

THE TICKING TIME

**THE
DURABILITY
ISSUES
NO ONE ELSE
IS TALKING
ABOUT!**





Our major investigation into the common-rail diesel failure epidemic is going to ruffle a few feathers...

WORDS BY STEVE COLLINS, PHOTOGRAPHY BY 4WD ACTION →

BOMB

UNDER YOUR BONNET

THIS ARTICLE COULD SAVE YOU A \$15,000 REPAIR BILL!




- Did you know it only takes one bad batch of fuel to destroy your engine
- Will CRDs go the distance?
- Why are experts worried about injector and turbo life?
- Would you know if your engine was about to blow up?

Twice the power - twice as many kilometres out of a tank - twice as likely to blow up. That's what many are saying about the new breed of common-rail diesel engines. Are modern diesels becoming like air craft? Are they now too complicated and at the risk of falling out of the sky if even the smallest issue arises?

There's no hiding that there are some common-rail engines out there - extremely popular ones - with some pretty serious issues. Sure, there's a long list of mechanical diesels that've had their share of dramas too, but experts are seeing an alarming number of modern common-rails fail, racking up some hefty repair bills along the way. Think about it - a set of big-ends on a 1HD-T 80 Series costs what, \$400? A set of dead injectors on a new common-rail can cost upwards of \$3000. Sure, they pull like a freight train, have an incredible towing ability and

return economy figures that'd leave any mechanic diesel for dead, but what good is any of that if it leaves you stranded in the middle of the Simmo?

So here's the question, is common-rail injection the devil it's made out to be, or can things be done to a common-rail 4WD to make them as reliable as any? People said coil springs were the end of 4WDs when they started replacing leaves. Everyone's always worried about new technology lasting, but this article's going to sort out, once and for all, whether it's fact or fiction.

This time we've teamed up with five of the country's leading diesel experts to help arm you with the cold - hard - facts. We've cut through the hype so you can see just how easy it is to safe guard your investment and save \$\$\$ in the process. So grab a tinny, go out to the shed and pull up a milk crate. If there's one thing that could save you serious coin this year - it's this right here! 

THE EXPERTS!

There are few more qualified in common-rail diesel repairs and upgrades than our panel of experts



ANDREW LEIMROTH
BERRIMA DIESEL

Andrew's the pinnacle of small-town 'service with a smile', and one of the most trustworthy blokes we know. Andrew boasts 65 years of combined industry experience he shares with his father, Reinhard Leimroth. The man behind DP Chip; Andrew specialises in all aspects of 4WD diesel fuel injection including injector servicing, fuel pumps, turbocharging, exhaust packages, dyno tuning, diagnostic testing and a whole heap more.



SCOTT WOOD
DENCO DIESEL

Scott's been in the diesel game longer than most. He's been with Denco Diesel for more than 30 years and specialises in all things common-rail. Denco have made a name for themselves as specialists in diesel fuel injection and turbocharger systems, and are credited as a premium service dealer for Denso, and a Bosch diesel centre.



Out with the old and in with the new. The bigger, louder and more reliable TD42 (right) is a distant memory nowadays, making way for the new breed of smaller, harder-revving common-rail ZD30s (left)



TONY MARTIN
MTQ ENGINE SYSTEMS

Tony's the Brand Manager at MTQ's Toowoomba service center, and he's also responsible for training their national team of technicians. That in itself is no easy feat, because MTQ is one of Australia's largest diesel fuel injection and turbocharger aftermarket sales and service providers, which means, if there's a problem with a diesel 4WD getting around or an upgrade worth doing, Tony knows about it. Tony's been dyno tuning diesel engines for 14 years now, and is largely behind the development of the Rapid performance module .



MATT BAILEY
BAILEYS DIESEL GROUP

Matt Bailey from Baileys Diesel Group has gone where few dare to tread, challenging industry heavyweights to help deliver you better competition and pricing. We're talking about a team that engineers and builds millions of dollars worth of specialist machinery just because it's going to get a better result (they've got 5 patented diesel test benches you just won't find anywhere else in the world). Matt and his team have pioneered common-rail injector blue-printing - which is similar to rebuilding - only they give it the Baileys upgrade and whack on a warranty that'll beat any OEM manufacturer. More on that later in the article.



DAVE COX
MT DARE HOTEL

Here's a bloke who needs no introduction. You all know him by now as the owner of the Mt Dare Hotel on the western side of the Simpson desert. But he's also one of the vehicle recovery operators for the surrounding desert areas, and so he sees firsthand what goes wrong with modern 4WDs in the outback. He's also a fuel retailer and he uses a new CRD LandCruiser as his recovery vehicle, so there are few more qualified to weigh in on the common-rail debate than Dave.



