



Winston H. Hickox
Secretary for
Environmental
Protection

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman

9528 Telstar Avenue • P.O. Box 8001 • El Monte, California 91731 • www.arb.ca.gov



Gray Davis
Governor

Mail-Out #MSO 99-08

August 31, 1999

**TO: ALL MANUFACTURERS OF SMALL OFF-ROAD ENGINES
ALL OTHER INTERESTED PARTIES**

**SUBJECT: Certification of 2000 Model Year (MY) and Later Small Off-Road
Engines (SOREs)**

In 1990, the Air Resources Board (ARB or Board) adopted emission regulations and test procedures applicable to SOREs produced on or after 1995. In March 1998, the Board amended the SORE standards and test procedures effective with the 2000 MY. Beginning with the 2000 MY, SORE engines will be required to comply with more stringent standards and other newer requirements, including useful life emission deterioration, averaging/banking/trading (ABT), Air Index labeling and new production-line test procedures. With the transition to the new requirements, the ARB provides the attached application format for the uniform and simplified certification of SORE engines. Selling or introducing SOREs into California before the Executive Order is issued is a violation of state law.

Typically, to certify an engine family under the SORE regulations, a manufacturer will have to conduct emission durability testing on a test engine. Attachment A is a suggested guideline for a durability test program. Then an application for certification is filled out and submitted to the ARB together with the manufacturer's ABT report, emission warranty statement, and engine and Air Index labels; the warranty and labels may be submitted in advance of the application and their approvals are required before the Executive Order is issued. Attachment B contains a filled-in sample of the form required for ABT reporting, and Attachment C contains a sample application format that has been streamlined significantly from the one used during 1995-1999. This format also allows for harmonization with federal requirements so only a single application needs to be completed; an electronic version of the application may be downloaded from the following United States Environmental Protection Agency (U.S. EPA) Internet site:

<http://www.epa.gov/oms/cert/eng-cert/template/smallph2.zip>

Alternatively, a copy of the application templates may be obtained by contacting Mr. Dean Hermano, Staff Engineer, at (626) 450-6103 or dhermano@arb.ca.gov. A glossary of the terms and acronyms used in the application is provided in Attachment D.

Note that although raw or intermediate test data and technical descriptions need not be submitted to the ARB as part of the application process, they must be retained by the engine manufacturer and made available within 30 days upon request by the ARB. Also, the ARB requires manufacturers to report all emissions and horsepower data in the certification application using the units *g/bhp-hr* and *hp*, respectively, for compatibility with the agency's database system. It is the ARB's understanding that the U.S. EPA will accept applications using these units exclusively.

If you have any questions or require further assistance, please telephone Mr. Duc Nguyen, Manager, Certification Section, or Mr. Dean Hermano, Staff Engineer, at (626) 450-6103.

Sincerely,

/S/

R. B. Summerfield, Chief
Mobile Source Operations Division

Attachments

GUIDELINES FOR
CERTIFICATION
OF 2000 AND LATER
SMALL OFF-ROAD ENGINES

August 1999

CALIFORNIA AIR RESOURCES BOARD
MOBILE SOURCE OPERATIONS DIVISION
P.O. BOX 8001
9528 TELSTAR AVENUE
EL MONTE, CALIFORNIA 91734-8001

TABLE OF CONTENTS

CHAPTER	SUBJECT	PAGE
1	REFERENCES	1
2	GENERAL INSTRUCTIONS	
2.1	Application Submittal	2
2.2	Letter of Intent	2
2.3	Compliance Statements	2
2.4	Confidentiality	3
2.5	Amendments to the Application	3
2.6	Engine Family Names	3
2.7	Engine Family Name Carryover	4
2.8	Labeling	4
2.9	Warranty	4
2.10	Test Procedures	5
2.11	Alternate Test Procedures.....	5
2.12	Adjustable Parameters	5
2.13	FEL Changes	5
2.14	Additional Comments	6
2.15	Certification Averaging, Banking and Trading.....	6

