



# TechNews

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INFINITI.

| **HID Headlights**

| **Timing Chains**

| **NOx Emissions**

| **Collision Repair**

| **Dealer Listing**



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Caution: Vehicle servicing performed by untrained persons could result in serious injury to those persons or others. Information contained in this publication is intended for use by trained, professional auto repair technicians ONLY. This information is provided to inform these technicians of conditions which may occur in some vehicles or to provide information which could assist them in proper servicing of these vehicles.

Properly trained technicians have the equipment, tools, safety instructions, and know-how to perform repairs correctly and safely. If a condition is described, DO NOT assume that a topic covered in these pages automatically applies to your vehicle or that your vehicle has that condition.

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# Let There Be (More) Light



Diagnosing HID headlight failure requires more than just the part number of the bulb. We'll cover the advanced systems involved in HID headlight operation and beam control, as well as some logical diagnostic strategies that may help in catching intermittent or difficult problems.

It should go without saying that a vehicle's headlights are one of the most important systems, but who ever thinks of them until they're burned out? A car's headlights are often forgotten until they aren't working, yet they literally show us the way at night. They're also responsible for signaling other drivers as well as increasing visibility both at night and during the day. That's why police require their operation, and why Nissan strives to improve their function. Enter Nissan's High Intensity Discharge (HID) headlights: greatly improved luminosity and longevity over conventional head lights.

### **With great power comes great responsibility**

First and foremost, safety precautions must be observed when diagnosing and repairing Nissan HID lights. It takes nearly 20,000 volts to produce the initial spark required to illuminate the bulb – that's quite a zap! Also, the bulbs are quartz glass and are under high pressure when the gas inside is excited. Be sure to diligently follow all appropriate safety guidelines in the vehicle's repair manual, and properly dispose of failed HID bulbs according to appropriate laws concerning mercury waste handling.

Many technicians are confused about some new automotive technologies, but this article should eliminate the mystery surrounding Nissan's HID headlight systems and prepare you for the next "standard option" on your customers' cars. Currently, only luxury or performance vehicles come equipped with HID headlights, but this will change in time as the industry costs associated with their production decreases. Will you be ready to diagnose HID headlight failure?

### **Why HID?**

Nissan's Xenon HID headlights produce both better quality and quantity of light over the standard tungsten-halogen bulb found in the majority of vehicles. When fully warmed up, a Xenon bulb can produce



**There's no dirt in this bulb!  
You can see the metal compound  
in its solid state up close.**

## Nissan & Infiniti Light Bulb Replacement

more than 2800 lumens of light that actually looks more like daylight. The HID bulb also maintains this output at a mere 35 watts. Nissan's HID bulbs are more efficient when compared with typical halogen bulbs that produce less than 1400 lumens using nearly 80 watts. Lastly, because the HID bulb does not contain a metal filament, it does not decompose as readily as a standard halogen bulb, and therefore enjoys a longer, brighter life.

HID headlights don't just "turn on" like standard halogen headlights because they do not produce light in the same manner. A typical halogen lamp uses applied voltage to drive current through a filament causing it to glow and emit light. Aside from a power source, the halogen bulb does not require any additional components to operate. An HID bulb does not contain a filament, and instead produces light by energizing two electrodes within an interior tube containing pressurized gas and a metallic compound that vaporizes, mixes with the gas, and begins to glow. The "filament" in a Nissan HID bulb is a glowing bridge of plasma whose discharge is light and heat. Both the gas and the metal compound are engineered in such a way to produce the recognizable blue-white light typical of HID systems.

### What happens when the switch is flicked

A Nissan HID headlight operates in three phases. First, a huge initial voltage is required to force the gas to ionize within the inner tube and create an electrical arc: the path for current to flow and generate heat. A resistor ballast and control unit produce the large necessary ignition voltage. Exercise extreme caution when turning on the bulb as this ignition phase generates more than 20,000 volts! Treat an HID headlight and its ballast like a primary/secondary ignition system. Nissan's Xenon HID bulbs will emit light from the arc during this primary phase, but it may appear to be dim, to flicker, or to be a different color. This is normal, and will be fixed by the second phase of the headlight operation.

After initial spark, the HID control unit will intentionally supply extra power to the bulb so the arc within the inner bulb tube generates more heat. At the appropriate



### The socket and control unit are not independently serviceable.

ate temperature, the small amount of metal compound within the bulb will vaporize, mix with the Xenon gas, and stabilize at the correct color. Simultaneously, the heat reduces resistance to current flow across the plasma arc between the two electrodes. The HID control unit detects this reduction and will cease providing excessive power so the bulb enters the stable third phase.

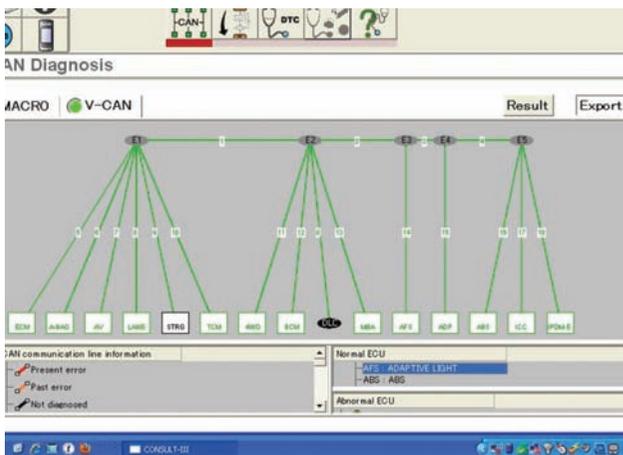
The third and final phase of an HID system is the continual operation stage, during which the control unit provides constant voltage to ensure normal, flicker-free headlight output. Nissan HID bulbs will require between 40 and 90 volts to maintain output, depending upon the bulb style. It is typically during this phase that a customer will experience the first indication of failure. A dying HID bulb will drastically dim, the light may begin blinking, or the color of the light will become reddish. It is important to note that Nissan discourages frequent on-off operation of HID headlights because it will shorten the life of the bulbs. Furthermore, a customer may complain of a failed headlight, but in reality they may have attempted to cycle them too rapidly after a short errand. If the metal compound within the bulb has not re-crystallized, the light will fail to illuminate and the bulb must rest 10-15 minutes before re-ignition.

## Anatomy of a headlight

In order to diagnose dead HID headlights, it's critical to understand the roles of and interactions between the various systems involved in their operation. All of Nissan's HID headlight setups will contain the following components: combination switch, fuse, HI and LO beam relays, bulb control unit, combination lamp assembly and bulb.

Ensure that the combination switch is operational and the headlight fusible links are intact before proceeding with diagnosis! Start with the combination switch, which commands the body control module (BCM) over the CAN communications line to activate the headlight relays within the Intelligent Power Distribution Module Engine Room (IPDM E/R -- the under hood fuse box). A failure among these devices or their wiring may result in both headlights being inoperative in HI, LO or both modes.

The Nissan Consult III scan tool provides a self-diagnosis program for all exterior lighting systems. Under the IPDM E/R active test section, choose exterior lighting. This will guarantee all relays are in place and operational, and that the CAN communications lines are responsive between the relevant exterior lighting systems and the driver controls.



**The Consult III can eliminate some diagnostic legwork by ruling out malfunction on the CAN line or the relays.**

Once the headlight relay within the IPDM E/R is engaged, the control unit for each side charges and then ignites the bulb. Nissan considers it normal behavior if the left or right headlight illuminates noticeably later than the other side; it does not imply that the lagging bulb is at end of life or that the control unit is going bad. However, if one side fails to illuminate at all during this step, which is the most common symptom, it could indicate a burned out HID bulb or another component.

