FROM BUSES AND TRUCKS

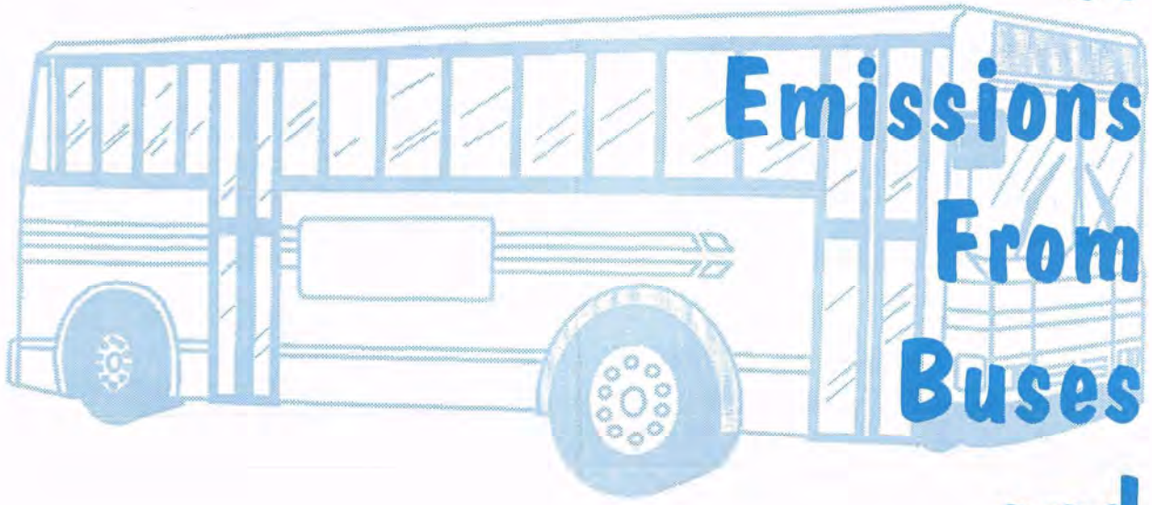
The purpose of this brochure is to answer the most frequently asked questions about heavy-duty diesel emissions and EPA's standards for controlling them.

In addition, NOx contributes to the formation of ground-level ozone (smog). Ground-level ozone is formed by complex photochemical reactions involving hydrocarbons and NOx in the presence of sunlight. Smog severely irritates the mucous membranes of the nose and throat, which can lead to coughing and even choking. It also impairs normal functioning of the lungs and chronic exposure may cause permanent damage. Smog also damages paint and other building materials. (Ground-level ozone should not be confused with stratospheric ozone, a protective layer of the upper atmosphere that filters the sun's harmful ultraviolet rays.)

Hydrocarbons (HC) are gaseous organic chemical compounds emitted by diesel engines that also contribute to the formation of ground-level ozone.

Carbon monoxide (CO) is a colorless, odorless, poisonous gas composed of carbon and oxygen. It is formed when carbon-based fuel is not burned completely. When inhaled, CO enters the bloodstream. It binds chemically to hemoglobin, which normally carries oxygen to the cells, and reduces oxygen delivery to all tissues. Even at relatively low concentrations, CO can adversely affect mental function, visual acuity, and alertness.

Control of Emissions From Buses and Trucks



For more information, write:

United States Environmental Protection Agency
National Vehicle and Fuel Emissions Laboratory
Engine and Vehicle Regulations Branch
2565 Plymouth Road
Ann Arbor, Michigan 48105

or call:

(313) 668-4278

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CONTROL OF EMISSIONS

Air pollution from diesel-fueled buses and trucks is a problem that confronts many large U.S. cities. To help alleviate this problem, the U.S. Environmental Protection Agency (EPA) now requires new heavy-duty diesel engines to meet stringent exhaust emission standards.

Heavy-duty diesel engine pollutants include diesel particulate matter (PM), oxides of nitrogen (NOx), hydrocarbons (HC), and carbon monoxide (CO).

Diesel particulate matter (PM) is a collection of small particles emitted by a diesel engine. Many different organic pollutants are adsorbed on these particles. The size and chemical composition of diesel particulate matter are the main reasons for concern about effects of PM on human health. Their small size increases the likelihood that the particles will reach and lodge in the deepest and most sensitive areas of the human lungs. This can lead to severe lung problems and increased susceptibility to respiratory infection, such as pneumonia, aggravation of acute and chronic bronchitis, and asthma. Also, diesel particulate matter contributes to the formation of the smoke that is widely associated with diesel engines and that impairs visibility.

Oxides of Nitrogen (NOx) include several gaseous compounds made of nitrogen and oxygen. They are lung irritants and can increase susceptibility to respiratory illness and pulmonary infection.

WHY TARGET EMISSIONS FROM HEAVY-DUTY DIESEL ENGINES?

Engines, rather than entire vehicles, are targeted by the regulations because heavy-duty engine manufacturers often do not assemble complete vehicles. Also, the same kind of engine can be used by multiple vehicle manufacturers in many different kinds of vehicles.

For many years, heavy-duty diesel engines were not substantially regulated. This was because passenger cars and light trucks were by far the largest source of mobile source air pollution.

However, three developments prompted EPA to reexamine the issue.

- As emissions were reduced from other sources (for example, new passenger car CO and HC emission standards have been reduced by more than 90 percent in the last 15 years), diesel engines became a proportionately larger source of total emissions from all vehicles.
- There is increasing public health concern about PM and NOx, both of which are emitted in relatively large amounts by diesel engines.
- With new technology, it has become more cost-effective to regulate heavy-duty engines.

WHAT ARE THE EXHAUST EMISSIONS STANDARDS FOR DIESEL ENGINES?

The following table contains the emissions standards for heavy-duty diesel engines. New engines must be certified by their manufacturers as meeting the appropriate standards for the year in which they are manufactured.

Generally, the manufacturer continues to be responsible for meeting these standards for the useful life of the engine.

The table shows that exhaust emission standards for heavy-duty diesel engines have been tightened substantially. The most recent standards represent more than 60% control for NOx and more than 90% control for PM from pre-1984 levels.

HOW CAN EMISSIONS BE REDUCED FROM CURRENTLY OPERATING FLEETS?

New emissions standards have no effect on engines manufactured in previous years. However, several technologies can help reduce emissions from earlier model heavy-duty diesel engines. For example, the formulation of diesel fuel has been modified to lower its sulfur and aromatic content, which helps reduce emissions from older engines.

Other ways to reduce emissions from heavy-duty diesel engines are being explored by various groups in North America and Western Europe. These include retrofitting buses with trap oxidizers and modifying engines to burn clean fuels. Buses are the main focus of these programs. This is because they operate primarily in urban areas, which means that pollution reductions will have a beneficial impact on urban air quality. Also, urban buses are often refueled and maintained at central facilities, which makes it easier for them to use alternative fuels. Finally, these vehicles are publicly owned, which means that the fleets are large enough to justify special refueling and maintenance programs. These technologies may also be applicable to heavy-duty engines in trucks and touring buses.

Of course, proper maintenance is critical to keeping emissions as low as possible.

WHAT IS THE DIESEL BUS REBUILD/ RETROFIT PROGRAM?

This program applies to pre-1994 model year urban buses used in large metropolitan areas. It requires that engines rebuilt or replaced after January 1, 1995, be modified to meet lower particulate emissions standards. Owners can comply in one of two ways with the urban bus particulate emission standards: on a per vehicle basis or on a fleet basis.

- *On a per vehicle basis*, an urban bus operator must reduce the particulate emissions of pre-1994 model year urban buses, at the time an engine is rebuilt or replaced, to a level of 0.10 grams per brake horsepower per hour (g/bhp-hr). If no retrofit equipment is certified to meet that standard, or if the equipment has a life cycle cost of more than $7,940, the operator is required to use retrofit equipment that will provide a 25% reduction if the equipment has a life cycle cost of less than $2,000. The life cycle cost includes the cost of the equipment, installation, fuel, and maintenance.
- *On a fleet basis*, urban bus operators must reduce the average particulate emissions of their pre-1994 model year urban bus fleet. The amount of annual particulate reduction required for a given fleet depends on the makeup of the fleet and the equipment certified for use in the program. The "averaging" approach should provide urban bus operators with maximum flexibility in designing the most cost-effective emission strategy for their fleets.

EPA Exhaust Emission Certification Standards for Heavy-Duty Diesel Engines

YEAR	NOx (g/bhp-hr)[1]	DIESEL PARTICULATE MATTER (g/bhp-hr)[1]	HYDRO-CARBONS (g/bhp-hr)[1]	CARBON MONOXIDE (g/bhp-hr)[1]	SMOKE (percent)[2]
1984-87	10.7	N/A	1.3	15.5	20% engine acceleration mode 15% engine lugging mode 50% peaks in either mode
1988-89	10.7	0.60	1.3	15.5	Same as above
1990	6.0	0.60	1.3	15.5	Same as above
1991	5.0	0.25	1.3	15.5	Same as above
1993	5.0	0.10 new buses 0.25 all other	1.3	15.5	Same as above
1994	5.0	0.07 new urban buses 0.10 all other	1.3	15.5	Same as above
1996	5.0	0.05[3] new urban buses 0.10 all other	1.3	15.5	Same as above
1998	4.0	0.05[3] new urban buses 0.10 all other	1.3	15.5	Same as above

[1] Grams per brake horsepower per hour (g/bhp-hr) is an emission rate based on the amount of work performed by the engine during the Federol transient test procedure.
[2] Smoke is measured in opacity. This is the fraction of a beam of light, expressed in percent, which fails to pass through the exhaust stream.
[3] The in-use standard is 0.07 g/bhp-hr.