"MOST ENGINE FAILURES ARE ENTIRELY PREVENTABLE"



HOW COMMON-RAIL DIESELS WORK

To understand what goes wrong, you first need to know what makes them tick

- 120 years ago, Rudolf Diesel invented the first ever compression-ignition engine
- In 1995, Denso offered the first commercial common-rail diesel fuel injection system
- Bosch followed suit in 1997
- In the mid-2000s common-rail technology hit Australian shores, bringing with it a wave of powerful, efficient and quiet 'oilers'

COMMON-RAIL TECHNOLOGY

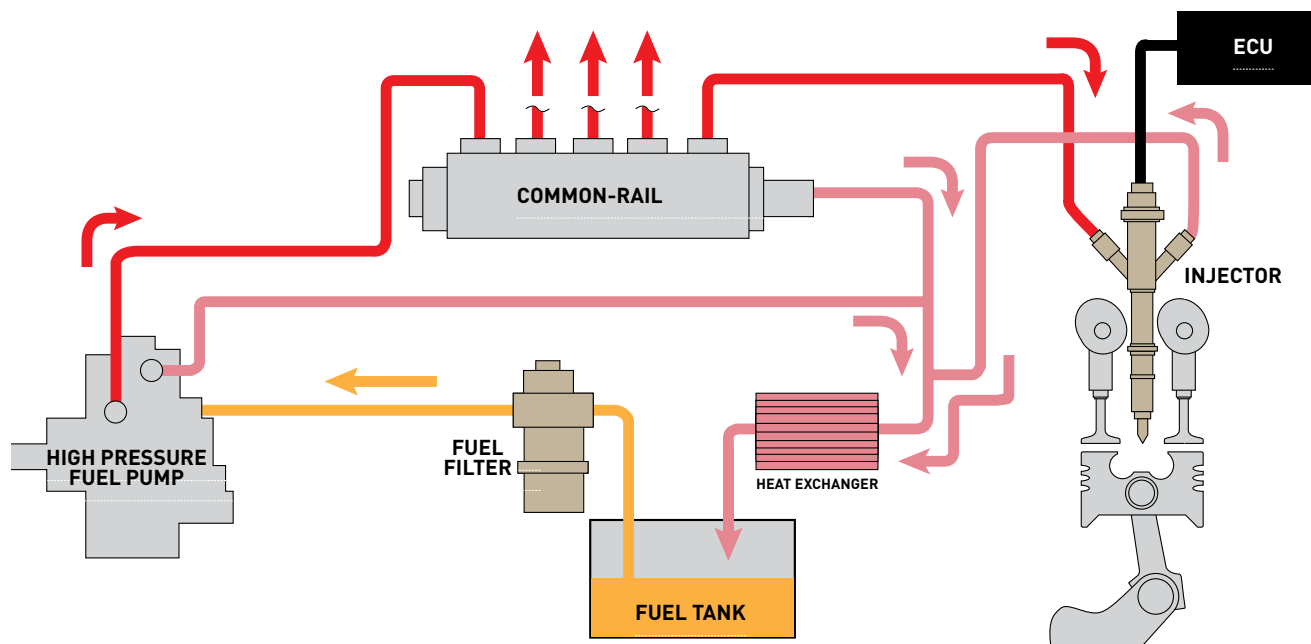
Common-Rail Diesel (CRD) engines themselves are essentially the same as any modern piston engine. Where common-rails differ is that the injector pump supplies fuel to one fuel rail common to all cylinders (hence the name common-rail), as opposed to generating pressure individually for each injector like older mechanically injected diesels. So in a sense, a CRD fuel system is more like to an EFI petrol engine than it is a traditional diesel.

The injector pump continually charges this 'common rail' with high pressure fuel. The injectors are connected to the fuel rail via high pressure lines, but instead of fuel pressure itself opening the injector like a mechanically injected diesel, the Engine Control Unit (ECU) controls when and how long the injector is opened by the use of an electronic solenoid inside the top of each injector. The ECU can also vary fuel pressure, timing and boost pressure, depending on the engine's load, via a handful of pressure sensors and regulating valves.

THE SECRET TO A POWERFUL & FUEL EFFICIENT ENGINE

The secret is a more efficient fuel burn that high fuel pressures allow. Higher pressure means more fuel can be injected in a shorter period of time, even at high RPM. High fuel pressures also mean better fuel atomisation with better and more precise fuel metering. These pressures can be as high as 40,000psi in a common-rail, where older mechanically injected diesels were running fuel pressures of only a few thousand PSI.

Running such high pressures also enables a CRD to utilise pulse injection, where the ECU injects multiple short bursts of fuel (most commonly 3-4 times per rotation, but can be as high as 5), rather than one single squirt of fuel like in older mechanical diesels. This injection methods means the fuel delivery is more precise, the burn is smoother, a lot more controlled and sustained over a larger portion of the pistons power stroke. It also helps to remove traditional diesel 'knock' - resulting in a very attractive engine package for consumers.



HOW CRD INJECTORS WORK

Inside a CRD injector is a spindle (or polished rod) that moves up and down a two-part chamber to control the flow of fuel. As fuel enters the injector, it makes its way into both chambers - the upper and the lower chamber. At this point, the pressures in both chambers remain equal.

The upper chamber is often referred to as the control plunger, which is connected to an electronic solenoid controlled by the ECU. As the ECU energises the solenoid, it pulls the control plunger upwards, releasing a small amount of fuel into the fuel return line, creating a pressure differential between the two chambers.

With higher fuel pressure now in the lower chamber, the spindle is pushed up off its seat and fuel is injected into the cylinder through precisely measured holes in the injector nozzle. The ECU actuates this sequence several times per injection cycle, so it all happens in a mere fraction of a second.

