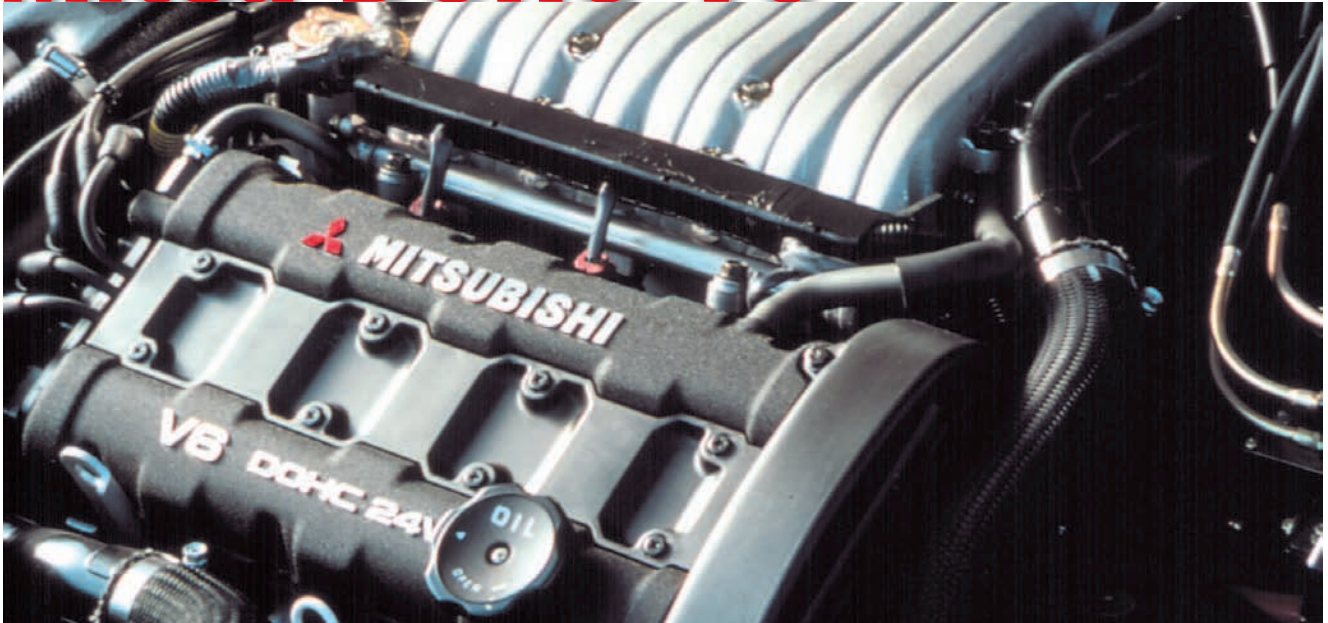


Rebelting the Mitsu DOHC V6



Some timing belt jobs are tricky, but on the Mitsu DOHC V6, you can get into serious, destructive trouble just while you're removing the old belt!

One of the most troublesome timing belt replacements is on the Mitsubishi double-overhead-cam V6 engines. There's not much difference, except for fewer parts, on the Mitsu inline fours, but we'll focus here on the four-cam V6's. With the timing belt off, not only do the camshafts want to snap out of the position you set because of the tension on the valve springs (and immediately bend a valve!), but there are also multiple positioning marks on the sprockets, the engine and the valve covers, all easy to confuse. The angle and opening dimensions of the valves mean that the intakes can strike the exhausts if you have the camshafts in the wrong position, *even if you have the head resting on a workbench*. To top it off, the instructions you'll find in the shop manual are confusing, as are those in the most common

aftermarket information sources (which are based on the confusing shop manual and accurately capture that confusion). Even the specialty timing belt books are unclear about the procedures for this engine. If you let the sprockets follow their 'druthers and line up wrong, what's more, you won't get to the point of fitting a new timing belt – you've already bent the valves before you have the old belt out of the timing cover.

The following techniques were developed by Brad Petersen of Petersen Automotive in Escondido, California, to avoid falling into one of the many looming valve-bending traps. Some self-defenses to begin with: If the old belt broke or stripped teeth off, don't even bother to check – pull the heads, check the pistons for holes and buy however many new valves you need to replace the bent ones. These are *all* interference engines and *will* sustain mechanical damage if the crankshaft turns without the camshafts, belt and sprockets all properly oriented. Should the car you're working on be in the shop for a routine timing belt replacement (which Mitsubishi recommends every 60K), do a complete compression check of the engine before you even begin. If there's a bad cylinder or burnt valve or jumped tooth, you want to know it before you begin the work. Of course, that sort of damage must be repaired first for the timing belt replacement to have any good effects.

