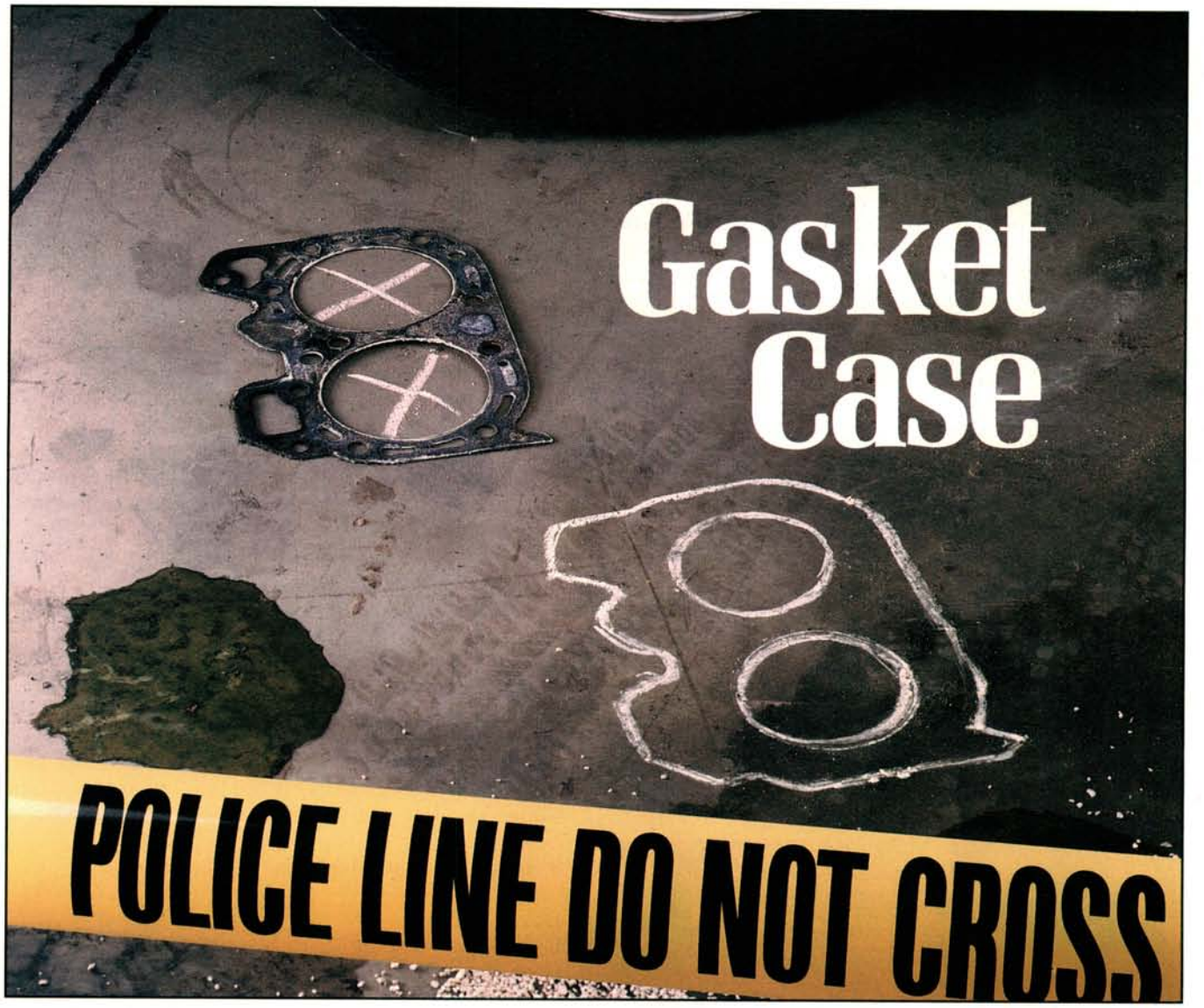


Gasket Case

Oil leaks. I'll be the first to admit that I hate them. I spent several of my "formative years" as a GM dealership technician, and during that time I developed a deep and probably life-long dislike for oil leaks. Maybe I'm exaggerating, but sometimes it seemed like all we fixed from one end of the day to the next was oil leaks.

For the last several months I've been looking at some oil spots on the garage floor at home, left there by our 1989 Subaru GL wagon. If you hate oil leaks as much as I do, the last thing you want to see is oil spots on your own garage floor.

