

Enclosure 2

State of California
AIR RESOURCES BOARD

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES
FOR 1995 AND LATER
~~UTILITY AND LAWN AND GARDEN EQUIPMENT~~ SMALL OFF-ROAD ENGINES

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NOTE: This document is printed in a style to indicate changes from the existing provisions. Only the sections that have changed from the text contained in Mail-Out MSC 98-32 have been included.

All existing language is indicated by plain type. All additions to language are indicated by underlined text. All deletions to language are indicated by ~~strikeout~~. The modifications presented in Mail-Out MSC 98-32 are shown in **bold double-underline** to indicate additions to the original proposal and **~~bold strikeout~~** to indicate deletions. The modifications to the language presented in Mail-Out MSC 98-32 are shown in shaded text to indicate additions and ~~shaded strikeout~~ to indicate deletions.

The numbering convention employed in this document, in order of priority, is:
I.1.a.1.i.A.

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES
FOR 1995 AND LATER
~~UTILITY AND LAWN AND GARDEN EQUIPMENT~~ SMALL OFF-ROAD ENGINES

Part I. Emission Regulations for 1995 and Later New ~~Lawn and Garden and Utility Equipment~~ Small Off-Road Engines, General Provisions.

8. Replacement Engines.

(a) No new engines below 225 cc ~~shall~~ may be produced for sale to replace pre-1995 model equipment after January 1, 1999, unless such new ~~those~~ engines comply with the 1995 model emission standards.

(b) (1) A new small off-road engine equal to or greater than 225 cc, intended solely to replace an engine in a piece of off-road equipment that was originally produced with an engine manufactured prior to the applicable implementation date as described in paragraph (b), shall not be subject to the emissions requirements of paragraph (b) provided that:

(i) The engine manufacturer has ascertained that no engine produced by itself or the manufacturer of the engine that is being replaced, if different, and certified to the requirements of this article, is available with the appropriate physical or performance characteristics to repower the equipment; and

(ii) Unless an alternative control mechanism is approved in advance by the Executive Officer, the engine manufacturer or its agent takes ownership and possession of the engine being replaced; and

(iii) The replacement engine is clearly labeled with the following language, or similar alternate language approved in advance by the Executive Officer:

THIS ENGINE DOES NOT COMPLY WITH CALIFORNIA OFF-ROAD OR ON-HIGHWAY EMISSION REQUIREMENTS. SALE OR INSTALLATION OF THIS ENGINE FOR ANY PURPOSE OTHER THAN AS A REPLACEMENT ENGINE IN AN OFF-ROAD VEHICLE OR PIECE OF OFF-ROAD EQUIPMENT WHOSE ORIGINAL ENGINE WAS NOT CERTIFIED IS A VIOLATION OF CALIFORNIA LAW SUBJECT TO CIVIL PENALTY.

(2) At the beginning of each model year, the manufacturer of replacement engines must provide, by engine model, an estimate of the number of replacement engines it expects to produce for California for that model year, and a description of the physical or performance characteristics of those models that indicate that a certified replacement is not available as per paragraph (1).

(3) At the conclusion of the model year, the manufacturer must provide, by engine model, the actual number of replacement engines produced for California during the model year, and a description of the physical or performance characteristics of those models that indicate that certified replacement engine(s) were not available as per paragraph (A) .

9. Exhaust Emission Standards For 1995 and Later ~~Utility and Lawn and Garden~~ Small Off-Road Engines.

(a) This section ~~shall be applicable~~ applies to ~~utility and lawn and garden equipment small off-road~~ engines produced on or after January 1, 1995.

(b) Exhaust emissions from ~~utility and lawn and garden equipment~~ small off-road engines manufactured for sale, sold, offered for sale, introduced, ~~or delivered or imported into California~~ for introduction into commerce in, ~~or imported into California,~~ shall must not exceed:

Exhaust Emission Standards
(grams per brake horsepower-hour)
[grams per kilowatt-hour]

