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This report presents documentation of an emission factor basic computer code which calculates composite vehicle emission factors in terms of gram per vehicle mile, for carbon monoxide, oxides of nitrogen, total hydrocarbons and reactive hydrocarbons. The factors are computed as a function of average route speed, vehicle type distribution, California low elevation, calendar year, ambient temperature and hot/cold vehicle starting mode.

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TRANSPORTATION LABORATORY

RESEARCH REPORT

Motor Vehicle Emission Factors For Estimates Of Highway Impact On Air Quality

INTERIM REPORT

CA-DOT-TL-7082-14-76-54

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DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES & ENGINEERING SERVICES
OFFICE OF TRANSPORTATION LABORATORY

August 1976

TL No. 657082

Mr. C. E. Forbes
Chief Engineer

Dear Sir:

I have approved and now submit for your information this interim research project report titled:

MOTOR VEHICLES EMISSION FACTORS FOR ESTIMATES
OF HIGHWAY IMPACT ON AIR QUALITY

Study made by . . . . . Enviro-Chemical Branch

Under the Supervision of . . . . . E. C. Shirley, P.E.

Principal Investigator . . . . . C. R. Sundquist, P.E.

Report Written by . . . . . D. M. Coats
P. D. Allen
W. V. Loscutoff

Very truly yours,

George A Hill

GEORGE A. HILL
Chief, Office of Transportation Laboratory

Attachment

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This manual has been authored by Deane M. Coats of the Transportation Laboratory, and Paul D. Allen and William V. Loscutoff of the Air Resources Board under the supervision of Carl R. Sundquist and Earl C. Shirley.

The computer program presented in this report was developed and written by Paul D. Allen.

The contents of this report reflect the views of the Transportation Laboratory, which is responsible for the facts and the accuracy of the information presented herein. The contents do not necessarily reflect the official views of the State of California. This report does not constitute a standard, specification, or regulation.

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INTRODUCTION

To determine the impact of transportation systems on the air environment, estimates of vehicular emission of carbon monoxide, hydrocarbons and oxides of nitrogen must be made. These emission estimates are then used as inputs to line source and regional air quality models to assess the impacts on air quality.

This report documents the Transportation Laboratory's computer program EMFAC3, which calculates composite motor vehicle emission factors from the most recent data compiled by the California Air Resources Board (ARB). The bulk of this data has been presented in an unpublished support document by the Air Resources Board entitled "EMFAC3 Technical Support Document", March 31, 1976 (1), and is based primarily on the Environmental Protection Agency (EPA) publication AP-42, Supplement No. 5 (3).

The methodology used in the computations is consistent with methodology expressed in the EPA April 1973, edition of AP-42 (2), and the December 1975, edition of AP-42, Supplement No. 5 (3).

These sources incorporate the latest available California information for: 1) speed correction factors, 2) vehicle population distributions for most vehicle types including light-duty autos (LDA), light-duty trucks (LDT), heavy-duty gasoline-powered trucks (HDG), heavy-duty diesel-powered trucks (HDD), 3) interim and established California Emission Standards, 4) hydrocarbon reactivity factors, 5) ambient temperature conditions, and 6) hot/cold vehicle start operation modes.

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At the present time, EMFAC3 is not designed to include some vehicle types, additional pollutants and other variables due to the lack of sufficient data. When new and additoinal information become available this program will again be updated.

Some of the items that may be included in future revisions are:

Medium-duty trucks (presently included with LDT)
Bus emissions, mileage, etc. (presently included with HDG & HDD)
Motorcycle emissions, mileage, etc.
>3500-ft elevation emission factors
Sulphur dioxide (So_2) emissions
Lead (Pb) particulates
Idle mode emissions
Speed adjustment factors for >45 mph
Expanded temperature range
Non-California vehicles
Light-duty diesels, (Mercedes 220D, Nissan, etc.)
Diesel evaporative emissions

Preliminary work has already started on many of the above items. Time and need will determine their priorities.

This interim report is presented in five subject areas; 1) conclusions, 2) recommendations and implementation, 3) procedure, 4) tables, and 5) appendix. The appendix contains EMFAC3 computer program, data file and user input-computer output. The body of the report, consisting of the procedure and the tables, is discussed here in a general manner for the reader's benefit.

The procedures present the methods and equations necessary for determining a composite emission factor for the pollutants carbon monoxide, CO; hydrocarbons, HC; and nitrogen oxides, NO_x.

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An equation for exhaust emissions is used to calculate emission factors for each vehicle type and each pollutant. For CO and NO_x, which only result from the exhaust, all that remains to be done is to combine the proportioned amount of each vehicle type for each pollutant to obtain the composite emission factor for a "typical" vehicle.

For HC, however, the results of equations to calculate crankcase and evaporative emissions must be proportioned by vehicle type and then added to the exhaust emissions to obtain the total hydrocarbons, THC, for each vehicle type. Proportions of vehicle types are then combined to obtain the composite emission factor for total hydrocarbons.

To obtain reactive hydrocarbons, RHC, a direct percentage of the hydrocarbons from each hydrocarbon emission source (exhaust, crankcase, and evaporation) is taken. The sum of these is the reactive hydrocarbon, RHC, composite emission factor.

The tables are generally straightforward, but note is made here of certain specifics that may cause the reader some confusion. Two types of the speed correction tables are presented. One is for average speeds of 15 mph to 45 mph and one is for low average speeds of 5 mph and 10 mph. There are tables for each pollutant, for light-duty autos, LDA; light-duty trucks, LDT; and heavy-duty gasoline powered trucks, HDG. For convenience, these have been combined in the computer files and are continuous from 5 mph to 45 mph. Heavy duty diesel truck speed correction uses a somewhat different equation format due to differing data sources. Again, in the computer, the equation is continuous from 5 mph to 45 mph.

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CONCLUSIONS

The results of this study have provided transportation planners and engineers with a vehicular emissions model to give estimates of composite emission factors for carbon monoxide, total hydrocarbons, reactive hydrocarbons, and oxides of nitrogen. The computer program EMFAC3 can be used to estimate emission factors for any desired:

1) Vehicle type; LDA, LDT, HDG, and HDD,
2) vehicle distribution; 0% to 100% of each or any combination of types noted,
3) average route speed; from 5 mph to 45 mph,
4) year of inventory; pre-1965 to year 2010,
5) California low elevation; <3,500 feet,
6) ambient temperature; from 20°F to 80°F, and
7) percentage hot/cold start operations; 0% to 100%.

The EMFAC3 vehicular emissions model can be interfaced easily with air quality models to give estimates of ambient concentrations due to pollutant emissions from roadways. Combined with stationary source and aircraft emissions, EMFAC3 can be interfaced with regional air quality simulation models to more accurately estimate regional ambient concentrations.

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RECOMMENDATIONS AND IMPLEMENTATION

The emission factors estimated by procedures illustrated in this report will replace those in the report entitled "Motor Vehicle Emission Factors For Estimates of Highway Impact on Air Quality", March 1976 (4). Some of the information presented here has been taken from that report.

This new emission factor program, which will be used on all future Air Quality Studies by Caltrans, is resident on the TENET timeshare computer, and can be accessed by linking the program "5;LAB;EMFAC".

This emission factor model has been interfaced in Headquarter's DOTP transportation simulation models to calculate vehicular emissions for links and grids in a given study resion (FREEWAY11). These total emissions will then be inputs into regional air quality models to predict the temporal and spatial concentration of air pollutants for a given transportation system. An assessment of various transportation alternatives and their impact on air quality can then be made.

All State of California computer programs estimating emissions from autos and trucks on transportation models should use the EMFAC3 program for the emissions information source.

This emission model will also be used with the CALINE2 line source dispersion model presently used by CALTRANS. By incorporating the emission model in the CALINE2 model, predictions of air quality can be made within the immediate vicinity of a highway.

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PROCEDURE

The EMFAC3 program computes composite emission factors for total and reactive hydrocarbons, oxides of nitrogen, and carbon monoxide, in units of grams per mile. For average speeds from 5 to 45 mph, the following 3 equations are used to calculate emission factors for each of the 4 vehicle types [light-duty auto (LDA), light-duty trucks (LDT), heavy-duty gasoline truck (HDG), and heavy-duty diesel trucks (HDD)]. The composite emission factors depend on the distribution of the vehicle type input by the user.

The <u>exhaust</u> emission factor for CO, HC, and NO_x is calculated using equation (1). Calculate for each vehicle type (LDA, LDT, HDG, and HDD) and exhaust pollutant (CO, HC, and NO_x) as follows:

$$e_{npstwx} = \sum_{i=n-16}^{n+1} c_{ipn}\, m_{in}\, v_{ips}\, z_{ipt}\, r_{iptwx} \qquad (1)$$

where

e_{npstwx} = the exhaust emission factor in grams/mile for calendar year (n), pollutant (p), average speed (s), ambient temperature (t), percentage cold start operation (w), and percentage hot start operation (x);

c_{ipn} = the exhaust emission rate in grams/mile for i^{th} model year vehicles during calendar year (n) and for pollutant (p);

m_{in} = the weighted percentage annual travel, of the ith model year vehicle during calendar year (n);

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v_{ips} = the speed correction factor for the ith model year vehicles for pollutant (p), and average speed (s);

z_{ipt} = the temperature adjustment factor for the ith model year vehicles for pollutant (p), and ambient temperature (t); (Applied to light-duty autos and light-duty trucks only.)

r_{iptwx} = the hot/cold vehicle operation adjustment factor for the ith model year vehicles for pollutant (p), ambient temperature (t), percentage cold start operation (w), and percentage hot start operation (x). (Applied to light-duty autos and light-duty trucks only.)

To calculate the total hydrocarbon emissions, evaporative and crankcase hydrocarbons must be added to the exhaust hydrocarbons. The following equations (2) and (3) describe the calculation of evaporative and crankcase hydrocarbon emissions respectively. Calculate for each vehicle type (LDA, LDT, HDG, not applicable to HDD) as follows:

$$V_n = \sum_{i=n-16}^{n+1} v_i \, m_{in} \qquad (2)$$

where

V_n = the evaporative hydrocarbon emission factor for calendar year (n);

v_i = the evaporative emission rate in grams/mile for the ith model year vehicle;

m_{in} = the weighted percentage annual travel, of the ith model year vehicle during calendar year (n).

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$$CC_n = \sum_{i=n-16}^{n+1} cc_i \, m_{in} \qquad (3)$$

where

CC_n = the crankcase hydrocarbon emission factor for calendar year (n);

cc_i = the crankcase emission rate in grams/mile for the ith model year vehicle;

m_{in} = the weighted percentage annual travel, of the ith model year vehicle during calendar year (n).