Closer examination revealed that both head gaskets, as well as the RTV sealer between both cylinder heads and the cam housings, were leaking oil. None of these leaks was producing huge puddles of oil, just a steady drip, drip, drip to remind me that they were there, and that they weren't going away.

I did some checking, and it turns out that oil leaks in these areas are not that unusual on this horizontally opposed overhead cam engine design. One of the technicians I spoke with gave me the classic "they all do that" response, while another suggested that these types of oil leaks were just something that Subaru owners everywhere would have to learn to live with.

I haven't met an oil leak yet that I would want to live with, so I decided it was time to find a way to stop the Subaru's incontinence. I'd have to guess that most Subaru owners don't like oil leaks any more than I do, so there may be some profit-making potential for you in this job, too.

Leave It In Or Take It Out?

There are two schools of thought on the best way of doing this job. Some technicians prefer to leave the engine in the car, while others prefer to take it out. Let's look at the pros and cons for both methods.

On the one hand, the cam housings and cylinder heads can be removed with the engine in the car. The heads are secured with head bolts, rather than the long

studs and nuts that were used on earlier Subaru pushrod engines. That means there is enough room in the engine compartment (barely) to remove all of the parts, without having to get creative with a cutting torch. Removing only the necessary parts can speed up the job, if you don't mind bending over the engine compartment while you work.

On the other hand, there is something to be said for pulling the engine before disassembly begins. Once the engine is out of the car, you'll have a clear and unobstructed shot at all of the major fasteners. When it comes time to clean and evaluate all of the parts before reassembly, it's also much easier to see what you're doing with the engine on an engine stand. Be prepared to take a bit more time with this method, however.

We have found that it's much easier to get good, clear photographs when the engine is on an engine stand. This was especially true with the Subaru's horizontally opposed cylinder layout. Taking a picture of the inside of the cam housings requires a periscope with the engine in the car. We also had a couple of other maintenance reasons for removing the engine that weren't related to this article, so that's the method we used.

We'll begin our photographs with the engine out of the car and on an engine stand. Equipment and accessories have changed over the years since this engine's 1985 model year introduction. We won't waste time describing how we got the engine out of the car. Just remember, any of the instructions that we give you can be accomplished using either the engine-in or engine-out option.

Special Tools and Procedures

While the head gaskets from some aftermarket gasket manufacturers do not require it, the head bolts must be retorqued when using original equipment head gaskets. When this job is done is a matter of personal preference. The factory manual calls for a head bolt retorque after the engine's first heating and cooling cycle. If you chose this method, make sure the engine has been thoroughly warmed up. Take a test drive, then wait until the engine has completely cooled before beginning the retorque procedure.

Some technicians prefer to wait until the rebuilt engine has run for 1,000 miles before retorquing the head bolts. At that point, the engine has undergone dozens of heating and cooling cycles and the head gaskets have fully compressed. Regardless of the method you choose, make sure the bolts get retorqued if the gaskets require it. If this step is overlooked, the engine may end up with fluid leaks all over again.

A special thin-wall 17 mm socket is required to reach two of the lower head bolts on each head during the retorquing procedure. Parts of the cam housing castings prevent easy access to these head bolts when the engine is assembled. We're also going to have to deal with this engine's twin timing belts. Several additional special tools are necessary to properly tension the timing belts. If the belts are incorrectly tensioned, they may make noise, wear out prematurely, or break. None of these possible outcomes will be acceptable to your customer.

If you plan on doing a large amount of Subaru engine work, you may want to check with your local dealer about ordering the special tools. If your resources are limited or if you like to make your own tools, it's also possible to make perfectly acceptable substitutes for the store-bought special tools.

We've used the factory tools to replace the timing belts before, but decided to make our own tools this time around. We fabricated all of the necessary tools, using materials we found around the shop. We'll describe the tools in more detail as they come up in our photo captions.

