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# Robison On Rovers

## Carbon Fouling – A New Kind of Valve Job

Many of you have heard about the carbon fouling problem affecting newer Discoveries and Range Rovers. This is a problem that affects Rovers using the 4.0 engines – primarily 1996 and newer Discoveries. This does not generally affect earlier Rovers – those with 3.9 engines. I do not know what percentages of Rovers are affected, but it is significant. Some of you learned about sticky valves when your Rover began losing power and you took it to the shop for diagnosis. If you were lucky, your truck was fixed under warranty. Others have heard or read about the problem on the Internet or elsewhere.

The first symptom of this problem is a sudden and momentary loss of power. While driving, usually at highway speed, one or more valves stick and the engine staggers. If the staggering goes on for more than 30 seconds the Check Engine warning light will come on, and a fault code will be stored in memory. As a rule, the problem clears up just as suddenly as it came on, and may not occur for days or even weeks.

This misfiring happens without warning. It may happen once a month, or it may happen daily. As a rule, the problem gets worse with time and temperature. It usually happens with a fully warmed up Rover engine. In my experience, valve sticking seems to get worse on hot humid summer days.

The valves that stick are the exhaust valves, so they are resistant to cleaning techniques like pouring injector cleaner or valve cleaner into the engine. Why? Because whatever you pour in has been burned in the engine before it reaches the exhaust valves so it doesn't do much good. Those products can help with sticky intake valves but that's not our problem here.

Those of you whose trucks are under warranty and have sticky valves can have the repair procedure performed at no charge by your dealer. If your truck is not in warranty, though, you can be looking at a big bill – perhaps over $2,000. In this article I'm going to take you through the steps involved in doing the job. Before we begin, I caution you that this is not a job for most do-it-yourself mechanics. Nonetheless, even if a professional does the actual work you'll be better off the more you know, so read on.

**Step one – diagnosis**

Our test Rover is losing power every now and then. Does it have sticky valves? Let's find out.

The first step is extracting the stored fault codes from the engine management computer's memory. On 1996 and newer vehicles you will connect an OBD II scan tool to the OBD II connector under the dash. These scan tools are several thousand dollars, but they're required to read or clear the codes. Disconnecting the battery no longer clears fault codes on 1996 and newer Rovers – only the tool will do it. If you don't have one, go to a shop that does and have your codes read.

Some scanners will give the text descriptions of the codes, while others give numbers and refer you to a book.

