useful life of the of the candidate in-use vehicles and must cover the breadth of the manufacturer's product line that will be covered by the durability procedure. Manufacturers not selecting Options 1 or 2 described in §86.005–10(f) may certify Otto-cycle engines using the provisions contained in §86.094–26(c)(2) rather than those contained in this paragraph (c)(2) for 2004 model year engine families certified using carry-over durability data, except for those engines used for early credit banking as allowed in §86.000–15(k).

(i) Service accumulation on engines, subsystems, or components selected by the manufacturer under §86.094–24(c)(3)(i). The manufacturer determines the form and extent of this service accumulation, consistent with good engineering practice, and describes it in the application for certification.

(ii) Dynamometer service accumulation on emission data engines selected under §86.094–24(b)(2) or (3). The manufacturer determines the engine operating schedule to be used for dynamometer service accumulation, consistent with good engineering practice. A single engine operating schedule shall be used for all engines in an engine family-control system combination. Operating schedules may be different for different combinations.

(3) Exhaust emission deterioration factors will be determined on the basis of the service accumulation described in §86.000–26(b)(2)(i) and related testing, according to the manufacturer's procedures.

(4) The manufacturer shall determine, for each engine family, the number of hours at which the engine system combination is stabilized for emission-data testing. The manufacturer shall maintain, and provide to the Administrator if requested, a record of the rationale used in making this determination. The manufacturer may elect to accumulate 125 hours on each test engine within an engine family without making a determination. Any engine used to represent emission-data engine selections under §86.094–24(b)(2) shall be equipped with an engine system combination that has accumulated at least the number of hours determined under this paragraph. Complete exhaust emission tests shall be conducted for each emission-data engine selection under §86.094–24(b)(2). Evaporative emission controls must be connected, as described in 40 CFR part 1065, subpart F. The Administrator may determine under §86.094–24(f) that no testing is required.

(d)(1)–(d)(2)(i) [Reserved]. For guidance see §86.094–26.

(d)(2)(ii) [Reserved]. For guidance see §86.000–26.

(d)(3) [Reserved]. For guidance see §86.094–26.

(d)(4)–(5) [Reserved].

(d)(6) [Reserved]. For guidance see §86.094–26.

[65 FR 59947, Oct. 6, 2000, as amended at 70 FR 40432, July 13, 2005]

§86.004–28 Compliance with emission standards.

Section 86.004–28 includes text that specifies requirements that differ from §86.094–28, §86.098–28, §86.000–28 or §86.001–28. Where a paragraph in §86.094–28, §86.098–28, §86.000–28 or §86.001–28 is identical and applicable to §86.004–28, this may be indicated by specifying the corresponding paragraph and the statement ''[Reserved]. For guidance see §86.094–28.'' or ''[Reserved]. For guidance see §86.098–28.'' or ''[Reserved]. For guidance see §86.000–28.'' or ''[Reserved]. For guidance see §86.001–28.''

(a)(1)–(a)(2) [Reserved. For guidance see §86.000–28.

(a)(3) [Reserved]. For guidance see §86.094–28.

(a)(4) introductory text [Reserved]. For guidance see §86.098–28.

(a)(4)(i) [Reserved]. For guidance see §86.000–28.

(a)(4)(i)(A)–(a)(4)(i)(B)(*2*)(*i*) [Reserved. For guidance see §86.094–28.

(a)(4)(i)(B)(*2*)(*ii*) [Reserved]. For guidance see §86.000–28.

(a)(4)(i)(B)(*2*)(*iii*)–(a)(4)(i)(B)(*2*)(*iv*) [Reserved]. For guidance see §86.094–28.

(a)(4)(i)(C)–(a)(4)(i)(D)(*2*) [Reserved]. For guidance see §86.098–28.

(a)(4)(ii)(A)(*1*)–(a)(4)(ii)(A)(*2*) [Reserved]. For guidance see §86.000–28.

(a)(4)(ii)(B)–(a)(4)(ii)(C) [Reserved]. For guidance see §86.098–28.

(a)(4)(iii) [Reserved]. For guidance see §86.000–28.

(a)(4)(iv) [Reserved]. For guidance see § 86.094–28.

(a)(4)(v) [Reserved]. For guidance see § 86.098–28.

(a)(5)–(a)(6) [Reserved]. For guidance see § 86.094–28.

(a)(7) introductory text [Reserved]. For guidance see § 86.098–28.

(a)(7)(i) [Reserved]. For guidance see § 86.000–28.

(a)(7)(ii) [Reserved]. For guidance see § 86.094–28.

(b)(1) This paragraph (b) applies to light-duty trucks.

