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Feature

Toyota Hybrid Camry: Basic Procedures

Index

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Hydrogen FCV Trials and Infrastructure Breakthrough?

Hydrogen is a theoretically infinite resource that has been touted as the fuel that will solve vehicle emission problems, as it only releases water vapour as a by-product of combustion or electricity generation. However, there have been many cost and efficiency problems that have stopped its widespread adoption. Research and development from many areas have now come together with new solutions. So the age of hydrogen could be around the corner. Maybe?

In 1806 Frenchman, Francois Isaac de Rivaz built the first internal combustion engine (ICE) which ran on a hydrogen/oxygen mixture, and there have been many successful modern engines developed which run on hydrogen (Tech Talk May 2007 page 2565). Sir William Robert Grove demonstrated the first Fuel Cell in 1845. Fuel Cells use a reaction between hydrogen and oxygen in an electrochemical cell that converts chemical energy from the fuel into electricity. NASA developed them further to produce electricity, heat and drinking water on their spacecraft from their rocket fuel, which was hydrogen and oxygen. (For more details on the operation of Fuel Cells see Tech Talk Dec 2005, page 2337)

Vehicle manufacturers have continued to develop Fuel Cell Vehicles (FCV), and Hyundai and Toyota both have models in Australia for testing. These vehicles are available for sale in other parts of the world where there is the appropriate infrastructure to refuel them. They use the hydrogen in their tanks and oxygen from the atmosphere to cause a reaction in the fuel cell stack to produce electricity.

The Hyundai ix35 Fuel Cell has been in Australia since 2014 for testing, and Hyundai have installed Australia's first and only light-vehicle hydrogen refuelling station at their HQ in Sydney. The Toyota Mirai has been in Australia since 2015, and they have a specially designed mobile refuelling unit that can follow them around the country. Otherwise, they would have to get back to Sydney and ask Hyundai for a top up. Both of these vehicles have an approximate range of 500 km per tank, can be refuelled in 5 to 10 minutes and have the performance and safety of current petrol and diesel vehicles.

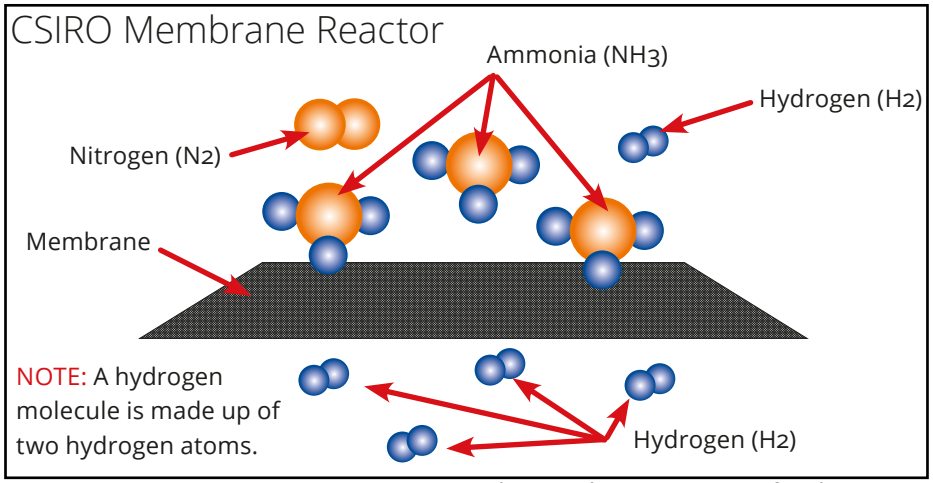
The cars are ready to go, so why aren't ▸

these type of vehicle more common? The first hurdle is the production of hydrogen. The three main techniques are:

- Steam reforming, in which high-temperature steam is applied to natural gas which splits the hydrogen from the hydrocarbons.
- Gasification, which processes organic material under high temperatures to separate hydrogen.
- Electrolysis, in which electricity is passed through water to split the hydrogen from the oxygen atoms.

All of these options require a lot of energy to produce a clean fuel. If the above processes could be done using less, or renewable energy and not fossil fuels it might be ok, but it is currently inefficient.

The infrastructure is the second hurdle, as hydrogen is difficult to transport. However, a breakthrough from the CSIRO could have the answer which will fill the gap between hydrogen production, distribution and delivery. They have created a membrane that will allow hydrogen to be transported in the form of ammonia and then reconverted back to hydrogen at the point of use. Ammonia is a molecule made of one atom of nitrogen and three atoms of hydrogen and is one of the most widely produced and transported chemicals globally. This thin metal membrane allows hydrogen to pass while blocking the nitrogen and all other gases. This membrane is fitted in a modular unit that can be used at, or near, a refuelling station. So the transportation issue could be solved.



This leaves us with the refuelling station itself. Hydrogen needs to be compressed to 80,000 kPa then cooled before being pumped into the vehicle, which is very energy intensive. All of the above steps are expensive, which does not make hydrogen an economical or environmentally friendly option with current technology.

Elon Musk is against FCV for the above reasons (He does have a vested interest to promote battery electric vehicles though). The advantage electric cars currently have is that they can be recharged from many locations, (if you have the time to wait, 30mins for a fast charger or overnight from a 15 A power point) and the supply chain of electricity is far more efficient than petrol, diesel or hydrogen. However, vehicle manufacturers and investors still believe in hydrogens potential.

As technology continues to overcome the hurdles of hydrogen production, distribution and refuelling, these fuel cell vehicles may become a viable future option. But not yet.

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Cover Image: Toyota / Hyundai

TechOnline

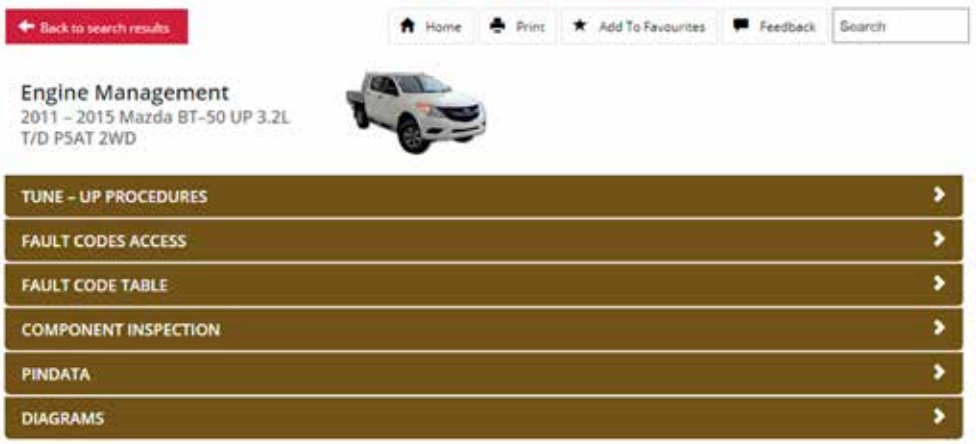
Engine Management: Developments

The VACC's Technical Development team is constantly updating the content for Tech Online, so our members and subscribers have the content that they require. The engine management module is one of the most popular areas. However, some of the newer users may not be aware of the information that it contains. We will use the recently uploaded Mazda BT-50 UP 3.2L T/D P5AT 2WD as an example of the content in an engine management article. Each engine management article is broken down into sub-sections to make finding information faster.

In the "Tune-Up Procedures" you will find specifications on idle speeds, fuel pressure testing and system bleeding, relearn and drive cycle procedures.

In the "Fault Code Access" section we give the location of the diagnostic connector and any procedures to read or erase the codes.

The "Fault Code Table" has a listing of all of the relevant diagnostic trouble codes for this variant with a description and possible causes. On some of these codes is a link to the component testing for that code if we have information available. If the code number is **blue**, it is a link.

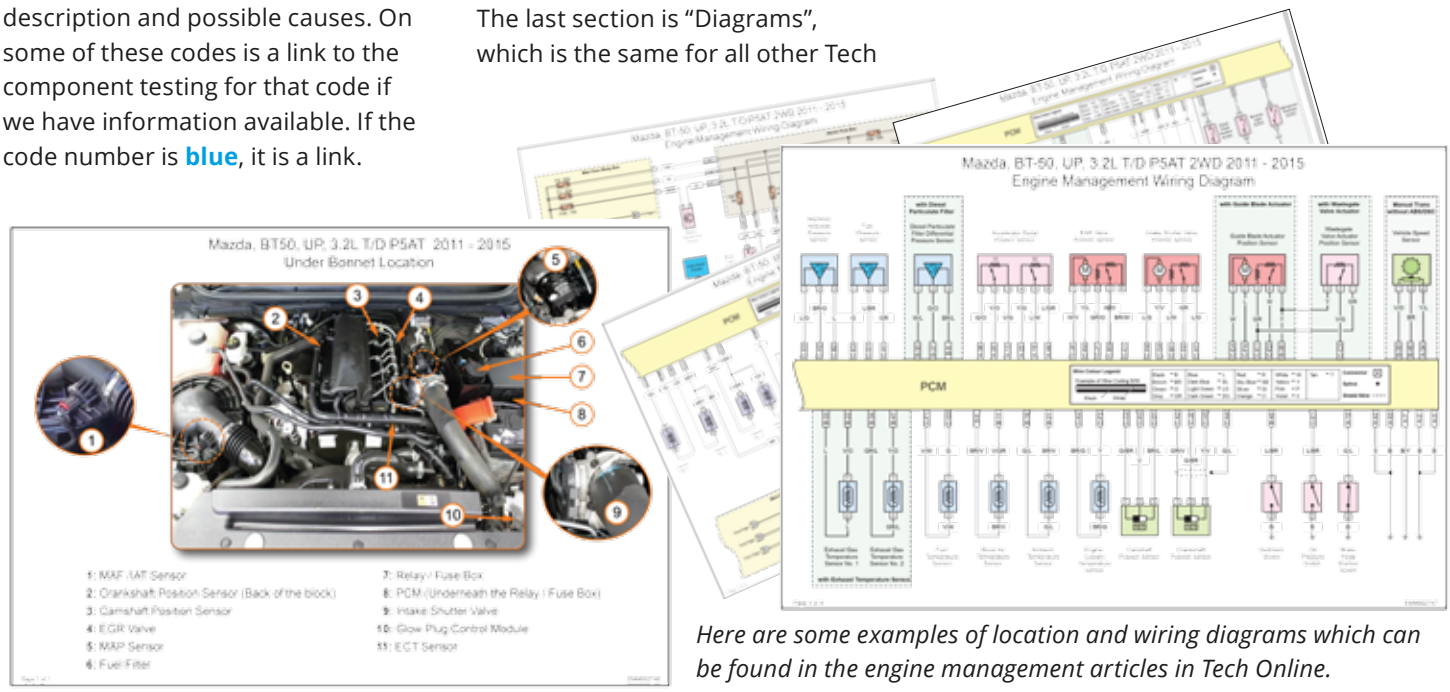


The next section is "Component Inspection" which will give you testing procedures and specifications for the sensors and actuators in the engine management systems.

The "Pindata" section has tables for the ECM/ECU/PCM connectors with wire colours, component descriptions and input or output values for the sensors or actuators for the terminals. Pindata is useful for speeding up diagnosis of circuits as you can check resistance, voltages and waveforms by back probing the connector.

The last section is "Diagrams", which is the same for all other Tech Online articles. These diagrams show component locations around the vehicle and under the bonnet, emission control and fuel supply layouts, component connector views and the wiring diagram for the engine management system.

All of this information has been compiled by trade experienced automotive technicians, and has been formatted to make it fast and easy to read. If you require any assistance finding information on Tech Online, don't hesitate to call the Technical Advisory Service for guidance.



Here are some examples of location and wiring diagrams which can be found in the engine management articles in Tech Online.

Ford Territory: Front Differential Bushes

2004 – 2017 Ford Territory SX – SZ AWD

The Territory has been a success for Ford Australia. It was based on the same platform as the BA series Falcon and was the only locally designed and built SUV. It was popular with the public and the press as it was the first SUV to win the Wheel's magazines Car of the Year in 2004. However, it is not without its faults. In the last issue of Tech Talk we covered the replacement of the rear differential bushes in the Territory and Falcon (October 2017 page 4414), and now we will cover the front differential bush replacement on the AWD Territory.

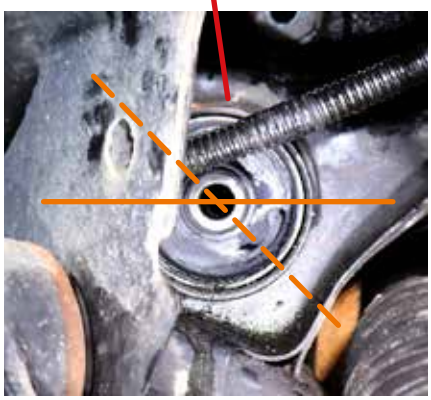
The symptoms of front differential bush failure are an audible clunk or thump from the front of the car under acceleration, or when shifting from drive into reverse. If the bushes are not replaced, they can cause other driveline component failures.

The workshop manual does not give a specific procedure to replace the bushes. However, it is suggested that the front K frame needs to be removed to accomplish the task, which is a massive job. As it turns out, some technicians have come up with a way to replace the bushes in place. This article will describe this procedure.

WARNING: This is not the manufacturer's procedure, so you should proceed at your own risk.

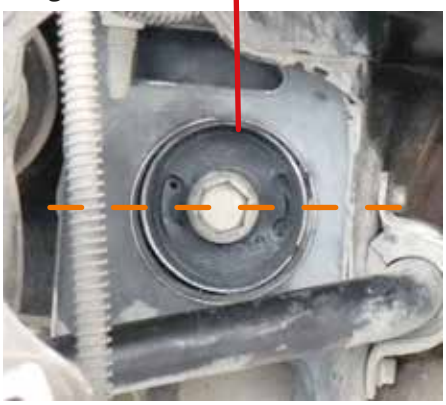
Diagram #1 *Front Differential Bush Locations*

Diagram #2



Front bush must be fitted with the voids at a 45° angle

Diagram #3



Rear bush must be fitted with the voids horizontal.