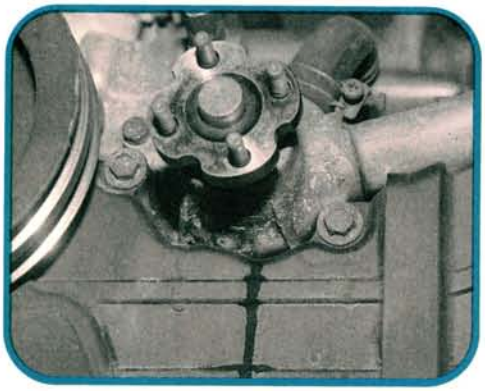
— By Karl Seyfert

1

This is what one of the oil leaks looks like. The cam housings are sealed to the cylinder heads with RTV. Hundreds of heating and cooling cycles, as well as the extra heat from the nearby exhaust port, may cause the sealer to fail. Look for loose strands of oil-soaked RTV hanging from the mating surface.

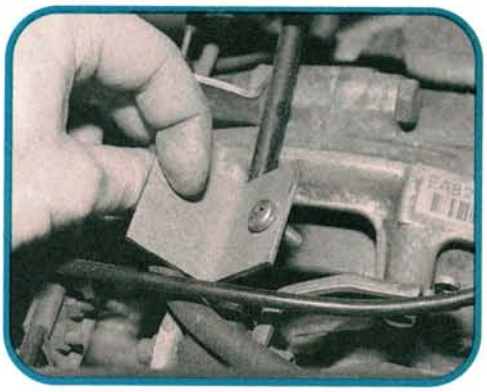
2

The head gaskets may also leak oil, even though coolant and compression retention are normal. Pressurized oil passes from the block to the head on its way to the cam followers and lash adjusters. The small o-ring seal at the bottom of the head gasket loses its ability to seal this passage, causing a leak.



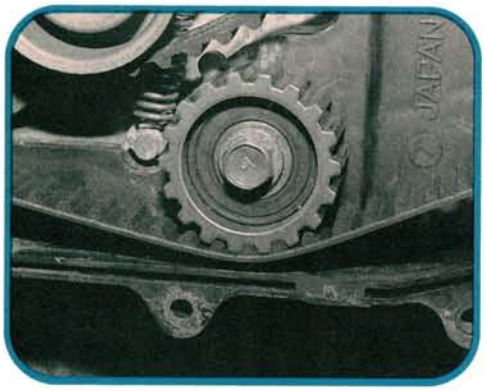
3

Here's another leak we found by accident. The water pump had been leaking from its weep hole. Coolant ran down the front of the plastic timing cover, as well as inside the cover. The whole cooling system only holds about 1.5 gallons, so a leaking pump could quickly empty the system.



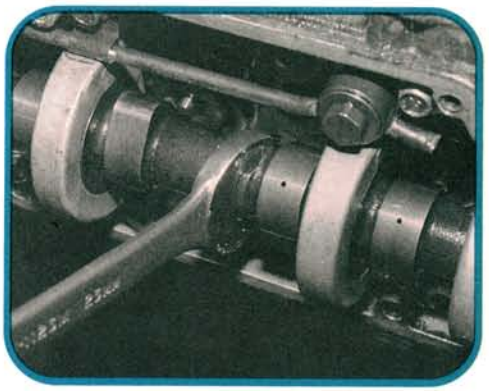
4

The crank pulley must be removed before removing the outer timing cover. We made a flywheel lock using a short piece of angle iron and a 6 mm screw. The screw engages one of six holes in the flywheel. A slightly different tool is required for models equipped with an automatic transmission.



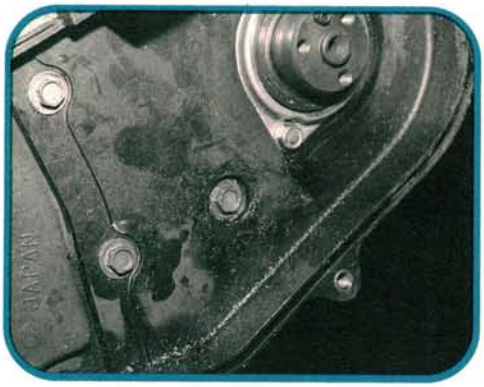
5

Remove all three pieces of the outer timing cover. Loosen both sets of timing belt tensioner bolts, then move the left and right tensioners out of the way. Inspect the condition of the tensioner bearings and rollers and the left timing belt idler. Also check the oil pump assembly for leaks.



