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Contents

Features

Departments

Identifying Nissan Axle Ratios

With the versatility in light truck drivetrains comes the inevitable variety in drivetrain parts. Both front and rear differentials must have the correct gear sets in them. Let's take a look at how to identify that axle and identify the parts you need to get the job done right.

It's an unfortunate situation we find ourselves in, diagnosing a failure inside the differential. What can make that a lot worse is installing the wrong gear set and having to do the job twice.

Different axle ratios were available in many Nissan trucks for a variety of reasons. Trying to get the most power to the ground with the best fuel mileage is the underlying thought. Unfortunately, this is dramatically different depending on what the truck is used for. Aside from aftermarket modifications and DIYers trying to take their trucks to the extreme, stock vehicles will have different gear sets for towing, off roading, economy or performance applications.

When ordering a replacement rear end, front differential, or internal gear parts, it is critical to confirm you are ordering the right part with the correct gear ratio inside. This doesn't have to be a difficult thing to accomplish. Many axle housings have the original part numbers on a sticker right on the differential housing.

On a 2005 Titan, for example, you'll find this will be on the right side of the pinion portion of the differential housing. Barring any modifications done previously, this is the first place to look to identify your axle. When you're talking to the parts department they will identify the type of differential you have without issue. They may not, however, be able to identify the actual gear ratio. All you need is the number representing the gear ratio.

With the identification sticker intact, this axle won't be difficult to correctly identify. The gear ratio of 2.937:1, the part number, and even the original Dana part number are all right there for you. Too easy.

Opposite Page: Along with the Dana part number and date of manufacture, the last two numbers, 47 and 16 indicate the number of teeth on the ring gear and pinion gear respectively. Simply divide the former by the latter to get the gear ratio. 47/16 equals 2.9375:1 gear ratio.

By opening the differential and counting the actual teeth on the gears, simply divide the number of ring gear teeth by the number of pinion gear teeth and round to the nearest gear set available. As an easy example 40 teeth on the ring gear and 20 teeth on the pinion gear is a gear ratio of 2.0:1. Of course, actual gear sets will not be quite that easy number- wise.

Take the example of the 2005 Titan we had earlier. If the sticker was missing, we could simply open

the differential and count 47 teeth on the ring gear and 16 on the pinion. Break out the calculator and, poof, 47 divided by 16 is 2.937. That's the number we need to get the right gear set. Of course, counting teeth is way too difficult. It's much easier to simply rotate the ring gear until the stamped Dana part numbers are visible and there you have it.

These methods are great if you have a sticker or easy access and time to remove the differential cover. There are still a couple of options if those methods aren't available. On many vehicles, assuming they're not modified, you can simply open the driver's door and read the factory identification sticker found low on the B-pillar. This is a great way to identify all kinds of factory options for the truck you're working on.

In the bottom left corner of the sticker is the axle identification code. This will be a letter and number combination of 4 digits. The first 2 indicate the differential housing type, and the last 2 indicate the gear ratio. Looking at an Xterra with a code of CA31 we know it has a C200K (8 bolt) axle housing due to the CA and a gear ratio rounded from 3.13:1. This is all the info needed to get the right gear sets. Another example might be HG43. That would be an H233B rear axle housing with, you guessed it, a 4.3:1 gear ratio. If the sticker isn't available in the door jamb you may find a similar tag on the bulkhead under the hood.

A well-used truck may have long lost any identification stickers and tags. This doesn't mean we're completely out of luck. With a bit more math and a jack we can positively identify that axle ratio and get the right gear set. First, we need to know if the truck has a limited slip differential. With both wheels

Found on the right side of the bulkhead (firewall), this ID tag has all the information you need, including VIN, engine, transmission, and axle information, making ordering the right parts an easy task.

Rotate the tire and count how many times the tape goes around. It's a bit "old school" and math heavy but you will be able to tell what that gear ratio is when you're done.

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off the ground, rotate one tire. Does the other turn the same direction or the opposite direction? If it turns the opposite direction perform the test with one wheel on the ground and multiply your final answer by 2. If it spins the same direction both wheels will have to be off the ground.

Next, mark the tire and driveline to identify a set point in the rotation. Then, with the front wheels chocked and transmission in Neutral, rotate the wheel and count the revolutions of both the tire and the driveline. If you're really good at identifying percentages of a circle your axle ratio is the number of times the driveline rotates when the tire makes one full rotation. For the rest of us rotate the tire 4 or 5 times and divide the number of driveline rotations by 4 or 5 respectively to get your answer. Remember, if you have an open differential and one wheel on the ground you will have to multiply your final answer by 2.

The presence of a factory trailer hitch receiver may indicate the truck has the factory towing package that comes with a shorter gear set to improve performance while towing heavy loads.

The more options for gear sets that are available for your application, the more precise you will have to be. Let's look at some numbers to make it make sense. On a truck with an open differential, you rotate the tire 4 times and count about 7 revolutions of the driveshaft. Divide 7 by 4 and you get 1.75. Multiply that by 2, due to the open differential, and you come up with 3.5. If your gear ratio options are 2.97, 3.56, or 4.625 you can assume it's 3.56.

One final thought to consider is that a lot of the time simply looking up the part or calling your Nissan parts department will be all you need to do to get the right gear set. There are frequently external indicators as to what equipment the vehicle came with from the factory.

A great example is if the truck came with a factory mounted trailer tow hitch receiver. It tends to be easily identified by the perfect fit, proper wire routing for the trailer lights and the complete lack of any stickers that identify it as an aftermarket part. Trucks with a factory towing package will have a shorter gear ratio (higher number) to provide more torque to the ground and increase the towing capacity.

If the part selection is in question, be thorough and make sure you match up the old with the new before installing it. If you suspect modifications have been done, it's important to make sure your front and rear differentials are a match. Any discrepancy between front and rear gear ratios will make the 4-wheel drive function impossible. With the availability of aftermarket parts and the ever-present backyard mechanic, it's not the best idea to assume you have the correct gears because of external markings or tags, but rather trust and then verify.

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Train to survive and thrive

Training is critical both to survival in this environment of rapidly evolving automotive technology and to the ability to succeed in the face of pressures from competitors and other market forces.

New body materials require repair procedures that often differ from those of traditional steels. Faster, more precise response to driving conditions and engine load require real-time inputs from many more vehicle systems than in the past. New sensor and other information input technologies require post-repair reset or calibration to communicate with control modules. This need may often be due not to damage to the sensor, but because it is part of a circuit that the technician disconnected from power during a repair that, in the past, would have been considered unrelated. And much of this new technology is mounted near the vehicle perimeter, or is networked through wiring connections in areas that are vulnerable to collision impact. As I-CAR® CEO and President John Van Alstyne has said, "If you are not training on new technologies, you are falling behind."

Eliminate training redundancies

The I-CAR In-Shop Knowledge Assessment™ program reduces the time required to learn by using competency testing to determine which classes a technician needs. The testing eliminates class requirements in all technological areas in which the technician demonstrates that he or she already has adequate knowledge.

That knowledge can come from experience, OEM training, or other sources, according to Gary Tench, Body Shop Manager at Jeffrey Automotive Group, a multi-brand new car dealership near Detroit. "For example, we've received the Nissan training on distance monitoring and safety sensor technology, and have already purchased related tools and begun repairing those systems. We know enough to pass assessment tests on those skills. We can focus on additional advanced training available from I-CAR."

"The Knowledge Assessment program allowed my technicians to test out of some classes that would otherwise have been required for them to achieve I-CAR Gold Class certification," said Kathleen Walters, Body Shop Manager at Lisle Auto Plaza, a multi-brand suburban Chicago area new car dealership. "It cut our shop's total training cost almost in half."

I-CAR training prepares technicians to perform complete, safe and quality repairs.

Test and train in your shop

All assessments and much of the subsequent training is done in your shop, to eliminate travel time and reduce expenses. Most training can be done after hours or scheduled to avoid significant lost technician productivity.

Instructors base assessments on oral interviews. Not using written tests reduces the potential for reading comprehension problems or English as a second language to slow the assessment process. "The In-House Assessment instructor asked questions and my technicians answered verbally, not in writing," said Walters. "At times they went into the shop for hands-on experiences."

The instructor provides an assessment results report to shop management. It identifies knowledge gaps and becomes the basis for developing a training plan for each technician.

Fast track to certification

Body shops can reach or maintain I-CAR Gold Class® status by having technicians that are certified at least I-CAR Platinum™ 1 in four functional areas: estimating, non-structural collision repair, structural repair, and refinishing. Using the knowledge assessment process is like switching from sandlot baseball to a professional sports team.

