

emissions, while the DI engine has better fuel efficiency and lower heat rejection.

c. What Data Indicates That the Proposed Standards Are Feasible?

We project the proposed Tier 4 PM standard can be met by 2008 based on:

- The existence of a large number of engine families which meet the proposed standards today;
- The use of engine-out reduction techniques; and
- The use of diesel oxidation catalysts.

We have examined the recent model year (2002) engine certification data for nonroad diesel engines less than 25 hp. These data indicate that a number of engine families meet the proposed Tier 4 PM standard (and the 2008 NMHC+NO_x standard, unchanged from Tier 2) today. The current data indicates approximately 28% of the engine families are at or below the proposed PM standard today, while meeting the 2008 NMHC+NO_x standard. These include both IDI and DI engines, as well as a range of certification test cycles.²⁰⁶ Many of the engine families are certified well below the proposed Tier 4 standard

while meeting the 2008 NMHC+NO_x level. Specifically, 15 percent of the engine families exceed the proposed Tier 4 PM standard by more than 20 percent. The public certification data indicate that these engines do not use turbocharging, electronic fuel systems, exhaust gas recirculation, or aftertreatment technologies.

These model year 2002 engines use well known engine-out emission control technologies, such as combustion chamber design and fuel injection timing control strategies, to comply with the existing standards. As with 25–75 hp engines, these data have a two-fold significance. First, they indicate that a number of engines in this power category 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. Second, despite being certified to the same emission standards with similar engine technology, the emission levels from these engines vary widely. Figure III.E–2 is a graph of the model year 2002 HC+NO_x and PM data. As can be seen in the figure, the emission levels cover a wide range. Figure III.E–2 highlights a specific example of this wide range: engines using naturally aspirated IDI technology and tested on the 6-mode test cycle. Even for this subset of IDI

engines achieving approximately the same HC+NO_x level of ~4.5 g/bhp–hr, the PM rates vary from approximately 0.15 to 0.5 g/bhp–hr. (A more detailed discussion of this data is contained in the draft RIA.) 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.

²⁰⁶ The Tier 1 and Tier 2 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 applications(s) of the engine.