THE HAINES GROUP

27/07/10

kscott@ephc.gov.au
Project Manager
NEPC Service Corporation
Level 5/81 Flinders Street
ADELAIDE SA 5000

Re: REDUCING EMISSIONS FROM NON-ROAD SPARK IGNITION ENGINES AND EQUIPMENT – CONSULTATION REGULATION IMPACT STATEMENT

Our family company has been involved in boat building in Australia for over fifty years. We are proud to say we are the leading builder of fiberglass boats in Australia and we took on the Suzuki Marine engine franchise in 2005.

We have developed RIVALE™ technology a unique closed moulding manufacturing process which ensures product consistency and reduced styrene emissions. The emissions are well below world minimum standards.

Our family company took a similar approach to outboards, severely self limiting the models of high emissions outboards we import and choosing to give these models no advertising support.

Haines Suzuki would be happy to drop these models and support the introduction of outboard emissions regulations paralleling USEPA 2010. We endorse the AMEC submission and agree with and assisted the EFFA submission to the RIS. This letter will therefore be restricted to one area where we have gathered particular expertise.

We have closely followed the progress towards small engine emissions regulations since 2005, within Australia, during our annual business trips to trade shows in the USA and in the course of our relationship with US boat builders, including the specialist boat range we import.

As a boat builder we have familiarized ourselves with the evaporative requirements of USEPA 2010 and kept ourselves well informed. It is clear from out 2010 visits to USA trade shows that US component manufacturers are well prepared.

The major boat building component importer in Australia, BLA, has existing franchise arrangements in place with manufacturers who supply the necessary components to the US boat building market. BLA has already delivered catalogues and sample products to our Queensland office.

The indicative cost for these new components is under $180 and we estimate that the additional fitting cost during boat construction will be around $52.

These costs will be lower if Sant Marine, Australia's major fuel tank manufacturer modifies their designs to include overflow capacity, rather than a separate overflow tank. This is a commercial decision they are considering, as are they considering importing and offering a complete boat solution including carbon canister filters.

In summary:

- There will be some cost to meet the new standards but these are neither excessive nor debilitating.
- There are no particular technical, boat building difficulties in meeting evaporative standards.
- We foresee no difficulty in sourcing components to meet evaporative standards
- As a leader in the Boating Industry Haines Signature will again share the knowledge we have gained on evaporative standards

We have already commenced educating our staff, who will in turn keep boat dealers, mechanics and Boat builders well versed in the requirements. (see attached Memo)

The writer has already assisted with two articles published in Industry magazines, which will go a long way to improving industry understanding, even in advance of legislation.

Yours sincerely

Greg Haines
Managing Director
The Haines Group

TO: All Haines Group territory Managers

FROM: Greg Haines

RE: Proposed DEWHA evaporative standards for boats.

Gents,

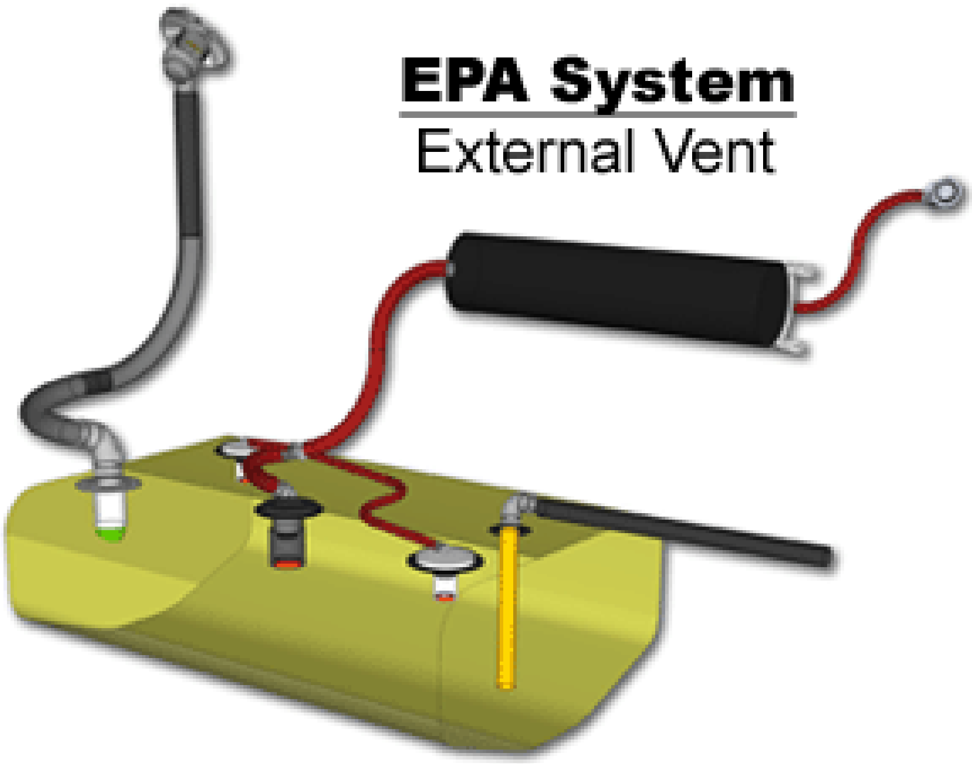
Please be aware that the proposed Department of Water, Heritage and Arts (DEWHA) emissions standards for non-road spark ignition engines and equipment, does include an evaporative standard for inbuilt fuel tanks on boats. This is a standard for Garden equipment, sterndrive and inboard engines, outboard motors and boats. It is suggested that it will implement some time in 2012.

What does this mean for boat builders?

All boat sold in Australia will have to comply with the US EPA rule for evaporative standards.
The standards include non permeable fuel lines, carbon canisters, Tank vent valves, fuel level vent valves, Inverted loops and inlet fill pipe check valves.