With a completed assessment in hand, shop management and the technician together develop a training schedule. The training plan shows the quickest path for each technician to become Platinum certified. Shops that participate in the I-CAR In-Shop Knowledge Assessment program achieve Gold Class status in about one-quarter of the time, compared to the average non-participating shop.

"We combined the Knowledge Assessment with in-shop classes, all in a three-day period, for fast-track to I-CAR Gold Class certification for our entire shop," explained Walters. "I-CAR instructors led live, hands-on classes after closing time in our shop."

"On-going classes are required to keep your certification up," said Tench. "I-CAR classes help us maintain our Gold Class status."

Gold Class marketing

Once the shop is Gold Class certified, I-CAR lists it on GoldClass.com, a site used by vehicle owners when they are in the market for collision repairs. Insurers and OEM network program administrators also visit the website to ensure that shops they are using are current with Gold Class status.

The I-CAR Gold Class marketing signage and website help attract customers to certified collision repair shops.

Increase productivity and job stability

The training teaches technicians how to use the proper tools, equipment, and repair information. "Old-school, trial-and-error body work doesn't cut it with today's vehicles," said Walters. "I see my technicians following OEM-recommended repair procedures and getting reduced cycle times, and that is partly the result of I-CAR training."

Nissan support

"I am filling out applications right now to a program offered by Infiniti to cover 50 percent of the cost to send a few of my technicians to I-CAR collision repair classes," said Walters. "We pay, with help from Nissan, for our techs to take I-CAR classes," agreed Tench.

"Every time we offer training support to our technicians, they are very excited about it," said Tench. "They see it as the shop investing in their future," said Walters.

The hottest ticket in town

I-CAR Knowledge Assessment points technicians to opportunities to learn about the latest tools, equipment, and repair procedures. "My techs understand that the grass is not greener on the other side," said Walters. "They tell me that we've got the hottest ticket in town." |

No-Clue No-Start

Oh, the frustration! You've got spark, fuel, and compression and the engine still won't start. Where do you go from here? Let's take a look at no-start diagnostics when, by all accounts, the engine should be running fine. The laws of physics still apply so let's think outside the box and solve that mystery no-start.

In nearly every no-start diagnostic that rolls into your shop, you're going to find one of the big three is the cause of your customer's problem. Fuel for the fire, spark to light the fire and compression so the fire can move the engine. Very rarely, an engine will seem to have all three and still refuse to start. The problem will always have a solution. The questions are, can you find it and can you fix it? As with any diagnostic, a solid understanding of how an engine works and how it is controlled are key to finding the fault. With these kinds of problems, you will have to add a bit of creativity to the mix and think about it from different angles.

The most frustrating situation with no-start diagnostics is when the test you did didn't give you the correct result. Either you relied on a test that was not as thorough as it needed to be, or the test flat out gave you the wrong result.

Take spark for example. If you test a coil with an induction probe and see the coil fire, it's usually safe to assume the spark is fine. It's almost unthinkable, but it is possible that the spark isn't getting all the way into the cylinder. Just a few possibilities might be: fouled spark plugs, oil in the spark plug tubes, broken spark plug insulators or even incorrect plug gap.

Knowing a history of how the no-start occurred can eliminate some of these possibilities. Consider that all it takes is one less than perfect, do-it-yourselfer to gum up the works. Perhaps someone thought they could save some money by changing their own spark plugs. They installed the new plugs with a standard 5/8" deep socket not knowing that spark plugs have insulators that can break, or perhaps they didn't understand that the spark plug gap should be more than zero. Seeing the spark at the actual plug can alleviate these concerns. Even with coil on plug distributorless ignition you can test for integrity in the ignition system; it's just a little trickier.

In the automotive world that just keeps advancing, it is interesting that these 2.4L and 3.3L vehicles with their distributors are still on the road. The primary method for ignition control for Nissan vehicles since the mid-2000s is the coil on plug distributorless ignition. It is so efficient, there don't seem to be any changes coming anytime soon. All of the issues the distributor presented seem to have departed with it.

There is one notable exception and that's the intermittent CMP sensor. It's so common and can be so hard to pin down that it has been suggested that the first step in diagnosis is to replace the part and move on. This problem doesn't seem, on the surface, to be related, as a CMP or CKP sensor failure will carry an obvious lack of spark and fuel injector pulse.

This is merely a cautionary message to be a little extra thorough. Rather than calling a fuel injector pulse good when you first see the noid light illuminate, watch it for a good 5-10 seconds.

Opposite Page: This is an induction probe. It senses the voltage spike in the coil to identify when it fires. This is typically a good test to verify you have spark at the cylinder. What it doesn't tell you is whether that spark is making it all the way to the end of the spark plug. Fuel or oil fouled spark plugs may not be revealed by this test.

Any drop-outs in the rhythm of the noid light may indicate intermittent driver failure, intermittent CMP sensor failure, or poor power and ground connectivity to the ECM, all of which can cause a no-start condition. Don't have a noid light? The same can be tested with an induction probe and lab scope watching the coil being triggered or even using the cowboy spark testing method of having an entire bank of coils with spark plugs connected to ground. The rhythm should be steady as the engine cranks. If it's not, find out why.

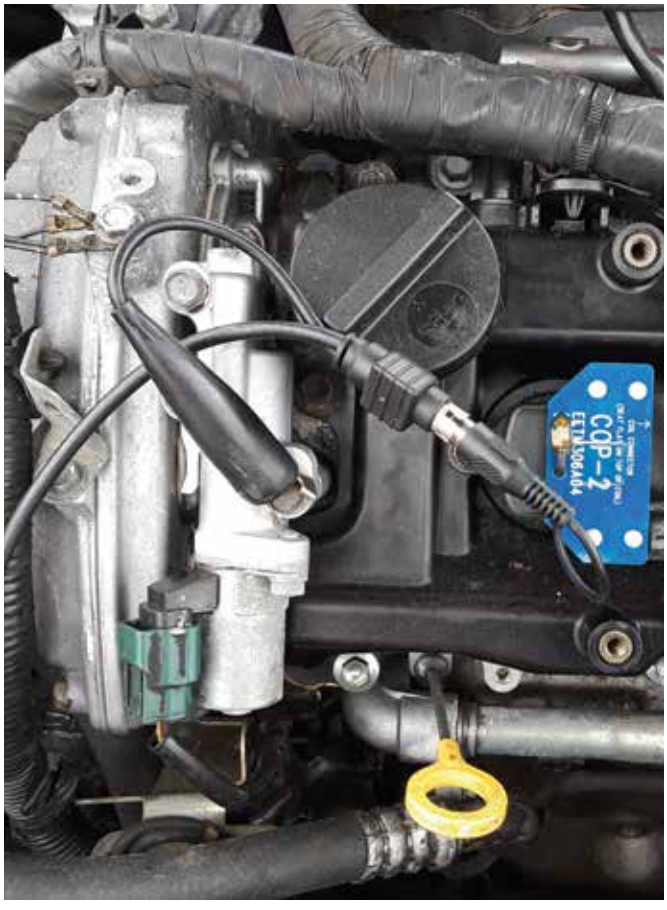
Is it modern art or a highly sophisticated testing implement? It's neither. This is a simple "cowboy" way of testing whether the spark is making it all the way into the cylinder. Please be sure and unplug the fuel injectors thus preventing raw fuel from being sprayed into the air.

There is an exception to the fuel, fire, compression triangle and that's in the timing. The internal combustion engine is basically a way to take the energy from an explosion and turn it into movement then repeat the process several hundred to several thousand times per minute. Using an explosion to make movement is easy, but making it repeatable requires precise timing. The pistons must move to exactly the right place and, at the same time, the valves have to open and close at the precise moment they are designed to. This gives you compression. Add in electronically controlled fuel and spark at exactly the right time and we have a functioning engine. Timing that is off a little can cause poor runnability and misfire. Timing that is off a lot will cause a no-start. Timing that changes while the engine is running will cause a no-start that is very difficult to diagnose.