Disassembly

1. Raise the vehicle safely on a hoist or jack stands.
2. Remove the LH front wheel.
3. To give yourself more room, remove the LH front brake calliper and hang it up out of the way, making sure not to kink or stretch the hose. You can also remove the rotor.
4. Remove the engine mount nuts and bolts on both sides.
5. Fit an engine support and raise the engine. ***See Diagram #8***
6. Mark the front propeller shaft in relation to the differential flange. Also, mark the position of any balance weights.
   NOTE: Be careful not to over extend the CV joint at the transfer case end.
7. Remove the bolts from the two front differential bushes. ***See Diagram #1***
8. Remove the nut and bolt from the RH differential support. ***See Diagram #9***
9. Jack up and support the differential assembly so it will give you room to access the rear side of the differential bushes on the LH side. ***See Diagram #7***

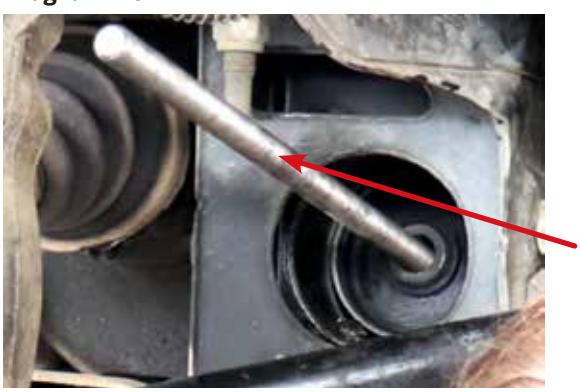
Bush Removal.

1. With a reciprocating saw (air or electric) cut out the inner parts of the bushes. Then cut through the outer tubes in two places to make removal easier.
   NOTE: Be careful not to damage the housing.
   See Diagram #4
2. Using a punch or a chisel remove the outer tubes from the housing.
   See Diagram #5
3. Check the holes in the housing for damage and remove any burrs and debris.

Diagram #4

Diagram #5

Diagram #6



Fit the bush into the housing from the rear with the voids aligned correctly.
See Diagram #2 & #3

Use threaded rod through the bush to pull it into the housing.

Diagram #7

Use an engine support pole to lift the front differential assembly out of the way to access the rear of the front bushes.

Diagram #8

Fit an engine support and raise the engine. Be careful not to over stretch hoses or wiring.

Diagram #9

Remove the nut and bolt from the RH differential support.

Bush Installation

The bushes must be installed in the correct orientation otherwise their performance and service life will be reduced significantly. You have some choice on replacement bushes as there are many aftermarket options available.

WARNING: Check and follow any fitting instructions that come with the bushes and or ask the manufacturer if you are in doubt. The diagrams in this article will give you the orientation for the genuine bushes.

1. Lubricate the housing (e.g. spray lube).
2. Align the front bush with the voids at 45° from horizontal, and fit into the housing. ***See Diagram #2***
3. Align the rear bush with the voids horizontal, and fit into the housing. ***See Diagram #3***
4. The same procedure is used to fit the front and rear bushes as follows.
5. Fit a threaded rod through the bush. ***See Diagram #6***
6. Fit a suitable backing plate with a nut at the rear of the bush. ***See Diagram #10***
7. With another nut and a suitable plate fitted to the front of the housing. ***See Diagram #11***
8. You can now gently pull the bush into the housing by tightening the nut. Or if you have access to a hydraulic ram, this will be easier and faster. ***See Diagram #12***

Diagram #10

Fit appropriately sized backing plates at the rear of the bush and thread a nut onto the rod.

Diagram #11

Fit appropriately sized plates on the outer side of the housing

Diagram #12

If you have access to a hydraulic ram, fit this over the threaded rod with a nut. If not you can wind the nut, which will pull the bush into the housing.

Diagram #13

To fit the front bush with a hydraulic ram you will have to use a spacer and extra plates to get around the part of the body that is in the way of the bush.

NOTE: For the front bush you may have to fit a spacer with another plate if you are using a hydraulic ram. ***See Diagram #13***

9. The bushes must be flush with the rear side of the housing.

Reassembly

1. Align the front differential housing with holes in the bushes.
2. Tighten both LH differential bush bolts to **108 Nm.** ***See Diagram #1***
3. Tighten the RH differential support nut and bolt to **80 Nm.** ***See Diagram #9***
4. Refit the front propeller shaft making sure to align the marks and to refit any balance weights in the correct position. Tighten the bolts to **36 Nm.**
5. Tighten the engine mount nuts to **102 Nm.**
6. Refit brake rotor and calliper and tighten the calliper bolts to **102 Nm.**
7. Refit wheel and tighten nuts to **125 Nm.**

For more information on the Ford Territory, login to Tech Online or call the Technical Advisory Service.

Australian Design ASP

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enginemount.com.au

We would like to thank the team at ASP Rubber Industries for allowing me to watch them fit the bushes and for their assistance with this article.

ASP will come to your workshop to fit bushes, or you can buy a hydraulic kit with spacers and fittings from them.

Basic High Voltage Safety Precautions.

Hybrid and electric vehicle systems can produce very high voltages (up to 650 volts) and enough current to kill you. There are no extra qualifications required to work on these vehicles. However, it is highly recommended that you become familiar with these systems before you decide to work on them. There are courses available to learn about high voltage system, how to work on them safely and the specialised tools and equipment required. If you have evidence that you have completed extra training on these systems, it will look good when Worksafe comes for a visit.

Below are some of the necessary information and warnings to keep in mind when working on hybrid and electric vehicles

- All of the high voltage cables are coloured orange, and the high voltage components are labelled as a warning. If you are going to be working on the high voltage system or any components near the high voltage system, you should investigate the procedure to disable/isolate the batteries before commencing work.
- If you are working on any high voltage components, it is recommended that you place a sign on the roof of the vehicle to warn your colleagues of the potential dangers (e.g. like what is on the top right of this page).
  NOTE: Login to Tech Online to download this warning sign so you can print it out.
- Wear insulated gloves rated to 1000 volts (Linesman's Gloves). Check for damage, leaks and used by dates before wearing. Also, wear some leather gloves over the insulated gloves to protect them.
- Wear insulated work boots.
- Remove the vehicles service plug and keep it in your pocket to prevent others from reconnecting it.
- Use insulated tools.
- Make sure that you do not have anything conductive in your shirt pockets that can fall out when you lean over, and that could bridge out high-voltage connections.
- Before touching any bare high voltage terminals, check that there is 0 voltage with a Cat III multimeter (rated to 1000 volts) while wearing your insulated gloves.
  NOTE: You should check your multimeter against a known voltage, like a 9-volt battery to make sure that it is giving a correct reading.
- Use the One-Hand Rule which means that you only use one hand to make any measurements. You will need an alligator clip for one of your multimeter probes to apply this rule. It reduces the risk of electrocution.

Above is a Class 0 glove that is rated to 1000 volts.

Use a 9-volt battery to check that your multimeter is reading correctly.

