

of each fuel type Otto-cycle HDE intended for use in vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds by the manufacturer.

(ii) The configurations certified to the emission standards of paragraph (a)(1)(ii)(B) of this section under the provisions of paragraph (a)(3)(i) of this section shall still be required to meet the evaporative emission standards set forth in § 86.099–10(b)(1)(i), (b)(2)(i) and (b)(3)(i).

(4) The manufacturer may exempt 2005 model year HDE engine families whose model year begins before July, 31, 2004 from the requirements in this paragraph (a). Exempted engine families shall be subject to the requirements in § 86.099–10.

(5) For certification purposes, where the applicable California evaporative emission standard is as stringent or more stringent than the applicable federal evaporative emission standard, the Administrator may accept California certification test data indicating compliance with the California standard to demonstrate compliance with the appropriate federal certification evaporative emission standard. The Administrator may require the manufacturer to provide comparative test data which clearly demonstrates that a vehicle meeting the California evaporative standard (when tested under California test conditions/test procedures) will also meet the appropriate federal evaporative emission standard when tested under federal test conditions/test procedures described in this part 86.

(b) [Reserved]. For guidance see § 86.099–10.

(c) [Reserved]. For guidance see § 86.098–10.

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in subpart N or P of this part to ascertain that such test engines meet the requirements of this section.

(e) [Reserved]. For guidance see § 86.099–10.

(f) *Alternative exhaust emission standards.* In lieu of the exhaust emission standards in paragraph (a)(1)(i)(A) or

(B) of this section, the manufacturer may select the standards and provisions in either paragraph (f)(1) or (f)(2) of this section.

(1) *Otto-cycle HDE Option 1.* The alternative exhaust emission standards in this paragraph (f)(1) shall apply to new 2003 through 2007 model year Otto-cycle HDEs and, at the manufacturers option, to new 2003 through 2006 model year Otto-cycle complete heavy-duty vehicles less than or equal to 14,000 pounds GVWR.

(i) *Oxides of Nitrogen plus Non-methane Hydrocarbons (NO<sub>x</sub> + NMHC) for engines fueled with either gasoline, natural gas, or liquefied petroleum gas.* 1.5 grams per brake horsepower-hour (0.55 grams per megajoule).

(ii) *Oxides of Nitrogen plus Non-methane Hydrocarbon Equivalent (NO<sub>x</sub> + NMHCE) for engines fueled with methanol.* 1.5 grams per brake horsepower-hour (0.55 grams per megajoule).

(2) *Otto-cycle HDE Option 2.* The alternative exhaust emission standards in this paragraph (f)(2) shall apply to new 2004 through 2007 model year Otto-cycle HDEs.

(i) *Oxides of Nitrogen plus Non-methane Hydrocarbons (NO<sub>x</sub> + NMHC) for engines fueled with either gasoline, natural gas, or liquefied petroleum gas.* 1.5 grams per brake horsepower-hour (0.55 grams per megajoule).

(ii) *Oxides of Nitrogen plus Non-methane Hydrocarbon Equivalent (NO<sub>x</sub> + NMHCE) for engines fueled with methanol.* 1.5 grams per brake horsepower-hour (0.55 grams per megajoule).

[65 FR 59950, Oct. 6, 2000, as amended at 66 FR 5160, Jan. 18, 2001; 70 FR 72927, Dec. 8, 2005]

#### § 86.005–17 On-board diagnostics.

(a) *General.* (1) All heavy-duty engines intended for use in a heavy-duty vehicle weighing 14,000 pounds GVWR or less must be equipped with an on-board diagnostic (OBD) system capable of monitoring all emission-related engine systems or components during the applicable useful life. Heavy-duty engines intended for use in a heavy-duty vehicle weighing 14,000 pounds GVWR or less must meet the OBD requirements of this section according to the phase-in schedule in paragraph (k) of this section. All monitored systems

and components must be evaluated periodically, but no less frequently than once per applicable certification test cycle as defined in appendix I, paragraph (f), of this part, or similar trip as approved by the Administrator.

(2) An OBD system demonstrated to fully meet the requirements in § 86.1806-05 may be used to meet the requirements of this section, provided that the Administrator finds that a manufacturer's decision to use the flexibility in this paragraph (a)(2) is based on good engineering judgement.

