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RE: Docket No. EPA-HQ-OAR-2018-0775 – Modifications to Fuel Regulations to Provide Flexibility for E15; Modifications to RFS RIN Market Regulations[1]

I. Introduction

The Environmental Protection Agency's ("EPA" or the "Agency") proposed extension of the one-pound RVP waiver to gasoline containing 15 percent ethanol ("E15") is unlawful. The statutory language is clear, and EPA lacks any authority to "modify [its] interpretation"[2] of Clean Air Act ("CAA") Section 211(h)(4) to extend the E10 volatility waiver to E15.

Section 211(h)(4) of the CAA plainly states that it applies only to "fuel blends containing gasoline and 10 percent denatured anhydrous ethanol." EPA's proposed interpretation, which would allow volatility waivers for E15 and potentially higher concentrations of ethanol, cannot be squared with this clear language. Had Congress intended the result EPA now seeks, it would have been easy for it to specify that the waiver authority applies to "fuel blends containing gasoline and 10 percent *or more* denatured anhydrous ethanol" or, as EPA posits, "fuel blends containing gasoline and *at least* 10 percent denatured anhydrous ethanol."[3] That it did not do so is dispositive. Moreover, the legislative history surrounding this provision of the Clean Air Act demonstrates that Congress specifically rejected the interpretation EPA now advances.

Even were Section 211(h)(4) ambiguous, EPA offers no compelling rationale for reversing years of consistent interpretation. EPA admits that the emission control systems of vehicles are designed and certified on 9.0 pounds per square inch ("psi") Reid Vapor Pressure ("RVP") gasoline and that higher volatility gasoline can lead to "uncontrolled evaporative emissions."[4]

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[1] U.S. Environmental Protection Agency, *Modifications to Fuel Regulations to Provide Flexibility for E15; Modifications to RFS RIN Market Regulations*, 84 Fed. Reg. 10584 (March 21, 2019) (the "Proposed Rule").
[2] Proposed Rule at 10585.
[3] *Id.*
[4] *Id.*, n. 3.

Data and analysis of the emission effects of E15 in the administrative record show increases in particulate matter ("PM") and an upward trend in emissions of nitrogen oxides ("NOx") with increased levels of ethanol. But rather than be concerned about such negative effects, EPA simply brushes them aside.

We also are concerned that EPA has prejudged the outcome of this rulemaking. Our concern stems from Administrator Wheeler's Senate confirmation hearing, where he committed to "get it [the E15 waiver] done before the summer driving season." [5] This concern is magnified by other reports indicating commitments were made with respect to the conclusion of this rulemaking.[6] EPA's Proposed Rule fits a pattern of promoting ethanol production to foster political and policy outcomes not authorized by Congress. In the 1990s, EPA attempted to create a renewable fuel standard out of whole cloth and without congressional authorization, but was ultimately prevented from doing so by the D.C. Circuit.[7] More recently, even though EPA lacked authority to grant partial waivers for E15, EPA did so anyway in 2010 and 2011, allowing its use in *some* vehicles despite automobile manufacturers' recommendations against refueling with E15 in vehicles and equipment not designed for its use.[8]

EPA now attempts to act directly contrary to clear statutory language that limits the 1 psi RVP waiver to E10 blends. Since the courts have repeatedly rejected EPA's and other agencies'

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[5] "Senator Ernst: . . . I would like to just have you reaffirm for me today, and you know exactly the questions I am going to ask, the commitment that we will see E15 for our summer driving season. Mr. Wheeler: Yes, we are still on schedule for that . . ." Hearing on the Nomination of Andrew Wheeler to be Administrator of the Environmental Protection Agency, Senate Committee on Environment and Public Works, January 16, 2019. https://www.epw.senate.gov/public/_cache/files/6/c/6ca552e9-7080-46b2-9aba-50f858dbfb31/EFD9580A8C9CFC98C19BFF1248249EC7.spw-011619.pdf.

[6] *See, e.g.*, EPA to tie rules on E-15, ethanol credits. Greenwire, February 12, 2019, (quoting Chris Bliley, Growth Energy, "The president has pledged to deliver E-15 in time for the summer driving season, and we support any effort that helps EPA move forward on this fix…."), https://www.eenews.net/greenwire/stories/1060120353/feed *See also* statements from Growth Energy, *The Path to Year-Round E15*, https://growthenergy.org/policy-priorities/yearrounde15/, *accessed* April 22, 2019 ("In October 2018, the administration directed the Environmental Protection Agency to lift summertime restrictions on the sale of E15, proclaiming 'we are unleashing the power of E15 to fuel our country all year long.' In response, the administrator of the EPA, Andrew Wheeler, has pledged to ensure that the new rules are in place before the start of the summer driving season on June 1."). United States Environmental Protection Agency, Year in Review 2018, p. 7 ("President Trump has made strengthening the Renewable Fuel Standard an important priority of this administration. EPA is actively working to implement President Trump's directive on year-round E15 and proceeding as expeditiously as practicable. These actions will give America's farmers the regulatory certainty and clarity they asked for – and deserve. The Agency plans to release Proposed Rule text by February 2019 and take final action on the proposal by the upcoming driving season.").

[7] *American Petroleum Institute v. EPA*, 72 F.3d 907 (D.C. Cir. 1996).

[8] Partial Grant and Partial Denial of Clean Air Act Waiver Application Submitted by Growth Energy To Increase Allowable Ethanol Content of Gasoline to 15 Percent; Decision of the Administrator, 75 Fed. Reg. 68094 (Nov. 4, 2010); Partial Grant and Partial Denial of Clean Air Act Waiver Application Submitted by Growth Energy To Increase Allowable Ethanol Content of Gasoline to 15 Percent; Decision of the Administrator, 76 Fed. Reg. 4662 (Jan. 26, 2011).

attempts to "interpret" clear statutory language, EPA must decline to finalize this aspect of the Proposed Rule.[9]

EPA also seeks to reinterpret the Agency's authority in Section 211(f) to consider E15 to be "substantially similar to any fuel" used in the certification of vehicles. This proposal would circumvent restrictions the Agency previously placed on E15 in 2010 and 2011 when it granted "partial waivers" pursuant to Section 211(f)(4). EPA lacks authority to apply "sub sim" in this manner and to do so would undermine the statutory purpose of the "sub sim" requirement – to protect the drivability of previously certified vehicles and ensure their ability to operate in accordance with their originally certified emissions profile. EPA must decline to finalize this element of the Proposed Rule.

With respect to EPA's proposals regarding Renewable Identification Numbers ("RINs") market reforms, it is clear the RFS is not working as originally intended. The program does little to accomplish its statutory objectives, contains unrealistic renewable fuel targets requiring annual waivers and exemptions, and has been characterized by litigation, volatile RIN prices, and incredible uncertainty. For these reasons, AFPM continues to advocate for broad legislative reforms.

EPA's recognition that the RFS program is dysfunctional and its desire to address it is laudable; however, the proposed RIN market reforms will not fix the underlying problems with the RFS. The proposed RIN market reforms will impact obligated parties in different ways, depending upon how each obligated party is situated in the marketplace. We, therefore, encourage EPA to closely review the individual comments filed by AFPM's members.

The RIN market reflects the broader RFS program that has been built on inaccurate fuel consumption forecasts, false promises of certain advanced biofuel producers, and a blatant disregard for consumers' interests. Nowhere are these foundational problems manifested more clearly than in the volatility of the RIN market. Indeed, as EPA signals its intent to push beyond the blendwall, RIN prices and volatility have increased.

When operating at the blendwall the market responds to every EPA statement, news event, and rumor that could affect EPA's decision to bust the blendwall and create a scarcity of RINs. For

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[9] For example, the Supreme Court rejected EPA's attempt to raise statutory thresholds for Clean Air Act permitting from 100 or 250 tons per year to 100,000 tons per year, in large part by arguing that Congress did not intend small sources of greenhouse gases to be subject to Prevention of Significant Deterioration permitting. In a 9-0 opinion, the court rejected such arguments. "An agency has no power to 'tailor' legislation to bureaucratic policy goals by rewriting unambiguous statutory terms. Agencies exercise discretion only in the interstices created by statutory silence or ambiguity; they must always 'give effect to the unambiguously expressed intent of Congress . . . It is hard to imagine a statutory term less ambiguous than the precise numerical thresholds at which the Act requires PSD and Title V permitting. When EPA replaced those numbers with others of its own choosing, it went well beyond the 'bounds of its statutory authority.'" *Utility Air Regulatory Group v. EPA*, 134 S. Ct. 2427 (2014), *citing National Assn. of Home Builders v. Defenders of Wildlife*, 551 U.S. 664,665 (2007), *City of Arlington, Texas v. Federal Communications Commission*, 555 U.S. 290 (2013).

these reasons, the most effective way to reduce programmatic costs and RIN volatility is for EPA to respect the blendwall and affirmatively acknowledge Congress's intent that conventional ethanol not exceed 10 percent of the gasoline supply.

This issue will be front and center now that EPA has triggered the statutory RFS reset provisions. Reset is a golden opportunity to lower the costs of the RFS and ensure that the program appropriately reflects market realities. To ameliorate the harms to the consumer and obligated parties caused by an RFS built on false assumptions, EPA must ensure that ethanol mandates remain below the E10 blendwall during the reset period and thereafter.

II. AFPM Members Would Suffer Economic Injury if the Proposed Rule is Finalized

One of the main objectives of EPA's proposed reinterpretation of the statutory 1 psi RVP waiver is to "help incentivize retailers to introduce E15 into the marketplace."[10] EPA also anticipates that allowing the 1 psi RVP waiver to apply to E15 "could help to further the use of increased volumes of renewable fuels under the RFS program . . ."[11]

AFPM's members manufacture and sell petroleum hydrocarbons for use as transportation fuel. Thus, AFPM's members' direct, pecuniary interests are adversely affected by government-created incentives to promote the sale and use of ethanol, which competes with and displaces the gasoline they produce. To the extent this rule would remove a barrier to increased blending of ethanol into gasoline (a stated goal of the Proposed Rule), it would reduce AFPM members' current market share of transportation fuels. This is precisely the type of competitive injury that courts have recognized as cognizable.[12] An increase in the amount of ethanol (largely derived from corn) sold in the marketplace and blended into fuel would result in a corresponding reduction in the sale of the gasoline and gasoline blendstocks (derived from petroleum) that AFPM's members manufacture. EPA predicts this outcome if the Proposed Rule is finalized, and ethanol producers have repeatedly confirmed that the intent of allowing E15 to qualify for a 1 psi RVP waiver, is to displace gasoline in favor of ethanol. The Renewable Fuels Association considers the lack of a 1 psi RVP wavier for E15 to be "the single most important barrier to ethanol growth over the past 5 years."[13] Similarly, Growth Energy, another ethanol trade association, characterized the proposed rule as eliminating a regulatory barrier to additional ethanol sales:

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[10] Proposed Rule at 10604.

[11] *Id.*

[12] *Sherley v. Sebelius*, 610 F.3d 69, 73-74 (D.C. Cir. 2010) (articulating that "the basic requirement common to all our cases is that the complainant show an actual or imminent increase in competition, which increase we recognize will almost certainly cause an injury in fact"); *Am. Inst. of Certified Pub. Accountants v. IRS*, 804 F.3d 1193 (D.C. Cir. 2015) (finding CPA association has standing to challenge IRS' decision allowing uncredentialed tax preparers to be listed in an IRS online directory).

[13] Renewable Fuels Association, *The Case for RVP Parity*, https://ethanolrfa.org/wp-content/uploads/2019/02/RFA-Talking-Points-The-Case-for-RVP-Parity.pdf, *last accessed on* March 22, 2019.

> E15 currently lacks the 1 psi RVP waiver, and because of this restriction, fuel retailers cannot offer E15 to consumers during the summer driving months . . . This means that fuel retailers must go through the costly and unnecessary hassle of relabeling every single E15 dispenser twice a year — once on June 1 and again on Sept.15 — causing fuel sales of E15 to plummet….[14]
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> * * *
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> "You give us the RVP waiver and immediately you're going to see 700 million gallons in terms of just conventional biofuel demand,' Skor says. 'So we've got some numbers to show this would have real economic impact.'[15]

Removing a generally-applicable regulatory barrier to a competitor's product produces concrete injury.[16] Where, as here, the injury would be directly traceable to a final rule that extends the 1 psi RVP waiver to E15, the regulatory change would directly harm AFPM's members. In litigation regarding EPA's Tier 3 rules and changes to requirements for certification fuel, petitioners argued that EPA's test fuel regulations impermissibly prohibited the use of E30 on the basis that it was not "commercially available." In addressing petitioner's standing, the D.C. Circuit determined that a "regulatory impediment . . . that prevents their product from being used as test fuel . . . qualifies as an injury in fact."[17] While Congress may have the authority to pick winners and losers in commerce, regulatory agencies should not seek to do so outside of their statutory mandate.

In addition to the impact from displaced gasoline and gasoline blendstocks, AFPM members operate petroleum bulk stations and terminals, own thousands of gasoline retail establishments, negotiate branding agreements with independent gasoline retailers, and employ thousands of individuals who would be impacted by a final rule implementing a 1 psi RVP waiver for E15. As noted above, proponents of changing current regulations restricting the waiver to E9 through E10 forecast substantial changes to the retail market for gasoline/ethanol blends. To the extent that there would be any change in the gasoline market as defined with respect to RVP, AFPM members will be affected in one form or another.

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[14] Growth Energy, *Removing Barriers to Consumer Fuel Choice*, December 13, 2018, https://growthenergy.org/wp-content/uploads/2018/12/ADVO-18089-Issue-Brief-Removing-Barriers-to-Consumer-Fuel-Choice-2018-12-13.pdf *last accessed on* March 22, 2019. *Note*, pump relabeling as suggested in this document is illegal (*see* Section VI, *infra*).

[15] Brownfield, *Ethanol Industry Focuses on RVP Waiver for E15*, https://brownfieldagnews.com/news/ethanol-industry-focuses-rvp-waiver-e15/ (November 14, 2017) *last accessed on* March 22, 2019.

[16] *La. Energy and Power Auth. v. FERC*, 141 F.3d 354 (D.C. Cir. 1998) ("We repeatedly have held that parties suffer constitutional injury in fact when agencies lift regulatory restrictions on their competitors or otherwise allow increased competition.").

[17] *Energy Future Coalition v. EPA*, 793 F.3d 141, 144 (D.C. Cir. 2015).

III. The Clean Air Act's 1 psi RVP Waiver Applies Solely to E10

EPA is charged with following and implementing federal environmental laws, including the Clean Air Act. The Proposed Rule, however, turns its back on the rule of law as EPA manufactures a variety of justifications to completely rewrite the clear language of the RVP limitation under the Clean Air Act to benefit ethanol producers. EPA attempts to argue that because Clean Air Act Section 211(h) was enacted in "the context of EPA's prior regulatory actions under *CAA sec. 211(c)*, which aimed to control the RVP of gasoline,"[18] EPA has authority to conform *Clean Air Act Section 211(h)* to changed circumstances in the fuel market. But EPA is not Congress. And despite claims in the Proposed Rule, Congress did not "codify" EPA's prior regulations and thus empower EPA to change the law as it would any other part of the Code of Federal Regulations. Instead, in 1990, Congress passed a law that directed EPA to allow a 1 psi RVP waiver only in certain limited circumstances.[19]

EPA's attempts to justify its reinterpretation lack any grounding in the statute. First, EPA indicates that the reinterpretation is based on a changing gasoline market. EPA justifies its proposal to relax E15 RVP standards on the basis that E15 faces "the same market limitation that prompted EPA to provide a 1-psi waiver for E10 in 1989 . . ."[20] But nowhere in Section 211(h) did Congress grant EPA authority to address the dynamics of the transportation fuel market. Instead, Congress established a broad prohibition in section 211(h)(1) making it unlawful to "sell, offer for sale, dispense, supply, offer for supply, transport or introduce into commerce" gasoline above 9.0 psi RVP during the high ozone season. Then Congress provided a *limited exception* to this general rule in Section 211(h)(4). Had Congress intended that EPA have authority to address the proper level of fuel volatility on the basis of different factors like market dynamics, it could have done so. It did not.

Next, EPA indicates that its proposed interpretation is consistent with "Congress' intent to promote ethanol blending into gasoline."[21] But Section 211(h) cannot be read to include such intent apart from fuel blends containing 10 percent ethanol. In addressing an attempt to create incentives for cellulosic biofuel within the RFS program, the D.C. Circuit was clear concerning EPA's ability to justify its actions on the basis of broad policy objectives, stating in *American Petroleum Institute v. EPA*:

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[18] Proposed Rule at 10588.

[19] It is instructive that Congress did not simply amend or even reference CAA Section 211(c), the source of EPA's authority to limit volatility through rulemakings prior to the 1990 Clean Air Act Amendments and the rules which EPA claims "codified" in CAA Section 211(h). Had Congress intended to "codify" EPA's rules, it could have done so through either direct reference or specific enhancement of Section 211(c). It did neither.

[20] Proposed Rule at 10590.

[21] Proposed Rule at 10590-91. In 2005 and 2007, Congress chose to provide limited support to the ethanol industry through the enactment of the RFS program in Section 211(o); however, nowhere in that section, or anywhere else in the Clean Air Act, did Congress give EPA the authority to extend the RVP waiver to higher ethanol blends.

> API challenges the special tilt with which EPA expressly viewed the data—a tilt, in its words, toward "promoting growth" in the cellulosic biofuel industry. We agree with API that such a purpose has no basis in the relevant text of the Act.
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> EPA is correct that one of Congress's stated purposes in establishing the current RFS program was to "increase the production of clean renewable fuels." See Pub. L. No. 110-140, 121 Stat. 1492, 1492 (2007). But that general mandate does not mean that every constitutive element of the RFS program should be understood to individually advance a technology-forcing agenda, at least where the text does not support such a reading. As we observed in *American Petroleum Institute v. EPA*, 52 F.3d 1113, 1119 (D.C. Cir. 1995), "EPA cannot rely on its general authority to make rules necessary to carry out its functions when a specific statutory directive defines the relevant functions of EPA in a particular area." Although here EPA invokes not its general rulemaking authority, but rather the general purpose of the RFS program, we think the same principle applies: a broad programmatic objective cannot trump specific instructions.[22]

EPA also claims it is acting in "response to the increased presence of E15 in the gasoline marketplace."[23] But even seen in the best possible light, such an increased presence is overstated. Currently, less than 1% of all retail outlets nationwide offer E15.[24] And EPA has indicated that it does not actually know how much E15 is being sold and consumed.[25] This is true despite direct governmental subsidies for E15 fueling infrastructure.[26]

Finally, EPA conflates its regulatory history with legislative history. EPA claims that the Agency's "statements on the imprecise nature of ethanol-gasoline blending also support the view that neither Congress nor EPA intended to limit ethanol content for the 1-psi waiver."[27] But an

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[22] *American Petroleum Institute v. EPA*, 706 F.3d 474, 479 (D.C. Cir. 2013).

[23] Proposed Rule at 10586.

[24] EPA has not developed data to support this assertion, but relies on industry data from ethanol producers. *See* 84 Fed. Reg. 10590, n. 52, citing Growth Energy publication. And while EPA points to 9.0 RVP requirements as a cause of market failure, it ignores the other market factors, including incompatible infrastructure and a lack of consumer demand, that have inhibited growth in E15 sales and would remain unaffected by extending the 1 psi waiver to E15. EPA acknowledges that the 1 psi waiver is "one of several hurdles to the continued entry of E15 into the marketplace." *Id*. But the Agency does not detail or seriously examine these other hurdles. Instead, EPA simply cites to a one-page marketing brochure developed by Growth Energy concerning its "Prime the Pump" initiative, which in any event fails to outline *any* such hurdles. EPA has therefore failed to consider "relevant factors" and examine "an important aspect of the problem." *Burlington Truck Lines v. U.S.*, 371 U.S. 16, 168 (1962).

[25] EPA rejected arguments that it needed to assess volumes of E15 in connection with the 2019 RFS standard. See 83 Fed. Reg. 62704, 63731 (Dec. 11, 2018).

[26] The Rural Energy for America Program provides loan and loan guarantees and grants to agricultural producers and rural small businesses to purchase renewable energy systems including flexible fuel pumps. *See* afdc.energy.gov. The Department of Agriculture lists approximately $100 million in grants for biofuel infrastructure. *See* fsa.usda.gov.

[27] Proposed Rule at 10591.

examination of EPA's supporting citation – a 1991 proposed rule – reveals that this is not the case. The imprecise nature of gasoline/ethanol blending (observed over 28 years ago) was used only as a basis for allowing a compliance margin *below* a precise E10 blend, *i.e.*, 9 to 10 percent blends could qualify for the 1 psi RVP waiver. This was done on the basis of practicality. EPA rightfully considered that requiring exactly 10 percent "would place a next to impossible burden on ethanol blenders."[28] Thus, EPA allowed blenders some room under the 10 percent cap in order to qualify for a waiver.

EPA claims that "Congressional action in CAA sec. 211(h) was largely a ratification" of prior agency rules.[29] But Congress did not refer to EPA's prior rules in the statute. Moreover, EPA amended its rules after enactment of the 1990 Clean Air Act Amendments to respond to the new statutory provisions and tellingly so. EPA modified the previous regulatory text of 40 C.F.R. §80.27, which had indicated that the blend of gasoline and ethanol "must contain at least 9% ethanol"[30] to qualify for a waiver, to specify that the fuel blend "must be at least 9% and no more than 10% (by volume) of the gasoline . . ."[31] In other words, EPA's codification argument proves precisely the opposite point. EPA changed its regulations after enactment of section 211(h) to limit the application of the 1 psi waiver to blends of 10 percent or less ethanol, removing regulatory language ("at least") that it is now seeking to insert through "reinterpretation" of the Clean Air Act.

The statutory provision modifying EPA's authority to regulate RVP in ethanol blends as well as EPA's prior interpretations of that provision make clear that the Agency has no legal authority to extend the 1 psi RVP waiver to E15 as proposed. As noted above, "[a]n agency has no power to 'tailor' legislation to bureaucratic policy goals by rewriting unambiguous statutory terms."[32] EPA's *post hoc* attempts to rationalize a departure from the plain meaning of the statute will not withstand judicial scrutiny. We discuss each of these deficiencies in greater detail below.

A. EPA's E15 Waiver Proposal Conflicts with the Plain Language of Section 211(h)

In 1990, Congress specifically addressed EPA's authority to prescribe RVP limits to control ground-level ozone.[33] The newly-enacted Section 211(h)(1) set a 9.0 psi limit on gasoline sold during the "high ozone season" and included a 1 psi RVP waiver specifically applicable to E10 blends:

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[28] 56 Fed. Reg. 24245 (May 29, 1991).
[29] Proposed Rule at 10589. This statement and others within the Proposed Rule echo Growth Energy arguments that Congress merely "codified" pre-existing EPA rules controlling fuel volatility. *See* Growth Energy, Renewable Fuels Association, Urban Air Initiative, and National Corn Growers Association, *Applicability of 1.0 PSI Reid Vapor Pressure Allowance for Blends of Gasoline and 15 Percent Ethanol*, at 1 (February 7, 2018), appended hereto as Attachment 1, *infra*.
[30] 40 C.F.R.§ 80.27(d)(2) (1990).
[31] Proposed Rule at 10590. *See* 40 C.F.R. §80.27(d)(1) (1992).
[32] *Utility Air Regulatory Group v. EPA*, 134 S. Ct. 2427 (2014).
[33] CAA Section 211(h)(1)-(4) was enacted as part of the 1990 Clean Air Act Amendments.

> For fuel blends containing gasoline *and* 10 percent denatured anhydrous ethanol, the Reid vapor pressure limitation under this subsection shall be one pound per square inch (psi) greater than the applicable Reid vapor pressure limitations established under paragraph (1).[34]

This statutory language does not extend the 1 psi RVP waiver to mid-level ethanol blends or authorize EPA to do so. The word "and"—conspicuous in Section 211(h)(4)—is a "function word to indicate connection or addition especially in terms within the same class or type—used to join sentence elements of the same grammatical rank or function."[35] Based on the function of the word "and" in Section 211(h)(4), that Section does not apply to fuel blends containing "at least" 10 percent ethanol or 10 percent "or more" ethanol, but to only to those fuel blends that contain gasoline *and* 10 percent ethanol.[36] Had Congress intended that the waiver provision apply to those other blends—those containing "at least 10 percent ethanol" or "10 percent or more ethanol"—Congress could have said so very simply. The construction given the provision by EPA in the Proposed Rule is so strained that it cannot withstand judicial scrutiny. When used as a conjunctive, "and" means that "all of the requirements must be satisfied." *Pueblo v. Santa Ana v. Kelly*, 932 F. Supp. 1284, 1292 (D.N. Mex. 1996), citing *United States v. O'Discroll*, 761 F. 2d 589, 597-98 (10th Cir. 1985). Therefore, the 10 percent ethanol requirement is *not met* when a fuel blend contains 15 or 20 percent or 30 percent ethanol.

E15 contains 50% more ethanol than E10. The normal meaning of a requirement that an item "contain" a specific percentage of an element is that it contains *that percentage*, not some other percentage.[37] To impose such constraints on EPA's discretion, Congress is not required to legislate in the negative. Instead, a statute is to be construed "in accordance with its ordinary or natural meaning." *FDIC v. Meyer*, 510 U.S. 471, 476 (1994). Thus, Congress did not need to specify that fuel blends qualifying for a 1 psi waiver contain "10 percent denatured anhydrous ethanol and no more than 10 percent denatured anhydrous ethanol" in order to establish a clear statutory directive. Especially where an exemption (special treatment) is involved, EPA must interpret the statute within its normal meaning. "[C]ontaining . . . 10 percent . . . ethanol" means actually containing that amount.

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[34] 42 U.S.C. § 7545(h)(4) (emphasis added).

[35] Merriam-Webster online dictionary, last accessed on July 27, 2018; https://www.merriam-webster.com/dictionary/and.

[36] EPA specifically addressed this point in 1991 when it promulgated regulations based on the 1990 Clean Air Act Amendments. 56 Fed. Reg. 24242 (May 29, 1991). EPA limited the 1 psi waiver to gasoline/ethanol blends of between 9 and 10 percent, indicating that it "believ[ed] this is consistent with Congressional intent." But in order to avoid a "next to impossible burden on ethanol blenders" if EPA required such blends to be precisely 90 percent gasoline and 10 percent ethanol, EPA determined that changes to previous regulatory requirements allowing a 1 psi waiver for 9 to 10 percent blends was appropriate. *Id*. In other words, the 9 to 10 percent requirement provided a compliance margin for gasoline/ethanol blends that were not precisely 10 percent ethanol.

[37] "Contain" is a transitive verb, defined as "to keep within limits: such as restrain, control, check, halt." https://www.merriam-webster.com/dictionary/contain.

To manufacture statutory ambiguity and to justify its new interpretation, EPA inappropriately focuses on the word "containing," and completely ignores the truly operative word, "and." That a blend must "contain" gasoline and ethanol as the first threshold to potentially qualify for the RVP waiver is obvious and, frankly, not all that helpful from a statutory construction standpoint. The real and controlling question is how much ethanol the blend can contain. Congress answered that question unambiguously through the use of "and." It must contain gasoline ***and*** 10 percent denatured anhydrous ethanol. Not "up to." Not "at least." But gasoline "and" 10 percent ethanol.

The absurdity of EPA's effort to manufacture ambiguity is painfully obvious if one considers a recipe in a cookbook. If a cake recipe calls for "1 cup sugar, 2 eggs, and 1 cup of flour," not even a novice chef would be confused or think she would be following the recipe by adding five cups of flour instead of one based on the theory that her mixing bowl contains at least one cup of flour. That is a recipe for disaster, not for a cake. So too for EPA's construction of the statute. Nor would the limited 211(h) exemption have any meaningful boundaries under EPA's construction that the 1 psi RVP waiver can apply to E15 because E15 necessarily includes at least 10 percent ethanol. In other words, the exception would swallow the rule since all blends at or above 10 percent ethanol would qualify for the waiver. It is clear that Congress did not intend that outcome.

B. EPA's Prior Interpretations Limit the 1 psi RVP waiver to E10 and Directly Conflict with EPA's Proposed Reinterpretations of Section 211(f)

1. EPA Considered the Statute Clear on its Face Following Enactment of 211(h) in 1990

EPA has consistently interpreted the statutory RVP waiver as applying to blends of gasoline and ethanol between 9 and 10 percent. In a 1991 final rule following enactment of Section 211(h), EPA promulgated RVP standards that clearly interpreted 211(h)(4) to impose a cap on the level of ethanol that could qualify for a one-pound waiver:

> In order to qualify for the special regulatory treatment . . . gasoline must contain denatured, anhydrous ethanol. The concentration of the ethanol, excluding the required denaturing agent, must be at least 9% *and no more than* 10% (by volume) of the gasoline.[38]

In the same rule, EPA also limited a defense against liability for exceeding RVP (also newly enacted by Congress and contained in Section 211(h)(4)) to "ethanol blends which meet the minimum 9 percent requirement in the regulations and the *maximum* 10 percent requirement in the waivers under section 211(f)(4)."[39] Thus, at its first opportunity to interpret and apply a

[38] Regulation of Fuels and Fuel Additives: Standards for Gasoline Volatility; and Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines: Standards for Particulate Emissions From Urban Buses, 56 Fed. Reg. 64704, 64708, 64710/3 (Dec. 12, 1991) *codified at* 40 C.F.R. § 80.27(d)(2) (emphasis added).
[39] *Id.* (emphasis added).

statutory waiver for gasoline/ethanol blends, EPA found the statute unambiguous and set both minimum and maximum limits. EPA stated:

> [i]n discussing this requirement, the House Committee on Energy and Commerce stated that EPA 'regulations shall permit gasoline containing *at least 9 but not more than 10 percent ethanol (by volume)* to exceed the volatility requirements by up to 1.0 pounds per square inch.' There is no indication that Congress intended a different result through the language finally adopted.[40]

Given this Congressional mandate, EPA also amended the text of previous regulations that provided that gasoline "must contain at least 9% ethanol" in order to receive a 1 psi RVP waiver to read that "the concentration of the ethanol . . . must be at least 9% and no more than 10% by volume . . ."[41] Thus, EPA's contemporaneous interpretation of the statutory authority conveyed by Congress in section 211(h) as well as its legislative intent was that the 1 psi waiver applies solely to blends of 90% gasoline and 10% ethanol while accounting for a compliance margin.[42] For the next two decades, EPA administered the waiver consistently and with seemingly little debate over its interpretation.

2. EPA Continued to Strictly Limit the Scope of its 1 psi RVP Waiver when it Issued Partial Waivers under Section 211(f)

In 2010, in the context of issuing its partial E15 waivers, the Agency reaffirmed its interpretation of the waiver as only applying to E10:

> Commenters questioned whether E15 would qualify for the 1.0 psi RVP waiver permitted for E10 under CAA section 211(h). As explained in the misfueling mitigation measures proposed rule, EPA interprets the 1.0 psi waiver in CAA section 211(h) as being limited to gasoline-ethanol blends that contain 10 vol% ethanol. [43]

Similarly, when considering its ability to grant sub sim waivers under Section 211(f)(4), EPA also maintained that this statutory authority did not alter the scope of the 1 psi RVP waiver in Section 211(h)(1). EPA specifically considered this issue in 2010 and 2011, and indicated that it:

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[40] 56 Fed. Reg. at 24242, 24245 (May 29, 1991) (emphasis added). *Note* the committee believed that the "at least" language of the House bill (prior to the House/Senate conference) also meant that a 10% cap applied.

[41] Proposed Rule at 10589-90, citing changes to 40 C.F.R. §80.27.

[42] EPA allowed for 9 to 10 percent blends to qualify given the realities of the market and splash blending. "[I]nterpreting this provision to provide a one psi allowance only if the blend contains exactly 10 percent ethanol would place a next to impossible burden on ethanol blenders . . ." 56 Fed. Reg. at 23245.

[43] *See* Partial Grant and Partial Denial of Clean Air Act Waiver Application Submitted by Growth Energy To Increase the Allowable Ethanol Content of Gasoline to 15 Percent, 75 Fed. Reg. 68094, 68149 (Nov. 4, 2010).

> interprets CAA section 211(h)(4) as limiting the 1.0 psi waiver to gasoline-ethanol blends that contain 10 vol% ethanol, including limiting the provision concerning ‘‘deemed to be in full compliance’’ to the same 10 vol% blends. This interpretation is also consistent with how EPA has historically implemented CAA section 211(h)(4) through 40 CFR 80.27(d), which provides that gasoline-ethanol blends that contain at least 9 vol% ethanol and not more than 10 vol% ethanol qualify for the 1.0 psi waiver of the applicable RVP standard.[44]

EPA also addressed the issue in its E15 misfueling mitigation rule, which was necessary to address the potential harms caused by EPA’s erroneous interpretation of the 211(f)(4) waiver provision and its issuance of two “partial waivers” applicable to a subset of motor vehicles.[45] This rule contained a section entitled, “The Applicability of the Statutory psi RVP Waiver to E15,” where EPA again explained that the text of Section 211(h)(4) and the legislative history support EPA’s interpretation that the one-pound waiver applies only to gasoline blends containing 9-10% ethanol by volume:[46]

> Relatedly, we are adopting our proposed interpretation that CAA section 211(h)(4) provides a 1.0 psi RVP waiver and related compliance provision only to gasoline-ethanol blended fuels containing between nine and 10 vol% ethanol, in light of the terms and legislative history of the relevant statutory provisions.[47]

Having explicitly solicited comment on expanding the 1 psi waiver to E15,[48] EPA reaffirmed its then nearly 20-year-old interpretation that Section 211(h)(4) “limits the 1 psi waiver to fuel blends containing gasoline and 9-10 vol% ethanol, including limited the provision concerning ‘deemed to be in full compliance’ to the same 9-10 vol% gasoline-ethanol blends.”[49] In doing so, EPA discussed and rejected several arguments that the 1 psi waiver could extend to gasoline/ethanol blends above 10 percent ethanol.[50]

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[44] *Id.* at 68117.
[45] *See* 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, 76 Fed. Reg. 44406 (July 25, 2011).
[46] Proposed Rule at 44434/2.
[47] Proposed Rule at 44408/2.
[48] 75 Fed. Reg. 68044, 68061 (Nov. 4, 2010).
[49] 76 Fed. Reg. at 44433.
[50] Particularly relevant to this Proposed Rule, EPA also addressed claims that the 1 psi waiver could be applied to any gasoline/ethanol fuel blends that had received a waiver under Section 211(f)(4) (and thereby applied to E15 based on the Agency’s recent approval of two partial Section 211(f)(4) waivers for E15). Here, EPA noted that provisions providing for alternative compliance were “not intended as a separate authorization for a relaxed RVP limit independent of the provision for a 1 psi waiver for 9-10% blends.”[50] Moreover, EPA observed that when enacted, “Congress was well aware of the existing section 211(f)(4) waiver conditions for 10% ethanol by volume.” *Id.*

3. EPA Interpreted Sections 211(h)(1), (h)(4) and (h)(5) as Limiting the Scope of the 1 psi RVP Waiver

EPA has also indicated that the broader statutory context of the Section 211(h)(4) waiver limits the range of possible interpretations. Specifically, EPA has asserted that when reading the different parts of Section 211(h) together, it was not rational to believe that the waiver could apply to gasoline/ethanol blends above or below the 9 to 10% range. This was because, among other impacts, the interpretation would mean that states could never "opt-out" of the waiver (as allowed under Section 211(h)(5)) since higher or lower blends would be "deemed to comply" with the 9 psi limitation in Section 211(h)(1).[51]

EPA has explained its historical interpretation of the 1 psi RVP waiver provision is the only one that is consistent with related statutory provisions. In its 2010 partial waiver determination, EPA stated that:

> EPA views these three provisions—the 1 psi waiver and the deemed to comply provision in section 211(h)(4), and the State relief provision in section 211(h)(5)—as related provisions that should be interpreted together in a way that harmonizes them and provides significance and a balanced meaning to each of them . . .This is consistent with the text and legislative history of the three provisions, which indicate that the RVP provisions in section 211(h)(4) are intended to work together to facilitate the use of ethanol blends of 9–10%, that the deemed to comply provision is not a free standing or separate provision that addresses fuels different from those covered by the 1 psi waiver, and that the provision for States in section 211(h)(5) is intended to provide relief coextensive with the RVP limits in section 211(h)(4).[52]

In responding pointedly to commenters who argued the waiver provision should apply to E15, EPA pointed out that such an interpretation would inherently conflict with Section 211(h)(5).[53] In addition, in its response to comments, EPA stressed its long-held belief that the waiver provision is not only properly interpreted as applying solely to E10 as a matter of congressional intent, but as a matter of sound policy.[54]

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[51] The "deemed to comply" provision provides an affirmative defense to RVP violations where a person blends ethanol into gasoline to achieve a 10 percent blend and has evidence that (1) the gasoline portion of the blend meets the applicable RVP limit; (2) the ethanol portion of the blend does not exceed the waiver under subsection (f)(4) (the "sub-sim" rule); and (3) no additives are used to increase the RVP of the ethanol portion of the blend.

[52] *Id*.

[53] *Id*.

[54] Regulation to Mitigate the Misfueling of Vehicles and Engines with Gasoline Containing Greater Than 10 Volume Percent Ethanol and Modifications to Reformulated and Conventional Gasoline Programs - Summary of Public Comments and Supplemental Response to Comments [EPA-420-R-11-006], June 2011, at 75, 77, EPA-HQ-OAR-2010-0448-0118.

C. EPA Cannot "Reinterpret" Clear Statutory Directives

By its terms, Section 211(h)(4) applies to "fuel blends containing gasoline *and* 10 percent denatured anhydrous ethanol." This language is neither ambiguous nor susceptible to a reinterpretation that would replace the word "and" with the phrase "at least" as EPA has proposed.

> We are proposing a new interpretation of this statutory provision under which the 1-psi waiver would apply to gasoline containing *at least* 10 percent ethanol.[55]

EPA attempts to redraft the clear statutory language by stating that the gasoline marketplace has changed since Congress enacted 211(h), citing alleged congressional intent, and positing policy goals that are not contained in the Clean Air Act. EPA summarized its rationale by alleging that:

> This proposed interpretation is consistent with the plain language of CAA sec. 211(h) and with Congress' intent to promote ethanol blending into gasoline, and is not expected to cause significant increases in emissions as compared to E10.[56]

But Congress, not EPA, chose specific language that was enacted in 1990. And Congress could have chosen to use the phrase "at least 10 percent" or "10 percent or more" in Section 211(h), but it did not do so. As explained in further detail below, Congress explicitly rejected statutory language that would have applied the 1 psi RVP waiver to fuel blends containing "at least" 10 percent ethanol. Thus, in rejecting this language, Congress deliberately chose to limit the waiver to blends containing 10 percent ethanol and no more.

Arguments that attempt to parse the statutory language of Section 211(h)(4) to suggest that EPA can grant a waiver for any fuel blend that contains more than 10 percent ethanol would render the "10 percent" limit essentially meaningless. Requiring only that a fuel blend contain *at least* 10 percent ethanol to benefit from the 1 psi RVP waiver would provide a level of discretion to EPA that is not supported by either the plain reading of the statute or common sense. Under this proposed reinterpreted reading, any fuel blend of gasoline and ethanol above 9% ethanol would qualify for a 1 psi waiver that Congress explicitly limited to "fuel blends containing gasoline and 10 percent denatured anhydrous ethanol," rendering the legislative language of Section 211(h)(4) almost null and void.[57]

Under EPA's proffered view of what "contain" means, a bottle of 80 proof Scotch would be said to "contain" 10 percent alcohol when clearly it contains (and is understood by the public to contain) far more. Just as no one would ever represent an 80-proof bottle of Scotch as "containing" 10 percent alcohol, a gasoline fuel retailer would never sell or be permitted to sell E15, E20 or E30 by claiming it contained 10 percent ethanol.

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[55] Proposed Rule at 10591.
[56] *Id.* at 10590.
[57] Section 211(h)(4) applies to "*fuel blends* containing gasoline and 10 percent denatured anhydrous ethanol" not specifically to gasoline containing 10 percent denatured anhydrous ethanol.

Congress knows how to use the phrase "at least," as that phrase is used nine times in Section 211, the very section at issue here. Altogether, the phrase "at least" is used 95 times in the Clean Air Act. But it is never used in Section 211(h).

EPA also posits that it can "read both the statutory 1-psi waiver provision and the 'deemed to comply' provision in CAA sec. 211(h)(4) together to limit the volume concentration of ethanol to between 9 and 10 percent, as only blends of gasoline and up to 10 percent ethanol had a waiver under CAA sec. 211(f)(4) at the time EPA promulgated the RVP requirements [in 1991]."[58] But in 1991, EPA was not acting under the authority that it used to previously establish volatility limits (Section 211(c)), rather it acted pursuant to entirely new authority enacted by Congress in 1990 (Section 211(h)). And Congress did not delegate EPA any authority to change the statutory language of Section 211(h). Congress did not "codify" EPA's previous volatility regulations; if it did so, it would have done so explicitly with reference to the pre-existing C.F.R. sections or Federal Register notices. EPA has no foundation on which to assert that Congress deferred to EPA's judgment both pre-and post-enactment of Section 211(h). Instead, after enactment of the 1990 Clean Air Act Amendments, EPA changed its regulations to specify that special provisions for alcohol blends, allowing an additional 1 psi RVP, applied *only* to gasoline blends that contained no less than 9% and no more than 10% ethanol.[59]

D. Congress Specifically Rejected EPA's Proposed Reinterpretation of Section 211(h)

As noted in more detail in the following section of these comments, EPA attempts to cite legislative history in support of its reinterpretation that the Section 211(h)(4) waiver can apply to fuel blends other than 9 to 10% ethanol. But EPA fails to explain the most relevant congressional action that bears on legislative intent in enacting Section 211(h) in 1990. Perhaps this is because Congress explicitly rejected the reinterpretation that EPA attempts to put forward in the Proposed Rule.

Specifically, when Congress amended the Clean Air Act to insert a new provision addressing fuel volatility, it took the following actions:

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[58] Proposed Rule at 10590.

[59] Prior to the enactment of the 1990 Clean Air Act Amendments, EPA regulations allowed for "special provisions for alcohol blends." In order to qualify for an additional 1.0 psi RVP, EPA specified that the "gasoline must contain at least 9% ethanol (by volume)." 40 C.F.R. 80.27(d)(2) (7-1-90 Edition; 7-1-91 Edition). After enactment of the 1990 Clean Air Act Amendments, EPA amended its regulations changing requirements for gasoline/ethanol blends that qualified for an additional 1.0 psi RVP. Specifically, EPA provided that "[i]n order to qualify for the special regulatory treatment . . . gasoline must contain denatured, anhydrous ethanol. The concentration of the ethanol, excluding the required denaturing agent, must be at least 9% and no more than 10% (by volume) of the gasoline." 40 C.F.R. 80.27(d)(2) (7-1-92 Edition).

- On April 4, 1990, the Senate approved S.1630 on a roll call vote. S. 1630 was the Senate version of the legislation that would ultimately become the Clean Air Act Amendments of 1990. S. 1630 contained Section 214, Fuel Volatility, which amended the Clean Air Act to insert at the end of Section 211, a new subsection 211(h).

- Section 214 of S. 1630 included a requirement for 9.0 psi RVP gasoline during "the high ozone period of each year" and also contained a waiver mechanism (in new section 211(h)(4)) which allowed for a 1.0 psi RVP waiver for "fuel blends containing gasoline and 10 per centum denatured anhydrous ethanol." This provision is nearly identical to the requirement contained in section 211(h)(4), as ultimately enacted by Congress in October 1990.

- On May 23, 1990, the House of Representatives passed their version of S. 1630 (based on H.R. 3030, the House-introduced Clean Air Act Amendments of 1990). This action cleared the way for appointment of a House-Senate conference committee to iron out differences between the two bills.

- The House bill as approved by that chamber included Sec. 216.[60] Section 216 similarly added a new Section 211(h) to the Clean Air Act addressing fuel volatility and also contained the 9.0 psi RVP requirement applying to gasoline during the high ozone season. The House bill also included a 1 psi waiver of the 9.0 psi RVP requirement (contained in subsection 211(h)(3)).

- But as opposed to the Senate bill, the House provision stated: "In establishing standards for fuel volatility under this subsection, the Administrator shall permit a 1.0 pound per square inch (psi) tolerance level for gasoline containing *at least 10 percent ethanol*." The House bill also included "deemed to comply" provisions within subsection 211(h)(3) that made relief available for gasoline containing "*at least 10 percent ethanol* . . ." (emphasis added).

- During the House-Senate conference on S. 1630, <u>the "at least" language included by the House was dropped (in both the waiver and the deemed to comply provisions)</u>. Congress then adopted legislative language based on the Senate version of the 1 psi RVP waiver limiting application of the 1 psi RVP waiver to fuel blends containing gasoline and 10 percent ethanol.[61]

- The current text of 211(h)(1)-(4) was thereafter agreed by the House and Senate in October 1990 and enacted into law on November 15, 1990 as Section 216 of the Clean

[60] *See* Attachment 2 (side-by-side comparison of House and Senate versions), *infra*.
[61] There were mostly minor technical changes to the Senate version of Section 211(h), but these have no bearing on the analysis of Congressional intent involving application of the 1 psi RVP waiver.

Air Act Amendments of 1990. The conference committee report (H. Rept. 101-952) included the current statutory language found in Clean Air Act Section 211(h)(1)-(4). The Joint Explanatory Statement of the Committee of Conference[62] did not further discuss fuel volatility or Section 216.

Thus, it is abundantly clear from the legislative history of Section 211(h) that Congress specifically and intentionally *rejected* statutory language ("at least") that EPA claims it has discretion to insert into the Clean Air Act. The House-Senate Conference Committee considered whether to apply the 1 psi RVP waiver to gasoline and ethanol fuel blends containing "at least" 10 percent ethanol and did not adopt this language, deferring to the Senate version of section 211(h)(4). This legislative history confirms EPA's nearly three-decade position that 211(h)(4) unambiguously limits the RVP waiver to E10 blends. EPA's new-found efforts to create legislative ambiguity are unavailing.

E. The Legislative History Cited by EPA Does Not Support EPA's Reinterpretation

EPA's prior interpretations (until the current, Proposed Rule) rested specifically on the terms of the statute and its legislative history, neither of which have changed since 1990 apart from the 2005 addition of Section 211(h)(5) – allowing states to opt-out of the 1 psi waiver.[63] Yet, in the Proposed Rule, EPA claims to have uncovered legislative history that now supports an entirely different view of its authority. This is ludicrous. For example, EPA cites as "legislative history" committee testimony by the President and CEO of the RFA.[64] First, this testimony actually supports viewing 10 percent ethanol as a "hard cap" for purposes of the 1 psi waiver. As Mr. Vaughn noted at the time, the "Clean Air Act itself . . . prohibits addition of more than 10 percent ethanol."[65] Second, portions of the testimony that EPA failed to cite make clear that Mr. Vaughn was advocating for the regulation of base gasoline as "the preferable control option for controlling the volatility of ethanol/gasoline blends."[66] In other words, the main point of his testimony was to control fuel volatility by regulating the refining and distribution industry and not the industry he represented or downstream gasoline/ethanol blenders. Mr. Vaughn was engaged in pure advocacy, not espousing Congressional intent. More importantly, EPA fails to note that the cited testimony occurred in 1987 and was directed to H.R. 3054, legislation that was never reported to the full House of Representatives, much less adopted into law. The hearing occurred approximately two years before the legislation that would become the 1990 Clean Air

[62] H.Rept. 101-952 at 3867-81.

[63] The Energy Policy Act of 2005 ("EPAct05"), Public Law 109-58, section 1501 subsection c.

[64] Proposed Rule at 10589 n. 43.

[65] *Id*. at 10589.

[66] Testimony of Eric Vaughn, Renewable Fuels Association, September 23, 1987, H.Rept. 100-129 at 365, 367. "Imposing the burden on the ethanol blending industry of testing the volatility of all blends – given that there does not now exist a field screening method, given the enormous number of samples which would have to be tested, and given the extremely high testing variations that now exist – makes absolutely no sense and provides no additional benefit to the environment . . . On the other hand, gasoline is generally manufactured in large quantities and transported by pipeline in large quantities. Each grade of gasoline is manufactured and distributed as a fungible commodity, and is routinely tested for RVP as well as other specifications." *Id*. at 367.

Act Amendments was introduced into Congress.[67] Thus, the testimony is irrelevant to determining Congressional meaning and intent of Section 211(h) as enacted in 1990.

EPA also ignores that Congress understood the limitations of ethanol when it enacted the RFS and took steps to limit the amount of ethanol in the marketplace to no more than 10 percent of the gasoline supply. The 2007 Energy Independence and Security Act, which substantially amended the original RFS, contained specific mandates for total renewable fuels and advanced biofuels, (*e.g.*, cellulosic biofuel and biomass-based diesel) through 2022. As EPA has acknowledged repeatedly in annual RFS rulemakings, the RFS contains an implied 15 billion gallon cap on the use of conventional biofuel (*i.e.*, corn starch ethanol).[68] This implied cap was intentional and stemmed from the expectation that corn starch ethanol would be blended into gasoline up to a limit of 10% based on EIA's 2007 Annual Energy Outlook.[69]

Thus, EPA is mistaken when it asserts that overall policy supports removing barriers to E15. Congress neither forecasted nor included E15 as a statutory goal within the RFS, the main vehicle in the Clean Air Act for the blending of ethanol into gasoline. Instead, legislative history subsequent to the enactment of the 1 psi RVP waiver shows precisely the opposite and is unsupportive of EPA's attempt to recast the purpose and effect of Section 211(h)(1).

F. Current Legislation Undercuts EPA's Argument on Authority to Extend Waiver

In addition to the plain meaning of the statute and EPA's prior interpretations, the proponents of extending the RVP waiver to E15 have also recognized limitations in the law and have repeatedly attempted to change it. Several bills were introduced in the 115th and 116th Congresses to remove the 10 percent cap on gasoline/ethanol blends that qualify for the 1 psi RVP waiver.[70] In effect, EPA's Proposed Rule is attempting to do through the regulatory process what Congress has recognized and debated as a legislative issue. For example, S.581, introduced on February 27, 2019, would amend Section 211(h)(4) to add "or more of" after the statutory language referring to "fuel blends containing gasoline and 10 percent." EPA's proposed "reinterpretation," which seeks to add "at least" at the same place in Section 211(h)(4), seeks a near-identical outcome.

These attempts to broaden the RVP 1-psi waiver have not succeeded. Yet they demonstrate that Congress currently considers that EPA lacks authority to extend the 1 psi RVP waiver beyond E10.

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[67] The cited testimony occurred on September 23, 1987. H.Rept. 100-129 at 364.
[68] *See, e.g.,* 83 Fed. Reg. at 63719. "Congressional intent is evident in the fact that the implied statutory volume requirement for convention renewable fuel is 15 billion gallons for all years after 2014 . . .".
[69] *See* AFPM Comments on 2017 RFS Proposal, July 11, 2016, EPA-HQ-OAR-2016-0004-1814.
[70] *See e.g.*, S.581, introduced February 27, 2019; S.3761, introduced December 17, 2018; S.517, introduced March 2, 2017; H.R. 1311, introduced March 2, 2017.

IV. EPA's Proposed Sub-Sim Interpretation is Contrary to Law

EPA compounds its error of expanding the 1 psi RVP waiver beyond the plain language of the statute by proposing an interpretive rulemaking that defines gasoline blended with up to 15 percent ethanol as "substantially similar" to the fuel used to certify Tier 3 motor vehicles, circumventing both sections 211(f)(1) and 211(f)(4).[71] This is nothing more than an "end-run" around critically important Clean Air Act provisions explicitly designed to ensure that new fuels are backward compatible and capable of working in all engines and vehicles.

To accomplish this end, EPA proposes a novel interpretation of the Clean Air Act with only cursory analysis of its effect on mobile source emissions (which analysis, in any case, does not support the proposed action but shows emission *increases*). So, the question that must be asked at this point is why? Why would EPA propose a novel interpretation of its sub-sim authority to accompany its unprecedented reinterpretation of the 1 psi RVP waiver? As EPA has stated, its overall objective is to allow E15 to "*take advantage* of the 1-psi [RVP] waiver that currently applies to E10 during the summer months."[72] But this goal simply cannot be squared with the Clean Air Act.[73] EPA's interpretation flies in the face of nearly 40 years of prior statutory interpretations for which EPA has provided no reasoned explanation.

A. EPA's Various Proposed Sub Sim Determinations Are at Variance with Clear Statutory Language

In assessing EPA's new interpretations of its sub sim authority in Section 211(f), the history of EPA's consideration of gasoline/ethanol blends pursuant to this authority is instructive. First, EPA never affirmatively determined that E10 was sub sim to E0. Instead, 40 years ago, a petition to EPA regarding E10 was granted by operation of law because the EPA Administrator failed to act (either affirmatively or negatively) within 180 days.[74] Nor has EPA ever sought to determine that E15 is sub sim to either E0 or E10. In 2010 and 2011, EPA granted "partial waivers" for the use of E15 in certain on-road vehicles pursuant to Clean Air Act Section 211(f)(4) based on a determination that E15 would not cause or contribute to the failure of certain Model Year 2001 and new vehicles to achieve compliance with emission standards.[75] Courts have never ruled on the merits of these waivers.[76] But clearly, E15 is not sub sim to either E0 or E10, because it cannot function as a "drop-in" replacement fuel.

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[71] Comments that follow adopt the commonly used term "sub sim" to refer to the statutory "substantially similar" requirement.

[72] EPA Rule Summary, accessed at: https://www.epa.gov/renewable-fuel-standard-program/notice-proposed-rulemaking-modifications-fuel-regulations-provide (emphasis added).

[73] Among the purposes of the Clean Air Act is the directive to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population. Clean Air Act Section 101(b)(1).

[74] 44 Fed. Reg. 20777 (April 6, 1979).

[75] 75 Fed. Reg. 68094 (Nov. 2, 2010); 76 Fed. Reg. 4664 (Jan 26, 2011)

[76] *Grocery Manufacturers Association v. EPA*, 693 F.3d 169, 180 (D.C. Cir. 2012) (Dismissing claims for lack of standing).

But in the rush to finalize a rule on RVP prior to the start of the summer driving season, EPA is now proposing two alternative interpretations. First, EPA is proposing that E15 with an RVP of 10.0 psi is sub sim to E10 with an RVP of 9.0.[77] Alternatively, EPA is taking comment on whether E15 with an RVP of 9.0 is sub sim to E10 with an RVP of 9.0.[78] The effect of the first determination would be to make it legal to introduce E15 into commerce without the restrictions imposed by the partial waivers EPA previously granted.[79] EPA states that

> [o]ne implication of a sub sim interpretation that includes E15 under CAA sec. 211(f)(4) would be that a waiver under CAA sec. 211(f)(4) will no longer be necessary for E15 to be introduced into commerce . . . This would mean that the conditions in the E15 partial waivers designed to limit the introduction into commerce of E15 to only MY 2001 and newer light duty vehicles would not apply.[80]

The effect of the second determination (*i.e*., determining that E15 with an RVP of 9.0 is substantially similar to E10 with an RVP of 9.0) is less clear from the description provided in the Proposed Rule. EPA indicates that the prohibitions in EPA's partial waivers (applicable to MY 2000 vehicles and earlier) would remain in place as well as requirements for fuel manufacturers to comply with MMR requirements.[81] But EPA also claims that this interpretation (in conjunction with its revised interpretation of CAA Section 211(h)(4)) "would allow all fuel manufacturers, not only downstream oxygenate blenders the ability to lawfully introduce E15 at 10.0 psi RVP from May 1 through September 15."[82]

EPA is claiming it has the authority to overturn the Section 211(f)(4) waiver conditions that it put in place in 2010 and 2011 on the basis of new interpretations of its statutory authority under Section 211(f)(1) and/or Section 211(h)(4).[83] But to the extent that EPA is claiming that a new sub sim determination can void or override a previous Section 211(f)(4) waiver determination, EPA has not explained why the determinations it made in 2010 and 2011 regarding partial waivers for E15 are no longer applicable or relevant. To the extent EPA claims that extending fuel volatility restrictions through 211(h)(4) can "override" a restriction placed on the introduction of E15, the Agency also has not sufficiently articulated its authority, much less provided a reasoned basis for departing from its prior interpretation.

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[77] EPA proposes to make this determination despite its earlier finding that E15 would not lead to violation of RVP standards as long as its RVP did not exceed 9.0 psi. *See, e.g.,*75 Fed. Reg. at 68096

[78] Proposed Rule at 10586.

[79] EPA does propose to retain some restrictions contained in a separate rule, the E15 Misfueling Mitigation Rule ("MMR"), although it also proposes modifications related to product transfer documents. *Id.* at 10585.

[80] *Id.* at 10602.

[81] *Id.* at 10596. Elsewhere, EPA cites CAA Section 211(c) as authority for misfueling provisions, but it is not clear from the text of the Preamble that this is the basis for EPA's assertion.

[82] *Id.*

[83] As we detail later, this means that EPA has reopened the 2010 and 2011 partial waiver determinations.

The current partial Section 211(f)(4) waivers contain several conditions.[84] These conditions: (a) specify that ethanol used must meet ASTM specifications; (b) require final fuel to not have an RVP in excess of 9.0 psi from May 1 to September 15; and (c) require that fuel and fuel additive manufacturers submit plans to EPA concerning their introduction of the fuel or fuel additive into commerce. Required plans must contain reasonable precautions to ensure that fuel and fuel additives are only introduced into commerce for specific Model Year vehicles covered by EPA's partial waivers. These plans must also include reasonable measures for labeling of retail fuel pump dispensers incorporating details of the partial waivers and informing consumers that Federal law prohibits the use of fuel in vehicles and engines not covered by the partial waivers. Consumers must also be warned that using E15 in other vehicles and engines might cause damage. Waiver conditions additionally contain requirements related to product transfer documents to ensure ethanol content is properly documented and require participation in a "survey of compliance" at fuel retail dispensing facilities. Failure to meet any condition of the partial waivers means that the fuel or fuel additive is not covered by a waiver and therefore illegal to sell, dispense or distribute among other actions.[85]

As noted above, the effect of EPA's proposed sub sim determination would be to eliminate or substantially revise these conditions. EPA is also specifically proposing that downstream parties (parties other than refiners and importers) would not be subject to the 2010 and 2011 waiver conditions.[86] And while EPA notes that some conditions have parallel restrictions in 40 C.F.R. part 80, Subpart N (addressing misfueling) these restrictions are not co-extensive. EPA indicates that it is seeking comment on "certain limitations" that are currently part of the partial (f)(4) waiver conditions that could be part of a interpretative sub sim rulemaking,[87] but it provides insufficient detail as to which limitations it may consider or how it would consider the same to apply in the context of a determination that E15 is sub sim to E10.

1. EPA's Proposed Actions Violate the Plain Meaning and Intent of Section 211(f)

a. EPA Lacks Authority to Add "Conditions" to Sub Sim Determinations

EPA posits that CAA Section 211(f)(1) authorizes "EPA to apply restrictions on a sub sim determination, where the restrictions are intended to avoid the kinds of problems that prompted the prohibition against introduction into commerce."[88] The intent of this interpretation appears to be to allow EPA to retain some of the restrictions currently applied through the Agency's Section 211(f)(4) partial waiver determinations, which EPA otherwise seeks to void or substantially restrict on the basis of its proposed sub sim determination.

While AFPM supports retaining current Section 211(f)(4) waiver conditions (even while it continues to dispute EPA's legal ability to promulgate partial waivers), AFPM strongly disagrees

[84] *See* 75 Fed. Reg. at 68149.
[85] A full list of all conditions may be found at 75 Fed. Reg. 68149-50 and 76 Fed. Reg. at 4682-3.
[86] Proposed Rule at 10593. EPA indicates that "downstream parties are not similarly bound."
[87] Proposed Rule at 10602.
[88] *Id*.

that EPA has authority to apply restrictions or otherwise impose conditions regarding a sub sim determination.

First, imposing conditions on a sub sim determination undermines the very purpose of the CAA's sub sim provisions, which is intended to ensure that fuel introduced into the U.S. market is completely backward compatible with vehicles produced since 1975. Specifically, EPA's proposed sub sim determination turns its back on millions of gasoline powered vehicles that were previously certified on Indolene, or E0. In 2017, the first year that use of E10 as a certification fuel was provided for in the Tier 3 rule, there were more than 270 million light duty vehicles on the road. EPA's proposed sub sim determination cannot simply ignore these vehicles. Instead, EPA must exercise its sub sim authority with reference to its overall purpose of fuel and vehicle certification requirements; EPA must ensure continued compliance of engines and vehicles with standards to which they were initially certified.

Second, there is no statutory language authorizing the addition of conditions to a sub sim determination and EPA cites none. The statutory prohibition on introduction into commerce provides that a fuel or fuel additive must be "substantially similar" to any fuel or fuel additive "for general use."[89] Therefore, just as AFPM and other parties objected to EPA's claimed authority to grant conditional waivers pursuant to CAA Section 211(f)(4), objections that we are attaching to these comments (Attachments 3-7), we maintain that EPA lacks authority to grant restrictive or conditional sub sim determinations.

Finally, EPA's proposal to include a series of restrictions on its sub sim determination is inapposite to its proposed determination that either E15 with 9.0 or 10.0 psi RVP is sub sim to E10 at 9.0 psi RVP. EPA has proposed to determine that E15 is sub sim to E10 and thus may be introduced into commerce since (allegedly) E15 does not significantly affect exhaust emissions, evaporative emissions, materials compatibility or driveability.[90] Yet in the same action, EPA is proposing that it can avoid the negative effects of using E15 through retaining some or all of these very same restrictions -- at either the wholesale/retail level or at these levels *and* the fuel manufacturer level. In other words, EPA's proposed interpretation allowing for a conditional sub sim determination is ironically and counterintuitively designed to help *avoid* the very same problems that EPA creates by promulgating the new interpretation.[91] This is nothing more than an admission that sub sim is not appropriate for E15.

b. EPA Cannot Determine E15 Is Sub Sim to Only One Certification Fuel

In evaluating whether E15 is substantially similar to gasoline, EPA ignores the plain meaning of Clean Air Act section 211(f)(1) by failing to compare E15 to E0. Clean Air Act section 211(f)(1) makes it unlawful to:

[89] CAA Section 211(f)(1)(A).
[90] Proposed Rule at 10598-10601.
[91] *Id*. at 10602.

> introduce any fuel or fuel additive . . . [or] to increase the concentration in use of, any fuel or fuel additives for general use in light duty motor vehicles . . . which is not substantially similar to any fuel or fuel additive utilized in the certification of any model year 1975, or subsequent model year, vehicle or engine under section 206.[92]

EPA has not proposed to determine that E15 is substantially similar to E0, which was used in the certification of hundreds of millions of light duty motor vehicles prior to the Tier 3 rule.[93] EPA's Proposed Rule analyzes only the emission impacts of E15 blends in comparison to E10 certification or market fuel at 9 or 10 psi.[94] Therefore, since EPA did not examine or make a determination that E15 was substantially similar to "any fuel" (*i.e*., E0) used in the certification of "any model year 1975, or subsequent model year, vehicle" (*i.e*., pre-Tier 3 certified light duty vehicles and a portion of Tier 3 certified vehicles), EPA's proposed sub sim determinations for E15 are unlawful.

Clean Air Act Section 211(f)(1) does not authorize EPA to make a sub sim determination with respect to just one fuel that is used in the certification of light duty vehicles; it explicitly says "any fuel." When conjoined with a reference to "any vehicle," this means that EPA must examine all fuels used in the certification of light duty vehicles, not just the vehicles that may have been certified to date using E10. As EPA notes, certification on E10 began only recently (Model Year ("MY") 2017) and most manufacturers are not required to certify on E10 until MY 2022.[95] Thus, to date, only a small minority of vehicles in-use have been certified on E10, the basis on which EPA proposes to make a sub sim determination for E15.

That the sub-sim determination must be made broadly with regard to the existing population of light duty vehicles is a natural reading of Section 211(f)(1) and one that EPA previously adopted. It is also firmly rooted in important policy objectives of the Clean Air Act's mobile source program: it is necessary to ensure the "backwards compatibility" of new fuels and fuel blends with respect to in-use vehicles. In litigation concerning the Tier 3 rule, EPA summarized the statutory background and purposes of the sub sim provision:

> To ensure that vehicles in fact achieve emission reductions throughout their useful lives, Congress prohibited the sale of any fuel or fuel additive for motor vehicles "which is not substantially similar to any fuel or fuel additive utilized in the certification of any model year 1975, or subsequent model year, vehicle or engine under section 7525 of this title." 42 U.S.C. §7545(f)(1)(B). In general, this CAA provision – sometimes called the "sub-sim" provision – is designed to ensure that vehicles on the roadways will be running on fuels that are "substantially similar" to the test fuel used for certification, so that vehicles will

[92] CAA Section 211(f)(1)(A).
[93] Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards, 79 Fed. Reg. 23414 (Apr. 28, 2014).
[94] Proposed Rule at 10604, Table II.E-1.
[95] *Id.* at 10596, n. 91.

continue to meet their emission standards throughout their useful lives while using the in-use fuel.[96]

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Among other things, EPA's emissions program is designed to ensure that testing at the time of vehicle certification accurately reflects the vehicle's performance under actual driving conditions. 79 Fed. Reg. 23,421 (stated goal of "making test fuel more representative of expected realworld fuel"). The mobile source program would not function as Congress intended unless, when EPA certifies that a vehicle meets applicable emission standards, there is reasonable assurance that the vehicle will actually do so when driven on the Nation's roadways. This is how EPA's program prevents vehicles from contributing to excessive air pollution.[97]

These concerns also were reflected by EPA in 2010 when the Agency rejected a request to "modify its substantially similar interpretative rule under CAA Section 211(f)(1) and allow higher oxygenate content, thus allowing for the introduction of E12 into the marketplace without the need for a waiver."[98] In evaluating this sub sim request based on comparing E12 to E10, EPA reiterated that it considered "all certification fuels used for the broad range of motor vehicle years, not just the current model years, and considered both the exhaust and evaporative emissions certification procedures. This is because the 'substantially similar' definition affects roughly 300 million motor vehicles which represent thousands of different designs by a wide range of manufacturers from around the world. These motor vehicles are in the transportation system and the marketplace affects the entire country."[99] EPA also relied on the fact that E10 was not then a certification fuel for purposes of emissions testing and therefore "E10 play[ed] a limited role in the certification process for a limited subset of motor vehicles."[100] While the status of E10 as a certification fuel has now changed, the broader considerations that EPA reviewed in 2010 have not: the vast majority of current vehicles were certified on E0 and remain on the road and EPA must assess the sub sim request with respect to the broad inventory of in-use gasoline-powered vehicles, not the small minority of new vehicles that may have been certified using E10.

An alternative interpretation – that EPA may just pick "any fuel" used in a prior certification as the basis for a sub sim comparison – makes no sense. For example, it would be illogical to pick a fuel used for the certification of 100,000 cars (*e.g.,* fuel B) and then declare this fuel as the basis for a sub sim determination for another new fuel (*e.g.*, fuel C) when there were 100 million cars on the road that had been certified for emissions on a different fuel (fuel A). In other words, it could not be assumed that fuel C was sub sim to fuel A (on the basis of comparing fuel A to fuel

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[96] *Energy Future Coalition v. EPA*, D.C. Circuit No. 14-1123, Brief for Respondents United States Environmental Protection Agency and Gina McCarthy, February 11, 2015 at 7.
[97] *Id*. at 39.
[98] 75 Fed. Reg. 68138 (Nov. 4, 2010).
[99] 75 Fed. Reg. at 68143.
[100] *Id.*

B) or that the emissions performance of cars certified on fuel A would be the same when using fuel C. Yet this is what EPA is proposing with respect to E15.

Again, the overall objective of the sub sim requirement is to help ensure that new *and existing* vehicles (which are always much more prevalent in the vehicle population) have available and utilize the same fuel (or a substantially similar fuel) to what they were certified. An alternative interpretation of "any" could lead to the absurd result that sub sim determinations could be "stair-stepped" with each newly approved certification fuel serving as the basis for a sub sim determination for another new fuel regardless of how many vehicles on the road were designed for and tested on that fuel or how many incremental differences occurred as between different fuels. Several sub sim determinations could compound to create large compositional differences between fuels over time. This may be the result that advocates for E30, E40 or E50 are looking for, but it is not supported in legislative text, legislative history or decades of EPA interpretation.

2. EPA Cannot "Link" Sub Sim Determination with a New Interpretation of Section 211(h)

EPA indicates that "under CAA sec. 211(f)(1) we only need to determine that E15 at 9.0 psi RVP is sub sim to Tier 3 certification fuel at 9.0 psi RVP in order for fuel manufacturers and downstream parties to take advantage of the CAA sec. 211(h)(4) waiver."[101] EPA further indicates that its new interpretation of sub sim "would make it lawful for refiners and importers to make and introduce into commerce E15 without the use of the E15 partial waivers."[102] That is, it appears that EPA is proposing a new interpretation of its CAA Section 211 authority that would allow a sub sim determination to "incorporate" the 1 psi waiver under CAA 211(h)(4). As EPA claims, "the proposed interpretation of 'substantially similar' in conjunction with the proposed interpretation of CAA sec. 211(h)(4) would also extend the . . . upper RVP limit from 9.0 to 10.0 psi for fuels containing 9-15 percent ethanol."[103]

There are at least two "consequences" from this interpretation. First, EPA believes that reading the two authorities together releases all downstream parties from the restrictions imposed on fuel volatility and may allow for future circumvention of limits imposed by Section 211(f)(4) waivers. Specifically, EPA proposes that the "deemed to comply" provision in Section 211(h)(4) "could not apply where the agency concludes that a fuel is substantially similar to certification fuels, under CAA Section 211(f)(1)."[104] EPA suggests that this reading could allow for fuels "that do not have a CAA sec. 211(f)(4) waiver, but *nonetheless can be introduced into commerce because they are substantially similar* to Tier 3 E10 certification fuel."[105]

It is unclear precisely what EPA's intent is with respect to this proposed interpretation. But EPA appears to suggest that fuels that do not have a CAA Section 211(f)(4) waiver – for example, E20 – "nonetheless can be introduced into commerce" if they are considered to be substantially

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[101] Proposed Rule at 10600.
[102] *Id*. at 10601.
[103] *Id.*
[104] *Id*.
[105] *Id*. (emphasis added).

similar to Tier 3 E10 certification fuel. But if this is what EPA is suggesting, then it is completely at odds with the function of both CAA Section (f)(1) and (f)(4) and the overall intent of these two provisions to provide for "backwards compatibility" of fuel for in-use vehicles. Under EPA's interpretation, fuels without a Section 211(f)(4) waiver could end run an Agency evaluation of their effect on "any emission control device or system" by positing that they were substantially similar to E10 or other certification fuels. This apparently would be the case even if, as here, EPA had previously determined that use of E15 cannot be allowed in any MY 2001 or earlier light duty vehicle, any medium or heavy duty vehicle or any gasoline-powered equipment. Even while AFPM disagrees that EPA has the legal authority to grant partial waivers under CAA Section 211(f)(4), this interpretation would render Section 211(f)(4) meaningless.

Second, EPA indicates that this interpretation would allow fuel manufacturers, refiners, and importers to take advantage of the 1 psi waiver. That is, under the Proposed Rule, EPA indicates that if the Agency only finalizes its proposed interpretation of CAA Section 211(h)(4) without also adopting this sub sim interpretation, only downstream parties would be able to "take advantage of the 1 psi waiver."[106] EPA would "[maintain] all of the CAA sec. 211(f)(4) waiver conditions for E15 as they currently apply to fuel and fuel additive manufacturers."[107] The same restrictions would not apply to downstream oxygenate blenders or retailers who made E15 with gasoline/blends for oxygenate blending, but would potentially apply to retailers who made E15 using "something other than gasoline/BOB."[108]

The problem with any of the interpretations that EPA advances with regard to CAA Sections 211(f) and (h) is that the statutory link between the two Sections relates only to the "deemed to comply" language in Section 211(h)(4). There is no direct linkage between the 1 psi waiver provision (in the first part of Section 211(h)(4)) with the proviso contained in Section 211(f)(4). Second, the tests for sub sim and Section 211(f)(4) waivers are different. While EPA has not defined sub sim, it has not indicated that a sub sim determination must look to the specific factors outlined in Section 211(f)(4) for granting of a waiver (*i.e.*, that the fuel or fuel additive will not cause or contribute the failure of emission control devices or systems). In short, Congress approved two different provisions and did not intend that one (Section 211(h)(4) be used to short-circuit the applicability of another (Section 211(f)(4)).

3. EPA's Proposed Actions Are Arbitrary and Capricious

a. The Administrative Record is Deficient with Regard to Emissions Effects

Even if EPA had legal authority to determine E15 is sub sim, the administrative record for the Proposed Rule is insufficient to support EPA's proposed alternative determinations. EPA purports to examine four criteria: exhaust emissions, evaporative emissions, materials compatibility, and driveability.

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106 *Id*.
107 *Id*. at 10593.
108 *Id*. at 10595-6.

With respect to effects on air quality, studies that EPA evaluated show that there were substantial increases (21%) in the emissions of particulate matter ("PM") when vehicles were fueled with E10 versus E0 and that this increase in PM emissions was exacerbated the more ethanol is blended into gasoline. On top of the initial 21% increase in PM caused by E10, EPA predicted that there would be an additional 10% increase in PM emissions when vehicles begin fueling with E15.[109] EPA also determined that new technology vehicles "may be more sensitive for PM."[110] In other words, rather than realize emission improvements from the combination of Tier 3 fuel and new technology vehicles, EPA's Proposed Rule would actually have the opposite effect for such emissions. This fact should be sufficient to bar a sub sim determination for E15.

EPA additionally indicates that, while there are difficulties in interpreting available data, one consistent factor between Tier 2 and Tier 3 vehicles is that using higher ethanol blends creates more NOx.[111] EPA glosses over these negative effects when applying its stated criteria for sub sim determinations. EPA notes only that it "believe[s] that the small changes from E15 relative to Tier 3 E10 certification fuel are within the scope of what we have determined to be sub sim in our prior sub sim interpretative rulemakings."[112] EPA also attempts to rely on the administrative record for the 2010 and 2011 partial waiver determinations for E15. But EPA makes no attempt at quantification (simply stating that the effects are "too small" to matter) and simply asserts that its determination in the Proposed Rule is within the scope of prior determinations (again, with no quantification or assessment of the potential negative impact of increased NOx emissions). Here again, the increase in NOx emissions ordinarily would be sufficient to prevent a sub sim determination. And comments EPA received during its consideration of the 2010 and 2011 partial waivers for E15 pointed to multiple negative effects of moving to higher concentrations of ethanol.[113]

EPA's assessment is insufficient to support its conclusion regarding sub sim and ignores the fact that EPA's sub sim determination would remove the very conditions (regarding unacceptability of E15 for pre-MY 2001 light duty vehicles, all medium and heavy duty vehicles and all nonroad vehicles and equipment) that previously were considered essential to avoid negative effects on public health and the environment.

With regard to evaporative emissions, EPA adopts a similar approach of not conducting additional studies, but relying on reviews made during the Tier 3 rule or earlier. EPA indicates that it only needs "to determine that E15 at 9.0 psi RVP is sub sim to Tier 3 certification fuel at 9.0 psi RVP in order for fuel manufacturers and downstream parties to take advantage of the CAA sec. 211(h)(4) waiver."[114] In other words, EPA believes it can sequence its statutory

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[109] Proposed Rule at 10598, citing 2017 and 2018 studies performed by the Southwest Research Institute.
[110] *Id*. at 10599.
[111] *Id*.
[112] *Id*.
[113] Comments EPA received from the Alliance of Automobile Manufacturers, the Association of International Automobile Manufacturers, the Alliance for a Safe Alternative Fuels Environment and the Outdoor Power Equipment Institute and the National Marine Manufacturers Association are included in Attachments 4-7, *infra.*
[114] Proposed Rule at 10600.

authority to make a comparison as between two 9.0 RVP fuels for purposes of sub sim even while, in the same action, it is proposing to allow a 1 psi RVP waiver that would raise the actual, in-use volatility level to 10.0 RVP for E15. This would ignore any real-world aspects of the different fuels.

It is conceivable that this insufficient analysis was all that was possible in the face of EPA's desire to finalize a rule prior to the 2019 summer driving season but the analysis and supporting documentation fall far short of conforming to the requirements of the Clean Air Act.

b. EPA's Proposed Changes to Prior Interpretations Lack Reasoned Explanation

EPA's rationale for changing its interpretation of sub sim flies in the face of previous Agency interpretations, without explanation. At least parts of EPA's rationale appear to be directly drawn from legal memoranda submitted to the Agency by Growth Energy.[115] In previous interpretations of sub sim authority, EPA has explained that:

> Congress intended only to include as "substantially similar" those fuels chemically and physically similar to fuels used in certification, recognizing that other fuels could potentially be shown not to cause vehicles to fail to meet emission standards. Thus, in general, the fact that EPA has granted a waiver for a fuel does not by itself bring that substance within the definition of "substantially similar." Conversely, any fuel or fuel additive not substantially similar to one used in the certification process is nonetheless eligible for a waiver, if the statutory prerequisites are met.[116]

When EPA raised the level of oxygenates in gasoline considered to be sub sim in 1981, it indicated that Section 211(f)(4) waivers would be needed for further increases.[117] And EPA relied on Section 211(f)(4) – not Section 211(f)(1) -- when it allowed higher ethanol blends for certain vehicles in 2010 and 2011, explicitly rejecting a request to consider E12 as sub sim. In the Proposed Rule, however, EPA eschews any reliance on Section 211(f)(4) or any need to examine the effect of E15 on "any emission control device or system (over the useful life of the motor vehicle, motor vehicle engine, nonroad engine or nonroad vehicle in which such device or system is used."[118] But EPA fails to explain how utilization of its Section 211(f)(1) authority is

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[115] Growth Energy and Renewable Fuels Association memorandum on sub sim, EPA-HQ-OAR-2018-0775-0064. This memorandum argues that "EPA can and should issue a new interpretation for what is 'substantially similar' to gasoline currently used in certification of light duty vehicles . . . (s)uch a definition of 'sub sim' would encompass a blend of gasoline with 15 percent ethanol by volume ('E15'), which as a result would not require a waiver under Section 211(f)(4)." *Id.* at 1. The memorandum also cites a study (the "UCR" Study) which EPA also cites at 84 Fed. Reg. 10599, n. 111. The authors of the study acknowledge funding from Growth Energy. *See* Final Report Impacts of Aromatics and Ethanol Content on Exhaust Emissions from Gasoline Direct Injection (GDI) Engines, Dr. Karavalakis et al., April 2018, EPA-HQ-OAR-2018-0775-0034.
[116] 46 Fed. Reg. 38582, 38583 (July 28, 1981).
[117] 56 Fed. Reg. 5352, 5355 (Feb. 11, 1991).
[118] CAA Section 211(f)(4).

justified when it previously determined that E15 should only be approved conditionally for a limited subset of vehicles pursuant to Section 211(f)(4), especially where it attempts to put forth novel interpretations in an attempt to retain at least some of these conditions.[119] This lack of explanation is especially troubling since ethanol advocates claim that if EPA revises its interpretation of Section 211(h)(4) (to extend the 1 psi waiver to E15), the Agency will have effectively undermined the rational basis for such mitigation measures.[120]

Second, EPA has failed to adequately consider whether the use of E15 at 10 psi RVP will adversely affect emissions – versus the status quo ante – namely, the current requirement that E15 meet 9.0 psi RVP. EPA claims that "the underlying basis of the [sub sim] interpretation is that fuels and fuel additives herein determined to be 'substantially similar' will not adversely affect emissions."[121] But if EPA does not finalize the Proposed Rule and more E15 was utilized under the current 211(f)(4)waivers -- reflecting what ethanol advocates claim is a growing market demand for this fuel -- then E15 would be forced to comply with 9.0 psi RVP and displace current E10 sales that are occurring at 10 RVP, resulting in emission *decreases*.

EPA has acknowledged the impact of lower RVP. The Agency straightforwardly admits that that "[r]efueling, diurnal, and running loss evaporative emissions increase as fuel volatility increases, with gasoline with an RVP of 10.0 psi producing significantly more vapor for the evaporative emission controls system to capture and purge through the engine than gasoline with an RVP of 9.0."[122] In past years, EPA has also taken numerous enforcement actions for exceedance of gasoline volatility standards, often by amounts far less than a 1.0 RVP increase.[123] But EPA somehow ignores these potential emission benefits from *not finalizing* the Proposed Rule and retaining 9.0 psi RVP for E15. If, as Growth Energy claims, E15 is a growing market,[124] then EPA's actions to lower emission standards that now apply to the fuel will not allow this emission benefit from E15 to be realized. This result is both counterintuitive to the Clean Air Act and counterproductive to decreasing mobile source emissions.

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[119] EPA posits that it can apply restrictions on a sub sim determination even while determining that a fuel is sub sim to a fuel that does not have such restrictions. Proposed Rule at 10602.
[120] Growth Energy and Renewable Fuels Association maintain that when EPA "supersedes the RVP condition of the partial waiver decisions and changes its reading of 211(h), [the] RVP-related provisions of the Misfueling Rule will lack any rational basis." Growth Energy memorandum regarding RVP Restrictions on E15 of EPA's 2011 Misfueling Rule, EPA-HQ-OAR-2018-0775-0065.
[121] 45 Fed. Reg. at 67445. *Note* that Growth Energy quotes other parts of the 1980 determination for the proposition that sub sim "does not directly address the emissions effects of the use of the fuel or fuel additive." Growth Energy sub sim memorandum at 8. But this selective quotation omits EPA's view that Congressional expectation was that using sub sim fuels and fuel additives would not adversely affect emissions.
[122] Proposed Rule at 10599.
[123] *See, e.g.*, https://www.epa.gov/sites/production/files/2018-01/documents/alonusalp-cafo.pdf. Enforcement action related to RVP gasoline exceeding 9.0 psi standard by 0.06 to 0.14 psi.
[124] The Renewable Fuels Association claims that E15 is now sold at over 1,700 nationwide and that 8 billion miles have been driven using E15. *See* https://growthenergy.org/policy-priorities/yearrounde15/?gclid=EAIaIQobChMInOydsObk4QIVl4-zCh1ncAiFEAAYASAAEgLabfD_BwE

At bottom, in the context of its Proposed Rule, EPA fails to analyze what emission benefits *will be lost* from abandoning the 9.0 psi RVP standard for E15. This not only fails to provide a rational basis for the proposed action, but makes such action arbitrary and capricious.

4. The Proposed Rule Reopens 2010 and 2011 E15 Waivers

EPA's Proposed Rule – despite claims to the contrary – has reopened EPA's 2010 and 2011 211(f)(4) partial waiver determinations. Specifically, EPA is proposing to maintain current CAA Section (f)(4) waiver conditions as they apply to fuel and fuel additive manufacturers, but at the same time in a regulatory sleight of hand also proposes to determine, through its sub sim determination, that "such waiver conditions would no longer apply . . ."[125] Attempts to shift attention to including "certain limitations"[126] within the new interpretation are unavailing. EPA's Proposed Rule clearly affects – and directly takes comment on – the 2010 and 2011 Section (f)(4) waiver conditions. By doing so, EPA has reopened the 2010 and 2011 waivers.

But EPA cannot eviscerate determinations previously made under one subsection (*i.e.*, Section 211(f)(4)) and then claim to have not impacted these determinations simply because it relied on authority under another subsection (*i.e.*, Section 211(f)(1)) to accomplish this feat. And EPA makes it manifestly clear this is the Agency's intent by claiming that it may act to re- impose certain conditions previously implemented under the 2010 and 2011 partial waivers using its authority under Section 211(f)(1).[127] In plain terms, EPA is proposing to strike all Section 211(f)(4) conditions and replace these conditions with other conditions. Simply put, EPA is proposing to amend the 2010 and 2011 partial waivers.

This interpretation is further reinforced when one considers that the two statutory authorities involved are located within the same Clean Air Act section, one limiting new fuels to those that are substantially similar (subsection (f)(1)) and the other provision (subsection (f)(4)) providing an exemption to the broader sub sim mandate. Not only does it violate traditional rules of statutory interpretation, but it defies common sense to claim that Section (f)(4) is unaffected by EPA's proposed reinterpretation of sub sim. Nor can EPA maintain that the 2010 and 2011 waivers remain "on the books" and legally effective while it acts to severely limit the scope of these waivers in practice (with the goal of promoting more ethanol sales).

In response to EPA's reopening of the 2010 and 2011 Section 211(f)(4) waiver determinations, AFPM is including and incorporating by reference, as Attachment 3 *infra*, comments it filed with respect to EPA's consideration of these partial waivers.[128] The thrust of these comments is that EPA lacks the legal authority to grant partial 211(f) waivers.

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[125] Proposed Rule at 10593, n. 76.
[126] *Id*. at 10602.
[127] *See* Section II.C.6(c) of the Proposed Rule, "Potential Conditions As Part of CAA sec. (f)(1)(A) Interpretative Rulemaking," Proposed Rule at 10602/3.
[128] *See* EPA-HQ-OAR-2009-0211-2550. At the time these comments were filed, AFPM was known as the National Petrochemical & Refiners Association.

As explained above, EPA lacks authority to reinterpret Section 211(f) to allow E15 to be considered substantially similar to either E10 or E0 or to add "certain limitations" or conditions to its sub sim determination. Furthermore, EPA has not provided data to support such a determination. But if EPA nonetheless proceeds with either of its proposed sub sim determinations, it would be inappropriate to extend its sub sim determination beyond Tier 3 vehicles that have actually been certified for emissions utilizing E10 fuel. A partial sub sim determination for E15 should not extend to Tier 2 vehicles that were certified using E0. Again, AFPM strongly disputes both EPA's legal authority and rationale for interpreting sub sim to apply to E15 and for imposing conditions on any determination, but the Agency should not compound this error by ignoring emissions testing that closely corresponds to real world emissions. This means that any sub sim determination for E15 must ensure that E15 is used only in vehicles that have actually undergone emissions testing on the certification fuel that most closely resembles E15, *i.e.*, E10.

V. Subsection 211(f)(4) Cannot Be Used to Allow a 1 PSI Waiver for Blends Above 10%

Biofuel producers have argued that the "deemed to comply" provisions in Section 211(h)(4) (that apply to distributors and other downstream parties) means that "any applicable waiver condition under 211(f)(4) imposes a ceiling on the ethanol concentrations eligible for compliance defense."[129] Under this interpretation, "the RVP allowance under 211(h)(4) [extends] to *all* blends containing ten percent ethanol, including blends containing more than that concentration."[130] Therefore, under this theory, the current waivers for E15 could be considered sufficient to extend a 1 psi RVP waiver to that fuel and, if the EPA were to grant future Section 211(f)(4) waivers for gasoline/ethanol blends above 15%, the 1 psi RVP waiver would also automatically apply to such blends.

EPA appears to have adopted this interpretation (originally put forth by ethanol producers in February 2018) in the Proposed Rule. Specifically, EPA states that:

> Congress contemplated that ethanol content may increase in the future, that parties would likely apply for an 211(f)(4) waiver for those higher blends, that the 211(h)(4) waiver would apply to these fuels, and that the 211(h)(4) "deemed to comply" provision would also apply.[131]

It is significant that EPA provides no citation for this string of conjecture. It does not cite any legislative history or prior interpretation, only asserts that because Congress did not explicitly

[129] Applicability of 1.0 PSI Reid Vapor Pressure Allowance For Blends of Gasoline And 15 Percent Ethanol, February 7, 2018, Memorandum from Renewable Fuels Association, Growth Energy, Urban Air Initiative, National Corn Growers Association to Mr. William Wehrum, Assistant Administrator, Office of Air and Radiation at 13-14. *See* Attachment 1, *infra*.
[130] *Id.* at 1 (emphasis in original). See also Memorandum at 11 ("the RVP allowance in §211(h)(4) is available for any fuel blend that contains at least 10 percent ethanol and complies with §211(f)").
[131] Proposed Rule at 10592.

restrain the Agency from taking this action, it is empowered to do so.[132] A much sounder conclusion is that no legislative history or rationale can be provided because the interpretation rests on a chain of unrealistic assumptions. Specifically, EPA's rationale assumes:

> (1) Congress somehow knew in 1990 that E15 blends would start to be used over 20 years later and thus meant to accommodate these fuels although it never said say so in the statute or in contemporaneous legislative history;
> (2) Unidentified parties would apply for an E15 waiver under Section 211(f)(4), even though use of ethanol in gasoline in 1990 was approximately 1% nationwide[133] and the Renewable Fuel Standard (which formed the basis of the request for the E15 waiver) was not enacted until 15 years later;[134]
> (3) Congress intentionally structured the language of Section 211(h)(4)(B) to take this theoretical possibility into account and thus authorized an "automatic" application of the 1 psi RVP waiver to any blends above E10, or "gasohol" as E10 blends were known in 1990.

This rationale is frankly absurd. The "deemed to comply" provision in Section 211(h)(4) is straightforward. It allows downstream parties to be considered to be in compliance with volatility standards applying to "fuel blends containing gasoline and 10 percent denatured anhydrous ethanol" if the gasoline portion of the E10 blend complies with RVP limitations, the ethanol part of the E10 blend doesn't exceed a waiver condition under Section 211(f)(4) and no additional alcohol or other additive has been added which increases the RVP of the ethanol portion. The cross reference in Section 211(h)(4) to Section 211(f)(4) simply means that providers of gasoline/ethanol fuel blends cannot, in EPA's terminology, "take advantage" of a 1 psi waiver if the blend exceeds other limits placed on the blend in other parts of Section 211. In other words, downstream parties need to comply with all applicable requirements in Section 211 and Section 211(h)(4) cannot be read to provide an exception to the operation of other provisions.

VI. Relabeling an E15 Pump is Illegal

The Agency established E15 retail pump label regulations in the 2011 E15 Misfueling Mitigation Rule. Retail stations, however, may be confused regarding E15 pump labels and summer RVP requirements. Thus, the current rulemaking provides an opportunity for EPA to clarify this matter.

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[132] EPA attempts to argue that since CAA section 211(h)(4) does not specifically "limit application of the (h)(4) waiver to E10," that EPA can apply 10 percent limitation in the section as a floor, rather than a ceiling. *Id.*

[133] EIA, *Biofuels Issues and Trends*, p.5 (October 2012) ("Ethanol was a little more than 1% of domestic gasoline consumption in 2011").

[134] Growth Energy and other petitioners petitioned for a 1 psi waiver in March 2009. 75 Fed. Reg. 68,094, 68,095 (Nov. 4, 2010). This petition indicates that the "mandate" for 36 billion gallons of renewable fuel under the RFS "will not be realized unless the government promptly removes artificial restrictions on ethanol and approves the use of higher ethanol blends in America's vehicles." Letter from Growth Energy to EPA Administrator Lisa Jackson, March 6, 2009 at 2. EPA-HQ-OAR-2009-0211-0002.

EPA's required pump label for E15 applies all year and is not seasonal (e.g., one label for the winter and a different label for the summer). The Agency stated that summer RVP cannot be circumvented by relabeling; "intended use" on a pump label does not exempt E15 from fuel quality requirements:

> All gasoline, including E15, is subject to all of the requirements applicable to gasoline because of its formulation, not because of its end use. These requirements cannot be circumvented by relabeling. Allowing a fuel to be exempted from fuel quality requirements simply based on a statement of its intended use would undermine the EPA's ability to assure compliance with fuel quality requirements.[135]

This reminder should be repeated in this final rule.

VII. Misfueling Mitigation

In its proposed rulemaking, EPA recognizes the potential need for additional misfueling mitigation measures and we believe the EPA should indicate that revised labeling mitigation measures will further reduce the risk of misfueling. Specifically, EPA should consider whether supplemental labeling regarding warranty coverage, reduced fuel economy, or other relevant information should be provided. If EPA is unwilling to so indicate, we believe the Agency should, at a minimum, affirm that any state-mandated requirement for labeling of E15 in addition to or different from those required by the EPA would conflict and/or cause confusion with the EPA-mandated label and therefore is preempted.

VIII. Conclusion

The statutory language that limits the 1 psi RVP waiver to E10 blends is clear on its face. There is not any ambiguity with respect to the meaning of "fuel blends containing gasoline and . . . 10 percent denatured anhydrous ethanol." Thus, EPA must withdraw the portions of the rule that would permit gasoline with 15 percent ethanol to "take advantage" of the 1 psi RVP waiver. EPA does not have the authority to reinterpret this part of the Clean Air Act in the manner it proposed; the rule of law must be respected.

Nearly 30 years ago, as Congress debated different House and Senate versions of the 1 psi RVP waiver, it specifically rejected the result that EPA now proposes, *i.e.*, that the 1 psi waiver can apply to gasoline/ethanol blends that contain "at least" 10 percent ethanol. EPA cannot now put these words into the Clean Air Act under the guise that the statute is suddenly ambiguous and that it is only "modifying" its interpretation of the Act.

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[135] 81 Fed. Reg. 80863.

EPA's lack of authority in this area has been widely recognized by Congress itself. Bills have been introduced in the last three sessions of Congress to amend the Clean Air Act to authorize 1 psi RVP waivers for fuel blends containing more than 10 percent ethanol. That these attempts have been unsuccessful only underscores the implausibility of EPA's contention that Congress always intended the 1 psi RVP waiver to apply in the manner EPA now proposes. Again, EPA's only option in the face of this hard reality is to abandon its proposed regulatory changes.

EPA's also seeks to ignore the law and reverse decades of statutory interpretation with respect to the meaning of the Clean Air Act's "substantially similar" provision. EPA interpretation that E15 (at either 9.0 or 10.0 psi) is sub sim to E10 lacks a legal and technical support.

EPA is also proposing to overturn restrictions it put in place in 2010 and 2011 to restrict E15 to the subset of vehicles the Agency believes are able to use this fuel. The conditions were intended to protect the millions of vehicles that were certified on gasoline alone and to guard against engine damage in vehicles and equipment not designed for E15 fuel blends. While EPA attempts to put an illegal band aid on its decision – by proposing to add "conditions" to its sub sim waiver determination – EPA does not explain where it possesses the authority to act in this manner. Similar to the partial waivers EPA granted for E15, EPA is proposing to exert authority it doesn't have while putting existing vehicles and engines at greater risk.

The combined effect of these actions is to eviscerate the statutory design and intent of the section 211(f)(1) sub sim and section (f)(4) waiver provisions. The overriding purpose of these provisions is to ensure that newly developed fuels can be used in older vehicles and equipment that remain in use across our nation. By statutory design, fuels and fuel additives are to be "backwards compatible" so that they will not harm existing vehicles and equipment and so that they maintain certified emission levels. But EPA proposes to wipe away these protections simply by declaring the law to mean something else than it has meant since the late 1970s. This EPA cannot do and the Agency must also walk away from these proposed determinations.

We appreciate the opportunity to present our views. Should you have any questions, please contact me at rmoskowitz@afpm.org or (202) 457-0480.

Respectfully submitted,

Richard Moskowitz
General Counsel
American Fuel & Petrochemical Manufacturers

INDEX OF ATTACHMENTS

Attachment 1: Growth Energy, Renewable Fuels Association, Urban Air Initiative, and National Corn Growers Association, *Applicability of 1.0 PSI Reid Vapor Pressure Allowance for Blends of Gasoline and 15 Percent Ethanol* (February 7, 2018).

Attachment 2: Side-by-side comparison of House and Senate CAAA of 1990.

Attachment 3: National Petrochemical & Refiners Association (now AFPM) comments on proposed E15 partial waivers (July 20, 2009).

Attachment 4: Alliance of Automobile Manufacturers comments on proposed E15 partial waivers (July 20, 2009)

Attachment 5: Association of International Automobile Manufacturers comments on proposed E15 partial waivers (July 20, 2009)

Attachment 6: Alliance for a Safe Fuels Environment and The Outdoor Power Equipment Institute comments on proposed E15 partial waivers (July 20, 2009)

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ATTACHMENT 1

February 7, 2018

Via Electronic and U.S. Mail

Mr. William Wehrum
Assistant Administrator
U.S. Environmental Protection Agency
Office of Air and Radiation (6103A)
1200 Pennsylvania Ave., NW
Washington, DC 20460

Dear Assistant Administrator Wehrum:

Thank you for meeting recently with representatives of the renewable fuels industry to discuss the legal authority for the Environmental Protection Agency ("EPA") to extend the 1.0 pound per square inch ("psi") Reid Vapor Pressure ("RVP") allowance that currently applies for blends of gasoline and 10 percent ethanol ("E10") to blends of gasoline and 15 percent ethanol ("E15"). At the meeting, you indicated that EPA was considering several options and would welcome additional explanation of EPA's authority, including the legislative history of Clean Air Act § 211(h)(4). The enclosed memorandum—structured as a legal brief defending extending the 1.0 psi RVP allowance to all blends containing at least ten percent ethanol, including E15—responds to your request.

