Cambustion

CLD500

Fast Response NOx Analyzer

Application Note: CLD 02v01

Measurement of engine-out NOx for transient SCR urea dosing accuracy

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Introduction

Permitted tail-pipe NOx emissions under recent emissions legislation require a dramatic reduction in NOx emissions. Many diesel engines are being fitted with Selective Catalytic Reduction (SCR) technology (whereby urea is injected in to the exhaust upstream of a catalyst to reduce NOx to N2 and H2O).

The quantity of injected urea needs to be carefully controlled: too little may cause some NOx to pass through the aftertreatment system unconverted, too much will cause ammonia to be emitted from the tailpipe. It is particularly difficult to determine the required urea dosing rate during engine transients where short-duration “spikes” of NOx can occur with rapid speed/load changes.

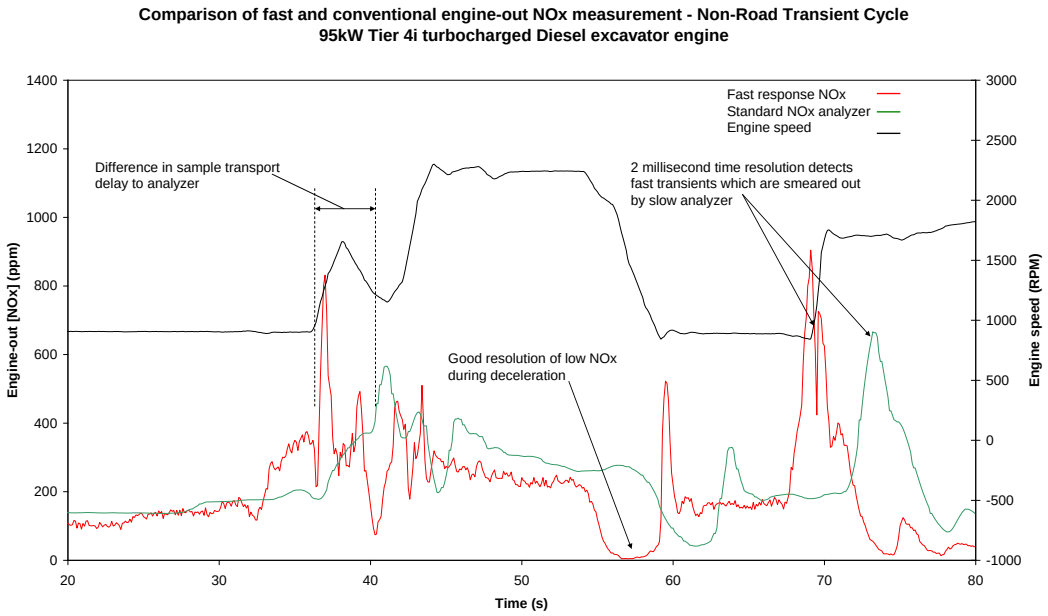
Fast response NOx analyzers can measure these transients accurately and may provide validation of engine-out NOx and urea dosing models for effective NOx control.

Experiment

In this experiment the CLD500 was used to measure engine-out NOx in a Tier 4i 95kW turbo-charged diesel engine for off-road application. The engine was driven by a dynamometer on a Non-Road Transient Cycle (NRTC) and the results were compared with the NOx measured by a conventional bench NOx analyser.

Various other engine parameters were logged simultaneously.

Results



The figure above shows a typical portion of this highly transient cycle. The 3-4 second delay in the standard analyser is not uncommon and can easily be adjusted for by data manipulation. However, the 1,000 x faster T10-90% response time of the CLD500 does have an advantage when resolving the rapid transients; the red trace in the plot above reveals some high frequency information which is smoothed-out within the green trace.

The fast transients which occur during acceleration and deceleration events are accurately recorded and even the NOx transient occurring within the acceleration (at 70s) can be seen – possibly due to AFR or EGR control issues. This suggests that some improvements can be made to the engine-out NOx emissions which may reduce the aftertreatment requirements.

Conclusions

A common industry aim is to model the engine-out NOx sufficiently accurately so that engine-out NOx sensors and ammonia oxidation catalysts may be deleted (bringing significant cost savings).