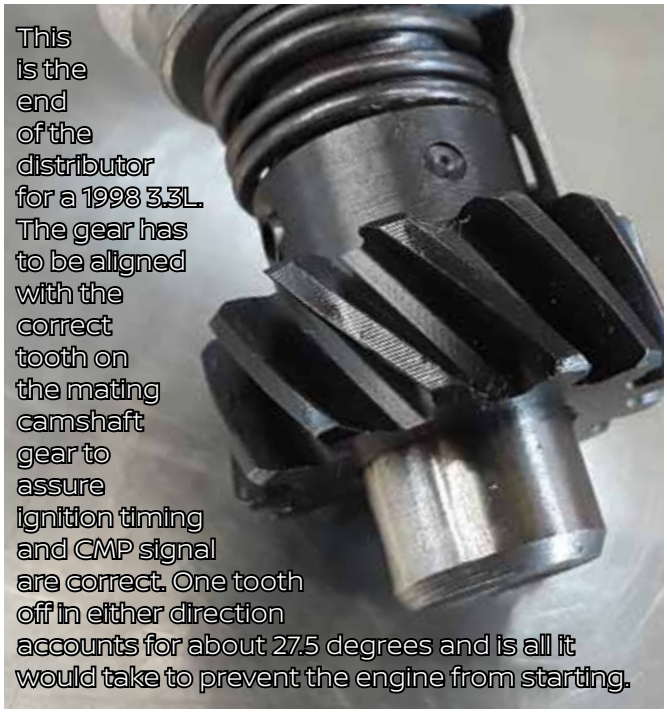
When ignition timing is off enough to cause a no-start it usually gives itself away while the engine is cranking. Backfiring in the exhaust or intake manifolds is often a solid sign your timing is off. If the engine was being worked on prior to the no-start, looking at what repairs might have been related to the ignition system will likely be a short cut to your answer.

When testing the signal from a CMP sensor, back probe the connector rather than piercing the wire harness and watch the signal for a few seconds to confirm it's not dropping out intermittently. In a 3.5L a CMP sensor-caused no-start is much less likely than in the 2.5L or 1.8L simply because of the second CMP sensor in the V-6.

Take the 3.3L you might find in an early 2000s Xterra, Frontier or Pathfinder. The distributor is gear driven off the bank 2 (left) camshaft. A very simple mistake in replacing the distributor can lead to an engine that will crank and crank without starting. To confirm the distributor is clocked correctly, turn the engine to top dead center on the compression stroke. Remembering the crankshaft has a TDC position in both the exhaust stroke and the compression stroke, use a compression whistle to make sure you are on the compression stroke.



This sensor sends an inductive signal to a lab scope or graphing multi-meter. Watching the signal for 5-10 seconds of cranking may reveal an erratic signal.



This is the end of the distributor for a 1998 3.3L. The gear has to be aligned with the correct tooth on the mating camshaft gear to assure ignition timing and CMP signal are correct. One tooth off in either direction accounts for about 27.5 degrees and is all it would take to prevent the engine from starting.

Install the whistle in place of the number 1 spark plug and turn the engine until it goes through a long whistle. As soon as the whistle stops align your timing mark on the crankshaft to TDC and you're ready to roll. Remove the cap and double check that the rotor is pointed at the spark plug wire that goes to cylinder number 1 (right bank, first spark plug). Even very experienced technicians have been known to make this simple mistake.

At this point, even if the rest of the cylinders are in the wrong firing order, you should get cylinder 1 to fire. Then simply confirm the firing order is correct (1-2-3-4-5-6 in the case of the 3.3L) and more importantly in the right direction, counter-clockwise. Putting the wires in order but clockwise will cause an interesting and possibly exciting failure to start.

Distributors are quickly becoming a thing of the past. Is it still possible to have a timing-related no-start with distributorless ignition? The answer is not likely. Significant hard parts damage would have to occur that would more likely lead to a no spark condition. CMP and CKP sensors can't be out of adjustment as there is no adjustment to be out of. Since most Nissan applications use hard parts like the actual camshaft or crankshaft to trigger the sensors any failure in these parts would be more catastrophic than a simple no-start.

This is a TDC whistle. The most valuable inexpensive tool in the tool box. Use it to identify top dead center using the engine's compression. Warning, if your valve timing is off it may not be accurate.

Valve timing can cause a no-start condition. With confirmed good compression however, it is unlikely to be the cause. Incorrect valve timing as a cause of a no-start condition is more likely to be noticed by the complete lack of compression as the engine is cranking. Other symptoms might be backfiring out of the exhaust or intake manifolds as valves, being open at the wrong time, allow the fire to escape. If valve timing is suspected, even a little, stop and check. The difference between "far enough out of time to cause a no start" and "far enough to cause valve damage" is very small with our most popular Nissan powerplants being interference engines.

With the CMP sensor built in, the engine has little means of detecting when a distributor is not clocked correctly. With the built-in coil, CMP sensor, and regular bearing failures, 3.3L distributors are the cause of many no-starts.

It's also important to realize that too little gasoline isn't the only fuel problem that can cause a no-start. Even in a modern fuel injected engine, too much fuel can flood the engine and foul the spark plugs. A failing fuel pressure regulator or leaking injectors allowing too much fuel can effectively short out the spark plugs inside the engine.

There is a provision in the ECM software to help deal with excess fuel in the cylinders. If the throttle is pushed to wide open while cranking, the fuel injectors are shut off, preventing any further fuel from entering the cylinders. So long as fuel isn't being provided by an alternative method, this should allow the cranking engine to blow the excess fuel out the exhaust and resolve the flooded condition.

With timing belt engines, valve timing can be easily checked. With timing chain motors like this 2.4L you will have to remove the cover and line up three colored links with the crankshaft and each camshaft. Assuming the timing chain wasn't recently replaced incorrectly, the chain would have to be loose to be out of time.

Since a single badly leaking injector isn't likely in the first place, there is almost no possibility of all 8, 6, or even 4 injectors being at fault. Of course, fuel injectors aren't the only possible failure that can cause extra fuel in the intake manifold. Fuel pressure regulators that are vacuum actuated, as in many pre-2000 Nissan engines, can be a place to investigate. Typically, this will result in a very rich running engine with misfiring and bad, gassy smells. If it's ignored by the driver long enough it can get to the point that fuel is puddling in the intake manifold and

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flooding the engine during cranking. This failure has a "tell" in that you will likely smell the excess fuel by just walking up to the vehicle.

Being a professional automotive technician, of course, we know that if you smell raw fuel, cranking the engine isn't a safe option. When excess fuel is suspected, simply remove the vacuum hose and check for raw fuel. Any liquid in the vacuum hose means a fuel pressure regulator is in your future. Most Nissan engines after about 2000 have a return-less fuel system and the fuel pressure is regulated by the fuel pump in the tank. If the engine is old enough to be carbureted, a leaking needle seat or sunken float will have the same effect.

There is another side of the fuel situation that is sometimes taken for granted, and that's the air side. It doesn't mater how hot your spark is, without air you have no fire. In older engines with a throttle cable, a stuck or plugged idle air control solenoid could actually be the cause of a no-start condition. Often this failure would present with the firing of a couple of cylinders then a quick stall. Simply raising the throttle off idle slightly would easily identify there was a problem present in the idle circuit.

With Nissan's adoption of the "fly-by-wire" electronic throttle bodies in the mid-2000s, the throttle control side of the equation has become more involved. Since an electronic motor controls the throttle plate, there is no need for an Idle Air Control solenoid (IAC) as the ECM can simply open the throttle plate directly. Failures in these throttle bodies are rare, but when they do happen a no-start condition can be one of the results.

Most often you will find a stored code as the ECM constantly monitors

This electronically controlled throttle body controls the air side of the air/fuel ratio. Too much or too little air can prevent the engine from starting. Fortunately, most failures will result in a stored DTC.

This air tube has been folded over on the underside of the throttle body. This is both preventing the air passing by the MAF and allowing unmetered air in at the same time. Under some circumstances this air flow metering failure can lead to a no-start condition.

the throttle body's performance with redundant throttle position sensors and a functional test when the key is turned on. A failure without codes is still possible in that the throttle position sensors only monitor the actual throttle plate. With enough carbon buildup around the throttle it can act just like a clogged IAC. If this is the case, simply depress the accelerator a little to see if the engine will start. Better still, inspect the throttle plate for signs of trouble.

Another consideration in the area of air flow is the ECM thinking the air flow is greater or less than it actually is. Something as simple as a torn intake air tube can prevent the engine from starting and, in some cases, can cause intermittent stalling.

The way it works is the opening in the air tube, after the MAF, allows air in without passing through the MAF, then the ECM sees much less air entering the throttle body. The ECM then drastically modifies the fuel flow preventing starting. After multiple attempts to start the engine the ECM will override the MAF reading and start the engine with default values. If the leak is in such a position that the air flow changes back and forth, the ECM can stay confused, resulting in a no-start condition.

Another situation to consider is the triggering of the NATS immobilizer system. Typically, the no-start will be accompanied by a flashing or steady security light. It's the light that looks like the outline of a car with a key inside it. Check for codes first. A dead battery in a key fob may be the core of the issue.

There are specific issues that affect all Nissan vehicles equipped with the system from 2005-2008. A TSB has been issued, NTB10-107. What can happen is a no-start situation that appears to be a security immobilization. The actual cause is a failed battery reducing the voltage to the ECM while cranking. The battery may even test good with a non-load type tester. Before getting too deep in any no-start or even engine performance diagnostic, be sure to confirm that your battery is good with a load test and your grounds are solid.