(b) *Malfunction descriptions.* The OBD system must detect and identify malfunctions in all monitored emission-related engine systems or components according to the following malfunction definitions as measured and calculated in accordance with test procedures set forth in subpart N of this part (engine-based test procedures) excluding the test procedure referred to as the "Supplemental emission test; test cycle and procedures" contained in § 86.1360, and excluding the test procedure referred to as the "Not-To-Exceed Test Procedure" contained in § 86.1370, and excluding the test procedure referred to as the "Load Response Test" contained in § 86.1380.

(1) *Catalysts and particulate traps.* (i) *Otto-cycle.* Catalyst deterioration or malfunction before it results in an increase in NMHC (or NO<sub>x</sub>+NMHC, as applicable) emissions 1.5 times the NMHC (or NO<sub>x</sub>+NMHC, as applicable) standard or FEL, as compared to the NMHC (or NO<sub>x</sub>+NMHC, as applicable) emission level measured using a representative 4000 mile catalyst system.

(ii) *Diesel.* (A) If equipped, catalyst deterioration or malfunction before it results in exhaust emissions exceeding 1.5 times the applicable standard or FEL for NO<sub>x</sub> (or NO<sub>x</sub>+NMHC, as applicable) or PM. This requirement applies only to reduction catalysts; monitoring of oxidation catalysts is not required. This monitoring need not be done if the manufacturer can demonstrate that deterioration or malfunction of the system will not result in exceedance of the threshold.

(B) If equipped with a particulate trap, catastrophic failure of the device must be detected. Any particulate trap whose complete failure results in ex-

haust emissions exceeding 1.5 times the applicable standard or FEL for NMHC (or NO<sub>x</sub>+NMHC, as applicable) or PM must be monitored for such catastrophic failure. This monitoring need not be done if the manufacturer can demonstrate that a catastrophic failure of the system will not result in exceedance of the threshold.

(2) *Engine misfire.* (i) *Otto-cycle.* Engine misfire resulting in exhaust emissions exceeding 1.5 times the applicable standard or FEL for NMHC, NO<sub>x</sub> (or NO<sub>x</sub>+NMHC, as applicable) or CO; and any misfire capable of damaging the catalytic converter.

(ii) *Diesel.* Lack of cylinder combustion must be detected.

(3) Oxygen sensors. If equipped, oxygen sensor deterioration or malfunction resulting in exhaust emissions exceeding 1.5 times the applicable standard or FEL for NMHC, NO<sub>x</sub> (or NO<sub>x</sub>+NMHC, as applicable) or CO.

(4) *Evaporative leaks.* If equipped, any vapor leak in the evaporative and/or refueling system (excluding the tubing and connections between the purge valve and the intake manifold) greater than or equal in magnitude to a leak caused by a 0.040 inch diameter orifice; an absence of evaporative purge air flow from the complete evaporative emission control system. Where fuel tank capacity is greater than 25 gallons, the Administrator may, following a request from the manufacturer, revise the size of the orifice to the smallest orifice feasible, based on test data, if the most reliable monitoring method available cannot reliably detect a system leak equal to a 0.040 inch diameter orifice.

(5) *Other emission control systems.* Any deterioration or malfunction occurring in an engine system or component directly intended to control emissions, including but not necessarily limited to, the exhaust gas recirculation (EGR) system, if equipped, the secondary air system, if equipped, and the fuel control system, singularly resulting in exhaust emissions exceeding 1.5 times the applicable emission standard or FEL for NMHC, NO<sub>x</sub> (or NO<sub>x</sub>+NMHC, as applicable), CO or diesel PM. For engines equipped with a secondary air system, a functional check, as described in paragraph (b)(6) of this section, may

satisfy the requirements of this paragraph (b)(5) provided the manufacturer can demonstrate that deterioration of the flow distribution system is unlikely. This demonstration is subject to Administrator approval and, if the demonstration and associated functional check are approved, the diagnostic system must indicate a malfunction when some degree of secondary airflow is not detectable in the exhaust system during the check. For engines equipped with positive crankcase ventilation (PCV), monitoring of the PCV system is not necessary provided the manufacturer can demonstrate to the Administrator's satisfaction that the PCV system is unlikely to fail.

