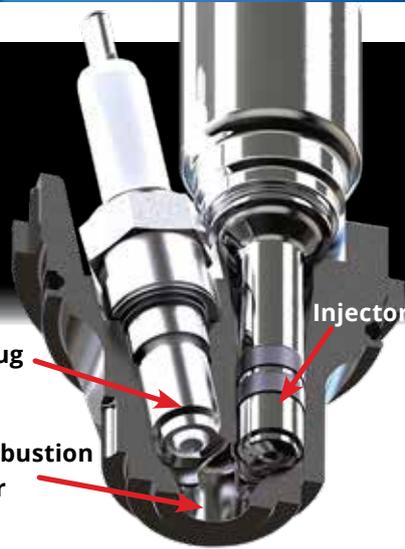


VACC Technical Publications

## Spark Plugs to Turbulent Jet Ignition

The need to produce more power from less fuel is starting to show the limitation of the humble spark plug. Leaner fuel mixtures are the goal for many automotive engineers to reduce fuel consumption and emissions. Unfortunately, lean mixtures are harder to ignite with a conventional spark plug based ignition system. However, with the revival of some old engine designs and the application of some new technology, it looks like the spark plug will still be a part of the automotive scene for many years to come.

The problem with spark plugs and combustion is that the first 10% of the flame front significantly affects the remaining



Spark Plug

Pre-Combustion Chamber

Injector

90%. This has led engineers to attempt to design combustion chambers to ignite and burn the air-fuel mixture more efficiently, all with various advantages and trade-offs.

One solution was a pre-combustion chamber, as used in the ED engines mounted in the Honda Civic in the 70's and 80's. This system was called Compound Vortex Controlled Combustion (CVCC). These engines have normal inlet and exhaust valves, plus a small auxiliary inlet valve which provides a relatively rich air-fuel mixture to an area near the spark plug.

When the spark plug fired, the rich mixture is ignited, and multiple flame fronts emerge from slots in a metal plate. These flame fronts ignited the lean mixture in the main combustion chamber very efficiently. The rise of electronic fuel injection gave the same efficiency gains to mechanically simpler engines, which was the end of the CVCC style engine, until recently.

MAHLE Powertrain Ltd has revived the pre-combustion chamber system by incorporating many readily available components to create the Turbulent Jet Ignition (TJI) system. The TJI system consists of a spark plug and a fuel injector which are mounted in a pre-combustion chamber, which is approximately 2% of the volume of the main combustion chamber. ▶

### Feature

**VW /Audi / Seat /Skoda: 7 Speed DSG Mechatronic Unit**



### Index

*Spark Plugs to Turbulent Jet Ignition* 4773

*MOTORTECH: VACC Technical Has Changed* 4775

*Online Vehicle Service History: The end of the service book?* 4776

*LIN Bus, CAN Bus, CAN Bus FD & Flex Ray: Basics* 4777

*VW / Audi / Seat / Skoda: 7 Speed DSG Mechatronic Unit* 4778

*Toyota 86 & Subaru BRZ: Spark Plug Replacement* 4784

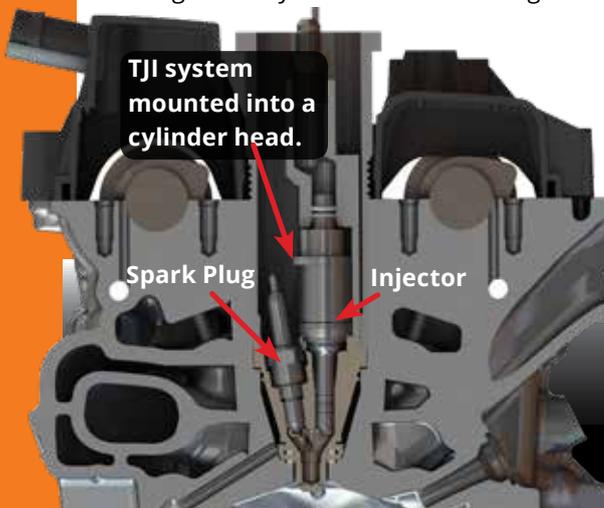
*DENSO: Why CRD Injectors Wear: Part 2* 4788

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4773



TJI system mounted into a cylinder head.

Spark Plug

Injector



Jets of burning fuel enter the combustion chamber from multiple directions to ignite the main ultra lean fuel charge.

Up to 3% of the fuel for the combustion cycle is injected into the pre-combustion chamber via the TJI injector, which creates a very rich mixture. The remaining 97% of the fuel is injected into the main combustion chamber via Port Fuel Injection (PFI) or Direct Fuel Injection (DFI) to create a very lean mixture.

The spark plug ignites the rich fuel mixture, which expands rapidly and emerges as jets of burning gas via multiple holes in the pre-combustion chamber. These jets of gas enter the main combustion chamber which ignites the ultra-lean fuel mixture in numerous places for a very efficient combustion event.

The advantages of the TJI system are;

- A dramatic reduction in fuel consumption.
- Allows for higher compression ratio.
- Low combustion temperatures.
- Reduced throttling or pumping losses.
- Depending on the head design, it can be fitted in place of a tradition spark plug.

An engine designed to take full advantage of the TJI system would have significant reductions in CO2 and particulate emissions. The lower combustion temperature would

## MAHLE Modular Hybrid Powertrain (MMHP)

Plug-in hybrid drive that incorporates a highly efficient 2- or 3-cylinder, turbocharged TJI engine.



allegedly reduce the production of NOx by 99%.

Formula 1 race teams have been using TJI for performance and efficiency gains. Mercedes has been running TJI since 2014, Ferrari from 2015 and Renault from 2016. Ironically, Honda was the last to start using this system.

The TJI system seems to be reliable

on the race track, which has led to significant investments for the development of a TJI engine. This engine will be making its way into a hybrid production vehicle soon.

The spark plug will live on. However, if a TJI unit develops a miss, I wonder if you will be able to replace the spark plug separately? 

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# VACC TECHNICAL HAS CHANGED

**VACC's Technical Department has seen many changes in the way automotive service and repair information has been distributed. From hard copy workshop manuals, microfiche, compact discs and now subscription websites, we have always strived to provide our members with the best information available. To continue to do this, we are now introducing three new levels of service, which will massively increase the range and coverage of technical automotive information available to VACC members.**

VACC's Tech Online, Times Guide, Tech Estimate, Technical Advisory Service and Tech Talk have an excellent reputation in the automotive industry for ease of use and reliability. However, with more vehicles being sourced from Europe, North America and Asia, it is always a challenge to provide all the information that an automotive repair business requires. Therefore, we have been in negotiations with a large multi-national data provider to assist us in helping you. We can now announce an agreement between VACC and the Haynes Publishing Group, to allow our members to access their vast amount of technical information.

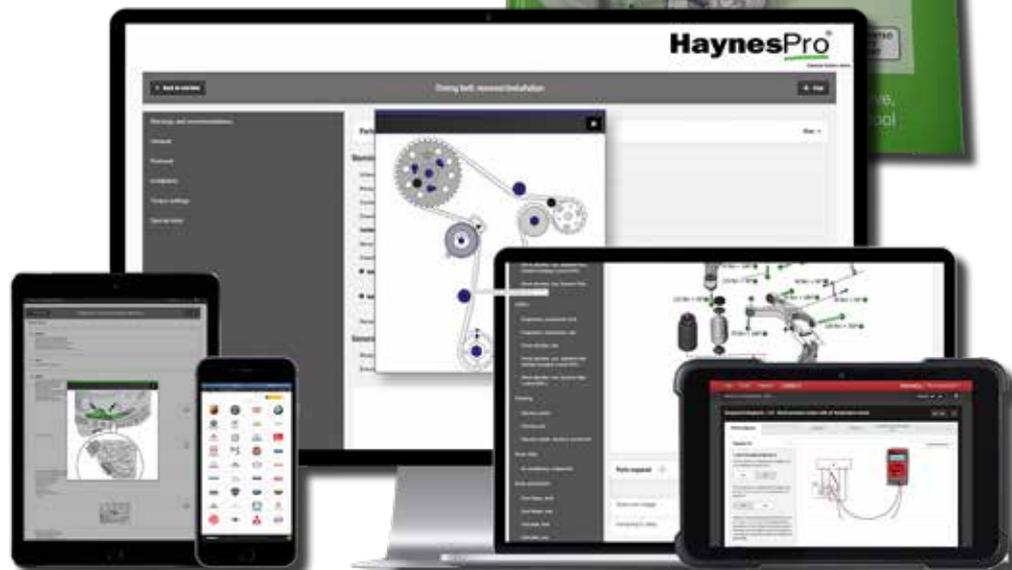
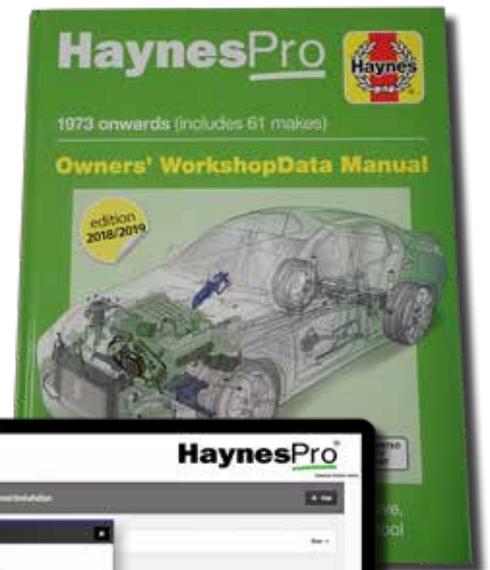
The Haynes Publishing Group is mainly known in Australia for their iconic Haynes Manuals that have been in print since 1965, and have sold over 200 million copies worldwide. However, they also provide automotive service, repair and diagnostic information via different online products, designed for professional automotive businesses under the Haynes Pro brand. Until this agreement with VACC, these Haynes Pro products have not been available in the Australian market in such an affordable and convenient package.