Calendar Year	Engine Class ⁽¹⁾	Hydrocarbon plus oxides of nitrogen ⁽²⁾	Hydrocarbon ⁽²⁾	Carbon Monoxide	Oxides of Nitrogen	Particulate
1995	I	12.0	--	300	--	0.9 ⁽³⁾
	II	10.0	--	300	--	0.9 ⁽³⁾
	III ⁽⁴⁾	--	220	600	4.0	--
	IV ⁽⁴⁾	--	180	600	4.0	--
	V ⁽⁴⁾	--	120	300	4.0	--
1996 to 1998 <u>1999</u>	I	12.0 (6)(5)	--	350	--	0.9 ⁽³⁾
	II	10.0 (6)(5)	--	350	--	0.9 ⁽³⁾
	III ⁽⁴⁾	--	220 (6)(5)	600	4.0 (6)(5)	--
	IV ⁽⁴⁾	--	180 (6)(5)	600	4.0 (6)(5)	--
	V ⁽⁴⁾	--	120 (6)(5)	300	4.0 (6)(5)	--
1999 and subsequent ⁽⁷⁾	I, II	3.2 ⁽⁷⁾	==	100	==	0.25 ⁽⁷⁾
	III, IV, V ⁽⁴⁾	==	50 ⁽⁷⁾	130	4.0 ⁽⁷⁾	0.25 ⁽⁷⁾

<u>Model Year</u>	<u>Engine Class ⁽¹⁾</u>	<u>Durability Periods (hours)</u>	<u>Hydrocarbon plus oxides of nitrogen⁽²⁾</u>	<u>Carbon Monoxide</u>	<u>Particulate</u>
<u>2000-2001</u> <u>(5)</u>	<u>SI</u> <u>0-65 cc,</u> <u>inclusive</u>	<u>50/125/300</u>	<u>54</u> <u>[72]</u>	<u>400</u> <u>[536]</u>	<u>1.5</u> <u>(4)</u> <u>[2.0]</u>
	<u>SI</u> <u>>65 cc - <225 cc</u>	<u>N/A</u>	<u>12.0</u> <u>[16.1]</u>	<u>350</u> <u>[467]</u>	
	<u>SI</u> <u>≥225 cc</u>	<u>N/A</u>	<u>10.0</u> <u>[12.0]</u>	<u>350</u> <u>[467]</u>	
<u>2000-2003⁽⁶⁾</u> <u>2002-2005</u> <u>(5)</u>	<u>Spark-Ignition</u> <u>(SI) Engines</u> <u>0-60 65 cc,</u> <u>inclusive</u>	<u>50/125/300</u>	<u>54</u> <u>[72]</u>	<u>400</u> <u>[536]</u>	<u>1.5⁽⁵⁾</u> <u>(4)</u> <u>[2.0]</u>
	<u>SI</u> <u>>60 65 cc -</u> <u><225 cc</u> <u>Horizontal</u>	<u>125/250/500</u>	<u>12.0</u> <u>[16.1]</u>	<u>410</u> <u>[549]</u>	
	<u>SI</u> <u>>65 cc - <225 cc</u> <u>Vertical</u>	<u>NA</u>	<u>12.0</u> <u>[16.1]</u>	<u>350</u> <u>[467]</u>	
	<u>SI</u> <u>≥225 cc</u>	<u>125/250/500</u>	<u>9.0</u> <u>[12.0]</u>	<u>410</u> <u>[549]</u>	
<u>2004</u> <u>2006 and</u> <u>sub-</u> <u>sequent⁽⁶⁾⁽⁵⁾</u>	<u>SI</u> <u>0-60 65 cc,</u> <u>inclusive</u>	<u>50/125/300</u>	<u>54</u> <u>[72]</u>	<u>400</u> <u>[536]</u>	<u>1.5⁽⁵⁾</u> <u>(4)</u> <u>[2.0]</u>
	<u>SI</u> <u>>60 65 cc -</u> <u><225 cc</u>	<u>125/250/500</u>	<u>9.0</u> <u>[12.0]</u> <u>12.0</u> <u>[16.1]</u>	<u>410</u> <u>[549]</u>	

	SI ≥225 cc	125/250/500	7.0 [9.4] <u>9.0</u> <u>[12.0]</u>	410 [549]	
<u>2000-2004</u> ⁽⁶⁾ <u>(5)</u>	CI <11 hp	3000 hours or 5 years	7.8 [10.4]	6.0 [8.0]	0.75 [1.0]
	CI ≥11-<25 hp	3000 hours or 5 years	7.1 [9.5]	4.9 [6.6]	0.6 [0.8]
2005 and sub- sequent ⁽⁶⁾ (5)	CI <11 hp	3000 hours or 5 years	5.6 [7.5]	6.0 [8.0]	0.6 [0.8]
	CI ≥11-<25 hp	3000 hours or 5 years	5.6 [7.5]	4.9 [6.6]	0.6 [0.8]
	CI ≥11-<25 hp	3000 hours or 5 years	5.6 [7.5]	4.9 [6.6]	0.6 [0.8]

[NOTE: That part of the table in Mail-Out 98-32 identified above was in error. The corrections noted in the table return it to the form adopted by the Board.]