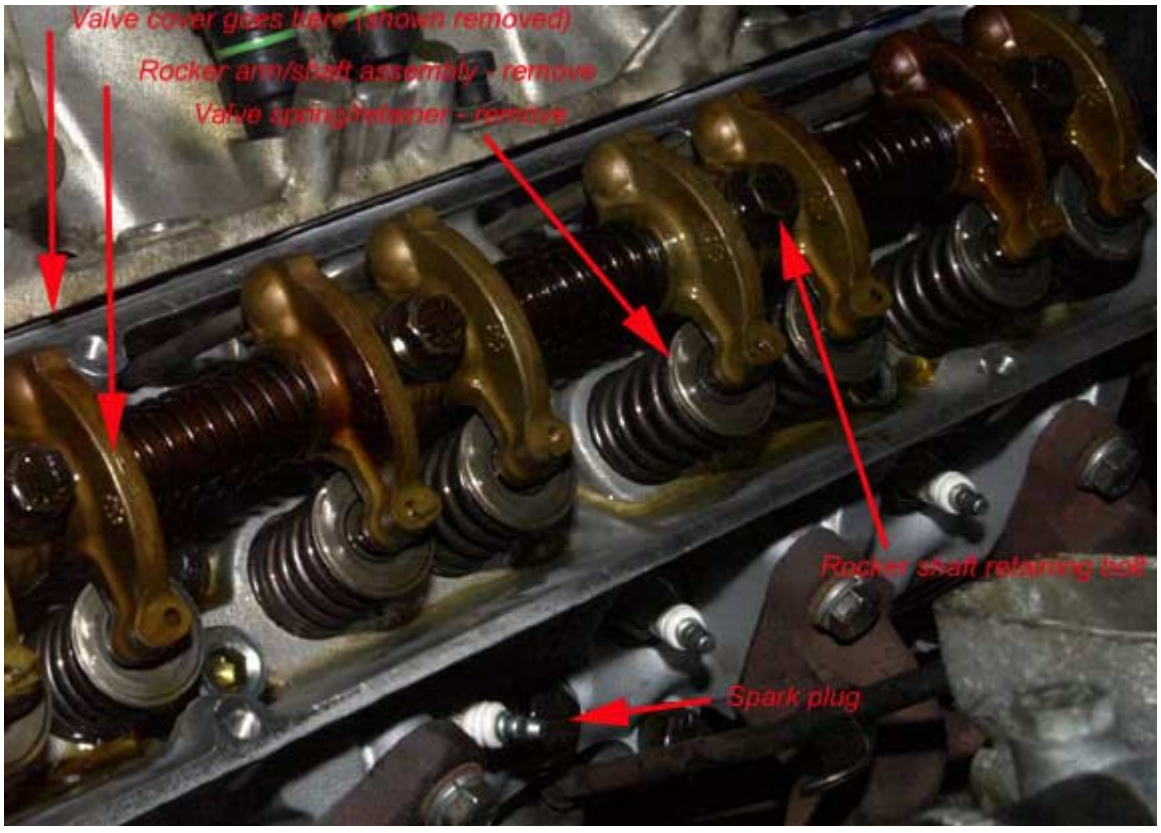
When the fault codes are read they will be misfire codes for specific cylinders, and often will include the random misfire code. Inexperienced technicians frequently (incorrectly) diagnose this problem as ignition or fuel system failure. Sometimes odd cylinder misfire codes are signaling a bad speed sensor. All too often, though, these codes indicate sticky valves.

Odd cylinder only misfire codes may indicate a faulty engine speed sensor, a much less troublesome repair. The speed sensor signals the computer that the truck is going too fast. It responds by cutting off the odd cylinders. If you're brave, you can see this circuit in operation by shifting into first at a stop and gradually gathering speed. When you exceed the maximum permissible engine speed it will cut out to tell you to back off.

The next and final step in diagnosis will be testing the valves themselves. You'll need common hand tools, a screw type valve spring compressor, and a screw-in compression gauge with a fitting that can be coupled to a source of compressed air (shop air). This is how it's done:

1 Remove the valve cover.
2 Remove the rocker arms and spark plugs.
3 Connect an air hose to a compression gauge adapter and screw it into the spark plug hole for the misfiring cylinder. Make sure the Schrader valve is out of the compression gauge adapter so the cylinder is pressurized with shop air.
4 Using a screw type spring compressor, remove the valve spring and seal from the exhaust valve. Clamp a vise-grip to the top of the valve stem. Clamp the top of the valve where the keeper rings seat, and don't gouge or damage it. **CAUTION**: If you do this without a proper shop air supply the valve may fall into the cylinder thereby requiring you to take the head off whether you wanted to or not.
5 Release the shop air.
6 Gently move the valve up and down using the vise-grip as a handle. If the valve is sticking you will be able to feel it bind as it closes, or it may not close at all. A good valve moves up and down smoothly and can be felt to seat with a positive "click". A sticky valve can be felt as it binds before it seats. If it's sticking badly, it won't seat at all.
7 If you're not taking the motor apart now, re-pressurize the cylinder and refit the valve spring. If you're not proceeding with the repair, install a new valve seal first. **SUGGESTION**: Even though you may be taking the head off right away, you reduce the risk of lost parts if you reassemble the valve spring first.

The illustration below shows the assembled head with the valve cover removed.



If you remove and check several exhaust valves you will probably see a big difference between a few. Good valves seat shut with a positive click. Sticky valves bind before they close. The feel is quite different.

