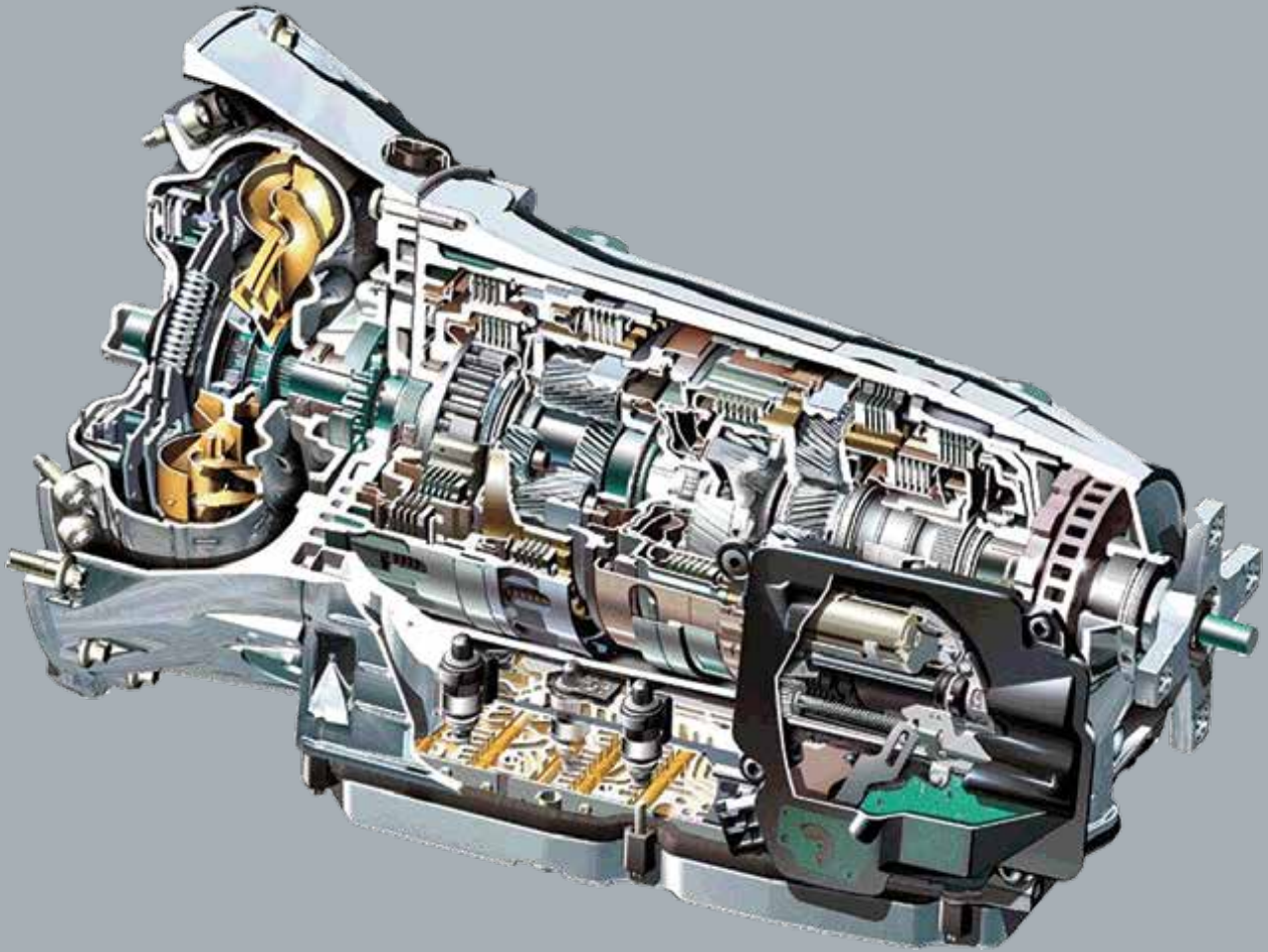


# The Intelligent Servo Module



The 722.9 New Automatic Gearbox 2 (NAG2) automatic transmission replaced the shifting linkage in some versions with an Intelligent Servo Module, or ISM.