Each variable will be discussed in later sections of this report.

It is important to note here that exceptions to the above equations exist in the calculation of a composite emission factor. The exceptions are noted here:

(1) All model year vehicles older than the calendar year (n)-16 are included in the 17 year old vehicle.

(2) Reactive hydrocarbons are calculated as a percentage of each of the hydrocarbon emission sources; exhaust, evaporative, and crankcase hydrocarbons. At present, evaporative and crankcase hydrocarbon emissions are not considered for heavy-duty diesel trucks.

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To obtain the composite emission factors of each pollutant for all vehicle types calculate by multiplying the emission factors for each pollutant (CO, NO_x, exhaust HC; crankcase HC; and evaporative HC) by the percentage of each vehicle type (LDA, LDT, HDG, and HDD where applicable) to obtain the proportioned amount. The sum of the products (proportioned amount) for each pollutant and all vehicle types is the composite emission factor for pollutants CO and NO_x. This is not so for hydrocarbons. The sums for exhaust, evaporative, and crankcase hydrocarbons must be added together to obtain the total hydrocarbon composite emission factor.

To calculate the reactive hydrocarbon composite emission factor, multiply the sums of the proportioned amounts for all gasoline powered vehicles (LDA, LDT, and HDG), for each HC emission source (exhaust, evaporative and crankcase) by the reactivity factors (5). Repeat for diesel. The sum of these products equals the reactive hydrocarbon composite emission factor. See Table 45 for reactivity factors.

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VEHICLE EXHAUST MISSION RATES

Vehicle exhaust emission rates (c_{ipn}) are taken directly from ARB's technical support document (1), March 1976.

These tables identify specific exhaust emission rates incorporated in the mobile source emissions program EMFAC3 developed by the Air Quality Modeling Unit of the Air Resources Board. EPA's AP-42, Supplement 5 (1), was the basis for all data in EMFAC3 with modifications to that data as noted below.

1) Emission standards of 0.41 HC, 9.0 CO, and 1.5 NO_x grams/mile were used for 1977-79 new model light-duty autos. Emission standards of 0.41 HC, 3.4 CO, 1.0 NO_x grams/mile were used for all post 1979 new light-duty autos. Emission rate schedules from Supplement 5, Table D.1-28, were used exclusively. It should be noted that the 1.5 grams/mile NO_x emission schedule, not found in draft versions of Supplement 5, was provided by EPA in the final version of Supplement 5, dated December 1975.

2) The emission rate at 45 miles per hour is assumed to remain constant at that value for speeds greater than 45 miles per hour, for all vehicle types. Previous emission models of EMFAC have extrapolated emission rates for speeds greater than 45 mph. EPA and ARB presently agree that insufficient data exist to warrant this assumption.

3) All post-1974 light-duty truck emission rates were developed differently from Supplement 5 recommended procedures. The specific modification included consideration of California's more stringent NO_x standard for 1975, standards of 0.9 HC, 17.0 CO, and 2.0 NO_x grams/mile for post-1975, and the weighting of 1976 and 1977 emission rates of 2/3 light-duty truck ($\leq$6000-lb. G.V.W., catalytic) and 1/3 heavy-duty truck, (>6000-lb. and $\leq$8500-lb. G.V.W. noncatalytic), gasoline powered.

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This weighting reflects EPA's definition of light-duty trucks ($\leq$8500-lb.) and California's legal definition of light-duty trucks ($\leq$6000-lb.) and the manufacturer's reclassification of 6000-lb. G.V.W. vehicles to 8500-lb. G.V.W. vehicles. This reclassification exempted those vehicles in the 6000-lb. to 8500-lb. G.V.W. range from having to install catalytic systems during that period. In 1978, catalytic systems will be required on most vehicles $\leq$8500-lb. G.V.W. to meet California's emission standards.

4) Supplement 5 normally provided deterioration data on emission rates for eleven years. In this report, all emission rate values were extrapolated to a total of seventeen years. In most cases, the vehicle's emission rate was considered constant after eleven years. Deterioration rates are included in the tables. This projection to seventeen years is possible because sufficient data exist to define California's vehicle population.

5) No retrofit correction factors were incorporated in EMFAC3 due to ARB's evaluation of the existing retrofit program. Actual test data are insufficient to determine the effectiveness of the program.

6) All heavy-duty gasoline truck (HDG) and heavy-duty diesel truck (HDD) emission data were incorporated explicitly as described in Supplement 5, except that seventeen year deterioration rates were extrapolated and included in the tables as discussed in 4) above.

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TABLE 1

EXHAUST EMISSION RATES

EMFAC3

Light-Duty Auto (LDA) - CO Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Vehicle Age, Years

Calendar Year	0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65	74.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	87.0	88.0	89.0	90.0	91.0	92.0	93.0	94.0
66	75.0	74.0	87.0	87.0	87.0	87.0	87.0	87.0	87.0	87.0	87.0	88.0	89.0	90.0	91.0	92.0	93.0	94.0
67	52.6	75.0	75.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	89.0	90.0	91.0	92.0	93.0	94.0
68	53.4	52.6	76.0	76.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	90.0	91.0	92.0	93.0	94.0
69	48.5	53.4	55.6	77.0	77.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	91.0	92.0	93.0	94.0
70	48.5	48.5	56.4	58.6	78.0	78.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	92.0	93.0	94.0
71	47.0	48.5	51.0	59.4	61.6	79.0	79.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	93.0	94.0
72	37.0	47.0	51.0	53.5	62.4	64.6	80.0	80.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	94.0
73	37.0	37.0	49.0	53.5	56.0	65.4	67.6	81.0	81.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0
74	5.4	37.0	39.0	51.0	56.0	58.5	68.4	70.6	82.0	82.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
75	5.4	5.4	39.0	41.0	53.0	58.5	61.0	71.4	73.6	83.0	83.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0
76	5.4	5.4	5.9	41.0	43.0	55.0	61.0	63.5	74.4	76.6	84.0	84.0	97.0	97.0	97.0	97.0	97.0	97.0
77	5.4	5.4	5.9	6.5	43.0	45.0	57.0	63.5	66.0	77.4	79.6	85.0	85.0	98.0	98.0	98.0	98.0	98.0
78	5.4	5.4	5.9	6.5	7.0	45.0	47.0	59.0	66.0	68.5	80.4	82.6	85.0	85.0	99.0	99.0	99.0	99.0
79	2.8	5.4	5.9	6.5	7.0	7.6	47.0	49.0	61.0	68.5	71.0	83.4	82.6	85.0	85.0	99.0	99.0	99.0
80	2.8	2.8	5.9	6.5	7.0	7.6	8.1	49.0	51.0	63.0	71.0	73.5	83.4	82.6	85.0	85.0	99.0	99.0
81	2.8	2.8	3.1	6.5	7.0	7.6	8.1	8.6	51.0	53.0	65.0	73.5	73.5	83.4	82.6	85.0	85.0	99.0
82	2.8	2.8	3.1	3.4	7.0	7.6	8.1	8.6	9.2	53.0	55.0	67.0	73.5	73.5	83.4	82.6	85.0	85.0
83	2.8	2.8	3.1	3.4	3.6	7.6	8.1	8.6	9.2	9.7	55.0	57.0	67.0	73.5	73.5	83.4	82.6	85.0
84	2.8	2.8	3.1	3.4	3.6	3.9	8.1	8.6	9.2	9.7	10.3	57.0	57.0	67.0	73.5	73.5	83.4	82.6
85	2.8	2.8	3.1	3.4	3.6	3.9	4.2	8.6	9.2	9.7	10.3	10.8	57.0	57.0	67.0	73.5	73.5	83.4
86	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	9.2	9.7	10.3	10.8	10.8	57.0	57.0	67.0	73.5	73.5
87	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	9.7	10.3	10.8	10.8	10.8	57.0	57.0	67.0	73.5
88	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	10.3	10.8	10.8	10.8	10.8	57.0	57.0	67.0
89	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	10.8	10.8	10.8	10.8	10.8	57.0	57.0
90	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	10.8	10.8	10.8	10.8	10.8	57.0
91	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	10.8	10.8	10.8	10.8	10.8
92	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	10.8	10.8	10.8	10.8
93	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	10.8	10.8	10.8
94	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	5.6	10.8	10.8
95	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	5.6	5.6	10.8
96	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	5.6	5.6	5.6
97	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	5.6	5.6	5.6
98	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	5.6	5.6	5.6
99	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	5.6	5.6	5.6
2000	2.8	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6	5.6	5.6	5.6	5.6	5.6	5.6

A-Represents new model year production beginning Oct. 1 of inventory year.

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TABLE 2

EXHAUST EMISSION RATES

EMFAC3

Light-Duty Auto (LDA) - HC Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Vehicle Age, Years

Calendar Year	0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65	2.3	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8
66	2.9	2.3	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8
67	3.8	2.9	2.9	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.3	8.4	8.5	8.6	8.7	8.8
68	3.3	3.8	3.5	3.5	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.5	8.6	8.7	8.8
69	3.8	3.3	4.4	4.1	4.1	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.5	8.6	8.7	8.8
70	3.5	3.8	3.8	5.0	4.7	4.7	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.6	8.7	8.8
71	3.6	3.5	4.3	4.3	5.6	5.3	5.3	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.7	8.8
72	3.2	3.6	3.9	4.8	4.8	6.2	5.9	5.9	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.8
73	3.2	3.2	3.9	4.3	5.3	5.3	6.8	6.5	6.5	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
74	0.6	3.2	3.5	4.2	4.7	5.8	5.8	7.4	7.1	7.1	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
75	0.6	0.6	3.5	3.8	4.5	5.1	6.3	6.3	8.0	7.7	7.7	9.0	9.0	9.0	9.0	9.0	9.0	9.0
76	0.3	0.6	0.7	3.8	4.1	4.8	5.5	6.8	6.8	8.6	8.3	8.3	9.1	9.1	9.1	9.1	9.1	9.1
77	0.3	0.3	0.7	0.8	4.1	4.4	5.1	5.9	7.3	7.3	9.2	9.0	9.0	9.2	9.2	9.2	9.2	9.2
78	0.3	0.3	0.3	0.8	1.0	4.4	4.7	5.4	6.3	7.8	7.8	9.3	9.0	9.0	9.3	9.3	9.3	9.3
79	0.3	0.3	0.3	0.4	1.0	1.1	4.7	5.0	5.7	6.7	8.3	8.3	9.3	9.0	9.0	9.3	9.3	9.3
80	0.3	0.3	0.3	0.4	0.4	1.1	1.2	5.0	5.3	6.0	7.1	8.8	8.3	9.3	9.0	9.0	9.3	9.3
81	0.3	0.3	0.3	0.4	0.4	0.5	1.2	1.3	5.3	5.6	6.3	7.5	8.8	8.3	9.3	9.0	9.0	9.3
82	0.3	0.3	0.3	0.4	0.4	0.5	0.5	1.3	1.4	5.6	5.9	6.6	7.5	8.8	8.3	9.3	9.0	9.0
83	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	1.4	1.6	5.9	6.2	6.6	7.5	8.8	8.3	9.3	9.0
84	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	1.6	1.7	6.2	6.2	6.6	7.5	8.8	8.3	9.3
85	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	1.7	1.8	6.2	6.2	6.6	7.5	8.8	8.3
86	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	1.8	1.8	6.2	6.2	6.6	7.5	8.8
87	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	1.8	1.8	6.2	6.2	6.6	7.5
88	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	1.8	1.8	6.2	6.2	6.6
89	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	1.8	1.8	6.2	6.2
90	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	1.8	1.8	6.2
91	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.8	1.8
92	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.8
93	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
94	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
95	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
96	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
97	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
98	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
99	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
2000	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8

A-Represents new model year production beginning Oct. 1 of inventory year.