Solving Power Window Woes

This article will focus on where to start with diagnosing faulty window behaviors, how to troubleshoot window-related problems that develop as a result of other repairs, and how to properly QC check a vehicle to avoid unnecessary come-backs regarding the power windows.

This article will not cover how to physically remove and replace power window components. Instead, we will explore where to begin when trying to figure out what went wrong with the window and how to properly initialize window control systems. We will also explore some possible situations when another repair may incidentally cause window misbehavior, and how to anticipate these complications when recommending work. Lastly, a good quality control checklist can prevent delivering a project that might have incomplete initialization.

Where to begin with non-functional power windows

Take time to document the window behavior that the customer describes. You should also operate all windows, even if the customer describes only one with a problem. Do the automatic UP or DOWN modes function? Does the sunroof function? This baseline information ensures that after repairs are performed you know whether the window is fixed properly, and whether any other windows need additional attention. If you never check other windows, you might release the car with new problems that could have been identified.

Always engage brain before hands! Don't rip right into the door panel as your first course of action. The computer is the best tool in your arsenal to begin fixing any power window malfunction. With access to the Nissan TechInfo website (http://www.nissan-techinfo.com), you can easily find relevant TSBs and the official service manual for any Nissan you're about to work on. If there are no TSBs, then check the service manual to understand how the circuit is designed.

Once you've ruled out any relevant TSB or open service campaign, think about general possibilities for the malfunctioning window:

- Has the door for the window ever been involved in a collision?

- Does this door open and close properly without hyperextension?
- Does the window make any noises while operating?
- Does the window move slowly or otherwise bind at any point while going up or down?
- How do the driver's master power window switch buttons physically feel when operated?
- For other windows, how do the sub-switches physically feel?

Consider these bullet points before opening the door panel. If the door has been involved in a collision, all bets are off as to what may be wrong with the window! Knowing this might help you prepare the customer for possibilities prior to your labor investment. If the door's over-travel check is broken, the hinge wiring harness can hyperextend and break.

Noisy windows suggest potential problems with the regulator, window glass, or the rubber run. Excessive friction from the window glass binding on a dry window run can cause a window motor's internal circuit breaker to trip. The window might operate – slowly – until it stops working entirely for a period of time. Silicon-based wet lubricants can alleviate this friction without swelling the rubber. A window regulator should be investigated if abnormal noise and movement is observed during window operation. Likewise, window glass mount points should reviewed if noises or erratic movement still exist.

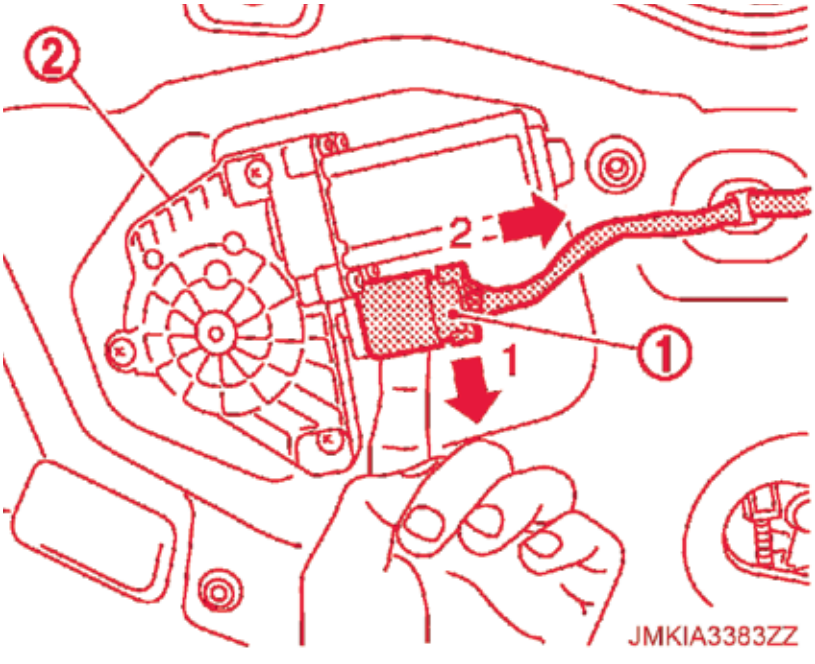
Even if the customer insists that a regulator was replaced recently on the problematic window, many shops will use aftermarket parts whose fitment is questionable. Unless repairs are performed using genuine Nissan parts, even new window regulators can have fitment issues that result in loose mounting bolts or poor operation. Likewise, a vandalized window repaired by insurance may not have used factory window glass, and therefore the aftermarket glass might be sized differently or have inaccurate mount locations.

The window switches are another area in which to look. Move the buttons on the switch and compare with the other switches on the same vehicle, or another known-good Nissan in the shop. It is quite common for a switch button to break, affecting the AUTO UP/DOWN functionality, or to send a constant incorrect signal that interferes with the desired window motor function. In other words, a switch might always be telling a motor to roll up, and therefore that motor can never "hear" the command to roll down.

Taking things apart for evaluation

If it's the next logical step in evaluation to disassemble the door panel, then be sure to reference the service manual first. While the disassembly procedure tends to be similar for every vehicle, some models have hidden clips or connectors that could create frustration.

Unless the diagnostic logic suggests otherwise, when evaluating a power window, it is best to begin by checking the signals out of the driver's window master switch. Consult the service manual to understand the expected voltage



Be aware that this motor's connector has a hidden release latch not immediately visible. Check the service manual before forcing things apart!

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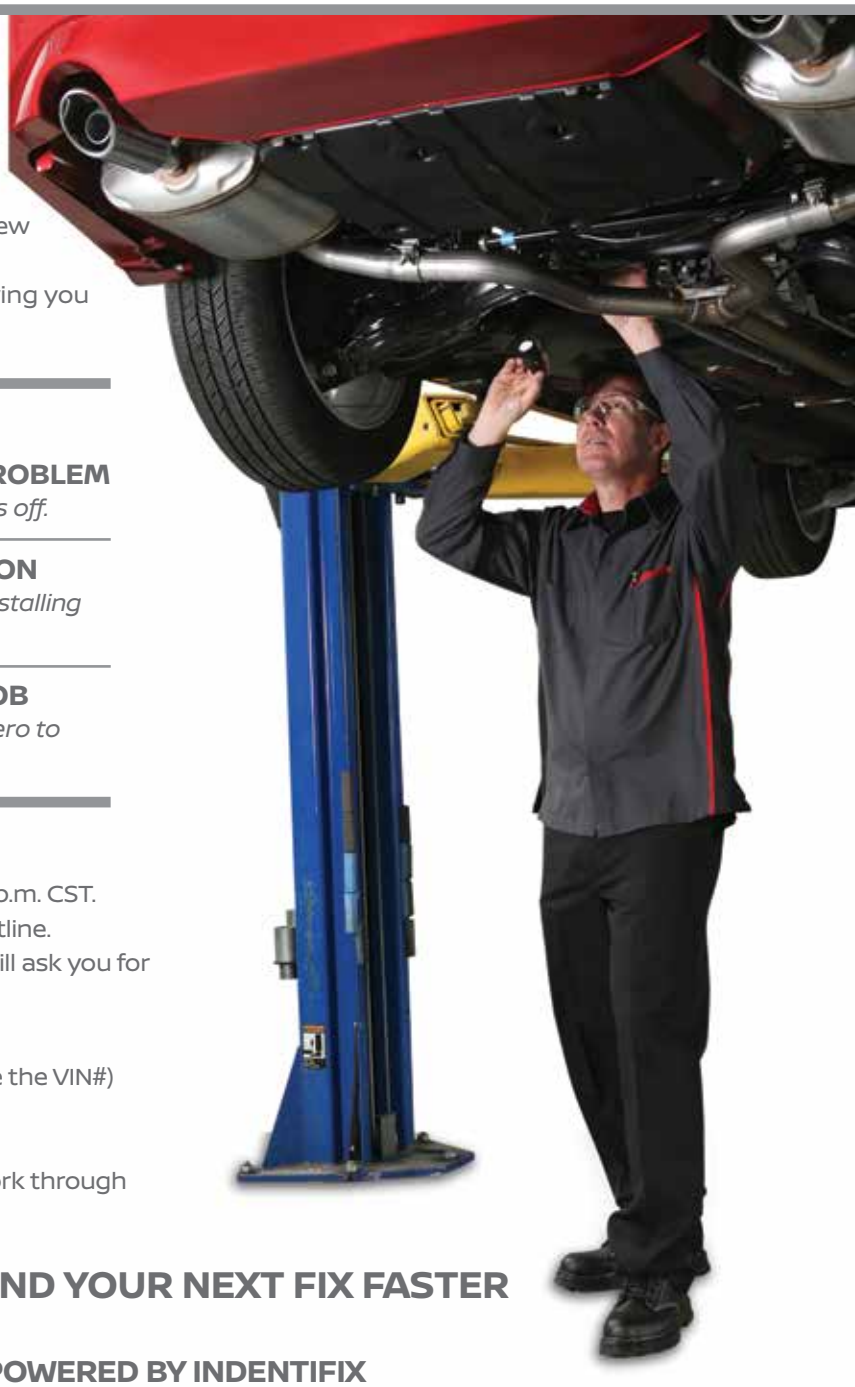

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signals and connector pins involved. First, you can immediately determine whether the signal arrives from the BCM and the in-between circuit wiring that is called the power window switch serial communication line. Then, you can see whether the signals out of the switch to the motor(s) are as anticipated and within specification.