Back in the day, selecting the auto trans gear was a mostly mechanical affair: a gear shift lever attached to a linkage, moving an arm on the side of the transmission. Just after the turn of the century, Mercedes-Benz came out with its 722.9 New Automatic Gearbox 2 (NAG2) automatic transmission, and replaced the shifting linkage in some versions with an Intelligent Servo Module, or ISM. In a future edition of *STARTUNED*, we plan to talk about the care and feeding of the 722.9 transmission, but for today we're going to focus on the ISM. These cars are most certainly showing up at your shop, so here's what you need to know about this new technology.

Even in models from just a few years ago, the shift lever and linkage arrangement served us well. Sure, you sometimes had to replace those plastic bushings on the linkage, and the shift-lock adjustment could get a bit fiddly, but for the most part things were good. As almost purely

mechanical systems, they were also fairly easy to troubleshoot, repair, and replace.

But the stylists were just itching to get rid of that gear shift level taking up valuable real estate in the center console, and the engineers were looking for something that not only used fewer mechanical parts, but increased vehicle security as well. Thus the ISM was born, in support of the DIRECT SELECT system.

### Little lever tip-off

You can spot a car equipped with DIRECT SELECT by the shift lever mounted to the side of the steering column. Unlike the column-shift levers of the past, this is an electrical switch: Tap once down for Drive, and once up for Reverse, and press the push-button on the end to put the trans into Park. (Some models have a conventional-looking shift lever — if there's a button for Park, you know it uses DIRECT SELECT as well).

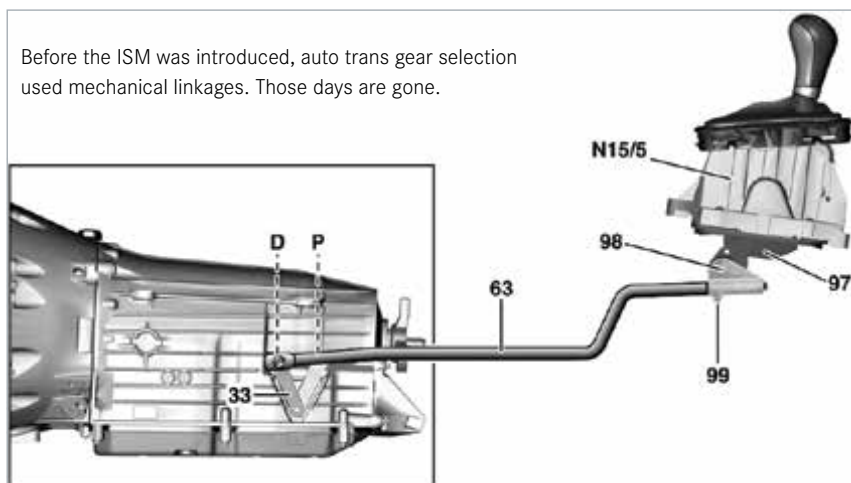
From a few feet away, the task of the ISM is remarkably simple: It moves a lever on the side of the transmission in response to the driver's gear selection. Although it sounds like they just replaced the mechanical linkage rod with a small motor, there's more to it than that. If we dissect the name Intelligent Servo Module, we can better understand what it's doing. Module just means that it's a control unit that is self-contained. Servo is the function of moving the transmission's shift lever, and keeping track of the position. Intelligent means that this isn't just a motor and sensor, but an integrated system for selecting a gear range.

The primary piece of intelligence is the theft protection system. As a component of the Drive Authorization System (DAS), the ISM needs to be unlocked by an encrypted message from the vehicle's SmartKey. With DAS, the key (A8/1) first confirms with the Electronic Ignition Switch (N73) that it is the correct key for the vehicle. If it passes this test, the Electronic Ignition Switch sends out encrypted messages to each of the other DAS components: The ME-SFI engine control module (N3/10), the ISM (A80), and the Electronic Transmission Control module (Y3/8). All of these need to respond correctly with their own encrypted response before they'll function.

### Stuck in Park

While this makes it really difficult to steal a Mercedes-Benz if you don't

Before the ISM was introduced, auto trans gear selection used mechanical linkages. Those days are gone.



have a key, it can also bring a few headaches for the Independent Service Provider – you. The typical situation you might encounter is that the car comes in on the hook (hopefully a flatbed), with the transmission stuck in Park. In an emergency situation – say, an under-voltage in the electrical system, or communication with the ISM is faulty – a small motor in the ISM puts the transmission into Park, and you cannot shift out of park until the problem is fixed.

