MERCURY MARINER

Service Bulletin

Bulletin No. 2006-10R1

Circulate to: ☑ Sales Manager ☐ Accounting ☑ Service Manager ☑ Technician ☑ Parts Manager

Alcohol Fuel Recommendation Outboards

NOTICE
Revised October 2006. This bulletin supersedes the previous bulletin number 2006-10 July 2006

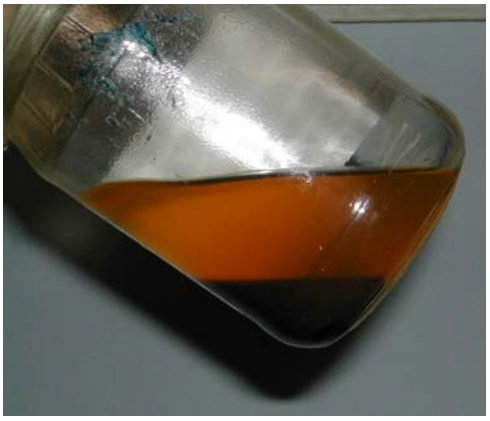
Models Affected

▲ All Mercury/Mariner and Mercury Racing Outboards, and Jet Drive.

Situation

▲ The use of alcohol in gasoline is increasing as an alternative to petroleum based fuel and used in reformulated (oxygenated) fuels that are required by the Environmental Protection Agency (EPA) in some areas of the US. Countries other than the US may also require oxygenated fuels. Below is the current Mercury fuel recommendation. With the increased use of alcohol in fuel, either ethanol (ethyl alcohol) or methanol (methyl alcohol), you should be aware of certain adverse affects that can occur. As the percentage of alcohol increases, the degree and possibility of adverse affects also increases.

- **Corrosion of metal parts:** Alcohol is infinitely soluble in water, and with vented fuel tanks the alcohol will tend to attract moisture. This can form a phase consisting of alcohol and water which will separate from the gasoline and sink to the bottom of the fuel tank (phase separation). Long periods of storage, common to boats, will increase the chance of this condition. The following picture shows a fuel sample with phase separation. In a pre-mixed oil two-stroke application, this phase of alcohol and water will not contain any lubricant and could cause piston scuffing. The alcohol/water phase can, over extended periods of time, form very strong organic acids and may attack the fuel tank or metallic fuel system components. The corrosion and attack on metallic fuel system components may lead to fuel system restrictions and a lean running condition.



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- **Deterioration of rubber or plastic parts:** Nonmetallic components of the fuel system, specifically plastics and elastomers, may be subject to swelling as well as reduction in physical properties and mechanical strength. This can result in some loss of effective sealing capability.
- **Fuel permeation through rubber fuel lines:** Because the molecules of alcohol are smaller than gasoline, the alcohol may pass through some rubber fuel lines where gasoline would not.
- **Starting and operating difficulties:** Some alcohols can change how temperature affects the fuel, causing vapor lock in warm weather conditions. As alcohol is added to gasoline, the reed vapor pressure increases. This can cause the fuel to turn from a liquid to a vapor form at lower temperatures. Normally, this occurs in two ways:
  - As the fuel is drawn from the fuel tank to the engine, the pressure on the fuel is reduced due to the suction of the fuel pump. The reduced pressure may cause the fuel to turn into a vapor prior to reaching the engine, making it difficult for the fuel pump to draw fuel into the carburetor or fuel injection system.
  - As the engine runs, heat builds up in the engine block and components. When the engine is turned off, the heat is radiated and conducted into the fuel system components turning the fuel into vapor, which can make the engine hard to start while still warm.

Fuel Recommendation

FUEL RATINGS

Mercury Marine engines will operate satisfactorily when using a major brand of unleaded gasoline meeting the following specifications:

▲ **USA and Canada -** having a posted pump Octane Rating of 87 (R+M)/2 minimum. Premium gasoline [92 (R+M)/2 Octane] is also acceptable, and is required in some Mercury Racing Outboards. Do NOT use leaded gasoline.

▲ **Outside USA and Canada -** having a posted pump Octane Rating of 90 RON minimum. Premium gasoline (98 RON) is also acceptable, and is required in some Mercury Racing Outboards.

