

§ 51.373

40 CFR Ch. I (7-1-99 Edition)

the 5-year period. All other requirements shall take effect within 24 months of the date EPA notifies the State that it is in violation of the ozone or CO standard or any earlier date specified in the State plan. The phase-in allowances of § 51.373(c) of this subpart shall not apply.

[57 FR 52987, Nov. 5, 1992, as amended at 60 FR 1738, Jan. 5, 1995; 60 FR 48036, Sept. 18, 1995; 61 FR 40946, Aug. 6, 1996; 61 FR 44119, Aug. 27, 1996]

§ 51.373 Implementation deadlines.

I/M programs shall be implemented as expeditiously as practicable.

(a) Decentralized basic programs shall be fully implemented by January 1, 1994, and centralized basic programs shall be fully implemented by July 1, 1994. More implementation time may be approved by the Administrator if an enhanced I/M program is implemented.

(b) For areas newly required to implement basic I/M after promulgation of this subpart (as a result of failure to attain, reclassification, or redesignation) decentralized programs shall be fully implemented within one year of obtaining legal authority. Centralized programs shall be fully implemented within two years of obtaining legal authority. More implementation time may be approved by the Administrator if an enhanced I/M program is implemented.

(c) All requirements related to enhanced I/M programs shall be implemented by January 1, 1995, with the following exceptions.

(1) Areas switching from an existing test-and-repair network to a test-only network may phase in the change between January of 1995 and January of 1996. Starting in January of 1995 at least 30% of the subject vehicles shall participate in the test-only system (in States with multiple I/M areas, implementation is not required in every area by January 1995 as long as statewide, 30% of the subject vehicles are involved in testing) and shall be subject to the new test procedures (including the evaporative system checks, visual inspections, and tailpipe emission tests). By January 1, 1996, all applicable vehicle model years and types shall be included in the test-only system. During the phase-in period, all requirements of

this subpart shall be applied to the test-only portion of the program; existing requirements may continue to apply for the test-and-repair portion of the program until it is phased out by January 1, 1996.

(2) Areas starting new test-only programs and those with existing test-only programs may also phase in the new test procedures between January 1, 1995 and January 1, 1996. Other program requirements shall be fully implemented by January 1, 1995.

(d) In the case of areas newly required to implement enhanced I/M after promulgation of this subpart (as a result of failure to attain, reclassification, or nonattainment designation) enhanced I/M shall be implemented within 24 months of obtaining legal authority.

(e) Legal authority for the implementing agency or agencies to implement and enforce an I/M program consistent with this subpart shall be obtained from the State legislature or local governing body in the first legislative session after November 5, 1992, or after being newly required to implement or upgrade an I/M program as in paragraph (b) or (c) of this section, including sessions already in progress if at least 21 days remain before the final bill submittal deadline.

(f) Areas that choose to implement an enhanced I/M program only meeting the requirements of § 51.351(h) shall fully implement the program no later than July 1, 1999. The availability and use of this late start date does not relieve the area of the obligation to meet the requirements of § 51.351(h)(11) by the end of 1999.

(g) On-Board Diagnostic checks shall be implemented in all basic, low enhanced and high enhanced areas as part of the I/M program by January 1, 2001.

[57 FR 52987, Nov. 5, 1992, as amended at 58 FR 59367, Nov. 9, 1993; 61 FR 39037, July 25, 1996; 61 FR 40946, Aug. 6, 1996; 63 FR 24433, May 4, 1998]

APPENDIX A TO SUBPART S—CALIBRATIONS, ADJUSTMENTS AND QUALITY CONTROL

(1) Steady-State Test Equipment

States may opt to use transient emission test equipment for steady-state tests and follow the quality control requirements in

paragraph (II) of this appendix instead of the following requirements.

(a) Equipment shall be calibrated in accordance with the manufacturers' instructions.

(b) *Prior to each test.* (1) *Hydrocarbon hang-up check.* Immediately prior to each test the analyzer shall automatically perform a hydrocarbon hang-up check. If the HC reading, when the probe is sampling ambient air, exceeds 20 ppm, the system shall be purged with clean air or zero gas. The analyzer shall be inhibited from continuing the test until HC levels drop below 20 ppm.

(2) *Automatic zero and span.* The analyzer shall conduct an automatic zero and span check prior to each test. The span check shall include the HC, CO, and CO₂ channels, and the NO and O₂ channels, if present. If zero and/or span drift cause the signal levels to move beyond the adjustment range of the analyzer, it shall lock out from testing.

(3) *Low flow.* The system shall lock out from testing if sample flow is below the acceptable level as defined in paragraph (I)(b)(6) of appendix D to this subpart.

(c) *Leak check.* A system leak check shall be performed within twenty-four hours before the test in low volume stations (those performing less than the 4,000 inspections per year) and within four hours in high-volume stations (4,000 or more inspections per year) and may be performed in conjunction with the gas calibration described in paragraph (I)(d)(1) of this appendix. If a leak check is not performed within the preceding twenty-four hours in low volume stations and within four hours in high-volume stations or if the analyzer fails the leak check, the analyzer shall lock out from testing. The leak check shall be a procedure demonstrated to effectively check the sample hose and probe for leaks and shall be performed in accordance with good engineering practices. An error of more than $\pm 2\%$ of the reading using low range span gas shall cause the analyzer to lock out from testing and shall require repair of leaks.

(d) *Gas calibration.* (1) On each operating day in high-volume stations, analyzers shall automatically require and successfully pass a two-point gas calibration for HC, CO, and CO₂ and shall continually compensate for changes in barometric pressure. Calibration shall be checked within four hours before the test and the analyzer adjusted if the reading is more than 2% different from the span gas value. In low-volume stations, analyzers shall undergo a two-point calibration within seventy-two hours before each test, unless changes in barometric pressure are compensated for automatically and statistical process control demonstrates equal or better quality control using different frequencies. Gas calibration shall be accomplished by introducing span gas that meets the requirements of paragraph (I)(d)(3) of this appendix

into the analyzer through the calibration port. If the analyzer reads the span gas within the allowable tolerance range (i.e., the square root of sum of the squares of the span gas tolerance described in paragraph (I)(d)(3) of this appendix and the calibration tolerance, which shall be equal to 2%), no adjustment of the analyzer is necessary. The gas calibration procedure shall correct readings that exceed the allowable tolerance range to the center of the allowable tolerance range. The pressure in the sample cell shall be the same with the calibration gas flowing during calibration as with the sample gas flowing during sampling. If the system is not calibrated, or the system fails the calibration check, the analyzer shall lock out from testing.

(2) *Span points.* A two point gas calibration procedure shall be followed. The span shall be accomplished at one of the following pairs of span points:

- (A) 300—ppm propane (HC)
- 1.0—% carbon monoxide (CO)
- 6.0—% carbon dioxide (CO₂)
- 1000—ppm nitric oxide (if equipped with NO)
- 1200—ppm propane (HC)
- 4.0—% carbon monoxide (CO)
- 12.0—% carbon dioxide (CO₂)
- 3000—ppm nitric oxide (if equipped with NO)
- (B) —ppm propane
- 0.0—% carbon monoxide
- 0.0—% carbon dioxide
- 0—ppm nitric oxide (if equipped with NO)
- 600—ppm propane (HC)
- 1.6—% carbon monoxide (CO)
- 11.0—% carbon dioxide (CO₂)
- 1200—ppm nitric oxide (if equipped with NO)

(3) *Span gases.* The span gases used for the gas calibration shall be traceable to National Institute of Standards and Technology (NIST) standards $\pm 2\%$, and shall be within two percent of the span points specified in paragraph (d)(2) of this appendix. Zero gases shall conform to the specifications given in §86.114-79(a)(5) of this chapter.

(e) *Dynamometer checks—(1) Monthly check.* Within one month preceding each loaded test, the accuracy of the roll speed indicator shall be verified and the dynamometer shall be checked for proper power absorber settings.

(2) *Semi-annual check.* Within six months preceding each loaded test, the road-load response of the variable-curve dynamometer or the frictional power absorption of the dynamometer shall be checked by a coast down procedure similar to that described in §86.118-78 of this chapter. The check shall be done at 30 mph, and a power absorption load setting to generate a total horsepower (hp) of 4.1 hp. The actual coast down time from 45 mph to 15 mph shall be within ± 1 second of the time calculated by the following equation:

$$\text{Coast Down Time} = \frac{0.0508 \times W}{\text{HP}}$$

where W is the total inertia weight as represented by the weight of the rollers (excluding free rollers), and any inertia flywheels used, measured in pounds. If the coast down time is not within the specified tolerance the dynamometer shall be taken out of service and corrective action shall be taken.

(f) *Other checks.* In addition to the above periodic checks, these shall also be used to verify system performance under the following special circumstances.

(1) *Gas Calibration.* (A) Each time the analyzer electronic or optical systems are repaired or replaced, a gas calibration shall be performed prior to returning the unit to service.

(B) In high-volume stations, monthly multi-point calibrations shall be performed. Low-volume stations shall perform multi-point calibrations every six months. The calibration curve shall be checked at 20%, 40%, 60%, and 80% of full scale and adjusted or repaired if the specifications in appendix D(I)(b)(1) to this subpart are not met.

(2) *Leak checks.* Each time the sample line integrity is broken, a leak check shall be performed prior to testing.

(II) *Transient Test Equipment*

(a) *Dynamometer.* Once per week, the calibration of each dynamometer and each fly wheel shall be checked by a dynamometer coast-down procedure comparable to that in §86.118-78 of this chapter between the speeds of 55 to 45 mph, and between 30 to 20 mph. All rotating dynamometer components shall be included in the coast-down check for the inertia weight selected. For dynamometers with uncoupled rolls, the uncoupled rollers may undergo a separate coast-down check. If a vehicle is used to motor the dynamometer to the beginning coast-down speed, the vehicle shall be lifted off the dynamometer rolls before the coast-down test begins. If the difference between the measured coast-down time and the theoretical coast-down time is greater than +1 second, the system shall lock out, until corrective action brings the dynamometer into calibration.

