

CONVERTER QUARTERLY

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Trouble Shooter

by Karl Seyfert – Motor Magazine

Catalytic converters usually are big-ticket items. The process of deciding when replacement is necessary, and determining the reasons for the original failure, shouldn't be rushed.

P0420 Redux

A customer forwarded your June Trouble Shooter column to me because my company has been selling catalytic converters in California for 20 years and I spend a tremendous amount of time trying to get technicians to actually work on the problems that cause converter failure. If I hear one more time that "the computer says it's a bad cat," I think I will scream! Could you discuss the relationship between DTC P0420 and the PCM's assessment of catalyst efficiency? I would appreciate your assistance in my educational efforts

Elaine Lester
Riverside, CA

A DTC P0420 indicates that the PCM believes catalytic converter efficiency has fallen below a prescribed level. This level is tied to the vehicle's ability to comply with applicable emissions requirements, OBD II's prime directive. So the converter could conceivably be working, just not well enough to meet with the PCM's approval. What could lead the PCM to believe something is wrong with the converter? There are several possibilities.

An exhaust leak in front of the converter or in front of the rear oxygen sensor could cause a P0420 Code.

First, the converter must have the correct feed gases to function properly, so a P0420 diagnosis should begin with a check of the basics. Are all of the oxygen sensors working properly? Watch the long-term and short-term fuel trims during a road test, as well as the rear sensor activity if the vehicle uses its input to determine fuel trims. If the vehicle is

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DIESEL DIESEL DIESEL !!!

Eastern Catalytic has now expanded Diesel coverage to include light, medium and heavy duty US Trucks.

Eastern has available many types of solutions for controlling diesel emissions. Ceramic or metallic oxidation catalysts help control HC & CO to meet Stage 1 emission levels and **replace light/medium duty OEM systems.** Particulate filters are generally used with diesel engines to remove diesel particulate matter (PM) as well as HC and CO. In the most common type, wall flow filters, particulate matter is removed from the exhaust by physical filtration using a honeycomb structure similar to an emissions catalyst substrate but with the channels blocked at alternate ends.



The exhaust gas is forced to flow through the walls between the channels and the PM is deposited on the walls. Since the wall flow filter would readily become plugged with particulate material in a short time, it is necessary to 'regenerate' the filtration properties of the filter by burning off the collected particulate on a regular basis. One successful methods to achieve regeneration is incorporating a catalytic coating on the filter to lower the temperature at which particulate burns to normal exhaust temperatures. Incorporating an oxidation catalyst upstream of the filter that, as well as operating as a conventional oxidation

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not in fuel control or if the PCM is forced to make large fuel trim corrections, the cat will not be able to do its job correctly.

Fix all exhaust leaks, both before and after the cat. Any stray oxygen that sneaks into the exhaust that didn't pass through the intake manifold will confuse the oxygen sensor readings and affect the PCM's fuel control decisions. An exhaust leak in front of the converter or in front of the rear oxygen sensor could cause a P0420.

Make sure the engine is in a proper state of tune. Even small changes in the feed gas mixture entering the converter can have a significant effect on how well the converter performs. Spend some time with an ignition scope to verify that combustion is occurring correctly in each cylinder. An intermittent misfire can destroy a new converter that was originally installed to correct a P0420.

If everything else is in order, it's time to let the PCM do the final test and see if it likes the converter it's supposed to be protecting. As I explained last time, the PCM doesn't directly monitor the operation of the converter. Rather, the PCM must *infer* the converter's state of health by monitoring the oxygen sensors (or air/fuel ratio sensors) that are located at the converter inlet and outlet. If the converter is working properly, the oxygen sensor signal *after* the converter should look decidedly different from the sensor signal *before* the converter.

The rear sensor reads the post-cat exhaust gases to monitor cat efficiency and to help the PCM determine if it's going bad on the oxidation side. On some vehicles, it also helps the PCM make decisions on injector ON-times to account for long-term fuel control errors (LTFT). The rear sensor will look slower and more gradual in its response because over 90% of the gases to which the sensor responds are taken away by the cat.

You can observe this with a two-channel lab scope. In closed-loop, the front sensor should cycle between rich and lean with a high number of crosscounts. The rear oxygen sensor should fluctuate much less and the crosscount rate should be much slower. The amplitude of the readings for the rear sensor will also be lower. This indicates the catalyst's ability to store free oxygen, which it then uses to reduce emissions. If the catalyst is degraded, the rear sensor waveform will look very similar to the front sensor waveform.

So if the front and rear sensors are switching at the same rate, we normally suspect that the converter has failed. This indicates low catalyst oxygen storage capability and the converter will fail the efficiency test when the PCM runs the monitor.



Conversely, a really good converter should clean the exhaust so well that it almost puts the rear sensor to sleep, or flatline at .20 volt. But the PCM has to know the rear sensor is working, so it attempts to drive it to the middle of its range.

After everything else has been eliminated, it really comes down to the accuracy of the vehicle's catalyst efficiency monitor. If the PCM says the catalyst efficiency has degraded and a P0420 has set, does that mean the converter really is bad?

Since the June column was published, I've heard from a few Motor readers who absolutely believe in the accuracy of the catalyst monitor on Subaru vehicles. If the PCM sets a P0420, they believe that it's time to pony up for a new converter. Some also are firmly convinced that only an original equipment replacement converter will satisfy the PCM during a catalyst efficiency monitor and prevent a recurrence of the P0420 on a Subaru.

Unless stated otherwise, all converters, whether from OE or aftermarket sources, are supposed to meet the same standards of performance. Before you install any converter, make sure you install it in an environment where it can do the job it was designed to do. ❖

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catalyst, also increases the ratio of NO₂ to NO in the exhaust. **Trapped particulate burns off at normal exhaust temperatures using the powerful oxidative properties of NO₂ and oxygen.**

A questionnaire is available for download at www.easterncatalytic.com or you can contact the office for a fax version. The questionnaire will assist EMI technical staff in developing a special diesel catalytic converter to meet your specific emission needs. ❖