For more information on hybrid and electric vehicle specifications logon to Tech Online or call the Technical Advisory Service.

The Fundamentals: High Voltage Awareness

To learn more about the effects of voltage and current on the human body and how to work safely on high voltage systems, watch this video from AutoMate Training. They also have other training videos on Hybrid systems.

Scan the QR code with your phone to access the video or use the following link: tinyurl.com/highvoltage2017

Toyota Camry Hybrid: Basic Procedures

2006 - 2012 Toyota Camry AHV40R
2012 - 2017 Toyota Camry AVV50R

Hybrid Synergy Drive (HSD) is Toyota's brand name for its hybrid drivetrain system which is used across many Toyota and Lexus models (Nissan also uses it under licence). HSD is an evolution of the Toyota Hybrid System which was used in the Toyota Prius which was first featured in Tech Talk back in 1997 as an emerging technology. The Camry Hybrid was released in the Australian market in 2010 as a part of the 40 series and has been updated with the release of the 50 series in 2015. This article will cover service plug removal and battery jump starting for the 40 and 50 series Hybrid Camry.

WARNING: Read Tech Talk page 4427 for high voltage safety precautions

This is the 40 series "READY" light, it indicates that the vehicle is powered up and ready to drive.

40 Series Service Plug Removal.

1. Turn off the ignition.
2. Remove the cover from the RH side of the luggage area to access the 12 volt auxiliary battery. ***See Diagram #1***
3. Disconnect the negative battery terminal from the auxiliary battery.
4. On the RH side towards the front of the boot area is a Battery Service Hole Cover. Lift this up to access the Service Plug.
5. While wearing insulated gloves, pull the lever on the service plug up vertically, then pull the top of the lever towards you so that it is 90° from its starting position.
6. You can now pull the service plug straight out towards you to remove it.

NOTE: Wait for at least 10 minutes to allow the capacitor in the inverter to discharge before starting work.

Diagram #1 40 Series Service Plug Removal.

1 Remove the cover on the RH side of the boot to access the 12V Auxiliary Battery and disconnect the negative battery terminal

2 Lift the cover at the rear of the boot to access the Service Plug

3 Pull the top of the lever straight up. Then pull the top of the lever towards you 90°.

4 Pull the service plug straight out towards you to remove it from the socket

Precautions / Inspection

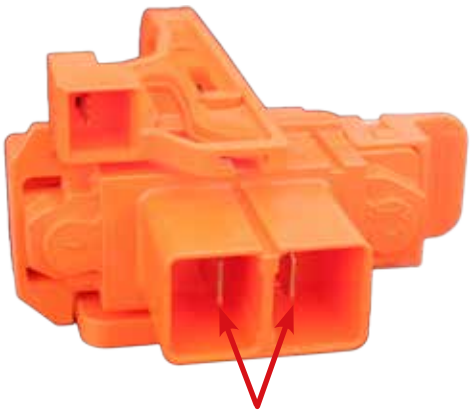
Before reinstalling the service plug make sure that:

- All high voltage components are reconnected correctly, and all terminals are tight.
- Check that all tools and other parts are not interfering with any high voltage components or terminals.
- Check the resistance across the service plug terminals. It should be below 1 Ω. ***See Diagram #2***

Installation

1. While wearing your insulated gloves, fit the service plug into its connector.
2. Then rotate the lever 90° away from you.
3. Push the lever in until you hear it click into place.
   NOTE: If it is not clicked into place the car will not start.
4. Reconnect the negative battery terminal on the auxiliary battery.
   NOTE: Some systems will need to be initialised when the cable is reconnected.
5. Refit the battery cover.

Diagram #2



40 Series Service Plug. Check the resistance across the main terminals to check the fuse.

Inside the Service Plug is a 125A Fuse. The external design is different for the 40 and 50 Series, but the fuse is the same.

50 Series Service Plug Removal.

1. Turn off the ignition (The READY light is off) and make sure that the key is out of range of the vehicle (at least 15 metres).
2. Remove the cover from the RH side of the luggage area to access the auxiliary battery.
   See Diagram #3
3. Disconnect the negative battery terminal from the auxiliary battery.
4. Remove the carpet from the floor of the luggage area.
5. Remove the trim from the rear of the luggage area that covers the battery.
6. There is a metal cover with two nuts on top of the battery. Remove this cover to expose the service plug.
7. While wearing your insulated gloves, pull the lever on the service plug to the right, then rotate the lever 90°towards you. You can then pull the service plug straight out towards you.

NOTE: Wait for at least 10 minutes to allow the capacitor in the inverter to discharge before starting work.

Workshop tip: Clean the battery vent and tubes

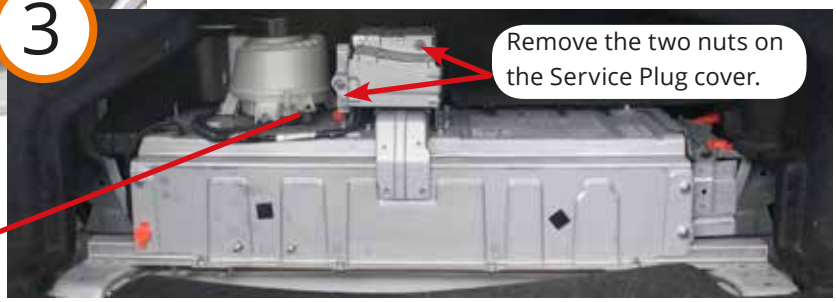
The 50 Camry has a vent in the LH side rear seat that draws air to cool the battery. Make sure that this is uncovered and give it a clean out during services to prolong battery life.

This is the 50 series "READY" light.

Diagram #3 50 Series Service Plug Removal.

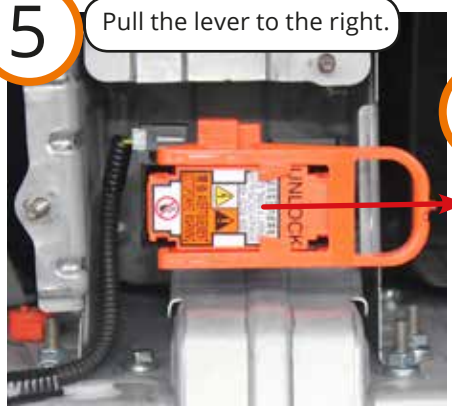
1 Remove the carpet and the cover at the rear of the boot

2 Remove the cover on the RH side of the boot to access the 12V Auxiliary Battery and disconnect the negative battery terminal



3 Remove the two nuts on the Service Plug cover.

4 With the cover removed the Service Plug can be accessed



5 Pull the lever to the right.

6 Pull the lever 90°towards you, then pull the plug straight out

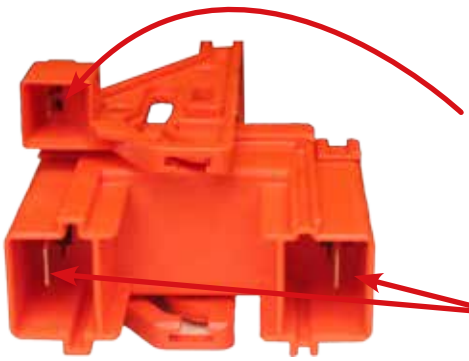
Precautions / Inspection

Before reinstalling the service plug make sure that

- All high voltage components are reconnected correctly, and all terminals are tight.
- Check that all tools and other parts are not interfering with any high voltage components or terminals.
- Check the resistance across the service plug terminals. It should be below 1 Ω.