(b) *Constant volume sampler.* (1) The constant volume sampler (CVS) flow calibration shall be checked daily by a procedure that identifies deviations in flow from the true value. Deviations greater than ±4% shall be corrected.

(2) The sample probe shall be cleaned and checked at least once per month. The main CVS venturi shall be cleaned and checked at least once per year.

(3) Verification that flow through the sample probe is adequate for the design shall be

done daily. Deviations greater than the design tolerances shall be corrected.

(c) *Analyzer system—(1) Calibration checks.* (A) Upon initial operation, calibration curves shall be generated for each analyzer. The calibration curve shall consider the entire range of the analyzer as one curve. At least 6 calibration points plus zero shall be used in the lower portion of the range corresponding to an average concentration of approximately 2 gpm for HC, 30 gpm for CO, 3 gpm for NO_x, and 400 gpm for CO₂. For the case where a low and a high range analyzer is used, the high range analyzer shall use at least 6 calibration points plus zero in the lower portion of the high range scale corresponding to approximately 100% of the full-scale value of the low range analyzer. For all analyzers, at least 6 calibration points shall also be used to define the calibration curve in the region above the 6 lower calibration points. Gas dividers may be used to obtain the intermediate points for the general range classifications specified. The calibration curves generated shall be a polynomial of no greater order than 4th order, and shall fit the data within 0.5% at each calibration point.

(B) For all calibration curves, curve checks, span adjustments, and span checks, the zero gas shall be considered a down-scale reference gas, and the analyzer zero shall be set at the trace concentration value of the specific zero gas used.

(2) The basic curve shall be checked monthly by the same procedure used to generate the curve, and to the same tolerances.

(3) On a daily basis prior to vehicle testing—

(A) The curve for each analyzer shall be checked by adjusting the analyzer to correctly read a zero gas and an up-scale span gas, and then by correctly reading a mid-scale span gas within 2% of point. If the analyzer does not read the mid-scale span point within 2% of point, the system shall lock out. The up-scale span gas concentration for each analyzer shall correspond to approximately 80 percent of full scale, and the mid-point concentration shall correspond to approximately 15 percent of full scale; and

(B) After the up-scale span check, each analyzer in a given facility shall analyze a sample of a random concentration corresponding to approximately 0.5 to 3 times the cut point (in gpm) for the constituent. The value of the random sample may be determined by a gas blender. The deviation in analysis from the sample concentration for each analyzer shall be recorded and compared to the historical mean and standard deviation for the analyzers at the facility and at all facilities. Any reading exceeding 3 sigma shall cause the analyzer to lock out.

(4) *Flame ionization detector check.* Upon initial operation, and after maintenance to the detector, each Flame Ionization Detector

(FID) shall be checked, and adjusted if necessary, for proper peaking and characterization. Procedures described in SAE Paper No. 770141 are recommended for this purpose. A copy of this paper may be obtained from the Society of Automotive Engineers, Inc. (SAE), 400 Commonwealth Drive, Warrendale, Pennsylvania, 15096-0001. Addi-

tionally, every month the response of each FID to a methane concentration of approximately 50 ppm CH₄ shall be checked. If the response is outside of the range of 1.10 to 1.20, corrective action shall be taken to bring the FID response within this range. The response shall be computed by the following formula:

$$\text{Ratio of Methane Response} = \frac{\text{FID response in ppmC}}{\text{ppm methane in cylinder}}$$

(5) *Spanning frequency.* The zero and up-scale span point shall be checked, and adjusted if necessary, at 2 hour intervals following the daily mid-scale curve check. If the zero or the up-scale span point drifts by more than 2% for the previous check (except for the first check of the day), the system shall lock out, and corrective action shall be taken to bring the system into compliance.

(6) *Spanning limit checks.* The tolerance on the adjustment of the up-scale span point is 0.4% of point. A software algorithm to perform the span adjustment and subsequent calibration curve adjustment shall be used. However, software up-scale span adjustments greater than ±10% shall cause the system to lock out, requiring system maintenance.

(7) *Integrator checks.* Upon initial operation, and every three months thereafter, emissions from a randomly selected vehicle with official test value greater than 60% of the standard (determined retrospectively) shall be simultaneously sampled by the normal integration method and by the bag method in each lane. The data from each method shall be put into a historical data base for determining normal and deviant performance for each test lane, facility, and all facilities combined. Specific deviations exceeding ±5% shall require corrective action.

(8) *Interference.* CO and CO₂ analyzers shall be checked prior to initial service, and on a yearly basis thereafter, for water interference. The specifications and procedures used shall generally comply with either § 86.122-78 or § 86.321-79 of this chapter.

(9) *NO_x converter check.* The converter efficiency of the NO₂ to NO converter shall be checked on a weekly basis. The check shall generally conform to § 86.123-78 of this chapter, or EPA MVEL Form 305-01. Equivalent methods may be approved by the Administrator.

(10) *NO/NO_x flow balance.* The flow balance between the NO and NO_x test modes shall be checked weekly. The check may be combined with the NO_x convertor check as illustrated in EPA MVEL Form 305-01.

(11) *Additional checks.* Additional checks shall be performed on the HC, CO, CO₂, and

NO_x analyzers according to best engineering practices for the measurement technology used to ensure that measurements meet specified accuracy requirements.

(12) *System artifacts (hang-up).* Prior to each test a comparison shall be made between the background HC reading, the HC reading measured through the sample probe (if different), and the zero gas. Deviations from the zero gas greater than 10 parts per million carbon (ppmC) shall cause the analyzer to lock out.

(13) *Ambient background.* The average of the pre-test and post-test ambient background levels shall be compared to the permissible levels of 10 ppmC HC, 20 ppm CO, and 1 ppm NO_x. If the permissible levels are exceeded, the test shall be voided and corrective action taken to lower the ambient background concentrations.

(14) *Analytical gases.* Zero gases shall meet the requirements of § 86.114-79(a)(5) of this chapter. NO_x calibration gas shall be a single blend using nitrogen as the diluent. Calibration gas for the flame ionization detector shall be a single blend of propane with a diluent of air. Calibration gases for CO and CO₂ shall be single blends using nitrogen or air as a diluent. Multiple blends of HC, CO, and CO₂ in air may be used if shown to be stable and accurate.

(III) Purge Analysis System

On a daily basis each purge flow meter shall be checked with a simulated purge flow against a reference flow measuring device with performance specifications equal to or better than those specified for the purge meter. The check shall include a mid-scale rate check, and a total flow check between 10 and 20 liters. Deviations greater than ±5% shall be corrected. On a monthly basis, the calibration of purge meters shall be checked for proper rate and total flow with three equally spaced points across the flow rate and the totalized flow range. Deviations exceeding the specified accuracy shall be corrected. The dynamometer quality assurance checks required under paragraph (II) of this

appendix shall also apply to the dynamometer used for purge tests.

(IV) *Evaporative System Integrity Test Equipment*

(a) On a weekly basis pressure measurement devices shall be checked against a reference device with performance specifications equal to or better than those specified for the measurement device. Deviations exceeding the performance specifications shall be corrected. Flow measurement devices, if any, shall be checked according to paragraph III of this appendix.

(b) Systems that monitor evaporative system leaks shall be checked for integrity on a daily basis by sealing and pressurizing.

[57 FR 52987, Nov. 5, 1992, as amended at 58 FR 59367, Nov. 9, 1993]

APPENDIX B TO SUBPART S—TEST PROCEDURES

(I) *Idle test*

(a) *General requirements*—(1) *Exhaust gas sampling algorithm.* The analysis of exhaust gas concentrations shall begin 10 seconds after the applicable test mode begins. Exhaust gas concentrations shall be analyzed at a minimum rate of two times per second. The measured value for pass/fail determinations shall be a simple running average of the measurements taken over five seconds.

(2) *Pass/fail determination.* A pass or fail determination shall be made for each applicable test mode based on a comparison of the short test standards contained in appendix C to this subpart, and the measured value for HC and CO as described in paragraph (I)(a)(1) of this appendix. A vehicle shall pass the test mode if any pair of simultaneous measured values for HC and CO are below or equal to the applicable short test standards. A vehicle shall fail the test mode if the values for either HC or CO, or both, in all simultaneous pairs of values are above the applicable standards.

(3) *Void test conditions.* The test shall immediately end and any exhaust gas measurements shall be voided if the measured concentration of CO plus CO₂ falls below six percent or the vehicle's engine stalls at any time during the test sequence.

(4) *Multiple exhaust pipes.* Exhaust gas concentrations from vehicle engines equipped with multiple exhaust pipes shall be sampled simultaneously.

(5) This test shall be immediately terminated upon reaching the overall maximum test time.

(b) *Test sequence.* (1) The test sequence shall consist of a first-chance test and a second-chance test as follows:

(i) The first-chance test, as described under paragraph (c) of this section, shall consist of an idle mode.

(ii) The second-chance test as described under paragraph (I)(d) of this appendix shall be performed only if the vehicle fails the first-chance test.

(2) The test sequence shall begin only after the following requirements are met:

(i) The vehicle shall be tested in as-received condition with the transmission in neutral or park and all accessories turned off. The engine shall be at normal operating temperature (as indicated by a temperature gauge, temperature lamp, touch test on the radiator hose, or other visual observation for overheating).

(ii) For all pre-1996 model year vehicles, a tachometer shall be attached to the vehicle in accordance with the analyzer manufacturer's instructions. For 1996 and newer model year vehicles the OBD data link connector will be used to monitor RPM. In the event that an OBD data link connector is not available or that an RPM signal is not available over the data link connector, a tachometer shall be used instead.

(iii) The sample probe shall be inserted into the vehicle's tailpipe to a minimum depth of 10 inches. If the vehicle's exhaust system prevents insertion to this depth, a tailpipe extension shall be used.