Attachment A Explanation of Test Procedures for Small Off-Road Engines

Attachment B Certification Averaging, Banking and Trading Worksheet Form

Attachment C Small Off-Road Engine Application Format

Attachment D Glossary of Terms and Acronyms

CHAPTER 1

REFERENCES

1. Title 13, California Code of Regulations (CCR), sections 2400 through 2407.
2. Air Resources Board Manufacturers Advisory Correspondence #92-06, Small-Engine Certification Procedures, July 8, 1992.
3. United States Environmental Protection Agency letter CD-94-03, dated February 18, 1994 or later.
4. California Exhaust Emission Standards and Test Procedures for 1995 and Later Small Off-Road Engines, amended March 26, 1998 (hereinafter referred to as the "Test Procedures").
5. Nonroad Small SI Engine Phase II Final Templates (<http://www.epa.gov/oms/cert/eng-cert/template/smallph2.zip>), United States Environmental Protection Agency, July 1999.

[In Chapter 2, references to the above documents are indicated by brackets.]

CHAPTER 2

GENERAL INSTRUCTIONS

This chapter provides general instructions regarding the preparation, submission and revision of a certification application.

2.1 Application Submission

One printed copy of the engine family application completed in accordance with Attachment C and with a cover letter (see subchapter 2.2) must be submitted to:

Mr. R. B. Summerfield, Chief
Mobile Source Operations Division
Air Resources Board
P.O. Box 8001
9528 Telstar Avenue
El Monte, California 91734-8001

Manufacturers completing the application using the electronic template should run the provided diagnostic check (located in the upper right margin of each page) before printing a copy for submittal. This simple task will quickly identify blank fields and incorrect entries, thereby reducing the need for future corrections.

2.2 Letter of Intent

Engine manufacturers should use a letter of intent to relay the basic information of all engine families to be certified. This includes identification of the engine family names and the anticipated dates when an application for certification is submitted and when the Executive Order is needed. This letter should be submitted as soon as possible, preferably before any certification applications are prepared. This will assist the ARB certification staff in planning and resources allocation for a timely approval of the applications.

2.3 Compliance Statements

The following statements of compliance must be provided in a cover letter that accompanies each engine family's application for certification:

- 1) Conformance with the general standards regarding an increase in emissions and unsafe conditions as stated in section 5 of the "California Exhaust Emission Standards and Test Procedures for 1995 and Later Small Off-Road Engines", adopted March 20, 1992, and amended March 26, 1998.

- 2) Conformance with the emission control and Air Index label specifications [Ref.: 1, section 2404].
- 3) Conformance with the standards and test procedure requirements by the test engine, and that the test engine was tested in accordance with the applicable test procedures and meets the requirements of such tests [Ref.: 4, Part 1, section 27(a)(1)].
- 4) Compliance, to the best of the manufacturer's belief, with the corporate average at the end of the model year when all credits are calculated for all of the manufacturer's engine families [Ref.:1, section 2408(g)(1)(a)].

2.4 Confidentiality

By default, the ARB will deem the engine manufacturer's projected California sales and catalytic converter composition, ratio and loading as confidential. Other portions of the application in Attachment C (i.e., items # 24, 41 and 66) are denoted as "Confidential Information," but the manufacturer must justify why it requires such status in the "Additional Comments" form of the application. If the manufacturer wishes other information to be considered confidential, it must also be justified in the "Additional Comments" form.

2.5 Amendments to the Application

After an engine family has been certified, the manufacturer may find it necessary to amend the application, for example, due to production running changes in engine calibration, changes in parts/part numbers, or an addition or deletion of models. The manufacturer may amend the application in advance of or concurrently with production. If the changes are typographical or administrative (e.g., change in the contact person) in nature, the engine manufacturer needs only to provide a brief description and the revised pages of the application. If the change affects an emission-related part or results in a new worst-case test engine, the engine manufacturer must show that the engine family will still remain in compliance by submitting new test data. If the change is not expected to affect emissions, the engine manufacturer must provide an engineering evaluation supporting this conclusion. Generally, only the following fields in the application need to be filled out for changes (e.g., corrections, running changes, field fixes, etc.): *manufacturer name, model year, engine family, process code, ARB engine displacement group, comments fields* (describing the update or change), *the field(s) that has been changed or corrected*. All other fields may be left blank.

