

(c) *Analyzers*—(1) *Accuracy*. The HC analyzer shall have an accuracy of ± 15 ppm at 200 to 220 ppm concentration HC (as hexane). The CO analyzer shall have an accuracy of $\pm 0.1\%$ CO from 1.0% to 1.2% concentration.

(2) *Response time*. Response time of the analyzers shall be 15 seconds to 95% of the final reading.

(3) *Drift*. Analyzer drift (up-scale and down-scale zero and span wander) shall not exceed $\pm 0.1\%$ CO and ± 15 ppm HC (as hexane) on the lowest range capable of reading 1.0% or 200 ppm HC (as hexane) during a one-hour period.

[49 FR 24323, June 12, 1984. Redesignated and amended at 58 FR 58403, 58412, Nov. 1, 1993]

§ 85.2225 Steady state test exhaust analysis system—EPA 91.

(a) *Special calendar and model year applicability*. The requirements of § 85.2224 apply concurrently for tests conducted under Emission Performance Warranty on 1995 and earlier model year vehicles or engines until December 31, 1993, after which the requirements of this section are solely in effect. The following exceptions apply: in a state where the Administrator has approved a SIP revision providing for implementation of a basic centralized program meeting the requirements of part 51, subpart S of this chapter, according to the schedule specified in § 51.373 of this chapter, the requirements of § 85.2224 are concurrently in effect until June 30, 1994, for 1995 and earlier model year vehicles or engines; in a state where the Administrator has approved a SIP revision providing for implementation of an enhanced program meeting the requirements of part 51, subpart S of this chapter, according to the schedule specified in § 51.373 of this chapter, the requirements of § 85.2224 are concurrently in effect until December 31, 1995, for 1995 and earlier model year vehicles or engines.

(b) *Sampling System*—(1) *General requirements*. The sampling system for steady state short tests consists, at a minimum, 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

for engine rpm. Materials that are in contact with the gases sampled may not contaminate or change the character of the gases to be analyzed, including gases from alcohol-fueled vehicles. The probe must 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 must be included if the test procedures described in § 85.2217 or § 85.2219 are conducted. Minimum specifications for optional NO analyzers are also described in this section. The analyzer system must be able to test, as specified in §§ 85.2213, 85.2215, 85.2217, 85.2218, 85.2219, and 85.2220 all model vehicles in service at the time of sale of the analyzer.

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

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

(4) *Barometric pressure compensation*. Barometric pressure compensation must be provided. Compensation is made for elevations up to 6000 feet (above mean sea level). At any given altitude and ambient conditions specified in paragraphs (b) (2) and (3) of this section, errors due to barometric pressure changes of ± 2 inches of mercury may not exceed the accuracy limits specified in paragraph (c) of this section.

(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 must 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 percent of the flow rate in the leg having lower flow).

(6) *System lockout during warmup.* Functional operation of the gas sampling unit must remain disabled through a system lockout until the instrument meets stability and warmup requirements. The instrument is considered “warmed up” when the zero and span readings for HC, CO, and CO₂ have stabilized, within ±3 percent 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 may not cause malfunctions or changes in the accuracy in the electronics of the analyzer system. The instrument design must 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 must 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 must 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.

(c) *Analyzers—(1) Accuracy.* The analyzers must be of a design certified to meet the following accuracy requirements when calibrated to the span points specified in §85.2233(e)(2):

Channel	Range	Accuracy	Noise	Repeat-ability
HC, as hexane	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 .....	.06	.08	
	5.01-9.99 ±0.40 .....	.10	.15	
CO ₂ , %	0-4.0 ±0.6 .....	.2	.3	
	4.1-14.0 ±0.5 .....	.2	.3	
	14.1-16.0 ±0.6 .....	.2	.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 must have sufficient resolution to achieve the level of accuracy indicated in paragraphs (c)(2)(i) through (v) of this section.

- (i) HC 1 ppm HC as hexane.
- (ii) CO 0.01% CO.
- (iii) CO₂ 0.1% CO₂.
- (iv) NO 1 ppm NO.
- (v) RPM 1 rpm.

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

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

(5) *Interference effects.* The interference effects for non-interest gases may 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 must provide an indication when the sample flow is below the acceptable level. The sampling system must be equipped with a flow meter (or equivalent) that indicates sample flow degradation when meter error exceeds three percent of full scale, or causes

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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 must 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 percent of the true rpm.

(8) *Test and mode timers.* The analyzer must 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 must be capable of measuring exhaust concentrations of gases specified in this section at a minimum rate of once every 0.75 second.

(d) *Demonstration of conformity.* The analyzer must be demonstrated to the satisfaction of the inspection program manager, through acceptance testing procedures, to meet the requirements of this section and to be capable of being maintained as required in § 85.2233.

[58 FR 58413, Nov. 1, 1993; 59 FR 33913, July 1, 1994]

§§ 85.2226–85.2228 [Reserved]

§ 85.2229 Dynamometer—EPA 81.

(a) *Applicability.* The requirements of this subsection apply to short tests conducted under Emissions Performance Warranty through December 31, 1993. The requirements of § 85.2230 apply concurrently until December 31, 1993, after which the requirements of § 85.2230 are solely in effect. The following exceptions apply: in a state where the Administrator has approved a SIP revision providing for implementation of a basic centralized program meeting the requirements of part 51, subpart S of this chapter, according to the schedule specified in § 51.373 of this chapter, the requirements of this section are concurrently in effect until June 30, 1994 for 1995 and earlier model year vehicles or engines; in a state where the Administrator has approved a SIP revision providing for implementation of an enhanced program meeting the requirements of part 51, subpart S of this chapter, according to the schedule specified in § 51.373 of this chapter, the requirements of this section are

concurrently in effect until December 31, 1995 for 1995 and earlier model year vehicles or engines.

(b) The loaded test dynamometer shall be adjusted to produce a load of 9.0 ± 1.0 hp at 30 mph.

(c) Speed shall be measured from the dynamometer roll(s) with an accuracy of ± 1.5 mph at 30 mph true roll speed.

[49 FR 24323, June 12, 1984. Redesignated and amended at 58 FR 58403, 58414, Nov. 1, 1993]

§ 85.2230 Steady state test dynamometer—EPA 91.

(a) *Special calendar and model year applicability.* The requirements of § 85.2229 apply concurrently for tests conducted under Emission Performance Warranty on 1995 and earlier model year vehicles or engines until December 31, 1993, after which the requirements of this section are solely in effect. The following exceptions apply: In a state where the Administrator has approved a SIP revision providing for implementation of a basic centralized program meeting the requirements of part 51, subpart S of this chapter, according to the schedule specified in § 51.373 of this chapter, the requirements of § 85.2229 are concurrently in effect until June 30, 1994 for 1995 and earlier model year vehicles or engines; in a state where the Administrator has approved a SIP revision providing for implementation of an enhanced program meeting the requirements of part 51, subpart S of this chapter, according to the schedule specified in § 51.373 of this chapter, the requirements of § 85.2229 are concurrently in effect until December 31, 1995 for 1995 and earlier model year vehicles or engines.

(b) The chassis dynamometer for steady state short tests must provide the capabilities described in paragraphs (b) (1) through (7) of this section.

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

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

(3) *Roll weight capacity.* The dynamometer must be capable of supporting