(2) Each exhaust, evaporative and refueling emission standard (and family emission limits, as appropriate) of § 86.004–9 applies to the emissions of vehicles for the appropriate useful life as defined in §§ 86.098–2 and 86.004–9.

(b)(3)–(b)(4)(i) [Reserved]. For guidance see § 86.094–28.

(b)(4)(ii)–(b)(6) [Reserved]. For guidance see § 86.000–28.

(b)(7)(i)–(b)(9) [Reserved]. For guidance see § 86.001–28.

(c)(1) Paragraph (c) of this section applies to heavy-duty engines.

(2) The applicable exhaust emission standards (or family emission limits, as appropriate) for Otto-cycle engines and for diesel-cycle engines apply to the emissions of engines for their useful life.

(3) Since emission control efficiency generally decreases with the accumulation of service on the engine, deterioration factors will be used in combination with emission data engine test results as the basis for determining compliance with the standards.

(4)(i) Paragraph (c)(4) of this section describes the procedure for determining compliance of an engine with emission standards (or family emission limits, as appropriate), based on deterioration factors supplied by the manufacturer. Deterioration factors shall be established using applicable emissions test procedures. NO_X plus NMHC deterioration factors shall be established based on the sum of the pollutants. When establishing deterioration factors for NO_X plus NMHC, a negative deterioration (emissions decrease from the official exhaust emissions test result) for one pollutant may not offset deterioration of the other pollutant. Where negative deterioration occurs for NO_X and/or NMHC, the official exhaust emission test result shall be used for purposes of determining the NO_X plus NMHC deterioration factor.

(ii) Separate exhaust emission deterioration factors, determined from tests of engines, subsystems, or components conducted by the manufacturer, shall be supplied for each engine-system combination. For Otto-cycle engines, separate factors shall be established for transient NMHC (NMHCE), CO, NO_X. NO_X plus NMHC, and idle CO, for those engines utilizing aftertreatment technology (e.g., catalytic converters). For diesel-cycle engines, separate factors shall be established for transient NMHC (NMHCE), CO, NO_X. NO_X plus NMHC and exhaust particulate. For diesel-cycle smoke testing, separate factors shall also be established for the acceleration mode (designated as ''A''), the lugging mode (designated as ''B''), and peak opacity (designated as ''C'').

(iii)(A) Paragraphs (c)(4)(iii)(A) (*1*) and (*2*) of this section apply to Otto-cycle HDEs.

(*1*) Otto-cycle HDEs not utilizing aftertreatment technology (e.g., catalytic converters). For transient NMHC (NMHCE), CO, NO_X. the official exhaust emission results for each emission data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(*2*) Otto-cycle HDEs utilizing aftertreatment technology (*e.g.*, catalytic converters). For transient NMHC (NMHCE), CO, NO_X. and for idle CO, the official exhaust emission results for each emission data engine at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor, except as otherwise provided in paragraph (c)(4)(iii)(A)(*3*) of this section. The deterioration factor must be calculated by dividing the exhaust emissions at full useful life by the stabilized mileage emission level (reference § 86.096–26(c)(4), e.g., 125 hours). However, if the deterioration factor supplied by the manufacturer is less than one, it shall be one for purposes of this paragraph (c)(4)(iii)(A)(*2*).

(*3*) An Otto-cycle heavy-duty engine manufacturer who believes that a deterioration factor derived using the calculation methodology described in paragraph (c)(4)(iii)(4)(A)(*2*) of this section are significantly unrepresentative for one or more engine families (either too high or too low) may petition the Administrator to allow for the use of an additive rather than a multiplicative deterioration factor. This petition must include full rationale behind the request together with any supporting data or other evidence. Based on this or other information the Administration may allow for an alternative procedure. Any petition should be submitted in a timely manner, to allow adequate time for a thorough evaluation. Manufacturers using an additive deterioration factor under this paragraph (c)(4)(iii)(A)(*3*) must perform in-use verification testing to determine if the additive deterioration factor reasonably predicts actual in-use emissions. The plan for the in-use verification testing must be approved by the Administrator as part of the approval process described in this paragraph (c)(4)(iii)(4)(A)(*3*) prior to the use of the additive deterioration factor. The Administrator may consider the results of the in-use verification testing both in certification and in-use compliance programs.

(B) Paragraph (c)(4)(iii)(B) of this section applies to diesel-cycle HDEs.

(*1*) Additive deterioration factor for exhaust emissions. Except as specified in paragraph (c)(4)(iii)(B)(2) of this section, use an additive deterioration factor for exhaust emissions. An additive deterioration factor for a pollutant is the difference between exhaust emissions at the end of the useful life and exhaust emissions at the low-hour test point. In these cases, adjust the official emission results for each tested engine at the selected test point by adding the factor to the measured emissions. If the factor is less than zero, use zero. Additive deterioration factors must be specified to one more decimal place than the applicable standard.

