Tank Institute (STI), the Petroleum Equipment Institute (PEI) and the Fiberglass Tank and Pipe Institute (FTPI). STI information can be found on their website at: www.steeltank.com. Among the items available are information on tests done for STI, as well as tests by others. In addition, statements of compatibility from STI and STI member companies are available.

Tank Manufacturer Statements of Compatibility

The below list of tank manufacturers have provided information on tank construction and compatibility:

Acterra Group Inc.	Mass Tank Sales Corp
Caribbean Tank Technologies Inc.	Metal Products Company
Eaton Sales & Service LLC	Mid-South Steel Products Inc
General Industries	Modern Welding Company
Greer Steel Inc	Newberry Tanks & Equipment LLC
Hall Tank Co	Service Welding & Machine Company
Hamilton Tanks	Southern Tank & Manufacturing Co Inc
Highland Tank	Stanwade Metal Products
J.L. Houston Co	Talleres Industriales Potosinos, S A de C V
Kennedy Tank and Manufacturing Co Inc	Tanques Antillanos C x A
Lancaster Tanks and Steel Products	Watco Tanks Inc
Lannon Tank Corporation	We-Mac Manufacturing Company

PEI has a “UST Component Compatibility Library” on their website: www.pei.org. They also have information on manufacturers of above ground gasoline dispensing components.

The FTPI has various information on their website at: www.fiberglasstankandpipe.com. Their website indicates that Fiberglass Reinforced Plastic (FRP) tanks are ideal for up to 100% ethanol storage. They state that UL listed fiberglass piping is suitable for “alcohol and alcohol-blended gasoline motor fuels” also stating:

“Fiberglass Piping: Underground fiberglass piping and fittings installed in service stations have been compatible with up to 100% percent ethanol for over 40 years.”

With regard to fiberglass tanks, a white paper on the FTPI website states the following:⁵

Fiberglass tanks:

- A. 1983 – The September 1983 issue of the Underwriters Laboratories (UL) Gas & Oil Equipment Directory includes multiple manufacturers with listings for fiberglass “non-metallic tanks for petroleum products, alcohol’s and alcohol gasoline mixtures.” The UL use of the term “alcohol’s and alcohol-gasoline mixtures” is defined in UL standard 1316 to include fuels with any level of ethanol or methanol up to and including 100%.
- B. 1988 – In 1988, UL began listing underground fiberglass piping for 100% ethanol and methanol.
- C. 1990 – By 1990, Institute member fiberglass tank manufacturers had modified their tanks constructions to handle gasoline with any level of ethanol or methanol up to 100% for all double-wall fiberglass tanks and in some cases single-wall fiberglass tanks.
- D. 2006 – UL did not include fiberglass piping or tanks in the 2004 suspension of UL markings for fuel dispensing devices that reference compatibility with alcohol-blended fuels containing greater than 15 percent alcohol.

The two major FRP tank manufacturers, Xerxes Corporation (www.xerxes.com) and Containment Solutions, Inc. (www.containmentsolutions.com), also offer positive guidance. Both Containment Solutions and Xerxes warranties indicate that their double-walled FRP UST’s are compatible with up to 100% ethanol. In the event you have a single-walled non-compliant FRP tank, Containment Solutions has the “BTU® Biofuel Tank Upgrade”⁶ which they state:

“The BTU®, Biofuel Tank Upgrade, is a cost-effective solution for upgrading existing fiberglass single-wall tanks to meet new regulations. Many of the earliest generation fiberglass tanks were not tested nor were they warranted for either biodiesel or ethanol blends exceeding 10%.

The BTU® can be applied in combination with typical tank upgrades like sumps and collars or as a stand-alone service. Unlike conventional tank lining methods, the BTU® upgrade is completed by CSI field service technicians who are experts in fiberglass tank manufacturing techniques.”

Nothing should be left to guess work. If documentation of the tanks compatibility is lacking, then the tank manufacturer should be consulted.

5. *Ethanol Compatibility with Fiberglass UST Systems, Fiberglass Tank and Pipe Institute.*

6. *Fiberglass Petroleum Tanks for Underground Storage, Containment Solutions, 2010.*

Investigative Checklists

It is important that you check all identified components and document their acceptability for use. The RFA has developed the following checklist for this preparatory / investigative phase.

UST System E15 Investigation

Component	Model/Brand	Mfg.	UL Listed	Mfg. Approved
Tank or internal lining				
Piping				
Line leak detector				
Flexible connectors				
Drop tubes				
Spill and overfill prevention equipment				
Submersible turbine pump & components				
Sealants (including pipe dope and thread sealant), fittings, gaskets, o-rings, bushings, couplings and boots				
Containment sumps (including submersible turbine sumps and under-dispenser containment)				
Release detection floats, sensors and probes				
Fill and riser caps				
Product shear valves				
Other				