2.6 Engine Family Names

Engine family names must follow the U.S. EPA nomenclature convention [Ref.: 3].

2.7 Engine Family Name Carryover

To remain consistent with the policy of the United States Environmental Protection Agency and to reduce additional burden on manufacturers, the ARB will allow the use of the original engine family name on engine labels for carryover families. However, this allowance cannot be utilized if a change (e.g., increase/decrease in displacement, addition of new emission control systems, etc.) causes the new engine to be ineligible for the original group.

2.8 Labeling

The engine manufacturer is required to submit, for each engine family, two labels to the ARB for review and approval. The first label is the emission control label, or engine label. This label must contain all information pursuant to Title 13, CCR, section 2404(c), except that certain information may be placed in the owner's manual. The second label is the Air Index label. The requirements of this label are provided in Title 13, CCR, section 2404(l). The application must indicate both labels' content, dimensions, character height and background/foreground colors. Also, the proposed location should be described by either a drawing, photograph or narrative description. Manufacturers are not limited to the size of the spaces provided in the application for facsimiles of the labels and their locations.

To allow for a single compliance statement on the engine label for both the U.S. EPA and the ARB, manufacturers may use the following example: "THIS ENGINE MEETS EMISSIONS REGULATIONS FOR U.S. EPA (specify PH1 or PH2, as applicable) SMALL ENGINES AND (model year) CALIFORNIA (specify SI SOREs, CI SOREs < 11 HP or CI SOREs \geq 11 HP, as applicable)."

It should be noted that for the engine label, compression-ignition engines are also subjected to the additional requirements in Part VI, section 89.110-96 of the California SORE Test Procedures (e.g., FEL stated on the label, engine designed for constant speed operation to so state on the engine label, Blue Sky Series label).

2.9 Warranty

A copy of the engine manufacturer's emission defect warranty statement that will be provided to the end users must be submitted for ARB review and approval (preferably) prior to, or concurrent with, the first engine family's application that employs that warranty statement. The warranty must be completed as prescribed in Title 13, CCR, sections 2405 and 2406. The Executive Order cannot be issued until after the warranty statement has been approved by the ARB. Once approved, the warranty statement may be used by the manufacturer for all subsequent engine families within the model year without the need for the manufacturer to resubmit the statement in subsequent engine

family applications. However, if any changes are made to the warranty statement, the amended warranty statement must be approved by the ARB before Executive Orders for any engine families with the amended warranty statement can be granted.

It should be noted that for compression-ignition engines, the applicable warranty period is three years or 1500 hours of operation, whichever first occurs, pursuant to Part VI, section 89.104 of the California SORE Test Procedures.

2.10 Durability Testing and Deterioration Factor Determination

See Attachment A for guidance on this subject. This is applicable to engine families that are certified to useful life standards.

2.11 Alternate Test Procedures

Any deviations to the prescribed test equipment and/or test procedures must be approved by the ARB before use, or the test data generated thereof may be rejected. An approved alternate equipment/procedures must be described in the first engine family application that employs the alternate equipment/procedures. Subsequent engine family applications that also employ the alternate equipment/procedures may reference the first such application.

2.12 Adjustable Parameters

All adjustable parameters, whether sealed or unsealed, that may significantly affect emissions must be reported in the application for certification. Any test engine with an adjustable emissions-related parameter must be tested at the allowable extremes of the adjustment (e.g., maximum rich and lean settings). All emission-related adjustments and their associated anti-tampering devices must be evaluated and approved by the ARB prior to use. The application must reference the ARB's approval of these anti-tampering devices.