There's also a new generation of common-rail injectors starting to make their way into 4WDs, called piezo-electric injectors. This technology utilises a small piezo crystal, that when energised, expands, lifting the spindle off its seat and injecting fuel. Its key benefit is that it operates much faster than conventional solenoid injectors, allowing even more precise control, but the technology is so new, it's not known how it'll fair long-term.

Where a lot of issues stem from in any common-rail system is that the clearances inside the fuel system of a common-rail diesel are as small as 2 micron, or 0.002mm. That means it doesn't take much by way of fuel contamination for these parts to fail.



Here you can see the insides of a common-rail injector, when located in the cylinder head



Matt from Baileys Diesel Group was the first in the country to offer a reconditioned injector, cheaper than OEM, and with a longer warranty

WHY THE HIGH PRICE TAG?

MATT BAILEY – BAILEYS DIESEL GROUP

“Two things cause high repair costs - lack of competition in the market and a lack of knowledge by repairers. Competition in the market will come in time, because at the end of the day the technology is so new. And when it does, prices will start to drop.

The second biggest problem is lack of knowledge in the industry, or ill-equipped mechanics who just don't know what they're dealing with. Too many rely on fault codes to narrow down on a problem and simple 'repair by replacement' which ends up costing you more.

Before we invested millions of dollars in specialist equipment, no one in the country was rebuilding common-rail injectors. They said it couldn't be done. But we knew injector rebuilding was 'the done thing' in Europe, and in the two years since our injector reconditioning project began, we've successfully rebuilt every 4WD common-rail diesel injector in Australia to a higher spec than factory. We offer a longer warranty than OEM type of replacement parts.

In the last 12 months alone we have rebuilt over 10,000 injectors. We also do this at a fraction of the price of an OEM part - for instance, we're able to offer blueprinted D-4D HiLux injectors for \$325 with a 3 year warranty.”

ARE THEY REALLY AS 'HIGHLY STRUNG' AS THEY'RE MADE OUT TO BE?

SCOTT WOOD – DENCO DIESEL

“With improvements in metal composition and engine design, we see no issues with CRD longevity, but it must be understood that engines are being designed to last for a given period. As engines wear, emissions are affected and a common-rail fuel system can compensate to a degree for certain conditions.

CRD engines are running up to 30psi of turbo boost pressure, but most 4WD applications are operating between 12-20psi. The engines are designed with this in mind and have relatively no issues unless modifications are performed that effect boost pressure outside of the engine's capacity. For instance, increasing boost can cause the turbocharger to go into an over-speed situation and result in failure due to the physical forces applied to the compressor and turbine wheels.”

WHAT ARE THEIR DOWNSIDES?

TONY MARTIN – MTQ ENGINE SYSTEMS

“Common-rail diesels have many sensors which can fail and are more expensive to repair. The systems that operate the vehicle are very complex, and difficult to diagnose and repair if you're in the middle of nowhere. It is not so much the engine that is complex, it's all of the extra componentry that is required to make the vehicles comply with emissions regulations. Common-rail fuel systems also require very clean fuel of a very high quality for the system to last.”

COMMON-RAIL INJECTION SYSTEMS COMPARED

Are all common-rail fuel systems created equal?



WHAT DIFFERS BETWEEN THE BRANDS?

SCOTT WOOD - DENCO DIESEL

"Most common-rail systems operate on similar principles and not a lot varies. Some Bosch systems have a cylinder cut out on the pump that stops one cylinder pumping and regulates the pressure via this control as well as a pressure regulating valve on the rail assembly. Others just have a pressure regulating valve.

Most late systems now regulate the pump as well as the rail to ensure that pressure is accurately regulated and has protection from over-pressurisation in-case one system fails. The injectors are individually controlled by the ECU and can perform multiple pre, post and main injections depending on load and engine conditions. Fuelling can be changed between cylinders to aid with smoother running, noise reduction or a power imbalance."

DENSO VS BOSCH INJECTION - THE TWO BIG PLAYERS

ANDREW LEIMROTH - BERRIMA DIESEL

"Bosch began the legacy of diesel injection. Denso introduced common-rail injection. These days, both are virtually the same and are following the same principles.

Bosch systems don't seem to have as many issues, at least at the moment, as the Denso common-rails. But it is truly hard to say whether one is better than the other because the technology is so new. Give it another ten years and we'll know for sure.

If replacement parts for either brand need to be sourced, owners are often forced to buy genuine, as each manufacturer makes specific systems for the engine it is used in, and so far there is little aftermarket support so you're forced to go back to the same manufacturer if there is a fault."