## Diagnosing HID problems

A vehicle that has one headlight out consistently can be logically diagnosed. Confirm that all relays, CAN lines and fuses are working as mentioned in the previous paragraphs. For example, a customer's 2009 Nissan 370z only has its right headlight operational at all times. First, swap the current HID bulbs and recheck: if the left headlight is now operational, we can condemn the bulb itself and recommend replacement. If after swapping the bulbs, the right headlight remains operational, we can condemn the left-side control unit or the combination lamp assembly itself. Finish diagnosis by swapping both control units. If the left light remains out after moving control units, the lamp assembly is bad.

A common customer complaint is that one headlight will intermittently flicker and fail while driving. Almost always, customers will discover that cycling the headlights off and on tends to bring back the once-dead headlight. As mentioned before, frequent cycling of HID bulbs can cause premature failure so try to discourage this! If one headlight tends to fail while driving, it can be due to a malfunctioning control unit or a bulb exhibiting end-of-life symptoms. A similar customer complaint may be that one headlight will flicker for a while prior to stabilizing or going dark. Any time during the 3rd phase of the bulb operation, if the control unit fails to provide constant alternating current, the arc within the bulb will flicker. Likewise, as a bulb ages, the gas, metal salts, and the electrodes will eventually deteriorate and stop working.



**The R-designation (D2R) indicates the bulb is coated with material to shape the beam pattern.**

Verify the intermittent failure before proceeding with the above-outlined logical diagnosis. More often than not, a customer's "I'm pretty sure it's the left one that goes out" will result in a come-back if you take their word for it. When dealing with very expensive bulbs and control units, take the time to verify the complaint! Use a jumper pack to support the battery while you wait for one headlight to fail.

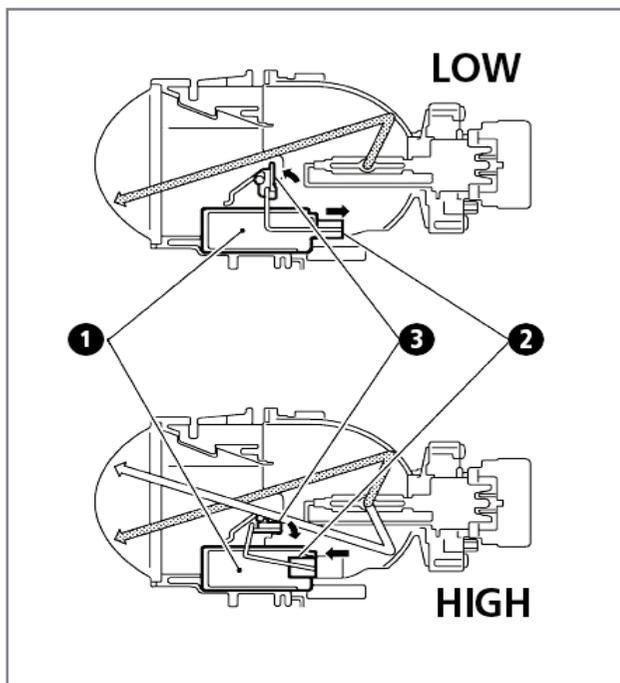
### Blinded by the light!

Due to the increased brightness of Nissan's Xenon headlights, some vehicles are equipped with systems to control the beam in sophisticated ways. The most basic HID headlight will use a bulb coated with opaque material that shapes the beam when reflected against the lamp housing. Headlights that use a projection lens housing to focus the beam will be equipped with uncoated bulbs.

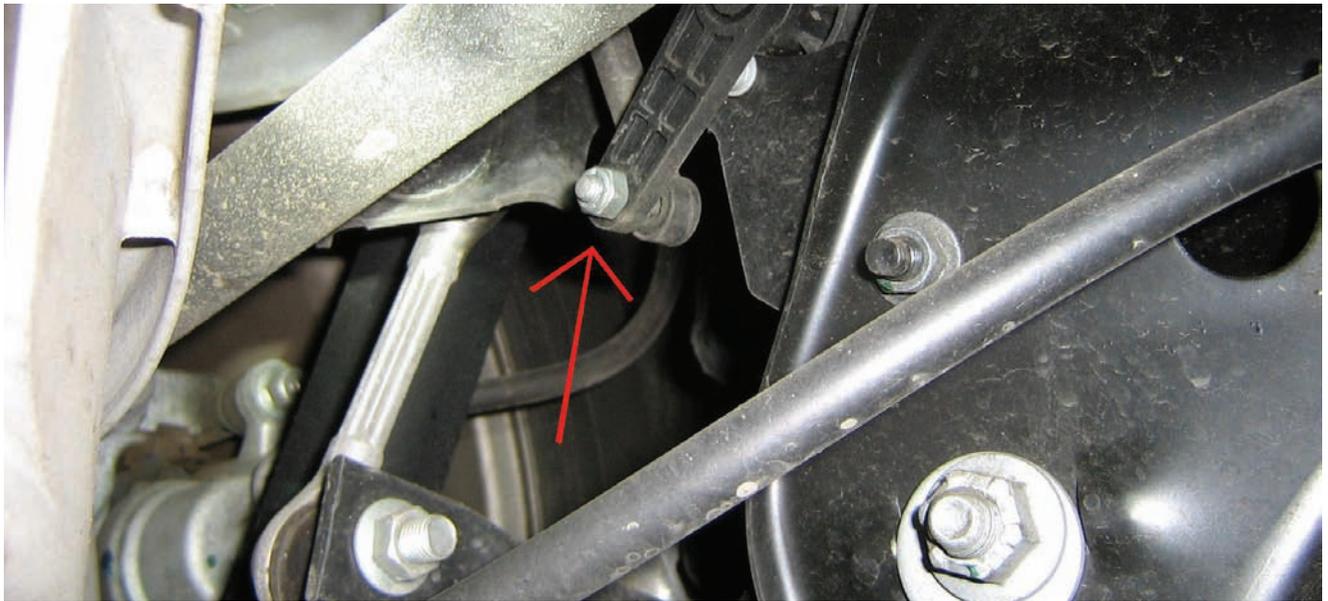
North America does not currently have any regulations to reduce glare by requiring leveling or advanced aiming systems. Currently, standard headlight housing aiming techniques are used to reduce glare, but Nissan employs electronic leveling methods as well as an

active Adaptive Front-Lighting System (AFS). While successful in reducing glare, AFS adds an additional layer of complexity to HID headlight diagnosis.

In some combination lamp assemblies, a single HID bulb provides both high and low beam functionality. This is achieved by physically redirecting the bulb output against a different reflective surface within the lamp assembly. The redirection occurs when the high beam relay is switched and then energizes a magnetic solenoid within the lamp assembly. The high beam solenoid actuates a pushrod and moves the mobile valve shade that then redirects the beam. In systems like these, a customer may complain that one side's high beam is out, but this is not the fault of the bulb. If only one high beam works, verify that the high beam solenoid for the inoperative side is receiving a signal from the IPDM E/R HI relay. The default position for the mobile valve shade is down – in the low beam position. A failed high beam solenoid or mobile valve shade will require replacement of the combination lamp assembly.



**A single HID bulb can provide both HI and LO beams using a mobile valve shade (3), moved by an actuator rod (2) controlled by the high beam solenoid (1).**



## The height sensor uses a mechanical arm to detect the pitch of the vehicle.

Some Nissan vehicles employ halogen bulbs for high beam functionality only. This allows for usage of an HID bulb behind a projection lens as well as active AFS. For example, the 2008 Infiniti EX35 uses Xenon HID bulbs in a projection lens set up for its low beams. The vehicle is also equipped with AFS, which allows for the front projector lenses to swivel as the steering wheel is turned dependent upon vehicle speed. The EX35 also comes equipped with a height sensor attached to the rear control arm that is responsible for detecting the pitch of the vehicle. The height sensor allows the BCM to command the AFS control unit to automatically aim the headlights lower, and reduce the perceived glare by oncoming vehicles.