2.13 FEL Changes

An engine manufacturer may change the family emission limit (FEL) retroactively to the beginning of production or to the commencement of a running change to an engine family. FEL changes are not permitted after the end of production. All FEL changes must be submitted as running changes in accordance with subchapter 2.5 of these instructions.

2.14 Additional Comments

In the space provided in item #66 of the application, the manufacturer may include additional information relevant to the certification of the engine family. This includes:

1. Information in the application that is considered confidential or proprietary in nature.
2. Special or alternate test procedures and/or equipment.
3. Running change and/or field fix information and data.
4. Descriptions of new emission control technologies such as three-way catalytic converters, stratified scavenging, etc.

2.15 Certification Averaging, Banking and Trading

Manufacturers choosing to voluntarily participate in the certification averaging, banking and trading program must submit a completed form similar to that included in Attachment B. The form should be inserted in the application binder under a tab divider titled "Certification ABT". An electronic version may be obtained from the following ARB Internet link: http://www.arb.ca.gov/msprog/mailouts/mouts_99.htm#mso99-08 Since compliance with the emission standards using the ABT program can also be used to determine compliance using corporate averaging (described in Title 13, California Code of Regulations, section 2403(e)), manufacturers only need to submit this single form to satisfy both provisions.

Manufacturers must demonstrate final compliance under the ABT program 270 days after the end of a given model year. Actual sales volume must be used in determining actual credits for this final report.

The engine manufacturer should allow for a minimum 15% compliance margin when selecting an FEL for an engine family (i.e., "Deteriorated HC+NOx" multiplied by 1.15). The following equation is used to calculate the number of credits (in grams) generated for an engine family:

$$\text{Credit}_{\text{certification}} = (\text{Std.} - \text{FEL})(\text{Sales})(\text{Load Factor})(\text{EDP})(\text{Power})$$

where: Std. = The applicable HC+NOx or PM standard in g/bhp-hr.

FEL = Family Emission Limit of the engine family.

Sales = Eligible sales as defined in 13 CCR 2401.

Power = The sales-weighted maximum modal power, in horsepower.

EDP = The emission durability period for which the engine family is certified.

Load Factor = For Test Cycles A and B, the Load Factor = 0.47. For Test Cycle C, the Load Factor = 0.85. For approved alternate test procedures, the load factor must be calculated according to the following equation:

$$\sum_{j=1}^n (\%MTT \text{ mode}_i)(\%MTS \text{ mode}_i)(WF \text{ mode}_i)$$

where: %MTT mode_i = percent of the maximum torque for mode i
%MTS mode_i = percent of the maximum engine speed for mode i
WF mode_i = weighting factor for mode i

Final corporate average compliance for HC+NO_x or PM must be made up with emission reduction credits or through incorporation in the following model year's corporate average plan. If done within the next model year, credits must be expended at a rate of 1 gram to 1 gram. If done after the next model year, credits must be expended at a rate of 1.5 grams to 1 gram, except for noncompliance based on a production line failure and subsequent raising of an FEL, in which case credits must be used at a rate of 1.2 grams to 1 gram.

Attachment A

Explanation of Test Procedures for Spark-Ignition, Small Off-Road Engines

The following describes an acceptable test plan that complies with the requirements of the test procedures for spark-ignition (SI) and compression-ignition (CI), small off-road engines. Information provided under “a.” is specific to SI engines, “b.” is specific to CI engines, and “c.” is common to both. Adherence to the provisions contained herein will provide engine manufacturers an accurate and uniform method of testing their engines. Manufacturers must report all emissions and horsepower data in the certification application using the units *g/bhp-hr* and *hp*, respectively.