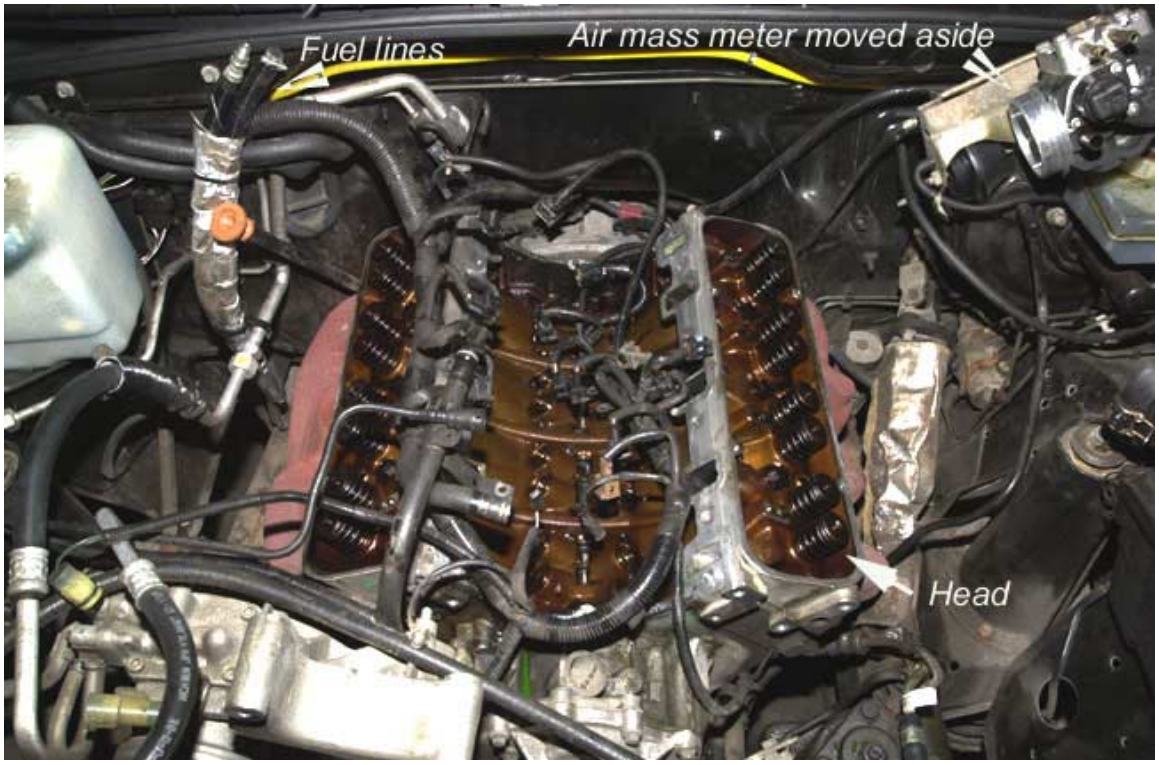
Here's a picture of a sticky valve

Step two – disassembly

The first thing to do is disconnect the battery. We'll be removing the fuel lines later, and we don't want any stray sparks lighting our Rover on fire. **TIP**: It's smart to remove the fuel pump fuse or relay so that if someone hooks up the battery later and turns on the key fuel won't spray from the open lines.

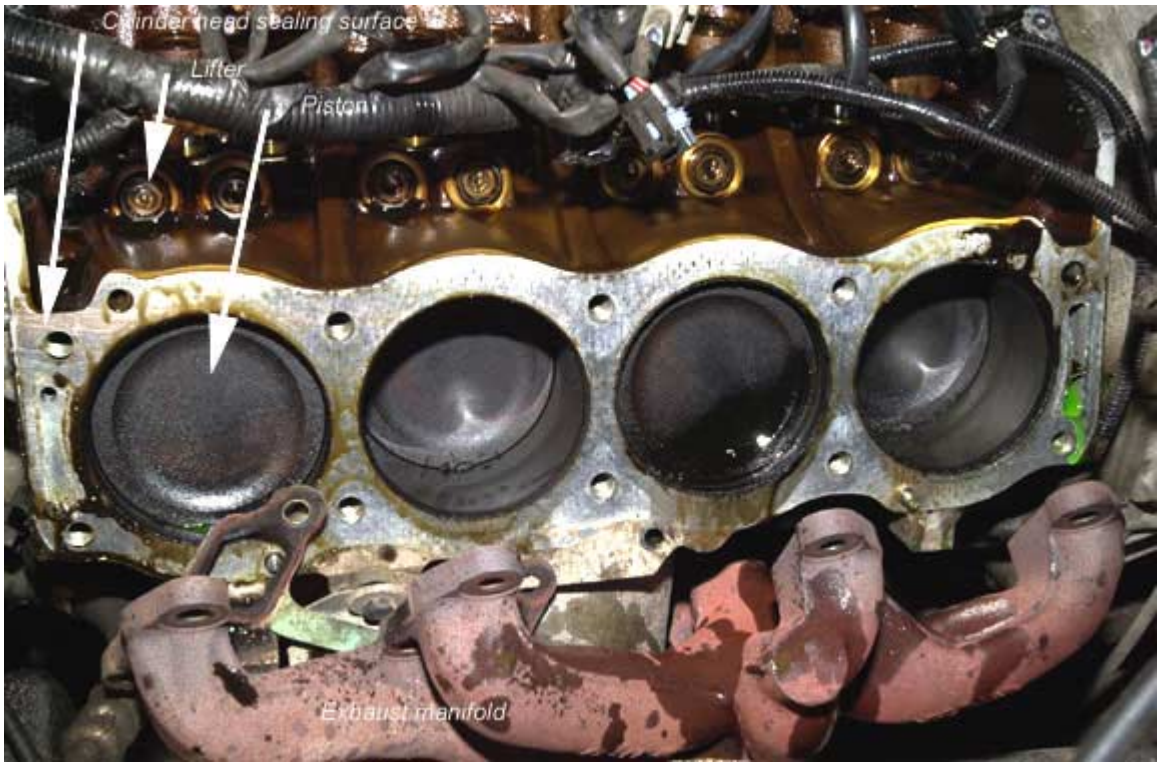
Next we remove the intake duct and hoses, the power steering pump (moved aside), the alternator (moved aside), and everything else on top of the motor. After removing the plenum cover and disconnecting the fuel lines, we remove the intake manifold complete with injectors and fuel rail. Note that we've left quite a few pieces installed. This speeds the work considerably. Some of you might also notice that a distributor has appeared on the front of the engine. That's because the pictures in this series were taken from two valve jobs – one a 96 Disco with carbon fouling, and the other (below) a 93 Range Rover with a burnt valve. I've used whichever images best illustrate the relevant points in this story.

With the intake off, this is what we see:

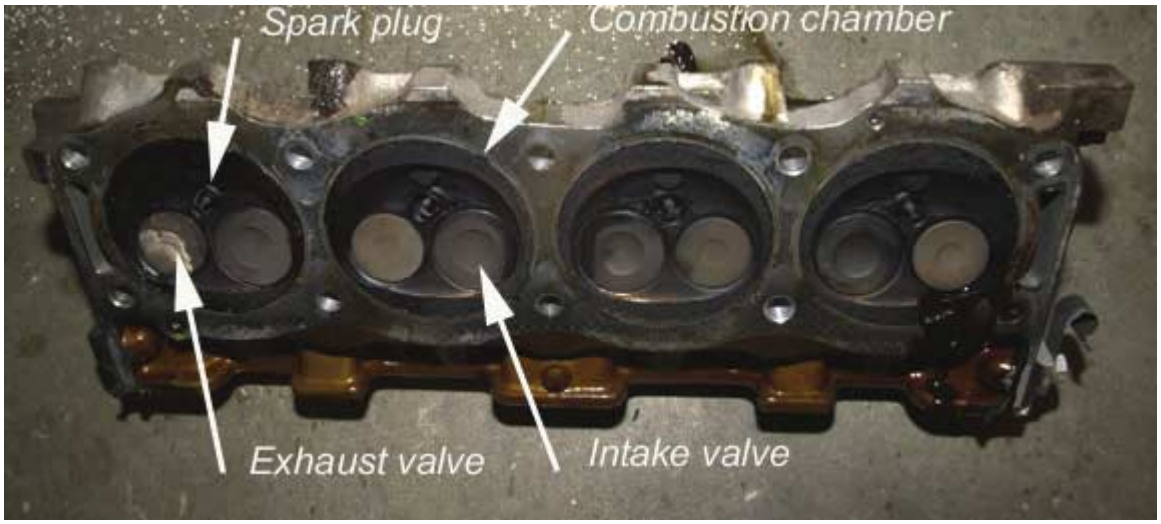



The brown coloring in the oiled areas is normal. The inside of this engine is fairly clean, indicating its owner took care of it with regular oil changes. What we don't want to see here is lumps of sludge, which would indicate someone didn't change their oil often enough. The 1996 Disco engine in this photo has about 50,000 miles on it.

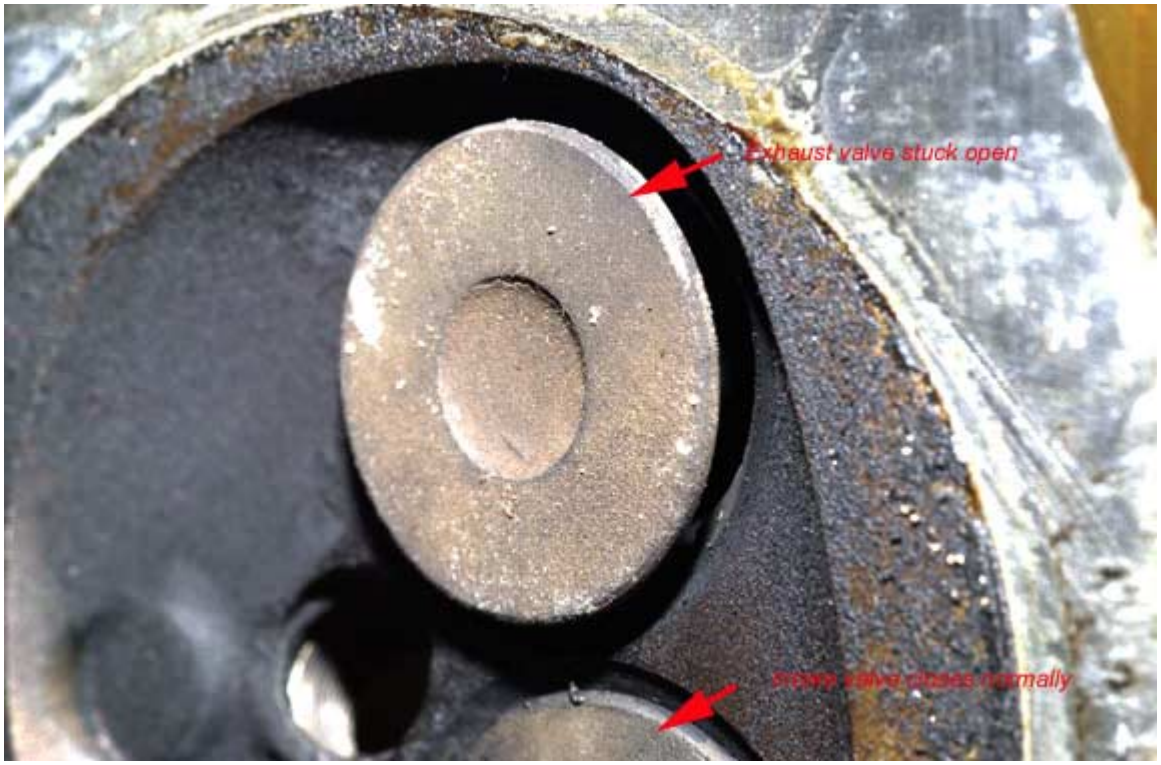
Next, we'll unbolt the exhaust manifolds and remove the accessory mounting brackets from the front of the heads. We'll unbolt the heads and off they come. This is what the cylinders look like. We'll use a specially made cleaning pad to clean up the piston tops and the cylinder head sealing surfaces before we reassemble the motor. The carbon buildup on the piston tops is again fairly normal for Rovers.