As the memorandum explains, we believe EPA may reasonably adopt this interpretation and convincingly defend it against any legal challenge. The statutory history, text, structure, and purpose strongly support it. The principal arguments are as follows:

- ***History***. Section 211(h) largely codified preexisting EPA regulatory limitations on RVP, which granted a 1.0 psi RVP allowance for any blend of at least nine percent ethanol, up to the maximum authorized by a waiver under § 211(f)(4). Nothing in the regulations at the time prevented a blend with more than ten percent ethanol from receiving the 1.0 psi RVP allowance if EPA granted that blend a waiver under § 211(f)(4). During the run-up to § 211(h)'s enactment, moreover, the Administration originally proposed a bill that would have explicitly *capped* eligibility for the RVP allowance at ten percent. But both chambers of Congress rejected that proposal.

  The Senate bill, which Congress adopted, provided for a 1.0 psi RVP allowance for all blends containing "gasoline and 10 percent denatured anhydrous ethanol," and it also included a proviso that the allowance would extend to blends with higher ethanol percentages if the blend complied with "its waiver condition under subsection (f)(4)." The House bill would have accomplished the same effect by applying the 1.0 psi RVP allowance to all "gasoline containing at least 10 percent ethanol."

- ***Text***. The first clause of § 211(h)(4) provides a 1.0 psi RVP allowance "[f]or fuel blends containing gasoline and 10 percent … ethanol." That language is best read, particularly in light of the statutory structure and purpose described below, to apply to *all* blends containing ten percent ethanol, including blends containing more than that concentration. E15, for example, contains ten percent ethanol, just as the statute requires, plus an additional five percent. By analogy, consider a labeling regulation providing that any beverage labeled as "juice" must "contain 5% real fruit juice." A company that marketed as "juice" a beverage containing 10, 50, or 100% real fruit juice would be in compliance with that regulation. So too here for E15.

- ***Structure***. The second clause of § 211(h)(4) provides a compliance defense where, among other things, "the ethanol portion of the blend does not exceed its waiver condition under subsection (f)(4)." The compliance defense thus references the separate potential ceiling that § 211(f)(4) may impose on ethanol content—a ceiling that exceeded ten percent when EPA granted the waiver for E15. Congress thus contemplated that the RVP allowance would extend to blends containing more than ten percent ethanol.

- ***Purpose***. The RVP allowance's purpose is to permit ethanol blends that do not substantially contribute to ground-level ozone formation to enter the market through blending with standard base gasoline. E15 and other blends containing more than ten percent ethanol have *lower* evaporative emissions than E10, and therefore have less of an impact on ground-level ozone. E15 also produces less *tailpipe* emissions than E10. And of course, E15 contains more ethanol than E10. Extending the RVP allowance to all blends containing at least ten percent ethanol, including E15, thus would further all of EPA's and Congress's policy goals.

We appreciate Administrator Pruitt's commitment to update EPA's RVP regulations once EPA has evaluated the statutory authorities for such a change. We trust that this memorandum will assist EPA in determining that sufficient authority exists, and we welcome the opportunity to address any additional questions you may have.

Sincerely,

Bob Dinneen
President and Chief Executive Officer
Renewable Fuels Association

Emily Skor
Chief Executive Officer
Growth Energy

David VanderGriend
President
Urban Air Initiative

Jon Doggett
Executive Vice President, Public Policy
National Corn Growers Association

Enclosure

APPLICABILITY OF 1.0 PSI REID VAPOR PRESSURE ALLOWANCE FOR BLENDS OF GASOLINE AND 15 PERCENT ETHANOL
February 7, 2018

INTRODUCTION

Section 211(h)(4) of the Clean Air Act allows the Reid Vapor Pressure (RVP)—a measure of gasoline volatility— to be 1.0 psi higher than EPA regulations otherwise require "[f]or fuel blends containing gasoline and 10 percent … ethanol." EPA currently interprets this provision to establish an RVP allowance for blends containing *between nine and ten percent* ethanol. EPA should change that interpretation and read § 211(h)(4) to establish an RVP allowance for blends containing *at least* ten percent ethanol. EPA should adopt this reading of § 211(h) for three reasons.

First, EPA can properly read the statutory text and structure to compel the conclusion that Congress intended the RVP allowance under § 211(h)(4) to extend to *all* blends containing ten percent ethanol, including blends containing *more* than that concentration. In ordinary parlance, a blend of gasoline and at least ten percent ethanol "contain[s] gasoline and 10 percent … ethanol," just as the statute requires. A blend of gasoline and 15 percent ethanol (E15), for example, contains ten percent ethanol, *plus* an additional five percent. In addition, the second clause of § 211(h)(4) establishes a compliance defense where, among other things, "the ethanol portion of the blend does not exceed its waiver condition under subsection (f)(4)." That language plainly provides that blenders of gasoline and 15 percent ethanol are in compliance with the RVP requirements, since there is a waiver for E15 under § 211(f)(4). Congress's reference to limits on ethanol content under § 211(f)(4) thus supports the conclusion that Congress understood the 10 percent to impose a floor on ethanol content rather than a ceiling.

The legislative history and purpose of § 211(h) confirm this reading. Congress enacted section 211(h) as part of the 1990 Clean Air Act amendments, which codified preexisting EPA regulatory limitations on RVP. The operative language of those regulations granted a 1.0 psi RVP allowance for any blend of "at least 9% ethanol," with "the maximum ethanol content …

not exceed[ing] any applicable waiver conditions under section 211(f)(4)." 40 C.F.R. § 80.27(d)(2) (1990). At the time, that maximum ethanol content was ten percent, since the only extant waiver under § 211(f)(4) was for a blend of gasoline and ten percent ethanol (E10). But nothing in the regulations prevented a blend with a higher ethanol concentration from receiving the 1.0 psi RVP allowance if EPA granted it a waiver under § 211(f)(4). In addition, the Administration originally proposed a bill that would have explicitly *capped* eligibility for the RVP allowance at ten percent. But both chambers of Congress rejected that proposal.

Second, at a minimum, § 211(h) is ambiguous, and it is reasonable for EPA to read it to extend the 1.0 psi RVP allowance to all blends containing ten percent ethanol, including blends containing more than that concentration. EPA and Congress have long understood that, while ethanol can increase gasoline's RVP by up to 1.0 psi, it does not substantially contribute to tropospheric (ground-level) ozone formation. A 1.0 psi RVP allowance thus ensures that ethanol can be blended with standard base gasoline, rather than a special base gasoline with a lower RVP. And blends containing more than ten percent ethanol have *lower* evaporative emissions than E10, and thus contribute less to ozone formation than E10. Thus, extending the RVP allowance to blends containing more than ten percent ethanol furthers the allowance's basic purpose—enabling ethanol blends that do not substantially contribute to ozone formation, and indeed contribute less to ozone formation than E10, to enter the market through blending with standard base gasoline.

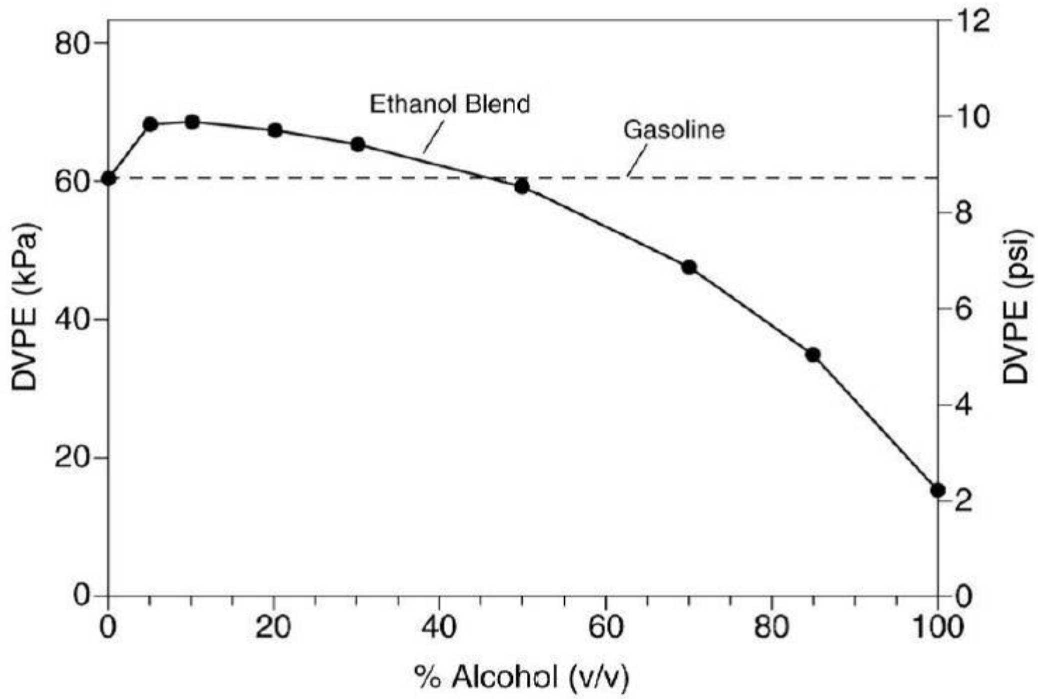
Finally, EPA can adequately explain a change of interpretation. EPA's current position rests on a basic misreading of the statute and an outdated set of facts. EPA's interpretation was largely inconsequential when the only waiver for an ethanol blend under § 211(h) was for E10. But now, at the very least because EPA has granted a waiver for E15, that misreading is preventing E15 from entering the market on the same terms as E10, even though E15 produces less evaporative and tailpipe emissions. Updating its interpretation thus would align EPA with the best reading of the statute, protect the environment, increase U.S. energy independence, lower costs, and remove a regulatory barrier to economic growth.

BACKGROUND

A. Factual Background

Ethanol is a simple alcohol produced extensively in the United States from corn and other feedstocks. When added to gasoline, ethanol increases the fuel's octane rating. Ethanol has been used as a fuel additive in the United States since 1979, when a waiver was granted for E10 by operation of law under § 211(f)(4). *See* 44 Fed. Reg. 20,777 (Apr. 6, 1979). Section 211(f)(4) authorizes EPA to waive § 211(f)(1), which prohibits manufacturers from marketing or increasing the concentration of any new fuel additive that is not substantially similar to an additive included in the fuel used to certify motor vehicle compliance with emissions standards. EPA may grant a waiver under § 211(f)(4) if a new fuel additive or concentration will not cause vehicles to exceed their emissions standards.

Pure ethanol is not very volatile due to its polar molecular structure. When added to gasoline in small concentrations, however, increasing amounts of ethanol by volume increase the volatility of the blend. This effect continues until approximately ten percent by volume, at which point ethanol increases the blend's RVP by roughly 1.0 psi. Beyond that point, as the concentration of ethanol increases, volatility *decreases*, such that blends containing 12, 15, or 20 percent ethanol are less volatile than E10. The graph below from the Department of Energy's National Renewable Energy Laboratory shows this relationship, plotting volatility against ethanol content by volume, with E10 representing the top of the curve:



Fuel volatility is important for pollution regulation principally because evaporative emissions can contribute to the formation of ground-level ozone, a respiratory irritant, during the summertime high ozone season. The volatility of ethanol does not contribute significantly to the formation of ozone, however, because ethanol is comparatively less reactive in the atmosphere than gasoline hydrocarbons. E10 also reduces tailpipe emissions of other ozone-forming pollutants, and available data indicate that E15 reduces such emissions even more than E10. *See* Nat'l Renewable Energy Lab. (NREL), Review and Evaluation of Studies on the Use of E15 in Light-Duty Vehicles, 32-34, 39-41 (Oct. 2013); NREL, Effect of Ethanol Blending on Gasoline RVP Memo (Mar. 2012).

B. Statutory and Regulatory Background

1. EPA Volatility Regulation Before the 1990 Clean Air Act Amendments

In 1989, pursuant to the agency's general authority to regulate fuels, additives, and emissions under § 211(c) of the Act, EPA promulgated "Phase I" of a two-phase regulation designed to reduce summertime gasoline volatility. 54 Fed. Reg. 11,868 (Mar. 22, 1989). The regulation imposed limits on the RVP of gasoline during summer months for certain areas of the country. 40 C.F.R. § 80.27(a) (1989).

The Phase I regulation also contained "[s]pecial provisions for alcohol blends," which provided that a qualifying blend would be in compliance with the RVP standards "if its [RVP] does not exceed the [otherwise] applicable standard … by more than one [psi]." *Id.* § 80.27(d)(1). The blends qualifying for this special treatment had to contain "at least 9% ethanol (by volume)," with "[t]he maximum ethanol content … not exceed[ing] any applicable waiver conditions under section 211(f)(4)." *Id.* § 80.27(d)(2). At the time, the maximum ethanol content was ten percent: Certification fuel did not include any additive substantially similar to ethanol, and the maximum ethanol concentration permitted by the 1979 waiver under § 211(f)(4) was ten percent. The preamble to the regulation thus described these special provisions as "an interim RVP allowance of 1.0 psi for ethanol blends of approximately 10 percent by volume," pending a "final decision on such an allowance for all blends … in rules covering the second phase of RVP control." 54 Fed. Reg. at 11,869. Nothing in the operative language of the Phase I regulation, however, would have prohibited a blend containing a higher concentration of ethanol from receiving the same 1.0 psi allowance if EPA granted that blend a waiver under § 211(f)(4).

The following year, but before Congress's enactment of the 1990 Clean Air Act amendments, EPA promulgated "Phase II" of its volatility regulations. 55 Fed. Reg. 23,658 (1990). The Phase II regulation left the "special provisions for alcohol blends" in 40 C.F.R. § 80.27(d) unchanged, including the language specifying that "[t]he maximum ethanol content of gasoline shall not exceed any applicable waiver conditions under section 211(f)(4)." 40 C.F.R. § 80.27(d)(1) (1990). Because EPA had not, in the meantime, granted any new ethanol waivers under § 211(f)(4), the preamble describes the Phase II regulation as "mak[ing] permanent the temporary 1.0 psi RVP allowance provided in the Phase I program for gasoline containing 9 to 10 percent ethanol." *Id*. As in Phase I, however, nothing would have prohibited a blend containing more than ten percent ethanol from qualifying for the 1.0 psi allowance if EPA granted a new waiver under § 211(f)(4).

EPA explained that it maintained the 1.0 psi RVP allowance for ethanol blends because "lower RVP [base] gasoline would be necessary to produce [ethanol blends] which could meet the gasoline RVP standards, and yet … the refining industry was not likely to make available sufficient lower-RVP product to maintain a significant [ethanol blend] market." 55 Fed. Reg. at 23,665. An RVP allowance was necessary to avoid "potential economic jeopardy to the fuel ethanol industry of requiring the same RVP standards for gasoline and [ethanol blends]." *Id.*

2. The 1990 Clean Air Act Amendments

Later that year, Congress enacted amendments to the Clean Air Act, including new § 211(h), which served largely to codify EPA's volatility regulations. Section 211(h)(1) requires EPA "to promulgate regulations making it unlawful … during the high ozone season to sell … or introduce into commerce gasoline with [an RVP] in excess of 9.0 [psi]." Those regulations must establish "more stringent [RVP] standards in … [ozone] nonattainment area[s]," and may allow lower standards in "[ozone] attainment area[s]." § 211(h)(2).

Like EPA's existing volatility regulations, § 211(h)(4) contains a special provision for certain alcohol blends. That provision, entitled "Ethanol waiver," provides in its first clause: "For fuel blends containing gasoline and 10 percent denatured anhydrous ethanol, the [RVP] limitation under this subsection shall be one [psi] greater than the applicable [RVP] limitations established under paragraph (1)." The second clause then contains a proviso setting forth a 3-

part compliance defense for any "distributor, blender, marketer, reseller, carrier, retailer, or wholesale purchaser-consumer." Such a party

> shall be deemed to be in full compliance with the provisions of this subsection if it can demonstrate … that (A) the gasoline portion of the blend complies with the [RVP] limitations promulgated pursuant to this subsection; (B) *the ethanol portion of the blend does not exceed its waiver condition under subsection (f)(4)*; and (C) no additional alcohol or other additive has been added to increase the [RVP] of the ethanol portion of the blend."

Id. (emphasis added). By providing this conditional defense not only for E10, but for any blend that does not "exceed its waiver condition under subsection (f)(4)," Congress plainly contemplated that, as under the Phase I and II volatility regulations, a blend containing more than ten percent ethanol could qualify for the 1.0 psi RVP allowance, provided that EPA granted an appropriate waiver under § 211(f)(4).

The text of § 211(h) changed as it proceeded through the legislative process. The original Administration bill (H.R. 3030) provided a 1.0 psi RVP allowance, but would have limited it to "gasoline containing at least 9 but not more than 10 per centum ethanol (by volume)." Clean Air Act Amendments, H.R. 3030, 101st Cong., § 214 (1990) 101st Cong., 1st Sess. (July 27, 1989). The Administration bill thus would have frozen in place the then-applicable numerical parameters of the 1.0 psi RVP allowance, preventing its extension to blends with more than ten percent ethanol if EPA changed the certification fuel or granted a new waiver under § 211(f)(4).

Both chambers of Congress, however, rejected the Administration's proposal for a 10 percent ceiling and instead adopted a 10 percent floor. The Senate bill provided for a 1.0 psi RVP allowance for "gasoline and 10 percent denatured anhydrous ethanol," but also provided a defense where the blend complies with "its waiver condition under subsection (f)(4)"—thereby making clear that the allowance could extend to blends with ethanol concentrations greater than ten percent. Clean Air Act Amendments, S. 1630, 101st Cong., § 214 (1990) 101st Cong., 1st

Sess. (Sept. 14, 1989). The House bill would have achieved the same result, though without any compliance defense—it simply provided that the allowance would apply to "gasoline containing at least 10 percent ethanol." *See* Clean Air Act Amendments, S. 1630 Engrossed Amendment House, 101st Cong., § 216 (1990) 101st Cong., 2nd Sess. (May 23, 1990); *see also* H.Rep. 101-490 at 71, 574 (similar). Congress ultimately adopted the Senate version.

The Senate Report explains the rationale for the 1.0 psi RVP allowance. As did EPA in promulgating the Phase I and II regulations, Congress "recognized that to require ethanol to meet a 9 pound RVP would require the creation of a production and distribution network for sub-nine pound gasoline. The cost of producing and distributing this kind of fuel would be prohibitive to the petroleum industry and would likely result in the termination of the availability of ethanol in the marketplace." S. Rep. 101-228 (Dec. 20, 1989) at 110. Congress further concluded that the allowance provision would "allow ethanol blending to continue to be a viable alternative fuel, with its beneficial environmental, economic, agricultural, energy security and foreign policy implications." *Id.* Nothing in the legislative history suggests any reason this rationale would apply to E10 but not blends with higher ethanol concentrations later shown to be compatible with motor vehicle emissions compliance and therefore granted waivers under § 211(f)(4).

C. EPA's Current Interpretation of § 211(h)(4)

1. The 1991 Volatility Rule

In 1991, EPA revised its volatility rules to implement new § 211(h). EPA stated that it "was not making any change to the current [RVP allowance] requirement that the blend contain between 9 and 10 percent ethanol (by volume)." 56 Fed. Reg. 64,704, 64,708 (Dec. 12, 1991). But in fact, EPA *did* change that requirement. Notwithstanding the fact that Congress had rejected the Administration proposal to limit the RVP allowance to blends containing nine-to-ten percent ethanol, EPA amended 40 C.F.R. § 80.27(d)(2) to provide that "the concentration of the ethanol, excluding the required denaturing agent, must be at least 9% and no more than 10% (by volume) of the gasoline." Despite adding that new ten percent cap, EPA strangely left intact the preexisting language stating: "The maximum ethanol content of gasoline shall not exceed any applicable waiver conditions under section 211(f)(4)." 40 U.S.C. § 80.27(d)(2).

In the same rulemaking, EPA also implemented the newly enacted "deemed to comply" provision. EPA described this provision as a "compliance defense" that "is limited to ethanol blends which meet the minimum 9 percent requirements in the regulations and the maximum 10 percent requirement in the waivers under section 211(f)(4)." 56 Fed. Reg. at 64,708. In other words, while the statute provides that, for the defense to apply, "the ethanol portion of the blend [must] not exceed *its waiver condition under subsection (f)(4)*," § 211(h)(4) (emphasis added), EPA's regulation provides that "[t]he ethanol portion of the blend [must] not exceed *10 percent (by volume)*," 40 C.F.R. §80.28(g)(8) (emphasis added).

2. The 2011 E15 Waiver and Misfueling Regulations

Two decades later, in 2011, EPA granted a waiver for E15 under § 211(f)(4). 76 Fed. Reg. 4,662 (Jan. 26, 2011).[1] Out of concern that E15 could damage emissions control systems on pre-2001 vehicles, EPA also adopted restrictions on "misfueling" such older vehicles with E15 pursuant to its general authority under § 211(c). 76 Fed. Reg. 44,406 (July 25, 2011). In the preamble to those regulations, EPA responded to comments arguing that it should read § 211(h)(4) to extend the 1.0 psi RVP allowance to E15. *Id.* at 44,433-35. EPA declined, "confirming" its view that the RVP allowance is limited to blends containing nine-to-ten percent ethanol. *Id.* at 44,433.

[1] This waiver was conditional in that EPA imposed a limit on the RVP of the base gasoline. *See* 76 Fed. Reg. at 4,662-63. That condition in the waiver decision is separate from and independent of the RVP limitations under § 211(h).

3. 2014 Emissions Standards

In 2014, EPA adopted new emissions standards for "Tier 3" gasoline-fueled motor vehicles under § 202(a). 79 Fed. Reg. 23,414 (Apr. 28, 2014). As part of those new standards, in light of the wide availability of E10 in the market, EPA replaced E0 with E10 as the "new emissions test fuel." *Id.* at 23,419. In discussing the new certification fuel in the preamble to the regulation, EPA asserted without explanation that "E15 is not covered by the [RVP allowance under § 211(h)(4)] and thus is restricted to 9 psi nationwide." *Id.* at 23,526; *see also id.* ("[T]he 1.0 psi RVP [allowance] for E10 does not apply to gasoline with higher ethanol levels.").[2]

ARGUMENT

I. Legal Framework

In the event a party were to challenge an EPA rule interpreting the RVP allowance under § 211(h) to cover blends with more than ten percent ethanol, judicial review would be governed by the familiar two-step analysis set forth in *Chevron* v. *Natural Resources Defense Council*, 467 U.S. 837 (1984). At step one, a court asks whether Congress has directly spoken to the precise question at issue, because "the court, as well as the agency must give effect to the unambiguously expressed intent of Congress." *Id.* at 842-43. Although step one begins with the plain text of the statute, "the court must examine the meaning of certain words or phrases in context and also exhaust the traditional tools of statutory construction, including examining the statute's legislative history to shed new light on congressional intent." *Sierra Club* v. *EPA*, 551 F.3d 1019, 1027 (D.C. Cir. 2008) (quotation mark omitted).

[2] By including ethanol in certification fuel, EPA arguably placed ethanol outside § 211(f)(1)'s general prohibition on new fuel additives, since ethanol is now "substantially similar"—indeed, identical—to a "fuel additive utilized in [vehicle] certification," namely, ethanol. § 211(f)(1)(B). Whether that is so, and whether the 2014 emissions standards therefore rendered the prior waivers under § 211(f)(4) for E10 and E15 unnecessary, is beyond the scope of this submission.

At step two, a court must defer to an agency's interpretation so long as it is "reasonable." 467 U.S. at 843. The agency's interpretation need not be the only permissible reading of the statute, nor the interpretation the court would have adopted. *Id*. at 843 n.11. "If the administrator's reading fills a gap or defines a term in a way that is reasonable in light of the legislature's revealed design, [a court will] give the administrator's judgment controlling weight." *NationsBank of N. Carolina, N.A.* v. *Variable Annuity Life Ins. Co.*, 513 U.S. 251, 257 (1995) (quotation marks omitted).

An agency is free to change its interpretation of a statute it administers "if doing so is reasonable, within the scope of the statutory delegation, and the departure from past precedent is sensibly explained." *FedEx Home Delivery* v. *Nat'l Labor Relations Bd.*, 849 F.3d 1123, 1127 (D.C. Cir. 2017). An agency's change of position is not subject to any form of "heightened scrutiny." *FCC* v. *Fox Television Stations, Inc.*, 556 U.S. 502, 525 (2009). As *Chevron* itself explains, "to engage in informed rulemaking, [an agency] must consider varying interpretations and the wisdom of its policy on a continuing basis." 467 U.S. at 863.

II. Traditional Interpretive Tools Compel Interpreting § 211(h)(4) To Provide an RVP Allowance for Blends Containing at Least 10 Percent Ethanol

Traditional tools of statutory interpretation show that Congress has spoken to the precise issue presented—the RVP allowance in § 211(h)(4) is available for any fuel blend that contains at least ten percent ethanol and complies with § 211(f). The statutory text and structure compel that reading, and the legislative history and purpose confirm it. EPA's current interpretation, while purporting to harmonize various provisions within § 211(h), in fact improperly distorts them.

A. The "10 Percent" Figure in § 211(h)(4) Is a Floor, Not a Ceiling or a Precise Requirement

Starting with the text, as explained, the first clause of § 211(h)(4) provides: "For fuel blends containing gasoline and 10 percent denatured anhydrous ethanol, the [RVP] limitation under this subsection shall be one [psi] greater than the applicable [RVP] limitations established under paragraph (1)." By its plain language, that provision establishes an RVP allowance for *all* blends containing ten percent ethanol, including blends like E15 containing *more* than that concentration. After all, a blend that contains more than ten percent ethanol still "contains ten percent … ethanol," as the statute requires. If Congress had wanted to limit the allowance to blends containing "exactly" ten percent ethanol, "approximately" ten percent ethanol, or "no more than" ten percent ethanol, it easily could have done so. But it did not.

To be sure, Congress also did not spell out that the allowance applies to blends containing "at least" ten percent ethanol. But in ordinary parlance, taking into account the context and purposes of the statute, such specificity is unnecessary. Because increasing the ethanol concentration beyond ten percent actually *lowers* volatility and *increases* the utilization of ethanol, allowing higher concentrations to benefit from the RVP allowance only better serves Congress's goals. Imagine a father tells his daughter, "If you eat 50 percent of your green beans, you may have dessert." If the daughter were to eat 75 or 100 percent of her green beans, better serving the goal of ensuring she got adequate nutrition, she would justifiably expect dessert. Or imagine a labeling regulation that provides that in order to call a beverage "juice," it "must contain 5% real fruit juice." A company that labeled as "juice" a beverage containing 10, 50, or 100% real fruit juice, having better served the goal of nondeceptive labeling, would not fear liability under that regulation. Even the Supreme Court has used the formulation "contain" an amount to mean "contain not less than" that amount. In *Hillside Dairy Inc. v. Lyons*, 539 U.S. 59

(2003), the Court referenced federal regulations requiring that reduced fat milk "shall contain not less than 8 1/4 percent milk solids." 21 C.F.R. § 131.110(a); *see* 539 U.S. at 65. In comparing those regulations to stricter California regulations, the Court stated: "Federal standards require that reduced fat milk contain only 8.25 percent solids-not-fat," *id.* at 65, without stating expressly that the regulations permit more than the amount. The Supreme Court thus understands that, in the right context, "contains" means "contains at least."

If there were any doubt about this reading, the defense in the second clause of § 211(h)(4) removes it. That defense applies if, among other things, "the ethanol portion of the blend does not exceed its waiver condition under subsection (f)(4)." Congress easily could have borrowed the words "10 percent" from the first clause and limited this defense to instances where the ethanol concentration "does not exceed 10 percent." But Congress did not do so, and "[w]here Congress includes particular language in one section of a statute but omits it in another section of the same Act, it is generally presumed that Congress acts intentionally and purposely in the disparate inclusion or exclusion." *Russello v. United States*, 464 U.S. 16, 23 (1983). Here, the logical explanation for the different language in the two clauses of § 211(h)(4) is that the first clause establishes a floor of ten percent, and the second clause establishes that any applicable waiver condition under § 211(f)(4) imposes a ceiling on the ethanol concentrations eligible for the compliance defense. Moreover, by referencing the separate potential ceiling in § 211(f)(4), Congress indicated that it did not intend the 10 percent itself to serve as a ceiling, but instead as a floor.

The legislative history reinforces this reading. Section 211(h) largely codified earlier EPA regulations on RVP. As explained, the operative language of those regulations granted a 1.0 psi RVP allowance for any blend of at least nine percent ethanol up to the maximum authorized by a waiver under § 211(f)(4). At the time, that maximum was ten percent, but nothing in the regulations prevented the maximum from rising if EPA granted a new waiver, as it later did for E15 in 2011. In addition, while the original Administration bill would have expressly capped eligibility for the RVP allowance at ten percent ethanol, Congress rejected the Administration's language.

As explained, reading "ten percent" in § 211(h)(4) as a floor also furthers the statutory purpose. The purpose of RVP regulations is to limit evaporative emissions that tend to produce ozone. Ethanol blends can increase a fuel's RVP by up to 1.0 psi, but that increase does not substantially contribute to ozone, because ethanol is comparatively nonreactive in the atmosphere. The purpose of the 1.0 psi RVP allowance in § 211(h)(4), therefore, is to allow ethanol to enter the market and be blended with standard base gasoline, notwithstanding the fact that it technically increases RVP. A ten percent floor for the 1.0 psi allowance serves that purpose. It ensures that blenders cannot evade the otherwise applicable RVP limitation by splashing in a trivial amount of ethanol. But it also ensures that ethanol blends containing at least ten percent ethanol, with their accompanying environmental, economic, and foreign policy benefits, can enter the market on a fair playing field. Extending the allowance to include E15 furthers that purpose particularly strongly—E15 has *more* ethanol than E10, but with *less* evaporative *and* tailpipe emissions.[3]

[3] Although the statutory context, purpose and legislative history compel the conclusion that the ten percent figure in § 211(h)(4) should be construed as a floor, even if it were to be construed as a ceiling or a precise requirement, the only plausible interpretation of § 211(h)(4)(B) creates an *exception* to that ceiling or requirement for ethanol blends that have been granted waivers under § 211(f)(4) at concentrations greater than ten percent. That is the plain meaning of the "Provided, however, that…" language, which precedes the deemed to comply provision in § 211(h)(4)(A)-(C).

B. EPA's Current Interpretation Distorts § 211(h)(4) and Frustrates its Purpose

EPA currently interprets § 211(h)(4) to limit the 1.0 psi RVP allowance to fuel blends containing between nine and ten percent ethanol. The most complete justification for that interpretation appears in the preamble to the 2011 misfueling regulations. None of the four basic rationales set forth there is persuasive.

First, the misfueling regulation relied upon the fact that § 211(f)(4) originated in a 1987 legislative proposal that in turn was based on "technical data indicating that blending gasoline with ethanol so that it contains 9-10% ethanol results in an approximate 1 psi RVP increase." 76 Fed. Reg. at 44,434. That snippet of legislative history may help explain why Congress provided a 1.0 psi RVP allowance for E10, and it gives some justification for EPA's decision to extend the allowance down to E9. But it cannot explain why Congress would *bar* the allowance from extending to higher ethanol concentrations. As explained, E15 and other blends with more than ten percent ethanol are *less* volatile than E10. The misfueling regulation fixates on the technical data underlying a bill considered by a different Congress in 1987, and never mentions the Administration proposal capping the allowance at ten percent ethanol, nor Congress's rejection of that proposal.

Second, the misfueling regulation reasoned that in the "deemed to comply" provision, "the condition of 'not exceed[ing]' the section 211(f)(4) waiver limit cannot be read literally," because that supposedly "would mean that blends containing 1%, or 2%, or 5% would [be] deemed to comply," which in turn would make the allowance for 9-10% ethanol "meaningless." *Id.* To avoid this purported problem, EPA read the defense, like the RVP allowance itself, as applying only to nine-to-ten percent ethanol. But the purported problem EPA identified concerns the *minimum* ethanol concentration necessary to trigger the compliance defense, which neither the second clause of § 211(h) nor § 211(f)(4) speaks to. However one addresses that interpretive gap, and EPA may have flexibility in reconciling these clauses with respect to the minimum, it does not justify imposing an atextual *maximum* on the concentration eligible for the RVP waiver, contrary to the text, history, and purpose of the first clause of § 211(h).

Third, the misfueling regulation asserted that limiting the allowance to nine-to-ten percent ethanol was necessary to give effect to the state opt-out provision in § 211(h)(5). In EPA's view, that was the only way "to provide States a meaningful and complete solution to emissions increases stemming from the relaxed RVP provisions in section 211(h)(4), not a partial solution" that addressed only the first clause, but not the second. 76 Fed. Reg. at 44,435. But EPA's current solution is not the only way out of this bind. More naturally, one could read § 211(h)(4) as establishing a floor for the blends that qualify for the 1.0 psi RVP allowance. One could then read § 211(h)(5), which employs the same language, to allow a state to opt out of the allowance, regardless of where a particular blend falls above the ten-percent floor.

Finally, EPA asserted that its interpretation furthers the allowance's purpose "to facilitate the participation of ethanol in the transportation fuel industry while also limiting gasoline volatility resulting from ethanol blending." Id. at 44,435. That argument appears to reflect a factual misunderstanding. As explained, E15 and other blends with more than ten percent ethanol have *more* ethanol and *lower* volatility than E10.

III. Even if the Statute Is Ambiguous, It Is Reasonable To Interpret § 211(h)(4) To Provide an RVP Allowance for Blends Containing At Least Ten Percent Ethanol

At a minimum, the arguments above demonstrate that the statute does not compel EPA's current interpretation, and affords EPA discretion to read § 211(h)(4) as extending the 1.0 psi RVP allowance to blends containing at least ten percent ethanol. Indeed, the reasonableness of that interpretation is difficult to dispute, since it would serve the RVP allowance's purpose better than EPA's current position. EPA's policy goal is "to facilitate the participation of ethanol in the transportation fuel industry while also limiting gasoline volatility resulting from ethanol blending." 76 Fed. Reg. 44,434. As explained, E15 contains *more* ethanol, is *less* volatile, and produces *less* tailpipe emissions than E10.

IV. EPA Can Adequately Explain its Change of Interpretation

Finally, EPA can adequately explain a change in its interpretation of § 211(h)(4). As the foregoing arguments show, EPA's current interpretation rests on a basic misreading of the statute and an outdated set of facts. When it initially implemented § 211(h) in 1991, EPA purported to leave its prior regulations unchanged, but in fact EPA retained only the then-existing numerical parameters of the RVP allowance, while eliminating the regulatory flexibility the regulations contained. In so doing, EPA adopted a nine-to-ten percent limitation on the RVP allowance that the Administration bill had proposed, but which Congress rejected. When the previous Administration attempted retroactively to justify maintaining that limitation twenty years later in the 2011 misfueling regulations, it relied on a mix of rationales that do not withstand scrutiny—a cherry-picked piece of legislative history, a conflation of a minimum with a maximum, a misunderstanding of the relationship between § 211(h)(4) and (h)(5), and an appeal to statutory purpose that actually disserves EPA's and Congress's policy goals. By contrast, reading § 211(h) to establish an RVP allowance for blends containing at least ten percent ethanol easily harmonizes the statutory text, structure, history, and purpose.

Until recently, EPA's misreading of the statute was largely inconsequential, since the only waiver granted under § 211(f)(4) was for E10. But now, at a minimum because EPA has granted a waiver for E15, this issue has taken on new significance. E15 contains more ethanol, has a higher octane rating, and produces less evaporative and tailpipe emissions than E10. Enabling E15 to benefit from the same RVP allowance E10 has enjoyed would protect public health, boost fuel efficiency, lower costs, increase U.S. energy independence, and further the

Administration's deregulatory agenda by eliminating an unwarranted regulatory burden on U.S. agriculture and industry. *See* Executive Order 13,771, 82 Fed. Reg. 9,339 (Feb. 3, 2017).

CONCLUSION

EPA should correct its prior interpretation of § 211(h)(4) to apply the 1.0 psi RVP allowance to blends of gasoline and at least ten percent ethanol. Given the 2011 waiver for E15, this change would allow blending of 15 percent ethanol with standard base gasoline year-round, just like ten-percent ethanol. This result is consistent with the statutory text, structure, history, and purpose, as well as EPA and Congress's policy goals.

ATTACHMENT 2

SIDE-BY-SIDE COMPARISON OF S. 1630 AND THE HOUSE AMENDMENTS THERETO

THE CLEAN AIR ACT AMENDMENTS OF 1990

VOLUME 1
TITLES I AND II

31-221

U.S. GOVERNMENT PRINTING OFFICE: 1990

SENATE BILL

FUEL VOLATILITY

SEC. 214. Section 211 of the Clean Air Act is amended by adding the following new subsection at the end thereof:

"(h) EVAPORATIVE EMISSIONS FROM MOTOR VEHICLE FUELS.—

"(1) The Administrator shall promulgate regulations to reduce evaporative emissions from motor vehicle fuels.

"(2) Regulations under this subsection shall include a standard for gasoline volatility which shall apply to all gasoline sold, offered for sale, or introduced into commerce or imported for use in motor vehicles during the high ozone period of each year, as determined by the Administrator under paragraph (3). Effective with respect to gasoline sold in the second high ozone period which commences after the date of enactment of the Clean Air Act Amendments of 1990, the standard shall require that such gasoline sold, or offered for sale, or introduced into commerce for use in motor vehicles in class C areas (as defined by the American Society of Testing Materials as of said date of enactment) shall not exceed a Reid vapor pressure of nine pounds per square inch, except that the Admin-

HOUSE AMENDMENTS

SEC. 216. FUEL VOLATILITY.

Section 211 (42 U.S.C. 7545) is amended by adding the following new subsection after subsection (g):

"(h) REID VAPOR PRESSURE REQUIREMENTS.—(1) Not later than 6 months after the date of the enactment of the Clean Air Act Amendments of 1990, the Administrator shall promulgate regulations making it unlawful for any person during the high ozone season (as defined by the Administrator) to sell, offer for sale, dispense, supply, offer for supply, transport, or introduce into commerce gasoline with a Reid Vapor Pressure in excess of 9.0 pounds per square inch (psi). Such regulations shall also establish more stringent Reid Vapor Pressure standards in a nonattainment area as the Administrator finds necessary to generally achieve comparable evaporative emissions (on a per-vehicle basis) in nonattainment areas, taking into consideration the enforceability of such standards, the need of an area for emission control, and economic factors. Such regulations shall not make it un-

SENATE BILL

istrator may establish a lower Reid vapor pressure as necessary and appropriate to achieve further overall reductions in motor vehicle emissions contributing to the formation of ozone, taking into account safety, enforceability, driveability, and public health. The Administrator shall establish standards for gasoline volatility for Class B and Class A areas that achieve comparable overall reductions in motor vehicle emissions to those achieved by the standard for Class C areas, taking into account appropriate variables such as temperature and humidity.

"(3) For purposes of regulations referred to in paragraph (2), the high ozone period shall be the period between May 16 and September 15 each year or such longer period as the Administrator establishes for any region to cover periods of potential ozone air pollution in excess of the standard for ozone for the region.

"(4) For fuel blends containing gasoline and 10 per centum denatured anhydrous ethanol, the Reid vapor pressure limitation pursuant to this subsection shall be one pound per square inch greater than the applicable Reid vapor pressure limitations established

HOUSE AMENDMENTS

lawful for any person to sell, offer for supply, transport, or introduce into commerce gasoline with a Reid Vapor Pressure of 9.0 pounds per square inch (p.s.i.) or lower in any area designated under section 107 as an attainment area.

"(2) Such regulations shall provide that the requirements of this subsection shall take effect not later than the high ozone season for 1992, and shall include such provisions as the Administrator determines are necessary to implement and enforce the requirements of this subsection.

"(3) In establishing standards for fuel volatility under this subsection, the Administrator shall permit a 1.0 pound per square inch (psi) tolerance level for gasoline containing at least 10 percent ethanol. A manufacturer or processor of gasoline containing at least 10 percent ethanol shall be

SENATE BILL

under paragraph (2): *Provided, however,* That a distributor, blender, marketer, reseller, carrier, retailer, or wholesale purchaser-consumer shall be deemed to be in full compliance with the provisions of this subsection and the regulations promulgated thereunder, if it can demonstrate (by showing receipt of a certification or other evidence acceptable to the Administrator) that (A) the gasoline portion of the blend complies with the Reid vapor pressure limitations promulgated pursuant to this subsection, and (B) the ethanol portion of the blend does not exceed its waiver condition under subsection (f)(4).

"(5) The provisions of this subsection shall apply only to the forty-eight contiguous States and the District of Columbia.".

DESULFURIZATION

SEC. 215. Section 211 of the Clean Air Act is amended by adding the following new subsection to the end thereof:

"(i) DESULFURIZATION OF DIESEL FUEL.—

"(1) Effective October 1, 1993, no person shall manufacture, sell, offer for sale, supply, offer for supply, dispense, transport or introduce into commerce motor vehicle diesel fuel which contains a concentra-

HOUSE AMENDMENTS

deemed to be in full compliance with such standards if the Administrator provides a certification (based on testing) or other evidence acceptable to the Administrator that—

"(A) the gasoline portion of the blend complies with the gasoline volatility standards under this subsection,

"(B) the ethanol portion of the blend does not exceed its waiver conditions under subsection (f)(4), and

"(C) no additional alcohol or other additive has been added to increase the Reid Vapor Pressure of the ethanol portion of the blend.

"(4) The provisions of this subsection shall apply only to the 48 contiguous States and the District of Columbia.".

SEC. 217. DIESEL FUEL SULFUR CONTENT.

Section 211 (42 U.S.C. 7545) is amended by adding the following new subsection after subsection (h):

"(i) SULFUR CONTENT REQUIREMENTS FOR DIESEL FUEL.—(1) Effective October 1, 1993, no person shall manufacture, sell, supply, offer for sale or supply, dispense, transport, or introduce into commerce motor vehicle diesel fuel which contains a concentration of sulfur in excess of

ATTACHMENT 3

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President

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Filed Electronically

July 20, 2009

Administrator Lisa Jackson
Ariel Rios Building
1200 Pennsylvania Avenue, N. W.
Mail Code: 1101A
U.S. Environmental Protection Agency
Washington, DC 20460

Subject: Comments on Growth Energy's E15 Petition
Docket EPA-HQ-OAR-2009-0211

Dear Administrator Jackson:

NPRA, the National Petrochemical and Refiners Association, is pleased to provide comments on Growth Energy's E15 petition to increase the allowable ethanol content of gasoline to 15 percent. NPRA's members comprise more than 450 companies, including virtually all U.S. refiners and petrochemical manufacturers. Our members supply consumers with a wide variety of products and services that are used daily in homes and businesses. These products include gasoline, diesel fuel, home heating oil, jet fuel, asphalt products, and the chemicals that serve as "building blocks" in making plastics, clothing, medicine and computers.

NPRA urges EPA to reject the petition for the following reasons: (1) the science on the impact of mid-level ethanol blends on consumer safety, engine performance, and potential environmental harm has not been completed and likely will not be completed for at least two years; (2) the information submitted by Growth Energy in support of its petition is a woefully inadequate foundation upon which to base such an important change in the nation's supply of gasoline; (3) the potential approval of Growth Energy's petition is not an effective short- or medium-term solution to avoiding the "blendwall" problem caused by the increasing conventional biofuels volumes mandated under the Energy Independence and Security Act of 2007 and thus EPA should not rush such an important decision until a scientifically-based rationale can be reached regarding consumer safety, engine reliability, and environmental concerns of mid-level ethanol blends use in all gasoline-powered motor vehicles and engines in use in the United States; and (4) this seemingly modest petition will, if granted, have wide-ranging implications on other federal and state fuels programs and will require a series of complex and lengthy rulemakings to harmonize these programs with the introduction of mid-level ethanol blends.

In addition, NPRA also opposes the grant of a "partial waiver" to permit the use of mid-level ethanol blends in some gasoline-powered engines for the following reasons: (1) it would cause significant disruption in the nation's wholesale and retail gasoline distribution infrastructure, widespread consumer confusion and potential misfueling, and potential liability for engine and fuel manufacturers for any damage caused to gasoline-powered engines not compatible with mid-level ethanol blends; and (2) EPA does not have the statutory authority under Section 211(f) of the Clean Air Act to grant a partial waiver.

NPRA supports the prudent development and use of biofuels, including ethanol, to diversify our nation's transportation and nonroad fuels portfolio. However, before the use of mid-level ethanol blends is permitted, EPA has an affirmative obligation to find, based on comprehensive and unbiased test data, that these blends are safe for consumers, do not harm gasoline-powered engines, and do not lead to increases in emissions from these engines that will harm the environment. The data submitted by Growth Energy in its petition does not come close to meeting these admittedly and necessarily high standards, and thus the petition must be rejected.

Additional discussion of these issues is available in the attachment.

Sincerely,

Charles T. Drevna
President

Attachment

cc: Gina McCarthy
Margo Oge
Jim Caldwell
Docket EPA-HQ-OAR-2009-0211

COMMENTS OF THE NATIONAL PETROCHEMICAL & REFINERS ASSOCIATION ON THE PETITION FOR A WAIVER TO APPROVE MID-LEVEL ETHANOL BLENDS (74 Fed. Reg. 18,228; April 21, 2009)

I. EXECUTIVE SUMMARY

NPRA respectfully submits the following comments in response to the Environmental Protection Agency's ("EPA") "Notice of Receipt of a Clean Air Act Waiver Application to Increase the Allowable Ethanol Content of Gasoline to 15 Percent and Request for Comments" ("Notice") (74 Fed. Reg. 18,228 (April 21, 2009)). In summary, NPRA urges EPA to reject the petition filed by Growth Energy for the following reasons: (1) the science on the impact of mid-level ethanol blends on consumer safety, engine performance, and potential environmental harm has not been completed and likely will not be completed for at least two years; (2) the information submitted by Growth Energy in support of its petition is a woefully inadequate foundation upon which to base such an important change in the nation's supply of gasoline; (3) the potential approval of Growth Energy's petition is not an effective short- or medium-term solution to avoiding the "blendwall" problem caused by the increasing conventional biofuels volumes mandated under the Energy Independence and Security Act of 2007 (EISA, Public Law 110-140) and thus EPA should not rush such an important decision until a scientifically-based rationale can be reached regarding consumer safety, engine reliability and environmental concerns of mid-level ethanol blends use in all gasoline-powered motor vehicles and engines in use in the United States; and (4) this seemingly modest petition will, if granted, have wide-ranging implications on other federal and state fuels programs and will require a series of complex and lengthy rulemakings to harmonize these programs with the introduction of mid-level ethanol blends.

In addition, NPRA also opposes the grant of a "partial waiver" to permit the use of mid-level ethanol blends in some gasoline-powered engines for the following reasons: (1) it would cause significant disruption in the nation's wholesale and retail gasoline distribution infrastructure, widespread consumer confusion and potential misfueling, and potential liability for engine and fuel manufacturers for any damage caused to gasoline-powered engines not compatible with mid-level ethanol blends; and, (2) EPA does not have the statutory authority under Section 211(f) of the Clean Air Act to grant a partial waiver.

II. INTRODUCTION

On March 6, 2009, Growth Energy LLC announced that it, joined by some ethanol manufacturers and other trade associations, submitted a petition to EPA pursuant to Clean Air Act Section 211(f)(4) for approval of E15. EPA published a Notice requesting comments on the petition on April 21, 2009. EPA should deny this petition. An unbiased assessment of the potential impacts on consumer safety, engine performance, and potential environmental harm of the use of ethanol blends higher than 10 percent ethanol ("mid-level ethanol blends") on conventional gasoline-powered engines has not been completed and likely will not be for at least two years. It would be premature for the Agency to grant such a waiver and would directly contradict congressional intent as evidenced by the 2007 amendments to Clean Air Act section 211(f)(4) by section 251 of EISA.

Ethanol should not be blended into gasoline at levels higher than 10 percent for use in non-flexible fuel motor vehicles and nonroad gasoline-powered engines until comprehensive and independent testing shows that mid-level ethanol blends are safe for consumers and do not harm the environment or public health. NPRA's position on the Growth Energy petition should not be characterized as "anti-ethanol." NPRA supports the prudent development and use of biofuels, including ethanol, to diversify our nation's transportation and nonroad fuels portfolio. However, before the use of mid-level ethanol blends is permitted, EPA has an affirmative obligation to find, based on comprehensive and unbiased test data, that these blends are safe for consumers, do not harm gasoline-powered engines, and do not lead to increases in emissions from these engines that will harm the environment. The data submitted by Growth Energy in its petition does not come close to meeting these admittedly and necessarily high standards and thus the petition must be rejected.

NPRA is not alone in our concern that science be placed above politics with respect to mid-level ethanol blends. Attached to these comments is a recent letter to senior officials in the Obama Administration signed by more than fifty national, state and local business, environmental, public health and agricultural associations and companies that echoes the same sentiment: Comprehensive and independent testing of mid-level ethanol blends must be completed before these fuels are allowed into commerce.

Currently, the maximum level of ethanol that may be blended into gasoline for use in conventional gasoline-powered engines is 10 percent by volume (referred to as "E10"). Some, like Growth Energy, advocate "breaching the blendwall" – as the E10 cap is characterized – before comprehensive testing is complete so that additional volumes of ethanol can be blended into gasoline. NPRA urges EPA to adhere to President Obama's words when he stated that science, not politics, would guide his Administration's approach to the difficult public policy issues we face today. To quote from President Obama's March 9, 2009 Memorandum on "Scientific Integrity":

> Science and the scientific process must inform and guide decisions of my Administration on a wide range of issues, including improvement of public health, protection of the environment, increased efficiency in the use of energy and other resources, mitigation of the threat of climate change, and protection of national security.

III. THE NEED FOR COMPREHENSIVE RESEARCH ON MID-LEVEL ETHANOL BLENDS AND CONVENTIONAL GASOLINE-POWERED ENGINES

There has been no comprehensive research conducted on the potential safety, public health, engine operation, or increased emission impacts from the use of mid-level ethanol blends in conventional gasoline-powered engines. The data that does exist can be summarized as follows:

- Past durability studies from earlier this decade indicate that mid-level ethanol blends result in increased emissions from, and emissions control device failures in, motor vehicle engines over their useful life and result in safety degradation and performance deficiencies with other gasoline-powered engines;
- More recent data developed and promoted by the ethanol industry on very small numbers of vehicles fueled with mid-level blends for short periods of time. The development of this data was not conducted under established federal test procedures and it has not been peer-reviewed; and
- Screening, or preliminary tests conducted by DOE and the Coordinated Research Council ("CRC") [1] that indicate that emissions of some pollutants increase when conventional vehicles use mid-level ethanol blends. Notably, 44% of the vehicles tested by DOE are vulnerable to catalyst deterioration during their useful life (marine engines have not been tested at all by any federal agency, although some private studies reveal significant problems).

Independent observers have concluded that a great deal of additional testing must be completed before the use of mid-level ethanol blends is authorized by EPA. And many research

[1] CRC is a non-profit organization that directs research on the interaction between automotive/other mobility equipment and petroleum products. The Sustaining Members of CRC are the American Petroleum Institute, the Society of Automotive Engineers and a group of automobile manufacturers (Chrysler, Ford, General Motors, Honda, Mitsubishi, Nissan, Toyota, and Volkswagen). See www.crcao.com

projects on mid-level ethanol blends have been identified that would fill critical gaps in knowledge, especially regarding the durability of vehicles and their emission control systems. The attached chart provides an overview of the needed vehicle studies, some of which are completed and some of which still require funding, with associated timelines. The research program would provide basic but comprehensive testing on such issues as durability (catalysts, evaporative systems, and fuel systems), tailpipe emissions, driveability, materials compatibility, and on-board diagnostics. We anticipate they can be completed in about two more years, assuming they are all fully funded and move forward on a reasonable schedule.

DOE has recently outlined future work related to vehicle testing:[2]

- "Complete Full Useful Life Vehicle Durability Study (V4) on 48 vehicles by September 2010
- Complete Phase 3 of Vehicles emissions study (V2) with EPA (January 2010)
- Complete high-temperature, high-altitude driveability study by September 2009 (V5)
- Complete 16 Vehicle evaporative emissions study (V3) by March 2010
- Complete vehicle materials studies with CRC (V6) January 2010
- Continue to work with UL, EPA, CRC and other industry stakeholders to execute test programs underway and define additional studies"

Obviously, substantial research is underway and all results will not be available in time for a decision in early December 2009 by EPA on the merits of Growth Energy's petition.

Separate and apart from past and ongoing vehicle testing, there has been virtually no testing on mid-level ethanol blends on nonroad gasoline engines. We are deeply concerned with the potential impacts on these engines, which consist of: (1) higher exhaust gas temperatures and attendant operational and safety risks; (2) possible irreversible damage to engines; (3) loss of durability; (4) materials compatibility; (5) emissions increases; (6) damages to manufacturers' reputations; and (7) warranty validity. Further, nonroad engines generally utilize open loop air-fuel control systems which cannot compensate for changes in the oxygen content caused by mid-level ethanol blends. Additional research is necessary on a variety of engines[3] and applications with

[2] "Mid-Level Ethanol Blends Test Program; DOE [Energy Efficiency and Renewable Energy], NREL, and ORNL Team, Biomass Program Infrastructure Peer Review," March 19, 2009, p. 48.

[3] 2-stroke, 2-stroke with catalyst, stratified scavenging, compression wave injection, 2-stroke/4-stroke hybrid, 4-stroke, and 4-stroke stratified with catalyst.

different load cycles and cooling designs and operation speeds[4] (including durability testing) and this has not yet begun.

Marine engines face many unique challenges, and none of which have been addressed yet in any research programs on mid-level ethanol blends. It has been alleged that ethanol may degrade fiberglass and aluminum fuel tank material with resulting leaks and build-up of resin on valves, rods and stems, and can clog fuel systems. An ethanol blend may experience phase separation when the fuel is stored for a long period in a container that can contact the atmosphere (such as portable marine fueling containers often used in outboard engine applications). Phase separation attracts water, which can damage engines and cause metallic fuel tanks to leak. Marine engine manufacturers are concerned about increases in engine temperatures causing increased NOx emissions and stress on other components such as valves, head gaskets and head bolts, increased permeation and diurnal emissions, vapor lock, as well as a broad range of performance and durability issues.

Therefore, the science on the impact of mid-level ethanol blends on consumer safety, engine performance, and potential environmental harm has not been completed and likely will not be for at least two years. Hence, EPA should not approve the petition currently under consideration.

IV. THE SHORTCOMINGS IN GROWTH ENERGY'S PETITION

A. The studies cited by Growth Energy's petition are insufficient.

In support of its petition seeking EPA approval of a mid-level ethanol blend, Growth Energy cites several studies indicating that mid-level ethanol blends may be compatible with some conventional gasoline-powered vehicle engines. However, an unbiased review of these studies reveals that at best they underscore the need for additional comprehensive testing and at worst they actually contain conclusions that violate the laws of physics. Conclusively, however, they do not come close to forming the scientific foundation upon which EPA can make an affirmation decision with respect to the petition.

The conclusions from Growth Energy's analysis of seven studies are described below. Growth Energy consistently spins each report to its advantage and ignores results that do not support approval of its E15 petition. Not surprisingly, Growth Energy is being very selective and is not

[4] Professional backpack blowers, homeowner handheld blowers, professional chainsaw (heavy use), armer chainsaw (moderate use), homeowner chainsaw (light use), professional trimmer/brush cutter, farmer trimmer/brush cutter, homeowner trimmer, professional hedge trimmer, and consumer hedge trimmer.

characterizing these studies objectively. For each of the studies cited by Growth Energy, NPRA below provides a much more objective read of the value of each study's data.

1. "DOE Study"

The first study selected by Growth Energy is *Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines, Report 1,* prepared by Oak Ridge National Laboratory for the U.S. Department of Energy (October 2008) ("DOE Study"). Growth Energy asserts that this "peer-reviewed report studied the effects of E-15 and E-20 on motor vehicles and small non-road engines and concluded that when E-15 and E-20 were compared to traditional gasoline, there were no significant changes in vehicle tailpipe emissions, vehicle driveability, or small non-road engine emissions as ethanol content increased."[5] The nonroad engine community has several concerns. DOE is not satisfied and is sponsoring further research. Furthermore, EPA is sponsoring further research.

Nonroad engines comprise over some 900 engine "families" currently regulated and certified for emissions by EPA. Of these 900 engine families, the Department of Energy ("DOE") tested 28 pieces of equipment to determine how mid-level ethanol blends may impact these engines. The Outdoor Power Equipment Institute ("OPEI"), the trade association of the manufacturers of much of this equipment, concluded that the technical data from this study reveals most of these engines experienced performance irregularities, operational issues, damage and/or failure during testing using mid-level ethanol blended fuel.

One finding of the DOE tests on nonroad engines is of extreme concern to OPEI -- safety hazards dramatically increased due to unintentional clutch engagement caused by high idle speeds. This means that blades engage in the idle position. The risks to a chainsaw user in this example are profound and unacceptable. Chainsaws are used by nearly every fire house, utility crew and emergency weather crew as well as commercial foresters and consumers. Their reliability and safe performance are critical to their users. Another example of genuine concern is the possible failure of emergency generators in a crisis. Again, their reliability and safe performance is critical to users. The potential use of mid-level ethanol fuels is a highly complex issue as related to outdoor power equipment and its users and it cannot be rushed by efforts that overlook the impacts on consumer safety and their economic interests.

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[5] Growth Energy, "Application for a Waiver Pursuant to Section 211(f)(4) of the Clean Air Act for E15," March 6, 2009, p. 12.

The DOE Study includes Chapter 4, Next Steps. DOE outlines further work on emissions testing with 30 fuels, evaporative emissions, catalyst durability, driveability, compatibility, and specialty engines. Clearly, EPA needs this research to be completed before approving any mid-level ethanol blend petition.

NPRA strongly disagrees with Growth Energy's assertion that "for the purposes of this waiver request, the DOE Study provides sufficient data to establish, for vehicle exhaust emissions, that E-15 does not cause or contribute to a failure of any emission control device or system to meet its certified emissions standards."[6] This is refuted by DOE's continuing work.

Wendy Clark, NREL researcher and one of the DOE Study authors, was quoted by *The New York Times* in an article dated May 8, 2009: "Ms. Clark said the study was preliminary and should be followed up with comprehensive research on emissions and durability. 'The sample size is way too small,' she said."[7] Therefore, even a DOE Study author thinks that this was just a scoping study.

In an EPA "note" dated November 13, 2008, Constance Hart provided an update on ethanol related light duty vehicle testing funded by the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007.[8] For light duty gas exhaust fuels, the fuel matrix was revised to add more E20 fuels and reduce the amount of E15 fuels. Phase 1 is complete and the data is under review by EPA. What are these Phase 1 results? The Phases 1-3 testing is expected to be completed in March 2010. Unfortunately, this is not in time for EPA's decision on the E15 petition. This on-going EPA test program is another reason to deny the petition.

In an EPA memo dated February 22, 2008, Craig Harvey estimates a large increase in hose permeation emissions (grams per square meter per day) for non-handheld equipment between E10 and E20.[9] This EPA conclusion is counter to Growth Energy's assertion that emissions from E15 are comparable to those from traditional gasoline for small nonroad engines.

2. "ACE Study"

The second study is *Optimal Ethanol Blend-Level Investigation, Final Report*, prepared by Energy and Environmental Research Center and Minnesota Center for Automotive Research for

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6 *Ibid*., p. 17.

7 "Ethanol Industry's 15% Solution Raises Concerns," http://www.nytimes.com/2009/05/10/automobiles/10ETHANOL.html?_r=1&ref=politics

8 From Constance Hart (Assessment and Standards Division of EPA's Office of Transportation and Air Quality) to RFS2 Docket EPA-HQ-OAR-2005-0161, "EPAct/EISA Test Program Update," EPA-HQ-OAR-2005-0161-0642, p. 1.

9 From Craig A. Harvey (Assessment and Standards Division of EPA's Office of Transportation and Air Quality) to Docket EPA-HQ-OAR-2004-0008, "Modeling of Ethanol Blends on Nonroad Fuel Hose and Tank Permeation – Updated," EPA-HQ-OAR-2005-0161-0409, pp. 5 and 6.

American Coalition for Ethanol (October 2007) ("ACE Study"). Growth Energy concluded that this "report studied the effects of ethanol blends ranging from E-10 to E-85 on motor vehicles and found that exhaust emissions levels for all vehicles at all levels of ethanol blend were within the applicable Clean Air Act standards."[10] The value of this report in support of Growth Energy's petition is compromised by the fuel economy claims and the failure of the FFV to meet the NMOG emissions standard.

"While only three non-flex-fuel vehicles were tested in this study, there is a strong indication that non-flex-fuel vehicles operated on optimal ethanol blend levels, which are higher than the standard E10 blend, can obtain better fuel mileage than on gasoline" (ACE Study, p. iv). This is an amazing statement and calls into question the entire study. If this is true, then it can be replicated by others and it has not been.

For example, this result is refuted by DOE. "All 13 vehicles exhibited a loss in fuel economy commensurate with the energy density of the fuel. With E20, the average reduction in fuel economy (i.e., the reduction in miles per gallon) was 7.7 percent compared to E0 (finished gasoline without any ethanol). Limited evaluations of fuel with as much as 30% ethanol were conducted, and the reduction in miles per gallon continued as a linear trend with increasing ethanol content" (DOE Study, p. xvii).

In addition, the MCAR Study concluded "that volumetric fuel economy decreased when using E30" (MCAR Study, p. 1). This is clearly contrary to the report's claim of "better fuel economy than on gasoline."

The ACE Study included three non-FFVs and one FFV. "The flex-fuel Chevrolet Impala exceeded the NMOG standard for the FTP-75 on E20 and Tier 2 gasoline" (ACE Study, p. iv). This FFV had only 7,000 miles on its odometer. This failure was not expected because you might assume that E20 could be used in a FFV. This failure is acknowledged by Growth Energy, but it is buried in footnote 43.[11] This failure is an important consideration in EPA's review of this study.

3. "Minnesota Compatibility/Driveability Study"

Third, Growth Energy discusses *The Feasibility of 20 Percent Ethanol Blends by Volume as a Motor Fuel*, Executive Summary, Results of Materials Compatibility and Driveability Testing, prepared by the State of Minnesota and the Renewable Fuels Association (RFA) (March 2008)

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[10] *Op. cit.*, Growth Energy, p. 12.
[11] *Op. cit.*, Growth Energy, p. 18.

(“Minnesota Compatibility/Driveability Study: Executive Summary”). This summarizes five reports.

a. *The Effects of E20 on Metals Used in Automotive Fuel System Components* (“Metals Study”) Growth Energy states that this “study compared the effects of E-0, E-10 and E-20 on nineteen metals and found that the metals tested were compatible with all three fuels.”

b. *The Effects of E20 on Elastomers Used in Automotive Fuel System Components* (“Elastomers Study”) Growth Energy believes that this “study compared the effects of E-0, E-10 and E-20 on eight elastomers and found that E-20 caused no greater change in properties than E-0 or E-10.”

c. *The Effects of E20 on Plastic Automotive System Components* (“Plastics Study”) Growth Energy concludes that this “study compared the effects of E-0. E-10 and E-20 on eight plastics and found that there was no significant difference in the properties of the samples exposed to E-20 and E-10.”

d. *The Effects of E20 on Automotive Fuel Pumps and Sending Units* (“Fuel Pumps Study”) Growth Energy asserts that this “study compared the effects of E-0, E-10 and E-20 on the performance of twenty-four fuel pumps and nine sending units and found that E-20 has similar effect as E-10 and E-0 on fuel pumps and sending units.”

e. *Demonstration and Driveability Project to Determine the Feasibility of Using E20 as a Motor Fuel* (“Driveability Study”) Growth Energy claims that this “study tested forty pairs of vehicles on E-0 and E-20 and found no driveability or operational issues with either fuel.”[12]

The Metals Study concluded that 18 of 19 metals tested were found to be compatible (Metals Study, p. 8). One metal, Zamak 5, exhibited pitting, the formation of loose corrosion by-products and excessive mass loss when exposed to E20. E10 and E20 were tested, but not E15.

Bob Beneditti, National Fire Protection Association, expressed concerns about E15 compatibility with polymeric and elastomeric components of the fuel delivery and transfer system and its possible corrosion of the fuel storage system at a workshop hosted by the American Petroleum Institute on April 8, 2009.[13]

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[12] *Op. cit.*, Growth Energy, p. 13.

[13] EPA’s Office of Transportation and Air Quality was represented at this workshop by Jeff Herzog and Joe Sopata.

4. "CRC Permeation Study"

The fourth study is *Fuel Permeation from Automotive Systems: E-0, E-6, E-10, E-20 and E-85,* prepared by the Coordinating Research Council, Inc. (CRC Report No. E-65-3) (December 2006) ("CRC Permeation Study"). Growth Energy concludes that this "study evaluated effects of E-0, E-6, E-20 and E-85 on the evaporative emissions rates from permeation in five newer California vehicles and found that there was no statistically significant increase in diurnal permeation rates between E-6 and E-20)."[14] However, Growth Energy did not acknowledge that varying the ethanol content was significant for the steady-state data.

"The presence or absence of ethanol was statistically significant ($p \leq 0.05$) for all three independent variables [1) test timing; 2) fuel aromatics level; and 3) fuel ethanol content]. Both ln(diurnal)[15] and steady-state emissions increased when ethanol was present, while Specific Reactivity decreased. Varying the ethanol content was significant for the steady-state data (emissions increased as ethanol content increased), but was not significant ($p \geq 0.44$) for the ln(diurnal) and reactivity data" (CRC Permeation Study, p. 48). Therefore, Growth Energy selected the conclusion that was not statistically significant, ln(diurnal) and reactivity data, and ignored the finding that was statistically significant (steady-state data). This is yet another example of Growth Energy's self-serving selectivity.

5. "RIT Study"

The fifth study relied on by Growth Energy is *Report to the US Senate on E-20 Ethanol Research*, prepared by the Rochester Institute of Technology (October 2008) ("RIT Study"). Growth Energy asserts that this "study evaluated effects of E-20 on ten legacy vehicles; initial results after 75,000 collective miles driven found no fuel-related failures or significant vehicle problems and documented reductions in regulated tailpipe emissions when using E-20 compared to E-0."[16] There must be some further concerns because RIT is conducting follow-up research this year.

The RIT Study found that five of the ten vehicles had increases in NOx emissions with two of the five having NOx emissions increases over 25 percent (RIT Study, p. 3). Although the NOx emissions from all ten vehicles were below EPA standards, this is still significant.

In addition, "the evaluation plan is to retest emissions starting March 2009 on E20 to determine if any degradation has occurred, and then reconvert all 10 vehicles to gasoline. This will

[14] *Op. cit.*, Growth Energy, p. 12.
[15] Natural log transformation
[16] *Op. cit.*, Growth Energy, p. 12.

provide additional emissions data and reveal any effects of changing fuels" (RIT Study, p. 3). The results from this follow-up analysis will provide more information.

"Vehicle performance will be quantified at the next set of emissions testing in March 2009. Horsepower and torque will be measured on each vehicle running E20 and gasoline to determine if there is a performance issue. Additional engine management parameters such as long-term trim will be collected to determine if the vehicle has enough range to compensate for the ethanol within the fuel" (RIT Study, p. 5). This follow-up is another clear indicator that this study is preliminary and incomplete.

"Long-term durability issues are still under study. We anticipate providing further research results by the end of 2009" (RIT Study, p. 6). Therefore, the results from this additional research will not be available in time for EPA's decision on the E15 waiver petition.

Growth Energy's summary of the RIT Study fails to mention a NOx emissions increase over 25 percent for two vehicles and the RIT's plans for follow-up tests in 2009.[17] This omission is serious. NPRA is confident that this will be noticed during the Agency's review of the RIT Study.

6. "MCAR Study"

Use of Mid-Range Ethanol/Gasoline Blends in Unmodified Passenger Cars and Light Duty Trucks, prepared by Minnesota Center for Automotive Research (July 1999) ("MCAR Study") is the sixth study. Growth Energy's spin is that this "one-year study evaluated the effects of E-10 and E-30 in fifteen older vehicles in 'real world' driving conditions; found no effect on driveability or component compatibility from either fuel and found that regulated exhaust emissions from both fuels were well below federal standards."[18] This "conclusion" is misleading because there were emissions impacts.

Growth Energy did not mention any emissions increases. "No apparent trend in vehicle emissions was identified. Some emissions increased while others decreased. Almost all emissions were below federal standards" (MCAR Study, p. 8). "Almost" is not the same as Growth Energy's assertion "that regulated exhaust emissions from both fuels were well below federal standards." Growth Energy's spin mistakenly leads one to think that every vehicle was below federal standards.

7. "Stockholm Study"

Blending of Ethanol in Gasoline for Spark Ignition Engines: Problem Inventory and Evaporative Measurements, prepared by Stockholm University et. al. (2004-05) ("Stockholm

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[17] *Op. cit.*, Growth Energy, p. 21.
[18] *Op. cit.*, Growth Energy, p. 12.

Study") is the seventh study relied on in this petition. Growth Energy states that this "study tested and compared evaporative emissions from E-0, E-5, E-10, and E-15 and found lower total hydrocarbon emissions and lower evaporative emissions from E-15 than from E-10 and E-5)."[19] However, EPA should examine this report carefully.

Growth Energy cites the charts in Appendix 2 of the Stockholm Study.[20] However, these charts in Appendix 2 of the Stockholm Study are unreadable in black and white. Growth Energy's conclusions may be accurate, but they can't be verified. Still most noteworthy, these emission test results are for 'diurnal' emissions from a gasoline storage container with a hole and not from any vehicle fuel system. There is no evidence provided to suggest that these results of this test procedure are representative or a predictor of changes in vehicle diurnal evaporative emissions tests. Even so, the results show that adding E15 to the 63 kpa basefuel (which is similar to the RVP of Certification fuel) increases the diurnal emissions by about 26% which would make it difficult for any model vehicle to meet the evaporative emissions standard in the certification procedure. Also, there is no attempt in this evaporative emissions study to measure the evaporative emissions of a vehicle following a 'hot soak' cycle which is part of the vehicle certification procedure.

Section 7.1 of this report also raises concerns for the much higher deterioration rates for NOx emissions for a five vehicle study conducted in Australia. The NOx data in Table 7.1 show that the rate of increase of NOx emissions over 80,000 km (50,000 miles) for the vehicles operated on the E20 fuels is more than five times greater than that for the vehicles operated on the basefuel with no ethanol and that the NOx emissions for the E20 fuel increased by 190% over this 50,000 mile operation. Assuming this high deterioration factor is representative, it is doubtful that any vehicle model would still be able to meet the NOx emission standard over the useful life of the vehicle as required by law.

In addition, EPA should examine Appendix 1 of the Stockholm Study. Comparing test results for E15 versus E10 in Canada, it shows significant CO and HC emissions increases for the Silverado in Tables A1 and A2, and a significant NOx emissions increase for the Honda Insight in Table A3.

8. "Orbital Study"

Growth Energy has ignored a key study. Orbital Engine Company submitted a report dated November 2002 to Environment Australia, *A Literature Review Based Assessment on the Impacts of*

[19] *Op. cit.*, Growth Energy, p. 12.
[20] *Op. cit.*, Growth Energy, p. 25.

a 20% Ethanol Gasoline Fuel Blend on the Australian Vehicle Fleet ("Orbital Study"). "Tailpipe NOx emissions increased by approximately 30% with a 20% ethanol blend compared with no increase for a 10% blend" (Orbital Study, p. 4). This report was not cited by Growth Energy and this finding should concern EPA.

B. Growth Energy's application fails to meet EPA's requirements for approving a CAA section 211(f) waiver.

Except for the 1978 Gasohol fuel waiver, the Agency guidelines for CAA section 211(f) fuel waivers for oxygenated fuels require that all fuels introduced into commerce must meet the volatility requirements of ASTM standard D 4814 for gasoline such as expressed in the Agency's interpretation ruling for the fuel to be "substantially similar" to the certification gasoline used in 1975 or subsequent model year certification. In addition to meeting RVP specifications, the Agency's interpretative ruling essentially requires that the waivered fuel must also meet other gasoline volatility specifications for maintaining fuel operating and emission performance in vehicles, such as the meeting the 50% distillation minimum temperature and the minimum temperature for 'vapor/liquid' ratios equal to 20. The waiver application by Growth Energy appears to be silent on this ASTM requirement, and suggests that the E20 fuel emission performance might not be any worse that the commercial E10 fuel blends that are currently allowed under the Gasohol fuel waiver. However, to the best of our knowledge, it has never been demonstrated that E10 fuels currently introduced to commerce blended under the Gasohol waiver will perform substantially similar to any fuel or fuel additive utilized in the certification of vehicles, or will not cause or contribute to a failure of any emission control device or system (over the useful life of the motor vehicle, motor vehicle engine, nonroad engine or nonroad vehicle in which such device or system is used) to achieve compliance by the vehicle or engine with the emission standards to which it has been certified pursuant to sections 206 and 213(a) of the Clean Air Act.

Essentially, per the Agency's guidelines, the Administrator may only grant a waiver for a prohibited fuel or fuel additive if the applicant can demonstrate that the new fuel or fuel additive will not cause or contribute to engines, vehicles or equipment failing to meet their emissions standards over their useful life. Based on this criteria, making a comparison to emissions from Gasohol blends does not meet the Agency's own criteria since Gasohol-waivered fuel blends have not been demonstrated to meet these substantially similar requirements.

V. GRANTING GROWTH ENERGY'S E15 PETITION IS NOT AN EFFECTIVE SHORT- OR MID-TERM SOLUTION TO AVOIDING THE "BLENDWALL."

The current EPA limit for blends of ethanol with gasoline for use in conventional gasoline engines is E10. Blends in excess of E10 (such as E85) are classified by EPA as alternative fuels, not gasoline, and may only be used in alternative fuel vehicles, such as those with flexible fuel designs. Thus, under the Clean Air Act and EPA "sub sim" regulations, it is unlawful for mid-level ethanol blends, such as E12, E13, E15 or E20 to be sold in the United States for use in conventional (non-FFV) motor vehicles or non-road engines.

Ethanol is currently blended into about 75 percent of all of gasoline sold in the U.S., generally at a blend of 10 volume percent (although some gallons do contain ethanol blends of 5.7 or 7.7 volume percent due to blending, tax, or environmental restrictions in some areas of the country). The volumes of conventional and cellulosic biofuels mandated in EISA are so large that even blending all gasoline with 10 volume percent ethanol will be an insufficient compliance strategy. Absent a full E15 or E20 waiver when sufficient testing and analysis are completed, the use of E85 may have to be substantially expanded.

However, EPA should not rush approval of E15 in order to postpone the blendwall. The Agency should make a scientifically sound decision based on an analysis of the safety of mid-level ethanol blends for use in all gasoline-powered motor vehicles and engines in the United States. Safety is paramount.

Implementation of E15 could not be done without other rulemakings to modify Federal and State gasoline regulations. For example, changes in ASTM quality specifications would also be necessary prior to implementation. These required regulatory and specification modifications would take several years to complete, thus E15 would not be allowed in the short-term until the required changes were in place.

Growth Energy estimates that the annual ethanol market is 20.4 billion gallons if an E-15 blend is used in **all** U.S. gasoline.[21] This is an increase over ethanol use in 2008 (9.6 billion gallons). However, Growth Energy's estimate of 20.4 billion gallons is an overstatement because it assumes that E-15 can be used in all RFG, older vehicles, boats and small engines.

The discussion below explains why other rulemakings would be necessary and why 20.4 billion gallons is an overstatement.

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[21] Growth Energy, Economic Impacts of Increasing the Ethanol Blend Limit, March 4, 2009, page 2.

Even if mid-level ethanol blends are approved by EPA, mid-level ethanol cannot be used in federal RFG or CaRFG3 without further rulemakings. Therefore, about one-third of U.S. gasoline would not be permitted initially to use mid-level ethanol blends. First, the complex model used for federal RFG VOC, NOx and toxics compliance has limits at 40 CFR 80.45(f)(1)(i). The acceptable range for oxygen is 0.0 – 4.0 weight percent. The complex model is not used now (since 2007) for RFG NOx compliance because of the Tier 2 sulfur standards (except for certain small refiners). The complex model will not be used for RFG toxics compliance beginning in 2011 because of the MSAT2 standard (except for small refiners who are exempt until 2015). EPA would have to conduct a rulemaking to revise the complex model to accommodate mid-level ethanol blends for the federal RFG VOC standard. Second, current EPA RFG product transfer document regulations in 40 CFR Part 80 do not recognize or allow mid-level ethanol blends.

Likewise, the complex model is not now used for conventional gasoline anti-dumping NOx compliance and will not be used beginning in 2011 for conventional gasoline anti-dumping toxics compliance (except for certain small refiners). Until 2011, the complex model used for federal conventional gasoline toxics anti-dumping compliance has limits at 40 CFR 80.45(f)(1)(ii). The acceptable range for oxygen is 0.0 – 4.0 weight percent. There is not yet a retail gasoline sampling and testing program in conventional gasoline areas so that refiners can claim oxygen dilution on conventional gasoline batch reports, but negotiations are underway. EPA could conduct a rulemaking to revise the complex model to accommodate mid-level ethanol blends for conventional gasoline anti-dumping toxics compliance before 2011, but this is unlikely. Therefore, the use of E15 in conventional gasoline in 2010 would create problems for anti-dumping toxics compliance.

CARB completed CaRFG3 rule revisions in June 2007 and they will be effective beginning December 31, 2009. These amendments do not require more ethanol (currently most gasoline in California contains 5.7 vol% ethanol), but the amendments update the Predictive Model and mitigate permeation emissions from the addition of ethanol up to 10 vol%. CARB would need to conduct another rulemaking to amend the Predictive Model for mid-level ethanol blends.

It has been suggested that the Agency may be considering a partial waiver that would permit only newer vehicles – perhaps Tier 2 vehicles – to fuel with a mid-level ethanol blend. If EPA is considering only Tier 2 vehicles, then this partial waiver for E15 would be restricted to a small fraction of the current gasoline vehicle fleet.

The potential increase in ethanol consumption from a partial E15 waiver would be very small because, as explained above, E15 cannot be used in RFG, older vehicles, any boats and any small engines. The following discussion explains why this potential is small.

The fact that E15 cannot be immediately used in RFG (as explained above) removes one-third of U.S. gasoline.

E15 cannot be used in nonvehicular engines in this partial waiver scenario. Gasoline use in non-passenger cars and non-LDTs removes 11%.[22]

About 60% of the new passenger cars and LDTs for MYs 2003-2007 were EPA Tier 2 control technologies because of the phase-in of the NOx emissions standards. This is significant because many newer vehicles during MY 2003-2007 were not designed to comply with all of the Tier 2 emissions standards. About 20% of the gasoline fleet are MY 2003-2007 vehicles. All new vehicles since MY 2007 are Tier 2 vehicles.

Therefore, 89% of gasoline is used in vehicles (versus small engines) x 66% of gasoline use in conventional gasoline (to remove the RFG volumes) x [[60% of the MY 2003-2007 cars are Tier 2 vehicles x 20% of the fleet are MY 2003-2007 vehicles] + [12% of the feet are full Tier 2 MY 2008-2010 vehicles]]. Or [0.89 * 0.66 * [[0.6 * 0.2] + 0.12]] = 0.14 These calculations show that only 14% of current gasoline use would qualify for a partial waiver.

0.14 * 135 billion gallons gasoline in 2008 = 18.9 billion gallons of E15.

Five percent[23] of 18.9 billion gallons = 1 billion gallons.

Therefore, a limited E15 waiver could increase the annual market for ethanol by as little as one billion gallons. Even if you assume rulemakings to allow E15 in RFG, a limited E15 waiver could increase the annual market for ethanol by an additional 0.5 billion gallons. This would have a small effect on the timing of the blendwall problem with RFS2 mandates of 12.95 billion gallons in 2010, 13.95 billion gallons in 2011, and 15.2 billion gallons in 2012 (most of which will be ethanol). Given the time required to complete the necessary rulemaking and specification changes required to implement E15 in the marketplace, a partial waiver would not be effective in extending the blendwall.

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22 This estimate of 11% includes recreational boats, aircraft, construction/mining equipment, agricultural equipment, motorcycles, snowmobiles, logging equipment, and lawn and garden equipment.

23 Because E15 adds 5 vol% ethanol to E10.

VI. IMPLICATIONS FOR FEDERAL AND STATE FUEL PROGRAMS

This petition, if granted, would have wide-ranging implications on other federal and state fuels programs and, as mentioned above, would require a series of complex and lengthy rulemakings to harmonize these programs with the introduction of mid-level ethanol blends. From a practical perspective, any waiver to allow the use of mid-level ethanol blends will have significantly diminished effect until such regulatory changes are made. Hence, once sufficient testing is complete, if EPA decides to grant a full waiver to allow the use of mid-level ethanol blends, it must undertake a series of regulatory changes on a priority basis.

A. Federal Complex Model

The complex model used for federal RFG VOC, NOx and toxics compliance has limits for specific parameters at 40 CFR 80.45(f)(1)(i). The acceptable range for oxygen is 0.0 – 4.0 weight percent. The complex model is not used now (since 2007) for RFG NOx compliance because of the federal Tier 2 gasoline sulfur standards (except for certain small refiners). The complex model will not be used for RFG toxics compliance beginning in 2011 because of the MSAT2 standard (except for small refiners who are exempt until 2015). If EPA approved a mid-level ethanol waiver petition for applicability to federal RFG, then the Agency would have to conduct a rulemaking to revise the complex model to accommodate mid-level ethanol blends for the federal RFG VOC standard. This is an additional reason for the Agency to deny the mid-level ethanol blend waiver petition because there is inadequate data to revise the complex model for federal RFG.

Likewise, the complex model is not now used for conventional gasoline anti-dumping NOx compliance and will not be used beginning in 2011 for conventional gasoline anti-dumping toxics compliance (except for certain small refiners). Until 2011, the complex model used for federal conventional gasoline toxics anti-dumping compliance has limits for specific parameters at 40 CFR 80.45(f)(1)(ii). The acceptable range for oxygen is 0.0 – 4.0 weight percent. If EPA granted the mid-level ethanol blend waiver petition for applicability to conventional gasoline before January 1, 2011, then the Agency would have to conduct a rulemaking to revise the complex model to accommodate mid-level ethanol blends for the federal anti-dumping toxics standard. This is yet another reason for the Agency to deny the mid-level ethanol blend waiver petition because there is inadequate data to revise the complex model for the federal anti-dumping toxics standard.

B. California Predictive Model

CARB has recently revised its CaRFG3 regulations to accommodate E10. These regulations do not include any flexibility for mid-level ethanol blends and would need to be revised if California decided to include mid-level ethanol blends for CaRFG3.

C. RFG PTD

EPA has extensive RBOB product transfer document (PTD) regulations in 40 CFR Part 80 and they do not recognize mid-level ethanol blends. If the Agency decided to approve the mid-level ethanol blend waiver petition for applicability to federal RFG, these RBOB PTD regulations would need to be revised.

D. One Psi RVP Waiver

CAA Section 211(h)(4) is applicable to conventional gasoline: "For fuel blends containing gasoline and 10 percent denatured anhydrous ethanol, the Reid vapor pressure limitation under this subsection shall be one pound per square inch (psi) greater than the applicable Reid vapor pressure limitations established under paragraph (1) [phase II RVP]; ..."

How would this apply to conventional gasoline/mid-level ethanol blends, such as E15? On the one hand, E15 contains 15 vol% ethanol, not 10 vol%. On the other hand, E15 contains 10 vol% plus some more. In this situation, Congressional intent is important. Congress clearly did not intend that this RVP waiver could be applicable to any other product than E10. Otherwise, this legislative provision would have been written differently.

EPA's interpretation of this provision could have a significant impact on the ability of the petroleum industry to supply such mid-level ethanol blends. The implications of the unavailability of this one psi RVP waiver for E15 are that refiners will have to produce a lower RVP blendstock and that ethanol could not be splash-blended at 15 vol% with E0 in the summer.

E. State E10 Mandates

There are a few states with year-round E10 mandates, including Hawaii, Minnesota, Missouri, and Oregon; these E10 mandates often include exceptions for boats, off-road vehicles, motorcycles, aircraft, snowmobiles, small engines, or if the price of ethanol is higher than the price of unblended gasoline. In addition, there are a few states with E10 mandates and effective dates in the future, including Florida, Louisiana, Montana, Pennsylvania and Washington. How would these state regulations be affected by EPA's approval of mid-level ethanol blends?

F. ASTM and State Gasoline Quality Specifications

There are a number of states, via regulatory language, that require gasoline-ethanol blends to meet ASTM D 4814 specifications. Recently, ASTM has adopted new volatility specifications applicable to gasoline-ethanol blends with maximum ethanol concentrations of 10 volume percent. ASTM would need to develop and adopt new specifications to account for higher ethanol volumes in the final gasoline blend. Without this modification, E15 could not be distributed in states requiring blends to meet the ASTM specification.

VII. CONCERNS ABOUT A PARTIAL OR CONDITIONAL WAIVER

The Agency is considering bifurcating the gasoline market by approving mid-level ethanol blends for use in some subset of the current or future gasoline-powered engine inventory.[24] In addition, EPA made this option clear in a written statement dated April 1, 2009 (p. 6) for the Subcommittee on Clean Air and Nuclear Safety of the Senate Environment and Public Works Committee:

> A key issue is whether a waiver should be granted in whole or in a conditional or partial manner, such that the use of up to E15 would be restricted to a subset of gasoline vehicles or engines covered by the waiver provision, while other vehicles or engines would continue using fuels with blends no greater than E10. If a conditional waiver were granted, it may necessitate changes in the fueling infrastructure to accommodate different blend levels. New pump labeling requirements or other measures may be needed to ensure consumers use the appropriate fuel for their vehicles and equipment.

NPRA vigorously opposes a partial or conditional waiver to permit mid-level ethanol blends to be introduced into commerce. Our opposition is based on multiple factors, both practical and legal: (1) the very real likelihood of misfueling in a balkanized gasoline distribution system; (2) the strain that such a division would place on an already strained wholesale and retail gasoline delivery infrastructure; (3) there is virtually no retail infrastructure (dispensers, underground storage tanks and piping) currently in place that is certified to handle mid-level ethanol blends; and (4) EPA lacks the statutory authority under the Clean Air Act to grant such a partial or conditional waiver.

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[24] "One potential outcome at the end of our process, after reviewing the entire body of scientific and technical information available to us, may be an indication that a fuel up to E15 could meet the criteria for a waiver for some vehicles and engines but not for others. Some vehicles and engines may be more susceptible to emission increases or durability problems that cause or contribute to these vehicles or engines failing to meet their emissions standards." 74 Fed. Reg. 18,229 (April 21, 2009). Also see 74 Fed. Reg. 25,016 (May 26, 2009).

A. Misfueling

Depending on the results of testing, misfueling may be a significant problem. Mid-level ethanol blends could find their way into older vehicles, small engines and boats with potential consequences for personal safety, irreversible damage, emissions increases, mass consumer confusion, operational problems, a loss of the manufacturer's reputation, and warranty arguments. This would be likely if the portable gasoline container was not marked or labeled.

During the transition from leaded to unleaded gasoline, a physical barrier – the incompatibility of a large diameter leaded gasoline pump nozzle and a new car's small diameter filler neck – was necessary to prevent (or minimize) misfueling so that leaded gasoline did not cause a failure for the new vehicle's catalyst. Depending on the severity of adverse impacts determined by the testing of the legacy fleet with E15, a similar physical barrier may be necessary to reduce the possibility of using E15 in an older vehicle. The lack of such a physical barrier today could be a significant impediment if one is needed. EPA would need to resolve the dilemma with strong preventive measures or drop its consideration of a partial or conditional waiver to approve E15 for only vehicles built in the last few years.

There was no need for such a physical barrier when RFG was introduced because it had no effect on the pollution control equipment efficiency or performance of legacy vehicles.

The Agency may be considering the use of an electronic card to activate an E15 retail pump in order to address consumer misfueling. This electronic card would be mailed by the government to owners of qualifying newer vehicles. An E15 retail pump could not be activated without the insertion of this electronic card. This "George Orwellian" idea would not be an effective program to eliminate consumer misfueling for many reasons.

A consumer who owns a newer vehicle could use this card to activate an E15 retail pump for filling a portable container or an older vehicle. These cards would be stolen, sold on the internet, or loaned to friends to purchase E15 when it is cheaper than E10.

Other electronic devices could be considered but would need to be affixed permanently to the eligible vehicle. Such a solution could work for new vehicles perhaps, but retrofitting legacy vehicles would be problematic.

B. Distribution

If the Agency approves E15 for vehicles built in the last several years, but not for older vehicles, small engines or boats, then the petroleum industry would be expected to provide E15 for these newer vehicles and E0-E10 for other gasoline engines. This would present distribution problems in terms of terminal storage capacity and retail station distribution by pump. Many terminals will not have enough excess tankage to support both products. In addition, retail stations with only two underground storage tanks would have a quandary as to what products to supply at specific octane ratings.

Underwriters Laboratories (UL) issued a statement on its view of ethanol blends and UL listed fuel dispensing devices:[25]

> The press release details UL's support of AHJs who decide to permit fuel dispensing devices, Listed to UL 87 (Power-Operated Dispensing Devices for Petroleum Products) and currently installed in the market, to be used with fuel blends containing a maximum ethanol content of 15 percent. UL stresses that fuel dispensing devices pumping this higher percentage of ethanol should be subject to regular inspection and preventative maintenance as specified by the dispenser manufacturer for the blend of fuel being dispensed ***because the potential for degradation of metals and materials used in a dispensing system increases as the percentage of ethanol increases.*** (emphasis added)

> In its press release dated February 19, 2009:

> UL stresses that existing fuel dispensers certified under UL 87 were for intended use with ethanol blends up to E10, which is the current legal limit for non-flex fuel vehicles in the United States under the federal Clean Air Act. However, data the company has gathered as part of the organization's ongoing research to investigate the impact of using higher ethanol blends in fuel dispensing systems supports that existing dispensers can be used with ethanol blends up to 15 percent. AHJs [Authorities Having Jurisdiction] are advised to consult with the dispenser manufacturer to confirm that the dispenser is compatible with the fuel to be dispensed. UL researchers found that using equipment certified to UL 87 to dispense ethanol blends with a maximum ethanol content of 15 percent should not result in critical safety concerns. However, the company stressed that dispensers pumping this higher percentage of ethanol should be subject to regular inspection and preventative maintenance as specified by the dispenser manufacturer for the blend of fuel being dispensed **because the potential for degradation of the metals and materials (e.g., plastics, elastomers and composites) used in a dispensing system increases as the percentage of ethanol increases**. UL determined that there is no significant incremental risk of damage between E10 and fuels with a maximum of 15 percent ethanol. This conclusion was reached after careful examination of the effects of varying levels of ethanol on components, said John Drengenberg, Consumer Affairs Manager for UL. We will continue to evaluate test and field findings, as well as the scientific literature, as it becomes available and make this

[25] "UL's support of AHJ's approving fuel dispensing equipment pumping fuels with a maximum of 15% Ethanol," http://www.ul.com/global/eng/pages/offerings/perspectives/regulator/e85info/ahjupdate/

> information available to AHJs. AHJs are the local regulatory and approval entities that make the final determination of the acceptance of fuel dispensing devices. UL makes its research findings available to the AHJs for their consideration. Standard UL 87 is used by UL research and testing staff members to evaluate fuel dispenser systems and their component parts for use with motor fuels with ethanol blends up to E10. (emphasis added)

UL has many reservations. The lack of an unqualified UL endorsement is a clear sign that the Agency should not approve the application to permit E15 as gasoline at this time.

Even if UL does certify a complete E15 system in the future, this would not apply to the vast majority of retail equipment currently in place. Fire codes and insurance regulations will not permit the sale of mid-level ethanol blends in existing equipment.

C. EPA Lacks the Authority Under CAA Section 211(f)(4) to Issue a "Partial Waiver."

EPA raises in the Waiver Notice the possibility of conditionally approving the use of E15 or lesser mid-level blends only for a limited subset of vehicles. 74 Fed. Reg. 18,230. If EPA were to develop such a "bifurcated fuels" program pursuant to a partial E15 waiver, the Agency would be at risk for a CAA section 307 judicial challenge alleging that the Agency's interpretation of section 211(f)(4) is unreasonable and exceeds the Agency's authority.

Whether EPA may grant a partial waiver under CAA section 211(f)(4) depends entirely upon the authority granted by that provision. The scope of EPA's authority is determined using the familiar two-part test set forth in *Chevron U.S.A. Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837 (1984). *Chevron* Step One asks whether the statutory language is clear. If it is, then that is the end of the matter and EPA has no discretion to pursue a contrary agency interpretation. If, however, the language is ambiguous, *Chevron* Step Two requires a court to accept any "reasonable agency interpretation" of the ambiguous statute. *Chevron*, 467 U.S. at 842-43.

Applying this test, we believe that CAA section 211(f)(4) is clear on its face and provides EPA only with the authority to grant full waivers. Section 211(f)(4) authorizes EPA to grant a waiver if:

> the applicant has established that such fuel or fuel additive or a specified concentration thereof, and the emission products of such fuel or additive or specified concentration thereof, will not cause or contribute to a failure of ***any*** emission control device or system (over the useful life of the motor vehicle, motor vehicle engine, nonroad engine or nonroad vehicle in which such device or system is used) to achieve compliance by the vehicle or engine with the emission standards with respect to which it has been certified . . . .

CAA § 211(f)(4) (emphasis added).

A plain reading of this provision prohibits the Agency from issuing partial waivers. To be eligible for a waiver, an applicant must show that the fuel or additive will not affect "any" emission control device found in the national fleet, not just a subset of controls found in certain vehicles or engines. Congress's use of the word "any" with respect to "emission control device" suggests that the language is clear and not ambiguous. Indeed, the courts on many occasions have found the use of the word "any" in statutory language to indicate clear legislative intent. The Supreme Court has drawn upon the word "any" to give the word it modifies an "expansive meaning" when there is "no reason to contravene the clause's obvious meaning." *Norfolk S. Rwy. Co. v. Kirby*, 543 U.S. 14, 31-32 (2004). The Court also has read the word "any" to signal expansive reach when construing the Clean Air Act. In *Harrison v. PPG Industries, Inc*., 446 U.S. 578 (1980), the Court interpreted the phrase "any other final Action" to have "no uncertainty." 446 U.S. at 588. "[I]n the absence of legislative history to the contrary," the Court held that the statutory phrase "must be construed to mean exactly what it says, namely, *any other* final action." *Id*.

In addition, the term "emission control device or system" which follows "any" in section 211(f)(4) cannot be interpreted to mean "some but not all devices or systems," because in doing so the use of "any" loses all meaning and violates principles of statutory construction. *See New York v. EPA*, 443 F.3d 880, 887 (D.C. Cir. 2006) ("EPA's position is that the word 'any' does not affect the expansiveness of the phrase 'physical change'; it only means that, once the agency defines 'change' as broadly or as narrowly as it deems appropriate, everything in the agency-defined category is subject to NSR. [But reading] the definition in this way makes the definition function as if the word 'any' had been excised from section 111(a)(4); there is virtually no role for 'any' to play."). Based on this case law, EPA cannot pick and choose which emission control devices will operate using E15, but rather must grant a waiver only if all devices will not be impacted by the fuel.[26]

Therefore, were EPA to proceed with a partial E15 waiver, there would be a viable challenge pursuant to CAA section 307 that EPA exceeded its statutory authority and hence that the decision was invalid. This is because EPA would have wrongly interpreted an otherwise clear statutory provision, in violation of *Chevron* Step One. Since the statutory language is clear, there is no need to consider whether the interpretation is reasonable under *Chevron* Step Two.

[26] It is notable that such devices now explicitly include both on-road and nonroad vehicles and engines pursuant to amendments to section 211(f)(4) enacted by the Energy Independence and Security Act of 2007 (Pub. L. 110-140). In amending section 211(f)(4), Congress expanded the types of devices for which an applicant must establish that a fuel or fuel additive will not cause or contribute to a failure while retaining the prohibition of causing or contributing to the failure of "any" device.

VIII. EPA SHOULD NOT ISSUE A REVISED INTERPRETATION OF "SUBSTANTIALLY SIMILAR."

The Agency has announced an interpretation of gasoline characteristics that is "substantially similar" to gasoline used in 1975 or subsequent model year certification. EPA has revised its interpretive rule, such as in 1991 to grant a request to increase the allowable oxygen content for "substantially similar" unleaded gasoline from 2.0 to 2.7 wt% for blends of aliphatic alcohols and/or ethers.[27]

In its cover letter dated March 6, 2009, Growth Energy acknowledged "the efforts underway between EPA and USDA to provide short-term relief through a substantially similar waiver for E12 or E13. The EPA is free to utilize the data contained herein to support an immediate increase to E12 or E13 while studying the merits and data relevant to the 211(f)(4) waiver up to E15 within the 270 day timeframe."

