

show that very low emission levels are possible even when engine-out emissions are exceedingly high (*e.g.*, a reduction of 0.558 g/bhp-hr is demonstrated on the AW2 cycle).

The results summarized in the two tables are also indicative of the feasibility of the proposed NTE provisions of this rulemaking. In spite of the Tier 1 baseline of this engine, there are only three test results with

emissions higher than the permissible limit for the proposed NTE. The first in Table III.E-1 shows PM emissions of 0.031 over the AW2 cycle but from a very high baseline level of nearly 0.6 g/bhp-hr. We believe that simple improvements to the engine-out PM emissions as needed to comply with the Tier 2 emission standard would reduce these emission below the 0.02 level required by the standard. There are two

other test points in Table III.E-2 which are above the proposed NTE emission level, both at 10 percent engine load. However, both are outside the NTE zone which excludes emissions for engine loads below 30 percent. It is important to note that although the engine would not be constrained to meet the NTE under these conditions, the resulting reductions at both points are still substantial in excess of 96 percent.

TABLE III.E-2—STEADY-STATE PM EMISSIONS FROM A TIER 1 NR DIESEL ENGINE W/CDPF

1999 (Tier 1) Caterpillar 3408 (480hp, 181)					
Engine speed %	Engine load %	PM ([g/bhp-hr])		Reduction %	
		Engine out	w/CDPF		
100	100	0.059	0.10	83	
100	75	0.103	0.009	91	
100	50	0.247	0.012	95	
100	25	0.247	0.000	100	
100	10	0.925	0.031	97	
60	100	0.028	0.011	61	
60	75	0.138	0.009	93	
60	50	0.180	0.010	95	
60	25	0.370	0.007	98	
60	10	0.801	0.018	98	
91	82	0.091	0.006	93	
80	63	0.195	0.008	96	
63	40	0.240	0.008	97	
0	0	
	(1)	0.127	0.011	91	

ISO C1 Composite.

The second engine tested was a prototype engine developed at Southwest Research Institute (SwRI) under contract to EPA.¹⁷⁸ The engine, dubbed Deere Development Engine 4045 (DDE-4045) because the prototype engine was based on a John Deere 4045 production engine, was also tested with a CDPF from a different manufacturer on the same 12 ppm diesel fuel. The engine is very much a prototype and experienced a number of part failures during testing, including to the turbocharger actuator. Nevertheless, the

transient emission results summarized in Table III.E-3 and the steady-state results summarized in Table III.E-4 show that substantial PM reductions are realized on this engine as well. The emission levels on the NRTC and the ISO C1 cycle would be compliant with the proposed PM standard of 0.01 g/bhp-hr once the appropriate rounding convention was applied.¹⁷⁹ It is also interesting to note that the highway FTP transient emissions are higher than for either of the proposed nonroad transient tests. This suggests that developing PM

compliant engines on the proposed nonroad transient cycles may not be substantially different from developing compliant technologies for highway engines. Our analysis of exhaust temperature characteristics for NO_x adsorber catalysts discussed in the preceding section, noted a similar trend for NO_x technologies (*i.e.*, that the exhaust temperature characteristics of the NRTC may be better matched catalyst technologies than the HD FTP).

¹⁷⁸ "Nonroad Diesel Emission Standards—Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

¹⁷⁹ The rounding procedures in ASTM E29-90 are applied to the emission standard, therefore, the emission results are rounded to the same number of significant digits as the specified standard, *i.e.*,

0.014 g/bhp-hr is rounded to 0.01 g/bhp-hr, while 0.015 g/bhp-hr would be rounded to 0.02 g/bhp-hr.