Just In Time

When you're removing the old belt, feel free to remove everything that's in the way down to the timing cover, but don't release the tensioner pulley yet. First, we're going to confirm that everything is in proper timing configuration, and then we're going to lock it all in place before we take off the old belt. Because of the valve-spring loading on camshaft # 3 (rear intake), just releasing the belt will let that cam snap hard enough to bend one or more valves!

So step one is to turn the crankshaft until the sprocket point lines up with the timing mark, as shown in **Figure 1**.

This may be TDC #1, of course, or you may be 360 degrees off, so you check the camshaft positions. You can't fault 'em for not putting enough timing marks on the sprockets: There are several on each. Of course, that can lead to confusion, but there is good reason for it – to keep from confusing one camshaft for another if they're removed from the heads.

If the engine was running normally before, you can be sure you have the right camshafts on the right sprockets in the right positions on the right heads. Or the left camshafts, sprockets and heads, as the case may be. There are timing marks visible both from the front of the sprockets and from the cylinder head side. We'll look at the front, or right, head first.

Figure 1

Always the first step in a timing belt replacement, set the crankshaft to TDC. This may not be TDC for cylinder # 1, however, so you'll check the cam positions and, if necessary, turn the crank another 360 degrees.

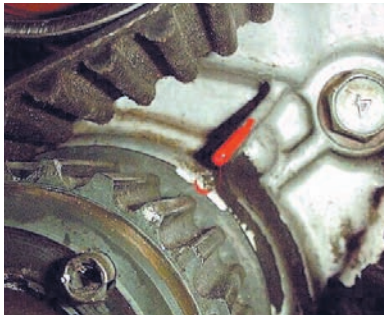


Figure 2

From the timing belt side, the sprocket marks line up as shown with the marks on the valve cover. Pay no attention to that bolt and nut until a bit later.

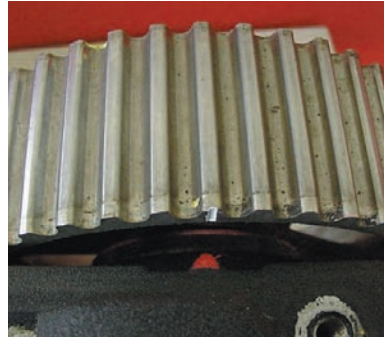


Figure 3

The outside cam on each head is the exhaust cam, and on the front or right side of the engine its sprocket carries a single notch that aligns with a triangular marker on the valve cover.

In **Figure 2**, from the timing belt side, we see the camshaft sprockets and their timing marks lined up. Shortly the point of the nut and bolt will become clear.

We daubed the paint on ourselves for clarity; it doesn't look like that under the hood. In **Figures 3** and **4**, we see the same sprockets, this time from the cylinder head side. You'll notice the twin notches on the intake cam matched with the square marker on the valve cover; likewise the single notch on the exhaust corresponding to the triangular marker, to keep from confusing which camshaft is which.

On the left, or rear, cylinder head, **Figure 5** shows the sprockets from the timing belt side, lined up with their position marks. **Figures 6** and **7** show the same sprockets from the cylinder head side: The intake cam has a single notch in the sprocket that lines up with the triangular marker on the valve cover: the exhaust cam has the double notches, lined up with the square marker. These are just the reverse of what we saw on the other head!

Surgery Begins

So far, except for the bracketry and coverings, we haven't removed anything of significance from the timing belt and gear. The engine could still run. Now's where the first trick comes in! Once you have the crankshaft and all four camshafts in their correct positions, lock the camshafts together with a flanged nut and bolt each, as shown in **Figure 8**. You can also buy special toothed-double-quadrant tools to do the same thing, but you probably already have a good selection of flanged nuts and bolts in your 'miscellaneous' drawer. Be careful, of course, to account for the whereabouts of all nuts and bolts when you're done with the belt replacement job. If you drop one down the inside of the timing cover and don't get it out before you turn the crank, you'll do all your careful work again, probably more carefully still!