NOTE: *Some Hi-performance engines require a higher octane fuel. See operation manual for octane requirements.*

USING REFORMULATED (OXYGENATED) GASOLINES (USA ONLY)

This type of gasoline is required in certain areas of the USA. The two types of oxygenates used in these fuels are alcohol (ethanol or methanol) or ether (MTBE or ETBE). If ethanol is the oxygenate used in the gasoline in your area, refer to Gasolines Containing Alcohol.

GASOLINES CONTAINING ALCOHOL

▲ If the gasoline in your area contains either ethanol (ethyl alcohol) or methanol (methyl alcohol), you should be aware of certain adverse affects that can occur. These adverse affects are more severe with methanol. Increasing the percentage of alcohol in the fuel can also worsen these adverse affects. Some of these adverse affects are caused because the alcohol in the gasoline can absorb moisture from the air, resulting in a separation of the water/alcohol from the gasoline in the fuel tank. The fuel system components on late model Mercury Marine engines will withstand up to 10% alcohol content in the gasoline. Any alcohol content higher than 10% may cause severe engine damage. We do not know what percentage the boat's fuel system will withstand. Contact the boat manufacturer for specific recommendations on the boat's fuel system components (fuel tanks, fuel lines, and filters). Be aware that gasoline containing alcohol may cause:

- Corrosion of metal parts
- Deterioration of rubber or plastic parts
- Fuel permeation through rubber fuel lines
- Starting and operating difficulties
- ▲ Lean running condition that could cause engine failure

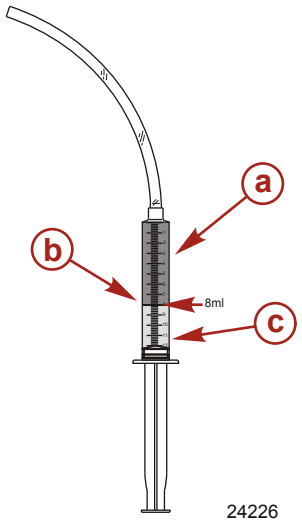
Testing For Alcohol in Fuel:

Equipment required = one syringe graduated in cubic centimeters (cc) that will hold 12 or more cc (obtain locally).

PROCEDURE:

- Draw approximately 6cc of water into the syringe. Point the syringe upward and squirt out all but 3cc. Squirting out the extra water removes the unwanted air from the syringe.
- Draw the fuel to be tested into the syringe up to the 12cc mark.
- Close off the tip of the syringe with your finger and shake the syringe to mix the fuel and water. Slowly remove your finger to relieve the pressure.
- Stand the syringe on a flat surface for about a minute. Be sure to keep the tip up.
- After a minute has passed, examine the syringe. If there is any alcohol in the fuel, it will have joined the water and settled to the bottom of the syringe.
- To determine the percentage of alcohol to gasoline use the chart below.

Graduated mark	Percentage of alcohol
9.0 cc	0 %
8.6 cc	5 %
8.1 cc	10 %
7.7 cc	15 %
7.2 cc	20 %
6.8 cc	25 %
6.3 cc	30 %
5.9 cc	35 %
5.4 cc	40 %



a - Gasoline
b - Separation between gasoline and alcohol/water mix
c - Alcohol/water mix

CHECKING FOR WATER IN FUEL

If there is a concern that water may be present in the fuel tank, a water finding paste can be used to determine if water is present. The paste is placed on the end of a probe (long wire or stick) and dropped into the fuel tank to its lowest point. If the paste turns color it's an indication that there is water in the tank. Water finding pastes can normally be found at local oil and fuel distributors.

Gasoila water finding paste is one common brand name available.

800-846-7325

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STORAGE OF BOATS WITH ALCOHOL FUELS:

PORTABLE FUEL TANKS: Most portable fuel tanks have closable vents. Close the vent while in storage to prevent air from entering the tank.

BUILT IN FUEL TANKS: Many boats have built in fuel tanks that are vented to outside air. The preferred method is to drain as much of the remaining gasoline as possible from the fuel tank, remote fuel line, and engine fuel system. If this is not practical, a second option is to fill the fuel tank to the top, which will allow little room for air to contact with the fuel. Then add Mercury/Quicksilver Gasoline Stabilizer for Marine Engines to any fuel remaining in the tank.