WHICH SYSTEM THEY USE

TOYOTA LANDCRUISER 1VD-FTV (4.5L)	DENSO
TOYOTA HILUX 1KD-FTV (3.0L)	DENSO
NISSAN PATROL ZD30 (3.0L)	BOSCH
NISSAN NAVARA YD25 (2.5L)	DENSO
NISSAN NAVARA 550 ST-X (3.0L V6)	BOSCH
MITSUBISHI TRITON (2.5L)	DENSO
MITSUBISHI PAJERO (3.2L)	DENSO
LAND ROVER DEFENDER TD4 (2.4L)	DENSO
LAND ROVER DISCOVERY TD5 (2.5L)	DELPHI
JEEP WRANGLER (2.8L)	BOSCH
JEEP CHEROKEE (3.0L)	BOSCH
FORD RANGER (3.2L)	SIEMENS
VW AMAROK (2.0L)	BOSCH
ISUZU D-MAX (3.0L)	BOSCH
HOLDEN COLORADO (2.8L)	BOSCH

*Some engine variants may vary depending on year of manufacturer

TOUGHEST COMMON-RAIL MOTORS OUT THERE

ANDREW LEIMROTH - BERRIMA DIESEL

"Hard to nut it down as they all have a variety of issues."

4.5L V8 TOYOTA LANDCRUISER

"The Toyota V8 CRD is very under stressed so it's probably the TD42 of the CRD engines."

2.5L NISSAN NAVARA/PATHFINDER

"We have one that's travelled 200,000km across this country. Serviced regularly with no issues."

2.5L MITSUBISHI TRITON

"One of the older CRD engines and is trouble free from our end."

3.2L MITSUBISHI PAJERO

"Another older CRD engine we see little to no issues... Don't buy the model with diesel particulate filter, though!"

3.0L ISUZU D-MAX

"Isuzu....truck proven."

TONY MARTIN - MTQ ENGINE SYSTEMS

"Most common-rails will respond to upgrades. It is not unreasonable to expect gains of 20% or more by fitting a chip and exhaust package."

3.0L MAZDA/FORD RANGER

"Responds well to a chip. Made the highest HP as tested by 4WD Action with a Rapid module."

3.0L ISUZU D-MAX

"Responds well to performance module and exhaust. Hardly ever see these in the workshop."

2.5L MITSUBISHI TRITON

"Has issues with carbon build up in the intake manifold so I recommend regular use of intake manifold cleaners that are suitable for diesel engines. But otherwise a solid performer."

3.0L D-4D HILUX

"Injectors aside, they are a tough motor. The best thing about the Toyota is when the vehicle has a fault it, in most cases, will not shut down the vehicle completely - it goes into a reduced power mode but it will still run."

What are the toughest common-rail motors out there? The ones that rarely break down, respond best to modifications and are rather forgiving...

MATT BAILEY - BAILEYS DIESEL GROUP

"Anything with a Bosch fuel system seems not to suffer the same reliability issues as others."

3.0L 4JJ1 ISUZU D-MAX/COLORADO

"We don't see many of these at all. We only ever see these if the fuel has been contaminated, which is a problem that can affect any vehicle."

4.5L 1VD-FTV TOYOTA LANDCRUISER

"These engines are a lot less stressed than the D-4D 1KD (HiLux) engine. They run lower fuel rail pressures, the engine RPM are lower and the average injector life is roughly 250,000km, as opposed to 175,000km for the 1KD."



MOST PROBLEMATIC ENGINES

What engines are undergoing repairs most often, and why?

Now look, we've got to take a second here to point out that every engine, at some point, experiences dramas. Search the word 'recall' online and you'll see manufacturer experiences issues. So when it comes to this

sort of thing, knowledge is king. And as a 4WD Action reader, we're giving you the knowledge of what goes wrong so you know what to look for, how to fix it, and how not to get ripped off in the process.

THE POTENTIAL FOR ENGINE FAILURE IS HUGE!

MATT BAILEY - BAILEYS DIESEL GROUP

"The potential for small problems to turn into something more costly is huge in any common-rail. The problem we face with common-rails is there's a real risk, in certain situations, of your engine being flooded with fuel which can lead to cracking pistons.

The same thing couldn't happen in a mechanical fuel injection system. The worst it could do was squirt in the small amount of fuel pressurised in that one injector line. Common-rails are constantly pressurised when-ever the engine is running, so all it takes is minor scoring or a few foreign particles to find their way into the injector before it begins to stick, flooding the cylinder with more fuel than it needs, causing it to run hot."

THE ENGINES WE FIX MOST...

ANDREW LEIMROTH - BERRIMA DIESEL

3.0L ZD30 NISSAN PATROL

"The motors themselves seem quite durable these days, but it's still experiencing ancillary issues (leaking manifold gaskets). It would appear to be a good choice as long as you don't intend towing heavy loads meaning the engine will be under full power all the time."

3.0L D-4D TOYOTA 1KD-FTV PRADO/HILUX

"With the number of injector issues that owners are experiencing with this motor, it's starting to make the ZD30 Patrol seem reliable. We had 150 emails within a few days from owners with problems after we ran a recent Facebook awareness post about the ongoing issues. Coincidentally a few months later Toyota 'quietly' recalled them, so we hear."

WHAT EXACTLY GOES WRONG WITH THEM, AND WHY?

What's causing three of the most common CRD failures around?

3.0L NISSAN PATROL ZD30

The ZD30 has a reputation for cracking pistons. Unfortunately, there is not just one cause, it's a combination of lubrication issues, sudden turbo and cylinder pressure fluctuations caused by either a boost leak, a faulty MAF or boost sensor, and even a build-up of carbon on the inlet valve stem and port areas. It's a recipe for disaster in anyone's book.

