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The Regulator

Emission Regulations and Related Information

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Design & Manufacturing of
Carburetors
Ignition Systems
Fuel Pumps
Fuel Tanks
Electronic Fuel Injection Sub-Systems

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Walbro Engine Management

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EPA and OPEI Work Out Tamper Resistance Guidance Document

2011 marked an uptick in EPA enforcement activity related to Small Off-Road Engines (SORE) and recreational products. Specifically EPA enforcement has focused on evaluating tamper resistant features such as adjustable mixture screws on carburetors and fixed metering jets on carburetors. EPA, working with US Customs officials, have been finding a number of products imported into the United States to have questionable tamper resistant design features. This has resulted in seizures of product entering the US, long negotiations with EPA/Customs officials and a delay in products reaching retailers.

SORE manufacturers, working through trade associations such as OPEI and EMA, have been working with EPA to define a streamlined process that engine/equipment manufacturers and carburetor manufacturers can use to help ensure their products meet the intended scope of the EPA regulations before they reach the US Customs. This effort developed an industry guidance document that outlines the necessary steps to help ensure proper certification documentation is provided to EPA.

Two primary pathways can be used during EPA certification, covering tamper resistance. First, EPA will rely on CARB tamper resistance approvals, provided the approval letter, photos of the specific tamper resistant design and a description of the tamper resistant method are uploaded to the EPA Verify web site during the certification application process. Second is the self-approval of a tamper resistant design. This second method is not the EPA preferred method but does allow a manufacturer to self-certify a design if needed. This self-approval method requires a detailed description of the tamper resistant design and a complete report proving the manufacturer has tested, evaluated and deemed adequate the tamper resistant design (includes all descriptions, test reports, test procedures, evaluation criteria, tools and methods used, photos and or movies showing the design and how it was evaluated). This information must also be uploaded to the EPA Verify site during the equipment certification application process.

There are four basic tamper resistant designs primarily being used on SORE products.

1) Limiter caps

2) Special tools not available to the end user or general public

3) Sealed caps or plugs preventing access to the adjustment needle

4) Restrictive covers/guards that prevent access to the adjustable needle

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EPA and OPEI Work Out Tamper Resistance Guidance Document cont.

These basic four methods are still available, however, each method will have new scrutiny applied during the approval process. As an example, it is likely that exposed plastic limiter caps will no longer be approved if common ordinary tools can easily defeat the design. Sealed caps or plugs will likely be scrutinized by trying to dig or pry out the plug using awls and screw drivers. Restrictive covers or guards that can be easily defeated or removed for adjustment purposes will not be acceptable in the future.

CARB is also in the process of reevaluating their current tamper resistant approvals. It is likely CARB will require all approvals dated 2005 and older to be resubmitted for CARB evaluation in order to receive a new approval number. If a current approval older than 2005 is not resubmitted or not reapproved it can still be used for service carburetors if they were already using that design. CARB has also indicated they will be adding an expiration date to all tamper resistant approvals and it's believed they will expire after five years.

For a copy of the official OPEI Guidance Document follow the link to the OPEI web site.

http://opei.org/news/detail.dot?id=20326

CARB To Harmonize With EPA Part 1065 Exhaust Test Procedures

The California Air Resources Board (CARB) announced a proposal to harmonize the SORE (Small Off-Road Engine) exhaust emission requirements with the EPA requirements found in 40 CFR Part 1054 and Part 1065. In 2009 EPA moved the small engine exhaust emission certification requirements to 40 CFR Part 1054 and their associated exhaust emission test procedures to Part 1065. CARB plans to harmonize with these requirements and procedures while yet retaining the specific goals of California such as emission credits. CARB plans to implement these new procedures with the 2013 model year. In addition to the test procedure changes CARB also plans to change the certification test fuel used from CARB Phase II to a ten-percent ethanol blend (E10). More information about ethanol fuels is covered on page 7 in the "Ethanol Fuels" article.

The exhaust emission harmonization should result in a more streamlined and simpler certification process for engine manufacturers and the need to perform two separate emission tests may now be eliminated.

While CARB has announced they will migrate to E10 certification test fuel making it mandatory by 2019 and optional until then, EPA is also in the process of investigating a change in their certification test fuel. EPA is investigating the use of E15 as their certification test fuel which better aligns with the changing direction of the RFS II fuel movement. The decision by EPA will not happen in the near future as full approval of E15 fuel in general will need to happen first. Should E15 be approved for EPA certification purposes this would likely cause a test fuel difference again between CARB and EPA small engine test procedures.