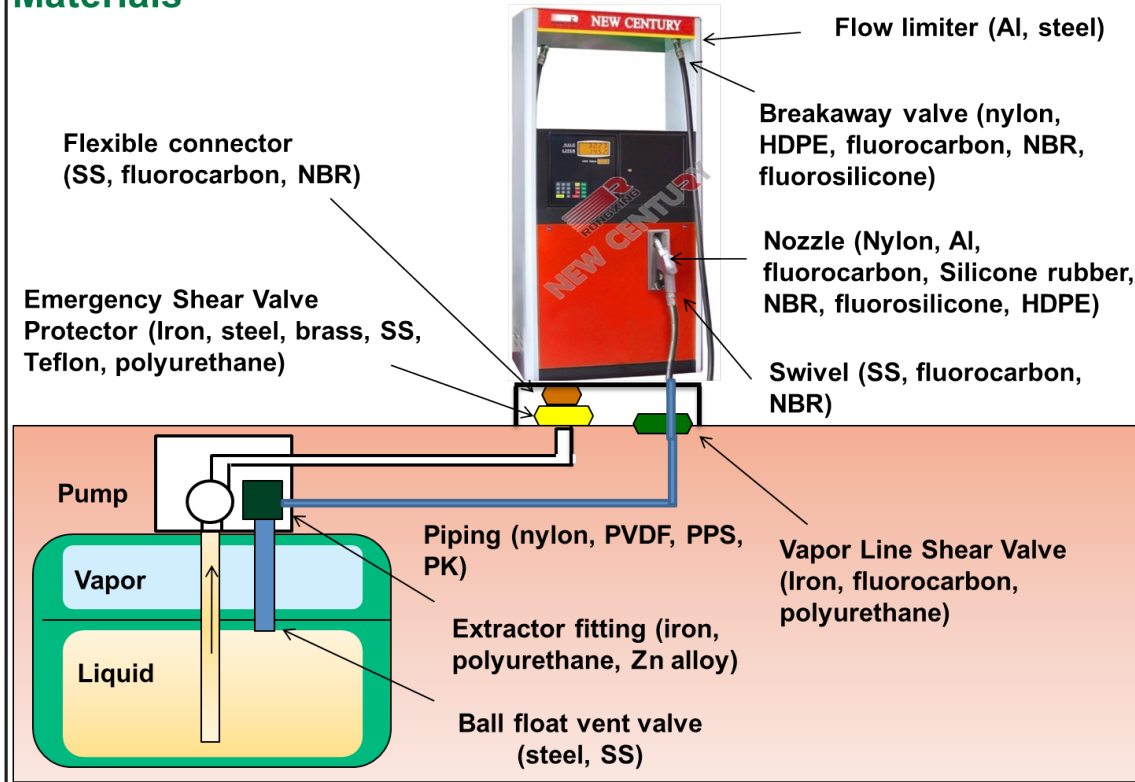
Date: _____ Signature: _____

This UST System E15 Investigation List attempts to cover common system components.

Due to the differences among systems and installation techniques, there may be system components which are not on the list.

The following graphic depicts components and materials found in the above ground gasoline dispensing system.

Relevance: Typical Above Ground Components and Materials



Source: Oak Ridge National Laboratory

The following checklist has been developed for above ground equipment such as the dispenser and its hanging hardware.

Dispenser, Dispenser Sump and Hanging Hardware Investigation

Component	Model/Brand	Mfg.	UL Listed	Mfg. Approved
Dispenser				
Pipe sealant				
Seals / Gaskets				
Suction Pump				
Hoses				
Nozzle / Swivel				
Break-away				
Filter				
Meter				
Dispenser / Sump				
Pipe				
Pipe sealant				
Flex Connector				
Sump				
Emergency Valve				
Sensor				
Check Valve				
Other				

Date: _____ Signature: _____

This Above Ground System E15 Investigation List attempts to cover common system components. Due to the differences among systems and installation techniques, there may be system components which are not on the list.

Retail Conversion Procedures

Once the UST system and above ground fuel system components have been confirmed as compatible, there are additional steps that should be taken when you are first preparing to introduce E15. The extent of these additional steps depends on whether you are converting from E10 to E15 or unblended gasoline (E0) to E15.

Conversion from E10 to E15

Most of the conversion steps for converting to E15 are identical to an E10 conversion. There are only a few additional items for such a conversion.

Vapor Pressure

1. Vapor Pressure: E15 must meet a RVP of 9.0 psi during the summertime volatility season (June 1 – September 15th). The E10 present in the tank may be of a higher RVP. Therefore, you should reduce E10 tank inventory to the lowest possible level so that the RVP level at conversion will be low enough to meet the RVP requirement for E15 (actually applicable to blends of 11 to 15v% ethanol).

Misfueling Mitigation

2. Misfueling Mitigation: At the time of conversion you must place the EPA required label on each dispenser offering E15. RFA also recommends that you develop a form explaining that E15 is for use only in 2001 and newer light duty vehicles and FFV's. Each retail employee should read and sign the form. This will help ensure that all existing and future employees are properly informed and trained to prevent misfueling of E15 into unapproved vehicles and equipment. You may also wish to visit the website www.E15Fuel.org. This site was set up to provide retailers and consumers with information on which vehicles and equipment are authorized to use E15 and which are not.

Product Transfer Documents

3. Product Transfer Documents (PTD's): The EPA requires that PTD's (e.g. bill of lading) disclose any volume of ethanol greater than 10v% and up to 15v%. You should be sure your fuel supplier is meeting this requirement.

Other Requirements

4. Other requirements: Some states may have additional conversion requirements. You should check with the proper state agency for any such requirements.

Color Code

5. Color Codes: It may be necessary to change the color code and any fill neck identification badges to indicate the product is E15 and the grade (i.e. regular, mid-grade or premium). API color codes (API Recommended Practice 1637) are the ones most often used but they have not yet developed a color / letter guide for E15. Until the API color scheme is updated, we recommend the manhole cover be painted with the color schemes for the grade of gasoline with E15 painted in the cross as demonstrated in the following examples.

Most of the conversion steps for converting to E15 are identical to an E10 conversion. There are only a few additional items for such a conversion.

Example E15 Manhole Covers



Regular



Midgrade



Premium

The following paint schemes are shown above

Regular: White background – black cross – white outer circle

Midgrade: Blue background – white cross – white outer circle

Premium: Red background – white cross – white outer circle

Conversion from E10 to E15 Checklist

1. Check with state agency for any special requirements.
2. Lower inventory for RVP control (June 1 to September 15).
3. Inform employees and have them sign form.
4. Check with supplier on product transfer document requirements.
5. Re-code product manhole covers / fill line.
6. At receipt of first load of E15, place the EPA required misfueling mitigation label on all dispensers offering E15.
7. Notify insurance carrier of new fuel blend.

Conversion from E0 to E15

Almost all gasoline in the U.S. is now E10. Therefore, converting from E0 to E15 will not often occur. However, if you are converting from E0 the process requires more detail. In addition to the previous steps listed for E10 to E15 conversion, the following steps should be taken.

E0 to E15 Conversion Checklist

1. Check for tilted tanks. Inspect both tank openings (may need to remove tank gauging equipment).
2. Inspect tank for cleanliness and residue. Clean tank and remove water bottoms, if necessary.
3. Verify a tight seal on fill caps and proper water run-off from manhole covers. Plug any holes in the fill line box.
4. Verify safety equipment for effectiveness with ethanol fuel blends. Utilize Alcohol Resistant Film Forming Foam (AR-AFFF) or dry chemical that is effective.
5. Modify inventory system for new fuel. Obtain fuel density and temperature compensation factors if necessary.
6. Train employees on new fuel properties.
7. Notify local authorities and emergency response personnel of ethanol fuel blend offering.

