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TechNews

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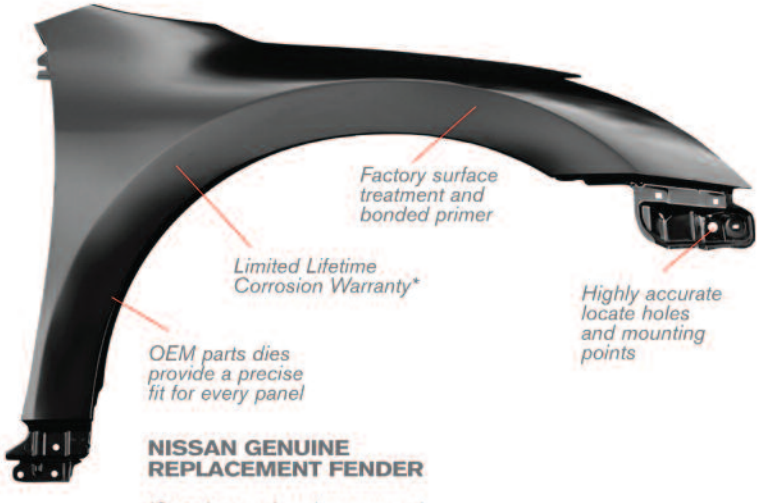

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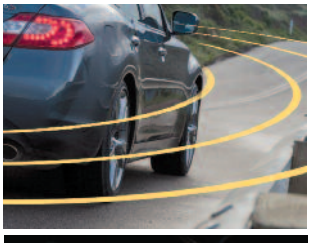


Department

Beyond the Belt

The automotive accessory drive belt is a staple maintenance item. Let's take a look at the types of drive belts, material structure, adjusting tension, diagnosing problems, and a few tech tips for working with them on a daily basis.

Everyone knows about drive belts. Even customers will often attempt to diagnose their own cars, claiming that their Altima's "fan belt" is making noise. Of course, that car has an electric cooling fan, but the sentiment is what matters most. Drive belts have been employed since the vintage vehicles from around World War I, so it's no real wonder that people are familiar with them. Yet, how familiar are we really with the details surrounding a drive belt? We'll shed some light on the history of the drive belt: its evolution from one shape to another; the chemical engineering involved in its materials; and the proper way to inspect and service it.

Before we get into the nitty-gritty of the drive belt, let's talk about practical information that may help your daily work. The purpose of a drive belt is to attach two pulleys and for one to drive the other using friction. Anything that prevents or reduces belt friction will also prevent the transmission of power from the crank pulley to the accessory pulley(s). Drive belt service should include checking tension, material wear or contamination, pulley alignment, and bearing roughness.

Types of Drive Belts

Let's address the different styles of drive belts you will encounter when working on Nissan vehicles. All drive belts are designed to do the same thing: transmit power from the crank shaft to the accessories. Each drive belt will be made up of three primary components:

1. The heat and oil resistant coating called the cover.
2. The stability and strength enhancing fiber band called the tension member.
3. The softest rubber, friction-providing compression section.

Until somewhat recently, the most common drive belt design was the V-belt. It is thin, using a trapezoidal compression section that wedges between the sloped sides of a deep pulley. However, this design has a few inherent problems that result in its comparatively short lifespan. Like a pencil eraser, rubber will scrub off over time from the sides of the trapezoidal compression section. Without automatic tensioning, this causes the belt to elongate and lose friction strength requiring periodic adjustment. The bottom of the belt is not providing the friction, it's the sides only. So, if the belt ever bottoms out, it's beyond its service life or too small for the application. Also, the V-belt requires a large, deep pulley for lots of contact area with the friction wedge. This can limit engine layout options.

The V-belt design was more or less multiplied and miniaturized to create the most common type of belt in modern cars called the multi-rib belt. This ribbed belt has many benefits over the V-belt. First, it eliminates the need for deep pulleys, which allow for better engine layout and design possibilities for compact cars. Second, the method of generating friction no longer scrubs significant amounts of rubber from the compression section. Additionally, since the belt is flatter and wider, the backside surface can be used to power accessories that may not command a significant load.

If there's only one belt to power all the accessories, it's a serpentine drive belt. Most similar in design to the standard multi-rib belt, the serpentine belt is often engineered in a way to resist the wear introduced by its circuitous route. The backing cover is reinforced on a serpentine belt to resist wear and abrasion from idler bearings or pulleys that use the back side for friction instead of the ribbed side. Nevertheless, a serpentine belt does not last quite as long as a standard multi-rib belt, so be certain to check periodically using the tips below. Just like its namesake, the snake, it bends both ways.

Notice the trapezoidal shape of the V-belt. This quality Nissan belt also has extra material in the compression section to improve longevity.

This serpentine belt has a reinforced backing seen in the white threads, and it has additional material for powering pulleys using the non-ribbed side.

This same adjuster pulley is available with and without the mounting bracket. At the top of the adjuster nut is a friendly reminder to retighten the belt after installation.

Properly Checking and Setting Belt Tension

With the different types of belt designs in mind, let's explore how to check and set their tension properly.

There's no way around it: checking belt tension requires tools. Nissan has an official gauge designed to check belt tension (P/N BT-3373-F), but any tension gauge will work. You should check and set the belt tension when the vehicle is cold. The gauge measures the amount of deflection in the belt with a controlled force applied. For instance, the 2003 Pathfinder A/C belt should deflect 12mm with 98 Nm of force applied. Using a different type of tool, you may be able to measure the amount of force it requires to deflect the specified amount. Either way, the proper tension or deflection measurement can be compared to a table in the service manual. Bear in mind that there is no "general rule" for tension because different belt styles, thicknesses and lengths will all deflect a different amount.

A newer drive belt will have a different published deflection or tension specification than an older belt. Consult the factory manual to determine the appropriate tension for each particular vehicle. This is because new belts will stretch, or break in, and Nissan accounts for that behavior.

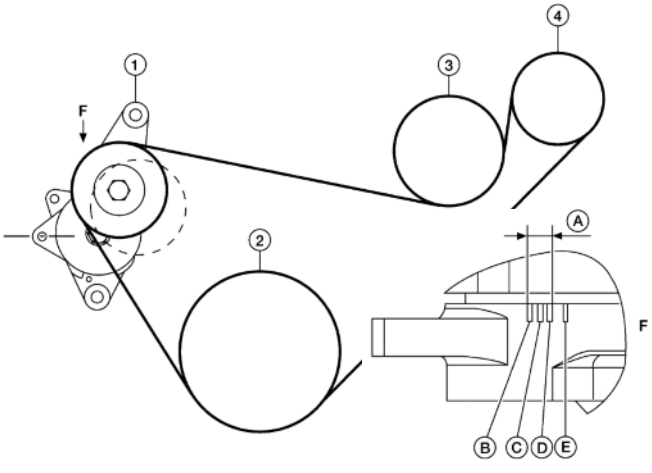
This spring-loaded automatic belt tensioner is actually the third version of the original (the last five digits began as EA200, then EA20A). A major benefit of buying Genuine Nissan OE parts is that they are constantly updating and improving designs. Aftermarket parts may be copying the design of the previous tensioners.

On many Nissan vehicles, belt tension adjustment is performed by physically manipulating a bolt to move an idler pulley. On other models, the accessory itself must be loosened and relocated to achieve the same effect.

Both methods require periodic manual adjustment. If the belt is automatically tensioned with a hydraulic or spring-loaded assembly, there will be markings on the device to indicate whether the belt has stretched beyond service life. Another major benefit is that no periodic adjustment is necessary.

When installing a drive belt, you should inspect the adjuster for play, rust, the presence of oil, proper alignment, as well as if the belt bounces or slaps while running. For automatic tensioners, check for hydraulic leaks and spring tension to determine whether the unit should also be replaced. If a spring tensioner can be moved by hand, it's likely worn out.

A drive belt with too much tension applied may cause the bearing to whine when the vehicle is on. Do not get in the habit of over-tensioning belts because "it'll just get looser." While a belt may stretch a little after the initial installation and setting of the tension, this is no reason to cause damage to pulleys and accessories in the meantime. Set the initial tension, run the engine for five minutes at 2,000 rpm, then re-set the belt tension once and for all. If you used a Genuine Nissan OE quality belt, this should be the last time you see that car for a belt!



The auto belt tensioner (F) will have markings to determine whether a drive belt has stretched too much. The side view shows the markings, including acceptable range (A).

Inspecting for Belt Wear or Signs of Contamination

A visual inspection of belt wear and contamination is necessary. Minor cracking of a multi-rib belt does not necessarily mean it must be replaced. If the belt is off the vehicle, bend it backwards and check if the cracks reach the backing band. If so, replace the belt. When the belt is on the car, rotate it so the ribs face upwards; if the belt is bad, the tension introduced should splay the cracks apart. A V-belt will lose material from its sides, which is harder to identify unless compared to a new belt. When setting a V-belt in the pulley, it should NOT touch the bottom of the pulley. The belt is designed to provide friction by being wedged in place like a dove-tail fitting, not by gripping the pulley bottom.


Light cracks; could be reused.


Moderate cracks; could be reused, probably should be replaced.


Heavy cracks; should be replaced.

If there is abnormal wear on the belt backing, verify that the course of the belt does not contact any cover or metal component. Many times, an out-of-place timing cover will contact a drive belt, causing noise and accelerating wear. Repair the initial source of contact first, then immediately replace any drive belt with backing wear. There isn't much "meat" on the back of a belt, and damage to this area can cause rapid belt failure.

Oil contamination from power steering fluid or an engine oil leak can shorten the lifespan of a drive belt. Even if the belt does not appear to be cracking or swelling, contact with oil will affect its internal chemical integrity. Identify and fix the source of oil leak first, then replace any contaminated drive belts. A splash of oil here or there, if cleaned off quickly, will not immediately ruin a modern drive belt whose external cover is engineered to resist compromise from oil. Contamination refers to consistent oil contact over a period of time.

Some drive belts may be noisy despite having proper tension, no visible cracks, and no oil contamination. The belt material is likely glazed. Glazing occurs when the belt surface heats up too much, which can be from initial over-tensioning, pulley bearing resistance, or just over time. As long as the belt retains tension, there is no action required due to glazing.