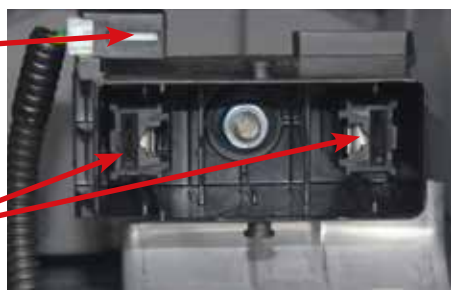
Installation

1. While wearing your insulated gloves, fit the service plug into its connector.
2. Then rotate the lever 90° away from you.
3. Push the lever to the left until you hear it click into place.
   NOTE: If it is not clicked into place the car will not start.
4. Refit the cover and tighten the nuts to **7.5 Nm**.
5. Refit the trims and floor covers.
6. Reconnect the negative battery terminal on the auxiliary battery.
   NOTE: Some systems will need to be initialised when the cable is reconnected.
7. Refit the battery cover.



This is a 50 Series Service plug. These are the terminals which must be engaged to indicate that the service plug is correctly locked in. The vehicle will not start/drive if this in not clicked in.

These are the high voltage terminals to the battery.



Jump Starting 40 and 50 Series

These vehicles have two batteries, a 12-volt auxiliary battery and a 244 volt (High Voltage) battery which have two different charging requirements if they are flat. This procedure is for both the 40 and 50 series Camry with the smart key option.

If the 12-volt battery is flat, the following symptoms will present.

- When the power switch is turned ON, nothing appears on the instrument cluster.
- The hybrid system does not start.
- The headlights are dim.
- The horn does not emit full volume.

The vehicle can be jump-started with the following procedure.

1. Park brake on.
2. The power switch is off and the key is out of range of the vehicle.
3. Remove the cover from the RH side of the luggage area to access the auxiliary battery.
4. Connect the positive jumper cable to the positive terminal of the auxiliary battery.
5. Connect the other end of the positive jumper cable to the positive terminal of the charged battery.
6. Connect the negative jumper cable to the negative terminal of the charged battery.
7. Connect the other end of the negative jumper cable to the boot lock striker. ***See Diagram #4***
8. Bring the key back in range of the vehicle.
9. With your foot on the brake pedal. Turn the power switch to ON (Ready light should be on). The hybrid system should now start.

Diagram #4

Connect the jumper cables in sequence to the positive terminal of the battery and the boot latch striker.

10. Disconnect the jumper cables in the reverse order immediately after restart.

If the vehicle does not recognise the smart key with the jump start battery connected. Open and close the driver's door and the vehicle should look for the key signal again.

If the key is still not being picked up by the vehicle, the key's battery may be flat. If so place the key up against the start button with the Toyota logo side to the switch and the vehicle should recognise it. ***See Diagram #5***

If the Hybrid system does not start and the following message is shown on the instrument cluster "Traction Battery Preservation Mode. Restart after shifting to the "P" Position" the High Voltage battery may be flat.

If the engine starts, leave it idling in park until the self-charging is completed, which will be indicated when the engine shuts off.

If the engine does not start the High Voltage battery will need to be charged using a suitable charger. **NOTE:** This is a job for the dealer.

For more information on the Toyota Camry, log on to Tech Online or call the Technical Advisory Service.

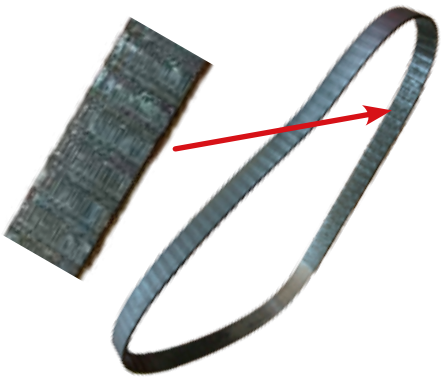
Diagram #5

If the battery is flat in the smart key, hold the side with the Toyota logo up to the start button

We would like to thank Barry at Toyots r us for allowing us access to their vehicles for the photos in this article.

Mitsubishi 4D56 2.5L Diesel Timing Belts: Common Faults and Revisions

The 4D56 diesel engine was released in 1980 and as a part of the "Astron" family of Mitsubishi engines which share common design features. The 4D56 has been in constant production ever since with improvements and additions over time, and one ongoing issue that persists.

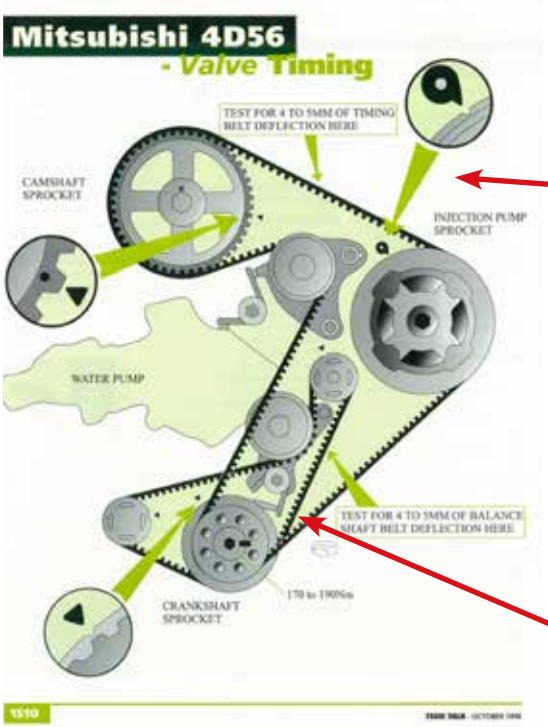


The common feature of this engine family is the use of twin balance shafts (originally called "Silent Shafts"). These are used to overcome a design quirk of the inline four-cylinder engine that causes vibrations. Even though all of the pistons and connecting rods are matched to the same weight, as they rotate, they do not cancel out all of the "up and down" motion, which means that there is some leftover "up" motion. This causes a second order vibration that gets worse as engine speed increases. The balance shafts rotate at twice engine speed, in opposite directions and are phased in a way that cancels out the leftover "up" motion with some extra "down" which equals a very smooth engine.