8. Notify insurance carrier of new fuel blend.
9. Notify transport drivers & dispatchers.

Pre-Delivery:

1. Equip pump or dispenser with 10 micron ethanol compatible filter. Water slug filters are optional. Remember: SAFETY FIRST — SHUT OFF BREAKER.
2. Recheck for water bottoms and remove any present.
3. Issue alcohol compatible paste. Discard any old incompatible pastes.
4. Procure proper pump labels.
5. Confirm any applicable accounting procedures.

First Delivery:

1. Check for water. Water bottoms must be removed before first delivery of blends.
2. Follow normal delivery procedures and ensure that accurate tank gauge and dispenser readings are taken.
3. Verify with transport driver correct product and compartment for correct tank.
4. Pumps should be shut down during initial delivery.
5. Purge lines from tanks to dispensers.
6. Install required decals and, if necessary, change octane decals. Also repaint manhole covers to proper color code (for example, API color code, or RFA recommended color/letter scheme).
7. Fill tanks to at least 80% of capacity. Keep as full as possible for 7 to 10 days.
8. Test for water bottoms at the beginning of each shift for the first 48 hours after initial delivery.

Post-Delivery and Ongoing Maintenance:

1. Check for water introduction daily. No level is acceptable.
2. Replace filters if pump/dispenser is running slow.
3. Check pump calibration two weeks after initial load conversion.

(Printed Name, Signature)

(Date)

NOTE: Be sure that you are using a water finder paste suitable for use with ethanol blends. Two suppliers of such paste are:

SAR-GEL Water Paste
Sartomer USA, Inc.
502 Thomas Jones Way
Exton, PA 19341
(610) 363-4100
www.sartomer.com/sargel

Gasoil All Purpose Water Finding Paste
Gasoil Chemicals
4520 Richmond Road
Cleveland, OH 44128
(216) 464-6440
www.gsasupplyco.com

For additional information on E10 programs refer to RFA's publication "Fuel Ethanol Industry Guidelines, Specifications and Procedures" available on the Renewable Fuels Association's website www.EthanolRFA.org.

Product Specifications & Properties

As with all transportation fuels, the quality of E15 must meet certain guidelines. The E15 waiver conditions established by EPA require that the ethanol used to produce E15 meet the properties as contained in ASTM D4806-10.

In addition to the EPA waiver conditions, RFA recommends that E15 blends meet the requirements set forth in ASTM D4814 – “Standard Specification for Automotive Spark-Ignition Fuel.”

For a more detailed discussion on the importance of these properties, refer to a copy of the specification. Copies of ASTM D4806 and other ASTM specifications and standards may be obtained from:

ASTM
100 Bar Harbor Drive
W. Conshohocken, PA 19428-2959
Publication orders • phone (610) 832-9585 • fax (610) 832-9555
www.astm.org

Water Tolerance

Water tolerance describes the ability of a gasoline/ethanol blend to dissolve water without phase separation. Ethanol has an affinity for water and will entrain common levels of water present in vehicle gasoline tanks and the gasoline distribution and storage system. For instance, it is not necessary to add any gas line antifreeze to a gasoline/ethanol blend since the ethanol will absorb trace amounts of water and pull it through the fuel system. Likewise, trace amounts of water in underground storage tanks are eliminated via the same mechanism. In normal operations ethanol protects against the buildup of water in vehicle tanks and underground storage tanks. Under normal conditions ethanol blends have the beneficial effect of entraining and removing small amounts of moisture from retail storage tanks and vehicle fuel systems.

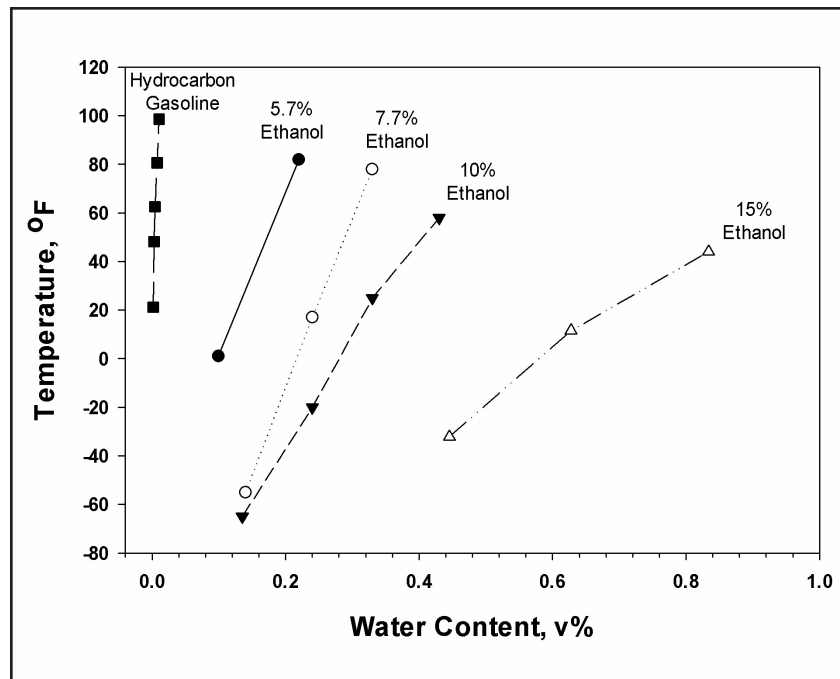
Prior to E15 introduction, investigate that the fuel system does not contain any water. If excessive moisture is absorbed, the ethanol and water can go into phase separation. Phase separation is the physical separation of the gasoline and the mixed ethanol and water. If an excessive amount of water is introduced to a blend of E10 or higher, the ethanol and water will mix, separating from the gasoline and sinking to the bottom of the tank. Aside from the fact that the vehicle engines would not operate on this ethanol/water blend, it can also cause corrosion of various metals with which it comes in contact.

Note: It's important to know that phase separated fuel is impossible to correct without sophisticated engineering equipment. The phase separated material should be handled as hazardous waste and properly disposed.

However, ethanol's affinity for water also necessitates that steps be taken to eliminate excessive moisture from the fuel storage and delivery system. If a gasoline/ethanol blend encounters excessive moisture contamination (e.g. water incursion into the storage

tank), the water can pull the ethanol out of the blend resulting in tank bottoms comprised of water, ethanol, and some hydrocarbon content. The amount of water tolerated by a gasoline/ethanol blend is dependent upon the product temperature: the lower the temperature, the lower the water tolerance. For instance, at 60°F, a 10v% ethanol blend will tolerate approximately 0.5v% water. However, at 10°F that tolerance is reduced to approximately 0.3%. The water tolerance of an E15 blend is actually better than E10. An E15 blend can tolerate approximately 0.75v% water at 60°F while at 10°F the tolerance is 0.45v% water.