The Haynes Pro products are as follows:

- **Haynes Manuals All Access** will allow you to access all the famous Haynes Manuals online. This will give you step by step repair and service information, as well as extra details that do not appear in the hard copy versions. Many of the most popular models also have access to the Haynes OnDemand video tutorials, which are the ultimate aid to getting a vehicle back on the road.
- **Haynes Workshop Data** contains extensive maintenance information like repair times, timing belt and chain replacement procedures, capacities, wheel alignment, torque specification and over 100,000 high-quality technical drawings and more.
- **Haynes Workshop Data Electronic and Smart** include the VESA guided diagnostics system, wiring diagrams for most vehicle systems, fuse and relay locations, earth point and control unit locations, TSB's and known fixes.

This agreement with Haynes is the next big push VACC is making to provide members with the automotive information coverage you require. These new options will give you easy access to repair information and repair times for vehicles which we could not offer before, in bundles to suit your business's needs.

VACC's Tech Online website has been updated to give you details about how we are bundling the Haynes Pro and VACC's technical products together, and their different pricing plans. This new combined platform will be named VACC MOTORTECH. The industry is evolving and VACC has made these changes to assist you. 📌



# Online Vehicle Service History: The end of the service book?



Sales research in the UK has found that a vehicle without a full-service history has a reduction in the resale value of approximately 25%. This makes the service information that little book in the glove box contains potentially worth a quarter of the value of the vehicle. Some manufacturers have started to secure this valuable information in their online systems which could become a problem for independent workshops.

The owner of the vehicle may not know the purpose or the value of their service information, but the savvy buyers of second-hand vehicles do, and the technician attempting to maintain the vehicle to the manufacturers schedule would like to know if the history is up to date. In the age of the extended warranty from the manufacturers, having a fast and easy way of checking the service history is an efficient way of evaluating warranty claims. To increase the security of this information, online systems are the way of the future.

Online service histories began in Europe in 2008 with Mazda. Now VW,



## Aftersales Online System

BMW's online service history system can be accessed by independent workshops.

Record organisation data

General organisation data

User group \* Select "Other" → Other (please justify your request)

Country \* Australia

Mercedes Benz, BMW, Jaguar and Land Rover have similar systems. Only a few of these manufacturers have these systems enabled in Australia and BMW is the only one that an independent workshop can access and update, and only once you know the trick.

To use the BMW system called Aftersales Online System (AOS) you must register at the following website: [aos.bmwgroup.com](http://aos.bmwgroup.com)

As this system is designed for BMW dealers and specialist in Europe, for an independent workshop in a country outside of Europe, you will have to

select "Other" from the drop-down list and not "Independent workshop/dealer". Then fill in your details and upload proof that you are an actual business, then wait for the system to accept you. It is recommended to set all of this up well ahead of time before the service job arrives. Once you are in, you can look up previous service histories and add to the system once a service is completed.

There are several independent online service history businesses that will store this information which are becoming more popular. It might pay for you to do some research on these companies and pick the one you like, then recommend them to your customers.

However, if the paper service book is lost or has run out of room, or you cannot access the manufacturers online system. VACC produces a Vehicle Service Record book that you can use as a professional way of recording the service history.

## Hard Copy Service Books from [autoistore.com.au](http://autoistore.com.au)

**Vehicle Service Records Books (20 Books per pack)**

Code: VAC0278  
 Price: \$20.00  
 UOM: pack of 20  
 Available: 396

Quantity:

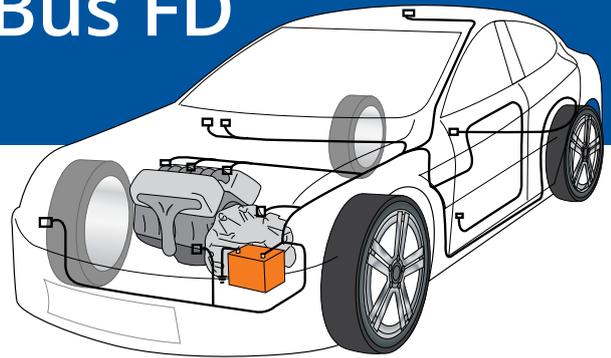
**ADD TO CART**

**Description**

The Service Record Book is a replacement service book that does not have any manufacturer logos or branding, making it suitable for any vehicle 8 pages per book and is sold in packs of 20.

To buy these Vehicle Service Record books, you can log in to the OurAuto istore: [autoistore.com.au](http://autoistore.com.au)  
 Search for product code: VAC0278  
 Or call 03 9829 1191

# LIN Bus, CAN Bus, CAN Bus FD & Flex Ray Systems



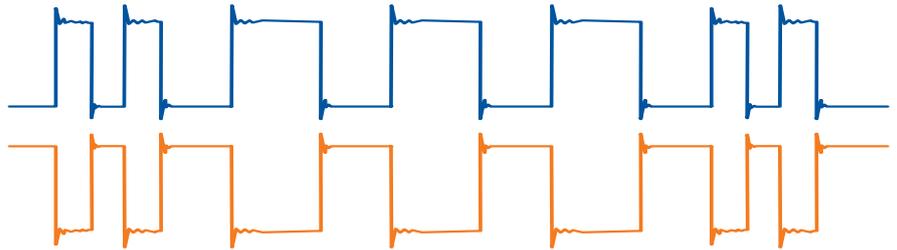
VACC's Technical Advisory Service receives calls from members about the data communication systems used in vehicles. These systems can be used for different purposes and as a result, have different construction and operational speeds. As more advanced systems are being added, more capacity and speed are required, which has led to the development of new system formats. I will now go through the available communication systems in order of speed.

But first, some revision on basic units. One "BIT" is a basic unit of information, e.g. 0 or 1 in binary, or OFF or ON in a duty cycle. One "BYTE" is eight bits or eight ON and OFF cycles.

**Local Interconnected Network (LIN)** is the cheapest of the networks and is used in vehicle systems in which speed and signal errors are not critical, such as power windows, wipers, climate control, electric seats. Some vehicles can have more than one LIN Bus system, which consist of a maximum of 16 nodes (control units, sensors or actuators) under one master control unit. This unit acts as the gateway to the rest of the vehicle. Signals are sent via a single wire; the system operates on 12 volts and has a maximum data speed of 20 kilobytes (kB) per second. One kilobyte is 1000 bytes.

**Controller Area Network (CAN)** is the faster, vastly more reliable and robust communication system, that is also cheap. It can allow many control units around the vehicle to communicate quickly via a network of two shielded wires twisted together to reduce interference. CAN operates on 5 volts and has a maximum data speed of 1 megabyte (MB) per second. One megabyte is one million bytes of information. But this is no longer fast enough.

