

General Guidelines for Ohio EPA's Program for the Retrofitting of School Buses with Control Equipment to Reduce Diesel Particulate Emissions

The following questions and answers explain the Ohio EPA's program for the retrofitting of school buses with emission control equipment and provide the general guidelines that must be followed by any school system that participates in the program.

1. Why is there a need to reduce diesel particulate emissions from school buses?

The exhaust gases from diesel, school bus engines contain significant amounts of organic compounds, carbon monoxide, nitrogen oxides (NO_x) and fine particulates. If inhaled, the fine particulates are so small that they are able to penetrate deep into the lungs and pose serious health risks such as aggravated asthma and lung damage. In addition, USEPA has identified diesel exhaust as a likely human carcinogen. These fine particulate emissions contribute to the poor ambient air quality in 27 counties in Ohio, which currently are not meeting the national health-based ambient air quality standards for fine particulates (i.e., PM 2.5, particles less than 2.5 microns in diameter). Reducing the particulate emissions from diesel school bus engines will have two primary benefits:

- a. For the children who ride buses, it will reduce their exposure to the harmful diesel exhaust emissions. Children are more susceptible to air pollution than healthy adults because their respiratory systems are still developing and they have a faster breathing rate.
- b. It will help in attaining the National Ambient Air Quality Standards for PM 2.5 in Ohio's nonattainment counties.

2. What retrofit options are available to reduce particulate emissions from school buses?

There are three primary ways to retrofit a school bus for particulate emission control:

- a. **Diesel particulate filters** are ceramic devices that collect particulate matter in the exhaust stream. The high temperature of the exhaust heats the ceramic structure and allows the particles inside to break down into less harmful components. These filters must be used in conjunction with ultra-low sulfur diesel ("ULSD") fuel, which is a fuel with a sulfur content of less than 15 parts per million. The combination of particulate filters and ULSD fuel can reduce emissions of particulates, organic compounds, and carbon monoxide in the exhaust gases by 60 to 90 percent. Particulate filters work best on engines built after 1994 and cost \$6,500 to \$7,500.
- b. **Crankcase filtration systems** allow a diesel engine's crankcase to be closed

and use an air filter to trap blow-by aerosols consisting mainly of oil droplets, with some carbon and traces of wear debris and PM10. Blow-by gas emissions can be as much as 25% of the total emissions from a diesel engine. The filtration efficiency of crankcase filters averages between 80% and 97%. The crankcase filter must be changed at every lube oil change (as recommended by the diesel engine manufacturer) or every 500 hours of operation, whichever comes first. Crankcase filters are inexpensive (a replacement element typically costs less than \$50.00) and are best used in conjunction with some type of filtration system in the exhaust stream.

- c. **Diesel oxidation catalysts** are devices that use a chemical process to break down pollutants in the exhaust stream into less harmful components. Diesel oxidation catalysts can reduce emissions of particulates by 20 percent, hydrocarbons by 50 percent, and carbon monoxide by 40 percent. Oxidation catalysts cost \$600 to \$2,000 and can be used with regular diesel fuel.

Only control equipment found on USEPA's "Verified Technology List" may be purchased and installed (see (4) below for further details).

3. Which types of school buses will be eligible to be retrofitted with particulate emission controls?

Only school buses that meet the following criteria should be retrofitted with particulate emission controls:

- a. The school bus must be equipped with a diesel engine.
- b. The school bus must have a gross vehicle rating of 19,500 pounds or more (Types C & D).
- c. The school bus must be driven not less than 5,000 miles per year.
- d. The school bus model year must be 1994 or newer.

4. Which types of control equipment would be acceptable for installation?

The USEPA publishes a "Verified Technology List." Only control equipment found on this list may be purchased and installed. Per the memorandum of understanding between USEPA and the California Air Resources Board (CARB), control equipment found in CARB's Diesel Emission Control Strategies Verification Currently Verified Technologies list are also considered eligible for purchase and installation. As additional technologies are found to be acceptable by the USEPA, they will be added to the list. A copy of this list can be accessed at the following web site:

<http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm>

This table summarizes all the diesel retrofit technologies that the U.S. Environmental

Protection Agency (EPA) has approved for use in engine retrofit programs. The table shows the percent reduction (of verified or tested levels) that EPA will recognize for emission reductions for each technology.