In normal operation, the main motor is controlled by the ISM's internal electronics in response to data signals from the DIRECT SELECT lever. The motor drives a screw shaft through a toothed belt and pulley system (earlier versions used gears). A slide nut, driven by the screw shaft, physically moves the transmission shifter level to the desired position, and a sensor tells the system where the lever actually is. Easy enough, right?

If there's a problem, the ISM needs to guarantee that it can put the trans into Park, so when a problem is detected, the Electronic Ignition Switch (EIS) can trigger the so-called Emergency-P Function. The EIS verifies that it is safe to put the transmission into Park (for example, the car is stopped), and then supplies power directly to the ISM on the Emergency-P pin, which drives the emergency motor in the ISM. The emergency motor slowly rotates an eccentric shaft, which pushes down on a button on the top of the sliding nut. When the eccentric pushes this button all the way down, the sliding nut de-couples from the screw shaft and the nut with the shifting lever are pushed by a spring into the Park position. There is no way to reverse the emergency motor from outside the ISM (and opening it is a disaster in the making), so the only way to make everything right again is to find and fix whatever sent the ISM into emergency-P mode in the first place.

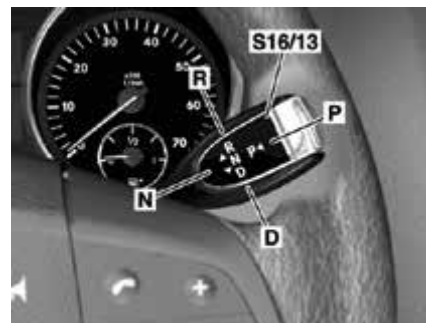
### Mini-batt

More recently produced cars can set the Emergency-P mode using the vehicle's main battery, even if it is partly discharged. Earlier models had a separate emergency battery, about the size of two packs of cigarettes, mounted somewhere in the car. In models with ECO Start/Stop, the somewhat larger secondary battery used for that system also serves as the emergency battery.

So, if we have a car stuck in Park, we need to figure out if whatever triggered Emergency-P can be reversed. Almost every time, it's been a dead (or nearly so) battery

triggering the system, so simply restoring system voltage usually brings the ISM out of Emergency-P mode. There is also a way to use XENTRY to bring the car out of Park and into Neutral, which might be handy for moving the car into a service bay.

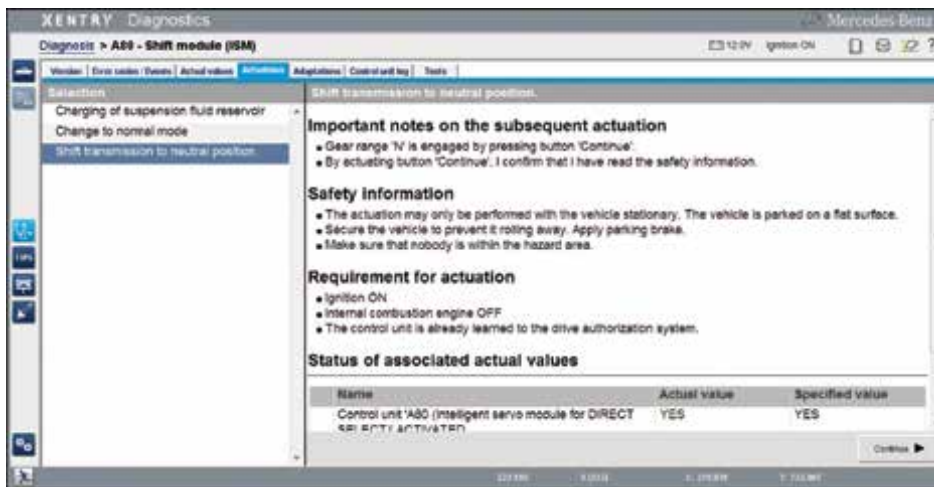
Any car with a shift stalk like this one has DIRECT SELECT, which means it uses the Intelligent Servo Module (ISM) to shift the transmission's gear ranges.