Identifying Drive Belt Pulley Problems

Some problems with the accessories can cause drive belt failure. If a vehicle's drive belt has broken or melted, you should suspect a seized accessory. With the belts off the car, check for binding or roughness of all the idlers and replace any that do not spin freely. Some accessories may also be the cause, so be sure to check A/C compressor clutch operation. Be careful, however, because many bearings will only misbehave when loaded. You may have to recheck for bearing noise with an automotive stethoscope after installing new belts.

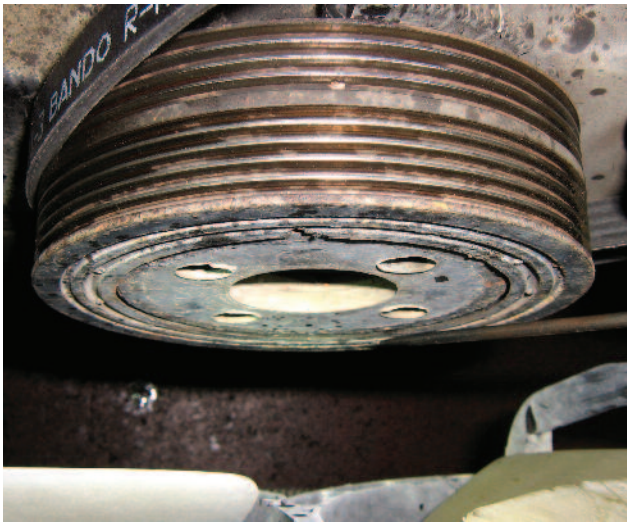
Pulley alignment and play are often overlooked inspection items. If a drive belt wears prematurely, it could be that the pulleys are misaligned, creating additional internal load on the belt. With the drive belts off the engine, you can easily use a straight edge to confirm proper alignment.

A pulley bearing that has excessive free-play may also cause premature wear by stretching the belt too much laterally.

A special note about crank pulleys with harmonic balancers: the rubber can deteriorate allowing the outer pulley ring to rotate with respect to the inner. This uncommon scenario can cause belt slip symptoms, or even belt failure.

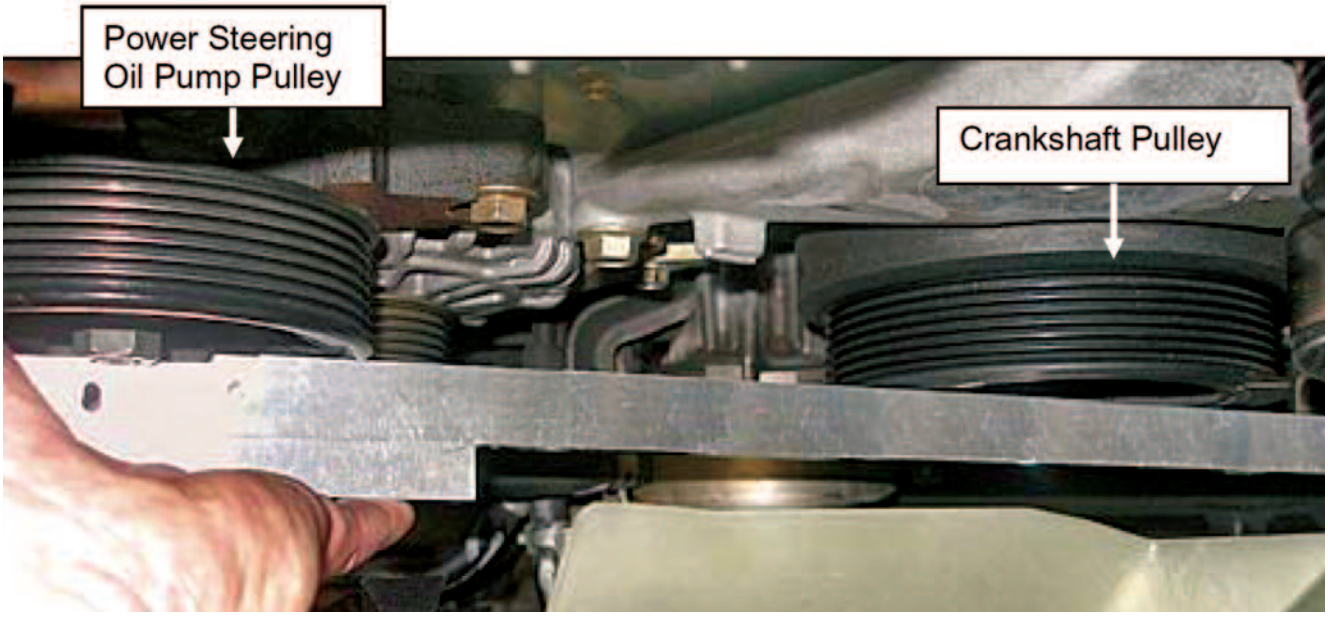
The Right Belts

Finish the job correctly by installing Genuine Nissan OE drive belts. The specifications for tension are published using these belts in mind. They are also manu-



Perfectly normal harmonic balancer/crank pulley assembly, right?

No! The pointer has remained in the same position between the two images.



Check pulley alignment between the crankshaft pulley and the power steering pump using a straight edge.

factured with superior materials, able to resist oil and other solvents better than inferior drive belts. Their internal reinforcement structures are also better engineered, which prevents excessive stretching over time. Whenever you finish installing drive belts, and adjusting the tension cold, run the vehicle for approximately five minutes. After this initial conditioning, wait for the belts to cool before checking and readjusting belt tension. If you used a Nissan belt, this final tension should last the majority of the life of the belt. Using quality Nissan belts, you will have fewer customers come back to your shop for readjustment.

Chemistry – a Brief History of Rubber Polymers

Now we know not to let oil touch the belts, but why is that? We should begin with a bit of history and terminology. Drive belts aren't made of rubber, per se, because traditional natural rubber is made from the sap of a tree. Modern rubbers are actually synthetic blends derived from molecules found primarily in petroleum oil. There was great demand in the early 20th century to develop an alternative to the plant-derived, natural rubber. Thus began the creation of many different petroleum-derived polymers that could function like traditional rubber.

Without going overboard in the explanation, a polymer is a generic term from chemistry. Many things are polymers, some of them are man-made and some exist in nature. A polymer is formed from multiple monomers, which is another generic term for any molecule structure that can conjoin with a similar structure. For instance, we often hear about high fructose corn syrup, which is a polymer created from the naturally occurring monomer called glucose found in corn.

Nissan drive belts are primarily made from neoprene, a synthetic rubber, which has undergone one further chemical process called vulcanization. Vulcanizing a polymer will introduce substances called curatives, and that allows the manufacturer to control many qualities of the polymer. Just like engine oil additives, the mixture is unique and secret. We're not just talking about "how stretchy" the synthetic rubber is, but also how resistant to heat, solvents and oil. To give you a sense of the control the chemical engineer has, just imagine that a bowling ball can be made from neoprene using a different vulcanization technique.

So, when oil contacts a drive belt or other rubber polymer you can start to piece together why this is bad. A slow chemical reaction occurs where the oil molecules begin to compete for the curatives within the polymer. This effect causes the properties of the syn-

This particular belt is clearly marked with its material type.

thetic rubber to change, and in the case of neoprene, the tensile strength and hardness are reduced, but the elongation increases. Tensile strength is how much pulling force you have to apply before it breaks. Hardness is what you would expect. Elongation refers to how much the material will deform before it breaks. Low tensile strength with high elongation means you would not have to pull very hard to break the material, but it would stretch a lot. This is exactly what you do not want to see in your drive belts, and now you know why you don't want them to come in contact with oil!

Nissan also uses a superior material called EPDM (Ethylene Propylene Diene Monomer) for some belts, found often in cooling system hoses. When exposed to oil contamination, EPDM does not lose tensile strength, but its elongation significantly increases. This is why you may see coolant hoses "balloon out" when oil-soaked.

Drive belts aren't solely composed of synthetic rubber. They also have fibers woven into the backing band. These polyester fibers tend to be a polymer of a different family called thermoplastics. Thermoplastics are affected by heat. In the case of drive belts, woven polyester fibers will contract and shrink when exposed to heat, which is a perfect behavior for keeping tension on a pulley. The fibers are coated with another plastic, PVC (polyvinyl chloride), which allows them to flex without fraying. The fibers gain increased tensile strength from the significant number of threads wrapped together, as well as their length.

Like tires, you get what you pay for with drive belts. There is a lot of materials technology and engineering involved in making drive belts, and just as with tires, investing in a better quality part is better for everyone involved. Nissan drive belts are the best belts for Nissan vehicles.

Where'd the Drive Belt Go?

In some new hybrid configurations, the drive belt may have gone the way of the Dodo. Using the high-voltage battery pack and multiple computer controllers, the Altima Hybrid eliminates the A/C compressor belt. The belt-driven compressor is replaced by an electrically-driven compressor, which allows for greater efficiency. The 2012 Infiniti M series has eliminated the power steering belt by using an all-electric power steering rack that does not have an external hydraulic pump.

For an engineer, being able to control the load and demand from accessories on the fly dramatically improves fuel economy. They can do this best by turning an "always on" drive belt configuration into an "on demand" electrical system. As with all their technologies, expect Nissan to develop a way to go beyond the typical drive belt.