Your boat builders should not be concerned the parts will be available through suppliers such as BLA and Sant Marine.

The below is a simple illustration of a certified fuel system.



The carbon canister will need to be fitted in the fuel tank vent line.

Carbon canisters have been used in automotive applications for decades. They filter hydrocarbons out of fumes vented during thermal expansion and/or refueling of tanks. Canisters are then purged when fresh air is drawn into the tank during thermal contraction or while the engine is running. By regulation, canisters must be protected from water and raw fuel. Both reduce their efficiency. Canister sizing is dictated by both boat and tank size. Sterndrive boats may need to use the heat-shielded canister if it is fitted in the engine compartment.

Fig. 0485015 Marine Canister

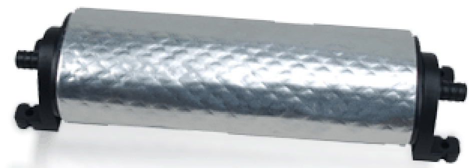


Fig. 0485H15 Marine Canister with heatshield attached

Below is an outline of the formula and some samples. Please note the fuel tank capacities are in US gallons

Trailerable

Canister (Liters)	Tank (Gallons)
1.0	25
1.5	37
2.0	50
3.0	75
4.0	100

LitersCC=0.04x Fuel Tank

Non-Trailerable

Canister (Liters)	Tank (Gallons)
1.0	62
1.5	93
2.0	125
3.0	187
4.0	250

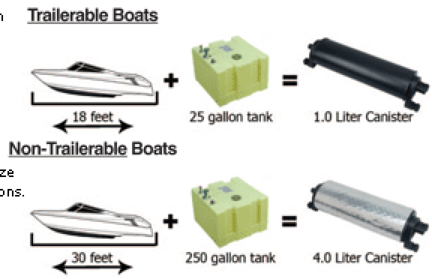
Formula (round up to the next largest size)
LitersCC=0.016x Fuel Tank

For **trailerable boats** the canister size in liters = .04 x Fuel tank capacity in gallons. (Trailerable is boat length less than 26 ft. and width less than 8.5 ft)

Example - an 18 foot boat with a 25 gallon tank would require a canister of .04 x 25 = 1.0 liters.

For **non-trailerable** boats the canister size in liters = .016 x Fuel tank capacity in gallons.

Example - a 30 foot boat with a 250 gallon tank would require a canister of .016 x 250 = 4.0 liters.



Note: Non-trailerable is defined as boat length equal to orgreater than 26 ft. or width equal to or greater than 8.5 ft.

I have attached a copy of the requirements (Doc A), and the parts needed, system overview, valve, loops, vents and fills (Doc B). We should have a sample of these parts over the next few days.

If any of your boat builders have any question please have them contact me and be sure we will keep you up to date with any relevant information as it comes to hand.

Environmental Protection Agency (EPA) Regulations

Control of emissions from spark-ignition propulsion marine engines
Control of evaporative emissions from new and in-use nonreader and stationary equipment

Implementation Timing

1045.112

(d) **Diurnal emissions**. Installed fuel tanks must meet the diurnal emission requirements specified in 40 CFR 1060.105. Fuel tanks for personal watercraft must meet diurnal emission standards starting in the 2010 model year. Other installed fuel tanks must meet diurnal emission standards for vessels produced on or after July 31, 2011, except as allowed by §1045.625.

1045.625

(b) **Allowances**. You may choose one of the following options to produce exempted vessels under this section:

Percent-of-production allowances. You may produce up to 50 percent of your vessels from July 31, 2011 through July 31, 2012 that are exempt from the diurnal emission standards. Calculate this percentage based on your total U.S.-directed production volume.

Small-volume allowances. Small-volume vessel manufacturers may produce up to 1200 vessels from July 31, 2011 through July 31, 2013 that are exempt from the diurnal emission standards.

EPA Diurnal Requirements

1060.105

Diurnal emissions from marine SI fuel tanks may not exceed 0.40 g/gal/day when measured using the test procedures specified in §1060.525 for general fuel temperatures. An alternative standard of 0.16 g/gal/day applies for fuel tanks installed in nontrailerable boats when measured using the corresponding fuel temperature profile in §1060.525

1060.101

(iii) If the emission controls rely on carbon canisters, they must be installed in a way that prevents exposing the carbon to water or liquid fuel.

EPA Warranty and Required Instructions

§1060.120 Warranty

(b) Warranty period. Your emission-related warranty must be valid for at least two years from the point of first retail sale.

§1060.125 What maintenance instructions must I give to buyers?

Give ultimate purchasers written instructions for properly maintaining and using the emission control system. You may not specify any maintenance more frequently than once per year. For example, if you produce cold-weather equipment that requires replacement of fuel cap gaskets or O-rings, provide clear instructions to the ultimate purchaser, including the required replacement interval.

§1060.130 What installation instructions must I give to equipment manufacturers?

(a) If you sell a certified fuel-system component for someone else to install in equipment, give the installer instructions for installing it consistent with the requirements of this part.

(b) Make sure the instructions have the following information:

(1) Include the heading: “Emission-related installation instructions”.

(2) State: “Failing to follow these instructions when installing [IDENTIFY COMPONENT(S)] in a piece of nonroad equipment violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.”

(3) Describe any limits on the range of applications needed to ensure that the component operates consistently with your application for certification.

EPA Labeling

1060.137 Labeling

(b) Label your certified fuel-system components at the time of manufacture. The label must be placed without being destroyed or defaced. This may involve printing directly onto the product

(1) Attached so it is not removable. For molded products, you may use the mold to apply the label.

(2) Durable and readable for the equipment’s entire life.

(3) Written in English.

