MERCURY MerCruiser service bulletin

No. 99-7

☐ WARRANTY INFORMATION ☑ SERVICE INFORMATION

▲ = Revised November 2001

Gasoline Engine Vapor Locking

Models

All Mercury MerCruiser 4 Cylinder, V6 and V8 engines.

Situation

Under certain conditions, engines may experience a 'vapor lock' condition. The three most common complaints that vapor locking cause are:

1. The engine starts. When the throttle is advanced, the engine quits running and will not restart.
2. If the engine does restart, it quits when advancing the throttle to get the boat up on plane or to pull up a water skier.
3. After running the boat and shutting the engine off for 1 to 3 hours, the engine does not want to restart.

Conditions That Affect Vapor Locking

Fuels containing alcohol and 'winter grade' fuels will cause vapor locking complaints to increase.

NOTE: *The new 'Reformulated' fuels have the RVP (Reid Vapor Pressure) very carefully controlled.*

It will normally take several following conditions to make an engine 'vapor lock'. These conditions include but are not limited to:

1. Type, formulation and RVP of the gasoline in the boat's fuel tank or sold in the area. 'Winter grade' fuels sold from October through March in most areas have the highest RVP.
2. Engine compartment air temperature and its ventilation system.
3. Temperature and vacuum on the fuel that is being delivered to the engine.
4. The location of the fuel tank.

Printed in U.S.A. - © 2001, Mercury Marine
provided by http://www.crowleymarine.com

5. The boat's fuel supply system. This includes Inside Diameter (ID) of fuel line and fittings, fuel line length, routing, bends or kinks and the clamps that secure it. Extra fuel filters, fuel manifolds, anti-siphon valves, shut off valves, tank selector valves and the number of 90 degree fittings used.
6. Engine coolant temperature.
7. How quickly the engine is shut off after running at cruising or higher rpms and how long the engine and engine compartment are allowed to cool off after use.
8. The outside air temperature on the day the boat is being operated.

Corrections That Can Be Done To Help Minimize Vapor Locking

Before looking at the customer's problem as a vapor locking condition, make sure something else is not causing the running problem.

▲Air leak in the engine or boat fuel system. Check the tightness of all fuel fittings and clamps. Check for a cracked housing where a brass fuel fitting is threaded in it.

IMPORTANT: ▲Do not pressurize the boat's fuel tank(s) in this test.

▲Disconnect the fuel line from fuel tank(s). Pressurize the fuel system that goes to the engine to 8 psi (55 kPa) with a hand pump to see if it holds this pressure. Often systems will leak air but not fuel. Always use a wrench to hold a brass fitting that is threaded into an aluminum casting when tightening another fitting threaded into it to prevent the casting from cracking.

Check the complete fuel supply system of the boat for a fuel restriction. Include the brass fitting threaded into the engine's inlet in this test. Use a portable outboard fuel tank connected directly to the engine's fuel inlet fitting as a quick way to test the system.

If these more common problems are not causing the complaint, then continue.

1. Follow instructions below:
   a. Find out what type of fuel is in the boat's fuel tank. Fuels containing alcohol are more likely to vapor lock on hot days.
   b. Find out what the RVP of the fuel in the boat's fuel tank is. 11 to 15 RVP (cool to cold weather) fuel will change from liquid to a vapor at lower fuel temperature than 8 to 10 RVP (warm to hot weather) fuel will. Refilling the boat's fuel tank with lower RVP fuel will decrease the chance of vapor locking. Fuels purchased in most areas of the USA from late September through early April will cause most of the problems.
2. Follow instructions below:
   a. Over the last several years, engine compartments have been designed to be quieter. This is done by using an insulation material and by making 'engine covers' tighter. This can cause high air temperature inside the engine compartment while the engine is operating and for a period of time after it is shut off. This period of time is called the 'heat soak' time. The air temperature inside the engine compartment during a 'heat soak' will rise higher than during the engine's 'running time'. This is because there is no air movement inside the compartment and no coolant flow through the engine. Normally, the quieter the engine compartment is, the hotter the air temperature will be on the inside during the 'heat soak'. The highest air temperatures during a 'heat soak' will occur 30-40 minutes after the engine is shut off and can stay at that peak for up to 1-1/2 hours. This greatly increases the chances of vapor locking.

provided by http://www.crowleymarine.com

b. Mercury MerCruiser engine compartment air temperature specification that became effective January 1, 1996 is:

   Under the hottest outside air temperature condition that the boat will be operated in, the maximum air temperature inside the engine compartment, measured at the flame arrestor, shall not exceed 176° F (80° C).

c. Increasing engine compartment ventilation to move the hot air out of it during a 'heat soak' will decrease vapor locking. Other items that can help reduce vapor locking are:

   Letting an engine idle for 3-5 minutes before shutting it off.