(iv) The measured concentration of CO plus CO₂ shall be greater than or equal to six percent.

(c) *First-chance test.* The test timer shall start (tt=0) when the conditions specified in paragraph (I)(b)(2) of this appendix are met. The first-chance test shall have an overall maximum test time of 145 seconds (tt=145). The first-chance test shall consist of an idle mode only.

(1) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset zero and resume timing. The minimum mode length shall be determined as described under paragraph (I)(c)(2) of this appendix. The maximum mode length shall be 90 seconds elapsed time (mt=90).

(2) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(i) The vehicle shall pass the idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(ii) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30), if prior to that time the criteria of paragraph (I)(c)(2)(i) of this appendix are not satisfied and the measured values are less than or equal to the applicable short test standards as described in paragraph (I)(a)(2) of this appendix.

(iii) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), the measured values are less than or equal to the applicable short test standards as described in paragraph (I)(a)(2) of this appendix.

(iv) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (I)(c)(2)(i), (ii) and (iii) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90). Alternatively, the vehicle may be failed if the provisions of paragraphs (I)(c)(2)(i) and (ii) of this appendix are not met within an elapsed time of 30 seconds.

(v) *Optional.* The vehicle may fail the first-chance test and the second-chance test shall be omitted if no exhaust gas concentration lower than 1800 ppm HC is found by an elapsed time of 30 seconds (mt=30).

(d) *Second-chance test.* If the vehicle fails the first-chance test, the test timer shall reset to zero (tt=0) and a second-chance test shall be performed. The second-chance test shall have an overall maximum test time of 425 seconds (tt=425). The test shall consist of a preconditioning mode followed immediately by an idle mode.

(1) *Preconditioning mode.* The mode timer shall start (mt=0) when the engine speed is between 2200 and 2800 rpm. The mode shall continue for an elapsed time of 180 seconds (mt=180). If engine speed falls below 2200 rpm or exceeds 2800 rpm for more than five seconds in any one excursion, or 15 seconds over all excursions, the mode timer shall reset to zero and resume timing.

(2) *Idle mode—(i) Ford Motor Company and Honda vehicles.* The engines of 1981–1987 Ford Motor Company vehicles and 1984–1985 Honda Preludes shall be shut off for not more than 10 seconds and restarted. This procedure may also be used for 1988–1989 Ford Motor Company vehicles but should not be used for other vehicles. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure.

(ii) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum idle mode length shall be determined as described in paragraph (I)(d)(2)(iii) of this appendix. The maximum idle mode length shall be 90 seconds elapsed time (mt=90).

(iii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the idle mode shall be terminated as follows:

(A) The vehicle shall pass the idle mode and the test shall be immediately termi-

nated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30), if prior to that time the criteria of paragraph (I)(d)(2)(iii)(A) of this appendix are not satisfied and the measured values are less than or equal to the applicable short test standards as described in paragraph (I)(a)(2) of this appendix.

(C) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), measured values are less than or equal to the applicable short test standards described in paragraph (I)(a)(2) of this appendix.

(D) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (I)(d)(2)(iii)(A), (d)(2)(iii)(B), and (d)(2)(iii)(C) of this appendix are satisfied by an elapsed time of 90 seconds (mt=90).

(II) Two Speed Idle Test

(a) *General requirements—(1) Exhaust gas sampling algorithm.* The analysis of exhaust gas concentrations shall begin 10 seconds after the applicable test mode begins. Exhaust gas concentrations shall be analyzed at a rate of two times per second. The measured value for pass/fail determinations shall be a simple running average of the measurements taken over five seconds.

(2) *Pass/fail determination.* A pass or fail determination shall be made for each applicable test mode based on a comparison of the short test standards contained in appendix C to this subpart, and the measured value for HC and CO as described in paragraph (II)(a)(1) of this appendix. A vehicle shall pass the test mode if any pair of simultaneous values for HC and CO are below or equal to the applicable short test standards. A vehicle shall fail the test mode if the values for either HC or CO, or both, in all simultaneous pairs of values are above the applicable standards.

(3) *Void test conditions.* The test shall immediately end and any exhaust gas measurements shall be voided if the measured concentration of CO plus CO₂ falls below six percent or the vehicle's engine stalls at any time during the test sequence.

(4) *Multiple exhaust pipes.* Exhaust gas concentrations from vehicle engines equipped with multiple exhaust pipes shall be sampled simultaneously.

(5) The test shall be immediately terminated upon reaching the overall maximum test time.

(b) *Test sequence.* (1) The test sequence shall consist of a first-chance test and a second-chance test as follows:

(i) The first-chance test, as described under paragraph (II)(c) of this appendix, shall consist of an idle mode followed by a high-speed mode.

(ii) The second-chance high-speed mode, as described under paragraph (II)(c) of this appendix, shall immediately follow the first-chance high-speed mode. It shall be performed only if the vehicle fails the first-chance test. The second-chance idle mode, as described under paragraph (II)(d) of this appendix, shall follow the second-chance high-speed mode and be performed only if the vehicle fails the idle mode of the first-chance test.

(2) The test sequence shall begin only after the following requirements are met:

(i) The vehicle shall be tested in as-received condition with the transmission in neutral or park and all accessories turned off. The engine shall be at normal operating temperature (as indicated by a temperature gauge, temperature lamp, touch test on the radiator hose, or other visual observation for overheating).

(ii) For all pre-1996 model year vehicles, a tachometer shall be attached to the vehicle in accordance with the analyzer manufacturer's instructions. For 1996 and newer model year vehicles the OBD data link connector will be used to monitor RPM. In the event that an OBD data link connector is not available or that an RPM signal is not available over the data link connector, a tachometer shall be used instead.

(iii) The sample probe shall be inserted into the vehicle's tailpipe to a minimum depth of 10 inches. If the vehicle's exhaust system prevents insertion to this depth, a tailpipe extension shall be used.

(iv) The measured concentration of CO plus CO₂ shall be greater than or equal to six percent.

(c) *First-chance test and second-chance high-speed mode.* The test timer shall start (tt=0) when the conditions specified in paragraph (b)(2) of this section are met. The first-chance test and second-chance high-speed mode shall have an overall maximum test time of 425 seconds (tt=425). The first-chance test shall consist of an idle mode followed immediately by a high-speed mode. This is followed immediately by an additional second-chance high-speed mode, if necessary.

(1) *First-chance idle mode.* (i) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum idle mode length shall be determined as described in paragraph (II)(c)(1)(ii) of this appendix. The maximum idle mode length shall be 90 seconds elapsed time (mt=90).

(ii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass

or fail determination shall be made for the vehicle and the mode terminated as follows:

(A) The vehicle shall pass the idle mode and the mode shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the idle mode and the mode shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (II)(c)(1)(ii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(C) The vehicle shall pass the idle mode and the mode shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), the measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(D) The vehicle shall fail the idle mode and the mode shall be terminated if none of the provisions of paragraphs (II)(c)(1)(ii)(A), (B), and (C) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90). Alternatively, the vehicle may be failed if the provisions of paragraphs (II)(c)(2)(i) and (ii) of this appendix are not met within an elapsed time of 30 seconds.

(E) *Optional.* The vehicle may fail the first-chance test and the second-chance test shall be omitted if no exhaust gas concentration less than 1800 ppm HC is found by an elapsed time of 30 seconds (mt=30).

(2) *First-chance and second-chance high-speed modes.* This mode includes both the first-chance and second-chance high-speed modes, and follows immediately upon termination of the first-chance idle mode.

(i) The mode timer shall reset (mt=0) when the vehicle engine speed is between 2200 and 2800 rpm. If engine speed falls below 2200 rpm or exceeds 2800 rpm for more than two seconds in one excursion, or more than six seconds over all excursions within 30 seconds of the final measured value used in the pass/fail determination, the measured value shall be invalidated and the mode continued. If any excursion lasts for more than ten seconds, the mode timer shall reset to zero (mt=0) and timing resumed. The minimum high-speed mode length shall be determined as described under paragraphs (II)(c)(2)(ii) and (iii) of this appendix. The maximum high-speed mode length shall be 180 seconds elapsed time (mt=180).

(ii) *Ford Motor Company and Honda vehicles.* For 1981-1987 model year Ford Motor Company vehicles and 1984-1985 model year Honda Preludes, the pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10) using the following procedure. This procedure may also be used for 1988-1989 Ford

Environmental Protection Agency

Pt. 51, Subpt. S, App. B

Motor Company vehicles but should not be used for other vehicles.

(A) A pass or fail determination, as described below, shall be used, for vehicles that passed the idle mode, to determine whether the high-speed test should be terminated prior to or at the end of an elapsed time of 180 seconds (mt=180).

(1) The vehicle shall pass the high-speed mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), the measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(2) The vehicle shall pass the high-speed mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (II)(c)(2)(ii)(A)(1) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(3) The vehicle shall pass the high-speed mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 180 seconds (mt=180), the measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(4) *Restart.* If at an elapsed time of 90 seconds (mt=90) the measured values are greater than the applicable short test standards as described in paragraph (II)(a)(2) of this appendix, the vehicle's engine shall be shut off for not more than 10 seconds after returning to idle and then shall be restarted. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure. The mode timer will stop upon engine shut off (mt=90) and resume upon engine restart. The pass/fail determination shall resume as follows after 100 seconds have elapsed (mt=100).

(i) The vehicle shall pass the high-speed mode and the test shall be immediately terminated if, at any point between an elapsed time of 100 seconds (mt=100) and 180 seconds (mt=180), the measured values are less than or equal to the applicable short test standards described in paragraph (II)(a)(2) of this appendix.

(ii) The vehicle shall fail the high-speed mode and the test shall be terminated if paragraph (II)(c)(2)(ii)(A)(4)(i) of this appendix is not satisfied by an elapsed time of 180 seconds (mt=180).