E15 blend can tolerate approximately 0.75v% water at 60 ° F



Spill / Run-Off Management

Ethanol that is dissolved in water will pass through the oil water separator. Therefore, spill and run-off areas should be separated from hydrocarbon products. Check with the Authority Having Jurisdiction (AHJ) for proper procedures for disposing of ethanol water mixtures.

Water tolerance of E15 blend is better than E10.

Transportation Issues

Retail fuel deliveries come in by transport trucks with a typical delivery being 7,800 to 8,200 gallons. Transport equipment suitable for handling gasoline and E10 blends is suitable for delivering E15 blends.

Shipping Name and Placarding

Transport personnel should be advised that the proper shipping name for E15 is “Ethanol and Gasoline Mixture” and it must be placarded as UN 3475. The table below lists the proper shipping name and placard designation for various “E” blends.

Ethanol Concentration	Preferred Proper Shipping Name, Placard
E1 to E10	Gasohol, UN 1203 or Gasoline, UN 1203
E11 to E94	Ethanol and Gasoline mixture, UN 3475
E95 to E99	Denatured Alcohol, NA 1987 or Alcohols n.o.s., UN 1987
E100	Ethanol, UN 1170 or Ethyl Alcohol, UN 1170

Transport equipment suitable for handling gasoline and E10 blends is suitable for delivering E15 blends.

Quality Assurance of E15 Blends

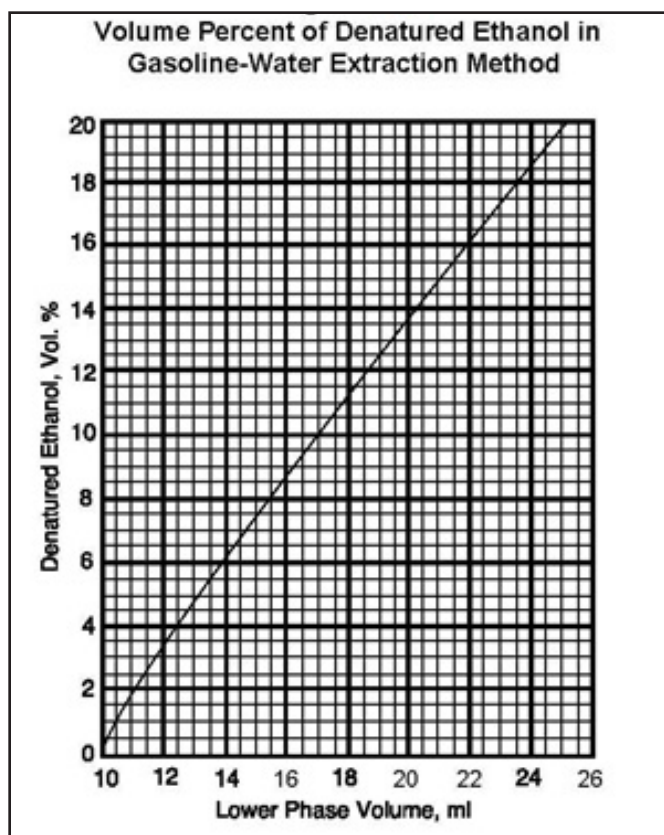
Ethanol Content

The ethanol content of gasoline ethanol blends can be approximated by the “Water Extraction Test.” This procedure is as follows:

Determination of Alcohol Content in Blends — Water Extraction Method

Place 100 ml. of the gasoline/ethanol blend in 100 ml. glass stoppered graduated cylinder. Pipette 10 ml. of water into the cylinder and shake thoroughly for about one minute. Set aside for 2 minutes. Read the volume of the alcohol-water layer on the bottom and compare to the graph below to read the alcohol content.

For example, a reading of 17.2 ml. lower phase volume by this test is 10v% ethanol in the blend, while a reading of 21.5ml. indicates the presence of 15v% ethanol. (See chart)



ASTM D4815 “Test Method for determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C1 to C4 Alcohols by Gas Chromatography” is a more accurate laboratory test for determining the ethanol content of gasoline/ethanol blends.

Blenders may also wish to consult ASTM D4814 “Standard Specification for Automotive Spark-Ignition Engine Fuel” for other test procedures relative to gasoline/ethanol blends.

Copies of ASTM specifications and standards can be purchased from ASTM’s website: www.astm.org.

Summary of Safety and Fire Fighting Procedures

Although ethanol and E15 do not present any danger beyond those of other flammable products, it is important that pertinent safety and fire fighting details be covered with appropriate personnel.

Material Safety Data Sheets (MSDS) should be provided to all personnel who may come in contact with E15. A current MSDS is available from your fuel supplier.



Safety is the top priority of America's ethanol industry and those who transport and bring ethanol and ethanol blends to the marketplace. It is with this commitment in mind that the Ethanol Emergency Response Coalition (EERC) has compiled and released the Complete Training Guide for Ethanol Emergency Response, to help prepare ethanol producers, transporters and first responders who may experience or come in contact with an ethanol-related emergency.

The EERC provides an ethanol emergency response training guide.

This complete training package includes two DVD's, an instructor's guide, interactive workshops and seven modules and PowerPoint presentations, each focusing on a specific and important aspect of ethanol response. Guidelines are also given for fire departments and first responders that have ethanol production facilities in their communities.

The complete guide to emergency response is available on the EERC website at www.EthanolResponse.com. The DVD's are also available on the RFA website.

Fire-Related Emergencies

Ethanol-blended fuels present the same type of flammability hazard as other transportation fuels, however ethanol's polar solvent nature may be a new consideration. A review of the fire response equipment at all levels of the distribution chain will ensure that the

E10 and higher ethanol blended fuels require the use of AR-AFFF foam.

appropriate tools are available in the event of an emergency. This review includes a check of appropriateness of the larger response equipment such as structural protection that includes firefighting foams through the small incident response tools such as fire extinguishers.

Ethanol-blended fuels with greater than 10v% ethanol require the use of a Polar Solvent or Alcohol Resistant (AR) type of foam, commonly known as an AR-AFFF. Traditional AFFF foams have limited to no ability to extinguish fire emergencies when the ethanol content is above 10% by volume. AR type foams are typically effective on all blend variations of

ethanol and gasoline from 0 to 100% ethanol. Consult the foam manufacturer for specific information.

