

California Environmental Protection Agency

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# **Air Resources Board**

**Vapor Recovery Test Procedure**

**TP-201.2A**

**Determination of Vehicle Matrix for  
Phase II Vapor Recovery Systems of  
Dispensing Facilities**

**Adopted: April 12, 1996**

California Environmental Protection Agency  
Air Resources Board

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Phase II Vapor Recovery Systems of  
Dispensing Facilities

**1 APPLICABILITY**

Definitions common to all certification and test procedures are in:

D-200 Definitions for  
Certification Procedures and  
Test Procedures for  
Vapor Recovery Systems

For the purpose of this procedure, the term "ARB" refers to the State of California Air Resources Board, and the term "ARB Executive Officer" refers to the 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.

**2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE**

The sample of vehicles to be used in method TP-201.2 for testing vapor control systems shall be made up of vehicles representative of the on the road vehicle population in terms of vehicle miles traveled (VMT). This calculation procedure produces such a representative vehicle matrix. The distribution in terms of model year can be derived from the VMT portion of the calculated input to EMFAC. EMFAC is the ARB computer model for estimating on road motor vehicle emissions and is administered by the Technical Support Division of ARB. Distribution in terms of manufacturer can be derived from the number of registered vehicles for each make and model year which can be obtained from the Department of Motor Vehicles.

**3 BIASES AND INTERFERENCES**

This section heading is not applicable to this procedure.

**4 SENSITIVITY, RANGE, AND PRECISION**

This section heading is not applicable to this procedure.

**5 EQUIPMENT**

This section heading is not applicable to this procedure.

**6 CALIBRATION PROCEDURE**

This section heading is not applicable to this procedure.

**7 PRE-TEST PROTOCOL**

This section heading is not applicable to this procedure.

**8 TEST PROCEDURE**

This section heading is not applicable to this procedure.

**9 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)**

This section heading is not applicable to this procedure.

**10 RECORDING DATA**

This section heading is not applicable to this procedure.

## 11 CALCULATING RESULTS

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

### 11.1 Vehicle Make

Obtain the number of registered vehicles by manufacturer and by model year from the Department of Motor Vehicles (DMV). The data shall resemble the following :

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Number of Registered Vehicles							
MODEL (e.g.)	CHRYSLER	FORD	GM	TOYOTA	HONDA	OTHER	TOTAL
YEAR							
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
etc.							

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## 11.2 Vehicle Miles Traveled (VMT)

Obtain data for the projected vehicle miles traveled (VMT) in the current year from EMFAC7EWT output. This is the vehicle population, trip, and VMT fraction input data for EMFAC. The required data are the fractions of the total VMT by each vehicle model year. The passenger car population for this data set is divided into three groups; non-catalytic gasoline, catalytic gasoline, and diesel powered. Use only the catalytic gasoline vehicles for this calculation. The data will appear similar to the following:

Distribution of VMT by Vehicle Model Year

MODEL YEAR	PERCENT OF VMT	VEHICLES PER 100 CAR TEST
1991	6.9	6.9
1990	10.5	10.5
1989	10.7	10.7
1988	10.3	10.3
1987	9.3	9.3
1986	8.2	8.2
1985	7.4	7.4
1984	6.7	6.7
1983	6.0	6.0
1982	5.2	5.2
1981	4.7	4.7
1980	4.1	4.1
1979	2.9	2.9
1978	2.4	2.4
1977	2.0	2.0
1976	1.5	1.5
1975	1.1	1.1
1974	0	0

The diesel vehicles are not fueled with vapor recovery equipment and shall not be included in the matrix. The non-catalytic vehicles were produced before 1979 and most were built before fillpipe standards and vapor emission standards were established for vehicles. They currently account for only 4% of the total VMT's and this fraction decreases each year. So the non-catalytic vehicles also need not be included in the matrix.

## 11.3 VMT per Make and Model Year

Multiply the VMT fraction for each model year (step 11.2) times the number of registered vehicles by each manufacturer (step 11.1) for the corresponding model year. The resulting products are proportional to the miles traveled by each manufacturer's vehicles, for each model year.

**11.4 VMT per Make for All Years**

Sum the products of step 11.3 for each manufacturer. These sums represent the total VMT for each manufacturer. Select at least five manufacturers responsible for the highest VMT sums. These five (or more) manufacturers will be used to establish columns in the matrix. A last column called "Others" will include the vehicles from all other manufacturers.

**11.5 Percentage of Vehicles for each Model Year**

Determine the number of vehicles from each model year which are required by the 100-car matrix. To do this, convert the VMT fractions of step 11.2 to percents by multiplying by 100%. These percent numbers also equal the number of vehicles required in the 100-car test for each model year. For example if 10% of all VMT's are traveled by 1990 model vehicles, the 100-car matrix would include ten 1990 vehicles.