(B) A pass or fail determination shall be made for vehicles that *failed* the idle mode and the high-speed mode terminated at the end of an elapsed time of 180 seconds (mt=180) as follows:

(1) The vehicle shall pass the high-speed mode and the mode shall be terminated at an elapsed time of 180 seconds (mt=180) if any

measured values of HC and CO exhaust gas concentrations during the high-speed mode are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(2) *Restart.* If at an elapsed time of 90 seconds (mt=90) the measured values of HC and CO exhaust gas concentrations during the high-speed mode are greater than the applicable short test standards as described in paragraph (II)(a)(2) of this appendix, the vehicle's engine shall be shut off for not more than 10 seconds after returning to idle and then shall be restarted. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure. The mode timer will stop upon engine shut off (mt=90) and resume upon engine restart. The pass/fail determination shall resume as follows after 100 seconds have elapsed (mt=100).

(i) The vehicle shall pass the high-speed mode and the mode shall be terminated at an elapsed time of 180 seconds (mt=180) if any measured values of HC and CO exhaust gas concentrations during the high-speed mode are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(ii) The vehicle shall fail the high-speed mode and the test shall be terminated if paragraph (II)(c)(2)(ii)(B)(2)(i) of this appendix is not satisfied by an elapsed time of 180 seconds (mt=180).

(iii) *All other light-duty motor vehicles.* The pass/fail analysis for vehicles not specified in paragraph (II)(c)(2)(ii) of this appendix shall begin after an elapsed time of 10 seconds (mt=10) using the following procedure.

(A) A pass or fail determination, as described below, shall be used for vehicles that passed the idle mode, to determine whether the high-speed mode should be terminated prior to or at the end of an elapsed time of 180 seconds (mt=180).

(1) The vehicle shall pass the high-speed mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), any measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(2) The vehicle shall pass the high-speed mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (II)(c)(2)(iii)(A)(1) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(3) The vehicle shall pass the high-speed mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 180 seconds (mt=180), the measured values are less than

or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(4) The vehicle shall fail the high-speed mode and the test shall be terminated if none of the provisions of paragraphs (II)(c)(2)(iii)(A)(1), (2), and (3) of this appendix is satisfied by an elapsed time of 180 seconds (mt=180).

(B) A pass or fail determination shall be made for vehicles that *failed* the idle mode and the high-speed mode terminated at the end of an elapsed time of 180 seconds (mt=180) as follows:

(1) The vehicle shall pass the high-speed mode and the mode shall be terminated at an elapsed time of 180 seconds (mt=180) if any measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(2) The vehicle shall fail the high-speed mode and the test shall be terminated if paragraph (II)(c)(2)(iii)(B)(1) of this appendix is not satisfied by an elapsed time of 180 seconds (mt=180).

(d) *Second-chance idle mode.* If the vehicle fails the first-chance idle mode and passes the high-speed mode, the test timer shall reset to zero (tt=0) and a second-chance idle mode shall commence. The second-chance idle mode shall have an overall maximum test time of 145 seconds (tt=145). The test shall consist of an idle mode only.

(1) The engines of 1981-1987 Ford Motor Company vehicles and 1984-1985 Honda Preludes shall be shut off for not more than 10 seconds and restarted. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure. This procedure may also be used for 1988-1989 Ford Motor Company vehicles but should not be used for other vehicles.

(2) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If the engine speed exceeds 1100 rpm or falls below 350 rpm the mode timer shall reset to zero and resume timing. The minimum second-chance idle mode length shall be determined as described in paragraph (II)(d)(3) of this appendix. The maximum second-chance idle mode length shall be 90 seconds elapsed time (mt=90).

(3) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the second-chance idle mode shall be terminated as follows:

(i) The vehicle shall pass the second-chance idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), any measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(ii) The vehicle shall pass the second-chance idle mode and the test shall be terminated at the end of an elapsed time of 30 sec-

onds (mt=30) if, prior to that time, the criteria of paragraph (II)(d)(3)(i) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(iii) The vehicle shall pass the second-chance idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), the measured values are less than or equal to the applicable short test standards as described in paragraph (II)(a)(2) of this appendix.

(iv) The vehicle shall fail the second-chance idle mode and the test shall be terminated if none of the provisions of paragraph (II)(d)(3)(i), (ii), and (iii) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90).

(III) Loaded Test

(a) *General requirements—(1) Exhaust gas sampling algorithm.* The analysis of exhaust gas concentrations shall begin 10 seconds after the applicable test mode begins. Exhaust gas concentrations shall be analyzed at a minimum rate of two times per second. The measured value for pass/fail determinations shall be a simple running average of the measurements taken over five seconds.

(2) *Pass/fail determination.* A pass or fail determination shall be made for each applicable test mode based on a comparison of the short test standards contained in appendix C to this subpart and the measured value for HC and CO as described in paragraph (III)(a)(1) of this appendix. A vehicle shall pass the test mode if any pair of simultaneous values for HC and CO are below or equal to the applicable short test standards. A vehicle shall fail the test mode if the values for either HC or CO, or both, in all simultaneous pairs of values are above the applicable standards.

(3) *Void test conditions.* The test shall immediately end and any exhaust gas measurements shall be voided if the measured concentration of CO plus CO₂ falls below six percent or the vehicle's engine stalls at any time during the test sequence.

(4) *Multiple exhaust pipes.* Exhaust gas concentrations from vehicle engines equipped with multiple exhaust pipes shall be sampled simultaneously.

(5) The test shall be immediately terminated upon reaching the overall maximum test time.

(b) *Test sequence.* (1) The test sequence shall consist of a loaded mode using a chassis dynamometer followed immediately by an idle mode as described under paragraphs (III)(c)(1) and (2) of this appendix.

(2) The test sequence shall begin only after the following requirements are met:

(i) The dynamometer shall be warmed up, in stabilized operating condition, adjusted,

Environmental Protection Agency

Pt. 51, Subpt. S, App. B

and calibrated in accordance with the procedures of appendix A to this subpart. Prior to each test, variable-curve dynamometers shall be checked for proper setting of the road-load indicator or road-load controller.

(ii) The vehicle shall be tested in as-received condition with all accessories turned off. The engine shall be at normal operating temperature (as indicated by a temperature gauge, temperature lamp, touch test on the radiator hose, or other visual observation for overheating).

(iii) The vehicle shall be operated during each mode of the test with the gear selector in the following position:

(A) In drive for automatic transmissions and in second (or third if more appropriate) for manual transmissions for the loaded mode;

(B) In park or neutral for the idle mode.

(iv) For all pre-1996 model year vehicles, a tachometer shall be attached to the vehicle in accordance with the analyzer manufacturer's instructions. For 1996 and newer model year vehicles the OBD data link connector will be used to monitor RPM. In the event that an OBD data link connector is not available or that an RPM signal is not available over the data link connector, a tachometer shall be used instead.

(v) The sample probe shall be inserted into the vehicle's tailpipe to a minimum depth of 10 inches. If the vehicle's exhaust system prevents insertion to this depth, a tailpipe extension shall be used.

(vi) The measured concentration of CO plus CO₂ shall be greater than or equal to six percent.

(c) *Overall test procedure.* The test timer shall start (tt=0) when the conditions specified in paragraph (III)(b)(2) of this appendix are met and the mode timer initiates as specified in paragraph (III)(c)(1) of this appendix. The test sequence shall have an overall maximum test time of 240 seconds (tt=240). The test shall be immediately terminated upon reaching the overall maximum test time.

(1) *Loaded mode—(i) Ford Motor Company and Honda vehicles.* (Optional) The engines of 1981-1987 Ford Motor Company vehicles and 1984-1985 Honda Preludes shall be shut off for not more than 10 seconds and restarted. This procedure may also be used for 1988-1989 Ford Motor Company vehicles but should not be used for other vehicles. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure.

(ii) The mode timer shall start (mt=0) when the dynamometer speed is within the limits specified for the vehicle engine size according to the following schedule. If the dynamometer speed falls outside the limits for more than five seconds in one excursion, or 15 seconds over all excursions, the mode timer shall reset to zero and resume timing.

The minimum mode length shall be determined as described in paragraph (III)(c)(1)(iii)(A) of this appendix. The maximum mode length shall be 90 seconds elapsed time (mt=90).

DYNAMOMETER TEST SCHEDULE

| Gasoline engine size (cylinders) | Roll speed (mph) | Normal loading (brake horsepower) |
|----------------------------------|------------------|-----------------------------------|
| 4 or less | 22-25 | 2.8-4.1 |
| 5-6 | 29-32 | 6.8-8.4 |
| 7 or more | 32-35 | 8.4-10.8 |

(iii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the loaded mode and the mode shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), measured values are less than or equal to the applicable short test standards described in paragraph (a)(2) of this section.

(B) The vehicle shall fail the loaded mode and the mode shall be terminated if paragraph (III)(c)(1)(iii)(A) of this appendix is not satisfied by an elapsed time of 90 seconds (mt=90).

(C) *Optional.* The vehicle may fail the loaded mode and any subsequent idle mode shall be omitted if no exhaust gas concentration less than 1800 ppm HC is found by an elapsed time of 30 seconds (mt=30).

(2) *Idle mode—(i) Ford Motor Company and Honda vehicles.* (Optional) The engines of 1981-1987 Ford Motor Company vehicles and 1984-1985 Honda Preludes shall be shut off for not more than 10 seconds and restarted. This procedure may also be used for 1988-1989 Ford Motor Company vehicles but should not be used for other vehicles. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure.

(ii) The mode timer shall start (mt=0) when the dynamometer speed is zero and the vehicle engine speed is between 350 and 1100 rpm. If engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum idle mode length shall be determined as described in paragraph (II)(c)(2)(ii) of this appendix. The maximum idle mode length shall be 90 seconds elapsed time (mt=90).

(iii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (III)(c)(2)(iii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (III)(a)(2) of this appendix.