Warranty

▲ Use of improper gasoline can damage your engine. Engine damage resulting from the use of improper gasoline is considered misuse of the engine, and damage caused thereby will not be covered under the limited warranty. The fuel system components on late model Mercury Marine engines will withstand up to 10% alcohol content in the gasoline. With any fuel containing alcohol, phase separation can occur. Damage to fuel system and/or engine components due to phase separation is NOT covered under warranty.

Mercury Marine's View of Ethanol

Mercury Marine remains very active in developing a thorough understanding of important issues and environments in which our products must operate. Mercury's engineers work constantly to expand our understanding of fuel technologies and their interactions with all Mercury products to ensure they perform properly and reliably. Mercury personnel work in concert with industry groups, such as the National Marine Manufacturers Association (NMMA), to offer input into the overall processes by which many decisions are made regarding fuel regulations and energy policies so future problems are minimized and future developments are beneficial to those who utilize our products.

Included below is a list of questions and answers that address typical concerns of consumers.

Please feel free to contact any Mercury Marine field representative with questions, or contact us at public.relations@mercmarine.com. Mercury will do its best to help find answers, whether you are seeking general information or wishing to discuss legal proposals, or if you are seeking information regarding ethanol-tolerant materials.

1. WHAT ARE ETHANOL AND ETHANOL-BLENDED FUELS?

Ethanol for fuel is highly refined beverage (grain) alcohol, approximately 200 proof, that can be produced from natural products such as corn, sugar cane and wheat. New technology will allow ethanol to be made from "cellulosic" feedstocks including corn stalks, grain straw, paper, pulp, wood chips, municipal waste, switchgrass and other sources. Ethanol used for fuel has been "denatured," or rendered unsafe to drink by the addition of a hydrocarbon (usually gasoline). The ethanol-blended fuel E-10 refers to fuel that contains 10 percent ethanol and 90 percent gasoline. Similarly, E-85 refers to fuel that contains 85 percent ethanol and 15 percent gasoline. E-85 is intended only for engines specially designed to accept high-ethanol content fuel blends, such as the Flexible Fuel Vehicles (FFV) made by some auto companies.

2. HOW IS ETHANOL MADE?

In the U.S., ethanol is typically produced by removing the starch or sugar portion of corn and fermenting it. The fermented starch is then distilled into alcohol. Excess water is removed, resulting in very pure – 200 proof – ethyl alcohol (ethanol). In some parts of the world, ethanol is made from a variety of raw materials. For example, sugar cane is used to produce ethanol in Brazil, while sugar beets and wheat straw are commonly used in Europe.

3. WHAT ARE THE CHARACTERISTICS OF ETHANOL?

Ethanol is an oxygenated hydrocarbon compound that has a high octane rating and therefore is useful in increasing the octane level of unleaded gasoline. The EPA, the agency responsible for setting some of the requirements for all gasoline used in the U.S., has allowed the use of ethanol in gasoline at levels up to 10 percent as an octane enhancer and to provide beneficial clean-burning combustion characteristics that help improve certain emissions.

Ethanol is hygroscopic (it has an attraction for water) and will more readily mix with water than with gasoline. It has different solvency behaviors than does gasoline, which allows it to loosen rust and debris that might lay undisturbed in fuel systems. And it can more readily remove plasticizers and resins from certain plastic materials that might not be affected by gasoline alone. Loose debris will plug filters and can interfere with engine operation. Additionally, ethanol is corrosive to some metals, especially in combination with water. Although gasoline does not conduct electricity well, ethanol has an appreciable capability to conduct electricity and therefore can promote galvanic corrosion.

4. WHAT IS MTBE AND WHY IS IT BEING REPLACED?

MTBE is the chemical shorthand description for methyl tertiary-butyl ether. MTBE is another oxygenated hydrocarbon compound that has a high octane rating. It was initially a preferred compound widely used for octane enhancement as a replacement for leaded compounds in gasoline. When the EPA developed regulations requiring oxygenated gasoline to help reduce smog in certain areas of the country, MTBE was the most commonly used compound to supply the additional oxygen, while ethanol was chosen for this purpose in the Midwest region of the country. Recently, most states have banned the use of MTBE because of its tendency to work its way into ground water systems, usually from leaks and spills, as an undesirable contaminant. Ethanol is being used as a replacement.

