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40 C.F.R. § 86.1823-08

Durability demonstration procedures for exhaust emissions.

This section describes durability demonstration procedures for exhaust emissions. Eligible small-volume manufacturers or small-volume test groups may optionally meet the requirements of §§ 86.1826 and 86.1838 instead of the requirements of paragraphs (a) through (m) of this section. A separate durability demonstration is required for each durability group.

(a) *Durability program objective.* The durability program must predict an expected in-use emission deterioration rate and emission level that effectively represents a significant majority of the distribution of emission levels and deterioration in actual use over the full and intermediate useful life of candidate in-use vehicles of each vehicle design which uses the durability program.

(b) *Required durability demonstration.* Manufacturers must conduct a durability demonstration for each durability group using a procedure specified in either paragraph (c), (d), or (e) of this section.

(c) *Standard whole-vehicle durability procedure.* This procedure consists of conducting mileage accumulation and periodic testing on the durability data vehicle, selected under the provisions of § 86.1822 described as follows:

(1) Mileage accumulation must be conducted using the standard road cycle (SRC). The SRC is described in appendix V of this part.

(i) Mileage accumulation on the SRC may be conducted on a track or on a chassis mileage accumulation dynamometer. Alternatively, the entire engine and emission control system may be aged on an engine dynamometer using methods that will replicate the aging that occurs on the road for that vehicle following the SRC.

(ii) The fuel used for mileage accumulation must comply with the mileage accumulation fuel provisions of § 86.113 for the applicable fuel type (e.g., gasoline or diesel fuel).

(iii) The DDV must be ballasted to a minimum of the loaded vehicle weight for light-duty vehicles and light light-duty trucks and a minimum of the ALVW for all other vehicles.

(iv) The mileage accumulation dynamometer must be setup as follows:

(A) The simulated test weight will be the equivalent test weight specified in § 86.129 using a weight basis of the loaded vehicle weight for light-duty vehicles and light light-duty trucks, and ALVW for all other vehicles.

(B) The road force simulation will be determined according to the provisions of § 86.129.

(C) The manufacturer will control the vehicle, engine, and/or dynamometer as appropriate to follow the SRC using good engineering judgement.

(2) Mileage accumulation must be conducted for at least 75% of the applicable full useful life mileage period specified in § 86.1805. If the mileage accumulation is less than 100% of the full useful life mileage, then the DF calculated according to the procedures of paragraph (f)(1)(ii) of this section must be based upon a line projected to the full-useful life mileage using the upper 80 percent statistical confidence limit calculated from the emission data.

(3) If a manufacturer elects to calculate a DF pursuant to paragraph (f)(1) of this section, then it must conduct at least one FTP emission test at each of five different mileage points selected using good engineering judgement. Additional testing may be conducted by the manufacturer using good engineering judgement. The required testing must include testing at 5,000 miles and at the highest mileage point run during mileage accumulation (e.g. the full useful life mileage). Different testing plans may be used providing that the manufacturer determines, using good engineering judgement, that the alternative plan would result in an equivalent or superior level of confidence in the accuracy of the DF calculation compared to the testing plan specified in this paragraph.

(d) *Standard bench-aging durability procedure.* This procedure is not applicable to diesel fueled vehicles or vehicles which do not use a catalyst as the principle after-treatment emission control device. This procedure requires installation of the catalyst-plus-oxygen-sensor system on a catalyst aging bench. Aging on the bench is conducted by following the standard bench cycle (SBC) for the period of time calculated from the bench aging time (BAT) equation. The BAT equation requires, as input, catalyst time-at-temperature data measured on the SRC.

(1) *Standard bench cycle (SBC).* Standard catalyst bench aging is conducted following the SBC

(i) The SBC must be run for the period of time calculated from the BAT equation.

(ii) The SBC is described in appendix VII to part 86.

(2) *Catalyst time-at-temperature data* (i) Catalyst temperature must be measured during at least two full cycles of the SRC.

(ii) Catalyst temperature must be measured at the highest temperature location in the hottest catalyst on the DDV. Alternatively, the temperature may be measured at another location providing that it is adjusted to represent the temperature measured at the hottest location using good engineering judgement.

(iii) Catalyst temperature must be measured at a minimum rate of one hertz (one measurement per second).

(iv) The measured catalyst temperature results must be tabulated into a histogram with temperature bins of no larger than 25 °C.

(3) *Bench-aging time.* Bench aging time is calculated using the bench aging time (BAT) equation as follows:

t_e for a temperature bin = t_h e((R/Tr)-(R/Tv))Total t_e = Sum of t_e over all the temperature bins Bench-Aging Time = A (Total t_e)

Where:

A = 1.1 This value adjusts the catalyst aging time to account for deterioration from sources other than thermal aging of the catalyst. R = Catalyst thermal reactivity coefficient. You may use a default value of 17,500 for the SBC. t_h = The time (in hours) measured within the prescribed temperature bin of the vehicle's catalyst temperature histogram adjusted to a full useful life basis e.g., if the histogram represented 400 miles, and full useful life was

100,000 miles; all histogram time entries would be multiplied by 250 (100000/400). Total t_e = The equivalent time (in hours) to age the catalyst at the temperature of T_r on the catalyst aging bench using the catalyst aging cycle to produce the same amount of deterioration experienced by the catalyst due to thermal deactivation over the vehicle's full useful life. t_e for a bin = The equivalent time (in hours) to age the catalyst at the temperature of T_r on the catalyst aging bench using the catalyst aging cycle to produce the same amount of deterioration experienced by the catalyst due to thermal deactivation at the temperature bin of T_v over the vehicle's full useful life. T_r = The effective reference temperature (in °K) of the catalyst on the catalyst bench run on the bench aging cycle. The effective temperature is the constant temperature that would result in the same amount of aging as the various temperatures experienced during the bench aging cycle. T_v = The mid-point temperature (in °K) of the temperature bin of the vehicle on-road catalyst temperature histogram.

(4) *Effective reference temperature on the SBC.* The effective reference temperature of the standard bench cycle (SBC) is determined for the actual catalyst system design and actual aging bench which will be used using the following procedures: