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Robison On Rovers

Carbon Fouling – A New Kind of Valve Job

In the last ***Robison on Rovers*** we diagnosed and disassembled an engine that suffered from carbon fouling. Its valves were sticking and it was losing power whenever that happened. We had sent the heads to our friend Steve Dutcher's machine shop, and now they are back. Dutcher's specializes in high performance machine work in Greenfield, Massachusetts.

This is what Steve's shop did to the heads:

- They cleaned them using a walnut shell blaster. This is a process like sand blasting, but it uses walnut shells instead of sand. The walnut shells remove carbon and grit but do not erode the metal.
- Our heads were pressure checked and tested for cracks.
- The flat surface where the head meets the block was checked and found to be less than fully flat. Our heads have been resurfaced on a machine like a precision belt sander to give a perfectly flat surface. **NOTE**: this step is often skipped (along with all other machine shop checks) when head gaskets alone are replaced, especially during warranty. The result of skipping this step is often failure of the new head gaskets a year or two later.
- The machinist checked the valve guides, and found a few exhaust guides loose. The loose exhaust guides have now been replaced. **NOTE**: on 1996 and newer trucks, we recommend having the maximum possible clearance between exhaust valve stem and guide at the bottom to minimize the likelihood of carbon fouling the engine again. We only change guides if they are loose at the top (valve spring) end, as that would lead to oil consumption.
- New "carbon cutting" exhaust valves were fitted, and the seating surfaces of all valves and seats have been re-cut. These replacement exhaust valves are supposed to resist buildup of carbon on their stems better than the original valves.
- The valve spring tension was checked and found to be OK. Weak valve springs can cause valve float. This is a condition where the spring cannot pull the valve shut fast enough at high engine speed. In extreme cases the valves hit the pistons as a result.

The operations above are what we mechanics refer to as a "complete valve job".

Before we can assemble the motor everything has to be clean. In our shop we use 3M *Scotch-Brite*™ pads because they remove the crud but don't cut into the soft aluminum. All carbon should be cleaned from the piston tops. The top of the block where the heads sit must be spotless. Any deposits here could lead to premature head gasket failure.

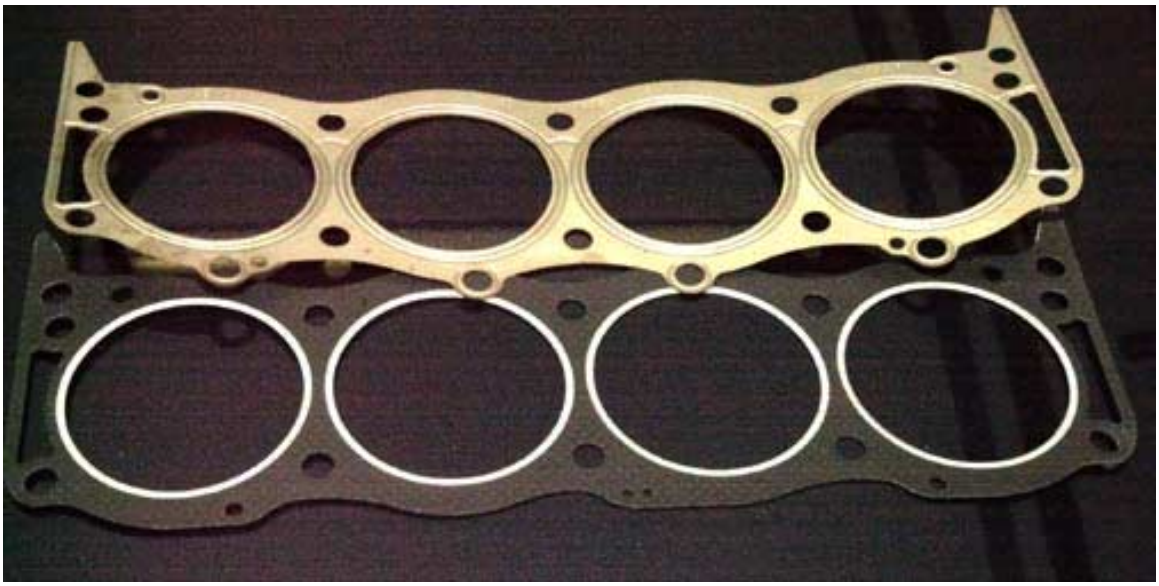
We've also carefully inspected everything now that it's clean. These are some of the things we looked at:

- We checked the piston tops for damage. We looked at the edges for signs of broken rings.
- We checked the cam for wear, and we made sure the hardening was not worn through on the lifters. If the engine had lifter rap before being taken apart we would have replaced the lifters.
- We checked the rocker arms and shafts for play because we know some Rover engines were prone to premature rocker arm and shaft wear, and some wore as a result of owner neglect (insufficient oil changes). If we found play we replaced the rockers and shafts to avoid valve train noise.
- We checked for broken studs, stripped holes, and other fastener problems.
- We checked the water pump for tightness, and checked the idler rollers for the fan belt(s).
- We fixed any other oil leaks – the pan gasket, the oil pressure sending unit, whatever else leaked.
- If we were working on a 1996 or newer Rover, we removed the engine ECU and installed a new updated GEMS prom chip if needed. GEMS is the engine management system Rover introduced in 1996. Rover's sticking valve troubles increased tremendously with the arrival of this system. We hope the new chip will decrease the likelihood of future trouble. How did we find out if a new chip was needed? We had a dealer check with Rover's proprietary *Testbook* system or we took apart the ECU and looked. We obtained the latest part number from our local Rover dealer's parts department.

There are two types of head gasket kit, and it's important to have the right one before beginning assembly. The difference is in the head gaskets – the 4.0 litre kit uses composite head gaskets, while the 3.9 litre kits have thin metal gaskets. The 4.0 litre engines have smaller combustion chambers in the head and use slightly thicker gaskets. I believe this thicker gasket also seals coolant leaks better.

The gaskets do not interchange directly because the older engines have an additional row of head bolts below the exhaust manifold. Therefore, one should not use incorrect gaskets in a repair. I have seen short block replacements done using a newer block on an older truck. In that situation the heads are surfaced to decrease combustion chamber size and the lowest row of head bolts is not used. The new style head gaskets are fitted, and the result is satisfactory.

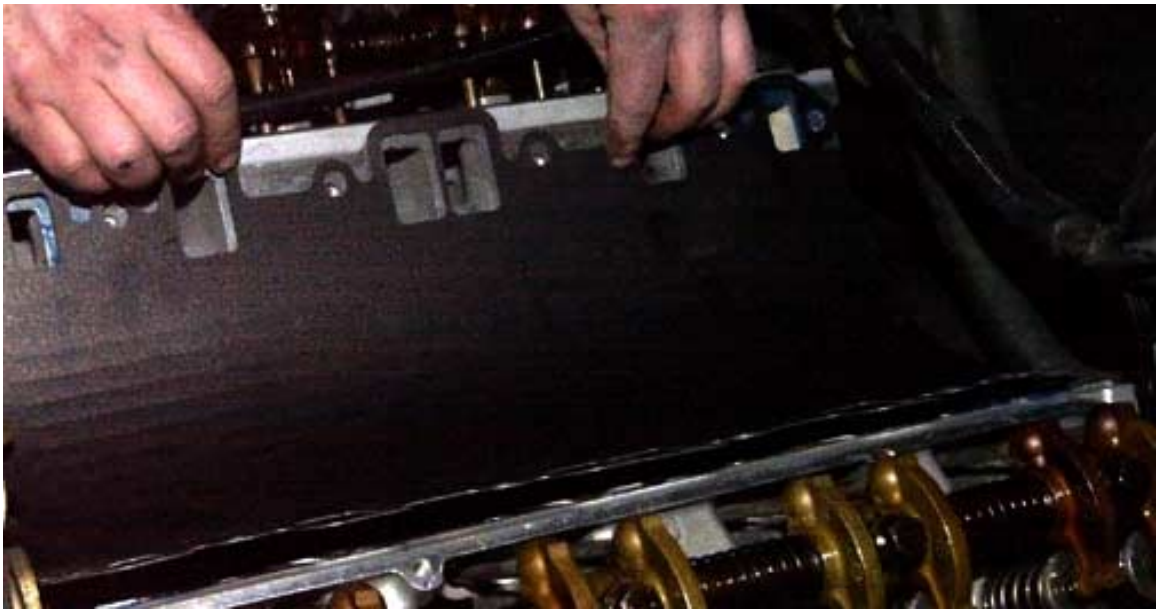
The photo below shows the differences between new and old type gaskets.



Once the heads are on we install the exhaust manifolds. We do this first so we don't have too much to take apart if any of the threads strip on installation. We make sure the lifters are in place, and fit the pushrods and rockers. **NOTE**: if we are working on a high mileage motor - or one whose heads have been off before - we use new head bolts. The head bolts stretch a little bit each time they are installed, and we want to be sure ours are fully up to the job of keeping our new motor together a long time.

If any foreign matter has dropped into the valley area now is the time to remove it. If you've been really sloppy about oil changes you may have sludge to scrape out of here too. We use a shop-vac to get this area clean.