Accordingly, RFA recommends that AR foam be used on all gasoline ethanol blend fires where the ethanol content is between E15 to E85. It should be mentioned that dry chemical fire extinguishing agents may also work on ethanol-blended fuels, however the dry chemical manufacturer must be consulted for appropriateness.

Another excellent resource is RFA's document "Implementing an Effective Safety and Health Program for a Fuel Ethanol Facility" which list numerous OSHA guidelines and other information.

Technical End Note:

While many of the recommendations in this recommended practice also apply to E85 and mid-level blends such as E20 and E30, the RFA has developed separate guides specifically for those fuels. These can be found at www.EthanolRFA.org.

- For E85 refer to: "E85 Fuel Ethanol Industry Guidelines, Specifications and Procedures"
- For Mid-Level Blends refer to: "Guidelines and Best Practices for Blending Mid-Level Ethanol Blends"

RFA recommends that Alcohol Resistant (AR) foam be used on all gasoline ethanol blend fires where the ethanol content is between E15 to E85.

Appendix

Appendix A: Guidance on Compatibility of UST Systems with Ethanol Blends Greater Than 10 Percent and Biodiesel Blends Greater Than 20 Percent 32

Appendix B: Effect of 15% Ethanol Blends on Anti-Knock Index 35

Guidance On Compatibility Of UST Systems With Ethanol Blends Greater Than 10 Percent And Biodiesel Blends Greater Than 20 Percent

This guidance discusses how owners and operators of underground storage tanks (USTs) regulated under 40 CFR part 280 can demonstrate compliance with EPA's compatibility requirement (40 CFR 280.32) when storing gasoline containing greater than 10 percent ethanol or diesel containing greater than 20 percent biodiesel. In 1988, EPA promulgated the compatibility requirement (and all other UST requirements) under the authority of Subtitle I of the Solid Waste Disposal Act, as amended.

This guidance applies in Indian country and in states that do not have state program approval (SPA). Because SPA states must have a compatibility requirement that is similar to the Federal compatibility requirement, SPA states may find this guidance relevant and useful to them as well.

The discussion in this document is intended solely as guidance. The statutory provisions and EPA regulations described in this document contain legally binding requirements. This document is not a regulation itself, nor does it change or substitute for those provisions and regulations. Thus, it does not impose legally binding requirements on EPA, states, or the regulated community.

In March 2009, EPA received a Clean Air Act (CAA) waiver application to increase the allowable ethanol content of a gasoline-ethanol blended fuel from 10 percent ethanol to 15 percent ethanol.¹ In October 2010 and January 2011, EPA conditionally granted partial waivers, allowing gasoline-ethanol blends that contain greater than 10 percent ethanol up to 15 percent ethanol (E15) to be introduced into commerce for use in 2001 and newer model year light-duty motor vehicles (which include passenger cars, light-duty trucks, and medium-duty passenger vehicles such as some sport utility vehicles).² If other state, Federal, and industry practices also support this introduction, E15 may become available in the marketplace. As a result, EPA anticipates that some UST system owners and operators may choose to store higher percentages of ethanol in their UST systems.

Please note that EPA's partial waiver under the CAA has no legal bearing on an UST owner or operator's requirement to comply with all applicable Federal UST regulations, including the UST compatibility requirement in 40 CFR 280.32. Specifically, in order to ensure the safe storage of higher ethanol and

Background

EPA published guidance in the [July 5, 2011 Federal Register](#) regarding compatibility of underground storage tank (UST) systems with biofuel blends. The entire *Federal Register* notice includes general information, background, response to public comments, and the final guidance. EPA published a minor typographical correction of the guidance in the [August 3, 2011 Federal Register](#). For convenience, here is the final, correct guidance.

This guidance discusses how owners and operators who wish to store gasoline containing more than 10 percent ethanol or diesel containing more than 20 percent biodiesel in their UST systems may demonstrate compliance with the compatibility requirement in 40 CFR 280.32. The guidance reflects public comments EPA received as a result of our [November 17, 2010 Federal Register notice of draft guidance](#).

¹ See 74FR18228 (April 21, 2009).

² See 75FR68093 (November 4, 2010), and 76FR4662 (January 26, 2011).

biodiesel blends, or any other regulated substance, owners and operators must meet the existing compatibility requirement for UST systems.

The UST compatibility requirement in 40 CFR 280.32 states, “Owners and operators must use an UST system made of or lined with materials that are compatible with the substance stored in the UST system.” Because the chemical and physical properties of ethanol and biodiesel blends may make them more aggressive to certain UST system materials than petroleum, it is important that all UST system components in contact with ethanol or biodiesel blends are materially compatible with that fuel.

UST System Components That May Be Affected by Biofuel Blends

To be in compliance with 40 CFR 280.32, owners and operators of UST systems storing ethanol-blended fuels greater than 10 percent ethanol or biodiesel-blended fuels greater than 20 percent biodiesel must use compatible equipment. EPA considers the following parts of the UST system to be critical for demonstrating compatibility:

- Tank or internal tank lining
- Piping
- Line leak detector
- Flexible connectors
- Drop tube
- Spill and overfill prevention equipment
- Submersible turbine pump and components
- Sealants (including pipe dope and thread sealant), fittings, gaskets, o-rings, bushings, couplings, and boots
- Containment sumps (including submersible turbine sumps and under dispenser containment)
- Release detection floats, sensors, and probes
- Fill and riser caps
- Product shear valve

For newly installed equipment comprised of multiple individual components such as submersible turbine pump assemblies, UST system owners and operators may obtain a certification from the equipment manufacturer documenting compatibility for the entire assembly. If equipment requires maintenance and components of that equipment (for example, sealants and gaskets) are subsequently added or replaced, manufacturer approval of the overall component is not sufficient to demonstrate compatibility.