(c) Except as specified in paragraph (d) of this section, you must create the label specified in paragraph (b) of this section as follows:

(1) Include your corporate name. You may identify another company instead of yours if you comply with the

provisions of §1054.640.

(2) Include EPA's standardized designation for the emission family.

(3) State: "EPA COMPLIANT".

(d) You may create an abbreviated label for your components. Such a label may rely on codes to identify the component. The code must, at a minimum, identify the certification status, your corporate name, and the emission family. For example, XYZ Manufacturing may label its fuel lines as "EPA-XYZ-A15" to designate that their "A15" family was certified to meet EPA's 15 g/m2/day standard. If you do this, you must describe the abbreviated label in your application for certification and identify all the associated information specified in paragraph (c) of this section.

EPA Design Based Certification

§1042.107 Evaporative emission standards.

(a) There are no evaporative emission standards for diesel-fueled engines, or engines using other nonvolatile or nonliquid fuels (for example, natural gas).

(b) If an engine uses a volatile liquid fuel, such as methanol, the engine's fuel system and the vessel in which the engine is installed must meet the evaporative emission requirements of 40 CFR part 1045 that apply with respect to spark-ignition engines. Manufacturers subject to evaporative emission standards must meet the requirements of 40 CFR 1045.112 as described in 40 CFR part 1060 and do all the following things in the application for certification:

(1) Describe how evaporative emissions are controlled.

(2) **Present test data** to show that fuel systems and vessels meet the evaporative emission standards we specify in this section if you **do not use design-based certification** under 40 CFR 1060.240

§1060.240 How do I demonstrate that my emission family complies with evaporative emission standards?

There are 2 methods of showing compliance

Provide test data

Design based compliance. Use of materials and designs as specified by the EPA to meet the regulatory limits.

§1060.525 How do I test fuel systems for diurnal emissions if I do not use a design based certification?

SHED testing

For detailed information, see actual regulation wording at:

http://www.epa.gov/otaq/marinesi.htm

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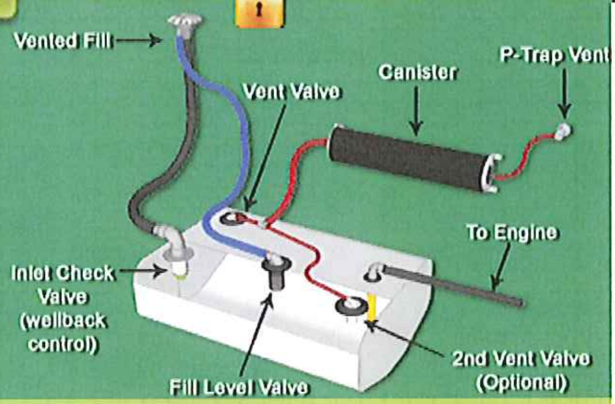


Overview | System Partner | Component Suppliers | System Design | Component Parts | Regulations | Installation | NMMA Testing Program

SYSTEM DESIGN

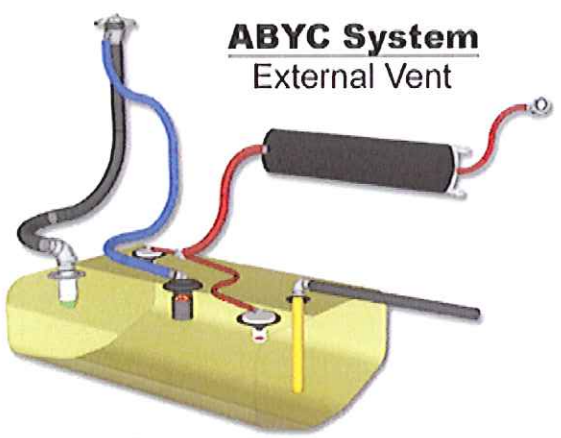
Canisters	Fills	Vents & Loops	Valves	Wellback & Spitback	Typical Systems

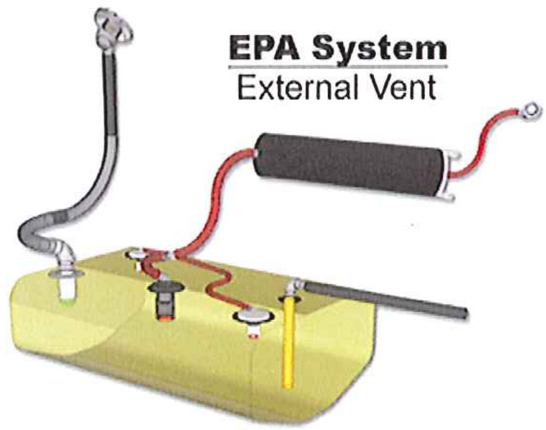
Overview

With government regulations now affecting system designers' thinking, fuel systems will become more complex. The Environmental Protection Agency (EPA) and the California Air Research Board (CARB) have both imposed requirements that directly impact design. They begin to affect boats built for the 2012 model year. It has become even more important now for boat builders to consider fuel system design early in their overall boat design process.

The EPA and CARB rules are not identical. In general, a boat meeting CARB requirements meets EPA requirements. But the reverse is not necessarily true. To avoid the limitations on where a boat can be sold, most builders will build in accordance with CARB rules. The American Boat and Yacht Council (ABYC) and the National Marine Manufacturers' Association (NMMA) are working together with industry volunteers to develop industry standards covering the installation and performance of these new fuel systems. It is expected that these standards will be based on CARB rules.

From the component standpoint, the primary difference between the CARB and the EPA versions involves whether or not to capture vapors generated during refueling through the pump nozzle. CARB (at least until 2020) requires it. EPA doesn't, but accepts certain CARB systems as meeting EPA requirements. Vented fills (with sealed caps) offer builders a way to comply with both. Such systems involve two independent vent lines. A high volume vent line is directed to a vented fill where refueling vapors are delivered to the pump. After refueling, a cap on the fill seals both the line and the fill pipe from the atmosphere. A second low volume line then channels vapor and make up air through a canister. Pressure relief systems work the same way but without the canister.





