

Exhaust System

Section 6D - Testing the Exhaust System

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Testing the Exhaust System

Through-Transom Exhaust Back Pressure

IMPORTANT: Mercury MerCruiser recommends checking the exhaust back pressure on all new applications with through-transom or through-hull exhaust to ensure that it is within specifications.

All exhaust systems have some restriction to flow or exhaust back pressure. The power output of an engine is directly related to the amount of exhaust that can flow out of the exhaust system. For example, large displacement engines will generally lose approximately 10 horsepower for the first 7 kPa (1 psi) of exhaust back pressure. For every additional 7 kPa (1 psi) of back pressure, an engine may lose approximately 5 horsepower. Back pressure at WOT must fall within the range shown below.

Models	Exhaust Back Pressure
All gasoline powered engines	1 psi (7 kPa) Minimum
	2 psi (14 kPa) Optimal
	11 psi (76 kPa) Maximum

IMPORTANT: Some exhaust back pressure is required to prevent water intrusion in the exhaust system. Do not use more than a 10.2 cm (4 in.) inside diameter exhaust hose within the first 45.7 cm (18 in.) of each exhaust elbow.

A higher output engine will cause a greater back pressure using the same size exhaust system as an engine with less output. The boat's exhaust system should be designed and tested for the highest horsepower engine to be offered in that boat.

Ensure that both cylinder banks of any engine are tested. Record the highest and lowest back pressure readings. If pressure is out of specifications, changes must be made to the system to reduce the pressure. These changes include:

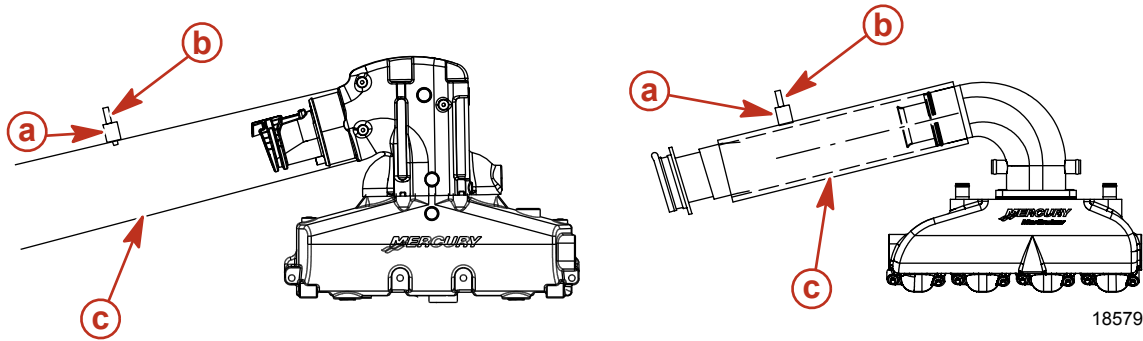
- Reduce exhaust system length.
- Eliminate sharp bends.
- Increase exhaust system diameter.
- Reduce muffler restriction.
- Ensure that through the transom or through the hull fittings are above water and are not restrictive while retaining internal and external flappers.

Exhaust Back Pressure Test

The boat should be in the water and underway for this test. No special loading of the boat is necessary. The engine must be capable of reaching the specified WOT RPM as verified using an accurate service tachometer or scan tool. Test both banks of each engine. Use the highest reading.

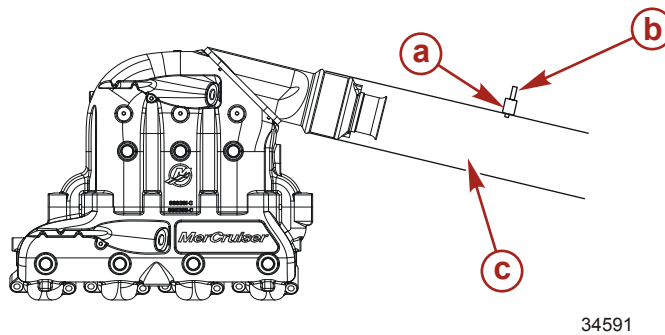
1. Drill 3/8 in. hole at the 12 o'clock position (facing up) in the exhaust hose 31–61 cm (12–24) inches from the engine exhaust elbow.

- Assemble the Schraeder valve and brass adapter. Insert the 1/8 in. NPT male end of adapter into the hole in the exhaust hose.