Options for Meeting the Compatibility Requirement

Acceptable methods for owners and operators of UST systems storing ethanol-blended fuels greater than 10 percent ethanol or biodiesel-blended fuels greater than 20 percent biodiesel to demonstrate compatibility under 40 CFR 280.32 are:

- Use components that are certified or listed by a nationally recognized, independent testing laboratory (for example, Underwriters Laboratories) for use with the fuel stored;

- Use components approved by the manufacturer to be compatible with the fuel stored. EPA considers acceptable forms of manufacturer approvals to:
 - Be in writing;
 - Indicate an affirmative statement of compatibility;
 - Specify the range of biofuel blends the component is compatible with; and
 - Be from the equipment manufacturer, not another entity (such as the installer or distributor); or
- Use another method determined by the implementing agency to sufficiently protect human health and the environment. EPA will work with states as they evaluate other acceptable methods.

Currently, a note in 40 CFR 280.32 allows owners and operators to use the American Petroleum Institute's (API) Recommended Practice 1626, an industry code of practice, to meet the compatibility requirement for ethanol-blended fuels. The original version of API 1626 (1st ed. 1985, reaffirmed in 2000) applies to up to 10 percent ethanol blended with gasoline and is not applicable to meet the compatibility requirement for ethanol blends greater than 10 percent. In August 2010, API published a second edition of API 1626. The second edition addresses ethanol blends greater than 10 percent and may be used to demonstrate compatibility for UST systems storing ethanol blends.

If the UST owner and operator is not able to demonstrate that the UST system is made of materials that are compatible with the ethanol blend or biodiesel blend stored, according to 40 CFR 280.32, the UST owner and operator may not use the system to store those fuels.

State UST program regulations may be more stringent than the Federal UST regulations. In addition to state and Federal UST requirements, UST system owners and operators may be subject to other Federal, state, or local regulatory requirements (for example, U.S. Occupational Safety and Health Administration, National Fire Prevention Association, and International Fire Code). UST system owners and operators should check with their state and local agencies to determine other requirements.

If you have questions about this guidance, please contact Andrea Barbery at barbery.andrea@epa.gov or (703) 603-7137.

Dated: June 17, 2011

Mathy Stanislaus
Assistant Administrator, Office of Solid Waste and Emergency Response

To: Kristy Moore
Vice President
Renewable Fuels Association

November 28, 2011

From: Robert L. McCormick Janet Yanowitz
National Renewable Energy Laboratory Ecoengineering, Inc.

Re: Effect of 15% Ethanol Blends (E15) on Anti-Knock Index

The octane level of a fuel is a measure of its resistance to engine knock, or premature ignition. The addition of ethanol to gasoline at nominal 10% concentration (E10) is well known to increase the octane level of the blend and improve the blend's anti-knock properties. Octane levels are measured under two standardized engine conditions as described in ASTM D2699 and ASTM D2700, known respectively as the Research Octane Number (RON) and the Motor Octane Number (MON). The two values are averaged to generate the anti-knock index (AKI), which is the value posted on gasoline fuel dispensing pumps.

This analysis shows the impact of ethanol on AKI levels as ethanol concentrations are increased from 10% to 15% by volume in a wide variety of base gasolines and blendstocks. In all cases, blending of 10% ethanol increased AKI and blending of higher levels of ethanol either gave the same or a higher AKI value than obtained for E10. Given the high blending octane value of ethanol (RON and MON) there is generally no question that E15 blends will have adequate AKI if blended into a finished gasoline or a blendstock intended for E10 blending (blendstock for oxygenate blending or BOB). This memo provides documentation of this fact through analysis of published data.

Regulations

State laws and regulations set minimum standards for octane levels in gasoline, including gasolines containing ethanol, in the form of a minimum AKI. In most states the minimum AKI requirement for "Regular" grade gasoline is 87, however in some high altitude areas it is 85. The Federal Trade Commission's Automotive Fuel Ratings, Certification and Posting Rule ("Fuel Rating Rule") also requires that the minimum AKI of gasoline fuels offered for sale be posted on the fuel dispenser using the label specified in the rule. The Fuel Rating Rule applies to all gasoline, including E15 blends.

The test methods for RON and MON are applicable to gasoline containing higher than 10% ethanol; however the precision of these methods for blends above 10% has not yet been

determined. An inter-laboratory study (ILS) is currently underway to determine method precision, and has confirmed that the RON and MON test methods, as written, are applicable to E15 blends. Statistical analysis of the ILS data and inclusion of updated precision statements in D2699 and D2700 is not likely to occur until mid-2012. In the interim, state regulators have no approved methods to determine the AKI of E15 blends or approved method precision to be used in establishing compliance tolerance for an E15 AKI.

Experimental Results

The American Petroleum Institute (API)¹ has tested the effect of added ethanol on 21 ethanol free gasolines and blendstocks, representing a wide range of fuels, with varying blend levels as shown in Table 1.. We additionally have results for E10 and E15 in the same base gasoline from two other studies.^{2,3} Various other studies have measured AKI for E10 and higher blends, but not for E15.⁴⁻¹⁶ These data are included in some of the charts below as well.

Table 1. Hydrocarbon gasolines and blendstocks used for ethanol blending and octane testing in the API study (from reference 1). ASTM D4814 volatility classes listed.

	Premium Unleaded	Regular Unleaded	Total
ASTM Class AA	2	3	5
ASTM Class A	3	2	5
ASTM Class B	-	-	-
ASTM Class C	-	1	1
ASTM Class D	-	-	-
ASTM Class E	1	1	2
Refiner-supplied Summer BOBs	2	4	6
Refiner-supplied Winter BOBs	1	1	2
TOTALS	9	12	21

Figure 1 shows the change in AKI from the base gasoline level as a function of the base gasoline AKI. In general lower AKI basestocks show a larger increase in AKI from ethanol blending. The data suggest that the impact of ethanol on AKI can vary significantly with different base fuels having the same AKI and far exceeds the variability that would be expected due to experimental error alone. Thus, in addition to base fuel AKI there are other fuel composition factors that affect how a fuel responds to ethanol blending. In all cases, blending of 10% ethanol increased AKI and blending of higher levels of ethanol either gave the same or a higher value than obtained for E10.

Figure 2 examines the data in a different way, by plotting AKI for E15 as a function of AKI for E10 in the same blendstock. As can be seen, *in every case, the AKI for E15 was higher than for E10*. On average E15 AKI was 1.2 AKI units higher than E10 AKI. Figure 3 shows the increase

in AKI as a function of base gasoline dry vapor pressure equivalent (DVPE), indicating that the octane effects of ethanol blending apply for all volatility classes.