- (1) "Class I" means ~~utility and lawn and garden equipment~~ small off-road engines **greater than 65 cc to less than 225 cc** in displacement.
"Class II" means ~~utility and lawn and garden equipment~~ small off-road engines greater than or equal to 225 cc in displacement.
"Class III" means ~~hand-held utility and lawn and garden equipment~~ small off-road engines less than 20 cc in displacement.
"Class IV" means ~~hand-held utility and lawn and garden equipment~~ small off-road engines 20 cc to less than 50 cc in displacement.
"Class V" means ~~hand-held utility and lawn and garden equipment~~ small off-road engines greater than or equal to 50 cc to 65 cc in displacement.
- (2) The Executive Officer may allow gaseous-fueled (i.e., propane, natural gas) engine families, that satisfy the requirements of the regulations, to certify to either the hydrocarbon plus oxides of nitrogen or hydrocarbon emission standard, as applicable, on the basis of the non-methane hydrocarbon (NMHC) portion of the total hydrocarbon emissions.
- (3) Applicable to all diesel-cycle engines.
- (4) ~~These standards may be used for engines that meet the requirements of (i) and (ii) below, and for two-stroke engines that exclusively power snow throwers.~~
 - (i) ~~The engine must be used in a hand-held piece of equipment. To be classified as a hand-held piece of equipment, the equipment must require its full weight to be supported by the operator in the performance of its requisite function.~~
 - (ii) ~~The engine and equipment must require multi-positional characteristics for use (e.g., it must be capable of operating in any position, upside down, or sideways as required to complete the job).~~
- (54) Applicable to all diesel-cycle engines, and all two-stroke engines.
- (65) Engines used exclusively in snowthrowers and ice augers need not certify to or comply with the HC and NOx standards or the crankcase requirements at the option of the manufacturer.

(c) In 1995 and subsequent years, fire and police departments, and other entities which that specialize in emergency response may purchase emergency equipment powered by a non-California-certified engine only when such equipment with a California-certified engine is not available. For purposes of this Section, a request to purchase emergency equipment powered by a non-California-certified engine ~~shall~~ must be submitted for approval to the Executive Officer.

(d) Averaging. For new 2000 and subsequent model year small off-road engines, a manufacturer may comply with the standards established in paragraph (b), above, by choosing either to certify an engine family to these standards or ~~through to use of~~ the corporate average described below. ~~Emission reduction credits (see California Code of Regulations, Title 12, Section 2408) may be used to modify the manufacturer's corporate average, as an addend in the numerator of the equation in paragraph (1), below.~~

(1) For each model year, the corporate average value for a pollutant is defined by the following equation:

$$\frac{\sum_{j=1}^n (FEL_j) (\mathbf{PROD}_j \mathbf{Sales}_j) (HP_j) (\mathbf{Load Factor}) (EDP_j) - \mathbf{credits expended}}{\sum_{j=1}^n (\mathbf{PROD}_j \mathbf{Sales}_j) (HP_j) (\mathbf{Load Factor}) (EDP_j)} = \mathbf{AVG}$$

where n = the number of small off-road engine families.

FEL = the Family emission level for an engine family.

PROD_j Sales_j = the **number of units eligible sales** of engine family j **produced in that model year for sale in California.**

HP = **sales-weighted maximum modal** Horsepower **determined during certification testing** of engine family j, or an alternative approved by the Executive Officer.

EDP_j = Emissions durability period of engine family j **produced for sale in California.**

AVG = For a given pollutant (HC+NO_x, CO, or Particulate **Matter**), a manufacturer's corporate average of the exhaust emissions from those California small off-road engines subject to the California corporate average pollutant exhaust emission standard, as established by an Executive Order certifying the California production for the model year.