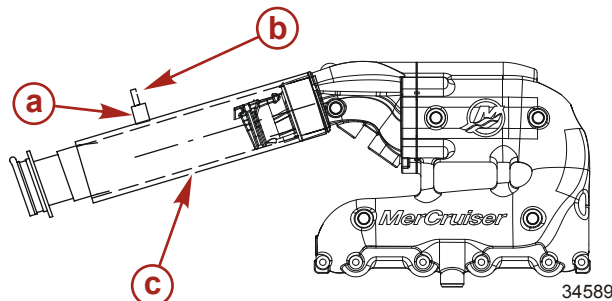


- a** - Brass adapter
- b** - Schraeder valve
- c** - Exhaust hose

For Products with Emissions Control



- a** - Brass adapter
- b** - Schraeder valve
- c** - Exhaust hose



- a** - Brass adapter
- b** - Schraeder valve
- c** - Exhaust hose

Description	Part Number
Drill and 3/8 in. drill bits or bit that match fittings	Obtain locally
Service Tachometer	Obtain locally
Schraeder valve, 2 required	22-860226
Brass 1/8 in. NPT male adapter fitting - 2 required	22-808002
Pressure gauge accurate to 7 kPa (1 psi)	Obtain locally

Testing the Exhaust System

3. Set the pressure gauge to zero before connecting it to the engine.
4. While underway, operate the engine at 1000, 2000, 3000, 4000, and WOT RPM respectively. Record back pressure at each setting.
5. Repeat steps for the second cylinder bank and remaining engines on multiple engine applications.
6. Replace exhaust hoses.

If pressure is not within specification, make appropriate changes to the system to reduce the pressure.

Check for Water Intrusion

IMPORTANT: Perform this check on all new applications with through-transom or through-hull exhaust.

Select and perform one of the two methods to check for water in the exhaust manifolds.

- **The exhaust elbow removal method**—This is the simplest and least time-consuming method to check for water in the exhaust manifolds, but it is also the least accurate.
- **The exhaust manifold tap method**—This test provides more accurate results, but requires that a hole be drilled in each manifold. The manifolds must be replaced after performing this check, so the procedure is best performed by Mercury MerCruiser's product integration engineer or where repeated testing will be performed at your facility.

IMPORTANT: If there is no water in one manifold, do not assume that there is not water in the other manifold. Check each manifold.

PREPARATION

Consider hose lengths and angle, exhaust elbow height to the water line, waterlift muffler exhaust outlet angles, water lift muffler water height, idle relief angles, exhaust collector angles, air temperature, water temperature, and humidity when performing these test.

EXTENDED IDLE TEST

1. Operate the engine until it is at normal operating temperature (73°C [160 °F]).
2. Place the remote control in neutral. Increase the engine speed to 3000 RPM for 1 minute.
3. Bring the engine back to idle slowly after 1 minute.
4. Shut the engine off.
5. Restart the engine and operate at idle speed for 15 minutes.
6. Shut the engine off.
7. Check for water.

IMPORTANT: If repeating this test, return the engine to operating temperature.

CHECKING BY EXHAUST ELBOW REMOVAL METHOD

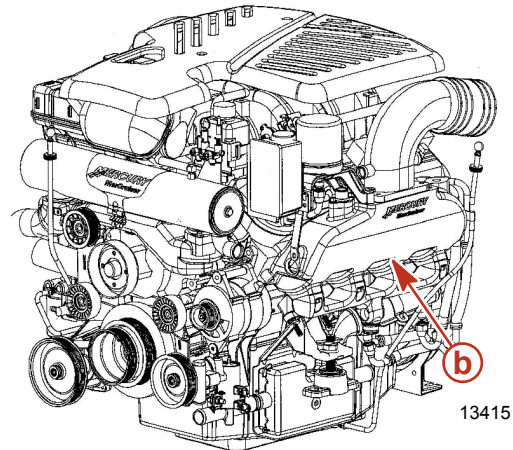
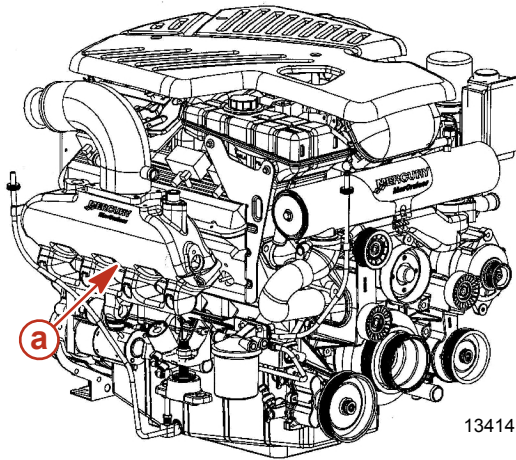
1. After the 15 minute idle preparation, drain the exhaust manifolds of water. If the engine uses a closed-cooling system, pinch or plug the hose from the heat exchanger to the exhaust elbow to prevent coolant from spilling because the heat exchanger is higher.
2. Remove the exhaust elbows.
3. Check for water in the exhaust manifold. Use a flashlight if needed to aid inspection. If water exists, measure the amount and record. See **Interpreting Results**.