Tell-tale signs of engine failure are coolant blowing out of the radiator cores or expansion tank, poor idling, lack of power and large chugging plumes of white smoke from the exhaust.

The trick to preventing the problem is to use low-ash engine oil, ensure the air filter is kept clean, ensure the air flow meter, boost sensor and intercooler are working correctly and not leaking or contaminated. Fit an oil catch can to prevent oil vapours contaminating the air flow meter. Also remove and clean the EGR circuit regularly - it's known to contribute to the problems.

3.0L TOYOTA HILUX/PRADO D-4D 1KD-FTV

Cold knocking can be a problem with this motor, which is caused by the injector spindle sticking open when cold. This can lead to that cylinder being over fuelled which makes it run hot, and if left unchecked, will ultimately crack a piston.

There's also been a run of leaking injector seals on this motor. These seals separate the combustion gases from the oil, and if they leak, can lead to excessive carbon (soot) contamination in the oil, which owners may not even notice. It may blow smoke on start up under certain conditions, e.g. if you park over night with the nose down. But other than that it can be hard to pick. Replacing the seals is the only fix, but regular 5,000km servicing will also go a long way to preventing engine damage.

4.5L 1VD-FTV TOYOTA LANDCRUISER

There are largely exaggerated stories that the 1VD-FTV has an oil usage problem. Simple truth is, it's not uncommon for any engine to use oil for up to the first 30,000km or so - it's not a 'fault' - it just takes time for components like seals and piston rings to bed in completely. It can be made worse in the Toyota V8 for two reasons.

The 1VD-FTV requires very specific C3 grade 5W-30 fully synthetic engine oil, and if you deviate from this grade of oil the engine will start to use oil. They also get pushed harder than other engines by their owners. As an agricultural vehicle, they're often tasked with towing heavy loads or lugging tray loads of gear, so a little blow-by is to be expected until everything has settled.



This is the D-4D injector seal everyone is talking about. When this lets go, carbon makes its way into the oil and can, over time, block the oil pickup



Notice the carbon build up on these D-4D injectors, it's a result of a failed injector seal, that separates combustion gases (carbon) from the engine oil





MATT BAILEY - BAILEYS DIESEL GROUP

2.5L YD25 NISSAN NAVARA

"EGR valves literally fall apart on these motors. You'd swear the engine had failed because it starts bellowing white smoke, but really all that's happening is the exhaust gas is being pumped straight into the intake, suffocating the combustion.

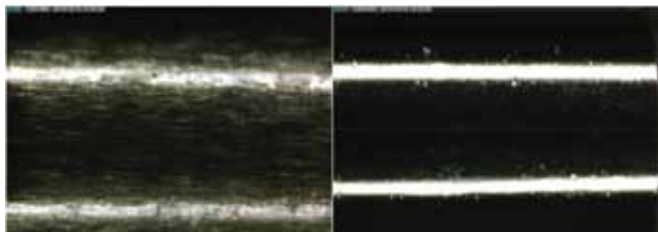
The suction control valve in the fuel pumps can be temperamental. Even when changing the fuel filter you often need to go in and reset the system.

D40s specifically are highly sprung from the factory, so you often don't see massive gains out of tuning these engines. A/F ratios and boost pressures are already quite high, so the only way to get a significantly power increase is to replace the turbo."

4.5L 1VD-FTV TOYOTA LANDCRUISER

"It's not worryingly common, but we have seen a number of fuel tanks rusting out, even with no evidence of water contamination. It's very unusual. This then goes through to the fuel system and causes damage."

Photo Credit: Baileys Diesel Group



This is an injector spindle under a microscope. On the left you can see scoring of the injector spindle, the right is what a new one looks like. When it gets bad enough, it sticks open, causing the dreaded 'injector knock'.

TONY MARTIN - MTQ ENGINE SYSTEMS

"All modern common-rail 4WDs have their own special problems. Some can be overcome and rectified easily, some are more difficult."

ZD30 3.0L COMMON-RAIL PATROLS

"We see plenty of turbocharger failures and plenty of manifold gasket leaks due to warped manifolds. This engine also has some injector problems and fuel rail pressure release valve issues, mass air flow sensor problems and EGR faults."

D-4D HILUX/PRADO

"Well-known injector problems here. The HiLux has also been known to have some issues with the electronic motor on the turbo which controls the VNT and the LandCruiser has some issue with injectors and turbochargers as well."

3.2L FORD RANGER/MAZDA BT50

"These are still a very new system and being a Peizo injection system, they are very sensitive. Fitting aftermarket accessories can cause you grief due to voltage changes. In this engine, the injectors are separated from the oiling system. If they burn out the seal they blow soot up the body of the injector and not into the engine oil."

THE MOST COMMON CAUSE OF FUEL CONTAMINATION IS NOT A SERVO

DAVE COX - MT DARE HOTEL

"I've had a few CRDs but never had any trouble with them. I've also been accused of selling contaminated diesel that has resulted in damage to a CRD injection system. This is very difficult to prove and was unlikely to have been the case. With the amount of vehicles that we refuel, including ours, a contamination would not be restricted to just one incident, there would be more.