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TABLE 3

EXHAUST EMISSION RATES

EMFAC3

Light-Duty Auto (LDA) - NO_x Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Vehicle Age, Years

Calendar Year	0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
66	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
67	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
68	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
69	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
70	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
71	3.1	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
72	3.1	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
73	2.0	3.1	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
74	2.0	2.0	3.3	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
75	2.0	2.0	2.1	3.5	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3	3.3
76	1.5	2.0	2.1	2.1	3.7	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3	3.3
77	1.5	1.5	2.1	2.1	2.2	3.9	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3	3.3
78	1.5	1.5	1.6	2.1	2.2	2.2	4.1	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3	3.3
79	1.0	1.5	1.6	1.6	2.2	2.2	2.3	4.3	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3	3.3
80	1.0	1.0	1.6	1.6	1.7	2.2	2.3	2.4	4.5	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3	3.3
81	1.0	1.0	1.0	1.6	1.7	1.7	2.3	2.4	2.4	4.7	3.8	3.8	4.4	5.1	4.3	3.6	3.6	3.3
82	1.0	1.0	1.0	1.1	1.7	1.7	1.8	2.4	2.4	2.5	4.9	3.8	3.8	4.4	5.1	4.3	3.6	3.6
83	1.0	1.0	1.0	1.1	1.1	1.7	1.8	1.9	2.4	2.5	2.5	5.0	3.8	3.8	4.4	5.1	4.3	3.6
84	1.0	1.0	1.0	1.1	1.1	1.2	1.8	1.9	1.9	2.5	2.5	2.6	5.0	3.8	3.8	4.4	5.1	4.3
85	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.9	1.9	2.0	2.5	2.6	2.6	5.0	3.8	3.8	4.4	5.1
86	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.9	2.0	2.0	2.6	2.6	2.6	5.0	3.8	3.8	4.4
87	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	2.0	2.0	2.1	2.6	2.6	2.6	5.0	3.8	3.8
88	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	2.0	2.1	2.1	2.6	2.6	2.6	5.0	3.8
89	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	2.1	2.1	2.1	2.6	2.6	2.6	5.0
90	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	2.1	2.1	2.1	2.6	2.6	2.6
91	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	2.1	2.1	2.1	2.6	2.6
92	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	2.1	2.1	2.1	2.6
93	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	2.1	2.1	2.1
94	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	2.1	2.1
95	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	2.1
96	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
97	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
98	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
99	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
2000	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

A-Represents new model year production beginning Oct. 1 of inventory year.

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DETAIL ON GENERATION OF EMFAC3 EXHAUST EMISSION RATE FILE FOR LIGHT-DUTY AUTOS

General

Incorporation of AP-42, Supplement 5, emission rates into the mobile source emission model "EMFAC3" required several modifications to reflect California's Standards not included in Supplement 5. Specifically, Supplement 5 assumes 1977 California Standards for light-duty autos of 0.9 CO, 9.0 HC and 1.5 NO_x grams/mile and implementation of statutory standards of 0.41 CO, 3.4 HC, and 0.4 NO_x grams/mile, in 1978. The ARB has adopted 1977 light-duty auto standards of 0.41 CO, 9.0 HC, and 1.5 NO_x grams/mile. This standard is assumed to be retained through 1979 with a change to new statutory standards of 0.41 CO, 3.4 HC, and 1.0 NO_x grams/mile for post 1979 vehicles in accordance with the January 16, 1976 internal memo from Tom Austin, Deputy Executive Officer, Technical, ARB, to the ARB staff.

Supplement 5 does not provide data for years between 1980 and 1985, 1985 and 1990, 1990 and 1995, and 1995 and 2000. Emission rates after 1990 are straightforward if one assumes constant emission rates after eleven years. However, other interim values required judgment. Specific considerations are listed below.

NO_x

1. Pre-1973 LDA exhibit constant NO_x rates for all values listed in Supplement 5. This is assumed true for all additionally needed values.

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2. 1973 LDA NO_x rate deteriorates 0.2 gram/mile/year until 1980, when it reaches an emission rate of 4.5 grams/mile. For 1985, Supplement 5 lists an NO_x emission rate of 5.0 grams/mile. From this, the following values are assumed or given.

Model Year	Exhaust Emission Rate	
1980	4.5 grams/mile	- Given
1981	4.7 " "	
1982	4.9 " "	
1983	5.0 " "	(11 yrs)deterioration
1984	5.0 " "	
1985	5.0 " "	- Given
Post-1985	5.0 " "	

3. Post-1973 LDA's follow the NO_x emission rate schedule presented in Table D.1-28, page D.1-19, of Supplement 5.

Model Year	NO_x Standard
1974-76	2.0 grams/mile
1977-79	1.5 " "
1980 +	1.0 " "

HC

1. Pre-1966 LDA's are assumed to retain constant HC emission rates of 9.3 grams/mile for calendar years after 1978. 9.3 grams/mile is the HC emission rate presented for 1978.

2. 1966 LDA's are assumed to deteriorate to 9.0 grams/mile HC, in 1977, and remain constant after that. The last value presented for 1966 LDA's in Supplement 5, (eleven years), is 8.3 grams/mile HC in 1976. An additional year of deterioration is assumed (total of twelve years) so that the final rate is equal to that presented for 1967 LDA's since other rates between 1973 and 1976 are identical for the two model years. The emission rate is assumed constant beyond 1977 for the 1966 model year.

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3. Post-1966 LDA's deteriorate for 11 years and then remain constant.

4. Post-1974 LDA's follow the HC emission rate schedule presented in Table D.1-28 page D.1-19 of Supplement 5.

Model Year	HC Standard
1975-76	0.9 grams/mile
1977+	0.41 " "

CO

1. Pre-1966 LDA's are assumed to retain constant CO emission rates of 99.0 grams/mile for calendar years after 1978. 99.0 grams/mile CO is the CO emission rate presented for 1978.

2. 1966 and 1967 LDA's are assumed to have a maximum CO emission rate of 85.0 grams/mile reached in calendar year 1977. All post calendar year 1977 CO emission rates are 85.0 grams/mile.

3. Post-1966 LDA's deteriorate for eleven years and then remain constant.

4. Post-1974 model LDA's follow the CO emission rate schedule presented in Table D.1-28, page D.1-19 of Supplement 5.

Model Year	CO Standard
1975-79	9.0 grams/mile
1980+	3.4 " "

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TABLE 4

EXHAUST EMISSION RATES

EMFAC3

Light-Duty Trucks (LDT) - CO Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Vehicle Age, Years

Calendar Year	0A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65	45.5	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
66	49.0	45.5	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
67	52.5	49.0	49.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
68	53.8	52.5	52.5	52.5	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
69	48.5	53.8	56.0	56.0	56.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
70	51.0	48.5	57.3	59.5	59.5	59.5	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
71	54.3	51.0	51.0	60.8	63.0	63.0	63.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
72	42.8	54.3	53.5	53.5	64.3	66.5	66.5	66.5	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
73	42.8	42.8	56.5	56.0	56.0	67.8	70.0	70.0	70.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
74	27.0	42.8	45.0	58.7	58.5	58.5	71.3	73.5	73.5	73.5	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
75	56.7	27.0	45.0	47.2	60.9	61.0	61.0	74.8	77.0	77.0	77.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
76	56.7	56.7	28.5	47.2	49.4	63.1	63.5	63.5	78.3	80.5	80.5	80.5	125.0	125.0	125.0	125.0	125.0	125.0
77	9.0	56.7	57.6	30.0	49.4	51.6	65.3	66.0	66.0	81.8	84.0	84.0	84.0	125.0	125.0	125.0	125.0	125.0
78	9.0	9.0	57.6	58.4	31.5	51.6	53.8	67.4	68.5	68.5	85.3	87.5	87.5	87.5	125.0	125.0	125.0	125.0
79	9.0	9.0	9.9	58.4	59.3	33.0	53.8	56.0	69.6	71.0	71.0	88.8	87.5	87.5	87.5	125.0	125.0	125.0
80	9.0	9.0	9.9	10.8	59.3	60.1	34.5	56.0	58.2	71.8	73.5	73.5	88.8	87.5	87.5	87.5	125.0	125.0
81	9.0	9.0	9.9	10.8	11.7	60.1	61.0	36.0	58.2	60.4	74.0	73.5	73.5	88.8	87.5	87.5	87.5	125.0
82	9.0	9.0	9.9	10.8	11.7	12.6	61.0	61.9	37.5	60.4	62.6	76.2	73.5	73.5	88.8	87.5	87.5	87.5
83	9.0	9.0	9.9	10.8	11.7	12.6	13.5	61.9	62.7	39.0	62.6	64.8	76.2	73.5	73.5	88.8	87.5	87.5
84	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	62.7	63.6	40.5	64.8	64.8	76.2	73.5	73.5	88.8	87.5
85	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	63.6	64.4	42.0	64.8	64.8	76.2	73.5	73.5	88.8
86	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	64.4	65.3	42.0	64.8	64.8	76.2	73.5	73.5
87	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	65.3	65.3	42.0	64.8	64.8	76.2	73.5
88	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	63.5	65.3	42.0	64.8	64.8	76 2
89	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	65.3	65.3	42.0	64.8	64.8
90	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	65.3	65.3	42.0	64.8
91	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	65.3	65.3	42.0
92	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	65.3	65.3
93	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	65.3
94	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0
95	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0
96	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0
97	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0
98	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0
99	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0
2000	9.0	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.0	18.0	18.0	18.0	18.0	18.0

A-Represents new model year production beginning Oct. 1 of inventory year.