(C) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), measured values are less than or equal to the applicable short test standards described in paragraph (III)(a)(2) of this appendix.

(D) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (III)(c)(2)(iii)(A), (c)(2)(iii)(B), and (c)(2)(iii)(C) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90).

(IV) Preconditioned IDLE TEST

(a) *General requirements*—(1) *Exhaust gas sampling algorithm.* The analysis of exhaust gas concentrations shall begin 10 seconds after the applicable test mode begins. Exhaust gas concentrations shall be analyzed at a minimum rate of two times per second. The measured value for pass/fail determinations shall be a simple running average of the measurements taken over five seconds.

(2) *Pass/fail determination.* A pass or fail determination shall be made for each applicable test mode based on a comparison of the short test standards contained in appendix C to this subpart, and the measured value for HC and CO as described in paragraph (IV)(a)(1) of this appendix. A vehicle shall pass the test mode if any pair of simultaneous values for HC and CO are below or equal to the applicable short test standards. A vehicle shall fail the test mode if the values for either HC or CO, or both, in all simultaneous pairs of values are above the applicable standards.

(3) *Void test conditions.* The test shall immediately end and any exhaust gas measurements shall be voided if the measured concentration of CO plus CO₂ falls below six percent or the vehicle's engine stalls at any time during the test sequence.

(4) *Multiple exhaust pipes.* Exhaust gas concentrations from vehicle engines equipped with multiple exhaust pipes shall be sampled simultaneously.

(5) The test shall be immediately terminated upon reaching the overall maximum test time.

(b) *Test sequence.* (1) The test sequence shall consist of a first-chance test and a second-chance test as follows:

(i) The first-chance test, as described under paragraph (IV)(c) of this appendix, shall consist of a preconditioning mode followed by an idle mode.

(ii) The second-chance test, as described under paragraph (IV)(d) of this appendix, shall be performed only if the vehicle fails the first-chance test.

(2) The test sequence shall begin only after the following requirements are met:

(i) The vehicle shall be tested in as-received condition with the transmission in neutral or park and all accessories turned off. The engine shall be at normal operating temperature (as indicated by a temperature gauge, temperature lamp, touch test on the radiator hose, or other visual observation for overheating).

(ii) For all pre-1996 model year vehicles, a tachometer shall be attached to the vehicle in accordance with the analyzer manufacturer's instructions. For 1996 and newer model year vehicles the OBD data link connector will be used to monitor RPM. In the event that an OBD data link connector is not available or that an RPM signal is not available over the data link connector, a tachometer shall be used instead.

(iii) The sample probe shall be inserted into the vehicle's tailpipe to a minimum depth of 10 inches. If the vehicle's exhaust system prevents insertion to this depth, a tailpipe extension shall be used.

(iv) The measured concentration of CO plus CO₂ shall be greater than or equal to six percent.

(c) *First-chance test.* The test timer shall start (tt=0) when the conditions specified in paragraph (IV)(b)(2) of this appendix are met. The test shall have an overall maximum test time of 200 seconds (tt=200). The first-chance test shall consist of a preconditioning mode followed immediately by an idle mode.

(1) *Preconditioning mode.* The mode timer shall start (mt=0) when the engine speed is between 2200 and 2800 rpm. The mode shall continue for an elapsed time of 30 seconds (mt=30). If engine speed falls below 2200 rpm or exceeds 2800 rpm for more than five seconds in any one excursion, or 15 seconds over all excursions, the mode timer shall reset to zero and resume timing.

(2) *Idle mode.* (i) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum idle mode length shall be determined as described in paragraph (IV)(c)(2)(ii) of this appendix. The maximum idle mode length shall be 90 seconds elapsed time (mt=90).

(ii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass

or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (IV)(c)(2)(ii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (IV)(a)(2) of this appendix.

(C) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), measured values are less than or equal to the applicable short test standards as described in paragraph (IV)(a)(2) of this section.

(D) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (IV)(c)(2)(ii)(A), (B), and (C) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90). Alternatively, the vehicle may be failed if the provisions of paragraphs (IV)(c)(2) (i) and (ii) of this appendix are not met within an elapsed time of 30 seconds.

(E) *Optional.* The vehicle may fail the first-chance test and the second-chance test shall be omitted if no exhaust gas concentration less than 1800 ppm HC is found at an elapsed time of 30 seconds (mt=30).

(d) *Second-chance test.* If the vehicle fails the first-chance test, the test timer shall reset to zero and a second-chance test shall be performed. The second-chance test shall have an overall maximum test time of 425 seconds. The test shall consist of a preconditioning mode followed immediately by an idle mode.

(1) *Preconditioning mode.* The mode timer shall start (mt=0) when engine speed is between 2200 and 2800 rpm. The mode shall continue for an elapsed time of 180 seconds (mt=180). If the engine speed falls below 2200 rpm or exceeds 2800 rpm for more than five seconds in any one excursion, or 15 seconds over all excursions, the mode timer shall reset to zero and resume timing.

(2) *Idle mode—(i) Ford Motor Company and Honda vehicles.* The engines of 1981–1987 Ford Motor Company vehicles and 1984–1985 Honda Preludes shall be shut off for not more than 10 seconds and then shall be restarted. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure. This procedure may also be used for 1988–1989 Ford Motor Company vehicles but should not be used for other vehicles.

(ii) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If the engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum idle mode length shall be determined as described in paragraph (IV)(d)(2)(iii) of this appendix. The maximum idle mode length shall be 90 seconds elapsed time (mt=90).

(iii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (IV)(d)(2)(iii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (IV)(a)(2) of this appendix.

(C) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), measured values are less than or equal to the applicable short test standards described in paragraph (IV)(a)(2) of this appendix.

(D) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (IV)(d)(2)(iii) (A), (B), and (C) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90).

(V) *Idle Test With Loaded Preconditioning*

(a) *General requirements—(1) Exhaust gas sampling algorithm.* The analysis of exhaust gas concentrations shall begin 10 seconds after the applicable test mode begins. Exhaust gas concentrations shall be analyzed at a minimum rate of two times per second. The measured value for pass/fail determinations shall be a simple running average of the measurements taken over five seconds.

(2) *Pass/fail determination.* A pass or fail determination shall be made for each applicable test mode based on a comparison of the short test standards contained in appendix C to this subpart, and the measured value for HC and CO as described in paragraph (V)(a)(1) of this appendix. A vehicle shall pass the test mode if any pair of simultaneous values for HC and CO are below or equal to the applicable short test standards. A vehicle shall fail the test mode if the values for either HC or CO, or both, in all simultaneous pairs of values are above the applicable standards.

(3) *Void test conditions.* The test shall immediately end and any exhaust gas measurements shall be voided if the measured concentration of CO plus CO₂ falls below six percent or the vehicle's engine stalls at any time during the test sequence.

(4) *Multiple exhaust pipes.* Exhaust gas concentrations from vehicle engines equipped with multiple exhaust pipes shall be sampled simultaneously.

(5) The test shall be immediately terminated upon reaching the overall maximum test time.

(b) *Test sequence.* (1) The test sequence shall consist of a first-chance test and a second-chance test as follows:

(i) The first-chance test, as described under paragraph (V)(c) of this appendix, shall consist of an idle mode.

(ii) The second-chance test as described under paragraph (V)(d) of this appendix shall be performed only if the vehicle fails the first-chance test.

(2) The test sequence shall begin only after the following requirements are met:

(i) The dynamometer shall be warmed up, in stabilized operating condition, adjusted, and calibrated in accordance with the procedures of appendix A to this subpart. Prior to each test, variable-curve dynamometers shall be checked for proper setting of the road-load indicator or road-load controller.

(ii) The vehicle shall be tested in as-received condition with all accessories turned off. The engine shall be at normal operating temperature (as indicated by a temperature gauge, temperature lamp, touch test on the radiator hose, or other visual observation for overheating).

(iii) The vehicle shall be operated during each mode of the test with the gear selector in the following position:

(A) In drive for automatic transmissions and in second (or third if more appropriate) for manual transmissions for the loaded preconditioning mode;

(B) In park or neutral for the idle mode.

(iv) For all pre-1996 model year vehicles, a tachometer shall be attached to the vehicle in accordance with the analyzer manufacturer's instructions. For 1996 and newer model year vehicles the OBD data link connector will be used to monitor RPM. In the event that an OBD data link connector is not available or that an RPM signal is not available over the data link connector, a tachometer shall be used instead.

(v) The sample probe shall be inserted into the vehicle's tailpipe to a minimum depth of 10 inches. If the vehicle's exhaust system prevents insertion to this depth, a tailpipe extension shall be used.

(vi) The measured concentration of CO plus CO₂ shall be greater than or equal to six percent.

(c) *First-chance test.* The test timer shall start (tt=0) when the conditions specified in

paragraph (V)(b)(2) of this appendix are met. The test shall have an overall maximum test time of 155 seconds (tt=155). The first-chance test shall consist of an idle mode only.

(1) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If the engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum mode length shall be determined as described in paragraph (V)(c)(2) of this appendix. The maximum mode length shall be 90 seconds elapsed time (mt=90).

(2) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(i) The vehicle shall pass the idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(ii) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (V)(c)(2)(i) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (V)(a)(2) of this appendix.

(iii) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), the measured values are less than or equal to the applicable short test standards as described in paragraph (V)(a)(2) of this appendix.

(iv) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (V)(c)(2)(i), (ii), and (iii) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90). Alternatively, the vehicle may be failed if the provisions of paragraphs (V)(c)(2) (i) and (ii) of this appendix are not met within an elapsed time of 30 seconds.

(v) *Optional.* The vehicle may fail the first-chance test and the second-chance test shall be omitted if no exhaust gas concentration less than 1800 ppm HC is found at an elapsed time of 30 seconds (mt=30).