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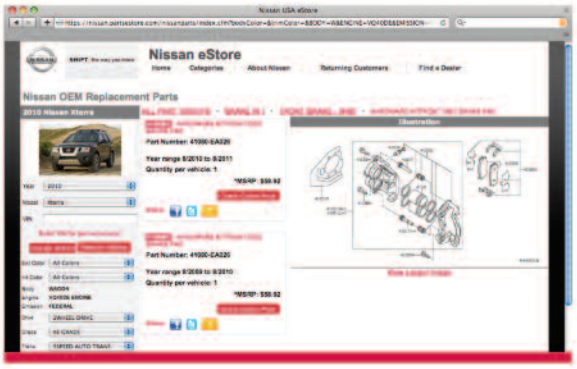

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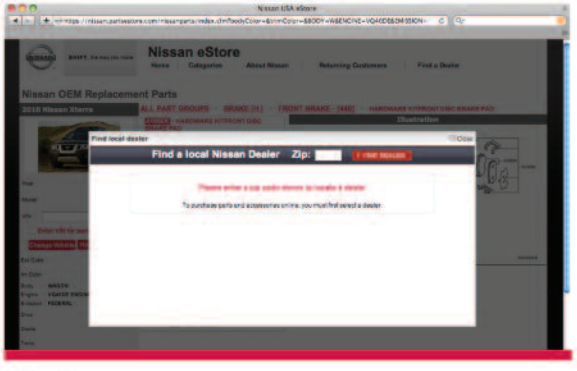

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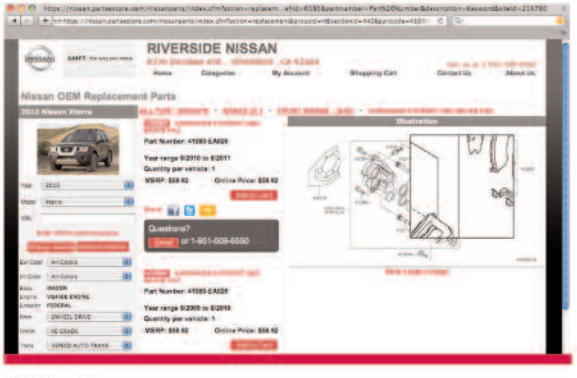
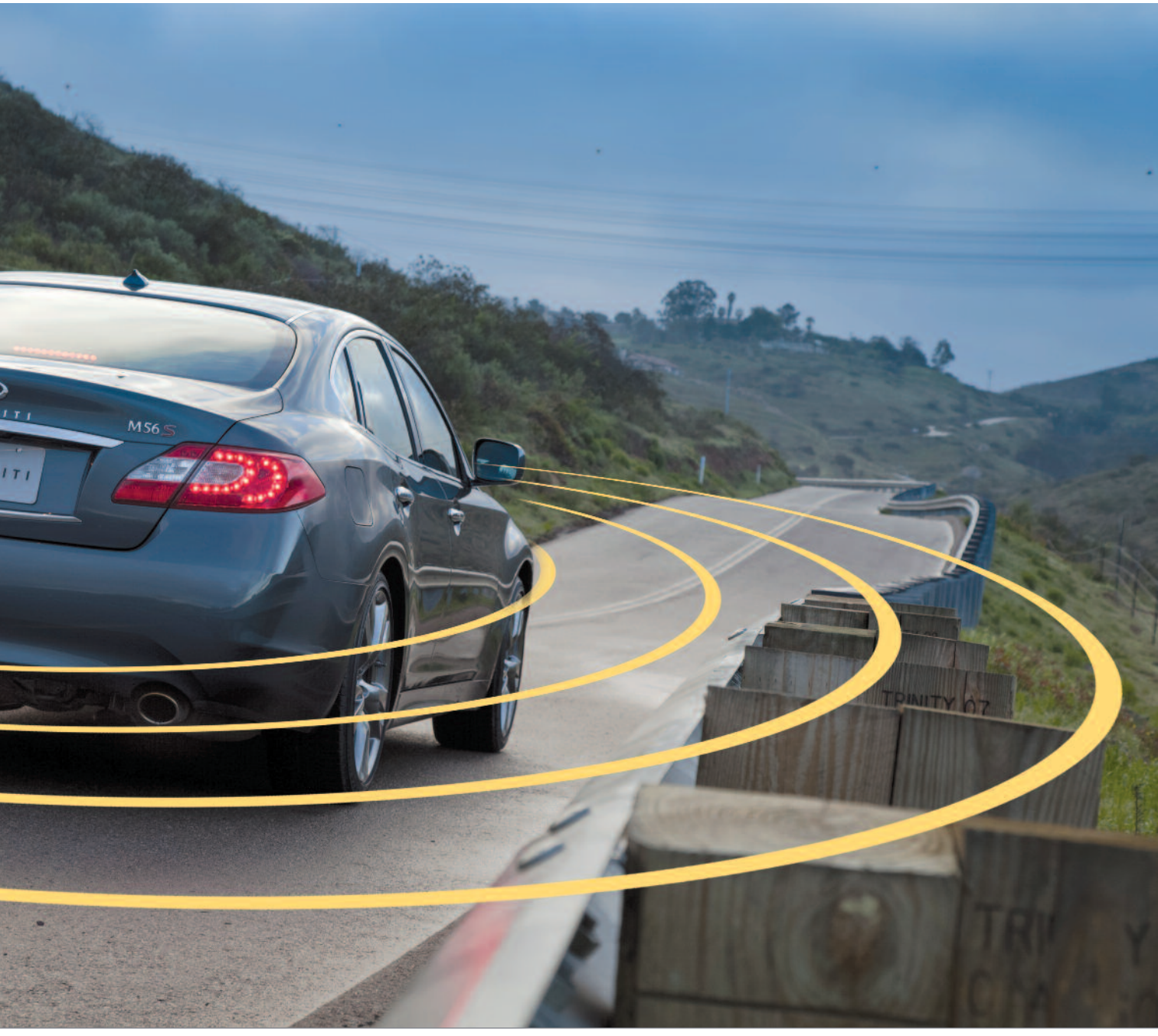


Click.

Once you're logged in, the chosen part(s) are still in your in box, but now the custom pricing of that dealer is shown. Once added to the shopping cart you can continue to checkout.

Advanced Driver Assistance System (ADAS)



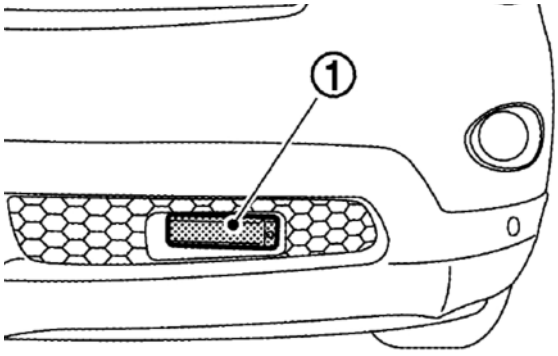
Lane Departure Prevention, Intelligent Cruise Control, and other advanced controls are Nissan's newest line of features in some vehicles.

Accidents happen. Sometimes nothing can be done to avoid a collision, but Nissan goes the extra mile with some of its newest vehicles to help reduce the likelihood of an accident occurring. We'll take a look at how radar, sonar, camera, and laser inputs are used to monitor the area around the vehicle. This information, when combined with on-board VDC (Vehicle Dynamic Control) and all-wheel ABS, creates a car that can alert the driver about potential hazards. In some cases, the car can help reduce the severity of an accident by predicting an imminent collision. Taken together, these are often referred to as "Nissan Safety Shield Concept Technologies."

High-tech help for the motorist

It's important to remain consistent with our terminology, so let's spend a moment to talk about all the vehicle controls that comprise the Advanced Driver Assistance Systems (ADAS). ADAS works with Vehicle Dynamic Control (VDC) to assist the driver by slowing the vehicle as necessary to maintain safe distance, or to use differential braking to create yaw adjustments, effectively steering the car. The core of ADAS is made up of sensors that are able to survey the road combined with VDC and ABS controls that allow the car to adapt to its surroundings.

In order to "see" forward-oriented objects, ADAS uses a forward-sweeping laser that can detect other vehicles, interpret their speed, and logically determine whether to apply the brakes and alert the driver. Two other assistance systems utilize this forward laser: Intelligent Cruise Control (ICC) and Distance Control Assistance (DCA). Both must be toggled and controlled by the driver using a switch. These systems utilize the forward ICC Sensor for decision making. In the case of ICC, the car will automatically adjust the vehicle's speed and distance in relation to another vehicle in front in order to provide comfort when cruising, and to eliminate the need for constant adjustments by the driver. DCA works in a similar fashion, but if it is turned on, the vehicle will attempt to assist the driver at all times. This means that when DCA is engaged, the car will actively brake to a stop within the limitations of the system as necessary.



The main ICC sensor (1) also houses the computer used in determining how to control the rest of the vehicle based on sensor input.

The ICC Reflector Detection Sensor (A) sweeps forward, identifying its surroundings based on other vehicles' standard-issue light reflectors.

Lane Departure Prevention (LDP) uses a front camera mounted in the windshield to help keep the driver

from wandering over the center lines, or onto the shoulder. This assistance feature must be toggled by the driver, and is temporarily disabled when using the turn signal.

Intelligent Brake Assist (IBA) helps the driver in the event of an emergency stop. IBA will remove the brake pedal free play, which shortens the effective reaction time of the driver. However, without any driver input, the vehicle won't do anything on its own.

There are also many audio and visual warning systems that increase the driver's awareness of his surroundings. When DCA detects another car ahead, the gauge cluster display will turn on the vehicle detected icon. If DCA cannot stop the vehicle in time, the Forward Collision Warning (FCW) will alert the driver with a chime that he must apply the brakes. Likewise, if another vehicle is located in a blind spot, the Blind Spot Warning (BSW) lights will be activated, and if the driver puts the turn signal on, a chime will sound. Of course, it's up to the driver to properly signal for turns, and the system will not steer the car for him or her.

Many of these new features also help make ordinary tasks like parking or commuting safer. Multiple cameras make it easier to park or maneuver in tight spaces, and the ICC can allow a driver to retain safe distances while driving on straight highways. Let's take a closer look at each subsystem..

The ICC Sensor makes DCA and Intelligent Cruise possible

There are multiple sensors, radar and sonar-emitting devices on the newest Nissan and Infiniti vehicles equipped with ADAS. Yet, the primary forward-looking sensor is a laser, and it lives below the bumper cover of vehicles so equipped. It also serves as the computer for making decisions about the vehicle's position in time and space. These calculations are shared over CAN communications so ADAS can coordinate with DCA and ICC as necessary. Keep in mind that these advanced sensors are a trim-level option, and are not standard on every car.

Nissan calls the forward sensor cluster the ICC Sensor because it sweeps a laser beam outwards, and makes decisions based on the light that reflects back. The horizontal motion is calibrated internally, or at time of replacement, and if any upcoming threats are identified, the unit itself will communicate with the vehicle's primary ECM and ABS control unit to act accordingly. In many models, all information about detected objects is calculated within the ICC sensor unit. These distance findings, when plotted over time, give the ICC ECU a sense of how fast the vehicle is moving toward identified objects.

When compared with inputs from the ABS ECU regarding vehicle speed, and from the ECM noting accelerator pedal position, the ADAS makes logical conclusions about whether the vehicle is at risk of collision with any of those perceived reflectors. It's the same way a police officer's laser gun determines speed.

An important note is that the forward ICC sensor is designed to ignore stationary reflectors, such as those found on guard rails or parked vehicles. Therefore, the driver is the most important safety feature on any vehicle, because only he or she can determine whether there is a stationary object on the road ahead, or if the road curves abruptly.