Testing and confirming failure of window components is not the focus of this article. The December 2016 Nissan TechNews article discusses in-depth test procedures. We will instead focus on electronic window behaviors and initialization after repairs.

Power window motor Encoder

Any Nissan equipped with automatic roll up or down features is also equipped with a window motor that has an on-board Encoder component. The Encoder provides a frequency signal to its respective window switch while the motor is operating. This pulse signal provides both speed and direction of the movement of the window glass.

The Encoder transmits its pulse to the window switch in a manner consistent with motor rotation. The power window switch remembers the current position of the window glass based on motor rotations reported by the Encoder, as well as both the minimum and maximum rotations for fully open and fully closed window positions, respectively.

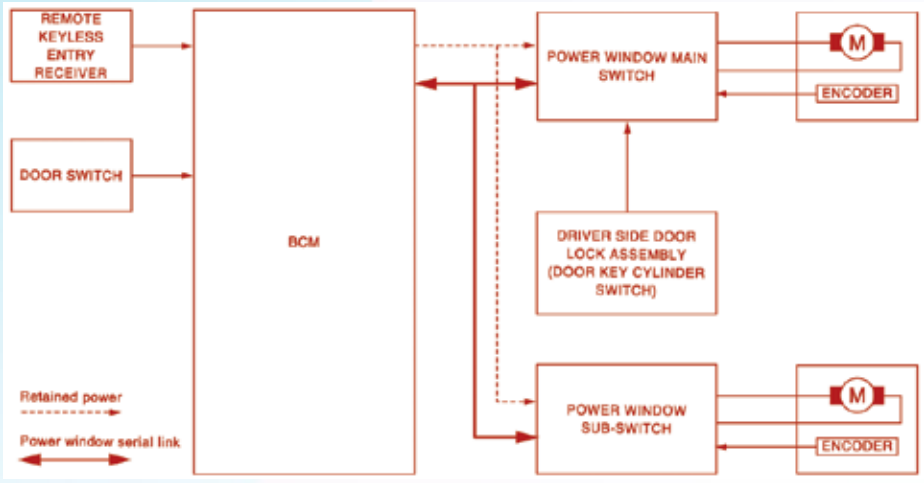
Power window control systems switch to fail-safe control when malfunction is detected in the Encoder signal. This can occur if a signal that is out of the expected value occurs outside of the upper/lower memorized positions for fully open/closed. When in fail-safe mode, the window control defaults to non-initialized mode, and any automatic functions stop operating.

If the Encoder fails, the window motor will require replacement. It is not serviceable separately.

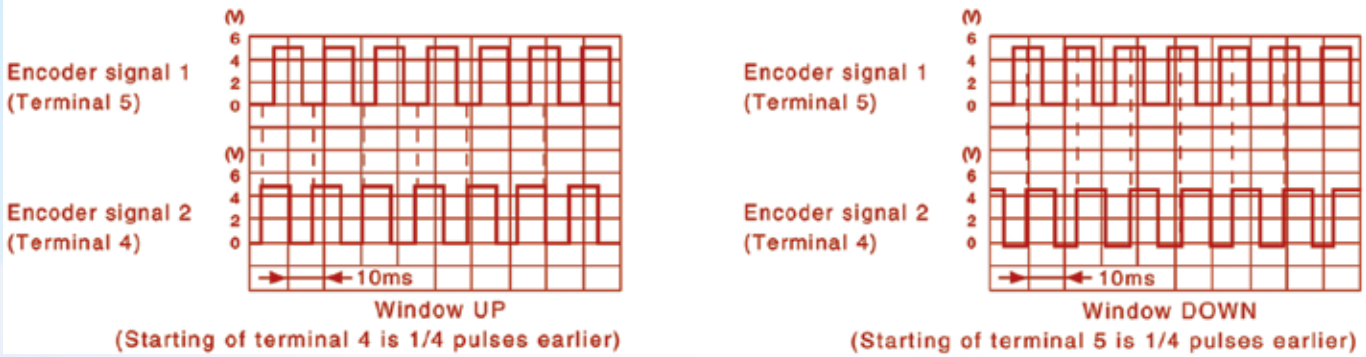
Other automatic window features

Aside from automatically going up or down when passengers push the switch buttons, many Nissan power window systems have a few other automatic features.

All Nissan windows include a safety "anti-pinch" feature. In the event that an object is pinched while the window is AUTO UP, the increased



This 370Z coupe's window circuit is abbreviated for quick reference in the service manual.



For this 2013 Altima, the D7 connector has pins to check the Encoder output with an oscilloscope. An erratic Encoder signal will create issues for the automatic windows.

resistance to the motor operation changes the Encoder signal. A change in the Encoder signal alerts the power window switch to halt upward movement, and to roll the window down about six inches. Bear in mind that the window switch ignores this anti-pinch logic at the nearly closed position by design. Likewise, forceful jounces while driving may inadvertently trigger anti-pinch behavior. Never test the anti-pinch functionality with a helper's or your actual hand; try a two-by-four block of wood!

Convertible Nissans like the 350/370Z and the Murano Cabriolet have door frames that do not completely enclose the window glass. Power window control for these designs adjusts the window position automatically during door opening and closing. This is to ensure a proper physical seal between the convertible top and the fully closed door and window.

Upon opening the door, the door switch sends a signal to the BCM. If the current position of the window glass is nearly fully closed as reported via the power window switch serial communication line, the BCM will command the switch to lower the window 10 mm. Upon closing the door, the opposite logic occurs and the window fully closes. Before opening the door, if the window is already open more than 10 mm, no automatic adjustment will take place.

Nissan vehicles equipped with automatic windows can also control them remotely. Even with the ignition turned off, turning and holding a key in the door lock cylinder for at least one full second will close or open all power windows. While holding the key, the lock switch sends a signal to the BCM. The BCM will then command the appropriate power window switch via the power window serial link, which then operates the respective window motor. When the key is released to the neutral position, the windows will stop.

On vehicles equipped with the Intelligent Key, the power windows can be controlled with the remote fob by holding the UNLOCK button. By default, the windows begin to roll down after holding unlock for 3 seconds. If desired, this function can be configured using CONSULT III Plus by navigating to ONE SYSTEM > BCM > INTELLIGENT KEY > WORK SUPPORT, then selecting the PW DOWN SET mode.

The windows will stop opening after any of the following conditions is met:

- Unlock button held for more than 15 seconds.
- Ignition switch turned ON while still holding unlock.
- Unlock button released.

It is also worth noting that the Intelligent Key remote window opening will not function during retained power mode activation. We will discuss retained power mode more below.

Automatic window function initialization

Window initialization refers to the memorized values inside the power window switch used in accurately determining window glass position. Without proper initialization, NONE of the power window automatic functions noted above will operate.

It is necessary to perform window initialization whenever the following repairs are performed:

- Battery cable(s) are disconnected
- Power window switch cable is disconnected
- Power window regulator and/or motor is removed and replaced
- Window regulator is operated as an independent unit
- Window glass or glass run is replaced
- Power window-related fuse is blown
- Window is partly opened and/or closed repeatedly without ever being fully open/closed

Note that these bullet points are outlined in a Technical Service Bulletin (NTB06-065f) and they offer a general guideline. The service manual will always indicate whenever a repair may coincidentally cause the loss of initialization.

Furthermore, each window switch must be initialized; there is no singular initialization procedure. For repairs like battery cable removal that broadly affect all window switches, be sure to go through and reinitialize each individual window. When in doubt, reinitialize the window one more time before making repair recommendations.

The window initialization procedure

The window initialization procedure can vary from Nissan model to model, so look up the "Additional Service when removing battery negative terminal" in the first pages of the PWC section in the repair manual.