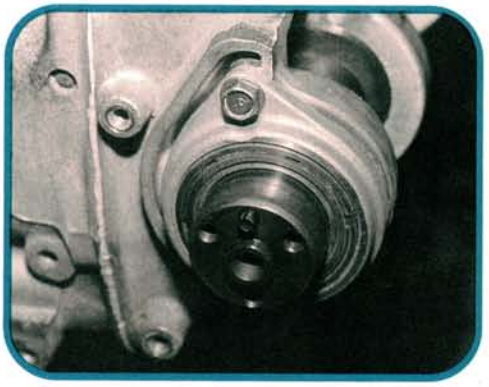
6

Turn both cam sprocket timing marks to 12 o'clock. This closes the valves and takes pressure off the cam. Remove both cam sprockets by removing the valve covers, then hold each camshaft with an open-end wrench. The timing belts are 20,000 miles old, but it seemed foolish not to replace them while here.



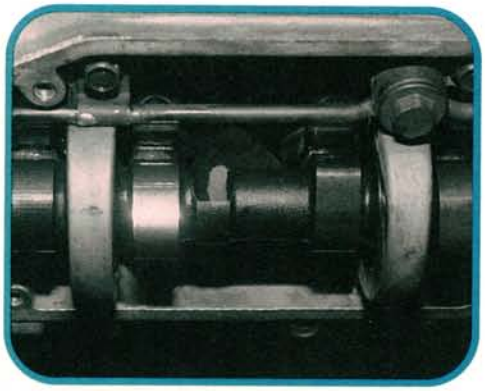
7

Remove both tensioners and the idler, then remove the three pieces of plastic inner timing cover. A large assortment of bolts, grommets, and rubber gaskets is used to secure the timing covers. If you don't want to go crazy later, group the hardware with the appropriate pieces of the cover.



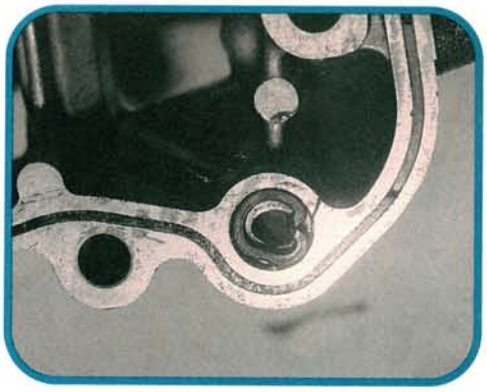
8

Make sure the camshaft timing marks are still at 12 o'clock. Temporarily reinstall the sprockets if necessary. The valves must be closed to take the strain off the camshaft and to prevent distortion of the aluminum cam housing. Now slowly and evenly loosen the cam housing bolts. Remove the cam housings.



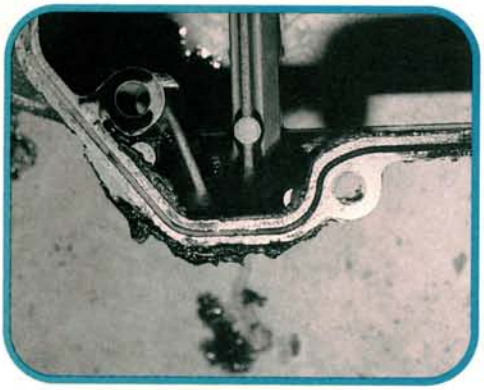
9

The cam followers are hooked over the ends of the lash adjusters and valve tips and may fall off when you remove the cam housing. Store the followers and lash adjusters in order so they can be reinstalled in their original locations in the heads when the engine is reassembled.



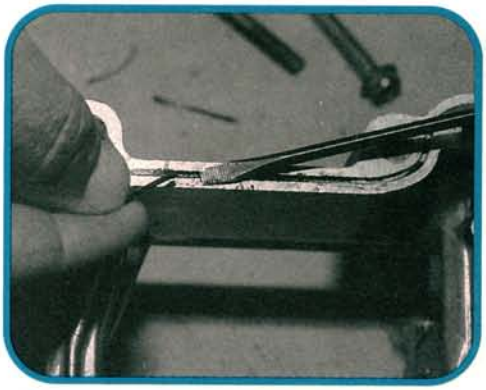
10

This is the cause of at least one of our oil leaks. This small o-ring seals the oil supply passage between the cylinder head and the cam housing. Engine heat, as well as the expansion and contraction of the aluminum parts, have caused the o-ring to flatten out and lose its original shape.