(d) *Second-chance test.* If the vehicle fails the first-chance test, the test timer shall reset to zero (tt=0) and a second-chance test shall be performed. The second-chance test shall have an overall maximum test time of 200 seconds (tt=200). The test shall consist of a preconditioning mode using a chassis dynamometer, followed immediately by an idle mode.

(1) *Preconditioning mode.* The mode timer shall start (mt=0) when the dynamometer speed is within the limits specified for the vehicle engine size in accordance with the

Environmental Protection Agency

Pt. 51, Subpt. S, App. B

following schedule. The mode shall continue for a minimum elapsed time of 30 seconds (mt=30). If the dynamometer speed falls outside the limits for more than five seconds in one excursion, or 15 seconds over all excursions, the mode timer shall reset to zero and resume timing.

| Gasoline engine size (cylinders) | Dynamometer test schedule | |
|----------------------------------|---------------------------|-----------------------------------|
| | Roll speed (mph) | Normal loading (brake horsepower) |
| 4 or less | 22-25 | 2.8-4.1 |
| 5-6 | 29-32 | 6.8-8.4 |
| 7 or more | 32-35 | 8.4-10.8 |

(2) *Idle mode.* (i) *Ford Motor Company and Honda vehicles.* (Optional) The engines of 1981-1987 Ford Motor Company vehicles and 1984-1985 Honda Preludes shall be shut off for not more than 10 seconds and restarted. This procedure may also be used for 1988-1989 Ford Motor Company vehicles but should not be used for other vehicles. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure.

(ii) The mode timer shall start (mt=0) when the dynamometer speed is zero and the vehicle engine speed is between 350 and 1100 rpm. If the engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum idle mode length shall be determined as described in paragraph (V)(d)(2)(ii) of this appendix. The maximum idle mode length shall be 90 seconds elapsed time (mt=90).

(iii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (V)(d)(2)(ii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (V)(a)(2) of this appendix.

(C) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), the measured values are less than or equal to the applicable short test standards as described in paragraph (V)(a)(2) of this appendix.

(D) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (V)(d)(2)(ii)(A), (B), and (C) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90).

(VI) Preconditioned Two Speed Idle Test

(a) *General requirements—(1) Exhaust gas sampling algorithm.* The analysis of exhaust gas concentrations shall begin 10 seconds after the applicable test mode begins. Exhaust gas concentrations shall be analyzed at a minimum rate of two times per second. The measured value for pass/fail determinations shall be a simple running average of the measurements taken over five seconds.

(2) *Pass/fail determination.* A pass or fail determination shall be made for each applicable test mode based on a comparison of the short test standards contained in appendix C to this subpart, and the measured value for HC and CO as described in paragraph (VI)(a)(1) of this appendix. A vehicle shall pass the test mode if any pair of simultaneous values for HC and CO are below or equal to the applicable short test standards. A vehicle shall fail the test mode if the values for either HC or CO, or both, in all simultaneous pairs of values are above the applicable standards.

(3) *Void test conditions.* The test shall immediately end and any exhaust gas measurements shall be voided if the measured concentration of CO plus CO₂ falls below six percent or the vehicle's engine stalls at any time during the test sequence.

(4) *Multiple exhaust pipes.* Exhaust gas concentrations from vehicle engines equipped with multiple exhaust pipes shall be sampled simultaneously.

(5) The test shall be immediately terminated upon reaching the overall maximum test time.

(b) *Test sequence.* (1) The test sequence shall consist of a first-chance test and a second-chance test as follows:

(i) The first-chance test, as described under paragraph (VI)(c) of this appendix, shall consist of a first-chance high-speed mode followed immediately by a first-chance idle mode.

(ii) The second-chance test as described under paragraph (VI)(d) of this appendix shall be performed only if the vehicle fails the first-chance test.

(2) The test sequence shall begin only after the following requirements are met:

(i) The vehicle shall be tested in as-received condition with the transmission in neutral or park and all accessories turned off. The engine shall be at normal operating temperature (as indicated by a temperature gauge, temperature lamp, touch test on the radiator hose, or other visual observation for overheating).

(ii) For all pre-1996 model year vehicles, a tachometer shall be attached to the vehicle

in accordance with the analyzer manufacturer's instructions. For 1996 and newer model year vehicles the OBD data link connector will be used to monitor rpm. In the event that an OBD data link connector is not available or that an rpm signal is not available over the data link connector, a tachometer shall be used instead.

(iii) The sample probe shall be inserted into the vehicle's tailpipe to a minimum depth of 10 inches. If the vehicle's exhaust system prevents insertion to this depth, a tailpipe extension shall be used.

(iv) The measured concentration of CO plus CO₂ shall be greater than or equal to six percent.

(c) *First-chance test.* The test timer shall start (tt=0) when the conditions specified in paragraph (VI)(b)(2) of this appendix are met. The test shall have an overall maximum test time of 290 seconds (tt=290). The first-chance test shall consist of a high-speed mode followed immediately by an idle mode.

(1) *First-chance high-speed mode.* (i) The mode timer shall reset (mt=0) when the vehicle engine speed is between 2200 and 2800 rpm. If the engine speed falls below 2200 rpm or exceeds 2800 rpm for more than two seconds in one excursion, or more than six seconds over all excursions within 30 seconds of the final measured value used in the pass/fail determination, the measured value shall be invalidated and the mode continued. If any excursion lasts for more than ten seconds, the mode timer shall reset to zero (mt=0) and timing resumed. The high-speed mode length shall be 90 seconds elapsed time (mt=90).

(ii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the high-speed mode and the mode shall be terminated at an elapsed time of 90 seconds (mt=90) if any measured values are less than or equal to the applicable short test standards as described in paragraph (VI)(a)(2) of this appendix.

(B) The vehicle shall fail the high-speed mode and the mode shall be terminated if the requirements of paragraph (VI)(c)(1)(ii)(A) of this appendix are not satisfied by an elapsed time of 90 seconds (mt=90).

(C) *Optional.* The vehicle shall fail the first-chance test and any subsequent test shall be omitted if no exhaust gas concentration lower than 1800 ppm HC is found at an elapsed time of 30 seconds (mt=30).

(2) *First-chance idle mode.* (i) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If the engine speed exceeds 1100 rpm or falls below 350 rpm, the mode timer shall reset to zero and resume timing. The minimum first-chance idle mode length shall be determined as described in paragraph (VI)(c)(2)(ii) of this

appendix. The maximum first-chance idle mode length shall be 90 seconds elapsed time (mt=90).

(ii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (VI)(c)(2)(ii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (VI)(a)(2) of this appendix.

(C) The vehicle shall pass the idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), the measured values are less than or equal to the applicable short test standards as described in paragraph (VI)(a)(2) of this appendix.

(D) The vehicle shall fail the idle mode and the test shall be terminated if none of the provisions of paragraphs (VI)(c)(2)(ii) (A), (B), and (C) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90). Alternatively, the vehicle may be failed if the provisions of paragraphs (VI)(c)(2)(i) and (ii) of this appendix are not met within the elapsed time of 30 seconds.

(d) *Second-chance test.* (1) If the vehicle fails either mode of the first-chance test, the test timer shall reset to zero (tt=0) and a second-chance test shall commence. The second-chance test shall be performed based on the first-chance test failure mode or modes as follows:

(A) If the vehicle failed only the first-chance high-speed mode, the second-chance test shall consist of a second-chance high-speed mode as described in paragraph (VI)(d)(2) of this appendix. The overall maximum test time shall be 280 seconds (tt=280).

(B) If the vehicle failed only the first-chance idle mode, the second-chance test shall consist of a second-chance pre-conditioning mode followed immediately by a second-chance idle mode as described in paragraphs (VI)(d) (3) and (4) of this appendix. The overall maximum test time shall be 425 seconds (tt=425).

(C) If both the first-chance high-speed mode and first-chance idle mode were failed, the second-chance test shall consist of the second-chance high-speed mode followed immediately by the second-chance idle mode as described in paragraphs (VI)(d) (2) and (4) of

Environmental Protection Agency

Pt. 51, Subpt. S, App. B

this appendix. However, if during this second-chance procedure the vehicle fails the second-chance high-speed mode, then the second-chance idle mode may be eliminated. The overall maximum test time shall be 425 seconds (tt=425).

(2) *Second-chance high-speed mode*—(i) *Ford Motor Company and Honda vehicles.* The engines of 1981–1987 Ford Motor Company vehicles and 1984–1985 Honda Preludes shall be shut off for not more than 10 seconds and then shall be restarted. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure. This procedure may also be used for 1988–1989 Ford Motor Company vehicles but should not be used for other vehicles.

(ii) The mode timer shall reset (mt=0) when the vehicle engine speed is between 2200 and 2800 rpm. If the engine speed falls below 2200 rpm or exceeds 2800 rpm for more than two seconds in one excursion, or more than six seconds over all excursions within 30 seconds of the final measured value used in the pass/fail determination, the measured value shall be invalidated and the mode continued. The minimum second-chance high-speed mode length shall be determined as described in paragraphs (VI)(d)(2)(iii) and (iv) of this appendix. If any excursion lasts for more than ten seconds, the mode timer shall reset to zero (mt=0) and timing resumed. The maximum second-chance high-speed mode length shall be 180 seconds elapsed time (mt=180).

(iii) In the case where the second-chance high-speed mode is *not* followed by the second-chance idle mode, the pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the high-speed mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the high-speed mode and the test shall be terminated if at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (VI)(d)(2)(iii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (VI)(a)(2) of this appendix.

(C) The vehicle shall pass the high-speed mode and the test shall be immediately terminated if, at any point between an elapsed time for 30 seconds (mt=30) and 180 seconds (mt=180), the measured values are less than or equal to the applicable short test standards as described in paragraph (VI)(a)(2) of this appendix.

(D) The vehicle shall fail the high-speed mode and the test shall be terminated if

none of the provisions of paragraphs (VI)(d)(2)(iii) (A), (B), and (C) of this appendix is satisfied by an elapsed time of 180 seconds (mt=180).