However, the procedure is nearly always identical:

1. Close the door
2. Ignition switch ON
3. Roll the window all the way down, if it is not already
4. Pull the AUTO UP switch until the window is fully closed, and CONTINUE TO HOLD AUTO UP for at least 3 seconds or more.

Some older style window control systems CANNOT be initialized by this easy method! In these instances, the initialization is performed similarly but while holding a reset button on the window motor itself. By reading the service manual first, you can avoid a potential mistake like putting the window panel back on before performing initialization. Also, if repairs in another region might affect window initialization, you can prepare customers to lose these automatic features unless they authorize necessary labor to perform a more challenging initialization.

Retained power mode

As a convenience, Nissan vehicles provide power to the window control system after the car is turned off. This retained power mode is activated immediately after the ignition switch is set to OFF. It lasts until the ignition is switched back on, the driver's door switch signal changes from CLOSED to OPEN (e.g. driver leaves the car), or after 45 seconds.

Be aware of retained power mode behavior when tracking down a parasitic key-off drain so as not to be confused by the increased draw. If retained power mode malfunctions, the most likely culprits are the door switch or the window switch.

Quality control

There is a word in the medical world for injuries that are caused by the doctor's involvement. For mechanics, one of the most common iatrogenic injuries is a failure to reinitialize automatic window systems. It's easy to lose track of the number of issues that disconnecting the battery might introduce. Knowing that Nissan windows require initialization is an important step in avoiding embarrassing come-back visits.

Whenever faced with a complaint about automatic behavior malfunction, begin with re-initializing the system. Any time you work on a window, for any manner of repair, anticipate needing to perform an initialization afterwards. Following window component replacement, or battery removal, simply test the automatic functions. Know that the AUTO UP / DOWN features may not be designed to work at all with the door open, even when properly initialized.

Don't forget the sunroof! Many Nissan vehicles are equipped with automatic sunroof controls. While initialization of the sunroof is often a similar process to window initialization, it is one more thing to remember to check. Successfully servicing Nissan vehicles becomes routine once you've developed an effective check list for quality control.

Physically pressing the circled button on this motor is required to initialize its Encoder. Be sure to check the service procedure before putting the door panel back on!

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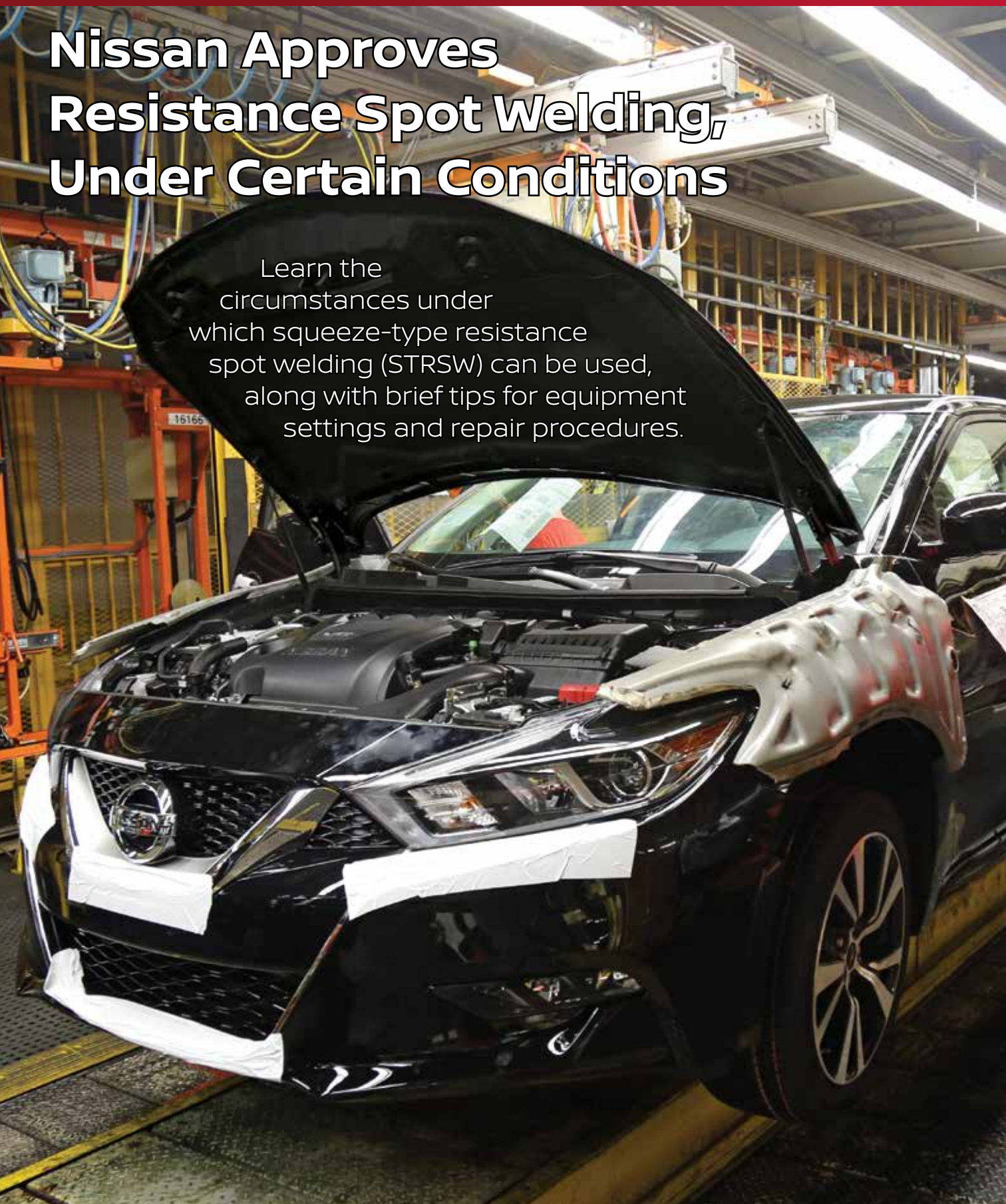
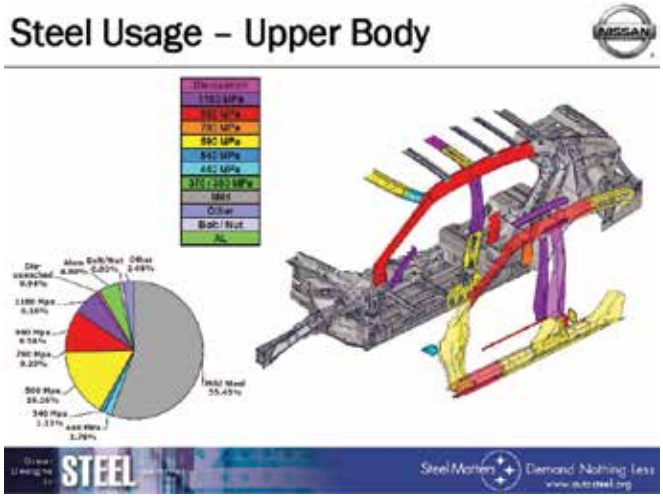
Nissan Approves Resistance Spot Welding, Under Certain Conditions

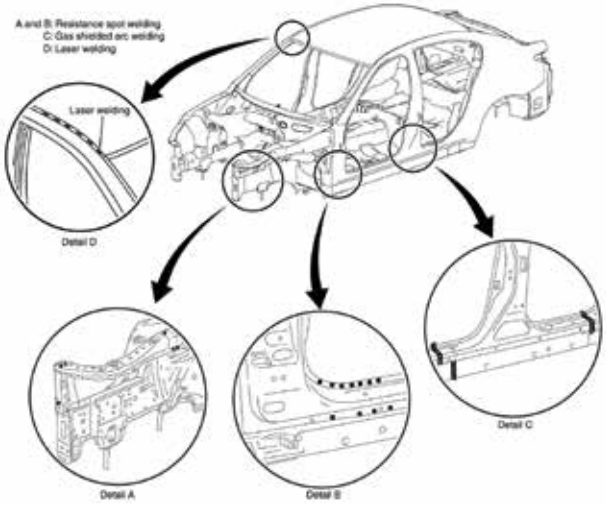
Learn the circumstances under which squeeze-type resistance spot welding (STRSW) can be used, along with brief tips for equipment settings and repair procedures.



Nissan allows Squeeze-Type Resistance Spot Welding (STRSW), but only under certain conditions. The part must be made of steel that is 980 mPa (megaPascals, a measure of tensile strength) or lower, you must use the spot welding parameter settings that are spelled out in the vehicle-specific body repair manual (Nissan BRM), and of course, the component must be accessible to your spot welder's arms (electrodes).



The 2016 Nissan Maxima includes some parts made of UHSS rated as high as 1.3 gigaPascals (gPa) in tensile strength.