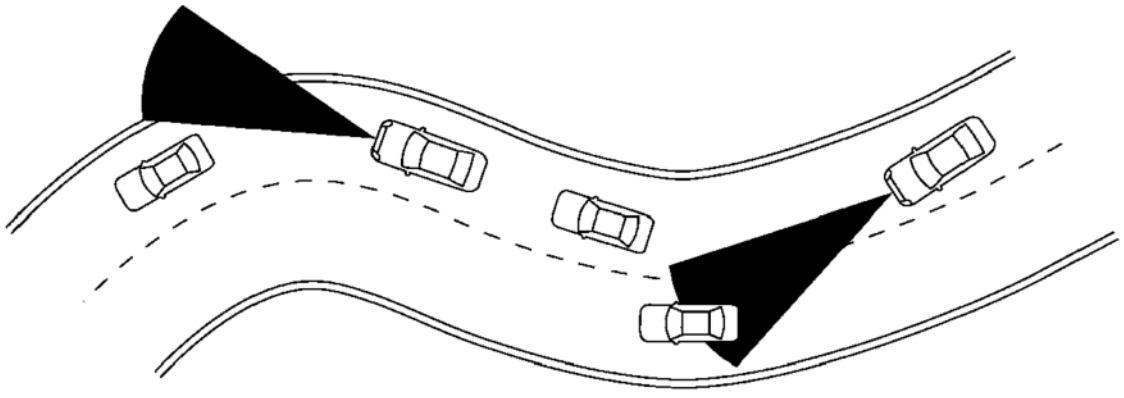
The ICC sensor is able to look just under 400 feet ahead. This long detection range makes DCA and Intelligent Cruise Control possible. Both features allow for the driver to set a desired following distance, and the ADAS can monitor and control the vehicle speed as necessary to maintain that distance. That is, with a little help from its friends, the ECM and the ABS control module. DCA logic works simply when its vehicle approaches another car:

1. If the driver DOES NOT have his or her foot on the accelerator pedal (information provided from the ECM), up to 25% of the vehicle's total braking power will be commanded (carried out by the ABS control unit) to slow the car down.

2. On some models, if the driver DOES have his or her foot on the accelerator, the pedal assembly's actua tor will push against the driver's foot in an effort to aid his or her letting off the accelerator.

If the driver forces the accelerator down despite the upward nudging mentioned above, Intelligent Cruise or DCA will be overridden. For as long as the driver is accelerating, the DCA or intelligent cruise will NOT apply braking even though it may "think" that is better. The driver may notice that the brake pedal goes down of its own accord during DCA or intelligent cruise. This is normal operation.

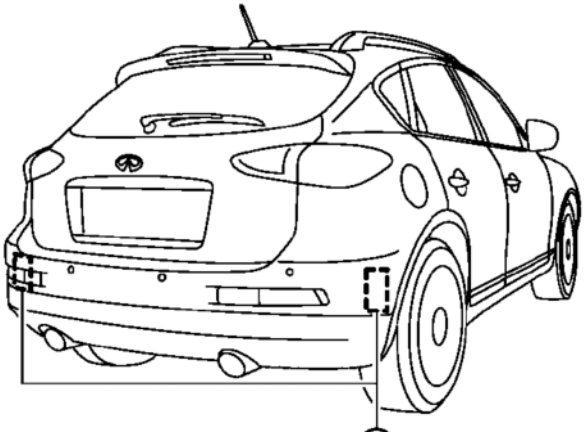
When driver braking input is required to stop, the FCW will sound a chime and blink the vehicle-ahead indicator on the gauge cluster display. If the driver goes against the DCA's attempts, the system will cancel and NOT fight the driver.



The sweep cone of the ICC Reflector Detection Sensor can be tricked by twisting roads. Safety systems are only a backup for the driver, who is responsible for paying attention at all times.

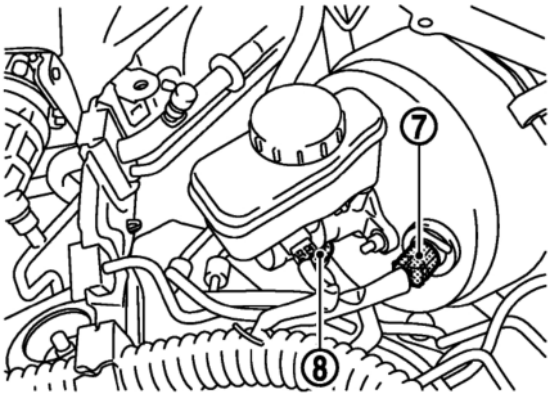
Vehicular Peripheral Vision

Human drivers don't just stare straight ahead without regard for what's around them. We must constantly monitor our surroundings to make safe lane changes, or react to possible threats. Some newer Nissan vehicles' advanced assistance features also include side radar devices to detect other cars in your blind spots and report on the danger using Blind Spot Warning (BSW) indicators. The BSW system has its limitations, however. For example, like the forward ICC sensor, side radar cannot detect stationary objects. Also, it may not observe another vehicle merging at a far lane into the blind spot during a lane change. Lastly, the BSW will not "check" for a vehicle unless you use your turn signals. The turn signal switch is the first step in activating BSW, and only good driving habits will ensure the driver is signaling. Most importantly, BSW does not take the place of checking with your own eyes.



BSW radar sensor locations (A)

Bumper stickers may obscure the sensors and prevent proper operation. If one of your customer's vehicles has body damage or bumper stickers on the rear corner areas, the BSW system may not work properly. Some calibration work is necessary after replacing sensors, and we will cover this later.

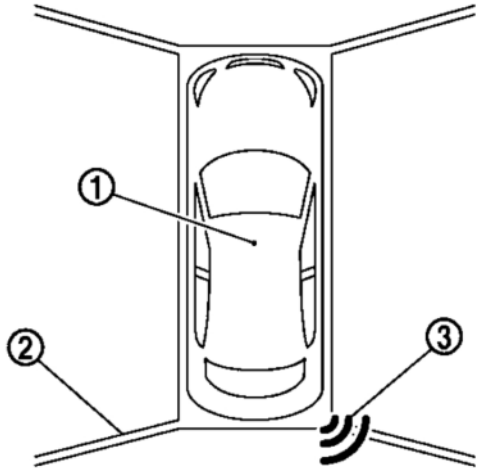


The boost solenoid (7) is responsible for firming up the pedal in event of emergency. The brake pressure sensor (8) is used in calculations for ABS/VSC behavior.

The "Voice" of an Intelligent Car

When the forward ICC sensor cluster determines that driver input is necessary to prevent a problem, there will be a warning chime and a gauge cluster indicator. This is also considered the Forward Collision Warning (FCW).

When a customer signals for a turn, the ADAS will check the right- or left-hand radar sensor about whether the blind spots are clear. If an object is detected, the blind spot indicator (BSI) located on the door



The bird's eye view camera shows the car (1), the wide angle rear camera view (2), and a sonar proximity warning indicator (3).

mirror corner cover will illuminate orange to alert the driver that something is there. Likewise, the dash indicator will illuminate. If the turn is continued, a warning chime will sound and the BSW dash indicator will blink. At that point, the driver may or may not stop the collision course, but the car has done all in its power to reduce the chances of mishap.

NOTE: Radar may not accurately detect small objects like bicycles or motorcycles.

Intelligent Brake Assist takes up the slack

Nissan has designed its new assistance systems well enough that a car equipped with ADAS features will often "know" that it will be in an accident before the driver does. The "preview function" will activate when the ADAS has determined that a forward collision is inevitable. In times of these detected emergencies, the ADAS communicates with the ABS control unit to provide a small amount of pressure to the booster, which eliminates the free play in the brake pedal. This happens before the driver even knows there's an emergency, and once he or she does, the brake pedal will be firm and immediately begin working.

If there is no emergency, after one full second, the preloaded brake pedal will return to normal. Likewise, if the driver pushes the brake or accelerator pedals, IBA will cease.

Vehicle Dynamic Control and ABS

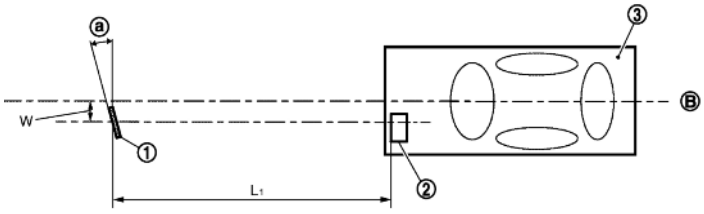
While the ICC systems are indispensable for figuring out what to avoid, Vehicle Dynamic Control (VDC) is responsible for ultimately making it all happen. VDC works in conjunction with ABS, interpreting signals from the ADAS computer and the primary ECU. VDC will control brake pressure to reduce wheel slip, so power is transferred to a non-slipping axle. It also controls engine output directly via the ECU and fuel injection cut off. It monitors brake pressure and accelerator pedal pressure to determine the reaction and intention of the driver. VDC is also the primary factor in making Lane Drift Prevention (LDP) possible.

The LDP uses a camera positioned near the rear-view mirror to interpret lane markings. If a road does not use lane markings, or the ones visible to the driver are worn, LDP will not work properly. It will also not make lane corrections greater than 20 degrees, so don't expect the car to steer for you. Also, LDP is only active at 45 mph or greater.

Lane Departure Correction begins when the ADAS notices that the driver steering input indicated by the steering angle sensor is not sufficient to continue the trajectory between the visible lane markings. Once this is detected, the system does NOT move the steering wheel. It begins to apply braking pressure by means of VDC to one side of the vehicle. In other words, if LDP wants to steer the vehicle slightly to the right, it will apply light brake pressure to the right front and right rear. VDC will receive the data from the ADAS, and then, in turn, command the ABS to apply brake pressure to the necessary wheels.

In the meantime, the LDP warning indicator will illuminate on the dash and a chime will attempt to wake up the driver, or otherwise alert him or her of the car's corrective action. If the driver was attempting to change lanes as indicated by the turn signal, LDP will not fight with the driver and once he or she continues to steer consistently in a particular direction, LDP will automatically cancel. As expected, if the driver uses the turn signal, LDP will temporarily be disabled in the direction of the signal.

Because LDP uses a forward-facing camera, driving directly into the sun can prevent normal operation. This is also true of the ICC sensor cluster's laser. It can also fail due to low light or adverse weather conditions. Using common sense, it would probably be best to control your car yourself in those situations anyway.