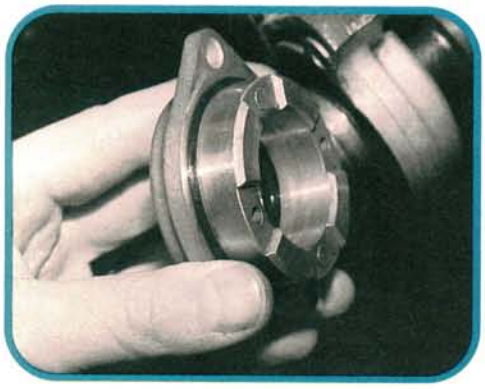
11

Engine heat has also done a number on the RTV used to seal the cam housing to the head. The RTV was originally grey in color, but engine heat has turned it black in the area closest to the exhaust port. Most of our oil leaks were coming from the blackened areas along the bottom of the groove.



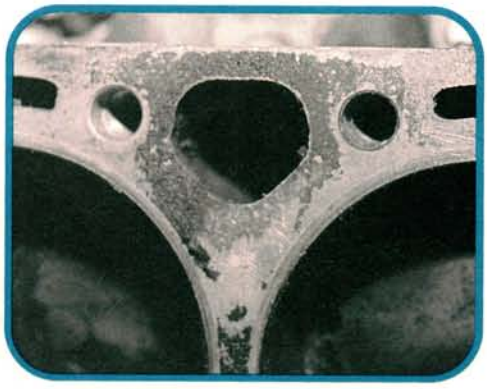
12

Take the cam housings over to the parts cleaning tank and begin removing the old RTV sealer. You should be able to use your fingers to remove most of the sealer from the groove. Then use a small screwdriver and a razor blade to get the rest. Use care to avoid gouging the cam housing's machined surface.



13

The camshaft support seals and o-rings are another spot to watch for oil leaks. These parts were replaced the last time we did the timing belts, but we decided to do them again for insurance. The o-rings flatten over time. Before installing the new o-ring, we backed it up with a thin layer of RTV.

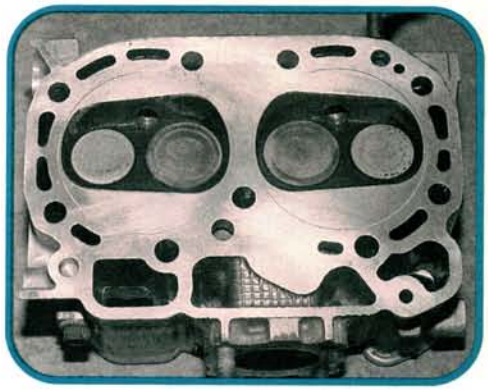


14

Use the reverse torque sequence to gradually loosen and remove the head bolts. Note the original location of each bolt; two different lengths are used. All of the engine castings are aluminum, so no air tools should be used. Remove all leftover RTV and head gasket material from the heads.

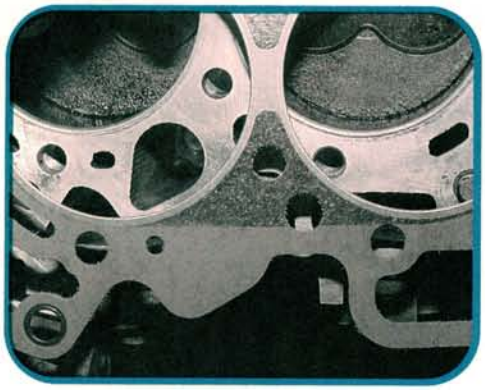
15

We've found our last oil leak. Lubricating oil passes through the head gasket on its way to the lash adjusters and camshaft. This small o-ring is molded into the head gasket to seal the passage. Time and engine heat have flattened the head gasket and its o-ring, preventing an effective seal.



16

It's not unusual to find small cracks between the valve seats on these engines. While some technicians automatically scrap the head when they find a crack, we've been told that these cracks are usually harmless. There are no cooling or oil passages nearby, so there's no risk of fluid loss.

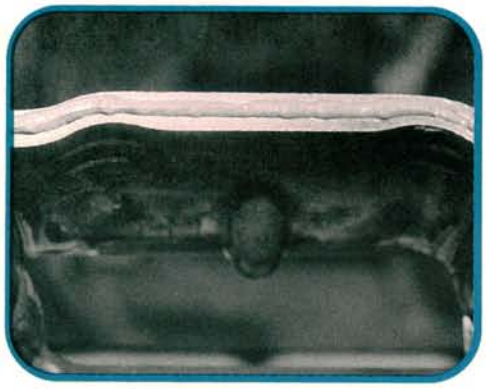


17

Finish cleaning the cylinder heads and gasket mating surfaces, then install the new head gaskets. Turbo head gaskets can be used on non-turbo engines in a pinch, but never the opposite. The gaskets are graphite impregnated and must be installed on clean and dry mating surfaces.