Working together, the NMMA and the ABYC have proposed an industry specification for installing carbon canisters and pressure relief systems, which the EPA and CARB have accepted. The actual, detailed specification is in development. Builders will be asked to demonstrate that their products are built in accordance with these specifications in order to obtain NMMA certification. This will demonstrate to the EPA & CARB that a boat is in compliance. Representatives from boat & engine builders, tank, fill, valve and canister manufacturers, test labs and the U.S. Coast Guard are among the authors of the new specifications. The plan is to have a draft available for review by the end of September with final approval scheduled before the end of 2009.

Early indications are that the specification will call for compliance with the CARB rules and automatic shut off at the pumps. It also appears that there will be a requirement that boat builders demonstrate that the fuel system of each boat they manufacture can be refueled at a rate of at least 14 gallons per minute without spitback, wellback or numerous premature pump shut offs. Most marine fuel systems will require rework to do this as well as to comply with the other components of the new rules. There are numerous additional issues designers may want to address with solutions possibly differing with each system.

In systems using canisters, regulations require that steps be taken to assure that water and liquid fuel do not enter the canister. Options include a means of preventing tanks from overfilling (i.e. maintaining 5% to 10% empty space), which reduces (but may not eliminate) the chances of raw fuel entering canisters and/or forcing its way back up fill tubes. Designers can consider several new components and/or design features into these new systems to aid in addressing these issues:

- Carbon Canisters
- Tank Vent Valves (TVV)
- Fuel Level Vent Valves (FLVV)
- Inverted Loops
- Inlet (i.e. fill pipe) check valves (ICV)

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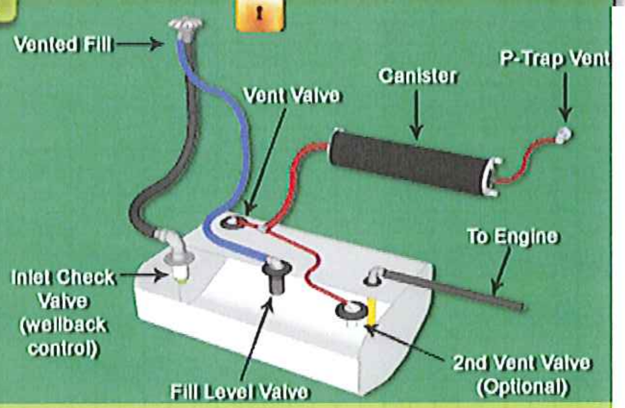

Overview | System Partner | Component Suppliers | System Design | Component Parts | Regulations | Installation | NMMA Testing Program

SYSTEM DESIGN

Canisters | Fills | Vents & Loops | Valves | Wellback & Spitback | Typical Systems

Canisters

Carbon canisters have been used in automotive applications for decades. They filter hydrocarbons out of fumes vented during thermal expansion and/or refueling of tanks. Canisters are then purged when fresh air is drawn into the tank during thermal contraction or while the engine is running. By regulation, canisters must be protected from water and raw fuel. Both reduce their efficiency. Canister sizing is dictated by both boat and tank size.

Fig. 0485015 Marine Canister

Fig. 0485H15 Marine Canister with heatshield attached

Trailerable

Canister (Liters)	Tank (Gallons)
1.0	25
1.5	37
2.0	50
3.0	75
4.0	100

LitersCC=0.04x Fuel Tank

Non-Trailerable

Canister (Liters)	Tank (Gallons)
1.0	62
1.5	93
2.0	125
3.0	187
4.0	250

Formula (round up to the next largest size)
LitersCC=0.016x Fuel Tank

For **trailerable boats** the canister size in liters = .04 x Fuel tank capacity in gallons. (Trailerable is boat length less than 26 ft. and width less than 8.5 ft)

Example - an 18 foot boat with a 25 gallon tank would require a canister of .04 x 25 = 1.0 liters.

For **non-trailerable** boats the canister size in liters = .016 x Fuel tank capacity in gallons.

Example - a 30 foot boat with a 250 gallon tank would require a canister of .016 x 250 = 4.0 liters.

Trailerable Boats

Non-Trailerable Boats

Note: Non-trailerable is defined as boat length equal to or greater than 26 ft. or width equal to or greater than 8.5 ft.

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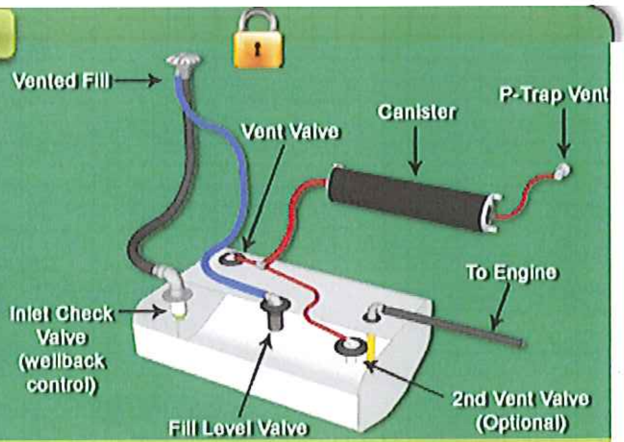

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Fuel Fills

The new requirements will cause changes in most current fuel fills. If the fill used in the system must be sealed when closed to assure that vapors to not escape into the atmosphere, it must provide a means of indicating that it has been properly closed. This can be an audible clicking type noise or some sort of visual indication. Most fill manufacturers are in the process of designing new fills or altering existing ones to meet these requirements.