Nissan uses resistance spot welding in many areas of its unibody vehicles. Example spot weld locations include the front side member (rail) inner and outer panels, the rocker panels and their reinforcement, and components that attach to these parts.

Nissan body repair manuals state explicitly: "Never spot weld components of tensile strength higher than 980 mPa. For this type of ultra-high strength steel, perform plug welding." Nissan uses Ultra High Strength Steel (UHSS) rated as high as 1,350 mPa, or 1.3 gPa (gigaPascals) on selected components of some vehicle models.

Faster, smarter, better

Resistance spot welding is faster, more cost-efficient and more straightforward to learn than traditional welding methods, but you cannot use it in every situation. It is perfect for joining thin sheet metal because it delivers a lot of energy in fractions of a second and generates only a small Heat Affect Zone (HAZ). The short application time and reduced HAZ allow delivery of enough current to melt the metal, but not so much as to weaken adjacent metal or to warp the panels. Spot welding is not ideal under some other conditions. For example, it generates too much heat for some high-strength steels, it may require multiple welds to replace a single factory spot weld, and you need to create test welds before any repair to make sure that your new joints meet strength requirements.

Current plus pressure and time = permanent joint

Joule's Law states that the heat produced when an electric current is input to a conductor is equal to the square of the current multiplied by the resistance of the conductor. In other words, the heat generated per second, or the electric power loss (P), equals the current (I) squared, times the resistance (R). This can be expressed as $P = I^2R$. The power (P) is expressed in units of watts, or joules per second, when the current is expressed in amperes and the resistance is expressed in ohms.

Resistance spot welding adds to this heat a precise amount of mechanical pressure to hold the joint stable as the weld is formed, plus a timer to control the length of time allowed for the heating and cooling phases of the welding process. The combination of electric current (heat), mechanical pressure and time management creates a permanent joint.

Multiple sheets of metal overlap while enough current is passed through the mating surfaces to melt the panels together in a tiny area. That area is pressed and held together by the mechanical force of the spot welding gun until the weld nugget cools enough to stabilize its shape. It all happens in a fraction of a second, and the welder moves on to the next area to place a spot weld.

Resistance is complicated, but not futile

Of course, resistance is not just one thing. There is resistance in the welder, and in its cables and electrodes. There is contact resistance between the electrodes and the work surfaces. There is resistance in the metal workpiece, and between each panel in the material stack.

Different material types and thicknesses present differing quantities of resistance. And resistance changes in value as the welding process moves from start to finish.

Resistance spot welding guidelines come in complicated charts that take all of these variables into account. Material thickness (mm), electrode tip diameter (mm), electrode force (kN), welding current (amps), welding time (# of cycles), hold time (# of cycles) are all equipment operating parameters that, when set properly, lead to the creation of a weld nugget in the desired size and strength. A small change in one parameter setting will affect the other parameter values and the outcome of the weld.

Newer spot welding equipment automates much of the decision making once you input the panel thickness. Some even determine the material type and thickness automatically, although you may have to conduct a test weld before starting the actual repair for the equipment to identify the material and panel thickness.

Regardless of whether you use equipment that sets spot weld parameters automatically or you enter parameters manually based on the sheet thickness and other data from a spot welding guidelines chart, it is crucial to understand that different material types, and single sheet thicknesses, dictate the use of diverse equipment parameter settings. Note: when joining sheets of different thicknesses, select parameter settings based on the thinner panel or, if there are three panels, the second narrowest.

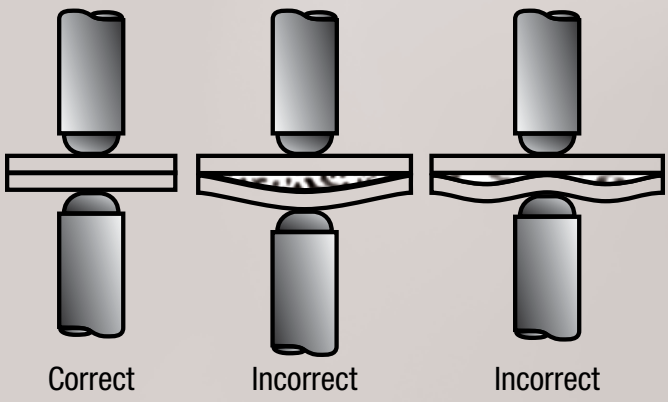
Preparation

The first step in the spot welding process is to inspect the panels that are being joined to make sure they are not warped or damaged. Any gap between panels reduces current penetration and allows moisture, air or other contaminants into the weld. Flatten and clamp sheets together before beginning to weld.

The second step is to clean the mating surfaces. Dirt or solid contaminants could prevent full contact between the panels, causing current to flow incompletely or improperly through the joint and weaken the weld. Some debris may contain chemicals that vaporize or off-gas under the heat of the spot welding process, introducing moisture or other contaminants into the weld nugget.

Model-specific spot welding parameter settings

You'll find one example of Nissan-approved spot welding parameter settings for 980 mPa steel in the 2016 Murano body repair manual. It lists electrode tip diameter, gun pressure, welding current and cycle times for a joint containing up to three plates of 980 mPa or less each.



Gaps in the material stack reduce current flow and weaken the weld nugget. Space between panels also allows moisture, air, and contaminants to enter the joint and hasten weld deterioration.

The parameter settings provided apply to the 2016 Murano only. The BRM states: "Never apply these same conditions to other vehicles."

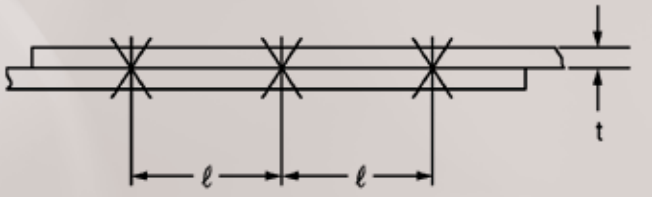
Increase the number of replacement spot welds

In an appreciation of the high power of factory spot welding robots versus the lower capacity of most aftermarket spot guns, Nissan recommends increasing the number of spot weld locations by 20 to 30 percent when doing repairs. Create at least five spot welds for every four factory locations.

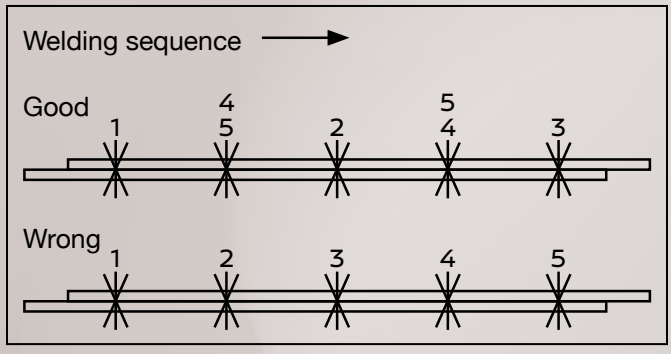
Note that the number of spot weld placements recommended in any given Nissan body repair manual may already reflect this recommended 20 to 30 percent increase. Compare the number of spot welds that you remove from the area to the number that the BRM suggests you put in as replacements.

Unit: mm (in)

Thickness (t)	Minimum pitch (ℓ)
0.6 (0.024)	10 (0.39)
0.8 (0.031)	12 (0.47)
1.0 (0.039)	18 (0.71)
1.2 (0.047)	20 (0.79)
1.6 (0.063)	27 (1.06)
1.8 (0.071)	31 (1.22)



Shunting occurs if two spot welds are too close together, and can weaken the new weld.



When making several spot welds on the same workpiece, alternate the sequence so that you vary the welding direction.

The minimum welding pitch (space between spot weld placements) varies with the thickness of welded panels. Insufficient spacing allows current to shunt (flow) away from the new weld nugget and over into the last weld you created. Diverting power results in weakening of the most recent spot weld. Shunting can occur in all types of metal. The table below shows minimum pitch values for typical automotive panel thicknesses.

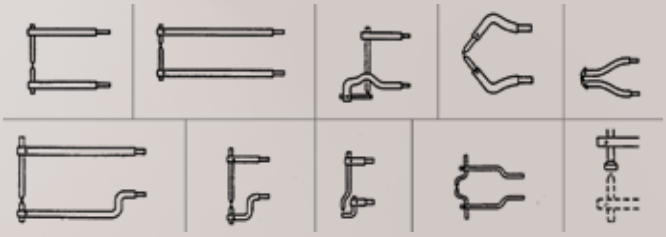
Shunting also occurs if you make sequential spot welds in one direction only. Avoid impairing the weld. Alternate the order of weld placement, and heat will not continually travel in the same direction. Also, if the electrode tips become red-hot, stop and allow the tips to cool.