Once the sprockets are locked together, you don't have to worry about the valve springs flipping cams into destruction. At that point you can loosen the timing belt tensioner, remove the old belt and get on with your work.

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Whether to replace the water pump, we leave to you. But junk the old hydraulic tensioner. These things relax over time and as the engine warms to operating temperature, and a relaxed tensioner can eventually mean a few jumped teeth. The setup for the new tensioner is critical, so don't just come 'close enough.' You first adjust the new tensioner to 90 inch-pounds. That probably won't be enough, but it is the specification. Then you tighten the center bolt.

If the crank and camshaft sprockets are all in their proper places and the tensioner is set, you can now pull the assembly pin on the tensioner. Don't throw it away yet or lose it down the timing cover. With the pin pulled, and the camshaft locking bolts removed, rotate the crankshaft a few turns by hand, being very cautious and feeling for interference. After a few turns, stop close enough to TDC to reconfirm the configuration of all the sprockets. Next, walk away from the job *for at least ten minutes*. This gives the hydraulic tensioner time to retract under belt tension. At this point, you should still be able to reinsert the locking pin into the tensioner, but if not, a clearance specification of 3.8 to 4.5 mm is acceptable, as shown in **Figure 9**.

Figure 4

Just next to the front exhaust cam sprocket is the front intake sprocket, which has two notches on the cylinder head side, notches that align on either side of a square marker.

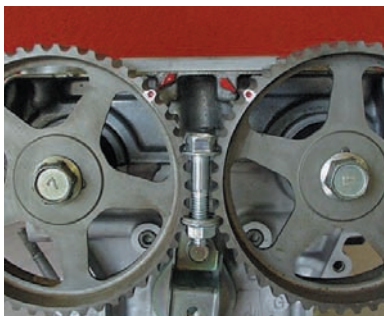
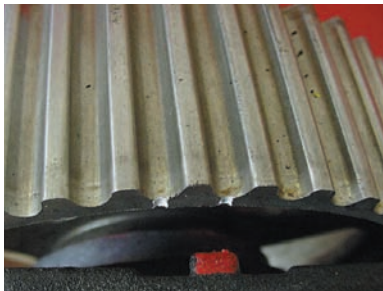


Figure 5

Like the front cylinder head, the rear has markers that correspond to points visible on the timing belt side of the sprockets. Hang tight on that bolt and nut — we'll get to them.

Figure 6

The intake camshaft on the rear (left) head has a single notch aligning with a triangular marker. Notice the differences from the other cylinder head's intake camshaft markers!



Figure 7

The exhaust camshaft on the rear, uses a double notch and a square marker on the cylinder head. Again, this is different from the front head!

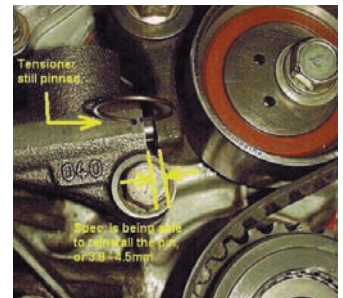


Figure 8

Don't even think about removing the old timing belt until you have the camshafts locked in position. While there is a special tool for the purpose, a pair of flanged nuts and bolts in each pair of sprockets will do the job just as well, and you already have them. Make sure you can account for where they are once the job is done!

Figure 9

Setting the pretension on the hydraulic tensioner is a critical step in the job. Too tight, and the belt will break prematurely; too loose, and the crankshaft may jump a tooth or so when starting, accelerating or decelerating. Follow the steps in the text exactly.



If you don't get that clearance or if you can't reinstall the locking pin, rotate the engine again to TDC # 1, lock the cams in position with your flanged nuts and bolts, remove the tensioner from the engine. Put the tensioner in a soft-jawed vice and *very slowly* recompress the tensioner rod so you can reinstall the locking pin. If you rush this step, you'll just bend the tensioner rod, so don't let frustration come into play now! Next, reinstall the tensioner as explained above until you can reinstall the pin and get the clearance measurements. This is a bit fussy, but it is a critical step since it puts the tensioner in an area that will not extend to its fullest. Otherwise it could lose tension on the timing belt when under sudden stress, as when starting or during sudden acceleration or deceleration.

Doing this job this way means a nice, uneventful job ending in those couple of split seconds right after you turn the key for the first time after replacing the timing belt. ■

— By Brad Petersen and Joe Woods