The special service tool reflection plate (1) must be placed about 13 feet (L1) from the ICC sensor (2). The center of the vehicle (3) will be about 10 inches (W) off-set from the reflection plate, which is set at a 25 degree angle (A).

Parking Assistance/Around View Monitor

Not only do modern Nissan and Infiniti vehicles enhance driving safely, they come equipped to handle the most common parking situations. Many low-speed accidents can occur, and multiple cameras can help drivers notice their surroundings better. There are usually three cameras and a set of sonar devices that will display the vehicle's surroundings when reverse is engaged. On the primary Multi-Function Display (MFD), once the car is shifted into reverse, the driver will get a rear camera view with two perspective lines. The two lines represent the width of the vehicle, and the tick marks represent approximate distance. The standard reverse camera is common enough, but once the driver toggles a button on the MFD, he or she can gain access to a wide-angle rear-view camera, a passenger side view, a bird's-eye view, and a front camera if necessary.

The side camera is located on the passenger-side mirror. The bird's eye view is actually quite interesting because it generates a composite from the input of all the cameras to create a facsimile of where your vehicle is in space. The front camera gives the same ability as the rear camera to "get right up" to something, which is excellent for parallel parking.

Service and Diagnosis of ICC

Considering the newness of these technologies, there is no precedent for what may malfunction as a matter of course. All cars break, but some cars will be involved in a collision despite their modern features. Many auto body shops will likely have to replace the ICC sensor module in the front bumper. Such service should be performed by a facility competent in Nissan repair. First, the CONSULT III plus is required for the calibration of the sensor once it's been installed. There is no way around this. Second, a special service tool (J-45718) is required to set up and calibrate the ICC laser.

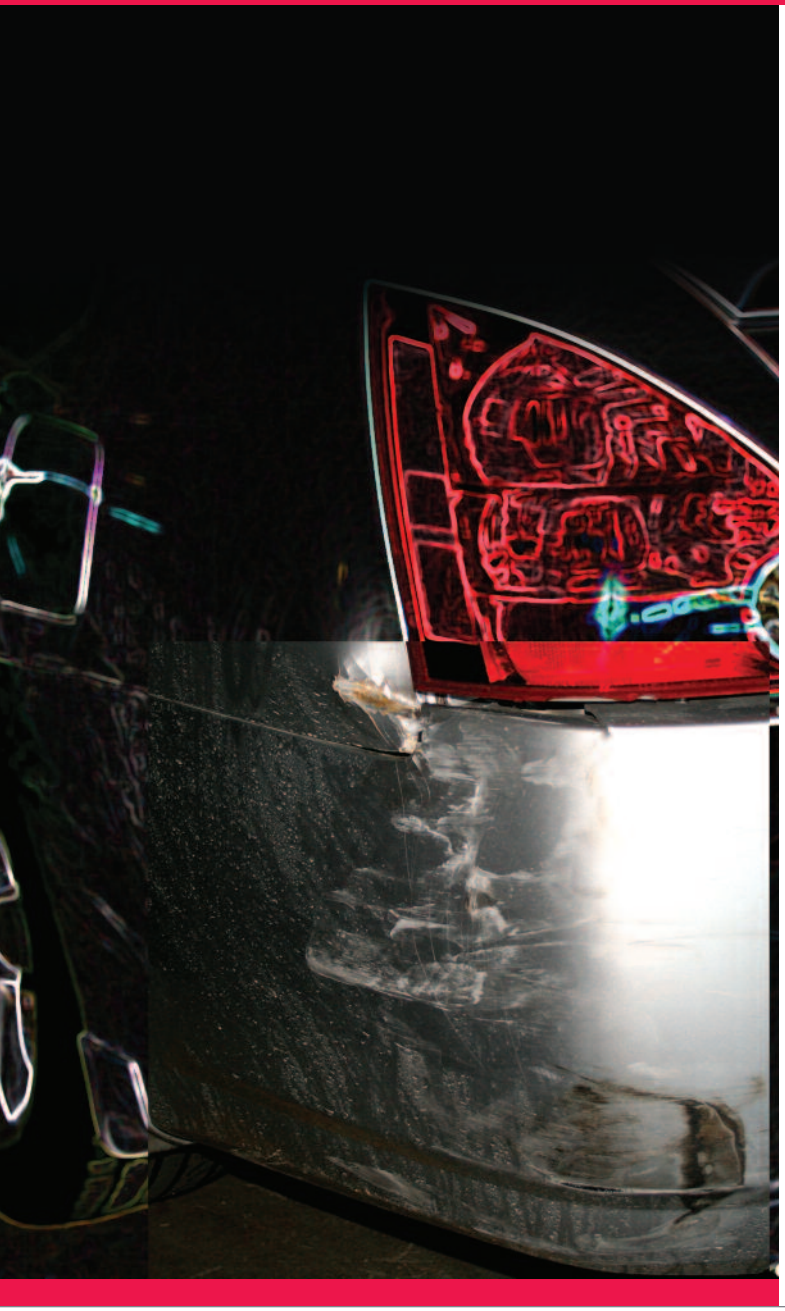
We cannot stress enough that it is important to look up the specific step-by-step procedure for the vehicle concerned at http://www.nissan-techinfo.com. Just to give you a basic idea of what's typically involved, however, we'll say that once the tools are set up, you should ensure that there is nothing behind the reflection plate that may interfere with calibration. Begin work support functionality on the CONSULT III plus, choose LASER BEAM ADJUST and begin to calibrate the vertical orientation of the laser. This requires turning the adjusting screw on the ICC sensor assembly, and once it is within vertical spec, pushing END on the CONSULT III plus. It will take about 10 seconds for the CONSULT III plus to automatically configure the horizontal scan. Confirm the repair with a test drive using DCA.

An important diagnostic tool is also the memory stored of the last reason for cancellation of cruise control. Many of the first difficulties with the system will likely be customer complaints that ICC "stopped working" for some reason. Using the CONSULT III plus, choose work support and you can identify the last five CAUSE OF AUTO-CANCEL. For example, operating the windshield wipers on high will cancel the auto-follow feature of ICC, but it will not cancel conventional cruise control. This may confuse your customers, but from the car's perspective, if you have to use your wipers, the reliance on a possibly obstructed laser may be a hazard. Likewise, when ABS is engaged, it cancels DCA as well as ICC, but not the conventional cruise control.

We'll close with a few extra notes:

- ADAS functions vary greatly by model and year.
- The newest JX model will use radar for the ICC sensor.
- The JX also has new functions that we will cover in a future article.
- Newer models have customizable settings for enable/disable.

Body Basics
Premier Products



Who knows better which body finishing tools and products work best than the manufacturer of the vehicle? Nissan thoroughly researches and tests the products used in the manufacture of its Nissan and Infiniti vehicles. The same scrutiny goes into deciding what tools and products should be used in Nissan and Infiniti dealers for repairing and servicing vehicles. These same tools and products are available to independent aftermarket body service and collision facilities.

It makes sense to use these Nissan-approved tools and products to return the vehicle to its factory-new condition. The vehicle will not only look and perform the way it was designed, but the customer will be satisfied that the vehicle still maintains its original beauty and integrity.

Body Alignment Equipment

The best end results begin with properly straightening and aligning the body. The body is the structure that holds the rest of the vehicle together. If it's not properly straightened, the components attached to it will not be correctly aligned. To achieve the best results, a high-quality, full-function body straightening and alignment system must be used. Nissan has thoroughly tested the best alignment systems available on the market today and mandates them for Nissan and Infiniti dealerships. These same systems are also available to independent aftermarket collision facilities.
Nissan recommends the use of a modern three-dimensional electronic measuring, and/or fixture system with an anchoring and straightening rack or bench to allow 360° pulling. Additionally, of course, the use of Nissan body dimension data for damage analysis and repair is the very best way to go.

In this installment, we'll look at the benefits of using Nissan-approved body alignment equipment and associated tools, bonding and mating products, surface prep, paint and finish products and tools.

Frame Racks

Among the Nissan-approved frame racks are:

▪ The BenchRack Series, the Mark 6 Series Bench Systems and the SPEED Plus Frame & Lift from the CAR-O-LINER Company.

The BenchRack Series offers several models and optional component packages to tailor the system to your own needs.

The Mark 6 Bench System is a movable system with an incorporated lift and improved lifting capacity.

The SPEED Plus Frame & Lift is ideal for light duty sheet metal pulling and pulls from both ends to keep your full-size alignment bench free for structural repair.

The SPEED Plus Frame & Lift from the CAR-O-LINER Company.

▪ The EZ Liner Express Portable Structural Repair System and the Impulse System from Chief Automotive Technologies.

The EZ Liner features five tons of power in a smaller, high-quality collision pulling system.

The Impulse System offers power and performance, versatility and options in one affordable package.

The Impulse System from Chief Automotive Technologies

▪ The Power-Pro Series Collision Repair Rack from Blackhawk.

The Power-Pro SL series of racks feature an extended-height lifting capability for ergonomic working heights, an open front and rear for greater accessibility to the vehicle for repairs, a faster pinch-weld anchoring system with fewer bolts to secure it to the rack platform and 60% more chain tie-downs for efficient vehicle tie backs.

The Power-Pro series repair rack from Blackhawk.

Each of these alignment systems has unique qualities and offers a range of purpose, sophistication, accessories and value. All are available through the Nissan Tech-Mate website at www.nissantechmate.com.

A good assortment of accessory pulling tools and devices helps make the work go quicker and easier.

Use accessory pulling tools to save time and get the proper measurements.

The Velocity measuring system from Chief Automotive Technologies.

Using accessory pulling tools and devices makes the work go quicker, smoother and more completely, resulting in the best alignment and body straightness. The components will fit better and the finished repair will look more professional. When selecting a rack system, make sure you can procure and use a variety of add-on tools for optimal results and quicker labor time for the highest profit margin and customer satisfaction.

Computer Measuring Systems

Using a computerized measuring system is the quickest, most accurate way to perform body straightening and alignment. Many good systems are on the market. Nissan offers the Velocity system from Chief Automotive Technologies through the Nissan TechMate website at www.nissantechmate.com.

The Velocity system is highly sophisticated, yet simple to learn and operate. It features a fast and easy set-up with full-color one-page reports on the exact condition of the vehicle's frame before, during and after repairs have been made indisputable evidence of damage severity and quality repairs.