### **DTCs for headlights? What's next, headlight fluid?**

The swivel motor position sensor, the steering angle sensor, and the vehicle height sensor all report information to the BCM. If there is an inconsistency, the vehicle will store a DTC relevant to the sensor's system. The AFS OFF dash indicator bulb will illuminate in the event of failure, or if the driver has deliberately disabled AFS with the dash switch. The combination lamp swivel motor engages when the steering wheel has gone beyond 20 degrees from center, up to 90 degrees

maximum as reported by the steering angle sensor in the column. The left swivel actuator only works when the vehicle speed is greater than 15.5 mph, but the right swivel will work at all speeds.

Headlight aim will be automatically adjusted by the AFS control unit based on input from the height sensor and how that signal differs from preset aim. The height sensor reference position is calibrated with the vehicle unloaded. After replacement of the sensor or the control arm, it is necessary to perform a relearn procedure using the Consult III. According to Nissan, adjusted axis position may differ from preset position despite normal auto aiming functionality if the suspension is worn.

Staying knowledgeable about modern vehicles is critical in an automotive world that is technologically advanced, and where changing out a headlight is not as simple as it used to be. |

**Always refer to the correct lighting systems service information for the vehicle you are servicing. Log onto the Nissan or Infiniti Service Information websites at [www.nissan-techinfo.com](http://www.nissan-techinfo.com) or [www.infiniti-techinfo.com](http://www.infiniti-techinfo.com) for the specific information.**

# Nissan Timing Chain Replacement: Gravy or Gristle?



Timing chain service on Nissan and Infiniti vehicles can be both satisfying and profitable. Or, it can be a miserable experience that wreaks havoc on your time sheet and makes you wish you'd stayed home. It all depends on whether the job is performed correctly the first time. If you make an error, it may take hours or days to correct, but if everything is done correctly the first time, there can be a real sense of satisfaction in doing this type of purely mechanical work well, not to mention a very nice payday.

## So simple a monkey could do it?

Timing chain service is not as simple as it once was. Older technicians will remember very simple timing chain designs: a couple of sprockets connected with a chain, channeled by a couple of guides, and held

taught with a hydraulic tensioner. Ah, the good ol' days.

Today's vehicles aren't so simple. Even a base-model Nissan will have four valves per cylinder, two cams per head, and variable cam timing. Because of this, the timing chain system needs to be more complex to keep the valves synchronized and the chain quiet.

Reading the instructions before starting a project is not a sign of incompetence. On the contrary, it's a sign of a true professional. A minor mistake may require a complete repeat of the job, which can take more than a day on some models. A major mistake may damage the engine, leading to great expense indeed. Much of the necessary information will not be "obvious" from examining the timing chain before and during disassembly. Reading the manual is the only way to get all of the information you'll need before you start.

## Preparation

A technician's efficiency of motion, focus, experience, and skill will all have an effect on how long a timing chain job occupies his service bay. However, waiting for parts to arrive will slow the progress of even the deftest technician. It may be impossible to predict every needed part before starting a job. On the other hand, if you have your local dealership email or fax you a copy of the exploded view, you can pick out and order all of the parts you know you'll need for sure, as well as have the reference on hand to order any damaged parts you find on disassembly.

The coolant and the motor oil should be drained before starting timing chain service. Opening the block drain in addition to the radiator drain will reduce mess and help prevent coolant from entering the crankcase during the service.

Good light will save time and help avoid costly mistakes. Replacing a timing chain will take several hours – at the least. Working with a flashlight occupying one hand is just silly. Take a couple minutes to install a hood light or a couple well-placed drop lights. Not only will you be able to use both hands, you'll be able to see things like the little glob of dried silicone you missed on the first cleaning, or the o-ring that fell out of position as you were installing the cover.

Many technicians have a powerful combination of memory and deduction. These "parts whisperers" are able to recall or deduce whether the yellow zinc-coated bolts were originally installed in the valve cover and the black oxide coated bolts were installed in the timing cover, or if it was the other way around. However, not everyone has this ability, and even those who do would benefit from the following suggestion: use a tray with compartments to organize bolts and small parts removed during disassembly. Even if you can restore the car to its original condition using a big pile-o'-bolts, it will take much less time if the bolts and small parts are grouped in sequence as they are removed, especially if the car ends up sitting for a week while waiting for customer authorization.

## Getting started

This article will focus on the VQ series engine, a powerful and popular engine with variants found in the 350Z, 370Z, G35, G37, and Maxima.

The front timing cover and timing chain can be removed without removing the oil pan. If the timing

chain is to be removed or the timing checked, the valve covers must be removed. If only the cover is being removed (to repair a leak for instance), the valve covers can be left in place.

There are a few parts blocking access to the front timing chain cover and valve covers, so they'll need to be removed to gain access:

- The upper and lower intake collectors (they block the valve covers)
- The radiator cooling fan
- Drive belts
- The air conditioning compressor (leave hoses connected and tie off to the side)
- The power steering pump and bracket (leave hoses connected and tie off to the side)
- The by-pass coolant hose and the fan idler pulley bracket

Now that the way is clear, it's time to remove the valve timing control covers, but wait! This is one of the procedures that can be costly if done incorrectly, but since you read the manual before starting, you already know that after using the seal cutter tool to break the RTV bond, you'll need to carefully remove it by pulling straight back without tilting until it has separated completely.



**A seal splitter tool (SST# J37228) should be used to avoid damaging the timing cover during disassembly.**

## Nissan & Infiniti Timing Chain

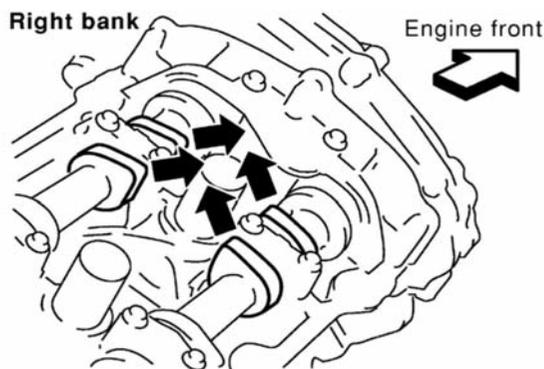
Next remove the valve covers and set the engine to TDC compression on cylinder #1 by lining up the TDC mark on the crank pulley. Then check the cam lobe position on cylinder #1 to verify it's on the compression stroke. If the valves are in overlap (all 4 lobes slightly downward and touching the lifters), rotate the engine 360 degrees and line up the TDC mark up again, then verify the lobes are now pointing slightly upward and there is clearance between the lifters and lobes.

The crankshaft pulley is removed next. The engine will need to be held while the pulley bolt is loosened. If the starter is removed, Nissan special tool J44716 can be used to lock the flywheel in place. There are also commercially available tools that will work, although not as elegantly. **DO NOT** use a belt wrench or chain wrench on the outer crank pulley. Doing so may damage the harmonic damper.

A standard two-jaw puller or similar tool can be used to remove the crank pulley once the bolt is loosened. Once again, do not apply any pressure to the outside of the crank pulley because it may damage the harmonic damper. Set the jaws on the inside of the pulley and set the puller drive bolt against the loosened crank pulley bolt head.