In general, builders building to CARB requirements will be looking for vented fills with sealed caps. These devices permit fumer generated while refueling to be pulled by vacumm into the pump . Then, when refueling is completed, these fills close. Fumes are then either forced through a canister or build up to 1.25 psi (in a pressure releif system) before venting through a pressure releif valve into the atmosphere.

Builders building to EPA regulations can look for totally sealed or vented fills, providing the venting vapors have first passed through a canister or pressure releif valve.

Fig. 0540

Fig. 0520

Fig. 1319

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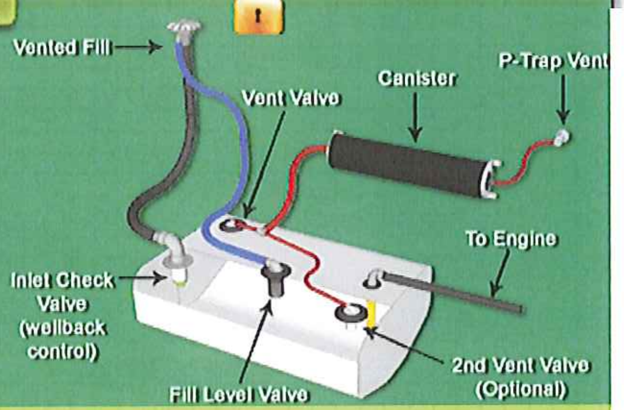


SYSTEM DESIGN

Vents & Loops

In current systems it only makes sense to try to keep water from entering the fuel tank via the vent. If a large amount of water accumulates in the bottom of a tank, it can eventually find its way into an engine causing damage. But small quantities of water are often tolerated. With the new regulation, steps must be taken to keep any water from getting into canisters. So the effort will have to become a more diligent, proactive one for most designers. There are 3 basic options available.

1. **INVERTED LOOPS**

   These methodologies and/or devices use gravity to help keep water from entering canisters. In their simplest form, they are a loop formed intentionally in the vent line immediately above the connection to the external vent. Gravity prevents any water entering the vent from flowing upwards and forces it back out the vent. Vents with integral 90° bends installed pointing upwards offer an easy and inexpensive way to address this issue.

2. **P-TRAPS**

   Like inverted loops, these devices use gravity, along with complex water channels, to prevent water from entering the system. Used in conjunction with vents designed with deflectors, they offer an effective, space saving method of keeping liquid water out of canisters.

3. **SPECIALIZED VENTS**

   These devices are essentially conventional vents with P-traps and/or deflector plates build into them as single thru-hull devices.

4. **SEPERATORS**

   These devices can differentiate between water and vapor. They allow vapor to pass and channel water away from the tank or canister. They are usually more expensive and often require regular maintenance.

Canisters	Fills	Vents & Loops	Valves	Wellback & Spitback	Typical Systems

Tank Vent Valves - (tvv)

These valves remain open in the presence of fumes allowing vapors to enter and exit the tank freely. They automatically close to prevent liquid fuel from leaving the tank. The orifice in these valves is sufficient to provide normal running or contraction/expansion venting needs but insufficient to adequately vent vapors created during refueling. Thus, they can help prevent overfilling when used in combination with other products. Pressure relief control options are also available in these valves.

Figure No. 0536F00 - Flanged Tank Vent Valve

Fuel Level Vent Valves - (flvv)

Like tank vent valves, these valves remain open in the presence of fumes allowing vapors to enter and exit the tank freely. They automatically close to prevent liquid fuel from leaving the tank. The orifice in these valves is large enough to adequately vent tanks during refueling. These valves can be set to close when fuel reaches a predetermined level. Thus, tank refueling valves can help prevent overfilling when used in combination with other products.

Figure No. 0529F00 - Flanged Refueling Vent Valve

Inlet Check Valves - (icv)

These normally closed valves open automatically to allow fuel to enter the tank via the fill pipe and then close to prevent fuel from pushing back up the fill tube and out the fill during refueling operations. Used in combination with other control devices on tanks, these valves can help prevent spill back.

Figure No. 0472000 - In-line Fuel Pipe Check Valve

Pressure Relief Valves

Most pressure relief valves are normally closed. They are set to open automatically when a predetermined pressure level is reached. The tolerance requirements on the accuracy of opening at the correct pressure can affect the cost of the valve with tighter tolerances resulting in increasingly more expensive valves. Pressure relief valves can be mounted directly onto the tank, installed as in-line valves in a section of hose or even built right into a fuel cap. A pressure relief feature can also be built into a normally open valve. Such a valve that happened to be closed because of fluid contact would see the pressure relief feature override the fluid contact and open the valve in cases of excess pressure.

Figure No. 0536P00 - Tank Vent Valve with optional pressure relief

Float Check Valves

These are simple (typically 2-piece) float valves, normally installed vertically in the vent line, that prevent water from entering the system. They are perhaps the most effective method of preventing water infringement but must be placed above the vent to avoid trapping water in the line making the availability of space a common problem with their use. Some versions have a small hole to relieve any pressure buildup making them more of a surge protector than a float check valve.

Anti-siphon Valves

Depending on the position of the fuel tank relative to the engine, the USCG requires the use of anti-siphon valves in the fuel (to engine or generator) supply lines. In the event of a break in the fuel line, these valves prevent the fuel in the tank from being siphoned out of the tank and into the boat. In pressure relief systems these valves become more important and more complex. Since tanks will be pressurized, all tanks will need these valves, not just those with downward sloping fuel lines. In addition, set pressures must be much higher than with current valves.