5. DOES ETHANOL AFFECT HORSEPOWER OR FUEL-EFFICIENCY?

Ethanol has a heating value of 76,000 BTU per gallon, which is approximately 30 percent less than gasoline's heating value (which is approximately 109,000 to 119,000 BTU/gal). The result is E-10 gasoline which should yield slightly lower mileage – a decrease of approximately 3 percent. Fuels containing higher levels of ethanol will have a corresponding reduction in mileage. For example, E85 fuels produce mileage approximately 30 percent less than gasoline.

The octane rating of pure ethanol (200 proof) is about 100 and is therefore useful in elevating the octane value of gasoline. In E-10 blends the presence of ethanol provides about 2.5 to 3 percent of the overall octane rating. The effect on engine horsepower is determined by the octane result of the blended fuel. Care should be taken to select fuels having the octane rating recommended for the engine as indicated in the owner's manual for proper operation.

Compatibility with Mercury Engines

1. ARE MERCURY ENGINES COMPATIBLE WITH ETHANOL FUELS?

▲ The fuel-system components of late model Mercury engines will withstand up to 10 percent alcohol content in gasoline – the maximum level currently allowed by the EPA in the U.S. There are some efforts to establish E-20 (20 percent ethanol mixed with 80 percent gasoline) for use in some areas, but that will require agreement from EPA to grant a waiver. Part of the EPA waiver process will require verification from studies that demonstrate that higher levels of ethanol do not create problems with fuel-system materials or operation of hardware. Do NOT use E-20 in Mercury products. It can damage fuel system components and may cause a lean running condition that could lead to engine failure. E-85 fuels must not be used in any Mercury engines and will seriously damage current Mercury products. It is not legal in the U.S. to market any ethanol fuel as gasoline if it contains more than 10 percent ethanol.

NOTE: *▲ To prevent engine damage, Verado engines should never be run on any gasoline containing more than 10% ethanol.*

2. WILL THE USE OF FUELS CONTAINING ETHANOL VOID MY ENGINE WARRANTY?

▲ Fuels containing up to 10 percent ethanol are considered acceptable for use in Mercury engines. Fuels containing higher levels of ethanol are not considered acceptable for use, and the use of fuels containing ethanol higher than 10 percent will void the warranty on components that are damaged by these fuels.

3. WHAT ABOUT THE FUEL-SYSTEM COMPONENTS ON THE BOAT?

▲ It is important to follow boat manufacturers' recommendations when selecting appropriate fuels. Use of an inappropriate fuel can result in damage to the engine and boat components that may require repair or replacement. Fuels with ethanol can attack some fuel-system components, such as tanks and lines, if they are not made from acceptable ethanol-compatible materials. This can lead to operational problems or safety issues such as clogged filters, leaks or engine damage, which will not be covered under Mercury warranty.

4. CAN ETHANOL-BLENDED FUELS AFFECT THE PERFORMANCE OF TWO-STROKE ENGINES?

Two-stroke outboards should experience little or no decrease in performance due to gasoline fuels containing up to 10-percent ethanol when operated according to Mercury's standard recommendations. When gasoline with ethanol is used for the first time after a fuel changeover from MTBE, the tank must be completely dry prior to introduction of gasoline with ethanol. Otherwise, phase separation could occur that could cause filter plugging or damage to the engine. If an engine is a 1990 or older model frequent inspections of all fuel-system components are advised to identify any signs of leakage, softening, hardening, swelling, or corrosion. If any sign of leakage or deterioration is observed, replacement of the affected components is required before further operation.

5. HOW DOES ETHANOL AFFECT MY FIBERGLASS FUEL TANK?

Fiberglass tanks manufactured prior to 1991 may not be compatible with gasoline containing ethanol. It has been reported that, in the presence of ethanol, some resins may be drawn out of fiberglass and carried into the engine where severe damage could occur. If an older fiberglass tank is used, check with the manufacturer to determine if gasoline with ethanol can be safely used.