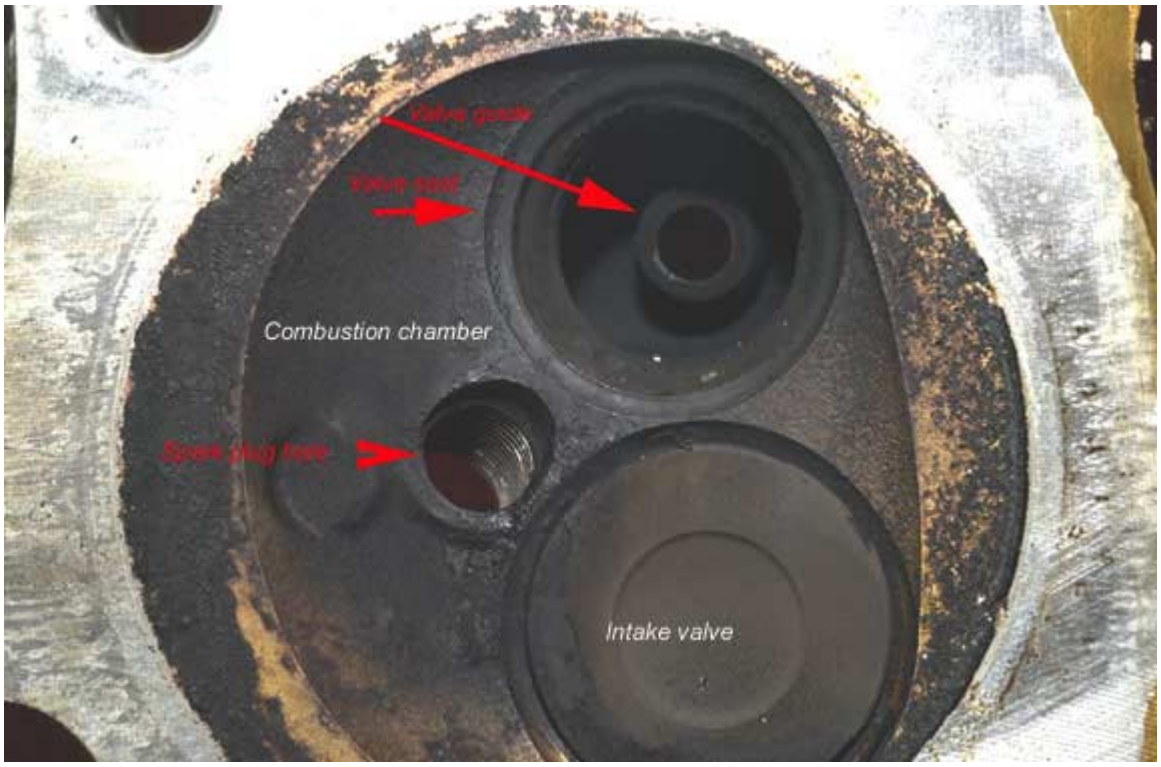

Below, on the floor, you can see the head we just took off.