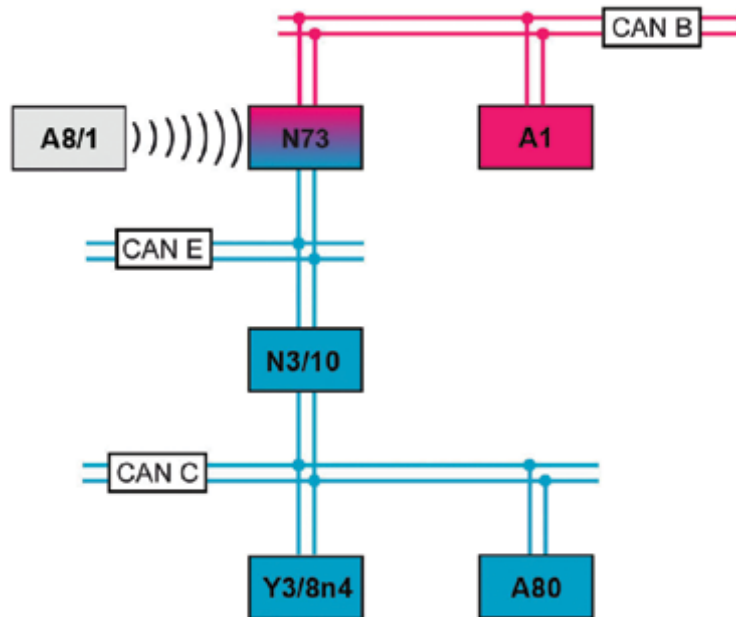
Inside an ISM. In normal use, the main motor (1) drives the screw shaft (4) via a timing belt (9) to move the shift lever (6) into the various gear ranges. If Emergency-P mode is required, emergency motor (2) drives the eccentric shaft (5) to push down the release (11) on the shuttle nut (3). Spring pressure then forces the shuttle nut and shift lever down the screw shaft into Park.



This tiny 1.2 Ah battery installed in some models is used exclusively to ensure the ISM can put the transmission in Park if the main vehicle electrical system has low voltage.



Undervoltage can put the ISM into Emergency-P mode. If restoring power doesn't reset the ISM, it may be possible to use XENTRY to put the trans into Neutral so the vehicle can be moved more easily.



This shows the CAN Bus networks involved in a typical Drive Authorization System (DAS4). CAN C is the engine CAN, through which the ISM (A80) gets all its data. Measure the DC voltage across the CAN wires for a quick check of the Bus.

Every so often we see codes in the XENTRY Diagnostics system for faulty communication to or from the ISM (A80) and one or more of the other control units. These need to be followed through and checked. Wiring concerns are at the top of the check list, but we use both the wiring and function diagrams from WIS or Star Wiring to develop a list of “players” (possible causes) for our diagnosis.

## CAN-C

After supply voltage, our biggest player when it comes to ISM communications problems is the Engine CAN Bus (CAN-C), so we start by taking a voltmeter measurement

between the two CAN Bus wires. We expect to see a DC voltage (measured to ground) of about 2.4 or 2.6V in a normally-functioning Bus. If we see 0V, that wire of the bus is shorted to ground, while about 12V means that it is shorted to power. If both wires read exactly the same, we can suspect the wires are shorted together, while both reading 0 is probably an unplugged connector somewhere. Once you know

what problem you're looking for, it becomes a matter of separating the CAN Bus at the voltage distributor (check the wiring diagram for each particular model) and measuring each wire separately.

It is rare, but if the CAN communications problem isn't related to the physical layer – wiring, connectors, and such – then it may be that some other control unit has gone crazy and is taking down the communications. We've seen this, but always connected to a bunch of other symptoms, the transmission staying in Park being the least of them.

XENTRY also has some tests for control module power supply, but if you can't communicate with the ISM, check for battery voltage at the ISM electrical connector, and even if there is, be sure to repeat the test under load by measuring

the supply voltage with the ISM connected. To do this, use the Mercedes-Benz electrical connector and test kit. Whatever you do, don't compromise the water-tightness of the wires or connector.

## Theft-Relevant

In the worst case – and to be honest, we've never had this happen – the ISM needs to be replaced. That opens up a whole new can of worms, because the ISM is a Theft-Relevant Part, or TRP, and that means the dealer is not allowed to sell the part to you unless you are enrolled in the NASTF Vehicle Security Professional (VSP) Registry. If you're not already enrolled, and your

customer’s car definitely needs an ISM (or any other TRP, for that matter), best send them off to the dealer right away, since enrollment takes some time, more than a few days in any case.

Way back in 2008, Mercedes-Benz updated its Theft-Relevant Parts policy to combat the rising trend of vehicle thefts using keys ordered from a dealer. For customers, the policy represents a bullet-proof assurance that nobody but they is going to get a key or other theft-relevant part for their car – after all, the value of a key is not what was paid, but the value of the car it can start. See the sidebar for a summary of the Mercedes-Benz TRP policy.

