

Does Ethanol Cause Chainsaw Failures?

Separating the facts from fiction

By Jeff Mullins

Early in May of 2008, I purchased a 1991 model Husqvarna 3120 chainsaw with a recent shop rebuild to power a 72-inch Alaska Mill. Fueled with fresh mixed gas according to manufacturer's specifications, the saw's 42-inch bar easily buried itself into a huge black walnut log. But before the second cut was finished, the engine casing began to smoke, and the saw was "toast."

At the shop, the factory-trained mechanic determined overheating/detonation had caused engine failure and added my 3120 to the growing list of recent saw failures. It was suspected the failures were related to ethanol, especially since Oregon recently mandated E10 at all their pumps.

Is Ethanol the Problem?

An informal survey of a dozen northwest Oregon saw shops revealed that all the shops had noticed fuel line and carburetor diaphragm issues related to ethanol. About half of the shops reported experiencing saw engine failures and suspected ethanol as the culprit.

Over the next few weeks, I sought out industry experts to try to separate myths from facts. The following information is a summation of interviews with Randy Scully, STIHL Inc. product service manager, James McNew, vice president technical affairs Outdoor Power Equipment Institute (OPEI), and Robert Reynolds, president of Downstream Alternatives, a fuels consulting company. All agreed that ethanol impacts chainsaw engine operation.

Engine Operation and Failure Modes

Chainsaws use precision engineered, high performance 2-cycle engines revving at 12,000 to 14,000 rpm. The proper mixture of the correct 2-cycle engine oil and gasoline provides fuel to power the engine and carries essential lubrication to the rapidly moving parts. High speeds, friction, and combustion processes all generate heat that must be removed to avoid damaging the engine.

Cooling a chainsaw occurs in two ways. Cylinder fins increase surface area available for transferring heat as the fan forces outside air over the cylinder/fins to remove heat. Heat is also dissipated by the inflow of cool air and fuel. As the air and fuel enter the combustion chamber, it absorbs heat energy prior to combustion and exiting exhaust gases carry away heat as well.

Most damage to chainsaw cylinders and pistons is directly related to engine overheating due to either excessive heat generation and/or failure to remove heat produced during operation.

Lean Seizure — This common failure mode occurs when the oxygen-to-fuel mix ratio is too lean and leads to overheating. Several factors contribute to lean seizure — a lean fuel-to-air mix burns hotter, saws runs faster increasing friction heat, lower fuel flow provides less cooling and reduced lubrication.

Increased heat production, combined with reduced cooling, leads to piston/cylinder scoring and engine failure. (Typically, a lean seizure is evidenced by scarring damage on the exhaust side of the piston and cylinder where temperatures are the hottest.)

The term "lean" is also used to refer to too little oil in the gas mixture. A "lean" oil-to-gas mixture results in more friction heat due to inadequate lubrication of moving parts and can lead to rapid

damage to engine components.

Detonation or Pre-Ignition — Another heat related failure mode is detonation (sometimes called “pre-ignition”). Under normal operating conditions, the sparkplug ignites the fuel mix, initiating a controlled burn that moves through the combustion chamber. This “burn” produces a smooth power stroke to drive the piston down at the proper time.

When overheated, excessive combustion chamber temperature can ignite fuel independent from the spark plug. When this happens, the two “fires” rapidly burn toward one another and collide creating even more heat and disrupting engine timing. The stress on the engine’s moving parts is greatly multiplied and may cause catastrophic failure. (Detonation failure is usually evidenced by physical piston/ cylinder damage and scarring at a location other than the exhaust side.)

Detonation is also a function of the fuel’s octane level. Generally speaking, octane is the characteristic of a fuel to resist detonation. In automobiles, low octane fuel causes “knocking” (detonation) in the engine.

Since automobile engines operate at relatively low rpm, the knocking is of much less consequence than in high speed chainsaw engines. For most operators, the chainsaw’s high rpm and louder ambient noise level mask the occurrence of detonation until symptoms of failure become evident. Many factors may contribute to overheat situations, including dirty cylinder/fins, plugged cooling air intake, improperly vented fuel tank, improperly adjusted carburetor, too little oil in fuel, wrong type of oil in fuel, air in-leakage, or an overheated spark plug.

Now Add Ethanol

Modern chainsaws are designed to run on gasoline (E0), but manufacturers offer assurances that they will operate properly on E10. However, it’s no secret that mixing ethanol with gasoline alters the characteristics of the fuel and potentially contributes to 2-cycle engine failures. Older equipment may be at a significantly greater risk for damage.

Increased Oxygen — Ethanol’s higher oxygen content leans the fuel-to-air mix causing saws to run faster and hotter. The leaner fuel is less effective at lubricating, further increasing heat through friction. Ethanol is also a less effective cooling medium than gasoline. All of these factors make chainsaws run hotter on E10 than they do on E0 — yet properly adjusted modern saws should function properly without failure when using gasoline mixed with 10 percent ethanol.