   Open the engine cover to let the hot air escape.

   Operate the bilge blower to remove the hot air.

3. Follow instructions below:

   a. Fuel temperature (at the engine's fuel inlet fitting) and the amount of vacuum required by the fuel pump to draw the fuel from the boat's fuel tank can contribute to vapor locking.

      Mercury MerCruiser's maximum engine fuel temperature specification that became effective January 1, 1996 is:

      Under the hottest outside air temperature condition that the boat will be operated in, the temperature of the fuel being supplied to the engine shall not exceed 110° F (43° C) at any location between the fuel tank and the engine's fuel pump.

      Mercury MerCruiser's specification for the maximum vacuum measured at the fuel inlet of any MerCruiser engine is:

      2 in. Hg (7 kPa) maximum at idle rpm, 3000, full throttle and back at idle rpm.

      Use an accurate digital vacuum gauge that reads in either in. Hg (inches of mercury) or (kPa) to check this specification. Common vacuum gauges to check an engine intake manifold vacuum are not accurate enough to make this type of measurement.

   b. Reducing the temperature and maximum vacuum of the fuel being supplied to the engine will help reduce vapor locking problems.

NOTE: *Carbureted and EFI/MPI with VST models only: The Water Separating Fuel Filter can be removed from the engine to a lower, cooler location. Use a Coast Guard approved fuel line between the filter and the fuel pump.*

4. Check to see if the fuel tank is in an area where engine compartment heat or sun can preheat the fuel that is in the fuel tank. Putting insulation between the fuel tank and the heat source can help keep the fuel cooler.

provided by http://www.crowleymarine.com

5. Follow instructions below:
   a. The fuel supply system can be a major cause of vapor locking. Remove all kinks in any of the fuel lines. Move the fuel line to be as close to the bottom of the boat as possible to keep it in the coolest area of the engine compartment. Replace clamps used to support the fuel line with larger clamps if the fuel line is being pinched or constricted with the current clamp.
   b. Reduce the total length of the fuel line to be as short as possible. Eliminate or reduce the number of 90 degree fittings used in the system to no more than 2.
   c. Any anti-siphon valve or restriction that causes a higher than specified vacuum reading can contribute to vapor locking and other driveability problems. If the vacuum reading is too high, try a less restrictive anti-siphon valve or the Electric Anti-Siphon Valve Kit.

NOTE: *An engine that has a vapor locking condition may show a very low vacuum reading. This could be a false reading because vapor can give a very low vacuum reading. Check the inlet fuel line to ensure that a good solid flow of fuel is in the line instead of a mixture of fuel and vapors. As a test only, use a clear plastic hose between the engine and the supply line to look at the fuel flow visually.*

   d. Going to the next larger Inside Diameter (ID) fuel line and fittings can help lower the vacuum and help correct vapor locking conditions. An example is shown below.

5/16 in. (8 mm) fuel line and fittings ID	5.5 in. Hg (17.8 kPa), too high.
3/8 in. (9.5 mm) fuel line and fittings ID	2.5 in. Hg (8.2 kPa), too high.
½ in. (12.5 mm) fuel line and fittings ID	0.8 in. Hg (2.7 kPa), good.

NOTE: *Engines with 3/8 in. (9.5 mm) ID fuel line and 15 ft (4.5 m) total length or less: Going to a ½ in. (12.5 mm) ID fuel line will not give much improvement. Fuel systems longer than 15 ft (4.5 m) may see an improvement by going to ½ in. (12.5 mm) fuel line and fittings.*

   e. Mount fuel manifolds as low as possible in the engine compartment to lower the fuel temperature or remove them if possible.

6. Follow instructions below:
   a. Make sure that the engine has the correct degree thermostat in it. Replace with the correct one.
   b. Keep fuel lines as far away from engine cooling hoses as possible.

provided by http://www.crowleymarine.com

c. EFI and MPI engines with the ‘Cool Fuel’ system should have the fuel cooler temperature measured after the engine is shut off. The coolant hose going to the ‘fuel cooler’ should not get much hotter to the touch after the engine is shut off for 10-20 minutes than what it is with the engine running. If it gets hot after the engine is shut off, hot water from the cylinder block might be siphoning back. Installing the Check Valve Kit will stop this backward water flow.