There is insufficient data for the Agency to revise its "substantially similar" definition to include mid-level ethanol blends (even those close to and slightly higher than E10, such as E12) because the Agency cannot conclude, until the ongoing research is completed, that emissions properties will be substantially similar to unleaded gasoline in vehicle certification fuel.

Allowing up to 4.5 wt% oxygen would accommodate 12 vol% ethanol (74 Fed. Reg. 25,019; May 26, 2009). This would be a substantial change in the interpretation of sub sim (maximum 2.7 wt% oxygen content for aliphatic alcohols) and, therefore, EPA could not immediately revise sub sim to include E12 or E13. The Agency could only amend the current sub sim interpretative rule with a substantial change through notice and comment.

IX. CONCLUSION

For the reasons stated above, NPRA urges EPA to reject the petition filed by Growth Energy to approve E15 as gasoline.

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[27] http://www.epa.gov/otaq/regs/fuels/additive/jan91.pdf 56 Fed. Reg. 5,352 (February 11, 1991) For more information on "substantially similar:" http://www.epa.gov/otaq/additive.htm

March 26, 2009

The Honorable Steven Chu Secretary of Energy U.S. Department of Energy Washington, D.C. 20585-1000	The Honorable Lisa Jackson Administrator U.S. Environmental Protection Agency Washington, D.C. 20460
The Honorable Tom Vilsack Secretary of Agriculture U.S. Department of Agriculture Washington, D.C. 20250	The Honorable Carol Browner Asst. to the President for Energy & Climate Change The White House Washington, D.C. 20500

Dear Secretaries Chu and Vilsack, Administrator Jackson and Mrs. Browner:

The undersigned diverse group of business, environmental, taxpayer, free-market and public health groups opposes any administrative or legislative efforts to increase the current cap on the amount of ethanol permitted to be blended into gasoline until independent and comprehensive testing has been completed that indicates that such mid-level ethanol blends (whether E12, E15 or E20) will not pose a risk to all gasoline-powered engines, to public health, to the environment and to consumers.

To quote from President Obama's March 9, 2009 Memorandum on "Scientific Integrity":

> "Science and the scientific process must inform and guide decisions of my Administration on a wide range of issues, including improvement of public health, protection of the environment, increased efficiency in the use of energy and other resources, mitigation of the threat of climate change, and protection of national security."

Some have advocated that Congress or the Environmental Protection Agency ignore President Obama's Memorandum, avoid the safeguards built into Section 211(f) of the Clean Air Act (safeguards that were just strengthened by Congress in 2007), and approve mid-level ethanol blends before comprehensive testing programs on these blends have been completed by qualified and independent stakeholders, such as the Department of Energy and the Coordinating Research Council. We collectively, and strongly, oppose such an ill-considered approach as contrary to scientific integrity and potentially harmful to our environment, public health and consumers.

Sincerely,

Alliance for Worker Freedom

American Bakers Association

American Beverage Association

American Conservative Union

American Lung Association

American Meat Institute

American Sportfishing Association

Americans for Tax Reform

Americans for the Preservation of Liberty

Association of International Automobile Manufacturers

Association of Marina Industries

Boat Owners Association of the United States

Center for Auto Safety

Clean Air Task Force

Competitive Enterprise Institute

Council for Citizens Against Government Waste

Earthjustice

Engine Manufacturers Association

Environmental Working Group

Friends of the Earth

Grocery Manufacturers Association

Hispanic Alliance for Prosperity Institute

The Hispanic Institute

International Dairy Foods Association

International Snowmobile Manufacturers Association

National Center for Public Policy Research

National Chicken Council

National Council of Chain Restaurants

National Marine Manufacturers Association

National Petrochemical and Refiners Association

National Restaurant Association

National Taxpayers Union

National Turkey Federation

Natural Resources Defense Council

Outdoor Power Equipment Institute

Personal Watercraft Industry Association

Public Citizen

Sierra Club

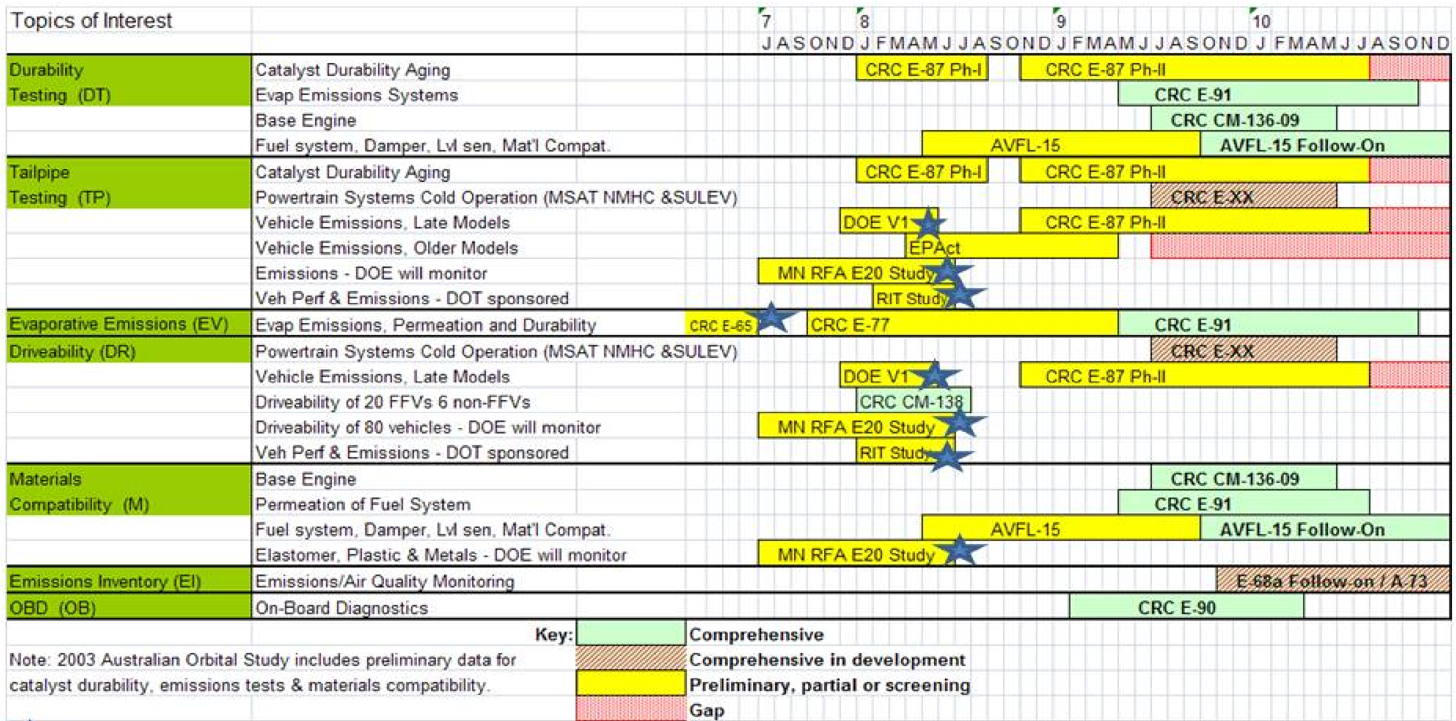
Small Business & Entrepreneurship Council

Snack Food Association
Taxpayers for Common Sense

Alabama Poultry and Egg Association
California Poultry Federation
Georgia Poultry Federation
Indiana Poultry Federation
Iowa Turkey Federation
Minnesota Turkey Growers Association
Mississippi Poultry Association
North Carolina Poultry Federation
Poultry Federation of Arkansas, Oklahoma and Missouri
Virginia Poultry Association

Butterball, LLC
FarmEcon LLC.
Gold'n Plump Poultry
Pilgrim's Pride

Program Summary



★ Cited by Growth Energy Petition, notation added by Auto Alliance

ATTACHMENT 4

ALLIANCE OF AUTOMOBILE MANUFACTUERS

COMMENTS ON

CLEAN AIR ACT WAIVER APPLICATION TO INCREASE THE ALLOWABLE ETHANOL CONTENT OF GASOLINE TO 15 PERCENT

SUBMITTED TO

U.S. ENVIRONMENTAL PROTECTION AGENCY

JULY 20, 2009

For more information, please contact:

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ALLIANCE OF AUTOMOBILE MANUFACTUERS

COMMENTS ON

GROWTH ENERGY'S APPLICATION FOR A WAIVER TO INCREASE THE ALLOWABLE ETHANOL CONTENT IN GASOLINE TO 15 PERCENT
74 Fed. Reg. 18228 (April 21, 2009)

The Alliance of Automobile Manufacturers (Alliance)[1] welcomes the opportunity to comment on the application submitted by several ethanol producers (Growth Energy Application) to waive Clean Air Act "substantially similar" requirements for gasoline-ethanol blends containing 15% ethanol by volume or, at least, more than the currently allowed 10% ethanol by volume.[2] The Alliance asks EPA to deny this waiver application, in whole and in part, because insufficient data are available to determine whether the proposed fuel blend(s) can satisfy the legal requirements under the Clean Air Act section 211(f)(4).

The Alliance intends these comments to be read in conjunction with comments being submitted separately by the Alliance for a Safe Alternative Fuels Environment (AllSAFE), of which the Alliance is a member.[3] The AllSAFE comments discuss more fully our concerns regarding the concept of a partial waiver. We incorporate the AllSAFE comments here by reference.

As many recognize, the Growth Energy Application is related to the revised Renewable Fuel Standard (RFS2) under the Energy Independence and Security Act of 2007 (EISA) and the so-called "blend-wall problem." Due to this linkage, EPA raised several additional policy and implementation issues in the application notice. These issues include, for example, the larger questions of how the country should deploy the volumes of ethanol called for by the RFS2, how EPA should address the blend wall issue and how it could implement a waiver for just part of the fleet. While we address some of these issues here, we do so only briefly and are reserving a more in-depth discussion for our pending comments on EPA's proposed rule to implement the RFS2. We would like EPA to incorporate those comments in the waiver docket when they become available. The additional issues raised by the Agency are very important, but they are outside the scope of the waiver decision, which must be based on the criteria contained in section 211(f)(4) of the Clean Air Act (CAA or Act).

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[1] The Alliance is an association of 11 vehicle manufacturers including BMW Group, Chrysler Group LLC, Ford Motor Company, General Motors, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche, Toyota and Volkswagen. Formed in 1999, the Alliance serves as a leading advocacy group for the automobile industry on a range of public policy issues. This association, which is open to all new car and light truck manufacturers, is especially committed to sustainable mobility. For more information about the Alliance, please visit www.autoalliance.org.

[2] Growth Energy, a trade association, submitted the application under the Clean Air Act sec. 211(f)(4) on behalf of 52 ethanol manufacturers. For simplicity, these comments refer to "Growth Energy" as the applicant and to the "Growth Energy Application" or "Application" as the submittal.

[3] AllSAFE members include national consumer and manufacturing associations whose members' products consumer gasoline and ethanol fuel blends. For more information see www.allsafe-fuel.org.

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Introduction

In these comments, the Alliance focuses on whether ethanol blend levels greater than 10% and up to 15% by volume can affect vehicle emissions, performance, durability and overall customer satisfaction. Essentially, this is a question concerning a fuel's composition, qualities, performance and characteristics (hereafter "fuel quality"), because fuel quality can significantly affect how a vehicle performs. Effects may occur immediately or become apparent only after repeated exposure to the fuel over time. Sometimes, the impact is irreversible. More importantly for policymakers, fuel quality can affect a vehicle's ability to comply with emission standards, deliver planned fuel economy and/or use certain technologies. In other words, fuel quality is a critical design element that determines vehicle compliance with emission standards for the vehicle's Full Useful Life (FUL) and justifiably limits vehicle warranty coverage. This is why vehicles and fuels must be viewed together as a functional system.

To achieve emission standards and customer satisfaction objectives, manufacturers must design and test vehicles using fuels with defined specifications. Some specifications, like ethanol content, may encompass a particular range. The narrower the fuel quality range, the higher the confidence that the vehicle will meet its emissions and performance targets. If the fuel property is outside the range for which the vehicle was designed or certified, the manufacturer cannot guarantee the vehicle will perform as expected when using the given fuel.

Historically, EPA has never allowed conventional vehicles to use gasoline blends with more than 10% ethanol. Until very recently, neither auto manufacturers nor others had a reason to design, test or warrant conventional vehicles (intended for the U.S. market) for use with higher ethanol blends. As a result, the public and private data bases are very limited. The application presents a serious concern for automakers and consumers. It is asking for approval of ethanol blends for which the vast majority of the current fleet and the near term future fleet have not been designed or validated. Flexible Fueled Vehicles (FFVs) can handle any ethanol blend from E0 to E85, and while their numbers are growing rapidly, they still represent a minority of the fleet. Furthermore, when E10 was granted a waiver, the renewable fuel standard did not exist, so ethanol's market share was small and continued to be so for decades.

The Clean Air Act requires, and the Alliance supports, a data-driven judgment on the extent to which E15 (or any other mid-level blend) may affect vehicle emissions and performance, and therefore, whether the fuel blend should be allowed in the U.S. market for use in conventional vehicles. To help EPA understand the existing data base of impacts, we review below the studies submitted with Growth Energy's waiver application as well as other studies of which we are aware. This review leads us to conclude that EPA currently lacks sufficient data to make a sound, science-based judgment about E15 (or any gasoline-ethanol blend between E10 and E15). EPA should deny this waiver and continue to reserve blends containing more than 10% ethanol for FFV use only.

Legal Requirements

Clean Air Act Sec. 211(f)(4)

Section 211(f)(4) states:

> The Administrator, upon application of any manufacturer of any fuel or fuel additive, may waive the prohibitions established under paragraph (1) or (3) of this subsection or the limitation specified in paragraph (2) of this subsection, if he determines that the applicant has established that such fuel or fuel additive or a specified concentration thereof, and the emission products of such fuel or additive or specified concentration thereof, *will not cause or contribute* to a failure of *any emission control device or system* (*over the useful life* of the motor vehicle, motor vehicle engine, nonroad engine or nonroad vehicle in which such device or system is used) to achieve compliance by the vehicle or engine with the emission standards *with respect to which it has been certified* pursuant to-sections 206 and 213(a). The Administrator shall take final action to grant or deny an application submitted under this paragraph, after public notice and comment, within 270 days of the receipt of such an application.

See Clean Air Act, 42 U.S.C. §7545, as amended by the Energy Independence and Security Act, P.L. 110-140 (2007); emphasis added.

This section of the Act contains several key elements. Most importantly, EPA must determine whether an applicant has demonstrated that its proposed fuel will not cause or contribute to any vehicle's failure to meet the emission control standards, over its useful life, to which it was certified. We believe the data submitted by the applicant, and the available information in general, are insufficient to support a waiver decision. Moreover, the applicant has not countered existing data that indicate potential problems with the fuel. Therefore, the applicant has failed to make the necessary demonstrations.

The applicant asserts that its fuel will meet the "not cause or contribute" test because none of the submitted studies show any vehicle violating its emissions standards. The studies submitted by the applicant wholly fail to address the issue of whether or not the waived fuel would *contribute* to a violation.[4] We understand this to mean the proposed fuel also must not hasten the deterioration of the effectiveness of the emission control system faster than would be the case on certification fuel, i.e., it cannot shorten the vehicle's useful life. None of the submitted studies addressed this durability question, and one study omitted from the application package suggests a faster deterioration rate is likely with certain types of vehicles.

Of course, vehicles do deteriorate to some extent under normal conditions, even if they use gasoline without any ethanol. It is well established that emissions may increase with deterioration, even as the vehicle remains in compliance. Manufacturers design emissions systems within a compliance margin, to ensure the vehicle will continue to comply with emission standards even at the end of its useful life. Given these margins, which vary by manufacturer and vehicle model, it is not surprising the studies submitted by Growth Energy found no violations of emission standards, even when the tested vehicles were older. But, vehicle durability affects automaker liability for compliance, so it is critical to investigate the fuel's

[4] The studies cited by Growth Energy do have some bearing on the issue of "cause." However, we disagree with the applicant's conclusion that it has satisfied even that test, as discussed in more detail *infra*.

impacts over time and under various operating conditions. In today's world of extremely stringent emission standards, the compliance margin has become very tight and the tolerance for deterioration has become extremely small. We discuss this issue further in more detail during our review of the various studies.

Another legal test is whether the fuel will affect "any" emission control device or system. We interpret the term "any" in the plain English sense, as have various courts using the *Chevron* test.[5] *Chevron* first asks if the statutory language is clear; if it is ambiguous, *Chevron* then requires an interpretation that is reasonable.[6] The Supreme Court has specifically assigned an expansive reading to "any" in the absence of any reason to constrain its meaning.[7] When qualified further by additional terms, such as "emission control device or system," interpreting "any" to mean "some but not all such devices or systems" would cause "any" to lose all meaning and would violate principles of statutory construction, as found by the D.C. Circuit Court.[8]

Based on the EPA notice seeking comment on the Growth Energy waiver application, it would appear that the Agency is open to the possibility that "any" could nevertheless refer to some subset of emission control devices or systems. We think this result could occur only if some reason existed to expect that certain emission control devices or systems simply would not or could not be exposed to the potentially waived fuel or additive. Absent some practical method to protect vehicles not compatible with E15—and no such method exists today—the impacts on all potentially affected emission control systems must be considered.

The Act requires an examination of the fuel's impacts over the vehicle's "useful life," which depends on the standard to which a given vehicle is certified. Newer vehicles meeting Tier 2 emission standards, phased in since 2004 and including light duty trucks, must meet their standards for at least 120,000 miles, and in some case, up to 150,000 miles. Older vehicles subject to Tier 1 and LEV I standards (phased in since 1993 and 1994, respectively) have a 100,000 mile full useful life requirement, and heavier light duty trucks designed to meet Tier 1 and LEV I standards have an 11 year, 120,000 mile FUL.[9] While many older vehicles will have outlived their "useful life" requirements under the Clean Air Act along with their warranty coverage, the applicant is required to provide information bearing on the useful life requirement, which it has not done.

None of the submitted studies provide information about the impact of E15 over the vehicle's useful life. The one study that does explore such durability issues and which was not included with the application (the Orbital Study[10]), investigated durability as it applied in Australia at the

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[5] *See* Chevron U.S.A. Inc v. Natural Res. Def. Council, Inc., 467 U.S. 837 (1984).

[6] *Chevron,* 467 U.S. at 842-843.

[7] *See, e.g., Norfolk S. Rwy. Co. vs Kirby,* 543 U.S. 578 (2004); and *Harrison v. PPG Industries, Inc.,* 446 U.S. 578 (1980).

[8] *See New York v. EPA,* 443 F.3d 880, 887 (D.C. Cir. 2006) ("EPA's position is that the word 'any' does not affect the expansiveness of the phrase 'physical change'; it only means that, once the agency defines 'change' as broadly or as narrowly as it deems appropriate, everything in the agency-defined category is subject to NSR. [But reading] the definition in this way makes the definition function as if the word 'any' had been excised from section 11(a)(4); there is virtually no role for 'any' to play.").

[9] 40 C.F.R. §86.708–94.

[10] The Orbital Study is actually a group of studies: Orbital Engine Company, Reports to Environment Australia, "A Literature Review Based Assessment on the Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian

time of the study,[11] and the results indicated catalyst impairment. Growth Energy's failure to include this study with its application, or to address its findings, was a serious omission because the Orbital Study is the only study to date to investigate operational durability. Applying this information to the submitted DOE study, almost half the existing U.S. fleet might be similarly affected. This is a critical area for more research.

Growth Energy misinterprets the case law and EPA decisions when it claims there should be no concerns about emission increases or durability impacts as long as the vehicle complies with its emission standards ("Emissions increases below applicable emission standards and emission of non-regulated compounds are not relevant to the waiver process.").[12] None of the application's cited cases and decisions, however, conflict with the need to investigate deterioration or durability effects, which go to the second part of the "cause or contribute" requirement. In *Ethyl*,[13] the court held EPA could not deny a waiver based on public health concerns, but it reached this decision because it believed it did not conflict with the requirements of 211(f)(4) and not because the court believed "contribute" does not apply. The second case used to support the applicant's claim restates the requirement that EPA "may grant a waiver as long as the fuel does not cause or contribute to a failure to achieve compliance with emission standards,..."[14] Dicta that "the Administrator is not required ... to adopt a 'no increase' standard" does not overturn the Act's plain language. The final citation Growth Energy uses to support its argument is an EPA denial of another application, where EPA said the waiver provision is "solely concerned with the emission standards."[15] In this statement, EPA expresses its concern with the vehicle's ability to comply with its standards; the Agency does not say that deterioration is not part of the examination. The applicant also must look to more recent communications from EPA about what is required, including the petition notice itself, which refers to durability in two of the possible outcomes of its decision.[16] Several recent public presentations by EPA staff consistently refer to the need for durability data.[17]

Vehicle Fleet," November, 2002; "A Testing Based Assessment to Determine Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian Passenger Vehicle Fleet," March 2003; "A Testing Based Assessment to Determine Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian Passenger Vehicle Fleet–2000 hrs Material Compatibility Testing," May 2003; "Testing Gasoline Containing 20% Ethanol (E20), Phase 2B Final Report," May 2004; *and* "Assessment of the Operation of Vehicles in the Australian Fleet on Ethanol Blend Fuels," February 2007.

[11] Orbital tested to 80,000 km, which is equivalent to 50,000 miles, which was the vehicle useful life under older U.S. standards.

[12] Application, page 10.

[13] *Ethyl Corp. v. EPA*, 51 F.3d 1053, 1058 (D.C. Cir. 1995) (*Ethyl*).

[14] *Motor Vehicle Mfrs. Ass'n of U.S. v EPA*, 768 F.2d 38, 390 (D.C. Cir. 1985) (MVMA).

[15] Petro-Tex Chemical Co., Denial of Application for Fuel Waiver for MTBE (0-15%), Decision Document, 44 Fed. Reg. 1447 (1978).

[16] *See, e.g.,* 74 Fed. Reg. at 18229.

[17] *See, e.g.,* Karl Simon, *Mid-Level Ethanol Blend Experimental Framework – EPA Staff Recommendations,* presentation to API Technology Committee, Chicago, June 4, 2008 ("Simon"); James Caldwell, *Mid-Level Ethanol-Gasoline Blends and the Clean Air Act,* presentation to SAE Government & Industry Meeting, May 13, 2008 ("Caldwell"); and Dave Kortum, *Mid-Level Ethanol-Gasoline Blends and the Clean Air Act, presentation to ACE Convention,* August 9, 2007 ("Kortum").

The application goes on to state that EPA and the courts have recognized the difficulty of testing all vehicles and systems, which is why they allow waiver studies to use statistical sampling techniques applied to representative fleets. The Alliance agrees that statistical sampling can be used in application to representative fleets; however, we saw very little of this methodology used in any of the submitted studies.

The waiver application notes that EPA guidance allows applicants to rely on theory with some additional testing to confirm the theory's validity in lieu of direct data.[18] Presumably, Growth Energy is relying on this guidance to show E15 will not adversely affect evaporative emissions, because it submitted only a minimal amount of data on those effects. Ethanol's effect on a blend's RVP is fairly well-understood, but important knowledge gaps remain, such as E15's impact on the durability of the evaporative emission systems and on permeation effects. These impacts need to be more fully evaluated with whole vehicles and with a wider variety of vehicles and engines.

Finally, the statute requires EPA to judge the impacts against the standards to which the vehicle was certified, which are based on a certification fuel containing no ethanol.[19] Manufacturers have been certifying conventional gasoline-powered vehicles with ethanol-free gasoline since the Agency began requiring such certifications, and the stringency of the emission standards themselves are related to the use of ethanol-free gasoline. The application acknowledges that certification fuel contains no ethanol and that this is the legal baseline but then goes on to compare E15 and E20 test results against performance with E10 when declaring the legal test has been met. Any comparison with E10 is irrelevant, since E10 is not the legal baseline and is itself a waived fuel.

EPA and the applicant also must consider the full range of emission standards to be evaluated. Much attention has been paid to legacy vehicles and existing Tier 2 standards, but new standards are in the process of being implemented and new vehicles designed to meet those standards are now being introduced. For example, the Tier 2 Bin 2 emission standards, which are virtually equivalent to California SULEV emission standards, will become more common in the future. Also, the cold ambient NMHC 20°F test will be phased in beginning with the 2010MY vehicles (some early compliance could occur with 2009MY vehicles). This test will greatly limit the vehicle's ability to maintain an acceptable catalyst temperature, and that fact is important because ethanol may increase catalyst temperature if the vehicle is unable to adapt to the increased ethanol in the fuel. EPA needs to know how these vehicles will respond to E15, and such data are not available either in the application or elsewhere.

With the passage of EISA in 2007, Congress changed section 211(f)(4) to reduce the possibility of an approval with insufficient data, as occurred with the E10 waiver approval by default (1978). Under the revision, EPA must make an affirmative decision, one way or the other, based on a record that can be judicially reviewed. This new requirement underscores the need for a sufficient and reliable data base to support any waiver decision.

Additional Legal Requirement

Section 211(b) of the Clean Air Act requires the Agency to register fuels and fuel additives, and such registration requires, among other things, testing "to determine potential public health

[18] Application, page 9.

[19] 40 C.F.R. §86.1313–2004.

effects of such fuel or additive (including, but not limited to, carcinogenic, teratogenic or mutagenic effects)."[20] EPA's waiver notice did not mention this requirement, either to say it has already been met or requires some additional actions by the waiver applicant.

Possible Outcomes

In the application notice, EPA listed three possible outcomes:

- Partial Waiver: E15 could meet the waiver criteria for some vehicles and engines but not for others, if measures are implemented to ensure proper use;
- Waiver for a Lower Ethanol Level: Some level of ethanol between E10 and E15 could meet the waiver criteria, if evidence, such as emission durability testing, were provided to support waiving a different blend level; or
- Conditional or Restricted Waiver: EPA could require ethanol producers to take certain steps to ensure market quality and prevent misfueling. EPA acknowledges that such downstream requirements would be novel in a waiver decision.

Missing from this list is a full waiver for E15. By omitting a full waiver as a possible outcome, EPA concedes it lacks the evidence for such a decision.

As to a partial waiver, it is questionable whether EPA has the authority to grant a partial waiver. If Congress intended for EPA to have such authority, it would have made that authority clear. Congress did so in section 211(m), for example, which authorizes waivers for oxygenated gasoline in carbon monoxide non-attainment areas by stating, "The Administrator shall waive, *in whole or in part*,..."[21] Thus, if Congress intended to allow partial waivers under section 211(f), it would have used the terms "in whole or in part," or some similar language.

If EPA asserts it has both the data and authority to grant something less than a full waiver, the Agency also has recognized here and in the RFS2 rulemaking the need to take additional steps to ensure proper implementation. We agree with such a judgment. Unfortunately, section 211(f) is designed only to handle a simple question: Has the applicant demonstrated the fuel meets the tests of section 211(f)(4)? Section 211(f) was not intended to address a broad range of policy and implementation issues inherent in establishing a major fuel program with downstream regulation. EPA admits it has never regulated downstream parties under section 211(f). If EPA decides to grant a partial waiver, we believe EPA would need to implement such a decision in conjunction with a major regulatory program to ensure consumers and others are protected from misfueling and other natural and unintended consequences of raising the blend level. Clean Air Act section 211(c) is the proper authority for such regulation, not section 211(f).

On a parallel path, EPA is considering similar questions in its RFS2 rulemaking and has proposed a new pump labeling program that could be used to help implement a partial waiver decision. Many stakeholders would be affected under such a strategy. Assuming EPA believes sections 211(f) and 211(o) jointly provide sufficient legal authority to implement the strategy, it has yet to publish sufficient details of how it would design and enforce any new program and how it would evaluate its costs, benefits, risks, impacts and liabilities. Consumers, in particular, need to know how the Agency will protect them in the marketplace. Since EPA has elaborated

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[20] *See* 42 U.S.C. §7545(b)(2)(A).

[21] 42 U.S. 7454(m)(3), emphasis added.

on its thinking to some extent in the RFS2 rulemaking, the Alliance will address these questions more fully in separate comments on that rulemaking, to the extent we can do so based on the record. We would be interested in seeing more programmatic details so that we can comment more specifically on them. In particular, assuming sufficient data were available, we have yet to see how EPA would define the particular subset of the vehicle population (besides FFVs) that might be allowed to use E15.

Characterizing the Existing Vehicle Fleet

As part of the waiver review process, EPA should consider the size and characteristics of the vehicle fleet. We provide a snapshot here in Figure 1 below, as background information.

Figure 1. Vehicle Registrations Across the United States as of March 2009; each model year is shown as a percentage of the total fleet[22]

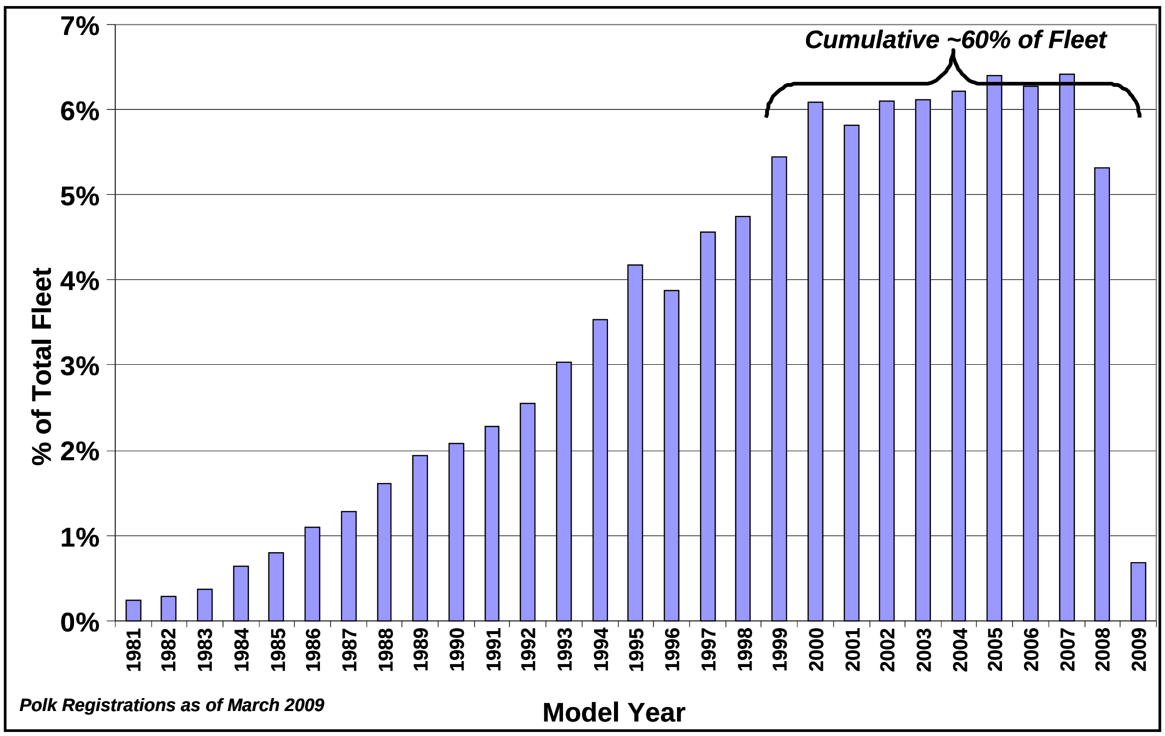

Figure 1 illustrates that the last ten model years include approximately 60% of the registered vehicles in the U.S. fleet, while vehicles 22 years and older make up less than 5%. Of the approximately 250 million vehicles in the fleet, flexible fueled vehicles (FFVs) number about 7-8 million vehicles, or 3-4% of today's fleet.[23] Tier 2-compliant vehicles have been phased in since 2004. It is instructive to remember that the vehicle fleet is not static but dynamic, constantly changing as new vehicles with new technologies enter the fleet and old ones are

[22] Dominic DiCicco, *An Auto Industry Perspective on the Ethanol Blendwall*, presented to the EPA Mobile Source Technical Review Subcommittee, May 13, 2009.

[23] Light duty diesel vehicles, which today make up about 3% of the fleet, must be considered separately because they cannot use any type of gasoline or gasoline-ethanol blend.

retired. Historically, it has taken about 20 years for an entire vehicle fleet to turn over, but with current depressed sales due to poor economic conditions, the turn-over rate could be slower in the near future. Going forward, automakers are striving to meet major public policy objectives related to fuel economy and greenhouse gas emissions, and this is driving them to consider introducing new types of technologies that may have unexpected reactions to new marketplace fuels.

Characterizing the Risks and Liabilities

Section 211(f)(4) is designed to protect vehicle and engine manufacturers from liability that would result from failing to comply with emission standards as a result of any new fuel or fuel additive. More implicitly, this section of the Clean Air Act should help protect consumers and states from the potential effects of widespread vehicle problems. Thus, EPA must consider the potential liabilities and risks associated with an Agency decision to grant this waiver application. Automobile manufacturers and consumers would both need protection from unforeseen and unplanned compliance and product liabilities and risks, should EPA grant the waiver at this time.

Approximately 250 million light duty vehicles, mostly of conventional (non-FFV) design, are in the U.S. vehicle fleet today, with new vehicles being added and others being retired every year. These vehicles carry performance warranties, for which the automobile manufacturer is liable. Manufacturers also are liable for compliance with emission standards, including those for toxic emissions, for the duration of the vehicle's useful life. We are unaware of any manufacturer that does not recommend against the use of gasoline containing more than 10% ethanol for its conventional vehicles and that does not advise conventional vehicle owners, in their printed owner's manuals, that using gasoline with higher ethanol content would void manufacturer warranties for those vehicles. According to the Polk registration data above, about 60% of the vehicles are newer than 10 years old and likely still within their useful life and warranty periods. Warranty and compliance liabilities are very significant. Granting the waiver request without considering them and protecting manufacturers would subvert the purpose of this section of the Act.

Manufacturers face other potential liabilities, as well. For example, in addition to the Environmental Protection Agency, agencies such as the California Air Resources Board and the National Highway Transportation and Safety Administration have the statutory authority to require manufacturers to recall vehicles to address various emissions and safety issues. Recalls require manufacturers to contact consumers, asking them to bring their vehicles into the repair shop for service. Recalls involving significant numbers of vehicles can cost millions of dollars. In addition, manufacturers are subject to product liability claims, regardless of vehicle age or warranty status. Such claims may relate to virtually any perceived problem with the vehicles, regardless of the cause. The cost of defending against such claims can be substantial, even if the manufacturer ultimately prevails.

The introduction of higher ethanol blends into the marketplace could have the effect of inappropriately increasing these risks and liabilities, if it is not handled carefully. Manufacturers could be blamed by both governmental agencies and consumers for problems that may appear on the surface to be vehicle defects but are actually the result of introducing the wrong fuel into the vehicle. This could add substantial burdens and costs to an industry that can ill afford them, particularly in these difficult economic times. The issuance of appropriate regulations under Section 211(c) would be necessary, at a minimum, to put in place appropriate measures to protect the market and automobile manufacturers from the potential costs associated with any misfueling, non-compliance and other liability risks.

Consumers would also bear potentially significant risks. Damage to fuel systems or engines, for example, would be very costly and time-consuming to repair. For vehicles outside their warranty periods, the repair cost would fall on the consumer. The large, aggregate consumer investment and potential for market impacts underscore the need for EPA to have an adequate database on which to judge the effects of any new fuel or fuel additive.

Further risk may accrue to states that have inspection and maintenance programs, if the new fuel interferes with the performance of the vehicle's onboard diagnostic (OBD) system. Most I/M programs rely heavily on OBD to confirm vehicle emission control systems are working properly. This reliance is written into many states' implementation plans to achieve or maintain the National Ambient Air Quality Standards under the Clean Air Act. If the fuel causes OBD to perform erratically, this would impose a large burden on the states and potentially set back their efforts to reduce air pollution.

Finally, reputations are at stake. Consumers might attribute any vehicle problems with the new fuel to the vehicle manufacturer. Ultimately, consumer interest and use of ethanol as a fuel could diminish, countering U.S. efforts to improve national energy security and reduce greenhouse gases. EPA must weigh all these risks and liabilities along with any associated implementation strategies as it considers its waiver decision under section 211(f)(4) of the Clean Air Act.

Overview of the Available Data and Remaining Data Needs

Growth Energy submitted seven studies to support its waiver application, addressing to various degrees the questions about impacts on tailpipe emissions, evaporative emissions, driveability and materials compatibility. We list them here in chronological order, along with the shorthand names (as used in these comments) and their focus:

Title	Short Title	Focus
Minnesota Center for Automotive Research, *Use of Mid-Range Ethanol/Gasoline Blends in Unmodified Passenger Cars and Light Duty Trucks*, July 1999.	MCAR Study	Driveability
Stockholm University et al., *Blending of Ethanol in Gasoline for Spark Ignition Engines: Problem Inventory and Evaporative Measurements*, 2004-2005.	Stockholm Study	Evaporative effects
Coordinating Research Council, *Fuel Permeation from Automotive Systems: E-0, E-6, E-10, E-20 and E-85, Report No. E-65-3*, December 2006.	CRC Permeation Study	Evaporative effects (permeation only)

Title	Short Title	Focus
Energy & Environmental Research Center and Minnesota Center for Automotive Research, *Optimal Ethanol Blend-Level Investigation, Final Report*, prepared for the American Coalition for Ethanol, October 2007.	ACE Study	Exhaust emissions
State of Minnesota and the Renewable Fuels Association, *Executive Summary: The Feasibility of 20 Percent Ethanol Blends by Volume as a Motor Fuel,* March 2008, including five reports on specific investigations.	MN/RFA Study	Driveability, materials compatibility
Rochester Institute of Technology, *Report to the U.S Senate on E-20 Ethanol Research,* October 2008.	RIT Study	Exhaust emissions (older vehicles)
Oak Ridge National Laboratory, *Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines, Report 1,* prepared for DOE, October 2008.	DOE Study	Exhaust emissions, driveability, small/non-road engines

In addition, the Alliance recommends EPA consider the data contained in the following studies:

Title	Short Title	Focus
Orbital Engine Company, *Market Barriers to the Uptake of Biofuels Study*, conducted for Environment Australia, 2002-2004.	Orbital Study	Exhaust emissions, durability, materials compatibility
DOE Study, *Updated Report*, February 2009 (follow up report to the study identified in the waiver application)	DOE Study[24]	Exhaust emissions, driveability, small/non-road engines
Coordinating Research Council, *Mid-Level Ethanol Blends Catalyst Durability Study Screening,* June 2009 (phase 1 of a 2 phase program).	CRC Screening Study	Durability of emission control systems

Based on this body of work, and relying on prior waiver decisions and EPA communications as guidance for judging the sufficiency and quality of supporting studies, the Alliance believes more research is necessary to meet the tests of section 211(f)(4). We provide our review of the studies in the following sections, with additional detail in Appendix A. Part of the discussion

[24] It is unclear why Growth Energy did not include DOE's Updated Report on its study, which includes the findings of the preliminary 2008 report. In these comments, we assume Growth Energy would have wanted to include the updated version and, accordingly, refer to both reports with a single name.

will note various gaps in the data base and the efforts of stakeholders to address these gaps in the most cost and time effective way possible.

Comments on the Available Research

To meet the requirements of section 211(f)(4), EPA requires applicants to investigate a new fuel or fuel additive's impacts on exhaust emissions, evaporative emissions, durability and driveability against the same effects when using certification fuel (which contains no ethanol).[25] EPA has been reluctant to specify requirements for research programs intended to support 211(f)(4) application decisions in specific cases but has communicated its expectations for the characteristics and scope of application demonstrations in recent public communications. These expectations cover such test design issues as fleet composition, test fuel characteristics and statistical interpretation.

Specifically, EPA has advised researchers to consider using the following techniques when designing studies for 211(f)(4) purposes:[26]

- Test fleet representative of the vehicles available in the market;
- Back-to-back vehicle pair testing, to minimize vehicle variability influencing the results;
- Certification fuel baseline (E0)
- Certification test procedures
- Vehicle useful life for durability testing
- Statistically meaningful and defensible results
- Real-world aging
- Materials compatibility testing
- Long term mileage accumulation
- Both PFI and carbureted vehicles

Most or all of the research submitted with the application is either flawed or incomplete in these aspects, and the additional three studies identified here improve but do not complete the database. This existing body of research will make it difficult for EPA to reach a science-based decision on the application.

Levels Between E10 and E15. EPA asks if the data base will support a waiver decision regarding some blend level above E10 and below E15, given that some of the studies tested E15 and others tested E20. We believe it will not.

As background, it should be noted that manufacturers are not required to test or certify using any fuel other than E0. The one exception is the requirement since 2004 to test (but not certify) evaporative emissions durability aging with the highest ethanol content blend available in the U.S. market for use in conventional (non-FFV) vehicles; currently, that level is E10. California fuel allows certification fuel to contain MTBE, although many vehicles are not certified with this fuel, depending on the manufacturer's certification strategy. A prudent automaker may test its vehicles using E10, but until very recently, E10 was a niche fuel. Most automaker testing is

[25] *See* Christine Todd Whitman, "EPA Response to Ethyl Corporation Applications Denying Reconsideration of Three EPA Regulations: CAP 2000, Heavy Duty Gasoline and OBD/IM," August 23, 2001, obtained from www.epa.gov/oms/standards.htm on May 19, 2009; *also see* 66 Fed. Reg. 45777 (August 30, 2001) ("Whitman").

[26] *See, e.g.*, Simon, pp. 5-13, and Caldwell, pp. 9-14.

done to ensure compliance with the emission standards (including durability) with primary certification and market fuels (E0, E5.7 and E10) and customer satisfaction in the marketplace, with some manufacturer variability in the details. Having experienced market problems with E10 fuels,[27] automakers are wary of making assumptions regarding higher levels of ethanol.

Several factors will affect the impacts of ethanol levels above E10 and the interpretation of the available data. Regarding the E20 test data, Growth Energy message is that, if the results at E20 can be deemed acceptable, one may reasonably conclude that levels below E20 ought to work as well. We agree with this thinking generally, but we disagree that the E20 data base is adequate. On the other hand, if the E20 results are unacceptable, the question about impacts with ethanol levels between E10 and either E15 or E20 remains open. Similarly, relying on E10 evaporative emissions data to predict the impact of higher levels, as the application does, overlooks the unique, often non-linear behavior of ethanol blends. Extrapolating beyond well understood data ranges in the case of ethanol blends is generally not advised.

Finished and test fuel properties for a given ethanol blend level can vary widely, depending on the quality of the base gasoline blendstock. The absence of a single set of recommended test fuel or finished market fuel specifications makes predicting the market responses from the existing data set problematic. Importantly, changes in the base gasoline blendstock used for making the ethanol test blends could very well change some or all of the test results in the research that has been conducted to date. Thus, we acknowledge and appreciate that Growth Energy has asked EPA to impose volatility conditions if a decision is made to grant the waiver, because the auto industry needs enforceable, good quality market fuel specifications for all finished fuels. We discuss this issue further later in these comments.

MCAR Study

This study attempted to investigate two issues, the impacts of E10 and E30 on driveabilty and on tailpipe emissions (HC, CO and NOx) from 15 vehicles of various makes and models. The vehicles ranged in age from the 1985 to 1998 model year, but other details were lacking. Interestingly, the report provided more information about the driveability portion because the authors never published the final results of the emissions testing. Even so, the study says little to nothing about the performance of vehicles either on E15 or other blends above 10%. Further, the emissions testing did not use E0 as a baseline fuel, among other flaws, which should disqualify the data for purposes of the waiver decision. The study looked at fuel economy effects, but these are not relevant for waiver purposes. The fuel economy results were consistent with ethanol's known impact on fuel economy, given its lower heating value.

Stockholm Study

The Stockholm Study is mostly a literature review of information from around the world, which was conducted in preparation for a very modest evaporative emissions experiment involving no vehicles or vehicle parts. The literature review included the Orbital Studies, reviewed elsewhere in these comments, and a preliminary report from a 2004 Environment Canada study, which had produced mixed results for formaldehyde emissions and showed some vehicles had significant

[27] For example, driveability problems with E10 in New Mexico have been reported at ASTM and National Council of Weights and Measures (NCWM) meetings. The problems occurred at about 5,000 ft elevation with an E10 fuel having a T50 of 150°F and a $T_{V/L=20}$ below the minimum temperature for the location and time of year specified in Table 4 of ASTM D4814.

and generally consistent increases in acetaldehyde emissions. Since the Stockholm study contained no independently generated vehicle or vehicle component data, it cannot be used to support the application's thesis on either evaporative or permeation emissions.

CRC Permeation Study

The CRC E-65-3 study was designed for the limited purpose of measuring the impact of various ethanol blends between E0 and E10 on permeation and evaporative emission rates of newer vehicles, to update and improve California's Predictive Model. The study team conducted a small amount of additional testing with an E20 test fuel to obtain an initial view of that fuel's impact on the late model fuel systems included in the program. The study was not designed to comprehensively test E20's impact on these systems and included no aging of the fuel systems, nor did it test a full range of vehicle types and ages. Importantly, it tested only fuel system "rigs," not whole vehicles, and it did not test any E15 fuels. Nevertheless, the statistically-tested findings are useful:

- Although permeation emission rates did not appear to increase as the level of ethanol increased from E6 to E10, they did appear to increase when the ethanol increased from E6 to E20. This increase, however, was not statistically significant.
- The highest diurnal permeation rates were obtained with the E20 test fuel, on 3 of the 5 fuel system rigs.
- The ethanol blends increased permeation in all the vehicle systems and technologies tested compared to the non-ethanol fuel (E0). These increases were statistically significant.
- The advanced technology LEV II and PZEV systems (2004 MY) had much lower permeation emissions than the MY 2000-2001 enhanced evaporative systems.
- The high-level ethanol blend (E85) tested in the flexible fuel vehicle system had lower permeation emissions than the non-ethanol (E0) fuel.
- Diurnal permeation rates do not appear to increase between E6 and E10, but do appear to increase between E6 and E20; however, this increase was not statistically significant.
- The average specific reactivities of the permeates from the low-level ethanol blends were significantly lower than those measured with the non-ethanol fuel (E0).

The lack of statistical representativeness and the small sample size prevent more conclusions to be drawn from the data. The study team necessarily concluded that additional research would be needed to fully understand the impacts of any blend greater than E10. Therefore, its usefulness for supporting the waiver application is very limited.

ACE Study

In December 2007, the American Coalition for Ethanol (ACE) and the Department of Energy released the results of a joint study, "Optimal Ethanol Blend Level Investigation," which investigated certain impacts of mid-level ethanol blends. According to the report, the study had two objectives: (1) investigate variations in vehicle fuel economy impacts to see if an optimal blend level could be identified, and (2) produce hot-start tailpipe emissions data for various blend levels. Researchers tested nine fuels (E0, E10, E20, E30, E40, E50, E60, E70 and E85)[28] on four 2007 MY sedans: a Ford Fusion (with about 5,000 miles on the odometer), a Toyota Camry (with about 7,000 miles), a conventional Chevrolet Impala (with about 31,000 miles) and a Chevrolet Impala FFV (with about 7,000 miles). This test fleet was too small to be called "representative" of the larger fleet and did not use back to back vehicle pairs. The report failed to indicate the specific emission standards to which the vehicles were certified.

Several anomalies undermine confidence in the study's results. For example, full-useful-life testing requires aged catalysts and sensors, but the study ignored this question. Further, given the possible impacts of wide open throttle (WOT) testing, the researchers should have investigated beyond monitoring the malfunction illumination light (MIL) to determine if the WOT testing had damaged any catalysts. Also, by saying three of the four vehicles met their full useful life emission standards, the researchers implied they had tested for full useful life impacts, but they inappropriately compared the emission results from low mileage vehicles against high mileage, full useful life standards. The results, therefore, do not shed any light on this issue. Perhaps the biggest anomaly is the report's conclusion that the volumetric fuel economy of these vehicles, when measured using the U.S. highway fuel economy test, improved as a result of adding ethanol to the gasoline. This surprising result is contrary to the known impact of ethanol on the energy content of gasoline blends and conflicts with numerous other studies, including the DOE study[29] included in the Growth Energy Application.

MN/RFA Study[30]

The MN/RFA Study investigated vehicle driveability and materials compatibility; it also intended to study emissions but never published the results.[31] The driveability portion of the study evaluated a fleet of 40 vehicle pairs split evenly among E0 and E20. Vehicles were part of the University of Minnesota Fleet Services car pool and represented model years 2000 – 2006. Each vehicle of the pair was dedicated to one fuel over the course of one year. Personnel driving the vehicles were requested to fill out questionnaires gauging driveability performance. The questionnaire response rate was very low, and trained rater evaluations did not test both fuels back to back in the same vehicle. Therefore, a direct driveability comparison of E0 to E20 was not possible with the test design used in the study. In addition, many of the batch fuel analyses were suspect, casting doubt on the actual fuel properties used in the study.

The MN/RFA Study examined materials compatibility by testing fuel impacts on metals, elastomers and plastics via short term bench scale testing. For the metallic materials, the study tested the effects of E20 on pieces of metal called "coupons." The tests involved soaking the coupons in the test fuels for certain periods of time and then examining the coupons for any

[28] Tier 2 gasoline was used as the base gasoline. The study is silent on the method used for blending, but we assume the authors splash-blended the components without rebalancing any other fuel properties.

[29] http://feerc.ornl.gov/publications/Int_blends_Rpt1_Updated.pdf

[30] The MCAR study's acknowledgment of automaker assistance should not be interpreted to mean that any of the named automakers reviewed, approved or endorsed any part of the test methodology, execution of the test program, data analysis or conclusions.

[31] *See*, e.g., Carl Jewitt, *Minnesota E 20 Fuel Research Program*, March 28, 2006; Jewitt memorandum to James Simnick and Jeff Jetter, CRC Performance Committee, April 21, 2007; *and* MN Executive Summary, *E20: The Feasibility of 20 Percent Ethanol Blends by Volume as a Motor Fuel* (undated).

effects. A similar approach was taken for the elastomeric and plastic materials, although the test pieces in these cases are called "slabs."

Simple coupon and slab soak testing is insufficient to characterize potential failure modes in the many different operating environments of vehicle fuel systems. Neither can such testing properly address the functional performance of automotive components or relate those issues to combustion stability, regulated emissions or customer satisfaction, whether for smooth driving performance or service avoidance. Importantly, the materials testing conducted in this study lacked any degree of "real world" durability validation for the test fuel. This study, at best, may be considered a screening program. Fundamentally, the study is manifestly insufficient for demonstrating that E15 is compatible with any vehicles, parts or other products that would contact gasoline-ethanol blends. A more detailed review of the research is found in Appendix A.

RIT Study[32]

RIT examined the impact of E20 on 10 older gasoline vehicles owned and operated by Monroe County, NY, with varying existing mileage. The summary report lacked critical details about the test vehicles, test fuels, mileage accumulation and other information necessary to judge the authors' claim that all the vehicles met EPA's full useful life (FUL) standards for all the regulated emissions. Without the actual study, we are unable to judge the results, the authors' claims or the quality of the investigation.

DOE Study

DOE recently completed a screening study that it has characterized as a "short term 'quick look' emissions study of 16 vehicles."[33] DOE selected several popular vehicles for the study (based on R. L. Polk market data) but did not specifically select them to statistically represent the U.S fleet, and the program included no vehicles older than the 1999 model year, nor did it use back to back vehicle pairs. The study did use E0 as the baseline fuel, comparing its results against those of E10, E15 and E20, but did not use a certification test cycle, instead using the LA92 drive cycle, also known as the unified cycle.[34] DOE chose this cycle because it represents a more real-world driving behavior than the FTP used for certification, but this disqualifies the results for waiver purposes because it is impossible to determine how the test vehicles performed against their emissions standards.

The first report in this study included a serious analytical flaw that was corrected in the second report. The test fleet included an equal number of vehicles with control systems that can adjust for ethanol during cold start and vehicles that cannot. Despite these critical design differences, DOE grouped the results of all the vehicles for purposes of statistical evaluation, enabling the authors to find, at a 95% confidence level, that increasing the amount of ethanol in gasoline

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[32] We are relying on a six-page summary produced for a Senate hearing in 2008 because we do not have a copy of the actual study. The only other source of information about the RIT study is a two-page summary provided by DOE. According to the Senate report, RIT planned to conduct additional testing in 2009 to determine whether any additional degradation had occurred, but no new information has become available in time for these comments.

[33] Steve Przesmitzki and Brian West, *Mid-Level Ethanol Blends Test Program*, presentation to the Biomass Program Infrastructure Peer Review Group, March 19, 2009, slide 14.

[34] For additional background, see California Air Resources Board Emissions Inventory Series, Vol. 1, Issue 9, "Federal Test Procedure & Unified Cycle, Driving Cycles—Models of Driving Behavior, date unknown, found at http://www.arb.ca.gov/msei/onroad/briefs/Publication3.pdf.

reduces carbon monoxide (CO) and non-methane hydrocarbon (NMHC) emissions. Not surprisingly, given this flaw, the data set showed a significant amount of scatter, which by itself undermines the ability to draw any well-founded conclusions. Similarly, the original analysis of pooled NOx emissions data showed no increase in emissions, contrary to predictions based on the literature. DOE's later re-analysis demonstrated the vehicles unable to adjust to fuel ethanol on cold start did have increased NOx emissions.[35]

One of the more important findings relates to what the researchers learned about the vehicles in the test fleet: seven of the 16 vehicle models tested did not use long term fuel trims in open loop control. This means that the test vehicles could have experienced the same type of degradation in catalyst performance as was seen in similar vehicles (i.e., those using the same control approach) tested in the Orbital Study (see below). Since the Orbital Study showed catalyst damage, this finding underscores the need to conduct full useful life testing to determine long term durability effects.

Orbital Study

This group of studies produced important results that contradict many of the waiver application claims and point directly to the need for more data, especially regarding durability, which is critical for emissions at full useful life, not to mention other important issues like customer satisfaction. The study, which covered several different technical issues, was described by Oak Ridge National Laboratory as "very comprehensive."[36] Specifically, the vehicle portion of the study included component tests, short and long term vehicle emission tests, vehicle operation and driveability, engine durability and vehicle durability. Orbital investigated "noxious" emissions as regulated in Australia (HC, CO and NOx).[37]

Orbital tested E0 and E20 on five new (2001) vehicle pairs representative of the Australian fleet at the time of the study. While not identical to U.S. vehicles or designed to meet U.S. emission standards, the test vehicles are relevant here because they use technologies similar to those currently found in the U.S. fleet. Using the same test fuels, Orbital also tested four older vehicles ranging in age from 1985 to 1993 for short term effects. Orbital purchased these vehicles used and repaired them as needed for the study. Except for one vehicle, the older vehicles had technologies similar to those used in the U.S. in the late 70s and early 80s, e.g., those with open loop control. Test procedures generally followed U.S. protocols, which are also used in Australia.

After 50,000 miles of aging on gasoline, average hydrocarbon emissions increases for the Ford, Holden, Hyundai and Toyota are 36% versus 51% after aging on E20 with most of the difference occurring in the Hyundai. The post aging average carbon monoxide emissions increases for these vehicles is 57% for E0 and 134% for E20, again with most of the difference occurring in the Hyundai. The post-aging average nitrogen oxide increases for these vehicles is 57% for E0

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[35] Effects of Mid-Level Ethanol Blends on Legacy Vehicles: Tailpipe Emissions using 0 to 20 % Ethanol in Tier 1 and Tier 2 Vehicles, 19th CRC On-Road Vehicle Emissions Workshop, Keith Knoll, March 23 – 25, 2009

[36] Bechtold, R., et al., *Technical Issues Associated with the Use of Intermediate Ethanol Blends (>E10) in the U.S. Legacy Fleet: Assessment of Prior Studies*, Oak Ridge National Laboratory, August 2007, found at http://www.osti.gov/bridge//product.biblio.jsp?query_id=0&page=0&osti_id=936789.

[37] The study also looked at CO2 and other greenhouse gases emissions, but these are irrelevant for waiver purposes.

and 134% for E20, again with most of the difference occurring in the Holden and Hyundai. The Hyundai failed the Australian emissions standard as a result of aging on E20.

The older test fleet exhibited modest changes in HC (small decrease) and NOx (small increase) emissions and significantly greater reductions in CO emissions, but the CO results were driven by the three vehicles with open loop control systems. Orbital concluded, “The emissions durability testing showed deterioration in the regulated tailpipe emissions for all vehicles regardless of the fuel type.”[38]

The Hyundai Accent, one of the newer test vehicles, did not have learned fuel trim on open loop control, and its emission results, particularly at the high mileage tested (80,000 km), are instructive:

Figure 2. Orbital Study Figure 1-1, Showing Hyundai Testing Results

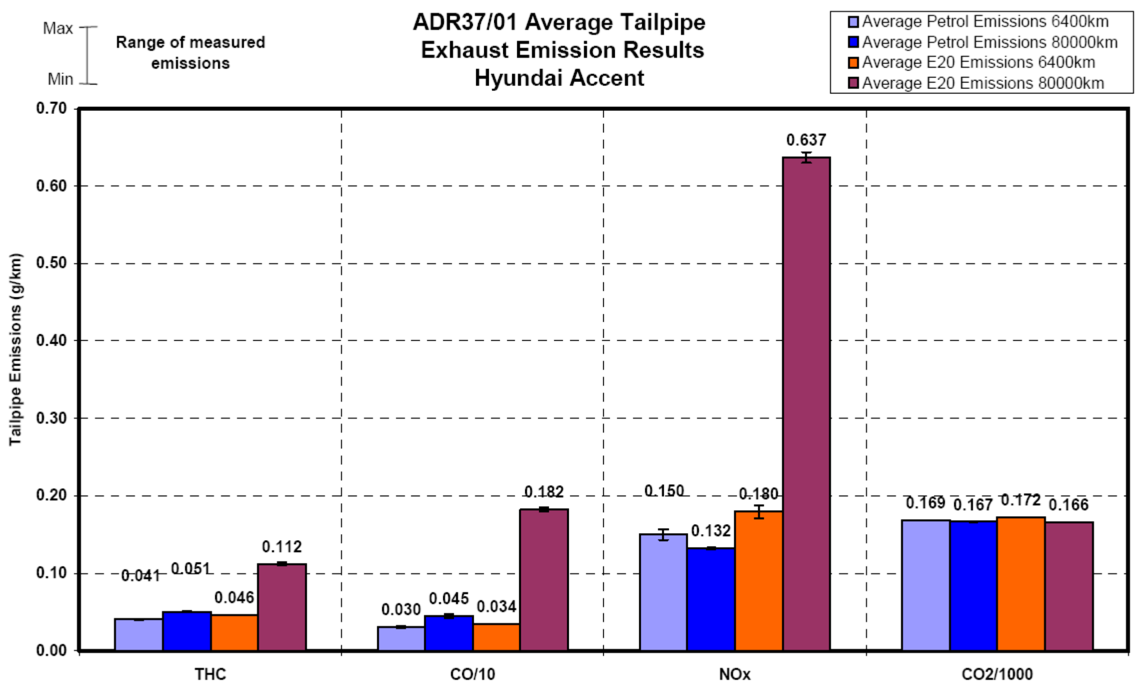


Figure 1-1 – ADR37/01 Average Weighted Tailpipe Emissions Comparison for the Hyundai Accent ULP v E20 6,400km and 80,000km

Orbital attributed these results to catalyst degradation stemming from increased exhaust temperature resulting from the use of the E20 test fuel during certain modes of operation. This vehicle’s engine control system could not compensate for the extra oxygen in the fuel introduced by the higher ethanol blend. The extra oxygen increases the exothermic reaction at the catalyst, leading to thermal degradation. Since the Hyundai had the smallest engine in the test fleet, it normally operated at a higher duty cycle, and with a higher exhaust gas temperature, than the other vehicles. It had very little tolerance for the impact of the E20 test fuel.

[38] Orbital Study, Phase 2B Final Report, page 2.

> It is therefore reasonable to conclude that other vehicles within the same class as the Hyundai also have a high probability of failing in the same manner, if the engine control systems cannot compensate in all modes of operation for the extra oxygen introduced with the ethanol.[39]

The use of E20 in this vehicle led to an approximate 25°C increase in catalyst temperatures throughout most of the test. This could produce a 40% increase in the rate of catalyst deterioration, or a 30% reduction in catalyst life. Much greater reductions in catalyst life were actually seen in the Hyundai due to E20: for HC, reduction was 85%, and for CO and NOx, the reductions were even greater. This suggests that the cause of the reduction in catalyst efficiency was more complex than just increased catalyst temperatures during WOT operation.

This system design -- an engine control system being unable to compensate for ethanol's oxygen in all modes of operation – is what the DOE study found in seven of its 16 test vehicles. Based on this information, we have every reason to expect that any or all U.S. vehicles with similar designs would experience similar impacts with higher ethanol blends if subjected to similar operating conditions.

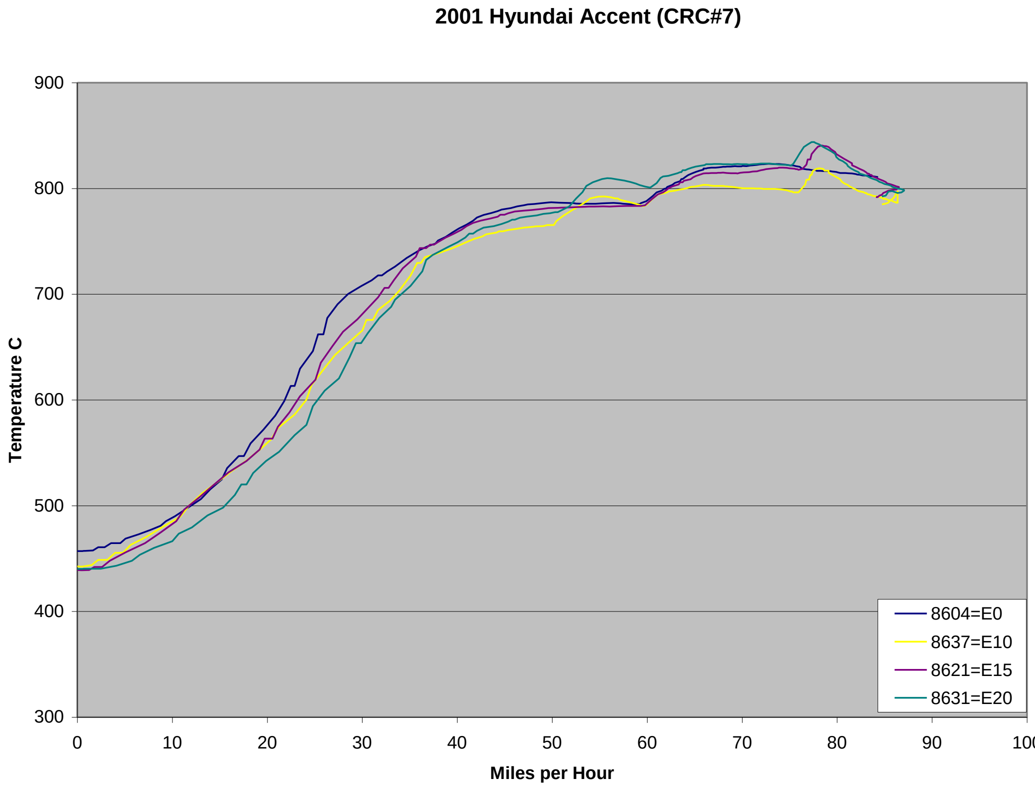
CRC Screening Study

The recently released CRC Screening Study (E-87-1) is the first phase of a test program developed to look at the effects of mid-level ethanol blends on U.S. vehicles. Performed in cooperation with the U.S. DOE, the study found that 13 of 25 vehicles tested did not compensate for the ethanol in the fuel in all modes of operation. This confirms the results of the DOE study and supports EPA's recommendation in its waiver notice for more durability testing.

Shown below are the catalyst temperatures for the 2001 Hyundai accent tested in that program. Note that the catalyst temperatures for E15 and E20 are significantly higher than for E0 and E10.

[39] Orbital Study, Phase 2B Final Report, page 3.

Figure 3. Changes in Catalyst Temperatures in the CRC E-87-1 Hyundai Test Vehicle[40]



[40] CRC Screening Study, page C-5.

Information Gaps: Exhaust Emissions

Regarding emissions impacts generally, the DOE Study is a start, but it was never intended to produce definitive data on the impacts of E15. Rather, it has been useful for identifying important areas for further research. For example, looking only at the 2007 vehicles meeting Tier 2 Bin 5 standards and that do not use long term fuel trims to adjust for the fuel ethanol, one finds the NOx emissions with E15 increasing by over 45% compared to the E0 results and about 43% compared to the E10 results. Only two vehicles in the test fleet met these criteria—the Honda Accord and the Chrysler Town and Country—but they are vehicles with very high sales rates. This is a significant discovery that merits further investigation, perhaps by repeating and broadening the testing using the FTP and SFTP cycles.

In general, there are no data documenting the emissions impacts of E15 (or other mid-level blends) using the FTP at 75 or 50°F or using the cold ambient test procedure. This testing must encompass a representative test fleet, including Tier 0, Tier 1 and Tier 2 vehicles.

EPA is conducting a test program now that it designed for gathering data for air quality modeling purposes, but the study is not using the FTP and it is only testing 2008 MY vehicles. According to various communications with EPA staff, as originally designed, the program included a statistically selected fleet; DOE has identified this test program as task V2, among other studies in that agency's ethanol test program. The current status and schedule of this broader, more waiver-relevant study is unknown.

The Orbital Study and the CRC Screening Study point to the most important data gap relating to exhaust emissions, namely, catalyst durability. This study stands as the only source of data on catalyst durability and the effects of long term exposure to mid-level ethanol blends. Its finding that vehicles without learned fuel trim during open loop control are likely to experience catalyst deterioration after prolonged exposure to mid-level ethanol blends needs to be confirmed for U.S. vehicles. Both the DOE Study and now the CRC Screening Study suggest approximately half the U.S. fleet is vulnerable to the same effect. Some of DOE's planned studies include an investigation of full useful life catalyst durability, and one study is scheduled for completion in 2010. This study will test mainly 2006-2009 MY vehicles meeting Tier 2 emissions standards. Given the evolution of emission system and control system designs, however, it is unclear whether the data produced by this study will apply to any other class of vehicles, including Tier 2 vehicles produced before 2006-2009.

Information Gaps: Evaporative Emissions

As noted, the CRC Permeation Study was not designed to comprehensively test E20's impact on evaporative emission control systems. It did not include any aging of the fuel system components, nor did it test a full range of vehicle types and ages. Importantly, it tested only fuel system "rigs," not whole vehicles, and it did not test any E15 fuels. The CRC studies listed below will attempt to address some of these evaporation system data gaps, but other priority needs are also identified.

Real-world evaporative emission impacts

CRC program number E-77-2C, now in progress and almost complete, is actually a series of projects that will help characterizes real-world evaporative emission events to support regulatory planning and emissions inventory modeling. E20 is being tested in a part of the research program. The study was designed to produce data useful for emissions modeling; it will not use a certification test procedure, which, while useful, will weaken the ability to use the results for purposes of section 211(f)(4).

Durability of evaporative emission control systems

CRC has designed the E-91 research program to investigate the impact of mid-level blends on the real-world durability of evaporative emission control systems. The data from this program should greatly enhance understanding of the evaporative impacts of mid-level blends. Testing and reporting the results would likely require about two years, however, and funding has not yet been secured.

Permeability and sealing ability effects

A fuel can significantly affect evaporative emissions if it affects rubber materials in contact with the fuel, and the literature points to permeation rates continuing to increase as ethanol goes above the 10% level. This impact is different from the impact of RVP, where the vaporization rate slowly declines as the ethanol content in gasoline blends goes above 10%. Any ethanol present in the fuel would be expected to increase permeation emissions. A fuel can also cause changes in swell or seal performance, which can affect evaporative emissions apart from permeation. E-blend impacts on various elastomeric materials, which may be non-linear for different ethanol blend levels, will also have a bearing on the overall durability of evaporative control systems. The testing that has occurred to date is so far insufficient to determine the possible evaporative emissions impacts with E15. Please refer to our comments on the various materials studies, below and in Appendix A.

New evaporative emission standards

California is beginning to develop new requirements to tighten evaporative emission standards, along with other standards, and this may include test procedure changes and will probably lead to vehicle design changes. E15 impacts under the new standards and any associated changes in test procedures need to be examined.

Information Gaps: OBD

The DOE Study was not designed to gather OBD-related data, but it is the only existing study that actively used a scan tool to gather set and pending DTCs. DOE did observe two DTCs during testing. The authors said the DTCs were unrelated to the ethanol test fuels, but they did not actually demonstrate the root causes of the codes.

None of the other studies submitted with the application went beyond driving the cars around, largely with untrained drivers, and observing whether any malfunction indicator lights illuminated. Neither did any of the application studies mention using an OBD drive cycle to test OBD operation, even though information about the requirements is readily available, pursuant to the California Motor Vehicle Service Information Rulemaking (CMVSIR).[41] None of the vehicles tested in the Orbital Study was equipped with OBD systems, so that study did not evaluate impacts on OBD. This is a critical information gap that could affect states' ability to implement I&M programs designed to attain or maintain ozone standards.

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[41] The CMVSIR requires automobile manufacturers to make available all emission-related information about their vehicles, including service manuals, technical service bulletins, OBD II descriptions, drive cycles, and diagnostic tools.

Information Gaps: Materials Compatibility and Durability

Engine Durability

Many years of automaker experience with developing and producing vehicles capable of using E22, E85 and E100 fuels have shown that engines need to be hardened for resistance to ethanol. Use of ethanol blends in unhardened engines can result in bore, ring, piston and valve seat wear. Deterioration of these components can lead to compression and power loss, misfire and catalyst damage. Many advanced engines and fuel injection systems (such as those using pressurized PFI at ~75 psi or spark ignition direct injection (SIDI) at ~1500 psi) are heavily loaded and stressed in the field. All modern systems are originally validated for use only with E0 to E10. It is important to evaluate thoroughly the corrosion failure modes associated with Stress Corrosion Cracking and other possible modes of failure. The Orbital Study documented accelerated wear in its test engines, after engine teardown at the completion of E20 testing. Its researchers found increased wear in the piston skirts, cylinder bores, valve seats and piston ring gaps. In fact, all of the engines had some accelerated wear with E20, and valve seat wear was found on all five engines. Neither the waiver application nor its studies mention this issue. Both DOE and CRC have flagged engine durability for further study. CRC plans to begin limited testing for engine durability later in 2009.

Parts Durability Using Long Term Mileage Accumulation

None of the available studies have looked at the durability of the whole vehicle fuel system or of components while installed in the vehicle. The data submitted with the application have no correlation with any other types of studies, but this type of investigation is a critical part of any new fuel or fuel additive evaluation.

E15 Impacts

Both the MN/RFA and Orbital studies examined the effects of E20 rather than E15, and extrapolating and interpolating the results for other ethanol blends can be problematic, especially with the Orbital Study showing E20 compatibility problems. So far, we have too little information to determine whether or how the impacts of E15 might differ from E20, for example, in any rate of deterioration. Good engineering practice, as well as EPA’s legal authority, would argue for more compatibility research specifically with an E15 test fuel.

Information Gaps: Driveability

Important information gaps remain about the performance of E15 on both older and newer vehicles. Older vehicles may have a more difficult time adapting to the higher ethanol fuel under a variety of climatic and fuel quality conditions, but even newer vehicles with greater adaptability should be tested at altitude and under load. Such testing is especially needed to create a data base that can be used to develop fuel volatility specifications. To some extent, researchers may be able to draw on existing information about vehicle response to different fuel volatilities and distillation curves, but data are specifically needed for the ethanol offset in the ASTM driveability index. Data also are needed to understand how ethanol affects T50 and $T_{V/L}$ in the E10+ blend ranges.

Collaborative Stakeholder Efforts to Fill the Data Gaps

Experts at the auto-oil Coordinating Research Council (CRC) recently compiled a summary of relevant CRC test programs on mid-level blends being conducted or planned and highlights of important knowledge gaps regarding the effects of these blends. This summary is shown as Table 1, below. An overview of the timing and funding needs of various projects is available at Appendix B.

Table 1. CRC Status Summary of E10+ Projects and Gaps

Auto/Oil E10+ Test Program for Highway "Non-FFV" Vehicles

<table>
<tr><th>Item #</th><th>Title</th><th>Project #</th><th>Status</th></tr>
<tr><td>1</td><td>Fuel Storage and Handling</td><td>CRC AVFL-15</td><td>While AVFL-15 is funded the follow-on program is not</td></tr>
<tr><td colspan="4">The industries understand system components for E10 and also for E85, but it is unclear at what level of ethanol content above 10% that E10-rated parts fail. The objective of AVFL-15 is to determine the durability of wetted fuel components/systems. Fuel storage and handling is studied in component/systems durability testing. Resource constraints limited the scope of AVFL-15, preventing a definitive program, hence additional testing is required.</td></tr>
<tr><td>2</td><td>Base Engine Durability</td><td>CRC CM-136-09</td><td>This expensive program awaits outside funding</td></tr>
<tr><td colspan="4">The industry knows what is required to upgrade engine components for E22, E85 and E100. Some automakers have done internal testing and have found sensitivity to intermediate ethanol blend levels for non-FFV vehicles. The proposed testing for base engine durability (base refers to the actual machinery as opposed to the sensors, controls and the like) is embodied in CRC RFP No. CM-136-09 which will be ready for contracting in mid-2009.</td></tr>
<tr><td>3</td><td>On-Board Diagnostics (OBD) Evaluation</td><td>CRC E-90</td><td>The first phase of E-90, site selection, is funded by CRC</td></tr>
<tr><td colspan="4">The automakers have a good understanding of the theoretical effects of ethanol on OBD. The issue is how OBD systems actually work in a fleet of aged production vehicles. The proposed testing for OBD is defined in CRC Project No. E-90.</td></tr>
<tr><td>4</td><td>Tailpipe Emissions for SULEV Vehicles and at Cold Ambient Temperatures</td><td>CRC E-92</td><td>A final project plan will be prepared by May 2009</td></tr>
<tr><td colspan="4">Starting with the 2010 model year automakers have to meet Non-Methane Hydrocarbon (NMHC) emissions at a 20F start temperature. Automakers have had to meet stringent SULEV emissions at a 50F start temperature for many years. The enleanment due to oxygen in ethanol and the low volatility of the ethanol portion of the fuel blend at low temperature gives concerns that existing and planned vehicles designed for federal and California emissions test fuels will not meet their required emissions standards when operated on mid-level ethanol blends. Since this program does not envision aging the vehicles it should not be unusually expensive.</td></tr>
<tr><td>5</td><td>Catalyst Durability and Degradation</td><td>CRC E-87</td><td>The course and fate of this program is currently unclear</td></tr>
<tr><td colspan="4">The issue of accelerated catalyst aging with intermediate ethanol blends was well-documented in the Orbital research study conducted in Australia. DOE found that 44% of vehicles they tested had the same control architecture as those that had problems with E20 in Australia and their data, when combined with CRC E-87-1 data, indicates that 35-45% of the US fleet will have this sensitive control architecture. Durability testing to identify this phenomenon was planned for CRC program E-87-2. E87-1 was funded by CRC and the report is pending. E-87-2 was funded by DOE with minor funding from CRC.</td></tr>
<tr><td>6</td><td>Evaporative Emissions Durability</td><td>CRC E-91</td><td>This expensive program awaits outside funding</td></tr>
<tr><td colspan="4">As reported in previous intermediate ethanol blend research coordination meetings, CRC has conducted research projects under E-65 and E-77 on the effects of ethanol on evaporative emissions. However, these tests have all looked at the effects of short exposures. This project has been defined in CRC RFP No. E-91 which will be ready for contracting in mid 2009.</td></tr>
<tr><td>7</td><td>Emissions Inventory and Air Quality Modeling</td><td>A-67 / A-73</td><td>A-67 are underway and A-73 is planned for a start in 2009</td></tr>
<tr><td colspan="4">The CRC Atmospheric Impacts Committee is leading this effort in coordination with others. A program to evaluate ethanol blends requires final release of the EPA MOVES Emission Factor Model, A-67 (Estimating Ozone from Fuel Reformulation) and A-73 (Emissions Modeling and Air Quality Modeling) are the CRC programs that will address this subject. These efforts rely on obtaining emissions data from the other CRC programs above.</td></tr>
<tr><td>8</td><td>Exhaust Emissions on Vehicles Aged On Mid-Level Ethanol Blends</td><td>CRC New Project</td><td>The details of this project are under development</td></tr>
<tr><td colspan="4">A good collection of aged vehicle data will be acquired in the above programs. These data will be available for assessing direct emissions impacts from intermediate ethanol blends and for conducting air quality modeling evaluations.</td></tr>
</table>

Over time, other public and private stakeholders have joined the auto/oil experts at CRC to determine more precisely where additional research and funding were needed and where additional research funding would be most effective. The Mid-Level Ethanol Research Coordination Group (Research Coordination Group) includes experts from the auto, oil, ethanol, small engine, marine, outdoor power equipment and motorcycle industries and from DOE and EPA. The Research Coordination Group has reviewed numerous test plans either underway or under development to identify gaps, overlaps, opportunities for collaboration and funding needs. The reviewers have been following EPA guidance regarding section 211(f)(4) criteria (exhaust emissions, evaporative emissions, durability and driveability) and recommendations for test design. As a result of this effort, DOE has identified a test program to examine several of the highest testing priorities and which will complement other testing already conducted and still being conducted elsewhere.[42] Much of DOE's testing is scheduled to run well into 2010 and for some programs into 2011 due to funding and availability of test facilities. The Alliance urges EPA to refrain from granting the Growth Energy waiver application until this work is done.

Alliance Conclusions Regarding the Available Research

In the following tables, the Alliance summarizes its evaluation of whether and the extent to which each of the above studies meets EPA criteria for waiver application decisions. See Table 2 and Table 3, below. Based on this review, the Alliance remains unconvinced that Growth Energy has met its burden of demonstrating that E15, or any other blend between E10 and E15, meets the criteria for waiving the substantially similar requirement of section 211(f) of the Clean Air Act. Further, to the extent EPA is considering a partial waiver, none of the available studies provide data to substantiate that a particular subset of the fleet would be unaffected by these blends, nor have any manufacturers declared that any portion of their non-FFV products would be compatible with more than 10% ethanol. Importantly, some of the studies suggest vehicles and emissions could be adversely affected. We believe much more research is needed to provide sufficient confidence that the existing fleet or any portion of the fleet can use E10+ without adverse impacts to vehicles, consumers and the environment.

[42] Since the details of DOE's test program remain under discussion, we direct interested parties to contact DOE and EPA.

Table 2. How Application Studies Compare with CAA Requirements[43]

CAA Require-ment	Test Design Elements	Require-ment met?	Growth Energy Application Studies (shading indicates outside study scope)						
			DOE Study	ACE Study	MN/RFA Study	CRC E-65-3	RIT Study	MCAR Study	Stockholm Study
Key	*Acceptable data*		*Partial data set*		*Invalid data set*		*Unknown*		*Not applicable*
Exhaust Emissions		Partial	Partial	Invalid	Performed but not published or submitted		Partial	Invalid	
	Representative test fleet	Partial, but not full legacy	16 vehicles, LEV-Tier 2	4 late models, emission stds unknown	No		Unk.	15 vehicles, 85-92 MY	
	Cert fuel baseline (E0) & procedures (FTP)	Partial	Tested E0 but used improper test cycle	Yes)	E0 yes; test cycle unk.		FTP yes; unknown test fuel	No	
	Full Useful Life	No	Instantaneous effects only; 7/16 lacked LFT (learned fuel trim)	No E15 aging	No		Unk.	No	
	Back to Back Vehicle Pairs	No	No	No	No		Unk.	Unk	
	Statistically meaningful & defensible		Simple but inadequate	No	No		Unk	No	
Evaporative Emissions		No			Performed but not published or submitted	Scope limited			*Literature review,** portable container data
	Representative test fleet	No			Unk	No; not federal, no whole vehicles			No*

[43] The table focuses on on-road light duty vehicles and trucks (LDV/LDT) but also generically includes small and non-road "engines" (e.g., such as used in gasoline-powered motorcycles, outdoor tools, boats and other product categories) to reflect CAA section 211(f)(4) requirements.

CAA Requirement	Test Design Elements	Requirement met?	Growth Energy Application Studies (shading indicates outside study scope)						
			DOE Study	ACE Study	MN/RFA Study	CRC E-65-3	RIT Study	MCAR Study	Stockholm Study
Key	*Acceptable data*	*Partial data set*	*Invalid data set*	*Unknown*	*Not applicable*				
	Cert fuel baseline (E0) & procedures	Partial			Unk	E0, novel procedure			No*
	Full Useful Life	No			Unk	No			No*
	Back to Back Vehicle Pairs	No			Unk	No			No*
	Statistically meaningful & defensible	No			Unk	No			No*
OBD[44]		No	No	Incorrectly done					
	General response	No	No						
	Real-world aging	No	No						
	Representativ e test fleet	No	Unk						
	Statistically meaningful & defensible	No	No						
Durability		Partial	Partial		Partial				
	Materials Compatibility	Partial	Screening only		Partial; significant failures				
	Long Term Mileage Accumulation	Partial	Partial		No (coupons only)				
	Representativ e test fleet	No	Unk		No				
	Statistically meaningful & defensible	No	Unk		Yes for E20, unknown for E15				

[44] OBD is included as a separate item because it relates to both exhaust emission and evaporative emission standards and because it requires separate testing.

CAA Require-ment	Test Design Elements	Require-ment met?	Growth Energy Application Studies (shading indicates outside study scope)						
			DOE Study	ACE Study	MN/RFA Study	CRC E-65-3	RIT Study	MCAR Study	Stockholm Study
Key		*Acceptable data*		*Partial data set*		*Invalid data set*		*Unknown*	*Not applicable*
Driveability		Partial			Partial		Partial		
	Both PFI& Carbureted Vehicles	Unk			Probably		Unk		
	Statistically meaningful & defensible	No			No		No		
Small Engines[45]		Partial	Partial						

*Coloring refers only to new testing, not the studies in the literature review.

[45] With this entry, the Alliance simply intends to note whether some small/non-road testing was included with the application, not whether that testing is sufficient for purposes of deciding whether to waive sec. 211(f) substantially similar restrictions.

Table 3. How Other Studies (past and planned) Compare with EPA Requirements

EPA Requirement (LDV/LDT only)	Test Design Elements	Requirements covered?	DOE Test Plan[46]	Auto/Oil Test Plan[47]	Orbital Study	Growth Energy Application
Key	*Acceptable data* (green)	*Partial data set* (yellow)	*Invalid data set* (red)	*Unknown* (grey)	*Not applicable* (hatched)	
Exhaust Emissions		Yes	Partial	Yes	Partial	Partial
	Representative test fleet	Yes	No	Yes	No[48]	No
	Cert fuel baseline (E0) & procedures	Yes	Yes	Yes	Yes	Partial
	Full Useful Life	Yes	Yes	Yes	Yes	No
	Back to Back Vehicle Pairs	Yes	Yes	Yes	Yes	No
Evaporative Emissions		Yes	No	Yes	Partial	Partial
	Representative fleet	Yes	No	Yes	No[48]	No
	Cert fuel baseline (E0) & procedures	Yes	No	Yes	No	Partial
	Full Useful Life	Yes	No	Yes	Yes	No
	Back to Back Vehicle Pairs	Yes	No	Yes	Yes	No
OBD		Yes	No	Yes	No	No
	General performance					No
	Real-world aging	Yes	No	Yes	No	No
	Representative technology?					No
Durability		Yes	Partial	Yes	Partial	Partial
	Materials Compatibility	Yes	Partial	Yes	Yes	Partial
	Long Term Mileage Accumulation	Yes	Partial	Yes	No	Partial

[46] Steve Przesmitzki and Brian West, *supra*; and Kevin Stork and Steve Przesmitzki discussion with API, Alliance and EPA on June 12, 2009. The DOE Test Plan includes research from EPA's EPAct study.

[47] Some studies are contingent on funding. *See* Appendix B.

[48] For the full useful life testing, the Orbital Study used new, then current model year, Australian vehicles.

EPA Requirement (LDV/LDT only)	Test Design Elements	Requirements covered?	DOE Test Plan[46]	Auto/Oil Test Plan[47]	Orbital Study	Growth Energy Application
Key		*Acceptable data*	*Partial data set*	*Invalid data set*	*Unknown*	*Not applicable*
	Representative technology?					
Driveability				Partial	Partial	Partial
	Representative test fleet					
	*Newer vehicles**					
	Older Vehicles		No		Yes	No

Other Considerations Regarding the Waiver Decision

Impact on the U.S. Emissions Inventory

The Alliance, in concert with AllSAFE colleagues, commissioned Sierra Research to analyze the potential impact of E15 on the emissions inventory, based upon available data and recognized modeling methods (most notably MOBILE 6.2). The complete Sierra Research study is available within AllSAFE's comments on the E15 waiver application. Here is an excerpted highlight:

> As shown, if E15 is provided an RVP exemption, *the increase in on-road NOx emissions estimated using all three methodologies is greater than the estimated reduction in VOC emissions*. If E15 is not provided an RVP exemption, the VOC reductions associated with the reduction in volatility are greater than the estimated increases in NOx emissions using two of the three methodologies. The NOx increase still exceeds the VOC reduction for the methodology involving the use of MOBILE6.2 with non-linear NOx effects due to oxygenate content. In all cases the higher oxygenate content of E15 leads to greater reductions in CO emissions than estimated with E10. (emphasis added)

These emission impacts could jeopardize the ability of many areas to attain the National Ambient Air Quality Standards for ozone. If emissions do increase as ethanol goes above E10 and EPA acts prematurely on the waiver request, future programs would be needed to offset the emission increases. The Alliance will expect EPA to offset the increases by tightening market fuel specifications, as required under the Energy Policy Act of 2005.[49]

Dynamics of the Blend Wall Concern

In its notice, EPA asks for comments on "the dynamics of the blendwall concern raised by Growth Energy, the extent to which the use of an E15 waiver would in practice help address this concern, and what additional steps would have to be taken to bring E15 to market should a waiver be granted.[50] We address these issues here to some extent and will comment further in our future comments on the RFS2.

The Waiver and the Blend Wall

The Alliance disagrees with the proposition that granting the E15 waiver request—or allowing any other blend level between E10 and E15—will address the blend wall issue. As EPA itself recognized in the waiver notice, granting the request would not automatically allow the fuel to be sold for use in conventional vehicles. Numerous federal and state regulatory actions, plus voluntary standard-setting by ASTM, would need to be taken before introduction as a general purpose fuel. Such actions will take years to implement. During this time, the vehicle fleet will also become more fuel efficient to meet new fuel economy rules, and economic growth may remain modest. Assuming ethanol production continues to grow at or near the pace seen in recent years, its volume will very likely exceed and remain ahead of the capacity of the gasoline pool to blend at rates up to 15% within just a few years. In other words, granting this waiver

[49] *See* 119 STAT. 1081, sec. 1506.

[50] 74 Fed. Reg. at 18230.

request for any new blend limit up to and including E15 would very likely do little, if anything, to “solve” the blend wall issue, even for a short while.

The Waiver, the Renewable Fuel Standard and the E85/FFV Market

The more important risk in granting the waiver is that it will undermine efforts to implement the RFS2. In 2007, Congress passed the RFS2 with aggressive renewable fuel targets, and the most viable of the renewable fuels is ethanol. High ethanol content fuel is the only fuel that can fulfill the RFS2 because it enables a much higher ethanol consumption rate than a low level blend can provide, especially as the vehicle fleet becomes more fuel efficient. Increasing the allowed blending level of ethanol in conventional gasoline may increase ethanol consumption in the short-term, but it will be vastly insufficient for staying ahead of the blend wall or achieving the long-term RFS2 goals. Importantly, as explained further below in our discussion about RIN values, a waiver would inhibit the expansion of high ethanol content fuel. Ultimately, this will both delay and undermine the nation’s ability to implement the RFS2.

Ethanol is now being produced from corn in this country, and Congress anticipated that future feedstocks will include cellulosic sources. To become commercially viable, cellulosic ethanol will require significant investments. While various government agencies are now providing some research and development assistance, securely establishing ethanol as an alternative fuel will provide the best incentive for commercializing cellulosic ethanol by creating a market many times larger than the conventional gasoline pool.

The numbers of existing and planned FFVs are sufficient to achieve near-term ethanol consumption targets, and as the fuel infrastructure expands and becomes more established with consumer-friendly prices, market demand will drive additional FFV growth as needed. Currently, more than seven million FFVs are on U.S. roads. More FFV models are being offered today than ever before; 47 FFV models are now available in the 2009 model year, compared to 32 models in 2008, which represents an increase of 47% over the previous year’s offerings.[51] The domestic automakers have committed to producing 50% of their annual sales as FFVs by 2012, contingent on E85 infrastructure development. Today’s FFV fleet could potentially use 6.5 billion gallons of E85 annually,[52] but it consumes less than 1% of that amount due to the limited number and sub-optimal location of existing E85 stations (most are in the Midwest/Plains states where only a fraction of the FFV fleet is located) and uncompetitive E85 pricing compared to gasoline on an energy equivalent basis. Using EIA estimates of more than 15 million FFVs in the market by 2014, this fleet has the potential to consume more than 12 billion gallons of E85 per year.[53] This potential is what must be nurtured now to achieve the RFS2 goals and promote market driven investments that will help make cellulosic ethanol a viable fuel.

The Waiver and RIN Values

One of the most important aspects of the decision on whether to grant the waiver involves the impact it could have on the value of RINs under the RFS2, which can be used as a proxy for

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[51] National Ethanol Vehicle Coalition: http://www.e85fuel.com/e85101/flexfuelvehicles.php.

[52] Energy Information Administration, Annual Energy Outlook 2009, available at http://www.eia.doe.gov/oiaf/aeo/supplement/suptab_58.xls.

[53] It is important to recognize that no rate of FFV production can replace the existing fleet overnight. Even if all new vehicles are sold as FFVs, it will take decades for the existing fleet to turn over. To meet the goal, it is only necessary for the availability of FFVs to outpace the availability of E85 in overlapping local markets.

judging the ability of the marketplace to absorb volumes of ethanol above 10% of gasoline volumes. EPA should understand and recognize the potential to allow market forces – specifically fluctuations in RIN prices – to enable the market to address the blend wall without regulatory intervention (i.e., by granting the waiver).

If EPA denies the waiver application, RIN values will likely increase. Progressively higher RIN prices will mean regulated parties are finding it increasingly difficult to find gasoline batches to which the ethanol can be added. As the scarcity of available unblended gasoline increases, each remaining gallon becomes more valuable with accordingly higher retail prices relative to E85.

EPRINC examined RIN economics as the market approaches the "blend wall" in a study published this year.[54] The study concludes that, "As ethanol approaches, and possibly exceeds the blend wall during 2009, we may see some additional discounting in ethanol at the pump to make sure obligated parties meet their mandates." As illustrated in the study's Figure 2 (reproduced below as Figure 4 of these comments), falling values of ethanol will be "mirrored in a rising value of RINs." In other words, a gallon of ethanol and its RIN together would fetch the same price in the market, but the market will increasingly value the RIN over the physical ethanol.

Perhaps because EPRINC generally opposes increasing RIN values, the study did not attempt to evaluate the benefits of such an impact, namely, a shift in the relative pricing of low-level gasoline-ethanol blends and high-level ethanol blends such as E85. When RIN prices are high enough to allow retailers to sell E85 at a price attractive to retail customers, the upward pressure on RIN prices should moderate.

For example, assuming retail gasoline prices of $3.00 per gallon for E10, E85 will be attractive at prices at or below $2.40 per gallon (roughly 20% below the E10 price to compensate for the difference in energy content). These retail prices translate roughly into untaxed values of $2.60 per gallon of E10 and $2.00 per gallon for E85. The RIN value necessary to support this example would vary inversely with the price of ethanol. If ethanol is selling for the same price as gasoline, however, the price differential of 60 cents would have to be compensated for in the value of RINs (0.60 would have to be associated with the 70-75% of a gallon difference in the ethanol content of E10 vs E85), or about $0.80 per RIN.

In effect, higher RIN prices will allow the market forces to overcome the blend wall without any regulatory action to modify vehicles. As E-85 becomes increasingly available at attractive prices, E-85 demand will enable new avenues of consumption that will quickly allow obligated parties to acquire additional needed RINs to satisfy their obligations under the RFS.

On the other hand, if EPA grants the waiver, the price dynamics associated with higher RIN prices would be delayed by an amount of time dependent on the size of the waived ethanol volume, perhaps a couple of years at best, until the next blend wall appears. RIN prices would fail to increase, ethanol prices would remain generally unattractive to consumers and retailers would continue to avoid offering E85 due to claims of poor marketability.

From this perspective, the so-called "blend wall problem" is not really a problem but a mechanism capable of signaling the arrival of low cost E85 in the marketplace, rather than a physical market limitation, and this mechanism is what is needed to implement the RFS2.

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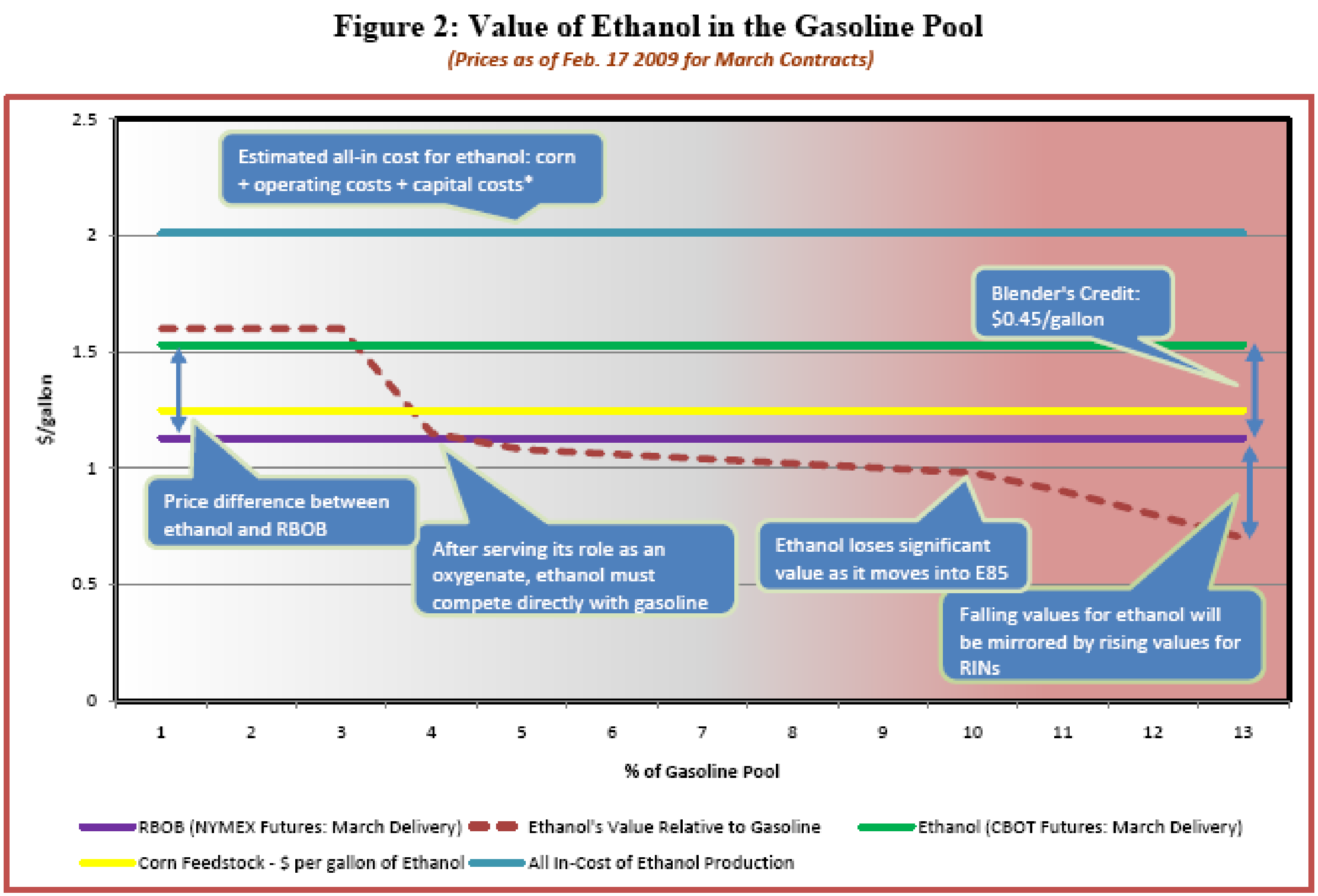
[54] *See* EPRINC, "Will the Ethanol Mandate Drive up the Cost of Transportation Fuels?" February 2009, available at http://eprinc.org/pdf/costofethanolmandate.pdf (as of July 9, 2009).

Therefore, EPA should embrace this natural market scenario as a beneficial outcome of denying the waiver application while continuing to implement the RFS2. In rejecting the waiver application, EPA should expressly acknowledge the high-RIN value/low E85 price scenario as a likely outcome of its decision. This will enable the benefits of true competition between ethanol and gasoline to be realized sooner rather than later.