The timing cover is held in place by over 20 bolts. It is also stuck in place with dried liquid sealer. It will take some carefully applied force to loosen and remove the timing cover once the bolts have been removed. Therefore, it's extremely important to be absolutely positive all of the bolts have been removed before attempting to remove the cover. The manual will have a diagram with the location and number of bolts holding the cover on. Count out the bolts removed before starting to pry.

The cover can be pried free using a combination of prying at two notches at the top of the timing cover, specially designed for that purpose, and working the seal cutter tool around the perimeter. Be very careful not to damage the sealing surface (or you could end up



**Cam lobe positioning.**

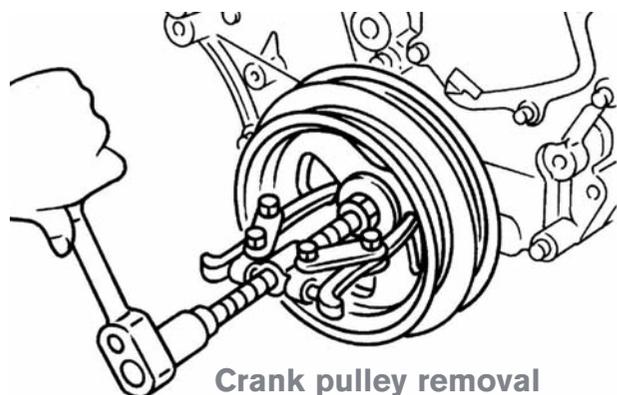
with a costly leak). Once the timing cover is off, store it with care. It is a fairly large and thin piece of aluminum, and can be damaged easily while unsupported.

### Removing the chains and sprockets

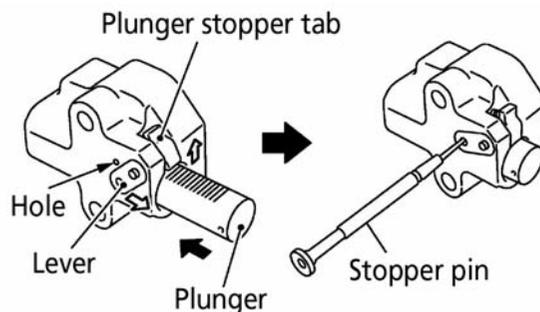
The VQ series engines have three timing chains. A primary chain connects the crank sprocket to the intake cam sprockets and two secondary chains connect the intake cam sprockets to the exhaust cam sprockets. The primary chain has three guides and one tensioner. Each secondary chain has its own tensioner which drives a plunger guide against the chain.

The primary chain must be removed first because it sits in front of the secondary chains. To remove the primary chain:

1. Compress the primary chain tensioner by pressing on the ratchet release lever, then pushing the plunger into the bore. Once compressed, the plunger can be locked in place using an allen wrench or pin punch.
2. Remove the slack guide (under the tensioner) and the internal guide (at the top of the chain).
3. Remove the chain.
4. Remove the tension guide.



**Crank pulley removal**



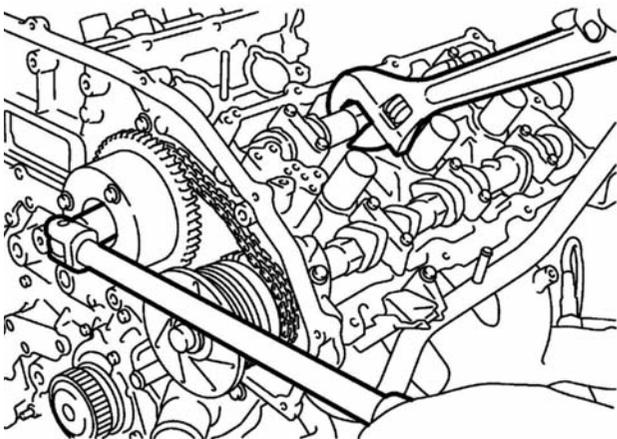
**Use a pin to lock the tensioner in the retracted position.**

**It's very important not to move the crankshaft or camshafts once the timing chain has been removed.** This is an interference engine and the valves can be damaged by the pistons.

The secondary chains are removed with the sprockets. There is not enough slack to remove the chains with the sprockets in place. To remove the secondary chains:

- Compress the secondary tensioner and use a .020 in. (0.5mm) pin to lock it in place.
- Hold each camshaft using the hex portion cast into the cam near the mid-point (under the valve cover) then remove the center bolt for each sprocket.

Insert a thin piece of metal or plastic between the secondary tensioner guide and the chain. This will aid in removal of the chain by preventing it from getting caught in the groove of the guide as it is removed.

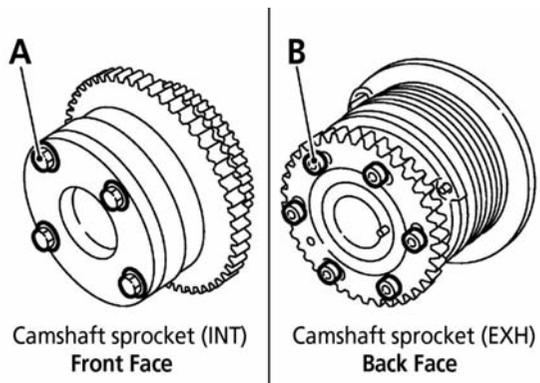


### **Don't loosen the small bolts or attempt to disassemble the intake cam VVT sprockets.**

- Pull the sprockets and chain out together. Once the chain has cleared the tensioner guide, the guide may fall. Have a helper ready to catch the tensioner guide.

### **Inspecting and replacing**

Check all components for damage and wear. When in doubt, it's probably better to be safe than sorry and replace suspect components. The water pump is driven by the timing chain, so be sure to inspect for leaks and play in the bearing. The water pump can be replaced without removing the timing chain through a handy service port.



**Do not remove small assembly bolts on the intake (A) or exhaust (B) sprockets.**

### **Installing the chains and sprockets**

The secondary chains and sprockets are installed first. Verify the cams are still close to the original position. The dowel should be "up" on the exhaust cams, and the small hole should be "up" on the intake cams.

The back side of each sprocket has two stamped marks: oval marks and round marks. The correct position for the marks depends on whether the sprocket is used on the right (passenger side) bank or the left (driver side) bank.

The secondary timing chains have three gold links, one by itself and two side by side. The single gold link should be lined up with the single mark on the intake cam. The side by side links should be lined up with the double marks.

If the sprockets are on the right (passenger) side, the round marks should be used. If the sprockets are on the left (driver) side, the oval marks should be used.

Because the marks are on the back side of the sprockets, they can be hard to see while installing the gears and chain. To make installation and timing verification easier, extend the marks over the top of the tooth or teeth with a paint pen before assembly.

Once the secondary chains are set up, install the primary chain. The tension guide (on the left side) and water pump must be installed before the chain. The crank key should be in roughly the 11 o'clock position, pointing towards the right (passenger side) cylinder head.

The primary chain also has colored teeth to aid in alignment. Two yellow teeth that line up with match marks on the intake cam sprockets and an orange tooth that lines up with the match mark on the crank sprocket.

## Nissan & Infiniti Timing Chain

It is possible to cause either of the secondary chains to jump time while installing the primary chain, so be sure to recheck both after the primary chain is installed.

It's easy to make a mistake, so use the manual, and recheck your work several times. Take the time to be absolutely sure it's right before moving on.

### Cleaning and sealing

When used properly, Nissan liquid sealer provides an excellent long-lasting seal. However, to duplicate the original seal, you'll need to recreate the original conditions. When the new engine was assembled, the parts were clean, there were no defects on the sealing surface, there was no dried silicone on any of the bolts or in any of the bolt holes, and the silicone was applied following the original design specifications.

