TECHNOLOGY DIGEST

Timely Technology Transfer

"Effects of Engine Blowby Diversion on Exhaust Emissions"

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Summary

The Association of American Railroads (AAR) and Southwest Research Institute (SwRI) are conducting a series of tests on locomotive diesel engines to determine the effects on gaseous and particulate emissions of different fuels and lubricants and of changes in engine configuration. The testing program supports the rail industry in dealing with both state and federal regulators.

Engine piston blowby into the crankcase is typically directed into the exhaust stream. Tests were conducted to determine whether blowby contributes significantly to exhaust emissions, especially particulates and NO_x. If so, then adding blowby to the exhaust may not be the most cost-effective approach, and other options should be explored.

SwRI's emissions testing equipment was configured so that the blowby gases could be either added to the exhaust stream or diverted away from it on both the General Motors Electro-Motive Division (EMD) and the General Electric (GE) locomotive-type test engines. Exhaust emissions were measured under each condition. The addition of blowby gases to the exhaust stream did not result in statistically significant changes in any of the exhaust emission components, including particulates and NO_x, for either the EMD or GE test engines.

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INTRODUCTION AND CONCLUSIONS

The United States Congress has mandated that the nation's air quality be raised to levels considered necessary for the sake of public health. To this end, the U. S. Environmental Protection Agency (EPA) is required to set emissions standards for most sources of air pollution, and the states must develop plans for complying with federal air quality standards.

EPA must develop emissions standards for all new locomotive engines by November 1995. The states cannot regulate new engines but can regulate existing engines. The California Air Resources Board (CARB) is studying several fuel and engine retrofit options for locomotive engines and may begin regulatory rulemaking in 1992.

In order to evaluate the effects of potential new reduced emissions requirements and strategies, AAR and SwRI enhanced their jointly owned diesel engine laboratory at San Antonio, Texas, by adding a complete gaseous and particulates emissions measurement facility. The principal engines in this facility are 12-cylinder, medium-speed, turbocharged EMD 645E3B and GE 7FDL engines, which their manufacturers assisted in updating to more current in-service configurations for these tests.

Since engine piston blowby enters the exhaust gas stream, there was some question about its net effect on engine emissions and about whether it might have to be treated separately. The test program completed in 1991 at SwRI included comparing the exhaust emissions of both EMD and GE diesel engines with and without blowby diversion from the exhaust stream.

The diversion of blowby gases from the exhaust stream did not have any significant effect on engine emissions. The test results do not, therefore, indicate a need for separate actions to deal specifically with pollutants in the blowby gases.

APPROACH

The equipment employed by SwRI to measure engine exhaust emissions was configured so that the blowby gases could be either added to the exhaust stream or diverted away from it (see Exhibit 1). Exhaust emissions were then measured both with and without the blowby gases added. Each emission value presented is based on the averages of three readings at each of three throttle positions (idle, notch 5, and notch 8) which are then normalized for a typical engine duty cycle. These values are presented in Table 1. In each case, statistical tests were conducted to determine whether the differences between the base and test cases were statistically significant.

RESULTS

Blowby diversion in the EMD test engine resulted in an essentially constant level of PM. The small increase in NO_x shown in Table 1 is not statistically significant, and is within the range of experimental error. In the GE engine, small decreases in both PM and NO_x were measured, but these decreases were also not statistically significant.

It should be kept in mind that the findings presented in this report are based on the averages from a small number of tests on only one EMD and one GE engine. There can be substantial variability in emissions among engines of the same design, or within the same engine over time, which could affect the conclusions presented in this report.

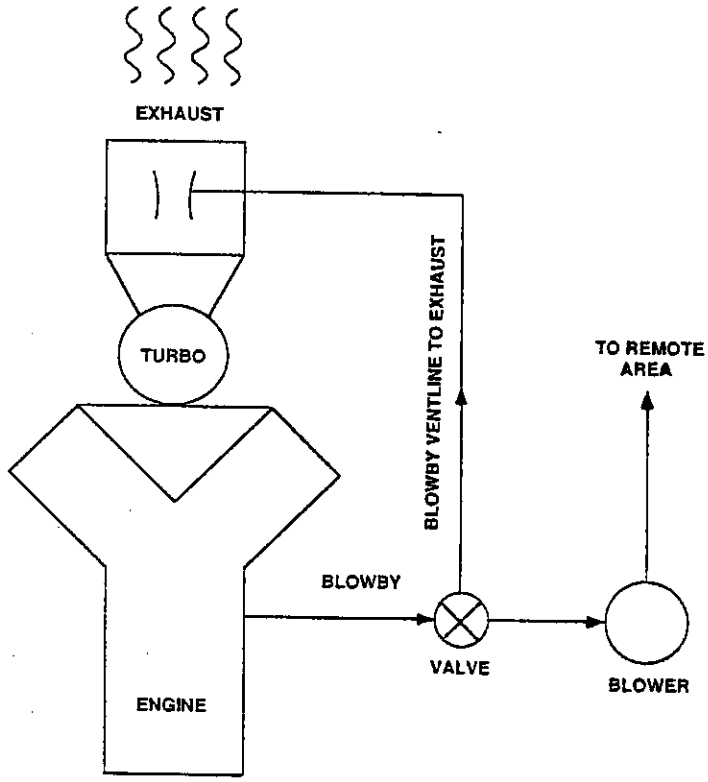

Exhibit 1. Test Configuration Schematic: Blowby Can Either Be Vented to the Exhaust Stream, or Drawn by a Blower to a Remote Area.

Table 1

Brake-Specific Engine Emissions With and Without Blowby Diversion					
Engine Mfr.	Blow Diversion	PM	No_x	HC	CO
EMD	No	0.22	10.93	0.34	1.01
	Yes	0.21	11.38	0.30	0.97
GE	No	0.28	12.21	0.38	1.73
	Yes	0.24	11.43	0.33	1.79

Note: None of these observed differences are statistically significant.

Note: Contact G. Richard Cataldi at (202) 639-2261 with questions or comments about this document.

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