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TABLE 5

EXHAUST EMISSION RATES

EMFAC3

Light-Duty Trucks (LDT) - HC Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Vehicle Age, Years

Calendar Year	0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65	2.3	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
66	2.3	2.3	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
67	3.9	3.1	3.1	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
68	3.5	3.9	3.9	3.9	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
69	3.6	3.5	4.7	4.7	4.7	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
70	3.7	3.6	4.1	5.5	5.5	5.5	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
71	3.8	3.7	4.2	4.7	6.3	6.3	6.3	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
72	3.6	3.8	4.2	4.8	5.3	7.1	7.1	7.1	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
73	3.6	3.6	4.2	4.7	5.4	5.9	7.9	7.9	7.9	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
74	2.7	3.6	4.0	4.6	5.2	6.0	6.5	8.7	8.7	8.7	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
75	2.4	2.7	4.0	4.4	5.0	5.7	6.6	7.1	9.5	9.5	9.5	17.0	17.0	17.0	17.0	17.0	17.0	17.0
76	2.4	2.4	3.0	4.4	4.8	5.4	6.2	7.2	7.7	10.3	10.3	10.3	17.0	17.0	17.0	17.0	17.0	17.0
77	0.6	2.4	2.5	3.3	4.8	5.2	5.9	6.7	7.8	8.3	11.1	11.1	11.1	17.0	17.0	17.0	17.0	17.0
78	0.6	0.6	2.5	2.6	3.6	5.2	5.6	6.3	7.2	8.4	8.9	11.9	11.9	11.9	17.0	17.0	17.0	17.0
79	0.6	0.6	0.7	2.6	2.7	3.9	5.6	6.0	6.7	7.7	9.0	9.5	11.9	11.9	11.9	17.0	17.0	17.0
80	0.6	0.6	0.7	0.8	2.7	2.8	4.2	6.0	6.4	7.1	8.2	9.6	9.5	11.9	11.9	11.9	17.0	17.0
81	0.6	0.6	0.7	0.8	1.0	2.8	2.9	4.5	6.4	6.8	7.5	8.7	9.6	9.5	11.9	11.9	11.9	17.0
82	0.6	0.6	0.7	0.8	1.0	1.1	2.9	2.9	4.8	6.8	7.2	7.9	8.7	9.6	9.5	11.9	11.9	11.9
83	0.6	0.6	0.7	0.8	1.0	1.1	1.2	2.9	3.0	5.1	7.2	7.6	7.9	8.7	9.6	9.5	11.9	11.9
84	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	3.0	3.1	5.4	7.6	7.6	7.9	8.7	9.6	9.5	11.9
85	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	3.1	3.2	5.7	7.6	7.6	7.9	8.7	9.6	9.5
86	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	3.2	3.3	5.7	7.6	7.6	7.9	8.7	9.6
87	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	3.3	3.3	5.7	7.6	7.6	7.9	8.7
88	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	3.3	3.3	5.7	7.6	7.6	7.9
89	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	3.3	3.3	5.7	7.6	7.6
90	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	3.3	3.3	5.7	7.6
91	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	3.3	3.3	5.7
92	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	3.3	3.3
93	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	3.3
94	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8
95	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8
96	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8
97	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8
98	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8
99	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8
2000	0.6	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8

A-Represents new model year production beginning Oct. 1 of inventory year.

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TABLE 6

EXHAUST EMISSION RATES

EMFAC3

Light-Duty Trucks (LDT) - NO_x Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Vehicle Age, Years

Calendar Year	0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
66	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
67	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
68	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
69	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
70	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
71	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
72	4.4	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
73	2.8	4.4	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
74	5.1	2.8	4.6	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
75	5.1	5.1	2.9	4.8	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2	4.2
76	5.1	5.1	5.2	2.9	5.0	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2	4.2
77	2.0	5.1	5.2	5.3	3.0	5.2	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2	4.2
78	2.0	2.0	5.2	5.3	5.4	3.0	5.4	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2	4.2
79	2.0	2.0	2.1	5.3	5.4	5.5	3.1	5.6	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2	4.2
80	2.0	2.0	2.1	2.1	5.4	5.5	5.6	3.1	5.8	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2	4.2
81	2.0	2.0	2.1	2.1	2.2	5.5	5.6	5.7	3.2	6.0	4.4	4.6	5.2	5.3	4.9	4.9	4.9	4.2
82	2.0	2.0	2.1	2.1	2.2	2.2	5.6	5.7	5.8	3.2	6.2	4.4	4.6	5.2	5.3	4.9	4.9	4.9
83	2.0	2.0	2.1	2.1	2.2	2.2	2.3	5.7	5.8	5.9	3.3	6.4	4.4	4.6	5.2	5.3	4.9	4.9
84	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.3	5.8	5.9	6.0	3.3	6.4	4.4	4.6	5.2	5.3	4.9
85	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	5.9	6.0	6.1	3.3	6.4	4.4	4.6	5.2	5.3
86	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	6.0	6.1	6.1	3.3	6.4	4.4	4.6	5.2
87	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	6.1	6.1	6.1	3.3	6.4	4.4	4.6
88	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	6.1	6.1	6.1	3.3	6.4	4.4
89	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	6.1	6.1	6.1	3.3	6.4
90	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	6.1	6.1	6.1	3.3
91	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	6.1	6.1	6.1
92	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	6.1	6.1
93	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	6.1
94	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
95	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
96	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
97	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
98	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
99	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
2000	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6

A-Represents new model year production beginning Oct. 1 of inventory year.

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DETAIL ON GENERATION OF EMFAC3 EXHAUST EMISSION RATE FILE FOR LIGHT-DUTY TRUCKS

General

Exhaust emission rates for light-duty trucks were more difficult to develop for two reasons:

1. A redefinition of classification from a limit of 6000-lb. G.V.W. to 8500-lb G.V.W., and

2. A difference in emission standards and methods of estimating for post-1974 light-duty trucks.

Pre-1975 light-duty truck exhaust emission rates were developed by applying the following relationship:

$$\text{LDT Calif.} = \text{LDT Supp.5} \times \frac{\text{LDA Calif.}}{\text{LDA Low Altitude Supp.5}}$$

where:

LDT Calif. = Light-Duty Truck Emission Rate for California (CO, HC, NO_x)

LDT Supp.5 = Light-Duty Truck Emission Rate as presented in Supplement 5 (CO, HC, NO_x)

LDA Calif. = Light-Duty Auto Emission Rate for California (CO, HC, NO_x)

LDA Low Altitude = Light-Duty Auto Emission Rate for Non-California, Low Altitude, as presented in Supplement 5 (CO, HC, NO_x)

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The 1975 light-duty truck HC and CO exhaust emission rates were assumed equivalent to values presented in Supplement 5. The 1975 light-duty truck NO_x exhaust emission rates were developed by assuming the 2.0 grams/mile NO_x deterioration rate schedule identified in Table D.1-28 of Supplement 5, and weighting this value 2/3 LDT (catalytic) and 1/3 HDT-gasoline (noncatalytic).

Post-1975 light-duty trucks are assumed to meet California emission standards of 0.9 CO, 17.0 HC, and 2.0 NO_x grams/mile. These standards are approximated by assuming the deterioration rate schedules for standards of 0.9 CO, 15.0 HC, and 2.0 NO_x grams/mile as defined in Table D.1-28 of Supplement 5.

The gross-vehicle-weight redefinition was considered for 1976 and 1977 light-duty trucks by weighting the 0.9 CO, 15.0 HC, and 2.0 NO_x grams/mile values 2/3 and the appropriate HDT-gasoline values 1/3. Post-1977 light-duty trucks are all considered to meet the 0.9 CO, 15.0 HC, and 2.0 NO_x grams/mile exhaust emission standard and no weighting was necessary.

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TABLE 7

EXHAUST EMISSION RATES

EMFAC3

Heavy-Duty Trucks-Gas (HDG) - CO Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Calendar Year	Vehicle Age, Years 0A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65		238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
66		238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
67		238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
68		238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
69		238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
70		188	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
71		188	188	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
72		188	188	188	238	238	238	238	238	238	238	238	238	238	238	238	238	238
73		188	188	188	188	238	238	238	238	238	238	238	238	238	238	238	238	238
74		167	188	188	188	188	238	238	238	238	238	238	238	238	238	238	238	238
75		152	168	188	188	188	188	238	238	238	238	238	238	238	238	238	238	238
76		152	153	169	188	188	188	188	238	238	238	238	238	238	238	238	238	238
77		152	153	154	170	188	188	188	188	238	238	238	238	238	238	238	238	238
78		117	153	154	155	171	188	188	188	188	238	238	238	238	238	238	238	238
79		117	118	154	155	156	172	188	188	188	188	238	238	238	238	238	238	238
80		117	118	119	155	156	156	173	188	188	188	188	238	238	238	238	238	238
81		117	118	119	120	156	156	157	174	188	188	188	188	238	238	238	238	238
82		117	118	119	120	121	156	157	158	175	188	188	188	188	238	238	238	238
83		117	118	119	120	121	122	157	158	159	176	188	188	188	188	238	238	238
84		117	118	119	120	121	122	123	158	159	160	176	188	188	188	188	238	238
85		117	118	119	120	121	122	123	124	159	160	160	176	188	188	188	188	238
86		117	118	119	120	121	122	123	124	125	160	160	160	176	188	188	188	188
87		117	118	119	120	121	122	123	124	125	126	160	160	160	176	188	188	188
88		117	118	119	120	121	122	123	124	125	126	126	160	160	160	176	188	188
89		117	118	119	120	121	122	123	124	125	126	126	126	160	160	160	176	188
90		117	118	119	120	121	122	123	124	125	126	126	126	126	160	160	160	176
91		117	118	119	120	121	122	123	124	125	126	126	126	126	126	160	160	160
92		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	160	160
93		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	160
94		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	126
95		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	126
96		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	126
97		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	126
98		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	126
99		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	126
2000		117	118	119	120	121	122	123	124	125	126	126	126	126	126	126	126	126

A-Represents new model year production beginning Oct. 1 of inventory year.