(iv) In the case where the second-chance high-speed mode *is* followed by the second-chance idle mode, the pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the high-speed mode and the mode shall be terminated at the end of an elapsed time of 180 seconds (mt=180) if any measured values are less than or equal to the applicable short test standards as described in paragraph (VI)(a)(2) of this appendix.

(B) The vehicle shall fail the high-speed mode and the mode shall be terminated if paragraph (VI)(d)(2)(iv)(A) of this appendix is not satisfied by an elapsed time of 180 seconds (mt=180).

(3) *Second-chance preconditioning mode.* The mode timer shall start (mt=0) when engine speed is between 2200 and 2800 rpm. The mode shall continue for an elapsed time of 180 seconds (mt=180). If the engine speed falls below 2200 rpm or exceeds 2800 rpm for more than five seconds in any one excursion, or 15 seconds over all excursions, the mode timer shall reset to zero and resume timing.

(4) *Second-chance idle mode*—(i) *Ford Motor Company and Honda vehicles.* The engines of 1981–1987 Ford Motor Company vehicles and 1984–1985 Honda Preludes shall be shut off for not more than 10 seconds and then shall be restarted. The probe may be removed from the tailpipe or the sample pump turned off if necessary to reduce analyzer fouling during the restart procedure. This procedure may also be used for 1988–1989 Ford Motor Company vehicles but should not be used for other vehicles.

(ii) The mode timer shall start (mt=0) when the vehicle engine speed is between 350 and 1100 rpm. If the engine exceeds 1100 rpm or falls below 350 rpm the mode timer shall reset to zero and resume timing. The minimum second-chance idle mode length shall be determined as described in paragraph (VI)(d)(4)(iii) of this appendix. The maximum second-chance idle mode length shall be 90 seconds elapsed time (mt=90).

(iii) The pass/fail analysis shall begin after an elapsed time of 10 seconds (mt=10). A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(A) The vehicle shall pass the second-chance idle mode and the test shall be immediately terminated if, prior to an elapsed time of 30 seconds (mt=30), measured values are less than or equal to 100 ppm HC and 0.5 percent CO.

(B) The vehicle shall pass the second-chance idle mode and the test shall be terminated at the end of an elapsed time of 30 seconds (mt=30) if, prior to that time, the criteria of paragraph (VI)(d)(4)(iii)(A) of this appendix are not satisfied, and the measured values are less than or equal to the applicable short test standards as described in paragraph (VI)(a)(2) of this appendix.

(C) The vehicle shall pass the second-chance idle mode and the test shall be immediately terminated if, at any point between an elapsed time of 30 seconds (mt=30) and 90 seconds (mt=90), measured values are less than or equal to the applicable short test standards described in paragraph (VI)(a)(2) of this appendix.

(D) The vehicle shall fail the second-chance idle mode and the test shall be terminated if none of the provisions of paragraphs (VI)(d)(4)(iii) (A), (B), and (C) of this appendix is satisfied by an elapsed time of 90 seconds (mt=90).

[57 FR 52987, Nov. 5, 1992, as amended at 61 FR 40946, Aug. 6, 1996]

APPENDIX C TO SUBPART S—STEADY-STATE SHORT TEST STANDARDS

(I) Short Test Standards for 1981 and Later Model Year Light-Duty Vehicles

For 1981 and later model year light-duty vehicles for which any of the test procedures described in appendix B to this subpart are utilized to establish Emissions Performance Warranty eligibility (i.e., 1981 and later model year light-duty vehicles at low altitude and 1982 and later model year vehicles at high altitude to which high altitude certification standards of 1.5 gpm HC and 15 gpm CO or less apply), short test emissions for all tests and test modes shall not exceed:

- (a) Hydrocarbons: 220 ppm as hexane.
- (b) Carbon monoxide: 1.2%.

(II) Short Test Standards for 1981 and Later Model Year Light-Duty Trucks

For 1981 and later model year light-duty trucks for which any of the test procedures described in appendix B to this subpart are utilized to establish Emissions Performance Warranty eligibility (i.e., 1981 and later model year light-duty trucks at low altitude and 1982 and later model year trucks at high altitude to which high altitude certification standards of 2.0 gpm HC and 26 gpm CO or less apply), short test emissions for all tests and test modes shall not exceed:

- (a) Hydrocarbons: 220 ppm as hexane.
- (b) Carbon monoxide: 1.2%.

APPENDIX D TO SUBPART S—STEADY-STATE SHORT TEST EQUIPMENT

(I) Steady-State Test Exhaust Analysis System

(a) *Sampling system*—(1) *General requirements*. The sampling system for steady-state short tests shall, at a minimum, consist of a tailpipe probe, a flexible sample line, a water removal system, particulate trap, sample pump, flow control components, tachometer or dynamometer, analyzers for HC, CO, and CO₂, and digital displays for exhaust concentrations of HC, CO, and CO₂, and engine rpm. Materials that are in contact with the gases sampled shall not contaminate or change the character of the gases to be analyzed, including gases from alcohol fueled vehicles. The probe shall be capable of being inserted to a depth of at least ten inches into the tailpipe of the vehicle being tested, or into an extension boot if one is used. A digital display for dynamometer speed and load shall be included if the test procedures described in appendix B to this subpart, paragraphs (III) and (V), are conducted. Minimum specifications for optional NO analyzers are also described in this appendix. The analyzer system shall be able to test, as specified in at least one section in appendix B to this subpart, all model vehicles in service at the time of sale of the analyzer.

(2) *Temperature operating range*. The sampling system and all associated hardware shall be of a design certified to operate within the performance specifications described in paragraph (I)(b) of this appendix in ambient air temperatures ranging from 41 to 110 degrees Fahrenheit. The analyzer system shall, where necessary, include features to keep the sampling system within the specified range.

(3) *Humidity operating range*. The sampling system and all associated hardware shall be of a design certified to operate within the performance specifications described in paragraph (I)(b) of this appendix at a minimum of 80 percent relative humidity throughout the required temperature range.

(4) *Barometric pressure compensation*. Barometric pressure compensation shall be provided. Compensation shall be made for elevations up to 6,000 feet (above mean sea level). At any given altitude and ambient conditions specified in paragraph (I)(b) of this appendix, errors due to barometric pressure changes of ± 2 inches of mercury shall not exceed the accuracy limits specified in paragraph (I)(b) of this appendix.

(5) *Dual sample probe requirements*. When testing a vehicle with dual exhaust pipes, a dual sample probe of a design certified by the analyzer manufacturer to provide equal flow in each leg shall be used. The equal flow requirement is considered to be met if the flow

rate in each leg of the probe has been measured under two sample pump flow rates (the normal rate and a rate equal to the onset of low flow), and if the flow rates in each of the legs are found to be equal to each other (within 15% of the flow rate in the leg having lower flow).

(6) *System lockout during warm-up.* Functional operation of the gas sampling unit shall remain disabled through a system lockout until the instrument meets stability and warm-up requirements. The instrument shall be considered "warmed up" when the zero and span readings for HC, CO, and CO₂ have stabilized, within ±3% of the full range of low scale, for five minutes without adjustment.

(7) *Electromagnetic isolation and interference.* Electromagnetic signals found in an automotive service environment shall not cause malfunctions or changes in the accuracy in the electronics of the analyzer system. The instrument design shall ensure that readings do not vary as a result of electromagnetic radiation and induction devices normally found in the automotive service environment, including high energy vehicle ignition systems, radio frequency transmission radiation sources, and building electrical systems.

(8) *Vibration and shock protection.* System operation shall be unaffected by the vibration and shock encountered under the normal operating conditions encountered in an automotive service environment.

(9) *Propane equivalency factor.* The propane equivalency factor shall be displayed in a manner that enables it to be viewed conveniently, while permitting it to be altered only by personnel specifically authorized to do so.

(b) *Analyzers—(1) Accuracy.* The analyzers shall be of a design certified to meet the following accuracy requirements when calibrated to the span points specified in appendix A to this subpart:

| Channel | Range | Accuracy | Noise | Repeatability |
|---------------------------|-----------|----------|-------|---------------|
| HC, ppm | 0-400 | ±12 | 6 | 8 |
| | 401-1000 | ±30 | 10 | 15 |
| | 1001-2000 | ±80 | 20 | 30 |
| CO, % | 0-2.00 | ±0.06 | 0.02 | 0.03 |
| | 2.01-5.00 | ±0.15 | 0.06 | 0.08 |
| | 5.01-9.99 | ±0.40 | 0.10 | 0.15 |
| CO ₂ , % | 0-4.0 | ± 0.6 | 0.2 | 0.3 |
| | 4.1-14.0 | ±0.5 | 0.2 | 0.3 |
| NO, ppm | 0-1000 | ±32 | 16 | 20 |
| | 1001-2000 | ±60 | 25 | 30 |
| | 2001-4000 | ±120 | 50 | 60 |

(2) *Minimum analyzer display resolution.* The analyzer electronics shall have sufficient resolution to achieve the following:

| | |
|-----------------------|------------------------|
| HC | 1ppm HC as hexane. |
| CO | 0.01% CO. |
| CO ₂ | 0.1% CO ₂ . |
| NO | 1ppm NO. |
| RPM | 1rpm. |

(3) *Response time.* The response time from the probe to the display for HC, CO, and CO₂ analyzers shall not exceed eight seconds to 90% of a step change in input. For NO analyzers, the response time shall not exceed twelve seconds to 90% of a step change in input.

(4) *Display refresh rate.* Dynamic information being displayed shall be refreshed at a minimum rate of twice per second.

(5) *Interference effects.* The interference effects for non-interest gases shall not exceed ±10 ppm for hydrocarbons, ±0.05 percent for carbon monoxide, ±0.20 percent for carbon dioxide, and ±20 ppm for oxides of nitrogen.