The source of contamination is mostly perceived to be the fuel retailer, when in fact it's probably due to a careless owner. Jerry cans are the most common source of fuel contamination, with steel ones at the top of that list. Check them thoroughly and clean them if required prior to use, there may be rust, algae, or dirt in them.

The fuel filler is the next culprit, especially on a ute. Try to clean as much dirt away prior to removing the cap.

As for CRD reliability. I rarely keep a 4WD for longer than 4 years or 100,000km. Reliability is paramount and I can't afford to break down, after all, who rescues a rescuer?"

WHAT'S THE BIGGEST KILLER OF ANY COMMON-RAIL DIESEL?

MATT BAILEY - BAILEYS DIESEL GROUP

"It's simple, fuel contamination and poor servicing. Because the tolerances in a common-rail fuel system are extremely tight, any contamination is going to cause damage. Once scoring occurs in the pump or injectors, it's too late - the damage is done. And preventing it is often as simple as installing a quality secondary filter and only filling up at a reputable service station.

Too often early warning signs are missed because inexperienced repairers don't know what they're looking at, so the engine is being driven into the ground while the owner is completely unaware. Once the engine light comes on - the damage has already been done. Common-rails are not like previous diesels. You can't have the 'she'll be right' mentality. Get yours checked and keep it maintained, and it'll last forever."



That ain't mud in the fuel - it's algae!



SERVICING YOUR COMMON-RAIL

Is it really that dangerous to work on your own common-rail, or is it nothing more than a scare tactic? And how much of it can you work on without diagnostic computers?

CAN YOU WORK ON A CRD YOURSELF?

ANDREW LEIMROTH - BERRIMA DIESEL

"Generally there is nothing to touch other than normal service items like filters so it's not a problem. In the early days of CRD release there was a lot of talk about the safety around the fuel injection parts due to dangerously high pressure. Basically this faded away as people realised that any fuel pressure areas touched had pressure but very little volume."

WHAT ABOUT DIESELS THAT CLAIM 15,000KM INTERVALS? SHOULD I SERVICE MINE EVERY 5,000KM?

"Manufacturers aren't interested in hearing their engine lasted 300,000km+, but you are. I recommend a flexible mindset to oil changes and service work. Do short runs over 6 months and change the oil every 5,000km. If you do quick mileage with little stress on the vehicle in 6 months, then you can stretch it anything up to 10,000km. Don't forget - you change oil because it's saturated with carbon deposits (among other things). The fact that CRD engines may run cleaner is one reason for the extended oil change idea. But like we're seeing with the HiLux D-4D engines, regular oil changes will almost certainly prolong the life of any engine."

ARE HIGH-PRESSURE FUEL LINES DESTROYING YOUR INJECTORS?

MATT BAILEY - BAILEYS DIESEL GROUP

"Our testing is starting to show that these lines are starting to erode from fuel cavitation at around 100,000-120,000km. What metal breaks off the inside of these lines has one place to go, and that's through the injector. So, like needing better filtration, it's obviously ideal that this is avoided as much as possible, and replaced before they become a problem (like replacing your timing belt). They're not as expensive as many people think, too."



SERVICING COMMON-RAILS WITH A DIESEL PARTICULATE FILTER

TONY MARTIN - MTQ ENGINE SYSTEMS

"Some engines require special oil (which costs more) because of engine emissions systems like the diesel particulate filters. If you use the wrong oil you can cause the filter to block up and fail prematurely. As modern diesels are a little more complex than the old push-rod engine, using the correct oil is more important to adequately lubricate bearing surfaces and to avoid engine failures."

HOW COME REPAIRS COST SO MUCH?

SCOTT WOOD - DENCO DIESEL

"Repair costs are relative to older systems with the exception of contamination. Contamination in a common-rail often damages all of the components it comes in contact with, and all of these parts must be replaced to prevent further failures. If injectors fail as the result of contamination there is no point replacing just these units as they are at the end of the line and will be re-contaminated with the particles that are still present within the pump, rail and lines."

If any repairs are required, it's essential it's carried out in a purpose built clean room, filtered to 0.5 micron, to ensure that the product will not fail. Testing of these components requires specialist equipment with protective cages over the benches to protect the operator as pressure equal to what is provided on the vehicle, up to 2200 bar, needs to be generated to check the operation of the component against the manufactures specification. Unfortunately this sort of stuff doesn't come cheap."



REPAIR COSTS COMPARED

Keep in mind that prices vary greatly depending on what parts are being used (rebuilt or new), labour rates and extent of damage.

Here's what you can expect;

	NISSAN 3.0L ZD30 CRD	NISSAN 2.5L YD25	TOYOTA 3.0L 1KD D-4D	TOYOTA 4.5L 1VD-FTV	MITSUBISHI 2.5L CRD
COST OF INJECTORS	\$2,500	\$3,000	\$3,000	\$6,500	\$3,000
COST OF A PUMP REBUILD	\$4,000	\$3,300	\$2,800	\$3,000	\$2,800
COST OF AN ENGINE REBUILD	\$10,000 - \$12,000	\$10,000 +	\$10,000 +	\$15,000 - \$20,000	\$8,000 +

CHIPS vs. FLASH TUNING

The secret to unlocking more power, or a first-class ticket to an engine rebuild?