NOTE: Use a suction device with a rubber hose attached to the end to remove the water from the manifold.

4. Replace the elbows using new gaskets. Refer to the appropriate Mercury MerCruiser Service Manual.

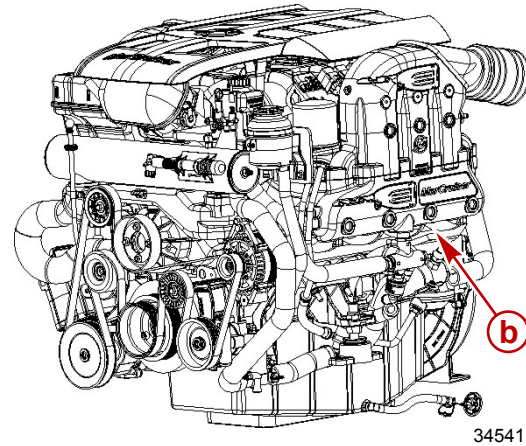
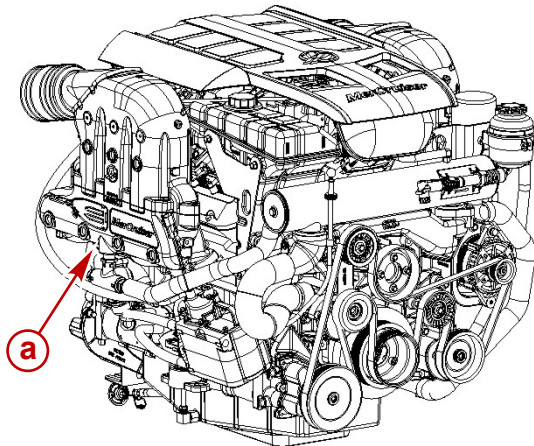
CHECKING BY DRILLING AND TAPPING EXHAUST MANIFOLDS

1. Drill and tap a 1/8 in. NPT hole into the bottom and center of the exhaust manifold runners for cylinders 4 and 5. Drill in the area that is not water-jacketed. For Products without Emissions Control



For products without Emissions Control

- a** - Number 4 exhaust manifold runner
- b** - Number 5 exhaust manifold runner



For products with emissions control

- a** - Number 4 exhaust manifold runner
- b** - Number 5 exhaust manifold runner

2. Insert brass drain plugs into the holes.

Qty.	Description	Part Number
2	Brass drain plugs	22-818390

3. Run the engine as outlined in **Extended Idle Test**.
4. Drain water from the manifolds into a suitable container. Measure and record the amount of water using a graduated cylinder. An acceptable amount of condensation water is 5 ml (0.2 fl. oz.).
5. Replace the manifolds.

INTERPRETING RESULTS

Water vapor is a normal by-product of the combustion process, so a small amount of water [5 ml. (0.2 fl oz.)] is acceptable. This condensation has not shown to cause a problem. Excessive amounts can indicate a water intrusion problem that requires corrective action. Some of the more common causes for this condition are:

- Insufficient exhaust riser height. See **Measuring Exhaust Elbow Height**.
- Improper exhaust hose slope.
- Failure to have at least 457 mm (18 in.) between the exhaust outlet and muffler, collector, or first angular fitting. See **Exhaust System Design**.
- Missing or improperly located exhaust resonators. See **Exhaust Resonators**.
- Improperly sized or incorrectly installed exhaust system components.
- Leaking exhaust elbows or risers.
- Improperly designed collector or Y-pipe. See **Exhaust System Design**.
- Exhaust system causing a tuning effect. See **Exhaust Resonators**.
- Improperly functioning or missing water shutters or flappers.
- Muffler not draining.
- Engine damage.
- Poor engine running condition.