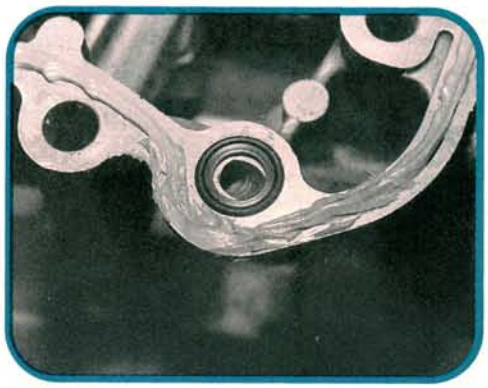
18

Clean the head bolt holes and bolt threads, then dip the bolt heads, washers, and threads in clean engine oil. Use the recommended torque sequence to torque the head bolts in three steps. Begin at 29 Nm (22 ft-lb), a second step at 59 Nm (43 ft-lb), then finish with a final pass at 64 Nm (47 ft-lb).



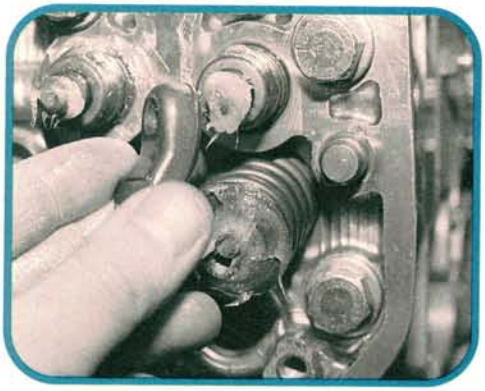
19

The cam housing sealer is next. The seal groove and cylinder head mating surface must be absolutely clean and dry. The thin bead of sealer must extend no more than 0.5-1.0 mm (0.020-0.039 in.) above the seal groove. Only Threebond 1215 or Permatex Ultra Grey sealer are recommended for this job.



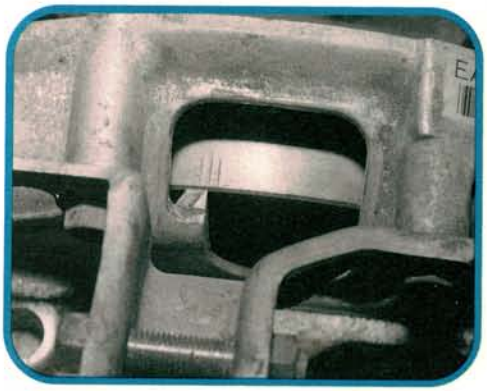
20

Don't get carried away with the sealer. There's very little space between the castings, and the extra RTV may squeeze out and clog passages. Hold the oil passage o-ring in position with petroleum jelly. Extra sealer here may clog the oil supply passage, causing lash adjuster problems.



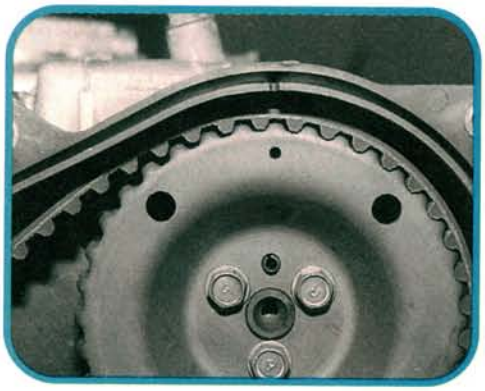
21

Reinstall the lash adjusters, and use petroleum jelly to hold the cam followers in position. Apply assembly lube to the cam and cam followers. Position the camshaft dowel pin at 12 o'clock, then lower the cam housing into position. Torque the cam housing bolts to 17.2-20.1 Nm (12.7-14.8 ft-lb).