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CARB Tier III and EPA Phase 3 Exhaust Regulations

In 2012, the final phase-in of the EPA Phase III exhaust emission standards will begin. With this final step the exhaust emission standards become fully harmonized with the CARB Tier III standards. One caveat of this is a slight difference in CO standards with EPA allowing a slightly higher value. Table 1 below summarizes the EPA Phase III standard and the CARB Tier III standard and notes this CO difference. The harmony between these two standards is evident. However, both regulations offer their own ABT (Averaging, Banking, & Trading) schemes on exhaust emissions. To encourage manufacturers to continue promoting clean technology, CARB has put a life expectancy of five years on existing and future credits. This means a credit generated in 2011 will expire in 2016 if it is not used.

Reviewing actual EPA certification data indicates CO compliance can be met without the extra margin EPA provides. CARB data also shows that many Class II engines are able to meet the emission standards without the use of a catalyst. Class I CARB data shows the big four manufacturers (Briggs & Stratton, Honda, Kawasaki and Kohler) have engines certified without a catalyst while many of the Chinese brand imports appear to require a catalyst system.

CARB and EPA both require that equipment meets the applicable exhaust standard throughout the full useful life period. EPA also requires engines to be fully compliant at any altitude or atmospheric pressure down to an equivalent 96 kPa for handheld engines and 94 kPa for non-handheld engines.

Table I

Category	CO g/kW-hr		HC + NOx g/kW-hr		Useful Life hours [1]	
	CARB	EPA	CARB	EPA	CARB	EPA
Class I 80-225 cc	549	610 [2]	10	10	125/250/500	125/250/500
Class II >225 cc	549	610 [2]	8	8	125/250/500/1000	250/500/1000
Class III & IV 20-50 cc	536	805	50	50	50/125/300	50/125/300
Class V 50-80 cc	536	603	72	72	50/125/300	50/125/300

1 Useful Life is selected by the engine manufacturer and should reflect the intended use such as Residential/Extend Life Residential/Commercial or Light use/Medium use/Heavy use

2 Marine Generators require 5 g/kW-hr CO standard

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Evaporative Emission Standards for CARB Tier III and EPA Phase 3

Evaporative emission requirements, in effect since 2006 in California, are fully phased in starting in 2013. Evaporative requirements have focused on three main evaporative sources: fuel tank venting, fuel tank permeation and fuel line permeation. Within each category there are additional sources that will require design attention such as running loss control, fuel line fitting integrity, fuel caps, fuel filters, fuel pumps, etc.

CARB has two paths for evaporative certification. The first is a performance test, which means the piece of equipment is tested in a SHED (Sealed Housing for Evaporative Determination) using a diurnal temperature test cycle. This type of performance testing will effectively include any potential hydrocarbon source and therefore is the true measure for evaporative emission testing. The CARB evaporative regulation requires walk-behind mowers be tested using this performance test (diurnal test). CARB understands the performance test is the true measure, however they do allow a design-based option for non-walk behind mower equipment. The design based method relies on component testing (fuel tanks, fuel lines, carbon canister) with each specific component having to meet its own evaporative requirement. In order to ensure the sum of all components perform correctly, CARB has included a validation study whereby CARB will test equipment certified under the design based approach, using the performance test (SHED diurnal test). When manufacturers use the design based method it is important that they design the system correctly to ensure it will meet the performance test requirements.

The CARB standards can be found on page 6 with the performance test listed as the Diurnal requirements. CARB handheld evaporative requirements focus solely on fuel tank permeation while Class I & Class II products cover fuel lines, fuel tanks, tank venting and running losses in addition to other sources via the validation study. All equipment is expected to meet these standards throughout the product's useful life.

EPA evaporative requirements are effectively less stringent and only focus on fuel lines and fuel tanks. Running loss control is required for Class I & Class II equipment but is not required for handheld equipment. The EPA program is based around component testing and does not consider the effects of other evaporative sources like CARB does. The EPA standards can also be found on page 6.

