bed at the location where the highest temperature occurs in the hottest catalyst (typically this occurs approximately one-inch behind the front face of the first catalyst at its longitudinal axis). Alternatively, the feed gas temperature just before the catalyst inlet face may be measured and converted to catalyst bed temperature using a linear transform calculated from correlation data collected on the catalyst design and aging bench to be used in the aging process. The catalyst temperature must be stored digitally at the speed of 1 hertz (one measurement per second).

5. Air/Fuel Measurement

Provisions must be made for the measurement of the air/fuel (A/F) ratio (such as a wide-range oxygen sensor) as close as possible to the catalyst inlet and outlet flanges. The information from these sensors must be stored digitally at the speed of 1 hertz (one measurement per second).

6. Exhaust Flow Balance

Provisions must be made to assure that the proper amount of exhaust (measured in grams/second at stoichiometry, with a tolerance of ±5 grams/second) flows through each catalyst system that is being aged on the bench. The proper flow rate is determined based upon the exhaust flow that would occur in the original vehicle's engine at the steady state engine speed and load selected for the bench aging in paragraph (7).

7. Setup

a. The engine speed, load, and spark timing are selected to achieve a catalyst bed temperature of 800 °C (±10 °C) at steady-state stoichiometric operation.

b. The air injection system is set to provide the necessary air flow to produce 3.0% oxygen (±0.1%) in the steady-state stoichiometric exhaust stream just in front of the first catalyst. A typical reading at the upstream A/F measurement point (required in paragraph 5) is lambda 1.16 (which is approximately 3% oxygen).

c. With the air injection on, set the ''Rich'' A/F ratio to produce a catalyst bed temperature of 890 °C (±10 °C). A typical A/F value for this step is lambda 0.94 (approximately 2% CO).

8. Aging Cycle

The standard bench aging procedures use the standard bench cycle (SBC) which is described in Appendix VII to Part 86. The SBC is repeated until the amount of aging calculated from the bench aging time (BAT) equation [ref. §86.1823–08 (d)(3)] is achieved.

9. Quality Assurance

a. The temperatures and A/F ratio information that is required to be measured in paragraphs (4) and (5) shall be reviewed periodically (at least every 50 hours) during aging. Necessary adjustments shall be made to assure that the SBC is being appropriately followed throughout the aging process.

b. After the aging has been completed, the catalyst time-at-temperature collected during the aging process shall be tabulated into a histogram with temperature bins of no larger than 10 °C. The BAT equation and the calculated effective reference temperature for the aging cycle [ref. §86.1823–08(d)] will be used to determine if the appropriate amount of thermal aging of the catalyst has in fact occurred. Bench aging will be extended if the thermal effect of the calculated aging time is not at least 95% of the target thermal aging.

10. Startup and Shutdown

Care should be taken to assure that the maximum catalyst temperature for rapid deterioration (*e.g.*, 1050 °C) does not occur during startup or shutdown. Special low temperature startup and shutdown procedures may be used to alleviate this concern.

[71 FR 2837, Jan. 17, 2006]

Appendix IX to Part 86—Experimentally Determining the R-Factor for Bench Aging Durability Procedures

The R-Factor is the catalyst thermal reactivity coefficient used in the bench aging time (BAT) equation [Ref. §86.1826–08(d)(3)]. Manufacturers may determine the value of R experimentally using the following procedures.

1. Using the applicable bench cycle and aging bench hardware, age several catalysts (minimum of 3 of the same catalyst design) at different control temperatures between the normal operating temperature and the damage limit temperature. Measure emissions (or catalyst inefficiency (1-catalyst efficiency)) for each constituent. Assure that the final testing yields data between one- and two-times the standard.

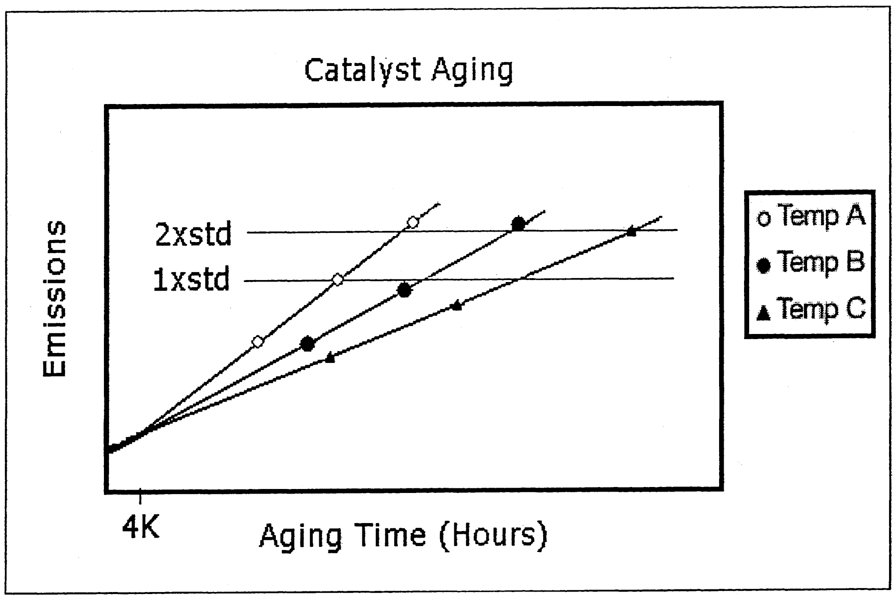
2. Estimate the value of R and calculate the effective reference temperature (T_r) for the bench aging cycle for each control temperature according to the procedure described in §86.1826–08(d)(4).