6. ARE OLDER FUEL LINES PRONE TO FAILURE? WHAT ABOUT GASKETS?

During the 1980s, many rubber components for use in fuel systems were developed to withstand exposure to fuels containing ethanol. If rubber components in a fuel system are suspected to be of this vintage or older it may be advisable to replace them with newer ethanol-safe components before using fuels containing ethanol. Check with the manufacturer for advice or frequently inspect these fuel-system components for signs of swelling or deterioration and replace if problems are noted.

Recommended Practices

1. ETHANOL IS REPLACING MTBE IN MY REGION? WHAT SHOULD I DO?

Before gasoline with ethanol is introduced to your fuel tank, ask your boat manufacturer if any special precautions should be considered with the use of fuel containing ethanol. Check for the presence of water in the fuel tank. If any is found, remove all water and dry the tank completely. As a precaution, it is advisable to carry a few extra water separating fuel filters in case filter plugging becomes a problem during boating.

2. SHOULD I ADD AN ADDITIONAL FINE-MICRON FILTER TO THE SYSTEM TO PREVENT DEBRIS FROM ENTERING THE ENGINE?

Mercury already provides the appropriate level of filtration to protect the engine from debris. The addition of another filter to the system will create another possible flow restriction that can starve the engine of fuel.

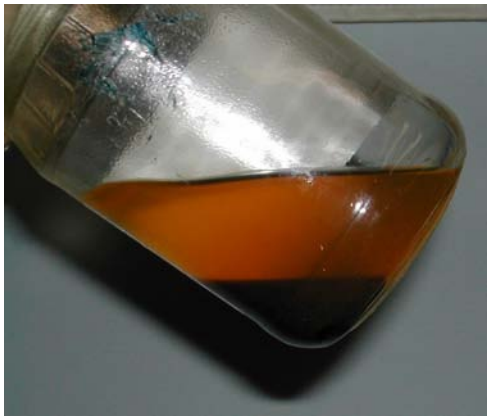
3. HOW CAN A MARINA PREPARE FOR THE CHANGE FROM MTBE TO ETHANOL AS THE FUEL OXYGENATE?

Check with the manufacturer to make certain the tank and lines will not experience problems with ethanol. Inspect the tank for water and, if present, pump out all water and thoroughly clean the tank. Install ethanol-compatible filters. The tank should be less than 20 percent full before adding the first load of fuel with ethanol.

4. WHAT IS PHASE SEPARATION, AND HOW DO I DEAL WITH IT?

If significant amounts of water are present in a fuel tank with gasoline that contains ethanol, the water will be drawn into the fuel until the saturation point is reached for the three-component mixture of water + gasoline + ethanol. Beyond this level of water, phase separation could cause most of the ethanol and water to separate from the bulk fuel and drop to the bottom of the tank, leaving gasoline with a significantly reduced level of ethanol in the upper phase. If the lower phase of water and ethanol is large enough to reach the fuel inlet, it could be pumped directly to the engine and cause significant problems. Even if the ethanol water phase at the bottom of the tank is not drawn into the fuel inlet, the reduced ethanol level of the fuel reduces the octane rating by as much as 3 octane numbers, which could result in engine problems.

▲ The level at which phase separation can occur is determined by a number of variables, including the amount of ethanol, the composition of the fuel, the temperature of the environment and the presence of contaminants. It is very important (A) that the system is inspected for significant quantities of water in the tank before using gasoline with ethanol and (B) to limit exposure of the fuel tank to excess water. For our method see recommendation in Checking for Water in Fuel Section. If phase separation has occurred, it is necessary to completely remove all free water from the system and replace the fuel before continuing operation. Otherwise, engine damage will occur.



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Sample of fuel from fuel tank in which phase separation has occurred. The upper phase is gasoline with a reduced level of ethanol. The lower level is a mixture of ethanol and water.

5. IS AN ADDITIVE AVAILABLE THAT CAN PREVENT PHASE SEPARATION?

There is no practical additive that can prevent phase separation from occurring. The only practical solution is to keep water from accumulating in the tank in the first place.

6. ARE THERE ANY ADDITIVES THAT CAN ALLOW THE PHASE-SEPARATED MIXTURE TO REMIX WHEN ADDED TO THE FUEL TANK?

No, the only way to avoid further problems is to remove the water, dispose of the depleted fuel, clean the tank and start with a fresh, dry load of fuel.