



Winston H. Hickox  
Secretary for  
Environmental  
Protection

# Air Resources Board

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Alan C. Lloyd, Ph.D.  
Chairman

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Gray Davis  
Governor

May 10, 1999

Reference No. C-99-313

Ms. Kate Drakos  
Director of Government Affairs  
Engine Manufacturers Association (EMA)  
1420 Fifth Avenue, Suite 2200  
Seattle, WA 98101

Dear Ms. Drakos:

This is in response to your April 26, 1999, letter that provides comments on the workshop conducted by the Air Resources Board (ARB) on April 8, 1999. In addition, the EMA amends its "DF Test Procedures" that was submitted previously; the amendment was to add one section for testing the durability engines with adjustable parameters.

- I. The EMA's Comments on the April 8, 1999, Workshop
  1. For a lack of manufacturer's data and information, the following scheduled maintenance on the test engines is acceptable to the ARB. For engines that are certified to 50, 125, 250, 300 or 500 durability hours, the scheduled maintenance for the test engines should be at the mid point (i.e., 25, 62 or 63, 125, 150 or 250 hours, respectively). This is determined by dividing the durability hours by the 2-year useful life defined by the emission warranty regulations. Other test engine maintenance schedules are approved on a case-by-case basis.
  2. The EMA's suggested substitution in item 6. of the streamlined application format is not acceptable. The intent of this item is to clearly indicate that engines that are normally preempted are certified to fulfil the agreement between the EMA and ARB leading to the adoption of the small off-road engine regulations in March 1998. The incidental use of some engines of a certified engine family in preempted equipment, as apparently suggested in your letter, does not fulfil this agreement. Nevertheless, to emphasize this point, the ARB will amend the heading of this item to read, "Are engines in this engine family intended mainly for use in preempted equipment?"

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California Environmental Protection Agency

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3. The EMA's proposal to include information about the 49-state projected sales figure in item 11.a. of the application of each engine family is acceptable.
4. The meaning of "maximum rated power" in item 34 of the streamlined application format is unchanged from presently. This is the maximum rating of some engine code or configuration among the many power ratings of the many engine codes or configurations that are offered in the engine family. Manufacturers can use the advertised power or the highest modal power; however, this needs to be consistent with the power reported for each engine code or configuration in the engine family and throughout the manufacturer's product offering.
5. Part number and the inclusion in warranty coverage for the "fuel pump" is limited to fuel injection pumps (e.g., throttle body fuel injection, multi port fuel injection, diesel injection). Transfer pumps (e.g., from the fuel tank to carburetor bowl) are not included.
6. The four small boxes for label and warranty information that are presented on the same page in the application format are intended as guidance about what information is required in an application. Manufacturers can use separate pages of the application for this purpose.
7. A "Glossary of Terms" will be added to the application format.

## II. Deterioration Factor (DF) Test Procedure (April 26, 1999)

This proposed DF test procedure is an amendment to the one dated March 8, 1999, by adding a section to address engines with adjustable parameters. As discussed at the workshop, engines with adjustable parameters are to be tested at the extreme ranges of adjustment at each test point. Optionally, manufacturers may test the engine using the nominal setting of the adjustment at each test point, provided that emission tests at the extreme ranges of adjustment are conducted at the final test point. The emissions, including those conducted at the extreme ranges of adjustment, must not exceed the emission standards (or family emission limits, FELs, as applicable). The projected deterioration line may exceed the emission standard (or FEL) at the useful life point, provided that no actual test data exceeds the standard (or FEL).

In the EMA's proposed DF test procedure, actual test data may exceed the standard (or FEL) as long as the projected deterioration line does not. This is not consistent with the discussion during the workshop or the ARB's requirement that the test engine complies with the emission standards (or FELs).

Based on the discussion above, the EMA's proposed DF test procedure (April 26, 1999) is approved with the following modification. The durability engine must comply with the emission standards (or FELs), including when tested at the extreme ranges of adjustment. The projected deterioration lines from which to determine the DFs may exceed the standards (or FELs) at the useful life point provided that no actual test data exceeds the standard (or FEL).

A Manufacturers Advisory Correspondence (MAC) will be issued soon to promulgate the ARB's implementation policies. The MAC will reflect the EMA's and others' comments, and the ARB's responses as discussed above. If you have further questions or comments, please contact Mr. Duc Nguyen, Manager, Certification Section at (626) 575-6844.