5. Is there a special type of fuel that must be used with the control equipment?

In some cases, yes. Each bus equipped with a particulate filter must use ultra low sulfur diesel (ULSD) fuel. Because of the high sulfur content of regular diesel fuel, the use of regular diesel fuel would cause the particulate filter to clog. This, in turn, could cause exhaust back-pressure increases and engine damage. The ULSD fuel contains less than 10% of the sulfur content of regular diesel fuel. Regular diesel fuel may contain 150 to 500 ppm of sulfur, compared to the maximum of 15 ppm for the ULSD fuel. As a result of recent changes in the U.S. federal fuel standards, ULSD fuel will become the standard diesel fuel throughout the U.S. beginning in June of 2006. Many parts of the country, including certain parts of Ohio, are already being supplied with ULSD fuel. The price differential between ULSD fuel and regular diesel fuel currently ranges between eight and 25 cents per gallon. In 2006, when ULSD fuel is available nationwide, the cost differential should be much less.

Diesel oxidation catalysts and crankcase filtration systems do not require special fuel.

6. What costs are associated with the installation and operation of the emission controls?

The estimated cost to retrofit each bus with a diesel particulate filter ranges from \$6,500 to \$7,500. On an annual basis, or about every 100,000 miles, these filters must be disassembled and cleaned either with compressed air or by heating the filter in a filter cleaning device. (The cost of such a device ranges from \$300 to \$350.) The cost for the annual maintenance for each filter, which normally takes less than 3 hours to complete, will depend upon whether the work is performed by school district personnel, the engine dealer, or the filter vendor. Also, until ULSD fuel becomes available nationwide in June of 2006, there will be an increased cost for the diesel fuel burned in each retrofitted bus. The current price differential between ULSD fuel and regular diesel fuel varies between 8 and 25 cents per gallon.

Crankcase filters are fairly inexpensive (a replacement element typically costs less than \$50.00). Crankcase filters must be changed at every lube oil change (as recommended by the diesel engine manufacturer) or every 500 hours of operation, whichever comes first.

The estimated cost to retrofit each bus with a diesel oxidation catalyst ranges from \$600 to \$2,000. Installation takes approximately one to three hours to complete. Diesel oxidation catalysts do not require annual maintenance and will operate with regular diesel fuel.

7. How will the control devices be funded by the Ohio EPA?

Ohio EPA enforcement case settlements will be the source of the funding for the diesel retrofit installations. Each enforcement case resolved either through administrative Findings and Orders or a Consent Order, that contains a significant civil penalty (a total civil penalty assessment \$5,000 or greater), will also include a Supplemental Environmental Project (SEP) that is equal in value to 20 percent of the total assessed civil penalty. The entity that is the subject of the enforcement case will be required to pay the SEP monies directly to a specific fund that Ohio EPA will establish for the retrofitting of school buses.

8. How will the school systems receive the SEP monies for the diesel retrofit installations?

A school system that desires to participate in the retrofit program must apply to Ohio EPA to receive funding to purchase and install USEPA approved control equipment. Once or twice per year, the Ohio EPA will solicit applications from the eligible school systems. In the application, an eligible school system must describe the proposed project, providing details such as the number and ages of the buses to be retrofitted, the type of equipment that will be purchased and installed (must be on the USEPA-published list of "Verified Retrofit Technologies"), a schedule for installation of the equipment, and a detailed cost breakdown. Ohio EPA will evaluate each application and provide funding to applicant school systems that meet the criteria specified by Ohio EPA's regulations. Priority will be given to those applicants that are located in a nonattainment county for PM 2.5 and that include a commitment to implement an anti-idling program at the applicant's school system.

9. What oversight will be provided by the Ohio EPA to ensure that the diesel retrofit control equipment is installed and maintained properly?

Ohio EPA will closely track the amount of enforcement monies directed to each public school system. Each participating school system must submit regular progress reports providing information regarding the equipment purchased and installed to date, as well as a final report summarizing the project results. Periodic inspections also may be conducted by District Office or local air agency staff to confirm that the control equipment has been correctly installed, that the diesel particulate filters are being maintained properly, and that the monies are being spent appropriately.