The 4D56 has two timing belts, one for the camshaft and a smaller belt behind the cam belt to drive the two balance shafts. They are designed to have the same service life and replacement interval. As the design of this engine has evolved so has the layout of the cam belt. For the earlier

Diagram #1

4D56: Same Engine Code, Two Different Fuel Systems and Two Timing Belt Layouts

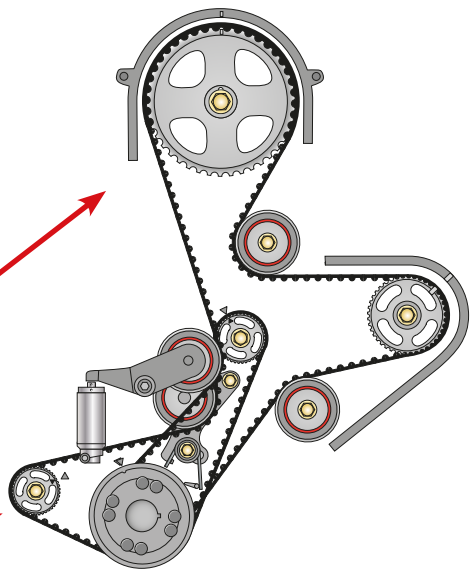


On the left is the layout diagram for the timing belt procedure for early models that can be found in Tech Talk October 1998 page 1508.

On the right is the layout diagram from the timing belt procedure for later models with common rail injection that can be found on Tech Online.

NOTE: The camshaft belt layout has changed but the balance shaft belt has remained the same.

Timing belt layout for models from 2008 with common rail diesel injection.



models from 1986 to 2003, they had a cam belt layout with a large fuel pump sprocket and spring tensioner.
See Diagram #1
(For replacement procedure refer to Tech Talk October 1998 page 1508)

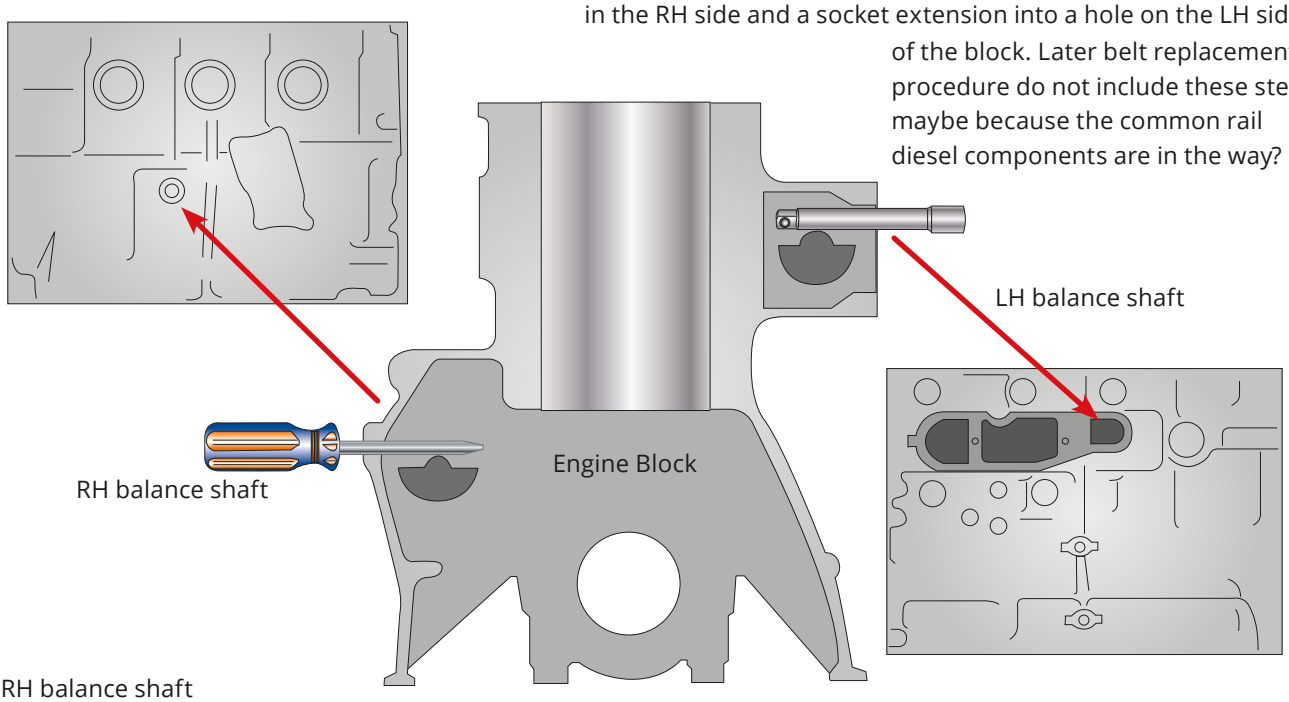
From 2008 in the ML Triton 4x2, the 4D56 was updated with the introduction of common rail direct injection. This resulted in the change in the layout of the cam belt to a small fuel pump sprocket and a hydraulic tensioner. The balance shaft belt layout has remained the same.
See Diagram #1
(For procedure logon to Tech Online)

The balance shaft belt has a habit of stripping its teeth before the replacement interval. In some cases people don't notice, other times owners might feel the extra vibration, and sometimes parts of the balance shaft belt interfere with the cam belt and then things gets expensive!

Sometimes, the balance shaft belt with the stripped teeth can make a whistling noise, which increases with engine speed due to the belt slipping on the sprockets. This sound is similar to a failed turbo bearing.

Diagram #2
Balance shaft layout and alignment

The belt replacement procedure for the early engine includes the steps to align the balance shafts by inserting a screwdriver in the RH side and a socket extension into a hole on the LH side of the block. Later belt replacement procedure do not include these steps, maybe because the common rail diesel components are in the way?