(6) *Other emission-related engine components.* Any other deterioration or malfunction occurring in an electronic emission-related engine system or component not otherwise described above that either provides input to or receives commands from the on-board computer and has a measurable impact on emissions; monitoring of components required by this paragraph (b)(6) must be satisfied by employing electrical circuit continuity checks and rationality checks for computer input components (input values within manufacturer specified ranges based on other available operating parameters), and functionality checks for computer output components (proper functional response to computer commands) except that the Administrator may waive such a rationality or functionality check where the manufacturer has demonstrated infeasibility. Malfunctions are defined as a failure of the system or component to meet the electrical circuit continuity checks or the rationality or functionality checks.

(7) *Performance of OBD functions.* Oxygen sensor or any other component deterioration or malfunction which renders that sensor or component incapable of performing its function as part of the OBD system must be detected and identified on vehicles so equipped.

(c) *Malfunction indicator light (MIL).* The OBD system must incorporate a malfunction indicator light (MIL) readily visible to the vehicle operator. When illuminated, the MIL must display "Check Engine," "Service Engine Soon," a universally recognizable en-

gine symbol, or a similar phrase or symbol approved by the Administrator. More than one general purpose malfunction indicator light for emission-related problems should not be used; separate specific purpose warning lights (e.g., brake system, fasten seat belt, oil pressure, etc.) are permitted. The use of red for the OBD-related malfunction indicator light is prohibited.

(d) *MIL illumination.* The MIL must illuminate and remain illuminated when any of the conditions specified in paragraph (b) of this section are detected and verified, or whenever the engine control enters a default or secondary mode of operation considered abnormal for the given engine operating conditions. The MIL must blink once per second under any period of operation during which engine misfire is occurring and catalyst damage is imminent. If such misfire is detected again during the following driving cycle (i.e., operation consisting of, at a minimum, engine start-up and engine shut-off) or the next driving cycle in which similar conditions are encountered, the MIL must maintain a steady illumination when the misfire is not occurring and then remain illuminated until the MIL extinguishing criteria of this section are satisfied. The MIL must also illuminate when the vehicle's ignition is in the "key-on" position before engine starting or cranking and extinguish after engine starting if no malfunction has previously been detected. If a fuel system or engine misfire malfunction has previously been detected, the MIL may be extinguished if the malfunction does not reoccur during three subsequent sequential trips during which similar conditions are encountered and no new malfunctions have been detected. Similar conditions are defined as engine speed within 375 rpm, engine load within 20 percent, and engine warm-up status equivalent to that under which the malfunction was first detected. If any malfunction other than a fuel system or engine misfire malfunction has been detected, the MIL may be extinguished if the malfunction does not reoccur during three subsequent sequential trips during which the monitoring system responsible for illuminating the MIL functions without detecting the

malfunction, and no new malfunctions have been detected. Upon Administrator approval, statistical MIL illumination protocols may be employed, provided they result in comparable timeliness in detecting a malfunction and evaluating system performance, i.e., three to six driving cycles would be considered acceptable.

(e) *Storing of computer codes.* The OBD system shall record and store in computer memory diagnostic trouble codes and diagnostic readiness codes indicating the status of the emission control system. These codes shall be available through the standardized data link connector per specifications as referenced in paragraph (h) of this section.

(1) A diagnostic trouble code must be stored for any detected and verified malfunction causing MIL illumination. The stored diagnostic trouble code must identify the malfunctioning system or component as uniquely as possible. At the manufacturer's discretion, a diagnostic trouble code may be stored for conditions not causing MIL illumination. Regardless, a separate code should be stored indicating the expected MIL illumination status (i.e., MIL commanded "ON," MIL commanded "OFF").

(2) For a single misfiring cylinder, the diagnostic trouble code(s) must uniquely identify the cylinder, unless the manufacturer submits data and/or engineering evaluations which adequately demonstrate that the misfiring cylinder cannot be reliably identified under certain operating conditions. For diesel engines only, the specific cylinder for which combustion cannot be detected need not be identified if new hardware would be required to do so. The diagnostic trouble code must identify multiple misfiring cylinder conditions; under multiple misfire conditions, the misfiring cylinders need not be uniquely identified if a distinct multiple misfire diagnostic trouble code is stored.