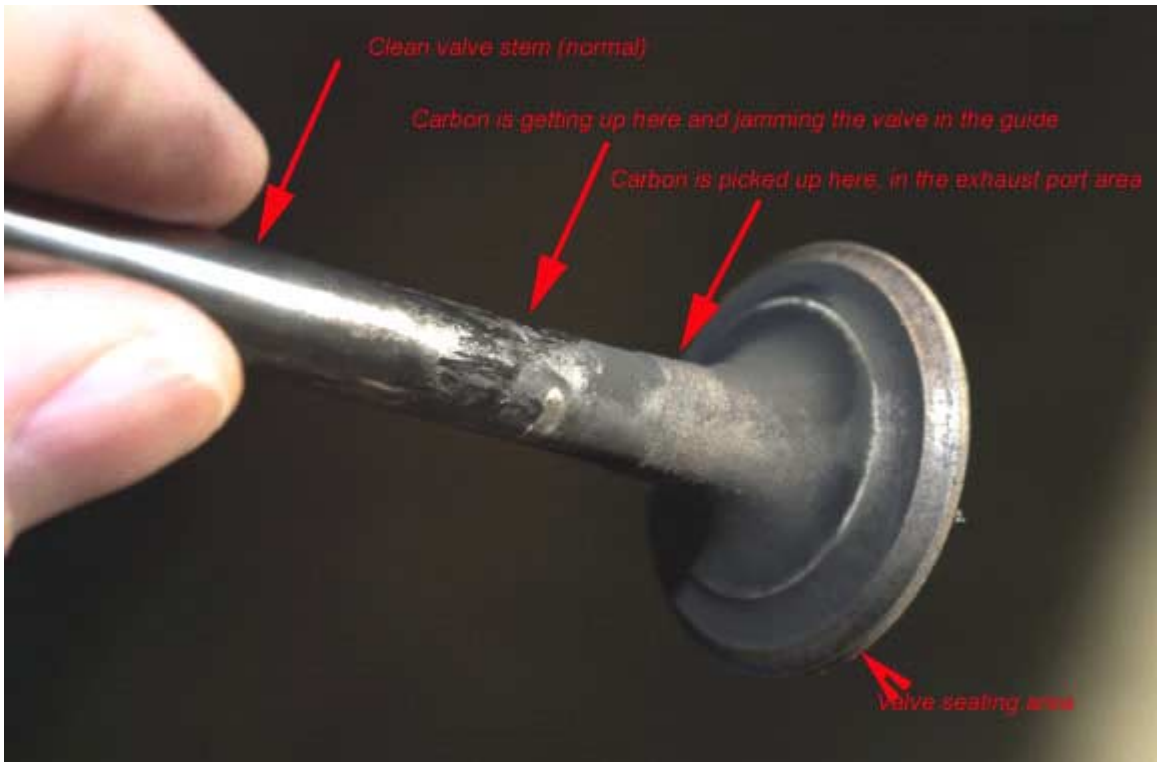
Here's a close up view of one of the sticky valves in place. This valve, with no spring to pull it shut, stays open as you see it. The valve below is closing, as it should. The edge the valve closes onto is called the seat. The seat should be clean and shiny as the closing valve bangs onto it with some force. In this photo, you can see the seat is covered with carbon because this valve wasn't closing as it should.




Here we've removed the valve, and the carbon buildup on the seat is quite evident. With carbon buildup like this on the seat, it's a safe bet this engine was down on power all the time. Once we've fixed it it's owner will surely see an increase in performance. The hole in the center of the port is the valve guide. The guide, seat, and head look like areas on one piece of metal but they are actually three distinct parts.




Having taken the head off, we can remove a valve spring and pull one of the sticky valves. Here's what a sticky valve looks like up close




You can see what is happening. The lower part of the valve (on the right) picks up a coating of carbon from the hot exhaust gases heading out the port (The exhaust port is the passage in the head leading to the exhaust system. The intake port leads from the intake valve to the intake manifold). This carbon works it way up the valve. The clearance between the valve and the valve guide is tight – perhaps one

thousandth of an inch.  When the carbon gets into this space it causes the valve to jam and creates the problem.

The next picture shows a detail of a valve stem.


Now it's all taken apart.  We'll clean the engine up, send the heads to the machine shop, and continue with the reassembly in the next ***Robison on Rovers***.

Your comments on this article, and suggestions for future articles are welcome.  Send them to robison@robisonservice.com

Notes:
The pictures in this article were take at Robison Service in Springfield, Massachusetts during the winter of 1999 by John Robison and Jonathan Gettier using a Nikon D1 digital camera system.  The images were processed using Adobe Photoshop on a Dell workstation.  None of the images shown here have been altered in any way other than by cropping, addition of captions, and adjustment of brightness, hue, and contrast to improve legibility.  These photos depict real repairs to real vehicles.

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