RH balance shaft

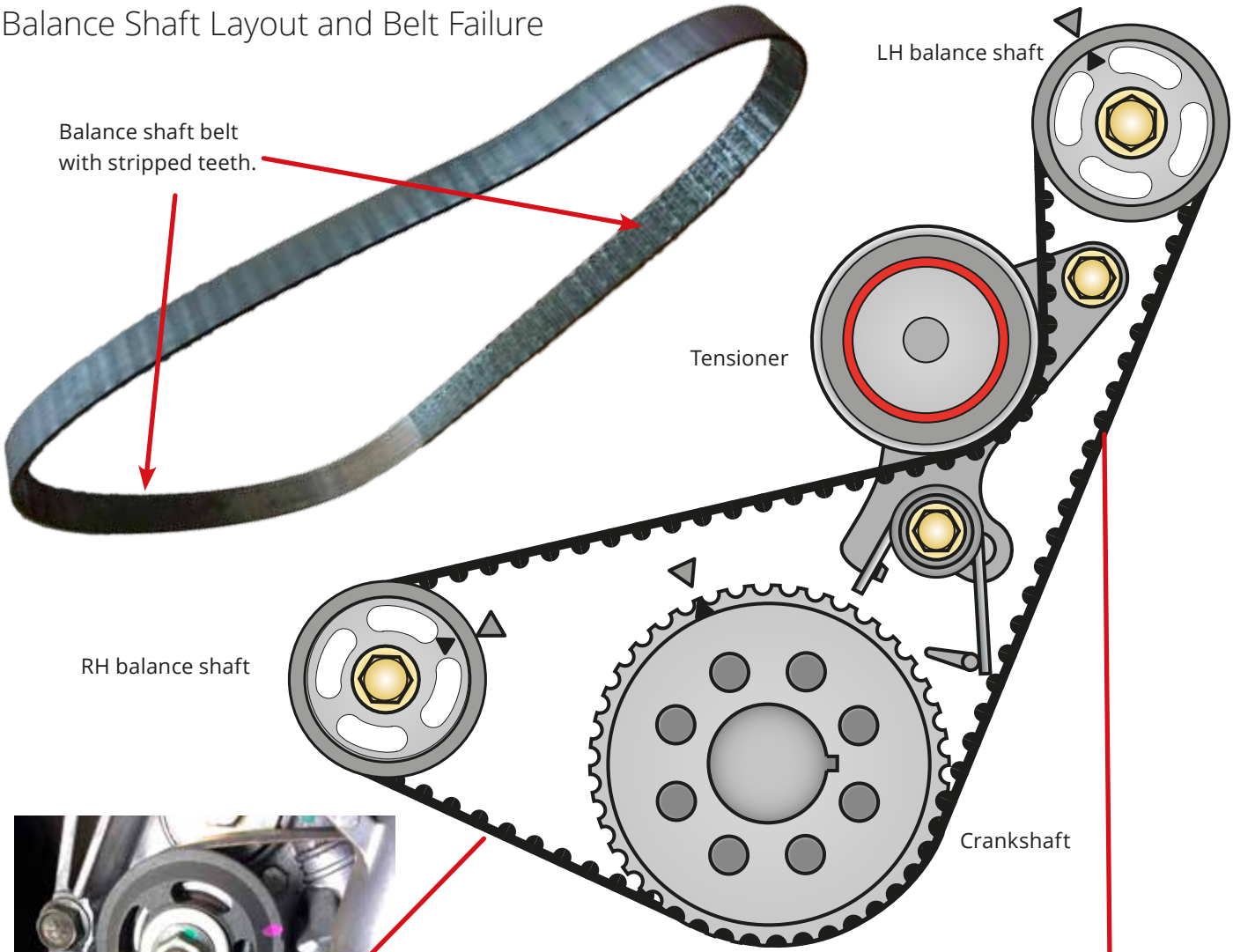
These bearing are the first to seize if there are any problems in the lubrication system as they are rotating at twice engine speed.

The RH shaft is driven via a gearset, which means that even though the timing marks are aligned, the weight could be out of phase. Check its position with the screwdriver in place.

LH balance shaft

Diagram #3

Balance Shaft Layout and Belt Failure



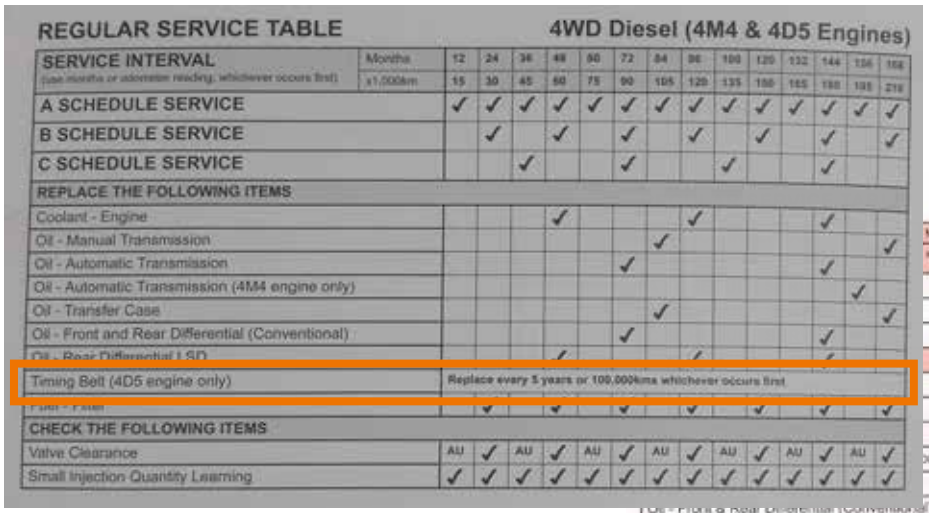
The balance shaft belt is the same across all engine variants, and it is common for the teeth to strip off. This can happen if there is increased resistance in the bearings of the balance shaft or just old age. With no teeth, the belt can make a whistling sound like a failed turbo.

Some variants of the 4D56 are turbocharged, and there have been stories of workshops replacing turbos only to find that the same noise is still there. So check the balance shaft belt before you go replacing turbos. ***See Diagram #3***

If the balance shaft belt has stripped teeth or has broken, always check that the shafts rotate freely. It is not unheard of for the balance shaft bearings to fail and the shafts to seize. If so, check the oil supply and oil pressure. ***See Diagram #2***

Problems that can affect the oil quality are lack of servicing, leaking injector seals and excessive DPF regenerations which can dilute the oil. So make sure that the oil changes are completed when specified with the correct oil, because if there are any lubrication problems, the balance shaft bearings are the first thing to grab, as the shafts are rotating at twice engine speed.

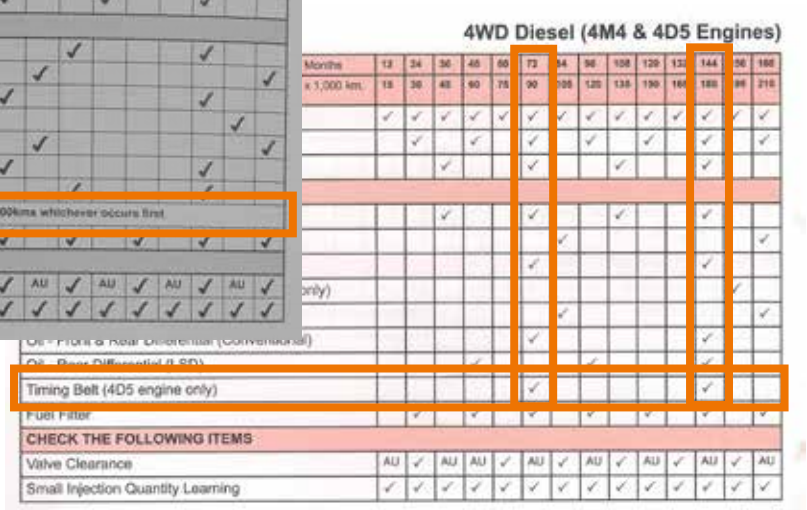
Diagram #4 Service Schedules for Mitsubishi Tritons



REGULAR SERVICE TABLE — 4WD Diesel (4M4 & 4D5 Engines)

SERVICE INTERVAL (use months or odometer reading, whichever occurs first)	Months	12	24	36	48	60	72	84	96	108	120	132	144	156	168
	x1,000km	15	30	45	60	75	90	105	120	135	150	165	180	195	210
A SCHEDULE SERVICE		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B SCHEDULE SERVICE			✓		✓		✓		✓		✓		✓		✓
C SCHEDULE SERVICE				✓			✓			✓			✓		
REPLACE THE FOLLOWING ITEMS															
Coolant - Engine					✓				✓				✓		
Oil - Manual Transmission								✓							✓
Oil - Automatic Transmission							✓						✓		
Oil - Automatic Transmission (4M4 engine only)														✓	
Oil - Transfer Case								✓							✓
Oil - Front and Rear Differential (Conventional)							✓						✓		
Oil - Rear Differential (LSD)					✓				✓						
Timing Belt (4D5 engine only)		Replace every 5 years or 100,000kms whichever occurs first													
Fuel Filter			✓		✓		✓		✓		✓		✓		✓
CHECK THE FOLLOWING ITEMS															
Valve Clearance		AU	✓	AU	✓	AU	✓	AU	✓	AU	✓	AU	✓	AU	✓
Small Injection Quantity Learning		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The service schedule on the left is for up to October 2012, the one below is for vehicles after October 2012 when they moved the timing belt interval to 90,000 km.