NOTE: *On inboard engines with water cooled prop shaft seals, make sure the water tap for this seal is not causing the siphoning. The only approved location from Mercury MerCruiser for this water supply is the raw water hose that goes to the 90-degree fitting (with Blue drain plug) in the bottom of the port exhaust manifold.*

7. How quickly the engine is shut off after running at cruising or higher rpms and how long the engine and engine compartment are allowed to cool off after use can greatly affect vapor locking. To help the boat owner reduce their chances of vapor locking, suggest that they do the items listed under 2c.
8. Nothing can be done about the air temperature the boat is being operated in. By following suggestions outlined in 1 through 7, the causes for most vapor locking complaints can be greatly reduced.
9. If all suggestions 1 through 7 have been done and engine still does not restart after it is shut off, the Fuel Pump Kit can be used. This kit will help a vapor locked engine to restart. IT DOES NOT CURE VAPOR LOCKING! The engine may still bog on acceleration. Kit contains a low pressure electric fuel pump, Check Valve Kit and installation instructions. This low pressure fuel pump helps feed fuel to the pump in the cool fuel system.

NOTE: *If the items in this Service Bulletin are not checked and corrected before putting the Fuel Pump Kit on, the kit might not correct the restarting of the vapor locked engine.*

Kit Part Numbers

P/N 21-862271A 1	Check Valve Kit.
P/N 862733A 1	Electric Anti–Siphon Valve Kit.
P/N 862264A 3	Fuel Pump Kit, (contains Check Valve Kit).

Test Equipment

Following is a list of equipment that can be used to testing.

Testing Fuel RVP:

SPX OTC sells a test kit, Gasoline Quality Testing Kit - P/N 7670.

provided by http://www.crowleymarine.com

Testing Fuel Temperature or Vacuum:

Fittings required to make connections between engine fuel inlet and the boat's fuel line and fitting.

(1) Pipe Fitting - ¼ in. pipe thread at both ends, 1-1/2 in. (38 mm) long.

(1) Tee Fitting - ¼ in. female pipe thread.

(1) Schrader Valve - P/N 22-805408.

(1) Cap, Schrader Valve - P/N 22-805515.

Tools required to measure fuel vacuum at fuel inlet of the engine.

(1) Digital Compound Gauge, that has an accuracy of within 2% of the reading. Cole-Parmer P/N P-68950-00. (Note 1)

(1) Gauge Guard (30 in. Hg to 15 psi). Cole-Parmer P/N U-07359-02. (Note 1)

(1) Gauge Guard Liquid (4 fl oz). Cole-Parmer P/N U-07359-50. (Note 2)

(1) Hose connected to digital gauge with adaptor to connect to the Schrader valve. Can use hose and Schrader valve connector from Fuel Pressure Kit, P/N 91-881833A 2.

Tools required to measure fuel temperature at fuel inlet of the engine.

(1) DMT 2000 Meter - P/N 91-854009A 3.

(1) Reducer Bushing - ¼ in. male to 1/8 in. female pipe thread - P/N 22-48556.

(1) Temp Probe Compression Fitting - 1/8 in. pipe thread. Cole-Parmer P/N H-08539-04.

(1) Temp Probe - 4 in. long with K connector. Cole-Parmer P/N P-08117-45.

(1) Temp Probe Extension Cable - 10 ft long with K connector. Cole-Parmer P/N H-08516-30.

Cole-Parmer Instrument Company

Phone: 847.549.7600 or 800.323.4340.

Fax: 847.247.2929 International Fax: 847.549.1700.

NOTE: *1. The Gauge Guard has to be used with the gauge listed to protect it from liquid gasoline or vapors. Failure to use the Gauge Guard will damage the gauge. When using the Guard, the maximum range that can be applied to this Guard installed on the Gauge is 30 in. Hg to 15 psi.*

NOTE: *2. The Gauge Guard Liquid has to be filled under a vacuum. You have to pull a vacuum through the diaphragm seal with a vacuum pump and fill the Guard through fill port on the side. Failure to do this will cause an incorrect gauge reading.*

provided by http://www.crowleymarine.com