*Modern cars could use more than one type of communication protocol for different systems. You need to know what you are dealing with.*



## CAN Flexible Data-Rate (CAN FD)

is a protocol developed by Bosch in 2012. This is an updated CAN system which can operate at different speeds depending on the importance of the signal. CAN FD can operate at 1 MB per second or as fast as 5 MB per second. CAN FD also allows for higher compression of the data which, effectively make the system ten times faster. CAN FD is predicted to be in vehicles from 2019 onwards.

**FlexRay** is a faster and more reliable system than the CAN-Bus based systems. It is designed to deal with the demands of autonomous and drive by wire applications, which makes it expensive.

FlexRay can use 2 or 4 twisted wires for extra redundancy and can use alternative system layouts. CAN system use a "multi-drop bus" or "party line" with all the control units tapping into the core network. FlexRay allows for a "Star Network" which allows one control unit to fail and not affect the rest of the network. FlexRay systems speed is 10 MB per second.

FlexRay was first installed in the 2006 BMW X5 E70 and has since been used in Audi, Bentley, Mercedes-Benz, Rolls-Royce, Land Rover and Volvo vehicles.

The advanced driver assistance

systems (ADAS), electric vehicles (EVs) and hybrid vehicles must manage very complex calculations and data. If you have ever updated a vehicles software or re-flashed an ECU you may have noticed that it can be a very time consuming job as the software files are massive. CAN FD and FlexRay will make updating the software much faster.

These updated communication protocols are also addressing the potential security vulnerabilities which have been exposed in the CAN-BUS system. These new systems will incorporate Secure Onboard Communication (SecOC) modules to prevent unwanted outside communications.

For more background information on CAN Bus systems, refer to the following articles;

- All Aboard the CAN Bus June 2007 page 2581
- CAN Bus Testing Times October 2018 page 4594
- CAN Bus Diagnostics Check List October 2018 page 4595

We encourage you to check out these previous articles as these systems are used in the majority of vehicles on the road today. [📌](#)

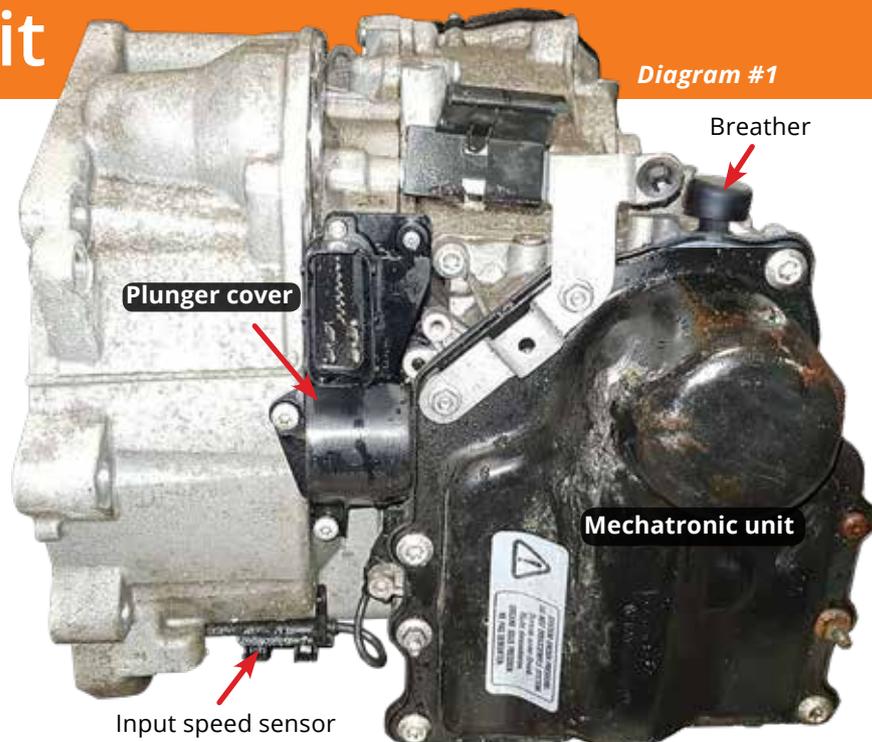
# VW / Audi / Seat / Skoda: 7 Speed DSG Mechatronic Unit

The term Mechatronics was coined in 1969 by engineer Tetsuro Mori to describe the synergy that exists between electrical control systems and the mechanical actuators they regulate. It is now used to describe the interdisciplinary area of engineering that combines mechanical engineering, electrical engineering and computer science, which is basically robotics. This article will cover the replacement of the mechatronic unit in the 0AM seven-speed DSG transmission that is used in many Volkswagen Group vehicles.

Volkswagen marketed the Direct Shift Gearbox or dual-clutch transmissions as DSG and S-Tronic by Audi. The seven-speed DSG was released in 2008, which has a Volkswagen Group internal code of DQ200, and a parts code prefix of 0AM. The seven-speed differs from the six-speed (DQ250 / 02E) as it uses two dry clutch plates of similar diameter instead of two wet clutches. The 0AM has separated the clutches from the mechanical gears and the hydraulic control systems (mechatronic unit) so that particles and contamination from one cannot affect the other systems.

The mechatronic unit contains;

- A hydraulic pump
- Oil pressure accumulator
- Eleven internal sensors and one external input speed sensor.
- Six hydraulically controlled valves for shifting gears and actuating the two clutches
- An electronic control unit for the transmission.
- All the hydraulic fluid which is separate from the gear oil in the transmission.



The mechatronic unit is not a serviceable item and is a sealed unit. They can be reconditioned, but it is a specialist's job. If a fault has been diagnosed in the mechatronic unit, it will have to be replaced.

## Diagnostics

If you have any of the following codes

- P0562 / 21148 - Supply Voltage of motor too low
- P177F / 21065 - Impermissible high voltage drop of the motor
- P175F / 21098 - No valid basic settings of the gearbox
- P189C/21247 - Pressure accumulator diagnosis not possible
- P174A / 21108 - Valve open load clutch 1

First, check the under-bonnet fuse box and check that the 30-amp fuse for the mechatronic unit (SB2) is intact and the correct amperage. There was a bulletin released which states that a 15-amp fuse had been incorrectly fitted in this position.

If this is the case, replace the fuse with a genuine 30-amp fuse and clear the codes and inspect the operation of the transmission. If the faults persist, carry out further diagnosis. **See Diagram #2**

## Common Problems

If the fuse related problems are ruled out, you can move on to the following.

### Gear selection Forks

Earlier versions of this gearbox had plastic parts on the shift forks which could fail. They have now been upgraded to metal parts.

### Worn Clutch

Like all other clutches, the DSG clutches can wear out and start to slip. The mechatronic unit adapts and adjusts for the clutch to wear, but once it reaches its limit, the clutch will slip, and the transmission might enter a fail-safe mode. The "PRNDS" display might start flashing, and the vehicle may only operate in one gear, usually third.

Usually, one clutch will slip before the other, so it will only impact the odd or even gears. ▶

### Diagram #2 Under Bonnet Fuse Box



Check these two fuses (SB2 30A & SB5 15A) and their circuit before making any decisions.

The clutch replacement procedure is available via VACC's Technical Advisory Service.

#### Mechatronic Unit

If you find fault codes relating to "play protection" and/or "insufficient pressure" this could indicate that the valve body in the unit has cracked. This causes internal leakage which reduces the operating pressure and sets the codes. A new mechatronic unit is required.

#### Software Pairing

When buying a replacement mechatronic unit, there are some questions that you need to ask your parts supplier, which will be the dealer or an aftermarket re-manufacturer.

There appear to be two different types of software requirements. It seems that earlier model vehicles did not require the mechatronic unit to be coded or paired with the vehicles security or immobiliser system. In which case you can replace the unit, carry out the clutch basic settings procedure, and you are on your way.

**See page 4783**

Allegedly, for later models (change over date is unknown) the mechatronic unit must be coded or paired with the vehicles security or immobiliser system for the vehicle to operate correctly. In some cases, the engine may start, but the mechatronic unit will not work. In other cases the engine will not start.

To rectify this situation, ask the customer for all sets of keys for the vehicle. Then use the correct equipment to pair the mechatronic

unit to the car. If you do not have the required equipment, you may need to contact the dealership or a third party that can do the job.

#### Removal Procedure

The mechatronic unit can be removed with the transmission still in the vehicle. Depending on the vehicle and engine, you may have to remove coolant or intake plumbing and any other components which are at the front side of the transmission to allow room to work and remove the unit.