The method precision (reproducibility or R) for E10 is +/-0.6 octane number units. Based on the available data, on average E15 AKI was 1.2 AKI units higher than E10 AKI. In the worst case E15 AKI was 0.4 units higher than E10 AKI. Due to the AKI increase from the additional 5 percent ethanol in E15 no compliance tolerance is needed for AKI posting requirements at this time. As noted, the ILS will produce experimentally determined method precision for E15 by mid-2012.

Conclusions

A large dataset on the AKI of 10% and 15% ethanol blends into gasolines and blendstocks shows that E15 AKI is, in every case, higher than the E10 AKI in the same base hydrocarbon blend. E15 has on average 1.2 units higher AKI than E10 with a low value increase of 0.4 and a high value increase of 2.5 AKI units. These data indicate that failure of the minimum AKI requirement should not occur for E15 blends if blended into finished gasoline or blendstocks with the essential properties to meet a target AKI as an E10 blend. Until approved RON and MON test methods are available for E15, posting of the E10 blend AKI on the fuel dispenser will provide consumers with an acceptable assessment of the minimum AKI of the fuel being dispensed.

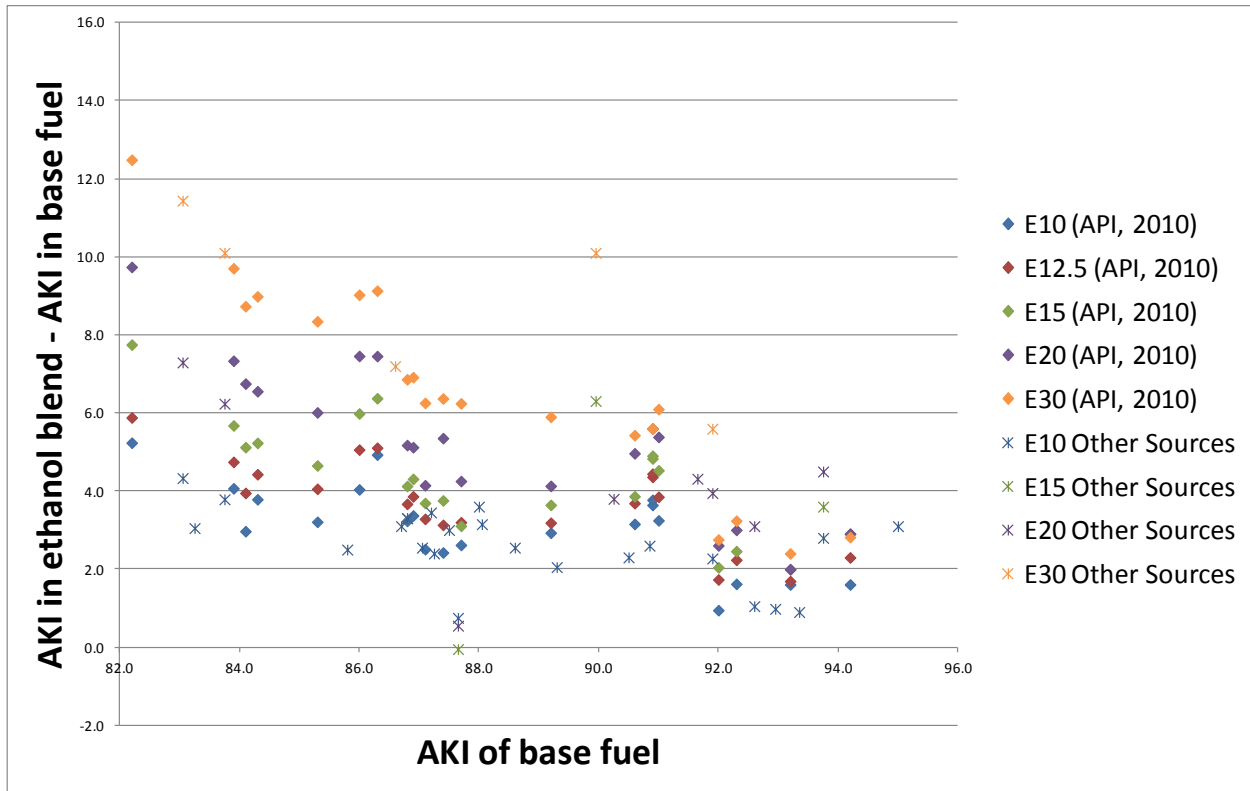


Figure 1. Increase in AKI for blending ethanol as a function of base fuel AKI.