Carbon canisters, the main technology used to control fuel tank venting losses, are used to control escaping hydrocarbons as a result of the liquid fuel and vapor volume inside the tank being heated. Additionally, carbon canisters can be used to control running losses which are also a form of tank venting losses, but are the result of heating of the fuel tank and inducing vibrational effects into the fuel during operation of the engine/equipment. After the canister has become loaded it must be cleaned in order to remain effective. This can be done either through active purging or passive purging. Active purging typically relies on the engine intake vacuum to draw a small amount of clean air through the canister and into the engine. Passive purging relies on the canister absorbing the hydrocarbons during the heating portion of the diurnal test cycle and then desorbing some of the hydrocarbons back into the fuel tank during the cooling portion of the test cycle. Passive purging is only be about 50% as effective as actively purged designs. However, this method has been able to meet the current CARB diurnal test requirements.

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Evaporative Emission Standards for CARB Tier III and EPA Phase 3 cont.

Fuel tank permeation results when fuel hydrocarbons escape directly through the plastic fuel tank and fuel cap material. This is a diffusion process and the amount of hydrocarbon loss is directly related to the fuel tank surface area, material type and test temperature. Fuel tank permeation losses are generally less then fuel tank venting losses. Reducing the fuel tank permeation rate in plastic has been accomplished through various technologies such as fluorination, engineered high grade plastics, sulfonation and multilayer fuel tanks. All these technologies have their advantages and disadvantages and determine their overall effectiveness. It is becoming clear to most manufacturers that the best solution available considering permeation reduction, long term durability, cold weather impact and costs is multilayer fuel tank technology.

Fuel line permeation is similar to fuel tank permeation since it deals with a diffusion process going through the fuel line material. The primary solution for low permeation fuel lines is a multilayer construction design using a barrier layer similar to the multilayer fuel tank concept. Fuel line fittings, filters and fuel pumps are additional sources of concern that require good engineering judgment be used during the design stage.

CARB and EPA standards may look similar however there are differences in the testing methods that need to be considered. Table II below shows the primary differences and options.

Table II

Test Component	Test Temperature		Test Fuel		Note
	EPA	CARB	EPA	CARB	
Fuel Tank	28°C Optional 40°C test with 2.5 g/m^2/day standard	40°C	E10	CARB Phase II	EPA requires fuel cap and bolted on components be included in test.
Fuel Line	23°C	40°C	CE10 Cold Weather Fuel Lines use E10	CARB Phase II	

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Evaporative Emission Standards for CARB Tier III and EPA Phase 3 cont.

Tables III and IV describe the CARB and EPA evaporative standards.

CARB Evaporative Emission Standards for Lawn & Garden Equipment 2012 and Beyond

Table III

Category	Useful Life (hours)	Fuel Line Permeation	Fuel Tank Permeation	Running Loss	Diurnal	Carbon Canister (Vapor Storage Capacity per liter of tank volume)
Handheld <80cc	50/125/300	NA	2.0 g/m^2/day	NA	NA	NA
Class I >80cc ≤225cc	125/250/500	15 g/m^2/day	1.5 g/m^2/day	Yes	[0.95 + 0.056 * tank vol (liters)] g/day	1.4 g <3.78 L tank vol 1.0 g >3.78 L tank vol
Class II >225cc	125/250/500/ 1000	15 g/m^2/day	2.5 g/m^2/day Starting in 2013 1.5 g/m^2/day	Yes	[1.2 + 0.056 * tank vol (liters)] g/day	1.4 g <3.78 L tank vol 1.0 g >3.78 L tank vol
Walk Behind Mowers	125/250/500	NA	NA	Yes	1.0 g/day	NA

Gray shaded area represents a Design Based Certification method (Component testing)
Red shaded area represents a Performance Based Certification method (SHED based diurnal testing)

EPA Evaporative Emission Standards for Lawn & Garden Equipment 2012 and Beyond

Table IV

Category	Useful Life	Fuel Line Permeation	Fuel Tank Permeation	Running Loss	Diurnal	Carbon Canister
Handheld	5 years	15 g/m^2/day	1.5 g/m^2/day [A]	NA	NA	NA
Class I ≤225cc	5 years	15 g/m^2/day	1.5 g/m^2/day	Yes	NA	NA
Class II >225cc	5 years	15 g/m^2/day	1.5 g/m^2/day	Yes	NA	NA

[A] Cold Weather Fuel Lines Phase-In Starting At 290 in 2012, 275 in 2013, 260 in 2014, 245 in 2015 and 225 in 2016