Credits expended = HC+NO_x or Particulate Matter credits, as defined in Sections 2408 and 2409, Title 13 of the California Code of Regulations, that are expended by the manufacturer to adjust the corporate average. This term has no meaning for any pollutants other than HC+NO_x and Particulate Matter.

~~(2) — The Executive Order certifying the California production for a model year must be obtained prior to the issuance of certification Executive Orders for individual engine families for the model year.~~

~~(4) (2)~~ The manufacturer's average pollutant exhaust emissions must meet the corporate average standard at the end of the manufacturer's production for the model year. At the end of the model year, the manufacturer must calculate a corrected corporate average using actual rather than projected sales. Any discrepancy must be made up with emission reduction credits **as explained in paragraph (3).**

(3) All excess **HC+NOx and Particulate Matter** emissions resulting from final non-compliance with the California standard must be made up **in the following model year** with emission reduction credits or through incorporation in **that the following model year's** corporate average.

(A) Emission reduction credits expended within the next model year to remedy final non-compliance **will be used at a rate of 1 gram to 1 gram.**

(B) For purposes of remedying non-compliance, Emission reduction credits **expended after the end of the next model year** to remedy final non-compliance **must be expended used at the a rate of 1.5 grams to 1 gram pounds for each excess pound.**

Part II. Spark-Ignition Engines - Determination of Emissions Durability Level.

1. Emissions Durability Period.

For 2000 and later model years all engines subject to a durability period, manufacturers must select an emissions durability period for each engine family as detailed below.

(a) Spark-ignition engines less than or equal to ~~60~~ **65** cc displacement. For each engine family, a manufacturer will select an emissions durability period from those listed below:

50 hours

125 hours

300 hours

(b) Spark-ignition engines greater than ~~60~~ **65** cc displacement. For each engine family, a manufacturer will select an emissions durability period from those listed below:

125 hours

250 hours

500 hours

12. Engine Test Procedure.

(a) Engine Pre-Test Procedures.

(1) Engine Service Accumulation and Stabilization Procedure.

(i) The procedure for stabilizing the exhaust emissions of an engine ~~shall~~ must be the service accumulation procedure determined by the engine manufacturer, and ~~shall~~ must be consistent with good engineering practice.

(ii) The engine manufacturer ~~shall~~ must determine, for each engine family, the amount of time required for stabilization of the engine- displacement-system combination with respect to emission test purposes. However, this stabilization time period ~~shall~~ must not exceed 12 hours unless an allowance to do so is approved by the Executive Officer. In the event an engine manufacturer requests approval for a stabilization time period that is greater than 12 hours, the engine manufacturer ~~shall~~ must maintain, and provide to the Executive Officer upon request, a record of the rationale used to determine the time period required for emission control system stabilization. The engine manufacturer may elect to accumulate up to 12 hours on each test engine within an engine family without making this determination.

(iii) The appropriate fuel and lubricants specified in Section 11 of this Part ~~shall~~ must be used in service accumulation.

(iv) Engine maintenance that is performed in service accumulation ~~shall~~ must be conducted in accordance with Part I, Section 22.

(2) Engine Pre-Test Preparation.

(i) [Reserved].

(ii) Measure the engine's fuel consumption and the power output before and after the emission sampling equipment (including the sample probe) is installed on the engine when the engine is operated on the dynamometer at the appropriate Test Mode (see Table 1-1 Engine Test Cycles, Part I, Section 20), and as follows.

(A) ~~Non-handheld equipment~~ Engines greater than 60 65 cc displacement volume to be tested as per Test Cycle A ~~shall~~ must be operated at Test Mode 6;

(B) ~~Non-handheld equipment~~ Engines greater than 60 65 cc displacement volume to be tested as per Test Cycle B ~~shall~~ must be operated at Test Mode 1; and,

(C) ~~Handheld equipment~~ Engines less than or equal to 60 65 cc displacement volume to be tested as per Test Cycle C ~~shall~~ must be operated at Test Mode 1.

(iii) The emission sampling equipment ~~shall~~ must not have a significant affect on the operational characteristics of the engine (i.e., the before and after results ~~shall~~ must be within five (5) percent).

(3) Analyzer Pre-Test Procedures.