(*2*) Multiplicative deterioration factor for exhaust emissions. Use a multiplicative deterioration factor if good engineering judgment calls for the deterioration factor for a pollutant to be the ratio of exhaust emissions at the end of the useful life to exhaust emissions at the low-hour test point. For example, if you use aftertreatment technology that controls emissions of a pollutant proportionally to engine-out emissions, it is often appropriate to use a multiplicative deterioration factor. Adjust the official emission results for each tested engine at the selected test point by multiplying the measured emissions by the deterioration factor. If the factor is less than one, use one. A multiplicative deterioration factor may not be appropriate in cases where testing variability is significantly greater than engine-to-engine variability. Multiplicative deterioration factors must be specified to one more significant figure than the applicable standard.

(*3*) Diesel-cycle HDEs only. For acceleration smoke (''A''), lugging smoke (''B''), and peak smoke (''C''), the official exhaust emission results for each emission data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(*4*) The emission values to compare with the standards (or family emission limits, as appropriate) shall be the adjusted emission values of paragraph (c)(4)(iii) of this section, rounded to the same number of significant figures as contained in the applicable standard in accordance with ASTM E 29–93a (as referenced in § 86.094–28 (a)(4)(i)(B)(2)(ii)), for each emission data engine.

(*5*) and (*6*) [Reserved]

(*7*) Every test engine of an engine family must comply with all applicable standards (or family emission limits, as appropriate), as determined in paragraph (c)(4)(iv) of this section, before any engine in that family will be certified.

(*8*) For the purposes of setting an NMHC plus NO_X certification level or FEL for a diesel-fueled engine family, the manufacturer may use one of the following options for the determination of NMHC for an engine family. The manufacturer must declare which option is used in its application for certification of that engine family.

(i) THC may be used in lieu of NMHC for the standards set forth in § 86.004–11.

(ii) The manufacturer may choose its own method to analyze methane with prior approval of the Administrator.

(iii) The manufacturer may assume that two percent of the measured THC is methane (NMHC = 0.98 × THC).

(d)(1) Paragraph (d) of this section applies to heavy-duty vehicles equipped with gasoline-fueled or methanol-fueled engines.

(2) The applicable evaporative emission standards in this subpart apply to the emissions of vehicles for their useful life.

(3)(i) For vehicles with a GVWR of up to 26,000 pounds, because it is expected that emission control efficiency will change during the useful life of the vehicle, an evaporative emission deterioration factor shall be determined from the testing described in § 86.098–23(b)(3) for each evaporative emission family-evaporative emission control system combination to indicate the evaporative emission control system deterioration during the useful life of the vehicle (minimum 50,000 miles). The factor shall be established to a minimum of two places to the right of the decimal.

(ii) For vehicles with a GVWR of greater than 26,000 pounds, because it is expected that emission control efficiency will change during the useful life of the vehicle, each manufacturer's statement as required in § 86.098–23(b)(4)(ii) shall include, in accordance with good engineering practice, consideration of control system deterioration.

(4) The evaporative emission test results, if any, shall be adjusted by the addition of the appropriate deterioration factor, provided that if the deterioration factor as computed in paragraph (d)(3) of this section is less than zero, that deterioration factor shall be zero for the purposes of this paragraph.

(5) The emission level to compare with the standard shall be the adjusted emission level of paragraph (d)(4) of this section. Before any emission value is compared with the standard, it shall be rounded, in accordance with ASTM E 29–93a (as referenced in § 86.094–28 (a)(4)(i)(B)(2)(ii)), to two significant figures. The rounded emission values may not exceed the standard.

(6) Every test vehicle of an evaporative emission family must comply with the evaporative emission standard, as determined in paragraph (d)(5) of this section, before any vehicle in that family may be certified.

(e) [Reserved]

(f)–(g)(3) [Reserved]. For guidance see § 86.001–28.

(g)(4) Vehicles certified to the refueling emission standard under this provision shall not be counted in the sales percentage compliance determinations for the 2004, 2005 and subsequent model years.

(h) [Reserved]. For guidance see § 86.001–28.

(i) Emission results from heavy-duty engines equipped with exhaust aftertreatment may need to be adjusted to account for regeneration events. This provision only applies for engines equipped with emission controls that are regenerated on an infrequent basis. For the purpose of this paragraph (i), the term ''regeneration'' means an event during which emissions levels change while the aftertreatment performance is being restored by design. Examples of regenerations are increasing exhaust gas temperature to remove sulfur from an adsorber or increasing exhaust gas temperature to oxidize PM in a trap. For the purpose of this paragraph (i), the term ''infrequent'' means having an expected frequency of less than once per transient test cycle. Calculation and use of adjustment factors are described in paragraphs (i)(1)–(i)(5) of this section.