Just a short comment about the VSP Registry: If you are serious about servicing modern cars, you need to consider joining the VSP Registry. Originally intended to support locksmiths in getting vehicle key codes from manufacturers, the Registry has evolved into a general “circle of trust” between vehicle manufacturers and ISPs. Applicants to the Registry undergo a background check and agree to the terms and conditions, pay a fee for the initial two-year license, and, once accepted, can buy virtually all Theft-Relevant Parts from their dealer. Aside from Mercedes-Benz, many other manufacturers accept VSP Registry credentials for the purchase of restricted parts.

### Specific VIN

Okay, let’s say you have been on the VSP Registry since forever, and you have concluded you need a new ISM to fix your customer’s car. Don’t bother buying a used ISM: They are programmed to a specific VIN, and that programming can’t be erased or changed. Instead, you need to complete the TRP form the dealer can provide (or download one from the STARTekInfo web site – no need to log in, just select the “Theft-Relevant Parts Info” link) and give them the proof they need: Proof of ownership, proof of identity (from the customer), and proof of your own identity (the form

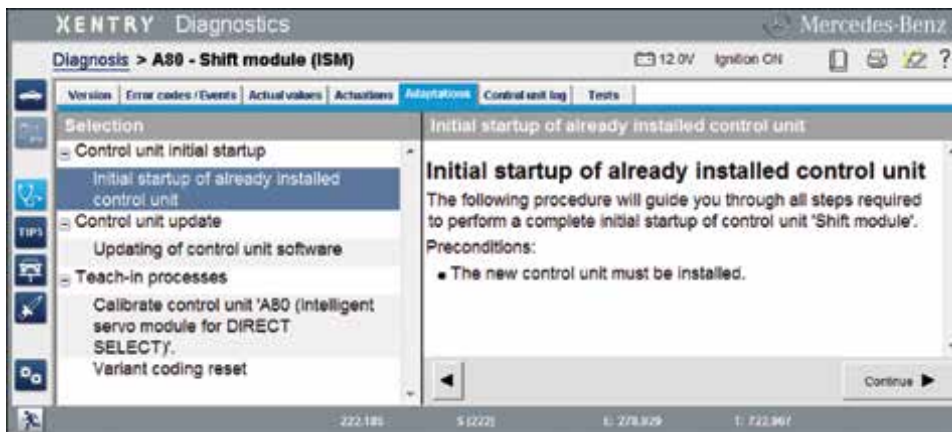
generated by the VSP registry). Once the part comes in, your dealer will want the old part so he or she can prove it has been destroyed, or at least your customer’s signature that the part has been kept by him or her.

Putting in the ISM isn’t as easy as bolting it on, though. You absolutely must have a XENTRY system and a valid XENTRY Flash account. The sale of the Theft-Relevant Part has been recorded by Daimler, and you need to log in to XENTRY Flash to activate and program the new part, as well as “marry” it to the specific vehicle. Unless you’re fully equipped for this task, you may better serve yourself and your customer by letting the dealer handle it.

Oh, and the bolts: They’re made of aluminum, and must be replaced each time they are loosened. Don’t try to



The NASTF home page. This is where you go to get on the Vehicle Security Professional (VSP) Registry, which allows you to buy Theft-Relevant Parts from the dealer. Anyone seriously engaged in automotive service should enroll, since this is an industry-wide organization.



After installing a new ISM, you first need to perform the “initial startup” procedure, followed by the “calibration” procedure. It’s a good idea to check whether the control unit has the latest software update installed too.

re-use them as you'll only end up breaking them and having to drill them out – after dropping the trans completely. Trust us, just buy the new bolts, and don't ask how we know. Replace the vent hose as well, because it will leak if re-used. Small cost for a high-quality repair. Both these requirements, and a complete procedure, are found in WIS under Group 27.19.

## Process

Since so many ISPs are indeed equipped to handle this task, let's take a quick look at the process. If you are completely unable to communicate with the old ISM, you need to complete all of the tests in XENTRY to verify beyond all doubt that the ISM is indeed faulty and needs to be replaced. It's worth spending some time on this simply because replacing the ISM can be challenging (particularly if you are not in the VSP Registry) and expensive. Once we conclude the ISM needs to be replaced, we install the new part and, using XENTRY, complete the routine for "Initial start-up of already installed control unit," the first item on the Adaptations tab for A80. This is a multi-step procedure, but completely guided by XENTRY, so just follow the instructions on-screen. In this process, you'll release the anti-theft transport protection of the new part, then personalize, activate, and enable the module for the specific VIN.