1. Test Engine

- a. One worst-case engine is tested with all emission control systems installed and functioning. This test engine is used for both DF determination and emission certification.
- b. The engine configuration (within each engine family) with the most fuel injected per stroke primarily at the peak torque, and secondarily at the rated power, will be selected as the test engine. In addition, the test engine must be selected so that its emission deterioration characteristics may be expected to represent those of in-use engines, based on good engineering judgment. This test engine may be used for both DF determination and emission certification.
- c. Manufacturers may also test additional engines of the same configuration to improve the reliability of the deterioration data; the ARB must be notified in advance. Data from the additional test engines may not be excluded from the DF determination. At the manufacturer's option and with advance notification to the ARB, an identical engine may be stabilized (broken in) and used for emission certification and/or running change purposes only.

2. Service Accumulation

- a. Accumulation of durability hours for SI engines will be done using the existing certification test cycles (and approved alternative cycles) and weighting factors. The cycle used must be stated in the application for certification.
- b. The manufacturer determines the form and extent of the service accumulation, consistent with good engineering practice to ensure that the test engine's emission deterioration characteristics are representative of in-use engines.

- c. The service accumulation procedure must be described in the applications for certification. Data to be recorded during the service accumulation will include engine hours and any other information required to assure the test cycle was performed. However, there is no requirement for engine performance, emissions or ambient conditions to be recorded during the test cycle. Engine manufacturers may record additional data for their own information at their discretion. Such accumulation may occur in a location other than the engine manufacturer's testing cell. Emission testing will always be conducted at the end of, not during, an aging cycle. The following service accumulation procedure, whose duration at each operating mode is based on the emission test cycle's weighting factors, is acceptable to the ARB; variations in test mode's duration must be approved by the ARB in advance. Alternative service accumulation methods, e.g., accelerated aging, component bench aging, etc., are acceptable subject to advance approval by the ARB.

<u>Test Cycle</u>	<u>Test Mode</u>					
A:	1	2	3	4	5	Idle
B:	6	7	8	9	10	Idle
C:	1					Idle

<u>Test Cycle</u>	<u>Test Mode's Duration (minutes)</u>						<u>Total</u>
A:	5:30	12:00	17:30	18:00	4:00	3:00	60:00
no-idle A:	5:30	12:30	18:30	19:30	4:00	0:00	60:00
B:	5:30	12:00	17:30	18:00	4:00	3:00	60:00
no-idle B:	5:30	12:30	18:30	19:30	4:00	0:00	60:00
C:	17:00					3:00	20:00
C:*	2:33					0:27	3:00

* Chain saws and ice augers only.

3. Test Procedures

- a. There must be a minimum of 3 test points, at the "0-hour" (completion of break-in), end of the durability period, and mid point. Additional test points are acceptable, provided they are equally divided +/- 2 hours. If multiple engines are tested, all engines must have the same test points. Zero hour emissions are obtained after the engine has been broken in. Extra test points may be added at the manufacturer's discretion. Additional test points must be equally divided.

If the engine manufacturer conducts more than one test at a test point, the number of tests at every test point must be the same. All tests must be used in the linear regression analysis as separate points. Additional engines may be tested with prior approval from the Executive Officer. If this is the case, data collection must remain consistent for all test engines. The testing of multiple engines requires the determination of separate deterioration factors (DFs) for each engine. In the case of multiple tests on a single engine, the engine manufacturer must select the last zero hour test as the official zero hour test upon which the DFs are applied.

- b. The manufacturer determines the test points, consistent with good engineering practice to ensure that the test engine's emission deterioration characteristics are representative of in-use engines. Smoke emissions are determined in accordance with Part VI of the Test Procedures.
- c. The test engine will be run on either the speed controller or on the engine governor, at the engine manufacturer's discretion. If the governor is used, the maximum load and operating speeds will be defined by governor droop. Testing at the extremes of adjustment is required by the Test Procedures, section 20(b)(4). However, the ARB will only require manufacturers to conduct these additional tests at the last test point of the EDP. If rich/lean testing is done only at the end of the EDP, the emission values for each setting must be below the applicable standards or FELs. DFs will be calculated using the nominal settings at each test point and applied to the emission value of the nominal setting at zero hours.