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TABLE 8

EXHAUST EMISSION RATES

EMFAC3

Heavy-Duty Trucks-Gas (HDG) - HC Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Calendar Year	Vehicle Age, Years 0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
66	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
67	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
68	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
69	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
70	13.6	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
71	13.6	13.7	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
72	13.6	13.7	13.8	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
73	13.6	13.7	13.8	13.9	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
74	13.1	13.7	13.8	13.9	14.0	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
75	6.0	13.2	13.8	13.9	14.0	14.1	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
76	6.0	6.0	13.3	13.9	14.0	14.1	14.2	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
77	6.0	6.0	6.1	13.4	14.0	14.1	14.2	14.3	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
78	6.0	6.0	6.1	6.1	13.5	14.1	14.2	14.3	14.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
79	6.0	6.0	6.1	6.1	6.1	13.6	14.2	14.3	14.4	14.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
80	6.0	6.0	6.1	6.1	6.1	6.1	13.7	14.3	14.4	14.4	14.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
81	6.0	6.0	6.1	6.1	6.1	6.1	6.2	13.8	14.4	14.4	14.4	14.4	35.4	35.4	35.4	35.4	35.4	35.4
82	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	13.9	14.4	14.4	14.4	14.4	35.4	35.4	35.4	35.4	35.4
83	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	14.0	14.4	14.4	14.4	14.4	35.4	35.4	35.4	35.4
84	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	14.0	14.4	14.4	14.4	14.4	35.4	35.4	35.4
85	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	14.0	14.4	14.4	14.4	14.4	35.4	35.4
86	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	14.0	14.4	14.4	14.4	14.4	14.4
87	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	14.0	14.4	14.4	14.4	14.4
88	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	14.0	14.4	14.4	14.4
89	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	14.0	14.4	14.4
90	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	14.0	14.0
91	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
92	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
93	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
94	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
95	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
96	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
97	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
98	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
99	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3
2000	6.0	6.0	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3

A-Represents new model year production beginning Oct. 1 of inventory year.

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TABLE 9

EXHAUST EMISSION RATES

EMFAC3

Heavy-Duty Trucks-Gas (HDG) - NO_x Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Calendar Year	Vehicle Age, Years																	
	0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
66		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
67		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
68		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
69		6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
70		12.5	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
71		12.5	12.6	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
72		12.5	12.6	12.6	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
73		12.5	12.6	12.6	12.7	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
74		12.5	12.6	12.6	12.7	12.7	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
75		11.4	12.6	12.6	12.7	12.7	12.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
76		11.4	11.6	12.6	12.7	12.7	12.8	12.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
77		11.4	11.6	11.8	12.7	12.7	12.8	12.8	12.9	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
78		11.4	11.6	11.8	12.0	12.7	12.8	12.8	12.9	13.0	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
79		11.4	11.6	11.8	12.0	12.2	12.8	12.8	12.9	13.0	13.0	6.8	6.8	6.8	6.8	6.8	6.8	6.8
80		11.4	11.6	11.8	12.0	12.2	12.4	12.8	12.9	13.0	13.0	13.0	6.8	6.8	6.8	6.8	6.8	6.8
81		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.9	13.0	13.0	13.0	13.0	6.8	6.8	6.8	6.8	6.8
82		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	6.8	6.8	6.8	6.8
83		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	6.8	6.8	6.8
84		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	6.8	6.8
85		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	6.8
86		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
87		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
88		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
89		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
90		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
91		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
92		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
93		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
94		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
95		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
96		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
97		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
98		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
99		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
2000		11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0

A-Represents new model year production beginning Oct. 1 of inventory year.

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DETAIL ON GENERATION OF EMFAC3 EXHAUST EMISSION RATE FILE FOR HEAVY-DUTY GASOLINE TRUCKS

NO_x

1. All pre-1970 heavy-duty gasoline trucks have an NO_x exhaust emission rate of 6.8 grams/mile.

2. All 1970-through 1974 heavy-duty gasoline trucks have the following NO_x exhaust emission rates:

	Vehicle Age, Years									
	1	2	3	4	5	6	7	8	9	10+
NO_x (gm/mi)	12.5	12.6	12.6	12.7	12.7	12.8	12.8	12.9	12.9	13.0

3. All post-1974 heavy-duty gasoline trucks have the following NO_x exhaust emission rates:

	Vehicle Age, Years								
	1	2	3	4	5	6	7	8	9+
NO_x (gm/mi)	11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0

HC

1. All pre-1970 heavy-duty gasoline trucks have a HC exhaust emission rate of 35.4 gram/mile.

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2. 1970 through 1973 heavy-duty gasoline trucks have the following HC exhaust emission rates:

	Vehicle Age, Years								
	1	2	3	4	5	6	7	8	9+
HC (gm/mi)	13.6	13.7	13.8	13.9	14.0	14.1	14.2	14.3	14.4

3. 1974 heavy-duty gasoline trucks have the following HC exhaust emission rates:

	Vehicle Age, Years									
	1	2	3	4	5	6	7	8	9	10+
HC (gm/mi)	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	14.0

4. All post-1974 heavy-duty gasoline trucks have the following HC exhaust emission rates:

	Vehicle Age, Years											
	1	2	3	4	5	6	7	8	9	10	11	12+
HC (gm/mi)	6.0	6.0	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.3

CO

1. All pre-1970 heavy-duty gasoline trucks have a CO exhaust emission rate of 238 grams/mile.

2. All 1970 through 1973 heavy-duty gasoline trucks have a CO exhaust emission rate of 188 grams/mile.

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3. 1974 heavy-duty gasoline trucks have the following CO exhaust emission rate:

	Vehicle Age, Years									
	1	2	3	4	5	6	7	8	9	10+
CO (gm/mi)	167	168	169	170	171	172	173	174	175	176

4. 1975 through 1977 heavy-duty gasoline trucks have the same deterioration rate but have 9 percent lower CO exhaust emissions. The rates are:

	Vehicle Age, Years									
	1	2	3	4	5	6	7	8	9	10+
CO (gm/mi)	152	153	154	155	156	157	157	158	159	160

5. All post-1977 heavy-duty gasoline trucks have the following exhaust emission rates:

	Vehicle Age, Years									
	1	2	3	4	5	6	7	8	9	10+
CO (gm/mi)	117	118	119	120	121	122	123	124	125	126

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TABLE 10

EXHAUST EMISSION RATES

EMFAC3

Heavy-Duty Diesel (HDD) - NO_x Emission Rates, (g/mi)
AP 42, Supplement 5 Emission Factors
Deterioration Rates Included
FTP @ 19.6 mph

Vehicle Age, Years

Calendar Year	0[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
65		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
66		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
67		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
68		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
69		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
70		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
71		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
72		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
73		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
74		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
75		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
76		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
77		20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
78		18.1	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
79		18.1	19.0	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
80		18.1	19.0	19.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
81		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
82		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
83		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
84		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
85		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
86		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
87		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
88		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
89		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
90		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
91		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
92		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
93		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
94		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
95		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
96		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
97		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
98		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
99		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
2000		18.1	19.0	19.9	20.8	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9

A-Represents new model year production beginning Oct. 1 of inventory year.

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DETAIL OF GENERATION OF EMFAC3 EXHAUST EMISSION RATE FILE FOR HEAVY-DUTY DIESEL TRUCKS

NO_x

1. All pre-1978 heavy-duty diesel trucks have an NO_x exhaust emission rate of 20.9 grams/mile.

2. All post-1977 heavy-duty diesel trucks have the following NO_x exhaust emission rates:

	Vehicle Age, Years				
	1	2	3	4	5+
NO_x (gm/mi)	18.1	19.0	19.9	20.8	20.9

HC

1. All heavy-duty diesel trucks have a HC exhaust emission rate of 5.2 grams/mile.

CO

1. All heavy-duty diesel trucks have a CO exhaust emission rate of 28.7 grams/mile.

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WEIGHTED ANNUAL TRAVEL DISTRIBUTIONS BY VEHICLE TYPE

The weighted annual travel (m_{in}) distributions used in EMFAC3 were provided by the ARB's Emission Inventory Unit, and are the same as was used in EMFAC2. Tables 11 through 18 show the distributions used in EMFAC3 for each vehicle type. Each distribution reflects a smooth curve drawn through 1973 distributions calculated by the ARB. The distributions shown in Tables 11 through 18 are used for all inventory years.

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TABLE 11

WEIGHTED ANNUAL TRAVEL
FOR
LIGHT-DUTY AUTOS (100%)

Nominal Age (Years)	Model Year		Distribution Factor (Mileage Weighted Each Year) (Population Mileage)
0		n+1	0.0101
1	Inventory Year	n	0.1667
2		n-1	0.1755
3		n-2	0.1411
4		n-3	0.1183
5		n-4	0.0992
6		n-5	0.0851
7		n-6	0.0690
8		n-7	0.0521
9		n-8	0.0357
10		n-9	0.0215
11		n-10	0.0060
12		n-11	0.0048
13		n-12	0.0039
14		n-13	0.0030
15		n-14	0.0020
16		n-15	0.0009
≥17		n-16	0.0049

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TABLE 12

WEIGHTED ANNUAL TRAVEL FOR LIGHT-DUTY AUTOS

Nominal Age (Years)	Average Age at End of Inventory Year (Years)	Fraction[1] of Total Vehicles In Use (1)	Average[2] Annual Mileage (2)	(1) X (2) (3)	(3) ÷ 8367 Fraction of Vehicle Miles Travelled
0	.125	.0035	24,208	84.7	0.0101
1	.75	.0794	17,564	1395.0	0.1667
2	1.75	.1047	14,022	1468.0	0.1755
3	2.75	.1003	11,774	1181.0	0.1411
4	3.75	.0958	10,334	990.0	0.1183
5	4.75	.0889	9,341	830.0	0.0992
6	5.75	.0838	8,492	712.0	0.0851
7	6.75	.0764	7,561	578.0	0.0690
8	7.75	.0679	6,418	436.0	0.0521
9	8.75	.0595	5,025	299.0	0.0357
10	9.75	.0520	3,464	180.0	0.0215
11	10.75	.0439	1,140	50.0	0.0060
12	11.75	.0355	1.140	40.5	0.0048
13	12.75	.0287	1,140	32.7	0.0039
14	13.75	.0221	1,140	25.2	0.0030
15	14.75	.0146	1,140	16.6	0.0020
16	15.75	.0069	1,140	7.87	0.0009
≥17	≥16.75	.0360	1,140	41.0	0.0049
	Total	1.0000		8367.0	1.0000

1/ Internal ARB report "Total Number of Motor Vehicles in Use and Distribution According to Model Year", Division of Implementation and Enforcement, January, 1975.

2/ Based on ARB study of "Periodic Vehicle Inspection, Semi-Annual Report 5" California Highway Patrol, December 5, 1972, and April 12, 1973.