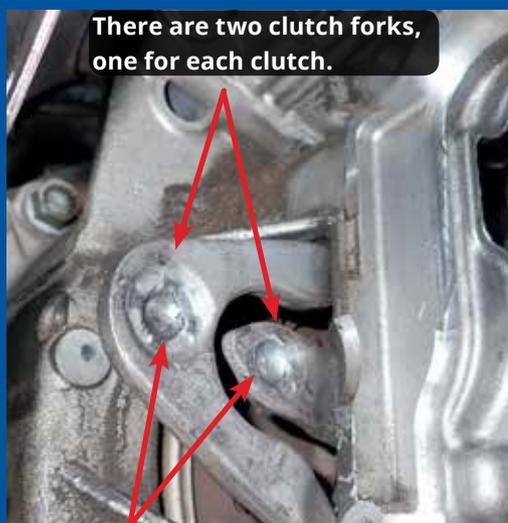
**See Diagram #6**

With a compatible scan tool, you should be able to set the transmission into neutral which will allow the mechatronic unit to be removed. Failure to set neutral, and trying to lever and force the unit out will possibly damage the gearbox.

**NOTE:** If the unit has failed in a way in which it cannot be electronically shifted into the neutral position you will have to remove the rear cover on the transmission and manually move the shift levers into the correct neutral position. **See Diagram #5**

1. Move gear selector in the vehicle to Park. ▶

### Diagram #3 Clutch Forks

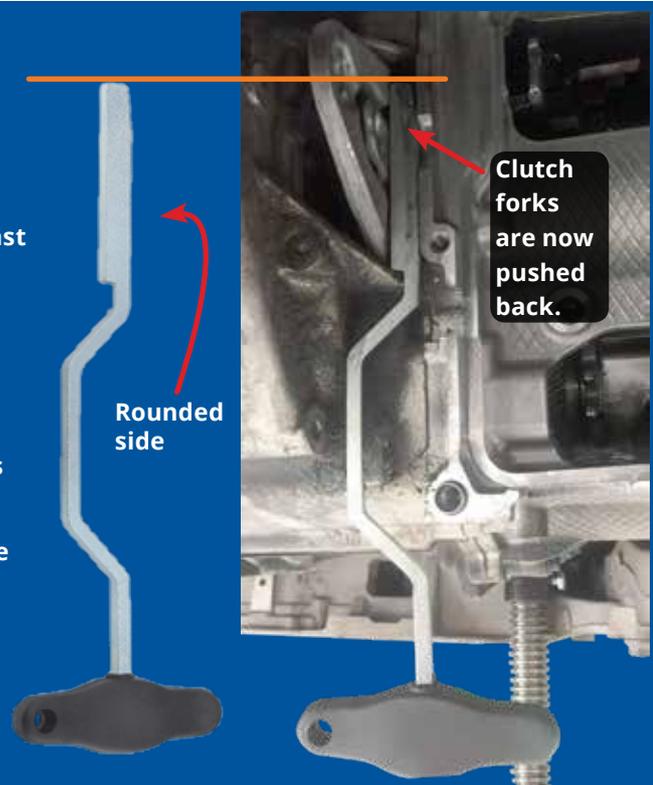


**WARNING:** When reassembling the mechatronic unit the plungers must be correctly seated in these cupped areas on the forks, otherwise you will damage the unit.

### Diagram #4 Special Tool

This tool should be inserted with the rounded side against the transmission.

Once it is inserted up to the level shown, turn the tool 90° so that the square side pushes both of the clutch forks away from the plungers on the mechatronic unit.



2. Connect a compatible scan tool, and turn the ignition on. Navigate to **Guided Functions / 7-speed dual-clutch gearbox / Moving gear actuator into neutral position**.  
**NOTE:** This may be different depending on the scan tool used.  
**NOTE:** If unsuccessful, use the manual procedure on this page.
3. Remove the battery and tray.
4. Raise the car on a hoist.
5. Remove the noise insulation from under the car.
6. Remove the pitch stop engine mount from under the vehicle.  
**NOTE:** You can use some ratchet straps between the engine and cross-member to lean the engine and transmission back which will give you more room.
7. Remove the air filter assembly.
8. In some vehicles, there might be a cover over the clutch plungers. If so, remove the cover. **See Diagram #1**
9. Remove the starter motor (this may not be required).
10. To release the mechatronic unit connector, pull straight up on the clip to unlock the connector. Then pull the connector straight out gently.  
**NOTE:** There is a risk that you can damage the electronics in the mechatronic unit through the build-up of static electricity in your body. Ensure you touch an earthed object (e.g. the hoist, a wall of the workshop) to remove any charge.
11. Place a drip tray under the transmission, then drain the gear oil via the drain plug. **See Diagram #6**
12. Remove the breather from the top of the mechatronic unit, then plug the opening in the unit. **See Diagram #1**
13. Remove all other brackets, harness or pipes connected to the mechatronic unit and the front of the gearbox.
14. Carefully unclip the input speed sensor from the bell housing and pull it gently out of the housing.  
**See Diagram #1, #6 & #9**

15. Remove and discard the bolts which attach the mechatronic unit to the gearbox. There are seven bolts, four long and three short.  
**NOTE:** Don't remove the cover nuts.
16. Now it gets tricky. The clutch forks are pressing on the plungers, which will prevent the mechatronic unit from being removed. So both forks will have to be gently levered away from the plungers. **See Diagram #3**
17. It is recommended to use the special tool T10407 (assembly lever) between the clutch forks and the housing. This tool will release the pressure from the plungers of the mechatronic unit. However, it is possible to release the forks with some pry bars and some help from an assistant.  
**See Diagram #4**
18. You should now be able to remove the mechatronic unit.  
**NOTE:** Don't tip it over as oil may come out of the breather if you have not plugged it correctly.

## Manually Selecting Removal Position

If the mechatronic unit will not come

### Diagram #5 Rear Cover

Remove this cover to shift the fork into neutral manually.

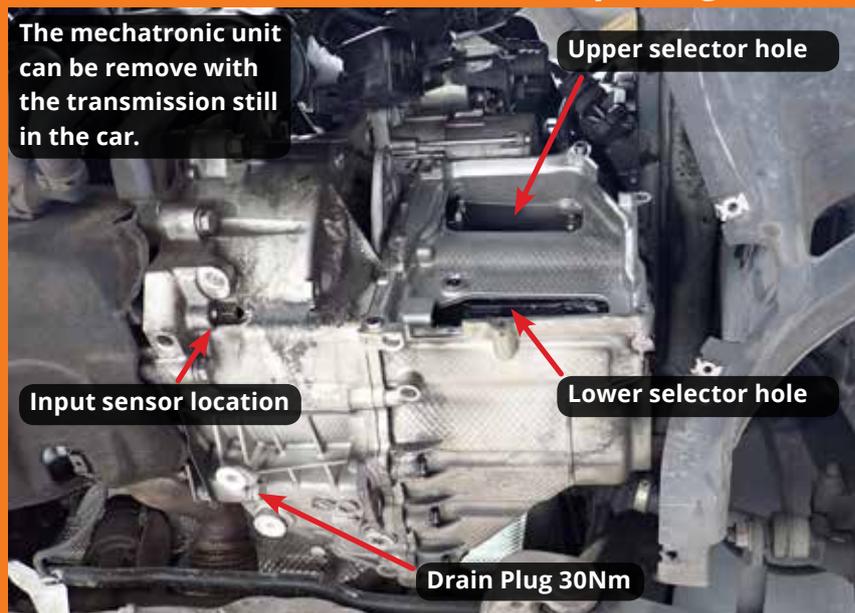


out easily and feels like it is stuck in one corner, this indicates that the unit has not been placed in the removal position due to a fault in the unit or the gearbox. You must now set the removal position by hand using the following steps.

1. Refit one bolt back into the unit to hold it into the gearbox. This is because if you have the clutch levers released with the special tool, once you engage the removal position the mechatronic unit might fall out.
2. Move gear selector in the vehicle into the Park position. ▶

### Diagram #6

## Mechatronic Unit Removed and Openings



- Remove the bolt from the lever, then remove the lever from the rear cover.  
**See Diagram #5**
- Remove the bolts from the cover then remove the cover from the gearbox.
- Looking into the gearbox, you should see a selector fork in the top right corner. Gently move this fork towards the left of the vehicle.
- The gearbox should now be in the correct position to allow the mechatronic unit to be removed.

### Gearbox Inspection

Before installing the new mechatronic unit, inspect the following.

