

California Environmental Protection Agency



**Vapor Recovery Test Procedure**

**TP-201.2A**

**DETERMINATION OF VEHICLE MATRIX FOR  
PHASE II SYSTEMS**

Adopted: April 12, 1996  
Amended: February 1, 2001  
**Amended: July 26, 2012**

*Note: The text is shown in ~~strikeout~~ to indicate that it is proposed for deletion and underline to indicate that it is proposed for addition. [Bracketed text] is not part of the proposed amendment.*

**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY  
AIR RESOURCES BOARD**

**Vapor Recovery Test Procedures**

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**Determination of Vehicle Matrix for Phase II Systems**

**1 Applicability**

Definitions common to all certification and test procedures are in:

**D-200 Definitions for Vapor Recovery Test Procedures**

For the purpose of this procedure, the term "CARB or ARB" refers to the ~~State of~~ California Air Resources Board, and the term "~~ARB~~ Executive Officer" refers to the ARB Executive Officer of the ARB or his or her authorized representative or designate.

This test procedure can be used to determine the characteristics of a test fleet of vehicles which, when tested by other test procedures, can yield data representative of the total vehicle fleet. For the purpose of ARB Test Procedure (TP)-201.2, Efficiency and Emission Factor for Phase II Systems, the test fleet shall consist of vehicles which do not have on-board refueling vapor recovery (ORVR).

**2 Principle and Summary of Testing Procedure**

A representative matrix of vehicle counts in various categories is calculated from registered vehicle data and other information. Vehicles are categorized by model year and by make and/or vehicle type. The number of vehicles specified in the matrix for each category is such that the average number of miles traveled in California by vehicles in each category is substantially similar.

**3 Biases and Interferences**

The number of vehicle miles traveled is not identical to the amount of gasoline used by vehicles in a category because gasoline consumption per mile will vary. ~~Correction for differences in gasoline consumption rate is considered impractical. It is a~~Also, impractical to calculate at the matrix cells have been adjusted so that model years that have a mix of ORVR and non-ORVR vehicles are grouped together in the same cell. where the vehicle miles traveled in each category is identical because of the need to round values off to integer vehicle counts in the matrix and include entire model years in categories.

#### 4 Calculating the Vehicle Matrix

The criteria defining vehicle categories and the information on which calculations are based shall be chosen as reasonable and appropriate for the purposes described in sections 1 and 2. The same matrix shall be used for all testing performed in any calendar year, except that the Executive Officer may approve an alternative matrix to be used in special cases where a vapor recovery system is demonstrated to serve a vehicle population substantially different from the California vehicle population as a whole.

The vehicle makes and types, and models, and the number of vehicles per cell in the examples below are for illustration purposes only. More cells and other models, or vehicle makes and/or types, and different numbers of vehicles or categories shall be included at the discretion of the ~~ARB~~ Executive Officer.

The calculation procedures described below are illustrative only and other reasonable and appropriate procedures may be specified or approved by the Executive Officer provided only that the resulting matrix delineates a diverse and representative variety of vehicles and vehicle counts are determined considering estimated vehicle miles traveled by vehicles in each category.

At the Executive Officer's discretion, testing of any particular vapor recovery system may be required to include, in addition to the vehicle matrix, a supplementary list of vehicles or vehicle categories having features or equipment which may pose particular challenges or incompatibilities with that vapor recovery system.

##### 4.1 Obtain Vehicle Make, Model, and Type Information

Obtain the number of vehicles in various categories from an appropriate source such as annual reports from the California Department of Motor Vehicles. An example of data for automobile categories defined by model year and make is illustrated in Table 1. ~~by the following:~~

Table 1 - Number of Vehicles

Model Year	Chrysler	Ford	GM	Toyota	Honda	Other	Total
1991	109,563	344,867	334,974	218,577	191,174	378,731	1,577,886
1990	138,427	352,293	323,953	203,156	189,973	460,906	1,668,708
2002	203,397	447,947	483,019	407,384	272,205	733,610	2,547,562
2001	228,930	491,262	499,856	400,682	279,396	752,566	2,652,702
etc.							