Bonding and Mating Products

The importance of using the correct bonding and mating products for each procedure cannot be overemphasized. One "glue" does not work for all applications. Various adhesives are required for different applications. The best adhesive for metals, plastics or composites to components of the same or different type will ensure a strong bond while offering flexibility where needed. Be sure to research the best choice before making a mistake that could jeopardize the entire repair.

Nissan has approved 3M bonding and mating materials for use on the company's vehicles. Other companies may offer bonding and mating products that may also meet Nissan approval.

Surface Prep

Surface prep is a critical step in producing a smooth, durable and handsome repair. No amount of paint and polish is going to hide a poorly prepped surface. Always use the proper body fillers, surface prep, buffing and polishing products that meet the manufacturer's specifications.

Nissan approves 3M surface prep tools and products. Other companies may offer surface prep tools and products that also meet Nissan approval.

Paint & Finish Products

If the paint and finish process isn't correct, it may not matter how strong the repair is or whether or not the body alignment is accurate. The first thing the customer – and anyone else who looks at the vehicle – is going to see is the finish. Always use the best and correct products in the finish process.

Nissan has approved several manufacturers for refinishing materials, including the Dupont family of products:

- **Dupont**
- **Spies Hecker**
- **Standox**

There may be other companies who offer paint finish products that meet Nissan's specifications. Please contact your local Nissan and Infiniti dealer to procure these products or further information.

As pointed out in the "All About Waterborne Paint" article in the March 2011 issue of Nissan & Infiniti Tech News, waterborne paint is the new industry standard. The Environmental Protection Agency (EPA) mandated by federal law that all facilities should comply by switching over to waterborne paint and application equipment earlier this year. Please see that article for more information.

Preparing the surface properly will give the best results.

Dupont paints and finish products are approved for use on Nissan and Infiniti vehicles.

Resources

The best source for obtaining many of these Nissan-approved products is the Nissan Tech-mate website at www.nissantechmate.com. The Tech-Mate website can also be accessed through the Nissan and Infiniti Technical Information websites at www.nissan-techinfo.com and www.infiniti-techinfo.com, without having to purchase a subscription or logging on.

Using the Nissan and Infiniti technical information websites ensures getting the proper information to get the job done right, the first time and quickly.

Here's a list of Nissan-approved suppliers. Many more companies also offer excellent products for body and collision service:

Aligning Systems

Blackhawk Equipment
www.blackhawkequipment.com
CAR-O-LINER Company
www.car-o-liner.com
Chief Automotive Technologies Inc.
www.chiefautomotive.com

Paint & Finish Products

Dupont
http://pc.dupont.com

Bonding & Mating Products and Surface Prep Products
3M
http://3mcollision.com

The Basics of Nissan's VVEL System

Here's an overview of Nissan's Variable Valve Event and Lift system. We'll look at which Nissan and Infiniti vehicles are equipped with VVEL, how the system functions, and maintenance considerations.

Variable Valve Event and Lift (VVEL) is a system that allows the driver to control engine air intake by manipulating the accelerator pedal, much like the throttle valve does on typical cars. The amount of intake valve opening (valve lift) can be varied from a tiny crack at idle, to maximum lift at wide open throttle. Because the air flow is being controlled by the valve lift, the throttle can be held open to virtually eliminate intake manifold vacuum, thereby increasing efficiency. VVEL is not just another acronym for a valve timing system; it's a major shift in the role of the intake valves and a leap forward in internal combustion engine efficiency, response, and power.

Controlling air flow directly at the combustion chamber has always been optimal, but because of technology, cost, and reliability hurdles, it hasn't been practical until now. We'll examine the benefits and operation of VVEL in the hope it will provide an appreciation and understanding of the system, so readers will have a leg up when they first encounter a diagnostic challenge on a VVEL-equipped engine.

Which Vehicles Have VVEL?

The following vehicle and engine combinations are equipped with VVEL systems:

2008 Infiniti G37 Coupe: V6 VQ37VHR
2009 Infiniti G37 Sedan: V6 VQ37VHR
2009 Nissan 370Z: V6 VQ37VHR
2009 Infiniti FX50: V8 VK50VE
2011 & 2012 Infiniti M37: V6 VQ37VHR
2011 & 2012 Infiniti M56: V8 VK56VD
2011 & 2012 Infiniti QX56: V8 VK56VD

You may notice these are all very nice cars. As usual, new technology is installed on the flagship vehicles first, for people willing to pay for the very best available. As production costs come down and efficiency requirements increase, you'll likely see this type of technology trickle down to some of the less expensive models.

Benefits of VVEL

The chief benefit of controlling engine air intake at the combustion chamber is the increase in efficiency due to the decrease in throttling losses. These are losses in engine efficiency due to the energy used to create intake manifold vacuum. In other words, creating intake vacuum is work and as such, burns fuel. If fuel is used to create a vacuum, it cannot be used to move the vehicle down the road, thus fuel is wasted on a function that does not aid engine output.

Have you ever blocked the hose on a household vacuum cleaner with your hand? Does the motor sound like it's working harder when the hose is blocked? It sure does! You may even notice the lights dim because of the extra load. The throttle plate restricts the intake flow just like a hand covering a vacuum cleaner hose. This makes the engine work harder, especially at idle, when the engine is doing no useable work at all. However, this is necessary on a conventional throttle engine, because without the throttle restriction, the engine would race uncontrollably. On a VVEL engine, the throttle is opened to reduce manifold vacuum at idle. The engine does not race because the air flow is being regulated with the intake valve lift. The engine is no longer being strangled to regulate rpm; it's operating at its own pace and breathing from an abundance of air at atmospheric pressure.

This brings us to cylinder filling. Superchargers and turbochargers increase the pressure in the intake manifold to help force more air into the cylinder. They increase air consumption beyond the engine's natural volumetric efficiency. So, what do you suppose happens when the intake manifold is at atmospheric pressure instead of a vacuum? Let's see.

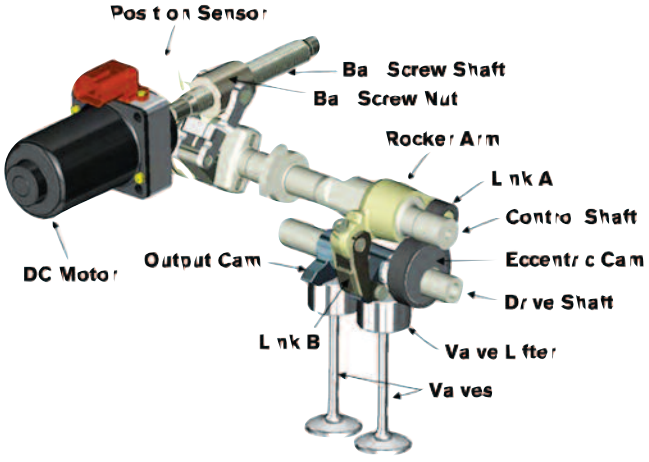
On a conventional throttle engine, air will not start to flow into a cylinder until suction generated by the cylinder during the intake stroke exceeds the vacuum in the manifold. If the intake manifold vacuum is 21 in.Hg, the cylinder must generate over 21 in.Hg before it starts to fill. So, if there is no vacuum stored in the manifold, but instead atmospheric pressure, air will be "pushed" into the cylinder sooner in the intake stroke, resulting in more air entering the cylinder, and thus, better cylinder filling.

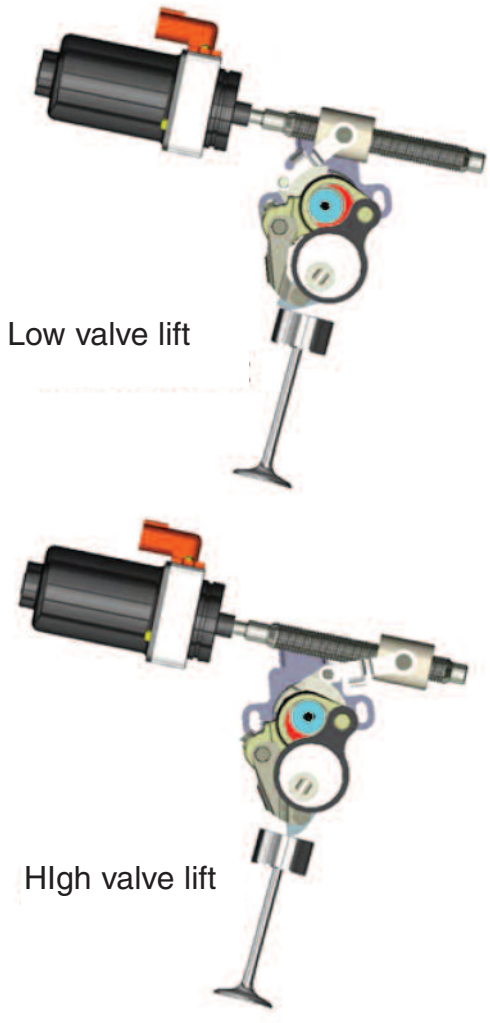
In addition, the velocity of the air entering the combustion chamber is higher, which results in better fuel atomization and a reduction in partial combustion. When fuel is burned completely, it increases fuel efficiency and decreases hydrocarbon emissions.

Improved throttle response is another benefit of VVEL. When the throttle plate is suddenly opened on a conventional throttle engine, it takes time for the intake manifold to fill with air, and for the vacuum to become equal to atmospheric pressure. This delay results in a lag time between when the accelerator pedal is pressed and when the engine output reaches the desired level. On the other hand, the response on a VVEL engine is near-instant. The power output matches the accelerator input in virtually real-time.

Finally, maximum valve lift can be increased without negatively affecting idle quality. On a conventional throttle engine, valve lift must be balanced between what is optimal for idle and what is optimal for maximum load. Creating a cam profile that has a lot of lift will also increase the duration; the ramps up and the ramps down can only be made so steep. At idle, excessive lift will cause poor air velocity and fuel atomization, and excessive duration will cause blowback into the intake manifold. If a camshaft is created for maximum power, idle quality will suffer. If a cam is created for the best idle quality, maximum output will suffer. With VVEL, the best of both profiles can be used without sacrificing anything, a silky smooth idle and up to over 400 horsepower!

As you may have gathered, the benefits of VVEL are most noticeable at low and medium loads, when the throttle plate would be more closed than open. Therefore, VVEL is most effective on vehicles with high output engines that are more likely to be operated at relatively low to medium loads.





Note the position of the control shaft, colored light blue and red. As the control shaft rotates, the fulcrum is moved and valve lift is modified.