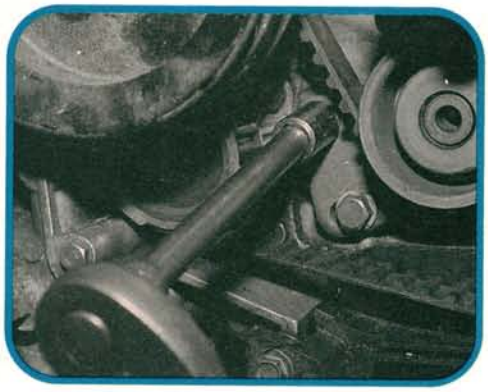
22

Reinstall the inner timing covers, tensioners, idler pulley, and timing sprockets. Temporarily reinstall the crank pulley, then line up the center of three lines scribed on the flywheel with the timing mark on the flywheel housing. This mark is used for belt installation only and is not the TDC mark.



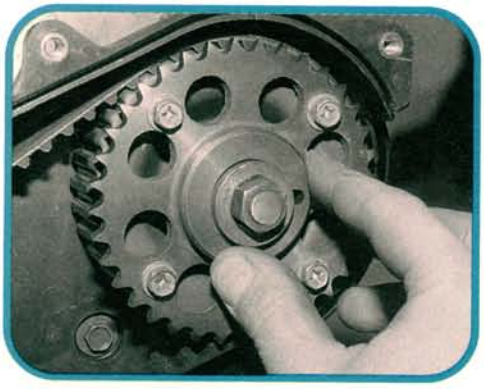
23

Align the left timing sprocket mark with the notch on the inner timing cover. Attach the new left timing belt to the crankshaft sprocket, belt idler, and camshaft, in that order. Keep all belt slack on the tensioner side of the belt while keeping the lower side of the belt as tight as possible.



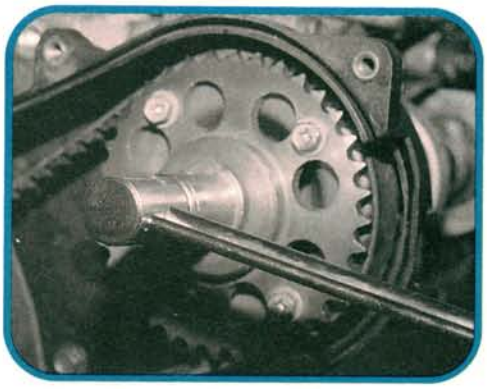
24

Loosen the tensioner bolts by a half turn to apply tension to the timing belt. Squeeze the timing belt by hand to ensure that the tensioner is moving smoothly. Rotate the crankshaft several times, to evenly distribute the tension around the belt. The timing marks should line up again on the fourth turn.



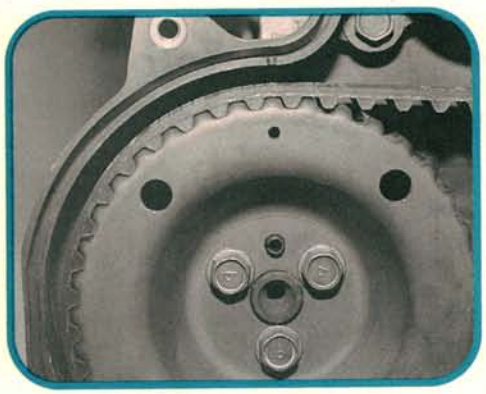
25

Proper belt tension is achieved by using a torque wrench to turn the cam sprocket counterclockwise. This removes all belt slack from the tight side of the belt. This fixture was made from an old timing gear, eliminating another special tool. Bolts engage the sprocket holes for the sprocket torque sequence.



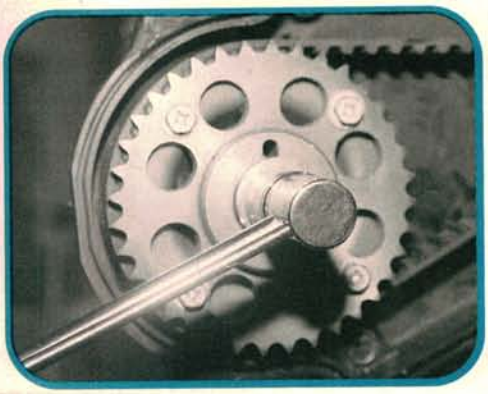
26

Loosen the tensioner bolts, then use the fixture to turn the cam sprocket counterclockwise. A new belt and head gasket call for a left belt torque of 25.3 ft-lb. Any other combination of new and used parts calls for a torque of 18.1 ft-lb. Tighten the tensioner bolts while holding the torque setting.