Sincerely,

A handwritten signature in cursive script, appearing to read "R. B. Summerfield".

R. B. Summerfield, Chief  
Mobile Source Operations Division

Engine Manufacturers Association  
 1420 Fifth Avenue  
 Suite 2200  
 Seattle, WA 98101  
 e-mail: ema@sba.com  
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 FACSIMILE TRANSMITTAL SHEET
 

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TO:	Duc Nguyen	FROM:	Kate Drakos
COMPANY:	ARB	DATE:	April 26, 1999
FAX NUMBER:	626 / 575-6685	TOTAL NO. OF PAGES INCLUDING COVER:	7
PHONE NUMBER:	626 / 575-6644	SENDER'S TELEPHONE NUMBER:	206 / 652-2470
RE:	DF Test Procedure	SENDER'S FAX NUMBER:	206 / 652-2471

URGENT   
  FOR REVIEW   
  PLEASE COMMENT   
  PLEASE REPLY   
  PLEASE RECYCLE

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 NOTES/COMMENTS
 

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Dear Duc –

Attached you will find a letter addressed to Rod Summerfield and a copy of the EMA DF Test Procedures to include discussion on adjustable parameters. This letter was sent to Rod via e-mail today.

Please call me at your earliest convenience so that we may discuss.

Many thanks – Kate

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April 26, 1999

C-99-313

VIA E-Mail

Mr. Rod Summerfield  
 Chief  
 Air Resources Board  
 Mobile Source Operation Division  
 9528 Telstar Avenue  
 El Monte, California 91731

Re: DF Test Procedures

Dear Rod:

First, the members of EMA (Engine Manufacturers Association) wish to thank you for hosting the certification and PLT workshop on April 8, 1999. The ARB Staff presentations and the question and answer period were both very informative.

At the conclusion of the question and answer period, EMA requested the opportunity to address any additional questions through written correspondence. EMA's additional questions and comments are as follows:

1. If a manufacturer's maintenance specification for a particular item is "yearly", or "every season", when (if at all) should that maintenance be performed on a test engine that is aged on a bench over a period of weeks?  
 YEAR SHOULD BE CONVERTED TO AN HOURLY BASIS.
2. Item number 6 of the *Small Off-Road Engine Family Information Form* currently asks, "Preempt Equipment Engine Voluntarily Certified?: \_\_\_N/A \_\_\_Yes." EMA recommends that this question be changed to, "Does the manufacturer expect that some engines in this family may be used in exempt applications?: \_\_\_Yes \_\_\_No." Since only a certain portion of any given engine family is likely to be used in exempt applications, this rephrasing will better address the issue. Also, it is not necessary to ask if the preempt engine is voluntarily certified - if the answer were no, the manufacturer would not be submitting an application. *ok?*
3. Item number 11(a) of the *Small Off-Road Engine Family Information Form* asks for "Projected California Annual Sales." To assist in the creation of a 50-state harmonized application format, it may also be useful to ask for the USEPA 49-state projected sales.

UP TO EPA, ARB HAS NO ~~PROBLEM~~ PROBLEM IF SEPARATE BOX.

DF Test Procedures

April 26, 1999

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- ↖ OVERALLS
4. Item number 34 of the *Small Off-Road Engine Test Information Form* requires the manufacturer to specify the maximum rated power. In this portion of the form, did ARB perhaps mean to ask for maximum modal power?  
NO MAX POWER, SAME AS IN #53 OF MODEL SUMMARY FORM
  5. Currently, the *Small Off-Road Engine Part Number Summary Form* lists "Fuel Pump" as a component that manufacturers must provide information for. During the April 8, 1999 workshop, ARB agreed that the *Small Off-Road Engine Part Number Summary Form* should refer to "Fuel Injection" instead of "Fuel Pump". (DIESEL)  
"FUEL INJECTION PUMP"?
  6. The *Small Off-Road Engine Label and Warranty Information Form* provides four boxes (item numbers 59-62) for sample labels and descriptions. EMA recommends that these boxes be enlarged to provide for more space.  
MFRS. NOT BOUND TO THE GIVEN BOX SIZE
  7. It would be helpful to have a "glossary of terms" identifying many of the acronyms used in the *Small Off-Road Engine Application Form*. SAME REQUEST AS STHL. CAN DO