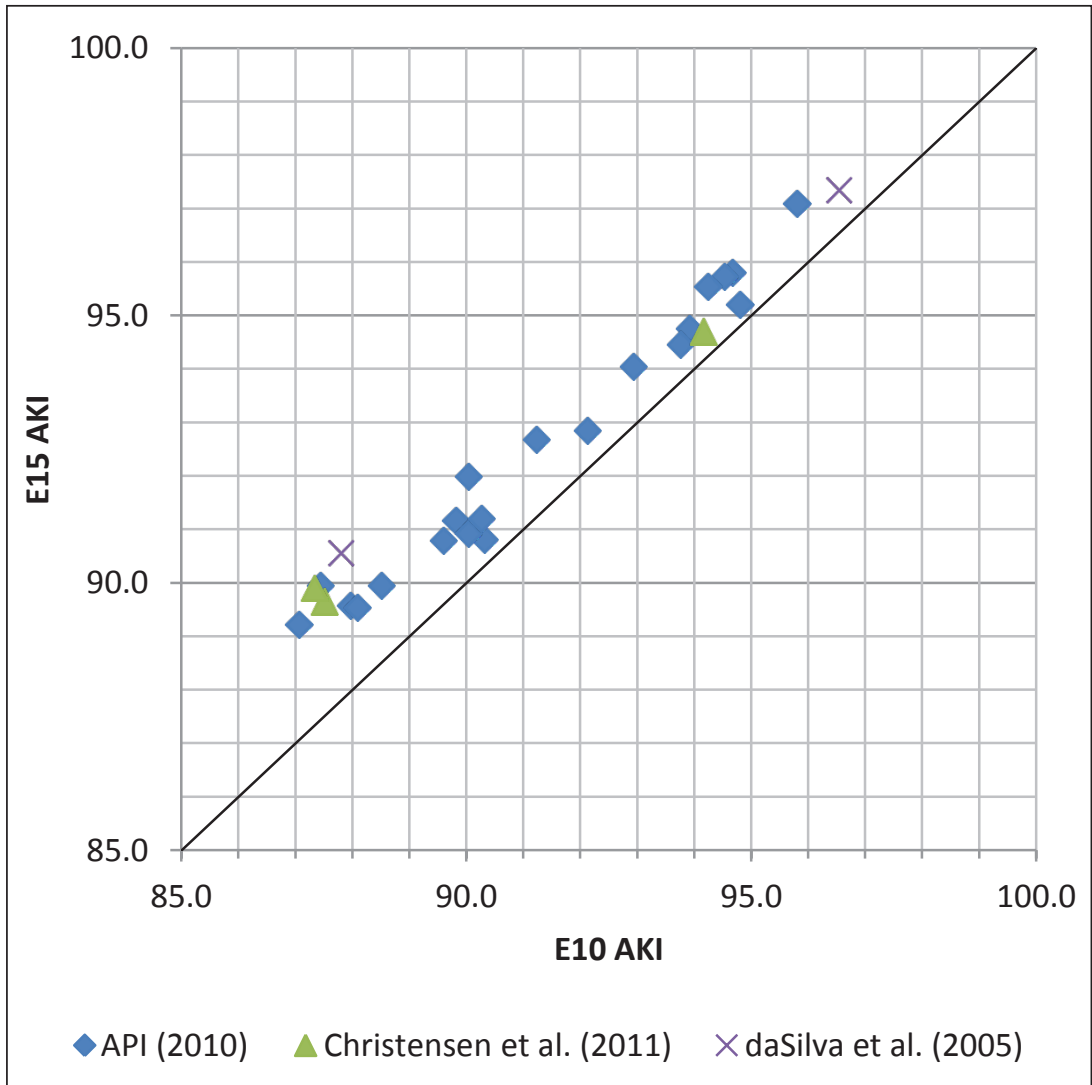


Figure 2. AKI for E15 versus AKI for E10 in the same base blendstock.

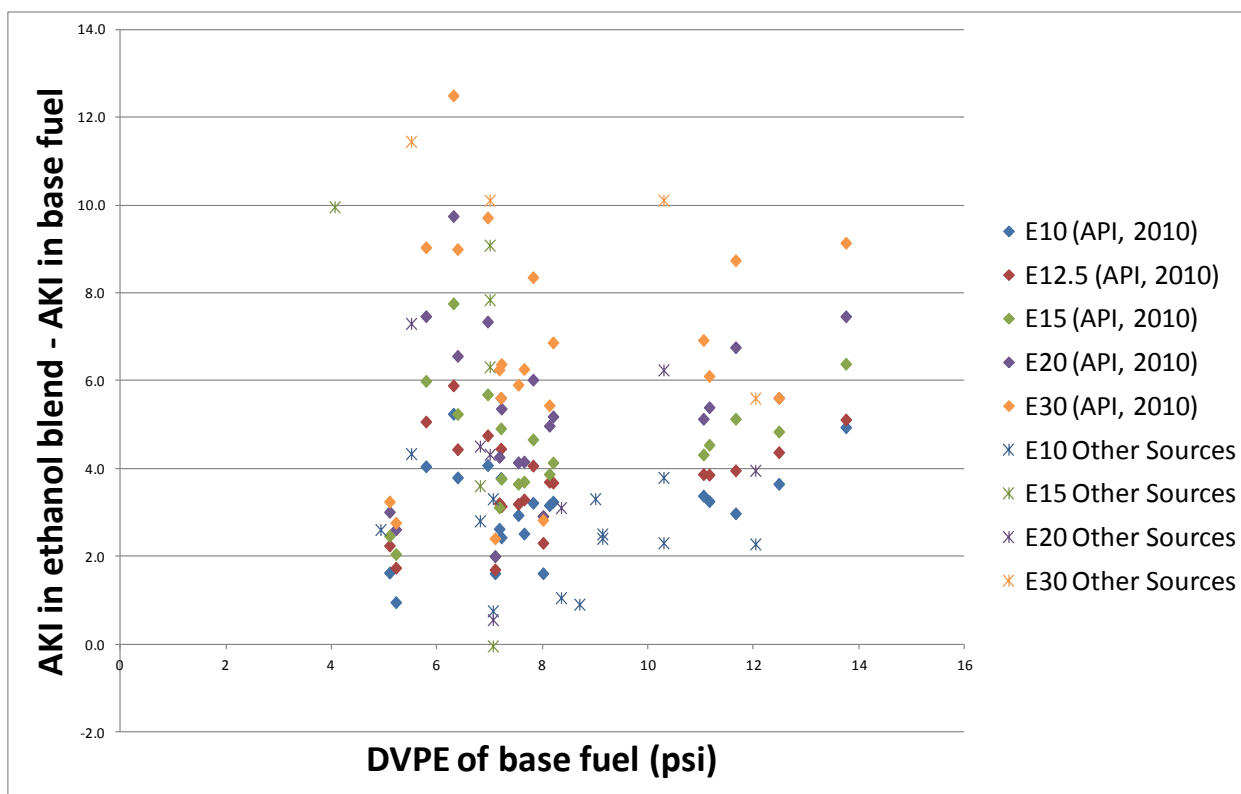


Figure 3. AKI for different ethanol blend levels as a function of base gasoline DVPE.

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Other Documents Available from the RFA

The RFA has developed and/or obtained a number of documents useful to those with interests in ethanol and gasoline/ethanol blends. These are available through the RFA website or from RFA member companies.

Fuel Ethanol Industry Guidelines, Specifications, and Procedures, (December 2010)

Changes in Gasoline IV – The Auto Technician’s Guide to Spark Ignition Engine Fuel Quality, (June 2009)

E85 Fuel Ethanol Industry Guidelines, Specifications, and Procedures
RFA Publication # 090301, (March 2009)

Guidelines and Best Practices for Blending Mid-Level Ethanol Blends
RFA Publication # 090616, (June 2009)

Handbook for Handling, Storing, & Dispensing E85
U.S. Dept of Energy (DOE / GO – 10 2008 – 2450), (April 2008)

Guidelines for Establishing Ethanol Plant Quality Assurance and Quality Control Programs
RFA Publication # 040301, (August 2004)

DVD – Complete Training Guide to Ethanol Emergency Response, (EERC 2009)

Best Practices for Rail Transport of Fuel Ethanol
RFA Publication, (November 2009)

Implementing an Effective Safety and Health Program for a Fuel Ethanol Facility
RFA Publication, (April 2009)



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