Electrode arms

In spot welding, the weld nugget forms at the location where the current passes through the metal. Electrodes made of copper function as conductors to channel current into the work. Electrode attachments for spot welding equipment come in a large variety of shapes and sizes to provide access to a flange or joint that might otherwise be impossible to reach.

Pressurizing

With any debris removed, the electrode arms hold the mating surfaces in close contact with each other for the application of current. Panels in proper contact with each other allow current to flow freely through the joint, helping form the correct weld nugget shape and size. Note that the electrodes do not provide clamping force in the traditional sense. Use C-clamps or other clamping methods to hold the materials together during the welding process.



Examples of just a few of the many different spot gun clamp attachments available from your Nissan tool and equipment supplier.

Energizing

The resistance spot welding equipment applies high current while the panels are squeezed together by the clamping arms. Resistance to the flow of current through the materials generates heat between the electrodes. Different material types and thicknesses require different levels of electrical power, applied for potentially varying amounts of time, to build up enough heat to fuse the metal panels.

For this reason, material thickness is one of the primary parameters used to adjust spot welding equipment settings for a given weld.

Balancing pressure and current

The electrodes also hold pressure at that exact location to ensure weld nugget formation at the desired size and shape. Weld strength deteriorates if current remains constant while pressure varies (or vice versa). Too little welding pressure results in some of the molten material splashing out of the weld area. This excess spatter reduces weld strength.

Too much welding pressure and the current spreads out at the contact point, reducing current density in the target area. Less material is melted and fused, resulting in a smaller, weaker weld nugget.

Similarly, if the pressure remains constant while current varies, the weld nugget size and density will be altered in a potentially unfavorable way. To achieve the ideal nugget size and weld strength, you must stay within the range for each welding parameter as specified in the Nissan body repair manual.

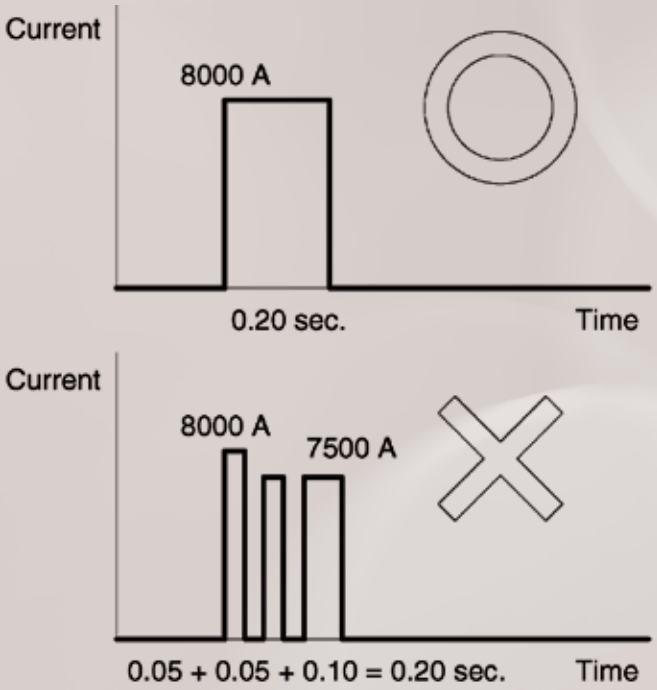
Stay within the specified amount of welding time

The amount of heat generated in the weld increases with welding time. As heat increases, the weld nugget gets larger, up to a point. Beyond a certain saturation point, instead of nugget size continuing to increase, thermal stress will begin to occur. Some spot welders can sense the nugget temperature and automatically step the current down if needed, without interrupting the welding pulse time.

Nugget	Small 	Large 
Welding pressure Welding current Welding time	High Small Short	Low Large Long

(However, the nugget size does not become larger or smaller after it reaches a certain size limit.)

Changes in welding pressure, current, and time each affect weld nugget formation independently.



Two-tenths of a second of current applied in three separate pulses will not achieve the desired weld nugget strength.

Apply welding current continuously

Apply the weld time specified in the repair manual with no interruption. If you pause or divide the current application time, even if the total adds up to the specified amount, the weld nugget will not form properly.

The BRM provides 50 and 60 Hertz (Hz) cycle times to accommodate whichever power type is supplied to your shop.

Hold time is important, too

The spot weld takes a small amount of time to cool down after the current stops flowing. Maintaining pressure during that cool-down time keeps the electrode in contact so it can quickly draw some of the residual heat away from the weld. This helps keep the molten material from spreading out and thinning and weakening the weld nugget.

Minimum panel overlap

Different sheet thicknesses require specific minimum overlap (pitch) widths. Too little overlap results in increased potential strain on one or both panels. This strain reduces long-term weld durability. See the panel overlap chart for minimum lap values by sheet thickness.

Pre-repair weld test

After setting your spot welding parameters, create a test weld before performing the final repair. Cut out a few pieces from the damaged area of the panels, so your test pieces have the same thickness as the new repair. Weld them together, then twist until you break them apart.

Unit: mm (in)

Thickness (t)	Minimum pitch (ℓ)
0.6 (0.024)	11 (0.43)
0.8 (0.031)	11 (0.43)
1.0 (0.039)	12 (0.47)
1.2 (0.047)	14 (0.55)
1.6 (0.063)	16 (0.63)
1.8 (0.071)	17 (0.67)

If the repair is good, the entire weld nugget will separate from one side of the joint, leaving a hole. If no hole forms, you need to set different welding parameters. If no spot weld parameter information is available in the Nissan body repair manual, refer to the parameter chart from your welding equipment manufacturer for guidelines appropriate to the material type and sheet thickness of your repair. Remember that Nissan does not permit resistance spot welding of ultra high strength steel rated at higher than 980 mPa tensile strength. Adjust the pressure, welding current, welding time, and other conditions and re-test until you achieve the desired result.

Post-repair weld test

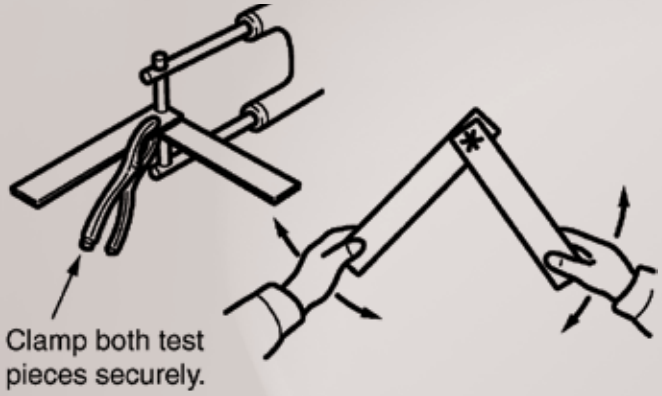
Resistance spot welds should have a shear strength equal to that of the base metal in the joint. When done correctly they are stronger than a rivet or fusion plug weld of the same diameter.

This test is for a hypothetical joint of 0.8 mm to 1 mm (0.12 inch to 0.16 inch) single-panel thickness. Insert a chisel between the panels of your weld and tap it in until the joint separates by 3 mm to 4 mm (0.12 to 0.16 inch). If the spot welds do not break or separate from the panels, the welding was successful. Restore your good weld by tapping the deformed portion back together.

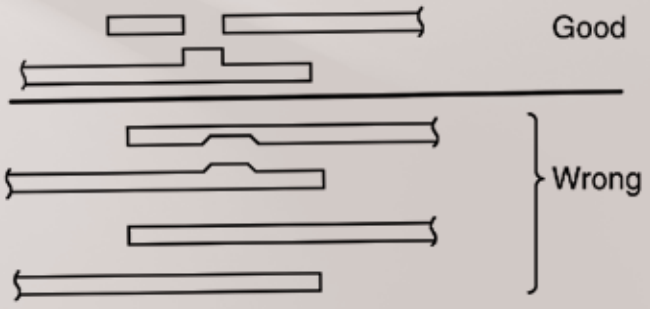
Note that the above specifications are for one sheet thickness for example purposes only. If your actual single panel is less than 0.8 mm (0.12 inch) thick, do not separate the finished joint by more than 1.5 mm to 2 mm (0.059 to 0.079 inches). Opening further may destroy your weld.

Applause, applause

As long as you use resistance spot welding only on metals rated 980 mPa or lower and follow the guidelines covered in the Nissan body repair manual for the vehicle you are repairing, Nissan will applaud your work.



Weld sample panels together, then twist to separate them for a quick shear test.



A shear test of a strong weld shows the entire weld nugget separating from one panel rather than leaving part of itself embedded in the top sheet and some in the bottom.

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