Second, as you will recall, EMA and ARB spent several weeks developing a proposed test procedure, and in a letter dated February 25, 1999, EMA requested ARB to approve the *EMA Proposal for an Acceptable Test Procedure*. Duc Nguyen has provided EMA with a verbal acceptance of that document, however, the actual written acceptance has not yet been issued. As such, EMA would like to take this time to "re-submit" the proposal in order to clarify a point raised during workshop. Attachment 1.1, (dated April 26, 1999) is identical to the version submitted on February 25, except that paragraph 5 has been added to clarify the approach that should be taken when an engine has adjustable parameters. Since paragraph 5 is consistent with the handout material provided by ARB, the addition of paragraph 5 should not alter ARB's approval decision.

In conclusion, we look forward to receiving answers to the questions provided above and to a written approval of the *EMA Proposal for an Acceptable Test Procedure* dated April 26, 1999. Once again, the April 8, 1999 workshop was very beneficial and EMA thanks you and your Staff for taking the time to host it.

Should you have any questions, please do not hesitate to call me. I can be reached at (206) 652-2470.

Sincerely,



Kate Drakos  
Director of Government Affairs

cc: Mr. Duc Nguyen

**EMA PROPOSAL FOR  
ACCEPTABLE DF TEST PROCEDURE  
(April 26, 1999)**

**1. Notification of Manufacturer's Plan:**

Manufacturers should get approval of a test plan prior to beginning testing. A test plan following the procedures herein will be considered acceptable. Manufacturers also may submit an alternate plan for approval.

**2. Fuel for Engine Aging Cycle:**

The manufacturer has the option to use any fuel for the engine aging cycle that satisfies the certification fuel specifications or represents commercially available fuel that is available through local retail outlets (except leaded gasoline).

**3. Engine-Aging Cycle:**

The standard engine-aging cycle will be based on the current ARB/EPA certification test cycles and approved derivatives with the same weighting factors.

It is accepted that the engine-aging may be carried out in a different location than the emissions cell, at the manufacturer's discretion. The speeds, loads and conditions at each mode may deviate from those used for certification to accommodate the manufacturer's equipment; provided that the aging conditions represent conditions expected in use by end users and these conditions are either higher load and/or speed than required. The total time at each mode will be weighted according to the emissions-weighting on the approved certification test cycle. Emission testing will always be conducted at the end of an aging cycle; e.g. not during a 100 or 120 minute cycle.

Accepted examples of these cycles are:

<u>Cycle</u>	<u>Mode</u>	<u>100%</u>	<u>75%</u>	<u>50%</u>	<u>25%</u>	<u>10%</u>	<u>Idle</u>	<u>Total Time - Minutes</u>
	Weighting	9	20	29	30	7	5	
<u>1</u>	Time	9	20	29	30	7	5	100
	Weighting	9	21	31	32	7		
<u>2</u>	Time	9	21	31	32	7		100
	Weighting	9	20	29	30	7	5	
<u>3</u>	Time	11	24	35	36	8	6	120
	Weighting	9	21	31	32	7		
<u>4</u>	Time	11	25	37	39	8		120

#### 4. Test Procedures:

"Zero" hours emissions are considered to be after break-in. Minimum data required is on one engine at the "zero-point", mid-point and end-of-test point (manufacturer may add extra engines and/or test points for improved accuracy at their discretion).

Emission test points are equally divided and the engine must be tested at half the engine-aging period. The manufacturer will run one test at each stage (hours), with option to run more than one test at the manufacturer's discretion.

If the manufacturer runs more than one test at each stage then the number of test points at each stage must be consistent throughout the engine-aging period. If the manufacturer runs more than one engine the agency must be notified prior to data accumulation and then the data collection on all engines must be consistent throughout the engine-aging period. If either multiple engines or multiple tests on a single engine are run at the zero hour point then the manufacturer must select the last zero hour test as the certification zero hour test level for the family. All test points must be used for the linear regression analysis.

The engine will run either on the speed controller or on engine governor, at the manufacturer's discretion. In the case of the engine running on governor the maximum load and operating speeds will be defined by governor droop, or maximum load provided that they meet the criteria defined in section 3 above.