(6) *Low flow indication.* The analyzer shall provide an indication when the sample flow is below the acceptable level. The sampling system shall be equipped with a flow meter (or equivalent) that shall indicate sample flow degradation when meter error exceeds three percent of full scale, or causes system response time to exceed 13 seconds to 90 percent of a step change in input, whichever is less.

(7) *Engine speed detection.* The analyzer shall utilize a tachometer capable of detecting engine speed in revolutions per minute (rpm) with a 0.5 second response time and an accuracy of ±3% of the true rpm.

(8) *Test and mode timers.* The analyzer shall be capable of simultaneously determining the amount of time elapsed in a test, and in a mode within that test.

(9) *Sample rate.* The analyzer shall be capable of measuring exhaust concentrations of gases specified in this section at a minimum rate of twice per second.

(c) *Demonstration of conformity.* The analyzer shall be demonstrated to the satisfaction of the inspection program manager, through acceptance testing procedures, to meet the requirements of this section and that it is capable of being maintained as required in appendix A to this subpart.

(II) *Steady-State Test Dynamometer*

(a) The chassis dynamometer for steady-state short tests shall provide the following capabilities:

(1) *Power absorption.* The dynamometer shall be capable of applying a load to the vehicle's driving tire surfaces at the horsepower and speed levels specified in paragraph (II)(b) of this appendix.

(2) *Short-term stability.* Power absorption at constant speed shall not drift more than ±0.5 horsepower (hp) during any single test mode.

(3) *Roll weight capacity.* The dynamometer shall be capable of supporting a driving axle weight up to four thousand (4,000) pounds or greater.

(4) *Between roll wheel lifts.* These shall be controllable and capable of lifting a minimum of four thousand (4,000) pounds.

(5) *Roll brakes.* Both rolls shall be locked when the wheel lift is up.

(6) *Speed indications.* The dynamometer speed display shall have a range of 0-60 mph, and a resolution and accuracy of at least 1 mph.

(7) *Safety interlock.* A roll speed sensor and safety interlock circuit shall be provided which prevents the application of the roll brakes and upward lift movement at any roll speed above 0.5 mph.

(b) The dynamometer shall produce the load speed relationships specified in paragraphs (III) and (V) of appendix B to this subpart.

(III) *Transient Emission Test Equipment*
[Reserved]

(IV) *Evaporative System Purge Test Equipment*
[Reserved]

(V) *Evaporative System Integrity Test Equipment* [Reserved]

[57 FR 52987, Nov. 5, 1992, as amended at 58 FR 59367, Nov. 9, 1993]

APPENDIX E TO SUBPART S—TRANSIENT TEST DRIVING CYCLE

(I) *Driver's trace.* All excursions in the transient driving cycle shall be evaluated by the procedures defined in §86.115-78(b)(1) and §86.115(c) of this chapter. Excursions exceeding these limits shall cause a test to be void. In addition, provisions shall be available to utilize cycle validation criteria, as described in §86.1341-90 of this chapter, for trace speed versus actual speed as a means to determine a valid test.

(II) *Driving cycle.* The following table shows the time speed relationship for the transient IM240 test procedure.

| Second | MPH |
|--------|------|
| 0 | 0 |
| 1 | 0 |
| 2 | 0 |
| 3 | 0 |
| 4 | 0 |
| 5 | 3 |
| 6 | 5.9 |
| 7 | 8.6 |
| 8 | 11.5 |
| 9 | 14.3 |
| 10 | 16.9 |
| 11 | 17.3 |
| 12 | 18.1 |
| 13 | 20.7 |
| 14 | 21.7 |
| 15 | 22.4 |
| 16 | 22.5 |
| 17 | 22.1 |
| 18 | 21.5 |
| 19 | 20.9 |
| 20 | 20.4 |
| 21 | 19.8 |
| 22 | 17 |
| 23 | 14.9 |
| 24 | 14.9 |
| 25 | 15.2 |

| Second | MPH |
|--------|------|
| 26 | 15.5 |
| 27 | 16 |
| 28 | 17.1 |
| 29 | 19.1 |
| 30 | 21.1 |
| 31 | 22.7 |
| 32 | 22.9 |
| 33 | 22.7 |
| 34 | 22.6 |
| 35 | 21.3 |
| 36 | 19 |
| 37 | 17.1 |
| 38 | 15.8 |
| 39 | 15.8 |
| 40 | 17.7 |
| 41 | 19.8 |
| 42 | 21.6 |
| 43 | 23.2 |
| 44 | 24.2 |
| 45 | 24.6 |
| 46 | 24.9 |
| 47 | 25 |
| 48 | 25.7 |
| 49 | 26.1 |
| 50 | 26.7 |
| 51 | 27.5 |
| 52 | 28.6 |
| 53 | 29.3 |
| 54 | 29.8 |
| 55 | 30.1 |
| 56 | 30.4 |
| 57 | 30.7 |
| 58 | 30.7 |
| 59 | 30.5 |
| 60 | 30.4 |
| 61 | 30.3 |
| 62 | 30.4 |
| 63 | 30.8 |
| 64 | 30.4 |
| 65 | 29.9 |
| 66 | 29.5 |
| 67 | 29.8 |
| 68 | 30.3 |
| 69 | 30.7 |
| 70 | 30.9 |
| 71 | 31 |
| 72 | 30.9 |
| 73 | 30.4 |
| 74 | 29.8 |
| 75 | 29.9 |
| 76 | 30.2 |
| 77 | 30.7 |
| 78 | 31.2 |
| 79 | 31.8 |
| 80 | 32.2 |
| 81 | 32.4 |
| 82 | 32.2 |
| 83 | 31.7 |
| 84 | 28.6 |
| 85 | 25.1 |
| 86 | 21.6 |
| 87 | 18.1 |
| 88 | 14.6 |
| 89 | 11.1 |
| 90 | 7.6 |
| 91 | 4.1 |
| 92 | 0.6 |
| 93 | 0 |
| 94 | 0 |
| 95 | 0 |
| 96 | 0 |
| 97 | 0 |
| 98 | 3.3 |
| 99 | 6.6 |

Environmental Protection Agency

Pt. 51, Subpt. S, App. E

| Second | MPH | Second | MPH |
|--------|------|--------|------|
| 100 | 9.9 | 174 | 47.2 |
| 101 | 13.2 | 175 | 47.4 |
| 102 | 16.5 | 176 | 47.9 |
| 103 | 19.8 | 177 | 48.5 |
| 104 | 22.2 | 178 | 49.1 |
| 105 | 24.3 | 179 | 49.5 |
| 106 | 25.8 | 180 | 50 |
| 107 | 26.4 | 181 | 50.6 |
| 108 | 25.7 | 182 | 51 |
| 109 | 25.1 | 183 | 51.5 |
| 110 | 24.7 | 184 | 52.2 |
| 111 | 25.2 | 185 | 53.2 |
| 112 | 25.4 | 186 | 54.1 |
| 113 | 27.2 | 187 | 54.6 |
| 114 | 26.5 | 188 | 54.9 |
| 115 | 24 | 189 | 55 |
| 116 | 22.7 | 190 | 54.9 |
| 117 | 19.4 | 191 | 54.6 |
| 118 | 17.7 | 192 | 54.6 |
| 119 | 17.2 | 193 | 54.8 |
| 120 | 18.1 | 194 | 55.1 |
| 121 | 18.6 | 195 | 55.5 |
| 122 | 20 | 196 | 55.7 |
| 123 | 20.7 | 197 | 56.1 |
| 124 | 21.7 | 198 | 56.3 |
| 125 | 22.4 | 199 | 56.6 |
| 126 | 22.5 | 200 | 56.7 |
| 127 | 22.1 | 201 | 56.7 |
| 128 | 21.5 | 202 | 56.3 |
| 129 | 20.9 | 203 | 56 |
| 130 | 20.4 | 204 | 55 |
| 131 | 19.8 | 205 | 53.4 |
| 132 | 17 | 206 | 51.6 |
| 133 | 17.1 | 207 | 51.8 |
| 134 | 15.8 | 208 | 52.1 |
| 135 | 15.8 | 209 | 52.5 |
| 136 | 17.7 | 210 | 53 |
| 137 | 19.8 | 211 | 53.5 |
| 138 | 21.6 | 212 | 54 |
| 139 | 22.2 | 213 | 54.9 |
| 140 | 24.5 | 214 | 55.4 |
| 141 | 24.7 | 215 | 55.6 |
| 142 | 24.8 | 216 | 56 |
| 143 | 24.7 | 217 | 56 |
| 144 | 24.6 | 218 | 55.8 |
| 145 | 24.6 | 219 | 55.2 |
| 146 | 25.1 | 220 | 54.5 |
| 147 | 25.6 | 221 | 53.6 |
| 148 | 25.7 | 222 | 52.5 |
| 149 | 25.4 | 223 | 51.5 |
| 150 | 24.9 | 224 | 50.5 |
| 151 | 25 | 225 | 48 |
| 152 | 25.4 | 226 | 44.5 |
| 153 | 26 | 227 | 41 |
| 154 | 26 | 228 | 37.5 |
| 155 | 25.7 | 229 | 34 |
| 156 | 26.1 | 230 | 30.5 |
| 157 | 26.7 | 231 | 27 |
| 158 | 27.3 | 232 | 23.5 |
| 159 | 30.5 | 233 | 20 |
| 160 | 33.5 | 234 | 16.5 |
| 161 | 36.2 | 235 | 13 |
| 162 | 37.3 | 236 | 9.5 |
| 163 | 39.3 | 237 | 6 |
| 164 | 40.5 | 238 | 2.5 |
| 165 | 42.1 | 239 | 0 |
| 166 | 43.5 | | |
| 167 | 45.1 | | |
| 168 | 46 | | |
| 169 | 46.8 | | |
| 170 | 47.5 | | |
| 171 | 47.5 | | |
| 172 | 47.3 | | |
| 173 | 47.2 | | |

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