Figure 4. EPRINC Study's Figure 2, Value of Ethanol in the Gasoline Pool



* Operating and capital costs are for a new 50 million gallon ethanol plant with a yield of 3 gallons/bushel. Source: ***The Long-Run Impact of Corn-Based Ethanol on the Grain***, Amani Elobeid, Simla Tokgoz, Dermot J. Haye, Bruce A. Babcock, and Chad E. Hart, Center for Agricultural and Rural Development, Iowa State University, November 2006

Implementation Issues

Variations on the Waiver Decision

Introduction. EPA raised various implementation concepts and options in the waiver notice but elaborated on its thinking in separate rulemaking, namely, its proposed rule to implement the revised renewable fuel standard (RFS2) required under the Energy Independence and Security Act of 2007 (EISA). The Alliance will comment on these ideas here only briefly; we intend to provide a more in-depth discussion of these issues in separate comments on the RFS2 rulemaking.

Waiver for Some Other Blend between E10 and E15. The available data do not yet support allowing any blend above 10% ethanol to be used in conventional vehicles; therefore, the Alliance opposes granting this waiver application for any blend level above E10.

Partial Waiver. EPA has suggested that it may take an action other than fully approving or disapproving this E15 waiver application. One of these actions might be to approve a partial waiver for a portion of the vehicle fleet. Putting aside the question of whether the Clean Air Act authorizes partial waivers, implementing a partial waiver would require numerous additional regulatory and non-regulatory actions to protect the remaining fleet and other vulnerable engine products from the effects of misfueling, as EPA itself acknowledges in the waiver notice. While EPA has suggested various implementation strategies, it has not yet explained in detail exactly how it would define and enforce such a program.

Conditional Waiver. Growth Energy has proposed that the "waiver be granted with a condition requiring E-15 to conform to ASTM fuel volatility specifications for the area and time of year where it is used."[55] We agree with the concept that all fuels must meet fuel quality specifications, including ASTM volatility standards; in fact, ASTM participants, including from the auto industry, recently approved revisions to T50 distillation temperatures to account for ethanol blending.[56] The waiver request prompts a question, however: if a proposed E15 is to conform to ASTM volatility specifications for area and time of year, why not E0 and E10? In a recent letter to the Alliance, EPA confirmed that E0 must meet one of the volatility classes of an outdated specification (D4814-88) but not necessarily the appropriate class, and E10 is exempt from meeting any volatility specifications whatsoever.[57]

We believe EPA should require all finished gasolines, both with and without ethanol or other oxygenates, to meet the specifications in D4814-09 in its entirety, including each ASTM fuel volatility specification (vapor pressure, distillation temperatures, and TVL20) for the area and time of year where it is used. We reserve the right to seek additional fuel quality requirements beyond those in the ASTM D4814-09 standard. For example, an issue of longstanding concern is the adequacy of additive packages in all finished fuels. We note that any conditions placed on finished fuel quality would need to be implemented under section 211(c), since ethanol

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[55] Waiver application, page 26.

[56] *See* ASTM D4814-09, Table 1, published February 2009. The auto industry participants generally supported this change as representing a significant improvement over the status quo and necessary for E10 market development, but some may continue to support tighter volatility standards for gasoline-ethanol blends than in the new ASTM standard.

[57] Letter from Karl Simon, EPA, to Ellen Shapiro, Alliance of Automobile Manufacturers, dated February 26, 2007.

producers generally would not be the responsible parties for complying with finished fuel quality requirements in the marketplace.

Conclusions

The Growth Energy waiver application has not met its burden of proof to show that the proposed fuel "will not cause or contribute to a failure of any emission control device or system (over the useful life of the motor vehicle ... to achieve compliance by the vehicle or engine with the emission standards with respect to which it has been certified."[58] The studies submitted with the application fail to cover the scope of needed data, and most do not provide reliable scientific information. We reviewed additional available studies and highlighted one that suggested a potential for damage to catalysts and other vehicle parts. The application did not produce any data to challenge this finding. Thus, the existing information base is inadequate to draw science-based conclusions that can inform EPA's waiver decision about any ethanol level between E10 and E15. The Alliance and its members have been working with other stakeholders, including EPA and DOE, to identify needed research to fill the data gaps, and we urge EPA to deny the request, since these data gaps will not be filled until well after the December 1, 2009, deadline for a decision.

Regarding the possibility of a partial waiver, the Alliance disagrees that the Clean Air Act provides sufficient authority under section 211(f)(4). To implement any strategy applying to a portion of the fleet, EPA must use other clean Air Act authorities, especially section 211(c), to develop a complete regulatory program that has greater capacity for protecting the non-compatible fleet and other products from adverse impacts. Through this process, EPA could implement a full range of needed fuel quality controls for all parts of the market. Finally, EPA has not yet identified which specific vehicle technologies or subset of the fleet might be able to successfully use blends above E10; currently, we think the data base is inadequate for this purpose.

Regarding the possibility of granting the waiver application for other blend levels below E15, putting aside that the data base for these blends also remains insufficient, this action would very likely not help address the so-called blend wall problem because so many additional federal and state regulatory actions would be needed that the fuel could enter the conventional market only well after the 10% blending limit is reached in the near future. Thus, granting a waiver for these blends would hardly be worth the trouble.

More importantly, granting a waiver would undermine efforts to build the E85 infrastructure, which is critically needed to fulfill the RFS2 mandate as directed by Congress in the EISA. Increasing ethanol consumption through the E85/FFV market is the only way the country has a chance of satisfying the RFS2 mandate throughout its term. As E85 infrastructure expands, future market demand and current automaker commitment to build more FFVs will allow high level of ethanol fuels to be consumed. EPA needs to consider more closely the implications of a waiver with respect to its impact on the E85 market and the ability to meet the RFS2 goals.

Finally, the Clean Air Act implicitly requires EPA to protect manufacturers and consumers from the potential risks and liabilities of a waiver decision and to protect all parties, including ethanol, from the risk of reputation damage. Importantly, EPA must have a high confidence that

[58] 42 U.S.C. §7545.

problems will not emerge; otherwise, consumers may reject ethanol in their fuel, and this outcome would prevent the country from meeting its renewable fuel targets and associated energy and greenhouse gas reduction objectives.

Appendix

A. Detailed Alliance review of the available research.

B. Automaker summary of the various research programs relating to mid-level ethanol blends.

Appendix A. Detailed Alliance Review of Available Studies

Reviews are organized by relevance to key technical issues, namely exhaust emissions, evaporative emissions, OBD, materials compatibility and durability, and driveability. Not all studies are mentioned in all sections.

a. Emissions studies, exhaust

This section reviews the studies with data bearing on exhaust emissions impacts. Several of the studies investigated fuel economy impacts in addition to conventional emissions; we also comment on these here, although fuel economy impacts are irrelevant for purposes of the waiver decision.

MCAR Study

This study tested tailpipe emissions in the spring and fall of a one-year project. For the test procedure, it used the U.S. FTP test protocol but limited the testing to the hot transient (Hot 505) portion of the drive cycle, only. This cycle is considered to simulate both highway and city driving. The study used E30 for on-road mileage accumulation for 11 of the 15 vehicles and E10 for the remaining four vehicles and tested all the vehicles on both E10 and E30 test fuels. It measured regulated exhaust emissions (HC, CO and NOx) from 15 vehicles of various makes and models ranging in age from the 1985 through the 1998 model year.

Study Design Elements

Representative test fleet. No.

Certification fuel baseline and test procedures. No. The study did not use E0 as a baseline fuel and used only a portion of the FTP, so the results are inapplicable.

Full Useful Life. MCAR performed emissions testing at the beginning and end of a one-year period. The researchers did not provide the existing mileage of any of the test vehicles, nor did they provide total accumulated miles driven during the test program, so the extent to which this study provides any information about E30's impacts on full useful life is unclear. Also, the existing mileage must have been accumulated using regular unleaded gasoline (probably E10, since Minnesota has an E10 mandate[59]), which precludes any conclusions about the full useful life impacts of E30.

Back to back vehicle pairs. This study did not examine any vehicles in pairs.

Results. A summary of the program said the study found no apparent trend in vehicle emissions.[60] Almost all the emissions data fell below the various federal tailpipe standards for the test vehicles. Notably, some vehicles failed to fully "learn" the different test fuels after 30 minutes of dynamometer driving. Also, since 100 miles of highway driving seemed to produce better responses, it would have been interesting to know if any of the vehicles would have produced the proper learning response with additional highway miles.

The study also examined fuel economy by using the carbon balance method on the results of data obtained during the Hot 505 emissions test cycle. The results showed reduced volumetric fuel

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[59] Minnesota adopted an E20 mandate in 2005 to be implemented contingent on the outcome of a relevant waiver application. *See* S.F. 4, sec. 5, amending Minnesota Statutes 2004, section 239.791, subdivision 1, adopted 2005.
[60] *See* Jones, *supra*. We could not verify this conclusion because the author never published the final results.

economy averaging 8.83% (ranging from 1.28-14.66%) on E30 compared to E10. These results are consistent with ethanol's known impacts.

Stockholm Study

The Stockholm Study is mostly a literature review of research from around the world, which was conducted in preparation for a very modest experiment involving no vehicles or vehicle parts. The literature review included the Orbital Study, reviewed below, and a preliminary report from a 2004 Environment Canada study, which produced mixed results for formaldehyde emissions and showed some vehicles had significant and generally consistent increases in acetaldehyde emissions. The U.S. FTP was used as the test protocol in that study.

ACE Study, 2007

Overview. In December 2007, the American Coalition for Ethanol (ACE) and the Department of Energy released the results of a joint study, "Optimal Ethanol Blend Level Investigation," which investigated certain impacts of mid-level ethanol blends. According to the report, the study had two objectives: (1) investigate variations in vehicle fuel economy impacts to see if an optimal blend level could be identified, and (2) produce hot-start tailpipe emissions data for various blend levels. Researchers at the University of North Dakota Energy and Environmental Research Center (UND-EERC) and the Minnesota State University Center for Automotive Research (MCAR) conducted the study, testing nine fuels (E0, E10, E20, E30, E40, E50, E60, E70 and E85)[61] on four 2007 MY sedans: a Ford Fusion (with about 5,000 miles on the odometer), a Toyota Camry (with about 7,000 miles), a conventional Chevrolet Impala (with about 31,000 miles) and a Chevrolet Impala FFV (with about 7,000 miles). The report failed to indicate the specific emission standards to which the vehicles were certified, which is key information for waiver purposes.

Study Design Elements.

Representative test fleet. No.

Certification fuel baseline and test procedures. Yes. The study used E0 as one of the test fuels and the FTP.

Full Useful Life. No. This study did not include full useful life testing, it merely judged results from low mileage vehicles against the full useful life standards.

Back to back vehicle pairs. No.

Results. The study found that three of the four vehicles tested met full useful life Tier 2 Bin 5 emissions limits when tested with Federal Emissions Test Fuel (labeled as "Tier 2" gasoline) and with E20, E30 or E40, whichever blend appeared to give the best fuel economy. This was not a particularly challenging goal, however, since three of the vehicles had been driven less than 10,000 miles and full useful life is a minimum of 120,000 miles for Tier 2 vehicles. The one vehicle failing to meet full useful life NOx emission standards on both test fuels (Tier 2 and E20) was the FFV, which had been driven 31,000 miles before the study began.

[61] Tier 2 gasoline was used as the base gasoline; presumably the fuel contained no ethanol. The study is silent on the method used for blending, but we assume the authors splash-blended the components without rebalancing any other fuel properties.

Other analytical and testing anomalies also undermine confidence in the study's results. For example, full-useful-life testing requires aged catalysts and sensors, but the study implied no additional aging beyond the miles already on the test vehicles and did not explicitly discuss this issue. This is a critical factor for all vehicle emission test programs. As was documented in the Orbital Study, catalyst deterioration, which occurs normally with aging, can be strongly influenced by ethanol. Further, given the possible impacts of wide open throttle (WOT) testing, the researchers should have performed confirmatory testing to determine if the WOT testing with the blends had indeed damaged any catalysts.

More importantly regarding the emission testing, the researchers correctly note in Section 3.3 that the study did not simulate all driving and environmental conditions and that some conditions may affect the vehicle's ability to "learn" to deliver sufficient fuel to the engine (known as learned fuel trim). In an effort to determine whether the fuel systems have enough flow capacity to operate at heavy load, however, the investigators tested the vehicles at WOT for "an extended period of time." This certainly provided an extreme test condition, but this test design decision and the researchers' interpretation of the results are very unusual and suggest a basic misunderstanding of how modern vehicles and diagnostic systems work.

The researchers planned to use the vehicle's diagnostic system to determine whether the fuel system would allow adequate fuel flow to the engine at different ethanol levels, assuming that the fuel trim diagnostic would be active and would signal a lean condition if the flow was inadequate. The oxygen sensor, however, cannot be used for engine control at WOT conditions because it is typically designed to operate only near stoichiometric air-fuel ratios. Also, at WOT, vehicle engines typically operate in fuel-enriched hardware and catalyst protection regimes, which can significantly affect the results. Since the oxygen sensor does not operate at WOT, the fuel trim diagnostic will not operate either and cannot set the lean code or illuminate the malfunction indicator light (MIL) as the investigators expected. The absence of a code in this study, therefore, did not necessarily mean the vehicle was successfully delivering sufficient fuel volume to compensate for additional ethanol in the fuel.

If a vehicle is unable to provide enough fuel at WOT to compensate for additional ethanol, its engine will simply run leaner, and as a result, hotter than designed without setting a code. If the engine runs lean enough—well lean of stoichiometric operation and thus running with quite hot exhaust gases—misfire may occur. In addition, misfire will deliver unburned fuel to the catalyst, which further increases its temperature when the unburned fuel oxidizes exothermically on the catalyst surface. If misfire is detected, the diagnostic system will set a fault code. If misfire occurs at high load (e.g., during WOT), the risk of catalyst damage is very high regardless of whether the diagnostic system triggers a code (e.g., if the ethanol was outside the range for which the system was designed). Another circumstance that could cause the diagnostic system to set a code would be if actual catalyst damage were detected.

Although the investigators possessed a diagnostic scan tool and the codes themselves are the same for each manufacturer, they did not report which codes were set during the tests. Thus, we were unable to determine which diagnostic trouble codes triggered the MILs reported by the authors. We note that testing was terminated at different ethanol levels for each of the non-FFV vehicles, presumably due to the illumination of the MIL, although this was not explained. This suggests catalyst damage may have indeed occurred.[62] Unfortunately, the study lacks any mention of checks to determine if catalyst damage occurred as a result of the WOT testing. This would have been useful information, particularly since one of the vehicles appears to have failed the FTP on Tier 2 fuel.

The study also used an unusual methodology for measuring and reporting non-methane organic gas (NMOG) emissions. The measuring device used, a Flame Ionization Detector, is known to significantly under-report both ethanol and methane. This means that the researchers start with partial results. Then, for some unexplained reason, the researchers multiplied the total hydrocarbon (THC) results by 0.84.[63] As a result, the researchers erroneously conclude that increasing the fuel ethanol level will decrease NMOG emissions. Any impact of ethanol concentration on the methane fraction in the exhaust is similarly obscured.

The reported blend inspection process also appears flawed. The test method used to determine vapor pressure, ASTM D323, is not accepted for use with fuel containing oxygenates other than MTBE because the method uses water and will produce erroneous results when a water soluble component—such as ethanol—is present in the sample. The ASTM D323 test method itself cautions that D323 should not be used for ethanol blends. Thus, when the specific gravity values of the test fuels are plotted, they do not produce a smooth curve as would be expected. This indicates issues either with the blend compositions or test operation. Further, the ethanol density used by the study, 0.800, disagrees with the generally accepted value of 0.789. These discrepancies suggest potential issues with the fuel composition and/or test operation.

The primary claim of this study and its most glaring flaw is the conclusion that the volumetric fuel economy of these vehicles, when measured using the U.S. highway fuel economy test, improved as a result of adding ethanol to the gasoline. This surprising result is contrary to the known impact of ethanol on the energy content of gasoline blends and conflicts with numerous other studies, including the DOE Study. The study lacks any analysis or energy balance to explain the unusual results.

Importantly, the results show very large discrepancies with published EPA data, which are based on the same Tier 2 gasoline and federal emissions test procedures used by UND-EERC. The test Toyota Camry had a fuel economy of 19.8 mpg using the FTP (city) test procedure and 27.9 mpg using the HWFET (highway) test procedure, which were 10% and 20% lower than the published EPA values of 24 and 32 mpg, respectively. When testing the Chevrolet FFV Impala, the authors measured a fuel economy of 17.7 mpg, which was 23% lower than the published EPA value of 23 mpg. Similarly, the authors were unable to replicate the published EPA results for any of the other vehicles tested. The baseline fuel economy is critical because, if the baseline is artificially low, a fuel economy reduction might go unnoticed or appear as an improvement and any improvement would be exaggerated.

Moreover, experienced researchers know that in 1984 EPA began adjusting the FTP and HWFET test results from its certification database downward, by 10% and 22% respectively, to

[62] Based on the lack of reported data at higher ethanol levels, we infer that testing was stopped at E65 for the Toyota Camry, E50 for the Non-FFV Impala and E45 for the Ford Fusion. Only the FFV Impala was tested for all ethanol levels up to E85.

[63] The origin of this adjustment is obscure. The application refers to test method sensitivity for methane, ethane, propane and pentane as approximately 1, and the corresponding value for ethanol is 0.46. *See* Dietz W. Response Factors for Gas Chromatographic Analysis. Journal of Gas Chromatography, Vol. 5, 68-71, (1967).

better approximate real-world fuel economy results for the public.[64] The unadjusted numbers, which are what the authors should have matched in their testing on Tier 2 fuel, can be obtained by dividing the reported EPA FTP data by 0.9 and the reported EPA HWFET data by 0.78. The results of this reverse adjustment, which underscore the discrepancy with the study's E0 results, are shown in Table 4:

Table 4. Baseline (E0) Fuel Economy Discrepancies

Test Vehicle	Test Type	EPA Published Data*	EPA Certification Data	UND-EERC Test Data	%Difference (Certification vs UND-EERC)	% Difference (Published vs UND-EERC)
Ford Fusion	City	23	25.6	19.8	23%	14%
Ford Fusion	Hwy	31	39.7	27	32%	13%
GM Impala	City	21	23.3	16.2	31%	23%
GM Impala	Hwy	31	39.7	24.5	38%	21%
Toyota Camry	City	24	26.7	19.8	26%	18%
Toyota Camry	Hwy	32	41.0	27.9	32%	13%
GM Impala FFV	City	21	23.3	14.6	37%	30%
GM Impala FFV	Hwy	31	39.7	23.5	41%	24%

*As provided in the ACE Study, referred to here as UND-EERC.

Comparing the UND-EERC data with the certification data for Tier 2 fuel that should have been replicated shows errors ranging from 26% to 41%. Similarly, there is a discrepancy for testing on E85. The EPA data for the FFV Impala is 16 mpg city and 23 mpg highway, equating to unadjusted values of 17.8 and 29.5 mpg, respectively. Again, the authors failed to replicate the EPA data using the EPA procedure, reporting 17.7 mpg for the HWFET as opposed to the EPA HWFET value of 29.5 mpg, another 40% error.

Fuel economy values for a vehicle are normally developed by applying a carbon balance to the tailpipe emissions numbers and fuel properties. In general, fuel economy test results should be reproducible on the same vehicle within 2% to 3% when tested according to the regulations and using best practice. Discrepancies as large as are found in the UND-EERC data, however, raise fundamental questions about the accuracy of the study's findings. Indeed, both the DOE Study and the just published CRC E-87-1 looked at E0 fuel economy and compared the results with the published EPA standards, and under the protocols used in those studies, a discrepancy of over 10% was grounds for further investigation, removal of the data point or removal of the vehicle from the study. No such action was required in either of these studies, but it is difficult to see how the ACE data would have survived under a similar protocol.

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[64] *See* EPA, "Regulatory Announcement: EPA Proposes New Test Methods for Fuel Economy Window Stickers," found at http://www.epa.gov/fueleconomy/420f06009.htm#background, and various, "Fuel Economy in Automobiles", found at http://en.wikipedia.org/wiki/Fuel_economy_in_automobiles#Current_EPA_testing_procedure_through_2007. The EPA adjustment procedures have since been revised, but this is not relevant here.

Several theories can help explain the discrepancies in the fuel economy results, and all point to testing issues. For example, the researchers might have used much higher dynamometer loadings or much more aggressive test driving relative to certification testing, or the measurements might have had a fundamental bias for some reason. Whatever the cause, the discrepancies raise significant doubt about the overall results, including but not limited to the fuel economy data. While fuel economy is not relevant under the CAA when deciding a waiver application, the results raise questions about the study quality and when combined with the other study anomalies, the outcome is a lack of confidence in any of the study's data.

RIT Study[65]

Overview. The Rochester Institute of Technology (RIT) examined the impact of E20 on 10 older gasoline vehicles with varying existing mileage, under sponsorship of the New York State Department of Transportation. The summary claims emissions testing was conducted using the Federal FTP-75 emissions test and regular unleaded gasoline at some unknown baseline ethanol level and at E20. The summary lacked critical details about the test vehicles, test fuels, mileage accumulation and other information necessary to independently judge the authors' claim that all the vehicles met EPA's full useful life (FUL) standards for all the regulated emissions. Without the actual study, we are unable to judge the results, the authors' claims or the quality of the investigation.

Study Design Elements.

Representative test fleet. RIT tested 10 older gasoline vehicles owned and operated by Monroe County, New York State, but the summary provided no details about the test fleet, such as vehicle make and model, existing mileage accumulation or vehicle emissions certification classification. We doubt the test fleet was representative.

Certification fuel baseline and test procedures. Unclear. RIT conducted emissions testing using the Federal FTP-75 emissions test on regular unleaded gasoline (baseline) and E20; the report is unclear whether the baseline test fuel was E0 or E10.

Full Useful Life. No. The summary lacked information about either the applicable emission standards or the existing mileage for each test vehicle. Also, it is unclear if the emissions testing occurred prior to or upon completion of the roughly six months duration (February through September) of on-road mileage accumulation on E20 fuel. Since the vehicles were taken from the existing fleet, however, all previous mileage accumulation would have taken place on regular unleaded gasoline (either E0 or E10) and not on the fuel being tested. The summary indicated a plan to retest the vehicles in March 2009, after roughly 10K-15K miles of aging on the test fuel (E20). This mileage accumulation would still fall well short of any full useful life aging requirement.

Back to back vehicle pairs. Unknown.

Results, criteria emissions. Since the complete RIT study is unavailable, we are unable to judge the summary report's claims of about 23% emission reductions in CO, 2.4% reductions to 25% increases in NOx and 13.7% emission reductions in total HC when the vehicles used E20,

[65] We are relying on a six page summary produced for a Senate hearing in 2008 because we do not have a copy of the actual study.

which, in any case, are meaningless without baseline information. Notably, increased NOx emissions are evidence of the vehicle running lean, which bears further investigation.

Other results. Like many of the other studies, RIT also investigated fuel economy and carbon dioxide (CO2) emissions impacts. For CO2, RIT reported seven of the 10 vehicles had lower emissions and the fleet average reduction was 3.6%. The researchers did not report whether they applied any statistical analysis to the data, however, so it is unclear whether the results were statistically significant or merely reflect numerical differences.

RIT's fuel economy data were derived from two sources: driver logs/tracking sheets and Federal Test Procedures (FTP-75) testing. According to RIT's brief report, the fuel economy results derived from the driver logs showed an average 3.5% increase in vehicle miles per gallon when the vehicles used E20 compared with the baseline fuel, whatever that was. Vehicle fuel economy calculated using the carbon balance method based on data collected during the FTP-75 emissions testing, however, showed a decrease in fuel economy of 6.8% for the fleet when using E20, which, directionally, is as would be expected due to the lower energy content of the fuel compared to a baseline fuel with either 10% or 0% ethanol.

For regulatory purposes, EPA calculates fuel economy using FTP-75 and not actual vehicle mileage tracking, in large part because vehicle fuel economy is highly sensitive to human and environmental inputs. This study appears to have lacked any controls on these extremely variable factors. Therefore, we conclude the so-called fuel economy benefit derived from the driver log data is meaningless.

DOE Study

Overview. DOE produced two reports on this study: a preliminary report in October 2008 and an "Update" in February 2009, which included the findings of the preliminary report. Growth Energy submitted only the preliminary report; this discussion focuses on the more complete Update and refers to it as the "DOE Study." DOE has characterized this test program, labeled Vehicle Task V1, as a "Short term 'quick look' emissions study of 16 vehicles."[66]

Study design elements.

Representative fleet. No. DOE presents data from R. L. Polk describing the U.S. fleet but did not select the vehicles to statistically represent that fleet. The study included no Tier 0 vehicles, for example, nor do the selected test vehicles proportionally represent the vehicles in the Polk table. The test program generally ignores pre-1999 vehicles, even though they will continue to be a large portion of the legacy fleet for many years. These older vehicles are most likely to have operational and emissions issues with E15 and E20. They should not be ignored.

Certification fuel baseline and test procedures. Partial. The DOE study includes E0 as the baseline fuel, for comparison with test blends of E10, E15 and E20. DOE also compared E15 and E20 with E10, but since E10 is not a certification fuel, these comparisons are irrelevant for purposes of the waiver decision.

DOE used the incorrect test cycle for waiver purposes. The study tested four fuels—E0, E10, E15, and E20—using the LA92 drive cycle, also known as the unified cycle. DOE described this drive cycle as "representative of real-world emission changes as it more accurately represents typical acceleration rates and speeds of actual drivers on the road than does the Federal Test

[66] Przesmitzki and West, *supra*, Slide 14

Procedure (used for emissions certification testing)." Further description of how this test relates to or correlates with the FTP used for emission testing is lacking and probably does not exist. This cycle's major shortcoming is that it is not used in any vehicle certification testing; therefore, it fails to meet EPA's requirement to use "certification tests."[67] Indeed, since the certification process does not use this cycle, it is impossible to determine whether the test vehicles used in the study met emissions standards on any fuel (the "cause" test) or experienced any additional degradation that impaired their ability to meet the standards (the "contribute" test).

Full Useful Life. No. The test program did not test the vehicles to full useful life but rather only for extremely brief periods, with less than 50 miles per fuel. This study did report that seven of the 16 models tested did not use long term fuel trims in open loop control. This indicates that the test vehicles could have experienced the same type of degradation in catalyst performance as was seen in the vehicles with the same control approach tested in the Orbital Study and emphasizes the need to conduct full useful life testing to determine long term durability effects.

Back to back vehicle pairs. No. This study tested only one of each test vehicle.

Comments on the conduct and design of the test. The sequential testing of ethanol fuels in the order E20, E10, and E15 for each vehicle raises concerns. Always preceding the testing of E10 and E15 by the E20 fuel creates the possibility of fuel carryover effects. If so, then the three fuels would be expected to perform more similarly to one another than they would if tested individually or with a purge cycle using non-ethanol fuel between the testing of each ethanol fuel. The US06 appears to be a purge cycle, but it uses the next ethanol fuel rather than a fuel with no ethanol.

Some of this concern could be alleviated if the two sets of E0 fuel test results were compared. This non-ethanol fuel was tested at the beginning and the end of the testing of each vehicle specifically to check on possible drift or other effects of the testing procedures. Emissions comparisons should be made to rule out any carryover effect and other possible effects such as drift.

Second and third emissions tests are performed without performing the entire prep cycle, but this may not qualify as a true repeat test.[68] For example, there is no indication of how long each vehicle waits until a subsequent test. If the time period is too short/long, the subsequent test may not be truly measuring the same emissions (e.g., Bag 1) as when the vehicle had the complete test prep prior to the first emissions test.

Results, criteria emissions. DOE looked at 16 vehicles from a variety of manufacturers and certified to a variety of different emissions standards. The vehicles were about evenly divided between vehicles with control systems that can adjust for ethanol during cold start and those that cannot. Despite these critical design differences, DOE nonetheless grouped the 16 test vehicles together for purposes of the statistical evaluation of ethanol's impact on tailpipe emissions. This analytical flaw enabled the authors to find, at a 95% confidence level, that increasing the amount of ethanol in gasoline reduces CO and non-methane hydrocarbon (NMHC) emissions. Not surprisingly given this flaw, the data set showed a significant amount of scatter, which by itself undermines the ability to draw well-founded conclusions.

[67] *See, e.g.,* Whitman, *and* Simon.

[68] *See* DOE Study, page A-5.

Similarly, DOE's original analysis of the pooled NOx emissions data showed no increase in emissions, contrary to predictions based on the literature. DOE conducted an additional analysis after publishing the updated report that demonstrated the vehicles unable to adjust to fuel ethanol on cold start did have increased NOx emissions.[69]

Parsing the test fleet further produces additional interesting information. For example, if one looks only at the 2007 vehicles meeting Tier 2 Bin 5 emissions and at those vehicles that do not use long term fuel trims to adjust for the ethanol in the fuel, one find that the NOx emissions from E15 use increasing by over 45% compared to the E0 results and about 43% compared to the E10 results. Only two vehicles in the test fleet met these criteria—the Honda Accord and the Chrysler Town and Country—but they are vehicles with very high sales rates. This is a significant discovery that merits further investigation, perhaps by repeating and broadening the testing using the FTP and SFTP cycles.

Comments on the statistical analyses. The comparisons beg the question of whether there is one E0 mean. Tests with E0 were conducted on each vehicle before and after the tests with the ethanol fuels. This was done explicitly to assess whether there was any change in the E0 emissions. No analysis of whether mean E0 emissions changed throughout the course of the testing was performed. Without such analyses, the E0 results should not be combined. Hypothetically, if there was a drift effect, the combined E0 averages would include the drift effect, as do the ethanol averages. If so, again hypothetically, all the comparisons of the fuels are invalid if the drift or other effects are not removed. Such effects could be present in individual vehicles or possibly in all of the vehicles.

t-Tests. The simplicity of making pairwise t-tests of the ethanol averages with the E0 averages ignores the possibility of biases if the other factors included in the design of this study have effects on emissions. Such other factors can include the use of different labs using different equipment and different operators, of the testing of different vehicles with different technologies and different mileages, among other possible differences in the vehicles themselves. All of these factors have been shown in many emissions studies to contribute to differences in mean emissions. They must be accounted for in any comprehensive analysis of the emissions results.

Comprehensive statistical modeling and analyses generally include the following:

- An assessment of model assumptions, including normality and constant variance. Repeatedly, emissions have been shown to be highly skewed, leading to an analysis of log-emissions. Failure to use a log scale when emissions are highly skewed can lead to high emitters dominating the calculation of averages and subsequent comparisons of fuel averages.
- An evaluation of the possibility of outliers in the data. Outliers could be due to individual vehicles, especially if emissions are skewed, or to individual test runs. Failure to accommodate outliers can lead to the same difficulties as failure to accommodate skewed emissions. Outliers should be evaluated in the transformed scale if a transformation is used to decrease skewness in the emissions data.
- A comprehensive analysis of variance (ANOVA) model that includes design factors such as labs, vehicles, etc. Moreover, all fuels, including E0, should be simultaneously

[69] Effects of Mid-Level Ethanol Blends on Legacy Vehicles: Tailpipe Emissions using 0 to 20 % Ethanol in Tier 1 and Tier 2 Vehicles, 19th CRC On-Road Vehicle Emissions Workshop, Keith Knoll, March 23 – 25, 2009

modeled, not differences in emissions between the ethanol fuels and the non-ethanol fuel. The more comprehensive the model, the less chance that fuel comparisons are biased by excluded factors and the better the estimates of experimental error variances.

- Appropriate multiple-comparison-corrected tests should be used to compare fuel averages. Ordinary t-tests do not properly control for error rates (significance levels) when two or more fuels are being compared. Moreover, the individual t-tests do not accommodate the correlations among them due to using the same E0 average in each of the t-tests.
- Averages for the fuels, perhaps for specified levels of the factors, can be back-transformed to the original scale of measurement (mg/mi). These back-transformed averages would suffer less from skewness or outliers than raw averages.

If factors such as vehicles or technology classes are judged to be statistically significant, more insight into the fuel differences can be provided. The nature of the fuel differences, specifically how they differ across vehicles or technology classes, might be valuable information in a comprehensive assessment of the effects of ethanol fuel blends.

Only if none of the design factors are judged to be statistically significant can t-tests be justified. Even so, the skewness and multiple comparison issues need to be investigated and accommodated.

Sign Test. The sign test does not alleviate the difficulties discussed above with the t-test. The vehicles are different models with different types of technologies from different manufacturers, and they have different mileages and were tested at different labs or with different operators. If the sign test rejects the hypothesis of no change between fuels, one cannot determine the reason. In particular, one cannot conclude the results are necessarily due to the fuels alone. Moreover, what conclusion is implied by significance? The fleet issue raised above must be addressed if one is attempting to infer beyond these 16 vehicles.

Percentage changes cannot ordinarily be compared using t-tests. If emission averages satisfy the usual assumptions for a t-test from ANOVA modeling or otherwise, percentages cannot satisfy those same assumptions and be compared using t-tests. Significance can be evaluated as outlined above using ANOVA models and then percentage changes – without confidence intervals – can be reported. Alternatively, as with ethanol changes, results can be reported in mg/mi with confidence intervals.

The pooled analysis presented in the preliminary report (October 2008) raises a number of questions. With only 16 vehicles, the presence of some vehicles with positive changes in average emissions and some with negative ones leads one to wonder what the analysis would look like if different decisions had been made on the selection of vehicles. Only fuel economy has a consistent narrow range of results. The issue of whether some technology classes or other groupings are clustered with positive differences and others with negative ones should be examined.

Other Results. Fuel economy and toxic emissions are less dependent on the ability of the vehicle to adjust for ethanol during cold start. Thus, the study produced results for these issues that are consistent with expectations. Specifically, the increased ethanol levels reduced fuel economy in proportion to the volume of ethanol, as would be expected from the literature and from basic physics. Ethanol, acetaldehyde and formaldehyde emissions also increased with increasing amounts of ethanol, again in accordance with the literature.

Orbital Study

Overview. Growth Energy omitted this seminal study from its application submittal, yet it produced important, highly applicable results that contradict application claims, are very relevant for EPA's decision-making and that urgently point to the need for more data.

In 2002, the Australian Department of Environment and Heritage commissioned a series of studies of the effects of E20 on Australian vehicles. The Orbital Engine Company, a powertrain engineering company based in Western Australia, conducted and published the studies between 2002 and 2004. While the experiments and reports were conducted and published in discrete batches, we refer to the group of studies collectively as the "Orbital Study." Growth Energy's failure to include this study with its application was a significant omission because it is the only study to date to investigate operational durability, which is critical for emissions at full useful life as well as customer satisfaction.

Importantly, the study covered several different technical issues; recently, a report by the Oak Ridge National Laboratory described the studies as "very comprehensive."[70] Specifically, the vehicle portion of the study consisted of a literature review, component tests, short and long term vehicle emission tests, vehicle operation and driveability, engine durability and vehicle durability. Orbital investigated "noxious" emissions as regulated in Australia as well as in the U.S. (HC, CO and NOx), and CO2 and other greenhouse gas emissions. The discussion immediately following focuses on the study's investigation of E20's impact on tailpipe emissions; other aspects of the study (e.g., relating to materials compatibility) are reviewed elsewhere in these comments.

Study Design Elements

Representative test fleet. Orbital tested five new (2001) vehicle pairs representative of the Australian fleet at the time of the study: a Holden (GM) Commodore equipped with a 3.8LV6 built in Flint, Michigan and a 4 speed automatic transmission built in Toledo, Ohio; a Ford Falcon equipped with a 4L V6 and an automatic transmission; a Toyota Camry equipped 2.2L I4 and an automatic transmission; a Hyundai Accent with a 1.5L I4 and a manual transmission; and a Subaru Impreza WRX with a 2.0L turbo H4 and a manual transmission. These vehicles were equipped with three way catalytic converters and closed loop control systems. While not identical to U.S. vehicles or designed to meet U.S. emission standards, the test vehicles are relevant for purposes of the application evaluation because they use similar technologies.

Orbital also tested four older vehicles for short term effects using the same fuels: a 1993 Toyota Camry with electronic fuel injection and a three way catalyst; a 1986 Mitsubishi Magna with a carburetor and catalyst; a 1985 Holden Commodore with a carburetor; and a 1985 Ford Falcon with fuel injection. Orbital purchased the vehicles used and repaired them as required for the tests. Except for the Toyota, the older vehicles are more representative of technologies used in the U.S. in the late 70s and early 80s, e.g., those with open loop control.

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[70] Bechtold, R., et al., Technical Issues Associated with the Use of Intermediate Ethanol Blends (>E10) in the U.S. Legacy Fleet: Assessment of Prior Studies, Oak Ridge National Laboratory, August 2007, found at http://www.osti.gov/bridge//product.biblio.jsp?query_id=0&page=0&osti_id=936789.

Certification fuel baseline and test procedures. Yes. Orbital's baseline fuel was an E0 gasoline, and the test fuel was E20. For testing, Orbital used the U.S. FTP procedure, which is also the standard Australian emissions test, to evaluate the tailpipe emissions from both the newer and older vehicles. The new vehicles were driven for 4,000 miles prior to testing, as required by the study protocol as well as by EPA certification procedures.

Full Useful Life and back to back vehicle pairs. Yes. The Orbital study tested the new vehicle pairs after 50,000 mile operation on E0 and E20; for these vehicles, this mileage represents full useful life. Orbital also used a European catalyst durability test cycle[71] similar to the EPA Standard Road Cycle now used for catalyst durability testing in the U.S.[72]

Results, criteria emissions. For Orbital's older test fleet, when compared to E0, using E20 produced modest reductions in HC emissions, large reductions in CO emissions and modest increases in NOx emissions. The three vehicles with open loop control systems showed the most CO benefit, dominating the fleet average reduction of 70%.

The new vehicles were tested after 4,000, 25,000 and 50,000 miles of dynamometer aging. The 4,000 mile results, when averaged over all five vehicles, demonstrated modest reductions of 4% and 9% in total HC and CO, respectively. NOx increased by 19%, although this average was dominated by one vehicle. After 50,000 miles of aging on gasoline, average HC emissions increased by 36% for the Ford, Holden, Hyundai and Toyota compared with 51% after aging on E20, with most of the difference occurring in the Hyundai. *See* Figure 5, below. For these vehicles, the post aging average CO emissions increased 57% for E0 compared with 134% for E20, again with most of the difference occurring in the Hyundai. *See* Figure 6, below. The post-aging average NOx emissions increased 57% for E0 compared with 134% for E20, with most of the difference occurring in the Hyundai and the Holden (Figure 7, below). The Hyundai failed the Australian emissions standard as a result of aging on E20.

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[71] European Parliament, Council , Directive 98/69/EC of the European Parliament and of the Council, 13 October 1998, relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive 70/220/EEC, found at http://fedlaw.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/framelodgmentattachments/5FB36F840DE1F773CA25747200047194

[72] *See* 71 Federal Register 2810 (January 17, 2006), and Australian Design Rule 79/02—Emission Control for Light Vehicles, 2005, found at http://fedlaw.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/framelodgmentattachments/5FB36F840DE1F773CA2574720004719.

Figure 5. HC Emissions Results from Orbital Study

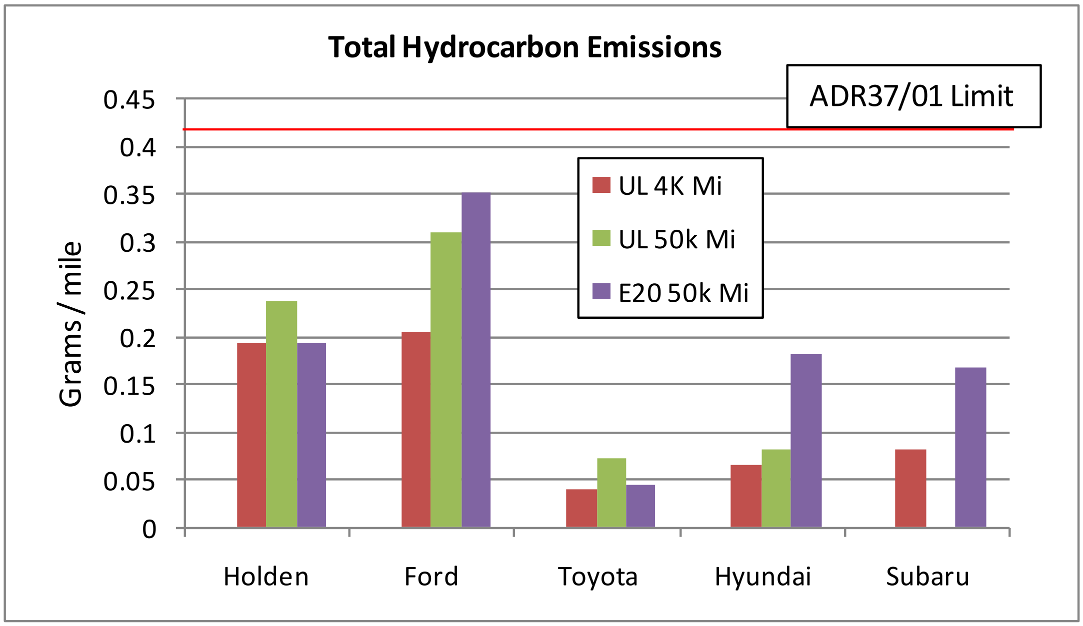


Figure 6. CO Emissions Results from Orbital Study

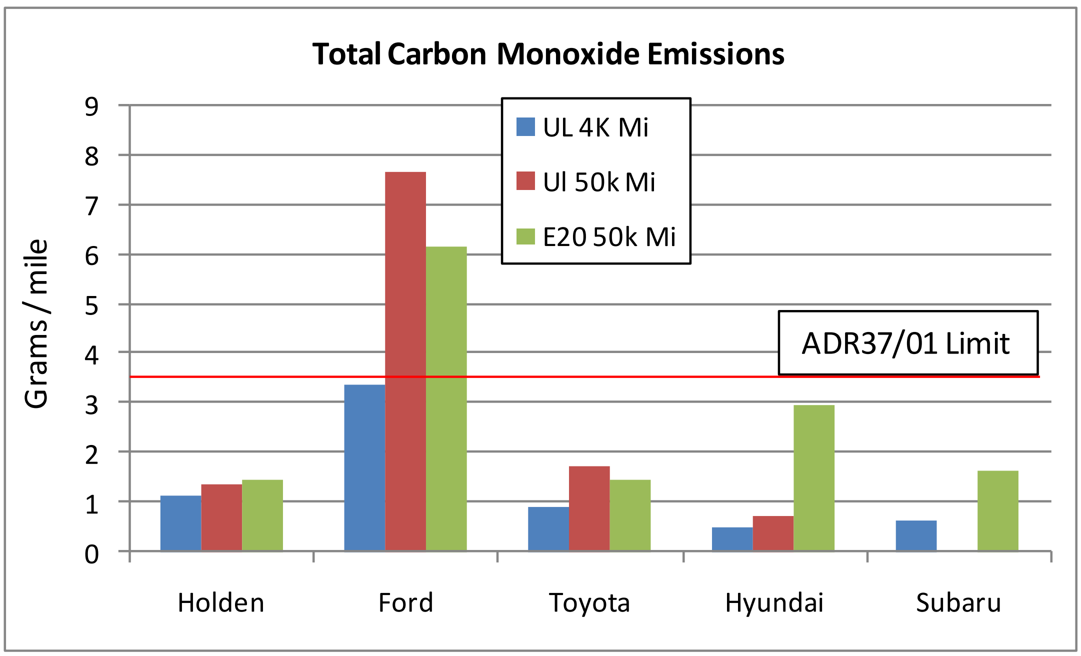
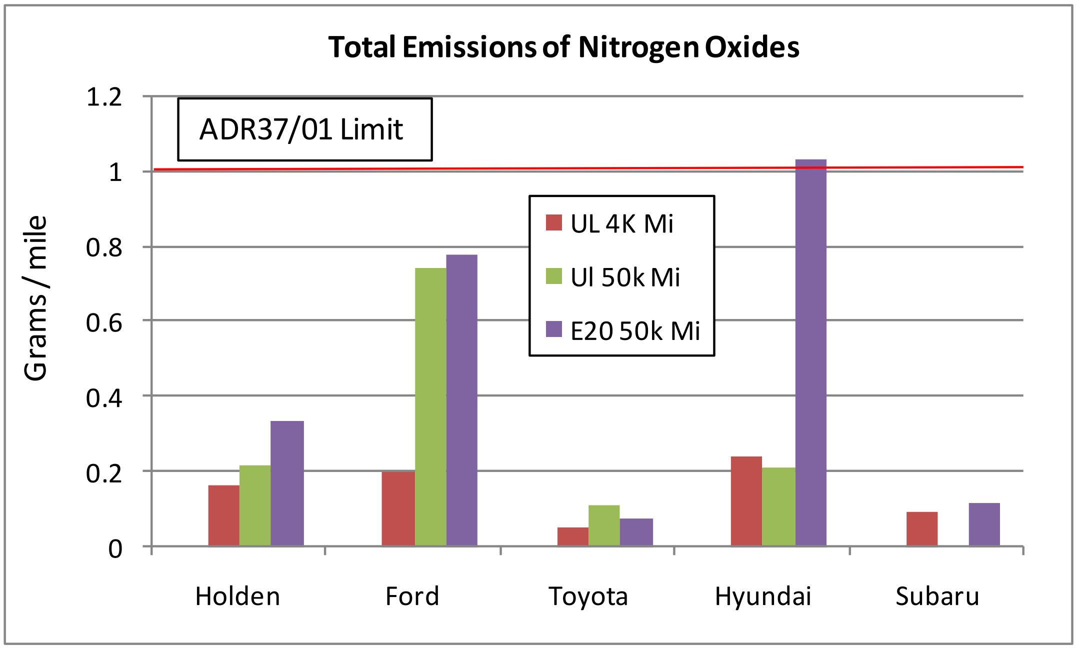


Figure 7. NOx Emissions Results from Orbital Study



To quote the Orbital study:

> The emissions durability testing showed deterioration in the regulated tailpipe emissions for all vehicles regardless of the fuel type. There was a significant impact on the regulated tailpipe emission for two vehicles when operated on E20. The vehicles were the Hyundai Accent and the Holden Commodore. As an example of this impact, Figure 1-1 shows the tailpipe emissions for the Hyundai Accent operated on gasoline and E20 after accumulating 80,000km. The NOx value for the E20 vehicle is above the legislative level for ADR37/01 at 80,000km. The E20 Hyundai Accent shows the most pronounced degradation whilst the E20 Holden Commodore follows a similar trend but the absolute levels of degradation are much less.[73]

Another view of the Hyundai emission results is shown above in Figure 2.

The Orbital authors examined catalyst efficiency changes as a possible cause of the changes in emissions as a result of aging the vehicles on E20. The Hyundai demonstrated significant efficiency reductions in CO catalysis in phases 2 and 3 of the tests with efficiencies decreasing from greater than 95% for the vehicle aged on E0 to less than 70% for the vehicle aged on E20. Similarly, the Hyundai and Holden vehicles aged on E20 demonstrated NOx conversion reductions in all three phases of the test when compared with the vehicles aged on E0. The Ford vehicle demonstrated significant efficiency reductions in all conditions as a result of aging with both E0 and E20. The Ford, Holden and Hyundai all used control systems that did not adapt to the enleaning effects of ethanol in open loop control.

To continue from the Orbital Study:

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[73] Orbital Study, Phase 2B Final Report, page 3.

The increases in tailpipe emissions have occurred due to degradation of the catalyst, the primary cause of which is the increase in the exhaust temperature caused by the use of the 20% ethanol blend during particular modes of operation.

In the case of the Hyundai and Holden, the engine control systems are not configured to compensate for the extra oxygen introduced by the ethanol in all modes of operation. The extra oxygen increases the oxidation on the catalyst, which in turn increases exothermic reaction, raising the temperature and resulting in thermal degradation of the catalyst.

In the fleet of vehicles tested, the Hyundai Accent had the smallest capacity engine, and considering that during mileage accumulation all vehicles are driven over the same cycle, the engine in the Hyundai would be operating at a higher duty cycle than vehicles with larger capacity engines. The higher duty cycle equates to higher exhaust temperatures that are further increased with the addition of ethanol to the fuel (16). It is therefore reasonable to conclude that other vehicles within the same class as the Hyundai also have a high probability of failing in the same manner, if the engine control systems cannot compensate in all modes of operation for the extra oxygen introduced with the ethanol.[74]

Figure 8, below, from the Orbital report, shows the Hyundai catalyst temperatures to be significantly higher when the vehicle is using E20 than when it is using E0.

Figure 8. Orbital Study Figure 5.8, Showing Catalyst Temperature Changes in Hyundai Accent

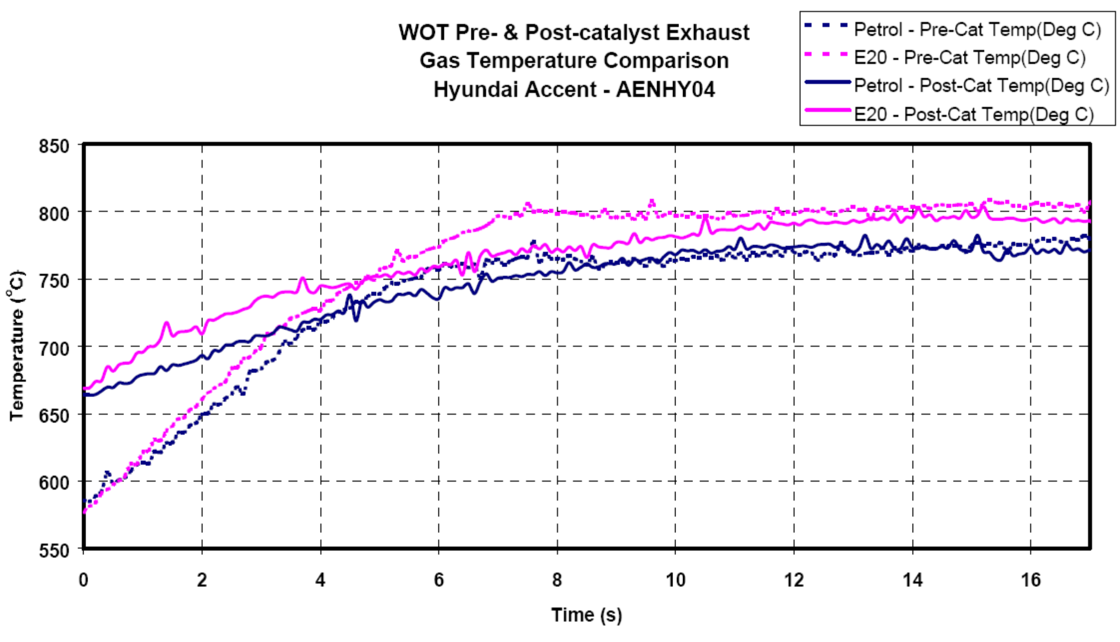


Figure 5.8 - WOT Exhaust Temperatures Hyundai Accent - AENHY04

This plot reveals an approximate 25°C increase in catalyst temperatures throughout most of the test. To analyze these data further, for a worst case scenario, one can assume this 25°C catalyst

[74] Orbital Study, Phase 2B Final Report, page 3.

temperature increase applies throughout the entire catalyst durability test[75], and apply the EPA bench aging time (BAT) equation[76] to typical catalyst temperatures found when running the EPA Standard Road Cycle (SRC).[77] This would produce a 40% increase in the rate of catalyst deterioration, translating to a 30% reduction in catalyst life. When we look at the Hyundai, however, we see much greater reductions in catalyst life due to E20 use: for HC, reduction in catalyst life was 85%, and for CO and NOx, the reductions were even greater. The temperature change cannot fully explain the catalyst performance change when using EPA's BAT equation. Therefore, one must conclude the cause of the efficiency reduction was more complex than merely the impact of increased catalyst temperatures seen during WOT operation. Possible theories include larger increases in catalyst temperature at lower throttle positions, an overly conservative BAT equation or some other mechanism is at work.

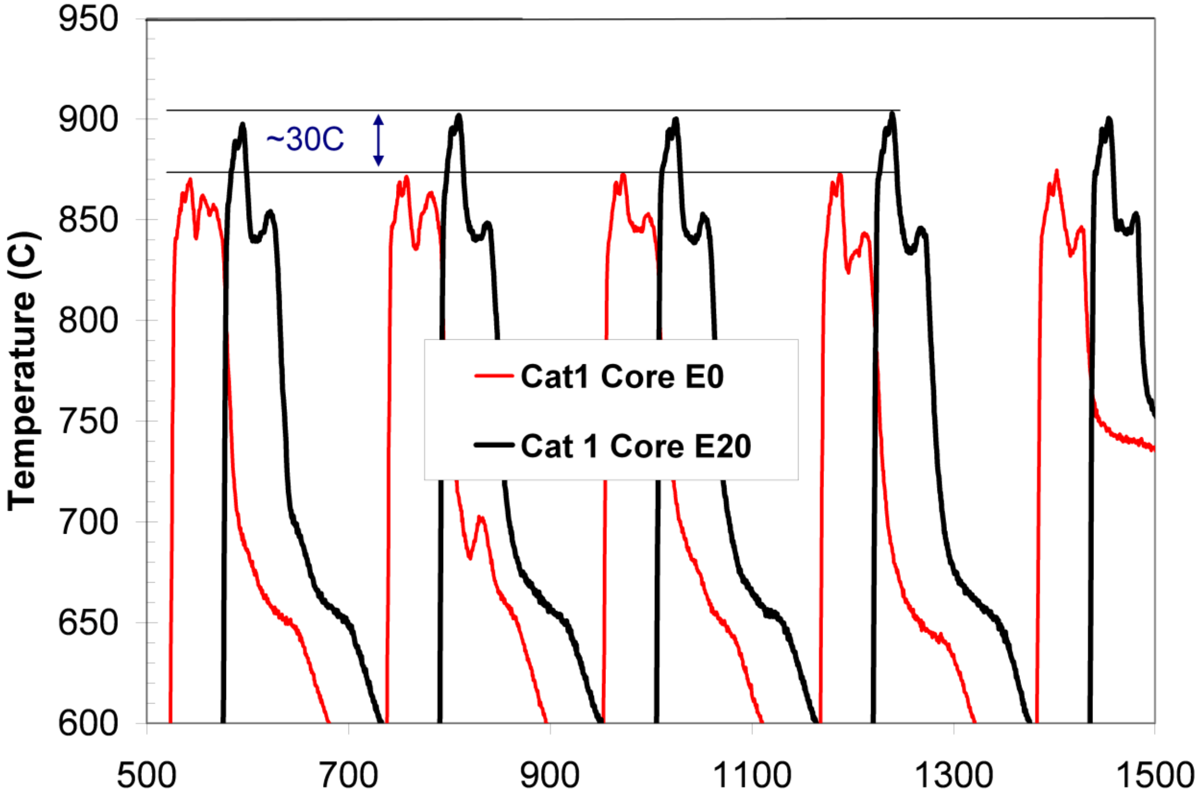
This phenomenon of an engine control system being unable to compensate for ethanol's oxygen in all modes of operation has been documented in the existing U.S. vehicle fleet. Specifically, the DOE Study found that 7 of the 16 vehicles tested had the same control design that leads to this inability to compensate. Figure 9, below, illustrates the effect in one of the DOE study vehicles. Based on this information, we have every reason to expect that the U.S. Tier 2 vehicle whose catalyst was tested for the data shown below, or any of the other 6 vehicles with similar results in the DOE study, *would behave the same as the Hyundai and Holden vehicles tested by Orbital* if exposed to a similar catalyst durability cycle as the EPA SRC.

[75] This is an unlikely event, however, since most of the testing occurred when the vehicle was in open loop control. This means the catalyst temperatures should have remained close, regardless of the fuel's ethanol content.

[76] 71 Fed. Reg. at 2830.

[77] Ibid. at 2816.

Figure 9. Catalyst Core 30°C Higher with E20 WOT in Vehicle Without Learned Fuel Curves, Offset in Time for Clarity[78]



CRC Screening Study (E-87-1)

The goal of the Coordinating Research Council (CRC) E-87-1 Mid-Level Ethanol Blends Catalyst Durability Screening Study was to identify vehicles which used learned fuel trims to correct open loop air-fuel ratios. This report covers the first of a two phase program to develop data on the durability effects of mid-level ethanol blends on emission control systems. The second phase will age the vehicles identified during this screening study to full useful life with mid-level ethanol blends, to determine their durability effects.

Procedure

For this screening study, the fleet consisted of 25 test vehicles based on criteria provided by the CRC, with approximately half of the models representing high production vehicles manufactured since 2000; the other half were identified as being unlikely to use adapted fuel trim and manufactured since 1990. Each test vehicle was screened prior to acceptance into the program using a standard exhaust emissions FTP. If the selected vehicles emission tested no more than 20% above their full useful life emissions certification standards, the vehicle was accepted into

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[78] DOE, ORNL and NREL Team, *Intermediate Ethanol Blends: Plans and Status, Vehicle and Small Non-Road Engine Testing*, presented at a joint meeting with the Alliance and AIAM, April 9, 2008.

the program. The vehicles were instrumented with a wide range universal exhaust gas oxygen (UEGO) sensor, thermocouples and an Engine Control Module (ECM) data link.

Following instrumentation, each vehicle performed a matrix of four tests using fuels with four different ethanol levels of 0%, 10%, 15%, and 20% by volume, designated as E0, E10, E15, and E20 respectively. The initial test cycle performed on the vehicle used E0 fuel while the test order for the remaining three fuels was randomized. Two complete iterations of the test cycle consisting of a vehicle warm-up phase followed by five successive wide-open throttle (WOT) accelerations from 0 to 84 mph each. During each test cycle, the UEGO, thermocouples, and ECM data were continuously recorded for post-test analysis. Vehicle speed, oxygen sensor air-fuel-ratio (AFR), and catalyst temperature data from the tenth WOT event for each vehicle and fuel combination were analyzed to make a determination for which vehicle used adaptive fuel trims during open loop control.

Results

Twenty-five vehicles were evaluated as to whether they adjusted their fueling with increased ethanol content to maintain a consistent fuel:air equivalence ratio (fuel:air actual/fuel:air stoichiometric) in open loop control. The assessment method for this study was the same as that used in the DOE Study (updated report).

Thirteen of the twenty-five vehicles did not adjust open loop fueling to compensate for ethanol in the fuel. Eight of the twenty-five vehicles did adjust open loop fueling to compensate for ethanol in the fuel. Four of the twenty-five vehicles gave unclear results.

The thirteen vehicles (and potentially the four that could not be analyzed or gave ambiguous results) that do not adjust for ethanol in open loop control are likely to have their fuel enrichment operation compromised when operated on mid-level ethanol blends. Similar to that documented in the Orbital Study, higher ethanol blends can lead to catalyst performance degradation with this vehicle design, and this will increase exhaust emissions. In addition, the durability of the engine and other systems may also be compromised. It is notable that one of the vehicles examined, the 2001 Hyundai Accent, demonstrated the same control behavior as a similar 2001 Hyundai Accent tested in the Orbital Study (as discussed above).

b. Emissions, evaporative

The waiver application relies on two studies to support its claim that E11-E15 will not cause or contribute to a failure of vehicles to meet evaporative emission standards: the CRC E-65-3 study of evaporative and permeation effects and the Stockholm study. Since the Stockholm study, essentially, was a literature review and contained no independently generated vehicle or vehicle component data, it cannot be used to support the application's thesis on evaporative and permeation emissions. The CRC study, which did produce data from vehicle components, showed, among other things, that vehicle evaporative emission control systems respond to increasing ethanol concentrations in the fuel. The CRC data, however, are extremely limited because they only covered fuel system permeation effects independently of the whole vehicle; CRC did not test the fuel effects against vehicle evaporative emission standards. While this study contains useful data and is helpful, it remains insufficient to demonstrate or quantify the full impact of E11-E15 blends on evaporative emission control systems in all vehicle types and ages in the U.S. fleet.

Stockholm Study. Aside from its literature review, this study measured evaporative emissions from a portable, specially designed fuel container of unknown size or configuration during a two-hour test in a shed at 40°C. This test has no relevance for vehicle evaporative emissions.

CRC Permeation Study

Overview. The CRC E-65-3 permeation study was designed for the limited purpose of measuring the impact of various ethanol blends between E0 and E10 on permeation and evaporative emission rates of newer vehicles, to update and improve California's Predictive Model. The study team conducted a small amount of additional testing with an E20 test fuel to obtain an initial view of that fuel's impact on the late model fuel systems included in the program. The study was not designed to comprehensively test E20's impact on these systems, nor did it test a full range of vehicle types and ages. Unfortunately, the study did not include any E15 fuels.

Study Design Elements.

Representative test fleet. This project was designed to investigate the permeation characteristics of "near zero" evaporative emission control systems scheduled for introduction in California beginning with the MY 2004; it was not intended to test vehicles designed for the Federal market. The program was developed to help ARB address a specific question regarding permeation.

Importantly, whole vehicles were not tested; rather, the researchers separated the fuel systems from the test vehicles and put them into specially constructed rigs. The sample size was very limited and not intended to meet any statistical test of representativeness. Two of the fuel system rigs were derived from vehicles with enhanced evaporative emission control systems. Additional rigs were eventually added to represent California LEV II emission controls, California PZEV emission controls and an FFV. The tested fuel systems came from the following vehicles:

Rig	Technology Group	MY	Make/Model
1	Enhanced Evaporative Emissions	2001	Toyota Tacoma
2	Enhanced Evaporative Emissions	2000	Honda Odyssey
3	California Near-Zero (LEV II)	2004	Ford Taurus
4	California PZEV (Zero Fuel Evaporative Emissions)	2004	Chrysler Sebring
5	Flexible Fuel Vehicle (FFV)	2005	Chevrolet Tahoe

Certification fuel baseline and test procedures. The CRC study used E0 as the baseline fuel.

Full Useful Life. This study was not intended to address impacts at full useful life.

Back to back vehicle pairs. This study looked at fuel systems rather than vehicles. It was not designed for comprehensive research on back to back vehicle pairs.

Results. The study's findings included the following:

- Although permeation emission rates did not appear to increase as the level of ethanol increased from E6 to E10, they did appear to increase when the ethanol increased from E6 to E20. This increase, however, was not statistically significant.

- The highest diurnal permeation rates were obtained with the E20 test fuel, on 3 of the 5 fuel system rigs.
- The ethanol blends increased permeation in all the vehicle systems and technologies tested compared to the non-ethanol fuel (E0). These increases were statistically significant.
- The advanced technology LEV II and PZEV systems (2004 MY) had much lower permeation emissions than the MY 2000-2001 enhanced evaporative systems.
- The high-level ethanol blend (E85) tested in the flexible fuel vehicle system had lower permeation emissions than the non-ethanol (E0) fuel.
- Diurnal permeation rates do not appear to increase between E6 and E10, but do appear to increase between E6 and E20; however, this increase was not statistically significant.
- The average specific reactivities of the permeates from the low-level ethanol blends were significantly lower than those measured with the non-ethanol fuel (E0).

The lack of statistical representativeness and the small sample size prevent more conclusions to be drawn from the data. The study team necessarily concluded that additional research would be needed to fully understand the impacts of any blend greater than E10. Therefore, its usefulness for supporting the waiver application is very limited.

CRC has proposed two new evaporative test programs that include E20 as a test fuel. The CRC evaporative durability test program (E-91) plans to investigate emission increases as well as the durability of the system; the actual scope of the study will depend on funding levels. CRC E-77 will investigate real world evaporative emission results for modeling purposes, with E20 as one of the test fuels. While neither is sufficient by itself for deciding the waiver application, their data should enhance understanding of the evaporative impacts of mid-level blends.

It should be noted that while the technology tested in this study is still being used, California is beginning to develop new requirements to tighten evaporative and other emission standards. Any ethanol present in the fuel would be expected to increase permeation emissions, and this study suggests permeation rates could increase as ethanol goes above the 10% level, unlike the direct evaporation rates due to the blend's RVP, which is likely to stay close to that of E10. If emissions do increase and EPA acts prematurely on the waiver request, a fuel control program would be needed to offset the emission increases.

c. Onboard Diagnostics (OBD) Testing

All devices in a vehicle whose failure could contribute to emissions increases must be diagnosed for deterioration or failures, and this is the function of Onboard Diagnostic systems (OBD). For example, OBD systems are designed to check for improper changes in the air-fuel ratio, which can affect tailpipe emissions, and fuel system leaks, which can increase evaporative emissions. Proper OBD operation also is a critical component of many state Inspection and Maintenance (I&M) programs, so if it doesn't work as designed, it will be difficult for states to meet their Clean Air Act responsibilities. OBD systems include computers that store Diagnostic Trouble Codes (DTC) for malfunctions and a dashboard Malfunction Indicator Light (MIL) to inform the consumer when a problem occurs. Thus, improper OBD operation can directly affect states and consumers in terms of cost and inconvenience.

OBDs in conventional vehicles can set a DTC for enleanment events, but these events can include enleanment caused by fuel ethanol as well as from hardware failures, such as a disconnected crankcase ventilation hose or a failing mass air flow sensor. The system needs to set a diagnostic trouble code (DTC) for hardware problems because they would require repairs. No repair is warranted if ethanol in the fuel causes a DTC, however, since the only requirement is to change the fuel quality to that recommended or required by the manufacturer. Such a DTC—i.e., one not caused by failed part—would be labeled a false DTC. Conversely, a DTC can fail to set when it should, for example, when enleanment caused by excess ethanol in the fuel masks a true hardware fault.

Insufficient research has been conducted to determine whether and to what extent mid-level ethanol blends degrade or otherwise affect OBD systems. When conducting research on the effects of fuel ethanol on OBD, it is not enough to simply check the MIL because, by itself, the MIL cannot identify masked problems or diagnose false DTCs.

d. Materials Compatibility and Durability

Overview. Materials compatibility and durability can be investigated in various ways. Bench-scale studies, which test discrete materials in a laboratory setting, are relatively inexpensive to conduct and much quicker at producing data compared with component durability testing in a vehicle using long term mileage accumulation. In general, bench testing can be an acceptable approach as a screening step. On its own, however, it is unacceptable as a substitute for component durability testing with long term mileage accumulation, which is critical for proving that components, built using successfully bench-tested materials, will function as intended and designed. The bench-scale MN/RFA study is supplemented by the Orbital Study, which also investigated materials compatibility.

MN/RFA Study (Materials Compatibility). The MN/RFA Study examined materials compatibility by testing fuel impacts on metals, elastomers and plastics via short term bench scale testing. For the metallic materials, the study tested the effects of E20 on pieces of metal called "coupons." The tests involved soaking the coupons in the test fuels for certain periods of time and then examining the coupons for any effects. A similar approach was taken for the elastomeric and plastic materials, although the test pieces in these cases are called "slabs."

Simple coupon and slab soak testing is insufficient to characterize potential failure modes in the many different operating environments of vehicle fuel systems. Neither can such testing properly address the functional performance of automotive components or relate those issues to combustion stability, regulated emissions or customer satisfaction, whether for smooth driving performance or service avoidance. This study and the findings it generated fall well short of the need satisfy EPA's recommendation that "all testing will need to be carried out over the useful life of vehicle or equipment."[79]

Importantly, the materials testing conducted in this study lacked any degree of "real world" durability validation for the test fuel. The report includes minimal discussion as to the relevance of the selected test cycles, the criteria used for selecting test cycle lengths or on the tests' significance as a predictor of the test fuels' effects on vehicle compatibility, durability, functional failure risks or performance. The study further needs to clarify what it means by the term "compatible" when inferring functional performance and durability from the data.

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[79] *See e.g.*, Przesmitzki and West, *supra*, page 14; *and* Simon, *supra*, page 5.

The study also examined whole fuel pumps and sending units but tested them by soaking the parts in test fuels inside a laboratory; the researchers did not test these parts while they were installed in a vehicle. Even as a laboratory study, test flaws prevent drawing any conclusions about the effects of E20.

The last part of the study was intended to provide information about parts durability, but like the other parts of the study, the investigation was very limited in scope and used a bench-scale approach only, among other shortcomings.

For these reasons, this study, at best, may be considered a screening program. Fundamentally, however, the study is manifestly insufficient for demonstrating that E15 is compatible with any vehicles, parts or other products that would contact gasoline-ethanol blends.[80] A more detailed review of the research follows.

Metals

- The detailed data in Appendix B of the report, when analyzed using a percent change methodology, show that 14 out of the 19 tested metal coupons exhibited greater than 50% measurable mass changes when tested with E20 compared to E10, which is a very significant outcome. As a matter of fact, some coupons showed more than a 200% mass change. *See* Table 5, below. If the test had been against an E0 baseline, the changes would have been even more significant. Since corrosion rates for unprotected metals often accelerate in a non-linear fashion—in many cases, exponentially faster—a significant increase in mass loss can be a very noteworthy indication of heavily accelerated corrosive effects. The report's omission of such a data analysis is a serious oversight that significantly undermines the authors' overall conclusion of "no materials compatibility problems."
- The authors asserted without explanation or justification that it was sufficient to show the differences between the effects of E20 and E10 are within the normal variation for the conditions of the test. This assertion does not make sense to us.
- Gaps. Many advanced engines and fuel injection systems (such as those using pressurized PFI at ~75 psi or SIDI at ~1500 psi) are heavily loaded and stressed in the field, and all modern systems are originally validated for use only with E0 to E10, it is important to evaluate thoroughly the corrosion failure modes associated with Stress Corrosion Cracking. This study has not addressed these risks in any significant manner.

[80] The MCAR study's acknowledgment of automaker assistance should not be interpreted to mean that any of the named automakers reviewed, approved or endorsed any part of the test methodology, execution of the test program, data analysis or conclusions.

Table 5. Mass Loss Differences in Metal Coupons Exposed to E20 compared to E10

Metal Coupon	Test Fluid Phase	% Mass Loss Differences Observed for E20 vs. E10
1018 Steel	Liquid	Measurable gain with E20; Measurable loss with E10
Copper Sample calculation: (-0.0063/-0.0021 * 100%) - 100%	Mixed	200%
Copper Sample calculation: (-0.0088/-0.0060 * 100%) - 100%	Liquid	47%
Brass	Mixed	135%
Brass	Liquid	67%
Aluminum 3003	Mixed and Liquids	No measurable change with E20; measurable loss with E10
Aluminum 6061	Mixed and Liquids	No measurable change with E20; measurable loss with E10
Lead	Vapor	392%
Lead	Mixed	12%
Lead	Liquid	279%
1018 Ni coated steel	Mixed	No measurable change with E20; measurable loss with E10
1018 Ni coated steel	Liquid	50%
1018 Zinc Di-chromate coated steel	Mixed	119%
1018 Zinc Di-chromate coated steel	Liquid	103%
1018 Zinc Tri-chromate coated steel	Mixed	67%
1018 Zinc Tri-chromate coated steel	Liquid	110%
1018 Zn/Ni coated steel	Mixed	213%
1018 Zn/Ni coated steel	Liquid	142%
Brass 260	Mixed	81%
Brass 260	Liquid	89%
Teme plate	Mixed	85%
Teme plate	Liquid	68%
Zamak 5	Mixed	235%
Zamak 5	Liquid	496%
Cast Aluminum	Mixed and Liquids	No measurable change with E20; measurable loss with E10

Elastomers (Rubber materials)

- The MN/RFA authors failed to discuss the relevance of the 500 hour exposure test period and its ability to help predict either compatibility or performance impacts.
- The report repeatedly asserts that the test results showed little difference between 10% and 20% ethanol but doesn't explain what kind of difference the authors are evaluating or provide any data regarding any impacts on performance or function.

Furthermore, it is misleading to say the results showed little difference without also saying "under the conditions of the test; no performance is implied." No one can justify product life durability on a 500h test at 55 degrees C when vehicle conditions operate at time and temperature conditions beyond those used in this study.

- A major shortcoming of the elastomeric testing is that the researchers tested only raw materials and not actual fuel system components such as hoses, seals and diaphragms. This is important because manufacturers vary the compounds used in manufacturers the parts, in part, because of different end user specifications and requirements or the production process (e.g., extrusion, injection, compression, etc.). Thus, any impacts on raw materials may differ from impacts on manufactured parts. Indeed, the authors state, "With the variety of applications that the elastomers used in this study represent, it was very difficult to distinguish at what point a change would represent a potential problem."[81]
- Many researchers have found that the effects of ethanol-gasoline blends on elastomers may be non-linear with increasing ethanol content. For example, a blend containing 10-25% ethanol may be more harmful for elastomers than E85 or E100.[82] In fact, more than thirty years of research has led many researchers to conclude that concentrations between 15 and about 50% ethanol provide the most challenging environment for elastomers compared to other ethanol levels. The authors agree with this point[83] and further recognize that "...as the concentration of ethanol increases from 0 to 100% there is no model that accurately predicts the effects on materials."[84]
- Gaps.
    - Missing from the study is any leak testing, which is an essential part of any evaluation of the types of elastomeric materials widely used in gaskets. To reach any reliable conclusions about the compatibility of elastomers with E15, the study should have used industry standard test protocols for screening elastomers for sealing performance, such as ASTM D6147 or ISO 3384, which test compression stress relaxation using automotive validation test conditions.
    - Most of the materials tested in the MN/RFA study are neither being used nor expected to be used in the future. More information is needed about impacts on more materials actually used in the market today or expected in the future.

Plastic materials

- The primary concern with this part of the study relates to the testing on polyester, in general, and polybutlyene terephthalate (PBT), specifically. Polyesters undergo transesterification when exposed to polar solvents, such as ethanol, at elevated temperatures (~65-70^{o}C), and industry data show a drop off of plastic performance at temperatures around 70^{o}C. These temperatures represent an upper range for the type

[81] MN/RFA Study, page 6.

[82] See, e.g., SAE 800786, SAE 2007-01-2738.

[83] *See* MCAR, page 2.

[84] *Ibid.*

of service most fuel system components experience in the real world. This study, however, soaked the plastic samples at only 55^{o}C, a temperature that is likely to produce different results than the higher temperature. The data presented do show a slight elevation in tensile elongation as the percentage of ethanol was increased; one could speculate that the results would have been more pronounced if a higher test temperature had been used.

- At least one automotive fuel system supplier used PBT in fuel pump modules between model years 1993 and 2004. This has implications for any decision to allow a partial waiver based on model year.

Fuel Pumps and Sending Units – Soak Testing

- The testing consisted of soaking fuel pumps in three fuels--(Fuel C (E0), Aggressive E10 (CE10a) and Aggressive E20 (CE20a)) for 30 days at 20 degrees C—using a test procedure derived from SAE J1537. The study exposed each of eight fuel pump models and three level sending unit models to all three of the test fuels at different times.
- This study lacked a reliable enough sample size to draw any conclusions as to the effects of E20 compared to E10 or E0. While the researchers tried to cover various fuel pump families (i.e., roller-vane, gear rotor and turbine) and, to a lesser extent, sending unit (also known as level sender) families,[85] there is a great deal of design variation within these part families. This variation includes, but is not limited to, the types of metals and plastics used in pumps, product design and metals used in sender units. The broad conclusion that these part families will be unaffected by E20 (or E15) in the marketplace is not warranted by the scope of the study.
- This study used a very short-term static soak test of only 720 hours as a means to predict long-term effects, but experience has shown that soak tests play a very small role in forecasting long-term performance. That is why operational testing for periods of at least 2,000 hours and up to 10,000 hours is the preferred method of validating designs and materials used in the fuel pump and level sender.

Endurance/Durability Testing

- The testing consisted of running fuel pumps in three fuels--Tier 2 (E0), Aggressive E10 (Tier 2 E10a) and Aggressive E20 (Tier 2 E20a)--for 4000 hours at 43°C. The samples consisted of eight fuel pump models and three level sending unit models, each tested in the three different test fuels. The test procedure was derived from SAE J1537.
- Like other aspects of this study, this testing program used too few samples to provide sufficient data for any conclusions about parts durability.
- The design of this study also was too severe. For example, the study used a 500 hr fuel change interval, which can allow harmful oxidation products to form, especially with a gasoline (E0) test fuel. In general, oxidation products contain peroxides, which are very corrosive to copper (used in commutators) and accelerate deterioration

[85] Since the authors provide no information about "type," it is unclear what they mean in this context.

of rubber components. In addition, the pumped fuel was not filtered as it would be in the vehicle. Finally, all level sending unit samples failed at the end of approximately 100,000 cycles, which is a fraction of the cycles seen in a lifetime test. This suggests the test was too severe to offer any useful data.

- Testing the different models of fuel pumps and level sending units in the same test drum could have added to the detrimental effects seen in the test data. As one pump wears, the debris given off by the brushes and commutators could have interacted with the other parts being tested. This potential for contamination makes it impossible to judge the performance of any of the tested parts.

- In addition to correcting the study design and increasing the number of samples, this testing needs to be conducted on the complete fuel module and not just on its components (fuel pump and fuel level sender).

Orbital Study. Orbital's Material Compatibility Testing effort examined E20's compatibility with various materials for a test period of 2000 hrs. The findings of adverse material impacts would seem to beg for more research. Orbital summarized its findings in the report's Executive Summary:[86]

- For metallic fuel system components that have exhibited corrosion when in contact with E20 fuel.
  a. This is considered a concern since the potential exists for the oxide to dislodge and become trapped in between moving components or to clog/block components responsible for fuel metering and/or delivery.
  b. The potential exists, depending upon the severity of the oxidation and the actual final location of the dislodged oxide, to cause engine failure.
- For all the brass fuel system and electrical components that were tarnished indicating an oxidation process had occurred.
  a. This is considered a concern since the oxidation of brass fuel and air metering jets or fuel control devices in the engine carburettor has the potential to lead to the loss of the intended nominal air metering and /or fuel metering, or control.
  b. This is also considered a concern since oxidation of electrical contact surfaces has the potential to reduce conductivity.
  c. The potential exists, depending upon the severity of the loss of metering and/or control, to result in the degradation or loss of engine function.
- For polymeric materials found to have significant changes in appearance due to contact with E20 fuel.
  a. This is considered as unacceptable since the changes have the potential to result in fuel leakage.

e. Driveability

Vehicle driveability is one of the pillars of EPA's evaluations of waiver applications because poor driveability can lead consumers to tamper with their vehicles or otherwise impair the operation of emission control devices. Such consumer behavior could lead to increased

[86] Orbital Study (2000hrs Material Compatibility Testing, May 2003), *supra*, pp 6-7.

emissions, in addition to violating the Clean Air Act. Therefore, in application submittals, EPA has long required information about a fuel's impact on driveability.

The Growth Energy application relies on just one study, the MN/RFA Study, to support the claim that E15 will not affect vehicle driveability. Unfortunately, this study says little to nothing about the performance of vehicles either on E15 or other blends above 10%.

MN/RFA Study (Driveability)

Overview. The study evaluated a fleet of 40 vehicle pairs split evenly among E0 and E20. Vehicles were part of the University of Minnesota Fleet Services car pool and represented model years 2000 – 2006. Each vehicle of the pair was dedicated to one fuel over the course of one year. Personnel driving the vehicles were requested to fill out questionnaires gauging driveability performance. The questionnaire response rate was very low, and trained rater evaluations did not test both fuels back to back in the same vehicle. Therefore, a direct driveability comparison of E0 to E20 was not possible with the test design used in the study. In addition, many of the batch fuel analyses were suspect, casting doubt on the actual fuel properties used in the study.

Study Design Elements.

Introduction. Any scientific endeavor attempting to evaluate two or more items must allow fair and equal comparisons to yield valid, sustainable conclusions. The effort can have a simple design, and the researchers need not have sophisticated training in statistics. Failure to follow basic precepts, however, will produce a misleading pile of numbers with little inherent meaning, and any conclusions based on the data will invite criticism.

Various approaches can be used to compare two fuels for driveability effects. One could test two fuels sequentially in a single vehicle, and if the driving was consistent, used the same course with both test fuels and experienced the same weather conditions, one could draw an accurate conclusion about the relative performance of the two fuels. Testing a single fuel in two different vehicles with different drivers, however, introduces several uncontrolled factors-- variation in vehicles, drivers and driving patterns--that can undermine any comparison of the test fuels. Even using the same vehicle but with different drivers would raise questions about the impact of different driving styles and patterns. The greater the variation in test subjects and driving circumstances, the greater the variation in factors that can affect the results, and ultimately, the lower the confidence in any conclusions.

The Minnesota driveability program intended to compare the driveability impacts of two fuels, E0 and E20. Unfortunately, the program design and implementation were both seriously flawed. The program succeeded only in generating a large mass of data that give the false impression of being useful. Delving into the details proves otherwise, and it is only after much twisting and data manipulation that the authors managed to wring out poorly substantiated conclusions.

Representative fleet. No. The university fleet, covering models years 2000-2006 and used in the customer evaluation portion of the study, represented only a portion of the models on the road in the U.S. The median age of automobiles is 8-9 years; thus, about half the on-road fleet is older than model year 2000, and older vehicles represent the most sensitive vehicles in the fleet. However, vehicles in this age group were not part of the test fleet. Some fleet vehicles were also tested by trained raters, but the study failed to explain how these vehicles were selected.

Certification fuel baseline and test procedures. Partial. The study used E0 as the baseline test fuel, but there were numerous anomalies in the test procedures, as explained further, below.

Back to back vehicle pairs. Improper method. Although the study used pairs, back to back driveability comparison of E0 to E20 in the same vehicle was not done.

Study Structure. Each driver saw only one fuel, which prevents a direct comparison of the two test fuels and any valid conclusions. This is a fatal flaw because people's perception of driveability varies considerably, and what one individual considers problematic may not be for another individual; some drivers are more sensitive than others.[87] Even technicians employed by the auto and oil industries whose job is to rate vehicle driveability vary in the severity of their ratings. A better approach would have been to have each driver evaluate both fuels under similar conditions. By contrast, the CRC uses the averages of several raters for a single fuel.[88]

Test Conditions. Evaluating driveability with fuels having the proper volatility will provide little to no information because one expects good performance with fuels that are appropriate for the time of year and geographic location. Rather, the critical test is evaluating driveability with fuels of lower volatility than appropriate for the climate. A standard CRC procedure is to evaluate summer fuels at 30-40°F, to simulate fuel performance during cooler periods, such as mornings in the months of April and May. Summer fuels are introduced into the market this early so that refiners are ensured of complying with EPA vapor pressure regulations at the terminal by May 1 and at the retail station by June 1. However, driveability evaluations were not done at these critical low temperatures.

Test Fuels: Volume Discrepancy. Since the test fleet was divided in half, one would expect the amount of fuel used by each half of the test fleet to be roughly the same, to reflect a comparable amount of driving with each test fuel (E0 and E20). The volume of E0 consumed, however, was twice that of E20. Besides raising questions about the amount of driving, this also raises questions about the type of driving done by each group, which introduces another source of bias.

Test Fuels: Quality. The reported results raised questions about the true properties of the test fuels and whether the test fuels had the intended fuel quality. In fact, taken as a whole, the handling and reporting of test fuel quality betrays a profound lack of attention to detail that raises serious questions about the program implementation, whether due to oversight failures or other causes.

For example, the vapor pressure results for the summer batches of E0 and E20 are inconsistent with what would have been expected, and they seem to indicate either a problem with the fuel batches themselves or with the testing process. The maximum allowable vapor pressure during summer in Minnesota is 9.0 psi for E0, and this cap is enforced by EPA. Since EPA allows no leeway for RVP test variation, refiners blend to a maximum of 8.7 psi, to account for the 0.3 psi test method reproducibility, to avoid selling illegal fuel. Yet only one batch result in the summer 2006 and 2007 tests was below 9.0 psi. Also, the jump in vapor pressure in the last batch of E0 in August 2007, from 8.79 psi to 10.45 psi, is not normal. Based on the test fuel's distillation results, the vapor pressure of this batch certainly should have been no higher than the first

[87] Buczynsky, A., *Effects of Driveability Index and MTBE on driver satisfaction at intermediate ambient temperatures*, SAE paper 932671 (1993); and Buczynsky, A., *Driveability Index and driver satisfaction with ETBE and MTBE gasolines at intermediate ambient temperatures*, SAE paper 952503 (1995).

[88] Reports of CRC driveability studies can be retrieved from www.crcao.org.

measurement. The high result should have been verified or explained, instead of leaving doubt about its validity.

E20 vapor pressure during the transition to summer fuel in 2007 was also unusual. Increasing ethanol content from 10 to 20% reduces vapor pressure slightly, so the vapor pressure of the summer fuel batches should have been about 10 psi. Thus, the batch received on May 23, 2007, should have lowered the vapor pressure of the fuel in the tank, not increased it to over 11 psi. Summer fuel was certainly available during this time period, as indicated by the E0 batch received on May 21, 2007, which tested at 9.1 psi; the same should have been true for E20. Also, the vapor pressure result for the final E20 batch is lower than expected (9.23 psi), considering the fuel in the tank was at 11.35 psi and summer E20 going into the tank would have been about 10 psi.

Based on the study's fuel delivery records, the researchers correctly evaluated the fall 2006 and winter 2007 fuels, since they had essentially the same vapor pressures (10.5 vs. 10.3 for the fall test fuels and 14.2 vs. 14.6 psi for winter test fuels). They did not do so for the spring 2007 evaluation, however, given that the test fuels had disparate vapor pressures (14.9 vs. 11.0 psi). Also, if the reported E20 summer vapor pressure was correct, then the researchers incorrectly tried to compare the impacts of two very different test fuels (8.8 psi vs. 11.35 psi).

Finally, the E0 sample from November 22, 2006, which the report characterized as "compromised," may not have been tested for all relevant properties, but the reported ethanol (14.87%) and benzene (14.01%) contents, if true, are very troubling, even outrageous. Frankly, the researchers never should have reported results for this batch without rechecking the fuel quality values.

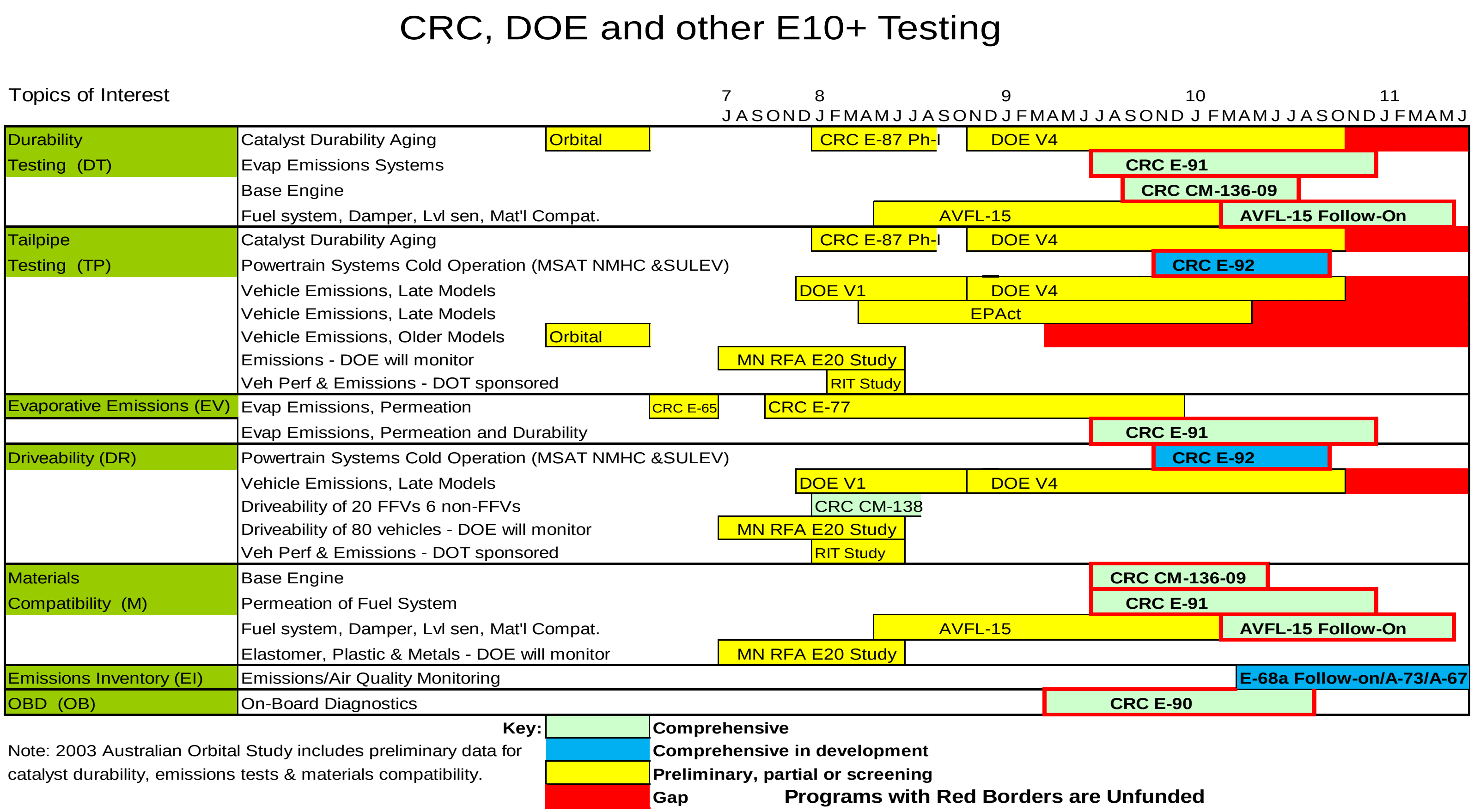
Implementation. The report characterized the driver response rate for completing their log sheets as "disappointing." This reveals apathy among a large portion of the drivers, since attentive drivers would have submitted log sheets regardless of whether they found any problems. The analysis used only those results for which both drivers of a vehicle pair submitted log sheets, so the true number of problems with each fuel is unknown. The E20 drivers responded more than the E0 drivers, but it would be difficult to read anything into this. Many factors may have influenced the response rate. For example, the E0 drivers may have failed to submit responses because the performance of their vehicles was not noteworthy (i.e., generally good). Another possible explanation is that the vehicles belonged to the university and were not owned by the drivers; if the drivers had owned their test vehicles, they may have had a greater interest in the vehicle performance. The bottom line is that the response rate raises additional questions that add to the difficulty of concluding anything valid about E20 performance.

Similar criticisms apply to the trained rater portion of the program. As explained previously, each rater should have evaluated every vehicle with both fuels under similar conditions, but each rater only evaluated one fuel, under the erroneous assumption that each vehicle in the pair would exhibit the exact same driveability with other factors being equal. Several CRC studies have demonstrated the need to consider vehicle to vehicle differences.

Reporting. The Appendix contained several errors regarding the vehicle test fleet. Nonexistent engine configurations were reported for vehicle pairs C (2005 Malibu), D (2005 Impala), FF (2001 Express van), I (2005 Ranger), J (2005 Ranger), and U (Escape). The second vehicle of the LL pair showed an incorrect VIN.

Results. The researchers report finding no driveability impacts from the use of E20 compared with E0, but the program raises many more questions than it purports to answer. It raises doubts about what fuels and vehicles were actually tested, and the program design prevents a direct comparison of the two tests fuels. The apparent apathy among the drivers makes any performance assessment tenuous, at best. Simply stated, the program does not rise to the scientific level required to make a valid judgment about the relative performance of the two fuels.

Appendix B. Status Report on Various Ethanol Test Programs, Presented at the May 8, 2009, Mid-Level Blends Research Coordination Group.



ATTACHMENT 5

Chairman
J. MENDEL
Honda

President
M. STANTON

VEHICLE MANUFACTURERS
Aston Martin
Ferrari
Honda
Hyundai
Isuzu
Kia
Maserati
Mitsubishi
Nissan
Peugeot
Subaru
Suzuki
Toyota

AFFILIATES
ADVICS
Bosch
Delphi
Denso
JAMA

July 20, 2009

Air and Radiation Docket
Docket ID No. EPA-HQ-OAR-2009-0211
U.S. Environmental Protection Agency
Mailcode: 6102T
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Dear Sirs or Madam:

The Association of International Automobile Manufacturers (AIAM)[1] is pleased to provide comments in response to EPA's *Federal Register* notice (74 FR 18228; April 21, 2009) announcing receipt of a Section 211 (f) Clean Air Act waiver application to increase the allowable ethanol content of gasoline up to 15 percent and requesting comments thereon. As explained further below, AIAM takes the following positions with respect to this waiver application:

1. EPA should deny this waiver application in its entirety due to the incompleteness of the supporting technical information submitted by the waiver applicant(s). The applicant(s) failed to provide information to demonstrate that ethanol blends exceeding the currently allowed level of 10 percent (i.e., E10) up to 15 percent (E15) will not cause or contribute to a failure of an emissions control device or system over the useful life of a vehicle or engine. Such information is not yet available to substantiate the applicant's claims.

2. AIAM cannot envision scenarios whereby a dual fuel distribution system (i.e., both current gasoline would remain available widely for some vehicle/engine applications and a new E15 blend would be available for specifically identified vehicle/engine applications) could be developed that would not result in misfueling of vehicles/engines and risk of adverse environmental, safety, and consumer impacts.

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[1] The Association of International Automobile Manufacturers, Inc. (AIAM) is a trade association representing 13 international motor vehicle manufacturers who account for 40 percent of all passenger cars and light trucks sold annually in the United States. AIAM provides members with information, analysis and advocacy on a wide variety of legislative and regulatory issues impacting the auto sector. AIAM is dedicated to the promotion of free trade and to policies that enhance motor vehicle safety and the protection of the environment. For more information, visit our website at www.aiam.org.

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Since the waiver applicant(s) have not provided the technical information necessary to justify EPA approval of a Section 211(f) waiver, AIAM believes the agency has no choice but to disapprove the waiver application.

In addition, as a member of the Alliance for a Safe Alternative Fuels Environment (AllSAFE), AIAM supports the comments submitted on behalf of AllSAFE.

Literature Search and Summary

To assist us in reviewing this E15 waiver request, AIAM retained an outside consultant to review the existing technical literature for studies pertaining to the impacts of the use of mid-level ethanol blends on vehicles, engines, and equipment. His report (enclosed) includes a list of the studies identified and summaries of relevant findings of these studies. This report is attached. Based on this literature search, our consultant concluded the following:

- E15 will tend to reduce exhaust emissions of total hydrocarbons/non-methane organic gases, carbon monoxide, benzene and butadiene in on-road and non-road engines.
- E15 will tend to increase exhaust emissions of nitrogen oxides and acetaldehyde in on-road and non-road engines.
- E15 will tend to raise exhaust gas temperatures in some on-road engines and in most non-road engines. This may have a negative impact on engine and catalyst durability.
- E15 will increase evaporative emissions in on-road vehicles.
- E15 will directionally worsen driveability in some on-road engines and in many non-road engines.
- E15 may cause serious safety hazards, such as inadvertent clutch engagement in non-road engines, which could lead to personal injury.
- E15 may cause premature failure of some parts in some non-road engines.
- More data is needed to understand the impact of E15, and a number of programs are being carried out or are being planned to address this need.

Lack of Technical Support Information

As noted above, the fundamental reason EPA must deny this waiver is that the applicant(s) failed to provide complete technical justification to support the waiver application. Section 211(f) of the Clean Air Act prohibits generally any new fuels or additives unless they are deemed "substantially similar" to conventional fuels; however, Section 211(f)(4) allows EPA to waive this prohibition, if the agency determines that a new fuel or additive "will not cause or contribute to a failure of any emission control device or system (over the useful life of any vehicle in which such device or system is used) to achieve compliance by the vehicle with the emission standards with respect to which it has been certified." In short, the producer of any new fuel or fuel additive (F/FA) must show that the new F/FA will not cause or contribute to the failure of any vehicle or engine to meet emission standards.

For the past thirty years, since these fuel waiver provisions have been effective, EPA has on many occasions[2] emphasized that waiver applicants must address four basic matters in their technical documentation for a waiver:

1. Vehicle/engine exhaust emissions
2. Vehicle/equipment evaporative emissions
3. Materials compatibility
4. Driveability and performance

These factors must be evaluated on a representative test fleet of sufficient size and with a variety of technologies. In addition, the testing program should include multiple test cycles per product to address test variability and must include testing to cover both short-term impacts and long-term durability impacts.[3]

For emissions, EPA requires both exhaust and evaporative emissions testing using the appropriate certification test procedures. Testing must cover all regulated vehicle and engine types for which the new F/FA could be used, including on-highway vehicles (cars, light trucks, medium and heavy trucks, motorcycles), as well as various types of regulated non-road engines, such as engines used in lawn and garden equipment, marine engines, snowmobiles, and outdoor power equipment. Testing must cover the potential for cumulative impacts that could result over prolonged use of the new F/FA (i.e., durability testing), such as those resulting from changes in combustion temperatures that could potentially lead to thermal impacts on sensors, catalytic converters, or other emissions systems components. For onboard diagnostics (OBD)-equipped vehicles, the immediate and longer term effects of a new F/FA on the OBD system should also be assessed.