##### 4.2 Obtain Vehicle Miles Traveled Information By Model Year

Obtain data for the projected values for the number of vehicle miles traveled or

percent of vehicle miles traveled in various model years expected in the current calendar year from an appropriate source such as projected values provided by ARB's Emission Factors Model (EMFAC) modeling program. Include only gasoline fueled vehicles. An example of such data is illustrated in Table 2 by the following:

Table 2  
Percent of Vehicle Miles Traveled by Vehicle Model Year

<b>Model Year</b>	<b>Percent of Vehicle Miles Traveled</b>
<u>2010</u>	<u>0.9</u>
<u>2009</u>	<u>3.0</u>
<u>2008</u>	<u>4.6</u>
<u>2007</u>	<u>5.7</u>
<u>2006</u>	<u>5.9</u>
<u>2005</u>	<u>5.7</u>
<u>2004</u>	<u>5.9</u>
<u>2003</u>	<u>5.6</u>
<u>2002</u>	<u>5.4</u>
<u>2001</u>	<u>5.7</u>
<u>1991</u>	<u>6.9</u>
<u>1990</u>	<u>10.5</u>
<u>1989</u>	<u>10.7</u>
<u>1988</u>	<u>10.3</u>
<u>1987</u>	<u>9.3</u>
<u>1986</u>	<u>8.2</u>
<u>1985</u>	<u>7.4</u>
Etcetera (percentage should add up to 100)	

4.3 Calculate Estimated Vehicle Miles Traveled for Each Make and/or Type Category and Each Model Year

Calculate the estimated vehicle miles traveled or percentage of vehicle miles traveled for each category of vehicle make or type in each model year using the data obtained above. For example, ~~calculate that because there were 203,397 2002 109563 1991 model Chrysler vehicles and 1,577,886 total 1991 2,547,562 total 2002 model vehicles, and projected vehicle miles traveled for 2002 1991 vehicles is 6.9%5.4% of all vehicle miles traveled.~~ From this data the projected percentage of vehicle miles traveled by 1991 2002 model Chrysler vehicles is calculated to be 0.43% ( $5.4\% \times (203,397 / 2,547,582)$ ) ~~will be 6.9%  $\times$  ( $109563 / 1577886$ ) or 0.4791%.~~

4.4 Calculate the Cumulative Percentage of Vehicle Miles Traveled for each Model Year

Calculate the number of vehicle miles traveled in each model year as a percentage of vehicle miles traveled in all model years and, for each model year,

the cumulative percentage of vehicle miles traveled by vehicles as new or newer than vehicles in that model year. The following table is an example calculations of the cumulative percent of vehicle miles traveled for 2010.

<b>Model Year</b>	<b>Percent of Total</b>	<b>Cumulative Percent</b>
<u>2010</u>	<u>0.9</u>	<u>0.9</u>
<u>2009</u>	<u>3.0</u>	<u>3.9</u>
<u>2008</u>	<u>4.6</u>	<u>8.5</u>
<u>2007</u>	<u>5.7</u>	<u>14.2</u>
<u>2006</u>	<u>5.9</u>	<u>20.1</u>
<u>2005</u>	<u>5.7</u>	<u>25.8</u>
<u>2004</u>	<u>5.9</u>	<u>31.7</u>
<u>2003</u>	<u>5.6</u>	<u>37.3</u>
<u>2002</u>	<u>5.4</u>	<u>42.7</u>
<u>2001</u>	<u>5.7</u>	<u>48.4</u>
1991	6.9	6.9
1990	10.5	17.4
1989	10.7	28.1
1988	10.3	38.4
1987	9.3	47.7
1986	8.2	55.9
1985	7.4	63.3
Etc.		

#### 4.5 Divide Model Years into Category Groups

Using the cumulative percentages of vehicle miles traveled previously calculated for each model year, divide the model years into groups each representing approximately the same percentage of vehicle miles traveled but group together the transition model years which include both ORVR and non-ORVR vehicles. ~~As an illustrative example~~ For example, divide ing model years into 54 groups such as 1966-1990, 1991-1997, 1998-2005, and 2006-2010. Although these groups are not equal, they can be used to create a non-ORVR vehicle test matrix. Table 3 shows that model years before 1998 have only non-ORVR vehicles, model years 1998-2005 have both ORVR and non-ORVR vehicles, and model year 2006 and later have only ORVR vehicles. ~~each representing approximately 20% of vehicle miles traveled would be done as follows using the example data above: 1990-1991 model years represent 17.4% of vehicle miles traveled, 1988-1989 model years represent 21.0%, 1985-1987 model years represent 24.9% of vehicle miles traveled, etc. Trial and error selection of model years may be necessary to arrive at an arrangement with the most equal division of vehicle miles traveled in each category group of model years. Do not subdivide model years. The groups will normally represent percentages of vehicle miles traveled which are only approximately equal.~~