(3) The diagnostic system may erase a diagnostic trouble code if the same code is not re-registered in at least 40 engine warm-up cycles, and the malfunction indicator light is not illuminated for that code.

(4) Separate status codes, or readiness codes, must be stored in computer memory to identify correctly functioning emission control systems and those emission control systems which require further engine operation to complete proper diagnostic evaluation. A readiness code need not be stored for those monitors that can be considered continuously operating monitors (e.g., misfire monitor, fuel system monitor, etc.). Readiness codes should never be set to "not ready" status upon key-on or key-off; intentional setting of readiness codes to "not ready" status via service procedures must apply to all such codes, rather than applying to individual codes. Subject to Administrator approval, if monitoring is disabled for a multiple number of driving cycles (i.e., more than one) due to the continued presence of extreme operating conditions (e.g., ambient temperatures below 40 °F, or altitudes above 8000 feet), readiness for the subject monitoring system may be set to "ready" status without monitoring having been completed. Administrator approval shall be based on the conditions for monitoring system disablement, and the number of driving cycles specified without completion of monitoring before readiness is indicated.

(f) *Available diagnostic data.* (1) Upon determination of the first malfunction of any component or system, "freeze frame" engine conditions present at the time must be stored in computer memory. Should a subsequent fuel system or misfire malfunction occur, any previously stored freeze frame conditions must be replaced by the fuel system or misfire conditions (whichever occurs first). Stored engine conditions must include, but are not limited to: engine speed, open or closed loop operation, fuel system commands, coolant temperature, calculated load value, fuel pressure, vehicle speed, air flow rate, and intake manifold pressure if the information needed to determine these conditions is available to the computer. For freeze frame storage, the manufacturer must include the most appropriate set of conditions to facilitate effective repairs. If the diagnostic trouble code causing the conditions to be stored is erased in accordance with paragraph (d) of this section,

the stored engine conditions may also be erased.

(2) The following data in addition to the required freeze frame information must be made available on demand through the serial port on the standardized data link connector, if the information is available to the on-board computer or can be determined using information available to the on-board computer: Diagnostic trouble codes, engine coolant temperature, fuel control system status (closed loop, open loop, other), fuel trim, ignition timing advance, intake air temperature, manifold air pressure, air flow rate, engine RPM, throttle position sensor output value, secondary air status (upstream, downstream, or atmosphere), calculated load value, vehicle speed, and fuel pressure. The signals must be provided in standard units based on SAE specifications incorporated by reference in paragraph (h) of this section. Actual signals must be clearly identified separately from default value or limp home signals.

(3) For all OBD systems for which specific on-board evaluation tests are conducted (catalyst, oxygen sensor, etc.), the results of the most recent test performed by the vehicle, and the limits to which the system is compared must be available through the standardized data link connector per the appropriate standardized specifications as referenced in paragraph (h) of this section.

(4) Access to the data required to be made available under this section shall be unrestricted and shall not require any access codes or devices that are only available from the manufacturer.

(g) *Exceptions.* The OBD system is not required to evaluate systems or components during malfunction conditions if such evaluation would result in a risk to safety or failure of systems or components. Additionally, the OBD system is not required to evaluate systems or components during operation of a power take-off unit such as a dump bed, snow plow blade, or aerial bucket, etc.

(h) *Reference materials.* The OBD system shall provide for standardized access and conform with the following Society of Automotive Engineers (SAE) standards and/or the following

International Standards Organization (ISO) standards. The following documents are incorporated by reference, see § 86.1:

(1) SAE material. Copies of these materials may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

(i) SAE J1850 “Class B Data Communication Network Interface,” (Revised, May 2001) shall be used as the on-board to off-board communications protocol. All emission related messages sent to the scan tool over a J1850 data link shall use the Cyclic Redundancy Check and the three byte header, and shall not use inter-byte separation or check sums.

(ii) Basic diagnostic data (as specified in § 86.094–17(e) and (f)) shall be provided in the format and units in SAE J1979 “E/E Diagnostic Test Modes—Equivalent to ISO/DIS 15031–5: April 30, 2002”, (Revised, April 2002).

(iii) Diagnostic trouble codes shall be consistent with SAE J2012 “Diagnostic Trouble Code Definitions—Equivalent to ISO/DIS 15031–6: April 30, 2002”, (Revised, April 2002).