- First, check the four magnets on the selector forks. It is normal for there to be some very fine metallic particles to be stuck on the magnets. Clean magnets before reassembly.  
**See Diagram #7**
- Then check that the selector forks can be moved easily in each direction to select each gear. Rotate the gearbox via the front wheels to make engaging the gears easier. Select one gear at a time. Ensure that you return the selector to its middle (neutral) position. If the gearbox is not in neutral, you will not be able to refit the mechatronic unit.  
**See Diagram #8**
- However, if the magnets are covered in larger shiny particles, or the selector forks do not engage gears easily, this indicates that there is a mechanical problem within the gearbox which will require attention before a new mechatronic unit is fitted.
- Suck out any remaining gear oil with a commercially available liquid removal tool.

### Pre-Installation Set-up

- Check that the clip on the input speed sensor is not damaged. If it is damaged a new mechatronic unit is required as it can not be replaced separately.  
**See Diagram #9**

- On the rear of the mechatronic unit are four gear selector actuators that must align with the four selector forks in the gearbox. You will have to align the new unit to the gearbox. To do this, you must ensure that the end of the actuator pistons are **25 mm** from the body of the housing.  
**See Diagram #9**
- Ensure that the seal/gasket is correctly positioned around the edge of the unit.  
**See Diagram #9**

### Mechatronic Installation

- Ensure that the clutch forks are out of the way with the special tool still in place.  
**See Diagram #4**
- Gently fit the mechatronic unit

onto the gearbox. Ensuring that you do not move the selector forks out of position. Otherwise, you may be missing a gear or two.

- Ensure the clutch actuator plungers engage with the cupped parts of the clutch forks. ▶

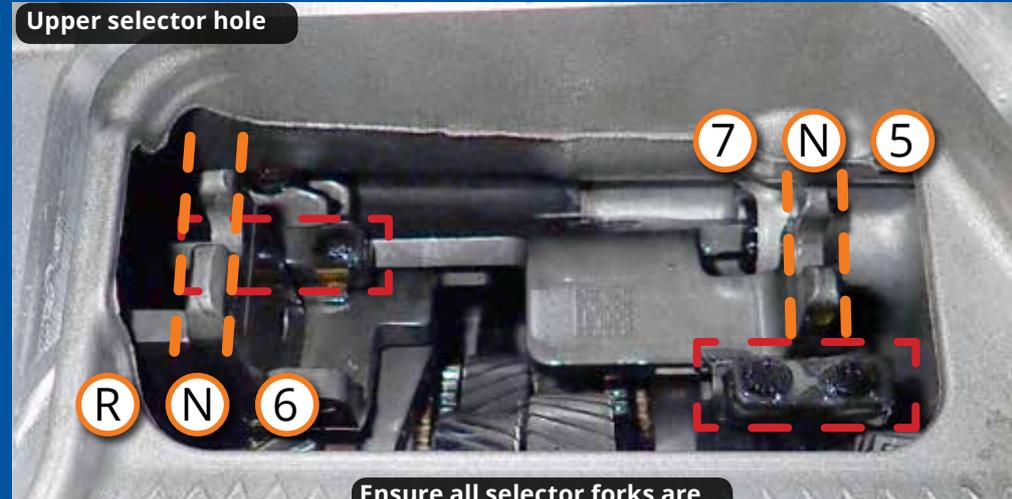
#### Diagram #7 Selector Magnets

This is an acceptable /normal amount of particles on the magnet. Clean before assembly



#### Diagram #8 Selector Fork Neutral Position

Upper selector hole



Ensure all selector forks are in the neutral position before installing the new unit.

Lower selector hole

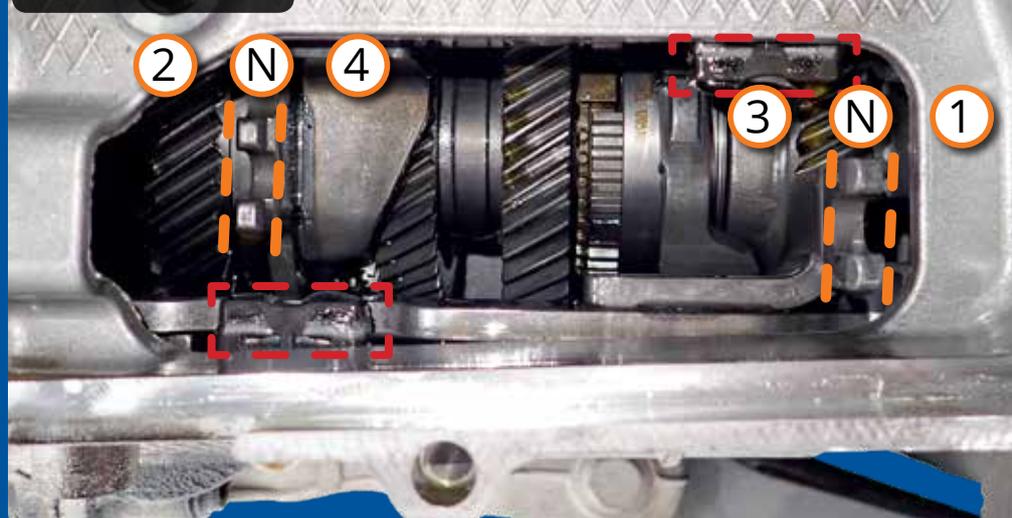
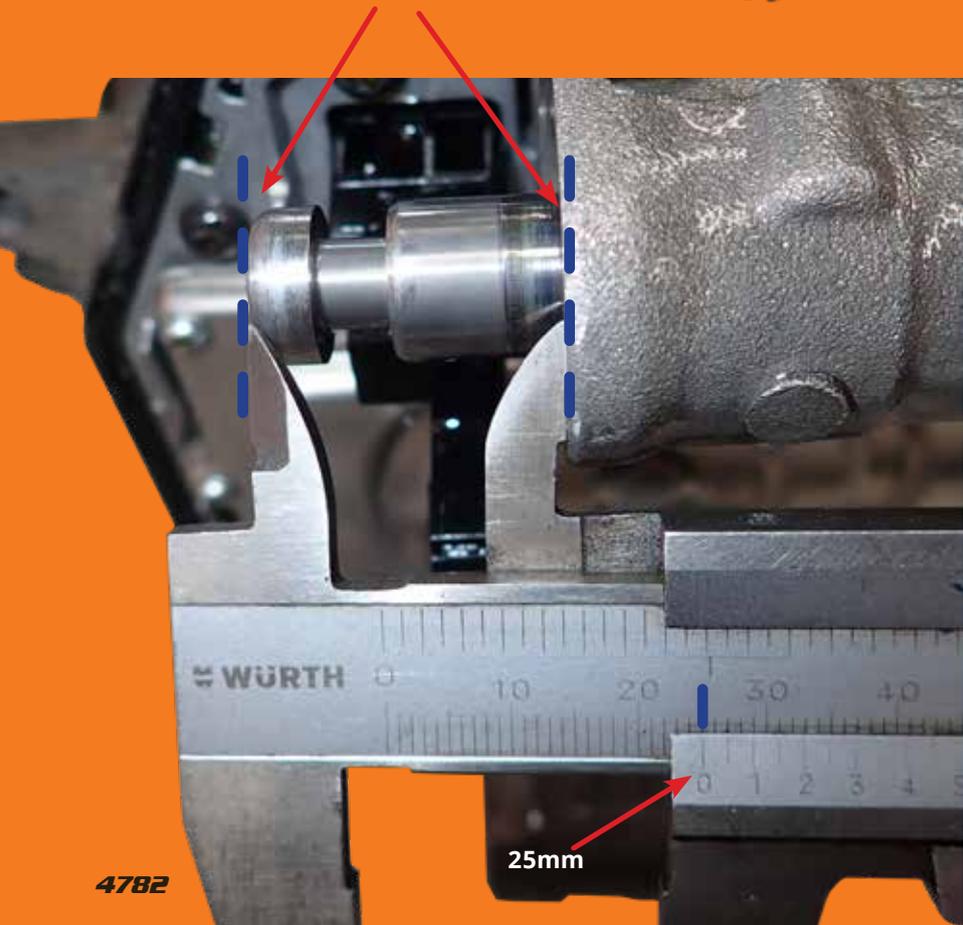
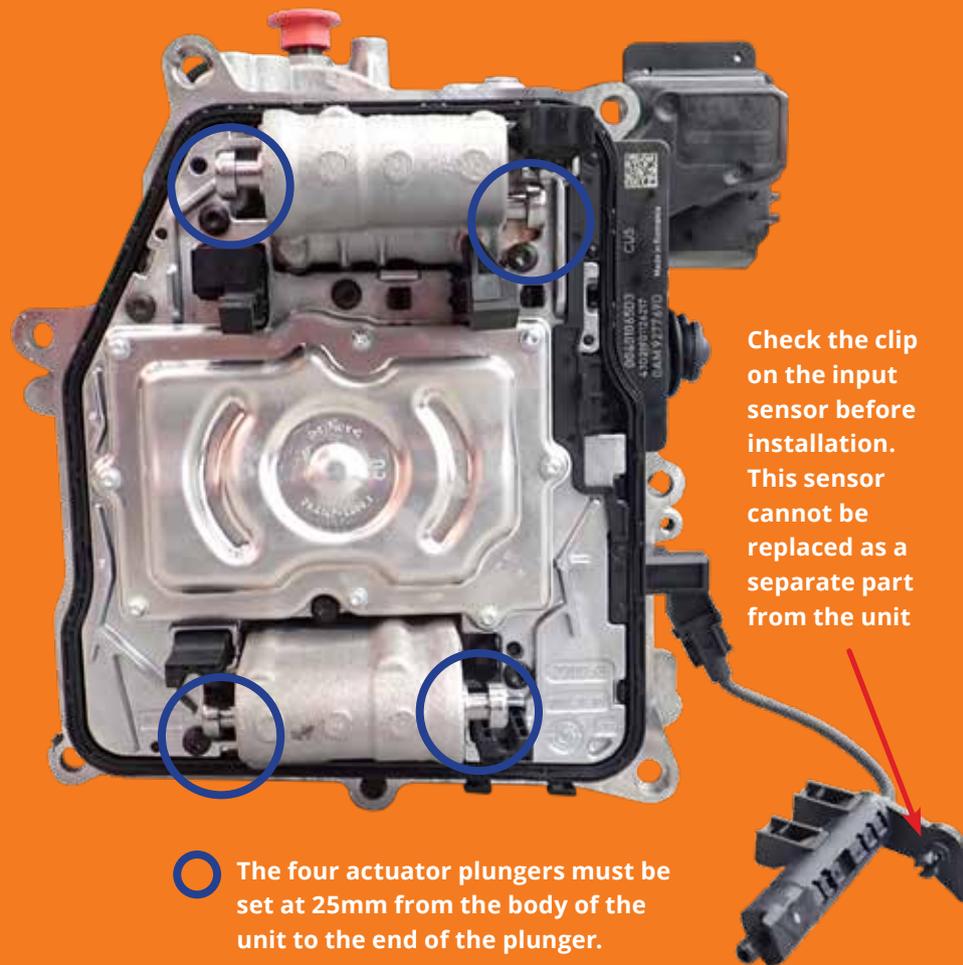