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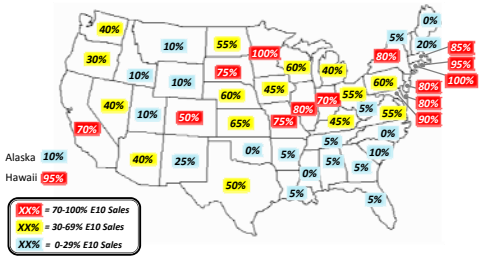
Ethanol
How It's Changing Our Gasoline

Does my gasoline contain ethanol? Today, it is highly unlikely that your gasoline does not contain ethanol. E10 gasoline (contains 10% ethanol) is quickly becoming the defacto base fuel for all spark ignited engines in the US. The following figures show how ethanol penetration has increased in just the past few years. The RFS II bill (Renewable Fuels Standard) requiring a yearly increase in the use of "biofuels" is the driving factor in growing the percentage of ethanol in our gasoline.

2007 E10 Market Penetration

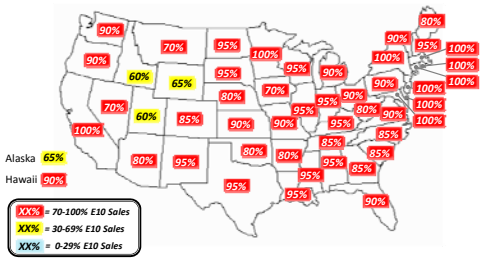
as % of Total Gasoline sales, by State



Approximately 40% of all gasoline sold is E10 with the high market penetration in the Midwest and Northeast

2010 E10 Market Penetration

as % of Total Gasoline sales, by State



Greater than 90% of all gasoline sold is E10 with the market penetration now in all areas

RFS II requires a steady increase in the use of ethanol from 9 billion gallons in 2008 to 36 billion gallons by 2022. 36 billion gallons would equal about 25% of the 2011 U.S. gasoline consumption. There are two major hurdles in meeting the RFS requirements. First, all this ethanol must be primarily blended into gasoline. The number of FlexFuel vehicles that can use up to an E85 blend is expanding, but not fast enough to consume the ethanol specified in RFS II. This is partly due to a limited E85 dispensing infrastructure and the fact that E85 is not priced in line with its resulting loss of fuel economy. E85 can have up to a 30% reduction in fuel economy while the cost of E85 at the pump is only 15-20% less.

Secondly, the RFS II bill limits the amount of ethanol that can be produced from corn at 15 billion gallons. Ethanol produced from corn is already near that limit so additional ethanol production must come from cellulosic production methods. So far these methods have not been economically competitive with corn ethanol fermentation methods. This may change in the future and will be critical in meeting the future RFS II requirements.

Since FlexFuel vehicles are not consuming the ethanol volume to meet future RFS II requirements there will have to be a change in the base gasoline used for most automobiles. Recognizing this, Growth Energy (and 54 ethanol producers) submitted a 211-f waiver requesting approval for a 15% ethanol-gasoline blend fuel on March 6, 2009 . EPA approved the E15 waiver and its use for 2001 and newer automobiles. E15 has not been approved for small engines, recreational vehicles, marine craft or automobiles older than 2001. Even though EPA approved E15, it has not made its way to the market place as gasoline because several key approvals still are needed. While UL has already approved legacy fuel dispensing pumps certified under UL87 to be compatible with gasoline containing 15% ethanol, there still remain concerns with underground storage tanks and the piping running to the dispensing pumps. Liability concerns in general and specifically covering potential misfueling still need to be worked out. EPA has approved a new pump label to address potential misfueling however customer awareness programs will still be needed. The figure below shows the approved E15 pump label. E15 still requires formal registration and this is well under way along with updating individual state regulations for E15 sales. Lastly, ASTM specifications also need to be updated before this new fuel can enter the market place.

