

# Camshaft Control Systems Part IV: Timing Chain Guides & Tensioners

An essential part of the timing chain system, guides and tensioners make sure the timing chain operates as it was designed. When symptoms occur, it's important to know what to look for and how to fix them.



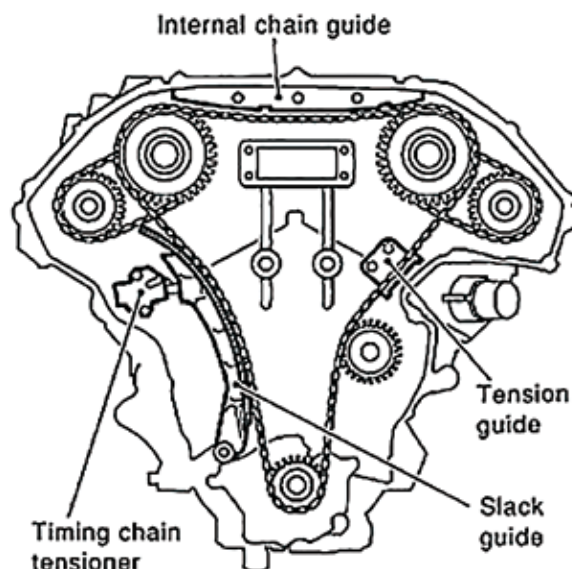
In this article, we will explore guides and tensioners on Nissan timing chain engines. While the chain does all the heavy lifting of keeping the lower end of the engine in time with the upper end, it cannot perform this function properly without guides and tensioners. They are the unsung heroes of the timing chain system. However, they are also the most common source of issues. Tensioners can weaken and cause the chain to be noisy, loose, and in extreme cases even jump a tooth. Guides can wear and lead to noises and premature timing chain wear. Sometimes they even break completely and, if not repaired in a timely fashion, destroy the engine.

First, we will look at how the guides and tensioners are supposed to work in Nissan's most popular VQ type V6 engines: the VQ30, VQ35/37, and the VQ40. Then we will look at common, and some uncommon, failures in the tensioner and guide system on these engines. And, most importantly, we will learn what causes these failures, how to identify them, and how to repair them.

For a timing chain to operate properly, it must have the correct tension. If it is too loose, it will rattle or even jump a tooth and throw the engine out of time. A loose chain will also lead to accelerated wear of the chain and sprockets. If the chain is too tight it will whine, bind, and will lead to accelerated chain and sprocket wear. The 6-cylinder VQ30, VQ35, and VQ40 engines all use three tensioners to keep its main chain, and two secondary chains correctly taut. All of them operate using oil pressure generated by the engine's oil pump. The primary chain tensioners on these engines apply tension through the slack guide, while all of the non-primary chain tensioners have guides built into their plungers. The tensioners all also contain a ratcheting mechanism to keep them from loosening too much when the engine is turned off, and to compensate for gradual timing chain wear.

The timing chain guides are typically constructed using a metal framework covered by high strength plastic. The chain rides along the plastic surface to keep it quiet, while the metal structure keeps the guide from flexing too much. These V6 engines all contain five timing chain guides:

1. The slack guide, which spans most of the distance between the crankshaft and bank 1 of the cylinder head. This guide is acted upon by the main timing chain tensioner, and is perhaps the most crucial of all the guides.
2. The internal chain guide, which the main chain rides along between bank 1 and bank 2 at the top of the engine.
3. The tension guide, which is much smaller than the slack and internal guides, is mounted between bank 2 and the water pump. It ensures that the water pump bearing is not damaged by taking some of the axial stress off of it.
- 4-5. And finally, the two secondary guides that are acted upon by the secondary



Here we see the main timing chain guides on a Nissan VQ35. All the V6 engines have similar guides.

tensioner to keep the secondary chain properly tensioned.

The issues we typically see associated with guides are accelerated wear and breakage. Both almost always lead to timing chain noise, but the noise varies depending on the nature and severity of the guide wear.

