

AIR RESOURCES BOARD

HAAGEN-SMIT LABORATORY
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MAIL OUT #96-05



February 16, 1996

TO: ALL LIGHT-DUTY/MEDIUM DUTY VEHICLE MANUFACTURERS
ALL PASSENGER CAR MANUFACTURERS
ALL OTHER INTERESTED PARTIES

RE: Guidelines for Reporting Full Range Misfire Detection Data for On-Board Diagnostic II (OBD II) Approval

Section (b)(3.3) of the OBD II regulation requires manufacturers to phase-in expanded misfire monitoring conditions beginning with the 1997 model year. The phase-in percentages are based on manufacturers' projected sales volume for all vehicles and engines. Small volume manufacturers are not required to meet the phase-in percentages but will need to have 100 percent implementation of the expanded monitoring conditions by model year 2000.

Upon review of the initial applications and after meeting with manufacturers, the staff has found that detailed misfire detection data is necessary in order for the staff to properly evaluate each manufacturer's monitoring capabilities. Therefore, the Air Resources Board staff requests all manufacturers to provide probability of misfire detection (Pd) values for all applicable engine speed and load conditions for selected misfire patterns. Probability of detection is defined as the ratio of the number of detected misfires to the actual number of induced misfires.

In order to expedite the review process, the staff has developed guidelines for reporting this data. In general, manufacturers will need to provide Pd data for all engine speed and load conditions in table format. Depending on the number of cylinders and the design of the ignition system (e.g., the number of coils), manufacturers are required to provide data for different misfire patterns as shown in Attachment A. For simplicity, the firing orders shown are hypothetically considered to be 1,2,3,4, etc. Engine speed criteria should start at idle and extend up to redline in increments of 500 rpm. Engine load criteria should start at zero percent load and extend up to 100 percent load in increments of 15 percent. Other units for load, and reasonable deviations from the specified increments will be accepted provided the misfire detection capability of the systems remains clear. Wide open throttle and zero torque lines must be shown and data outside these regions may be omitted. A sample for the format of the required tables is provided in Attachment B. Manufacturers must also note any operating operating conditions where misfire can be detected but the misfiring cylinder cannot be properly identified along with an explanation and/or data for the cylinder identification limitation.

Lastly, to minimize OBD II approval delays at the time of certification, the staff requests manufacturers to provide available misfire detection data for a reasonable cross section of engine applications as soon as possible. This will allow staff to become familiar with manufacturers' systems and obtain

any necessary clarifications or additional information prior to formal OBD II review.

Should you have any questions or require clarification regarding this letter, please contact Mr. Allen Lyons, Manager, Advanced Engineering Section at (818) 575-6833.

Sincerely,

A handwritten signature in black ink, appearing to read "K. D. Drachand", with a large, stylized flourish at the end.

K. D. Drachand, Chief
Mobile Source Division

Attachment A Required Data with OBD II Application For Full Range Misfire Detection

CASE 1			
Cylinders - 3		Firing Order	1/2/03
Table - 1	Any One Cylinder Out		
Table - 2	Cylinder Misfire XX % = FTP Criteria (Random Cylinders)		
CASE 2			
Cylinders - 4	Coils 2	Firing Order	1-2-3-4
Table - 1	Any One Cylinder Out (25% Misfire)		
Table - 2	Cylinder Misfire XX % = FTP Criteria (Random Cylinders)		
Table - 3	Cylinders Sharing One Coil Out e.g. (1,3); (2,4);		
CASE 3			
Cylinders - 4	Coils 4	Firing Order	1-2-3-4
Table - 1	Any One Cylinder Out (25% Misfire)		
Table - 2	Cylinder Misfire XX % = FTP Criteria (Random Cylinders)		
CASE 4			
Cylinders - 5		Firing Order	1-2-3-4-5
Table - 1	Any One Cylinder Out		
Table - 2	Cylinder Misfire XX % = FTP Criteria (Random Cylinders)		
Table - 3	Consecutive Cylinders Out e.g. (1,2); (2,3) ..		
Table - 4	Non-Consecutive Cylinders Out e.g. (1,3); (2,4)..		
CASE 5			
Cylinders - 6		Firing Order	1-2-3-4-5-6
Table - 1	Any One Cylinder Out		
Table - 2	Cylinder Misfire XX % = FTP Criteria (Random Cylinders)		
Table - 3	Paired Cylinders Out e.g. (1,4); (2,5)..		
Table - 4	Consecutive Cylinders Out e.g. (1,2); (2,3) ..		
Table - 5	Non-Consecutive Cylinders Out e.g. (1,3); (2,4)..		
Table - 6	3 or Greater Cylinder Combination if Caused by Single Component Failure		
CASE 6			
Cylinders - 8		Firing Order	1-2-3-4-5-6-7-8
Table - 1	Any One Cylinder Out		
Table - 2	Cylinder Misfire XX % = FTP Criteria (Random Cylinders)		
Table - 3	Paired Cylinders Out e.g. (1,5); (2,6)..		
Table - 4	Consecutive Cylinders Out e.g. (1,2); (2,3) ..		
Table - 5	Non-Consecutive Cylinders Out e.g. (1,3); (2,4)..		
Table - 6	Any One 3 Cylinder Combination Out e.g. (1,2,3)		
Table - 7	4 or Greater Cylinder Combinations if Caused by Single Component Failure		

Attachment A Required Data with OBD II Application For Full Range Misfire Detection

CASE 7

Cylinders - 10	Firing Order	1-2-3-4-5-6-7-8-9-10
Table - 1	Any One Cylinder Out	
Table - 2	Cylinder Misfire XX % = FTP Criteria (Random Cylinders)	
Table - 3	Paired Cylinders Out	e.g. (1,6); (2,7)..
Table - 4	Consecutive Cylinders Out	e.g. (1,2); (2,3) ..
Table - 5	Non-Consecutive Cylinders Out	e.g. (1,3); (2,4)..
Table - 6	Any One 3 Cylinder Combination Out	e.g. (1,2,3)
Table - 7	Any One 4 Cylinder Combination Out	e.g. (1,2,3,4)
Table - 8	5 or Greater Cylinder Combinations if Caused by Single Component Failure	

CASE 8

Cylinders - 12	Coils-6/12	Firing Order	1-2-3-4-5-6-7-8-9-10-11-12
Table - 1		Any One Cylinder Out	
Table - 2		Cylinder Misfire XX % = FTP Criteria (Random Cylinders)	
Table - 3		Paired Cylinders Out	e.g. (1,7); (2,8)..
Table - 4		Consecutive Cylinders Out	e.g. (1,2); (2,3) ..
Table - 5		Non-Consecutive Cylinders Out	e.g. (1,3); (2,4)..
Table - 6		Any One 3 Cylinder Combination Out	e.g. (1,2,3)
Table - 7		Any One 4 Cylinder Combination Out	e.g. (1,2,3,4)
Table - 8		Any One 5 Cylinder Combination Out	e.g. (1,2,3,4,5)
Table - 9		6 or Greater Cylinder Combinations if Caused by Single Component Failure	

Attachment B Probability of Detection Chart

$$\text{Probability of Detection} = \frac{\text{Total number of Detected Misfires}}{\text{Total number of Induced Misfires}}$$

Engine RPM >	Idle	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	Redline
Zero Torq.													
15													
30													
45													
50													
65													
80													
WOT													

The load on Y-Axis can also be presented in increments of 10 Kpa, 100 Torr, or in approximate equivalent units.