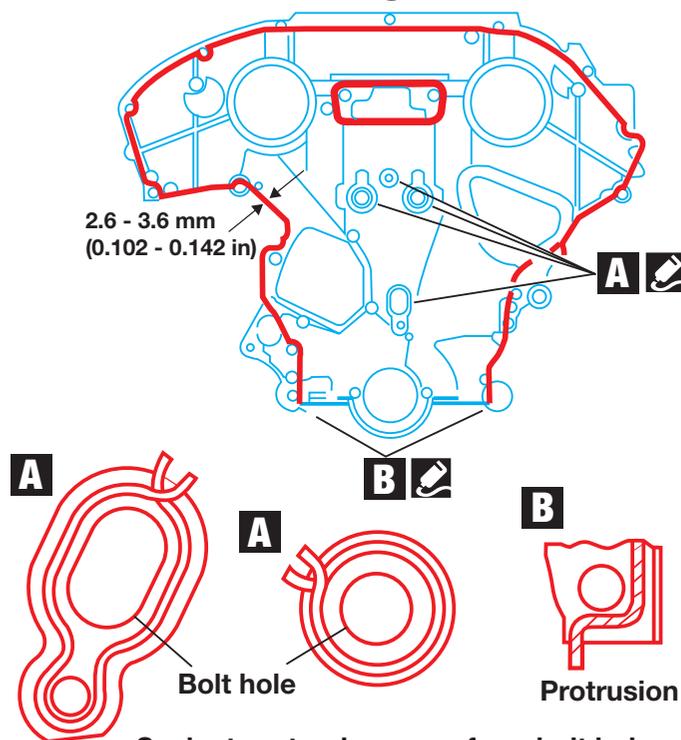
- Use a small pick to check for and clean old silicone from bolt holes.
- Use a scraper and fine wire "toothbrush" to clean dried silicone from flats and corners.
- Use solvent that leaves no residue to remove oil, moisture and other debris.
- Follow the silicone application procedure in the manual. Don't "wing it."

Nissan does allow for the use of "equivalent" silicone sealant, but most quality sealants are roughly the same price, so why take a chance? Why not order a tube of Nissan Ultra Gray (PT # 999MP-AM003P) with your parts order. That way you'll be sure that you have the correct type of sealer for the application.

While it's not strictly necessary, the Nissan tube squeezing tool (SST# WS3993000) makes application in a uniform fashion easier and reduces wasted product. There are also several gaskets, o-rings and seals that must be replaced.

- Verify the front crank seal is installed square, that the lip is not damaged, and the garter spring has not fallen off.
- Be very careful with the collared o-rings for the VVT system. Be sure they don't fall out of place and get pinched on installation.
- Be careful the valve cover gaskets do not fall out of position during installation and become pinched. Also be sure to apply silicone to the areas noted in the manual.

### Front timing chain case



Sealant protrusion away from bolt hole

 Apply liquid gasket. (Use Genuine RTV silicone sealant or equivalent. Refer to GI section.)

**Sometimes it does matter which side of a bolt hole a bead is applied. Follow the schematics to avoid leaks.**

### Torque

Sometimes it isn't possible to use a torque wrench on every fastener, at least not while the engine is in the car, but for the fasteners that can be accessed, using a torque wrench will reduce your chances of problems. You'll find the torque specifications in the manual. Of particular importance are the cam sprocket bolts, crank pulley bolt, timing cover bolts, and valve cover bolts. The crank pulley bolt is the torque-to-yield type, so you'll need an angle gauge in addition to a torque wrench.

### Quality control

When the job is complete, double check all of your work. Run the engine at fast idle and check for oil and coolant leaks. Test drive to check for performance and abnormal noise. |



# Get better performance from a cleaner engine with Nissan Fuel System Cleaner.

Lower quality gasolines are formulated with less effective and less expensive detergent additives. Over time, even occasional use of these gasolines can rob your engine of its power, performance and fuel economy.

To get the most performance, fuel economy - and fun - from every mile, and for optimum cleaning of fuel injectors, intake valves, and combustion chambers, use one (20 fl. oz.) bottle of Nissan System Cleaner every 3,000 miles when refueling.

## One tankful treatment can help:

- Clean fuel injectors, intake valves and combustion chambers
- Restore lost power and performance
- Maximize fuel economy\*
- Lower harmful emissions

\*Restores lost fuel economy by removing harmful fuel injector deposits



## Fuel System Cleaner

• Cleans deposits from fuel injectors, intake valves, and combustion chambers

**DANGER!** COMBUSTIBLE. HARMFUL OR FATAL IF SWALLOWED CAN ENTER LUNGS AND CAUSE DAMAGE EYE AND SKIN IRRITANT. READ CAUTIONS ON SIDE LABEL.  
20 FL. OZ. (591 mL)



# Knocking Out **NOx**



**NOx failure without a MIL is not very common on newer Nissan and Infiniti cars, but older vehicles still have this type of emissions failure.**

Do you remember the last time you had to diagnose a NOx failure? It may have been a while for some of us. Newer cars almost always develop a fault code long before they fail a tailpipe test, but Nissan cars don't wear out so easily, and there are many older models still serving as daily drivers.

Some "fresher" technicians may have never encountered a NOx failure, and when you're not familiar with the potential causes of the failure and efficient NOx diagnostic methods, finding the problem can be a real pain. This article serves as an intro to NOx for the uninitiated, a refresher for those who are out of practice, or perhaps just edification for its own sake for those in states without emissions programs.

### What NOx is and why it's bad

NOx (nitrogen oxides) is a term used to describe these environmentally harmful nitrogen/oxygen molecules:

- NO (nitrogen monoxide)
- And NO2 (nitrogen dioxide)

Unlike N2O (nitrous oxide), they're no laughing matter. Nitrogen oxides cause smog, cancer, acid rain, and respiratory ailments. Most NOx in the atmosphere is generated by human activity, and the largest single human generated source of NOx is transportation: cars, trucks, buses, etc.

There's no point in feeling vaguely guilty every time you climb behind the wheel. We can't function without transportation, and advances in technology have greatly reduced vehicle emissions. Every new generation of vehicles pollutes less than the last. The U.S. Environmental Protection Agency (EPA) sets new goals and Nissan engineers find innovative ways to exceed them, such as the new Nissan Leaf; the first fully electric zero emission vehicle available at an accessible price. What we can do is keep older cars functioning properly, including maintenance and repair of emissions systems.

### How NOx is generated

Our atmosphere is composed primarily of nitrogen (N2) and oxygen (O2), 78% and 21% respectively; the ingredients for NOx surround us. However, the nitrogen molecule (N2) is mostly inert and can't be split apart without some force, so it's not normally available to bond with oxygen. Nitrogen and oxygen molecules can be broken then shuffled together in the

following ways: bacteria, lighting, burning biomass and heat. Since we're concerned with fixing cars, we can probably safely remove bacteria, biomass, and lighting from the list of things to check for when diagnosing emissions failures. That leaves heat, but heat where?