Common-rail turbo diesels incorporate a dedicated Electronic Control Unit (ECU) as the brain-box behind the fuel system. Various sensors monitor engine parameters like fuel rail pressure, engine RPM, load, exhaust temps, boost pressure and air temperature, and convey these messages to the engine's ECU. The ECU processes them in combination with a pre-programmed fuel map, which enables the ECU to

determine the correct amount and time to inject the fuel, depending on what else is happening.

Both performance chips and flash tuning work to achieve the same result, in that; they both enable you to make changes to fuel timing, injector duration and rail pressure in order to increase the engine's performance.



↓ WHY AREN'T THEY LIKE THAT STOCK?

Most manufacturers err on the side of caution and tune their engines conservatively to allow for variations in fuel quality and to ensure the reliability of the engine and ancillaries like the turbo and injection system.

Some also opt for a safer tune so they're able to extend their service intervals. The more power an engine can make lazily the better, because then the manufacturer can extend service intervals and draw you in by advertising lower maintenance costs.

↓ WHAT IS ECU FLASHING?

Flash tuning enables tuners to re-write parts of ECU which control the fuelling, timing, boost pressures and safety features. Not all ECU flashing is done by plugging into the OBD port. Some vehicles require the tuner to open the ECU to connect to the pins that enable the ECU to be re-written. These changes often override the manufacturer's settings, meaning, you cannot revert back to factory settings if you sell the vehicle or something goes wrong. It's all for nothing if there is a software update issued by the manufacturer that is, unbeknownst to you, uploaded to your ECU during a routine service. Instantly, you've lost your tune. And the only way to get it back is to take it back to the tuner to get the performance tune loaded in again - obviously at your expense.



↓ HOW PERFORMANCE CHIPS WORK

Chips are an external module that interrupts or varies signals going to or from the ECU in order to get the engine to perform in a way the tuner wants. Chips do not change the manufacturer's original fuel map and most do not vary or override the ECU's safety parameters, but they can change the inputs or outputs to and from the ECU.

Unlike flash tuning, if you sell your vehicle, you can remove most diesel chips and sell it, or take it with you and fit it to another compatible vehicle.



DOES ECU FLASHING/PERFORMANCE CHIPS AFFECT MY WARRANTY?

TONY MARTIN - MTQ ENGINE SYSTEMS

"All chips can affect your new vehicle warranty. It often depends on the dealer and how they view the addition of a module or a re-flash. The advantage of a plug in performance 'chip' is that you can remove it and it does not leave a trace. The dealers can see when an ECU has been flashed."

HOW PERFORMANCE GAINS ARE ACHIEVED

ANDREW LEIMROTH - BERRIMA DIESEL

"A diesel performance chip allows you to tune an engine to widen its available torque range in one of two ways; by increase fuel rail pressure or extending the injection duration. By delivering more torque down low, your 4WD gets up and moving quicker, and you're able to get off the accelerator earlier to save fuel. Fuel economy comes from the driver, not the chip, because at the end of the day it comes back to your right foot; where your foot is, is where the fuel is."



Some chips come with a plug in loom, which can also be removed if you sell the vehicle. An ECU flash can be overwritten by the manufacturer and can't be transferred to another vehicle

DANGERS OF CHIPPING YOUR COMMON-RAIL

MATT BAILEY - BAILEYS DIESEL GROUP

"Thinking about it logically, higher power output and better fuel economy (as most chips claim) is the holy grail for all vehicle manufacturers. If it was possible to do this and meet the reliability and emission constraints, they would have done this from factory.

With chips that increase rail pressure, firstly you cause the injector to wear out faster. The injector nozzle also suffers long-term. The increase in fuel pressure changes the atomisation of the fuel as it's injected into the cylinder, and the mixture may ignite too early or too close to the injector, resulting in the nozzle becoming super-heated. At high RPM it's not so much of a problem as the heat doesn't hang around, but at lower RPM the heat soaks into the injector nozzle, accelerating wear. In extreme cases the nozzle can absorb carbon and shatter if the temperatures get hot enough.

Chips that increase injector duration might make power, but they aren't as efficient in doing so, because a long injector duration means fuel is often still being injected while the piston is starting to move down the cylinder.

Chips are a highly personal choice, some people want more power regardless (I have a chip for example). But I'm also aware that it will have an impact on fuel system (and sometimes turbo) life, but it's an educated choice I make."

Photo Credit: Baileys Diesel Group



This is one of the precisely machined holes in the injector nozzle under the microscope. The left is excessively worn, the right is new

SHOULD I ALWAYS PAIR A CHIP FLASH WITH AN EXHAUST UPGRADE?

TONY MARTIN - MTQ ENGINE SYSTEMS

"This depends on the vehicle. Some vehicles respond well to the addition of an exhaust, but others see very little gain. You have to be careful of the size of the exhaust and that it has all of the parts that are needed to keep your 4WD legal, i.e.; cat converters and diesel particulate filters.

WILL COMMON-RAIL ENGINES LAST?

How will common-rail engines fare in 30 years time? And what can you do to make yours last?

WILL THEY SEE 30 YEARS?

ANDREW LEIMROTH - BERRIMA DIESEL

"The engine may but will the rest of the stuff running it? With good maintenance it should."

