Certification Methods Errors in the Analysis of NMHC and VOCs in CNG-Based Engine Emissions

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This presentation reviews the errors associated with the different analysis methods allowed for the determination of non-methane hydrocarbon (NMHC) and Volatile Organic Carbon (VOC) for compliance emissions testing, specific to engines that must meet EPA 40 CFR Part 60 subpart JJJJ or EPA 40 CFR Part 63 subpart ZZZZ. Some of the analysis methods that will be reviewed are: (1) FTIR based analysis following Method 320 or ASTM D6348, and (2) FID and/or GC based analyses methods: EPA 40 CFR Part 1065 (methane cutter with THC-FID), as well as Method 25A (THC-FID) combined with Method 18 (GC-based for CH4 and/or C2H6).

For the FID-based methods the largest source of error is due to the subtraction of two large numbers (THC – CH4/C2H6) which is compounded further by the additional error in the CH4 FID response factor. FID analyzers are also unable to accurately measure oxygenated hydrocarbons such as aldehydes (in particular formaldehyde) or ketones. All of the methods except the FTIR need to run a separate analysis at the same time for moisture (Method 4) in order to apply the moisture correction to the data, which presents another potential source of error due to time alignment issues.

The FTIR and GC based methods determine NMHCs and VOCs by direct speciation of the C1-C6 carbon based components. In those methods, the largest error derives from the ability of the analyzer to accurately speciate all the components, with additional errors in the case of the GC due to the sampling method and detector used. This uncertainty however is much smaller than the errors associated with the FID-based difference method provided there is low cross interferences from other components.

We will examine the sources of errors for each of the allowed methods and demonstrate the magnitude of the errors for each case as well as when each method would be preferred for use for different situations.