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TABLE 13

WEIGHTED ANNUAL TRAVEL
FOR
LIGHT-DUTY TRUCKS (100%)

Nominal Age (Years)	Model Year		Distribution Factor (Mileage Weighted Each Year) (Population Mileage)
0		n+1	0.0106
1	Inventory Year	n	0.1908
2		n-1	0.1861
3		n-2	0.1417
4		n-3	0.1129
5		n-4	0.0915
6		n-5	0.0790
7		n-6	0.0584
8		n-7	0.0438
9		n-8	0.0304
10		n-9	0.0178
11		n-10	0.0050
12		n-11	0.0044
13		n-12	0.0037
14		n-13	0.0032
15		n-14	0.0026
16		n-15	0.0021
≥17		n-16	0.0159

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TABLE 14

WEIGHTED ANNUAL TRAVEL FOR LIGHT-DUTY TRUCKS

Nominal Age (Years)	Average Age At End Of Inventory Year (Years)	Fraction[1] of Total Vehicles In Use (1)	Average[2] Annual Mileage (2)	(1) X (2) (3)	(3) ÷ 8016 Fraction of Vehicle Miles Travelled
0	.125	.0035	24,208	84.7	0.0106
1	.75	.0871	17,564	1530.0	0.1908
2	1.75	.1064	14,022	1492.0	0.1861
3	2.75	.0965	11,774	1136.0	0.1417
4	3.75	.0876	10,334	905.0	0.1129
5	4.75	.0785	9,341	733.0	0.0915
6	5.75	.0746	8,492	634.0	0.0790
7	6.75	.0619	7,561	468.0	0.0584
8	7.75	.0547	6,418	351.0	0.0438
9	8.75	.0485	5,025	244.0	0.0304
10	9.75	.0413	3,464	143.0	0.0178
11	10.75	.0353	1,140	40.2	0.0050
12	11.75	.0309	1,140	35.2	0.0044
13	12.75	.0260	1,140	29.6	0.0037
14	13.75	.0223	1,140	25.4	0.0032
15	14.75	.0186	1,140	21.2	0.0026
16	15.75	.0148	1,140	16.9	0.0021
≥17	≥16.75	.1116	1,140	127.0	0.0159
	Total	1.0000		8016.0	1.0000

1/ Internal ARB report, "Total Number of Motor Vehicles in Use and Distribution According to Model Year", Division of Implementation and Enforcement, January, 1975.

2/ Based on ARB study of data, "Periodic Vehichle Inspection, Semi-Annual Report 5", California Highway Patrol, December 5, 1972, and April 12, 1973.

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TABLE 15

WEIGHTED ANNUAL TRAVEL
FOR
HEAVY-DUTY GAS TRUCKS (100%)

Nominal Age (Years)	Model Year	Distribution Factor (Mileage Weighted each Year) (Population Mileage)
0	n+1	0
1	Inventory Year n	0.0552
2	n-1	0.1102
3	n-2	0.1007
4	n-3	0.1007
5	n-4	0.0832
6	n-5	0.0818
7	n-6	0.0613
8	n-7	0.0603
9	n-8	0.0507
10	n-9	0.0481
11	n-10	0.0329
12	n-11	0.0303
13	n-12	0.0258
14	n-13	0.0219
15	n-14	0.0180
16	n-15	0.0148
≥17	n-16	0.1044

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TABLE 16

WEIGHTED ANNUAL TRAVEL FOR HEAVY-DUTY GAS TRUCKS

Nominal Age (Years)	Average Age At End Of Inventory Year (Years)	Fraction[1/] of Total Vehicles In Use (1)	Average[2/] Annual Mileage (2)	(1) X (2) (3)	(3) ÷ 11820 Fraction of Vehicle Miles Travelled
0	0	.0000	0	0	0
1	.5	.0331	19,700	652	.0552
2	1.5	.0661	19,700	1,302	.1102
3	2.5	.0661	18,000	1,190	.1007
4	3.5	.0661	18,000	1,190	.1007
5	4.5	.0651	15,100	983	.0832
6	5.5	.0640	15,100	966	.0818
7	6.5	.0630	11,500	725	.0613
8	7.5	.0620	11,500	713	.0603
9	8.5	.0599	10,000	599	.0507
10	9.5	.0568	10,000	568	.0481
11	10.5	.0527	7,370	388	.0329
12	11.5	.0486	7,370	358	.0303
13	12.5	.0413	7,370	304	.0258
14	13.5	.0351	7,370	259	.0219
15	14.5	.0289	7,370	213	.0180
16	15.5	.0238	7,370	175	.0148
≥17	≥16.5	.1674	7,370	1,234	.1044
	Total	1.0000		11,820	1.0000

1/ Internal ARB report "Total Number of Motor Vehicles in Use and Distribution According to Model Year", Division of Implementation and Enforcement, January 15, 1975.

2/ Based on study of "1972 Census of Transportation, Truck Inventory and Use Survey", U.S. Bureau of the Census, May, 1973.

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TABLE 17

WEIGHTED ANNUAL TRAVEL
FOR
HEAVY-DUTY DIESEL TRUCKS (100%)

Nominal Age (Years)	Model Year	Distribution Factor (Mileage Weighted each Year) (Population Mileage)
0	n+1	0
1	Inventory Year n	0.0763
2	n-1	0.1495
3	n-2	0.1312
4	n-3	0.1242
5	n-4	0.0968
6	n-5	0.0897
7	n-6	0.0627
8	n-7	0.0564
9	n-8	0.0446
10	n-9	0.0391
11	n-10	0.0248
12	n-11	0.0208
13	n-12	0.0173
14	n-13	0.0133
15	n-14	0.0092
16	n-15	0.0046
>17	n-16	0.0398

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TABLE 18

WEIGHTED ANNUAL TRAVEL FOR HEAVY-DUTY DIESEL TRUCKS

Nominal Age (Years)	Average Age At End Of Inventory Year (Years)	Fraction[1] of Total Vehicle In Use (1)	Average[2] Annual Mileage (2)	(1) X (2) (3)	(3) ÷ 53,685 Fraction of Vehicle Miles Travelled
0	0	.0000	0	0	0
1	.5	.0521	78,600	4,095	.0763
2	1.5	.1021	78,600	8,025	.1495
3	2.5	.0978	72,000	7,042	.1312
4	3.5	.0926	72,000	6,667	.1242
5	4.5	.0863	60,200	5,195	.0968
6	5.5	.0800	60,200	4,816	.0897
7	6.5	.0736	45,700	3,364	.0627
8	7.5	.0663	45,700	3,030	.0564
9	8.5	.0600	39,900	2,394	.0446
10	9.5	.0526	39,900	2,099	.0391
11	10.5	.0452	29,400	1,329	.0248
12	11.5	.0379	29,400	1,114	.0208
13	12.5	.0316	29,400	929	.0173
14	13.5	.0242	29,400	711	.0133
15	14.5	.0168	29,400	494	.0092
16	15.5	.0084	29,400	247	.0046
≥17	≥16.5	.0726	29,400	2,134	.0398
	Total	1.0000		53,685	1.0000

1/ Internal ARB report "Total Number of Motor Vehicles in Use and Distribution According to Model Year", Division of Implementation and Enforcement, January 15, 1975.

2/ Based on study of "1972 Census of Transportation, Truck Inventory and Use Survey", U.S. Bureau of the Census, May, 1973.

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SPEED CORRECTION FACTORS

The speed correction factors (v_{ips}) used in EMFAC3 were taken directly from Supplement 5 except as noted for the individual vehicle types.

Tables 19 through 31 present the equations and methods for calculationg speed correction factors. Tables 32 through 41 present the pre-calculated speed correction factors, v_{ips}.

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TABLE 19

LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK
SPEED CORRECTION REGRESSION EQUATIONS
FOR CARBON MONOXIDE

$$v_{ips} = e^{[A + B(S) + C(S^2)]}$$

$$\text{Ln } v_{ips} = A + B(S) + C(S^2)$$

Where: v_{ips} = the speed correction factor the ith model year, pollutant (p), and speed (s),

Ln v_{ips} = the natural logarithm of the speed correction factor as it is used in Equation (1) to calculate e_{npstwx},

A,B & C are regression coefficients, and

S = average route speed in miles per hour.

REGRESSION COEFFICIENTS

Model Year Vehicle	A	B	C
Pre-1966	0.967	-6.07×10^{-2}	5.78×10^{-4}
1966-1967	0.981	-6.22×10^{-2}	6.19×10^{-4}
1968	1.047	-6.52×10^{-2}	6.01×10^{-4}
1969	1.259	-7.72×10^{-2}	6.60×10^{-4}
1970	1.267	-7.72×10^{-2}	6.40×10^{-4}
Post-1970	1.241	-7.52×10^{-2}	6.09×10^{-4}

The above equation should not be extended beyond the speed range of 15 through 45 mph. For speed correction factors at low speeds, 5 and 10 mph, see the following, Table 20.

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TABLE 20

LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK
LOW AVERAGE SPEED CORRECTION FACTORS
FOR CARBON MONOXIDE

Model Year Vehicle	v_{ips} 5 mph	v_{ips} 10 mph
Pre-1966	2.72	1.57
1966-1967	1.79	1.00
1968	3.06	1.75
1969	3.57	1.86
1970	3.60	1.88
Post-1970	4.15	2.23

For convenience, intermediate values for v_{ips}, between 5 and 10 mph, and 10 and 15 mph, have been interpolated with a best-fit equation and are included in EMFAC3 data file. This provides v_{ips} values for the entire speed range of 5 mph through 45 mph, the limits of data.

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TABLE 21

LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK
SPEED CORRECTION REGRESSION EQUATIONS
FOR EXHAUST HYDROCARBONS

$$v_{ips} = e^{[A + B(S) + C(S^2)]}$$

$$\text{Ln } v_{ips} = A + B(S) + C(S^2)$$

Where: v_{ips} = the speed correction factor for the ith model year, pollutant (p), and speed (s),

$\text{Ln } v_{ips}$ = the natural logarithm of the speed correction factor as it is used in Equation (1) to calculate e_{npstwx},

A,B & C are regression coefficients and

S = average route speed in miles per hour.

REGRESSION COEFFICIENTS

Model Year Vehicle	A	B	C
Pre-1966	0.953	-6.00×10^{-2}	5.81×10^{-4}
1966-1967	0.957	-5.98×10^{-2}	5.63×10^{-4}
1968	1.070	-6.63×10^{-2}	5.98×10^{-4}
1969	1.005	-6.27×10^{-2}	5.80×10^{-4}
1970	0.901	-5.70×10^{-2}	5.59×10^{-4}
Post-1970	0.943	-5.92×10^{-2}	5.67×10^{-4}

The above equation should not be extended beyond the speed range of 15 through 45 mph. For speed correction factors at low speeds, 5 and 10 mph, see the following, Table 22.