(i) Filter elements ~~shall~~ must be replaced or cleaned as necessary; and the system ~~shall~~ must be leak checked. The maximum allowable leakage rate on a vacuum side of a portion of the system is 0.5 percent of the in-use flow rate in that portion of the system. The

maximum allowable leakage rate on a pressure side of a portion of the system is five (5) percent of the in-use flow rate in that portion of the system. The emission analyzers ~~shall~~ must be stabilized as necessary prior to calibration; heated sample lines, filters and pumps ~~shall~~ must be stabilized thermally as necessary.

- (ii) Perform (as applicable) system checks, such as, sample-line temperatures, system response time, hydrocarbon hang-up, etc.
- (iii) Analyzer zero and span ~~shall~~ must be checked before and after each test cycle.
- (iv) System flow rates and pressures ~~shall~~ must be checked, and re-set as required.

(b) Engine Dynamometer Test Run.

(1) Engine and Dynamometer Start-up.

(i) Only engine adjustments in accordance with Section 22 of Part I ~~shall~~ must be allowed prior to the start of a test.

(ii) The dynamometer ~~shall~~ must be warmed up as necessary, and as recommended by the dynamometer manufacturer; or use good engineering practice.

(iii) An engine may be operated using the engine's speed governor if the engine is so equipped, or with the throttle in a fixed position. The requirements of paragraph (d) of this Section must be satisfied.

(2) The following steps ~~shall~~ must be conducted for each test.

(i) Record applicable data as specified in Section 13.

(ii) Spark-ignition engines are recommended to be preconditioned by operating the engine at a power greater than or equal to 50 percent maximum power at the rated or intermediate speed (as applicable) for 20 minutes.

(iii) Diesel-cycle engines ~~shall~~ must be preconditioned as follows.

(A) Operate the engine at idle for 2 to 3 minutes;

(B) Operate the engine at approximately 50 percent power at the maximum torque speed for 5 to 7 minutes; and,

(C) Operate the engine at rated speed and maximum power for 25 to 30 minutes.

(iv) For both spark-ignition and diesel-cycle engines, the engine service accumulation may be substituted for the engine preconditioning if such service accumulation has been occurring for at least 40 minutes prior to commencing the test cycle.

(v) The test cycle portion of the emission test (i.e., the initial thermal stabilization determination) ~~shall~~ must begin within 5 minutes after completing the engine preconditioning.

(vi) Test modes ~~shall~~ must be performed in the numerical order specified for the appropriate test cycle.

(vii) Determine the maximum engine torque output at the rated or intermediate engine speed, as applicable. For ~~non-handheld~~ engines greater than 60 65 cc displacement volume, determine and record the torque values that correspond to 75, 50, 25 and

10 percent of the maximum engine torque output. The minimum torque capability of an engine may be substituted for the 10-percent value when a 10-percent value of the maximum engine torque output is not attainable.

(viii) Once engine speed and load are set for a particular mode, the engine ~~shall~~ must be operated for a sufficient period of time to achieve thermal stability. The objective is to stabilize all engine parameters that affect emissions prior to the start of any emissions measurements. The method used to determine thermal stability (e.g., variation in cylinder temperature, engine oil temperature, etc.) ~~shall~~ must be recorded.

(ix) Record continuously all modal emission data specified in Section 13 (as applicable) for a minimum of two (2) minutes and as dictated by good engineering practice in order to obtain accurate and reproducible data. The duration of time during which these data are recorded ~~shall~~ must be labeled as the "sampling period". ~~Data sample intervals should be less than one-half of the response time of the fastest instrument system being used~~ one second. The data collected during the sampling period ~~shall~~ must be used for modal emission calculations.

(x) Continuously record the analyzer's output to the exhaust gas during each mode.

(xi) A test mode may be repeated.

(xii) If a delay of more than one (1) hour occurs between the end of one mode and the beginning of another mode, the test is void and ~~shall~~ must be re-started at paragraph (b)(1)(iv)(A) ~~(2)(i)~~ of this Section.

(xiii) If the test equipment malfunctions at any time during a test mode, the test is void and ~~shall~~ must be aborted. Corrective action should be taken and the test re-started.