Wellback & Spitback

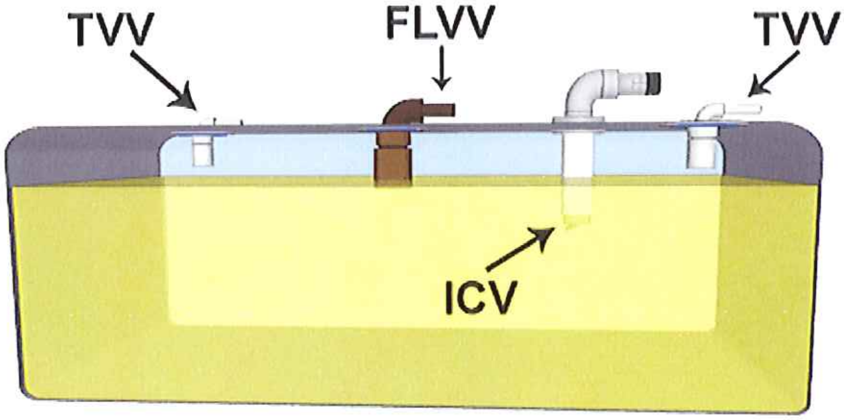
During refueling there are instances when the fuel entering the filler pipe is not contained properly and may quickly come back at the operator. The main instances of this phenomena are generally known as wellback or spitback.

- **SPITBACK**

  This is generally identified when during initiation of the refueling event the fuel instantly comes back at the operator. The cause is most often a venting issue or improper filler tube design which does not allow proper fuel flow from the filler nozzle, the main identifying feature being the instantaneous ejection of the fluid.

- **WELLBACK**

  Occurs when upon completion of refueling the ICV does not close fast enough thus allowing a wave of fuel to rush out of the filler neck. There is generally a small pause between the filler nozzle stopping and the fuel flowing from the filler neck, the main identifying feature being the short pause before the flow from the filler neck. The flow is often characterized as gurgling, bubbling or foaming due to the pressure build up.



Canisters	Fills	Vents & Loops	Valves	Wellback & Spitback	Typical Systems

Typical Systems

EPA System

Click image to enlarge

Note: Refueling vapors vent through the canister while refueling. Fill is conventional (non-venting)

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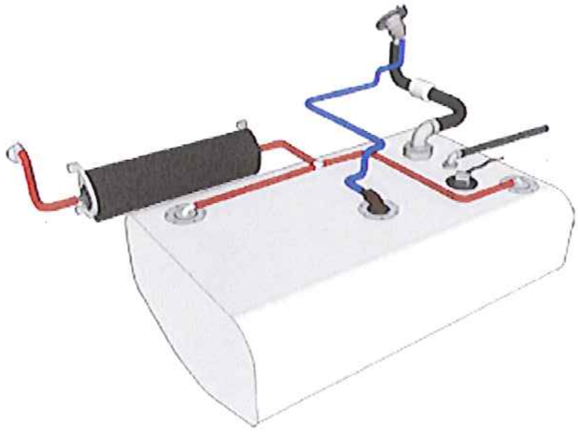
CARB System

Click image to enlarge

Note: Refueling vapors bypass canister and vent through a vented fill to the fuel pump. This line is then closed with a sealed cap after refueling and diurnal vapors forced through the canister.



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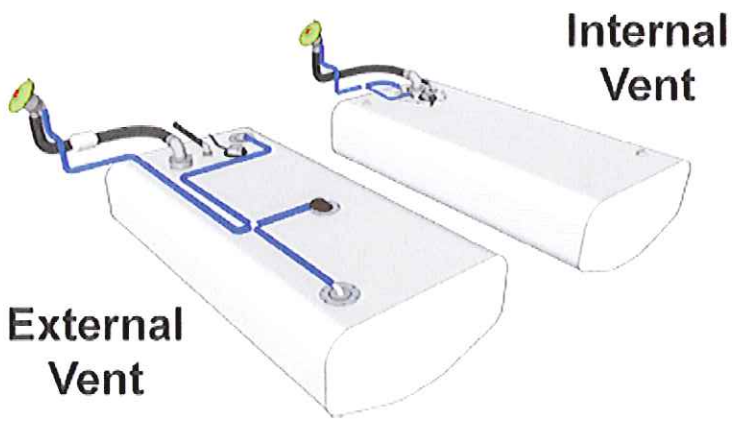
Pressurized System

Click image to enlarge

Sketch below shows pressure relief valve built into fuel cap. This valve can be placed elsewhere in the system as long as a means of relieving pressure from the tank is provided prior to attempting to refuel.



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NMMA Summer 2005 Canister Test

- DELPHI Canisters were added to 14 various size boats to determine if the addition of a carbon canister would cause any issues.
- The canisters were on the boats for one summer boating season.
- The EPA requirement is for the canister to have an efficiency of 50%. (capture 50% of the hydrocarbon going into the canister).

DELPHI

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Test Boats

14 Boats In-Service (Sorted by Canister Size)

1. Four Winns 17' Open Bow 24 gallon Delphi 1.0L
2. Four Winns 18' Open Bow 32 gallon Delphi 1.0L
3. Crestliner 17' Open Boat 24 gallon Delphi 1.0L
4. Crestliner 18' Open Boat 31 gallon Delphi 1.0L
5. Crestliner 23' Pontoon 25 gallon Delphi 1.0L
6. Crestliner 23' Pontoon 25 gallon Delphi 1.0L
7. Four Winns 19' Open Bow 50 gallon Delphi 1.5L
8. Four Winns 21' Open Bow 50 gallon Delphi 1.5L
9. Four Winns 27' Cruiser 85 gallon Delphi 2.5L
10. Century 26' Sportfisherman 150 gallon Delphi 4.0L
11. Century 26' Off Shore 150 gallon Delphi 4.0L
12. Grady White 23' Off Shore 150 gallon Delphi 4.0L
13. Grady White 30' Off Shore (2) 150 gallon Delphi 4.0L (1 tank fitted with canister, 1 tank was not modified to be used as a control)
14. Century 29' Sportfisherman 300 gallon Delphi (2) 3.5 L (in series)

DELPHI

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Typical Installation for Test program

Inverted loop prevents water from entering canister

Fuel vapor separator prevents liquid fuel from entering the canister

The canister was protected from fuel slosh and from water splash. Note: This alone will not be a production solution. A 5% vapor space must be maintained in fuel tank to allow for thermal expansion of the fuel.

