

3 standards will likely result in the significant use of turbocharging and electronic fuel systems, as well as the introduction of both cooled and uncooled exhaust gas recirculation by some engine manufacturers and possibly the use of charge-air-cooling.¹⁸⁶ In addition, we have heard from some engine manufacturers that the engine technology used to meet Tier 3 for engines in the 50–75 hp range will also be made available on those engines in the 25–50 hp range which are built on the same engine platform. For the Tier 2 standards for the 25–50 hp products, a large number of engines meet these standards today, and therefore we expect to see only moderate changes in these engines, including the potential additional use of turbocharging on some models.¹⁸⁷

c. Are the Proposed Standards for 25–75 hp Engines Technologically Feasible?

This section will discuss the technical feasibility of both the proposed 2008 PM standard and the 2013 standards. For an explanation and discussion of the proposed implementation dates, please refer to section III.B of this this proposal.

i. 2008 PM Standards.¹⁸⁸ As just discussed in section III.E.4.b, engines in the 25–50 hp category must meet Tier 1 NMHC+NO_x and PM standards today. We have examined the model year 2002 engine certification data for engines in

the 25–50 hp category. These data indicate that over 10 percent of the engine families meet the proposed 2008 0.22 g/bhp-hr PM standard and 5.6 g/bhp-hr NMHC+NO_x standard (unchanged from Tier 2 in 2008) today. These include a variety of engine families using a mix of engine technologies (IDI and DI, turbocharged and naturally aspirated) tested on a variety of certification test cycles.¹⁸⁹ Five engine families are more than 20 percent below the proposed 0.22 g/bhp-hr PM standard, and an additional 24 engine families are within 30 percent of the proposed 2008 PM standards while meeting the NMHC+NO_x standard. A detailed discussion of these data is contained in the draft RIA.

Unfortunately, similar data do not exist for engines between 50 and 75 hp. There is no Tier 1 PM standard for engines in this power range, and therefore engine manufacturers are not required to report PM emission levels until Tier 2 starts in 2004. However, in general, the 50–75 hp engines are more technologically advanced than the smaller horsepower engines and would be expected to perform as well as, if not better than, the engines in the 25–50 hp range.

The model year 2002 engines in this power range use well known engine-out emission control technologies, such as optimized combustion chamber design and fuel injection timing control strategies, to comply with the existing standards. These data have a two-fold significance. First, they indicate that a number of engines in this power range can already achieve the proposed 2008 standard for PM using only engine-out technology, and that other engines

should be able to achieve the standard making improvements just to engine-out performance. Despite being certified to the same emission standards with similar engine technology, the emission levels from these engines vary widely. Figure III.E–1 is a graph of the model year 2002 HC+NO_x and PM data for engines in the 25–50 hp range. As can be seen in the figure, the emission levels cover a wide range. Figure III.E–1 highlights a specific example of this wide range: engines using naturally aspirated DI technology and tested on the 8-mode test cycle. Even for this subset of DI engines achieving approximately the same HC+NO_x level of ~6.5 g/bhp-hr, the PM rates vary from approximately 0.2 to more than 0.5 g/bhp-hr. There is limited information available to indicate why for these small diesel engines with similar technology operating at approximately the same HC+NO_x level the PM emission rates cover such a broad range. We are therefore not predicating the proposed 2008 PM standard on the combination of diesel oxidation catalysts and the lowest engine-out emissions being achieved today, because it is uncertain whether or not additional engine-out improvements would lower all engines to the proposed 2008 PM standard. Instead, we believe there are two likely means by which companies can comply with the proposed 2008 PM standard. First, some engine manufacturers can comply with this standard using known engine-out techniques (e.g., optimizing combustion chamber designs, fuel-injection strategies). However, based on the available data it is unclear whether engine-out techniques will work in all cases. Therefore, we believe some engine companies will choose to use a combination of engine-out techniques and diesel oxidation catalysts, as discussed below.

¹⁸⁶ See section 2.2 through 2.3 in “Nonroad Diesel Emission Standards—Staff Technical Paper”, EPA Publication EPA420–R–01–052, October 2001. Copy available in EPA Air Docket A–2001–28.

¹⁸⁷ See Table 3–2 in “Nonroad Diesel Emission Standards—Staff Technical Paper”, EPA Publication EPA420–R–01–052, October 2001. Copy available in EPA Air Docket A–2001–28.

¹⁸⁸ As discussed in section III.B., manufacturers can choose, at their option, to pull-ahead the 2013 PM standard for the 50–75 hp engines to 2012, in which case they do not need to comply with the transitional 2008 PM standard.

¹⁸⁹ The Tier 1 standards for this power category must be demonstrated on one of a variety of different engine test cycles. The appropriate test cycle is selected by the engine manufacturer based on the intended in-use application of the engine.