3. Plot emissions (or catalyst inefficiency) versus aging time for each catalyst. Calculate the least-squared best-fit line through the data. For the data set to be useful for this purpose the data should have an approximately common intercept between 0 and 4000 miles. See the following graph for an example.

4. Calculate the slope of the best-fit line for each aging temperature.

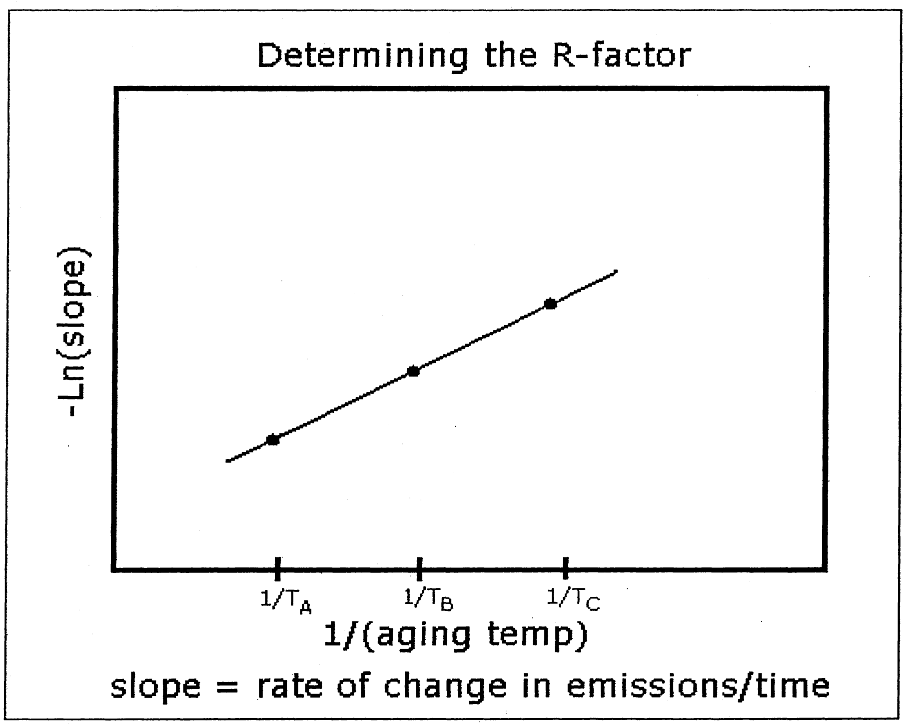
5. Plot the natural log (ln) of the slope of each best-fit line (determined in step 4)

along the vertical axis, versus the inverse of aging temperature (1/(aging temperature, deg K)) along the horizontal axis, Calculate the least-squared best-fit lines through the data. The slope of the line is the R-factor. See the following graph for an example.



6. Compare the R-factor to the initial value that was used in Step 2. If the calculated R-factor differs from the initial value by more than 5%, choose a new R-factor that is between the initial and calculated values, then repeat Steps 2–6 to derive a new R-factor. Repeat this process until the calculated R-factor is within 5% of the initially assumed R-factor.

7. Compare the R-factor determined separately for each constituent. Use the lowest R-factor (worst case) for the BAT equation.



[71 FR 2837, Jan. 17, 2006]

Appendix X to Part 86—Sampling Plans for Selective Enforcement Auditing of Heavy-Duty Engines and Light-Duty Trucks

TABLE 1—SAMPLING PLAN CODE LETTER

Annual sales	Code letter
50–99	A.
100–299	B.
300–499	C.
500 or greater	D.

TABLE 2—SAMPLING PLAN FOR CODE LETTER "A"

[Sample inspection criteria]

Stage	Pass No.	Fail No.	Stage	Pass No.	Fail No.
1	(1)	(2)	16	6	11
2	(1)	(2)	17	7	12
3	(1)	(2)	18	7	12
4	0	(2)	19	8	13
5	0	(2)	20	8	13
6	1	6	21	9	14

TABLE 2—SAMPLING PLAN FOR CODE LETTER "A"—Continued

[Sample inspection criteria]

Stage	Pass No.	Fail No.	Stage	Pass No.	Fail No.
7	1	7	22	10	14
8	2	7	23	10	15
9	2	8	24	11	15
10	3	8	25	11	16
11	3	8	26	12	16
12	4	9	27	12	17
13	5	10	28	13	17
14	5	10	29	14	17
15	6	11	30	16	17

[1] Test sample passing not permitted at this stage.
[2] Test sample failure not permitted at this stage.

TABLE 3—SAMPLING PLAN FOR CODE LETTER "B"

[Sample Inspection Criteria]

Stage	Pass No.	Fail No.
1	(1)	(2)
2	(1)	(2)
3	(1)	(2)
4	(1)	(2)
5	0	(2)
6	1	6