



**Commercial Products**

# **Diesel Engines**

## **Diagnostic Testing**

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### Suggested Testing Tools:

Diesel engine compression tester. TOR3003A

Cylinder leak-down tester. TOR4076

Air pressure regulator. (Purchase Locally)

### Use of This Manual

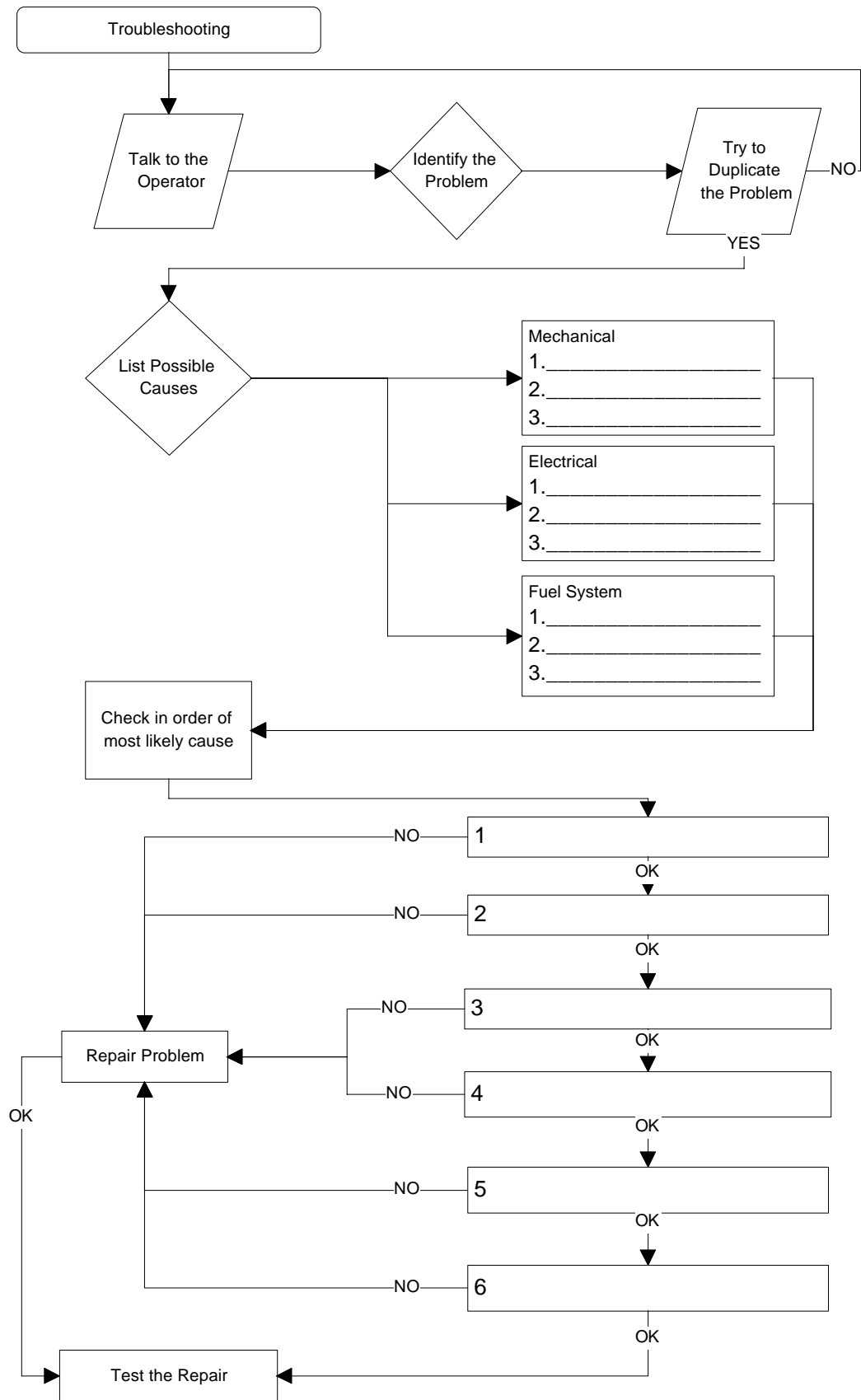
The information contained in this manual is supplementary to material found in other sources, it is not a replacement for them. You should always consult Service Manuals, Service Bulletins, Operator's Manuals and Parts Books when necessary.

Service Manual Updates and Service Bulletins can be found on the internet at:  
**[www.toro.com/golf/custsvc.html](http://www.toro.com/golf/custsvc.html)**

This Manual and the training program, which it supports, are both designed to help you gain knowledge of the product, and to inform you of when and why to make the necessary repairs. We have also included tips for performing those repairs.

This program is designed for you. Your input and participation is appreciated.

There is plenty of space in this manual for you to add your own notes and observations.



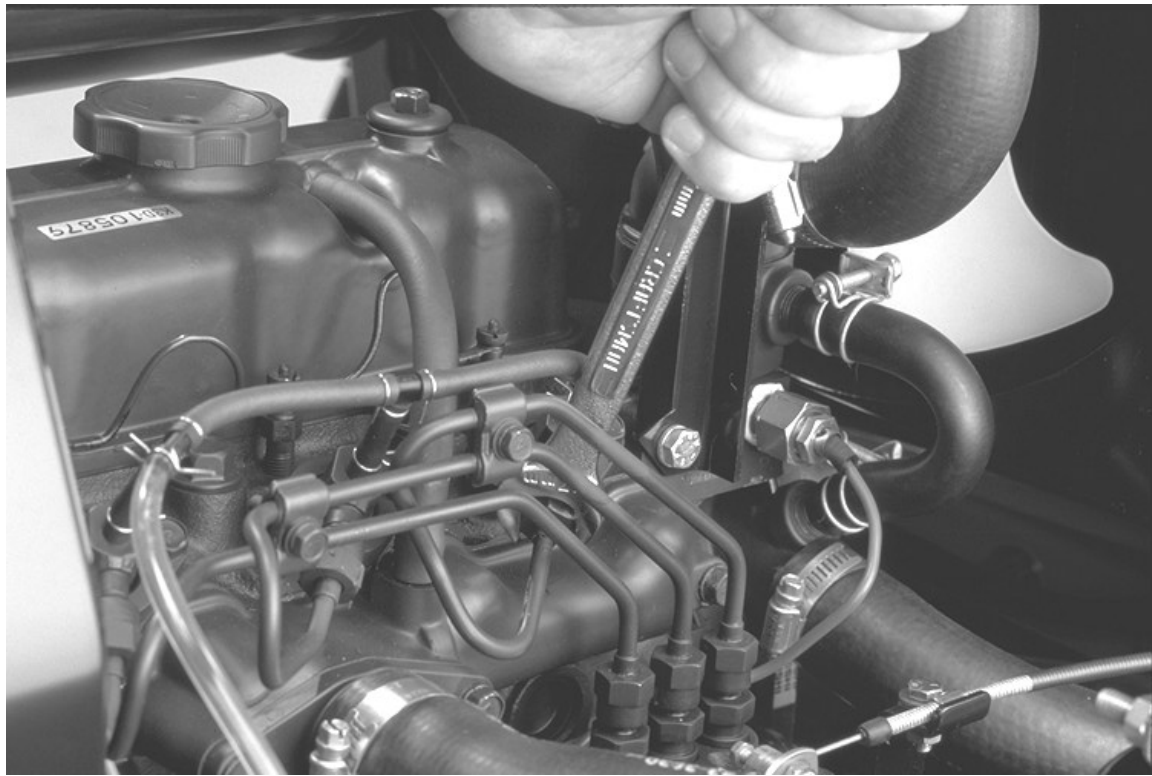
## Steps to a successful diagnosis.

These diagnostic steps apply to any troubleshooting procedure on any system you are testing.

1. Talk to the operator
  - The operator is usually the person who has witnessed the problem. By asking the right questions they can tell you what the problem is, with out knowing what the problem is.

Ask the following questions:

  - When did the problem start.
  - What were you doing right before the problem occurred.
  - How was the machine being operated when the problem occurred. (i.e going up-hill, down-hill, full throttle, steering, cutting units up or down, etc..)
  - How long was the unit operated before problem occurred. (engine warm or cold)
2. Identify the problem
  - Is it really a problem or a normal situation (operator not familiar with sounds or operational characteristics).
3. Try and duplicate the problem.
  - Can you duplicate the problem. (hard to fix what you can't find)
4. List all the possible causes.
  - List the mechanical, electrical and fuel system components that could cause the problem.
5. Test the most likely causes.
  - Begin by checking the most likely causes first.
  - Repair problems found, before continuing testing.
  - When a defective component is found, it must be replaced before further testing is performed
6. Test the repair
  - When the testing and repairs are completed, you should again operate the machine and try to duplicate the problem.



## **Cylinder Cancel Test**

One quick and easy test is a cylinder cancel test.

With the engine running, crack open the injection line to each cylinder one at a time.

If the engine pulls down or the sound changes, then you know that that cylinder is functioning.

If cracking the line for the cylinder does not make a difference, then you know that that cylinder isn't running well and it is probably the cylinder causing the problem

If the engine has a knock, this test can also help us to identify the problem.

1. If the noise goes away when the injection line is loosened, there could be a problem with the injector or the injection pump.
  - The injection timing to the cylinder could be incorrect and this is causing the knock.
2. If the noise changes but does not fully go away, there could be a problem with a wrist pin or possibly a scored piston.
  - With a scored piston, the sound may not go away but will usually change. (The stresses on the piston change so the sound changes).
3. If the noise does not change or go away, then the problem is a hard mechanical problem. (ie. Piston hitting the head, etc...)





## **Compression test.**

When you do a compression test you are looking for the compression pressure that the engine is able to produce. Don't get as concerned about the actual pressure reading as the relationship between all the cylinders. If all the pressures are low, there are several things that could cause it; slow cranking speed, plugged air filters, weak starter.

Be more concerned that all the cylinders are similar, within 15%. If the cylinders vary by more than that, there is a possible problem with that cylinder.

To perform the compression test:

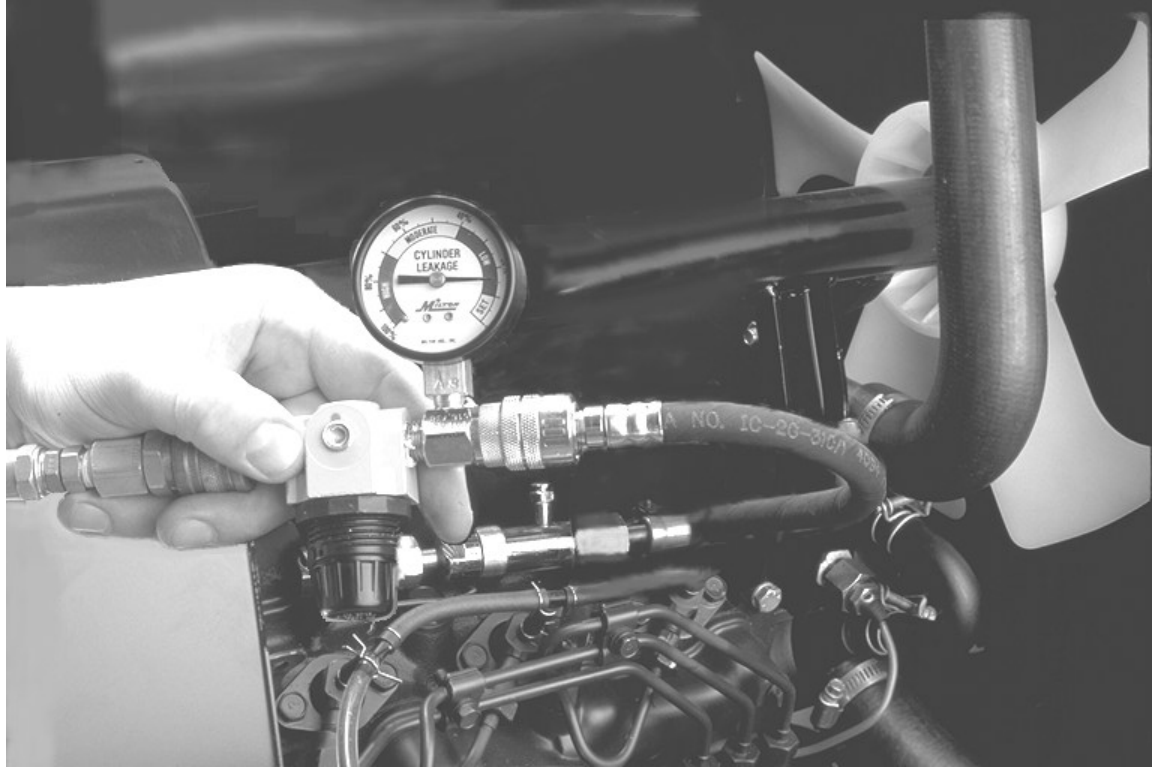
1. Remove all the glow plugs. (If the engine is not equipped with glow plugs, remove all the fuel injectors).
2. Disconnect the fuel solenoid. (This prevents the cylinders from being washed down with fuel during the test).
3. Connect a battery charger to the battery. (This insures that the cranking speed remains constant during the test).
4. Connect the compression test tool (TOR3003A or equivalent).

Make sure that everyone is clear of the unit and crank the engine.

Crank the engine a consistent number of compression strokes.

Read the pressure on the gauge.

The compression readings should be within 15% from the high to the low cylinder.



## **Cylinder Leak-Down Test**

Another and more accurate test is the cylinder leak-down test.

When performing a cylinder leak-down test, the cylinder being tested is cranked up to TDC on the compression stroke. A controlled amount of air is pumped into the cylinder and the gauge indicated how much air is leaking.

You read the gauge to see if the air loss is at an acceptable level. If there is excessive air leakage, the test will also show where the problem is.

If you hear air leaking from the intake manifold or the air filter housing, then we know that we have a leaking intake valve.

Air leaking from the muffler shows a leaking exhaust valve.

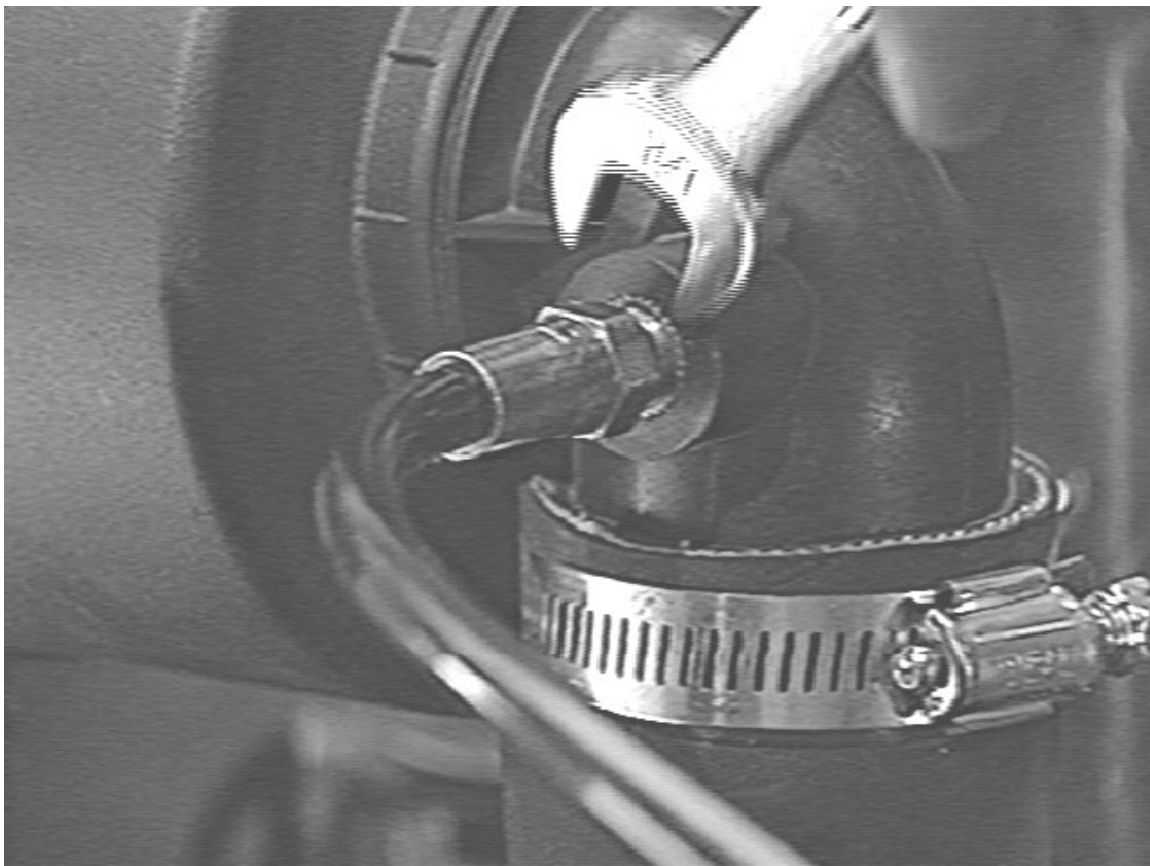
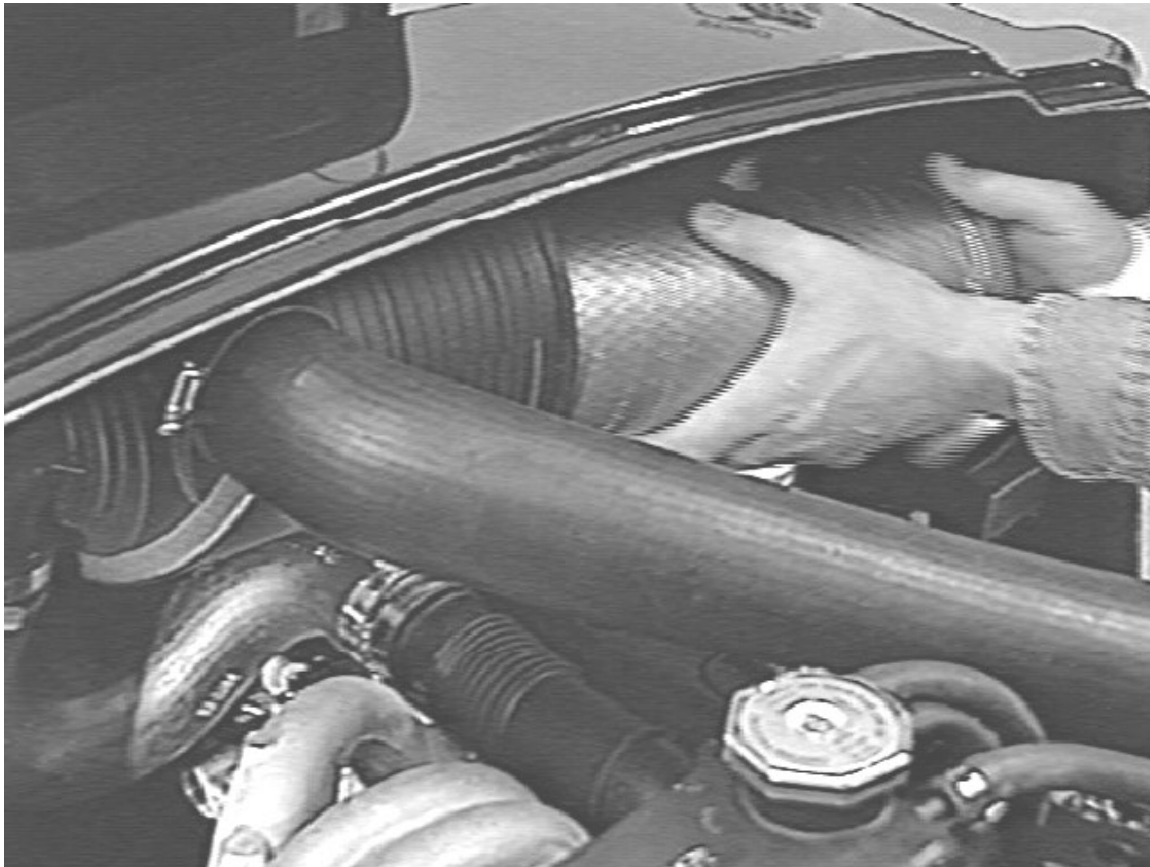
Air bubbling in the radiator or around the cylinder head indicates a cracked head or a faulty head gasket.

NOTE: There will always be air leaking from the crankcase. If the gauge shows excessive leakage and the only place air can be heard is coming from the crankcase, then the piston rings can be suspected.

To perform the cylinder leak-down test:

1. Remove the glow plug from the suspected cylinder. (If the engine is not equipped with glow plugs, remove the fuel injector).
2. Remove the valve cover. This is done to identify when the engine is at or near TDC.
3. Rotate the engine until both valves on the cylinder to be tested are loose. (This is TDC ready to fire).
4. Calibrate the cylinder-leak down tester (TOR4076 or equivalent) to the set position on the gauge.
5. Connect the cylinder leak-down test tool
6. Check the reading on the gauge.

If excessive leakage is shown, checking the air filter and the exhaust can give us an indication of the area of the leak.