Diagram #9

## Rear View of the Mechatronic Unit



4. Fit a **NEW** set of seven bolts to mount the mechatronic unit finger tight.
5. **WARNING:** Double check that the clutch actuator plungers engage with the cupped parts of the clutch forks. If they are out of position, damage may occur to the mechatronic unit.  
**See Diagram #3 & #10**
6. Tighten the mechatronic unit bolts in a diagonal pattern to **10 Nm**.
7. Remove the special tool to allow the clutch forks to press on the mechatronic unit actuator plungers.
8. Install the input speed sensor into the bell housing. Ensuring that the sensor is in firm contact with the housing and the clip has engaged securely. **See Diagram #1 & #6**
9. Fit a new breather onto the mechatronic unit. **See Diagram #1**
10. Refit the harness connector to the mechatronic unit. **NOTE:** There is a risk that you can damage the electronics in the mechatronic unit through the build-up of static electricity in your body. Ensure you touch an earthed object (e.g. the hoist, a wall of the workshop) to remove any charge before reconnecting the harness.
11. Refit the drain plug and tighten to **30 Nm**.
12. To refill the gearbox. First, give the new oil bottle a shake. If you have had to remove the rear cover to engage neutral, pour in **1.9L** of oil into the gearbox via this opening (this is more than the normal refill capacity of 1.7L as extra oil has been sucked out and some lost with the unit). If the cover is still in place, remove the breather from the rear cover, and using an appropriate adapter, fill the gearbox.  
**NOTE:** There is no level plug, or level checking procedure as this gearbox was designed to be filled for life.  
**WARNING:** Do not overfill.
13. If the rear cover has been removed. Ensure that the sealing surface is clean, lubricate the shaft seal lips ▶

- with grease, then refit the cover.
- 14. Tighten the rear cover bolts to **8 Nm**
- 15. Refit the park lever and tighten the bolt to **15 Nm**.
- 16. Refit the cable to the ball joint and fit a new clip (if it has been removed).
- 17. Ensure the lever is in the 1 o'clock position.
- 18. Refit all other components in the reverse order.
- 19. Coding or pairing of the mechatronic unit may now be required. Basic settings and drive cycle must be completed.

### Basic Settings

This will teach the mechatronic unit the clutch position for smooth operation.

#### Requirements

- No fault codes stored.
- Transmission temperature 30°C - 60°C.

- Gear selector in Park.
- Ignition on, engine off.
- Park brake applied.
- Brake pedal held down for the duration of the setting procedure.
- Throttle pedal not touched for the duration of the setting procedure.

With a compatible scan tool select: **02 Transmission / 04 Basic Settings**. This should bring up a keypad for the Group selection. Enter **"060"**. You might have to press a button for the resetting to start, but some scan tools begin automatically.

The scan tool should show "4 | 4 | 0" after about 5 minutes. If it does not display, there is something wrong in the requirements list above or the transmission.

Once "4 | 4 | 0" is displayed, start the engine and allow it to idle.

The engine and transmission will make thumping and clicking noises for 4 to 6 minutes, which is normal.

Once complete, the scan tool should

display "254 | 0 | 0" and the transmission will not be making noise.

#### NOTE:

"254 | 7 | 0" = Incomplete

"255 | 0 | 0" = Failed / Interrupted

Turn ignition off, wait for 10 seconds then turn ignition on.

Check for fault codes and repair or clear as required. Then test drive.

### Test Drive Cycle

To ensure smooth shifting before handing the vehicle back to the customer complete the following.

**NOTE:** This is a general drive cycle, different models might specify a different procedure.

1. In Drive, at half throttle accelerate until 2nd gear is engaged.
2. Stop and repeat step 1.
3. Stop and select reverse, then drive backwards.
4. Stop and repeat step 3.
5. Using Tiptronic shifter drive in each gear for at least 3 seconds.
6. For the following steps, go to WOT at least once in the odd and even gear sets.
7. Select 4th gear, drive for at least 1 minute with the engine between 2000 and 4500 rpm.
8. Select 5th gear, drive for at least 1 minute with the engine between 2000 and 4500 rpm.

If the above procedure cannot be completed safely, the adaptations should complete eventually during normal driving by the customer.

For more information on Volkswagen Group vehicles, login to Tech Online or call VACC's Technical Advisory Service. [↗](#)

Thanks to Andrew and the team at AutoPlus Nunawading for their assistance with this article.

(03) 9877 7600  
[autoplus.com.au](http://autoplus.com.au)

Diagram #10

### Clutch Fork Actuator Plungers



If these two plungers are not aligned with the cupped areas on the clutch forks, the mechatronic unit will be damaged when you start the basic settings procedure.

# Toyota 86 & Subaru BRZ: Spark Plug Replacement

2012 - 2019 Subaru BRZ 2.0L FA20

2012 - 2019 Toyota 86 2.0L 4U-GSE

**The Toyota 86 and the Subaru BRZ have been a critical and commercial success for both companies, with the looks, performance, and reliability of both brands. However, it is a pain to replace the spark plugs. This article will give you a procedure which is less of a pain, maybe.**

The coupé and hatchback versions of the Toyota Corolla AE86 from 1983 to 1987 have gone on to become a cult collector vehicle for its looks, lightweight, front-engine rear-wheel drive layout, 50/50 weight balance and ease of modification.

The AE86 is still used in many classes of motorsport, but it was in the early days of drifting where it became famous. The AE86 became the main character's drift and tofu delivery car in the long-running Japanese manga and anime series titled Initial D, which has increased the popularity and value of this model.