PM must be measured using the International Organization for Standardization (ISO) 8178-1 test procedures as modified in Part V of the Test Procedures.

4. Maintenance

For both SI and CI engines, maintenance may not be performed more frequently than that specified by the engine manufacturer in the owner's manual. In the event where a maintenance event occurs at the same number of hours as an emission test, the engine manufacturer is required to conduct the emission test before the scheduled maintenance. At the engine manufacturer's discretion, the engine may also be tested after the scheduled maintenance. If both before and after tests are conducted, the two tests will be averaged as a single test for the purposes of determining

DFs. Multiple maintenance events occurring in close proximity of each other can be combined such that no more than one test is performed before and after the maintenance. If a scheduled maintenance event is within 10 hours of an emission test point, the maintenance or test point must be rescheduled to coincide with the test point or maintenance, respectively.

Unscheduled maintenance may only be conducted with prior approval from the Executive Officer. This approval is conditioned on both before and after emission tests being performed unless otherwise specified by the Executive Officer. In such a case, the Executive Officer will waive the requirement to space tests equally over the EDP and the two test will be averaged as a single test for inclusion in the calculation of the subject DF.

5. Deterioration Factor

- a. All HC+NO_x, CO and PM data are plotted against the service accumulation hours, and a deterioration line is fitted with the least-square linear regression method to determine the DF for each of these pollutants. The deterioration lines or test points must not exceed the applicable emission standards or FELs, or the data will not be accepted for DF determination. The DFs are multiplicative and determined as the calculated emission (carried out to two additional significant figures more than the standard) at the end of the durability period divided by the calculated "0-hour" emission. If the result is less than 1.000, the DF is then set at 1.000.
- b. All HC, NO_x, CO, PM, and smoke emissions ("accel", "lug" and "peak") data are plotted against the service accumulation hours, and a deterioration line may be fitted with the least-square linear regression method to determine the DF for each of these pollutants. The deterioration lines or test points must not exceed the applicable emission standards or FELs, or the data will not be accepted for DF determination. For engines with exhaust aftertreatment (e.g., catalytic converter, trap), the DFs for HC, NO_x, CO and PM are multiplicative and may be determined as the calculated emission (carried out to two additional significant figures more than the standard) at the end of the durability period divided by the emission calculated at the "0-hour". If the result is less than 1.000, the DF is then set at 1.000. For engines without exhaust aftertreatment, the DFs for HC, NO_x, CO and PM are additive and may be determined as the calculated emission (carried out to two additional significant figures more than the standard) at the end of the durability period minus the emission calculated at

the "0-hour". If the result is less than zero, the DF is then set at 0.000. For smoke emissions, whether the engine uses exhaust aftertreatment or not, the Dfs are additive and may be determined as the calculated emission (carried out to two additional significant figures more than the standard) at the end of the durability period minus the emission calculated at the "0-hour". If the result is less than zero, the DF is then set at 0.000.

Furthermore, separate DFs for HC, NO_x, HC+NO_x, CO, PM, and smoke emissions ("accel", "lug" and "peak") must be determined. For the HC+NO_x DF, a negative deterioration in one pollutant may not be used to offset the deterioration of the other; the HC+NO_x DF is determined as the average of the HC DF and NO_x DF that are subject to the constraints described above.

- c. For multiple test engines, the DFs will be determined for each test engine and the certification DF will be the average of all the test engines.

6. Certification Level

The certification emission levels are determined by multiplying the last of the zero hour tests with the multiplicative DF, or by adding the last of the zero hour tests to the additive DF. The certification levels of all pollutants must not exceed the applicable standards or FELs before an engine family is certified by the ARB.