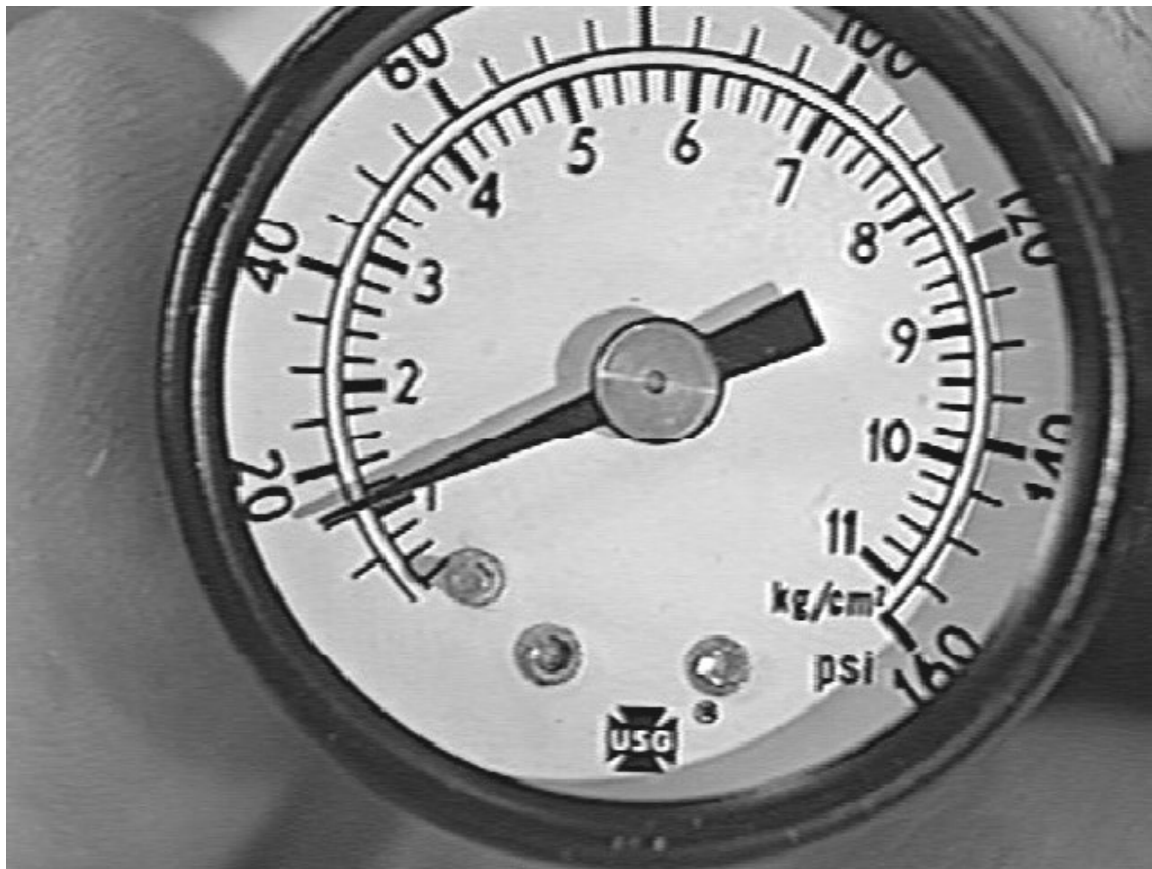


## **Air Induction Test**

To determine the condition of the intake system, an air induction test can be performed. This test will check for air leaks in the intake system, which can allow dirt to be injected into the engine.

To perform the air induction test:

1. Remove the air filter and install a filter that has been wrapped with duct tape.
  - This will allow us to pressurize the intake system.
  - You can wrap a used or new filter.
2. Connect an air pressure regulator to the intake system.
  - There is a fitting located on the outlet elbow of the new Donaldson® air filter housings.
  - If the unit is equipped with a different air filter housing, the air pressure regulator can be connected to any port or hose that is connected to the intake.



**Air induction system test**

3. Pressurize the system to approximately 15-psi.
4. Spray the hoses and manifold with soapy water.

If bubbles are found, then an air leak is present.

All the hoses, manifold and mounting areas should be checked.

NOTE: It is recommended that this test be performed after the unit has been reassembled and before it is put back into service. This test will insure that all of the removed intake components have been properly reinstalled and all the connections are tight and sealed.









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