

paths identified here to address constraints specific to nonroad equipment, and the additional lead time afforded by the timing of the standards, we have concluded that the proposed standards are feasible.

4. Are the Standards Proposed for Engines ≥ 25 hp and < 75 hp Feasible?

As discussed in section III.B, our proposal for standards for engines between 25 and 75 hp consists of a 2008 transitional standard and long-term 2013 standards. The proposed transitional standard is a 0.22 g/bhp-hr PM standard. The 2013 standards consist of a 0.02 g/bhp-hr PM standard and a 3.5 g/bhp-hr NMHC+NO_x standard. As discussed in section III.B, the transitional standard is optional for

50–75 hp engines, as the proposed 2008 implementation date is the same as the effective date of the Tier 3 standards. Manufacturers may decide, at their option, not to undertake the 2008 transitional PM standard, in which case their implementation date for the 0.02 g/bhp-hr PM standard begins in 2012.

In addition, we have proposed a minor revision to the CO standard for the 25–50 hp engines beginning in 2008 to align these engines with the 50–75 hp engines. This proposed CO standard is 3.7 g/bhp-hr.

The remainder of this section discusses:

- What makes the 25–75 hp category unique;
- What engine technology is used today, and will be used for applicable Tier 2 and Tier 3 standards;

- Why the proposed standards are technologically feasible; and,

- Why EPA has not proposed more stringent NO_x standards at this time for these engines.

a. What makes the 25–75 hp category unique?

As discussed in section III.B.1.d, many of the nonroad diesel engines ≥ 75 hp are either a direct derivative of highway heavy-duty diesel engines, or share a number of common traits with highway diesel engines. These include similarities in displacement, aspiration, fuel systems, and electronic controls. Table III.E–3 contains a summary of a number of key engine parameters from the 2001 engines certified for sale in the U.S.¹⁸³

TABLE III.E–3: SUMMARY OF MODEL YEAR 2001 KEY ENGINE PARAMETERS BY POWER CATEGORY

Engine Parameter	Percent of 2001 U.S. Production ^a			
	0–25 hp	25–75 hp	75–100 hp	>100 hp
IDI Fuel System	83%	47%	4%	<0.1%
DI Fuel System	17%	53%	96%	>99%
Turbocharged	0%	7%	62%	91%
1 or 2 Cylinder Engines	47%	3%	0%	0%
Electronic fuel systems (estimated)	not available today	limited available today	availability today	commonly available today

Notes:

^a Based on sales weighting of 2001 engine certification data.

As can be seen in Table III.E–3, the engines in the 25–75 hp category have a number of technology differences from the larger engines. These include a higher percentage of indirect-injection fuel systems, and a low fraction of turbocharged engines. (The distinction in the < 25 hp category is quite different, with no turbocharged engines, nearly one-half of the engines have two cylinders or less, and a significant majority of the engines have indirect-injection fuel systems.)

The distinction is particularly marked with respect to electronically controlled fuel systems. These are commonly available in the ≥ 75 hp power categories, but, based on the available certification data as well as our discussions with engine manufacturers, we believe there are very limited numbers, if any, in the 25–75 hp category (and no electronic fuel systems in the less than 25 hp category). The research and development work being performed today for the heavy-duty highway market is targeted at engines

which are 4-cylinders or more, direct-injection, electronically controlled, turbocharged, and with per-cylinder displacements greater than 0.5 liters. As discussed in more detail below, as well as in section III.E.5 (regarding the < 25 hp category), these engine distinctions are important from a technology perspective and warrant a different set of standards for the 25–75 hp category (as well as for the < 25 hp category).

b. What Engine Technology Is Used Today, and Will Be Used for the Applicable Tier 2 and Tier 3 Standards?

In the 1998 nonroad diesel rulemaking, we established Tier 1 and Tier 2 standards for engines in the 25–50 hp category. Tier 1 standards were implemented in 1999, and the Tier 2 standards take effect in 2004. The 1998 rule also established Tier 2 and Tier 3 standards for engines between 50 and 75 hp. The Tier 2 standards take effect in 2004, and the Tier 3 standards take effect in 2008. The Tier 1 standards for engines between 50 and 75 hp took

effect in 1998. Therefore, all engines in the 25–75 hp range have been meeting Tier 1 standards for the past several years, and the data presented in Table III.E–3 represent performance of Tier 1 technology for this power range.

As discussed in section III.E.4.a, engines in the 25–75 hp category use either indirect injection (IDI) or direct injection (DI) fuel systems. The IDI system injects fuel into a pre-chamber rather than directly into the combustion chamber as in the DI system.¹⁸⁴ This difference in fuel systems results in substantially different emission characteristics, as well as differences in several important operating parameters. In general, the IDI engine has lower engine-out PM and NO_x emissions, while the DI engine has better fuel efficiency and lower heat rejection.¹⁸⁵

We expect a significant shift in the engine technology which will be used in this power category as a result of the upcoming Tier 2 and Tier 3 standards, in particular for the 50–75 hp engines. In the 50–75 hp category, the 2008 Tier

¹⁸³ Data in Table III.E–3 is derived from a combination of the publically available certification data for model year 2001 engines, as well as the manufacturers reported estimates of 2001 production targets, which is not public information.

¹⁸⁴ See for example “Diesel-engine Management” published by Robert Bosch GmbH, 1999, second edition, pages 6–8 for a more detailed discussion of the differences between IDI and DI engines.

¹⁸⁵ See chapter 14, section 4 of “Turbocharging the Internal Combustion Engine”, N. Watson and M.S. Janota, published by John Wiley and Sons, 1982.