To cash in on this heritage, Toyota was inspired to develop the modern 86 based on the same layout.

To achieve a low centre of gravity they wanted a flat-four engine. Toyota approached Subaru who have some experience with boxer engines to partner in the development of the vehicle. **See Diagram #1**

Subaru makes both the BRZ and 86 at its plant. BRZ stands for **B**oxer engine, **R**ear-wheel drive, and **Z**enith. Zenith is an astronomy term for the highest point reached by a heavenly body (marketing). ▶



## Diagram #1

### Same Engine with Two Identification Codes

This engine is called a FA20 by Subaru and a 4U-GSE by Toyota. It is based on the flat four or boxer layout for which Subaru is famous, and uses Toyota dual injection system which uses both port and direct injection for more power.

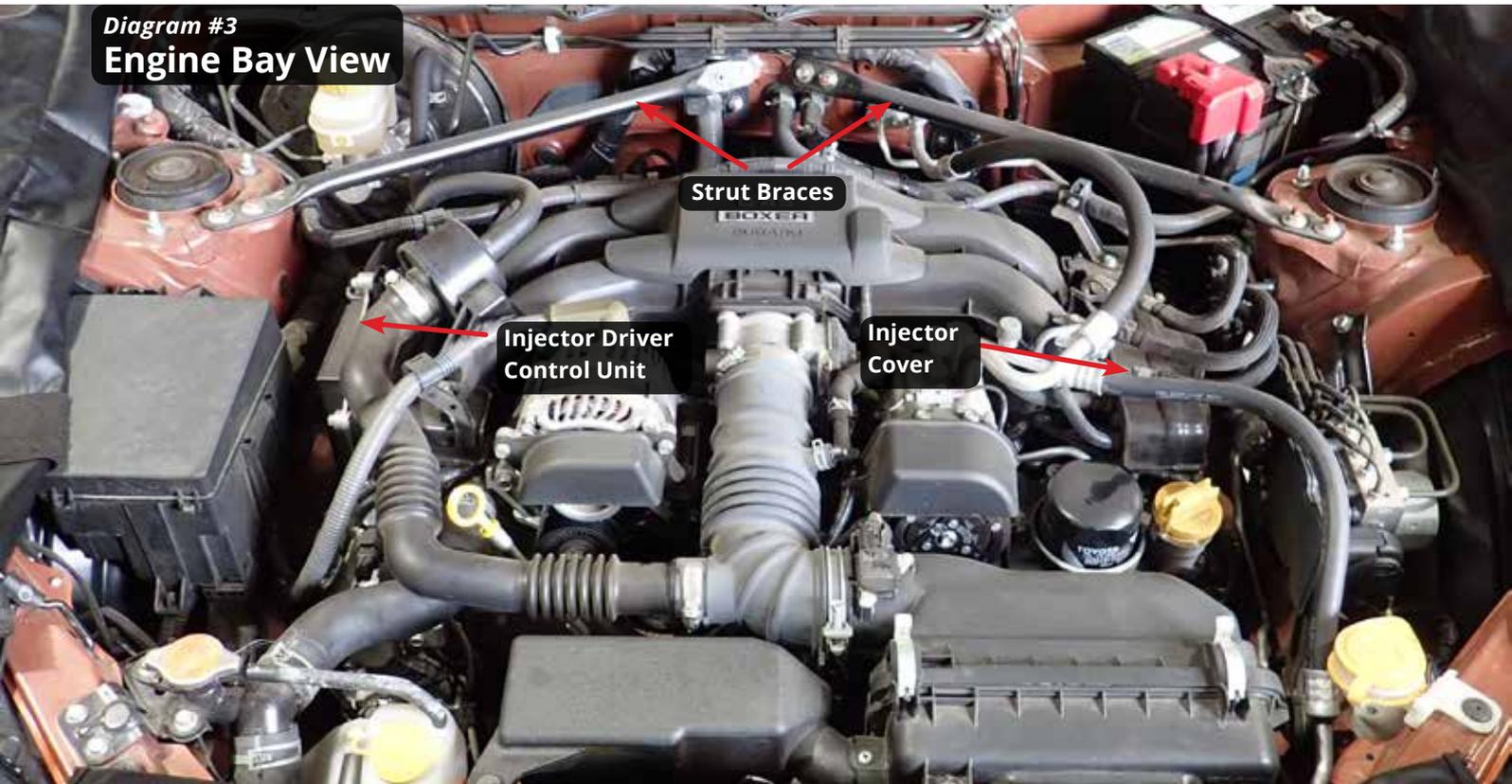


## Diagram #2

### 14mm Spark Plug



**Diagram #3**  
**Engine Bay View**



Both companies take the credit for the excellent performance, so they are both responsible for putting the boxer engine tight up against the frame rails, which makes removing the spark plugs time-consuming.

The spark plugs required are iridium with three grounding electrodes. They have a 26.5mm reach and a 14mm single hexagon. **See Diagram #2**

The service schedule indicates that the

spark plugs require replacement at 90,000 km.

The factory procedure to replace the spark plugs is to disconnect many wiring harness connectors, dismantle the exhausts from the engine. Then release the engine mounts to allow you to raise the engine so the spark plug holes clear the frame rails.

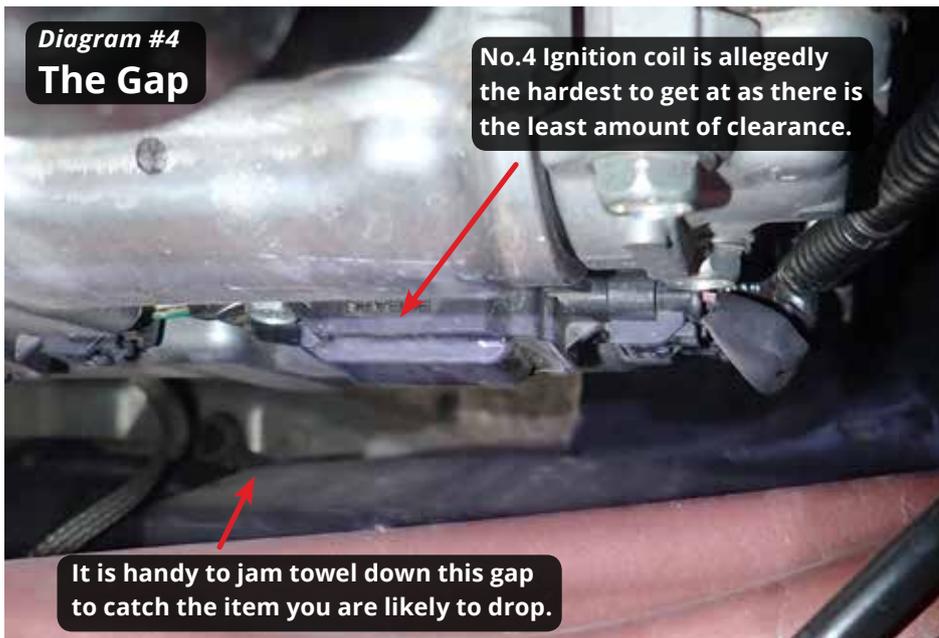
This will allow easier access to the plugs, but it is time-consuming as it

takes approximately 3 hours.

Trade experience has shown that it is possible to remove the plugs with the engine in place, if you have the right tools, some preparation and patience. It will be fiddly, but it can be done with an average human hand with the following procedure.

This non-manufacturer approved procedure may take approximately 1.5 hours, after some practice. ▶

**Diagram #4**  
**The Gap**



No.4 Ignition coil is allegedly the hardest to get at as there is the least amount of clearance.

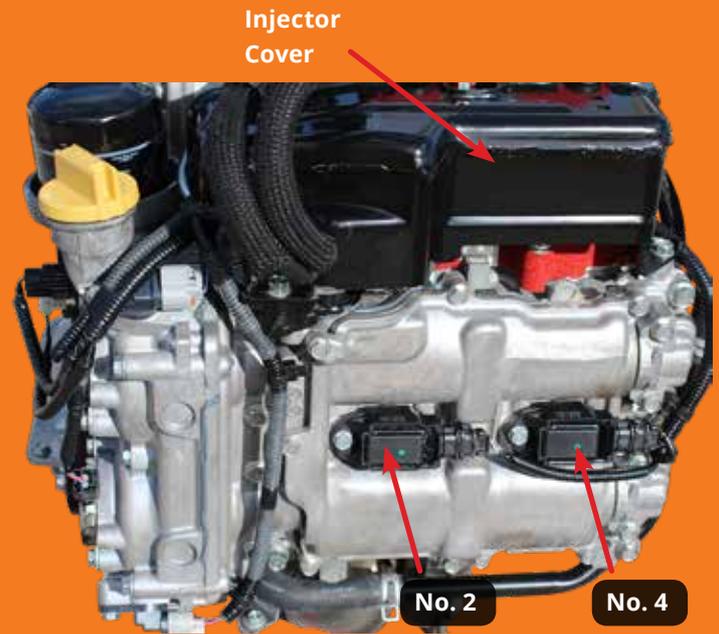
It is handy to jam towel down this gap to catch the item you are likely to drop.

