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.

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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 no mention 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.

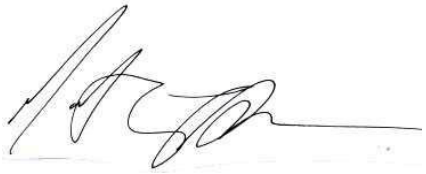
V. CONCLUSION

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



Mathew P. Dunn
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.

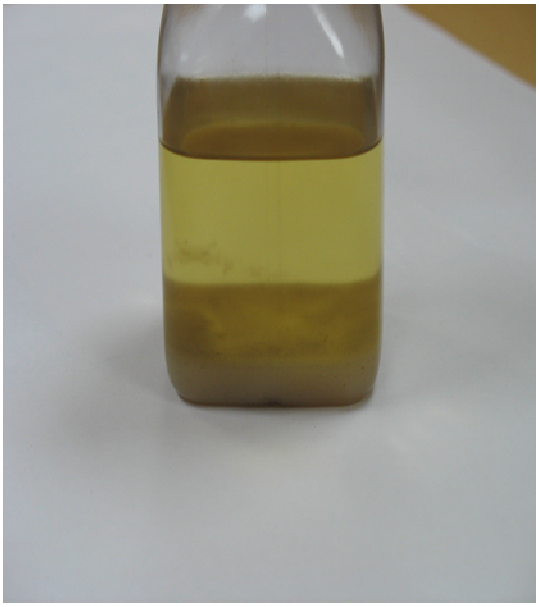
ATTACHMENT II

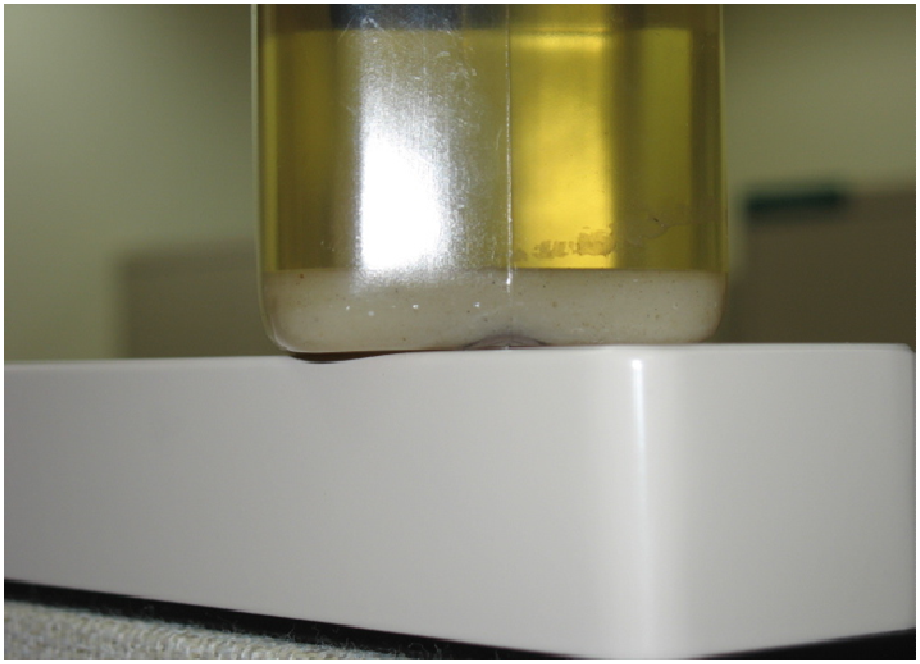
Outboard Engine Fuel Pump Rubber Flapper Valve Exposed to Ethanol Fuel

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

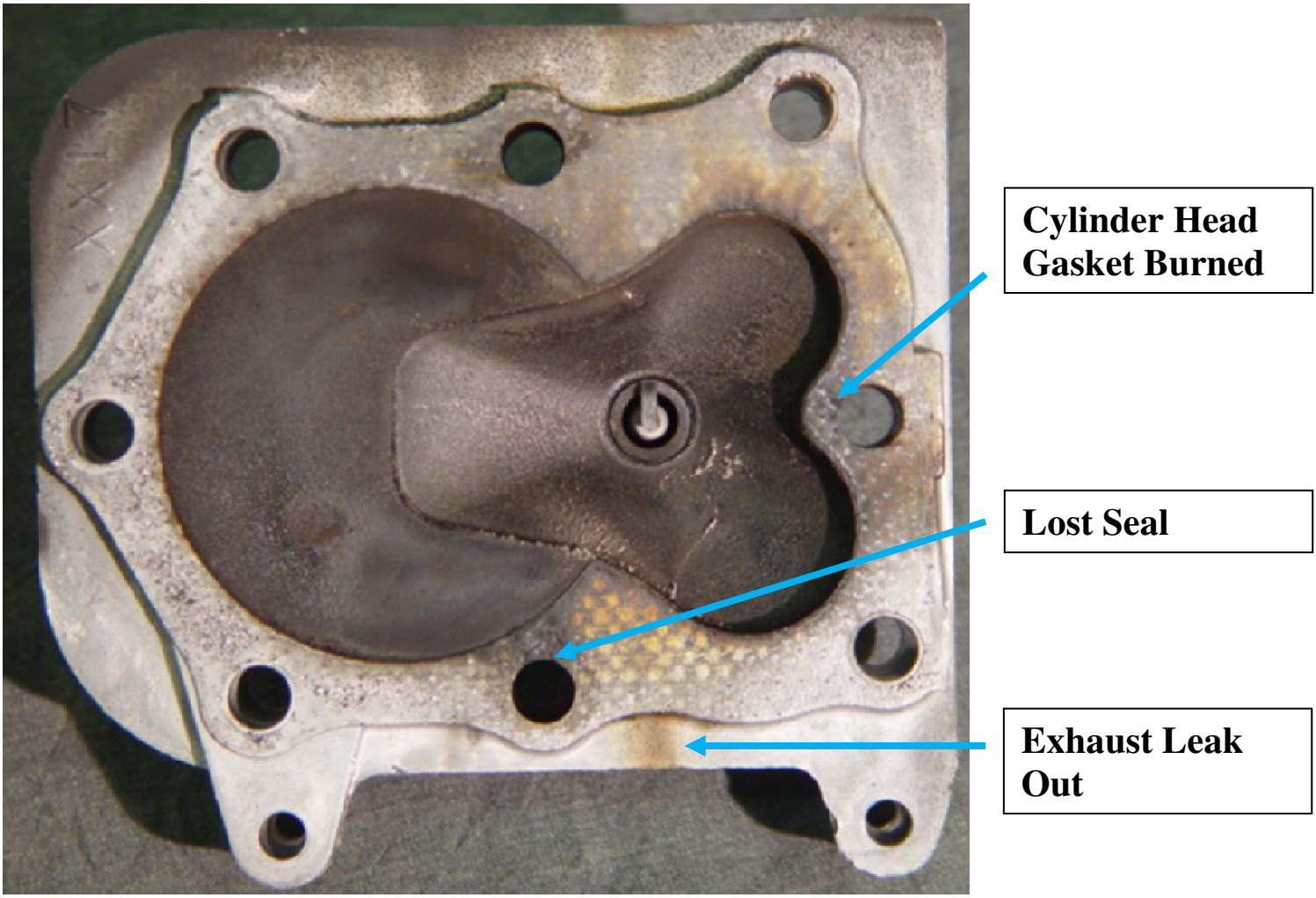
Post-Mortem Analysis:

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.