



Regulatory Announcement

Final Emissions Standards for Locomotives

The Environmental Protection Agency (EPA) is finalizing emission standards for oxides of nitrogen (NO_x), hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and smoke for newly manufactured and remanufactured diesel-powered locomotives and locomotive engines, which have previously been unregulated. The new standards will achieve approximately a two-third reduction in NO_x emissions, which is equivalent to removing over thirty million passenger cars from the road. In addition, HC and PM emissions will be reduced by 50 percent.

History of Rulemaking

The 1990 Clean Air Act Amendments mandated EPA to establish emission standards for a variety of previously unregulated nonroad mobile sources. Included in those requirements was a specific mandate to regulate the emissions from locomotives. Current unregulated locomotives are estimated to contribute almost 5 percent of the total nationwide emissions of NO_x, which is more than 10 percent of the nationwide mobile source NO_x emissions. This makes locomotives one of the largest remaining unregulated sources of NO_x emissions. Thus, this rulemaking will result in emissions reductions that states need to comply with the National Ambient Air Quality Standards (NAAQS) for ozone and PM.

Overview of Rulemaking

Since locomotive emissions have not been regulated before, it was necessary for EPA to create a comprehensive program, including not only emission standards, but also test procedures and a full compliance program. This rulemaking, which takes effect in 2000, will affect railroads, locomotive manufacturers, and locomotive remanufacturers.

In general terms, the overall program is similar to previously established programs for heavy-duty highway engines and other nonroad engines. One unique feature included for locomotives, however, is the regulation of the engine remanufacturing process, including the remanufacture of locomotives originally manufactured prior to the effective date of this rulemaking. Regulation of the remanufacturing process is critical because locomotives are generally remanufactured 5 to 10 times during their total service lives (typically 40 years or more). Standards that only applied to locomotives originally manufactured after the effective date of the rule would not achieve significant emissions reductions in the near term, as those locomotives slowly replaced the existing fleet.

Emission Standards

Three separate sets of emission standards have been adopted, with applicability of the standards dependent on the date a locomotive is first manufactured. The first set of standards (Tier 0) apply to locomotives and locomotive engines originally manufactured from 1973 through 2001, any time they are manufactured or remanufactured. The second set of standards (Tier 1) apply to locomotives and locomotive engines originally manufactured from 2002 through 2004. These locomotives and locomotive engines will be required to meet the Tier 1 standards at the time of original manufacture and at each subsequent remanufacture. The final set of standards (Tier 2) apply to locomotives and locomotive engines originally manufactured in 2005 and later. Tier 2 locomotives and locomotive engines will be required to meet the applicable standards at the time of original manufacture and at each subsequent remanufacture. Electric locomotives, historic steam-powered locomotives, and locomotives originally manufactured before 1973 do not contribute significantly to the emissions problem, and thus, are not included in this rulemaking.

Exhaust Emission Standards for Locomotives				
Tier and duty-cycle	Gaseous and Particulate Emissions (g/bhp-hr)			
	HC¹	CO	NO_x	PM
Tier 0 line-haul duty-cycle	1.00	5.0	9.5	0.60
Tier 0 switch duty-cycle	2.10	8.0	14.0	0.72
Tier 1 line-haul duty-cycle	0.55	2.2	7.4	0.45
Tier 1 switch duty-cycle	1.20	2.5	11.0	0.54
Tier 2 line-haul duty-cycle	0.30	1.5	5.5	0.20
Tier 2 switch duty-cycle	0.60	2.4	8.1	0.24

1. HC standards are in the form of THC for diesel, bio-diesel, or any combination of fuels with diesel as the primary fuel; NMHC for natural gas, or any combination of fuels where natural gas is the primary fuel; and THCE for alcohol, or any combination of fuels where alcohol is the primary fuel.

In addition to the exhaust emission standards, this final rule establishes smoke opacity standards for all locomotives and locomotive engines.

Smoke Standards for Locomotives (Percent Opacity - Normalized)			
	Steady-state	30-sec peak	3-sec peak
Tier 0	30	40	50
Tier 1	25	40	50
Tier 2	20	40	50

Production Line Testing

EPA has adopted a production line testing (PLT) program that requires manufacturers and, in some cases, remanufacturers of locomotives to perform production line testing of newly manufactured and remanufactured locomotives as they leave the point where the manufacture or remanufacture is completed. The PLT program for newly manufactured units is based on actual testing, while the PLT program for remanufactured units is based on an audit of the remanufacture kit's installation, with EPA having the ability to require testing if in-use data indicates a possible problem with production.