(iv) The connection interface between the OBD system and test equipment and diagnostic tools shall meet the functional requirements of SAE J1962 “Diagnostic Connector—Equivalent to ISO/DIS 15031–3: December 14, 2001” (Revised, April 2002).

(v) All acronyms, definitions and abbreviations shall be formatted according to SAE J1930 “Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms” Equivalent to ISO/TR 15031–2: April 30, 2002”, (Revised, April 2002).

(vi) All equipment used to interface, extract and display OBD-related information shall meet SAE J1978 “OBD II Scan Tool” Equivalent to ISO 15031–4: December 14, 2001”, (Revised, April 2002).

(vii) As an alternative to the above standards, heavy-duty vehicles may conform to the specifications of the SAE J1939 series of standards (SAE J1939–11, J1939–13, J1939–21, J1939–31, J1939–71, J1939–73, J1939–81).

(2) ISO materials. Copies of these materials may be obtained from the International Organization for Standardization, Case Postale 56, CH-1211 Geneva 20, Switzerland.

(i) ISO 9141-2 "Road vehicles—Diagnostic systems—Part 2: CARB requirements for interchange of digital information," (February 1, 1994) may be used as an alternative to SAE J1850 as the on-board to off-board communications protocol.

(ii) ISO 14230-4:2000(E) "Road vehicles—Diagnostic systems—KWP 2000 requirements for Emission-related systems", (June 1, 2000) may also be used as an alternative to SAE J1850.

(iii) ISO 15765-4.3:2001 "Road Vehicles-Diagnostics on Controller Area Network (CAN)—Part 4: Requirements for emission-related systems", (December 14, 2001) may also be used as an alternative to SAE J1850.

(3) Beginning with the 2008 model year and beyond, ISO 15765-4.3:2001 "Road Vehicles-Diagnostics on Controller Area Network (CAN)—Part 4: Requirements for emission-related systems", (December 14, 2001) shall be the only acceptable protocol used for standardized on-board to off-board communications for vehicles below 8500 pounds. For vehicles 8500 to 14000 pounds ISO 15765-4.3 or the SAE J1939 series of standards (SAE J1939-11, J1939-13, J1939-21, J1939-31, J1939-71, J1939-73, J1939-81). All other standardized on-board to off-board communications protocols: SAE J1850 "Class B Data Communication Network Interface," (Revised, May 2001) in (h)(1)(i), ISO 9141-2 "Road vehicles—Diagnostic systems—Part 2: CARB requirements for interchange of digital information," (February 1, 1994) in (h)(2)(i), and ISO 14230-4 "Road vehicles—Diagnostic systems—KWP 2000 requirements for Emission-related systems", (June 1, 2000) in paragraph (h)(2)(ii) of this section will at that time no longer be accepted.

(i) *Deficiencies and alternate fueled engines.* Upon application by the manufacturer, the Administrator may accept an OBD system as compliant even though specific requirements are not fully met. Such compliances without meeting specific requirements, or deficiencies, will be granted only if compli-

ance would be infeasible or unreasonable considering such factors as, but not limited to: technical feasibility of the given monitor and lead time and production cycles including phase-in or phase-out of engines or vehicle designs and programmed upgrades of computers. Unmet requirements should not be carried over from the previous model year except where unreasonable hardware or software modifications would be necessary to correct the deficiency, and the manufacturer has demonstrated an acceptable level of effort toward compliance as determined by the Administrator. Furthermore, EPA will not accept any deficiency requests that include the complete lack of a major diagnostic monitor ("major" diagnostic monitors being those for exhaust aftertreatment devices, oxygen sensor, engine misfire, evaporative leaks, and diesel EGR, if equipped), with the possible exception of the special provisions for alternate fueled engines. For alternate fueled heavy-duty engines (e.g. natural gas, liquefied petroleum gas, methanol, ethanol), beginning with the model year for which alternate fuel emission standards are applicable and extending through the 2006 model year, manufacturers may request the Administrator to waive specific monitoring requirements of this section for which monitoring may not be reliable with respect to the use of the alternate fuel. At a minimum, alternate fuel engines must be equipped with an OBD system meeting OBD requirements to the extent feasible as approved by the Administrator.