(xiv) If the engine stalls while in a test mode, the engine ~~shall~~ must be restarted immediately and the test continued at paragraph (b)(1)(iv)(G) ~~(2)(vi)~~ of this Section. If the engine is not restarted within two (2) minutes, the test ~~shall~~ must be voided. If maintenance is required on the engine, advance approval from the Executive Officer is required as specified in Section 23 of Part I. After corrective action is taken, a test of the engine may be rescheduled. The reason for the malfunction (if determined) and the corrective action implemented ~~shall~~ must be recorded.

(xv) Idle-mode fuel and air flow measurements may be determined immediately before or after the dynamometer sequence or as dictated by good engineering practice.

(c) Exhaust Gas Measurements.

(1) Measure HC, CO, CO and NOx concentrations in the exhaust sample.

(2) Each analyzer range that may be used during a test cycle ~~shall~~ must have the zero and span response recorded prior to the execution of each test cycle. Only the range(s) used to measure the emissions during a test cycle is required to have its zero and span recorded after the completion of the test cycle. The span ~~shall~~ must be conducted at the same flow rates used to analyze the test sample. Span gases should have concentrations of 75 to 100 percent of full scale. Actual concentrations ~~shall~~ must be recorded.

(3) Filter elements may be replaced between modes.

(4) System leak checks may be performed between modes.

(5) A hydrocarbon hang-up check may be performed between modes.

(d) Engine Test Cycle.

(1) The appropriate six-mode test cycle for ~~non-handheld~~ equipment engines greater than 60 65 cc displacement volume, and the appropriate two-mode test cycle for ~~handheld~~ equipment engines less than or equal to 60 65 cc displacement volume, shall must be utilized (See Table 1-1 Engine Test Cycles; Part I, Section 20).

(2) ~~The engine speed values specified in Table 1-1 Engine Test Cycles, Section 20, Part I, shall must be maintained to within +/- five (5) percent for a power mode. The engine speed only shall must be maintained to within +/- ten (10) percent of the engine manufacturer's specified engine idle speed for an idle mode. The engine load values specified in Table 1-1 Engine Test Cycles, Section 20, Part I, shall must be maintained, for all applicable loads, to within the larger range provided by +/- 0.27 Nm (+/- 0.2 lb-ft), or +/- ten (10) percent of the specified load value for loads of 50 percent and less, or +/- five (5) percent of the specified load value for loads above 50 percent. All tolerance ranges shall must be determined and recorded for each test mode.~~

(i) For all pre-2000 engines, for 2000 and later model-year engines 0-65 cc, and for those 2000 and later model-year engines above 65 cc that are not equipped with an engine speed governor:

(A) During each non-idle mode, hold both the specified speed and load within ± five percent of point.

(B) During the idle mode, hold speed within ± ten percent of the manufacturer's specified idle engine speed.

(ii) For 2000 and later model-year engines above 65 cc that are equipped with an engine speed governor:

(A) During Mode 1 hold both the specified speed and load within ± five percent of point.

(B) During Modes 2-5, hold the specified load with ± five percent of point.

(C) During the idle mode hold the specified speed within ± ten percent of the manufacturer's specified idle engine speed.

(3) The Executive Officer shall must specify tolerances for engine speed and load for test purposes when such specifications are supported by test data and results, surveillance information, and other engineering information.

(e) Analyzer Post-Test Procedures.

(1) Begin a hydrocarbon hang-up check within one minute of the completion of the last mode in the test cycle.

(2) Analyzer span checks shall must be commenced within six (6) minutes of the completion of the last mode in the test cycle. The zero and span response for each analyzer

range used in the test cycle ~~shall~~ must be recorded.

(3) A vacuum check ~~shall~~ must be performed immediately after the span checks if filter elements were cleaned or replaced in the test. The results ~~shall~~ must satisfy the specifications of Section 12(a)(3)(i) of this Part.

(4) The analyzer drift between the before- and after-test cycle span checks of each analyzer ~~shall~~ must satisfy the requirements as follows:

(i) The span drift (i.e., the change in the difference between the zero response and the span response) ~~shall~~ must not exceed two (2) percent of the full-scale deflection for each range used in the test.

(ii) The zero response drift ~~shall~~ must not exceed two (2) percent of full-scale deflection for each range used above 155 ppm (or ppmC); or three (3) percent of full-scale deflection for each range below 155 ppm (or ppmC).