Fuel Separation — When contaminated with .5 percent water (about four teaspoons per gallon) ethanol will separate from gasoline. This is called phase separation.

Phase separation is most likely to occur when first introducing E10 into a storage tank previously used for non-ethanol fuels. If not thoroughly cleaned and dried before filling with E10, water already in the tank may cause phase separation. Tests have shown that in fuel stored at 70 degrees at 70 percent humidity it will take more than 100 days before the ethanol will absorb enough water from the air to cause phase separation. However, repeated heating and cooling of storage containers, or exposing them to moisture, may increase risk of phase separation.

Ethanol acts as a solvent — When operating a chainsaw on E0, residue can build up in the fuel system. The introduction of the ethanol, which acts as a solvent, dissolves the residue and allows it to pass through the carburetor, plugging the jets and preventing the carburetor from properly mixing the fuel and air. This again leads to a lean air-to-fuel ratio that can cause a failure. It is important to thoroughly clean the fuel system, tank, fuel lines, and carburetor, before switching to the E10 fuel.

Pre-existing Problems Amplified

Although using E10 gasoline should not cause a chainsaw to fail, equipment with pre-existing problems, not yet serious enough to cause failure when using E0, may fail when the switch is made to E10.

A chainsaw adjusted to run hot and fast on E0, may run too hot when fueled with E10 if the fuel/air mix is not adjusted to compensate. An existing air leak, grime on cylinder fins, air flow obstructions, or any other problem that either increases heat production or hinders heat removal, may elevate a latent problem into a source of failure.

Making the Switch to E10

Switching from an E0 to an E10 fuel should be made in conjunction with verification of proper operation of the chainsaw by giving special attention to air cooling systems and fuel flow.

Tip No. 1 — Adjusting fuel/air mixture for the fuel being used will ensure engine operation is within design parameters and that there is adequate fuel flow for cooling and lubrication. When using E10, saws manufactured after 1997 should be set to the “rich stop” on the carburetor adjustment screw. Carburetors without “rich stops” should be set with a tachometer to manufacturer specifications.

Tip No. 2 — Experts agree, increasing oil-to-gas mix ratios will not compensate for the presence of ethanol in gasoline. Instead, they caution that exceeding manufacturer’s recommended oil-mix ratio may lead to carbon deposits and damage in the combustion chamber. Excess oil may also foul the exhaust system reducing the cooling capability of the engine.

However, when using E10 it is advisable to mix oil with fuel at the richest ratio recommended by manufacturers. Tip No. 3 — When switching to E10 fuel, it is also important to verify that the saw’s external cooling mechanisms are performing properly. Cylinders and fins should be free from dirt, pitch, grease, or any other contaminant that could reduce heat transfer capability. Air passageways should be clear of any obstructions and kept clear during saw operation. Allowing sawdust, vegetation, or a shirt tail to block air flow can quickly lead to engine failure.

Tip No. 4 — Normal precautions should be taken to prevent contamination of E10 fuels. Fuel should not be stored for long periods of time (over 60 days), and it is better to keep tanks completely full or completely empty to minimize danger of moisture accumulation. Adding a fuel stabilizer will help keep the fuel “good.” When using E10, it is even more necessary that fuel containers be shaken well prior to mixing with oil and filling power equipment. It is also important to shake the saw prior to running after extended idle periods.

Older equipment may experience deterioration of fuel lines and carburetor diaphragms, requiring replacement. Manufacturers and fuel industry experts agree that 10 percent ethanol in gasoline will not, by itself, damage chain saws that have been adjusted, cleaned, and are operated properly. However, switching from E0 to E10 may escalate an existing problem to the point that the saw engine fails. Saw owners who ensure proper oil/fuel mix, correct carburetor adjustment, and maintain adequate cooling air flow should be able to transition to E10 gasoline with little problem.

For more information about using biofuels and outdoor equipment, check out these websites. n Renewable Fuels Association (RFA) <http://www.ethanolrfa.org/> has resources for service technicians.

Outdoor Power Equipment Institute (OPEI) www.opei.org/ is an international trade association representing the \$15 billion landscape, forestry, utility, and lawn equipment manufacturing

industry. OPEI is committed to ongoing efforts to ensure consumer safety and access to outdoor power equipment in order to maintain, invigorate, and enhance outdoor landscapes. OPEI works with federal, state, and local groups to ensure that equipment operates efficiently and effectively and is fully emission compliant.

Alliance for a Safe Alternative Fuels Environment (AllSAFE) <http://www.allsafe-fuel.org/> assures all new bio-based fuels (such as ethanol or other renewable fuels) are promoted in a thoughtful manner that is safe and will not harm consumers, their products, the environment, or the economic infrastructure, both manufacturing and retail.