DELPHI

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Canister Efficiency

- **Canister Efficiency** – The mass of hydrocarbons that the Test Canister holds divided by the total amount of hydrocarbons sent to the Test + Slave Canister times 100.

$$\left(\Delta M_{TC} \big/ \Delta M_{TC} + \Delta M_{SC} \right) \times 100$$

DELPHI

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Canister Efficiency Testing

The marine canister must demonstrate a minimum of 50% efficiency when tested per the following procedure:

- Use nominal carbon BWC (e.g. 9.2 BWC-9.3 BWC), nominal carbon fill, nominal canister housing.
- Stabilize the canister by loading to a 2 gram breakthrough with a 50/50 mixture of butane/nitrogen for a minimum of 10 cycles. The load rate shall be 15 grams/hour followed by a 100 bed volume purge at 22.7 L/min.
- Weigh test canister and a purged slave canister which is used to measure test canister breakthrough amount.
- Connect test canister vapor inlet tube to fuel tank of proper volume for canister size (1 liter of canister volume for every 25 gal. of fuel tank volume). Fuel tank should be 40% full of 9 RVP test fuel.
- Connect air inlet of test canister to a purged slave canister.
- Place fuel tank, test canister, and slave canister inside a variable temperature chamber.
- Temperature cycle the chamber from 72-96-72°F per the EPA diurnal temperature profile.
- Measure the weight gain of the test canister and the slave canister after the chamber has been heating for 12 hours.
- Disconnect the slave canister from the test canister for the cool down portion of the diurnal. This allows the test canister to be passively purged by the fuel tank. Purge the slave canister for 300 bed volumes at 22.7 L/min. to prepare it for next day. Re-weigh slave canister after purge.
- Repeat steps 4 through 8 for a total of 5 days.
- Calculate test canister efficiency for the 5th day.
- Canister efficiency % =

$$\left(\Delta M_{TC} \big/ \Delta M_{TC} + \Delta M_{SC} \right) \times 100$$

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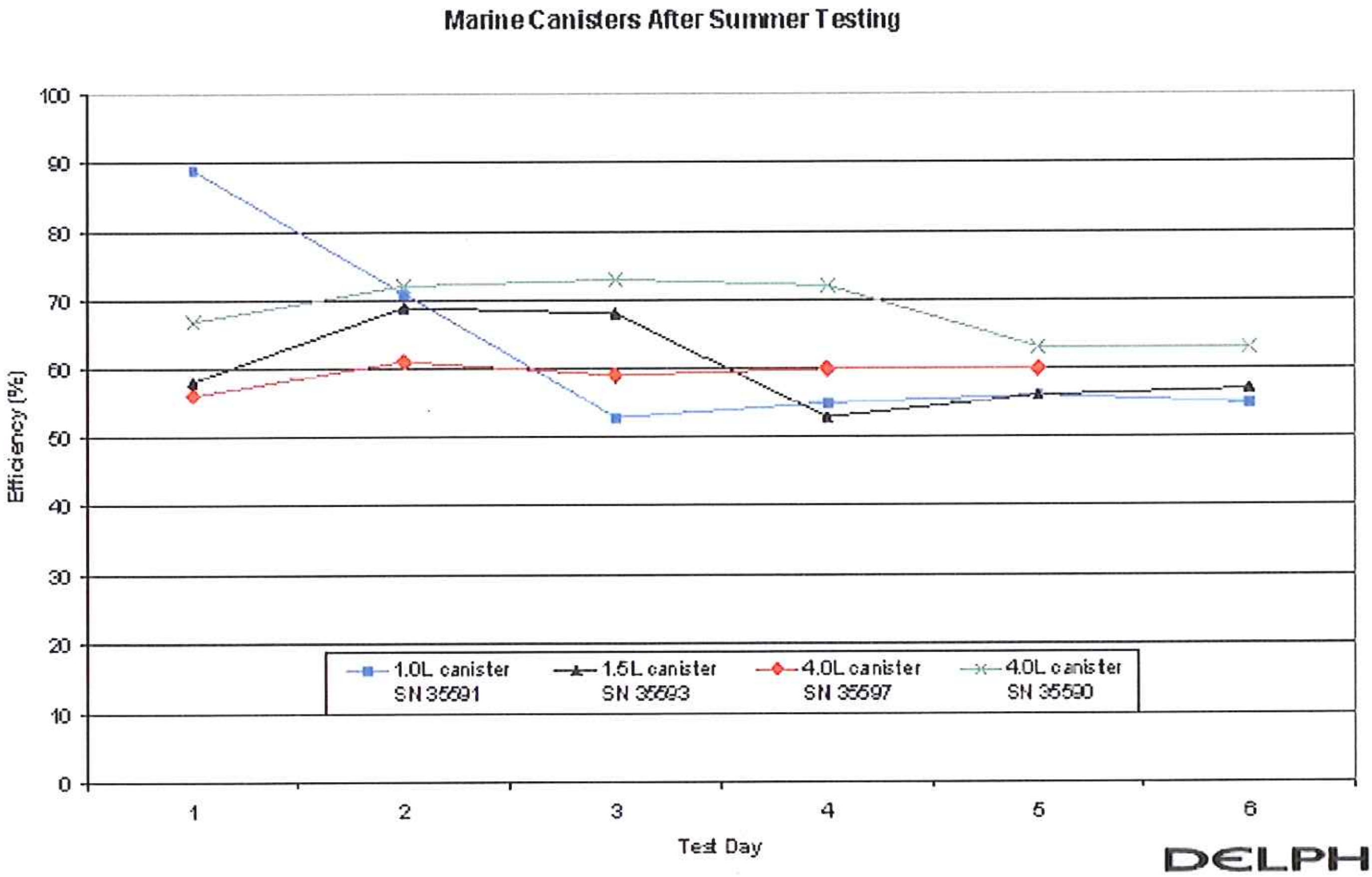
Efficiency Results



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Summary

- The canister efficiency at the end of testing met the EPA requirement of 50%.
- Refueling rates were not affected.