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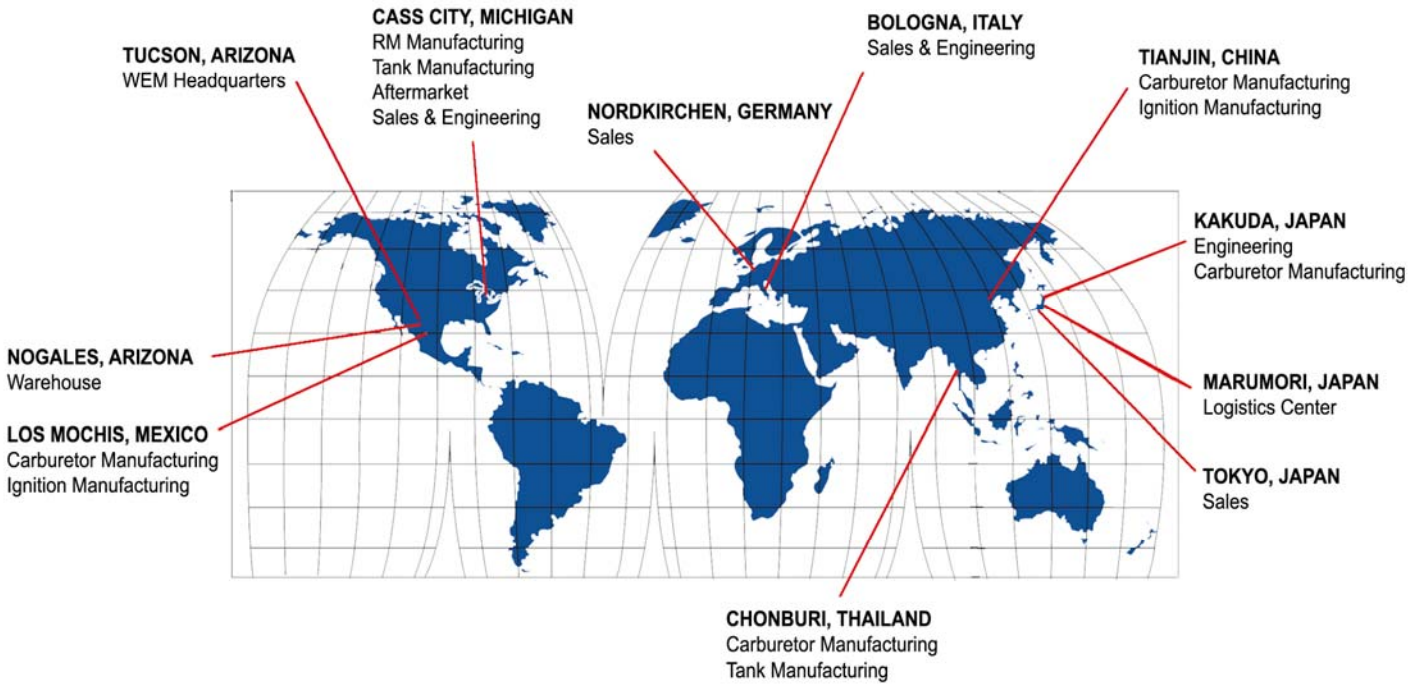
Ethanol
How It's Changing Our Gasoline cont.

The inevitable transition to higher ethanol blends of gasoline is also being reflected in future emission certification test fuel changes. Both CARB and EPA are working on proposals to change the exhaust certification test fuel to E10 and E15 respectively. CARB is proposing E10 certification test fuel be used for small engines as part of their LEV III rule making for on-highway vehicles. This proposal allows E10 to be used as an option until 2018, and it will become mandatory in 2019.

EPA is looking at a different approach. Knowing that small engine manufacturers already agree today's engines can tolerate a 10% ethanol window, meaning engines calibrated with straight gasoline (E0, no ethanol) will allow the engine to function correctly and remain emission compliant even if E10 fuel is used, EPA is looking to change the certification fuel to E15. EPA recognizes the RFS requirements have already made E10 the base gasoline in the market place and future RFS II requirements may require them to further increase this ethanol concentration. Proposing an E15 certification fuel would provide a greater margin for EPA should the RFS II continue to drive up the ethanol percentage in base gasoline. The E15 certification fuel for small engines could then provide a pathway to encourage compatibility with E15 and expand its acceptance and approval in small engines. With this trend towards higher ethanol levels already in the works, it is becoming imperative that engine and carburetor manufacturers ensure their products evolve with higher ethanol compatibility and functionality changes. Walbro has been active along these lines by testing fuel system components for compatibility up to E25. Walbro also is working on very low cost electronic engine management systems that control both ignition timing and air/fuel ratio and can correct for the ever changing gasoline and environmental changes. This is ongoing work but shows the proactive approach needed to support the small engine industry's future needs.

Walbro Facilities



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