Usually the damage from guide issues is limited to what is under the timing cover, but if ignored for too long they can lead to internal engine damage. Do not ignore timing chain related noises, as they will only get worse and lead to more damage.

Nissan's various V6 powerplants are all excellent engines, and are used in more Nissan vehicles than any other engine. They are typically trouble free engines, but can suffer from a couple of timing chain guide-related issues. These issues are usually identified by noise from behind the timing cover, and require only a stethoscope or similar tool to diagnose. Repairs, unfortunately, are much more time consuming. The first issue we will discuss is the main timing chain slack guide breakage, and how to repair it. Then we will discuss what happens when the secondary timing chain guides (commonly referred to as shoes) wear excessively, and how to repair them. Then we will look at some less common tensioner and guide issues, as well as problems with water pumps.

There is no TSB released from Nissan regarding slack guide breakage. It can be identified by a hard rattle on startup, typically after cold soak, from beneath the timing cover. Typically, the noise changes tune when the engine speed changes. As engine speed increases the rattle frequency increases, but the volume and distinctness decrease. Usually, the noise will go away once the engine warms up a bit, but not always. The first step in diagnosing this failure requires only a stethoscope. Probe around the timing cover area with it, and if the noise is coming from the right side (towards the rear in front wheel drive applications) on the upper half of the cover, then it is likely to be a broken slack guide. Luckily, there is an access panel that

covers the main timing chain tensioner. It can easily be removed to verify this diagnosis. Remove the three bolts holding the cover down and pry it off. Be careful not to damage the mating surfaces though. Once this cover is removed, use a mirror to take a look at the tensioner. If its plunger is fully extended, then you have confirmed that the slack guide has broken and proceed with repairs. The reason the plunger is fully extended is the plastic portion of the guide has broken near the top, and the remaining portion has slid down the metal frame. The plunger should be pressing against a formed plastic section of the guide, but that section has slid down along with the rest of the guide's plastic. The plunger is then allowed to extend fully until it contacts the metal frame of the guide. The tensioner was not designed to extend this far, so it cannot provide proper tension to the guide, and ultimately, the chain. The noise that you hear is from the chain slamming back and forth into the guide and tensioner plunger.



Here we see the tensioner contacting the correct portion of the guide, but the guide has broken and started to slide down the frame.

If the tensioner cover is removed and you find that everything looks normal, it is likely that the problem lies in the tensioner itself, or the lubrication circuit. It is possible that oil pressure is bleeding off while the engine is off, or that proper oil pressure is not reaching the tensioner quickly enough. Oil pressure bleed-off can be caused by something as simple as a poor quality, non-OEM oil filter. Nissan oil filters have anti-drain back valves built into them that keep this kind of thing from happening. Low oil volume will cause many problems, including weak timing chain tension. It should go without saying, but be sure to check oil level and condition before spending time investigating anything else.

Another possibility is that the chain tensioner itself has a leaking plunger seal. This will cause oil pressure to bleed off any time the engine is off, and can potentially not allow proper oil pressure to ever build in the tensioner. Luckily this chain tensioner can be replaced fairly economically, as it does not require removing the timing cover. If there is not a problem with the tensioner or the guide, the next possibility is that there are clogged filter screens in the timing cover that are not allowing proper oil volume to reach the tensioner quickly enough. The best way to check for this without tearing down half of the engine is to simply remove the oil filter and tensioner, and apply shop air to the oil filter mounting stud. The main chain tensioner is one of the first components to receive oil pressure after the filter. A steady stream of air should be felt at the tensioner oil feed hole. If it is not, then there is a restriction in the lubrication circuit that must be addressed.