How VVEL Works

The exhaust cam is a traditional design. Its egg-shaped lobes push on solid lifters mounted atop the exhaust valves. The VQ37VHR engine does not incorporate variable exhaust valve timing. The VK56VD and VK50VE engines use hydraulically actuated duty-cycle-controlled camshaft sprockets to adjust exhaust cam timing to match engine operating conditions, similar to the continuously variable valve timing system found in many previous engine packages. In short, the exhaust valve system on a VVEL engine is the same as on a conventional throttle engine.

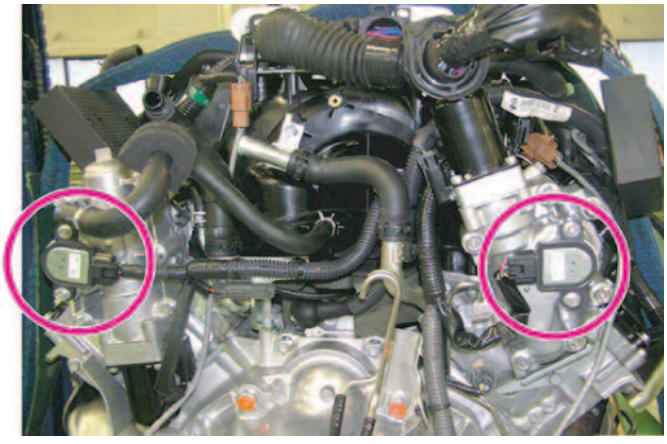
The intake side is wildly different. The intake cam is replaced by a drive shaft with eccentric cams where the lobes would normally be. It does not have conventional egg-shaped lobes; it's more like a small circle offset within a large circle. The drive shaft is mounted to an electro-hydraulically adjustable cam sprocket, so intake valve timing is continuously variable. The eccentric cam does not ride on the lifters directly. Its movement is transmitted through a link, to a rocker arm, to another link, and then to an output cam, which presses directly on the lifter. The fulcrum of the rocker arms is a control shaft, which is connected to a DC stepper motor called the VVEL actuator. When the VVEL actuator rotates the control shaft, the rocker fulcrum is shifted due to an eccentric mount, and the valve lift is changed.

Think of a seesaw. If the fulcrum (pivot) is in the center, the amount of movement on each side will be equal. If the fulcrum is moved to the left of center, a smaller amount of travel on the left will cause the movement on the right will be increased. If the fulcrum is moved to the right of center, the opposite will be true. This is how valve lift is controlled with the VVEL system.

The ECM looks at the crankshaft position sensor to determine engine speed and piston position, and the accelerator pedal position sensor to determine desired power output. The ECM then continuously adjusts the control shaft position via a VVEL control module while receiving feedback from a position sensor mounted on the VVEL actuator assembly.

Service Considerations

As a service technician, valve adjustment may be the first concern that comes to mind when considering VVEL. These engines all have solid lifters and therefore, there is no self-adjusting mechanism. However, special coatings, years of metallurgical development, and top quality engineering have resulted in valve trains that are very durable, and can go hundreds of thousands of miles without needing adjustment. That being said, valve clearance should be checked "whenever you're in the neighborhood." If the valve covers are removed for any reason, or there is unusual noise or engine roughness, valve clearance should be inspected.



Replacement VVEL control shaft position sensors require a one-time adjustment when new. The sensors are not variable resistance potentiometers like a TPS. They are resolvers. A permanent magnet is mounted to the end of the control shaft, when the shaft rotates changes in the magnetic field cause sensor output voltage to vary with shaft position. The output signal is interpreted by the VVEL control module, and then sent to the ECM.

Both intake and exhaust valve clearance should be measured, but only exhaust valve clearance can be adjusted. If any of the intake valves are out of specification, the cylinder head and VVEL ladder must be replaced as an assembly. If the exhaust valves are out of specification, selective thickness lifters are available to provide up to .020 in. of correction in .0008 in. increments. The exhaust valves, valve seats, guides, and stem seals can all be replaced if need be, provided your shop has the necessary machine equipment, but no individual parts are available for the intake side.

If the VVEL actuator is replaced, an initial adjustment must be performed. The VVEL system must be prepared for adjustment using the CONSULT. Under WORK SUPPORT, select VVEL POS SEN ADJ PREP. Once complete, adjust the VVEL actuator position sensor so that its PID reads 500mV +/- 48mV. This procedure should ONLY be performed when the actuator is replaced, and ONLY on the side that was replaced. Make sure not to get confused and mess with the adjustment on the wrong bank. If you do, you'll need to replace the VVEL actuator.

Correct Lubrication

Service requirements are pretty typical for VVEL-equipped cars. Motor oil requirements are SM/GF4 or SN/GF5 depending on model, with no requirement for full synthetic or a proprietary certification. The service interval should be 3,750 miles for most drivers, and 7,500 miles for the atypical all-clear-freeway type driver. However, it would be wise to consider the most common cause of failure in variable valve timing systems: oil level and oil quality. Nissan Ester Oil (P/N 999MP-5W30EP) is far less likely to become sludge than conventional oils. It's also far superior to most "synthetic" motor oils. It's certainly not the cheapest motor oil, but then again, we're talking about some pretty high-end vehicles here, which, if poorly maintained, will retaliate with very high repair costs. If you take care of your VVEL equipped vehicle, it will take care of you.

Sources of Additional VVEL Information

For more detailed VVEL information, use the following resources, which are free with a Techinfo subscription:

- Introduction to Engine Mechanical Systems, Variable Valve Timing Module. This document can be found in the E-Learning Modules section of nissan-techinfo.com.
- 2008 Infiniti G37 Coupe New Model Introduction. This document can be found in the E-Learning Modules section of infiniti-technifo.com.
- Service manuals for G37, 370Z, FX, and QX56

These resources are available for purchase on nissan-techinfo.com and/or infiniti-techinfo.com:

- Video (DVD) Training, Volume 145: Variable Valve Event and Lift System ($24.95)
- Classroom training materials (PDF booklets), 2009 Infiniti FX New Technology ($74.95)
- Classroom training materials (PDF booklets), 2011 Infiniti QX56 New Technology ($74.95)
- Classroom training materials (PDF booklets), Engine Mechanical Service Course EMTC9915A ($74.95)

Wheel Bearing Diagnosis and Service

Here are the basics of wheel bearing diagnosis and service, as well as some old-time wisdom and techniques that used to be a little more commonplace prior to the information age. We'll focus on the fixed-preload cartridge style wheel bearings that are most common in modern vehicles.

Perform road testing only in an area where the traffic conditions allow for it.

These days, a lot of emphasis is placed on teaching the electronic and engine management skills associated with automotive diagnosis and repair because they are the most rapidly changing and complex aspects of our industry. However, this does not make mastery of "basic" skills such as wheel bearing diagnosis and repair any less important. Which do you suppose would cause your customer more concern, a MIL/Check Engine Light on, or a wheel falling off? Wheel bearing service, while relegated to "B" skill level in the labor guide, requires skill and knowledge to be performed properly. This skill set can be easily missed in automotive school and in continuing education, and is often taught on-the-job by a co-worker, which can be good or bad, depending on the teacher.

Finding Bad Wheel Bearings

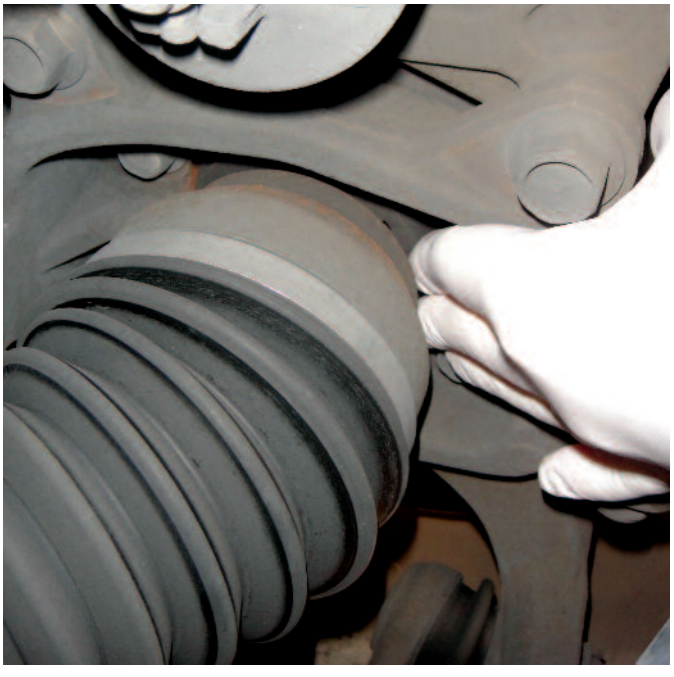
Wheel bearing failures fall within one of two categories: noise/roughness or excessive play. Either way, your customer may not notice anything until the problem has developed into an unacceptable safety issue. Wheel bearing noise may go unnoticed by a driver because the level increases gradually. The noise may be very subtle, similar to the noise caused by rough road surfaces at first and the driver may not notice that the noise continues on smooth roads as well. With every mile driven, the noise gets a little worse, but the day-to-day increase is so slight, it does not register with the driver. Therefore, it is important to road test cars when they are in for service. A wheel bearing will make a droning noise while moving; in the beginning stages it may only be audible at 35 MPH or greater.

Wheel bearings are not the only possible sources of droning noises. Irregular tire wear, aggressive tread patterns, axle shaft support bearings, and output shaft or differential carrier bearings can all make noises similar to a bad wheel bearing. So how can these other sources be eliminated as the cause?

Road Test Procedures

A road test is critical because it is the only way to test the wheel bearing and drivetrain under strain. A series of maneuvers and observations will help isolate

It doesn't take long to check for play once the car is on a rack.



If you find play in the wheel, have an assistant rock the wheel while you determine if the wheel bearing is the source of the movement. Ball joints, bushings, and loose suspension bolts can also cause play.

the cause of the noise. First, accelerate and decelerate slightly while the noise is occurring. Usually, transaxle or differential problems will be affected more by acceleration or deceleration than will wheel bearings. So, if the pitch and amplitude of the noise change substantially with drive train load, suspect the transaxle. Next, swerve the car side to side, if the noise changes with side load, it usually indicates a wheel bearing is the source of the noise. If a variety of road surfaces are easily accessible, take note of how the noise responds to rough and smooth roads. Wheel bearing noise will not be affected by road condition, but tire noise will. Finally, take note of where the noise sounds like it's coming from: front, rear, left, or right.