The internal combustion engine is going to create heat; after all, combustion is right in the name. However, if the combustion temperature is kept below 1300 deg. C (2370 deg. F), the creation of NOx is greatly reduced. Since pocket thermometers can't be used to measure combustion temperature, we'll have to look for things we know can cause increased combustion temperatures, such as:

- Lack of Exhaust Gas Recirculation (EGR) function
- Incorrect ignition timing
- Poor fuel control (lean mixture)
- Overheating
- Incorrect spark plugs
- An excessive compression ratio



**Exhaust Gas Recirculation (EGR) valve**

### EGR

The Exhaust Gas Recirculation (EGR) system exists to reduce NOx. If the car has an EGR system, checking its function should be near the top of the diagnostic checklist. EGR reduces combustion temperature and pressure by introducing inert gases (exhaust gases) to the air fuel charge. When testing an EGR system, you must verify these three things:

- Valve function
- EGR flow
- EGR control

The EGR valve must be able to open and close. On older cars, this is usually tested by applying vacuum to the EGR valve diaphragm with a hand-held vacuum pump. You should observe that the valve holds vacuum (doesn't leak), and that the valve opens when vacuum is applied and closes when vacuum is released. Over time, carbon deposits build up on the walls of the EGR passage, reducing the volume of gas that can flow through the passage, which will decrease the effectiveness of the EGR system. A clear passage is usually verified by operating the EGR valve with a vacuum pump while the engine is running at idle, then observing whether the engine stumbles or stalls. Be careful here; the EGR passage may be partially restricted, and the engine may stumble a little bit, even though the EGR volume is insufficient.

If both the valve and the passage are OK, the only thing left to check is EGR valve control. EGR valve controls varies from car to car, so be sure you understand the system you're working on. The manual will have all of the information you need.

All control systems share these common functions: activation of the EGR valve when desired and exclusion of the EGR valve when inappropriate. The EGR should not operate when the engine is cold, so any testing must be performed with the coolant temperature over 145 deg. F. The EGR should only operate when the engine is under moderate load, so the EGR will only operate off idle. There are also some other conditions, such as high RPM, low battery voltage, and overheating, which will prevent the EGR from working, so they should be kept in mind as well.

Older Nissans will use an exhaust pressure transducer to modify the vacuum signal to the EGR valve based on exhaust backpressure. As engine load increases, so does exhaust backpressure. A diaphragm-controlled valve in the transducer modulates the vacuum signal to the EGR so that EGR flow will be proportional to the engine's load.

Older Nissans will also use a solenoid valve to allow or prevent EGR operation. This valve will prevent EGR operation before the engine has reached operating temperature, but there will be other blocking conditions as well. The manual will contain a vehicle specific system description and testing procedures. If you find the solenoid is blocking the signal when the engine is warm, check the manual for the details.

Some systems are monitored by the ECM via a temperature sensor located in the EGR passage. When the



**Solenoid valve**



**Temperature sensor**



**Looks like someone has elongated the timing adjustment slots beyond the normal range – a sure sign of problems.**

EGR is operating, the temperature sensor reacts to the passing hot exhaust gas. On cars with monitored EGR systems, there may be a stored EGR flow code to aid in diagnosis.

Newer Nissans use an EGR volume control valve. This is an ECM-controlled stepper motor that regulates the EGR pintle position. The ECM uses a pulsed push-pull signal to control the pintle position in precise steps. In the event of no signal, the EGR valve is pushed closed by an integral spring. These EGR valves can be tested using the Consult II or Consult III, depending on the model year of the car. However, you'll likely find these more modern cars usually won't fail an emissions test for NOx without also providing useful self-diagnostic information through the OBDII system.

### Timing

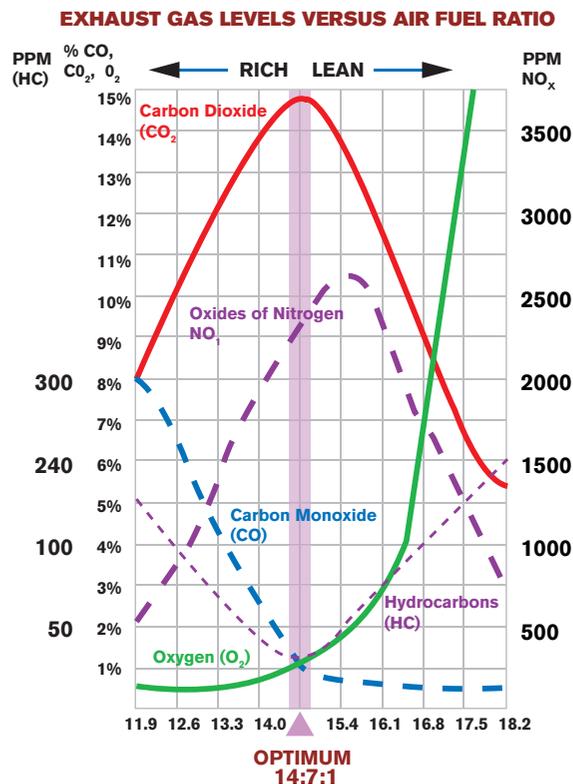
Ignition timing will have an effect on NOx emissions. Advanced timing will usually cause NOx to increase, and retarded timing may decrease NOx. Base timing should always set to specification for the best performance, efficiency, and emissions. Don't forget to check timing advance systems like mechanical and vacuum advance. Binding centrifugal weights or a stuck breaker plate can also cause problems. If the car is a little more modern and has computer timing control, it's not a bad idea to check advance function just to be safe.

### Fuel Control

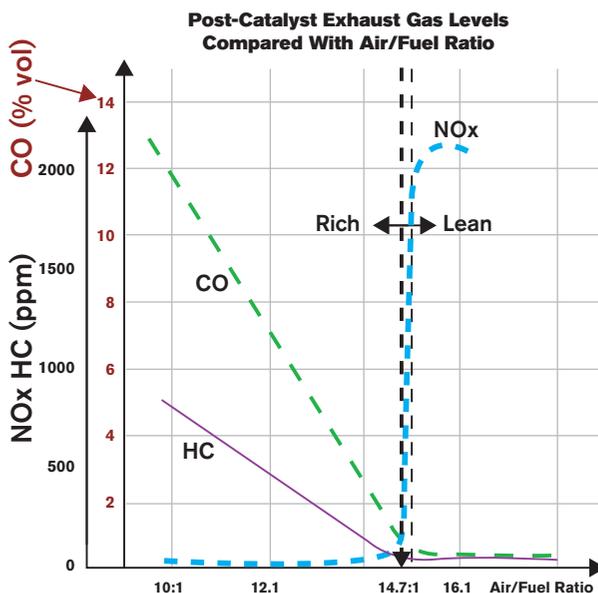
Fuel control is very important. A lean-running engine will produce a lot more NOx, so it important to verify the mixture is stoichiometric (a 14.7:1 air to fuel ratio), especially in the load cells used during the emissions test. In other words: if the NOx is too high at 15 MPH at 15% load, you should verify the mixture is stoichiometric under the same conditions. The oxygen sensor should also be tested, even if the average mixture reading at the tail pipe is good.

Below are two graphs. One demonstrates emission levels response to changes in air/fuel ratio pre-converter; the other demonstrates emission response to air/fuel ratio post converter. Notice that NOx gradually increases as the mixture gets leaner. If the mixture becomes 5% leaner, the NOx will increase about 13%. A lean mixture increases NOx before the converter, but the effect is nowhere near as dramatic as it is post converter.

Now compare the effects of air/fuel ratio on emissions post-converter. Notice NOx is quite low at air fuel mixtures up to 14.7:1, but there is a rapid spike in NOx as soon as the mixture becomes leaner than 14.7:1.



Pre-converter emission levels response.



Post-converter emission levels response.

A seemingly small 5% deviation from the ideal air/fuel mixture can cause a 2000% increase in NOx emissions post converter.

Obviously, verifying correct air/fuel mixture at the same conditions as the emissions test failure is an extremely important diagnostic step because the converter can't efficiently reduce NOx emissions unless the mixture is 14.7:1 or lower.