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TABLE 22

LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK
LOW AVERAGE SPEED CORRECTION FACTORS
FOR EXHAUST HYDROCARBONS

Model Year Vehicle	v_{ips} 5 mph	v_{ips} 10 mph
Pre-1966	2.50	1.45
1966-1967	1.87	1.12
1968	2.96	1.66
1969	2.95	1.65
1970	2.51	1.51
Post-1970	2.75	1.63

For convenience, intermediate values for v_{ips}, between 5 and 10 mph, and 10 and 15 mph, have been interpolated with a best-fit equation and are included in EMFAC3 data file. This provides v_{ips} values for the entire speed range of 5 mph through 45 mph, the limits of data.

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TABLE 23

LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK SPEED CORRECTION REGRESSION EQUATIONS FOR NITROGEN OXIDES

$$v_{ips} = A + BS$$

Where: v_{ips} = the speed correction factor for the ith model year, pollutant (p), and speed (s), as it is used in Equation (1) to calculate e_{npstwx},

A & B are regression coefficients, and

S = average route speed in miles per hour.

REGRESSION COEFFICIENTS

Model Year Vehicle	A	B
Pre-1966	0.808	0.980×10^{-2}
1966-1967	0.844	0.798×10^{-2}
1968	0.888	0.569×10^{-2}
1969	0.915	0.432×10^{-2}
1970	0.843	0.798×10^{-2}
Post-1970	0.843	0.804×10^{-2}

The above equation should not be extended beyond the speed range of 15 through 45 mph. For speed correction factors at low speeds, 5 and 10 mph, see the following, Table 24.

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TABLE 24

LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK
LOW AVERAGE SPEED CORRECTION FACTORS
FOR NITROGEN OXIDES

Model Year Vehicle	v_{ips} 5 mph	v_{ips} 10 mph
Pre-1966	1.08	1.03
1966-1967	1.16	1.09
1968	1.04	1.00
1969	1.08	1.05
1970	1.13	1.05
Post-1970	1.15	1.03

For convenience, intermediate values for v_{ips}, between 5 and 10 mph, and 10 and 15 mph, have been interpolated with a best-fit equation and are included in EMFAC3 data file. This provides v_{ips} values for the entire speed range of 5 mph through 45 mph, the limits of data.

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TABLE 25

HEAVY-DUTY GASOLINE TRUCK
SPEED CORRECTION REGRESSION EQUATIONS
FOR CARBON MONOXIDE

$$v_{ips} = e^{[A + B(S) + C(S^2)]}$$

$$\text{Ln } v_{ips} = A + B(S) + C(S^2)$$

Where: v_{ips} = the speed correction factor for the ith model year, pollutant (p), and speed (s),

Ln v_{ips} = the natural logarithm of the speed correction factor as it is used in Equation (1) to calculate e_{npstwx},

A,B & C are regression coefficients, and

S = average route speed in miles per hour.

REGRESSION COEFFICIENTS

Model Year Truck	A	B	C
Pre-1970	0.967	-6.07×10^{-2}	5.78×10^{-4}
Post-1969	1.047	-6.52×10^{-2}	6.01×10^{-4}

The above equation should not be extended beyond the speed range of 15 through 45 mph. For speed correction factors at low speeds, 5 mph and 10 mph, see the following, Table 26.

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TABLE 26

HEAVY-DUTY GASOLINE TRUCK
LOW AVERAGE SPEED CORRECTION FACTORS
FOR CARBON MONOXIDE

Model Year Truck	v_{ips} 5 mph	v_{ips} 10 mph
Pre-1970	2.72	1.57
Post-1969	3.06	1.75

For convenience, intermediate values for v_{ips}, between 5 and 10 mph, and 10 and 15 mph, have been interpolated with a best-fit equation and are included in EMFAC3 data file. This provides v_{ips} values for the entire speed range of 5 mph through 45 mph, the limits of data.

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TABLE 27

HEAVY-DUTY GASOLINE TRUCK
SPEED CORRECTION REGRESSION EQUATIONS
FOR EXHAUST HYDROCARBONS

$$v_{ips} = e^{[A + B(S) + C(S^2)]}$$

$$\text{Ln } v_{ips} = A + B(S) + C(S^2)$$

Where: v_{ips} = the speed correction factor for the ith model year, pollutant (p), and speed (s),

Ln v_{ips} = the natural logarithm of the speed correction factor as it is used in Equation (1) to calculate e_{npstwx},

A,B & C are regression coefficients, and

S = average route speed in miles per hour.

REGRESSION COEFFICIENTS

Model Year Truck	A	B	C
Pre-1970	0.953	-6.00×10^{-2}	5.81×10^{-4}
Post-1969	1.070	-6.63×10^{-2}	5.98×10^{-4}

The above equation should not be extended beyond the speed range of 15 through 45 mph. For speed correction factors at low speeds, 5 mph and 10 mph, see the following, Table 28.

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TABLE 28

HEAVY-DUTY GASOLINE TRUCK
LOW AVERAGE SPEED CORRECTION FACTORS
FOR EXHAUST HYDROCARBONS

Model Year Truck	v_{ips} 5 mph	v_{ips} 10 mph
Pre-1970	2.50	1.45
Post-1969	2.96	1.66

For convenience, intermediate values for v_{ips}, between 5 and 10 mph, and 10 and 15 mph, have been interpolated with a best-fit equation and are included in EMFAC3 data file. This provides v_{ips} values for the entire speed range of 5 mph through 45 mph, the limits of data.

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TABLE 29

HEAVY-DUTY GASOLINE TRUCK
SPEED CORRECTION REGRESSION EQUATIONS
FOR NITROGEN OXIDES

$$v_{ips} = A + B(S)$$

Where: v_{ips} = the speed correction factor for the ith model year, pollutant (p), and speed (s), as it is used in Equation (1) to calculate e_{nsptwx},

A & B are regression coefficients, and

S = average route speed in miles per hour.

REGRESSION COEFFICIENTS

Model Year Truck	A	B
Pre-1970	0.808	0.980×10^{-2}
Post-1969	0.888	0.569×10^{-2}

The above equation should not be extended beyond the speed range of 15 through 45 mph. For speed correction factors at low speeds, 5 mph and 10 mph, see the following, Table 30.

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TABLE 30

HEAVY-DUTY GASOLINE TRUCK
LOW AVERAGE SPEED CORRECTION FACTORS
FOR NITROGEN OXIDES

Model Year Truck	v_{ips} 5 mph	v_{ips} 10 mph
Pre-1970	1.08	1.03
Post-1969	1.04	1.00

For convenience, intermediate values for v_{ips}, between 5 and 10 mph, and 10 and 15 mph, have been interpolated with a best-fit equation and are included in EMFAC3 data file. This provides v_{ips} values for the entire speed range of 5 mph through 45 mph, the limits of data.

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HEAVY-DUTY DIESEL TRUCK SPEED CORRECTION EQUATIONS

The speed correction factor v_{ips}, can be calculated using data below. Table 31 below lists heavy-duty diesel CO, HC, and NO_x exhaust emission factors in grams per minute for, idle mode, an urban transient mode with average speed of 18 mph, and an over-the-road mode with an average speed of approximately 60 mph. Even though the units used are grams/minute instead of grams/mile, it is of no consequence since v_{ips} is unitless.

For average speeds less than 18 mph, the equation for the speed correction factors is:

$$v_{ips} = \frac{\text{Urban} + (\frac{18}{S} - 1)\ \text{Idle}}{\text{Urban}}$$

where: S, is the average speed in mph, and the urban and idle values in grams/minute are obtained from Table 31.

For average speeds above 18 mph, the equation for the speed correction factors is:

$$v_{ips} = \frac{\frac{18}{42S}\ [(60-S)\text{Urban} + (S-18)\ \text{Over the Road}]}{\text{Urban}}$$

where: S, is the average speed in mph, and the urban and over-the-road values in grams/minute are obtained from Table 31. Emission factors for heavy-duty diesel trucks assume all operation to be under warmed-up operating conditions. Temperature correction factors, therefore, are not included because ambient temperature has minimal effect on warmed-up operation.

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TABLE 31

EMISSION FACTORS FOR HEAVY-DUTY DIESEL TRUCKS
UNDER DIFFERENT OPERATING CONDITIONS

Pollutant	Emission Factors, Gram/Minute		
	Idle	Urban (18 mph)	Over-The-Road (60 mph)
Carbon Monoxide	0.64	8.61	5.40
Hydrocarbons	0.32	1.38	2.25
Nitrogen Oxides (NO_x as NO_2)	1.03	6.27	28.3

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TABLE 32

SPEED CORRECTION FACTORS FOR LIGHT-DUTY AUTOS & LIGHT-DUTY TRUCKS
FOR LOW ELEVATION
PRE-1966 MODEL YEARS

SPEED	HC	CO	NOX
5	2.488	2.718	1.084
6	2.158	2.338	1.072
7	1.922	2.067	1.059
8	1.745	1.863	1.047
9	1.607	1.705	1.035
10	1.497	1.578	1.022
11	1.407	1.475	1.009
12	1.332	1.389	.997
13	1.268	1.315	.984
14	1.214	1.253	.972
15	1.202	1.205	.955
16	1.152	1.155	.965
17	1.106	1.108	.975
18	1.063	1.064	.984
19	1.023	1.023	.994
20	.986	.984	1.004
21	.950	.949	1.014
22	.918	.915	1.024
23	.887	.884	1.033
24	.859	.855	1.043
25	.832	.828	1.053
26	.807	.802	1.063
27	.784	.778	1.073
28	.762	.756	1.082
29	.742	.736	1.092
30	.723	.716	1.102
31	.706	.698	1.112
32	.689	.681	1.122
33	.674	.666	1.131
34	.660	.651	1.141
35	.647	.638	1.151
36	.635	.626	1.161
37	.624	.614	1.171
38	.614	.604	1.180
39	.605	.594	1.190
40	.596	.585	1.200
41	.588	.577	1.210
42	.582	.570	1.220
43	.575	.563	1.229
44	.570	.557	1.239
45	.565	.552	1.249