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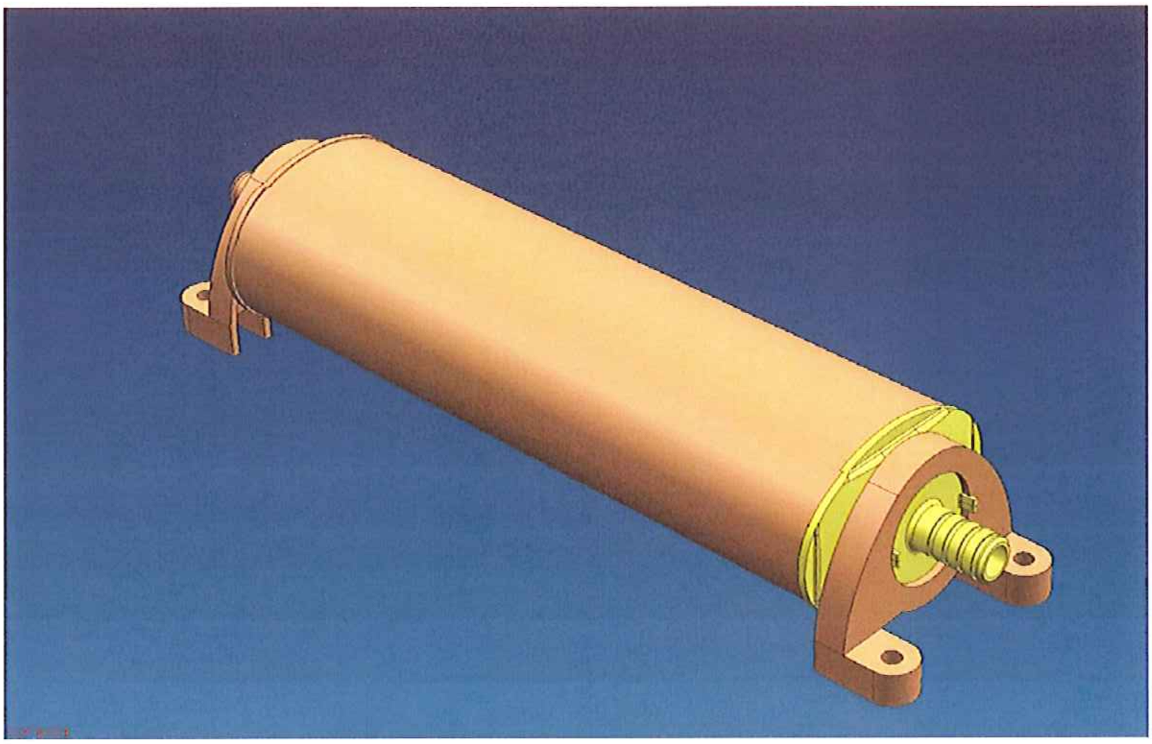
Emission-related installation instructions

Failing to follow these instructions when installing the evaporative emissions canister in a piece of nonroad equipment violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act

Marine Evaporative Emissions Canister Installation Guidelines



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Location

The canister can be mounted in any location that the current vent line is located. The canister is installed between the fuel tank vent fitting and the fresh air vent fitting. The canister must be mounted above the highest point of the fuel tank. Thought must be given to the following when choosing a location:

- The hose connections to the canister must be accessible for inspection and service.
- The canister should not be mounted in a location where it will be stepped on or otherwise have a force exerted upon it.
- The canister is designed to withstand a temperature of 115°C continuously. Short term excursions (15 minutes) to 125°C is acceptable
- The canister can be mounted in any orientation
- If mounted in the engine compartment, the canister must have a heat shield (this is an optional component that will be integral to the canister).

System Requirements

The fuel tank vent system must be designed in such a way that liquid fuel is not passed through the vent line and into the canister. The vent system must also prevent the intake of water into the vent system and into the canister. These are requirements of the EPA regulation. When designing your fuel system you must also consider fuel expansion and situations such as storage of the vessel with a full tank on an incline.

Mounting of the Canister

The canister (with the bracket) is designed to be mounted with (4) # 10 screws or 3/16" bolt. This is the setup that has been validated to ABYC standards. If the end user chooses to mount the canister in some other fashion, they are responsible for the validation of the mounting. Please note that the canister has an internal plate and spring that must be able to move inside the body of the canister. For this reason any mounting mechanism must not constrain the body for 25 mm from either end of the canister body.

Connection of the Vent Line to the Canister

The vent hose must be anchored to the boat structure within 6 inches of the canister fittings. The vent hose must be routed to prevent a load from being exerted onto the canister fittings.

The hose clamp must be a minimum of 3/8" wide. The clamp must not distort the fitting on the canister when tightened.

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Revisions:

Rev .2 Date 5/27/08 added Note in mounting that body can not be restrained for 25 mm from either end.

Rev. .3 Date 5/28/08 Added canister to be mounted between fuel tank and fresh air vent and above highest point of tank.

Rev .4 Date 5/28/08 Replaced torque requirement with "clamp must not distort fitting"

Rev 1.0 Date 2/4/09 "emission related component" statements per EPA requirement