(j) *California OBDII compliance option.* For heavy-duty engines weighing 14,000 pounds GVWR or less, demonstration of compliance with California OBD II requirements (Title 13 California Code of Regulations §1968.2 (13 CCR 1968.2)), as modified, approved and filed on April 21, 2003, shall satisfy the requirements of this section, except that compliance with 13 CCR 1968.2(e)(4.2.2)(C), pertaining to 0.02 inch evaporative leak detection, and 13 CCR 1968.2(d)(1.4), pertaining to tampering protection, are not required to satisfy the requirements of this section. Also, the deficiency provisions of 13 CCR 1968.2(i) do not apply. The deficiency provisions of paragraph (i) of this section and the

evaporative leak detection requirement of paragraph (b)(4) of this section apply to manufacturers selecting this paragraph for demonstrating compliance. In addition, demonstration of compliance with 13 CCR 1968.2(e)(16.2.1)(C), to the extent it applies to the verification of proper alignment between the camshaft and crankshaft, applies only to vehicles equipped with variable valve timing.

(k) *Phase-in for heavy-duty engines.* Manufacturers of heavy-duty engines must comply with the OBD requirements in this section according to the following phase-in schedule, based on the percentage of projected engine sales within each category. The 2004 model year requirements in the following phase-in schedule are applicable only to heavy-duty Otto-cycle engines where the manufacturer has selected Otto-cycle Option 1 or Option 2 for alternative 2004 compliance according to § 86.005–01(c)(1) or (2). The 2005 through

2007 requirements in the following phase-in schedule apply to all heavy-duty engines intended for use in a heavy-duty vehicle weighing 14,000 pounds GVWR or less. Manufacturers may exempt 2005 model year diesel heavy-duty engines from the requirements of this section if the 2005 model year commences before July 31, 2004 from the requirements of this section. Manufacturers may exempt 2005 model year Otto-cycle heavy-duty engines and vehicles from the requirements of this section if the manufacturer has selected Otto-cycle Option 3 and if the 2005 model year commences before July 31, 2004. For the purposes of calculating compliance with the phase-in provisions of this paragraph (k), heavy-duty engines may be combined with heavy-duty vehicles subject to the phase-in requirements of paragraph § 86.1806–05(l). The OBD Compliance phase-in table follows:

OBD COMPLIANCE PHASE-IN FOR HEAVY-DUTY ENGINES INTENDED FOR USE IN A HEAVY-DUTY VEHICLE WEIGHING 14,000 POUNDS GVWR OR LESS

Model year	Otto-cycle phase-in based on projected sales	Diesel Phase-in based on projected sales
2004 MY .....	Applicable only to Otto-cycle engines complying with Options 1 or 2; 40% compliance; alternative fuel waivers available.	
2005 MY .....	60% compliance; alternative fuel waivers available.	50% compliance; alternative fuel waivers available.
2006 MY .....	80% compliance; alternative fuel waivers available.	50% compliance; alternative fuel waivers available.
2007 MY .....	80% compliance; alternative fuel waivers available.	100% compliance.
2008+ MY .....	100% compliance .....	100% compliance.

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**§ 86.007–11 Emission standards and supplemental requirements for 2007 and later model year diesel heavy-duty engines and vehicles.**

This section applies to new 2007 and later model year diesel HDEs. Section 86.007–11 includes text that specifies requirements that differ from § 86.004–11. Where a paragraph in § 86.004–11 is identical and applicable to § 86.007–11, this may be indicated by specifying the corresponding paragraph and the statement “[Reserved]. For guidance see § 86.004–11.”.

(a)(1) Exhaust emissions from new 2007 and later model year diesel HDEs shall not exceed the following:

(i) *Oxides of Nitrogen (NO<sub>x</sub>)*. (A) 0.20 grams per brake horsepower-hour (0.075 grams per megajoule).

(B) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the NO<sub>x</sub> and NO<sub>x</sub> plus NMHC emissions ABT programs for HDEs, within the restrictions described in § 86.007–15 or § 86.004–15. If the manufacturer elects to include engine families in any of these programs, the NO<sub>x</sub> FELs may not exceed the following FEL caps: 2.00 grams per brake horsepower-hour (0.75 grams per megajoule) for model years before 2010; 0.50 grams per brake horsepower-hour (0.19 grams per megajoule) for model