The next step is to calibrate the ISM, again using the procedure defined in XENTRY. This is how the ISM learns the correct positions for each shifter setting. Finally, you should use your XENTRY Flash account to verify that the control unit has the latest version of software installed. If it's already up-to-date, the system will tell you, but if an update is needed, be sure you can guarantee the car's battery voltage by using an approved battery maintainer, and the XENTRY system's power supply by making sure the batteries of both the Tab and the Connect are fully-charged. Although rare, it is possible to "brick" (render completely inoperative) a new control unit if the update process is interrupted at the wrong spot.

We're hoping it never gets that far, but perhaps with this bit of advice you'll get through the process with a successful repair and a happy customer. As we mentioned, the ISM is rarely faulty, so be sure to follow up on all other possibilities before heading down this trail. |

# Mercedes-Benz Theft-Relevant Parts Purchasing Policy

It's not a secret that Mercedes-Benz USA instituted a new Theft-Relevant Parts (TRP) policy about 8 years ago. But many independent workshops (just like yours) have decided to leave the game entirely, believing that theft-relevant parts are simply not available to them.

Completely untrue. Virtually any part is available to you, with a 'catch': You need to be a registered VSP (Vehicle Security Professional). Let's take a closer look at MBUSA's current TRP policy and at the VSP Registry.

MBUSA's TRP policy is available for anyone to see and download at [startekinfo.com](http://startekinfo.com), on the "Theft-Relevant Parts Info" link – you don't need to log in to access it. There, you'll find the MBUSA Policy (at the time of this writing it was dated March 2015) along with a handy guide for independent workshops.

MBUSA's policy states that "TRPs are parts that may be required to steal a vehicle and/or to give it a new identity". Of course, the vehicle owner has a specific interest in avoiding getting their car stolen, as does MBUSA and, indeed Daimler AG in Germany. For that reason, the sale of any TRP requires some documentation, generally from the vehicle owner, but this requirement is somewhat different if the vehicle is being serviced by a dealer as opposed to the parts being sold over the counter to an outsider, since authorized Mercedes-Benz dealers have a higher level of accountability as compared to someone walking in off the street.

Here's a list of typical TRPs:

- Vehicle keys (electronic and mechanical)
- Electronic steering locks
- Electronic ignition switches (and workshop key where needed for programming)
- Electronic selector levers
- Transmission control unit (722.6 and later)
- Integrated shift modules
- Engine control units
- Integrated starter-alternator used with DAS4
- High-voltage control units (Hybrid/electric vehicles)
- Complete mechanical lock sets
- VIN plates and related labels and components

Of these parts, the only ones not available except to an Authorized Mercedes-Benz Dealer are the last four. The starter-alternator and High Voltage components are restricted for safety reasons, complete mechanical lock sets for security reasons (although individual locks can be ordered keyed to the car), and VIN plates are simply not available to anyone (not even a dealer).

A comment on the High Voltage parts: Unless you have high-voltage training, just stay away. It's no longer a matter of profit and loss, but of life and death. Without the proper training and equipment for automotive high-voltage work, don't risk it. All HV parts are clearly identified, and we dare say it's worth your while to pay attention.

Anyway, we can see the majority of TRP are available to you, as long as you follow some common-sense rules:

- First, you must have the (written) agreement of the vehicle owner (kind of obvious).
- Second, you must be a registered VSP. More on that in a minute.
- Third, complete the on-line form at [www.startekinfo.com](http://www.startekinfo.com) under the Theft-Relevant Parts Info link. The form asks for information such as the VIN and customer info, which part you need, your VSP Registry credentials, and at which dealer you'd like to pick up the part. Remember, this is a transaction between you and the dealer you select: the form is just so the dealer can independently verify your VSP Registry info. (The dealer doesn't see your password: Instead, the VSP Registry sends them information to verify your credentials). You'll get a copy of the form by e-mail, which you bring to the dealer. You also hand over a so-called "D-1 form" (from NASTF) which the dealer completes and hands back to you for your records.
- Finally, you'll need to bring copies of the vehicle proof of ownership (registration or title) and your own personal identification (driver's license or passport), along with your shop's repair order.

