MaK Parts Comparison Bulletin

Genuine MaK Parts

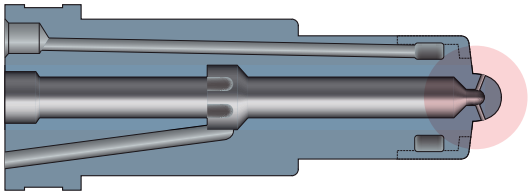
Fuel Systems: The Hidden Value of Genuine MaK Components

Introduction

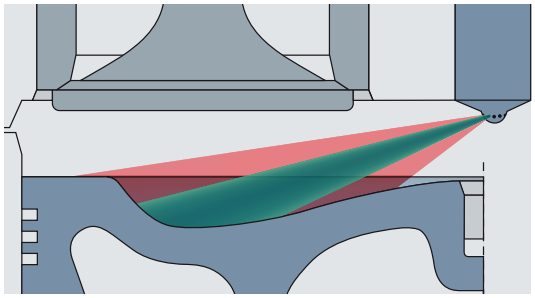
As an engine builder, Caterpillar designs, develops and supplies its own MaK fuel injection system with components manufactured to the highest OEM quality, giving you the assurance of long component life.

For the past 25 years, MaK designed fuel injection equipment has been seen as one of the core technologies of a modern diesel engine. The benefits of MaK injector nozzles, manufactured at the Caterpillar owned factory in Kiel, Germany, are described in our Caterpillar publication, *Injector Nozzle Elements – Leaflet No. 411.*

The quality material and stringent process controls ensure our products are durable and OEM guaranteed to offer long service life with minimal risk of failure - claims that cannot be made by non-original parts manufacturers.



Compared to non-original nozzle elements, MaK injector nozzles are fluid machined with a Caterpillar proprietary after treatment to the fuel delivery ports, where operating stress is reduced due to the smooth, round edges.



The smooth and consistent geometry ensures an optimized fuel spray penetration angle.

- Non-original nozzle element **without** after treatment
- Original MaK nozzle element **with** after treatment

The following bulletin describes further engineering analysis, which compares a genuine MaK M 43 C nozzle element to a non-original part for its conformance to OEM dimension and metallurgical specification. Further conclusions are drawn concerning the effect on fuel consumption and durability.

Findings

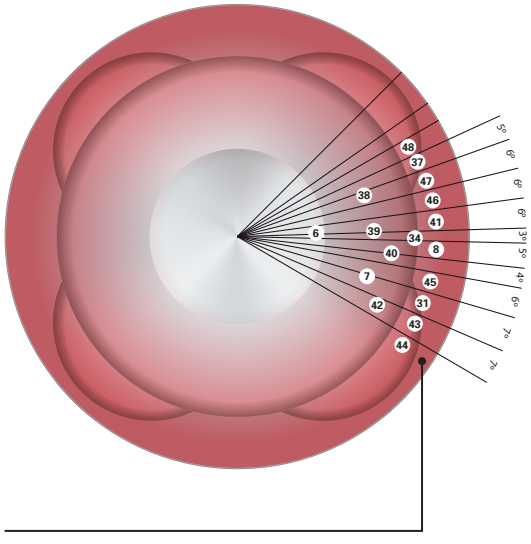
Our laboratory examinations on non-original fuel injectors revealed major differences in material, design and quality when compared to the genuine MaK product. For example:

Critical weaknesses in the construction, design, fit and function of the non-original fuel injectors highlighted not only a risk of needle valve seizure, cooling deficiencies and potential leakage, but also that the use of inferior materials in the manufacturing process could lead to early failure and consequential damage to other engine components (i.e. valves, pistons, liners and turbochargers).

Further, measurements made during MaK engine tests on non-original fuel injectors showed substantial deviations in temperature, fuel consumption, emissions and performance when compared to the genuine MaK product.

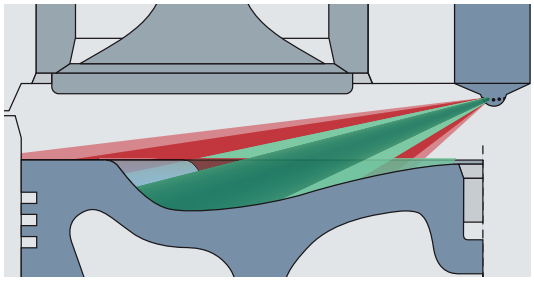
For example, the effect on durability: Restricted fuel flow of the non-original injection nozzles produces higher injection pressure, leading to a finer spray pattern causing increased temperatures at the piston crown and exhaust valves.

At various positions on the piston crown upper surface (48 positions in total), a 40°C difference in material temperature was measured between a new genuine MaK nozzle and a new OEM equivalent grey market component on a test bed engine.