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[2] See, for instance: Jim Caldwell, EPA Office of Transportation and Air Quality, presentation at the SAE Government/Industry Meeting, May 13, 2008; and/or
Karl Simon, EPA Office of Transportation and Air Quality, presentation at the American Petroleum Institute's Technology Committee meeting, June 6, 2008.

[3] See Christine Todd Whitman, Letter to Ethyl Corporation, Denying Petitions for Reconsideration of Three EPA Regulations: CAP 2000, Heavy Duty Gasoline, and OBD/IM, http://www.epa.gov/oms/standards.htm, August 23, 2001. See also AllSAFE comments on this E15 waiver consideration, Exhibit B, Supplemental Statutory Appendix.

For materials compatibility/durability, the most important factor is whether vehicle, engine, and fuel system, as well as infrastructure equipment, exposed to a new F/FA experience property changes due to prolonged exposure that could lead to deterioration or failure. The primary focus on materials compatibility is typically on shrinkage, swelling, cracking, corrosion and other physical changes in the fuel system.

For driveability and performance, testing must show that the use of the new F/FA does not result in poor driveability or performance of vehicles. Poor driveability or performance could result in impairment of components of an emission system or OBD system, could cause customer dissatisfaction with their vehicle, or could cause consumers to tamper with emission controls in an effort to improve performance.

Table 1 summarizes the information required by EPA and what was submitted by the applicant in support of this E15 waiver compared to ongoing, existing test plans for mid-level ethanol blends by the U.S. Department of Energy (DOE), the Coordinating Research Council (CRC) and AllSAFE. As demonstrated in Table 1, the data submitted by the applicant was incomplete and did not sufficiently cover all topics required by EPA. Table 1 also shows that DOE, CRC, and AllSafe in coordination with EPA have plans to test all aspects required for a waiver submittal. In many cases, the studies are under way today. Others are scheduled and still others are awaiting necessary funding; testing is expected to continue into 2010. Under the waiver submittal process, EPA has 270 days to respond to the waiver (December 1, 2009 as designated in the *Federal Register* notice of April 21, 2009). In order to make an informed decision on the waiver, the data should be complete prior to the waiver decision. Although the needed studies have been identified and interested stakeholders are moving ahead to fill the gaps in current knowledge, a complete data set will not be available in time to inform the waiver process prior to EPA's deadline.

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Table 1: Comparison of Technical Support Documents Required by EPA Versus Those Submitted by the Applicant(s) and Those In DOE and CRC/AllSAFE Test Plans

Highway Vehicles				
Item	**EPA Requirements**	**E15 Application**	**DOE Test Plan (Timing)**	**CRC/AllSAFE Test Plan (Timing)**
1.	**Exhaust Emissions**	Limited use of certification procedure	Yes (1: Catalyst Temperatures Completed May 2008 2: Selected Legacy Vehicles June 2009 3: Durability, Dec. 2009)	Yes
	a. Comparison to E0 and E10	Some	Yes	Yes
	b. Full Useful Life	No	Yes	Yes
	c. Back to Back Vehicle Pairs	No	Yes	Yes
2.	**Evaporative Emissions**	Yes	Yes (Completed Sept 2008)	Yes (Completed Sept 2008)
	a. Comparison to E0 and E10	Yes	Yes	Yes
	b. Full Useful Life	No	Yes	Yes
	c. Back to Back Vehicle Pairs	No	Yes	Yes
3.	**OBD Testing**	No	No	Yes
	a. Real World Aging	No	No	Yes
4.	**Materials Compatibility**	Yes: Significant Failures	Yes: Screening (1: Fuel System Materials Completed Dec. 2008 2: Dispenser Materials, TBD)	Yes (Fuel System Materials Completed Dec. 2008)
	a. Long Term Mileage Accumulation	No	Partial	Yes
5.	**Driveability**	Yes	Yes (Completed June 2008)	Yes (Completed June 2008)
	a. Older Vehicles	No	No	?
6.	**Representative Test Fleet**	No	No	Yes
7.	**Health Effects**	No	No	No

While industry is attempting to close the information gaps related to E15 use with plans for numerous studies, EPA is ultimately responsible for assessing whether the completed and planned test programs will provide adequate information about E15 impacts on a (statistically) representative fleet. In addition, EPA must ensure that a study is conducted that evaluates the health and environmental impacts from E15 use, and this information should be considered in determining the appropriateness of a waiver; AIAM is not aware of any health effects testing underway at this time for E15. EPA may also want to consider developing a panel of experts to review and assess all testing and whether it will be adequate, in the future, to address concerns related to E15 use.

Auto Manufacturer In-Use Compliance Liability

Under EPA regulations, if motor vehicles fail to meet emissions standards in-use within the statutory useful life period, then auto manufacturers are liable for recall and repair of the subject vehicles. AIAM is concerned that the use of mid-level ethanol blends could lead immediately to higher emissions of oxides of nitrogen (NOx) and higher evaporative emissions (due both to higher vapor loads as well as increased permeation rates). In addition, automakers are concerned that the use of mid-level ethanol blends could potentially lead to more rapid deterioration and possibly failure of emissions control components. Such emissions increases would at least reduce the head-room that manufacturers design into vehicles to ensure emission compliance in-use. If such issues are realized in the field, then they could "contribute to" the possibility of future in-use failures. In all these cases, auto manufacturers' recall liability is increased. Given the extremely stringent vehicle emissions standards in effect today, it is probable and perhaps likely that such emissions increases could cause or contribute to vehicles failing to meet emissions standards in use.

Other potential concerns that could lead to emissions increases are that:

- Permeation-related evaporative emissions may increase due to E15 impacts on the physical characteristics of materials over an extended timeframe, and
- Higher exhaust temperatures with E15 may lead to more rapid deterioration of catalytic converters or exhaust sensors.

Auto Manufacturer Warranty Liability

AIAM is concerned that the in-service fleet was not designed for ethanol blends greater than E10 (except for FFVs) and use of such blends could result in a higher occurrence of warranty-related repairs. Such cases could be exacerbated by the fact that all 1996 and newer model year light duty vehicles manufactured are equipped with onboard diagnostics (OBD) systems, which would indicate to the owner that the vehicle may be experiencing an emissions-related issue. In many cases, the OBD MIL illumination may be due solely to fuel effects and may not be readily identifiable or repairable by technicians. Without sufficient vehicle durability and performance testing, it cannot be determined whether the use of E15 will cause or contribute to higher OBD MIL illumination and resultant warranty claims.

Consumer Liability

AIAM is concerned that the pre-mature introduction of E15 without complete testing has a high risk of creating consumer problems and potentially result in consumer dissatisfaction with E15 and/or their vehicles. First, AIAM is concerned that the in-service fleet was not designed for ethanol blends greater than E10 (except for FFVs); therefore, there is a concern that legacy vehicles will not perform properly in-use when using a mid-level ethanol blend. The vast majority of in-service vehicles are no longer covered under manufacturer warranties, and repairing any in-service issues due to the use of E15 may result in increased costs to the customer. Such cases could be exacerbated by the fact that all 1996 and newer model year light duty vehicles manufactured are equipped with onboard diagnostics (OBD) systems, which would indicate to the owner that the vehicle may be experiencing an emissions-related issue. Any performance issues, driveability issues, OBD failures, or other problems associated with E15 fuel will be the responsibility of the vehicle owners to have corrected at their own expense. These problems could be particularly problematic in areas with vehicle inspection/maintenance (I/M) programs. Approximately 150 million vehicles in over 30 states are subject to I/M programs.

Second, due to the lower energy content of E15 blends, consumers will be experiencing reduced fuel economy in service. It is very important for consumers to be made aware that any reduction in fuel economy is due to the new F/FA and not the vehicle. However, inevitably manufacturers and dealers will receive a multitude of related complaints.

Third, potential increases in vehicle-related problems could damage product reputations. If certain brands, models, or types of vehicles fail to perform properly with E15 fuel, the impacted vehicles could create negative brand images for the affected manufacturers through no fault of their own. These impacts could include higher OBD MIL illuminations, higher I/M program failure rates, poor driveability or performance, poorer fuel economy, and higher warranty claims. All of these problems could lead to significant inconvenience for and dissatisfaction of consumers.

Finally, an evaluation of in-use issues, such as vehicle labeling, pump labeling, misfueling, consumer education, etc., needs to be conducted. Information on such issues is not readily available. EPA should fully consider all in-use scenarios and evaluate potential information needs to address each scenario. Use of a new fuel should require adequate lead time and a well-thought out implementation strategy in order to prevent in-field issues.

Fuel Quality and Infrastructure Considerations

AIAM member companies are particularly concerned about the effects of an E15 fuel on overall transportation fuel quality. While we expect the fuel industry to elaborate extensively on fuel quality issues, auto manufacturers are equally concerned that the proper process is followed and that adequate lead-time is provided to ensure that both legacy and future products have the proper fuels in the marketplace. The American Society for Testing & Materials (ASTM), which is supported by the auto and oil industries, has traditionally set specifications for transportation fuels. Currently there are no ASTM specifications for an E15 blend. This lack of standards raises concerns among AIAM members about what is required for producing blendstocks suitable for blending E15 fuel and ensuring adequate fuel quality.

In EPA's *Federal Register* notice of April 21, 2009, the agency asked specifically for comments on how an E15 waiver might affect other fuel regulations and the need for amendments. Again we expect the oil industry to comment extensively on this matter, but AIAM believes that EPA must fully consider the potential impacts an E15 blend could have on EPA's fuel regulations for fuel volatility, reformulated gasoline, anti-dumping requirements, gasoline detergency, and any other fuel regulation which may be affected.

It is essential for EPA to consider any potential fuel distribution infrastructure impacts which could result from the use of a new F/FA. AIAM notes that the section 211(f) requirements for EPA's evaluation of the acceptability of a fuel waiver does not explicitly include the consideration of the impacts a new F/FA could have on the production, distribution, storage, and marketing of the fuel. However, in its April 21, 2009 *Federal Register* notice, the agency requested comments on the potential impacts E15 could have on the fuel production, distribution, and marketing infrastructure. Only by collection and review of such information can there be assurance that the new F/FA will not cause or contribute to fuel leaks, vapor leaks, or other service station storage or pump system issues which could have public health and safety concerns. To our knowledge, there are no studies underway to evaluate infrastructure impacts, but such work should an important consideration in the waiver decision process.

Implications of a Partial or Conditional Waiver[4]

In its April 21, 2009 Federal Register notice, EPA requested comments on the possibility of a partial or conditional waiver of E15 blends. The concept as presented is that E15 fuel could be approved for certain applications and not others. For instance, EPA might conclude that E15 was acceptable for certain motor vehicles and not others, or for certain highway vehicles but not for non-road engines. Such action would result in a complicated bifurcated fuel distribution system which would raise a wide range of potential policy and technical issues. A partial list of these issues includes:

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[4] Based on AIAM's preliminary legal analysis of section 211(f) of the Clean Air Act (and the legal analysis contained in AllSAFE's comments), it is not clear what, if any, authority EPA has for granting a partial or conditional fuel waiver. The underlying rationale for the abbreviated waiver process as opposed to requiring a full rulemaking under the Administrative Procedure Act (APA) for approving new fuels, was premised on the notion that such agency action could be based on a quick review of the technical factors presented in the applicant's supporting tests and other documentation and any public comment. Here, EPA is proposing a complex approach that requires more regulatory guidance more appropriately addressed as part of a rulemaking process under the APA and analogous Clean Air Act prescriptions.

- How to identify vehicles and engines capable of using E15 versus those that should not
- How to prevent misfueling
- How to accommodate dual distribution systems at fuel stations
- What are the costs of a dual distribution system
- How to educate consumers about which fuel they need and the fuel economy impacts of that fuel
- What pump labeling should be required
- What vehicle/engine labeling should be required

As noted earlier, AIAM can envision no scenarios whereby a dual fuel distribution system (i.e., both current gasoline would remain available widely for some vehicle/engine applications and a new E15 blend would be available widely for specifically identified vehicle/engine applications) that would not result in misfueling of vehicles/engines and creating risk of environmental, safety, and consumer issues. Given the complexity and diversity of these issues, AIAM believes it would be necessary for EPA to consider such matters only through a formal rulemaking under section 211(c). EPA's experience with the problems associated with the bifurcated leaded and unleaded fuels distribution system in the 1970s, 1980s, and early 1990s, is illustrative of the myriad issues that can arise due to a bifurcated system.

Conclusion

In light of the above, AIAM believes that it is clear that the waiver applicant(s) has not met the statutory and regulatory requirements necessary to support the waiver application due to a lack of information; the required information to grant a waiver, in full or partially, was incomplete, and other parties' studies will not be completed in time to inform this waiver consideration. Consequently, EPA has no choice but to deny the waiver for E15 blended gasoline at this time.

Although the current situation – a lack of adequate test data – warrants that EPA deny the waiver at this time, the waiver may be appropriate in the future, once sufficient, statistically-valid data are available. AIAM cannot support hasty implementation of E15 when the full impacts of usage are not understood and will not be understood for some time, but AIAM believes that EPA and industry have an opportunity to work together, now, to plan for future ethanol uses, including vehicle-related needs and in-field implementation strategies (labeling, pumps, education).

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Sincerely,

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cc: Margo Oge, EPA
Karl Simon, EPA

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A Literature Survey of the Effects of Higher Ethanol Concentrations in On-Road and Off-Road Engines and Vehicles

Emissions, Operability and Materials Compatibility

Prepared for the

Association of International Automobile Manufacturers

by

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July 15, 2009

EXECUTIVE SUMMARY

Growth Energy submitted a request to EPA[1] to approve use of 15% ethanol in gasoline blends. A review was conducted of the technical literature pertaining to the use of intermediate levels of ethanol (>10%) in gasoline. Based on the review, the following conclusions about the potential use of E15[2] relative to E0 were reached:

- E15 will increase emissions of NOx and acetaldehyde, and will reduce emissions of HC, CO, benzene and butadiene in on-road and non-road engines.
- E15 will increase exhaust gas temperatures, and may negatively impact engine and catalyst durability in on-road and non-road engines.
- E15 will increase evaporative emissions.
- E15 will worsen driveability in some on-road engines and in many non-road engines.
- E15 may cause serious safety hazards and increased risk of injury in non-road engines.
- E15 may cause premature failure of parts in non-road engines.

More data are needed to be able to draw sound conclusions about the extent and magnitude of these effects. Considerable research is underway and/or being planned to address many of these issues. Therefore, it is premature to conclude that the use of E15 will not have serious adverse impacts on end-use equipment.

INTRODUCTION

On March 6, 2009, Growth Energy submitted a request to EPA to approve the use of gasoline containing 15% ethanol in the United States. EPA approval is required under Section 211 (f) (4) of the Clean Air Act before a new fuel or fuel additive can be introduced into commerce. The applicant must show that the proposed fuel composition will not "cause or contribute to the failure of any emission control device or system" to meet the applicable emission standard. The target population would include cars, gasoline fueled trucks, small engines such as used in garden equipment, and marine engines.

In past rulings, EPA has defined negative effects as

- causing emissions to increase directly
- causing emissions to increase indirectly by causing failures in control systems or system materials

[1] A list of acronyms appears on page 21 of the report.

[2] Throughout this report, the symbol Exx refers to ethanol-gasoline blends containing xx% ethanol. For example, E15 is a mixture containing 15% by volume ethanol and 85% by volume gasoline.

- causing engines to operate poorly, thereby encouraging owners to disable emission control systems

This report describes the results of a literature survey and analysis to determine the state of existing knowledge concerning these effects. Technical literature was surveyed, as well as government reports and reports by independent organizations such as the Coordinating Research Council (CRC).

A great deal of literature has been published concerning the effects of 10% ethanol, and 85% ethanol. Since the waiver request is for an ethanol concentration of 15%, the existing literature is much less complete. This review focused on programs that tested concentrations above 10% and less than 85%.

Some programs tested ethanol concentrations of 20%. Where no problems were encountered, it is likely that 15% will also be acceptable. However, where problems were encountered with 20%, the implications for 15% are less clear. It can be argued that the Precautionary Principle[3] should apply and that 15% should not be approved. On the other hand, it can be argued that problems at 20% have no bearing on the existence or lack of problems at 15%. That decision will have to be made by EPA in its evaluation of the waiver request.

ISSUES IN THE LITERATURE

There are a number of common issues that were encountered when surveying the literature, and these are discussed below. The impact of these issues will be highlighted where relevant.

1. Existing Versus Modified Equipment – The waiver request must consider existing vehicles and equipment that were not designed and certified to use ethanol concentrations higher than 10%. There may also be issues with Flexible Fuel Vehicles that can operate on ethanol concentrations between 0% and 85%. Many current FFVs are designed to "expect" refueling with gasoline containing ethanol in one of two ranges: 0-10% or 70-85%. Refueling with gasoline containing ethanol outside these ranges may confound the calculation of proper stoichiometry and may cause an increase - temporarily - in emissions and a degradation in driveability.

   Some published studies have shown that it is possible to modify equipment to operate on higher concentrations of ethanol. While this is important for future designs, it is not relevant to the current question which must focus on existing vehicles and equipment.

2. Fuels Blending – Most of the studies cited in the literature tested fuels that were splash blended, and this introduces some uncertainty into the results and conclusions. Well designed fuel studies control levels of all other chemical and physical properties when comparing fuels. For instance, since ethanol generally contributes to an increase in the RVP (Reid Vapor Pressure) of the blend, it is necessary to adjust the RVP of the blended fuel. Otherwise, it is not possible to determine whether the effect was due to the addition of

[3] One definition of the Precautionary Principle states that it is the responsibility of an activity proponent to establish that the proposed activity will not (or is very unlikely to) result in significant harm. (www.wikipedia.org)

ethanol or to the change in RVP.

Similarly, in comparing splash blended fuels, emissions effects may be due to the addition of ethanol or to the dilution of other properties such as sulfur. A negative effect of ethanol that has been reported is an increase in exhaust NOx (oxides of nitrogen) emissions. There is also evidence that reducing aromatics and/or sulfur will reduce exhaust NOx emissions. If ethanol is splash blended, the impact on exhaust emissions is difficult to assign. If no effect was found, it could be because the aromatics and sulfur effects cancelled out the ethanol effect.

Another example involves material compatibility tests. If ethanol is splash blended, then other properties, such as aromatics change. Aromatics are known to affect the swelling of elastomers. When two fuels are compared which have different levels of ethanol and different levels of aromatics, it may not be possible to determine the cause of the response measured.

The issue of fuel properties is important because most commercial fuels are not made by splash blending ethanol. Special blends are made to be combined with the appropriate amount of ethanol at the terminal before delivery to service stations. Properties of the base blend are adjusted so that the final blend including ethanol has the appropriate properties specified by law and by standard setting organizations such as ASTM. The base blend may be called a BOB (blendstock for oxygen blending) or RBOB (reformulated blendstock for oxygen blending).

In some cases, technical judgment may be used to clearly identify an effect, while in others the uncertainty may remain. These will be discussed in more detail below.

3. Proper Fuels for Comparisons – When testing fuels and drawing technical conclusions, it is important to specify the proper comparison to be made. The question is whether E15 should be compared to E10 or to E0. The Clean Air Act defines the impact of a new fuel by comparing it to the fuel used in 1974, which did not have any oxygenate. Many of the studies, and the waiver request as well, compared E15 and E10. The syllogistic argument is made that if E10 is no worse than E0, and if E15 is no worse than E10, then E15 must be no worse than E0. This argument is logically sound, but ignores the uncertainty introduced by experiment variability. If two fuels have properties that are close to each other, then it is difficult to design a test with enough statistical power to be certain of finding an effect if it exists. Therefore, the best approach should be to compare E0 and E15 directly.

4. Emissions Testing and Measurements – Standard tests exist for measuring emissions. For instance, in the U.S., the standard test is defined by EPA and consists of simulated driving on a dynamometer. Some programs in the literature used steady state testing, which makes the results less applicable to the issue at hand. Some programs change design parameters and operating conditions to optimize operation on different fuels. While this approach can generate useful information for future applications, it may not be relevant when considering use of ethanol in existing vehicles and equipment which cannot be modified to accommodate new fuels.

   Hydrocarbon exhaust emissions are typically measured using a Flame Ionization Detector (FID). When the fuel contains high concentrations of ethanol, the exhaust contains ethanol as well. Emissions that may contain high concentrations of ethanol should measure the property NMOG (non-methane organic gases). NMOG is also the appropriate measure for EPA emissions certification. This measurement involves measuring the ethanol content of the exhaust and correcting the FID measurements. Many of the reports in the literature did not use this approach, so that the emissions measurements may have some uncertainty. This might lower the benefits claimed for ethanol in reducing hydrocarbon emissions. It is expected that for E10 and E20, this effect will be small. For example, in the CRC E-67 program [1], with E10, ethanol represented about 3% of the NMOG emissions.

The standard equations for calculating fuel economy from an emissions test are not applicable for fuels with ethanol, because they contain a factor to correct all fuels to a common volumetric energy content. A method using carbon balance technique without an energy correction should be used.[2] It is not clear in the literature whether this approach was always followed.

5. Test and Equipment Location - The location of the test may be an important factor in evaluating the literature. Some countries have different emission standards leading to different vehicle and engine designs and different control equipment. Countries that have significant numbers of automobiles with carburetors may not be representative of the fleet in the U.S. The same may be true of materials used in engines. In the U.S., automotive materials have been compatible with E10 for over 30 years; equipment in other countries may exhibit compatibility problems. By the same token, experience from Brazil, where high levels of ethanol have been mandated for many years may not be relevant for the U.S.

SURVEY OF TECHNICAL LITERATURE

Methodology

A number of technical resources were used to locate published literature. The database maintained by the Society of Automotive Engineers – Global Mobility Database - is an extremely useful tool that can be searched easily. A number of references were cited in the waiver request, and a number of independent literature surveys have been carried out.

The literature is presented chronologically by end-use – on-road and non-road. Within each end-use application, it is organized according to the effects measured – emissions, operability and materials compatibility. Operability refers to proper and expected operation. For cars, this would mean that a car starts promptly and drives with no hesitation, misfire, stalling, etc. Materials generally refers to the impact of fuel properties on the integrity of materials such as rubbers, plastics and metals. Metals should not rust, plastics should not crack and rubbers should maintain their elasticity, strength and shape.

Two groups of programs are worth mentioning. One is a series of projects carried out by Orbital Engine Company in Australia, when that country was considering the use of E20.. The second group is a series of programs carried out by the Minnesota Center for Automotive Research (MCAR) at the Minnesota State University. Both organizations ran experimental programs, as well as literature searches. They will be discussed below. These programs are very relevant to the questions at hand because they were designed to answer specific questions about ethanol use. By contrast, some of the published technical literature may not be directly applicable because the research was not targeted at E15 use in existing equipment.

Publications dated later than 1994 were included in this report. It was felt that this time frame represents the vast majority of vehicles and engines in use today. A full bibliography of references is included at the end.

Summary reports and surveys:

- NREL (National Renewable Energy Laboratory) [3] wrote a report evaluating issues associated with use of higher ethanol blends, and included a complete literature survey. They concluded that there were no likely compatibility issues and that catalysts were probably unaffected.
- Orbital Engine Company [4] studied the state of knowledge of ethanol use in non-automotive engines for Environment Australia. They concluded that use of up to 10% ethanol was probably acceptable, but there was little if any information on blends containing more than 10% ethanol. Use of ethanol containing blends in aircraft engines was highlighted as a special concern.
- The Swedish Emission Research Program financed the Stockholm Study [5] to evaluate the possibility of increasing the ethanol content in Sweden from 5% to some higher value. That study reached the following conclusions:
    - Blends up to 15% will not have a significant effect on engine or vehicle performance.
    - No significant differences in regulated emissions can be seen up to 10-15% ethanol.
    - There are some increases in unregulated emissions, such as aldehydes.
    - Blends with 20% ethanol should be avoided until more data are collected.
    - For 15%, more data should be collected on cold weather starting, and health/environmental impacts.

  The conclusions, especially concerning emissions, are somewhat surprising. They did not reference the extensive U.S. Auto/Oil Air Quality Improvement Research Program [6], which showed that ethanol up to 10% has a statistically significant effect on exhaust emissions of HC (hydrocarbons), CO (carbon monoxide), NOx and aldehydes. It also concluded that alcohols and ethers had similar effects that were a function of their oxygen content.
- Waytulonis et al. [7] published results of a literature search for effects of E20 in small non-road engines. The report contains a useful summary of the issues involved in using 20% alcohol blends. The authors analyzed the available information and concluded that many gaps existed, and pointed to studies being carried out at MCAR, which have since been published and are cited below.

On-Road applications

Emissions

1. Guerreri et al. [8] tested six in-use vehicles (1990-92 model years) with ten fuels (E0, E10, E12, E14, E17, E20, E25, E30, E35 and E40) prepared by splash blending into a base gasoline. Emissions were measured as OMHCE (Organic Material Hydrocarbon Equivalent). OMHCE is similar to NMOG except for the inclusion of methane, and that the oxygen portion of ethanol is excluded in OMHCE. Over the entire range of concentrations, emissions of OMHCE, THC (total hydrocarbons) and CO decreased as ethanol concentrations increased. Similarly, emissions of NOx and acetaldehyde increased over the range of concentrations. All trends were statistically significant (95% CL). The authors conjectured that all these effects could be explained by changes in stoichiometry. At high ethanol concentrations, the closed-loop A/F control on the vehicle may not have been able to adjust fully, while at low levels, the adjustment may not have been perfect. Fuel economy was also reported and varied with energy content of the fuels.

2. Kremer et al. [9] tested four Brazilian cars on alcohols (22% in gasoline) made from sugar cane, corn, natural gas and coal. The ethanol content of the non-sugar based alcohols varied from 53% to 90% (corn). Higher molecular weight alcohols made up the difference. The report concluded that corn and sugar alcohols had similar performance and that the other alcohols increase CO emissions and had worse corrosion of metal parts. This research has little relevance to the U.S. situation because of the strict standards regulating ethanol content of fuel grade ethanol.

3. Barbosa deSa and Marins [10] tested three Brazilian vehicles with two fuels (E22, E26). One vehicle was carbureted, one had single point injection, and one had multipoint injection. Comparing E22 and E26, CO emissions were lower in one vehicle and NOx emissions were higher in one vehicle. The relevance of this study for the U.S. situation is uncertain because of the high ethanol contents and because Brazilian cars are specially designed for high ethanol content.

4. Hsieh et al. [11] tested a 1.6 liter MPFI (multi-point fuel injection) 4 cylinder engine at steady state conditions. Emissions of HC, CO and NOx depended on air-fuel ratio. When ethanol addition caused the engine to run leaner, HC and CO emissions were reduced. NOx emissions varied with equivalence ratio and went through a maximum at an equivalence ratio of about 1.

5. He et al. [12] tested a MPFI closed loop engine at two steady state conditions with three fuels (E0 and splash blended E10 and E30). The ethanol fuels had lower emissions of HC, CO and NOx under most load conditions. At full load, CO emissions for E30 were higher and NOx emissions for E10 were higher. The authors did not attempt to explain the unusual results, and they did not discuss statistical significance. Ethanol and acetaldehyde emissions were higher with the ethanol fuels.

6. Orbital Engine [13] tested five new vehicles and four older vehicles from the Australian market. Comparing splash blended E20 and E0 for the new vehicles, exhaust emissions of THC and CO were reduced (~30%) and exhaust NOx emissions increased (48%).

Acetaldehyde emissions were higher and benzene emissions were lower. In the older vehicles, HC and CO emissions were reduced (4% and 70%, respectively). NOx emissions increased for the vehicles with open loop control and decreased for the vehicle with closed loop control (average increase of 9%). There was considerable variability among the vehicles in the size of the emissions effect. Acetaldehyde emissions were higher, while emissions of benzene and 1,3 butadiene were lower (20% and 15%, respectively). Exhaust gas temperatures were higher with E20 in five of the nine vehicles, including some with closed loop control. This indicates that even with closed loop control, there can be some shift in stoichiometry. The increase in exhaust gas temperatures may have negative consequences for long term durability of the catalysts and other components of the emissions control system. See below for a description of Orbital's long term studies. [14]

There was an increase in evaporative emissions with E20, although it is not possible to ascribe the difference to ethanol since RVP likely changed as well.

7. Kaneko et al. [15] measured running loss emissions in four Japanese cars with different design features, five fuels – E0 at two levels of RVP, E3 at two levels of RVP, and E10. They showed that vehicle design parameters such as canister capacity, canister purge rate, and fuel heating are important. They also showed that even though RVP of different fuels may be matched, vapor pressure at temperatures above 100ºF may be higher for fuels with ethanol than without ethanol. This implies that even if fuels are volatility matched, there may still be a small effect of ethanol content on evaporative and running loss emissions.

8. Akasaka [16] reported on tests in nine Japanese vehicles – three passenger cars (0-5 years age), one commercial truck (10 years old), two Kei cars (minivans or mini trucks, 0-5 years old) and three motorcycles 0-10 years old). Seven fuels were tested – a base gasoline, five splash blends (E1, E3, E5, E7, E10), and an RVP adjusted blend (E5). With increasing ethanol content, exhaust emissions of CO generally went down, exhaust NOx and aldehydes generally increased, and exhaust HC were mixed for the cars, and went down for the motorcycles. Evaporative emissions were tested in two cars, and increased with higher ethanol content, but this could also be the results of increased RVP. The RVP adjusted fuel had emissions that were a little higher than the E0 fuel in one car, but the same in the second car.

9. Maheshwari et al. [17] studied splash blended E5 and E10 in Indian cars and two wheelers. Generally emissions of HC and CO decreased and emissions of NOx increased. They did not discuss the statistical analysis of these conclusions. The relevance of this study for the U.S. is uncertain because of the low ethanol concentrations, and the different equipment.

10. Orbital Engine [14] accumulated 80,000 km in five pairs of new Australian vehicles. One vehicle in each pair used E0 and one used splash blended E20. Two of the vehicles exhibited more deterioration of emissions on E20 than on E0. Orbital attributed this result to higher exhaust temperatures and greater catalyst degradation. The two vehicles did not operate under closed loop control under all driving conditions. At 80,000 km, the fleet average emissions were higher for E20 than for E0 for all three exhaust components. No effect of ethanol on deterioration of toxics emissions was seen.

11. Subramanian et al. [18] tested four Indian scooters with two-stroke engines with three fuels (E0 and splash blended E5, E10). Tests were conducted at 1,000 km, 10,000 km and 20,000 km. HC and CO emissions were reduced by large amounts with the addition of ethanol, except at low mileage. At 1,000 km, HC and CO emissions increased when ethanol was added. The explanation for this effect was unclear. NOx emissions were not reported. Acetaldehyde emissions also increased with higher ethanol levels.

    One four-stroke motorcycle was tested and emissions of HC and CO also were reduced when ethanol was added.

12. Ning et al. [19] tested two four-stroke motorcycles and one two-stroke motorcycle commonly used in China. E0 and splash blended E10 were compared after accumulating 16,000 km. Emissions of HC and CO went down significantly while NOx emissions were somewhat variable.

13. CRC carried out a program to measure emissions from 15 vehicles (2001-2003 model years) as a function of volatility and ethanol content up to 10%[1]. While the results are not directly relevant to the question of E15, this is one of the few published studies that controlled fuel properties in an orthogonal design, and which allowed statistical inferences to be drawn with certainty. There were a number of interactions among fuel properties, but generally, increasing ethanol content tended to reduce CO and NMHC (non-methane hydrocarbons) emissions and to increase NOx emissions.

14. Shockey et al. [20] measured emissions from four 2007 cars on E0 and splash blended E20 or E30. The results were scattered. THC emissions went up in two vehicles and down in two. CO emissions went up in one vehicle, down in two and were the same in one. NOx emissions were up in one vehicle, down in two and were the same in one. No statistical analysis was presented.

15. Wallner and Miers [21] tested a 2.2-liter direct injection gasoline engine with E0 and four splash blended ethanol fuels (E10, E20, E50, E85). Testing was done at various steady state conditions. Under these controlled conditions, NOx and HC emissions generally decreased as ethanol concentrations increased. The authors recognized that the NOx effects could also be explained by the fact that aromatics were also decreasing as ethanol increased, and that aromatics are known to contribute to higher flame temperatures and higher engine-out NOx emissions. Not mentioned in the paper is that HC emissions, when measured by a FID, would also tend to decrease because ethanol is not fully detected by an FID. Better measures such as OMHCE or NMOG should be employed, especially at higher ethanol concentrations.

16. Gogos et al. [22] tested a 1.3-liter, four-cylinder engine from Greece with E0 and three splash blended fuels (E10, E20, E50) under steady state conditions. The engine was removed from a car and had accumulated 170,000 km. Adding higher levels of ethanol reduced HC and CO and increased NOx emissions. These results can be explained by the fact that the engine was running rich with E0 and adding ethanol leaned out the mixture.

17. Kumar et al. [23] tested a single-cylinder automotive engine manufactured by AVL with E0 and three splash blended fuels (E10, E30, E70) in an optimized and non-optimized condition. In both configurations, as ethanol content increased, brake specific CO

emissions decreased, NOx emissions increased, and HC emissions did not change. Optimization consisted of adjusting spark advance and injection duration. They did not report stoichiometry for any of the cases.

18. Lin and Liu [24] tested a 125-cc, carbureted four-stroke motorcycle in Taiwan with E0 and five splash blended fuels (E3, E10, E20, E30, E40). Three different carburetor jets were tested. In general, for a given set of jets, as ethanol was added, CO and HC decreased and NOx increased.

19. NREL [25] carried out a study to measure emissions from 16 late model vehicles with four fuels (E0 and splash blended E10, E15, E20). The report concluded that NMHC and CO decreased with increasing ethanol, and that NOx and NMOG showed no significant change. The statistical analysis was straightforward and the confidence limits were fairly broad, suggesting that there could have been other effects that were not possible to determine. Emissions of ethanol, formaldehyde and acetaldehyde increased with increasing ethanol.
    The study also measured catalyst temperatures, a good indicator of potential long term emissions changes. Nine of the cars operated under closed loop control of air/fuel ratio under all operating conditions. These cars had no change in temperature with ethanol content. At wide open throttle, seven cars ran leaner (but still rich) with E20 than with E0. For these vehicles, catalyst temperatures at wide-open throttle averaged 10ºC higher with E10, 24ºC higher with E15 and 31ºC higher with E20.

20. Shanmugam et al. [26] tested a number of Indian cars meeting Euro3 standards with E0 and splash blended E10. While not directly relevant to the E15 question, they showed that at wide open throttle, there was an effect of ethanol on air-fuel ratio and through that change, an effect on emissions of CO, HC and NOx. There was little if any effect on emissions while the vehicles were under closed loop control of stoichiometry.

21. Muralidharan et al. [27] measured PM (particulate matter) emissions in a 97-cc, four-stroke motorcycle meeting Euro2 standards with five fuels (E0 and splash blended E5, E10, E20, E30). PM number and mass distributions were measured using the Indian driving cycle and under steady state conditions using an ELPI (Electrical Low Pressure Impactor) instrument. Under transient conditions, increasing ethanol concentration reduced the PM number concentration. This was attributed to both the presence of ethanol and the reduction in sulfur concentrations. The concentration of nanoparticles (0.028-0.94 micron) increased with higher ethanol levels. Under steady state conditions, there was no trend in PM emissions.

22. CRC [28] carried out a number of projects to measure the contribution of ethanol to evaporative emissions as a result of permeation of fuel through fuel system materials such as elastomers. They determined that the presence of ethanol increases permeation emissions significantly from light duty vehicles in the U.S. The original testing was carried out with E6, but subsequent testing showed that E10 and E20 did not have higher permeation emissions than E6. The importance of these results depends on the comparison made for the purpose of considering the waiver request. If E15 is compared to E10, then there is no impact. If E15 is compared to E0, then the impact can be considerable.

23. CRC [29] carried out a project to measure emissions at various levels of RVP and oxygenate in 15 vehicles. An E20 fuel was included in the program. Regression analysis showed that higher ethanol content reduced exhaust emissions of THC and CO and increased emissions of NOx. E20 reduced THC by 15%, reduced CO by 20% and increased NOx by 18%. While composition and RVP levels were tightly controlled, other volatility parameters such as T50 could not be controlled because of the high ethanol content. The authors pointed this out in their analysis.

24. CRC has completed the first phase of a two phase study to evaluate catalyst durability of mid-level ethanol blends. [30] Twenty-five vehicles manufactured since 1999 were evaluated over a severe wide open throttle driving cycle with four test fuels (E0, E10, E15, E20). Thirteen of the vehicles did not adjust the stoichiometry during open loop operation when fuels were changed. Eight vehicles did adjust the stoichiometry, and four vehicles gave unclear results. The implications of these results are that some vehicles may have higher exhaust gas temperatures and therefore impaired emissions as a result of long term use of E15 due to increased deterioration to catalytic converters.

    The second phase of the study will conduct long term tests of ten of the vehicles from Phase 1 that did not adjust stoichiometry during wide open throttle operation.

<u>Operability</u>

1. Bonnema et al. [31] tested 15 U.S. cars (1985-1998 model years) on E10 and E30 for one year and reported no driveability problems with either fuel. They reported that it required about 100 miles of driving for the vehicles to “learn” to operate on the new fuel.

2. Barbosa deSa and Marins [10] tested three Brazilian vehicles with two fuels (E22, E26). One vehicle was carbureted, one had single-point injection, and one had multi-point injection. Comparing E22 and E26, one vehicle had worse cold start performance and minor increases (3%) in acceleration times. Fuel consumption was also higher with the 26% ethanol fuel. The relevance of this study for the U.S. situation is uncertain because of the high ethanol contents and because Brazilian cars are specially designed for high ethanol content.

3. Orbital Engine [13] tested five new vehicles (2001 model year) and four older vehicles (1985-1993 model years) from the Australian market with E0 and splash blended E20. Driveability was assessed at ambient conditions (~25ºC), at hot temperatures (40ºC) and at cold temperatures (-10ºC). Differences between the fuels were judged to be noticeable to the average driver in the following cases. Two of the new vehicles had significantly worse starting performance on E20 at the cold condition. In the older vehicles hot driveability was significantly worse with E20, and would be noticeable by the average driver. Cold driveability was also significantly worse with E20 and was judged noticeable by the average driver.

4. Maheshwari et al. [17] studied splash blended E5 and E10 in Indian cars and two wheelers. No degradation in performance was seen going from 5% to 10% ethanol between 5ºC and 45ºC, except for a marginal increase in acceleration times. This is consistent with a lower

energy content. Four scooters and four passenger cars accumulated up to 40,000 km, and wear and deposit ratings were similar for E5 and E10. The authors speculated that higher doses of antioxidant and corrosion inhibitors would be needed to meet product quality specifications with higher levels of ethanol.

5. Akasaka [16] reported on tests in five Japanese vehicles – three passenger cars (0-5 years old), one commercial truck (10 years old), and two Kei cars (minivans or mini trucks, 0-5 years old). Six fuels were tested – a base gasoline and five splash blends (E1, E3, E5, E7, E10). The high ethanol fuels (E7, E10) exhibited hesitation in one of the carbureted cars. This could have been the result of higher volatility, not necessarily the ethanol itself.

6. Subramanian et al. [18] tested four Indian scooters with two-stroke engines with three fuels (E0 and splash blended E5, E10). Engine components were rated for cleanliness and wear after 20,000 km. Generally, merit ratings of E5 were better than E0. Piston cleanliness was worse for E10, but the authors felt that this could be solved by higher concentrations of antioxidants.

7. Ning et al. [19] tested two four-stroke motorcycles and one two-stroke motorcycle commonly used in China. E0 and splash blended E10 were compared after accumulating 16,000 km. With the E10 fuel, the top speed was lower, sediment was higher in one of the 4 stroke motorcycles and some piston scrape was evident. None of these problems were described as serious.

8. Cracknell and Stark [32] modeled the kinetics of lubricant oxidation and suggested that ethanol in the fuel has a positive effect on lubricant oxidative stability, but that the effect is small because ethanol has a low solubility in engine oil.

9. Kapus et al. [33] studied ethanol fuels (E0, E85, E100) in a direct injection, single-cylinder, turbocharged automotive engine. While the work is not directly relevant to the use of E15, the authors point out some of the advantages of using ethanol, such as high octane and high latent heat of evaporation. Challenges include low energy content, hard starting, cylinder wall film formation leading to excess wear, and oil dilution.

10. Taniguchi et al. [34] tested a number of ethanol concentrations in a direct injection V6 engine. Comparing E0 and E20, they found that the injector tips had lower temperatures with E20, presumably because of ethanol's high latent heat of vaporization. In a severe test, E20 had lower injector tip deposits than E0.

11. Kittelson et al. [35] compared E0 and E20 in 40 pairs of vehicles in customer driving situations for one year. The fleet consisted of seven pairs of cars and 33 pairs of trucks and vans. Each vehicle stayed on one fuel for the entire length of the test. The two fuels were not blended to match properties, and the E20 used a different base fuel than the E0. Driveability Index (DI) values were reported and the E20 had lower DI than the E0 throughout the year. This makes any comparison of driveability on the two fuels suspect, since the E20 would be expected to perform better than E0. Since the E20 was splash blended, the RVP was significantly higher than E0.

    Drivers filled out forms daily, and trained raters conducted tests four times over the course of the year. The only differences that were statistically significant were observed by lay drivers in the spring and fall, when E20 had worse driveability than E0. Trained raters did not perceive statistically significant differences. No data were shown for hot fuel handling. The analysis did not take into account the major differences in the two fuels which could either cause differences in performance or mask differences that might have occurred.

12. CRC [36] studied hot fuel handling in 27 vehicles with four fuels (E0, E5, E10, E20) blended to statistically determined volatility properties. Very few driveability demerits were measured, even under conditions that would be expected to result in hot fuel handling problems. The CRC committee could not fully explain the lack of response. It is possible that fuel flushing and handling procedures could have contributed to the lack of response, but no firm conclusions were drawn in the report. Therefore, no conclusions about fuel performance can be drawn from this study.

13. Boons et al. [37] tested lubricant performance with two ethanol fuels (E10 and E85). They were concerned that higher ethanol levels might lead to more water in the oil and to problems with rust and wear. In a severe test with four 2007 model year Dodge Dakotas and three engine oils, no problems were found that were attributed to the high ethanol content.

14. NREL [25] carried out a study to measure emissions from 16 late model vehicles with E0 and three splash blended fuels (E10, E15, E20). Limited operability evaluations were made, but no problems were uncovered.

15. CRC [38] conducted a driveability evaluation of six conventional vehicles (1981-2008 model years) with E0, E15 and E20 at cool ambient temperatures (20ºF-40ºF). The E15 and E20 results were combined when it was determined that there was no difference. Regression analysis showed that the driveability of E15/E20 was worse than E0 (marginally significant, p=0.94). This program is important because the fuels were blended to control volatility, so that it was possible to determine the effect of ethanol independent of the impact of volatility.

Materials

1. Orbital [39] tested materials taken from three high volume Australian vehicles. Polymeric materials were tested with E0 and splash blended E20, while metallic samples were tested with E20 only. The ethanol fuels had 1% corrosive water, (defined in SAE J1748). There were many instances of corrosion and tarnishing of metal parts including fuel pump casings and internals, fuel injectors, fuel tank metal and PCV valve. Orbital concluded these changes are cause for concern.

   Some polymeric materials were found to have significant changes with E20 compared to E0. These included fuel sender float, hoses, fuel regulator diaphragm, cork gaskets, etc. The changes that were seen were considered unacceptable because they could lead to fuel leaks.

   See Appendix 1 for a discussion of the composition of fuels used for materials testing.

2. Orbital engine [14] accumulated 80,000 km in 5 pairs of new Australian vehicles. One vehicle in each pair used E0 and one used splash blended E20. No major differences were

seen in wear, deposits or other factors related to mileage accumulation. E20 had slightly higher levels of wear and deposits, but these were judged to be not important. The authors felt, however, that the driving cycle was not particularly severe.

3. Nihalani et al. [40] studied the impact of gasoline-ethanol blends on polymeric materials commonly used in carburetors in Indian two wheelers and Indian fuel dispensing equipment. Three levels of ethanol (E0 and splash blended E5, E10) and two levels of aromatics (15.8%, 37.9%) were tested. Acrylonitrile Butadiene Rubber (NBR) had poor resistance to swelling in ethanol blends, and is not recommended with ethanol levels above 5% if aromatic concentrations are above 20%; and is not recommended for 10% ethanol for all aromatic levels. Conventional rubber used in the tips of carburetor float pins also had poor performance and is not recommended. The relevance of this study to the U.S. situation is uncertain because it is not known whether these materials are commonly used in U.S. applications.

4. Akasaka [16] reported on tests with five fuels – a base gasoline and four splash blends (E1, E3, E5, E10). Aluminum and aluminum/zinc samples were immersed in test blends for 720 hours at 100ºC, and developed serious corrosion. Six types of rubber and three types of plastic were immersed in fuel blends for 720 hours at 70ºC. Changes were observed as ethanol concentrations increased: the rubber hardness and tensile strength decreased, and the volume increased; and the plastics yield stress and modulus of tensile elasticity dropped and the volume increased. Details of the tests and results are available from the Japanese Agency for Natural Resources and Energy (in Japanese).

5. Orbital [41] reported on a study comparing E0, splash blended E5, and splash blended E10 in 16 cars ranging from 1984 to 2000 model years. The choices were designed to cover a large part of the Australian driving population and included five fuel-injected models and 11 carbureted models. Pre-1986 cars were not tested on E10. Orbital concluded that the fuel injected vehicles were suitable for use with E5, but had some material and durability issues with E10. The carbureted vehicles had a number of problems with E5, and Orbital concluded that these vehicles are not compatible with ethanol use. The relevance of this study to the U.S. situation is uncertain. It might be argued that since a large portion of the Australian population is not suitable for even E5, then it is not surprising that E10 had problems, and that this study should not be extrapolated to U.S. conditions when considering E15. On the other hand, it can be argued that the Australian results point out potential problems and that many of the same materials and catalyst formulations have been used in the U.S. fleet.

6. Jones et al. [42] compared the effects of splash blended E10 and E20 on 19 metals commonly used in automotive fuel systems. Metals used in FFVs were excluded from this effort because they assumed that these metals would not be affected by E20 if they had already been developed for E85. Testing was carried out according to SAE J1747 ("Recommended Methods for Conducting Corrosion Tests in Gasoline/Methanol Fuel Mixtures"). The E0 is a 50/50 mixture of toluene and iso-octane. According to SAE J1681, the ethanol was mixed with small amounts of water, sodium chloride, sulfuric acid and glacial acetic acid, and is called "aggressive ethanol". One material showed discoloration with E0, eleven showed discoloration with E10 and fourteen showed discoloration with E20.

Most of the samples showed greater discoloration with E20 than with E10. One metal, Zamak 5 had unacceptable levels of corrosion with both E10 and E20. This metal is used in some carburetors, and is sometimes plated with a more stable metal.

The authors noted that Orbital reported finding more problems with metal corrosion with E20. One possible reason is differences in the composition of the water phase between the two studies. Another is that Orbital compared E20 with E0, while Jones et al. compared E20 with E10. (See Appendix 1)

7. Jones et al. [43] studied the impact of ethanol on eight elastomers commonly used in automotive fuel systems, but not in FFVs. They used standard ASTM and SAE test methods for evaluating the impact of fuels on these elastomers. On a number of elastomers, the presence of ethanol caused different changes than E0, but the authors found that splash blended E10 and E20 were similar. The authors discussed the somewhat different results obtained by Orbital [13, 44] and concluded that there were two possible explanations. One possible reason is differences in the composition of the water phase between the two studies. Another is that Orbital compared E20 with E0, while Jones et al. compared E20 with E0. (See Appendix 1)

8. Jones at al. [45] compared the effects of splash blended E10 and E20 on eight plastics commonly used in automotive fuel systems. They did not include plastics that have been in use in FFVs, since these would likely not cause problems with E20. PVC (polyvinyl chloride flexible version), PUR (polyurethane 55D-90Adurameter Hardness), and PBT (polybutylene terephthalate) performed significantly worse in E10 and E20 than in E0. However, no fuel system components could be located that were fabricated with PUR or PVC. Based on this, it is not clear why these materials were tested. The authors discussed the somewhat different results obtained by Orbital [13, 44] and concluded that there were two possible explanations One possible reason is differences in the composition of the water phase between the two studies. Another is that Orbital compared E20 with E0, while Jones et al. compared E20 with E0. (See Appendix 1)

9. Hanson et al. [46] tested eight fuel pumps and three sending units with three fuels (E0 and splash blended E10, E20) using 30 day soak tests derived from SAE J1537. All of the pumps passed the test. One had a significant flow change with E10. All of the pumps became discolored, but the authors did not view this as a problem. None of the sending units had any significant problems. One possible problem with this test is that the ethanol did not contain any elemental sulfur, which has been shown to cause severe corrosion in some sending units. A better test would have been to include a small amount of elemental sulfur in the ethanol.

10. Thomas [47] tested a number of fluoroelastomers in six fuels (E0, E100, and splash blended E25, E50, E85). Generally performance in softening, swelling and strength tests were best for the pure fuels (E0 and E100), and worse for blends such as E10 and E25. Elastomers with higher levels of fluorine had better performance. Thomas did not discuss the relevance of these results for operation in current automobiles.

Summary of On-Road Effects

Most of the literature supports the conclusion that blending gasoline with ethanol reduces exhaust emissions of THC and CO and increases exhaust emissions of NOx and acetaldehyde. While there is not a great deal of data collected using E15, it is likely that the same effects will hold. The newest vehicles, which maintain closed-loop control of stoichiometry under all conditions, might have smaller or even zero impacts. However, most cars on the road today in the U.S. do not fall into this category.

If volatility is controlled, ethanol will not increase the volatility controlled portion of evaporative emissions, but will increase the permeation portion. In this case, the evidence suggests that E15 would be no worse than E10.

E15 will increase the emissions of aldehydes especially acetaldehyde. Other toxics, such as benzene and butadiene, should be reduced proportionally as THC is reduced.

Some data suggest that E15 use will result in higher exhaust gas temperatures, and that long term catalyst durability could be negatively impacted.

There is limited operability data, and much of it is of questionable value. The CRC program [38] found driveability differences that were marginally statistically significant. Orbital [13] found some differences, but the relevance to the U.S. fleet is not clear. Other studies had fuel design that did not separate variables [35] or used test designs with limited statistical power [25] and no definitive conclusions can be made concerning operability.

The data for ethanol's impact on materials are conflicting. MCAR [42, 43, 45, 46] programs on E20 tended to show little or no effects. Orbital's programs [13, 39] showed serious effects with E20. The relevance of Orbital data to the U.S. fleet should be evaluated carefully. There were also differences in the way that the fuels were blended for testing (see Appendix 1).

Off-Road Applications

Emissions

1. Bresenham and Reisel [48] studied emissions from three 1994 model year small (12.5 hp) engines using SAE and EPA procedures. A series of splash blends were made starting with a commercial RBOB (E0, E10, E25, and E50). As the ethanol concentration increased, HC and CO emissions decreased, and NOx emissions increased. The engines were running rich with E0, and increasing oxygen content leaned out the stoichiometry. The emissions results were fully consistent with the observed stoichiometries. Since regulations for these engines are stated in terms of HC+NOx, from a regulatory perspective, the regulated measurements were not affected by the changes in stoichiometry.
2. Martinez and Ganji [49] tested a single cylinder utility engine (2.5 hp) with five fuels (E0, E100 and splash blended E10, E20, E40). Ignition timing and stoichiometry were adjusted for each fuel for the steady state tests. At the same equivalence ratio, there was no clear trend between ethanol content and CO emissions. E100 had the lowest CO emissions, followed by E0 and then the other ethanol blends. This suggests that equivalence ratio explains most of the effect of ethanol on CO emissions. Emissions of HC+NOx were shown,

and generally, higher ethanol levels reduced HC+NOx. The reasons for this were not explored. This study has limited relevance because the engine was adjusted for each fuel. However, it demonstrates that stoichiometry has a major impact on CO emissions, if the engine is within its range of operability in terms of handling fuels.

3. NREL [25] carried out a study with 28 SNREs (Small Non-Road Engines) with four fuels (E0 and splash blended E10, E15, E20). One copy of six different engines was tested on all four fuels using EPA emissions tests or “reasonable surrogates”. These engines have open loop control of air-fuel ratio and run on the rich side of stoichiometric, so that adding ethanol leans out the mixture. As expected, when ethanol was added, emissions of HC and CO were reduced, and emissions of NOx increased. This occurred when the engines were new and also at the end of their useful life. Exhaust temperatures increased when ethanol was included in the fuel, increasing 10ºC to 50ºC between E0 and E15.

Operability

1. Orbital Engine Company [50] tested ten two-stroke, 15-hp, outboard marine engines with three fuels (E0 and splash blended E10, E20). In a test at wide open throttle following in-gear low engine speed operation, one engine stalled on E10 and three engines stalled when operating on E20. None of the engines stalled with E0. Furthermore, when operating on E20, the frequency of engine misfire and stall increased, and there was difficulty in maintaining a constant engine speed during the in-gear motoring test.
2. NREL [25] carried out a study with 28 SNREs with four fuels (E0 and splash blended E10, E15, E20). With greater ethanol content, three hand-held trimmers demonstrated higher idle speed and experienced inadvertent clutch engagement. This is a serious safety issue for existing equipment, and EPA must consider how to prevent serious personal injury if these fuels are approved for use.

Materials

1. Orbital Engine Company [44] tested polymeric materials and metals taken from two two-stroke engines – a 15-hp outboard marine engine and an engine from a hand-held line trimmer. Polymeric materials (rubber, plastic, etc.) were tested on gasoline and E20, while metals were tested on E20 only. Significant corrosion was found on a number of metals parts including carburetor body and throttle, pistons, crankshaft bearings, piston rings, and others. All brass components were tarnished, some of them heavily. A number of the polymeric materials showed significant changes with E20 compared to E0. These included the fuel delivery hose and fuel line connector for the outboard engine and crankshaft seal on the line trimmer engine The report concluded that some of the changes were cause for concern and others were unacceptable.

Summary of Non-Road Effects

There is much less data for non-road applications than for on-road vehicles. Emissions effects are likely to be larger because much of the fleet operates on open loop control of stoichiometry. Since many engines operate with rich air-fuel ratios, exhaust NOx emissions and exhaust temperatures are likely to increase with higher levels of ethanol in the fuel. A number of studies raised concerns for the U.S. fleet in terms of driveability, operability and safety (idle speed and inadvertent clutch engagement).

It seems clear that more data should be collected in this area before a conclusion of compatibility can be reached.

TECHNICAL REVIEW OF WAIVER REQUEST

In the waiver request, Growth Energy presents most data as a comparison between E10, which is currently approved, and E15. This comparison is questionable from a regulatory perspective and from a statistical perspective as discussed above.

The waiver request states a number of times that there are "generally" no emissions effects, or that emissions are "*largely* unaffected". This is an oversimplification. One of the studies cited is the NREL study [25], which found that compared to E0, E15 did not significantly increase emissions. Unfortunately, the NOx effect from the NREL report was stated as -1.78% +/- 22.43%. This large confidence interval means that the effect could have been as large as 20% and the program might not have detected it. The finding of "no statistically significant effect" does not mean that an effect does not exist, just that if it is larger than about 20% the program might have found it.

The waiver request did not cite a number of programs that found negative effects on automotive NOx and aldehyde exhaust emissions. [1, 8, 29]

As a result of increased permeation, evaporative emissions with E15 are higher than with E0, even when volatility is closely controlled. This was not acknowledged in the waiver request.

The waiver request did not cite the finding in the NREL study [25] that catalyst/exhaust temperatures in some cars are higher with E15, and that this has negative implications for long term emissions. This has a direct impact on the ability of vehicles to meet emission standards, which have high mileage requirements. The Orbital studies in Australia showed a link between catalyst temperatures and long term durability. [13, 14]

The driveability studies cited in the waiver request [25, 31, 35] all suffered from a serious defect in that they did not compare ethanol and non-ethanol fuels at constant volatility. For instance, in cold weather a splash blended ethanol fuel will have higher vapor pressure and should perform better. The lack of a negative impact is not a good predictor of ethanol's performance in the field where RVPs will be the same.

The waiver request seems to ignore the problems found in non-road engines that were documented in the NREL report. [25] They also did not cite the significant problems with outboard marine engines that were described in the Orbital reports. [44, 50]

CURRENT AND PLANNED PROGRAMS

A number of major programs are under way and others are being planned, indicating that more information is required about the use of blends with more than 10% ethanol.

The Coordinating Research Council, in collaboration with EPA and DOE [51] has defined a number of programs:

- CRC E-87 Catalyst Durability and Degradation - CRC in conjunction with DOE is investigating the issue of catalyst durability and degradation when using ethanol concentrations higher than 10%. This follows on the results from research by Orbital in Australia and DOE, both cited above. Phase 1 has been completed (see below) and Phase 2 is underway.
- CRC E-92 Tailpipe Emissions for SULEV Vehicles at Cold Ambient Temperatures – Starting in 2010, automakers have to meet emission standards at 20ºF in addition to 50ºF. There are concerns that with higher levels of ethanol, such as E15, vehicles will be harder to start at low temperatures and therefore lead to higher emissions. Previous work has suggested that starting at cold temperatures could be a problem for blends with higher levels of ethanol.
- CRC AVFL-15 Fuel Storage and Handling – This project, cofunded with DOE/NREL will determine the durability of wetted engine components/systems that were designed to operate with E10, on higher levels of ethanol.
- CRC CM-136-09 Base Engine Durability – This project will test engine durability for engines designed to operate with E10, when they are operated on gasoline with E20.
- EPA, DOE and CRC (E-89 EPAct Light Duty Vehicle Fuel Effects) – This project will test a number of fuel properties including ethanol content (E0, E10, E15, E20) in a fleet of Tier 2 vehicles.
- CRC E-91 Evaporative Emissions Durability – The objective of this program is to test the immediate and long effects on evaporative emissions of E20 or other mid-level ethanol blends.
- CRC E-90 On-Board Diagnostics (OBD) Evaluation – There is concern among the automakers that the use of E15 and E20 could illuminate the MIL (check engine light) in a substantial fraction of in-use vehicles, often when there is no actual effect on emissions. In the first phase of this study, OBD-related parameters are being recorded from in-use vehicles operating on E0 and E10 fuels.
- CRC CM-138 and others – The CRC is conducting vehicle driveability studies in field test programs to evaluate vehicle performance as a function of fuel ethanol content, under a variety of driving conditions.

There is widespread consensus in the technical community that more data are necessary to understand the effect of intermediate blends of ethanol and gasoline.

CONCLUSIONS AND SUMMARY

A thorough review of the technical literature pertaining to the use of ethanol in gasoline at concentrations higher than 10% was carried out. In addition, the waiver request submitted by Growth Energy to EPA to approve use of E15 was reviewed along with supporting documents.

The consensus of literature reached the following conclusions. Relative to E0, the use of E15 will cause or may cause the following changes in on-road and non-road applications:

- E15 will tend to reduce exhaust emissions of THC/NMOG, CO, benzene and butadiene in on-road and non-road engines.
- E15 will tend to increase exhaust emissions of NOx and acetaldehyde in on-road and non-road engines.
- E15 will tend to raise exhaust gas temperatures in some on-road engines and in most non-road engines. This may have a negative impact on engine and catalyst durability.
- E15 will increase evaporative emissions in on-road vehicles.
- E15 will directionally worsen driveability in some on-road engines and in many non-road engines.
- E15 may cause serious safety hazards, such as inadvertent clutch engagement in non-road engines, which could lead to personal injury.
- E15 may cause premature failure of some parts in some non-road engines.

More data are needed to understand the impact of E15, and a number of programs are being carried out or are being planned to address this need.

LIST OF ACRONYMS

BOB - gasoline Blendstock for Oxygen Blending (may also be referred to as RBOB)

CO – Carbon Monoxide

CRC – Coordinating Research Council, Inc.

DI – Driveability Index

Exx – Ethanol/gasoline mixture, xx represents percent ethanol

FID – Flame Ionization Detector

HC - Hydrocarbon

NMHC – Non-Methane Hydrocarbons

NMOG – Non-Methane Organic Gases

NOx – Oxides of Nitrogen

NREL – National Renewable Energy Laboratory of the Department of Energy

MCAR – Minnesota Center for Automotive Research

MPFI – Multi-point Fuel Injection

OMHCE – Organic Material Hydrocarbon Equivalent

PM – Particulate Matter

RBOB – Reformulated gasoline Blendstock for Oxygen Blending

RVP – Reid Vapor Pressure

SNRE – Small Non-Road Engines

THC – Total Hydrocarbons

Appendix 1

Fuel Properties for Corrosion and Materials Testing

A number of tests were conducted to determine the corrosiveness of fuels and the compatibility of fuels with elastomers and plastics. Most of these used methods defined by SAE and/or ASTM. A problem arises concerning the composition of the fuels to be used when testing ethanol fuels and comparing them to hydrocarbon only fuels.

SAE Recommended Practice J1681 (Gasoline, Alcohol, and Diesel Fuel Surrogates for Materials Testing, Revised January, 2000) defines the composition of fuels for testing. For hydrocarbons, ASTM Fuel C is recommended. Fuel C is a 50/50 mixture of toluene and isooctane. If isooctane cannot be procured, then another isoparaffin is substituted and the mixture is labeled ASTM Surrogate Fuel C (SC).

Ethanol is denatured with 2% CDA 20 (Rubber Hydrocarbon Solvent) which is primarily made up of heptane isomers. When received, ethanol should be mixed with 1% (weight) deionized water. If aggressive ethanol is desired, sodium chloride (0.00048% by weight), sulfuric acid and glacial acetic acid are added as well.

For conducting corrosion tests, SAE J1681 defines corrosive water that may be added to Fuel C or Fuel SC or C/SC with MTBE only. No mention is made of using corrosive water with ethanol blends. Corrosive water contains sodium chloride (0.0165% by weight).

The problem arises when trying to compare different fuel formulations (e.g. E0 and E10), as opposed to qualifying materials for use in engines or fuel systems. If different water phases are used, then the results might not be indicative of the true differences between the fuels. Therefore, it is reasonable to use the same water phase for all fuels in materials testing.

In their reports, Orbital Engine Company disclosed that they used SAE defined corrosive water in the E20 mixtures for all materials testing - corrosion and compatibility. They did not disclose what was used for E0, but it is reasonable to assume that the E0 also used corrosive water, since this is the basis for SAE J1681.

In their work, MCAR used corrosive water only for corrosion testing and only for E0. For ethanol fuels, they used aggressive ethanol as described above.

The issue of how to formulate fuels for comparative testing is being discussed in the technical committees of CRC at this time, and no decision has been reached about future testing.

In any case, the approach adopted by Orbital, while it may be outside the scope of SAE J1681, can certainly be defended as technically justified.

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ATTACHMENT 6

UNITED STATES OF AMERICA
ENVIRONMENTAL PROTECTION AGENCY

Notice of Receipt of a	**)**	**Docket ID No.:**
Clean Air Act Waiver Application	**)**	**EPA-HQ-OAR- 2009-0211**
To Increase the Allowable Ethanol	**)**	**FRL–8894–5**
Content of Gasoline to 15 Percent	**)**	**74 Fed. Reg. 18228 (April 21, 2009)**

COMMENTS OF ALLIANCE FOR A SAFE ALTERNATIVE FUELS ENVIRONMENT (ALLSAFE) AND THE OUTDOOR POWER EQUIPMENT INSTITUTE (OPEI)

July 20, 2009

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On April 21, 2009, EPA issued a Federal Register notice requesting comment on a waiver request for fuels containing 15% ethanol submitted by Growth Energy pursuant to section 211(f)(4) of the Clean Air Act. 74 Fed. Reg. 18228 (April 21, 2009).

The Alliance for a Safe Alternative Fuels Environment ("AllSAFE") is made up of the national consumer and manufacturing associations whose members' products consume gasoline and ethanol fuel blends. AllSAFE speaks on fuel-related legislation for over 250 million Americans that own and operate over 400 million products, including recreational boats and marine engines, chainsaws, lawnmowers, motor vehicles, motorcycles, all-terrain vehicles ("ATVs"), snowmobiles, generators, and related vehicles and equipment. AllSAFE appreciates and understands all the compelling reasons that support expanding the market for renewable fuels, including ethanol. In fact, AllSAFE wants to avoid potential consumer rejection of all ethanol blends (including E85) that could occur if mid-level ethanol blends (above 10% ethanol) ultimately damage consumer products – for example, as a result of increased heat and corrosion when mid-level fuels are used in engines, boats, equipment, and vehicles designed for *conventional* gasoline. The use of ethanol blends in these conventional vehicles is totally different from using these fuels in flexible fuel vehicles ("FFVs"), which are specifically designed to run on any level of ethanol up to *E85*.

Members of AllSAFE include:

Alliance of Automobile Manufacturers
American Motorcyclist Association
Association of Marina Industries
Association of International Automobile Manufacturers
Boat Owners Association of the United States
Engine Manufacturers Association
International Snowmobile Manufacturers Association
Motorcycle Industry Council
Motor & Equipment Manufacturers Association
National Marine Manufacturers Association
Outdoor Power Equipment Institute
Personal Watercraft Industry Association
Specialty Vehicle Institute of America

Most of the individual associations that belong to AllSAFE will be submitting separate comments that address their industries' concerns and the specific impacts of mid-level ethanol blends on their very different engines, vehicles, boats and equipment. These comments will serve as the sole comments of the Outdoor Power Equipment Institute ("OPEI"). OPEI represents the manufacturers of lawn, garden and forestry equipment (such as chainsaws, lawnmowers and utility vehicles) as well as the manufacturers of engines and other components that are used in these products.

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EXHIBITS

I. OVERVIEW

Growth Energy's waiver application requests EPA approval under section 211(f)(4) of the Clean Air Act ("CAA") to allow 15% ethanol in gasoline as a "general purpose" fuel for use in on-road and non-road engines, vehicles, and equipment. In its waiver request, Growth Energy never raised directly or indirectly whether EPA should issue a "partial waiver" that would approve the use of E-15 for some limited subset of the on-road, vehicle fleet.

In its notice announcing Growth Energy's application, EPA requested comments on two very different categories of issues. The first set of issues involves technical responses to Growth Energy's waiver application in terms of the impacts of E-15 on on-road and non-road engines, vehicles, and equipment. These technical issues are addressed in Sections IV through XI.

In its notice, EPA unexpectedly also requested comments on a potential "partial fuel waiver" that would in concept only apply to certain newer on-road vehicles. EPA's novel "partial waiver" concept would be based on somehow bifurcating the national production, distribution, blending, and marketing of separate ≤ E-10 fuels (for non-road products and older automobiles) versus E-15 fuels for some yet-to-be fully defined group of newer automobiles.[1] EPA expressed the hope that misfueling risks could be addressed through unspecified legal authority, controls, and procedures. These "partial waiver" and misfueling issues are addressed in Sections II and III.

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[1] EPA suggests in its separate RFS II rulemaking that Tier 2 vehicles might be able to accommodate E15 but provides neither data to support this proposal nor a well-defined boundary of the subset, for example, whether it would include all types of vehicles within this group. See 74 Fed. Reg. 24904, 25016 (May 26, 2009.

II. A PARTIAL FUELS WAIVER COULD RESULT IN MASSIVE MISFUELING PROBLEMS

EPA has not developed an administrative record at this time or in this waiver-review proceeding that would indicate that any controls – including incredibly expensive and intricate controls – could ultimately prevent substantial misfuelings. Under a "partial waiver" for E-15, misfueling would likely occur at even higher rates than when there were separate pumps dispensing unleaded and leaded fuels in the 1970s and 1980s, in part because the pump nozzles will be the same for both E-15 and fuels containing 10% ethanol or less. During this timeframe, the fuel inlets for new motor vehicles were totally redesigned with narrower diameters in order to prevent the insert of the larger diameter nozzles that dispensed leaded gasoline. However, in 1984 (12 years after the initial lead phase-out), EPA concluded that widespread "intentional misfueling" by consumers continued to circumvent these controls through "funneling leaded gas in the gas tank," or "removing or damaging the nozzle restriction in the fuel filler inlet of a vehicle."[2]

In 1982, EPA completed a comprehensive misfueling study based on 2,637 vehicles (comprising the 1975 to 1982 model years of production). EPA concluded that 13.5% of the vehicles (on average across the nation) designed for unleaded fuel were being misfueled with leaded fuels in 1982.[3] EPA recognized that this misfueling rate probably underestimated actual misfueling.[4] EPA recognized that despite the Agency undertaking "vigorous enforcement of the misfueling regulations, misfueling is expected

2 See 49 Fed. Reg. 31032, 31034 (August 2, 1984).

3 See 49 Fed. Reg. 31032, 31034 (August 2, 1984).

4 *Id.*

to persist as long as leaded gasoline with a higher octane rating and a lower price than unleaded gasoline remains available on the market."[5]

Even if EPA similarly requires sophisticated gas inlets and nozzle controls to be in place under a "partial waiver" for E-15, consumers will find a way to misfuel – particularly if E-15 is less expensive than E-10. In EPA's proposed Renewable Fuels Standard ("RFS-II") proposal, EPA states it expects that mid-level ethanol blends would be marketed as the less expensive regular-grade fuels.[6] In this same proposal, EPA also recognizes that (just as occurred with leaded gasoline) many consumers will intentionally misfuel to save only a few cents per gallon. Conservatively, assuming the 13.5% misfueling rate cited above (and roughly 400 million legacy products), over 50 million legacy products would be misfueled with E-15 under a "partial waiver."

Even assuming EPA can develop a workable system for protecting the legacy vehicle fleet, AllSAFE cannot envision a practical system to protect off-road engine or equipment from the improper use of a mid-level ethanol fuel. Off-highway engines are generally fueled from portable containers which are in turn fueled at the same time and location as the vehicle utilized to transport the container from the filling station to the off-road equipment location. In fact, many types of non-road products, including lawn, garden, and forestry products and off-road vehicles like ATVs and utility vehicles, are exclusively refueled from portable containers. Portable fuel containers have a range of opening sizes for refueling of the container and clearly any fuel dispensing nozzle that could be utilized to fill a vehicle could, and would, also be utilized to fill the portable container. Pump labeling warning the user about misfueling will be helpful to guide

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5 *Id.* at 31035.

6 See 74 Fed. Reg. 24904, 25017 (May 26, 2009).

vehicle owners but will likely have minimal influence on the consumer's perceived convenience of filling both the vehicle and portable container from the same nozzle, especially during a single transaction at the fuel retailer.

In addition, off-highway fuel use is a very small percentage of the total fuel delivered by any given fueling station. The incentive for fueling stations to maintain a separate tank and pump for off-highway equipment is minimal and most likely would result in higher unit fuel costs to provide sufficient operating margin for the station to offer off-highway fuel. The additional cost would provide an additional disincentive for consumers to locate and utilize a special off-highway fuel. There is also a strong potential that the reduced volume of fuel required in the marketplace would result in elimination of supply, further eroding special off-road fuel availability. This potential is heightened by the fact that the base fuel utilized for an E15 blend would not be a legally viable fuel for blending and distribution with lower ethanol concentrations required for off-highway engines and equipment.

Even if the market preserves one grade of gasoline as an E10 fuel, as EPA suggests in its RFS II proposed rule preamble, this will not address the concern about misfueling. Indeed, this will likely exacerbate the risk of misfueling because E10 will be uniformly more expensive than E15.

As documented in Sections VI through XI of these comments, misfueling non-road and on-road equipment with fuels with ethanol content higher than 10% could cause serious, permanent damage to millions of legacy products, emission – related failures, and increased operating hazards for millions of consumers, notwithstanding that up to

E10 is acceptable today for vehicles and some non-road products.[7] There is no meaningful discussion or review of these adverse impacts in Growth Energy's waiver application, in EPA's Notice in response to that application, or even in EPA's RFS-II proposal, which provides more information about EPA's thinking regarding possible implementation approaches.

III. PRACTICAL AND LEGAL REASONS EPA MUST NARROW THE SCOPE OF E-15 WAIVER REVIEW PROCESS

As explained below, for legal and practical reasons, an individual section 211(f)(4) fuel waiver is an inappropriate and ill-suited process to seek comments and develop an administrative record that would address broad fuel segregation and related misfueling controls across the country at over 175,000 gasoline retailers. If EPA wants to pursue such a "bifurcated fuels" program with different ethanol blends for different products, then EPA should initiate a separate major rulemaking process under section 211(c), rather than bootstrapping these broad issues into the narrow section 211(f)(4) waiver-review process.

First, because of explicit concerns about the adverse impacts of mid-level ethanol on non-road products, in 2007, Congress expanded and strengthened Section 211(f)(4).[8] Congress specifically directed EPA to only approve a fuel waiver if all non-road and on-road engines or vehicles would not be adversely impacted with regard to their applicable emission standards. EPA would be acting in direct contradiction to these new statutory requirements if it now failed to address impacts on any portion of the onroad and non-

7 See Dr. Sahu's Technical Study attached as Exhibit A.

8 See Section 251 of the Energy Independence and Security Action of 2007 (EISA).

road vehicle and engine population, by instead relying on an unjustified and vague "partial waiver" concept.

Second, Section 211(f)(4) is simply designed to address whether a new proposed fuel or fuel additive (when used as a "general purpose" fuel) will likely cause or contribute to an emission-related failure, or operational or "materials compatibility" problems. Section 211(f)(4) does not create the legal authority for EPA to establish a "partial waiver" based on a bifurcated fuel "concept." When EPA has tried to consider and address other broader public policy issues in an individual fuel waiver determination, the federal courts have: 1) struck down EPA's expansion of its limited discretion and authority under section 211(f)(4); and 2) directed EPA to address those issues in the context of another CAA authority (such as section 211(c)).[9]

Third, Section 251 of EISA amended section 211(f)(4) to allow 270 days for EPA to either "grant or deny" the submitted waiver application, which is more time than afforded EPA for a waiver decision before the amendment but which remains an expedited schedule. In this case, EPA will be hard-pressed to respond (within the remaining 130 days) to all the legal and technical issues directly raised in the Growth Energy waiver application and in thousands of responsive comments. To date, EPA has not yet proposed a program whereby it could address all the various market issues, leaving stakeholders with nothing to evaluate. EPA has too little time before the waiver's December 1 deadline to propose and finalize such a program, with associated compliance and enforcement mechanisms. Without a fully defined implementation program, EPA

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9 Ethyl Corporation v. EPA, 51 F. 3d 1053, (D.C. Cir. 1995); MVMA vs. EPA, 768 F. 2d 385 (D.C. Cir. 1985).

may be unable to prevent misfuelings and avoid related damage to millions of products and repeated violations of applicable standards under the CAA.

Fourth, Section 211(f)(4) does not provide the regulatory process and legal safeguards needed to address bifurcated fuels and misfueling in a thoughtful manner. In fact, EPA has consistently claimed that Section 211(f)(4) fuel waivers do not rise to the level of a "rulemaking" subject to a "cost-benefit" analysis and the other protections provided under section 553 of the Administrative Procedures Act ("APA"). However, the absence of such a formal, comprehensive rulemaking (or any related criteria) means that EPA would fail to develop, much less evaluate, the costs, benefits, safety risks, consumer impacts, and practicability of potential controls designed to prevent misfueling and other related liabilities under a bifurcated fuel system and stakeholders would be unable to evaluate EPA's analyses and program design.

Fifth, it is unclear whether EPA would have the legal authority (under section 211(f)(4)) to adopt or enforce any labels or misfueling controls at a gasoline retailer – given that a fuels waiver is only granted to the "manufacturer" of the new fuels or additives. EPA admits in its Notice that there "may be legal and practical limitations on what a fuel manufacturer may be required or able to do to ensure compliance with the conditions of the waiver, including preventing misfueling." While EPA has managed market fuel transitions under other CAA authorities through pump labeling, consumer education and other approaches, it has never in the thirty year history of waiver proceedings established downstream conditions on fuel *retailers* in a waiver proceeding specifically addressed to, and authorizing the production by the *manufacturers*, of the fuels or fuel additives. We recognize that EPA has proposed a labeling scheme in its

RFS II rulemaking,[10] but the labeling proposal lacks detail about how it would work with any of the possible waiver outcomes EPA identifies in the waiver notice.

Sixth, EPA should address controls on the "sale" of any bifurcated fuels through a major rulemaking under section 211(c) of the CAA, not through section 211(f)(4). EPA has long recognized that regulation of the "sale" of fuels clearly falls under 211(c). Section 211(c) covers regulatory programs that "control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive…." Thus, EPA's proposal – to issue a bifurcated waiver that would somehow "control the sale or offering for sale" of E-15 – would fall squarely within the 211(c) provisions.

Seventh, in analogous circumstances, EPA has completed various extensive rulemakings under 211(c) to manage bifurcated fuel markets to minimize the risk of misfueling. When EPA proposed labeling, reporting, and other requirements for diesel fuel producers, marketers and retailers under the Ultra Low Sulfur Diesel rule, it did so through a comprehensive 211(c) rulemaking that considered a multitude of related issues, including the cost-effectiveness of the program, misfueling concerns, liability concerns, and the effects upon small businesses. Similarly, EPA engaged in a series of 211(c) rulemakings during the phaseout of leaded gasoline in order to address labels and misfueling controls, including different nozzle and fuel-inlet configurations. Before completing these rulemaking proposals, EPA conducted years of outreach with stakeholders, including the auto industry and the automotive fuel marketing industry, in an effort to determine the feasibility of various control methods to combat misfueling.

[10] See § 80.1469 – (74 Fed. Reg. at 25143).

Eighth, in all these prior 211(c) rulemakings that involved phasing in new fuels and bifurcated markets, EPA provided engine and equipment manufacturers, fuel distributors, and gasoline retailers with the needed lead-time to implement all the different misfueling controls as well as certain accommodations regarding compliance with regulations during the transition periods. It is unclear how EPA could create such a transition process (with future effective dates for misfueling controls) under a section 211(f)(4) waiver – given that these waivers typically would become immediately effective if granted.

Ninth, all the affected stakeholders would need much greater specificity on EPA's proposed "bifurcation structure," and on proposed alternative control measures and their projected costs and impacts – in order to develop meaningful responsive comments. Growth Energy's waiver application, EPA's notice of the application, and the RFS II rulemaking do not provide any details on how EPA could practically bifurcate the fuel supply and avoid misfueling under any conditional waiver. There is no practical means to respond to EPA's vague "bifurcated fuels" concepts.

Tenth, further complicating this situation is the fact that on May 5th, EPA solicited similar, but broader, comments on addressing misfueling (under an E-15 "partial waiver" option) as part of its RFS-II proposal. AllSAFE appreciates the fact that the RFS-II proposal at least generally identifies several different types of potential misfueling controls and recognizes their limitations and challenges. However, the RFS-II proposal does not explain whether or how EPA will integrate or consider comments received over the next few months on the RFS-II proposal in its expedited E-15 waiver review process. It is not clear whether Section 211(o), which is the basis for the RFS-II regulations, could somehow serve as the legal framework to develop, implement, and enforce misfueling controls for mid-level ethanol blends that are specifically approved under a section 211(f)(4) waiver.

EPA admits in its RFS-II proposal that "it is not possible at this time to know the contours of a partial waiver with conditions, or even if one might be appropriate."[11] In that same proposal, EPA also recognizes it is unclear how any conditions in a partial waiver – that would only apply directly to the "manufacturer" of the fuel – could somehow be expanded to essentially regulate the activity of consumers, gasoline retailers, and the manufacturers of all the affected products.[12]

Finally, to the extent EPA wants to pursue a "partial waiver" approach, EPA should initiate a separate future rulemaking process (under section 211(c)) and develop a well-supported, specific proposal and administrative record that carefully evaluates all the complex issues associated with potentially bifurcating the national fuel supply system through practical and specific proposals to avoid misfueling.

From a legal and public policy standpoint, EPA would need to first adopt a federal regulatory program that addressed misfueling through practical and legally enforceable controls before EPA could ever rely on such controls in any fuels waiver decision under section 211(f)(4). In other words, EPA should not approve any "partial" mid-level ethanol fuel waiver until after EPA has developed and implemented a comprehensive and effective regulatory program under section 211(c) to prevent misfueling.

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[11] See 74 Fed. Reg. 25017, FN 251 (May 26, 2009).

[12] 74 Fed. Reg. 25016-25017 (May 26, 2009).

IV. SECTION 211(F)(4) – FUELS WAIVER CRITERIA

Pursuant to Section 251 of the 2007 Energy Independence and Security Act (EISA), EPA must consider the impacts of the proposed fuel or additive on all the affected non-road engines, products, vehicles and equipment, as well as on motor vehicles. Off-highway engine/equipment categories requiring evaluation will be significantly greater than on-highway test fleet due to the diversity of engines/equipment included in the off-highway category. For example, handheld lawn and garden equipment engines now include approximately eight different engine design technologies, all of which may be designed to any of three different life categories. This means a possible 24 different engine designs which may be included in multiple application usages. (See illustrative test plans summarized in Section X below). Below in Table 1 is a detailed list of the different types of off-road equipment that must be evaluated by the waiver application.

Table 1

Types of Off-Road Equipment

Broad Categories

- Lawn and Garden
  - Hand-Held (chainsaws, trimmers, blowers, edgers, etc.)
  - Ground-Supported (lawn mowers, rider mowers, etc.)
- Industrial Equipment (generators, forklifts, etc.)
- Snow (snowmobiles, etc.)
- Marine (outboard/PWC, inboard, stern-drive)
- Off-Road Motorcycles
- All Terrain Vehicles

B. Detailed List

2-Wheel Tractors	Other Agricultural Equipment
Aerial Lifts	Other Construction Equipment
Agricultural Mowers	Other General Industrial Equipment
Agricultural Tractors	Other Lawn & Garden Equipment
Air Compressors	Other Material Handling Equipment
Air Conditioners	Paving Equipment
Air Start Units	Personal Water Craft
All-Terrain Utility Vehicles	Plate Compactors
Asphalt Pavers	Pressure Washers

Baggage Tugs	Pumps
Balers	Rear Engine Riding Mowers
Belt Loaders	Rollers
Bobtails	Rough Terrain Forklifts
Bore/Drill Rigs	Rubber Tired Loaders
Cargo Loaders	Sailboat Auxiliary Inboard Engines
Cement and Mortar Mixers	Sailboat Auxiliary Outboard Engines
Chainsaws	Shredders
Chippers/Stump Grinders	Signal Boards
Combines	Skid Steer Loaders
Commercial Turf Equipment	Snowblowers
Concrete/Industrial Saws	Snowmobiles
Cranes	Specialty Vehicles
Crushing/Processing Equipment	Sprayers
Deicers	Surfacing Equipment
Dumpers/Tenders	Swathers
Forklifts	Sweepers/Scrubbers
Front Mowers	Tampers/Rammers
Fuel Trucks	Tillers
Generator Sets	Tractors/Loaders/Backhoes
Golf carts	Transport Refrigeration Units
Ground Power Units	Trenchers
Hydro Power Units	Trimmers/Edgers/Brush Cutters
Lav Carts	Vessels w/Inboard Engines
Lav Trucks	Vessels w/Inboard Jet Engines
Lawn & Garden Tractors	Vessels w/Inboard/Outboard Engines
Lawn Mowers	Vessels w/Outboard Engines
Leaf Blowers/Vacuums	Water Trucks
Minibikes	Welders
Motorcycles	Wood Splitters

Under Section 211(f)(4) of the federal Clean Air Act, the waiver applicant must prove that the use of the fuel additive "will not cause or contribute to the failure of any emission control device or system...to achieve compliance…with the [applicable] emissions standards" – at any point throughout the useful life of the product. Courts have held that EPA must deny waiver applications for fuels or additives that would result in any emission-related failure or exceedance of a standard – even when EPA believes such failures are not "significant."[13]

To supplement these comments, we are submitting a comprehensive legal analysis of binding judicial precedent that governs the application of Section 211(f) waiver criteria

13 See MVMA v. EPA, 768 F.2d 385 (D.C. Cir. 1985).

in this waiver application and any future waiver application.[14] Part I of that analysis documents the compelling reasons why any EPA approval of the Growth Energy application, or similar action, would not withstand judicial review. Part II of the enclosed analysis documents the functional relationship between Section 211 waivers and the vehicle and engine remedial provisions, such as recall, under other Sections of the CAA.

As explained in the enclosed legal analysis, because in this waiver application, there is evidence of "the potential for harm" to engines, and their emission control devices or systems, "the applicant has the burden of proving that such harm will <u>not</u> occur."[15]

The available test data and studies indicate that E-15 will result in widespread "potential harm" to the types of emission-related components used in non-road and on-road engines, vehicles and equipment.[16]

V. GROWTH ENERGY'S APPLICATION FAILS TO MEET THE MINIMUM CRITERIA THAT EPA HAS SET FORTH AS BEING APPLICABLE TO ANY MID-LEVEL ETHANOL WAIVER.

A. EPA Test Program and Waiver Criteria

To implement Section 211(f)(4), EPA has developed and applied four separate "waiver criteria" in 24 previous waiver applications. The four "waiver criteria" are adverse impacts on: 1) engine exhaust emissions; 2) evaporative emissions; 3) "materials compatibility" with fuel-system components; and 4) the "drivability/operability" of the engine/vehicle/equipment. (Each of these four criteria are applied to the major studies on non-road engines, vehicles and equipment in Section VI through XI, below).

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[14] See "Supplemental Statutory Appendix" attached as Exhibit B.

[15] See <u>MVMA</u>, 768 F.2d at 400.

[16] See Dr. Sahu's Technical Study attached as Exhibit A, and Sections VI through XI below.

In public presentations,[17] and public letters,[18] EPA has given more specific direction as to the data submission required to support a 211(f)(4) waiver request for mid-level ethanol blends. This data submission can be divided up into four components. These are tests required, test fuel characteristics, fleet composition, and statistical interpretation.

In the recent RFS-II proposal, EPA cites to an influential "EPA staff recommendation" on the testing framework needed to support a mid-level ethanol waiver (See attached Exhibit I).[19] This 2008 EPA recommendation confirms that a waiver applicant for mid-level ethanol would have to provide test data on operability, compatibility, exhaust emissions, and evaporative emissions from a representative group of both on-road and non-road engines and equipment categories. In this guidance, EPA has specified that the applicant's test programs must include "a complete cross-section of the impacted engine/equipment categories," in order to represent a sufficient number of models in terms of:

- Major sales models;
- Variety of Engine technologies;
- HP range, speed range;
- Applications, markets

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17 Jim Caldwell, Office of Transportation and Air Quality, SAE Government/Industry Meeting, May 13, 2008.

18 Christine Todd Whitman, Response to Ethyl Corporation Petitions Denying Reconsideration of Three EPA regulations: CAP 2000, Heavy Duty Gasoline, and OBD/IM, http://www.epa.gov/oms/standards.htm, August 23, 2001.

19 Mid Level Ethanol Blend Experimental Framework – EPA Staff Recommendations, Karl Simon, EPA Office of Transportation and Air Quality, API Technology Committee Meeting, Chicago, June 6, 2008 (Exhibit I).

For each engine/equipment category (and for each waiver criteria), EPA must evaluate: 1) new equipment/vehicles; 2) legacy equipment/vehicles; and 3) future technologies that will be required for upcoming new emission regulations.[20]

For each test category, the applicant must include durability testing based on field-aging.[21] The applicant must provide "an engine tear down and inspection," including "wear and deposit" evaluations.[22]

EPA has typically required a fuel waiver petitioner to demonstrate durability impacts through the operation of complete engines and vehicles as operated for their useful lives under actual, real-world conditions. For example, in 2001, the EPA Administrator rejected a petition from Ethyl, a fuel additive manufacturer, to rely on accelerated aging procedures to predict the impact of a new fuel additive. In its response to Ethyl, EPA explained that in order to show that their fuel additive does not cause additional deterioration to vehicles:

> [A] fuel or fuel additive manufacturer would likely evaluate the effect of their fuel or fuel additive by using a whole vehicle aging procedure. A whole vehicle aging procedure would show the effects of the fuel or fuel additive under more real-world driving conditions. Moreover, as stated before, the real-world effects of contaminants or additives are best evaluated after operating vehicles for an extended period of time such that engine and emission control system cycle through a variety of normal operating procedures.[23]

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20 *Id*.

21 *Id*.

22 *Id*.

23 Response to Ethyl Corporation Petitions Denying Reconsideration of Three EPA regulations, *supra* note 6, at 55-56.

B. Growth Energy Application

Growth Energy has failed to provide test data or cite any studies that would meet EPA's test criteria outlined above or cited in EPA's recommended test program.

Table 2 below compares Growth Energy's application to the EPA waiver requirement for *non-road* products. Table 5 in Exhibit K provides a similar comparison of EPA's criteria to the Growth Energy's application vis-à-vis *on-road* products. Each EPA requirement is given a reference and an item number and each is discussed individually either below or in the next few sections.

As Table 2 shows, Growth Energy has presented very limited data on an unrepresentative and incomplete group of non-road engines, vehicles and equipment. For example, Growth Energy has failed to cite to any test data or studies that evaluate the impacts of ethanol fuels on the operability or the evaporative emissions of any class or category of non-road engines, vehicles or equipment. Growth Energy has not cited to any tests or evaluations of most of the unique plastics, polymers, and rubbers (including nylon) that are used in non-road engines and products. Growth Energy has not cited to any test data on evaluations of the impacts on exhaust emissions from any of the non-road categories – except for small spark-ignited engines (SSIE). Even these SSIE exhaust tests did not include a representative or statistically significant group of products. These SSIE tests failed to meet EPA's recommended test requirements and actually indicate substantial engine durability, operability and emission-related failures.

Item	EPA Requirements for OFF-ROAD	TABLE 1 - OFF-ROAD Growth Energy Petition - Supporting Studies (from www.growthenergy.org)											Orbital Studies[1]	Auto/Oil/ AllSAFE Test Plan[2]
		DoE/ORNL (10/08)	EERC/MCAR (10/07)	MN/RFA (3/08)					CRC (12/06)	RIT (10/08)	MCRA (7/99)	SU (2004-05)	-	-
	Ref. # Below	[GE-1]	[GE-2]	[GE-3a]	[GE-3b]	[GE-3c]	[GE-3d]	[GE-3e]	[GE-4]	[GE-5]	[GE-6]	[GE-7]	-	-
1	Representative Fleet[13]	No	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		Yes
2	Tailpipe Emissions[7]	See Cmts	No	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No		Yes
2A	Comparison to E0 and E10	See Cmts	No	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No		Yes
2B	Full Useful Life[8]	See Cmts	No	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No		Yes
3	Evaporative Emissions[9]	No	No	N/A	N/A	N/A	N/A	N/A	No	No	No	No		Yes
3A	Comparison to E0 and E10	No	No	N/A	N/A	N/A	N/A	N/A	No	No	No	No		Yes
3B	Full Useful Life[10]	No	No	N/A	N/A	N/A	N/A	N/A	No	No	No	No		Yes
4	Durability[3]	See Cmts	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		Yes
5	Materials Compatibility[6]	No	No	See Cmts	See Cmts	See Cmts	No	N/A	N/A	No	No	No		Yes
5A	Real Use Conditions[4]	No	No	No	No	No	No	N/A	N/A	No	No	No		Yes
5B	Engine Teardown with Rating[5]	No	No	No	No	No	No	N/A	N/A	No	No	No		Yes
6	Safety[11] Simon, Slide 14	No	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		No
7	Oil and Fuel Aging Interaction[12]	No	No	N/A	N/A	N/A	N/A	No	N/A	No	No	No		Yes

N/A Not Applicable

No **This report or study did not consider Off-Road or did not consider the EPA Item for Off-Road**

[1] Orbital Engine Studies

[2] Dr. Sahu's Compability Report attached as Exhibit C

[3] Karl Simon, EPA OTAQ - Mid Level Ethanol Blend Experimental Framework – EPA Staff Recommendations, API Technology Committee, June 6, 2008 Slide 14 & 18

[4] Simon, Slide 14, 16, 19

[5] Simon, Slide 16 & 20

[6] Whitman; Caldwell, Slides 9 & 12; Simon, Slide 5

[7] Whitman; Caldwell, Slide 10;Simon, Slides 16, 18 & 19

[8] Simon, Slides 16, 18 & 19

[9] Simon, Slides 16 & 18

[10] Simon, Slides 16 & 18

[11] Simon, Slide 14

[12] Simon, Slide 20

[13] Simon, Slides 14-17

Study Ref.	Study Full Title
[GE-1]	Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines, Report 1, prepared by Oak Ridge National Laboratory for the U.S. Department of Energy (October 2008). This peer-reviewed study regarding the effects of E15 and E20 on motor vehicles and small non-road engines concludes that when E15 and E20 were compared to traditional gasoline, there are no significant changes in vehicle tailpipe emissions, vehicle driveability, or small non-road engine emissions.
[GE-2]	Optimal Ethanol Blend-Level Investigation, Final Report, prepared by Energy & Environmental Research Center and Minnesota Center for Automotive Research for American Coalition for Ethanol (October 2007). This report studied the effects of ethanol blends ranging from E10 to E85 on motor vehicles and found that exhaust emissions levels for all vehicles at all levels of ethanol blend were within the applicable Clean Air Act standards.
[GE-3]	The Feasibility of 20 Percent Ethanol Blends by Volume as a Motor Fuel, Results of Materials Compatibility and Driveability Testing, prepared by the State of Minnesota and the Renewable Fuels Association (March 2008):
[GE-3a]	The Effects of E20 on Metals Used in Automotive Fuel System Components. The study compared the effects of E0, E10 and E20 on 19 metals and found that the metals tested were compatible with all three fuels;
[GE-3b]	The Effects of E20 on Elastomers Used in Automotive Fuel System Components. The study compared the effects of E0, E10 and E20 on eight elastomers and found that E20 caused no greater change in properties than E0 or E10;
[GE-3c]	The Effects of E20 on Plastic Automotive System Components. The study compared the effects of E0, E10 and E20 on eight plastics and found that there was no significant difference in the properties of the samples exposed to E20 and E10;
[GE-3d]	The Effects of E20 on Automotive Fuel Pumps and Sending Units. The study compared the effects of E0, E10 and E20 on the performance of 24 fuel pumps and nine sending units and found that E20 has a similar effect as E10 and E0 on fuel pumps and sending units;
[GE-3e]	Demonstration and Driveability Project to Determine the Feasibility of Using E20 as a Motor Fuel. The study tested 40 pairs of vehicles on E0 and E20 and found no driveability or operational issues with either fuel).
[GE-4]	Fuel Permeation from Automotive Systems: E0, E6, E10, E20 and E85, prepared by the Coordinating Research Council, Inc. (CRC Report No. E-65-3) (December 2006). This study evaluated effects of E0, E6, E20 and E85 on the evaporative emissions rates from permeation in five newer California vehicles and found that there was no statistically significant increase in permeation rates between E6 and E20.
[GE-5]	Report to the US Senate on E20 Ethanol Research, prepared by the Rochester Institute of Technology (October 2008). This study evaluated effects of E20 on 10 legacy vehicles. Initial results after 75,000 collective miles driven found no fuel-related failures or significant vehicle problems and documented reductions in regulated tailpipe emissions when using E20 compared to E0.
[GE-6]	Use of Mid-Range Ethanol/Gasoline Blends in Unmodified Passenger Cars and Light Duty Trucks, prepared by Minnesota Center for Automotive Research (July 1999). This one-year study evaluated the effects of E10 and E30 in 15 older vehicles in "real world" driving conditions. It found no effect on driveability or component compatibility from either fuel and found that regulated exhaust emissions from both fuels were well below federal standards.

[GE-7] Blending of Ethanol in Gasoline for Spark Ignition Engines: Problem Inventory and Evaporative Measurements, prepared by Stockholm University et. al., (2004 - 2005). This study tested and compared evaporative emissions from E0, E5, E10 and E15 and found lower total hydrocarbon emissions and lower evaporative emissions from E15 than from E10 and E5.

C. Growth Energy Has Failed to Compare Differences From EPA Certification Fuels

Growth Energy insinuates that the "baseline" fuel should be E-10 and that it only has to prove that there is not a significant difference in performance between E-10 and E-15 fuels.[24] In fact, in many instances Growth Energy only provides information on the projected impacts of shifting from E-10 to E-15, rather than comparing E-0 to E-15.[25]

Carbureted engines must be set at a fairly lean air-fuel ratio to ensure emissions compliance when the engine is run on the EPA "certification" and "confirmatory" test fuel. Indolene (E-0) remains the principal EPA certification fuel used for all on-road and non-road EPA engine exhaust certifications. EPA's emission standards are typically based on test data that has been generated with the engine operating on Indolene or E-0. Many non-road carbureted handheld engines experience difficulty running on E-10 fuels – in part because they already have very lean air-fuel ratios in order to meet EPA emission standards when operating on E-0 certification fuel.[26]

In order to determine the impacts that E-15 would have on EPA's existing emission-related programs and on certified products, EPA would have to compare E-15 fuels with its E-0 certification fuels.[27] For that reason, CAA Section 211(f)(1)(A) makes it unlawful to introduce into commerce or increase the concentration of any fuel or fuel additive which is not "substantially similar" to any fuel or fuel additive utilized in the "certification of any vehicle or engine."