### Poor cooling

If the engine is overheating or has localized hotspots, the NOx emissions will increase as a result. Start with the basics: things like coolant level, thermostat operation, fan operation, air pockets, or any other cooling system issues. If the cooling system was badly abused and sediment has blocked a portion of the cooling gallery, this could cause a hot spot and high NOx production on one or two cylinders – although this is pretty rare.

### Spark plug heat range

Running spark plugs with the wrong heat range can increase NOx. Original-equipment spark plugs are designed to run hot enough to prevent fouling, but not so hot they create pre-ignition and high NOx. Some aftermarket spark plugs are not properly designed for all of the applications they're purported to "fit." If they run too hot, NOx will increase as a result. Ordering plugs from a Nissan dealer by VIN will ensure a good match between plug and engine.

### Compression

Technicians often think of compression pressure decreasing as an engine ages. Leakage past the piston rings and valves will increase as the engine wears. However, there are a couple of things that may



**The only way to eliminate excessive compression as a cause of high NOx is to check it.**

have caused compression pressure to increase on an older engine.

First, if carbon builds up on the piston tops and combustion chambers, the combustion chamber volume will be reduced and compression pressure will increase. If the rate of compression increase exceeds the rate of compression loss through engine wear, the engine may develop a higher compression ratio as it ages.

Another way compression pressure can increase is as the result of engine repair. If the cylinder head or block deck has been resurfaced, the combustion chamber volume will decrease and compression will increase. Nissan publishes maximum resurface limits and cylinder head height specifications in the Engine Mechanical (EM) section of the service manual, but some shops choose to ignore these specifications, and that can cause some real expense for their customers when the car comes up for an emission recertification.



**This converter was installed to "correct" a NOx failure. Two years later this truck is failing with even worse numbers. Not only was the converter an inappropriate repair, the aftermarket converter did not hold up very well.**

### Catalytic converter

Three-way converters are designed to reduce NOx, as well as hydrocarbon (HC) and carbon monoxide (CO) emissions. So obviously, if the converter performance has degraded, the NOx will increase as a result. The reason the converter is last on the list of things to check is this: a new converter may temporarily mask a problem that could have been corrected more permanently with a far less expensive repair. Condemning a converter should be approached like condemning an ECM: replacement should only be considered after all other possibilities have been eliminated. |

# SOMETIMES THINGS ARE NOT WHAT THEY APPEAR TO BE.



## TRUST THE ORIGINAL. GENUINE NISSAN PARTS

NISSAN OEM ADVANTAGE #49

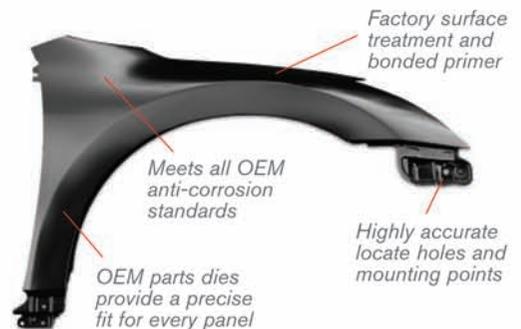
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### NISSAN OEM FENDER ASSEMBLY



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# | The Perfect Body

In this first body service article in a series, Nissan's position on the use of non-OEM parts, salvaged air bag components and the repair limitations of steel and aluminum wheels is defined.



The importance of using the correct body repair parts and materials cannot be overstated. Using non-OEM or aftermarket parts to offer your customer a lower price is not a good business practice for many reasons. Such parts are not engineered by Nissan or the company's suppliers for the best structural integrity, longevity, safety, form and fit. To return a Nissan or Infiniti vehicle to its correct specification and appearance, the best answer is to use Genuine Nissan and Infiniti replacement parts.

The use of salvaged parts from wrecked or dismantled vehicles is not a good idea either. While they may have been Nissan-approved when new, the possibility of hidden structural damage or other defects that could cause failure or early corrosion outweighs the possible savings. These defects may be the result of a number of conditions, such as crash damage, the vehicle having been in a flood, a fire - or simply excessive age. You may not be aware of such defects when you obtain the part, but that doesn't lessen your liability. Don't take a chance if you don't have to.

## Nissan position statements

Nissan has issued several position statements covering the use of non-OEM parts, salvaged air bag components and the repair limitations of steel and aluminum wheels.

These position statements were most recently issued in the form of Parts and Service Bulletins on February 24, 2010. These bulletins are intended as guidelines for Nissan and Infiniti dealers, and the independent repair facilities that purchase repair parts and materials from them. These bulletins are printed below for your information. Printed copies of the bulletins are available from your local Nissan or Infiniti Program Dealers, which are listed in the final pages of this magazine.

## Use of Non-OEM Parts on Nissan Vehicles

### Nissan Parts & Service Bulletin 10-016:

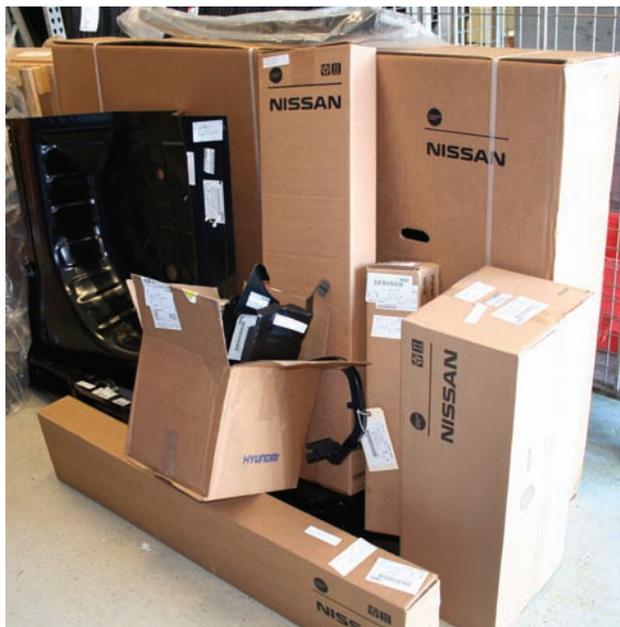
*The original parts used on a Nissan automobile are designed and built to provide optimum fit, function safety and structural integrity of the vehicle.*

When collision repairs are necessary, Nissan North America recommends that any repairs be performed by

an experienced professional using the Nissan body repair manual and Nissan Genuine original equipment replacement parts designated for the use on the specific Nissan vehicle being repaired. This includes: mechanical, electrical, body panels, safety and structural components. Genuine Nissan replacement parts are developed to deliver the same fit, function, safety and structural integrity as when the vehicle was originally built. Parts of the vehicle are designed to work together as a system. Integrating non-Nissan Genuine parts or aftermarket parts into these systems can change the crash performance engineered into the design in the case of a future collision.

Following the recommendation, especially with regard to safety and structural components will assist to avoid compromises to the structural integrity and safety of the vehicle that could occur when parts other than Genuine Nissan original equipment replacement parts are used.

Vehicle lease agreements, such as those offered by Nissan Motor Acceptance Corporation, may stipulate that ONLY Genuine Nissan replacement parts be utilized for collision repairs to the vehicle.



**For the best results, always use Genuine Nissan Parts to restore your customer's vehicle to its original beauty, safety and structural integrity.**



**The use of salvaged or used air bags when repairing a Nissan vehicle may compromise the safety of the occupants.**

### Parts Warranty

Nissan North America's replacement parts warranty does not apply to any part other than a Nissan Genuine original equipment replacement part. Repairing a leased vehicle with other than Genuine Nissan replacement parts may not only be prohibited by applicable lease terms, but may also limit or restrict coverage under the manufacturer's vehicle warranty or any additional warranties, service contracts or maintenance contracts covering the vehicle. Customers should review their specific leases/warranties/contracts for details. Nissan North America is not responsible for any damage or repair costs resulting from the use or failure of parts other than Nissan Genuine replacement parts or parts otherwise approved by Nissan.