**Diagram #4**  
**Ignition Coil**



The rubber insulation on the coil should be flexible enough to allow removal.

**Diagram #6**  
**Left Hand Bank Components**



The LH rear plug (number four cylinder on bank 2) seem to be the one with the least room. So start there, while your patience is at maximum.

**See Diagram #4**

**NOTE:** The bonnet stay can be repositioned to hold the bonnet open wider to give you more room.

**Disassembly**

1. Disconnect the battery.
2. Remove the strut tower bracing for both sides. **See Diagram #3**

3. Remove the bracket which supports the fuel lines on the LH bank, one bolt. **See Diagram #6**
4. Remove the injector cover on the LH bank, two bolts. **See Diagram #6**
5. Remove the injector driver module on the RH bank, three bolts. **NOTE:** You can move the module out of the way or disconnect the harness and remove it completely, so it does not bother you. **See Diagram #7**

6. It is recommended to jam a towel down between the valve covers and frame rails. This will make it easy to retrieve bolts and tools that will be dropped. Without the towel, lost items will get stuck in the tray under the engine. **See Diagram #4**

**Spark Plug Removal**

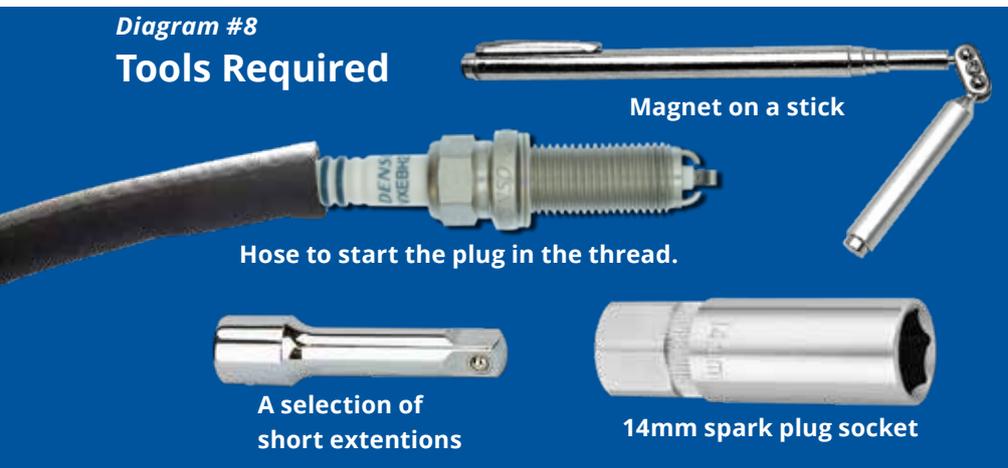
1. Mark the coils and harness then disconnect the wiring harness from the ignition coils. ▶

**Diagram #7**  
**Right Hand Bank Components**



### Diagram #8

### Tools Required



Magnet on a stick

Hose to start the plug in the thread.

A selection of short extensions

14mm spark plug socket

- Using a 10mm ratchet ring spanner or ¼ drive socket remove the ignition coil bolts.
- This may not make any difference, but it is good workshop practice to mark which cylinder the coils are mounted in, then remove the coils. The rubber ends should bend enough to get them out. **See Diagram #5**
- Insert a 14mm spark plug socket into the spark plug hole (a deep 14mm socket might also work). **See Diagram #8**
- Then insert one or two 3/8 drive short extensions into the spark plug hole and engage it into the socket. Then ensure that it is engaged correctly with the spark plug. **See Diagram #8**
- You should now be able to fit your ratchet to the extension and loosen the plug. Don't unwind it all the way with the ratchet as it

will jam against the frame rail.

- Disconnect the ratchet from the extension and unwind the plug by hand.
- Remove the extension from the socket, then remove the socket from the hole. You might need to use a magnet. **See Diagram #8**
- Use a magnet to remove the plug. **See Diagram #8**

### Spark Plug Installation

- Using a piece of hose, gently insert the new plug into the hole and ensure that the thread is started correctly. Then remove the hose. **See Diagram #8**
- Insert the tools in the same order as the removal.
- Tighten the plugs to **17 Nm**.
- Refit the coils back into their original positions and tighten the bolts to **8.5 Nm**.

- Reconnect the harnesses to the coils.

### Reassembly

Refit all components in reverse order to the following torque specifications.

- Injector cover **19 Nm**.
- Injector driver module **6.4 Nm**.
- Strut tower bracing **16 Nm**.

### Valve Spring Recall

If your customer requires their spark plugs replaced, check with them if they are booked in for the valve spring recall. If so, ensure that the plugs are replaced by the dealer when they remove the engine to replace the valve springs. For more information, go to the following website and search for the details below.

[www.productsafety.gov.au/recalls](http://www.productsafety.gov.au/recalls)

**MY2012-2013 Impreza, XV and Forester Vehicles (fitted with a 2L engine) and MY2013 BRZ Vehicles**

- PRA No.2018/17142
- Date published: 5 Nov 2018
- Campaign Number: SI0491

#### Toyota 86

- PRA No. 2018/17140
- Date published: 11 Nov 2018
- Campaign Number: LGG85

For more information on the Toyota 86 and the Subaru BRZ, log on to Tech Online or call VACC's Technical Advisory Service.



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# Ask an EXPERT...



## Why CRD Injectors Wear: Part 2



Clogged injector due to poor combustion.

Continuing on from our previous article, discussing the main cause of Diesel injector failure.

### Excessive Injection

#### Indicators:

- Excessive smoke at idle, poor running, and banging
- Cylinder Balance rates are low (negative), indicating fuel is being reduced to the cylinder because the computer thinks the fuel injector is flowing too much, normally this is the side effect of another much larger issue.
- Excessive exhaust gas temperature
- Engine damage from excessive heat or hydraulic lock from excessive fuel in the cylinder

#### Causes:

- Worn ball seat in injector or the end of injection has been cut off
- Nozzle needle seat worn or damaged
- Debris in control system of injector, which holds it open
- Debris in nozzle needle seat holding it open
- Cracked nozzle from overpressure, or overheated nozzle from improper installation of injector



Moisture / heat damage due to worn injector seat or improper install of the injector.

#### Prevention:

- Replace worn and high-mileage injectors; do not use these injectors as a foundation
- Keep fuel system clean, change filters, purchase fuel from reliable sources, and avoid filling from portable fuel tanks or questionable sources
- Do not use after market counterfeit injection components that are not properly designed or manufactured

### Incorrect Injection Rate

#### Indicators:

- Rough running and poor cylinder balance
- Large cylinder-to-cylinder exhausts temperature variation

#### Causes:

- Poor nozzle flow balance
- Nozzle needle lift incorrect (mixed or missing parts)
- Partially plugged nozzle
- Wire-brushed nozzles

#### Prevention:

- Keep fuel system clean, change filters, purchase fuel from reliable sources, and avoid filling from portable construction fuel tanks or questionable sources
- Reject all fuel system replacement parts that have metallic burrs
- Do not use after market counterfeit injection components that are not properly designed or manufactured
- Ensure injectors are serviced or purchased from a reliable source
- Do not clean nozzles with a wire brush.

### Incorrect Injection Timing and Duration

#### Indicators:

- Rough running, poor cylinder balance, and knocking
- Piston damage
- Large cylinder-to-cylinder exhausts temperature variation

#### Causes:

- Ball seat wear
- Incorrect injector assembly, parts mixed, or parts missing
- Injector needle lift increased to increase output

#### Prevention:

- Replace worn injectors
- Ensure injectors are serviced, tested, and purchased from a reliable source.

Stay tuned, for the next part in this series discussing fuel related injector failure.



Over pressurisation inlet filter of the diesel injector or clogging due to foreign contaminants in the diesel