Rack Inspection

Once back at the shop, rack the car and check the tires for irregular wear and proper pressure. A scalloped or feathered tread pattern can make a noise very similar to a worn wheel bearing. Also, some ultra-aggressive tread patterns will make noise, even when the tread is in good condition. If the tires are suspect, and the location of the noise seemed obvious during the road test, rotation followed by another road test may be helpful. If not, substituting wheels from an identical but noiseless car can be helpful (but not always possible).

If the tires look okay, check for play in each of the wheel bearings by grabbing the tire at 12:00 and 6:00 o'clock, then attempting to rock it by alternately pushing with one hand and pulling with another. If the wheel has play, have an assistant continue to rock the wheel while you verify the movement can be felt by touching the outer CV joint and the knuckle, or the rotor and the knuckle. If movement is found, use a dial indicator and service manual to verify whether or not it is out of specification (usually, only a couple thousandths of an inch is allowed at the hub).

Now, the tricky part: All wheel bearings with excessive play are bad, but not all bad wheel bearings will have excessive play. In fact, you'll find a great number of wheel bearings that make terrible noises, but do not have any play at all…. yet! Noise is caused by pitting on the races or the balls/rollers, but unless the pitting is prolific enough, the un-pitted areas of the bearings may be able to maintain proper preload, and there will be no play as a result. However, a noisy bearing with no play is not "good to go." Roughness in wheel bearings will

Springs do a pretty good job of amplifying vibration enough to be felt. When in doubt, compare side to side.

cause extra friction and heat. Once a bearing has started to make noise, it can fail very rapidly, especially if it's worked for a long time without a break, which might occur during a long freeway drive.

When a car is on a rack, the wheels are unloaded, and a normally noisy wheel bearing may fall silent. One technique that is quite useful is to spin the wheel while holding the spring. Vibrations from the wheel bearings are amplified by the spring and can be felt even though they cannot be heard. This works especially well on the non-drive wheels because they spin more freely due to the reduced rotating mass. "Driving" the car on the rack and using a stethoscope to listen for noise at the knuckle will work for some cars. However, most modern cars are equipped with ABS and VSC, so trouble codes will almost certainly set during this type of testing. Also, extreme care should be used when working around moving parts.

What If the Source isn't Obvious?

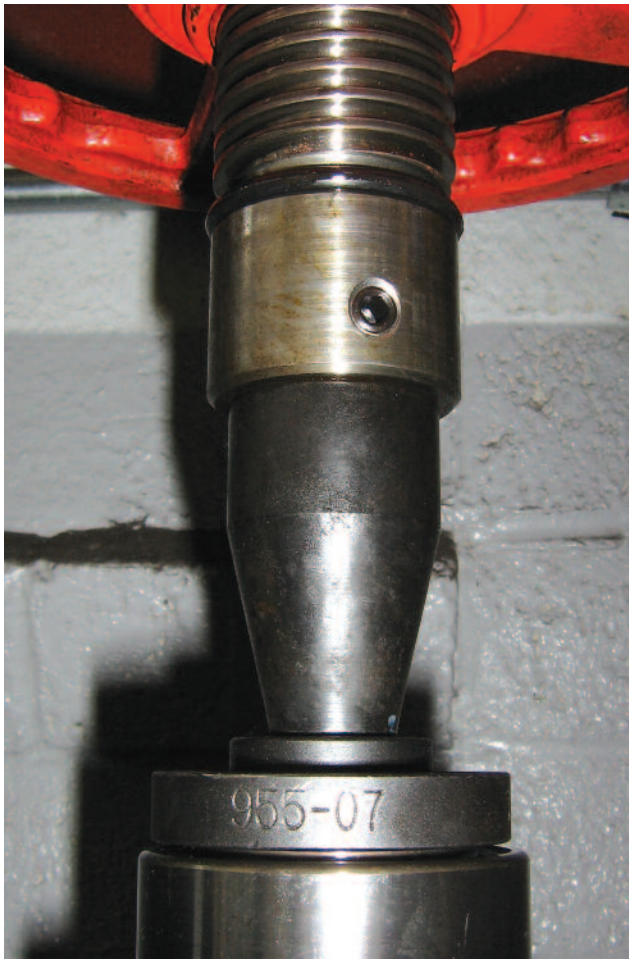
If road testing and rack inspection do not reveal the source of the noise, a Chassis Ear can be used to listen to the car while the driving on the road. With a microphone clipped to each knuckle, you'll be able to listen while the wheel bearings are loaded to find the noisy one. The only downside is the setup time and the inevitable wear and tear on the Chassis Ear (microphone clips sometimes fall off, and do not survive being dragged along the asphalt).

Replacing Wheel Bearings

Replacing wheel bearings, like all things, is easy if you know how to do it. However, it's possible to ruin a wheel bearing during the installation, or to overlook wear that will cause a repeat visit. Here are the key points to remember:

- Verify the hub is true, especially if you suspect that a collision caused the bearing failure.
- Always inspect the knuckle bore and hub sleeve for wear or burrs.
- Always install retaining clips.
- Never put any load on the balls or rollers while pressing in the new bearing.
- Always install new seals and LUBRICATE them before installation.
- Always use a torque wrench to install the axle/spindle nut.
- Always use a new cotter pin or lock nut.

Ball bearings and bearing races are surface hardened, and can crack or chip if too much force is applied, like the m&m in this photo.



Pressing on the inner race like this will put too much pressure on the bearings and races and can cause premature failure.

Use an adaptor that is slightly smaller than the outer race and does not contact the inner race to press the wheel bearing into the knuckle.

Detailed bearing removal and installation instructions can be found online at nissantechinfo.com and infinititechinfo.com, but the procedure usually goes something like this:

Pre-Removal Inspection

Check the hub face for runout. You'll find the maximum specification in the service manual, but it is typically less than .002 in. If the wheel bearing is loose, this test may not be possible.

Removal

First, let's discuss proper pressing technique. When removing the wheel bearing, putting load through the bearing is okay. This is because there is no other way to press the bearing apart and **IT'S NEVER ACCEPTABLE TO REUSE A WHEEL BEARING ONCE IT HAS BEEN SEPARATED FROM THE HUB AND KNUCKLE.**

To remove the bearing:

1. Support the knuckle with a suitable tool and press the hub out of the bearing being careful not to damage the splash shield.
2. Remove the seals (if any).
3. Remove the bearing retaining clip.
4. Support the knuckle from the other side then press the wheel bearing from the knuckle.

5. Remove the inner race from the hub.

6. Throw the bearing in the scrap metal bin. It should never be used again.

Post-Removal Inspection and Dressing

The areas of the knuckle and hub that contact the bearing must be free of defects. A small pocket or recession is acceptable, but a raised area is not as it may catch and gall the surface during installation. Check the knuckle bore for burrs or galling. Remove any raised areas with a mill file or stone. Check the hub sleeve for wear. Most of the time, hub wear will be obvious once the outboard inner race is removed. When in doubt, use calipers or a micrometer. The hub sleeve should be the same diameter where both of the races ride.

Installation:

1. Some wheel bearings contain a magnetic encoder for the ABS sensor on one side and are directional; they must be installed with the encoder on the correct side. Always take a few minutes to consult the service manual before starting the job to avoid this and other pitfalls.

2. Make sure the knuckle bore and hub sleeve are clean and grit-free. Use a lint-free rag wet with acetone (brake cleaner) or rubbing alcohol. Press fit lubricant is not required, but it does make the job a bit easier. Grease or oil should not be used on the press fit surfaces.

3. Press the bearing into the knuckle **PUSHING ONLY ON THE OUTER RACE**. Pressing on the inner race can damage the bearing, causing a premature failure.

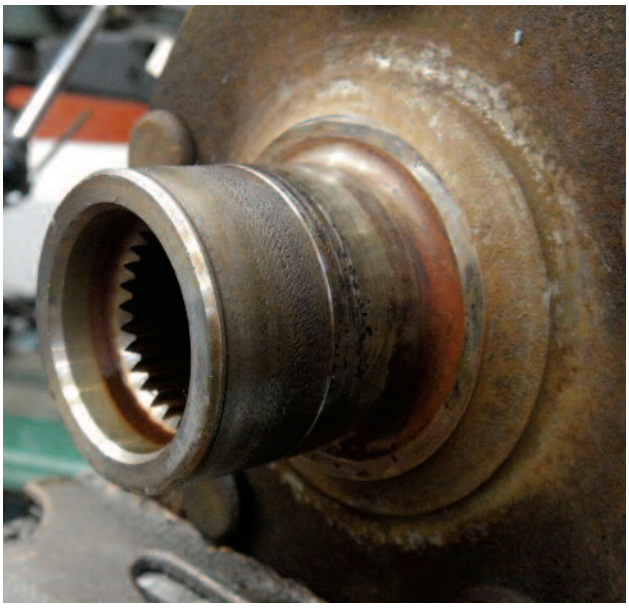
4. Install the retaining clip.

5. Lubricate the seals with wheel bearing grease and install (if applicable).

6. Press the hub into the bearing. It is important to press only on the hub and the inner race. Pressing on the hub and the knuckle will put pressure on the ball bearings, and can damage the new bearing.

Torque It!

Immediate catastrophic bearing failure caused by over-torque is not as common as it once was when



The most common problem is a seized bearing causing an inner race to spin on the hub. The race is a press fit, so if it's forced to turn, it will quickly start to gall and wear away at the hub.

taper roller bearings with user-set preload were typical. However, torque is still very important, and it's still possible to ruin a bearing with improper torque. Here's why: today's powerful impact wrenches can easily generate enough torque to compress the hub sleeve, and increase preload to the point where there is no longer any clearance left for a film of bearing grease. The bearing will in essence run dry and fail as a result. Axle nut torque specifications can vary anywhere from 80 ft.lb. to almost 200 ft.lb. Achieving the required torque with just an impact wrench cannot be done. Always use a torque wrench, and follow the thread lubrication instructions found in the service manual.

Lock It Up

Most designs will include some sort of secondary axle/spindle nut retention. The nut shouldn't back off if it is properly tightened, but since keeping the wheel on the car is a priority, one can never be too safe. Common retention methods include staking, cotter pins, and self-locking nuts. Staked nuts should be de-staked before removal to avoid damaging the axle or spindle threads, and should not be reused. Cotter pins and self-locking nuts are also one-time use.

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