Attachment B

Certification Averaging, Banking and Trading Credit Worksheet Form SAMPLE

Engine Family	Engine Model	Forecast California Units	Load Factor	EDP (hours)	HC+NOx Std (g/bhp-hr)	zero hour HC+NOx (g/bhp-hr)	Deterioration Factor	Deteriorated HC+NOx (g/bhp-hr)	FEL (g/bhp-hr)	Weighted Maximum modal HP	Credit
YYZXS0123IRA	ARB 01	1000	0.47	125	12.0	10.1	1.3	13.1	15.1	3.2	-582,706
YYZXS0234IRA	ARB 11	6400	0.47	250	9.0	6.5	1.3	8.5	9.7	5.3	-2,859,668
YYZXS0345IRA	ARB 21	1300	0.47	250	9.0	5.8	1.4	8.1	9.3	8.1	-418,199
YYZXS0456IRA	ARB 31	1400	0.47	250	9.0	5.6	1.1	6.2	7.1	10.2	3,137,673
YYZXS0567IRA	ARB 41	300	0.47	500	9.0	5.3	1.2	6.4	7.3	13.0	1,545,219

TOTAL - Model Year: 822,319

	Banked Credits*	Prev. MY Deficit	Prev. 2 MY Deficit**
Initial Balance	1,513,000	0	-250,000
Withdrawn	0	0	250,000
Remaining Deficit	N/A	0	-125,000
Deposited	572,319	N/A	N/A

Other Credits expended (kg):
Withdrawn from Bank:
Purchased: 0

250,000

Projected Final Balance 2,085,319

Credits left over:
(must be nonnegative) **572,319**

Additional Notes:

* The source of banked credits may be from previous years, trading or PLT credit program. (PLT credits are used at a rate of 1.1 grams to 1 gram.)
** Certification credits must be used at a rate of 1.2 grams to 1 gram (for a change in FEL due to PLT failure) or 1.5 grams to 1 gram (for a sales misestimate).

Attachment C

Small Off-Road Engine Application Format

In this electronic version of this mail-out, the hardcopies of Attachment C are not available.
Please download the files from:

<http://www.epa.gov/oms/cert/eng-cert/template/smallph2.zip>

Attachment D

Glossary of Terms and Acronyms

2TWC - Three way catalytic converter (two in parallel)	RPM - Revolutions per minute
ABT - Averaging, banking and trading	SC - Supercharger
AIR - Secondary Air Injection	SFI - Sequential multiport fuel injection
CAC - Charge air cooler	SI - Spark-ignition
carb - Carburetor	SORE - Small off-road engine
CBG - Cleaner Burning Gasoline	SVM - Small volume manufacturer
cc - Cubic centimeter(s)	TBI - Throttle body fuel injection
CI - Compression-ignition	TC - Turbocharger
CNG - Compressed natural gas	TWC - Three way catalytic converter
CO - Carbon Monoxide	V-2 - Vee two cylinders
DDI - Direct diesel injection	
deg. - Degree(s)	
DF - Deterioration Factor	
ECM - Electronic control module	
EDP - Emission Durability Period	
EGR - Exhaust Gas Recirculation	
EM- Engine modification	
F-2 - Flat two cylinders	
F/F - Field Fix	
FEL - Family emission limit	
g/bhp-hr - Gram(s) per brake horsepower-hour	
g/kw-hr - Gram(s) per kilowatt-hour	
g/l - Gram(s)/liter	
HC+NO _x - Hydrocarbons plus oxides of nitrogen	
hp - Horsepower	
I-2 - Inline two cylinders	
ID - Identification number	
IDI - Indirect diesel injection	
kw - Kilowatt(s)	
L - Side valve	
LPG - Liquefied petroleum gas	
MAP - Manifold absolute pressure	
meoh - Methanol	
MPI - Multiport fuel injection	
N/A - Not applicable	
NA - Normally aspirated	
N-m - Newton-meter(s)	
NMHC - Non-methane hydrocarbon(s)	
O ₂ S - Oxygen Sensor	
OC - Oxidation Catalyst	
OC-2 - Oxidation catalytic converters (two in series)	
OHV - Overhead Valve	
PCV - Positive crankcase ventilation	
PM - Particulate Matter	
R/C - Running change	