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24 See p. 5-7 of waiver application.

25 See evaporative emissions evaluation on page 23-27 of waiver application.

26 See Exhibit A, Section A.

27 Many non-road manufacturers are currently obtaining EPA evaporative certifications based on California's certification fuel which also does not contain any ethanol. See Section IX below.

In its prior waiver-review process, EPA has consistently required the waiver applicant to submit comparison "baseline" tests using Indolene as EPA's certification fuel.[28]

EPA (and manufacturers of ethanol) have consistently recognized (for the last 28 years) that E-10 is not "substantially similar" to EPA "certification fuels," which typically do not contain any ethanol whatsoever.[29] For that reason, a waiver application (under Section 211(f)(4)) had to be filed for 10% ethanol. Moreover, EPA has previously recognized that – "consistent with Congressional intent," even new fuels containing less than 10% ethanol "are best addressed in the Section 211(f)(4) waiver process" (given the substantial "uncertainties" with their environmental impacts).[30]

EPA has also recognized that "Congress intended only to include as 'substantially similar' those fuels chemically and physically similar to fuels used in certification."[31] According to EPA, "it is not an issue of whether mid-level ethanol blends are substantially similar to a fuel that has received a waiver."[32] Fuels or fuel additives (like E-10) that are ultimately granted a waiver under Section 211(f)(4) do not somehow become "substantially similar" to the EPA certification fuel.[33] Nor do such "waived" fuels become the "baseline fuel" on which future "substantially similar" comparisons are based.[34] Such a flawed approach would allow "incremental creep" which would undermine the purpose of the waiver process.

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28 See EPA's Guidelines for Section 211(f) Waivers for Alcohol-Gasoline blends, 43 Fed. Reg. 24131, 24132 (June 2, 1978).

29 See 40 C.F.R. § 86.113.

30 See 46 Fed. Reg. at 38582, 38584 (July 28, 1981).

31 *Id.* at 38583.

32 See 74 Fed. Reg. 25019, FN 260 (May 26, 2009).

33 46 Fed. Reg. at 38583.

34 *Id.*

D. Instead of Conducting Tests on E-15 fuels, Growth Energy Would Inappropriately Require EPA to Extrapolate or Interpolate Results Based on Different Ethanol Blends than E-15

Throughout its waiver application, Growth Energy relies on test data on the impacts of ethanol-gasoline blends other than E-15. For example, all of the compatibility and driveability studies performed by Minnesota State University ("MSU") only considered the impacts of E-20 and not E-15. In other cases, for example, to show evaporative emissions, Growth Energy relies mainly on pre-existing E10 data from conventional vehicles. Growth Energy failed to conduct the required testing with E-15 fuel blends. According to EPA's waiver precedent, the applicant must submit data on the specific concentration of the requested fuel additive (i.e., E-15); EPA does not contemplate having to extrapolate data based on different concentration levels.[35] From a technical standpoint, properties of gasoline-alcohol mixtures are often non-linear, and there can be uncertainties when interpolating or extrapolating results.

VI. NON-ROAD MATERIALS COMPATIBILITY STUDIES

The well-established chemical properties and principles that cause mid-level ethanol blends to result in "material compatibility" problems are discussed and documented in Dr. Sahu's Technical Study attached as Exhibit A (particularly in Sections A, G, D, and F).

A. Existing Major Studies on Non-road and Marine Small-Engines

1. Orbital-Engineering Reports (2003)

The most comprehensive and complete study on the "materials compatibility" problems with small engines and marine outboard engines is the May 2003 Orbital Engine Report to the

35 See 43 Fed. Reg. 11258, 11259 (March 17, 1978).

Australian Government based on 2,000 hours of extensive "materials compatibility" testing.[36] This report concluded that "E-20 fuel is incompatible with both base engine components and with fuel system components utilized in the Mercury outboard and Stihl line trimmer engine."[37] Specifically, E-20 caused the following documented problems on EPA-certified outboard marine engines and Stihl line trimmers:

- Severe corrosion, rusting and pitting of metallic and brass components – such as the carburetor body and throttle, piston rings, crankshaft seal housing, crankshaft bearings and surfaces, connecting rod, cylinder liner, throttle blades
- Swellings, distortion and degradation of fuel delivery hose, fuel primer bulbs, fuel line connector, and crankshaft seal

The Orbital report concluded these problems would likely cause: 1) oxides that may dislodge and damage the engine; 2) the loss of intended fuel-air metering and control, and 3) fuel leakage.[38]

2. Briggs and Stratton Study (2007)

In a 2007 study, Briggs and Stratton completed evaluations of the impacts of E-20 on EPA-certified engines – through soaking fuel components and evaluating the heat-related damage caused by:

- Substantial distortion and swelling of elastomers, rubbers and plastics;
- Metals, expoxy and other materials that dissolved or corroded to the point that several components failed and could cause fuel leaks; and

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[36] Market Barriers to the Uptake of Biofuels Study – A Testing Based Assessment to determine impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on Non-Automotive Engines, Orbital Engine Company, (May 2003). (http://www.environment.gov.au/atmosphere/fuelquality/publications/).

[37] *Id.* at 20.

[38] See 2003 Orbital Report at p. 4-6.

- Higher operating temperatures resulting in damage to gaskets resulting in a head gasket failure after only 25 hours of light duty testing.[39]

Thus, the Briggs study confirms the conclusions of the Orbital Studies. (See Briggs study attached as Exhibit A).

B. Growth Energy's Application

To support its claims that there are not "materials compatibility" problems with all non-road products, Growth Energy relies on the following 3 inter-related studies prepared by MSU from March 2008:

- A metals study which allegedly concluded that 18 of 19 tested metals exposed to E-20 were compatible (with problems only observed on Zamak 5);
- An elastomer study which allegedly concluded that the magnitude of the changes observed on eight elastomers exposed to E-20 were "not great enough to represent a concern."
- A plastics study which allegedly concluded that there was no significant differences for eight plastics exposed to E-20.

C. Critique of Growth Energy Waiver

First, Growth Energy has failed to address any of the comprehensive Orbital compatibility studies, attached to these comments cited above.

Second, the MSU study only focused on components used in automobiles. The Alliance of Automobile Manufacturers ("AAM") has thoroughly critiqued the 2008 Minnesota compatibility studies to assess the actual detected compatibility-impacts vis-à-vis motor vehicles. In spite of soliciting information on the types of materials used in non-road applications, MSU did <u>not</u> test most of the plastics, polymers and elastomers that are typically used in *non-road* products. Dr. Sahu has determined that MSU failed to evaluate 19 of 22

[39] See Briggs report at p. 3.

plastics/polymers/elastomers that AllSAFE had specifically identified as being used in non-road products.[40] All these typical non-road components still need to be evaluated for materials-compatibility.[41]

Third, even for the materials tested by MSU, there are significant technical and interpretive flaws in the MSU report. Some of the major flaws include:

> a. Failure to use E15 fuels as discussed earlier;
>
> b. Although simple coupon testing was used to simulate actual operating conditions, the metals results still demonstrated that significant corrosion would occur. Real world testing with loads/stresses, temperatures, pressures, etc. associated with actual operations should result in actual operation failures were true fleet testing to be done using these fuels.
>
> c. Relevance of the test cycles chosen by MSU and associated parameters such as the length of the test; the MSU work does not address how these choices are predictors of compatibility, durability, or functional performance;
>
> d. The summary-conclusions in most instances that the tested E20 fuel is "compatible" without any discussion of what "compatible" means in each instance. The authors seem to imply that E20 is compatible with the performance of the equipment that uses the tested materials – yet, as noted, the test conditions have no correlation to equipment performance;
>
> e. The repeated statements noting that the degradation associated with E20 are somehow marginally higher than those observed with E10, when in fact, the analysis of the actual test data in the reports does not support this conclusion. For example, when analyzed with a percent-change criteria, 14 out of 19 metal coupons exhibited higher (greater than 50%) measurable mass change. Metals experiencing a reduction in mass indicate both a reduction in the strength of the remaining metal component and an increase in the contamination of the corresponding fuel. The study did not evaluate metal engine or fuel system components to identify if either the reduced physical properties or corresponding contamination of the fuel on contact with the metal components would result in engine or fuel system failure to function or result in an unsafe condition.

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40 See Dr. Sahu's Compability Report attached as Exhibit C.

41 See Sahu Report attached as Exhibit D.

f. Elastomers were tested utilizing an arbitrary test time and temperature without any corresponding determination of acceptable elastomer component function. Because none of the elastomers were evaluated for their influence on their related components performance, MSU's conclusion is not justified. Many fuel system elastomer components utilized in off-highway engines are significant for both product operation/function and safety. For example, a gravity feed fuel system relies on the seal of the carburetor fuel inlet needle to seal, preventing additional fuel from entering the carburetor, at the prescribed fuel level. Elastomers are also utilized in crankcase vacuum pulse actuated fuel pumps that are sensitive to changes in elastomer properties including swell and strength.

VII. NON-ROAD DRIVABILITY/OPERABILITY STUDIES

"Materials incompatibility" typically results in problems in engine operation and performance. EPA and the federal courts have recognized that the fuel's impacts must be considered on both engine emissions as well as engine performance or "drivability." This is because "drivability can directly result in increased emission due to constant misfires and repeated stalling, and possibly lead to tampering with the emission controls of the vehicle."[42] Accordingly, EPA has stated:

> EPA believes that harm to emission control devices or systems which adversely effects vehicle performance, such that removal or rendering inoperative of such devices or systems may be reasonably expected, should be considered a basis under Section 211(f)(4) for denying a waiver. **Where the potential for such harm is evidenced, the applicant has the burden of proving that such harm will not occur**. [emphasis added].[43]

The chemical properties and scientific principles that cause mid-level ethanol blends to result in "operability" and drivability" problems are discussed in the study attached as Exhibit A – particularly in Section F, G and H.

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42 See Motor Vehicle Mfrs. Ass'n v. EPA, 768 F.2d 283, 401 (D.C. Cir. 1985).

43 34 Fed. Reg. 24132 (June 2, 1978).

A. Existing Non-road, Small Engine and Marine Studies

1. Orbital Studies (2002 and 2003)

The most comprehensive study on the impacts of mid-level ethanol on the "operability" of small non-road and marine engines is the Orbital Engine's Report to Environment Australia entitled "Testing Based Assessment to Determine Impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on Non-Automotive Engines" (January, 2003).[44] That report (which was part of the same May 2, 2003 Orbital compatibility report cited above) concluded that E-20 fuel caused the following adverse operational impacts on Stihl line trimmers and on outboard Mercury Marine engines:

- increases in engine misfires and stalling
- difficulty in maintaining constant engine operating speed
- damage to the engine, including piston ring and exhaust port deposits increasing wear rates
- damage to the engine carburetor diaphragm resulting in the loss of internal and external sealing and likely fuel leakage
- corrosion of metallic engine components.[45]

In 2002, Orbital Engine Company prepared a related comprehensive "Technical Assessment" and "Failure Mode and Effects Analysis" (FMEA) on the impacts of E-20 on Stihl line trimmers and Mercury Marine outboards.[46] That FMEA analysis concluded that E-20 would cause "material degradation" (like "corrosion or perishing" of the piston, piston rings and crankshaft) in 62% of the total affected "mechanisms." Other very high percentages of "mechanism failures" included "gumming," "lubricant deficiency," and "altered combustion."[47]

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44 See http://www.environment.gov.au/atmosphere/fuelquality/publications/.

45 See 2003 Orbital Report at p. 2-3.

46 See http://www.environment.gov.au/atmosphere/fuelquality/publications/.

47 See p. 26 of 2002 Orbital Report.

According to the Orbital-FMEA report, these "mechanism of failures" caused the following "effects of failure" (at the following "percentage of total effects"):

- A lack of power (32%)
- Rough engine operation (19%)
- Fuel leaks (which would be a safety hazard and an evaporative emissions failure) (17%)
- Engine seizure (13%)
- Engine stops (11%)[48]

The problems documented in the Orbital Studies would likely be even more pronounced for more recent EPA-certified products. Since 2004, the EPA exhaust regulations applicable to non-road products (including small engines and outboard marine engines) have become increasingly more stringent, requiring catalysts and other emission-related modifications. Current EPA-certified engines must run under leaner operating conditions.

These leaner conditions result in narrower acceptable tolerance limits for increasing the oxygen content in the fuel without causing excessive heat and other operational problems.[49]

2. Briggs and Stratton Study (2007)

In its 2007 study, Briggs and Stratton identified the following operability features resulting from E-20 fuels on their EPA-certified engines:

- head gasket failure after 25 hours (due to high temperatures so that gases escaped past the gasket);
- loss of power;
- decreases in RPM stability and audible speed oscillations;
- poor acceleration;
- damages to rubber and plastic fuel system components, causing leaks due to alcohol swelling and degradation.[50]

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48 See 2002 Orbital Report at p. 30.

49 See Study attached Exhibit A, Sections A and B.

B. Growth Energy Position

In its petition, Growth Energy does not address the comprehensive Orbital studies summarized above. In fact, for non-road products, Growth Energy solely argues that the DOE small engine study concluded that "it is not possible to isolate the effects of ethanol on the operability of SNRE [small non-road engines] because of the great variance in performance among small non-road engines, regardless of the fuel used." On that basis, Growth Energy incorrectly claims that "E-15 will not have a discernable impact on the performance and operability of SNREs." Growth Energy also claims that the recent DOE study on small engines "concluded that no obvious materials compatibility issues were observed during testing."

C. Critique of DOE Study and Growth Energy Waiver

In the enclosed 2009 critique of the DOE study (see Exhibit B), Dr. Sahu documents the following operability and performance problems on the SNREs that were tested in the DOE study:

- Substantially higher temperatures which will cause long-term damage to the engines and their emission-control systems;
- The total failures (at around 25 hours) of the 2 Weed Eater leaf blowers running on E-15;
- The failure of the Weed Eater blower to idle on E-20;
- The degraded performance of the Poulan leaf blower at 30-55 hours on E-15 fuels;
- The stalling, loss of power and abrupt stopping of the Briggs and Stratton 3500 kw generator on E-20;[51]
- The high idle speeds leading to improper clutch engagement both on the Stihl trimmers (in the Pilot study and the complete study).

50 See Briggs Report, Exhibit C, at p. 3-5.

51 The 2008 DOE report hypothesizes that the Briggs engine stalled probably due to the swelling of the elastomeric needle for the carburetor (similar to the same problems discussed above).

In its final report, even DOE recognizes that some of these operational problems could directly lead to tampering – which could increase emissions in contradiction to the very purposes of EPA's fuel-waiver criteria. For example, the DOE contractors had to adjust the "low-idle adjustment" and the "low-speed screws" to prevent unintended clutch engagement.[52] The similar operational problems with other engines would likely result in owners tampering with their products' carburetor settings so that they would run "richer" to accommodate E-15. These richer settings could cause an emission exceedance if those tampered products were run on E-0 fuels.

VIII. EXHAUST EMISSIONS STUDIES

The well-established chemical properties and principles that result in mid-level ethanol blends causing increased exhaust emissions are discussed in the Study attached as Exhibit A, Sections A and B.

A. Existing Studies

1. Briggs and Stratton Study (2007)

The 2007 Briggs and Stratton study concluded that E-20 caused a 10.5% increase in HC + NOx emissions because NOx increased by 233%. This increase would apparently constitute a "failure" or exceedance of the EPA standard for that certified engine family.

B. Growth Energy's Application

For all non-road applications, Growth Energy exclusively relies on the recent DOE small engine report as concluding that E-15 does <u>not</u> cause engines to emit greater combined concentrations of HC + NOx. Accordingly, Growth Energy argues E-15 would <u>not</u> cause an exceedance or failure of an applicable standard.

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[52] See p. 3-19 of the DOE study.

C. Critique of Waiver Application and DOE Study

First, Growth Energy has failed to test a representative mix of all the diverse categories of affected non-road engines, equipment, and recreational boats. It has only tested a discrete group of small engines that excluded certain sensitive products like chainsaws. Accordingly, Growth Energy would still need to implement a comprehensive test program to evaluate engine exhaust impacts across all these different non-road categories.[53]

Second, the DOE report incorrectly indicates that HC+NOx emissions decrease in most cases. However, in every case involving ground-supported lawn and garden products – the use of mid-level ethanol resulted in increased emission levels, and significant increases in emission control deterioration over the useful life of the tested product:

Engine	Figure	HC+NOx new	HC+NOx full life
Briggs & Stratton Pressure Washer	D.3.	Increase w/ increasing ethanol content	Decrease w/ increasing ethanol content[54]
Briggs & Stratton Pressure Washer	D.7.		Increase w/ increasing ethanol content
Honda Generator	D.11.	Increase w/ increasing ethanol content	Increase w/ increasing ethanol content[55]

Third, the DOE test program was flawed and deficient for all the additional technical reason set forth in Dr. Sahu's 2009 enclosed Critique.[56] In particular, DOE's test program failed to accurately evaluate the increased emissions resulting from the degradation and deterioration of the tested engines and fuel systems over their useful lives. In fact, the significant heat increases

[53] See suggested test programs for certain non-road product categories discussed below in Section X.

[54] Decreasing trend line is due to E0 testing of engines after aging with E15 and E20 that were significantly out of compliance due to the aging influence of mid-level ethanol blends.

[55] E0 testing at full life on engines aged with E15 and E20 fuels showed significantly higher emission levels than engines aged on E0 and E10 fuels.

[56] See Exhibit E.

documented in the DOE study would adversely impact numerous emission-related components, including pistons, crankshafts, gaskets, and catalysts (particularly under off-nominal conditions). These effects were well-established in EPA's recent Phase III rulemaking record for small engines.

IX. NON-ROAD EVAPORATIVE EMISSION STUDIES

The well-established chemical properties and principles that cause mid-level ethanol blends to increase evaporative emissions are discussed in the Study attached as Exhibit A – particularly Section E.

A. Scope of Regulated / Affected Small Engines and Products

In prior waiver reviews, EPA has concluded that the applicant must evaluate the impacts of the additive or fuel on "emissions technology that is available and imminent, and is reasonably certain to be applied in a prospective model year."[57]

B. Evaporative Controls + Baseline Fuels

Accordingly, Growth Energy's waiver application would need to include comprehensive test data on all evaporative-regulated products, including, for example:

- All the evaporative systems and designs (i.e., fuel tanks, fuel caps and lines) that have been certified, are being certified, and soon will be certified under the new EPA Phase III standards for small engines and lawn and garden products;
- All the additional diurnal (canister) controls mandated by the CARB Tier 3 small engine regulations since these systems will also be EPA-certified for early banking and other purposes.
- Handheld fiberglass tanks that must be certified with EPA in the 2010 MY. These tanks and their regulated caps and gaskets are particularly sensitive to ethanol.

[57] See 43 Fed. Reg. 41426 (Sept. 18, 1978) (an interpretation that was subsequently upheld in the *Ethyl* decision).

In the 2009 through 2011 model years, EPA evaporative emission certifications for the vast majority of EPA-regulated handheld fuel tanks and caps are based on reciprocal CARB certifications, which, in turn, are based on CARB certification fuels.[58] Thus, for the next several years, the same EPA and CARB certification fuels for most handheld tanks (and many ground-supported tanks that are being certified under "early banking" provisions) will continue to be based on MTBE, which does not contain any ethanol.

Growth Energy therefore would still need to perform evaporative testing on all these currently regulated (and soon to be regulated) evaporative components using CARB's MTBE certification fuel as the "baseline fuel."[59] It is likely that E-15 fuels will cause widespread evaporative emission failures in a substantial number of these EPA and CARB-certified tank families.

In fact, there are relatively tight compliance margins with certain current EPA-certified 2009 MY fuel tank families with evaporative certifications based on MTBE test data from CARB certifications. For example, the enclosed certification application is for a fluorinated, blow-molded, handheld fuel tank that is fairly common. Using MTBE fuels under the CARB procedures, this EPA-certified 2009 MY tank family emits 1.95 gr/m^2/day of HC.[60] Based on this application and the underlying CARB certification, EPA has issued an evaporative emissions certification for the current 2009 model year of this tank family that indicates the applicable EPA certification standard is 2.00 gr/m^2/day.[61]

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[58] See 40 C.F.R. § 1054.154; 73 Fed. Reg. 59034, 59105 and 59117 (Oct. 8, 2008).

[59] See proposed evaporative test programs discussed below in Section X.

[60] See certification application attached as Exhibit F.

[61] See Exhibit F.

If E-15 fuels only increased the certified evaporative emission rate from this tank family by 2.5%, then E-15 fuels would result in an exceedance or failure of the applicable EPA-certified standard. Based on the CARB and EPA test programs summarized below, E-15 would likely increase the evaporative emissions rate for this tank family – compared to its MTBE-based certification – by more than 30% (or more than 10 times the acceptable compliance threshold). OPEI expects that there are many other EPA-certified tank families (based on MTBE certification fuels) that would exceed the applicable EPA standards on E-15.

C. Existing Studies

Because we are not aware of any studies evaluating the impacts of E-15 on any non-road products, below we have included a summary of two E-10 studies that show that the rate of evaporative emissions continues to increase as the concentration level of ethanol increases. In fact, there is every reason to believe that E-15 would result in dramatically greater evaporative emissions than E-10.

1. CARB Study

In the context of developing its current Tier-3 evaporative program, CARB conducted extensive evaporative tests comparing its MTBE certification fuels to 10% ethanol. Based on testing 5 lawnmowers in 2003, ARB concluded E-10 would increase diurnal emissions by an average of 36%:

Table 4 Evaporative Emissions from Off-Road Sources based in ARB's Five Lawnmower study			
	Diurnal		
Manufacturer	MTBE	EtOH*	% Diff.
	(g/day)	(g/day)	
Toro	5.5	7.0	+25%
Lawn Boy	2.1	3.1	+49%
Yard Machine	2.5	3.2	+32%
Craftsman #1	2.2	3.1	+44%
Craftsman #2	2.3	3.2	+40%
Average	2.9	3.9	+36%

2. EPA-SAE 2006 Paper

A 2006 paper (authored by Mike Samulski at EPA) documents the substantial evaporative emission increases resulting from E-10 compared to E-0 fuels used in lawn and garden products.[62] This SAE report confirms that the following types of fuel tanks and seals will be the most adversely impacted by ethanol:

- Permeation rates increased by more than 50% for chainsaws, clearing saws and hedge-clippers made from nylon – 6 with less than 35% glass and NBR O-rings and gaskets.
- Permeation rates increased by 80% for CARB-certified portable fuel tanks made from non-continuous barrier platelets;
- Permeation rate increases of 45% for sulfonated HDPE tanks and 30% for fluorinated HDPE tanks.

As a result of these documented impacts, EPA stated in the Phase III small engine regulations that, starting in the 2012 model year, "we are [ultimately] requiring the use of a test fuel containing 10% ethanol . . . because ethanol substantially increases permeation rates for many materials" used in regulated small engines.[63]

[62] "Characterization and Control of Evaporative Emissions from Fuel Tanks in Non-road Equipment." (SAE #2006-32-0094).

[63] See 73 Fed. Reg. at 59111.

D. Growth Energy's Application

Growth Energy's application does not provide any studies that address the impact of E-15 on evaporative emissions from any non-road products, which have dramatically less sophisticated and robust evaporative controls than on-road vehicles. Growth Energy fails to evaluate any of these unique and more sensitive tanks, lines, and fuel systems used in non-road products. Instead, Growth Energy relies exclusively on studies of motor vehicles.

In order to address all evaporative concerns, Growth Energy argues that EPA should condition its requested waiver so that E-15 would have to conform to the ASTM fuel volatility specification.

E. AllSAFE's Critique of Growth's Position

First, Growth Energy must conduct confirmatory testing to support the assumption that E-15 would not increase evaporative emissions as long as ASTM fuel volatility specifications are met. Reviewing courts have indicated that assumptions on fuel volatility and evaporative emissions must be supported by confirmatory test data.[64]

Second, matching volatility is not an adequate measure to control the increasing evaporative emissions due to ethanol.

Third, regardless of the proposed vapor pressure cap, evaporative-permeation emissions for certain materials (like nylon and Viton gaskets) will substantially increase from EPA-regulated products – due to the chemical properties of those materials when exposed to alcohol. (See Section B and C above). Accordingly, Growth Energy would need to conduct a substantial evaporative test program in order to quantify these impacts. (See Section X below).

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[64] See Motor Vehicle Mfrs. Ass'n v. EPA, 768 F.2d 283, 401 (D.C. Cir. 1985).

X. ILLUSTRATIVE TEST PLANS TO FILL DATA GAPS FOR CERTAIN NON-ROAD PRODUCT CATEGORIES

Enclosed are two illustrative examples of the types of test plans that would need to be implemented in order to address some of the gaping data gaps discussed above:

- OPEI has developed a proposed exhaust and evaporative test plan for handheld lawn and garden products. This plan has been submitted to the Coordinating Research Council (CRC) for review and consideration for implementation. (See Exhibit G).
- EMA has developed a proposed plan for evaporative and exhaust emissions from ground-supported lawn and garden and utility engines. (See Exhibit H). This plan has also been submitted to the CRC for their review.

Many of the other AllSAFE members have developed similar recommended test plans for their industries that try to account for unique considerations with their affected products.

XI. COMPARISON OF GROWTH ENERGY WAIVER TO ON-ROAD CRITERIA

The testing program relied upon by Growth Energy to demonstrate compatibility with on-road vehicles also fails to meet the minimum data requirements that EPA has articulated for a mid-level ethanol waiver. A detailed analysis comparing Growth Energy's on-road testing program to EPA requirements and other test plans is attached as Appendix K.

XII. NATIONAL IMPACT OF E-15 FUELS BASED ON PREDICTIVE MODELING

Although emissions test data for on- and non-road gasoline powered vehicles and engines on ethanol gasoline blends above the E10 level are limited, it is possible to estimate the potential impacts on mobile source emissions by extrapolating available algorithms used for purposes of estimating the impacts of gasoline oxygenates on emissions inventories. In order to estimate the potential E15 effect on emissions relative to E10, MOBILE6.2 and NONROAD2008 were used along with input data for estimating emissions on a nationwide basis for calendar years 2010 and

2020. This modeling was performed by Tom Austin of Sierra Research and it is included in the comments submitted by the Motorcycle Industry Council (MIC).

MOBILE6.2 was modified to account for the higher oxygen content of E15 by extending the linear relationships between oxygen content and exhaust HC and CO emissions in the model. As MOBILE6.2 does not account for changes in NOx emissions associated with oxygenates, the model was modified to account for oxygenate impacts on NOx emissions using the California Air Resources Board's Predictive Model.[65] Because the Predictive Model includes non-linear relationships between oxygen content and NOx emissions, two extrapolation methods were used. The first involved direct use of the relationship and the second involved linear extrapolation of the effects based on the slope near the E10 point. A third method, based on the statistical analysis of vehicle emissions data collected on E0, E10, and E20 fuels under the CRC E-74b program, was also used to estimate the potential impact of E15 on exhaust emissions. In this case, MOBILE6.2 was run assuming E0 and then adjusted using the relationships established between oxygen content and emissions from the CRC E-74b data.

Impacts of E15 on non-road emissions were obtained directly from the NONROAD2008 which was specifically configured for that purpose when it was released by EPA in April, 2009. It should be noted that in all cases, no adjustment was made to account for the potential use of E15 to result in greater deterioration of emission control system performance.

With respect to evaporative emissions, the impact of ethanol depends on whether the approximately one pound per square inch increase (psi) in RVP associated with its addition to gasoline at levels that include E15 is allowed to occur of if the ethanol blend is required to meet the same volatility standards as non-oxygenated gasoline. Under existing federal regulations, in

[65] Available at http://www.arb.ca.gov/fuels/gasoline/premodel/premodel.htm.

those areas of the country where reformulated gasoline is required, the RVP of E15 blends (if they are allowed) would be subject to the same RVP requirements that apply to other RFG blends, including E10 blends. In areas where reformulated gasoline is not required, the volatility of most ethanol-gasoline blends is required to be the same as non-oxygenated gasoline. There is however a one psi RVP exemption for ethanol gasoline blends sold in non-RFG areas provided that:

> The concentration of the ethanol, excluding the required denaturing agent, must be at least 9% and no more than 10% (by volume) of the gasoline.

Given the above language, it appears that E15 blends will not be eligible for the 1 psi exemption absent changes to the existing federal regulations. However, the following language in the waiver application makes it appear that the applicant assumes E15 and E10 will be blended to the same RVP – "The volatility of the two fuels also is essentially identical."

In fact, the applicant specifically states on page 25 of the application:

> Growth Energy proposes that this waiver be granted with a condition requiring E-15 to conform to ASTM fuel volatility specifications for the area and time of year where it is used.

With the requested condition, E15 could even have higher volatility than E10. Since there will obviously be pressure on EPA to allow the same RVP exemption for E15 as is allowed for E10, Sierra prepared emission estimates with and without accounting for a 1.0 psi RVP waiver.

The analysis also addressed evaporative emissions related to ethanol permeation. For non-road sources, permeation estimates were obtained from the NONROAD2008 model which, in addition to being configured to estimate impacts of E15 blends, includes an algorithm that adjusts permeation emissions as a function of fuel ethanol content. For on-road vehicles, a methodology developed by Air Improvement Resource, Inc.[66,67,68] was used along with the algorithm from the NONROAD2008 model for adjusting permeation emission rates as a function of ethanol content. With respect to this assumption, it should be noted that it is consistent with the trend of permeation emissions increasing with increasing ethanol content observed in the CRC E-65-3 study, although that effect was not found in that study to be statistically significant at the 95% confidence level.

The results of the emissions analysis are shown in Table 8 for on-road sources. Table 8 presents nationwide summer emissions of VOC, NOx, and CO for calendar years 2010 and 2020 assuming that all reformulated and conventional gasoline is either E10 or E15. The difference in emissions associated with the substitution of E15 for E10 is shown both on an absolute and on a percentage basis where positive numbers indicate higher emissions with E15 and negative numbers indicate lower emissions with E15. Finally, the effect of eliminating the one psi RVP exemption is shown.

As shown, if E15 is provided an RVP exemption, the increase in on-road NOx emissions estimated using all three methodologies is greater than the estimated reduction in VOC emissions. If E15 is not provided an RVP exemption, the VOC reductions associated with the reduction in volatility are greater than the estimated increases in NOx emissions using two of the three methodologies. The NOx increase still exceeds the VOC reduction for the methodology

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66 "Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory from On-Road and Off-Road Sources," prepared by Air Improvement Resource for the American Petroleum Institute, March 3, 2005.

67 "Continuing Ethanol Permeation Issues" presented by Air Improvement Resource to CARB, August 25, 2006. Presentation can be found at *http://www.arb.ca.gov/fuels/gasoline/meeting/2006/mtg2006.htm*.

68 "Updated Final Report Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory from On-Road and Off-Road Sources, Inclusion of E-65 Phase 3 Data and Other Updates," prepared by Air Improvement Resource for the American Petroleum Institute, May 24, 2007.

involving the use of MOBILE6.2 with non-linear NOx effects due to oxygenate content. In all cases the higher oxygenate content of E15 leads to greater reductions in CO emissions than estimated with E10.

Table 8
Estimated Nationwide Impacts of E15 on On-Road Gasoline Vehicle Emissions
(tons per summer day unless noted)[a]

Method	Fuel	VOC		NOx		CO	
		2010	2020	2010	2020	2010	2020
MOBILE6.2 + Linear NOx Effect	E10	7393	4772	12231	5696	70718	60878
	E15	7264	4655	12441	5812	66819	57807
	Change (TPD)	-129	-117	+210	+116	-3899	-3071
	Change (%)	-1.7	-2.4	+1.7	+2.0	-5.5	-5.0
MOBILE6.2 + Non-Linear NOx Effect	E10	7393	4772	12231	5696	70718	60878
	E15	7264	4655	13016	6195	66819	57807
	Change (TPD)	-129	-117	+785	+499	-3899	-3071
	Change (%)	-1.7	-2.4	+6.4	+8.8	-5.5	-5.0
CRC E-74b	E10	7578	4917	12350	5799	60332	51308
	E15	7537	4870	12637	5978	56527	48021
	Change (TPD)	-41	-47	+287	+179	-3805	-3287
	Change (%)	-0.54	-0.96	+2.3	+3.1	-6.3	-6.4
Additional Change Assuming 1.0 psi RVP Increase Not Allowed in Non-RFG Areas		-489	-269	-	-	-	-

[a]Note plus sign indicates increased emissions with E15.

Table 9 presents the results of the analysis for non-road sources. The results for non-road sources are similar to those observed for on-road sources with estimated NOx emission increases associated with E15 being greater than estimated VOC reductions unless there is no RVP waiver available for E15.

Table 9
Estimated Nationwide Impacts of E15 on Non-Road Gasoline Vehicle Emissions (tons per summer day unless noted)[a]

Method	Fuel	VOC 2010	VOC 2020	NOx 2010	NOx 2020	CO 2010	CO 2020
NONROAD2008	E10	9273	5033	6503	3800	61116	55326
	E15	9134	4951	6675	3947	53578	48150
	Change (TPD)	-139	-82	+172	+147	-7538	-7176
	Change (%)	-1.5	-1.6	+2.6	+3.9	-12.3	-12.9
	Additional Change Assuming +1.0 psi RVP Not Allowed in Non-RFG Areas	-105	-93	-	-	-	-

[a]Note plus sign indicates increased emissions with E15.

XIII. CONCLUSIONS AND RECOMMENDATIONS:

AllSAFE recommends that EPA deny the waiver request based on the following:

- A partial waiver alone cannot legally or practically control the use of E15 without causing widespread misfueling.
- The waiver application does not include most of the information EPA has outlined as required supporting information.
- The data supplied with the waiver application does not support the claims made regarding the emission and operability influence of E15 fuel.
- For non-flexible fuel vehicles, use of E15 fuel is expected to result in "materials incompatibility" and the degradation of critical emission-control components, including catalysts and fuel tank barriers.
- For non-flexible fuel vehicles, use of E15 fuel is expected to cause unacceptable engine and/or equipment "operability"– resulting in an increase in tampering.
- For non-flexible fuel vehicles, use of E15 fuel has been demonstrated to result in increased exhaust emission of HC+NOx and significantly higher exhaust gas temperatures resulting in engine degradation.
- Use of E15 fuel could result in increased evaporative emissions.
- Use of E15 fuel would increase national emissions based on well-established predictive modeling.

EXHIBIT A

OVERVIEW –IMPACTS OF MID-LEVEL ETHANOL ON-ROAD AND NON-ROAD ENGINES AND EQUIPMENT (PREPARED BY DR. RON SAHU, MAY 15, 2009)

A. Change Due to the Enleanment Effect of Ethanol

Gasoline is a mixture of many hydrocarbon compounds that consist mainly of hydrogen and carbon.[1] Ethanol also contains hydrogen and carbon – but, in addition, it also contains oxygen. The exact air-to-fuel ratio needed for complete combustion of the fuel (to carbon dioxide and water vapor) is called the "stoichiometric air-to-fuel ratio." This ratio is about 14.7 to 1.0 (on weight basis) for gasoline. For ethanol/gasoline blends less air is required for complete combustion because oxygen is contained in the ethanol and because some of the hydrocarbons have been displaced. For example, for E10 the stoichiometric air-to-fuel ratio is 14.0 to 14.1 pounds of air per pound of fuel. Indeed, the stoichiometric air-to-fuel ratio for straight ethanol is 9 to 1 so that as the proportion of ethanol in the gasoline blend increases so must the air-to-fuel ratio decrease. To deliver the required power for any given operating condition, engines consume enough air and fuel to generate the energy required, to the limit of the engine's capabilities. Because fuel delivery systems are designed to deliver the prescribed amount of fuel on a volume control basis the fuel volume delivered is related to the volume of air introduced. The engine design anticipates that the fuel utilized will match the air-to-fuel ratio characteristics utilized in the engine design and calibration. Because ethanol blended fuels require more fuel for the same amount of air to achieve stoichiometric conditions, the fuel system must adapt by introducing more fuel or the desired mixture is not achieved. If additional fuel is not introduced to compensate for the ethanol the resulting mixture has less fuel than desired; the effect of this type of fuel change on an engine is called "enleanment."

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1 Sulfur, nitrogen, and trace elements also may be present.

Even with closed-loop systems, where the engine has a control system that can detect and compensate for the effects of ethanol addition (adapt), if the fuel contains an amount of ethanol that is outside the range of the system design, the engine similarly may receive too much oxygen and operate in a lean condition. Lean operation can lead to a variety of performance problems, for example the combustion and exhaust gas temperatures will be higher, engine starting may become more difficult, and the engine speed control may become inaccurate.[2] These problems may result in the unintentional engagement of cutting chains and blades on chainsaws and other products – because the engines driving these products will run at higher speeds, especially at idle conditions.

The increased combustion and exhaust gas temperatures resulting from lean operation can result in severe damages to pistons, gaskets, catalysts and emissions-related components, in turn, resulting in the failure of the product to operate and increased exhaust emissions.[3] These increased temperatures can also damage and destroy critical safety components like spark arrestors – as required by the U.S. Forest Service to be used on chainsaws to reduce fire risks.

B. Effect on Exhaust Emissions

Enleanment and the increased heat from mid-level ethanol blends will cause heat-related damage to the engine over its useful life, which can cause dramatic increases in hydrocarbon emissions. NOx emissions from conventional products and vehicles generally increase

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2 Issues associated with driveability and operational problems have been discussed for on-road vehicles and for off-road equipment in a series of reports in 2002-2004 by Orbital Engine Company for a biofuels assessment conducted in Australia. In particular, see (a) A Testing Based Assessment to Determine Impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on Non-Automotive Engines, January 2003; (b) Marine Outboard Driveability Assessment to Determine Impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on a Small Batch of Engines, February 2003 and (c) A Testing Based Assessment to Determine Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian Passenger Vehicle Fleet – 2000hrs Material Compatibility Testing, May 2003.

3 Id.

immediately since enleanment creates conditions which increase NOx.[4] For less sophisticated open-loop engines, NOx emission increases can be dramatic.

While some of the toxics in exhaust emissions show expected decreases in the presence of ethanol, some toxics, such as aldehydes, can show increases. Besides the potential toxic effects of aldehydes in exhaust gases, the aldehydes act as an ozone precursor and increase the smog-forming potential.

C. Effect on Water Solubility and Phase Separation

Separation of a single phase gasoline into a "gasoline phase" and a "water phase" can occur when too much water is introduced into the fuel tank. Water contamination is most commonly caused by improper fuel storage practices at the fuel distribution or retail level, or the accidental introduction of water during vehicle refueling. Water has a higher density than gasoline, so if water separates, it will form a layer below the gasoline. Because most engines obtain their fuel from, or near, the bottom of the fuel tank, engines will not run if the fuel pick up is in the water-phase layer.

Typically, gasoline can absorb only very small amounts of water before phase separation occurs. Ethanol/gasoline blends, due to ethanol's greater affinity with water, can absorb significantly more water without phase separation occurring than gasoline. Ethanol blends can actually dry out tanks by absorbing the water and allowing it to be drawn harmlessly into the engine with the gasoline. If, however, too much water is introduced into an ethanol blend, the water and most of the ethanol will separate from the gasoline and the remaining ethanol. The amount of water that can be absorbed by ethanol/gasoline blends, without phase separation, varies from 0.3 to 0.5 volume percent, depending on temperature, aromatics, and ethanol content.

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4 The higher combustion temperatures and the excess of oxygen in the combustion chamber result in the excess oxygen combining with nitrogen to produce nitrogen oxides.

If phase separation were to occur, the ethanol/water mixture would be drawn into the engine and the engine would most likely stop.

In some situations, ethanol/gasoline blends might absorb water vapor from the atmosphere, leading to phase separation. Such problems are of greater concern for engines with open-vented fuel tanks that are operated in humid environments, such as marine engines.

Additionally, more complex phenomena such as lubricating oil/fuel separation (in 2-stroke engines) and temperature-induced phase separation of various fuel components have also been noted.

D. Effect on Material Compatibility

A variety of components in engine/equipment systems can come into contact with the fuel. These include

- Fuel Lines
- Fuel Tanks
- Fuel Pumps
- Fuel Injectors
- Fuel Rails
- Carburetors (and internal components)
- Pressure Regulators
- Valves
- O-Rings
- Gaskets

Materials used in these components should be compatible with the full range of expected fuel composition. Table A shows the types of metals, rubbers, and plastics that are used in existing engines and fuel system components currently designed to run on E10 fuel blends.

Table A – Illustrative Materials Used in Engines and Fuel Systems

Table A

A. Metals

- Aluminum (various grades)
- Brass
- Carbon Steel
- Cast Iron
- Copper
- Magnesium (and alloys)
- Zinc (and alloys)
- Lead
- Tin
- Terne Plate
- Solder (tin/lead)
- Other metals and alloys

B. Rubbers

- Buna N
- Silicon Rubber (VMQ)
- HNBR (Hydrogenated Nitrile Butadiene Rubber)
- Others

C. Plastics/Polymers/Monomers/Elastomers

- Hydrin (epichlorohydrin)
- H-NBR (copolymer from butadiene and acrylonitrile)
- Low Temp Viton (FKM) grades such as GFLT
- Nylons (various grades)
- Polyester urethane foam
- NBR with 16% PVC and 32% ACN content
- Ozo-Paracril (blend of PVC and nitrile rubbers)
- CSM - Chlorosulfonated polyethylene, such as Hypalon
- FVMQ - Fluorosilicone
- HDPE – High Density Polyethylene
- PS - Polysulfone
- PC - Polycarbonate
- ABS - Acrylonitrile Butadiene Styrene
- EVOH -Ethylene Vinyl Alcohol
- PPA - Polyphtalamide
- PBT - Polybutylene Terephthalate
- PE - Polyethylene – High Density Polyethylene (HDPE),
- PE - LDPE Low Density Polyethylene (LDPE)
- PET - Polyethylene Terephthalate (Mylar)
- PP - Polypropylene
- PPS - Polyphenylene Sulfide
- PUR - Polyurethane
- PVC - Polyvinyl Chloride
- PEI - Polyetherimide (GE Ultem)
- POM - Acetel Copolymer
- HTN - DuPont™ Zytel® HTN
- PTFE - Polyteraflouroethylene (Teflon)
- POM - Polyoxymethylene (acetal/Delrin)
- Fluorosilicones

Others

This is not an exhaustive list and is meant as an illustration of the diversity of materials used presently. Based on existing studies, it is clear that several rubbers and elastomers can swell and deteriorate more rapidly in the presence of ethanol.[5] Ethanol also corrodes certain metals. Corrosion occurs through different mechanisms including acidic attack, galvanic activity, and chemical interaction. The first is caused by water in the fuel. Ethanol attracts and dissolves water, creating a slightly acidic solution. Unlike gasoline, ethanol alone or combined with water conducts electricity; this conductivity creates a galvanic cell that causes exposed metals to corrode. So when ethanol is blended with gasoline the resulting blend is conductive and the conductivity increases as the amount of ethanol is increased. The addition of ethanol greatly increases the ability of gasoline to dissolve ionic impurities which can facilitate corrosive attach of many metals. Another mechanism is direct chemical interaction with ethanol molecules on certain metals.

Clearly, deterioration of materials would result in loss of function of critical engine components, resulting in fuel leaks, fires from fuel leaks, and equipment failure. This has obvious safety implications.

E. Effect on Evaporative Emissions

Permeation of fuel through elastomers can result in deterioration of these materials. In recent testing, all of the tested ethanol blends showed higher permeation rates through elastomers

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5 A Testing Based Assessment to Determine Impacts of a 20% Ethanol Gasoline Fuel Blend on the Australian Passenger Vehicle Fleet – 2000hrs Material Compatibility Testing, May 2003 and A Testing Based Assessment to Determine Impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on Non-Automotive Engines - 2000hrs Material Compatibility Testing, May 2003.

than conventional gasoline.[6] An important emissions concern that remains poorly understood is ethanol's ability to permeate through rubber, plastic, and other materials used widely in the fuel tank, fuel system hoses, seals, and other parts of the fuel handling system. Recent studies have shown these emissions can be quite significant.[7]

F. Impacts Associated with Fuel Volatility

Mid-level ethanol gasoline blends are documented as causing the following operating problems resulting from their different volatility and vaporization characteristics. First, because ethanol has a lower vapor pressure, it has been shown to cause starting problems because there is inadequate vapor pressure to a vapor mixture rich enough to ignite. In turn, such problems could result in consumer tampering of the engine's carburetor.

Second, because ethanol vaporizes at lower temperatures than gasoline, mid-level ethanol can cause "vapor lock." Vapor lock is a condition where the fuel in the engine's fuel delivery system vaporizes preventing the transport of liquid fuel to the carburetor or fuel injectors. Increasing the ethanol concentration beyond E10 is likely to increase the likelihood of vapor lock for open loop fuel control system engines typically used on older vehicles and most off-road engines. Even in the closed loop engine systems used in some off-road engines and in most late-model vehicles, there remains the likelihood of vapor lock.

Other concerns about low temperature fuel characteristics of ethanol blends include a) increased viscosity of ethanol/gasoline blends which may impede fuel flow and b) phase separation in the vehicle fuel system due to reduced water solubility.

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6 (a) See EPA-420-D-06-004, Draft Regulatory Impact Analysis: Control of Hazardous Air Pollutants from Mobile Sources, Chapter 7, February 2006. (b) See also, Fuel Permeation from Automotive Systems: E0, E6, E10, E20, and E85, Final Report, CRC Project No. E-65-3, December 2006.

7 See, e.g.:, the CRC E-65-3 Project Report referenced earlier as well as the EPA document referenced earlier which also discusses testing conducted by the California Air Resources Board.

G. Summary of Impacts

The effects of increased ethanol in gasoline are generally not linear with the amount of oxygen in the fuel. Hence, the effects of increasing the ethanol content beyond E10 on current engines are not fully known. Table B presents an overview of all these effects and how they can influence emissions, performance, and durability, mainly for automobiles; but, in some instances, the effect of increased ethanol on less sophisticated off-road engines is also noted.

Table B
Properties of Ethanol And Associated Implications

Property	***Implication***
Hydrogen Bonding/Vapor Pressure	This makes pure ethanol have a very low vapor pressure compared to gasoline. But it also means the vapor pressure of a mixture can be higher than the gasoline alone. Where the peak vapor pressure occurs depends on the base gasoline vapor pressure and ethanol concentration. With a 9 RVP base gasoline, the peak occurs at around 6-7% by volume.[8] Vapor pressure directly affects the evaporation rate and potential hydrocarbon emissions.
Hydrogen Bonding/Water Attraction	Easy hydrogen bonding makes ethanol attract water. The presence of water, in turn, increases the risk that certain metals will corrode. This becomes a problem when fuel remains in storage (including vehicle fuel tanks) and handling systems for a long time.
Oxygen Atom	Ethanol's oxygen atom lowers its energy content, which reduces fuel economy. A blend's final energy content and the impact on fuel economy depends on the amount of ethanol and gasoline density. Most blends up to 10% ethanol by volume do not affect fuel economy to a significant extent (about 1-3%).
Oxygen Atom	Ethanol mixed with gasoline makes the air-to-fuel ratio leaner than with gasoline alone. Controlling the air-to-fuel ratio is critical to the combustion process and engine performance. Performance problems include hesitation, stumbling, vapor lock, and other impacts on drivability. Pre-ignition also can occur, causing engine knock and potential damage. Ambient temperature and pressure are important factors.
Oxygen Atom	Manufacturers calibrate the oxygen sensors (used in modern vehicle technologies but not in off-road equipment, in general) to recognize specific levels of oxygen in the exhaust stream. If a mixture is outside the calibration range, the sensor will send inaccurate signals to the air-to-fuel feedback and on-board diagnostic systems. This could cause improper air-to-fuel ratios as well as an increased risk of causing one of the dashboard's warning lights (MIL) to illuminate.
Higher Combustion Temperature	This increases the formation of NOx, an ozone precursor, in the exhaust gas. Modern three-way catalysts in vehicles reduce NOx by more than 99%, except before the catalyst fully warms up (i.e., during cold-start engine operation). Excessive combustion temperatures also can cause engine damage.
Higher Latent Heat of Vaporization	This can delay catalyst "light-off," which is period of time before the catalyst warms up and can reduce exhaust emissions of HC, CO, and NOx.
Higher Electrical Conductivity	This property increases galvanic corrosion of metals.
Permeability	Ethanol readily permeates at significant rates through elastomers, plastics, and other materials used widely for hoses, o-rings, and other fuel system parts. Depending on temperature and the materials used in the fuel system, this can significantly increase

8 See API Publication 4261, June 2001

	hydrocarbon emissions.
Solvency	Under certain conditions, the presence of ethanol can cause certain detergency additives to precipitate out of solution, leaving the engine unprotected from gummy deposits. Deposits can increase emissions, lower fuel economy, and increase drivability problems.
Polarity or Oxygen Atom	Ethanol lowers fuel lubricity by binding to metal surfaces and displacing motor oil. This effect increases cylinder bore wear.
Solvency	Ethanol is an effective solvent that mixes readily with both polar and non-polar chemicals. This property allows ethanol to dissolve some adhesives used to make paint adhere to vehicle bodies. Ethanol also dissolves certain resins and causes them to leach out of the fiberglass fuel tanks used in some boats. Not only does this cause the tank to deteriorate, it also creates a sludge that coats the engine and can cause stalling and other performance problems.[9]

[9] See "Important News for Boat Owners," at www.ethanolrfa.org.

H. Ethanol-Compatible Design

It is instructive to review the types of changes that have been made in certain automobiles to handle greater than E10 fuels. Table C, below, shows the types of changes that have been made in Brazilian vehicles in order to accommodate higher ethanol blends.

Table C
Adaptation of Brazilian Vehicles[10] for Use with E22 or E85+[11]

System	Part Change
Air-Fuel Feed	Electronic fuel injectors: must use stainless steel and modify the design to improve fuel "spray" and throughput. Manufacturers calibrate the system to the fuel, to ensure the proper air-to-fuel ratio and an appropriate Lambda sensor working range.
	Carburetors: must treat or otherwise protect aluminum or zinc alloy surfaces.
Fuel Handling System	Fuel pumps: must protect internal surfaces and seal connectors; a different metal may be required.
	Fuel pressure regulators: must protect internal surfaces; internal diaphragm may need to be up-graded.
	Fuel filter: must protect internal surfaces and use an appropriate adhesive for the filter element.
	Fuel tank: if metallic, must protect (coat) the internal surface. If plastic, may need to line the interior to reduce permeation.
	Fuel lines and rails: may need to coat steel parts with nickel to prevent corrosion or replace with stainless steel.
	Fuel line quick connects: must replace plain steel with stainless steel.
	Hoses and seals: "o-ring" seals and hoses require resistant materials.
Emission Controls	Vapor control canister: may need to increase the size of the canister and recalibrate it for the expected purge air flow rate.
	Catalyst: may need to adjust the kind and amount of catalyst and wash coating.
Powertrain	Ignition System: must recalibrate ignition advance control.
	Engine: should use a higher compression ratio for proper operation; new camshaft profile and phase; and new materials for the intake and exhaust valves and valve seats.
	Intake manifold: must be able to deliver air at a higher temperature; requires a new profile and must have a smoother surface to increase air flow.
	Exhaust pipe: must protect (coat) the internal surfaces and ensure design can handle a higher amount of vapor.
Other	Fuel filler door paint: must change paint formula used on plastic fuel filler door to avoid loss of paint adhesion.
	Motor oil: may require reformulation and/or a new additive package.
	All parts that might be exposed to the fuel: avoid polyamide 6.6 (nylon), aluminum, and various zinc alloys. If these materials are used, their surfaces must be treated or otherwise

10 Brazil's vehicle emission standards are less stringent than those in the U.S., so U.S. vehicles may require additional effort and calibration to meet emission and durability standards.

11 "Fuel Specifications in Latin America: Is Harmonization a Reality?" Henry Joseph Jr., ANFAVEA (Brazilian Vehicle Manufacturers Association), presented at the Hart World Fuels Conference, Rio de Janeiro, 21-23 June 2004.

	protected.
	Vehicle suspension: may need to modify to accommodate a higher vehicle weight
	Cold start system (for E85or above): may require an auxiliary start system with its own temperature sensor, gasoline reservoir, extra fuel injector, and fuel pump; also, the vehicle battery must have a higher capacity.

For automobiles designed to handle greater than E10, the changes involve the use of innovative and ethanol-compatible technologies, material changes, and adjustments in calibration. In all cases, one cannot adapt or retrofit existing products because too many parts and design steps are involved and the product may have size constraints. Necessary modifications must occur during design and production to ensure compliance with strict emission standards and to meet consumer expectations for safety, durability, performance, and cost.

To ensure materials compatibility at higher ethanol levels for use with flexible fuel vehicles (FFVs), manufacturers use corrosion resistant materials in any part that may contact fuel. For example, Brazilian auto manufacturers, who have considerable experience producing ethanol-compatible vehicles, recommend using electronic fuel injectors made with stainless steel, larger holes, and modified designs to improve fuel spray. Significant changes to the fuel pump and fuel pump motor are also often needed. Similarly, manufacturers of carbureted engines—for example, almost all small engine products such as chain saws and lawn mowers, as well as older and antique vehicles—recommend, among other steps, coating or anodizing aluminum carburetors or substituting a different metal not susceptible to attack.

Boats have similar compatibility concerns. Many, for example, use aluminum fuel tanks that are susceptible to corrosion. While sacrificial zinc anodes often are added later to the external parts of these tanks, they are not feasible for the tank's interior.[12] Older yachts with fiberglass tanks have a different problem. Ethanol can chemically attack some of the resins used

[12] NMMA Ethanol Position Paper, no date, available at www.nmma.org/government/environmental/?catid=573.

to make these tanks causing them to dissolve. In doing so, the ethanol causes leaks, heavy black deposits on marine engine intake valves, and deformation of push rods, pistons, and valves.[13]

Conventional vehicles and products do not have these material adaptations for higher level ethanol use. One device particularly difficult to address after-the-fact is the fuel tank level sensor. These sensors, which are placed inside the fuel tank, directly expose wiring to the fuel. Depending on how much ethanol these devices contact and for how long, galvanic or electrolytic corrosion would be expected to dissolve the wires and eventually cause device failure.

Manufacturers make additional design changes to address emissions and performance needs.[14] In this context, it is important to remember that U.S. emission standards are more stringent than those in Brazil. For U.S. vehicles, manufacturers select oxygen sensors and onboard diagnostic (OBD) systems specifically to cover the expected range of oxygen in the exhaust gas. If the fuel ethanol pushes the exhaust oxygen content outside the range of the oxygen sensor, the vehicle's OBD system won't work properly and may erroneously illuminate or fail to illuminate the dashboard warning light. In addition, manufacturers must calibrate vehicle and product systems to the expected fuel to ensure the proper air-fuel ratio for both emissions and performance purposes. In the U.S., off-road engines are also regulated for emissions regardless of their size or equipment that they power. Generally, the off-road engines do not utilize oxygen sensors and computer controls to adjust fuel delivery by a closed loop system. In many products, emission compliance has dictated air-to-fuel ratio controls that are a delicate balance between being too rich and, therefore, out of compliance, or too lean, resulting in performance or durability problems.

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13 Id.

14 "Fuel Specifications in Latin America: Is Harmonization a Reality?" Henry Joseph Jr., ANFAVEA (Brazilian Vehicle Manufacturers Association), presented at the Hart World Fuels Conference, Rio de Janeiro, 21-23 June 2004.

The long term durability of emission control systems is a critical issue, with current U.S. federal and California emission standards requiring on-road vehicles to comply for up to 150,000 miles and off-road engines to comply for full useful life periods. If the control system of the vehicle was not designed to accommodate the leaning effect of ethanol, the vehicle's catalyst protection routine will be disabled. For off-highway engines, or older vehicles without closed loop systems, the enleanment influence can result in higher exhaust gas temperatures. This can cause thermal degradation of the catalyst over time, either through sintering of the precious metal wash-coat or damage to the substrate and can also degrade critical engine components such as pistons and exhaust valves.

EXHIBIT B

Supplemental Statutory Appendix

To the Comments of the Alliance for a Safe Alternative Fuels Environment

On the Request for Waiver of the Prohibition in Section 211(f)(1) of the Clean Air Act

Noticed for Comment at 74 Fed. Reg. 18,228 (April 21, 2009)

Table of Contents

This Appendix to the Comments of the Alliance for a Safe Alternative Fuels Environment ("AllSAFE") provides additional analysis of the statutory provisions that should govern EPA's consideration of the application for a waiver under Clean Air Act section 211(f)(4) for gasoline-ethanol blends containing 15 percent ethanol by volume (E15) submitted March 6, 2009 ("the Application").

Part I of this Appendix outlines the judicial precedents establishing what an applicant must prove in order to meet the standards for a waiver under section 211(f)(4). Part II of the Appendix relates the requirements of section 211(f)(4) to the obligations of on-road vehicle and engine manufacturers to provide remedies for class-wide nonconformities with emissions standards, pursuant to Clean Air Act section 207(c)(1) and regulations adopted by EPA for non-road vehicles and engines under Clean Air Act section 213. The analysis in Part II is premised on an assumption that EPA may choose or will be required in the future to consider additional applications for a waiver under section 211(f)(4) for E15 or other ethanol blends, or may be considering taking some other action that might permit the lawful sale of ethanol blends with greater than 10 percent ethanol by volume.

I. Judicial Precedent under Clean Air Act Section 211(f)(4) Governing the Application

A. Background

As amended by the Energy Independence and Security Act of 2007, Pub. L. No. 110-140, 121 Stat 1492 (2007) (the "2007 Energy Act"), Clean Air Act section 211(f)(4) provides in pertinent part as follows:

> The Administrator, upon application of any manufacturer of any fuel or fuel additive, may waive the prohibitions established under … this subsection, if he determines that ***the applicant has established*** that such fuel or fuel additive or a specified concentration thereof, and the emission products of such fuel or

> fuel additive or specified concentration thereof, ***will not cause or contribute*** to a failure of any emission control device or system … to achieve compliance by the vehicle or engine with the emission standards with respect to which it has been certified pursuant to sections 206 and 213(a).

42 U.S.C. § 7545(f)(4) (emphasis added); *see also id.* (applicant must establish no such contribution to failures over the "useful life" of vehicles or engines).

An applicant for a waiver under section 211(f)(4) has the "clear burden" of establishing that a nonconforming fuel or blend will not cause or contribute to the failure of an emissions control system to meet applicable EPA standards at any point during the useful life of the vehicle. *See, e.g., Motor Vehicle Mfr's Ass'n v. EPA*, 768 F2d 385, 388 n.4 (D.C. Cir. 1985) ("*MVM 1985*"). This does not require a waiver applicant to prove that a given fuel, additive or blend will not contribute to any failure of emissions control systems to meet applicable standards. Instead, the applicant is required to use a "reliable statistical sampling [method] and "fleet testing protocols" to demonstrate no contribution to "significant failures" to meet those standards. As EPA explained its position in the Petrocoal Waiver matter that was the subject of the *MVMA 1985* decision:

> This burden [of proving no impact on emissions compliance], which Congress has imposed on the applicant, if interpreted literally, is virtually impossible to meet as it requires proof of a negative proposition, *i.e.*, that no vehicle will fail to meet emission standards with respect to which it has been certified. Taken literally, it would require the testing of every vehicle. Recognizing that Congress contemplated a workable waiver provision, mitigation of this stringent burden was deemed necessary. For purposes of the waiver provision, ***EPA has previously indicated that reliable statistical sampling and fleet testing protocols may be used to demonstrate that a fuel under consideration would not cause or contribute to a significant failure of emission standards by vehicles in the national fleet.***

46 Fed. Reg. 48,975, 48,976 (Oct. 5, 1981), quoted in *MVMA 1985*, 768 F.2d at 391. The *MVMA 1985* court ultimately concluded that EPA had not actually required the use of the requisite "reliable statistical sampling and fleet testing protocols" in granting a waiver for Petrocoal, and reversed EPA's decision granting that waiver. *Id.* at 402

Since 1985, every subsequent waiver proceeding under section 211(f)(4) reviewed in the court of appeals has largely depended on whether (i) the applicant used "reliable" statistics for the relevant "fleet" of vehicles, and (ii) whether EPA's analysis of the data was reasonable. *See, e.g., Ethyl Corp. v. EPA*, 51 F.3d 1053, 1064 (D.C. Cir. 1995) ("*Ethyl 1995*") (directing EPA to grant waiver, when Agency had accepted data from most extensive testing program in history of waiver proceedings showing that additive would not contribute to "a significant level of emissions failures"). The applicant has the burden of proof, but the burden is satisfied by demonstrating that the nonconforming fuel will not cause or contribute to "significant" failures. The proper construction of "significant" in this context is examined in Part II. Before examining that question, it is important to review the salient features of the current Application.

B. The Current Application

For the reasons outlined in the main text of these comments, the Application cannot be approved. Any decision by EPA approving the Application would not withstand judicial review. In brief:

1. The relevant "fleet" of vehicles and engines has not been fully tested. *MVMA* requires sound "fleet testing protocols." The data contained in the Application does not cover the entire "fleet" of vehicles and engines that would be exposed to E15 as a general-purpose fuel. Congress made it clear in the 2007 Energy Act that all vehicles and engines

meeting EPA standards that might encounter a nonconforming fuel must be included in the necessary fleet testing protocol. That was the purpose of the amendment to section 211(f)(4) included in the 2007 Energy Act. (*See* Main Comments at xxx, xxx.)

2. The limited portions of the relevant fleet that have been tested have not been tested in a statistically useful or meaningful way. The Application contains no data demonstrating the impact, or lack of impact, on the ability of the tested vehicles and engines to meet each of the applicable emissions standards over full useful life. None of the on-road vehicle testing cited in the Application covers the range of useful-life FTP, Supplemental FTP, I/M and onboard diagnostics testing that vehicles manufacturers are required to apply in determining whether their vehicles meet EPA's emissions standards. The Applications' reliance on the interim Department of Energy vehicle test results that it cites is completely misplaced, because the Energy Department vehicle testing did not use any of the test procedure that EPA uses to determine compliance with emissions standards. *Cf. Portland Cement Ass'n v. Ruckelshaus*, 375, 396 (D.C. Cir. 1973) (test procedures that will be used to determine compliance with emission standards must be used in agency determinations of feasibility of standards).

Several other comments on the Application are in order. The Application is wrong or misleading in suggesting that EPA has "repeatedly" granted waiver applications without requiring tests that reliably predict evaporative emissions performance and impacts on evaporative control system components. (*See* Application at 26.) Since the onset of significant evaporative emissions control requirements, such testing has been routinely required and sufficient to represent the entire relevant fleet in the case of alcohol blends.

The Application is also not correct in ignoring the need for a statistical method projecting emissions performance at the end of useful life. The data in Orbital Engineering's reports, as well as the interim Department of Energy data, provide *prima facie* evidence of accelerated losses in efficiency owing to higher exotherms in the converters used in some modern emissions control systems. (*See* Main Text at xxx.) When the relevant effects can include accelerated catalyst deterioration, "back to back" testing to determine so-called "instantaneous" emissions impacts is not sufficient. *Cf. MVMA 1985,* 768 F.2d at 392-93. As the *MVMA 1985* court stated, in an era when 50,000 miles marked the end of the relevant "useful life:"

> Section 211(f)(4) only requires that the EPA determine that a fuel will not cause or contribute to a failure of an emission device to comply with applicable emission standards during a vehicle's useful life, it does not specify that the EPA must base this determination on actual 50,000-mile durability tests in all cases. ***Nonetheless, given section 211(f)(4)'s clear directive that the EPA must evaluate the effect of a fuel over the useful life of a vehicle, the EPA must have a clearly sound basis for determining in a given case that back-to-back testing provides an adequate and sufficient means of evaluation in lieu of actual 50,000-mile testing.***

768 F.2d at 392-93. Even for the limited population of vehicles and engines included in the few portions of the Application that rely on documented tests, there is no discussion of how deterioration factors might be applied to the relevant data points, much less a demonstration that the increases in emissions of oxides of nitrogen shown in Orbital's testing would not contribute to significant failures at the end of useful life.

Finally, without expressing a view on the public policy objectives cited in support of the Application, it bears noting that EPA "may not simply disregard the specific scheme Congress has created for the regulation of fuels" in pursuit of objectives outside the limits of section 211(f)(4). *Id.* at 1060 n.9; see also id. at 1055 ("The language of section 211(f)(4) is clear, directing the Administrator to consider only emissions effects in determining what action to take on a waiver request).

In sum, a decision to approve the Application based on the data proffered in the Application would lack "any rational basis" and could not be affirmed. *MVMA 1985*, 768 F.2d at 393. Because the Agency has indicated that it seeks comments on alternative means of increasing the ethanol content of gasoline in general use, it is also important to consider such strategies in the full statutory context outlined in Part II below. [1]

II. The Relationship Between Section 211 and the Vehicle and Engine Remedial Provisions of the Clean Air Act.

The overall goal of title II of the Clean Air Act is to assure the control of in-use emissions from vehicles and engines, based on full useful-life standards set by EPA pursuant to its delegated authority from Congress. That goal can be frustrated in many ways. One is by the introduction of fuels, additives, or blends that contribute to a significant number of emissions failures. In section 211(f)(4), "Congress adopted a preventative approach" and carefully limited the grounds on which EPA could allow fuel and additive manufacturers to introduce new, nonconforming fuels into commerce *Ethyl 1995*, 51 F.3d at 1055.

After repairing the evident deficiencies in the current Application, parties seeking permission for the energy industry to use blends of ethanol higher than E10 will undoubtedly try to claim that any emissions failures that may result will not be "significant." Indeed, they must prove that such failures will ***not*** be significant in order to obtain a waiver. In denying

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1 For example, in its Notice of Proposed Rulemaking to implement amended section 211(o) of the Clean Air Act, EPA indicates that it may consider defining a blend such as E12 as "substantially similar" to currently authorized fuels for some motor vehicles. *See* 74 Fed. Reg. 24,904, 25,019 (May 26, 2009).

the current Application, EPA would well-serve all stakeholders by clarifying what "significant" means in this context.

The starting point for that clarification should be the provisions of the Clean Air Act that articulate the vehicle and engine industries' duties to ensure compliance with EPA's emissions standards. The bedrock provision of title II in this regard is section 207(c)(1) of the Clean Air Act, which provides in pertinent part as follows:

> If the Administrator determines that ***a substantial number*** of any class or category of vehicles or engines, although properly maintained and used, do not conform to the regulations prescribed under section 202, when in actual use throughout their useful life (as determined under section 202(d), he shall immediately notify the manufacturer thereof of such nonconformity, and he shall require the manufacturer to submit a plan for remedying the nonconformity of the vehicles or engines with respect to which such notification is given. The plan shall provide that the nonconformity of any such vehicles or engines which are properly used and maintained will be remedied at the expense of the manufacturer.

42 U.S.C. § 7541(c)(1) (emphasis added). [2]

Section 207(c)(1), strikes a balance "among competing goals of consumer convenience, improved air quality, and the technical accuracy which would insure that manufacturers are not forced to repair ***significant numbers*** of properly functioning vehicles." *Motor Vehicle Mfr's Ass'n v. Ruckelshaus,* 719 F.2d 1169, 1168 (D.C. Cir. 1983) ("*MVMA 1983*") (emphasis added; internal quotation marks omitted). A vehicle or engine manufacturer "incurs heavy costs -- both financial and goodwill -- simply by issuing [a recall]

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[2] EPA has written similar criteria for remedial action into its non-road regulations adopted under section 213. *See, e.g.,*40 C.F.R. § 90.808 (limiting recall authority to cases in which "substantial number" of engines in a defined class or category subject to Part 90 standards and test procedures do not conform with the Part 90 standards).

notice to owners." *General Motors Corp. v. Ruckelshaus,* 742 F.2d 1561, 1566 n.7 (D.C. Cir 1984) (en banc).

Accordingly, section 207(c)(1) only permits "classwide remedies" in response to "classwide defects." *General Motors*, 742 F.2d at 1568. As in section 211(f)(4) proceedings, the use of reliable statistics is critical in determining whether a recall can be ordered under section 207(c)(1).[3] Recalls cannot be not required for nonconformities that do not appear in a "substantial number" of vehicles in a given class, which *MVMA 1983* equated to a "significant numbers" of vehicles.

Equally important, the court of appeals has recognized that Congress did not intend to impose recall liability on manufacturers, even for class-wide emissions failures in a substantial or significant number of vehicles, if those failures could not have been reasonably avoided by the manufacturer. As Chief Judge Wright explained in 1980, "Unless the cause of the nonconformity is within the manufacturer's control, an imposition of liability would be an unwarranted financial burden on the manufacturers, unrelated to the strategy of forcing technological progress." *Chrysler Corp. v. EPA*, 631 F.2d 865, 888 (D.C. Cir. 1980).

Combining those two strands of case law under section 207(c)(1), the only reasonable way to understand the term "significant failures" in EPA's section 211(f)(4) doctrine is as follows: a waiver applicant under section 211(f)(4) has the burden of proving that any level of failure in the relevant vehicle and engine population will not rise to a class-wide level that EPA could treat as "substantial" enough to warrant an ordered recall. Otherwise, vehicle and

[3] Congress expected EPA to define the recall "class or category" by reference to a "representative sample" of vehicles. Summary of the Provisions of Conference Agreement on the Clean Air Act Amendments of 1970, *reprinted in* 116 Cong. Rec. 42,384 (1970).

engine manufacturers will be made responsible for emissions failures and recalls based on conditions beyond their control, in violation of the liability rule established in the 1980 *Chrysler* decision.

Because it is impractical to make a party seeking a section 211(f)(4) waiver generally responsible for in-use emissions failures that warrant recalls or other remedies, it is critical for EPA to determine up-front, ***before*** granting a waiver, that the relevant fuel, additive or blend will not contribute to a substantial failure rate in the relevant vehicle population. Stated another way, the statistical demonstration needed to support a recall order under section 207(c)(1) should define the proof needed to grant a waiver under section 211(f)(4). That is the only way that EPA can effectuate the "preventative approach" embodied in section 211(f)(4) that recognizes the limits on its recall and remedial powers with respect to vehicles and engines. Once EPA grants a waiver under section 211(f)(4) for a given fuel, additive or blend, it cannot therefore properly order a recall or other remedy for in-use emissions failures that can be attributed to that fuel, additive or blend. Likewise, any EPA determination that a blend greater than E10 is "substantially similar" to E10 (such as E120 must necessarily rest on the premise that any failures in the in-use vehicle population to which the higher ethanol blend contributed would not be substantial enough to warrant a recall or other remedial action.

EXHIBIT C

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Minnesota E20 EPA Fuel Waiver Evaluation - Quantum

Revisions

Date: 4/27/2007 - Written by Kevin Goplen
5/4/2007 - Kevin Goplen added M10 stability testing results.
5/14/2007 – Kevin Goplen revised chart on page 23.

Background

Minnesota state legislature is mandating the use of gasoline containing 20% by volume ethanol (E20) to replace current gasoline containing 10% by volume ethanol (E10) by August 30, 2013. E20 poses a problem for off highway engines due to enleanment of the air/fuel mixture in carbureted, open loop systems.

Conclusion

Initial testing indicates that E20 is not substantially similar to E0 under Section 211 of the Federal Clean Air Act. The following is a summary of conclusions for each test:

Materials Compatibility
Fuel Soaking - E20 is not compatible with some fuel system components, especially fibrous and rubber gaskets. Failure of these components will cause fuel to leak contributing to evaporative emissions and pose a safety hazard.
Temperature Testing - Higher operating temperatures experienced with E20 leads to problems such as head gasket failure and vapor lock.

Drivability and Performance
Stability - Strip Chart Testing - Enleanment from the extra oxygen in E20 decreased stability leads to poor performance, such as harsh audible rpm oscillation, for the end-user.
Starting - Strip Chart Testing - Slower acceleration leads to poor load acceptance and reduces performance for the end-user.
Horsepower and Torque Testing - E20 showed a negligible increase in peak horsepower of approximately 2% and negligible change in peak torque.

Emissions
Exhaust Emissions - E20 HC + NO_X increased 10.5%. A carburetor calibration would be required to maintain current levels.
Evaporative Emissions - To be completed

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Health and Safety Issues - No testing to date

One of the major concerning issues is the 10.50% increase in weighted HC + NO_X. The increased oxygen content in ethanol accounts for a leaner air/fuel mixture. In order to obtain the correct air/fuel ratio using E20 a carburetor calibration is required. For E20 to be considered substantially similar to E0, E20 must be backwards compatible with product that is currently in use in the field. Thus, the use of E20 in existing engines would require tampering with an emissions control devise in order to maintain HC + NO_X levels and thus violate the Federal Clean Air Act.

Recommendations

E20 should not be considered substantially similar to E0 due to the increase in exhaust emissions and required carburetor calibration, the decrease in rpm stability, and material incompatibility.

Procedure

E20 fuel specifications do not exist and need to be determined. The Code of Federal Regulations (CFR) and ASTM specifications are not established for E20 fuel. Specifications are needed for vapor pressure, volatility, and additive packages that include corrosion and oxidation inhibitors and their required concentrations. E22 Brazilian Yellow fuel is the closest legal option to E20. The assumption has been made that E22 Brazilian Yellow is representative of future specifications of E20 fuel. E22 Brazilian Yellow is used for all testing and is referred to as E20 in the entirety of this report. The Certificate of Analysis for E22 Brazilian Yellow is included at the end of this report.

To determine the specific problems associated with the use of E20 in small off-road engines E20 is being tested vs. E10 vs. Non-reformulated gasoline (E0) using a 6.0 HP Quantum engine (engine 123K02 0239E1 04061458 was used for all testing except exhaust emissions). The EPA registration process of E20 consists of four categories of testing: Materials compatibility, Drivability and Performance, Emissions (exhaust and evaporative), and Health and Safety. The following outlines the testing completed, in progress, and planned:

Materials Compatibility
Fuel Soaking
Temperature Testing

Drivability and Performance
Stability - Strip Chart Testing
Starting - Strip Chart Testing
Horsepower and Torque Testing

Emissions
Exhaust Emissions
Evaporative Emissions

Health and Safety Issues
No testing to date.

Results

Material Compatibility

Fuel Soaking

Fibrous and rubber gaskets have been observed to need frequent replacement during testing of E20 fuel. These gaskets include the fuel bowl nut gasket and the fuel bowl gasket. The failure of either of these gaskets causes fuel to leak from the carburetor. Leaking fuel increases evaporative emissions and present a danger to the consumer.

A controlled study on the affects of different levels of ethanol has also been conducted. A fuel soak test was performed on all parts that come into direct contact with the fuel. These parts include carburetor bodies of zinc and aluminum, brass fuel metering jets, rubber and fiber gaskets, rubber primer bulbs, floats, and fuel bowls. These parts were soaked in three different fuel samples: E0, E10, and E20. This test does not expose differences at the same rate as does actually running due to the controlled environment in a sealed jar with minimal exposure to the air to promote oxidation.

After six months of testing the affects of the different fuels became more apparent. E20 caused the gaskets and rubber parts to swell and gain mass by approximately 5 – 10% more than E0. Primer bulbs and fuel nut gaskets were affected the most of the parts. On the carburetor bodies the epoxy that holds the Welch plug in place over the progression holes was severely attacked by the E20 and caused the epoxy to dissolve and cover the entire Welch plug surface. While the plug did not fall out, on a running engine this could occur and cause fuel to leak from the carburetor. The inlet needle seats also swelled and could cause the needle to not make a solid seal, which could also cause a fuel leak. Fuel cap gaskets swelled to the point of becoming nonfunctional and prevented the caps from being completely tightened, which also increases evaporative emissions.

Another fuel soak test was conducted on garden tractor fuel tank caps and seals. It was found that the samples soaked in E20 exhibited extreme swelling compared to samples soaked in E0. Figure 1a shows the dry caps and seals prior to soaking. Figures 1b,c show the extreme swell as a result of the E20 soak.

Temperature Testing

The excess oxygen present in the fuel causes a hotter combustion and results in a higher operation temperature. The higher temperature causes material compatibility issues. For example, head gasket failure was observed after only 25 hours of very light duty testing. Figures 2a,b are photographs of the failure area around the exhaust valve. The photos clearly show the failure due to high temperatures at the exhaust valve and the location of where gasses started to escape past the gasket. The increased operation temperatures of E20 can be seen in Figures 3a-c.

Drivability and Performance

Stability - Strip Chart Testing

As seen in Figures 4a,b, E20 increases the peak-to-peak rpm operating stability range considerably. A 29% increase over E0 was observed with E20 at 70° conditions compared to only an 11% increase using E10. The decrease in rpm stability using E20 is almost three times worse than the decrease in rpm stability using E10. Figures 5a,b show the strip chart readout for 120 seconds of steady state operation for 40° F and 70°F, respectively.

At 40°F the cooler air creates a leaner operating condition than at the design temperature of 70° F due to the increase in air density. This, in combination with the enleanment from the ethanol containing fuels, decreases the rpm stability considerably over E0, 35% for E10 and 41% for E20. The further decrease in stability caused by the enleanment of E20 is masked by the enleanment caused by the cooler air. At these conditions the rpm operation range reaches a point where little to no decrease in stability is observed from the further enleanment. This is the reason for only a 6% increase from E10 to E20 at 40° F with a blade load. The 40° F bare shaft results emphasize the previous point. The decrease in stability caused by the reduced inertia results in little change in stability when using E10 and E20. Therefore, tests conducted at 70° F with a blade load most accurately represent the decrease in stability with the use of E20.

The decrease in stability will have a negative impact on the quality of the product. The tight exhaust emission restrictions have pushed operating conditions to the lean limit. The further enleanment from E20 will cause harsh and annoying audible speed oscillations. Also, the rpm instability will cause generators to violate the SAE J1444 regulation and fail the requirements for Class A and Class B speed regulation.

In addition to the above testing, stability problems have been observed with M10 7/16 venturi air vane governor. This testing was conducted using engine 10A902-1020-81-00022355. Two different nozzle suppliers were used in this testing. The new supplier has a slightly leaner main jet than the original supplier. The data shows a 15% decrease and a 41% decrease in stability with E20 with a normal calibration and slightly lean calibration respectively. CO was reduced by 51% and 62% for the normal calibration and slightly lean calibration respectively. This is a further example of the decreased performance caused by the further enleanment of the air/fuel ratio due to the use of E20 in an E0 engine.

Starting - Strip Chart Testing

Figures 6a,b show the starting strip chart results at 40° F and 70° F respectively. The colored dots on the graph represent approximately when the engine rpm’s reach a level speed. E20 typically takes longer to accelerate to a level speed than E10 and E0. The implication to the end-user of poor acceleration from E20 decreased ability of the engine to accept load. Once reaching a level speed E0 remains stabile while E10 and E20 continue to oscillate. Additional testing should be conducted to further determine if starting difficulty is observed with E20 at lower temperatures.

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Horsepower and Torque Testing

Figure 7 and Figure 8 are horsepower and torque curves, respectively, for each fuel type. A drop in horsepower and torque is observed when operating on E10. This is caused by the reduced energy density of the ethanol in the fuel. A negligible increase in peak horsepower of approximately 2 % is observed with the combustion of E20. Increased evaporative cooling of the intake charge from the extra ethanol provides an increase in power that compensates for the drop in energy density. Also, a negligible change in peak torque was observed.

Emissions

Exhaust Emissions

Standard weighted emissions tests were conducted using a Quantum engine (125K02 – 0500E1 – 05072158). Figure 9a shows the % CO modal data for E0 and E20. Approximately a 3.5 % CO enleanment of E20 vs. E0 was seen at every loading condition. This reduction in CO pushes engine operation to the lean limit. This leads to poor performance for the end-user as previously discussed. Figure 9b shows the specific weighted CO and CO_2 emissions. CO_2 is not considered a pollutant, but is considered a greenhouse gas and leads to global warming. E20 increased CO_2 emissions 107 g/hp-hr, which equates to a 14 % increase. Figure 9c shows the specific weighted HC, NO_X, and HC + NO_X emissions. Despite the reduction in HC with E20, NO_X emissions increased 133%, and therefore resulted in an overall 10.5 % increase in combined HC + NO_X emissions. NO_X is a smog-forming agent that contributes to the production of acid rain.

Table 1 shows the tabulated results from the emissions tests. The results show that a carburetor calibration would be required to maintain current emission levels obtained with E0 and California Phase II Certification fuel. An increase of 10.5 % in weighted HC + NO_X was observed when running on E20. The use of E20 in existing engines would require tampering with an emissions control devise in order to maintain HC + NO_X levels and thus violate the Federal Clean Air Act.

Evaporative Emissions

Due to the ethanol in the fuel, the evaporative emissions testing will be conducted at Automotive Testing Labs (ATL).

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Appendices of Data

Material Compatibility Appendix

Figure 1a: New and Dry fuel caps and seals prior to fuel submersion testing

Figure 1b: Fuel cap and seal assembly after a week's submersion into E20. Notice the bulging of the seal due to the extreme swelling of the gasket seal.

Figure 1c: Fuel seal after a week's submersion into E20. Notice the deformation of the gasket due to the extreme swelling.

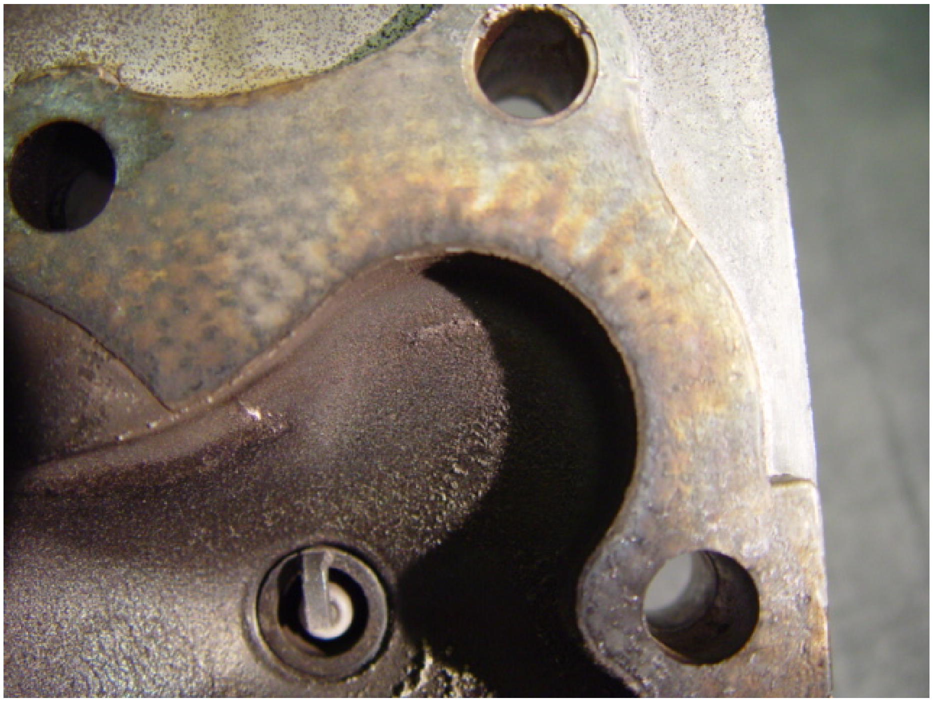

Figure 2a: Cylinder head exhaust blow-by caused by high combustion temperatures.

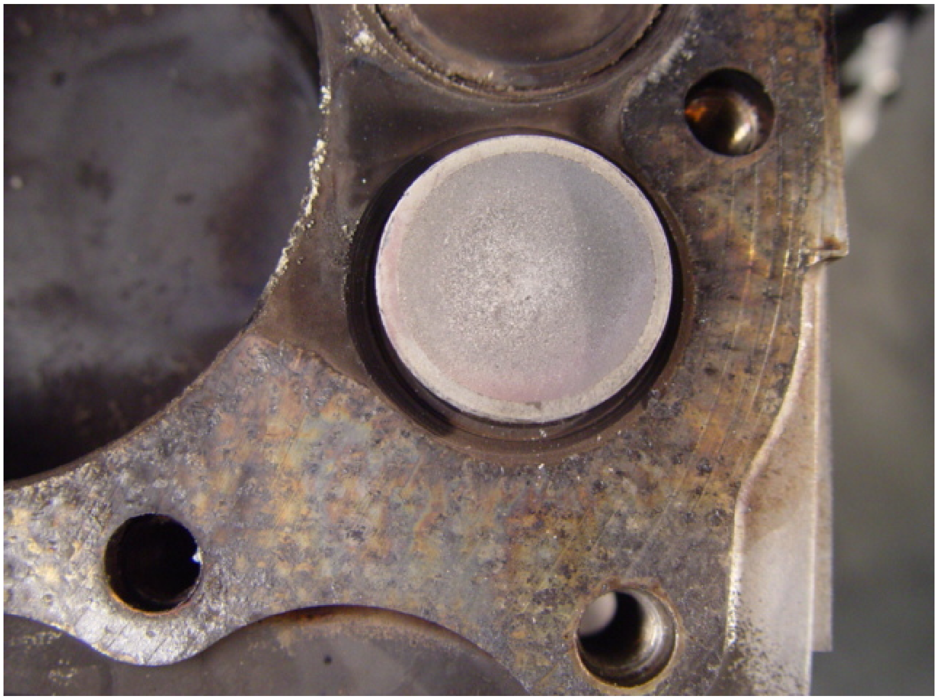

Figure 2b: Hot exhaust valve with blow-by caused by high combustion temperatures.