Next we fit the valley cover that allows us to fit the intake. Make sure your gasket kit includes the new rubberized valley gasket, not the old metal one as it is much better. The illustration below shows a rubber gasket being installed.



Don’t forget to secure this gasket to the block as shown before setting the intake in place. Metal strips secure each end of the valley gasket to the block. Leaks from this area are often mistaken for rear main seal leaks as oil tends to run out the rear of the motor at the transmission joint. The new gaskets are designed to seal without any additional sealants but we use *Hylomar* just to be sure. In the photo below the technician is securing the rear of the valley gasket to the block.

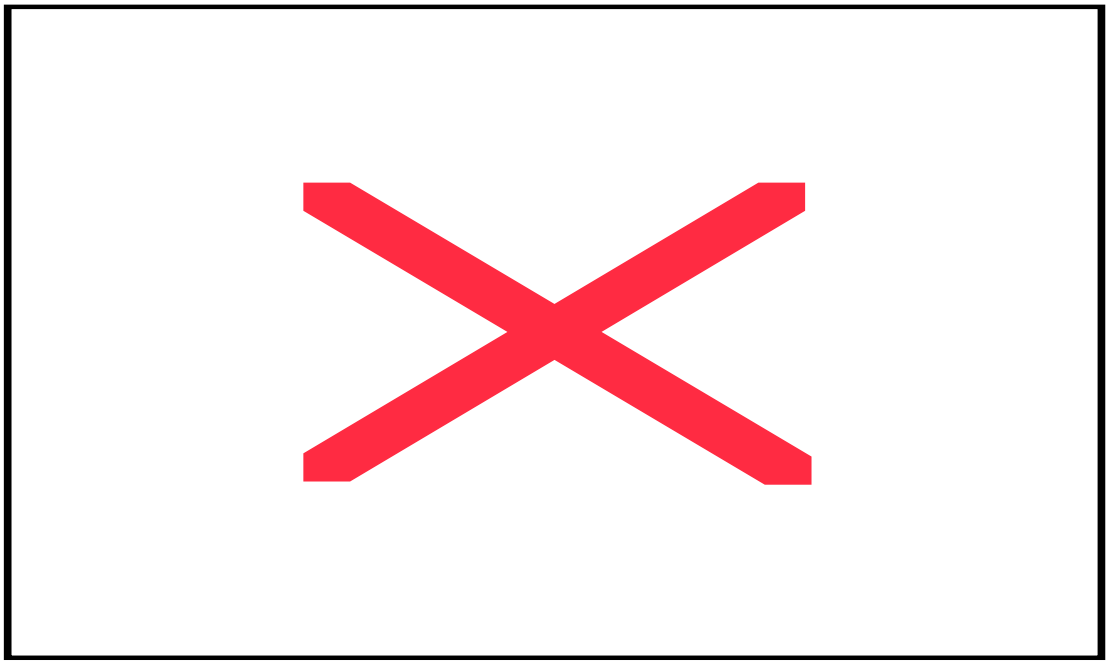
Next the intake assembly is fitted. Note that we saved time by leaving the fuel rail and sensors installed.

From this point the assembly is straightforward. Expect to spend most of a day hooking up hoses, wires and lines and installing everything else. Be sure and clean the breather. Plugged breathers are a big cause of blown gaskets and bad oil leaks later in life. When the breather plugs up crankcase pressure has nowhere to go. It rises until something (usually your gaskets) blows out to relieve the pressure. I suggest you install new plugs, belts, filters, and hoses as required. This is the time to change your heater hoses if they show signs of swelling or are more than 4 years old.

Make sure you install the new rubber valve cover gaskets. If your truck had cork gaskets you'll also need new screws. They are not part of the head gasket kit.

Remember – extra parts are not a good thing at the end of a job! Make sure everything is in place. Fill with oil and coolant. I suggest removing the threaded plug on the radiator and the plug on the heater hose and filling both with a small funnel. Connect the battery. Clear the fault codes if you didn't do that before. If you have a 1996 or newer truck you'll need an OBD II scan tool for this.

Here's a picture of the radiator filler. There's a similar filler on the heater pipe to the left of the plenum. Remove both and fill.



If you've done everything right it will now start and run like new. If your truck had 75,000 or more miles on its odometer you should see a noticeable increase in performance as a result of the valve job. Run the truck with the heat on full until the cooling system has bled itself. This will take 5-10 minutes. Modern cars don't require many adjustments to run like new if everything's in proper order. You should now be able to get in and drive away into the sunset.

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 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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