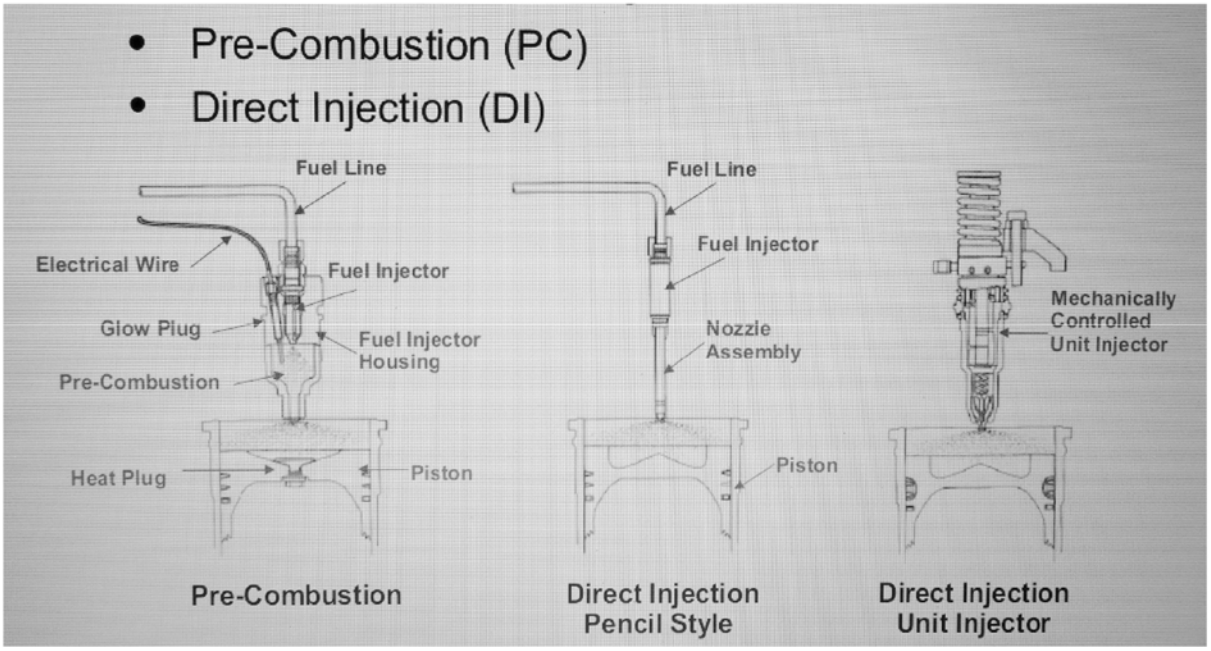
KMP BRAND TECHNICAL BULLETIN

Injector Failures

KB-15006

INJECTROR FAILURES

This bulletin will illustrate the types of damage that occur when injectors are subjected to adverse operating conditions.
Whilst there are many different types of fuel injectors, some more sophisticated than others, they all perform the same operation, which is to atomise the fuel in a manner that efficient combustion is achieved.



Whilst the older generation injectors are more forgiving when it comes to contaminated fuel passing through them, they are still prone to failure as evidenced in the following examples.

These injectors were returned because they were no longer atomising the fuel correctly.

Contamination found inside the injector

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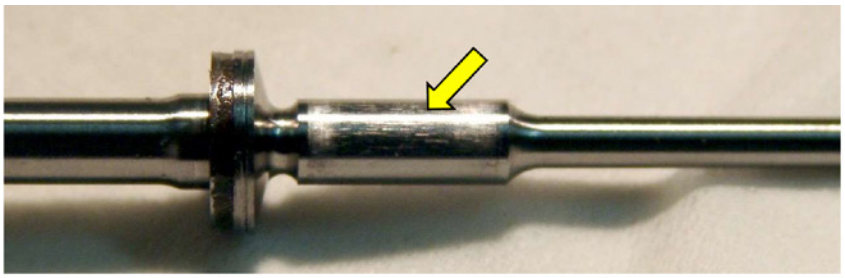
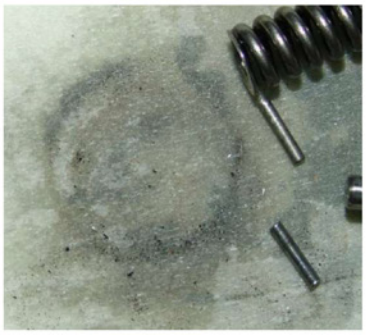


The resultant damage to the needle

The scoring on the needle results in the bypass of pressure which is necessary for the successful atomisation of the fuel.