MATT BAILEY - BAILEYS DIESEL SERVICES

"Yes, with maintenance."

SCOTT WOOD - DENCO DIESEL

"With quality fuel the systems are reliable. We've seen them last to 500,000km without incident."

TONY MARTIN - MTQ ENGINE SYSTEMS

"This will depend on the vehicle and how it is maintained. My concern is the electronics lasting and parts availability for people to keep them maintained and on the road."

DAVE COX - MT DARE HOTEL

"I think that machining accuracy and tolerances in modern engines has helped to make them last mechanically. Electronically is another issue and to have electronics last 30 years may be a tall ask. If one of these items fail then that could mean the end of your engine, as a repair may cost more than its worth."

HOW TO EXTEND THE LIFE OF A COMMON-RAIL MOTOR

SCOTT WOOD - DENCO DIESEL

"Water ingress is the main cause of failure in all common-rail systems. Simple things can be done to prevent these failures like using only genuine filters, and regularly inspecting the fuel system to ensure water is not present."

As most common-rail pumps control pressure by regulating the fuel entering the pumping plungers, we recommend that devices that cause additional restriction, such as extra filters, not be fitted. A water trap with an internal diffuser can be fitted to most vehicles which are designed to catch water with minimal restriction. Some of these are available with sensors to alert the driver that water is present. With quality fuel the systems are reliable. We have seen some vehicles exceed 500,000km without incident."

DON'T HEAD OFF-ROAD WITHOUT...

ANDREW LEIMROTH - BERRIMA DIESEL

"It's almost essential these days to carry a diagnostic tool that allows you to reset fault codes if a problem arises while you're off-road. Often, the computer will put the engine into a 'fail safe' mode if a fault occurs regardless of the severity, and it could simply shut the engine down. It's the engine's way of protecting itself, the problem is, it can leave you stranded. A diagnostic tool like the EDS allows you to monitor exactly what the engine is doing in real time, and also allows you to read and reset fault codes."

THIS GREAT DEVICE CAN SAVE YOU THOUSANDS



HOW TO MAKE YOUR INJECTORS LAST

MATT BAILEY - BAILEYS DIESEL GROUP

"I think that the best thing is to get better filtration. We strongly recommend 2 micron secondary filter systems as they have better filtration (less foreign particles through the injectors means a longer life) and additional water trap capabilities."

The container Matt is holding is full of injector spindles that have worn. Each one represents a failed or sticky injector, and that's just one very small batch!



No prizes for guessing what these are... One heavily blocked fuel filter, and one fresh one ready to go in. Replacing your fuel filter regularly is the only way to make your CRD last!



Two things will prolong the life of your engine; regular servicing and good quality fuel



PROTECTING YOUR INVESTMENT

There's no doubt about it, small capacity engines are the way of the future, and experts agree, that with the right care and maintenance these engines will last as long as any larger-capacity mechanical diesel. They are predicting, however, that parts like your turbo and fuel injectors should be considered 'serviceable items', much like your clutch or timing belt, and it should be expected to repair or replace these parts at given intervals for the overall good of your engine.

When it comes to power up modifications, go with a reputable brand and tuner, and err on the side of caution when it comes to extracting more power if you want it to last well in to the future.

Routine servicing every 5,000km using quality parts and the use of clean fuel from a reputable supplier will extend the life of any common-rail engine. Water separators offer additional protection and should be considered, too, but it pays to consult a diesel expert when selecting the correct filtration for your vehicle, as some of these fuel systems can be quite temperamental to restrictions in the fuel line.

HOW TO MAKE YOUR CRD GO THE DISTANCE

- Carry out routine engine oil and filter changes every 5,000km.
- Replace the fuel filter every 15,000km.
- Install an OBD-II engine monitor to keep tabs on the health of your engine.
- Have your CRD inspected by a reputable diesel specialist once a year.
- When choosing a power-up mod, only use proven brands and have them installed and tuned by an experienced diesel workshop.

Like anything, if you look after it, it'll look after you.



SAFETY FIRST!

A trick used on older diesels is cracking the pressure through the injector line to get rid of any air locks. Thanks to the extreme pressure build up in the rail and injector in a CRD engine, this is fraught with danger on modern engines. Before commencing any work, fuel pressure should be relieved through the dedicated bleed off system. Failure to do this may result in serious injury.

HOW TO PREVENT YOUR COMMON-RAIL FROM FAILING

STEPHEN COUGHLAN - TOYOTA AUSTRALIA

"Regardless of the brand, common-rail diesel engines utilise precise technology and require diligent maintenance (in-line with the timeframe and mileage stipulated by the manufacturer) as well as good quality diesel fuel to ensure optimal performance and longevity."



CONTACTS

BAILEYS DIESEL GROUP

PH: 1800 INJECTORS (1800 465 328)

W: www.baileysdiesel.com

BERRIMA DIESEL

PH: (02) 4877 1256

W: www.berrimadiesel.com

DENCO DIESEL

PH: 1300 305 359

W: www.dencodiesel.com

MTQ ENGINE SYSTEMS

PH: 07 4592 5999

W: www.mtqes.com.au

TOYOTA AUSTRALIA

W: www.toyota.com.au