### Use of SALVAGED and or USED Air Bag Components on Nissan Vehicles

Nissan Parts & Service Bulletin 10-016:

*The original supplemental restraint system parts utilized on a Nissan automobile are designed and specifically engineered for use in that vehicle. This includes the new service air bag system components. Nissan North America is confident that such supplemental restraint systems and their components will help protect occupants in Nissan vehicles.*

*The installation and use of a salvaged or used supplemental restraint systems component in a Nissan vehicle may compromise the intended performance of the vehicle's air bag system as there is no certainty of the history, quality, condition, compatibility, environmental or other degradation prior to salvage of a salvaged or used air bag system component.*

When supplemental restraint system repairs are necessary, Nissan North America recommends that any repairs be performed by an experienced professional using only new Nissan Genuine original equipment replacement parts designated for the use on the specific Nissan vehicle supplemental restraint system. Following this recommendation, vehicle owners and repairers can best ensure that the supplemental restraint system parts used in the repair of the Nissan vehicle will help protect vehicle occupants in a possible future crash.

### Steel and Aluminum Wheel Repair on Nissan Vehicles

Nissan Parts & Service Bulletin 10-014:

*Nissan North America does not approve of any repairs or the use of any repaired steel or aluminum wheel that involves welding, bending, hammering, straightening, re-machining, reforming, or adding new material as this can compromise the structural integrity of the wheel and safety of the vehicle.*

Any repair of steel or aluminum wheels must be strictly limited to minor cosmetic sanding or polishing that removes just the finish.

### Wheels – more than just pretty

Everyone loves sharp wheels. They are part of the vehicle's design and add to the overall beauty. The aftermarket wheel industry sells millions of dollars worth of custom wheels each year. Now, more than ever before, we can easily (but often at significant cost) add that personal touch to our rides.

Nissan creates wheels for its vehicles that will aesthetically compliment the overall design, but are far more important than just looking attractive. Basically, wheels are the component that supports the vehicle's entire weight during all aspects of driving and transfer the driving force to the tires that contact the ground.

The torque applied to the wheels during acceleration and braking – often while turning – is immense. Add to that the impact from road surface variations:



**Minor wheel damage, such as this scrape caused by hitting a curb, can be repaired. Cracks, deep dents and noticeable bends cannot.**

potholes, railroad tracks, road debris, the inadvertent curb bumps and other hazards, and you'll see that the structural integrity of the wheels is far more important than merely adding beauty.

Deciding when a damaged wheel can be repaired or discarded due to cracks, dents, bending or imbalance is a critical safety factor for a service facility. You want to keep the cost down for your customer, but when a wheel is damaged more than cosmetically, you must make the hard decision that replacement is the only option.

This requires that you thoroughly inspect the wheel and report the findings to the customer. You don't want to jeopardize the driving safety of the vehicle and its occupants or expose your shop to any legal action that could ensue. If you are sure that any minor damage can be repaired – fine. But, if there is damage that could lead to the wheel breaking, which could cause a serious accident, you must let the customer know and be prepared to explain (in a technical, not frightening manner) the possibilities.

Any damage to the bead area where the wheel seals against the tire (bends, dents and cracks from an

accident or hitting a hard object, such as a pothole) calls for replacement. In such cases, the tire – if it survived – is probably beyond saving.

If you perform a wheel repair that removes any more than the smallest amount of metal, you should re-balance the wheel and tire assembly.

## Paint

Nissan does not specify a particular source for paint. It is assumed, however, that the collision service facility will use a top-tier supplier and will have received training from that supplier in the use of the paint and finish products.

## Structural integrity

The term “structural integrity” refers to the design of strength and durability that was established when the vehicle or component was created. It encompasses the relationship between each component in the entire assembly and its ability to perform within that assembly. If one part is not capable of performing at the optimum level, the entire assembly is therefore compromised. To put it simply, we can use the old adage, “a chain is only as strong as its weakest link.”



**This 2006 Infiniti Q56 is getting an entire new frame. Just imagine the problems that could occur if non-original frame parts – the vehicle's foundation – were used. Talk about structural integrity!**

## Collision Repair



**The combination of Genuine Nissan parts, top-quality products and personal skill will bring your customer's Nissan or Infiniti vehicle back to pre-crash condition.**

In this context, structural integrity means that all the parts were designed with a common interrelated purpose and if one part should fail, the entire assembly of parts is rendered incapable of serving its designed function. To simplify again: one bad part can cause the entire vehicle to fail. That's why it's important to use the very best parts.

### **Nissan offers all you need**

Your local Nissan and Infiniti Program Dealer can supply all the body parts and products you need to restore your customer's vehicle to its original structural integrity, safety and beauty.

Nissan also offers its helpful "Body Repair Manual – Fundamentals" guide. This manual is prepared to provide service personnel with the general knowledge necessary to perform body repairs on Nissan vehicles. Information is provided on auto body construction, sheet metal work, welding, plastic repair and safety. It is available on the Nissan Tech Info website at [www.nissan-techinfo.com](http://www.nissan-techinfo.com). |

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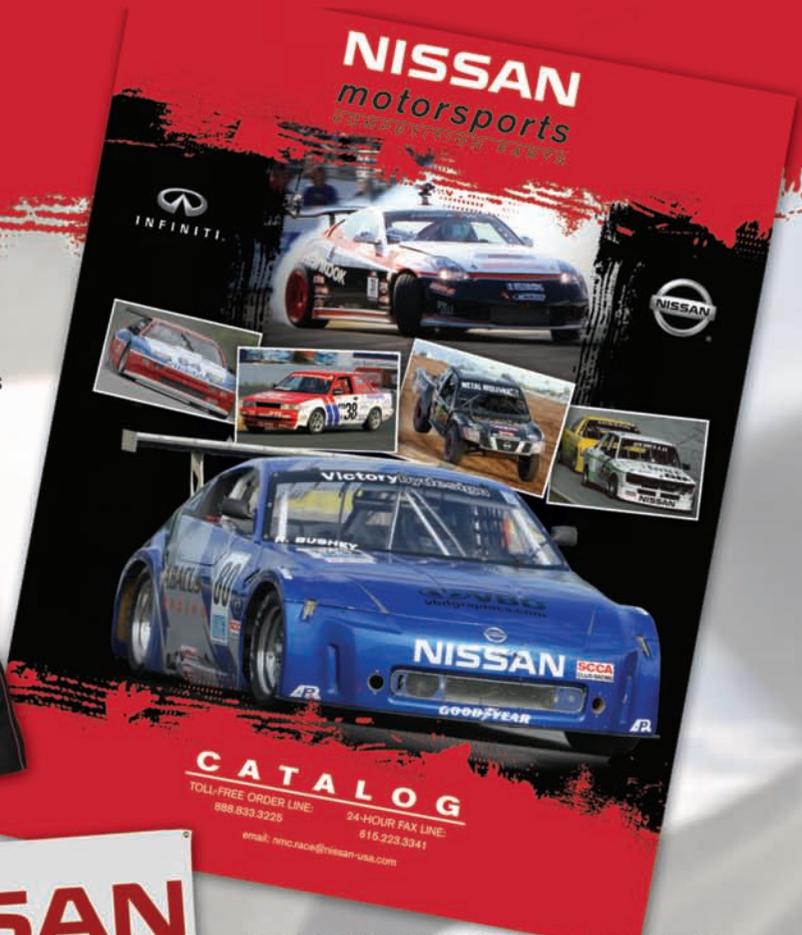
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