Another item on Nissan V6 engines is excessive secondary timing chain guide wear. This can be identified by a high pitched buzzing or whining from the secondary timing chain area. It increases in frequency as engine speed is increased. If it does not increase in frequency, then there is likely to be another problem and it should be diagnosed properly, per the service manual. The noise is caused by the chain rubbing through the secondary tensioner

shoes and thus riding on a surface that was not designed for this. This condition also makes it very difficult for the tensioner to properly tension the secondary timing chains. Nissan has released a TSB (NTB07-042d) detailing it, as well as upgraded tensioner shoes (P/N 13028-ZK01C) that don't wear out in this fashion.

The secondary tensioners themselves do not require replacement, as the worn shoes can be pried off of them easily. Special Service Tool J-50246 is required, however, to compress the new guide shoes into place



Here we see a broken slack guide has completely dropped, and the main tensioner plunger has fully extended. Notice how the plunger is contacting the metal frame of the guide. You can check for this relatively quickly by simply removing the main tensioner cover.



Typically the slack guide breaks near the top and the entire plastic portion slides down the metal frame.

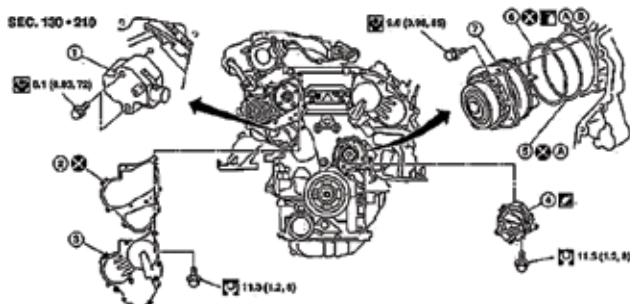
once the old ones have been removed. The tool can be ordered from Nissan's Tech-Mate authorized tool and equipment program website at [nissantechmate.com](http://nissantechmate.com).

The TSB also requires replacing both secondary timing chains, as they wear excessively due to lack of proper tension. All other components under the timing cover, including the secondary tensioners, will typically be reused, but they must be carefully inspected to ensure they are not worn.

Nissan V6 engines drive the water pump with the timing chain. These water pumps can become noisy, and mislead you into thinking there is a problem with timing chains or guides. The tension guide is just above the water pump, so when we hear noises from the left side of the engine we must determine if the problem lies in the water pump or the tension guide.



This is a secondary shoe being replaced without removing the secondary tensioner. It requires special service tool J-50246.



In this image we can see the location of the water pump, primary tensioner, and their covers in relation to the rest of the VQ35 engine.

Excessive wear to the tension guide will typically result in a higher pitched whine from the upper left of the engine, similar to the secondary tensioner whine. A noisy water pump, in contrast, will usually rattle, screech intermittently, or produce a wheel bearing type droning sound from the pump. Probe it with a stethoscope and try to determine if the sound is louder at the water pump cover or just above it. If there is a noise from the area, but you aren't sure if it is the pump or the tension guide, there is a fairly quick way to rule out the water pump. Set the engine to TDC compression for cylinder #1. Remove the water pump cover and primary tensioner cover or the valve timing control cover bank 1, which covers the tensioner on the newer engines. Release the tension by pulling the lever on the tensioner body downwards, pushing the tensioner plunger into the body, and then locking the lever using an Allen wrench. Then remove the tensioner bolts and the tensioner. Now that there is some slack in the chain, turn the crankshaft pulley approximately 20° counter clockwise. This transfers the slack to the water pump side of the engine so the pump can be removed. We do not need to remove the pump for this test, however, simply free it from the timing chain so it can be spun by hand. If any grittiness or roughness is felt, then the water pump is the problem. If the water pump feels normal, then the tension guide is likely the source of the noise.

While it is not possible to cover every scenario in which a component of the timing chain tensioner and guide system fails, this article should shed some light on what you are most likely to see fail in this system. The purpose of this article is to familiarize you with how the tensioners and guides are supposed to work, how to service them, and what to look for first. Servicing any of the timing chain guides requires removal of the timing cover, which is quite a lot of work. That is why diagnosing properly is so important. It is well worth spending an extra hour to be sure, rather than pulling the timing cover only to find that nothing under it is damaged. |