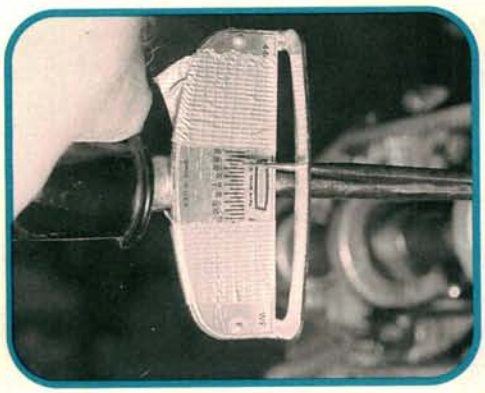
27

Turn the crankshaft one complete turn. The center flywheel timing line should line up with the timing mark. The left camshaft sprocket timing mark should line up with the timing notch at the bottom of the left inner timing cover. Align the right camshaft sprocket hole with the 12 o'clock timing cover notch.



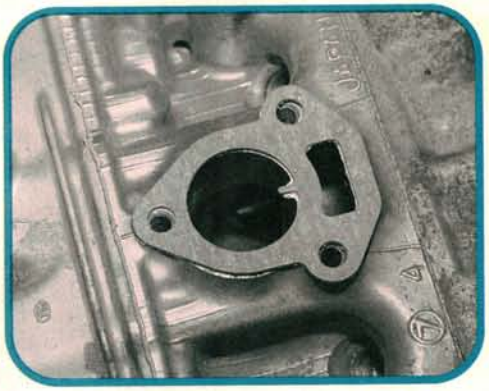
28

Attach the timing belt to the crankshaft sprocket and cam sprocket. Keep the upper section of the belt tight, while leaving the slack on the lower, tensioner side of the belt. Loosen the tensioner bolts to take up the slack, then rotate the crankshaft several times to distribute the belt tension.



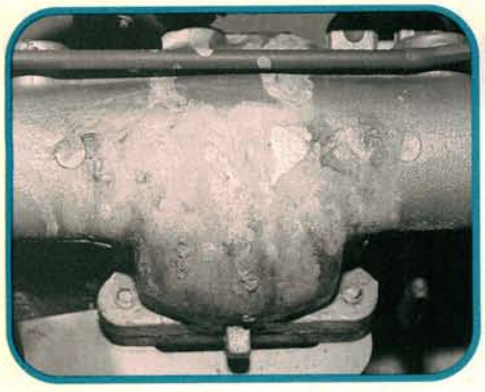
29

Line up the belt timing marks again, then install the tensioning fixture on the right cam sprocket. Use the torque wrench to apply 18.1 ft-lb to the cam sprocket. Tighten the tensioner bolts while maintaining this torque. Don't overtorque the belt. This may cause noise and will shorten belt life.



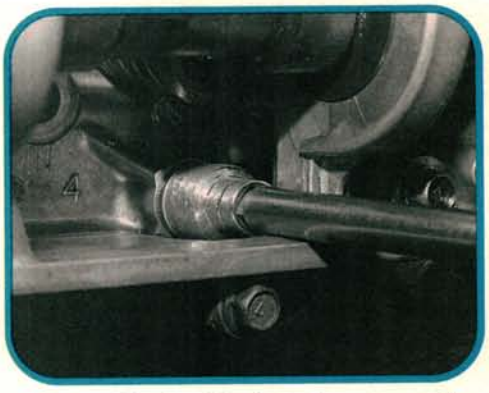
30

The intake manifold and gaskets must also be installed dry to allow for normal expansion and contraction of the alloy engine. The mating surfaces must be clean and flat. Coolant passes adjacent to the intake port. An internal leak between these passages may mimic a blown head gasket.



31

Another spot to watch for coolant leaks is the formed o-ring below the throttle housing. This o-ring may flatten over time, allowing either external or internal coolant leakage. Our external leak left a coolant trail on the surrounding metal. An internal leak here could also mimic a blown head gasket.



32

Retorque the head bolts when the engine is cold. Loosen the right side intake manifold bolts by 60 degrees. Following the torque sequence, loosen and tighten each head bolt 60 degrees. Repeat several times, then final torque each bolt to 64 Nm (47 ft-lb). This grinder-modified socket reaches the lower head bolts.