(1) *Development of adjustment factors.* Manufacturers must develop separate pairs of adjustment factors (an upward adjustment factor and a downward adjustment factor) for each pollutant based on measured emission data and observed regeneration frequency. Adjustment factors may be carried-over to subsequent model years or carried-across to other engine families only where the Administrator determines that such carry-over or carry-across is consistent with good engineering judgment. Adjustment factors should generally apply to an entire engine family, but manufacturers may develop separate adjustment factors for different

engine configurations within an engine family. All adjustment factors for regeneration are additive.

(2) *Calculation of adjustment factors.* The adjustment factors are calculated from the following parameters: the measured emissions from a test in which the regeneration occurs (EF_H), the measured emissions from a test in which the regeneration does not occur (EF_L), and the frequency of the regeneration event in terms of fraction of tests during which the regeneration occurs (F). The average emission rate (EF_A) is calculated as:

$EF_A = (F)(EF_H) + (1 - F)(EF_L)$

(i) The upward adjustment factor (UAF) is calculated as: $UAF = EF_A - EF_L$.

(ii) The downward adjustment factor (DAF) is calculated as: $DAF = EF_A - EF_H$.

(3) *Use of adjustment factors.* Upward adjustment factors are added to measured emission rates for all tests in which the regeneration does not occur. Downward adjustment factors are added to measured emission rates for all tests in which the regeneration occurs. The occurrence of the regeneration must be identified in a manner that is readily apparent during all testing. Where no regeneration is identified, the upward adjustment factor shall be applied.

(4) *Sample calculation.* If EF_L is 0.10 g/bhp-hr, EF_H is 0.50 g/bhp-hr, and F is 0.1 (i.e., the regeneration occurs once for each ten tests), then:

$EF_A = (0.1)(0.5 \text{ g/bhp-hr}) + (1.0 - 0.1)(0.1 \text{ g/bhp-hr}) = 0.14 \text{ g/bhp-hr}$

$UAF = 0.14 \text{ g/bhp-hr} - 0.10 \text{ g/bhp-hr} = 0.04 \text{ g/bhp-hr}$

$DAF = 0.14 \text{ g/bhp-hr} - 0.50 \text{ g/bhp-hr} = -0.36 \text{ g/bhp-hr}$

(5) *Options.* (i) A manufacturer may elect to omit adjustment factors for one or more of its engine families (or configurations) because the effect of the regeneration is small, or because it is not practical to identify when regenerations occur. In these cases, no upward or downward adjustment factor shall be added, and the manufacturer is liable for compliance with the emission standards for all tests, without regard to whether a regeneration occurs.

(ii) Upon request by the manufacturer, the Administrator may account for regeneration events differently than is provided in this paragraph (i). However, this option only applies for events that occur extremely infrequently, and which cannot be practically addressed using the adjustment factors described in this paragraph (i).

[61 FR 54890, Oct. 22, 1996, as amended at 62 FR 54726, Oct. 21, 1997; 65 FR 59948, Oct. 6, 2000; 66 FR 5159, Jan. 18, 2001; 71 FR 31486, Aug. 30, 2006]

EFFECTIVE DATE NOTE: At 77 FR 34145, June 8, 2012, §86.004–28 was amended by revising the introductory text of paragraph (i), effective August 7, 2012. For the convenience of the user, the revised text is set forth as follows:

§ 86.004–28 Compliance with emission standards.

* * * * *

(i) Emission results from heavy-duty engines equipped with exhaust aftertreatment may need to be adjusted to account for regeneration events. This provision only applies for engines equipped with emission controls that are regenerated on an infrequent basis. For the purpose of this paragraph (i), the term ''regeneration'' means an event during which emission levels change while the aftertreatment performance is being restored by design. Examples of regenerations are increasing exhaust gas temperature to remove sulfur from an adsorber or increasing exhaust gas temperature to oxidize PM in a trap. For the purpose of this paragraph (i), the term ''infrequent'' means having an expected frequency of less than once per transient test cycle. Calculation and use of adjustment factors are described in paragraphs (i)(1) through (5) of this section. If your engine family includes engines with one or more AECDs for emergency vehicle applications approved under paragraph (4) of the definition of defeat device, do not consider additional regenerations resulting from those AECDs when calculating emission factors or frequencies under this paragraph (i).

* * * * *

§ 86.004–30 Certification.

Section 86.004–30 includes text that specifies requirements that differ from §86.094–30, §86.095–30, §86.096–30, §86.098–30 or §86.001–30. Where a paragraph in §86.094–30, §86.095–30, §86.096–30, §86.098–30 or §86.001–30 is identical and applicable to §86.004–30, this may be indicated