4WD Diesel (4M4 & 4D5 Engines)

Months	12	24	36	48	60	72	84	96	108	120	132	144	156	168
x 1,000 km	15	30	45	60	75	90	105	120	135	150	165	180	195	210
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		✓		✓		✓		✓		✓		✓		✓
			✓			✓			✓			✓		
			✓			✓			✓			✓		
						✓	✓					✓		✓
						✓						✓		
Timing Belt (4D5 engine only)						✓						✓		
Fuel Filter		✓		✓		✓		✓		✓		✓		✓
CHECK THE FOLLOWING ITEMS														
Valve Clearance	AU	✓	AU	AU	✓	AU	✓	AU	✓	AU	✓	AU	✓	AU
Small Injection Quantity Learning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Replacement Intervals

Another revision that has caused some confusion is the change of service interval for the timing belts. For models up to Oct 2012, the interval is 100,000 km or 60 months (5 years), from Oct 2012 the interval is 90,000 km or 72 months (6 years). ***See Diagram #4***

After some research, the reason for the change is to smooth out the service requirements. For example, the MN Trition has 15,000 km oil change interval which means that there is a 90,000 km service and a 105,000 km but not a 100,000 km service. So the customer has to come back in the middle for the timing belt replacement. Mitsubishi moved the timing belt interval forward to 90,000 km to be more convenient to the owner. There was no mechanical update, and the belts are the same.

It could be a good idea to replace the earlier models belts at 90,000 km due to the nasty habit of the balance shaft belt not going the distance, and creating more inconvenience to the customer.

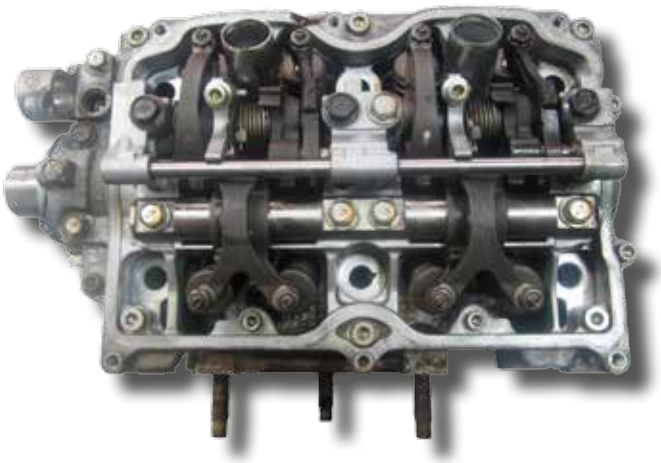
The 4D56 has a second life by also been built under licence by Hyundai and Kia for vehicles overseas. These variants have a different cylinder head with only a single overhead camshaft. They use the timing belt layout from the early 4D56 with the same balance shaft belt system. The engine codes are D4BB, D4BF and D4BH and maybe have been imported as the block is the same as a 4D56.

For more information on the 4D56 engine log on to Tech Online or call the Technical Advisory Service.

S. & S.J. MECHANICAL REPAIRS
33 High St Broadford. 03 57842048

We would like to thank Steve from S & SJ Mechanical Repairs for the photos in this article.

Dry Start, Camshaft Seizure!



The bearing surface of the camshaft has been damaged from lack of lubrication on start-up.

A pair of Subaru EJ255 SOHC cylinder heads had been fully reconditioned on our production line and sold to a customer. The customer contacted us after fitting the heads, stating that the camshafts in both cylinder heads had seized up while warming the vehicle up and has bent the valves!

The cylinder heads were removed and sent in for inspection. You can see in the pictures above and below where the camshaft had seized and damaged the camshafts and the cam tunnels. It was found that the camshafts had been fitted without lubricant, which in turn, caused the camshafts to seize.

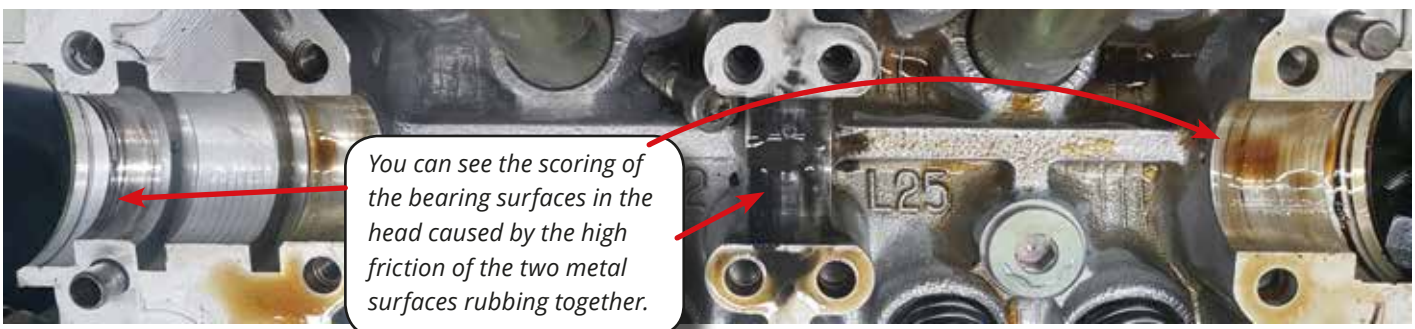
It is imperative that all camshafts, journals and bearing surfaces have "Assembly Lube" applied when cylinder heads or engines are being reassembled. Assembly lube is made by many suppliers and is designed to provide protection from scoring and seizing of engine components on initial start-up before the oil has a chance to be pumped through.

Assembly lube is a sticky paste or grease which can cling to surfaces better than oil. It is highly recommended for engines that are to be stored before installation as oil can seep out over time. It should be applied in a thin film, and it will be absorbed by the engine oil after start-up. To reduce the time that the engine is running without oil pressure, you should prime the lubrication system before initial start-up, if you can.

The initial starting and running in period is a critical time, and the vast majority of these type of camshaft failures can be attributed to a lack of lubricant.

The Subaru cylinder heads were repaired by resizing the cam tunnels. However, new valves and two new camshafts were required, as the originals were beyond repair, making this an expensive job that could have been avoided easily if assembly lube had been applied!

We would like to thank Geoff, from All Head Services, for sharing this practical information and photos
www.allhead.com.au



You can see the scoring of the bearing surfaces in the head caused by the high friction of the two metal surfaces rubbing together.