In-Use Compliance Program

A critical element in the success of this locomotive program is ensuring that manufacturers and remanufacturers produce locomotives that continue to meet emission standards beyond certification and production stages, during actual operation and use. EPA is adopting an in-use compliance program with two distinct components. The first program

requires the manufacturers and remanufacturers to test representative locomotives from all engine families using the Federal Test Procedure (FTP). This testing will occur between 50 and 75 percent of useful life. Actual repair in the event of a determination of noncompliance or recall action, however, will apply to all locomotives of that family, regardless of whether the locomotives have exceeded their useful lives. Second, EPA is requiring that Class I railroads annually test a sample of their locomotives which have met or exceeded their useful lives, also using the FTP.

Emissions Averaging Provisions

EPA has adopted averaging, banking and trading (ABT) provisions to allow manufacturers and remanufacturers the flexibility to meet overall emissions goals at the lowest cost, while allowing EPA to set emissions standards at levels more stringent than they would be if each and every engine family had to comply with the standards. ABT is also designed to encourage early introduction of cleaner engines, which will secure emissions benefits earlier than would otherwise be the case.

Preemption

EPA has adopted regulations that will codify and clarify Clean Air Act preemption of certain state and local requirements relating to the control of emissions from new locomotives and new locomotive engines. This preemption was included in the Clean Air Act because of the inherent interstate nature of the railroad industry. Moreover, EPA believes that a strong federal program that addresses manufacturing, remanufacturing and in-use compliance is the best way to achieve the necessary emissions reductions.

Health and Environmental Benefits

Emissions from diesel-powered locomotives, such as NO_x, HC, and PM, contribute to air pollution in both urban and rural areas, and have significant health and environmental effects. NO_x is a major component of smog and acid rain. NO_x emissions combine with HC in the atmosphere to form ground-level ozone, the primary constituent of smog. Ozone is a highly reactive pollutant that damages lung tissue, causes congestion, and reduces vital lung capacity, in addition to damaging vegetation. Acid rain damages buildings and crops, and degrades lakes and streams. NO_x also contributes to the formation of secondary PM, which causes headaches, eye and nasal irritation, chest pain, and lung inflammation. Environmental impacts of PM include reduced visibility and deterioration of buildings.

The primary focus of this rulemaking is on reducing NO_x and PM emissions, although there are also reductions in HC and CO. NO_x emissions from locomotives will be reduced by 60 percent by 2040, compared to 1995 baseline levels. This would be almost 650,000 metric tons per year. Most of these reductions will come early in the program (e.g., 41 percent reduction by 2010), due to the standards that apply to pre-2000 locomotives when they are remanufactured. In addition to the NO_x benefits, the final rule will provide some PM benefits through the Tier 2 standards. A PM reduction of 46 percent is expected by 2040, compared to 1995 baseline levels. This reduction is over 12,000 metric tons per year, and amounts to over one percent of national PM emissions from mobile sources.

Flexibility For Industry

The final rule codifies the Clean Air Act's preemption of state and local emission requirements, which is intended to prevent inappropriate burdens on interstate commerce. The flexibility provided by ABT lowers the costs to manufacturers and makes it easier to meet the technological challenges posed by the new standards. EPA is also exempting the smallest railroads from compliance with the Tier 0 standards, with some restrictions, and is providing a phase-in of the standards for small manufacturers.

Cost of New Program

EPA estimates that the lifetime cost per locomotive will be approximately \$70,000 for the Tier 0 standards, \$186,000 for the Tier 1 standards and \$252,000 for the Tier 2 standards. Lifetime cost components consist of initial equipment costs; remanufacturing costs; fuel economy costs; and certification, production line and in-use testing costs. The average annual cost of this program is estimated to be \$80 million per year. This would be about 0.2 percent of the total freight revenue for railroads in 1995. The average cost-effectiveness of the standards is expected to be about \$163 per ton of NO_x, PM and HC.

For More Information

The final rule and other documents on locomotives are available electronically from the EPA Internet server at:

<http://www.epa.gov/OMSWWW/locomotv.htm>

Document information is also available by contacting Russ Banush at:

U.S. Environmental Protection Agency
2565 Plymouth Road
Ann Arbor, MI 48105
(734) 668-4333