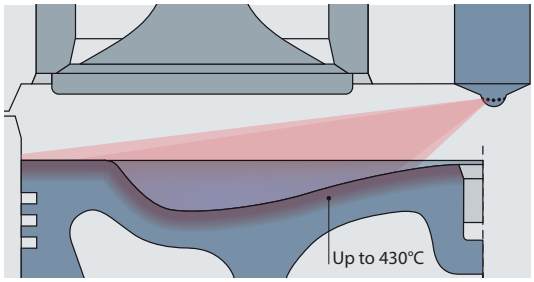


Over 75°C increase in piston crown temperature.

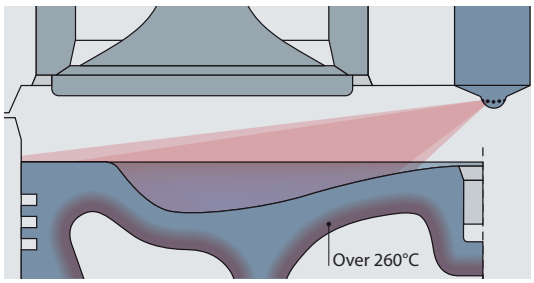
In the same test, a comparison was made using a genuine MaK nozzle, which had been in operation for 5000 hrs. The result was a piston crown temperature difference of 50% lower or half of that obtained with the **new** non-original (OEM equivalent) nozzle. Therefore, if we consider using non-original nozzles for up to 5000 hrs, we could expect a material temperature difference twice that found during normal operation.



Even after 5000 hours, the genuine MaK nozzle still produces an acceptable spray pattern and temperature distribution.

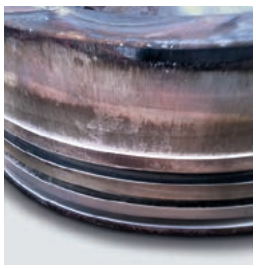


Installing brand new non-genuine nozzles runs the risk of increased piston crown temperatures, which will become more apparent after 5000 hours.



Non-original injectors can result in increased piston crown temperature of more than 75°C. This leads to high temperatures over 260°C on the underside of the piston and results in lacquering of the lubrication oil cooling surfaces.

For the above example: If we consider the ambient conditions present in an operating engine with OEM equivalent grey market injectors, this can result in an increase in piston crown temperature of more than 75°C. Continued operation at these elevated temperatures could lead to severe lacquering on the underside of the piston, thermal overload, material burn off and potential piston or exhaust valve failure.



An example of increased crown temperatures leading to severe lacquering on the underside of the piston, thermal overload, material burn off and potential piston failure.

Since the results of poor practice are often only evident or discovered at sea, or during dry dock, where the cost of repair and replacement are higher than the savings in daily operating costs, we trust you will consider the above when making decisions on planned maintenance, selecting suppliers or budgeting your next major overhaul.

Conclusion

It was also established and confirmed by test bed results under ISO conditions that both fuel consumption (SFC > 1,0 g/kWhr) and IMO exhaust emissions (NO_x > 1,0 g/kWhr) were higher on the engine fitted with OEM equivalent nozzles.

This was especially prevalent at part load, around 50% MCR, where visible smoke and exhaust temperatures were at their highest. It can be concluded that, over time, these conditions would worsen and result in not only higher fuel costs, but also NO_x values that were above the MARPOL Annex IV limits for the engine.

You Get what You Pay for

Using such components is often done in order to save costs, although the consequences of installing non-genuine parts in the fuel systems of a MaK engine, for example, are often overlooked. Through extensive and comparative engine testing using genuine and non-original parts, Caterpillar has identified the following ship owner risks.

1. Higher fuel consumption, particularly at part load or reduced vessel speed
2. Increased NO_x emissions up to 10% higher than the original engine values
3. Non conformance of EAPP certification and IMO Emissions Technical File
4. Between 40 - 75°C higher piston crown and cylinder head component temperatures
5. Increased risk of piston crown burn, liner impingement and higher thermal load
6. Exhaust valve wear rate increased, valve seat life reduced, lower time between overhauls
7. Failure of fuel injector nozzle tips, seized fuel pumps, sticking needles
8. Incomplete injection, poor atomization and reduced cylinder head cooling
9. Uncooled injectors, damaged turbocharger, increased unplanned maintenance

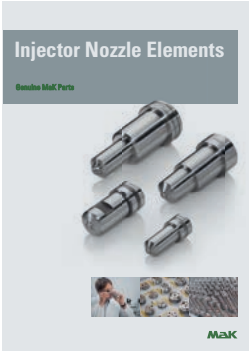
How to Identify Genuine MaK Nozzle Elements?

There are two ways to identify an original MaK nozzle element:

Laser engraved MaK logo together with the IMO identification

Genuine MaK packaging for visual authentication

The information in this report came from a random sample of components from Caterpillar and a competitive brand. The test procedures and results on file are certified to represent the components actually tested. Caterpillar implies nothing further, and no one should infer that these components typify the manufacturers` OEM approved production.



Injector Nozzle Elements
Leaflet No. 411.

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