Same problem on a different injector – contamination is the biggest contributor to injector failures.

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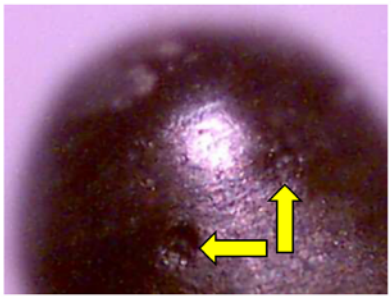
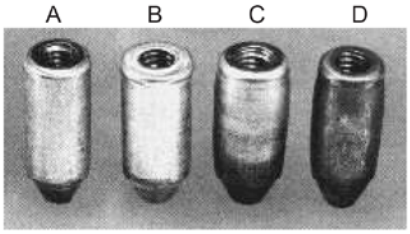
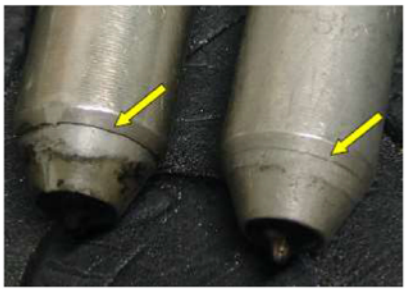


The injector orifices were completely blocked and as a result the pressure build-up inside the injector was sufficient to cause breakage at the grooved section where the carbon dam was located.

These capsule nozzles had been severely overheated which had resulted in the melted plating (bubbled). The damage also resulted in internal damage rendering the nozzles unsuitable for further use.



The above illustrations show the resultant damage when the nozzle installation is incorrect.
A – new nozzle correctly installed.
B – distortion at the top of the metal case because too much torque was applied to the adaptor nut.
C – casing bulged in the middle because of insufficient torque on the adaptor nut which means the internal components are not sealed and this allows fuel to leak past the components causing a buildup of pressure which causes the casing to bulge. Contamination can cause a similar failure because the dirt will also prevent the components from sealing.
D – an overheated engine can also result in damaged nozzles, if a nozzle becomes too hot it may have a "blued" or darkened case and could possibly be bulged.



Metal casing damaged due to overtightening

Incorrectly tightened nozzle which allowed the high pressure fuel injection pulses to crack the casing.

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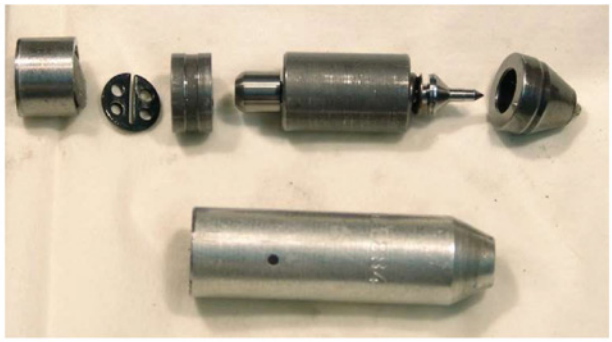
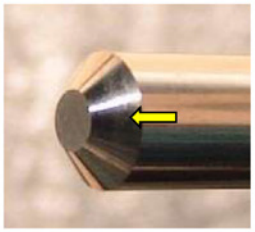
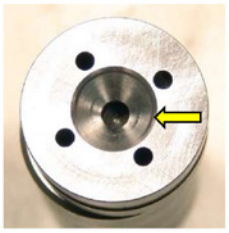
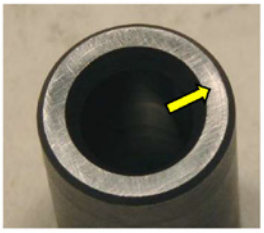


Satisfactory operation of an injector nozzle is dependent on the successful sealing of all mating surfaces; this allows the fuel pressure to build up ready for the next injection cycle.
The presence of any form of contamination would damage the mating faces of the internal components and result in a malfunction of the nozzle, as was the case with this nozzle that was stripped to indicate the resultant damage.