Table 3  
Federally Mandated Phase-In Schedule for ORVR Vehicles

<u>Vehicle Category</u>	<u>Model Year</u>			
	<u>Non-ORVR Vehicles</u>	<u>40% ORVR</u>	<u>80% ORVR</u>	<u>100% ORVR</u>
<u>Passenger Cars</u>	<u>1997 and earlier</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>
<u>Light Duty Trucks</u> <u>≤6,000 pounds</u> <u>gross vehicle weight</u> <u>rating (GVWR)</u>	<u>2000 and earlier</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>
<u>Medium Duty</u> <u>Vehicles and Light</u> <u>Heavy Duty Trucks</u> <u>6,000 to 10,000</u> <u>GVWR</u>	<u>2003 and earlier</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>

Source: U.S. Code of Federal Regulations (CFR), Title 40, Part 86

4.6 Calculate Percentage of Vehicle Miles Traveled In Each Model Year Category by Vehicles in Each Vehicle Make or Type Category

Sum the percentage of vehicle miles traveled for each category of vehicle in each model year category. For example using data above, because 1991 2002 Chrysler vehicles represent 0.4791% 0.43% of total vehicle miles traveled and 1990 2001 Chrysler vehicles represent 0.49% 0.8710%, When these percentages the total percentage of vehicle miles traveled by Chrysler vehicles are added together with the percentages of Chrysler vehicle miles for model year 1998, 1999, 2000, 2003, 2004, and 2005, the total percentage for Chrysler for the 1990-1991 1998-2005 model year category is 3.5% 1.3501%.

4.7 Calculate the Vehicle Count Matrix

For the purpose of TP-201.2, the test fleet shall consist of non-ORVR vehicles only. Therefore, remove the categories for model years after 2005, since 2005 is the last year that non-ORVR vehicles with GVWR less than 10,000 pounds were manufactured. During the model years, 1998 through 2005, ORVR vehicles were phased in, as shown in Table 3. Use information from Table 3 and EMFAC to determine the likely percentage of non-ORVR vehicles in the model-years 1998-2005. For example, the likely percentage of non-ORVR vehicles in the model year 1998 is about 79% and the likely percentage of non-ORVR vehicles in 2005 is 2%. Multiply the percentage of vehicle miles travelled in the 1998-2005 model year category groups by the likely percentage of non-ORVR vehicles for these years. Select a constant AK@ with a value of approximately 2. Calculate a count of non-ORVR vehicles to be tested in each category of vehicle make or type and each model year range by rounding off the product the constant AK@ and the percentage of vehicle miles traveled by vehicles in that category of make or type

and model year range. Calculate the total of the resulting counts of vehicles in all categories of vehicle make or type and all model year ranges (the total will be approximately 200). Adjust the value of the constant AK@ in small increments by trial and error, and recalculate the total, until the total is exactly 200 100. This is best done using a spreadsheet program.

Table 4 is an ~~An illustrative~~ example of a non-ORVR vehicle test matrix. The first row in Table 4 includes the model years 1998-2005, during which both ORVR and non-ORVR vehicles are manufactured. The matrix must include 21 non-ORVR vehicles manufactured between 1998 and 2005. Since vehicles manufactured after 2005 are all equipped with ORVR, these newer vehicles are not included in the test matrix. ~~completed table of vehicle counts is shown below.~~

1992 200-VEHICLE MATRIX							
Model Yr	Chrysler	Ford	GM	Toyota	Honda	Other	Totals
89-92	3	12	11	8	7	13	54
86-88	6	9	10	9	4	16	54
82-85	5	9	11	6	4	13	48
77-81	3	6	9	3	2	9	32
< 77	3	4	5	0	0	2	12
<b>TOTALS</b>	<b>18</b>	<b>40</b>	<b>46</b>	<b>26</b>	<b>17</b>	<b>54</b>	<b>200</b>

Table 4  
100 Non-ORVR Vehicles for Test Matrix in 2010

<u>Model Year</u>	<u>Chrysler</u>	<u>Ford</u>	<u>G.M.</u>	<u>Toyota</u>	<u>Honda</u>	<u>Nissan/ Datsun</u>	<u>VW/ Volvo</u>	<u>Others</u>	<u>Total</u>
1998-2005	<u>2</u>	<u>4</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>3</u>	<u>21</u>
1991-1997	<u>3</u>	<u>8</u>	<u>8</u>	<u>6</u>	<u>5</u>	<u>1</u>	<u>3</u>	<u>5</u>	<u>39</u>
1990 and earlier	<u>3</u>	<u>7</u>	<u>11</u>	<u>5</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>5</u>	<u>40</u>
<b>Totals</b>	<b><u>8</u></b>	<b><u>19</u></b>	<b><u>23</u></b>	<b><u>14</u></b>	<b><u>10</u></b>	<b><u>6</u></b>	<b><u>7</u></b>	<b><u>13</u></b>	<b><u>100</u></b>