The cycle used will be documented in the certification application. Data recorded during the engine-aging period will include engine hours and any other information required to assure the engine-aging cycle was performed. However, there is no requirement for engine performance, emissions, or ambient condition data to be recorded during the engine-aging cycle. Manufacturers may record extra data for their own information, at their discretion. If mass or specific emission levels are recorded during the aging cycle then they must be reported.

The final emission test point should be conducted at the completion of the engine-aging cycle.

#### 5. Engines with Adjustable Parameters:

For engines with adjustable parameters, at least two tests (at the extreme ranges of the adjustment) are to be performed at each test point. Optionally, manufacturers may test engines with adjustable parameters at the nominal setting, provided that two emission tests (at the extreme ranges of adjustment) are performed at the final test point, and the use of the least mean squares method through each of these data points demonstrates that the test engine complies with the emissions standards (or FELs as applicable).

#### 6. Servicing:

Normal servicing and maintenance may not be performed more frequently than the periods identified in the operator's manuals. In the case of a service event occurring exactly at an emission test point, emission tests will be performed prior to and, at the manufacture's option, after the service has been completed. If before and after maintenance tests are conducted, the data will be averaged as a single point in the deterioration analysis.



Multiple service events that occur at the same interval can be combined such that no more than 1 emission test before and, if applicable, 1 emission test after are performed. If a scheduled maintenance point is within 10 hours prior to an emission test point the maintenance or emission test point will be rescheduled to coincide with the other. Unscheduled maintenance must only be carried out with prior approval of the agency. Approval may require a before and after maintenance test to be performed. In such an occurrence the requirement to have all emission tests equally spaced over the aging cycle will be waived.

**7. EPA Requirements for Side-Valve Engines and All Engines with After-Treatment:**

One engine from each engine family will be bench aged to its full useful life to demonstrate compliance with the standards. The manufacturer will be required to run the full test procedure described in this rule when the engine is stabilized, accumulate hours on the engine, and then run a full test procedure at full useful life hours to determine a test value for certification. The 250 hour-life category Class II S-V engines, and Class II engines with after-treatment have dispensation to test to less than useful life.

**8. EPA Engine Phase-Out Clause:**

For engines which the manufacturer commits to cease production by the end of the transition to the Phase 2 standards (2004 model year), manufacturers will have the option to age engines for half of their full useful lives and extrapolate the deterioration factor to the full useful life using good engineering judgment (run 125 hours for 250 hour certification, etc). Again, demonstration of such good engineering judgment will need to be made to the satisfaction of the Administrator.

**9. Certification Level Requirements**

**9.1 Selection of Engine-Aging Period:**

The manufacturer will select a total engine-aging period of 125, 250, or 500 hours (S.I. engines greater than 60cc) for EPA Class I and ARB Class I and II certification. For EPA certification of Class II engines ( $\geq 225$ cc), the manufacturer will select a total engine-aging period of 250, 500, or 1000 hours.

Table of Useful Life Categories for Nonhandheld Engines (hours):

<b>ARB - Class I &amp; II</b>	125	250	500	
<b>EPA - Class I</b>	125 Category C	250 Category B	500 Category A	
<b>EPA - Class II</b>		250 Category C	500 Category B	1000 Category A

Note: For EPA Class II Category A engine families also certified for ARB (at 500 hours) a minimum of zero hour, 250 hour, and 500 hour tests are required. If the manufacturer wishes to use the least mean squares line calculation for EPA DF determination then an additional test(s) at 750 hours would also be required. Note that only data points inclusive

in the ARB life period will be used for ARB DF determination.

### 9.2 Deterioration Factor:

Deterioration factor (DF) will be determined for the engine-aging period selected.

There are two potential methods to calculate DF for EPA; Option #2 is the only option acceptable for ARB.

1. End of Test Result (HC+NOx only)

Zero Hour Result

2. A least mean squares line is applied to the HC+NOx and CO data points and the DF is calculated from the points of the line by dividing the end point level by the start point level.

### 9.3 Certification Level(s):

There are two potential methods to calculate certification level for EPA; Option #2 is the only option acceptable for ARB:

1. End of test result. The DF will be used to adjust the results of engines tested in the Production Line Testing Program (PLT)
2. "Zero Hour" Test Result \* DF.

Note: The actual certification Family Emissions Level (FEL) will be higher than, or equal to, the certification level for ABT calculations to provide a compliance margin.