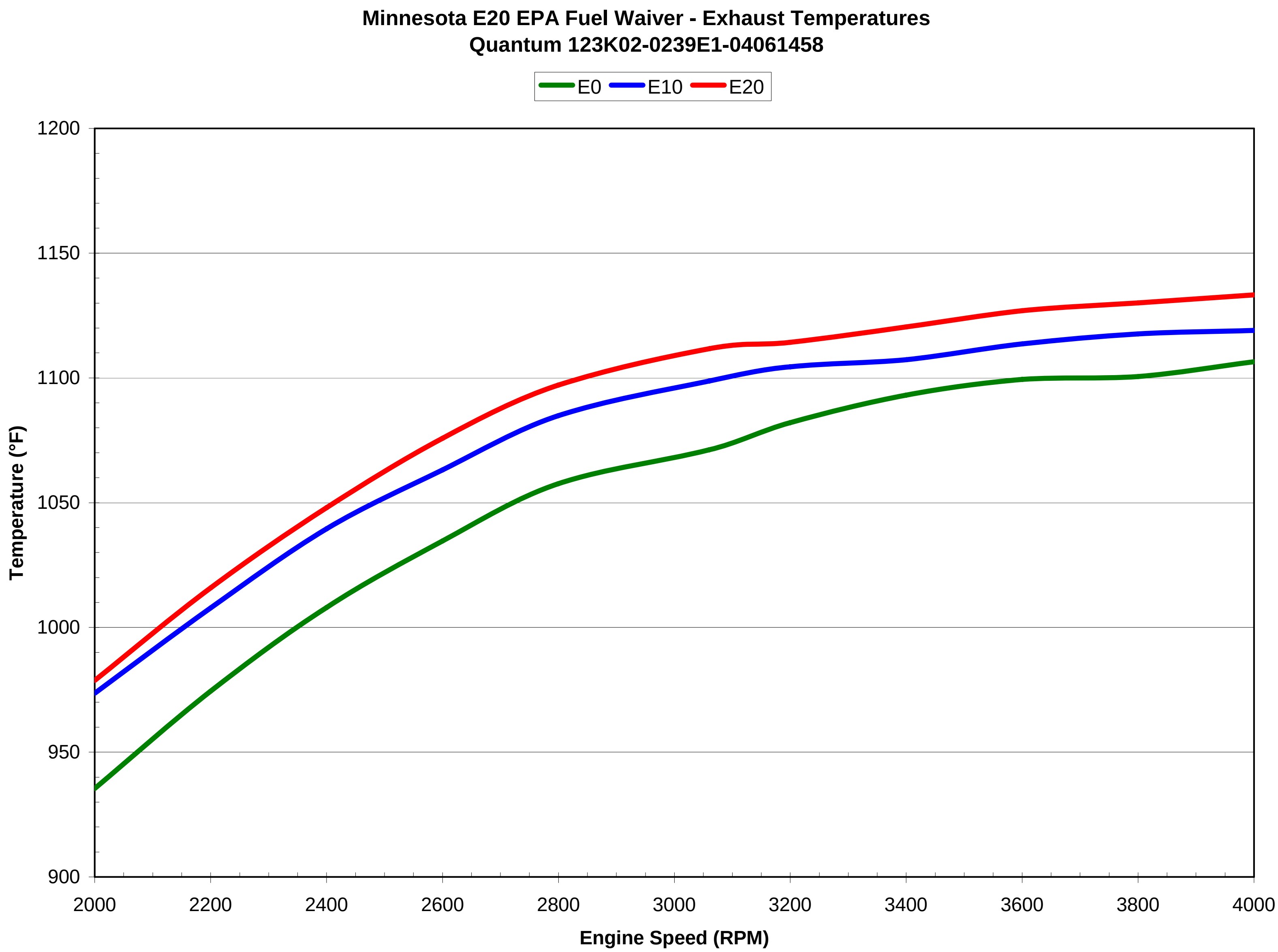

Figure 3a: Exhaust Temperature Curves

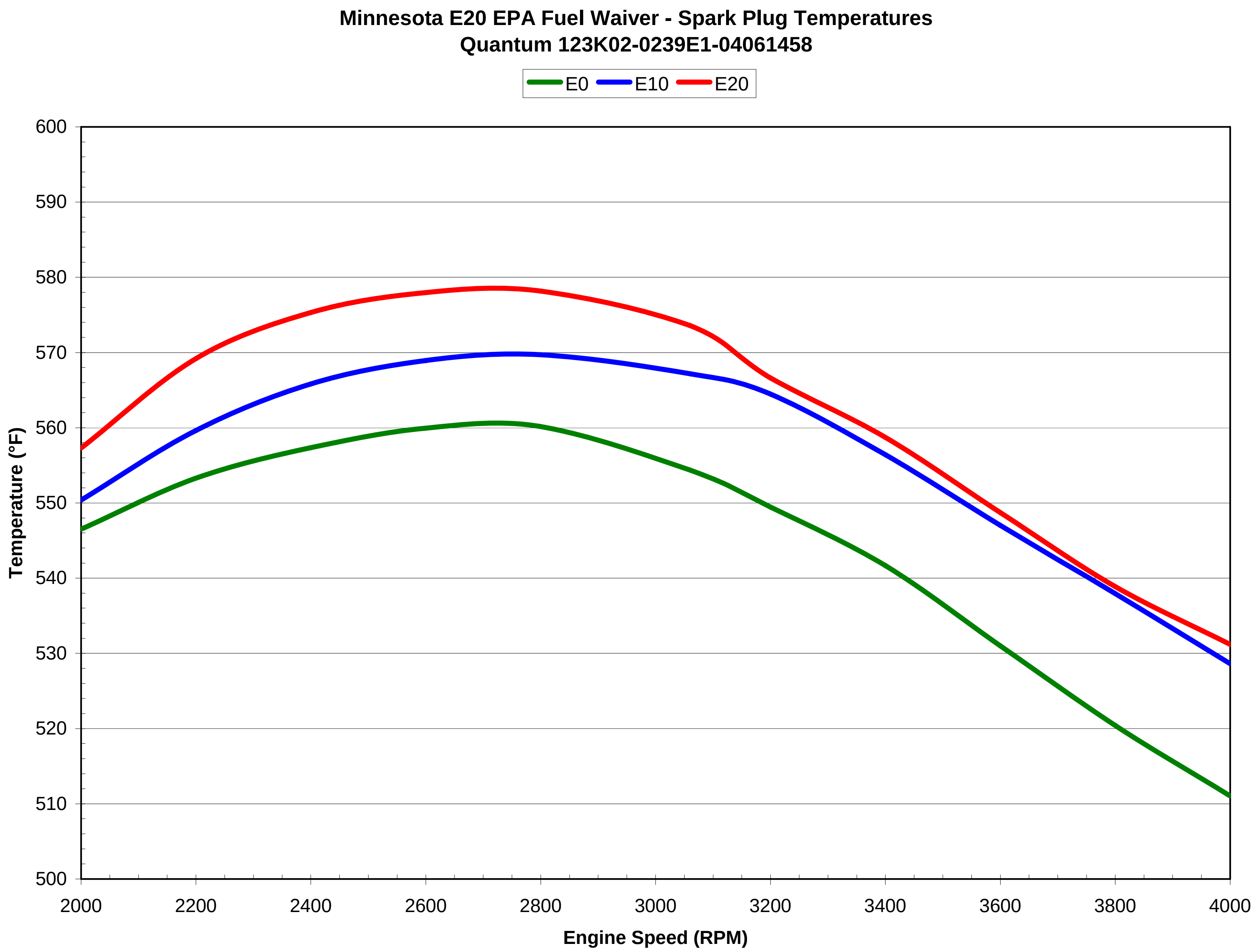

Figure 3b: Spark Plug Temperature Curves

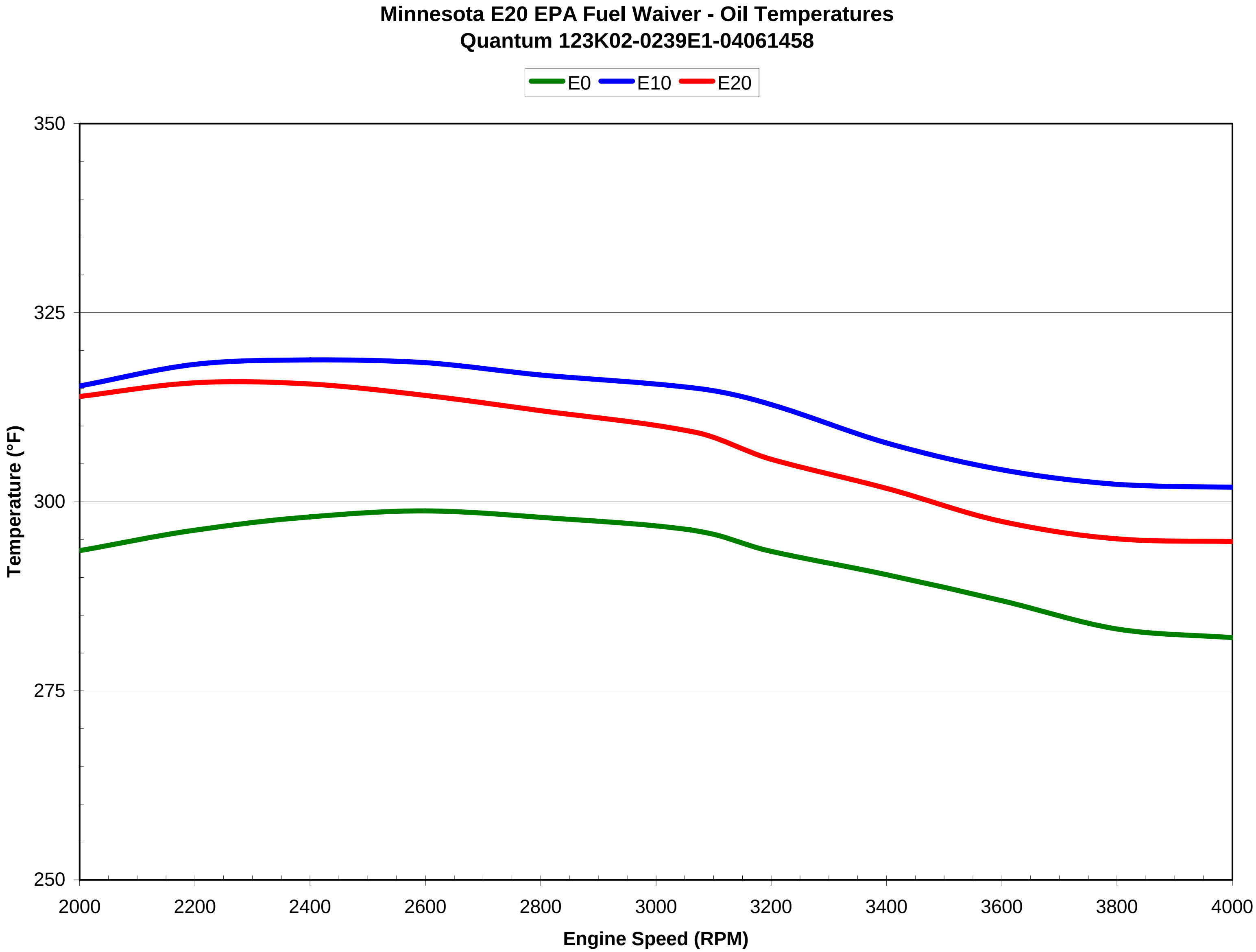

Figure 3c: Oil Temperature Curves

Drivability and Performance Appendix

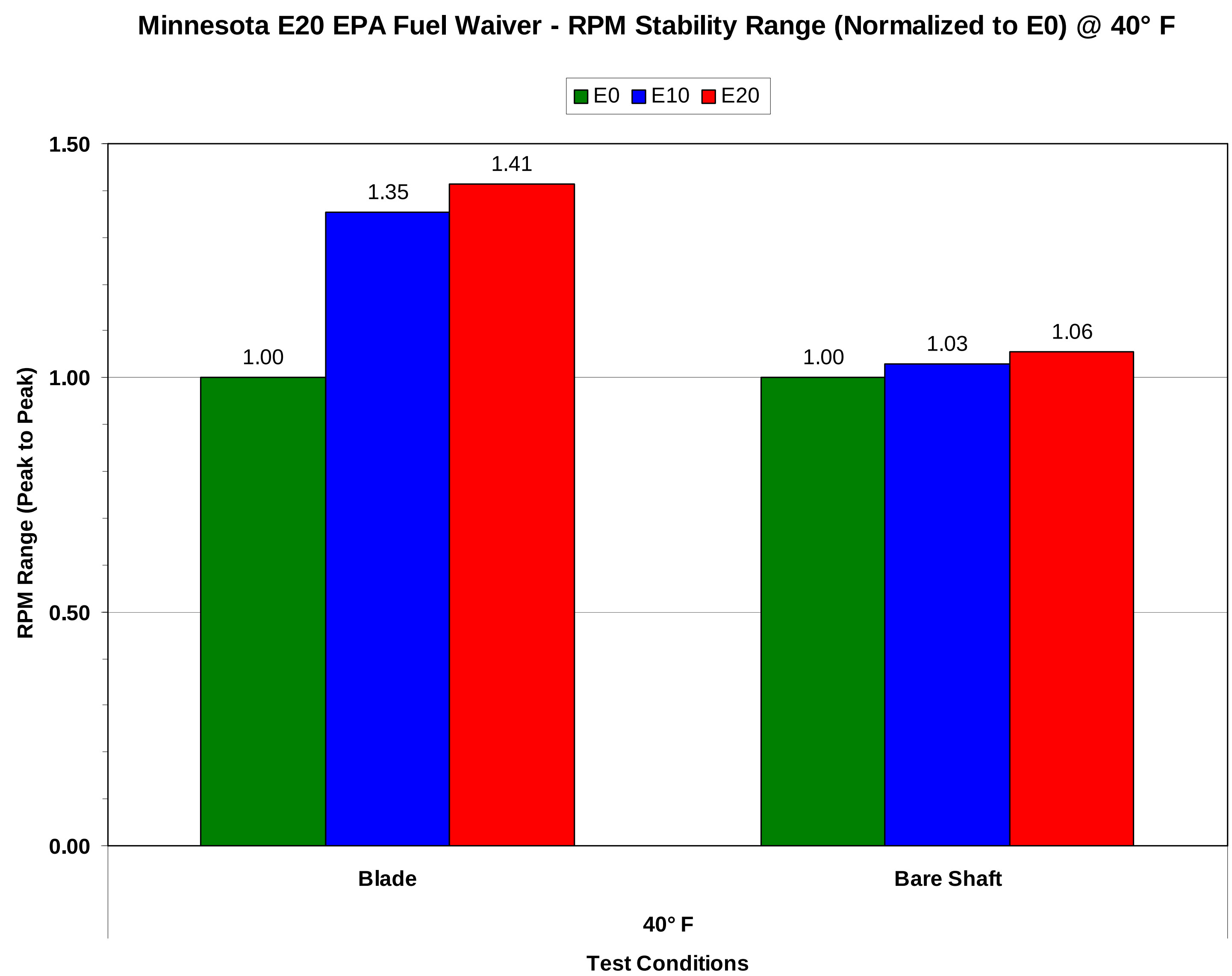

Figure 4a: RPM peak to peak stability range normalized with respect to E0 @ 40° F

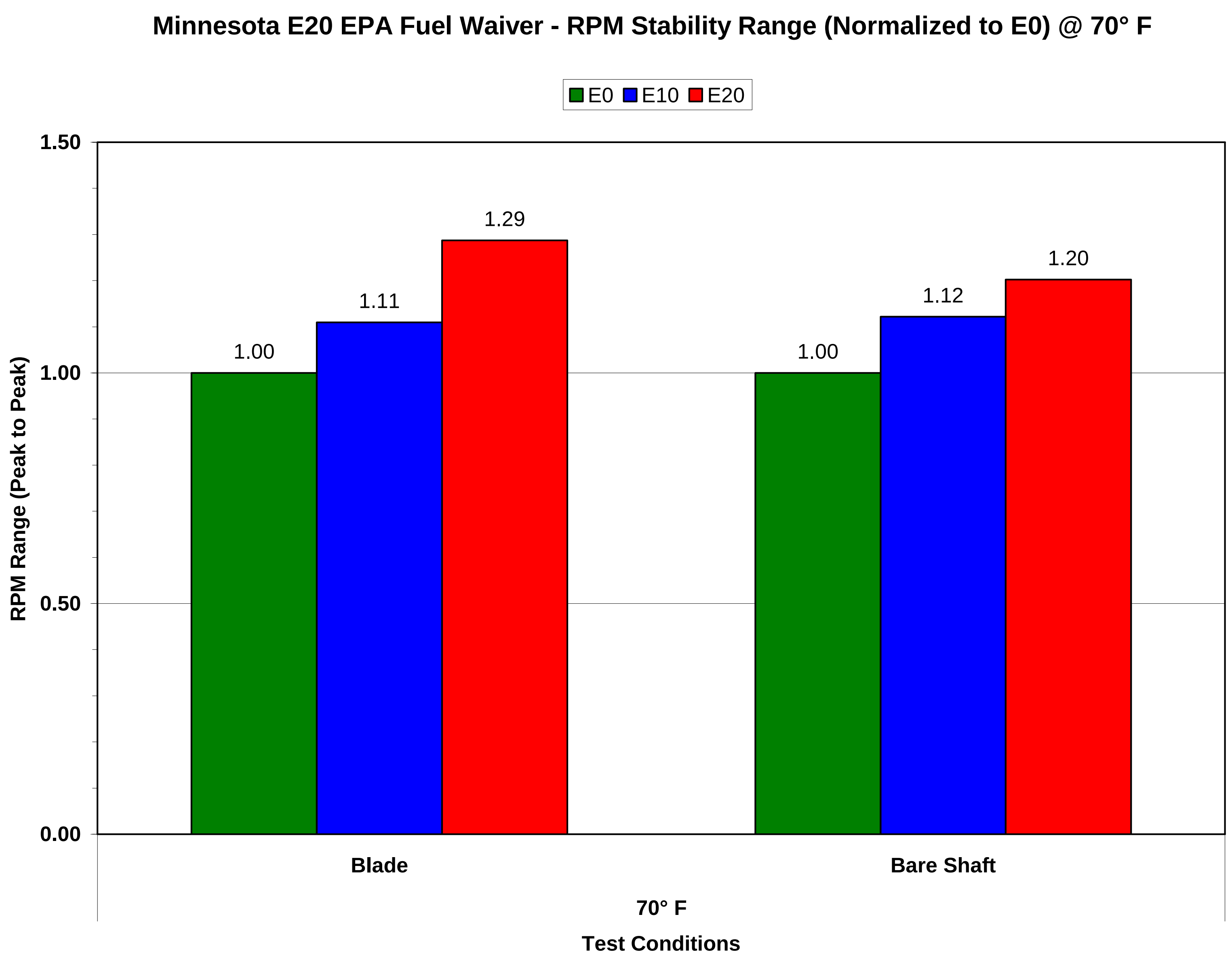

Figure 4b: RPM peak to peak stability range normalized with respect to E0 @ 70° F

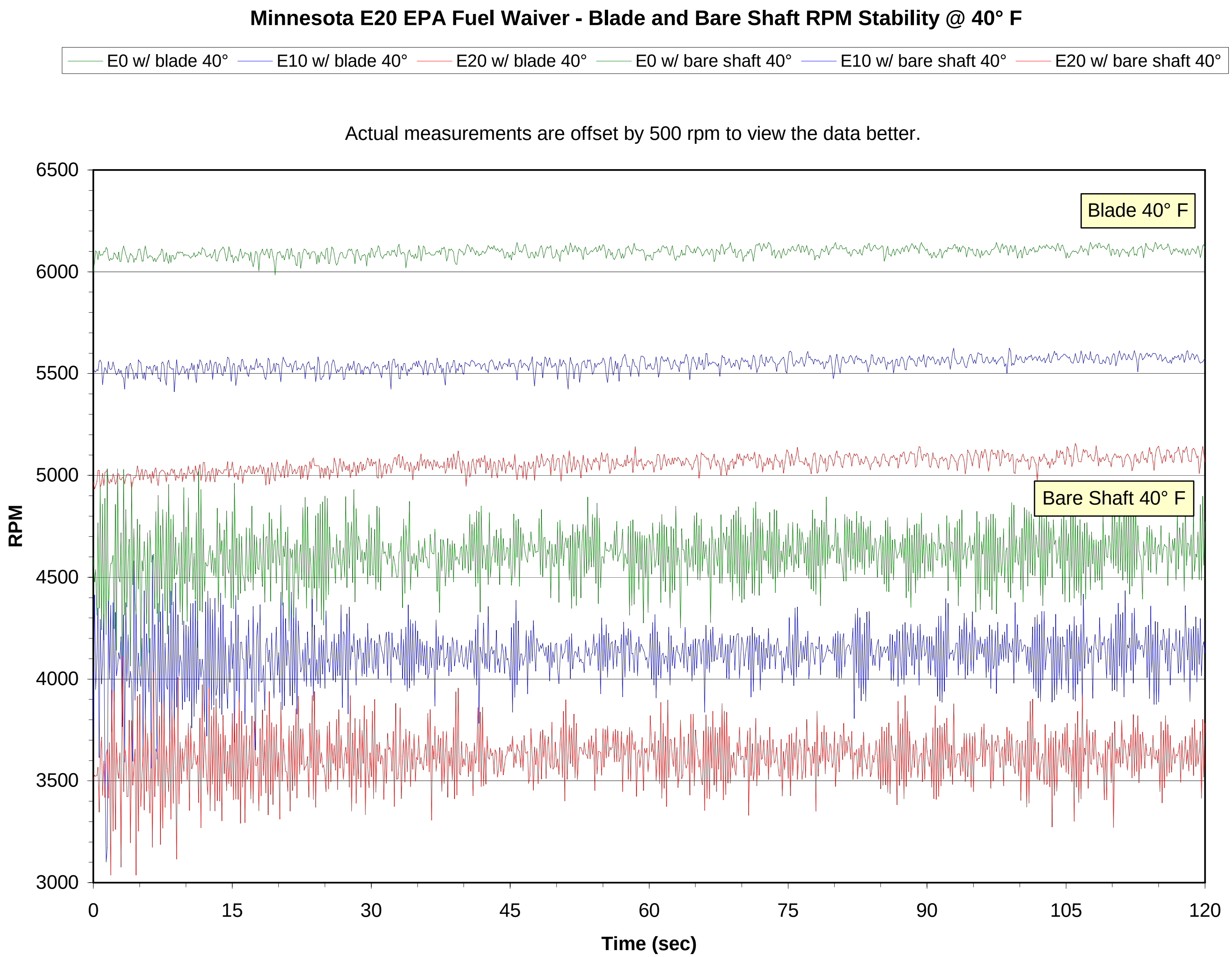

Figure 5a: RPM Stability Strip Chart Results @ 40° F

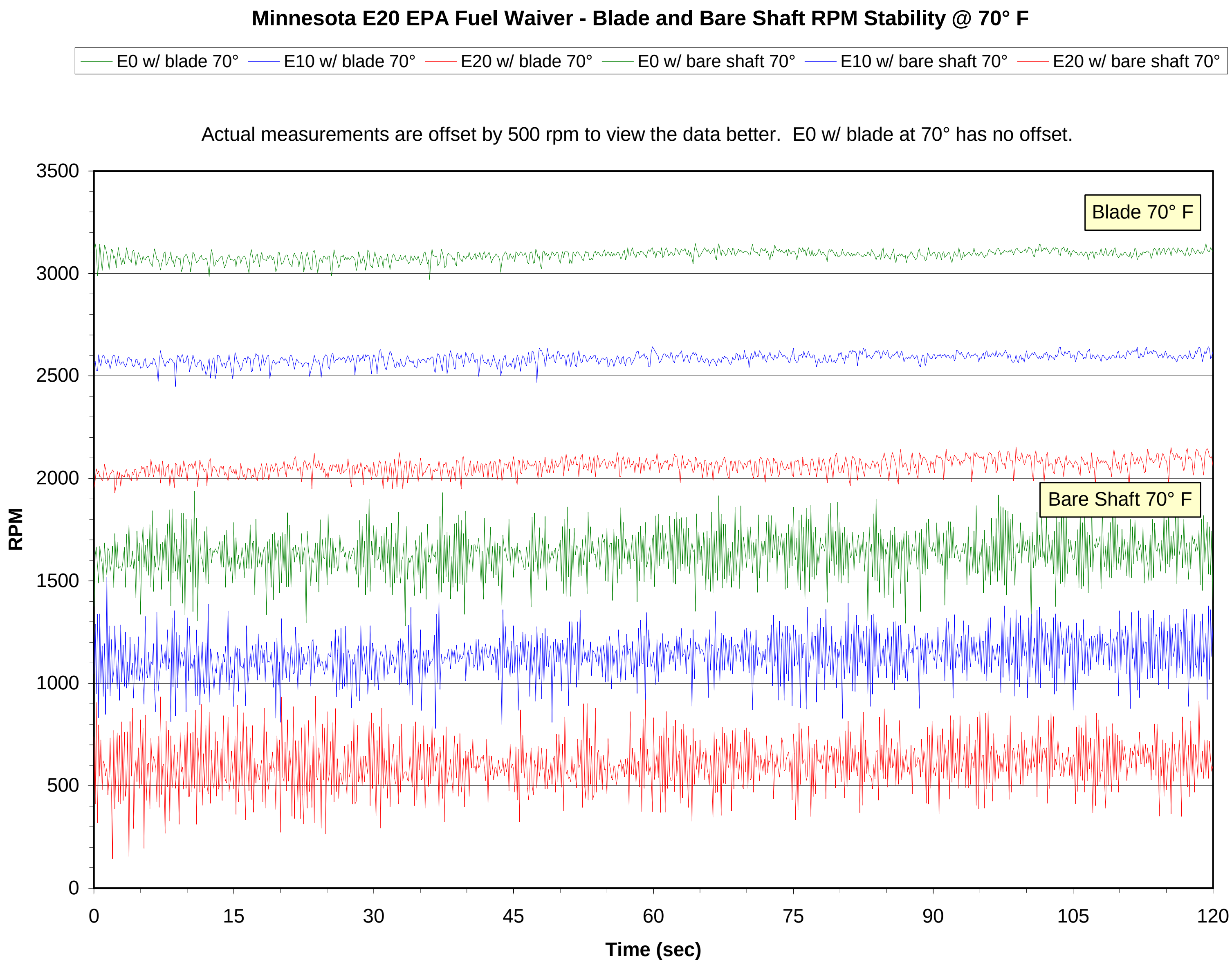

Figure 5b: RPM Stability Strip Chart Results @ 70° F

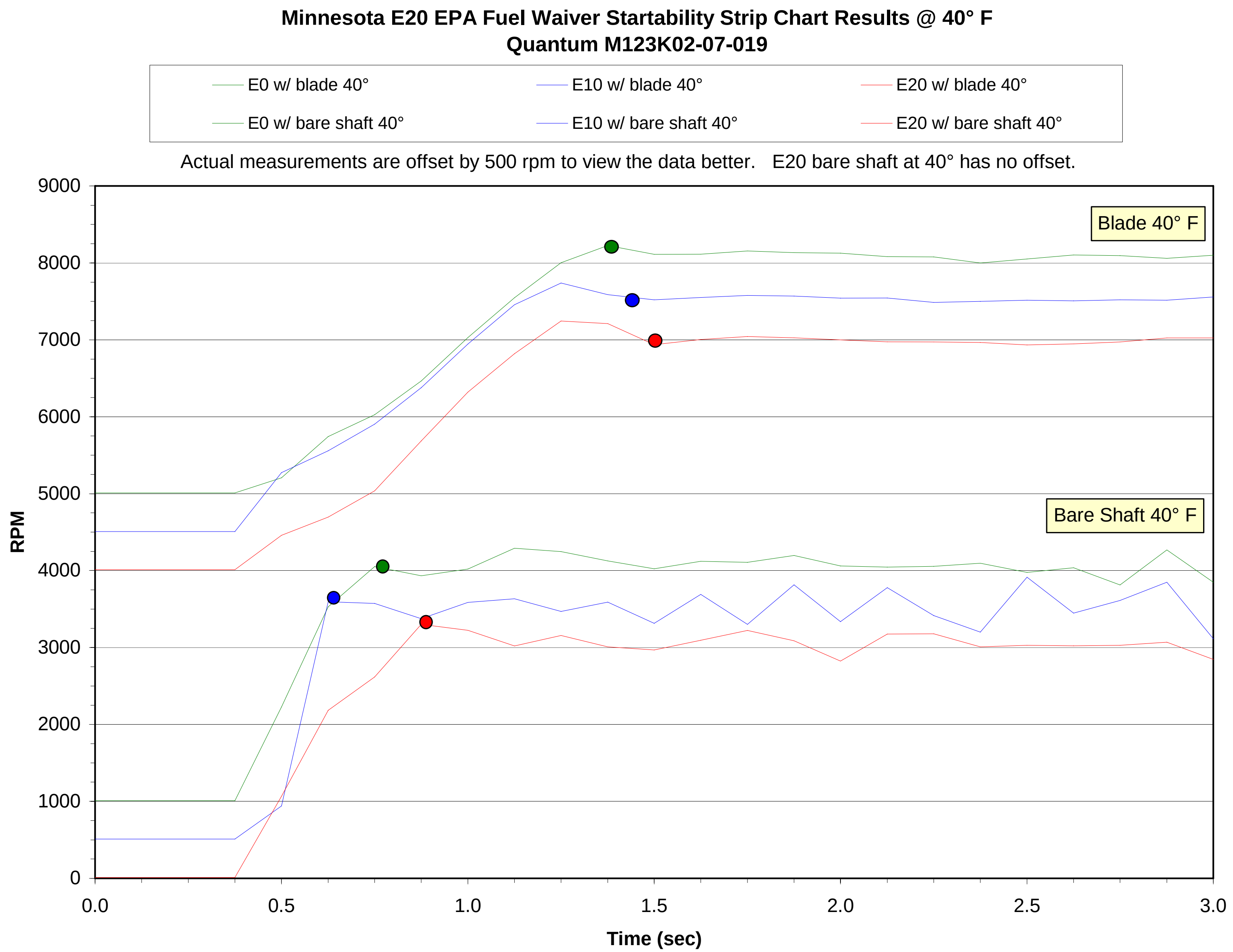

Figure 6a: Startability Strip Chart Results @ 40°F

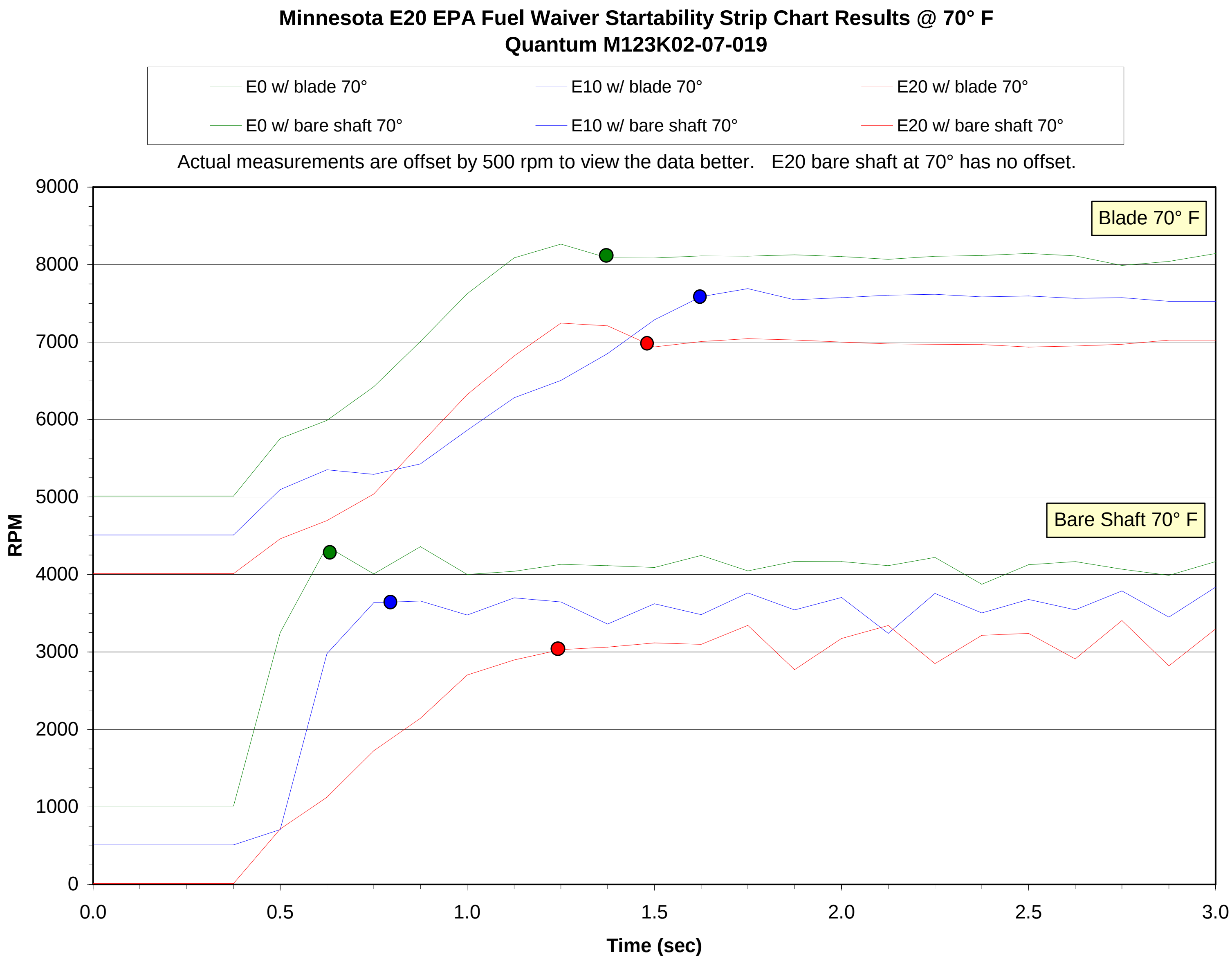

Figure 6b: Startability Strip Chart Results @ 70° F

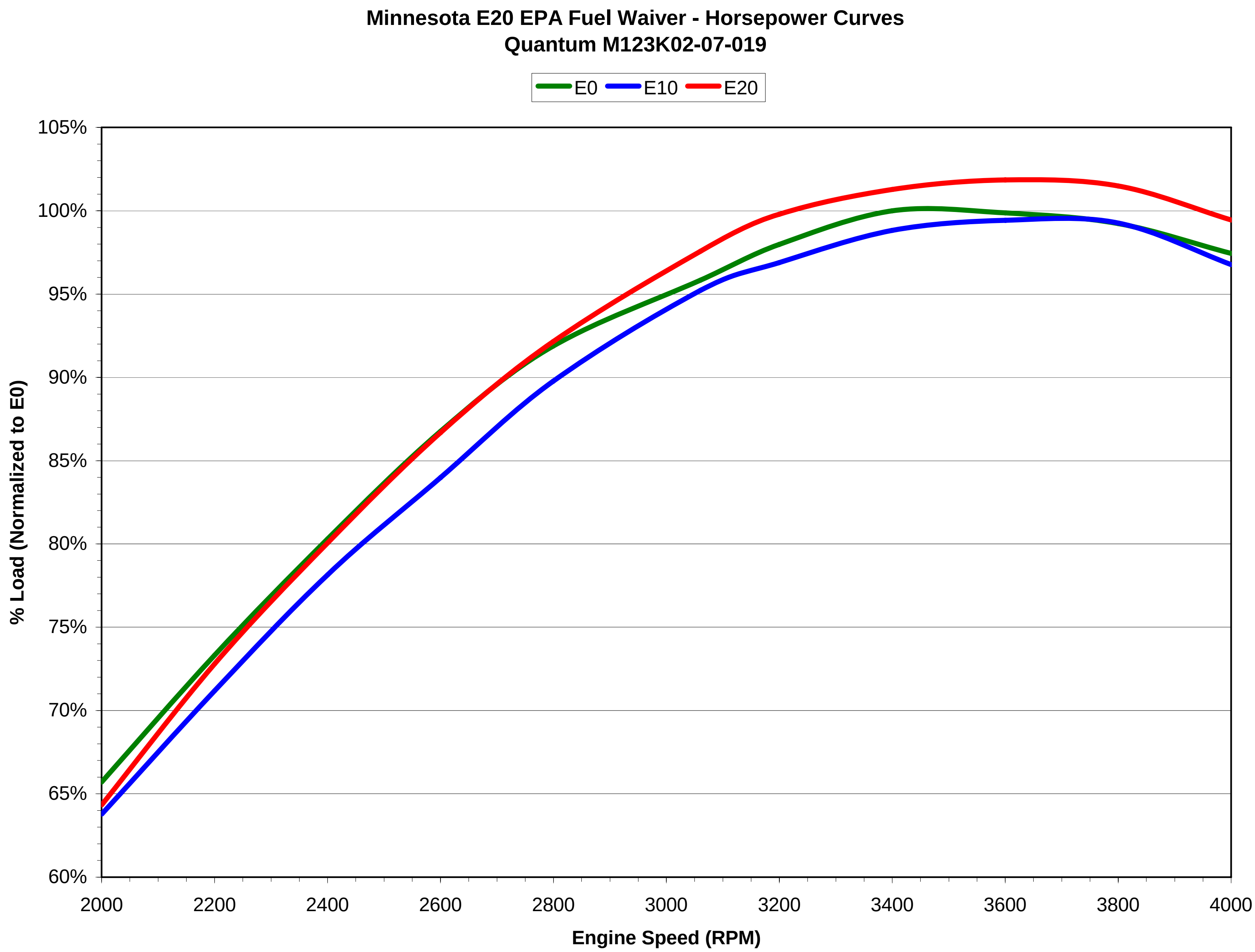

Figure 7: Horsepower Curves

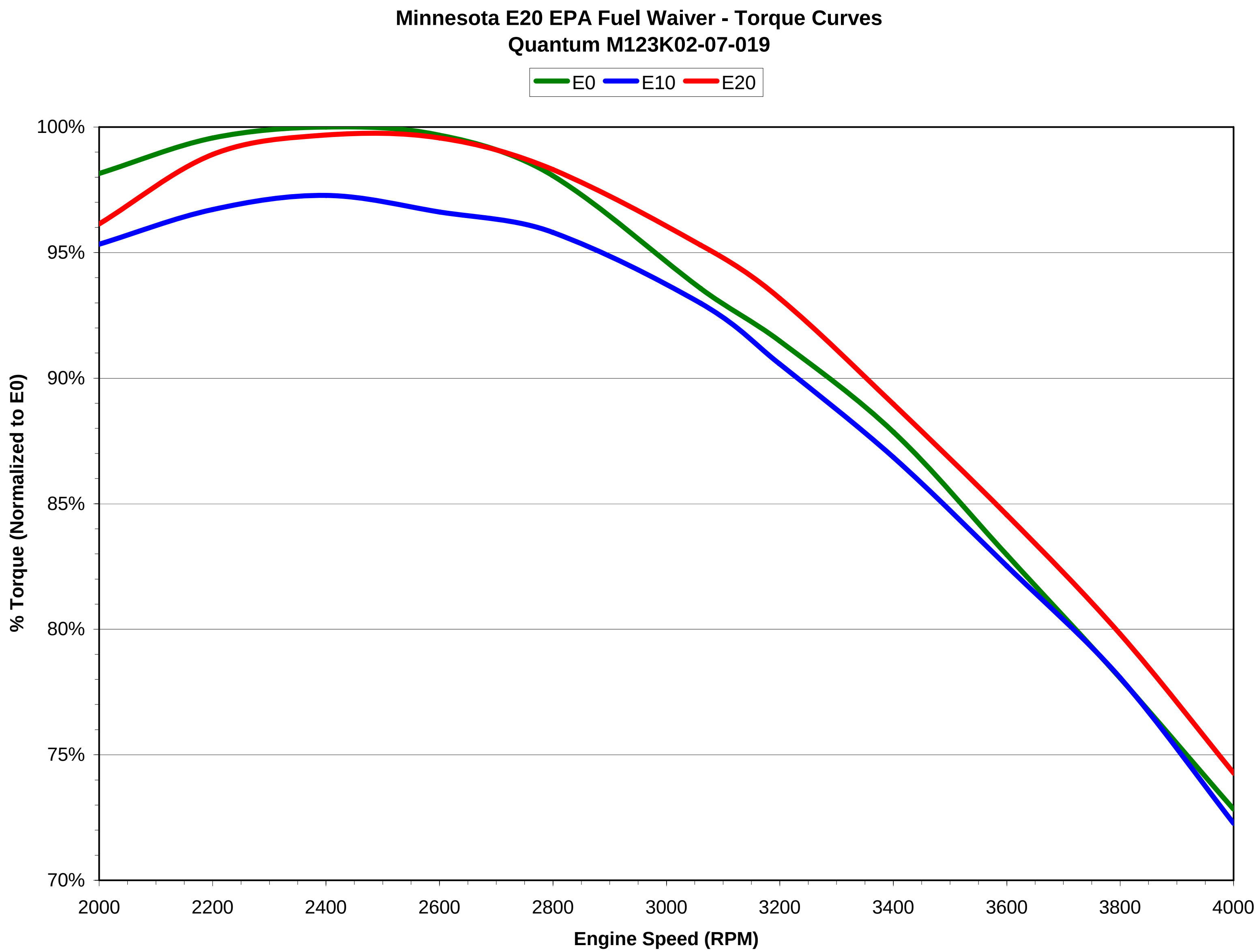

Figure 8: Torque Curves

Emissions Appendix

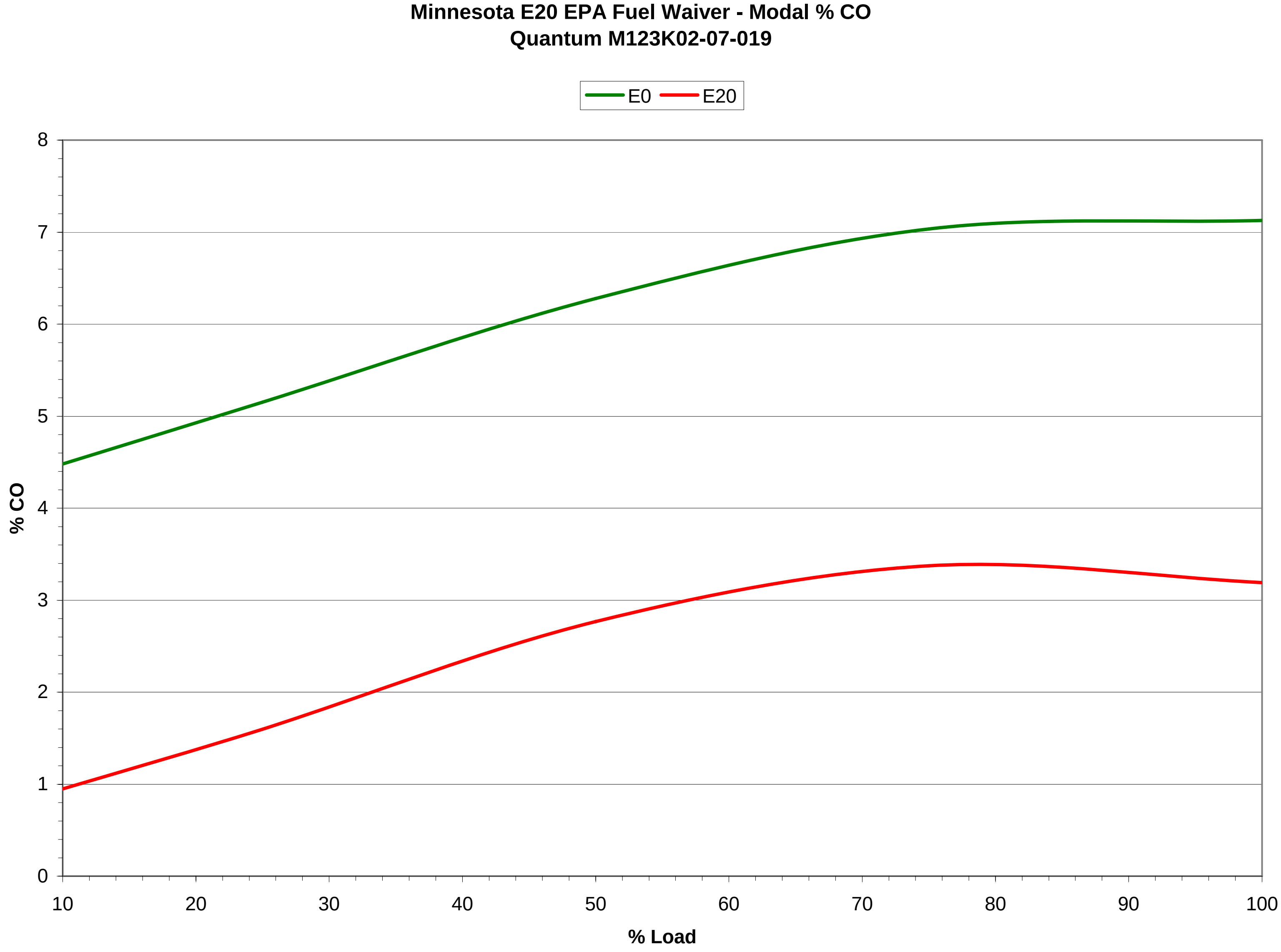

Figure 9a: % CO vs. % Load

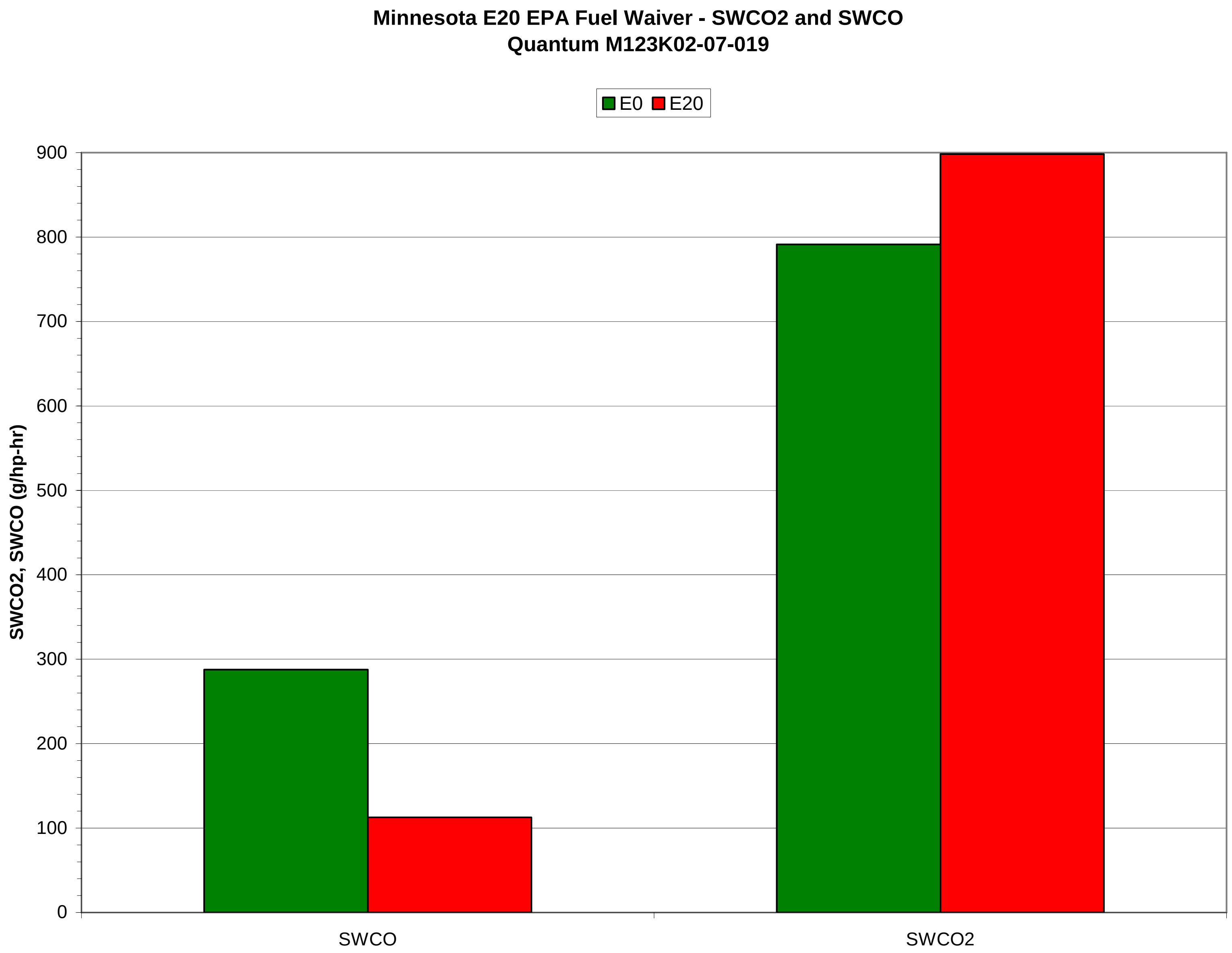

Figure 9b: Specific Weighted CO and CO_2

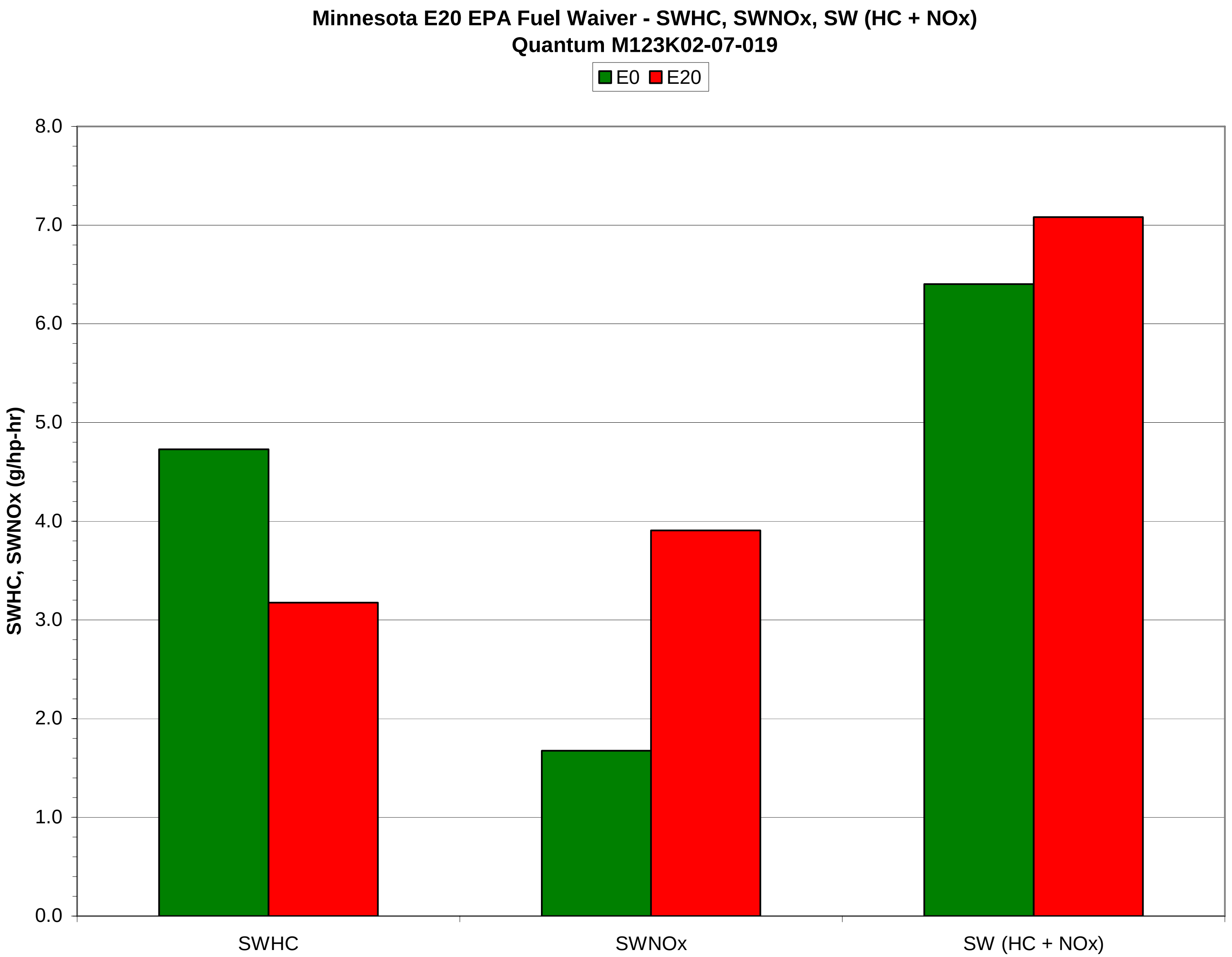

Figure 9c: Specific Weighted HC, NO_X, and HC + NO_X

Engine: 125K02 - 0500E1 - 05072158

	Weighted Specific Emissions					
	CO2	HC	NOx	CO	HC+NOx	
E0	791.360	4.729	1.675	287.620	**6.404**	(g/hp hr)
Cert Fuel (~E10)	813.790	4.545	1.862	238.970	**6.408**	(g/hp hr)
E20	898.230	3.174	3.907	112.660	**7.081**	(g/hp hr)

	E0	Cert Fuel (~E10)	E20	
Input	CO	CO	CO	Weight
Mode	percent	percent	percent	Factor
3 - 100%	7.13	6.28	3.19	0.09
4 - 75%	7.04	5.65	3.37	0.21
5 - 50%	6.28	5.77	2.77	0.31
6 - 25%	5.15	4.21	1.6	0.32
7 - 10%	4.48	3.95	0.95	0.07
Weighted	**156.950**	**133.967**	**61.659**	
Normalized	**39.734**	**33.916**	**15.610**	

HC+NOx Normalized	E0	**1.000**
	Cert Fuel (~E10)	**1.001**
	E20	**1.106**
HC+NOx % Change	E0	**0.00%**
	Cert Fuel (~E10)	**0.06%**
	E20	**10.57%**

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CUSTOMER PO NO.

SALES ORDER NO.
MFG DATE: 12-2004
SHELF LIFE: UNDETERMINED

Chevron Phillips Chemical Company LP

CERTIFICATE OF ANALYSIS

BRAZILIAN YELLOW GASOLINE
LOT 4LPBYG01

Tests	Results		Specifications	Method
Specific Gravity 60/60	0.7441		0.7400 – 0.7650	ASTM D-4052
API Gravity	58.65		Report	ASTM D-1250
Phosphorous, g/L	<0.0011		0.005 Max	ASTM D-3231
Manganese, g/L	<0.0011		0.001 Max	ASTM D-3831
Sulfur, ppm	571		400 - 1000	ASTM D-2622
Corrosion, 3 hr @ 50°C	1A		1B Max	ASTM D-130
Ethanol, lv%	21.5		21 - 23	Chromatography
Water Content, wt%	0.077		0.50 Max	Karl Fischer
Oxidation Stability (min)	1440+		360 Min	ASTM D-525
Existent Gums (mg/100ml)	1.2		Report	ASTM D-381
Existent Gums (mg/100ml)(washed)	0.50		5 Max	ASTM D-381
Reid Vapor Pressure	8.6		8.0 – 9.4	ASTM D-6378
TEL (g/L)	<0.0008		0.005 Max	ASTM D-3237
Benzene Content, lv%	0.34		Report	
Distillation, °F				**ASTM D-86**
IBP	110.5		91.4 - 113	
5%	124.5			
10	131.9		122 - 140	
20	142.9			
30	145.2			
40	153.9			
50	158.4		154.5 - 172	
60	161.6			
70	166.5			
80	262.6			
90	332.8		320 - 356	
95	365.2			
EP	394.9		406.4 - 428	
Loss	1.1			
Residue	1.0			
Hydrocarbon Type, Vol%	**Uncorr.**	**Corr.**		**ASTM D-1319**
Aromatics	21.0	16.5	16 - 24	
Olefins	24.0	18.8	16 - 22	
Saturates	55.0	--	Report	
Research Octane Number	93.1		93.0 – 95.0	ASTM D-2699
Motor Octane Number	82.4		80.5 – 81.5	ASTM D-2700
Antiknock Index	87.8		Report	

D.G. Doerr tdh

D. G. Doerr
Fuels Unit Team Leader

EXHIBIT D

Exhibit D
Summary of Additional Materials That Should Be Tested For MN E20 Testing Program

Prepared By Dr. Ranajit (Ron) Sahu
May 15, 2009

Below is the list of materials that AllSAFE suggested be included in the MSU compatibility program testing. I have highlighted the materials that I do not believe MSU tested. In some instances, the descriptions provided by MSU for the materials tested is not specific as to exact composition, so it is difficult to know if they in fact tested our suggested materials. But I believe, I have been conservative - i.e., when in doubt, I have assumed that they have tested.

A. Metals

1. Diecast quality Magnesium (AZ91). Composition as shown below in %.

	Al	Zn	Mn	Cu	Si	Fe	Ni	Be
Min	8.00	0.300	0.170					0.00050
Max	9.50	1.00	0.400	0.0250	0.050	0.0040	0.0010	0.0015

B. Plastics/Polymers/Elastomers/Others

1. Hydrin (epichlorohydrin)
2. H-NBR (copolymer from butadiene and acrylonitrile)
3. Low Temp Viton (FKM) grades such as GFLT
4. Nylon PA 6.6 with 33% glass fiber
5. Nylon PA 6 with EPDM modifier + 30% glass fiber
6. Nylon PA 6 with NBR
7. Nylon 66
8. Nylon 11
9. Nylon 12
10 Polyester urethane foam
11. NBR with 16% PVC and 32% ACN content
12. Ozo-Paracril (blend of PVC and nitrile rubbers)
13. CSM (Chlorosulfonated polyethylene, such as Hypalon)
14. Fluorosilicone (FVMQ)
15. HDPE

16. Cork
17. Polysulfone
18. Polycarbonate
19. FMQ
20. AEM
21. ACM
22. CR

C. Rubbers

1. Buna N
2. Silicon Rubber (VMQ)
3. HNBR (Hydrogenated Nitrile rubber)

EXHIBIT E

Preliminary Comments
on the report titled
"Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines, Report 1 – Updated," NREL/TP-540-43543 and ORNL/TM-2008/117, dated February 2009

Dr. Ron Sahu, Consultant to the Outdoor Power Equipment Institute (OPEI)

These comments focus exclusively on major adverse impacts observed during the tests performed on Small Non-Road Engines (SNRE), including lawn, garden and forestry products, like lawnmowers and trimmers.

I. THE TESTS DOCUMENT THE FOLLOWING MAJOR ADVERSE IMPACTS RESULTED FROM FUELS GREATER THAN 10% ETHANOL

A. Engine exhaust temperatures rose significantly. Significant rises in temperatures (exhaust, cylinder head, etc.) occurred on the order of 20 to 70 C from engines run on E0 compared to E20. For several categories, significant temperature rises resulted between E10 and E15. Additional heat generation has obvious implications on increased burn and fire hazards – considering the proximity of cut grass, wood chips and the operator to the engine's hot exhaust. However, the report does not delve into the implications of the additional heat and its ramifications on engine and equipment failure, personnel safety, increased fire hazards, or the inability to mitigate any of these hazards on millions of pieces of legacy equipment.

B. Risks to operators dramatically increased. The report recognizes that unintentional clutch engagement resulted on several tested products because of high idle speeds. Obviously significant risks are created when a chainsaw blade becomes engaged when the product should be idling. However, there is no discussion in the Report of this increased hazard. If anything, the mitigation proposed (i.e., adjustment of fuel air mixture enleanment) is unworkable and may even be illegal "tampering" under the EPA regulations. It is certainly not feasible to adjust carburetors on millions of legacy equipment that are already in use.

C. Damage to Engines. Both of the tested "Residential Handheld Engines" (engines B-3 and B-7 as shown in Figure 3.9, pp. 3-18) suffered total and complete failures and would not start or operate after running on E-15 fuel for 25 or less hours, which is less than half of their useful life.

D. Operational Problems. Many of the engines tested on mid-level ethanol suffered from erratic equipment operation, "missing" and stalling of engines, and power-reduction.

II. MISCHARACTERIZATION OF RESULTS IN THE EXECUTIVE SUMMARY

The Executive Summary does not accurately summarize the scope, results as well as uncertainties associated with the testing. Since most of the policy-makers will focus only on the Executive Summary, this could result in misinformed policies based on misleading conclusions.

There appear to be numerous, material inconsistencies in the manner in which the results are reported in the main body of the report versus in the Executive Summary, including the following examples:

A. The Executive Summary merely notes three handheld trimmers experienced higher idle speeds and unintentional clutch engagement. (See Sec. E.5.2). The report recognizes that this same problem could also occur on chainsaws. (See Sec. 3.2). The implications of unintentional clutch engagement in chainsaws and hedgeclippers (which are both examples of close-to-the-body, sharp-bladed equipment) are obvious and alarming; this substantial problem should have been fully addressed in the Executive Summary.

B. With regards to materials compatibility, the Executive Summary incorrectly concludes that "…no obvious materials compatibility issues were noted…" (see p. xix). In fact, the report itself recognizes that materials incompatibility (such as swelling of the elastomeric seat for the needle in the carburetor bowl) could be the cause of the engine stall for the Briggs and Stratton generator observed in the pilot study (see pp. 3-15). The report also states that: 1) "…various fuel-wetted materials in some small engines may not be compatible with all ethanol blends…" (see p. 3-9); and 2) "..materials compatibility issues…were not specifically characterized as part of the study…" (see p. 3-12).

C. Engines in the study experienced "unstable governor operation," "missing" and "stalling" when operating on E20 fuel, indicating unacceptable performance. (See Section 3.2.2). However, the Executive Summary omitted any discussion of these substantial problems.

D. Discussing emissions, the Executive Summary simply notes that HC emissions "generally decreased" and that combined HC+NOx emissions "decreased in most instances." (See p. xix). However, the report notes that while HC emissions generally decreased, they also increased in some engines. The net change in HC+NOx emissions ranged from -36% to +41% as reported in Sec. 3.2.2. It is important to note that for new engines, the net change in HC+NOx was often greatest in going from E0 to E10 and smaller in the other transitions (i.e., from E0 to E15 or E0 to E20). (See Table 3.7). For example, the numerical average for all engines shows that the HC+NOx reduction was -16.6% from E0 to E10; -13.5% from E0 to E15 and only -9.5% from E0 to E20. Since small engines are already capable of E10 operation and that fuel is already available, this data indicates that transitioning to E15 and E20 may actually increase HC+NOx from E10. (As a side note, what is actually measured as HC in the study is unclear since a FID was used for this purpose, uncorrected for any ethanol or aldehydes, as noted in the report).

III. DEFICIENCIES IN THE TESTING PLAN AND SCOPE

A. No emissions testing pertaining to evaporative emissions was conducted. Thus, all references to "emissions" means tail-pipe emissions from the engine. Evaporative emissions are now regulated by EPA for small engines and equipment and covered by the EPA "certification" program. Lack of evaporative emissions is a major omission.

B. The report does not contain any direct data on "materials compatibility" testing or results – i.e., involving the various fuels tested and the materials that may be exposed to these fuels and how they interact. Material compatibility is a significant concern with E15 and E20 fuels when used in small engines, leading not only to "operational issues" but also to durability, emissions, and safety impacts.

C. The report notes that the following fuels were used: E0, as well as splash-blended E10, E15, and E20. However, the report does not contain the actual ASTM specification of the blended fuels, including all relevant properties such as distillation cut point temperatures, etc. Table 2.2 of the report contains a few parameters of the blends. This is incomplete and a more compete fuel specification should be provided. The executive summary concludes that "…the different fuel characteristics of match-blended and splash-blended fuels were not expected to have a significant impact on temperature" or on durability. (See p. xviii). However, there is not any cited technical support for these statements. Similarly, there is no support for the observation that "…emission results…are not expected to vary significantly…between splash-blended and match-blended fuels." *Id*.

D. As the report notes, neither cold-start, nor warm-up testing was done, although these are two very common modes of operation for many categories of small engines. Additional performance tests that impact "operational issues" which should have been tested include: (i) acceleration; (ii) application performance; (iii) carburetor and breather icing; (iv) fuel consumption; (v) governor stability; (vi) load pick up; and (vii) vapor lock. Individual categories of small engines will likely have additional performance-related test requirements.

E. As the Executive Summary notes, the report presents "initial results…focused on identifying emissions or operational issues and measurement of several key engine temperatures…" (See p. xviii). It is not clear what is meant by "operational issues" or what quantitative surrogates and/or metrics were used to substitute for operational issues. It appears that erratic operation, high idle, stalling, etc. were used as evidence of operational issues. While these are undeniably evidence of operational issues, no testing appears to have been done on various actual equipment operational modes (as discussed later) so the full extent of operational issues has by no means been evaluated.

F. The report does not fully flesh out the issue and implications of irreversibility – i.e., once exposed to E15 and/or E20, performance is not restored simply by reverting to E0. In the case of the Poulan weedeater, it is noted that there were poor operations with E15 and E20 and that "normal operation could not be restored on E0." (See Section 3.2.2). This is significant. Actual users, when faced with operational problems with ethanol blended fuels, will, as common sense dictates, revert to E0. What they will find is that doing so will not "unring the bell" since the damage by the ethanol blends is not reversible simply by changing the fuel.

IV. UNREPRESENTATIVE AND LIMITED NUMBER OF TESTS CONDUCTED

A. The category of forestry, lawn and garden equipment includes a broad swath of equipment and engine types. Yet, the category has not been defined in the report so that the extent of test results presented can be judged in context. While noting that millions of products with small engines are sold each year (actually tens of millions), and that EPA certifies on the order of 900 engine emission families, the report does not cover the immense diversity of the category including: 1) the various engine and equipment types used, 2) the fuel delivery mechanisms, 3) the various sizes and functions of the equipment, 4) the constraints that the equipment operate under (such as close proximity to operators, as an example), and 5) many other characteristics. Engines in this product category utilize a wide variety of engine architecture including both single and twin cylinders, two cycle and four cycle combustion, ported and valve charge controlled, side valve and overhead valve orientations, with and without exhaust after-treatment, governed load and product load controlled, etc. The report should clearly qualify its findings are based on a tiny fraction of the diverse population of affected products.

B. The types and numbers of engines and equipment tested are inadequate to be representative of even the limited types of small engines that were the subject of testing. While practical constraints such as time and money will always constrain the amount of testing that can be done, the basis for choosing the engine and equipment – namely those found in "…popular, high sales volume equipment…" appears not to have been followed. For example, of the six pieces of equipment selected for the pilot study, four were generators. No chainsaws were tested, even though the OPEI had directly requested that they be included – because of their extreme operating conditions and sensitivity to mid-level ethanol. Also, it is explicable why only one residential hand-held engine would be tested, even though these are likely to be very sensitive to fuel changes. The report should provide the basis of selection rather than referencing unspecified EPA sources. One of the constraints also seems to have been the available laboratory equipment (i.e., lack of small engine dynamometers). This is clearly an inappropriate basis for constraining equipment selection, especially if the goal is to obtain data on the entire class of affected engines and products.

C. The report rightly notes the challenges associated with multi-cylinder engines – although characterizing these as being "more sensitive" is too vague. (See p. 3-11). It is unfortunate that while the study included one twin cylinder engine in the initial screening process, there were no twin cylinder engines included in the more in depth portions of the testing program. Particularly when the initial screening test clearly demonstrated significant influences of higher ethanol blends. A significant portion of the Class 2 (>225 cc) non-handheld engines produced each year are two cylinder engines. The omission of these engines in the expanded program is puzzling. The detailed test program should include engines and equipment that demonstrated any significant influence during the screening tests.

D. The limited number of tests conducted cannot provide assurances that the results presented have any statistical significance, where appropriate. In fact, no attempt is made to discuss results in terms of statistical significance. Nor are such issues discussed in support of the design of the test matrix itself. For example, no pair-wise tests were run or results reported even though those opportunities were available even with the limited equipment selection.

E. The manner in which the tests were run makes it difficult to separate the effects of engines, fuels, and aging. For example, the full-life tests do not allow the ability to distinguish between fuel-driven and engine-driven causes since only one engine was tested on each fuel. In the pilot study, the effects of the fuel and aging are similarly hard to separate. These types of issues could have been avoided with better test planning.

V. OTHER COMMENTS

A. The comments are preliminary because not all of the test data discussed in the report are included. Specifically, backup test data for all tests conducted by the Dept. of Energy (NREL and ORNL) and its contractors (TRC) still need to be provided.

B. The report notes that the test plan was developed with close consultation involving, among others, "…US automobile companies, engine companies, and other organizations…" It would be helpful to have details of all the companies and individuals consulted in an Appendix to the report.

C. The report does not separately discuss the comments of the peer reviewer(s) and what changes were made to the draft report as a result. While the Acknowledgements note that the peer review panel was led by Joseph Colucci, the report does not contain a list of all peer reviewers used, what portions of the report were peer reviewed by whom, and the necessary vitae for the reviewers. This should be included.

DC01/SAHUD/360000.12

Biographical Sketch

RANAJIT (RON) SAHU, Ph.D,

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EXPERIENCE SUMMARY

Dr. Sahu has a Bachelors of Technology (Mechanical Engineering) degree from the Indian Institute of Technology (IIT, Kharagpur) as well as a M.S/Ph.D in Mechanical Engineering (Combustion) from the California Institute of Technology (Caltech).

Dr. Sahu has over sixteen years of experience in the fields of energy, environmental, mechanical, and chemical engineering including: program and project management services; design and specification of air pollution control equipment; soils and groundwater remediation; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.); multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over fifteen years of project management experience and has successfully managed and executed numerous projects in this time period. This includes basic studies and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector, and public interest group clients. His major clients over the past sixteen years include the Outdoor Power Equipment Institute and its various members who are manufacturers of small engines and equipment, various steel mills, petroleum refineries, cement companies, aerospace companies, power generation facilities, spa manufacturers, chemical distribution facilities, and various entities in the public sector including the EPA, U.S. Dept. of Justice, California DTSC, and various municipalities. Dr. Sahu has performed projects in over 48 states, numerous local jurisdictions, and internationally.

In addition to consulting, Dr. Sahu has taught and continues to teach numerous courses in several southern California universities including UCLA, UC Riverside, and Loyola Marymount University for the past fourteen years. In this time period, he has also taught at Caltech and USC.

Dr. Sahu has and continues to provide expert witness services in a number of environmental areas discussed above in both state and federal courts as well as before administrative bodies.

EXHIBIT F

New Record

Save a copy

Component Tank Certification

Menu

Note: A fee must be paid for component tank certification. Create a new record for each separate permeation family.
Most fields (even with pull-down menus) are modifiable. If the appropriate choice isn't given you can simply put it in the correct answer.

Type of Certification:	(●) Tank ( ) Line ( ) Cap	
Applicable regs:	( ) 1060 (●) 90	
Permeation Family:	9PWEPTANK003	---->Follow the tank family naming convention outline in the guidance
Manufacturer:	Husqvarna Consumer Outdoor Products N.A.,	
Process code:	New Submission ▼	
Manuf. contact name:	George Hansen	
Manuf. contact address:	3636 New Boston Road. Texarkana, TX 75501	
Manuf. contact phone:	903-223-4158	
Manuf. contact fax:	903-223-4101	
Manuf. contact email:	george.hansen@husqvarna.com	

CARB EO #:	U-U-013-0050	---->if using an EO for EPA certification
Applicable Std:	(●) CARB TANK ONLY TEST ( ) 40CFR 1060.103 ( ) CARB SHED	
Permeation level (g/m^2/day):	1.95	---->if applicable
Numerical Permeation Std:	2.0 g/m^2/day ▼	
ABT?:	( ) Yes (●) No	
Family Emission Limit(FEL):		---->if applicable
ID markings on tank:	9066-311001	
Useful life:	2 years ▼	
Material type:	Plastic ▼	
Production Method:	Blow-molded ▼	
Gasket Material:	Not Applicable	
Emission control Strategy:	Barrier surface treatment ▼	
Fuel cap information:	Cap not tested (for tanks covered by CARB EO only) ▼	

Fuel cap FEL: ---->if applicable

Comments:

CARB EO U-U-013-0050 is used for Fuel Tanks used on following engine families:
9PWES.0354CJ
9PWES.0404CK

---->Integrate
the engine fa
in the comme

Container Field 1:

Container Field 2:

Files such as word documents, PDFs, and Excel documents can be placed in container fields. The CARB EO or a list of engine families which utilize this component, can be placed in the

u-u-013-0050.pdf

California Environmental Protection Agency AIR RESOURCES BOARD	MCCULLOCH CORPORATION	EXECUTIVE ORDER U-U-013-0050 New Off-Road Small Spark-Ignition Equipment

Pursuant to the authority vested in the Air Resources Board by the Health and Safety Code, Division 26, Part 5, Chapters 1 and 2; and

Pursuant to the authority vested in the undersigned by Health and Safety Code Sections 39515 and 39516 and Executive Order G-02-003;

IT IS ORDERED AND RESOLVED: That the following equipment produced by the manufacturer is certified as described below. Production equipment shall be in all material respects the same as those for which certification is granted.

ENGINE DESCRIPTION			
MANUFACTURER	ENGINE FAMILY (E.O. NUMBER)	ENGINE SIZE (cc)	FUEL TYPE (CNG/LNG=compressed/liquefied natural gas LPG=liquefied petroleum gas)
MCCULLOCH CORPORATION	8MHXS.0354AA (U-U-013-0049)	35	Gasoline

* TBC = To Be Certified

EQUIPMENT DESCRIPTION			
MODEL YEAR	EVAPORATIVE FAMILY	FUEL TANK SIZE (liters)	EQUIPMENT APPLICATION
2008	8MHXESP.3110	0.25	Chainsaw

EMISSION CONTROL SYSTEMS	ENGINE and/or EQUIPMENT MODEL(S)
P	9066-311001F

TANK TYPE: S=sealed M=metal P=treated HDPE or PE C=coextruded L=selar N=nylon A=acetal O=other (specify)

The following are the evaporative emission standard (Title 13, California Code of Regulations, 13 CCR Section 2755 or 2757, as applicable), and certification level in grams per square meter per day ($g/m^2/day$) for this evaporative family or the component Executive Order, as applicable.

PERFORMANCE BASED or DESIGN BASED	
FUEL TANK PERMEATION ($g/m^2/day$)	
STANDARD	CERTIFICATION LEVEL OR EXECUTIVE ORDER
2.0	1.95

BE IT FURTHER RESOLVED: That for the listed equipment, the manufacturer has submitted, and the Executive Officer hereby approves, the information and materials to demonstrate certification compliance with 13 CCR Section 2759 (labeling) and 13 CCR Sections 2760 and 2764 (emission control system warranty).

Equipment certified under this Executive Order must conform to all applicable California emission regulations.

This Executive Order is only granted to the engine family and model-year listed above. Equipment in this family that is produced for any other model-year is not covered by this Executive Order.

Executed at El Monte, California on this 21 day of February 2008.

Annette Hebert, Chief
Mobile Source Operations Division

EXHIBIT G

Fuels Test Plan for Mid-grade Ethanol Blend Validation on Handheld Engines

(Re-written 12/3/08—RS)
(Revised 12/4/08—RS)
(Red Line 1/13/09 – RTG)
RS 1/23/09
RS/JF (4/21/09)

(1) SCOPE:

This test program is designed to determine the effects of mid-grade ethanol blends (such as E15 and E20) on current production hand-held engines using existing certification/market fuels. All engines used in this test program will be production versions in full compliance with 40 CFR Part 90 provisions for exhaust and evaporative emissions.

Three engines from each engine type should be used for emission testing to full emission durability period (EDP) for deterioration factor (DF) determination. Running time for the full EDP shall be accumulated on the test bench. One engine will be tested with certification fuel, one with E15 and one with E20.

Six more engines from the same engine type will be selected for field-testing. Each engine will be zero hour emission tested on certification fuel. There of the engines will be field tested on E15 (?) fuel and the remaining 3 engines will be field tested on E20 (?) fuel.

(2) Background:

a. Small SI (SSI) engines are currently regulated for exhaust emissions by ARB and EPA. The industry is also currently regulated for evaporative emissions by ARB and will soon be regulated by EPA.
b. Small SI engines are generally air cooled, operate at richer than stoichiometric air-fuel ratios, utilize simple fuel delivery and metering systems, and are utilized for a wide variety of products including lawn & garden, forestry, construction, electrical power generation, etc.
c. SSI engines generally utilize open loop air-fuel control systems. As such they cannot compensate for air density changes, oxygenated fuels, or fuel changes in general. Changes in ethanol content resulting in significant fuel property changes may cause large scale changes in engine performance, starting usability and durability
d. Engine air-fuel ratio controls are either fixed calibration or limited adjustment calibrations required to provide exhaust emission compliance. It should be noted that the engines are designed to operate within a specific air-fuel ratio range which does not change just because of different fuels. The products should have their carburetors reset or revised for fuel composition changes and since this is not possible with legacy products in the field, we need to gauge the degree of issues (if any) that would surface.
e. SSI engines are often stored for extended periods during off-season periods with fuel present in their systems.

(3) Assumptions:

a. Test Fuels:

- Fuels tested should be compared against current E0 and E10 blends and/or EPA or CARB cert fuels to establish comparative baseline results for any alternative fuel tested.
- Alternative fuels tested must comply with applicable fuel regulations and be representative of fuels that would be in the market if these blends were allowed to enter the marketplace.
- Intermediate blends of Ethanol (like E15 or E-20) will only be tested in engines that have been adjusted with current EPA certification/market fuels.

b. Fuel "Set" Conditions:

- Evaluate performance (bench only) and durability (bench and field) on product set with CAA Baseline fuel that is run on E-xx fuels.
-
- Evaluate performance (bench only) and durability (bench and field) on product set with CAA Baseline fuel that is run on CAA Baseline.
- Ethanol concentrations to consider include E-10, E-15 and E-20
- Oil-fuel ratios used for testing should be per manufacturer recommendation.

(4) Technology and Product Test Scope

a. Existing HH Technologies to Evaluate (assume all meet EPA Phase 2)

- 2-stroke
- 2-stroke w/catalyst
- Stratified scavenging
- Compression wave injection
- 2-stroke/4-stroke hybrid
- 4-stroke
- Stratified with catalyst

b. Handheld Product Types/Applications—Note: applications mean different load cycles/cooling designs, operation speeds etc.

- Professional Backpack Blowers (EDP 300h)
- Homeowner Handheld Blowers (EDP 50h)
- Professional Chainsaw (heavy use) (EDP 300h)
- Farmer Chainsaw (moderate use) (EDP 125h)
- Homeowner Chainsaw (light use) (EDP 50h)
- Professional Trimmer/brush cutter (EDP 300h)
- Farmer Trimmer/brush cutter (EDP 125h)
- Homeowner Trimmer (EDP 50h)
- Hedge trimmer (professional) (EDP 300h)
- Hedge Trimmer (consumer) (EDP 50h)

c. Existing HH Technologies versus Product Applications Available on Market

Technology	Product Type					
	Pro Blower (Backpack)	Chainsaws			Trimmer/Brushcutter	
		300-hour	125-hour	50-hour	300-hour	50-hour
2-Stroke w/cat	Yes	No	Yes	Yes	No	Yes
Stratified	Yes	Yes	Yes	Yes	Yes	Yes
Stratified w/cat	Yes?	Yes	Yes	No	No	Yes
Compression Wave	No	No	Yes	No	No	No
4-Stroke	No	No	No	No	Yes	Yes
2/4-Stroke hybrid	Yes	No	No	No	Yes	No
2-Stroke / tuned exhaust	Yes	No	No	No	No	No

d. Proposed Technology/Product Matrix for Test Program—Note: model names to be determined

Technology	Product Type		
	Handheld Leaf Blower	Backpack Leaf Blower	Hedge Trimmer
	50-hour	300-hour	300-hour
2-Stroke w/cat	Husky (125B)	ECHO: (PB-755)	---
2-S Stratified	---	---	---
2-S Stratified w/cat	---	---	---
Compression Wave	---	---	---
4-Stroke	---	Dolmar (PB7601.4)	---
2/4-Stroke hybrid	---	STIHL: (BR600)	---
2-Stroke/tuned exhaust	---	Husky (356)	---

Technology	Product Type					
	Chainsaws			Trimmer/Brushcutter		
	300-hour	125-hour	50-hour	300-hour	125-hour	50-hour
2-Stroke w/cat	---	---	---	ECHO (SRM-225)	---	HOP (Weedeater FL20)
2-S Stratified	STIHL (MS-441)	Redmax (GZ3500T)	HOP (Poulan 3818AV)	Redmax (BCZ2450)	---	STIHL BG55D
2-S Stratified w/cat	---	---	---	---	---	UT21546 MightyLite
Compression Wave	---	EMAK EFCO MT4000	---	---	---	---
4-Stroke	---	---	---	Robin (MS251.4)	---	Ryobi S430
2/4-Stroke hybrid	---	---	---	STIHL (FS-110)	---	---
2-Stroke/tuned exhaust	---	---	---	---	---	---

(5) Unit Tests to be Performed

a. Exhaust Emissions and Engine Performance Test—Note: A failure will be defined as any emission test or DF value that results in emission levels that exceed the current EPA/CAB certified levels.

- With the exception of the test fuel all tests are conducted following the requirements of 40 CFR Part 90.
- All tests shall be run with the carburetor set to the manufacturer's recommended setting
- Randomly select 3 engines for the engine type and tag each engine according to type of fuel to be used for testing; "1" for certification fuel testing, "2" for E15 fuel testing and "3" for E20 fuel testing.
- Standard engine/product set-up and break-in procedures must be used as defined by the manufacturer.
- Any operational and performance issues throughout the test shall be noted.
- Performance with E15 and E20 shall be compared to the baseline engine tested on certification fuel.
- Report the test information required by the EPA for certification (see sample EPA test data sheet in Appendix "B") as well as a statistical comparison of the different fuels and their effects (if any).

b. Conduct the exhaust gas and surface temperature test using SAE J335. Report results according to SAE J335—A failure is deemed to be results outside SAE limits for mulitposition products.

c. Starting/Acceleration/RPM Stability Performance Tests (data sheet in Appendix "A")—A failure should be defined as a unit that stalls, a unit that has an idle speed increase to unsafe limits, or a unit that will not start at cold temps.

- Fill product with test fuel and store in test ambient environment for 4-hours.
- Open fuel cap for 30-seconds and then re-install the fuel cap.
- Follow manufacturer recommended starting procedure. Record the number of fuel purges, choke on pulls, partial choke on pulls (if applicable) and choke off pulls. Record the throttle position during starting. Record the product's specified clutch engagement speed.
- Immediately perform rpm, acceleration and rollout test following the sequence in the data sheet included in Appendix A.
- Record the humidity and ambient temperature at the beginning and end of each test on each unit.
- Repeat test three times on three production samples at each of the specified test ambients.
- Test ambient (+/-5 °F):
  - I. Cold Ambient (-30 °F for saws and 25 °F for others)
  - II. Hot ambient for all products (100-110 °F)
  - III. Normal (70 °F)

d. Durability/Deterioration Accumulation (bench and field Testing)—RS comment—need to mention field and bench test procedure and data sheets

- Bench Testing Procedure
  - I. Three engines shall be used for this test. For each fuel type (Current cert fuel, E-15 and E-20). All engines shall be adjusted using the baseline (current) EPA test fuel. Each product shall then be designated for use with one of the test fuels.

II. The engines shall be run-in (break-in) according to the manufacturers recommendation on the bench. The manufacturer's standardized test fixturing shall be used. The break-in time shall be according to the manufacturer's recommendations. The break-in shall be recorded using a data sheet similar to that in Appendix "D".

III. The "zero hour" emission and performance test shall be conducted (see Section (4)a above. As an option, the emission/performance test may be run on each of the test fuels for each product.

IV. Durability time shall be accumulated for one half the product's designated EDP on the units with each applicable test fuel using the manufacturer's recommended bench test set-up. The time shall be accumulated using the appropriate CARB WOT-Idle cycle for emission test durability accumulation time. Maintenance on the engine may be performed during this time according to the manufacturer's recommendations spelled out in the product Operator's Manual. An incidence log shall be kept documenting the accumulated time.

V. The "mid-point" emission and performance test shall be conducted (see Section (4)a above. As an option, the emission/performance test may be run on each of the test fuels for each product. If maintenance is required, it shall be performed after the initial test. A second emission test may be performed after the maintenance and the average of these two tests used in the DF calculation below.

VI. Durability time shall be accumulated for the rest of the product's designated EDP on the units with the assigned test fuel using the manufacturer's recommended bench test set-up. The time shall be accumulated using the appropriate CARB WOT-Idle cycle for emission test durability accumulation time. Maintenance on the engine may be performed during this time according to the manufacturer's recommendations spelled out in the product Operator's Manual. An incidence log shall be kept documenting the accumulated time.

VII. The "ending" emission and performance test shall be conducted (see Section (4)a above. As an option, the emission/performance test may be run on each of the test fuels for each product. If maintenance is required, it shall be performed after the initial test. A second emission test may be performed after the maintenance and the average of these two tests used in the DF calculation below.

VIII. The deterioration value for emission shall be determined for each engine/fuel type tested following normally accepted CARB/EPA calculation procedures.

IX. The manufacturer of the product shall perform an engine teardown inspection for each engine. Specific documentation and reporting (including pass-fail criteria) shall include:
   i. Crankshaft assembly (bearings etc)
   ii. Cylinder/piston (varnish, finish, port clogging, deposits etc
   iii. Carburetor and other fuel system components
   iv. Other (per manufacturer)

- Field Test Procedure—Note: every effort should be made to accumulate field durability time in a manner consistent with real world conditions. This may be done using professional crews, homeowners or manufacturer crews. The users should be allowed to use the product without outside influence by the manufacturer or other interested parties. This would include their normal usage and maintenance patterns. Instruction on the use and care of the product can be provided to the users by the manufacturer at the beginning of the program using only that information provided in the users manual.

I. Three products of the same engine type shall be selected for the test. Each product shall be adjusted using the manufacturer's current procedures and fuel. Each product shall then be designated for use with only one specific test fuel. The manufacturer may break-in the engine and run an emission/performance test prior to the field test program start. The manufacturer may run this test on all of the test fuels if they desire.

II. Product users shall be pre-selected and screened for their willingness to accumulate durability time on the product and complete a basic weekly log sheet (see Appendix "E)". Each approved user shall be assigned a product, be provided with a sufficient amount of fuel (need to determine if all fuel is supplied at one time or if weekly/monthly increments are given). The user shall be instructed on safe use and care of the product per the user's manual. The user shall be provided with any necessary safety gear, tools and oil for the test.

III. The manufacturer shall monitor the test product through the submission of weekly test log sheets. Once the product has reached its designated EDP, it shall be removed from test.

X. The "ending" emission and performance test shall be conducted (see Section (4) above. As an option, the emission/performance test may be run on each of the test fuels for each product. If maintenance is required, it shall be performed after the initial test. A second emission test may be performed after the maintenance and the average of these two tests used in the DF calculation below.

XI. The deterioration value for emission shall be determined for each engine/fuel type tested following normally accepted CARB/EPA calculation procedures.

XII. The manufacturer of the product shall perform an engine teardown inspection for each engine. Specific documentation and reporting (including pass-fail criteria) shall include:
   i. Crankshaft assembly (bearings etc)
   ii. Cylinder/piston (varnish, finish, port clogging, deposits etc
   iii. Carburetor and other fuel system components
   iv. Other (per manufacturer)

(6) <u>Fuel System Component Tests to be Performed</u>

a. <u>Component tests (material compatibility)</u>—Failure of components (in terms of material physical properties) is to be determined.

Note: Test both short term and long-term exposure of fuel system materials with proposed ethanol blends to determine changes in physical properties (dimensional and functional). Short term defined as 30-day exposure and long term defined as 2-year exposure.

- Carburetors

I. Corrosion test for components (carburetor body, metering diaphragm, float, inlet needle, adjustment needles, pump diaphragm, pump and metering chamber gaskets, float bowl gasket/seal, inlet needle screen, inlet fuel fitting, bowl nut and gasket, sealants (Welch plug) and vapor purge valves/bulbs).
II. Functional tests – inlet needle pop off and sealing test, vapor purge test, durability.

- Fuel Tanks
    I. Fuel Resistance—The fuel tank shall be submerged the test fuel for 100 hours. The tank shall be removed from the fuel and allowed to air dry at 80°C for four hours. The tank shall have no cracks develop. The cap for the fuel tank shall not be installed for the test.

- Fuel Lines
    I. Fuel Resistance—The fuel line shall be submerged in each of the test fuels fuel for 100 hours. The line shall be removed from the fuel and allowed to air dry at 80 °C for four hours. The line shall have no cracks develop.
    II. Fuel Line Strength and Accessibility—Fuel lines accessible by the probe in Appendix "C" shall not break, crack, leak or become detached from their fittings or connections when an axial load of 60-Newtons is applied with the tip of test probe described in Appendix "C". All guards and covers shall be installed for the test. The fuel line and connections shall be tested by inserting the probe into any openings in the machine which can be used to access the lines. The test probe shall be mounted to a force meter. The force shall be applied to any line the probe contacts. The fuel lines shall be soaked in the test fuel for 96 hours prior to this test. Flexing of the probe is acceptable during the test. The test shall be conducted at room temperature.

b. Permeation Tests (Use proposed EPA Chapter I, Sub-chapter U, part 1060 test procedure)—A permeation failure should be defined as any emission component that fails the EPA/CARB regulated permeation level

- Tanks—Use 1060.520 (test with each test fuel)
- Lines—Use 1060.515 (test with each test fuel)

c. Fuel Data to Determined and Recorded

- Specific gravity—ASTM D4052
- Ethanol concentration (vol%)—ASTM D4185
- Benzene content—D3606
- RVP and boiling curve—ASTM D5191
- Gum formation testing according—ASTM D381
- Corrosion testing—ASTM D130
- Water content—(Carl Fischer + FTIR)
- RON + MON (calculated?) —ASTM D2699/D2700-86
- Phase separation
- Toxics/Smell
    I. Aldehydes for all fuels in (3)(a)(v)—per DNPH/HPLC EPA test

II. Aromatic Substances (BTXE) —per gas chromatographic test

(7) Other Tests

a. Fuel Compatibility Tests with HH engines—See Pass-fail criteria below.

- Mixability of oil in fuel—Use SAE J1536 F/M Category 2. Results should be the same for each fuel tested.
- Storage compatibility—Test with fuel stored in product for 12 months including exposure to free water and a temperature range -20° F to 130° F. Failure is deemed if any proposed fuel presents results with higher corrosion or different fuel changes compared with existing cert/market fuels.
- Phase Separation (water)—phase separation of proposed fuels should be no greater than existing cert/market fuels.

APPENDIX A—Start/Rollout Data Sheet

Date: ______ **Model and ID :** ______ **Technician** ______

Weather: Ambient Temp: ______ Humidity: ______ Bar: ______

Speed Data (Spec) : Idle Range: ______ No-Load WOT: ______
Clutch-in Speed: ______

Cold Starting Data: Purge #: ______
Full Choke on Pulls # (Idle): ______
Partial Choke on Pulls # (Idle): ______
No Choke on Pulls # (Idle): ______

Speed Data (RPM):

Idle speed (10-s after start):		**Stay at Idle**
Idle speed (30-s after start):		**Go to WOT**
WOT speed (10-s after WOT):		**How was Accel?** ______
WOT speed (30-s after WOT):		**Stay at WOT**
WOT speed (3-min after WOT):		**Go to Idle**
Idle speed (30-s after go to Idle)):		**Go to carb side up**
Min Idle speed (during 30-s after position change):		**Go to standard position**
Min Idle speed (during 30-s after position change):		**Go to carb side down**
Min Idle speed (during 30-s after position change):		**Go to standard position**
Min Idle speed (during 30-s after position change):		**Go to carb side inverse**
Min Idle speed (during 30-s after position change):		**Go to standard position**
Min Idle speed (during 30-s after position change):		**Go to PTO side up**
Min Idle speed (during 30-s after position change):		**Go to standard position**
Min Idle speed (during 30-s after position change):		**Go to PTO side down**
Min Idle speed (during 30-s after position change):		**Go to standard position**
Idle speed (10-s after start):		**Go to WOT**
		How was Accel? ______
WOT speed (30-s after WOT):		**Stop engine**

Hot Starting Data: Conduct this test 5-minutes after engine stop.

Purge #: ______
Full Choke on Pulls # (Idle): ______
Partial Choke on Pulls # (Idle): ______
No Choke on Pulls # (Idle): ______

Idle Speed (10-s after start):		**Go to WOT**
		How was Accel? ______
WOT speed (30-s after WOT):		**Stop Engine**

APPENDIX B—Typical Emission Test Data Sheet (example)

Quality Audit Test Summary

EF0023

			PRE	POST	AVG	C wt%		Y			
DATE		Dry Temp (°C)				H wt%		B		Test Type	
BUILD DATE		Wet Temp (°C)				O wt%		KH		Operator	
MODEL		Barometric Pressure (mmHg)				Sample Line (°C)				Test Cell No.	
S/N		Vapor Pressure (mmHg)				Dehumidifier (°C)				Carburetor Setting	
Test Number		Air Humidity (mg/kg)				Test Status:				Comments:	
Family		Air Humidity (%)				Repairs:					
FUEL		"f" Factor .96<f< 1.04				Notes:					

MODE A: RATED SPEED

TIME [hr:min:sec]	RPM	TORQUE N-m	POWER kW	POWER Bhp	FUEL g/hr	PLUG (°C)	INLET (°C)	CO %	CO2 %	NOx ppm	O2 %	THC ppmC	CO g/hr	THC g/hr	NOx g/hr	K	TC
AVG																	
MAX % ERROR																	
MIN % ERROR																	

MODE B: IDLE SPEED

TIME [hr:min:sec]	RPM	TORQUE N-m	POWER kW	POWER Bhp	FUEL g/hr	PLUG (°C)	INLET (°C)	CO %	CO2 %	NOx ppm	O2 %	THC ppmC	CO g/hr	THC g/hr	NOx g/hr	K	TC
AVG																	
MAX % ERROR																	
MIN % ERROR																	

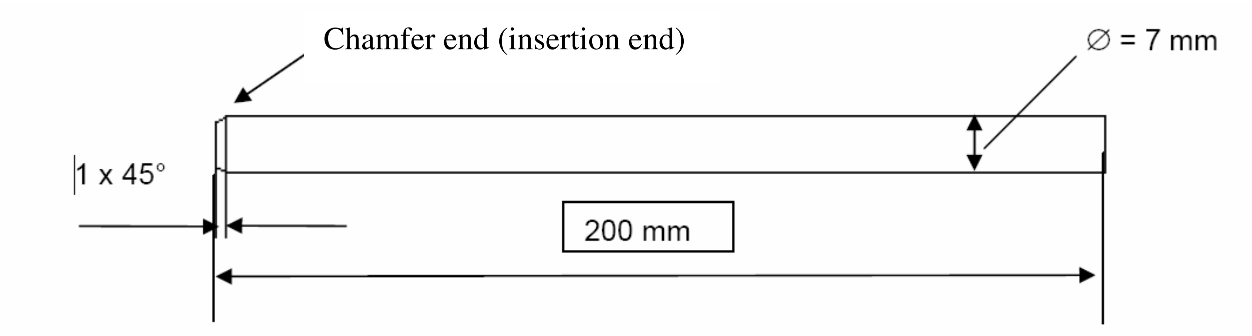
TOTAL EMISSIONS [g/kW-hr]			
	FEL	ACTUAL	300 hr
CO			
THC			
NOX			
THC+NOx			
PM			
CLASS			

Total BSFC	
g/kW-hr	

GAS & SPEED CHECKS
Emission Check

D.F.	
CO	
THC+NOx	
PM	

Appendix C—Fuel Line Test Probe



Note: The probe represents branches in the working environment that might come into contact to the machine and might go into the openings of the machine.

Appendix D—Engine break-in Log Sheet (example)

BREAKIN LOG SHEET

FAMILY:		MODEL:		S/N:	
PURPOSE OF TEST:		TEST LOCATION:		DATE:	
FUEL:		FUEL OIL RATIO:		TESTER:	
NUMBER OF PURGES:		CHOKE IDLE PULLS:		NO-CHOKE IDLE PULLS:	
TEMPERATURE (oC):		HUMIDITY (%):		BAROMETER (IN HG):	

TIME OF DAY	TOTAL UNIT ACCUMULATION TIME (MIN.)	ENGINE SPEED	LOAD (Bhp) (If Appliccable)	THROTTLE POSITION	COMMENTS

Appendix E—Field Test Data Sheet

Put test location (company) and Contact info here

PLEASE FAX HOURS UNITS RAN EACH WEEK TO:

Place Your contact info here

Model Name: PB-XYZ

Serial/ID Number: S/N xxyyzz

Day	Date	Average Temp (F)	Humidity	Weather	Run Time	Fuel Used	Maintenance Performed	Comments/notes on Issues, Performance, Starting etc
Monday								
Tuesday								
Wed								
Thru								
Fri								
Sat								
Sun								

PLEASE REPORT ANY PROBLEMS WITH UNITS:
Call: John Doe @ 555-5555-5555, email @.

EXHIBIT H

Engine Manufacturers Association®
www.enginemanufacturers.org

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Suite 2200
Chicago, Illinois 60602
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[redacted]

DRAFT

Test Plan for Mid-level ethanol blend validation – Small Spark Ignition (SSI) Engines

Scope:

This test program is designed to determine the effects of mid-grade ethanol blends (assumed to be E15 and E20) on current production non-handheld engines using existing certification/market fuels. All engines used in this test program will be production versions in full compliance with 40 CFR Part 90, 40 CFR Part 1054, or ARB Title 13 provisions for exhaust and evaporative emissions as applicable.

Engines from each engine technology category should be used for emission testing to full emission durability period (EDP) for deterioration factor (DF) determination. Running time for the full EDP shall be accumulated on the test bench. Equal number(s) of engine should be tested with certification fuel, E15 fuel, and E20 fuel.

Additional engines from the same engine technology category will be selected for product performance testing. An equal number of engines will be tested using E10 (baseline) fuel, E15 fuel, and E20 fuel where all blends will represent the same petroleum gasoline blend stock.

Background:

SSI engines are currently regulated for exhaust and evaporative emissions by the California Air Resources Board (hereafter ARB) and the U.S Environmental Protection Agency (hereafter EPA). This test plan refers to non-handheld engines only, a sub-set of the SSI engine category.

SSI engines are generally air cooled, operate at richer than stoichiometric air/fuel ratios, utilize relatively simple fuel delivery and metering systems, and are utilized for a wide variety of products including lawn & garden, construction, electrical power generation, general utility, etc.

SSI engines generally utilize open loop air-fuel control systems. As such they cannot compensate for air density changes (including altitude), oxygenated fuels, or fuel changes in general. Changes in ethanol content resulting in significant fuel property changes may cause large scale changes in engine performance, starting ability and durability. Engine air-fuel ratio controls are either fixed calibration or limited adjustment calibrations required to provide exhaust emissions compliance. It should be noted that the engines are designed to operate within a specific air-fuel ratio range which does not change due to use of different fuels. If fuels change, engines need to have their carburetors reset or revised for fuel composition changes; since this is not possible with a large population of current production or legacy products currently in use, there needs to be an assessment of the impacts of potential fuel changes and the extent of the issues (if any) that may surface. To compensate for air density changes as a result of altitude carburetor modifications are required. These modifications are required to be documented and certified per EPA exhaust emission regulations. Test programs that evaluate leaner air-fuel ratio influences, such as increasing ethanol content, should be conducted at elevations approaching sea level to preclude altitude induced air density changes from misrepresenting the test results.

SSI engines are often stored for extended time periods during "off-seasons" with fuel present in the engine and equipment.

Assumptions:

Fuels tested should be compared against current E0 and E10 blends and/or EPA or CARB certification fuels to establish comparative baseline results for the midlevel ethanol fuels to be tested. The mid-level ethanol fuels tested must comply with all applicable fuel regulations, be representative of fuels that would be sold in the market, and available to consumers if such blends were allowed to enter the marketplace. The baseline gasoline and petroleum portion of the mid-level ethanol blends evaluated should be the same to minimize variations in petroleum gasoline influence.

All testing should be conducted at elevations of less than 1000 feet above sea level to minimize the influence of altitude induced enrichment on the test results and/or analysis.

Technology and Product Test Scope

a. Existing non-handheld engine technologies to evaluate (assumed all meet EPA Phase 2)
   A - Class I – Side Valve; consumer product (125 hr EDP); Diaph./pulse carburetor
   B - Class I – Side Valve; consumer product (125 hr EDP); Float carburetor
   C - Class I – OHV; consumer product (125 hr EDP); Float carburetor
   D - Class I – OHV; commercial product (500 hr EDP); Float carburetor
   E - Class II – Side Valve; consumer product (250 hr EDP); Float carburetor, Gravity feed
   F - Class II – OHV Single cylinder; consumer product (250 hr EDP); Float carburetor, Gravity feed
   G – Class II – OHV Single cylinder; cross over product (500 hr EDP); Float carburetor, Gravity feed
   H - Class II – OHV Single cylinder; consumer product (250 hr EDP); Float carburetor, Fuel pump
   I - Class II – OHV Single cylinder; commercial product (1000 hr EDP); Float carburetor, Fuel pump
   J - Class II – OHV Twin cylinder; consumer product (250 hr EDP); Float carburetor, Gravity feed
   K - Class II – OHV Twin cylinder; commercial product (1000 hr EDP); Float carburetor, Fuel pump

b. Additional non-handheld engine technologies to evaluate if available (complying with ARB Tier III and/or EPA Phase 3)
   All of the technology categories above, except category E, are expected to remain in the marketplace with revised fuel system calibration, engine design changes, etc. required to comply with ARB Tier III and/or EPA Phase 3 standards. However, in some cases compliance with these standards may require the addition of aftertreatment. Those categories anticipated to utilize aftertreatment include:
   - Class I – Side Valve; consumer product (125 hr EDP); Diaphragm/pulse carburetor, Catalyst in exhaust – category designation AA
   - Class I – Side Valve; consumer product (125 hr EDP); Float carburetor, Catalyst in exhaust – category designation BA
   - Class I – OHV; consumer product (125 hr EDP); Float carburetor, Catalyst in exhaust – category designation CA

- All other categories listed above are designated *A when compliant with ARB Tier III and/or EPA Phase 3 requirements. Where * indicates the technology category defined in (a) above.

c. Engine technologies versus products available in the market (Phase 2)

Technology – per categories above	Product Type															
	Walk behind mower				L&G tractor		Generator				Construction		General utility			
	Emission Durability Period															
	125	250	500	1000	250	1000	125	250	500	1000	500	1000	125	250	500	1000
A, AA	Yes												Yes			
B, BA	Yes												Yes			
C, CA	Yes						Yes						Yes			
D, DA			Yes						Yes		Yes				Yes	
E		Yes			Yes								Yes			
F, FA		Yes			Yes			Yes						Yes		
G, GA			Yes						Yes		Yes				Yes	
H, HA		Yes			Yes			Yes						Yes		
I, IA				Yes		Yes				Yes		Yes				Yes
J, JA		Yes			Yes			Yes						Yes		
K, KA				Yes		Yes				Yes		Yes				Yes

d. Proposed Technology/Product Matrix for Test Program

When both EPA Phase 2 and ARB Tier III/EPA Phase 3 products are available testing should be conducted utilizing the ARB Tier III/EPA Phase 3 compliant product.

Technology – per categories above	Product Type															
	Walk behind mower				L&G tractor		Generator				Construction		General utility			
	Emission Durability Period															
	125	250	500	1000	250	1000	125	250	500	1000	500	1000	125	250	500	1000
A, AB	**Yes**												**Yes**			
B, BA																
C, CA	**Yes**						**Yes**						**Yes**			
D, DA									**Yes**		**Yes**				**Yes**	
E		**Yes**														
F, FA					**Yes**			**Yes**								
G, GA															**Yes**	
H, HA																
I, IA				**Yes**						**Yes**						
J, JA					**Yes**											
K, KA						**Yes**				**Yes**		**Yes**				**Yes**

Tests to be Performed

Exhaust Emissions and Engine Performance Test

- With the exception of the test fuel all exhaust emission tests are to be conducted following the requirements and procedures of 40 CFR Part 90, all evaporative emission tests are to be conducted per ARB TP-901 or TP-902 as applicable and all performance tests are to be conducted utilizing manufacturer defined procedures as outlined.
- All tests shall be run with the carburetor set to the manufacturer's recommended setting (if applicable) or standard production carburetor (no altitude kits installed).
- Randomly select 3 engines for the engine type and tag each engine according to type of fuel to be used for testing; "1" for certification/baseline fuel testing, "2" for E15 fuel testing and "3" for E20 fuel testing.

- Standard engine/product set-up and break-in procedures must be used as defined by the manufacturer.
- Any operational and performance issues during and throughout the test period shall be reported.
- Test results with E15 and E20 fuels shall be compared to the baseline engine tested on emission certification test fuel or E10 baseline fuel as applicable.
- Exhaust emission report should include the test information required by the EPA for certification (see sample EPA test data sheet in Appendix A).
- Engine performance test information to include critical functionality as described.

Emissions Testing:

Exhaust:

Failure is defined as any test result or deterioration factor adjusted test result that exceeds the applicable EPA/ARB standard level.

Exhaust emissions to be tested utilizing EPA Cycle A, B, or approved alternate as applicable.

Exhaust emissions shall be evaluated when the engine is new (after break-in period), at the mid point of the hour accumulation period, and after the full useful life hour accumulation period.

Monitor and report weighted brake specific fuel consumption for each emission test.

Evaporative Emission Testing:

Failure is defined as any test result that exceeds the applicable EPA/ARB standard level.

Evaporative emissions shall be tested per ARB diurnal or permeation testing as applicable utilizing ARB test procedure TP901 or TP902 as applicable.

Performance Tests:

Starting and Acceleration:

Failure is defined as the inability to start within 5 starting attempts (pulls if manual, 15 seconds cranking if electric) or inability to accelerate and maintain operating speed within a reasonable time period after starting (maybe temperature dependent).

Cold start performance to be evaluated at the following temperatures:

Year round product: 23 to 27° C, ±2° C, and -18 to -22° C

Summer only product: 23 to 27° C and ±2° C

Winter only product: ±2° C and -26 to -30° C

Hot start performance to be evaluated at the following temperatures:

Year round and summer product: 40 to 44° C

Winter only product: 7 to 10° C

Hot restart performance to be evaluated at the hot start temperatures after operation for 1 hour or approximately 50% of fuel capacity, whichever is longer, followed by a shut down period of 5 minutes prior to the first restarting attempt.

Carburetor & Breather Icing

Failure is defined as the inability to continue operation through one full fuel tank capacity, refueling and continued operation for at least one half of fuel tank capacity.

Operating conditions: temperature 2 to 5° C and ambient relative humidity of 97 to 100%

Governor Stability/Regulation and Load Pick-up

Generators - Reference SAE Procedure for Evaluating Transient Response of Small Engine Driven Generator Sets SAE J1444 for acceptance/failure criteria.

Other categories – failure is defined by excessive speed loss under load (>500 rpm), instability of rpm (audible speed fluctuation, or ± 75 rpm), or inability to pick up 75% load when load clutching mechanism is engaged.

Vapor Lock – note that product applications are required for vapor lock testing due to interactions between the engine and the product.

Failure defined as the inability to continue operation through one full fuel tank capacity, refueling and continued operation for at least one half of fuel tank capacity.

Operating conditions:

Year round and summer product: 40 to 44° C

Winter only product: 7 to 10° C

Durability and fuel consumption

Failure is defined as the inability to complete the prescribed aging period, excessive oil consumption, or inability to produce a minimum of 90% of power available at either rated speed or peak torque speed when compared with baseline testing power levels, or unacceptable critical engine temperatures.

All engines shall be instrumented to allow monitoring of critical temperatures as prescribed by their respective manufacturers.

All engines shall be operated over a test cycle that represents either emission test cycle A or B as appropriate, without idle, where the test cycle is 2 hours in duration and repeated for the emission durability period. All engines shall be stopped ever 8 hours to check and replenish oil level. All engines shall be maintained per manufacturer defined maintenance intervals for lubricating oil, air filter, spark plug, etc.