The following injector had the appearance of a "seized injector" because the follower spring was slightly compressed and the rack would not move.

Although there was evidence of contamination the wear pattern on the plunger indicated that the failure had occurred because of a lack of lubrication.

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Compare the wear pattern with the plunger illustrated in the photographs below.

The plunger shown above was removed from an injector because the customer complained that the rack was not moving freely, this normally indicates that there has been fuel contamination (or the rack is bent). Note the location of the two different areas of galling.

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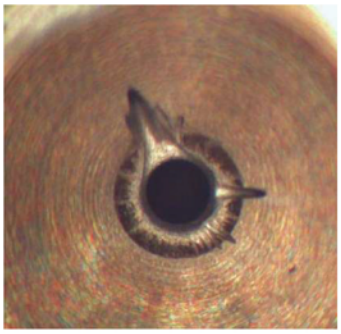
CONDITION:
Galling at lower end.

CAUSE:
Contaminated fuel.

RECOMMENDATION:
DO NOT REUSE
Determine source of fuel contamination.
Review fuel filter maintenance schedule and fuel handling procedures.

Although there are now a number of different fuel systems, MUI, MEUI and HEUI which have been developed as a result of technological advancements, they are now even more susceptible to failures because of the increased operating pressures, and the tighter tolerances with reduce running clearances. Failures can result from a number of possibilities.

- Diesel fuel contamination
- Poor fuel filtration
- Water in the fuel system
- Debris in the fuel system
- Improper installation of injector(s)



This is what a washed-out common-rail injector ball seat looks like. Without a flush surface to seal against, the injector will not shut off, and piston damage is usually the result. Aggressive tuning and debris in the fuel is usually the culprit.

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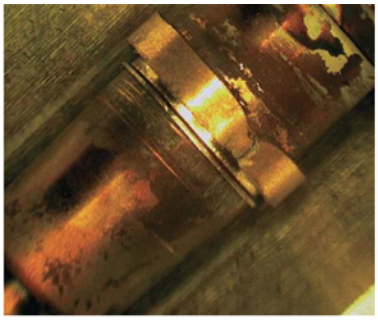

This illustration shows a blown high-pressure seal found inside a common-rail injector.
Possible causes of this could be any of the following, debris or rust in the injector which plugs the nozzle, armature and/or nozzle needle stuck or the loss compression in the cylinder alternatively a mechanical problem.

Failure of the injector resulted from the debris and rust found inside the fuel system. Deposits on the internal components such as the injector needle and pilot valve often look similar to coking deposits in appearance, and these are very prone to appear in the newer engines with the precision injection systems.

Generally a diagnosis as to what is wrong with a diesel engine can be identified by the colour of the smoke coming from the exhaust pipe.
There are three basic colours - "Black," "White" and "Blue".

Black Smoke – this is the most common one and is really just an imbalance in the air to fuel ratio – too much fuel and not enough air. This means either too much fuel is being added to the mix or there is not enough oxygen being supplied to burn the fuel. The black smoke is full of particulates that are basically large diesel particles that would normally be burnt as fuel.
The most common causes of black smoke are faulty injectors, a faulty fuel injector pump, a clogged air filter, a defective EGR valve, or even a faulty turbocharger.

White Smoke – this means that the fuel that is being injected into the combustion chamber is not being burnt properly.
The common causes of white smoke can be as simple as low engine compression, water in the fuel or the fuel pump timing being incorrect because something is starving the fuel supply to the pump causing the pump timing to work incorrectly.

Blue Smoke – blue smoke results from burning engine oil, this is a mechanical problem because the oil is not supposed to be entering the area where it can be burnt.
There could be a faulty injector pump or lift pump which is allowing the oil to mix with the fuel and be burnt, the valves or valve stem seals could be bad, worn liners and/or piston rings allowing the bypass of oil, or it could simply be that too much oil has been put into the engine.

When fuel system components are replaced because of failure or reduced service life, it is extremely important to analyse what caused the failure of the part which is being replaced.

When the repairs are being undertaken you should always replace fuel and air filters as well as checking the quality of the fuel which is being delivered into the system.

Fuel systems which exhibit signs of fuel contamination will require a thorough inspection, and if need be, the replacement of components which may still contain contamination.
Failure to troubleshoot can lead to the subsequent failure of newly installed injectors.

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