It is most accurate to maintain fractions through the calculations and round to whole vehicle numbers only at the last step of determining the matrix.

**11.6 Percentage of Vehicles by Make for each Model Year**

Obtain the fractions of registered vehicles by manufacturer for each model year. This shall be done for the five main manufacturers (step 11.4) and for the "Others" total. First, sum the numbers of registered vehicles of all manufacturers for each model year. Second, divide this sum into the registered vehicle numbers of each of the five main manufacturers and "Others" to get the desired fraction. For example, a recent calculation yielded:

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**Percentage of Registered Vehicles by Manufacturer for Each Model Year**

MODEL	CHRYSLER	FORD	GM	TOYOTA	HONDA	OTHERS	TOTAL
YEAR							
1991	6.9	21.9	21.2	13.9	12.1	24.0	100.0%
1990	8.3	21.1	19.4	12.2	11.4	27.6	100.0%
etc.							

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### 11.7 Yearly Matrix Values

Distribute the vehicles for each model year (step 11.5) among the six columns (step 11.4). The number of vehicles assigned for each manufacturer shall be proportional to the fraction of registered vehicles (step 11.6) for each model year. A recent example follows:

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Number of Vehicles for 100-car Matrix by Manufacturer and Model Year

MODEL	CHRYSLER	FORD	GM	TOYOTA	HONDA	OTHERS	TOTAL
YEAR							
1991	0.48	1.51	1.46	0.96	0.83	1.66	6.9
1990	0.87	2.22	2.04	1.28	1.20	2.90	10.5
etc.							

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**11.8 Vehicle Matrix**

The vehicle matrix shall be constructed per the requirements of the certification procedure. Examples for two such requirements are given below:

**11.8.1 Vehicle Cell Limits**

The following example shows the results of constructing a vehicle matrix for August 1992 with a ten vehicle cell limit. Any other matrix with another cell limits, such as less than five vehicles per cell, shall be constructed in the same manner.

Combine the data into groups of model years to facilitate filling the matrix during the 100-car field test. Beginning with the current year, add previous years in succession until a maximum of ten vehicles accumulate in any cell. This group of model years will form the first row of cells. Repeat this process starting with the next preceding year to determine the group of years for the second row of cells. Repeat until all previous years combined yield less than 10 vehicles in any cell. This will normally require four rows of cells and the result will resemble the following table:

100 VEHICLE MATRIX AUGUST 1992							
MODEL YR	CHRYSLER	FORD	GM	TOYOTA	HONDA	OTHER	TOTALS
89-92	2	6	5	4	3	7	27
86-88	3	5	5	4	2	8	27
82-85	2	4	6	3	2	7	24
77-81	1	3	5	2	1	4	16
< 77	1	2	2	0	0	1	6
TOTALS	9	20	23	13	8	27	100

Be careful when rounding to whole numbers of vehicles. This can result in a matrix with slightly more or less than 100 vehicles. One can often determine the best place to add or subtract a vehicle by comparing the sums of rounded numbers and unrounded numbers for each row and column.



## 11.8.2

### Special Cell Limits

Other cell limits shall be placed outside the totals for vehicle cell limits, as required by the application of the certification procedure.

For example, a requirement for

"at least five vehicles with 89-92 model years with a vehicle tank vapor return line entering the fillpipe above the unleaded restrictor"

would place a "5" in a special limit column to the right of the "TOTALS" column and in the "89-92" row. The row at the bottom of the table would be unaffected except for the addition of a total cell for the sum of the vehicles required by the special limit.

Regardless of the number of special limits required, the total number of vehicles in the matrix shall remain 100.

Be careful when applying special limits, or the resources required to find suitable vehicles can be increased beyond practical limits.

## **12 REPORTING RESULTS**

This section is reserved for future specification.

## **13 ALTERNATIVE TEST PROCEDURES**

Test procedures, other than specified above, shall only be used if prior written approval is obtained from the ARB Executive Officer. In order to secure the ARB Executive Officer's approval of an alternative test procedure, the applicant is responsible for demonstrating to the ARB Executive Officer's satisfaction that the alternative test procedure is equivalent to this test procedure.

- (1) Such approval shall be granted on a case-by-case basis only. Because of the evolving nature of technology and procedures for vapor recovery systems, such approval shall not be granted in subsequent cases without a new request for approval and a new demonstration of equivalency.
- (2) Documentation of any such approvals, demonstrations, and approvals shall be maintained in the ARB Executive Officer's files and shall be made available upon request.

## **14 REFERENCES**

This section is reserved for future specification.

## **15 FIGURES**

This section heading is not applicable to this procedure.