All engines shall be monitored and crankcase oil consumption reported utilizing drain and weigh procedures for both additions and changes.

All engines shall have crankcase oil properties evaluated for wear metals and fuel components at each oil change.

All engines tested shall be inspected by their respective manufacturer after testing to evaluate internal engine conditions including compression, cylinder leak down, combustion chamber deposits, piston deposits and condition, bearing condition, cylinder bore condition, intake system deposits, exhaust system integrity, etc.

Fuel System Component Compatibility and Exposure Tests

Failure is defined as changes in materials properties that result in unacceptable product performance or increased safety risk.

Test both short term (30 day exposure) and long term (2 year exposure) exposure of fuel system materials with proposed ethanol blends to determine changes in physical properties (dimensional and functional).

Fuel utilized for testing shall have maximum content of water, acids, etc. allowed by ASTM finished fuel standards.

Short term testing to be conducted at 40-44° C

Long term testing to be conducted over a temperature and relative humidity range of 15-44° C and 50-100% respectfully. All ambient vents shall remain open to the atmosphere during the aging process. Fuel additions required to maintain a minimum of 10% fuel capacity shall be documents for both volume and chemistry of the fuel added.

Test fuel properties including oxidation stability, peroxide level, etc. shall be recorded at the beginning and end of the test.

EXHIBIT I

Mid Level Ethanol Blend Experimental Framework – EPA Staff Recommendations

Karl Simon
EPA Office of Transportation and Air Quality

API Technology Committee Meeting
Chicago
6/4/08

Outline

- Introduction
  - Blend Wall
  - Waiver qualification
  - Concerns about data submission & quality
- Experimental framework
  - Fuel properties
  - On Road
  - Non Road

E10 Blend Wall Effects

- Energy Independence & Security Act & RFS2 specifies 36 Bill gal of renewable fuels (primarily ethanol) to be infused into US fuel market
- E10 fuel will saturate market by ~2012 (“blend wall”)
- Beyond this, increased use of E85 or Mid-level blends (E15 & E20) will help absorb the excess
- Mid level ethanol blends (E15/E20) fail to meet “substantially similar” criteria for gasoline in oxygen content (must be <=2% by wt, 2.7% for alcohol)
- A waiver would be needed under 211(f)(4) of the CAA

Waiver Qualification

- CAA section 211(f)(4), as revised: The Administrator, upon application of any manufacturer of any fuel or fuel additive, may waive the prohibitions established under paragraph (1) or (3) of this subsection or the limitation specified in paragraph (2) of this subsection, if he determines that the applicant has established that such fuel or fuel additive or a specified concentration thereof, and the emission products of such fuel or fuel additive or specified concentration thereof, *will not cause or contribute to a failure of any emission control device or system (over the useful life* *of the motor vehicle, motor vehicle engine, nonroad engine or nonroad vehicle* in which such device or system is used) to *achieve compliance* by the vehicle or engine *with the emission standards* with respect to which it has been certified pursuant to sections 206 and 213(a) of this title. The Administrator shall take final action to grant or deny an application submitted under this paragraph, after public notice and comment, within 270 days of the receipt of such an application.

Data submissions in support of a waiver request must include:

- Exhaust emissions
- Evaporative emissions
- Durability issues:
  - Materials compatibility
  - Driveability or operability
- All testing will need to be carried out over the useful life of vehicle or equipment

Experimental Framework

- The following is an experimental framework for an example waiver test program
- This framework provides suggestions and describes what a test program MAY look like
- Actual implemented test programs are expected to be similar, giving statistically meaningful and defensible results

On Road: What are the factors for the test program?

- Fuels
  - What type, how many? (E0, E10, E15, E20)
  - Fuels should have “typical” properties
- Vehicles
  - Type (FFVs excluded)
  - Model year, make, model
  - How many? Repeat tests?
- Tests
  - Exhaust/evap
  - Test procedures
    - Cycle, Temperature conditions
  - Aging/durability procedures

Example Test Fuel Specifications

- Ethanol level depends on level of waiver requested (E15, E20, etc)
  - Base fuels are E0 & E10 and comparisons should be made to both
- Fuels should have “typical” characteristics
- During seasonal testing, winter/summer fuels should reflect RVP differences

On Road Test Program

Vehicles and Motorcycles

- Type
  - – Ideally, should represent LDV, LDTs, MDPV, HDG, Motorcycle
  - – FFVs excluded
- Make/Model
  - – Manufacturers and models should be represented on their sales basis (not random recruitment)
  - – Model Year
    - New Tier 2 vehicles (average Bin 5)
    - Select used (low mileage) NLEV/T1 vehicles
  - – Number of vehicles and tests depends on statistics
- Tests
  - – Exhaust and Evap (certification tests)
  - – Durability
    - Aging vs mileage accumulation

On Road Test Program

Vehicle Durability Example

- FUL mileage of 120k/150k on new blend
  - Emissions tests at defined mileage breakpoints
    - E0, E10 and new blend fuel tested at each point
      - Exhaust & Evaporative emissions
  - Mileage accumulation approaches (combination expected)
    - Traditional durability program (mileage accumulation dyno/track)
    - “Real world” on road aging (e.g. OBD durability)
      - Seasonal and regional climate change exposure
      - On road environment (e.g. fuel sloshing, moisture, altitude, prolonged road grades)

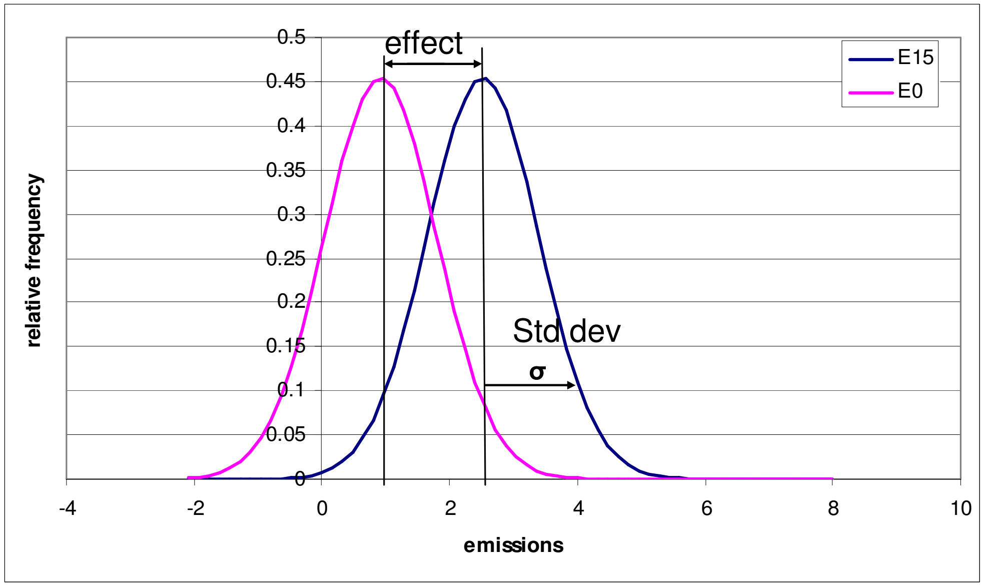
- Statistically based sample size
  - New Tier 2 vehicles (average Bin 5)
  - Select used (<=50k) interim non-Tier 2/NLEV/Tier 1 type vehicles

- Selection considerations:
  - High volume durability groups preferred
  - Fleet make-up related to fuel timing (Tier 2, NLEV, Tier 1)
    - LDV/LLDT 10 yr FUL
    - HLDT/MDPV 11 yr FUL

- Motorcycles may follow similar approach
  - 20k FUL

On/Non Road Statistics

- Number of tests depends on
  - Variance of emissions
    - Greater the variance/variability, more tests required
  - Size of the effect
    - The larger the effect, fewer tests required
  - This may call for a pilot program to determine N's
    - Or dependence on previous testing programs
- Statistical analyses of the data and comparison of data sets as per Title 40 CFR § 1065.602
  - Comparison to fuels
  - Comparison to certification levels at FUL
  - t-test @ 90% conf intervals
  - F-test compares variances
  - Binomial test
    - Sign of difference test
- Confidence levels must be chosen (e.g. 90 or 95%)
- Assumptions of normality should be examined



This figure is for illustrative purposes only

Sample Size Calculation Example

- This is a calculation based on Tier 2 vehicles in preparation for EPAct testing
- Delta = Fuel Effect %
- Expected effect is small (~25% used in Auto Oil)
- Std Dev estimated

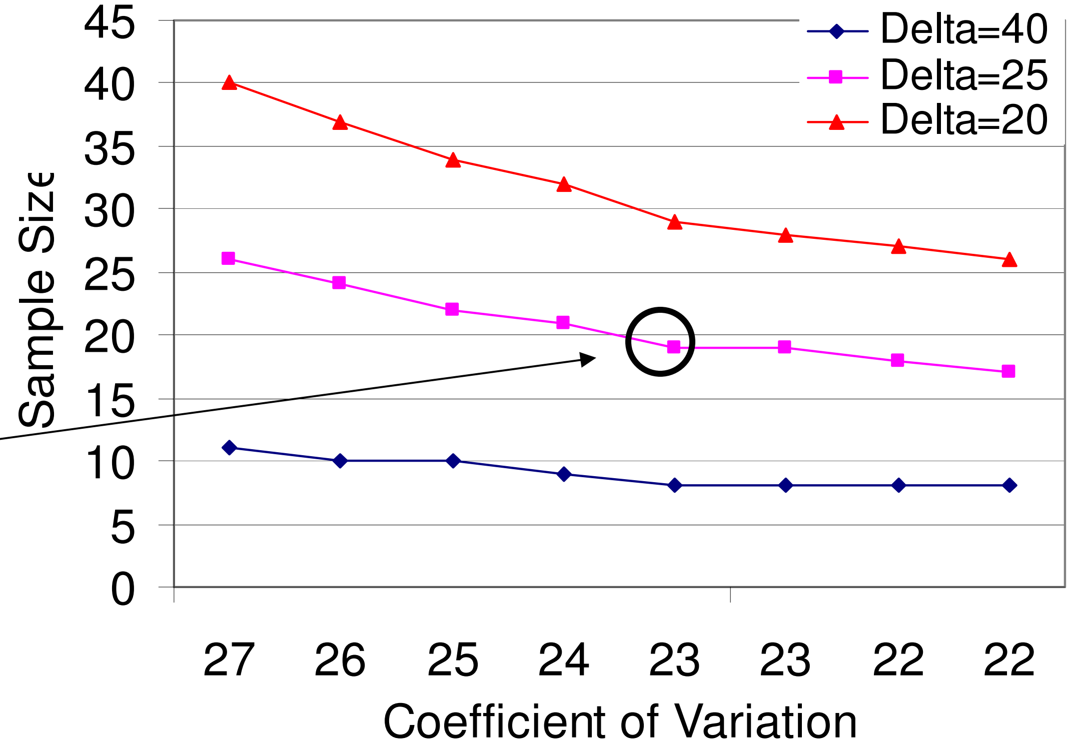
from prior Tier 2 testing (CRC, MSAT, CARB) CoV ~ 23% (NMHC)

- To discern effect

@ 95% Confidence

- Sample size = 19
- Similar analysis will

help in experiment design



How Many Vehicles?

- For Tier 2 vehicles, previous study found that 19 vehicles should capture a small effect
  - With 3 fuels, this comes to N=57 vehicles
  - May need to repeat statistical estimates for other vehicle "types": NLEV/legacy, LDT>8500, HDG, & motorcycles
  - They may have greater variability, increasing N (pilot study may be called for)
- Vehicles should represent large volume manufacturers
- All vehicles are tested out to FUL
- All vehicles have exhaust & evap testing

- The above design represents an ideal (but large) test program
- A more streamlined program may get sufficient statistics while reducing:
  - Types of vehicles
  - Fuels
  - N (vehicles within a "type")
  - Tests

NonRoad Overview

- 9 Different Equipment Categories (see next table)
- Each Equipment Category is Unique
  - High power to weight ratio (snowmobiles)
  - High Speed (some handheld: 10,000, nonhandheld: 3500 rpm)
  - Air cooled and Water Cooled engines
  - Extreme Environmental Conditions (-30F to 120+F)
- Variability in emission results notable in air cooled engines
  - Use statistics to determine if real difference in emission levels exist with new fuels
- Engine concerns with higher oxygenated fuels
  - Overly lean operation can result in engine damage (engines tend to run rich of stoichiometry now)
  - Exhaust gas temperature increase
  - Catalyst durability
  - Safety (surface temperatures, engine speed increases, etc.)
  - Startability
- Durability in real in-use conditions is of concern for new technologies AND legacy fleet

NONROAD EQUIPMENT/ VEHICLE	First Emission Standards	Modeling Average Life (Yrs)	Regulatory Emission Useful Life (Hours)	Type (certified by engine mfr unless otherwise noted)	2008 Model Population (Millions)	HC/NOx Exhaust Rating (1-10)
Small SI <19kW: Handheld (ex: trimmer)	1997	2.5 1	50/300	2 & 4 stroke/cat (Residential) 2 & 4 stroke/cat (Commercial)	32.9 2 strk 5.7 4 strk	HC: 7 / NOx: 8
Small SI <19kW: Nonhandheld **Class I engines (ex: lawnmower/**	1997	6 2	125/250/500	4 stroke/cat (Residential) 4 stroke/cat (Commercial)	85.4	HC: 2 / NOx: 2
Class II engines (ex: lawn tractor)		6 3	250/500/1000	4 stroke/cat (Residential) 4 stroke (Commercial)		
Recmarine Outboard	1998	25	350	2 stroke: carb/DI	7.1	HC: 1 / NOx: 4
				4 stroke: carb/DI/supercharge	2.4	HC: - / NOx: 5
Recmarine PWC	1998	10	350	2 stroke: carb/DI	0.8	HC: 6 / NOx: 9
				4 stroke: carb/open EFI	0.5	HC: - / NOx: 7
Large SI	2004	25	5000 hrs (cert 2500)	4 stroke automotive tech (few gas/mostly LPG)	1.2	HC: 8 / NOx: 1
NR Motorcycle	2006	13	10,000km	2 str/4 str *certified by equip mfr	2.4	HC: 5 / NOx: -
ATV	2006	13	10,000km or 1000 hours	2 str/4 str *certified by equip mfr	9.8	HC: 4 / NOx: 6
Snowmobile	2006	13	400 hours/ 8000 km	2 stroke: air/water/DI *certified by equip mfr	2.2	HC: 3/NOx: 10
				4 stroke: carb/EFI *certified by equip mfr	0.07	HC: -/ NOx: -
Marine Sterndrive/ Inboard	2010	20	480	4 stroke: carb/EFI/cat	2.0	HC: 9 / NOx:3

Nonroad engines

- How will nonroad differ from on-road?
  - Many more equipment/vehicle types and engine categories need to be tested in order to be representative
  - Some engines are used in multiple applications within one category
    - Engines must be removed from equipment for emission measurement
  - Equipment/Vehicles are certified for snowmobile/nonroad motorcycle and ATV only
  - Useful Life/Durability aging is much shorter than on-road
  - Engines may be more sensitive to fuel changes
    - Carbureted/Open loop EFI
    - Air-cooled nonroad engines

- Test programs must include:
  - A complete cross-section of impacted engine/equipment categories
  - In-use fleet and in-use operating condition aging where necessary
  - Baseline fuel and waiver fuel
    - Exhaust emissions
    - Evaporative emissions
  - Engine teardown and inspection
  - All equipment/vehicle data must be reported – including engine failures

Non Road Test Program Recruitment

- Obtain the Equipment for the Study
  - Sufficient number of models to represent
    - major sales models,
    - variety of engine technologies,
    - hp range, speed range,
    - applications, markets,
    - etc.
  - New Equipment/Vehicles
    - Range of engine tech may include catalyst, 2stroke, 4 stroke, carbureted, EFI
    - 2-3 equipment/vehicle per model per fuel (due to production variability)
  - Legacy equipment/vehicles
    - With low/mid life mileage
      - Range of technologies/manufacturers/applications, etc.
  - Future technology engines for upcoming new emission regulations, if available
  - Snowmobile, Nonroad motorcycles and ATV's are certified by equipment manufacturer
    - Consider equipment manufacturer differences
  - Pilot study may be required to determine sample sizes to discern fuel effects but streamlining may be required due to sheer variety of equipment types

Non Road Emission & Durability Test Program Example

- Exhaust Emission Testing per Engine/Vehicle
  - New: (at least 3 points) New, mid-life and end of durability cycle.
  - Legacy: (at least 2 points) Received and end of aging.
  - 3 emissions tests per test point on baseline and waiver fuel
    - Perform statistical comparison to determine if there is a difference.
  - Follow EPA regulatory test procedures for applicable equipment/vehicle

- Evaporative emissions tests
  - Follow EPA regulatory test procedures for applicable equipment/vehicle
  - Baseline and waiver fuel
  - 2 points: New/Received and End of useful life for New and Legacy

Non Road Emission and Durability Test Program, Continued

Real World Durability Testing for New and Legacy Equipment/Vehicle

- New: 50-100% of Emissions Useful Life (Hours)
- Legacy: 25-50% of Emissions Useful Life (Hours)
- Field aging: operate in real world application and ambient conditions
  - typical of in-use operation
  - include temperature extremes
- Dynamometer aging may be acceptable for some engine categories if in-use operation, ambient conditions and operation under extreme conditions can be replicated – for example:

	Small SI <19kW HH	**Small SI <19kW NHH Class I**	**Small SI <19kW NHH Class II**	**Snow-Mobile**	**NR Motor-Cycle/ ATV**	**Rec-Marine Out-Board**	**Rec-Marine PWC**	**Rec Marine Stern-drive/ Inboard**	**Large SI**
Infield/Dyno Durability Testing	InF	InF	InF	InF	InF/D	InF/D	InF/D	InF/D	InF/D
Reason For In-Field	Env Cond	Env Cond	Env Cond	Ambient Temp	-	-	-	-	

Non Road Emission and Durability Test Program, Continued

- CRC Wear and deposit rating
  - Destructive testing/tear-down of statistical sample of all tested engines following the final emissions tests
  - Destructive testing/tear-down of any engines that fail to operate or fail emissions standards during the course of testing

- Observe "side" effects of new fuel
  - 2 strokes fuel/oil mix impacts
  - 4 strokes with fuel that has been stored in fuel containers and/or equipment fuel tanks between seasons

EXHIBIT J

Vehicle Selection & Sample Size Issues for Catalyst and Evap Durability Testing

Nov 12, 2008

Waiver Qualification

- CAA section 211(f)(4), as revised: The Administrator, upon application of any manufacturer of any fuel or fuel additive, may waive the prohibitions established under paragraph (1) or (3) of this subsection or the limitation specified in paragraph (2) of this subsection, if he determines that the applicant has established that such fuel or fuel additive or a specified concentration thereof, and the emission products of such fuel or fuel additive or specified concentration thereof, will not cause or contribute to a failure of any emission control device or system (over the useful life of the motor vehicle, motor vehicle engine, nonroad engine or nonroad vehicle in which such device or system is used) to achieve compliance by the vehicle or engine with the emission standards with respect to which it has been certified pursuant to sections 206 and 213(a) of this title. The Administrator shall take final action to grant or deny an application submitted under this paragraph, after public notice and comment, within 270 days of the receipt of such an application.

Interpretation of CAA 211(f)(4)

- Current catalyst durability test plans seem to concentrate on a strict interpretation of the "any" wording
  - OTAQ staff does not believe that failure of a single model, or even a limited group of models, necessarily warrants denial of a waiver
    - Consideration of overall inventory impacts will likely be paramount in a waiver decision
    - The background rate of failure contributes critical information
    - EPA believes that the CAA language might allow for a partial waiver that would permit, for example, E15 use in just Tier 2 (2004) and later MY vehicles
    - If a partial waiver is granted, a strategy would need to be developed to address concerns with the misfueling of vehicles and equipment not approved for use with EXX
- OTAQ staff believe it is also important to address the "contribute" wording
  - Test programs should compare the measured rate of failure with a new fuel/additive with the natural failure rate and determine if there is a statistically significant increase in failures with the new fuel/additive

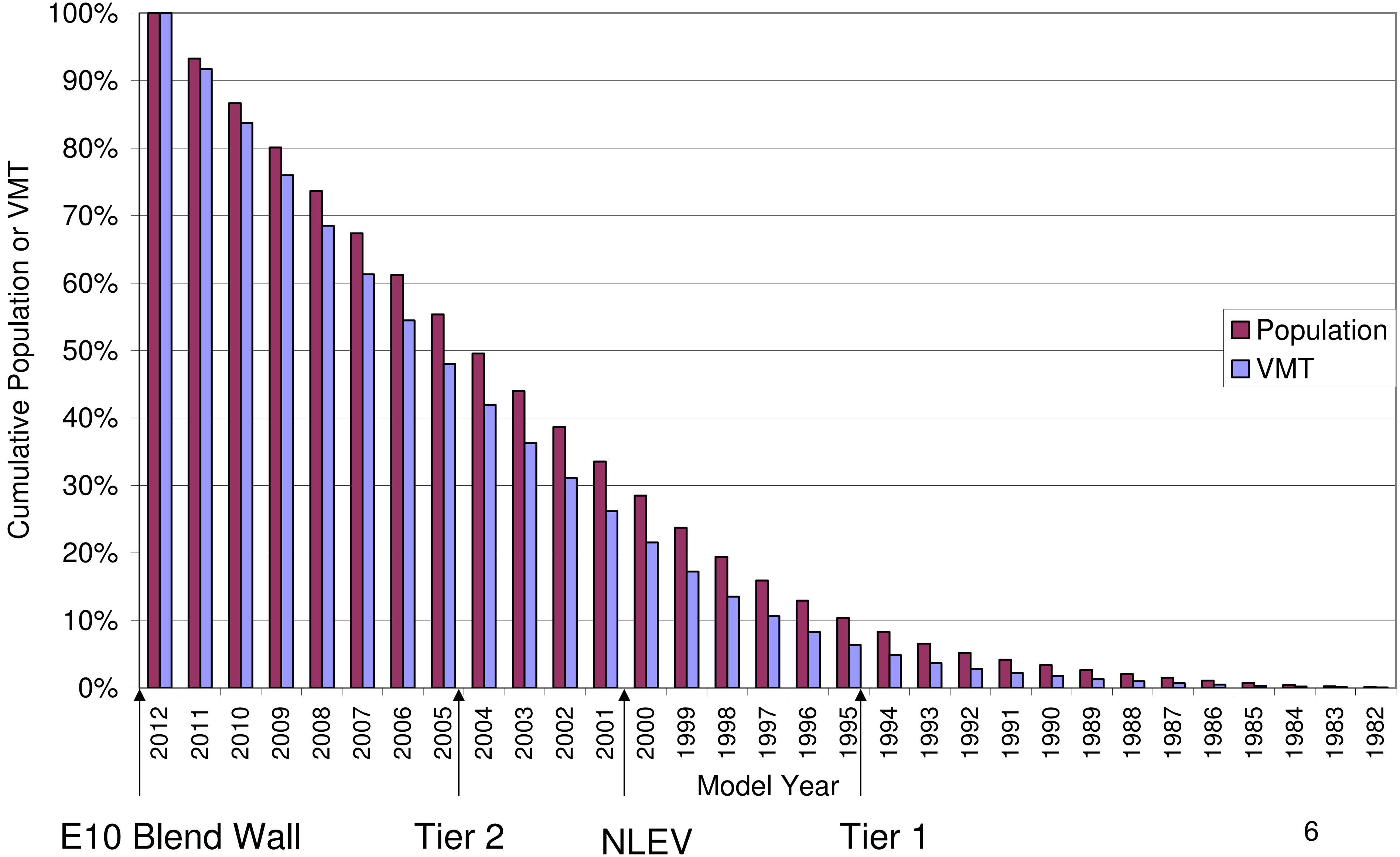
Catalyst Durability Hypotheses

- A test program with a limited budget can not include sufficient vehicles and fuels for consideration of a full fleet waiver on E20
  - Different certification groups have different variabilities and sensitivities to ethanol
  - Each would have to have its own large test matrix
  - E.g. test program concentrating on E0 and E15 (omitting E10 & E20) will allow for more vehicles and give better statistics
- Also EPA requires additional information to quantify emissions effects of regulated pollutants to the inventories to mitigate any effects of ethanol (anti-backsliding)
- Thus the test programs should be designed for more focused hypotheses (and waiver):
  - The vast majority of Tier 2 vehicles are able to adapt to E15 and thus are not "sensitive" in that they are not contributing to failure to meet emissions standards
  - The test program should concentrate on tier 2 vehicles to prove out this hypothesis

Subsamples

- If testing is concentrated on "sensitive vehicles" then a measure of the background rate (tier 2) of failure is still required
  - May use in-use and certification data as a guide, but these may not go out to 120K miles.
- Tier 1 vehicles will be beyond Full Useful Life at time of blend wall.
- In 2012 (appx time to blendwall) NLEV vehicles will be 8+ years old
  - NLEVs will also mostly be beyond FUL
  - NLEVs will have spent most of their (VMT) lives exposed to fuels ≤ E10 (see next slide)

Fleet & VMT fraction in 2012 (MOVES)



Sample Size--Auto/Oil Procedures

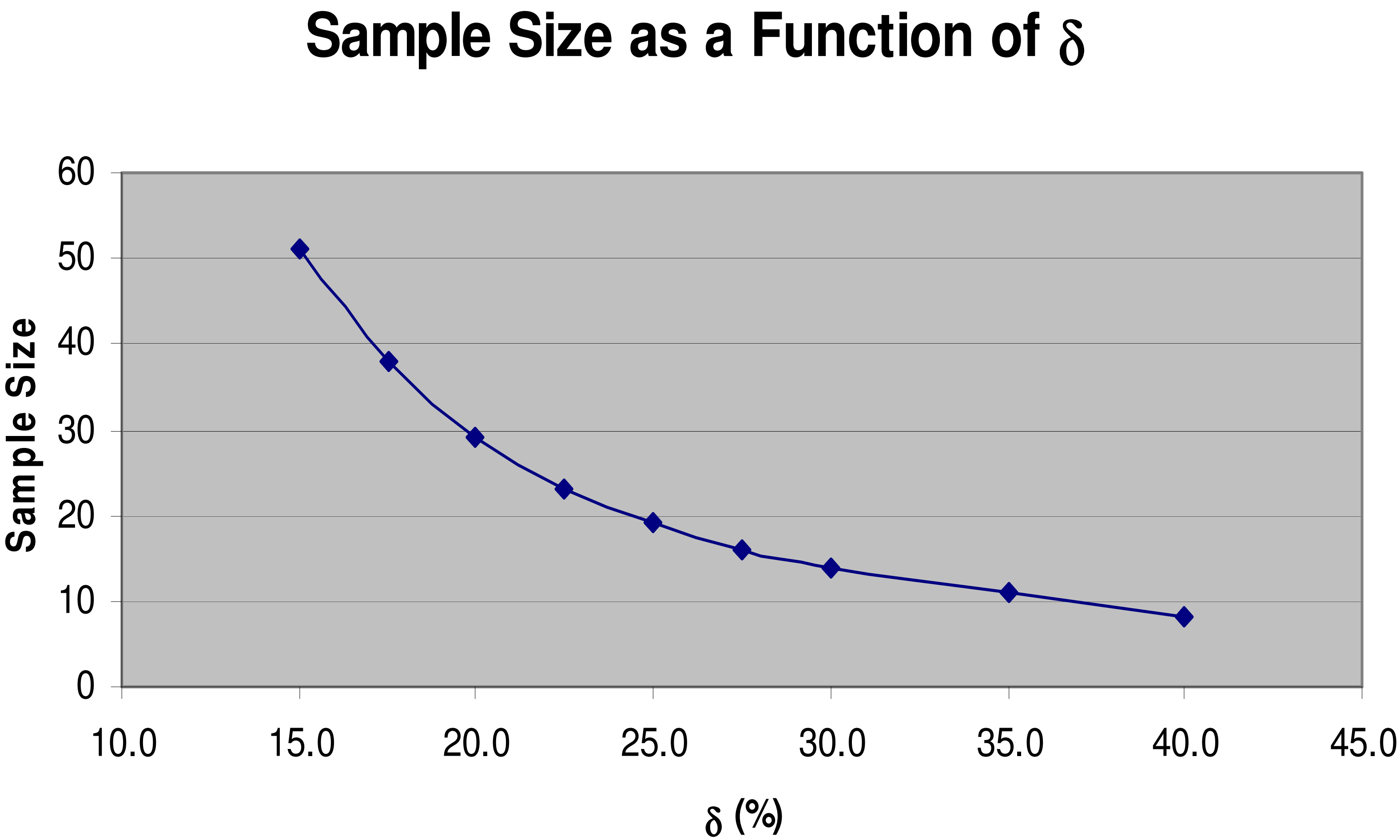
- Taken from Auto/Oil Approach Found in L.J. Painter and Rutherford, J. A., "Statistical Design and Analysis Methods for the Auto/Oil Air Quality Research Program," SAE Paper 920319, 1992.
- For Auto/Oil, sample size is the number of vehicles required to detect a statistically significant difference in emissions from different fuels
- Requires the following variance determinations:
  - Car x Fuel interaction (C x F)
  - Repeat test variance
- Auto/Oil used GM data for estimates

EPAct Procedure From Auto/Oil

- Using variances estimated from Tier 2 vehicle testing, compute:

  C x F error = sqrt (C x F + repeatability/n)
- Select δ, the minimum percent difference between fuel emissions, that can be statistically significant at $\alpha = .05$ and $\beta = .10$ (.05 in Auto/Oil), for n = 2 replicates.
- For 2 replicates, plot the relationship between δ and the number of vehicles required for testing.
- For $\delta = 25\%$, a sample size of 19 cars is required. For $\alpha = .10$, a sample size of 16 is required. The $\delta = 25\%$ was selected by Auto/Oil.

Selecting δ, the Minimal Detectable Difference in Emissions for Fuels (n = 2)



Problems Applying These Auto/Oil Procedures to Durability Waiver Tests

- For Auto/Oil, sample size was computed for cars; for durability waiver testing, sample size should be computed for models.
- Each test car is only tested on one fuel so there can be no C x F term computed for the durability waiver data.
- Only NOx and NMHC data considered in EPAct sample size computations.
- No data are available to estimate variances after mileage accumulation.
- Only Tier 2 vehicles used to determine EPAct sample size.

Example Guidelines for Model Selection

- Randomly select a total of at least 10* Tier 2 bin 5 models, taking into consideration model sales
  - If fuels are reduced to E0 & E15, 20 models may be selected
- For example, if model A has twice the sales of model B, then the probability of selecting model A should be twice that of model B
- A variety of OEMs should be represented
- If "sensitive" models are included, this should be a separate (and minority) "strata" and weighed appropriately later
- The non-sensitive models should exclude highly specialized or low sales volume types of vehicles such as luxury, sport vehicles and FFV's

* Limitations of current catalyst durability program due to cost

EVAP Durability Testing

- The same criteria for cat durability should apply
  - Variability can be determined from manufacturer certification data
  - Representative test fleet can be determined
  - If catalyst durability program is targeted for a partial waiver, then evap durability should also
  - Most cost effective evap durability program would combine with catalyst durability

Conclusions

- Preliminary test results show that newer vehicles may be less sensitive to mid-level blends across the DOE test program
- Evidence exists to indicate that Tier 1 and older vehicles may have issues with mid level blends
- Since almost all Tier 1 and most NLEVs will be past their FUL when we hit the blend wall, EPA believes that a test program that concentrates only on “sensitive” NLEV and Tier 1 vehicles would not best utilize scarce testing resources
- EPA believes that a partial/conditional 211(f)(4) waiver for newer vehicles is the best option for expeditiously collecting and considering test data for a mid-level ethanol blend waiver
  - However, issues with the misfueling of vehicles and equipment not approved to use mid-level blends must be addressed
- **Therefore, EPA believes that testing (for both catalyst and evap durability) should concentrate on a representative sample of Tier 2 vehicles**

EXHIBIT LIST IN

COMMENTS OF
ALLIANCE FOR A SAFE
ALTERNATIVE FUELS ENVIRONMENT (ALLSAFE)
AND
THE OUTDOOR POWER EQUIPMENT INSTITUTE (OPEI)

Notice of Receipt of a:	) Docket ID No.:
Clean Air Act Waiver Application	) EPA-HQ-OAR- 2009-0211
To Increase the Allowable Ethanol	) FRL–8894–5
Content of Gasoline to 15 Percent	) 74 Fed. Reg. 18228 (April 21, 2009)

EXHIBIT A	Sahu Technical Study
EXHIBIT B	Supplemental Statutory Appendix
EXHIBIT C	Briggs Study on E20
EXHIBIT D	Sahu Minn Compatibility Study
EXHIBIT E	Sahu's DOE Critique
EXHIBIT F	Two Cert. Applications
EXHIBIT G	OPEI Test Program
EXHIBIT H	EMA Test Plan
EXHIBIT I	Karl Simon Presentation

ATTACHMENT 7

National Marine
Manufacturers Association

July 20, 2009

**VIA ELECTRONIC MAIL
& FACSIMILE**

Office of Air & Radiation
U.S. Environmental Protection Agency
6102T, 1200 Pennsylvania Avenue, NW
Washington, DC 20460

RE: Docket ID No. EPA-HQ-OAR-2009-0211 – National Marine Manufacturers Association Comments to the U.S. Environmental Protection Agency Regarding the Waiver Application to Increase the Allowable Ethanol Content of Gasoline to 15 Percent

The National Marine Manufacturers Association (NMMA) is pleased to provide the U.S. Environmental Protection Agency (EPA) with comments regarding the "Notice of Receipt of a Clean Air Act Waiver Application to Increase the Allowable Ethanol Content of Gasoline to 15 Percent" (74 Federal Register 18,228 (April 21, 2009).

NMMA is the nation's leading recreational marine industry association, representing over 1,600 boat builders, engine manufacturers, and marine accessory manufacturers. NMMA is also a member of the Alliance for a Safe Alternative Fuels Environment ("AllSAFE") and we herein incorporate in total the comments submitted to EPA regarding Docket ID No. EPA-HQ-OAR-2009-0211 by AllSAFE. NMMA members collectively produce more than 80 percent of all recreational marine products made in the United States. With nearly 13 million registered boats (and nearly 17 million boats in the field) and 70 million boaters nationwide, the recreational marine industry is a major consumer goods and services industry that contributed $33.6 billion in new retail sales and services to the U.S. economy in 2008 and generates nearly 340,000 jobs nationwide.

I. INTRODUCTION & OVERVIEW

NMMA strongly urges EPA to deny the petition submitted by Growth Energy and 54 ethanol manufacturers ("Petitioners") pursuant to Clean Air Act Section 211(f)(4) on March 6, 2009 requesting a waiver for ethanol-gasoline blends of up to 15 percent ethanol by volume ("E15"). NMMA further strongly opposes the granting of any "partial" or "conditional" waiver for E15 or any other ethanol blend level over ten percent ethanol ("E10"). NMMA strongly opposes the approval of a waiver under Sec. 211(f)(4) of E15 (or any other intermediate ethanol blend) for a subset of vehicles or engines, as the fuel waiver process under Sec. 211(f)(4) never contemplated such a partial approach and it is clear that there are very serious practical and legal implications to the issuance of a partial waiver.

Executive Committee
Chairman, NMMA David Slikkers Tiara Yachts
Vice Chairman, NMMA Jason Pajonk-Taylor Taylor Made Products
Treasurer, NMMA Joan Maxwell Regulator Marine
Secretary, NMMA Mark Schwabero Mercury Marine
BMD Representative John Dorton MasterCraft Boats
EMD Representative Paul Dierksen Volvo Penta
AMD Representative Fred Sherrerd ASA Electronics
Member At-Large Chuck Rowe Indmar
President Thomas J. Dammrich NMMA

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Petitioners have clearly failed to meet the requisite statutory burdens outlined under Sec. 211(f)(4) to justify a decision by EPA to grant a waiver for E15, or any other ethanol blend above 10 percent. NMMA does not oppose the use of ethanol of not more than 10 percent in gasoline (or E85 for specially-manufactured flexible fuel cars and trucks), although E10 has negatively impacted recreational marine engines and fuel systems in certain and significant cases. NMMA members have been designing their engines and fuel systems to be compatible with E10 since the early 1980s. As EPA clearly indicated in its determination that E15 is not "substantially similar" to E10, there are serious design and certification distinctions between these two totally separate fuels for engine manufacturers, regulators, and consumers. For the marine sector as with all other engine manufacturing sectors, one of the most substantial concerns is the enormous and diverse array of nearly 17 million legacy marine products currently operating in the United States—and those boats, engines, and fuel systems currently being manufactured—none of which has been designed, calibrated, or certified to be compatible with any gasoline fuel containing more than 10 percent ethanol by volume.

Recreational marine fuel systems are not unique in this regard. The overwhelming majority of non-road engines, from chain saws to weed trimmers to lawnmowers, operate similarly to recreational marine engines with open loop systems where the carburetor is set at the factory and designed to be tamper proof. It is for these reasons and the following supporting information that NMMA strongly urges EPA to deny this waiver petition in its entirety.

II. CURRENT RECREATIONAL MARINE INVENTORY & THE LEGACY FLEET

As has been mentioned, there are an estimated 17 million recreational boats currently in operation in the U.S. No gasoline marine engine—or any other marine equipment including gasoline generators—currently in the field was designed, calibrated, certified or is warranted to run on anything over 10 percent ethanol. Available data strongly suggest that all of the 12,875,568 registered boats on the water today (with the exception of approximately 260,000 diesel-powered boats and the roughly 430,000 registered non-motorized craft) may be negatively impacted by anything over E10. Although the exact number of engines in use today is unknown, approximately 95 percent of mechanically-propelled boats registered are less than 26 feet long, meaning that they are likely powered by a single engine. NMMA estimates that there are approximately 400,000 of the currently registered boats that are larger than 26 feet in length and many are powered with multiple engines. Single engine models dominate the sterndrive market, accounting for 94.2 percent of sales in 2007 and the remainder being twin sterndrive engines for this segment.

In addition to the millions of recreational boats and marine engines currently in the field, it is important that EPA understand the diversity in product in the marine engine segment. In the spark-ignited (SI) marine systems category, there are outboards, personal watercraft, stern drive/inboard engines, and marine generators. Of these gasoline-powered engines, horsepower (HP) ranges from the single digits to 1100 HP, all with very different, diverse engine configurations and fuel systems designed for highly-specific and sophisticated purposes. Not a single piece of marine equipment or data on the impact of E15 on these products is referenced in Petitioner's application for a waiver.

Additionally, marine engines, as well as the vessels they power, are a significant investment for the consumer. In 2007, 275,500 outboard units were sold at an average cost of $9,761. The 50-75 HP segment for outboards had the largest market share with over 16 percent of sales, followed by the

200 HP and greater segment with slightly more than 15 percent market share. The average cost of a new 200 HP or greater outboard engine is $21,418. The average cost of an outboard boat, engine and trailer in 2007 was $29,398, while the average cost of a sterndrive boat in 2007 was $44,237. For sterndrive craft over 24 feet in length, the average 2007 cost was $86,063. In the inboard cruisers segment, more than half are powered by diesel engines, and in 2007 diesel engines share of the inboard boat market increased to 56 percent, up 3 percent from 2006. Nine out of 10 inboard cruisers sold in 2007 were powered by at least two engines, with slightly less than half of the inboard market being powered by gasoline engines. The average price of an inboard ski boat (generally gasoline-powered) in 2007 was $47,234. The average price of an inboard cruiser in 2007 was $465,826. Recreational marine equipment is a substantial investment for the consumer.

Of the recreational 16.93 million recreational boats in operation in 2007, the market is comprised in the following way:

- Outboard Boats 8.34 MM
- Inboard Boats 1.12 MM
- Sterndrive Boats 1.67 MM
- Personal Watercraft 1.23 MM
- Sailboats 1.55 MM
- Other 3.01 MM

In the marine market, fleet turnover is comparatively slow and the legacy fleet is much older than other sectors. In 2006, an estimated 684,000 boats were retired from the fleet, of which 57 percent were outboard boats and another 16 percent were sterndrive boats. NMMA estimated there were 354,400 new powerboats sold in the United States during 2007; therefore, approximately 225,000 powerboats were retired from the fleet during the year, or less than 2 percent of the total powerboat fleet. Of all engine segments, marine almost certainly has the oldest legacy fleet in the field. Additionally, 73 percent of all boat sales in 2007 were pre-owned boats, of which the majority is pre-owned outboard boats. However, 57 percent of all powerboat and registered sail boat owners were still owned by their original buyer after 11 years. The current economic downturn will further slow retirement of boats and engines.

As already stated, none of the product in the field is designed to run on gasoline blended with anything above 10 percent ethanol. Given the comparatively long fleet turnover period, the substantial pre-owned market, and the significant and long-term investment consumers make in marine engines and recreational boats—whether new, pre-owned, or rehabilitated—it is imperative that EPA fully ensure that performance, durability, and reliability issues do not arise as a result of the introduction of an incompatible fuel or consumer misfueling, which would inevitably be the result of the issuance of a "partial" waiver for E15.

III. E15 Raises Serious Performance, Durability, Emissions & Safety Issues in Marine Equipment; More Testing is Needed

EPA has requested comment on whether "an appropriate level of scientific and technical information exists in order for the Administrator to determine whether the use of E15 will not cause or contribute to the failure of any emission control device or system over the useful life of any non road vehicle or non road engine (certified pursuant to sections 206 and 213(a) of the Act) to achieve compliance with applicable emission standards." Given the near-total lack of scientific information on the impacts of E15 on recreational marine equipment in particular, and insufficient testing of other non-road as well as on-road product, there is clearly *not* an appropriate level of scientific or technical information to warrant an EPA approval of E15 at this time—EPA should deny the petition outright. Indeed, much of the data cited in the Growth Energy petition, including the Department of Energy study, demonstrate that higher ethanol blends cause substantial performance problems for small engines and *increase* air emissions (see comprehensive critique of Growth Energy's data submission in AllSAFE comments and exhibits).

Petitioners have stated that they are requesting this waiver to allow the sale of E15 as a general purpose fuel, but not to require it. This argument is clearly immaterial to EPA's contemplation of the waiver application under Sec. 211(f)(4). As will be outlined below, Sec. 211(f)(4), EPA's internal recommendations on the statutory requirements in terms of necessary data, and Congressional intent per the Energy Independence and Security Act of 2007 clearly indicate that EPA must evaluate a petition for a new fuel for all on-road and non-road engines and equipment. Further, non-road or off-highway fuel use is a relatively small percentage of overall gasoline consumption in the United States. EPA approval of E15 would remove the incentive for fuel stations to maintain a separate tank and pump for non-road vehicles and equipment, since doing so would result in higher fuel costs for the fuel station and reduce its operating margin. In any event, fuel for non-road engines and equipment would become a specialty fuel at best, raising its cost, discouraging consumers from buying it, and therefore exacerbating the risk of misfueling, which will be further discussed below.

A. NO TESTING ON RECREATIONAL MARINE ENGINES, FUEL SYSTEMS, OR COMPONENTS

In May 2008, NMMA submitted a formal test protocol to the Department of Energy (DOE) outlining the requisite testing for the recreational marine sector with respect to an increased ethanol blend (Attachment I). NMMA subsequently met with DOE on several occasions and has held a mutually informative dialogue with the Department in an effort to secure independent and methodologically robust scientific testing for marine products. No such testing has yet occurred. Subsequent to the formal waiver submission by Petitioners, NMMA further engaged DOE on marine testing which, if funded, will evaluate the effect that E15 has on marine engine durability. Pursuant to requirements outlined in Sec. 211(f)(4) such testing is necessary—but not sufficient—in providing EPA with additional scientific and technical information in order for the Administrator to determine, in part, whether the use of E15 will cause or contribute to the failure of any emission control device or system. Even when this engine durability test is completed, however, there are still many technical questions that need to be answered before EPA can allow higher blends of ethanol-gasoline to be introduced into commerce. At this time, EPA clearly lacks sufficient technical and scientific information to evaluate the effect of E-15 on boat fuel systems, engine fuel systems, engine emissions and power and drivability issues.

Furthermore, it is the burden of the petitioner to prove that there will be no "potential for harm" to existing on-road and non-road engines. Specifically, EPA has indicated in internal staff guidance that a fuel manufacturer petitioning for an intermediate ethanol blend must provide test data on (1) operability; (2) materials compatibility; (3) exhaust emissions impacts; (4) and evaporative emissions impacts from a representative dataset of on-road and non-road engines and equipment. In every case, the Petitioner's application fails to meet this guidance and supply the recommended data.

Neither EPA nor DOE, or any other federal agency, has conducted any testing of E15 on marine equipment. Tellingly, Petitioners make no mention of marine testing in their waiver application, although Congress explicitly strengthened the 211(f)(4) fuel waiver petition process in the Energy Independence and Security Act of 2007 to require EPA to evaluate the implications of a new fuel (e.g. E15) on non-road equipment, including recreational marine engines, fuel systems and their components. Given widespread and well-documented problems associated with E10 in marine engines, it is likely that independent scientific marine engine durability and emissions testing will demonstrate that E15 is simply not compatible with recreational boats and marine engines as well as other non-road equipment of similar design. Even after durability and emissions testing, there will remain many questions that EPA must answer as it examines the wisdom, appropriateness and desirability of allowing E15 for general sale. NMMA strongly urges that, in addition to marine engine durability and emissions testing, EPA undertake evaluations on both new and legacy marine products in all of the areas outlined below.

B. WELL-DOCUMENTED E10 IMPACTS ON RECREATIONAL MARINE EQUIPMENT WILL LIKELY BE EXACERBATED BY E15

Neither NMMA nor its members have conducted any studies or testing to determine whether the use of E15 or a mixture between E10 and E15 will cause or contribute to the failure of an emission control device. More importantly, neither EPA nor DOE have conducted any such testing. Petitioners have neither conducted nor do they reference any testing on marine equipment, although legal precedent and a clear reading of the statute place the burden squarely on the fuel waiver applicant. As EPA well knows, the Agency has very stringent emission standards for recreational boat fuel systems and marine engines that are designed to reduce emissions of HC, NOx and CO both from engine exhaust and fuel system permeation. NMMA members have spent substantial dollars and resources to comply with federal emissions regulations set by EPA. NMMA recognizes that the oxygen level in the fuel plays an important role in ensuring that these engines meet these standards.

There is a significant amount of technical and anecdotal information that concludes that the introduction of E10 into the gasoline supply has caused significant damage and failure to boats. Manufacturers, marine service businesses, and boaters have reported problems with:

- Damage to rubber parts (Attachment II)
- Water contamination in the fuel system due to ethanol's hydroscopic properties (Attachment III)
- Increased water absorption and phase separation of gasoline and water while in tank
- Corrosion of fuel system components and fuel tanks (Attachment IV)
- Higher exhaust gas temperature due to enleanment (Attachment V)
- Performance issues, such as drivability (i.e. starting, stalling, fuel vapor lock)
- Damage to valves, push rods, rubber fuel lines and gaskets.

NMMA anticipates that these problems, as well as others, will be significantly exacerbated by the introduction of mid-level ethanol blends. Further performance failures and other problems associated with ethanol, particularly in light of an EPA decision to grant a waiver for E15 even in the absence of requisite information and testing, will likely result in a substantial consumer backlash and potential consumer rejection of ethanol generally, including E85.

C. ENLEANMENT

In addition to the physical evidence of ethanol's damaging effects, NMMA's concerns are also based on the physical properties of ethanol in gasoline. Gasoline is a mixture of many hydrocarbon compounds that consist mainly of hydrogen and carbon. Ethanol also contains hydrogen and carbon, but in addition it also contains oxygen. The exact air-fuel ratio needed for complete combustion is called the "stoichiometric air-to-fuel ratio." This ratio is about 14.7 to 1 on a weight basis for gasoline. When more ethanol is added to gasoline, less air is required for complete combustion because air is already contained in the ethanol. For example, for E10 the stoichiometric air-to-fuel ratio is 14 to 14.1 pounds of air per pound of fuel. The stoichiometric air-to-fuel ratio for straight ethanol is 9 to 1 so as the proportion of ethanol in gasoline increases so must the air-to-fuel ratio decrease. To deliver the required power for a given operating condition, engines are designed to consume enough air and fuel to generate the required energy. The marine engine is designed and calibrated to anticipate a specific fuel-to-air ratio and nothing different. Because ethanol-blended fuels require more fuel for the same amount of air to achieve stoichiometric conditions, the fuel system must adapt by introducing more fuel. If additional fuel is not introduced to compensate for the ethanol the resulting mixture has less fuel than needed and the engine experiences a condition known as "enleanment."

Enleanment can lead to a variety of performance problems. For example, the combustion and exhaust gas temperatures will be higher, engine starting may be more difficult, and the engine speed control may become inaccurate. The increased combustion and gas temperatures resulting from lean operation can result in severe damage to pistons, head gaskets, catalysts and emission related components, and, in turn, result in the failure of the engine and increased exhaust emissions.

D. BOAT FUEL SYSTEMS

The boat fuel system consists of fuel tanks, lines, connections, anti-siphon valves, fuel fill, and vent systems. Fuel tanks are routinely made of Aluminum, Fiberglass, and Cross-Linked Polyethylene. Each has its challenges. Documented cases of galvanic corrosion have occurred in aluminum tanks, causing fuel leaks in the boat bilge. This is attributed to the fact that adding ethanol to gasoline makes the fuel conductive. With ethanol's affinity for water and the fact that boat fuel systems are vented, serious quantities of water are often present in the fuel, leading to phase separation. In a saltwater environment, water in the fuel system will contain salts, which increase the corrosive effects. Fiberglass tanks have already shown catastrophic damage/destruction on E10.

When the Northeastern United States transitioned from MTBE to E10, many older boats with fiberglass tanks experienced significant failures. The ethanol dissolved the fiberglass resin and the resulting sludge went into the engines and caused damage. Furthermore, in many boats the tanks developed fuel leaks into the bilge, creating safety and environmental hazards. Most of the repair bills were in the thousands of dollars. With the newer cross-linked polyethylene tanks, little or nothing is known about long term durability when exposed to higher ethanol blends. EPA has recently identified these tanks as being a significant source of evaporative emissions due to permeation and has regulations phasing-in to control permeation. Increased ethanol concentrations will likely increase that permeation rate and could potentially undo or undermine EPA's recent regulatory work in this area. In addition, other remaining boat fuel system components (hoses, valves, filler, vent, fuel gauge float and sender, deck plates, etc) need to be evaluated for deterioration from higher ethanol blends. Studies conducted by the Orbital Engine Company (at the request of the Australian government) revealed substantial materials compatibility problems on Mercury Marine outboard engines, as discussed below.

Petitioners have submitted no data in their waiver application on the impacts of E15 on boat fuel systems and potential materials compatibility concerns.

E. ENGINE FUEL SYSTEMS

Most of the older marine engines use carburetors for fuel systems. Marine repair and service companies already see carburetor problems associated with the use of E10. These include damaged floats, rubber hoses and parts, gumming and plugging of jets and passageways, etc. Given the seasonal nature of recreational boating, unlike motor vehicles, boats are often stored for five to six months, and many have experienced phase-separation of E10 with absorbed water during storage. Phase separation is well-documented and frequently results in engine failure, often without warning. While this is inconvenient in a car, even temporary loss of power in a boat can be problematic as the inability to maneuver and power a vessel, particularly in volatile seas, can lead to potential safety issues. At the very least, it can lead to costly engine repairs for the consumer.

If the marine engine is within its warranty period, the engine manufacturer will honor the warranty even though the engine itself was not at fault. However, engine manufacturers specifically advise consumers in their owner's manual and warranty documents that usage of incompatible fuel, including gasoline blended with more than 10 percent ethanol-blended gasoline, could void the warranty. All marine engine manufacturers warranty their products up the E10, the current maximum allowable legal limit. Marine engine manufacturers are not in a position to provide warranty support—and have not accrued warranty funds—for products run on fuels containing more than 10 percent ethanol.

Petitioners have submitted no data in their application of the impact of E15 on marine engine fuel systems and potential materials compatibility.

F. FUEL VOLATILITY

Mid-level ethanol gasoline blends are documented as causing the following operating problems resulting from different volatility and vaporization characteristics. First, because ethanol has a lower vapor pressure, it has been shown to cause starting problems due to inadequate vapor pressure of the vapor mixture. The vapor mixture is not rich enough to ignite. The second problem is that ethanol vaporizes at lower temperatures than gasoline and mid-level ethanol can cause "vapor lock." Vapor lock is a condition where the fuel in the engine's fuel system vaporizes, preventing the transport of liquid fuel to the carburetor or fuel injectors. For safety reasons, the U.S. Coast Guard requires that marine fuel systems are not pressurized, so the fuel pump pulls the fuel to the engine from the fuel tank rather than pump the fuel from the tank to the engine. Although boats are currently designed and manufactured to handle problems with vapor lock, increasing the ethanol content in gasoline (e.g. E15) and lowering the vapor pressure will result in the use of a fuel that exceeds the design capabilities of existing boat fuel systems.

Petitioners have submitted no data on the impact of E15 on boat operability concerns that would arise as a result of increased fuel volatility.

G. Marine Engine Emissions

While engine emissions are difficult to predict, it is fully expected based on all available evidence that the introduction and use of E15 or any ethanol-blended gasoline above E10 will result in an increase in NOx emissions due to leaner operation and higher combustion temperatures. In particular, the effect on two-stroke legacy product is completely unknown. Engines with higher ethanol content would likely have more water contamination issues that can lead to gumming or corrosion of fuel systems. These impacts will have a negative effect on emissions.

NMMA encourages EPA to conduct the appropriate fuel and aging tests in order to determine the emissions implications of E15 on the existing legacy fleet of marine engines. Additionally, it is expected that valve train wear and valve damage on four-stroke engines associated with E15 will lead to higher emissions. New inboard and sterndrive engines have three-way catalytic converters that are close coupled and will be subjected to higher temperatures. Should marine engines be brought out of compliance by the use of fuel for which they were neither designed nor certified by EPA, the marine industry would pose the question to EPA as to whom would be responsible for paying for the emissions recall were an engine to fail an in-use emissions test. The manufacturer developed, certified, and warranted the engine based on the fuel regulations in place at the time the engine was certified.

Petitioners again have submitted no data and referenced no study on the impacts of E15 on recreational marine engine emissions (exhaust or evaporative).

H. Power and Drivability

Any loss of power, acceleration, or drivability is unacceptable in a marine engine. Given the harsh marine environment, marine engines are designed to perform to a high degree of specificity and to be reliable. Some recreational craft are powered very close to the level of power required to get the boat on plane, a situation where the vessel rises partly out of the water to reduce drag, increase fuel efficiency and meet the vessel's performance capabilities. Any loss of acceleration or power could mean that the boat would never achieve planing operation, which would cause an enormous loss of performance and increase in fuel consumption, not to mention customer dissatisfaction. Many boats are used for towed sports, including water skiing and wakeboarding, and a loss of power, acceleration, or drivability could render the boat incapable of performing these activities for which they were designed and purchased.

Any disruption in power, drivability or operability must be thoroughly reviewed by EPA as these problems can directly result in increased emissions and potentially lead to tampering with the engine's emissions control devices. Yet again, however, Petitioners have provided no data on E15's potential impacts on power and drivability issues for marine engines and recreational boats.

IV. EPA Should Not Consider Fuel System Bifurcation, or a "Partial Waiver," Under Section 211(f)(4)

EPA has requested comment on "all legal and technical aspects regarding the possibility that a waiver might be granted, in a conditional or partial manner, such that the use of up to E15 would be restricted to a subset of gasoline vehicles or engines that would be covered by the waiver, while other vehicles or engines would continue using fuels with no blends greater than E10." NMMA strongly urges EPA to deny the petition in its entirety and not to approve any "partial" or "conditional" waiver that would result in an untested and unproven "bifurcated" fuel system.

From a practical and legal perspective, Sec. 211(f)(4) is an inappropriate and ill-suited process to discern the myriad and complex policy issues associated with potentially bifurcating the national production, distribution, blending, and marketing of separate E10 (or less) fuels (for non-road products such as marine) and E15 fuels for newer automobiles. As EPA notes in its scoping request, EPA has never "previously imposed this type of 'downstream' condition on the fuel manufacturer as a condition for obtaining a section 211(f)(4) waiver" (74 Federal Register 18,229). The waiver itself would apply to the fuel *manufacturer,* not the fuel retailer or any other downstream regulated entity, so it is highly dubious that EPA has the authority under Sec. 211(f)(4) to issue a partial waiver at all. Petitioners never raised, directly or indirectly, whether EPA should issue a "partial waiver" that would somehow conditionally approve the use of E15 for some limited subset of the on-road, vehicle fleet while attempted to exclude its use for non-road engines and vehicles and older automobiles.

EPA requests comments to develop an administrative record that would address broad fuel segregation and related misfueling controls for over 175,000 gasoline retailers and marine fuel docks. If EPA wants to pursue a "bifurcated fuels" program with different ethanol blends for different products, NMMA urges EPA to initiate a separate major rulemaking process under Section 211(c) rather than proposing this broad national measure with potentially serious economic consequences into a the narrow section 211(f)(4) waiver review process, for which it was never intended to address. NMMA is not qualified to address the legal and policy issues solicited by EPA with respect to fuel marketing, refining, distribution, infrastructure and education associated with a potential "partial" waiver. But it is impossible to comment meaningfully, in this forum, on the vague partial waiver concept as requested in EPA's notice.

However, NMMA would emphasize that an issuance of a partial waiver under the recently-strengthened Sec. 211(f)(4) fuels waiver process would seem to directly contravene Congressional intent under the Energy Independence and Security Act of 2007 (EISA). Specifically, because of the explicit concerns about the adverse impacts of mid-level ethanol on non-road products including recreational marine engines and equipment, Congress built into EISA new safeguards in the Clean Air Act fuels waiver process, specifically directing EPA to only approve a fuel waiver if all non-road and on-road engines or vehicles would not be adversely impacted with regard to their applicable emission standards. EPA would be acting in direct contradiction to these new and clearly-expressed statutory requirements were it now to unilaterally exclude any consideration of non-road products by instead relying on an unjustified and vague "partial waiver" concept.

Additionally, for EPA to employ the Section 211(f)(4) waiver process in consideration of a bifurcated fuel distribution system would ignore the "cost-benefit" analysis and Small Business Regulatory Enforcement and Flexibility Act (SBREFA) protections so critical to ensuring that EPA decisions properly address their potential impact. The statutorily narrow Sec. 211(f)(4) waiver process does not consider the important protections provided by SBREFA, much less address them. The waiver process is not designed to and is not capable of meaningfully evaluating the costs, benefits, safety risks, consumer impacts, small business impacts and practicality of unleashing an entirely new type of fuel and fuel distribution system throughout the United States.

The potential of misfueling is especially large in the recreational marine sector. As indicated above, the overwhelming majority of recreational boats are trailerable and refueled at regular automotive gas stations—95 percent of recreational boats are under 26 feet in length. The premium paid for fueling at a marina can run between seventy five cents and one dollar and fifty cents, so only those boaters who have no other option but to purchase fuel at a marina do so. As with lawn and garden equipment, most recreational boat owners and operators obtain fuel at automotive gas stations, not filling stations on the water.

Should a new fuel, such as E15, be sold at gas stations as a general purpose fuel, no amount of labeling and virtually no economically viable safeguard would prevent the misfueling of recreational boats. Additionally, it is unreasonable for EPA to consign recreational boat owners and operators to using more expensive premium fuel, as EPA's comment request suggests and the recently-published RFS-II Proposed Rulemaking explicitly contemplates. Recreational boating activity and recreational marine sales are closely correlated to the price of gasoline. Even a marginal increase in the price of fuel drives down new boat sales and discourages boating activity. These impacts would need to be evaluated in a comprehensive manner outside of the context of Sec. 211(f)(4) in order to adequately address the full implications of a "partial waiver."

Ultimately, boaters put the same gasoline in their boats as they put in their cars, trucks, and outdoor power equipment. Any effort the "bifurcate" the fuel supply would raise serious liability issues and raise questions with respect to who would be responsible were incompatible fuel, inadvertent or otherwise, to be put into an expensive recreational boat or other small or non-road engine. These are serious issues that cannot be addressed in the vague, unspecified contemplation of a "partial waiver" in EPA's notice for comment.

IV. WAIVER PETITION SCIENTIFICALLY & TECHNICALLY DEFICIENT

When explicit concerns were raised about the impacts of mid-level ethanol on non-road products, in 2007, Congress expanded Section 211(f)(4) by directing EPA to only approve a fuel waiver if all non-road engines or vehicles would not be adversely impacted in regards to emission standards. Petitioners have not met this burden, as outlined above and further discussed below.

Under Clean Air Act Sec. 211(f)(4), petitioners requesting a waiver to sell E15 have a very specific and narrow burden to fulfill: demonstrate with independent scientific and technical data that E15 will not cause defeat or inhibit air emissions devices and bring engines out of compliance with federal clean air laws. Again, in its waiver submission, Petitioners make <u>no mention</u> of recreational marine engines or equipment. There appears to be no understanding of and no regard for the complex and unique set of issues for the marine sector, including:

1) the span of horsepower from single small engines to 1100 horsepower multi-engine applications;

2) the fact that recreational marine engines operate at very high power settings in order to meet performance requirements;

3) the fact that, unlike automobiles, there are no gravity or pressure feed fuel systems in marine engines;

4) the open-vent design of marine fuel systems, which compounds water corrosion concerns associated with a mid-level ethanol blend;

5) the lack of feedback loop engine controls in marine in all legacy engines (feedback loops are only now coming online for sterndrive/inboard engines);

6) the long storage periods for recreational boats, resulting in phase- separation;

7) the challenging marine environment where boat products must be durable and performance must be reliable.

The studies cited in the Petitioner's formal submission to EPA reflect a severe paucity of technical data with respect to the impacts of E15 on a wide array of product, from automotive to motorcycle to outdoor power, and certainly recreational marine. In many cases, the studies demonstrate that intermediate ethanol blends will cause engine failure, materials degradation, and increased air emissions. As outlined above, in each of the critical areas that EPA has determined must be reviewed under Sec. 211(f)(4), Petitioners have submitted zero information for marine engines and equipment. With only marginal exceptions, Petitioner's have relied exclusively on a limited and incomplete set of data for newer motor vehicles (and, in the case of the DOE study, a handful of small spark-ignited engines (none marine)).

For example, Petitioners assert that E15 will not degrade materials on certain non-road products and cite a series of related studies published in March 2008 by Minnesota State University ("Minnesota Study"). First, it is important to note these studies, as is the case throughout the Petitioner's waiver application, rely on data compiled from testing completed with fuels other than E15—a seriously flawed approach which is inconsistent with EPA's fuels waiver precedent that the applicant submit data on the specific concentration of the requested fuel additive (in this case, E15). This notwithstanding, the Minnesota study cited by Petitioners is seriously deficient for other reasons. The Alliance of Automobile Manufacturers ("AAM") and AllSAFE have both thoroughly critiqued the 2008 Minnesota studies. The table below represents NMMA's most significant concerns with the Minnesota Study with respect to its conclusions about recreational marine components.

DEFICIENCIES WITH MINNESOTA STATE UNIVERSITY STUDIES

Priority	Description	Concern
1	Engine Storage	Marine fuel is stored for long periods of time in an extremely wet environment. A more extensive study needs to be conducted to evaluate phase separation and the affect that increased alcohol will have on water absorption in the marine environment.
2	Engine Durability	The Minnesota study only looked at fuel injected auto and truck

		engines. There needs to be a study of marine carbureted engines and two stroke engines. In addition, engine durability on a standard SI marine engine durability test is 300 hrs, full power, at wide-open throttle (WOT). This is not examined in the Minnesota Study.
3	Engine Exhaust Emissions	EPA cannot approve a fuel waiver if information exists that E20, or any other fuel blend, will result in an increase in exhaust emissions. The Minnesota study contains no information on the emission impact that E20, or E15, would have on marine engines.
4	Evaporative Emissions	EPA cannot approve a fuel waiver if information exists that E20, or another blend level, will result in an increase in evaporative emissions. As with engine emissions, the Minnesota study did not examine marine engines, nor did it contain a wide range of legacy autos and trucks.
5	Engine/ Equipment Operation	Marine drivability and operational issues are not automotive test procedures. The Minnesota Study does not examine, nor can the data provided in the report be extrapolated, to apply to marine.
6	Engine Starting	With the majority of vessels having a remote fuel pump, vapor lock is a significant issue. Cold weather starting is also an issue that is not sufficiently addressed in this report, nor is it specifically contemplated in marine applications in any of part of the Minnesota Study.
7	Elastomer Study	The Minnesota Study revealed changes to the materials, but dismissed them as not a problem. There was no testing of components for function. There was also no testing of marine legacy components. Several materials that need to be tested are fuel tank sender gaskets, hoses and other plastics that have been commonly used in marine fuel systems in the past.
8	Metal Study	The study reported metal deterioration, but determined that it was "not significant enough of a corrosion rate."

9	Fuel Specification	There is no current specification for E20 fuel. The Minnesota Study did not examine E15.
10	Executive Summary	The study does not address the effect of E20 on marine. It is unclear how conclusions and key findings were developed based on the data provided in the report.

To date, the only comprehensive study on the impacts of mid-level ethanol on the marine and other non-road engines is the Orbital Engine Company's Report to Environment Australia, "Testing Based Assessment to Determine Impacts of a 10% and 20% Ethanol Gasoline Fuel Blend on Non-Automotive Engines" (January, 2003). This report is not referenced in Petitioner's application. The Orbital Report concluded that E20 fuel caused the following adverse operational impacts on 15 HP two-stroke outboard Mercury Marine engines:

- increases in engine misfires and stalling;
- difficulty in maintaining constant engine operating speed;
- damage to the engine, including piston ring and exhaust port deposits increasing wear rates;
- damage to the engine carburetor diaphragm resulting in the loss of internal and external sealing and likely fuel leakage;
- corrosion of metallic engine components.

In 2002, Orbital Engine Company prepared a related comprehensive "Technical Assessment" and "Failure Mode and Effects Analysis" (FEMA) on the impacts of E20 Mercury Marine outboards and Stihl line trimmers. That FEMA analysis concluded that E20 would cause "material degradation" in 62 percent of the total effected "mechanisms." Other higher percentages of "mechanism failures" included "gumming," "lubricant deficiency" and "altered combustion." These "mechanism of failures" caused the following "effects of failure" (at the following "percentage of total effects"):

- A lack of power (32%)
- Rough engine operation (19%)
- Fuel leaks (which would be a safety hazard and an evaporative emissions failure) (17%)
- Engine seizure (13%)
- Engine stops (11%)

Although marine engine technology is changing, and in part because of that fact, these Orbital Engine Reports demonstrate the need to undertake <u>further</u> testing of recreational marine engines, fuel systems, and components. Old-technology two-stroke outboard engines are being phased-out, but that fleet turnover will take time. The lack of technical data on a much broader range of marine engines, including DFI two-strokes and four-stroke engines across a representative spectrum of horsepower ranges, is a very serious gap in Petitioner's application.

V. CONCLUSION

It is abundantly clear that the waiver petition currently before EPA for decision fails to meet the very specific and narrow burdens outlined in Clean Air Act Sec. 211(f)(4). Although NMMA understands the challenging position EPA is in with respect to implementing renewable fuel mandates required by the Energy Independence and Security Act of 2007, we strongly urge EPA to recognize that it would be premature, without sufficient scientific basis, and potentially harmful to manufacturers, consumers and the environment to grant any waiver—full, partial or conditional—at this time. NMMA encourages EPA to deny the waiver petition outright until and unless a petitioner can meet the statutory obligations outlined in the Clean Air Act.

On behalf of the entire recreational marine industry, NMMA appreciates the opportunity to submit comment on this highly significant matter. If you have any questions, please contact either John McKnight jmcknight@nmma.org; (202) 737-9757 or Mathew Dunn mdunn@nmma.org; (202) 737-9760.

Respectfully submitted,

John McKnight
Director, Environmental & Safety Compliance
Government Relations

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Legislative Director, Government Relations

ATTACHMENT I

National Marine Manufacturers Association

Date: May 9, 2008

To: Joan Glickman, Department of Energy
Kevin Stork, Department of Energy
Carolyn Clark, Department of Energy

From: John McKnight, Director of Environmental, Health & Safety Compliance, National Marine Manufacturers Association

RE: Marine Intermediate Ethanol Blend Test Plan

The National Marine Manufacturers Association (NMMA), the nation's leading recreational marine industry trade association, presents this preliminary evaluation to the Department of Energy (DOE) for consideration as the Department moves forward with its Congressionally-mandated implementation of the Renewable Fuel Standard (RFS) per H.R. 6, the Energy Independence and Security Act of 2007 (EISA), signed into law by President Bush on December 19, 2007.

EISA expands the RFS to 9 billion gallons in 2008 and increases it to 36 billion gallons by 2022. As part of that legislation, Congress also clearly indicated its intent that all relevant federal agencies thoroughly review and consider the impact of intermediate ethanol blends on existing gasoline-powered engines, including recreational marine engines, and the impact of such new fuels on air quality and federal air emission regulations. NMMA recognizes that DOE is working to conduct due diligence in such a review and appreciates the opportunity to provide the Agency with guidance for an intermediate ethanol test plan for recreational marine engines and components.

NMMA represents nearly 1,700 boat builders, engine manufacturers, and marine accessory manufacturers who collectively produce more than 80 percent of all recreational marine products made in the United States. With almost 73 million boaters nationwide, the recreational boating industry is a major consumer goods industry with expenditures on recreational marine products and services of $39.5 billion in 2006 alone. Spending by recreational boaters is responsible for 900,000 U.S. jobs nationwide.

Please see below for NMMA's preliminary test protocol for the marine sector. For more information, please contact John McKnight at jmcknight@nmma.org; (202) 737-9757.

National Marine Manufacturers Association

NMMA Test Protocol on Impact of Mid-Level (Intermediate) Ethanol Blends on Spark-Ignited Marine Engines, Fuel Systems and Components

May 9, 2008

OBJECTIVES

The objective of this test plan is to conduct a preliminary evaluation of the effects of mid-level or intermediate ethanol blends on spark-ignited marine engines. The evaluation will help to establish what effects such blends have on the durability, operating characteristics, operating temperatures, performance and exhaust emissions on marine engines.

This test plan should not be considered the only testing needed to determine if spark-ignited marine engines are capable and safe to operate on mid-level ethanol blends.

1. MARINE ENGINE POPULATION & TESTING

NMMA has completed its evaluation of the vast array of marine engines currently in the field that could potentially have significant emission and durability problems if required to operate on >E10 fuel. The wide range of proposed engines and fuel system components in this guidance document reflects the diversity and uniqueness of marine engine and fuel system technologies that have developed over the years. These technologies are so different and the populations are so evenly distributed across horsepower ranges that it is impossible to exclude any of them and consider a test program to be a proper and comprehensive evaluation of the marine sector.

(a) PROPOSED OUTBOARD ENGINES

Table 1. Proposed Outboard Engines	
Two-Stroke Engines	**Four-Stroke Engines**
2-10 hp 2 stroke	2 hp 4-stroke (air cooled)
150 -200 hp EFI 2 stroke	40-75 hp 4-stroke
40-75 hp DI 2 stroke	150 HP 4-stroke 4 cylinders
200-250 DI 2 stroke	L6 300 p supercharge 4-stroke

Table 2 breaks down the sales and application of outboard engines by horsepower. Within these horsepower ranges there are three main technologies that are captured in the NMMA proposed test plan:

1. **Carburetor / EFI 2-Stroke Engines**. These are the engines where the fuel and lubricant are either pre-mixed in the fuel tank or combined prior to being combusted.

2. **Direct Injection 2-Stroke Engines.** These are the engines where the lubricant is injected directly into the cylinder, while the fuel is injected under high pressure prior to combustion.

3. **Four-Stroke Engines.** These engines can be either carbureted, fuel injected naturally aspirated, turbocharged, and supercharged.

Table 2. Outboard Engine Retail Sales

HORSEPOWER	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Less than 4	12,382	11,304	12,944	10,461	11,366	10,876	10,451	10,758	10,058	7,596
4.0--9.9	47,112	48,670	47,794	47,075	44,267	41,690	41,599	41,785	40,614	40,624
10.0—29.9	47,414	49,612	50,449	53,002	44,566	40,784	40,864	39,290	39,542	33,544
30.0—49.9	38,354	34,854	35,181	34,521	29,013	27,491	25,392	21,711	20,047	17,308
50.0—74.9	33,824	38,936	44,807	49,167	40,079	42,596	42,811	47,558	47,361	45,511
75.0—99.9	31,710	33,912	35,513	41,495	34,097	34,439	35,582	36,766	37,289	35,731
100.0—149.9	34,428	38,308	40,492	40,101	34,397	41,690	42,746	41,057	37,347	36,235
150.0—199.9	29,596	28,574	28,875	32,778	26,321	23,262	22,871	31,633	31,987	37,082
200 & Over	27,482	29,516	36,177	40,101	34,995	39,273	43,084	44,742	47,763	48,070
TOTAL	**302,302**	**313,686**	**332,232**	**348,700**	**299,100**	**302,100**	**305,400**	**315,300**	**312,008**	**301,701**

Source: NMMA 2007 Statistical Abstract

Table 3 illustrates the outboard boat retail sales by boat type since 1997 based on the most recent NMMA industry statistics. This information is useful in determining the type of application for the outboard marine engine platforms.

Table 3. Outboard Boat Retail Sales										
BOAT TYPE	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Bass Boat	23.7%	22.0%	21.8%	15.0%	15.5%	13.3%	17.2%	17.4%	20.0%	20.2%
Center Console	9.5%	10.4%	11.3%	13.5%	12.0%	14.9%	14.0%	13.0%	12.7%	10.7%
Deck Boat	2.8%	3.5%	3.7%	3.0%	2.8%	2.9%	4.2%	3.0%	2.9%	2.9%
Express Cruiser	0.1%	0.1%	0.0%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Express Fish Boat	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Fish-in Ski	6.4%	4.7%	1.7%	5.2%	5.5%	6.3%	4.9%	4.7%	3.4%	3.1%
Houseboat (Prior to 2003 reported in UtilityNEC Category)							0.1%	0.1%	0.0%	0.2%
Jon (Prior to 2003 reported in Utility Category)							13.5%	9.9%	11.0%	11.5%
Other Fish Boat	15.1%	14.9%	10.8%	17.0%	18.8%	18.9%	19.2%	16.9%	15.1%	13.7%
Performance Boats	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%	0.1%
Pontoon Boat	12.2%	12.4%	18.5%	17.7%	18.0%	18.6%	15.3%	18.2%	19.2%	19.3%
Runabout Bowrider	3.8%	3.6%	2.6%	2.8%	2.0%	1.1%	1.3%	1.2%	0.8%	0.5%
Runabout Cuddy	1.4%	1.3%	0.6%	0.4%	0.4%	0.2%	0.2%	0.3%	0.5%	0.3%
Tournament Ski	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Utility/Not else where classified	22.8%	24.3%	25.5%	21.2%	21.8%	19.7%	6.3%	11.8%	10.9%	14.8%
Walkaround	2.0%	2.7%	3.3%	3.8%	2.9%	4.0%	3.4%	3.1%	3.0%	2.3%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Source: NMMA 2007 Statistical Abstract										

(b) PROPOSED STERNDRIVE AND INBOARD ENGINES

NMMA has evaluated the range of sterndrive and inboard engines that should be included in this test protocol. **Table 4** outlines these proposed engines.

Table 4. Proposed Sterndrive & Inboard Engines		
3.0L Carburetor	5.0 L Carburetor	6.0L Catalyst Supercharged
3.0L EFI Catalyst	5.7L EFI	
	5.7L EFI Catalyst	

Tables 5-8 assess the distribution of sales and application of sterndrive and inboard engines. Typically, these engines start as base engines, which today are almost exclusively supplied by General Motors, but there are many sterndrive and inboard engines in the field that have been derived from Ford, Chrysler and other engine manufacturers. Inboard and sterndrive engine both have the same base engine. It is the drive system that distinguishes a sterndrive from an inboard.

STERNDRIVE ENGINES (SALES AND APPLICATION BY YEAR)

Table 5. Sterndrive Boat Retail Sales

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Fiberglass	77,300	76,700	77,500	74,900	68,500	66,100	66,100	68,200	69,900	65,300
Aluminum	1,500	1,000	2,100	3,500	3,500	3,200	3,100	2,900	2,400	2,400
TOTAL	**78,800**	**77,700**	**79,600**	**78,400**	**72,000**	**69,300**	**69,200**	**71,100**	**72,300**	**67,700**

Source: NMMA 2007 Statistical Abstract

Table 6. Sterndrive Boat Retail Sales by Boat Type

BOAT TYPE	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Center Console	0.2%	0.1%	0.1%	0.1%	0.1%	0.8%	0.3%	0%	0%	0%
Express Cruiser	11.5%	12.6%	12.8%	14.2%	12.6%	12.6%	13.6%	12.5%	12.0%	10.9%
Fish-in Ski	1.1%	1.2%	0.4%	2.6%	2.4%	2.0%	1.4%	1.2%	1.0%	0.8%
Fly bridge Sedan	0.1%	0.2%	0.4%	0.3%	0.2%	0.1%	0.0%	0.1%	0.1%	0.0%
Houseboat								0.3%	0.1%	0.4%
Deck Boat	2.9%	3.8%	6.5%	6.6%	6.2%	7.0%	9.0%	9.8%	10.9%	11.1%
Pontoon Boat	1.0%	0.5%	1.8%	1.9%	1.6%	1.2%	1.5%	1.5%	1.9%	1.9%
Express Fish Boat	1.1%	0.7%	0.3%	0.4%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%
Other Fish Boat	1.6%	1.7%	0.4%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%
Performance Boats	2.8%	3.1%	3.3%	2.8%	2.8%	2.4%	1.8%	1.8%	1.6%	1.1%
Runabout Bowrider	47.8%	58.8%	60.2%	58.7%	65.5%	65.2%	62.3%	62.4%	61.3%	64.6%
Runabout Cuddy	29.3%	16.3%	11.7%	10.0%	6.7%	6.6%	8.3%	8.7%	9.6%	8.4%
Walk around	0.6%	1.0%	2.1%	2.0%	1.4%	1.7%	1.4%	1.3%	1.3%	0.8%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: NMMA 2007 Statistical Abstract

INBOARD ENGINES (SALES AND APPLICATION BY YEAR)

Table 7. Inboard Cruiser Retail Sales

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total Units Sold	176,000	130,000	106,000	92,000	80,900	79,300	80,600	79,500	80,200	82,200

Source: NMMA 2007 Statistical Abstract

Table 8. Inboard Cruiser Retail Sales by Boat Type

BOAT TYPE	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Center Console	1.9%	3.1%	2.5%	1.5%	1.1%	1.4%	0.9%	0.4%	0.4%	0.5%
Convertible	7.2%	7.7%	8.6%	8.4%	10.8%	10.6%	10.1%	11.7%	8.3%	8.5%
Express Cruiser	43.9%	42.4%	48.7%	50.0%	48.9%	47.4%	53.3%	52.4%	56.1%	52.8%
Fly bridge Sedan	8.9%	11.0%	15.9%	15.5%	13.7%	14.9%	16.6%	15.1%	13.6%	14.1%
Houseboat								0.8%	0.8%	0.3%
Motor Yacht Cabin	21.8%	17.8%	9.5%	12.6%	10.1%	13.3%	12.0%	14.4%	12.7%	14.7%
Open Express Fish	7.2%	6.2%	7.5%	6.7%	7.4%	6.9%	3.4%	2.2%	3.1%	3.1%
Trawler	0.4%	7.2%	3.5%	3.1%	3.9%	3.9%	3.0%	2.9%	3.1%	3.3%
Walk around	2.9%	3.3%	3.1%	2.2%	3.9%	1.6%	0.7%	0.1%	1.8%	2.7%
Utility	5.7%	1.4%	0.7%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**100.0%**

Source: NMMA 2007 Statistical Abstract

(c) PROPOSED PERSONAL WATERCRAFT (PWC) ENGINES

Table 9 outlines the personal watercraft engines NMMA proposes for testing.

Table 9. Proposed Personal Watercraft Engines

Two-Stroke Engines	Four-Stroke Engines
135 hp 2-stroke	215 hp 4-stroke (supercharged)

PERSONAL WATERCRAFT SALES BY YEAR

Table 10 illustrates retail sales in personal watercraft since 1997, indicating the scope of the sector and the average cost per unit. **Table 10** is broken into two parts, 1997-2001 and 2002-2006

Table 10. PWC Retail Sales (1997-2001)

	1997	1998	1999	2000	2001
Total Units Sold	176,000	130,000	106,000	92,000	80,900
Retail Value	$ 1,135,904,000	$ 868,530,000	$ 771,044,000	$ 720,176,000	$ 641,456,100
Average Unit Cost	$ 6,454	$ 6,681	$ 7,274	$ 7,828	$ 7,929

Table 10. PWC Retail Sales (2002-2006)

Total Units Sold	2002	2003	2004	2005	2006
Total Units Sold	79,300	80,600	79,500	80,200	82,200
Retail Value	$ 697,681,400	$ 716,501,800	$ 733,454,700	$ 761,531,000	$ 792,079,200
Average Unit Cost	$ 8,798	$ 8,890	$ 9,226	$ 9,495	$ 9,636

TEST METHOD FOR MARINE ENGINES

Table 11 illustrates the ISO 8178-E4 Emission Test Cycle, the international standard designed for non-road engine applications, including marine.

Table 11. ISO 8178-E4 Emission Test Cycle

Mode Number	1	2	3	4	5
Speed (%)	100	80	60	40	Idle
Torque (%)	100	71.6	46.5	25.3	0
Weighting Factor	0.06	0.14	0.15	0.25	0.40

(a) Durability Demonstration

All engines should be run on two different schedules. **Table 12** represents real world time accumulation. This cycle is based on the E-4 test schedule. The operating time at each point represents the weighting factors from the test. These weighting factors were developed from real world data supported by average time boats spent operating at the various conditions. The 40 minutes of idle was broken onto 10 minute periods between the cruise modes to more closely represent real world operation. The tests should be run for 480 hours for sterndrive/inboard engines and 350 hours for outboard engines—the useful life of a spark-ignited marine engine.

Table 13 represents a high speed engine operation and is a required test for all marine engines. It is run for 300 hours. These cycles should be run on E15 and E20 only. The marine industry has confidence our engines will complete these cycles on E10 fuel. Exhaust emissions on different ethanol fuel blends are not well known and need to be run on all four fuels. Maintenance should be performed during hour accumulation per owner's instruction manual. A visual inspection of the engines should be conducted at the end of each 8 hour shift.

Table 12. General Durability Operation	
WOT	6 Minutes
IDLE	10 Minutes
80 % WOT RPM (71.6% torque)	14 Minutes
IDLE	10 Minutes
60 % WOT RPM (46.5% torque)	15 Minutes
IDLE	10 Minutes
40 % WOT RPM (25.3% torque)	25 Minutes
IDLE	10 Minutes
REPEAT CYCLE	

Table 13. High Speed Durability Operation	
WOT	55 Minutes
IDLE	5 Minutes
REPEAT CYCLE	

(b) Emissions Testing

All engines should be broken-in per manufacturer's recommendations. Each engine should then be tested on E0, E10, E15, and E20. Emission testing should be conducted half-way through the durability running (240 hours and 150 hours respectively) and at the completion. All engines should be run on all four test fuels each time.

2. FUEL SYSTEM COMPONENT TESTING

One of the major concerns with intermediate blend ethanol testing of marine fuel systems would be that the test be able to reproduce the marine environment in a laboratory setting. As DOE knows, water and salt attack metal and rubber parts and it can be assumed that by increasing the ethanol content in gasoline, these effects would be exacerbated.

Galvanic corrosion is also of significant concern. Galvanic corrosion differs from corrosion caused by water and occurs as a result of the fuel's molecular conductivity. This conductivity increases substantially as blends of ethanol in gasoline increase above 10 percent. E20 is expected to have much higher conductivity than E10. This causes exposed wires to the fuel pump, and other metals, to dissolve over time.

It is recommended that a complete marine fuel system be tested (see attached drawing).

Table 14 lists fuel system components that need to be tested to determine the effects of exposure to intermediate blends of ethanol. Boat testing is also necessary to assess the impact on performance and drivability. Boat tests will are also necessary to determine if the vessel fuel system can withstand the potentially high levels of water in the fuel.

Table 14. Fuel System Components	
Fuel Pumps	Seals-Injector O-Rings
Primer Bulbs	Hoses
Fittings	Vapor Separators
Filters	Pressure Regulators
Carburetor Floats	Electrical Harnesses
Injectors	Fuel Tank Sending Units

3. MARINE ENGINE & FUEL SYSTEM TEST PROTOCOLS

The United States Coast Guard (USCG) has recently completed a study designed to develop test protocols for manufacturers that want to evaluate safety and drivability of vessels when operated with propeller guards. These attached protocols could be modified to evaluate safety and drivability with increased ethanol fuels. It must be noted that the protocols are still in draft form

- On water Coast Guard test protocol for maneuvering
- Other normal uses, skier, bass fishing, trolling, sight seeing
- Cold water – New England fishing
- Warm Gulf waters
- During maneuvers, observe and record the severity of any of the following malfunctions:
    1. Hesitation
    2. Stumble
    3. Surge
    4. Stall
    5. Backfire
    6. Stability at Idle and Cruise

(a) Exhaust Emission Testing

In addition to the EPA and CARB testing requirements, toxic emissions and NMOG needs to be evaluated with E10 and greater fuels. Emission testing should include these constituents:

- NMOG
- Benzene
- 1,3-butadiene
- Acetaldehyde

(b) Evaporative Emission Testing

In the 3rd Qtr. 2008, USEPA is scheduled to finalize stringent new evaporative emission requirements for boat fuel systems. These requirements will set emission limits for a host of fuel system components, including plastic fuel tanks, fuel hoses, and diurnal emissions from fuel tank vents. An emissions study needs to evaluate these technologies to determine if there are increased emissions on:

- Current products

- Future products

(c) Fuel Aging in a Marine Environment

DOE should also evaluate the impact of fuel aging in the marine environment, when in many cases boats will sit idle in a marina or boatyard for many months prior to being operated. To accurately determine the impacts of fuel aging on marine engines and fuel systems:

- The fuel system must be vented to atmospheric conditions (diurnal temperature, relative humidity, barometric pressures) which are found typically in a marina during all testing;

- All testing must include a period of prolonged storage (90 Days) with temperatures at the extremes (180 ºF simulating a boat storage facility near Lake Havasu, AZ and -40 ºF simulating winter boat storage in northern MN)

- DOE should also consider impacts on actual output and horsepower de-rating.

- Fuel economy deterioration is also of concern when fuel deteriorates due to ageing.

- Startability, including cold cranking time, hot cranking time, and warm up time, is also an area of concern with respect to intermediate ethanol blends exacerbating fuel degradation do to aging.

(d) Fuel Type

For **emissions** testing, NMMA recommends that DOE use an EEE certified fuel, such as EEE15 and EEE20.

For **durability** testing, NMMA recommends that DOE use an E15/20 blended fuel that is 15 or 20% ethanol by volume splash blended to ASTM D 4806 Fuel grade ethanol with 40 CFR 86.113-94(a)(1) certification gasoline.

Facilities Where DOE Can Conduct Testing

NMMA directs DOE to several facilities at which to test intermediate ethanol blended gasoline on marine engines and fuel systems, including:

- **In-Water Testing.** USCG Marine Test Facility, Solomon's Island, MD.

- **Manufacturer Test Facilities.** Marine engine manufacturers would consider the possibility of offering their test facilities and engines for emission testing.

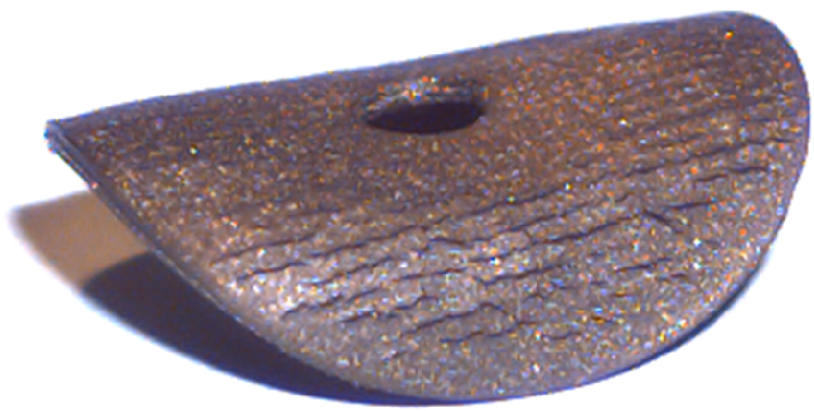
- **Marine Engine Durability Testing.** Southwest Research Institute, San Antonio, TX; Roush Engineering, Detroit, MI; Lotus Engineering, Ann Arbor, MI; Carnot, San Antonio, TX

4. CONCLUSION

NMMA, on behalf of its marine engine manufacturers and fuel system manufacturers, appreciates the opportunity to submit this preliminary intermediate ethanol blend test protocol to the Department of Energy for its consideration. NMMA hopes DOE finds this guidance helpful and informative, and looks forward to working with the Agency as it initiates a comprehensive testing program for the marine sector. Should you have any questions, please contact John McKnight at jmcknight@nmma.org; (202) 737-9757.

ATTACHMENT II

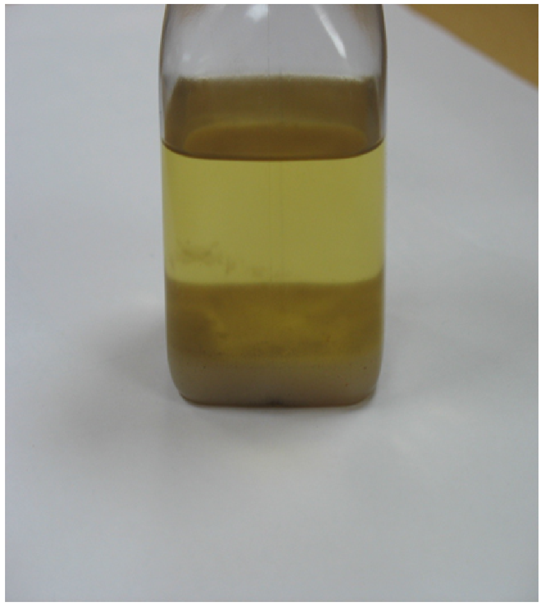
Outboard Engine Fuel Pump Rubber Flapper Valve Exposed to Ethanol Fuel

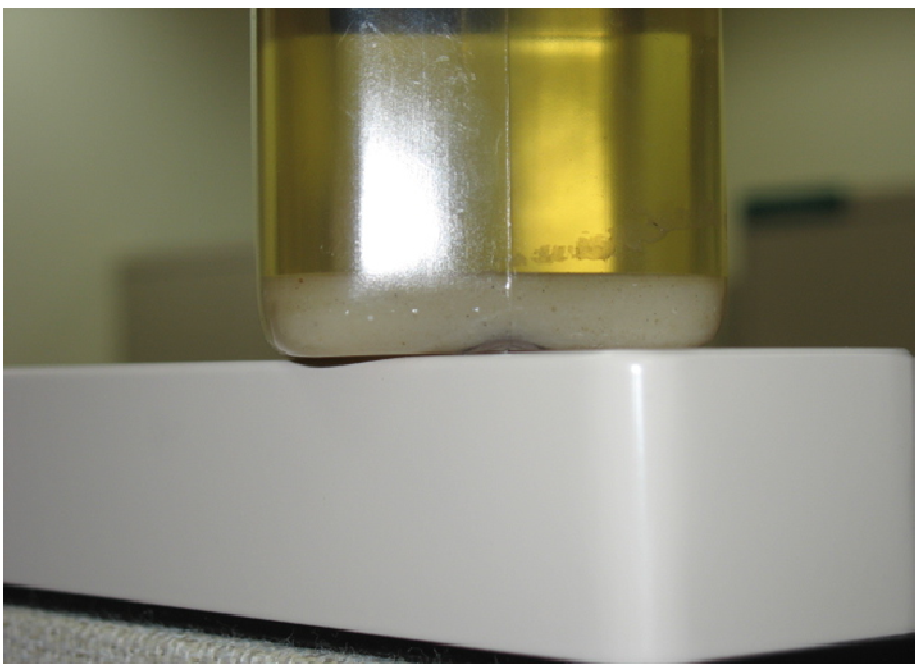


This fuel pump rubber flapper valve was retrieved from a typical mid- to late-1990s model outboard marine engine. The fuel pump experienced total failure, attributed to the valves and other materials hardening as a result of ethanol in the fuel.

ATTACHMENT III

Phase Separation:
Ethanol Fuel Retrieved from a Boat in 2006





This fuel, which clearly shows phase separation, was retrieved by a manufacturer from a 2006 model fuel-injected sterndrive motor, which had come out of storage in the Spring of 2007. The engine had experienced total failure and the fuel system had to be replaced.

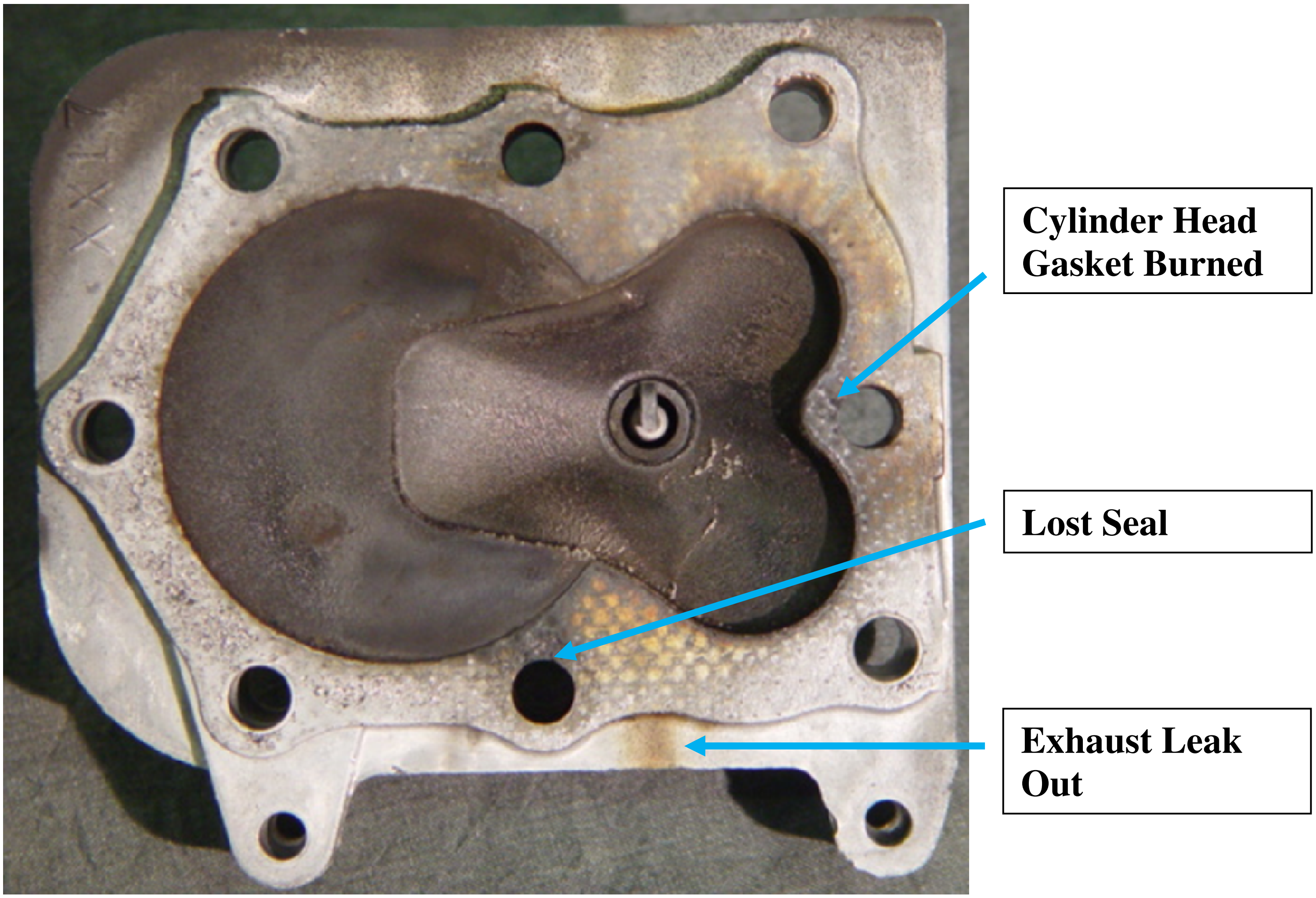
ATTACHMENT IV

Post-Mortem Analysis:

Fiberglass Fuel Tank after Exposure to Ethanol Fuel
Result of ethanol scouring inside of fuel tank

ATTACHMENT V

Ethanol Implications on Engine Durability



Source: Briggs & Stratton, 2007.