These requirements are fairly solid at preventing theft, but not so difficult to comply with. Not to mention you're protected if your customer's car shows up stolen some time in the future. Plus, you have all this available to you already, except perhaps the VSP Registration. Let's see how to get it.

The National Automotive Service Task Force (NASTF), according to their website [nastf.org](http://nastf.org) is "...a not-for-profit organization established to facilitate the identification and correction of gaps in the availability and accessibility of automotive service information, service training, diagnostic tools and equipment, and communications for the benefit of automotive service professionals. NASTF is a cooperative effort among the automotive service industry, the equipment and tool industry and automotive manufacturers." This means it is a group of auto-industry suppliers and manufacturers dedicated to supporting you,

the independent workshop. If you're not a member, you should consider joining (it's free).

If you want to become a Registered Vehicle Security Professional, which enables you to buy security-relevant parts from nearly every manufacturer, follow the link for "Locksmith/Vehicle Security" on the NASTF website. You'll need to complete a form (and get it notarized) with your personal details, agree to a background check, provide info on your business, insurance and bonding, and an application fee (currently \$75). If you are granted a license, the cost is \$300 for two years, hardly a burden if this is how you make your living.

The form can seem a little intimidating, so NASTF has quite a lot of information on both the application and parts ordering process. If you are even remotely interested, go visit their site and read up. They also have phone and e-mail contact info in case you have any questions their publications don't answer, but we found what they had pretty comprehensive. |

**Form D-1**  
**NASTF** National Automotive Service Task Force  
**AUTHORIZATION FOR AUTOMOTIVE KEY GENERATION and/or IMMOBILIZER SYSTEM/ANTI-THEFT SERVICES**  
 The LSID holder must fill out this form, after personally looking at the photo LSID, the registration and the VIN plate on the vehicle. These forms are to be kept for 2 years in a secured location as per the NASTF positive ID Policy. The NASTF Director of Operations will randomly audit these forms to ensure compliance with positive ID policy. Failure to produce D-1 forms when requested will result in LSID registry suspension and possible prosecution.  
 I hereby certify that I have the authority to order keys and immobilizer system reset services for the vehicle indicated below. I agree that the information I am providing is true and correct. Further, to the maximum extent permitted by applicable law, I agree to indemnify and hold harmless the service provider (listed below) and related parties providing security information from any and all liability or claims that may arise from the performance of this service. I further agree to indemnify the automaker and their affiliates, successors, assignees, and nominees from any and all claims, losses, or costs (including reasonable attorney's fees) arising from any acts or omissions of the service provider, the service provider's employees, subcontractors, or agents.  
 Vehicle Owner/Customer Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City / State / Zip Code: \_\_\_\_\_  
 Telephone: \_\_\_\_\_  
 Vehicle Owner/Customer Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
 Driver's License Number: \_\_\_\_\_ State: \_\_\_\_\_ Expiration Date: \_\_\_\_\_  
 Other Form of ID (specify type and number): \_\_\_\_\_  
 Vehicle Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_ Color: \_\_\_\_\_  
 License Plate Number: \_\_\_\_\_ State of Vehicle Registration: \_\_\_\_\_  
 Vehicle ID Number (VIN) (17 characters): \_\_\_\_\_  
 Odometer Reading (miles): \_\_\_\_\_ (mi) Not Available:   
 For Dealership/Auction:  PO / Stock # \_\_\_\_\_  
 Service Performed:  Key cut from code  Immobilizer reset  Other (describe below): \_\_\_\_\_  
 VSP/Service Provider Business Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City / State / Zip Code: \_\_\_\_\_  
 VSP/Technical Name: \_\_\_\_\_ LSID: \_\_\_\_\_  
 VSP/Technical Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
 Contracting Shop Owner/Manager Signature (Must be the Positive ID Policy): \_\_\_\_\_ Date: \_\_\_\_\_  
**IMPORTANT: Positive Service Provider** - If the VSP is not present at the time vehicle is received for service by a contracting service facility, the contracting service facility must make a photocopy of the vehicle owner's photo ID (shown above) and attach to this form. Additionally, a valid registration must be attached to the vehicle so that the VSP can verify that the owner's license reflects the vehicle's registration.  
 NASTF Form D-1 (12/11) Page 2 of 2

For every TRP order you need to complete a D-1 form from NASTF and hand it to the dealer. The dealer completes their part of the form, and you (the LSID holder) keep the form securely on file as specified by the NASTF. The NASTF audits these randomly, so be sure to keep your records straight.