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TABLE 33

SPEED CORRECTION FACTORS FOR LIGHT-DUTY AUTOS & LIGHT-DUTY TRUCKS
FOR LOW ELEVATION
1966 MODEL YEAR

SPEED	HC	CO	NOX
5	1.831	1.735	1.169
6	1.646	1.562	1.149
7	1.513	1.439	1.130
8	1.414	1.346	1.110
9	1.337	1.274	1.091
10	1.275	1.216	1.071
11	1.224	1.169	1.051
12	1.182	1.130	1.032
13	1.146	1.096	1.012
14	1.116	1.068	.993
15	1.205	1.206	.964
16	1.155	1.155	.972
17	1.109	1.108	.980
18	1.065	1.064	.988
19	1.024	1.023	.996
20	.986	.985	1.004
21	.951	.949	1.012
22	.917	.916	1.020
23	.886	.885	1.028
24	.857	.856	1.036
25	.830	.829	1.043
26	.805	.804	1.051
27	.781	.781	1.059
28	.759	.759	1.067
29	.738	.739	1.075
30	.719	.720	1.083
31	.701	.703	1.091
32	.684	.687	1.099
33	.668	.672	1.107
34	.654	.658	1.115
35	.640	.646	1.123
36	.627	.634	1.131
37	.616	.623	1.139
38	.605	.613	1.147
39	.595	.605	1.155
40	.586	.597	1.163
41	.578	.589	1.171
42	.570	.583	1.179
43	.564	.577	1.187
44	.558	.573	1.195
45	.552	.569	1.203

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TABLE 34

SPEED CORRECTION FACTORS FOR LIGHT-DUTY AUTOS & LIGHT-DUTY TRUCKS
FOR LOW ELEVATION
1967 MODEL YEAR

SPEED	HC	CO	NOX
5	1.831	1.735	1.169
6	1.646	1.562	1.149
7	1.513	1.439	1.130
8	1.414	1.346	1.110
9	1.337	1.274	1.091
10	1.275	1.216	1.071
11	1.224	1.169	1.051
12	1.182	1.130	1.032
13	1.146	1.096	1.012
14	1.116	1.068	.993
15	1.205	1.206	.964
16	1.155	1.155	.972
17	1.109	1.108	.980
18	1.065	1.064	.988
19	1.024	1.023	.996
20	.986	.985	1.004
21	.951	.949	1.012
22	.917	.916	1.020
23	.886	.885	1.028
24	.857	.856	1.036
25	.830	.829	1.043
26	.805	.804	1.051
27	.781	.781	1.059
28	.759	.759	1.067
29	.738	.739	1.075
30	.719	.720	1.083
31	.701	.703	1.091
32	.684	.687	1.099
33	.668	.672	1.107
34	.654	.658	1.115
35	.640	.646	1.123
36	.627	.634	1.131
37	.616	.623	1.139
38	.605	.613	1.147
39	.595	.605	1.155
40	.586	.597	1.163
41	.578	.589	1.171
42	.570	.583	1.179
43	.564	.577	1.187
44	.558	.573	1.195
45	.552	.569	1.203

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TABLE 35

SPEED CORRECTION FACTORS FOR LIGHT-DUTY AUTOS & LIGHT-DUTY TRUCKS
FOR LOW ELEVATION
1968 MODEL YEAR

SPEED	HC	CO	NOX
5	2.960	3.070	1.038
6	2.528	2.616	1.031
7	2.219	2.293	1.024
8	1.988	2.050	1.017
9	1.808	1.861	1.011
10	1.664	1.710	1.004
11	1.546	1.586	.997
12	1.448	1.483	.991
13	1.365	1.396	.984
14	1.294	1.321	.977
15	1.234	1.227	.973
16	1.176	1.171	.979
17	1.123	1.119	.985
18	1.073	1.070	.990
19	1.027	1.025	.996
20	.983	.984	1.002
21	.943	.944	1.007
22	.906	.908	1.013
23	.871	.874	1.019
24	.838	.842	1.025
25	.808	.813	1.030
26	.779	.785	1.036
27	.753	.759	1.042
28	.728	.735	1.047
29	.705	.713	1.053
30	.683	.692	1.059
31	.663	.673	1.064
32	.645	.654	1.070
33	.627	.638	1.076
34	.611	.622	1.081
35	.596	.607	1.087
36	.582	.594	1.093
37	.569	.581	1.099
38	.557	.570	1.104
39	.545	.559	1.110
40	.535	.549	1.116
41	.526	.540	1.121
42	.517	.532	1.127
43	.509	.524	1.133
44	.502	.518	1.138
45	.495	.512	1.144

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TABLE 36

SPEED CORRECTION FACTORS FOR LIGHT-DUTY AUTOS & LIGHT-DUTY TRUCKS
FOR LOW ELEVATION
1969 MODEL YEAR

SPEED	HC	CO	NOX
5	2.950	3.571	1.087
6	2.516	3.000	1.077
7	2.207	2.592	1.067
8	1.974	2.286	1.057
9	1.794	2.047	1.047
10	1.649	1.857	1.037
11	1.531	1.701	1.027
12	1.432	1.571	1.017
13	1.349	1.461	1.007
14	1.277	1.367	.997
15	1.215	1.283	.980
16	1.162	1.213	.984
17	1.113	1.147	.988
18	1.066	1.087	.993
19	1.023	1.031	.997
20	.983	.979	1.001
21	.946	.931	1.006
22	.911	.887	1.010
23	.878	.846	1.014
24	.847	.808	1.019
25	.819	.772	1.023
26	.792	.739	1.027
27	.767	.709	1.032
28	.744	.680	1.036
29	.722	.654	1.040
30	.702	.629	1.045
31	.683	.607	1.049
32	.665	.585	1.053
33	.649	.566	1.058
34	.634	.547	1.062
35	.619	.530	1.066
36	.606	.514	1.071
37	.594	.500	1.075
38	.583	.486	1.079
39	.572	.473	1.083
40	.563	.462	1.088
41	.554	.451	1.092
42	.546	.441	1.096
43	.539	.432	1.101
44	.532	.423	1.105
45	.526	.415	1.109

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TABLE 37

SPEED CORRECTION FACTORS FOR LIGHT-DUTY AUTOS & LIGHT-DUTY TRUCKS
FOR LOW ELEVATION
1970 MODEL YEAR

SPEED	HC	CO	NOX
5	2.509	3.603	1.132
6	2.178	3.026	1.115
7	1.941	2.614	1.098
8	1.763	2.305	1.081
9	1.625	2.064	1.065
10	1.515	1.872	1.048
11	1.425	1.714	1.031
12	1.349	1.583	1.015
13	1.286	1.472	.998
14	1.231	1.377	.981
15	1.187	1.288	.963
16	1.141	1.216	.971
17	1.098	1.150	.979
18	1.058	1.088	.987
19	1.020	1.032	.995
20	.985	.979	1.003
21	.952	.931	1.011
22	.921	.885	1.019
23	.892	.841	1.027
24	.865	.805	1.035
25	.840	.769	1.043
26	.816	.735	1.050
27	.794	.704	1.058
28	.774	.675	1.066
29	.754	.648	1.074
30	.736	.623	1.082
31	.720	.600	1.090
32	.704	.578	1.098
33	.690	.558	1.106
34	.677	.539	1.114
35	.664	.522	1.122
36	.653	.505	1.130
37	.642	.490	1.138
38	.633	.476	1.146
39	.624	.463	1.154
40	.616	.451	1.162
41	.609	.439	1.170
42	.602	.429	1.178
43	.597	.419	1.186
44	.592	.410	1.194
45	.587	.402	1.202

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TABLE 38

SPEED CORRECTION FACTORS FOR LIGHT-DUTY AUTOS & LIGHT-DUTY TRUCKS
FOR LOW ELEVATION
POST-1970 MODEL YEARS

SPEED	HC	CO	NOX
5	2.756	4.185	1.141
6	2.372	3.486	1.122
7	2.098	2.987	1.104
8	1.892	2.613	1.085
9	1.732	2.322	1.067
10	1.604	2.089	1.048
11	1.499	1.898	1.029
12	1.412	1.739	1.011
13	1.338	1.605	.992
14	1.274	1.490	.974
15	1.200	1.284	.964
16	1.151	1.214	.972
17	1.106	1.149	.980
18	1.063	1.083	.988
19	1.023	1.033	.996
20	.986	.981	1.004
21	.951	.933	1.012
22	.919	.888	1.020
23	.888	.847	1.028
24	.860	.808	1.036
25	.833	.772	1.044
26	.808	.739	1.052
27	.785	.708	1.060
28	.763	.679	1.068
29	.743	.652	1.076
30	.724	.627	1.084
31	.707	.604	1.092
32	.690	.582	1.100
33	.675	.561	1.108
34	.661	.542	1.116
35	.648	.525	1.124
36	.635	.508	1.132
37	.624	.493	1.140
38	.614	.478	1.149
39	.604	.465	1.157
40	.596	.453	1.165
41	.588	.441	1.173
42	.581	.430	1.181
43	.575	.420	1.189
44	.569	.411	1.197
45	.564	.403	1.205

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TABLE 39

SPEED CORRECTION FACTORS FOR HEAVY-DUTY GAS TRUCKS
FOR LOW ELEVATION
PRE-1970 MODEL YEARS

SPEED	HC	CO	NOX
5	2.488	2.718	1.084
6	2.158	2.338	1.072
7	1.922	2.067	1.059
8	1.745	1.863	1.047
9	1.607	1.705	1.035
10	1.497	1.578	1.022
11	1.407	1.475	1.009
12	1.332	1.389	.997
13	1.268	1.315	.984
14	1.214	1.253	.972
15	1.202	1.205	.955
16	1.152	1.155	.965
17	1.106	1.108	.975
18	1.063	1.064	.984
19	1.023	1.023	.994
20	.986	.984	1.004
21	.950	.949	1.014
22	.918	.915	1.024
23	.887	.884	1.033
24	.859	.855	1.043
25	.832	.828	1.053
26	.807	.802	1.063
27	.784	.778	1.073
28	.762	.756	1.082
29	.742	.736	1.092
30	.723	.716	1.102
31	.706	.698	1.112
32	.689	.681	1.122
33	.674	.666	1.131
34	.660	.651	1.141
35	.647	.638	1.151
36	.635	.626	1.161
37	.624	.614	1.171
38	.614	.604	1.180
39	.605	.594	1.190
40	.596	.585	1.200
41	.588	.577	1.210
42	.582	.570	1.220
43	.575	.563	1.229
44	.570	.557	1.239
45	.565	.552	1.249

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TABLE 40

SPEED CORRECTION FACTORS FOR HEAVY-DUTY GAS TRUCKS
FOR LOW ELEVATION
POST-1969 MODEL YEARS

SPEED	HC	CO	NOX
5	2.960	3.070	1.038
6	2.528	2.616	1.031
7	2.219	2.293	1.024
8	1.988	2.050	1.017
9	1.808	1.861	1.011
10	1.664	1.710	1.004
11	1.546	1.586	.997
12	1.448	1.483	.991
13	1.365	1.396	.984
14	1.294	1.321	.977
15	1.234	1.227	.973
16	1.176	1.171	.979
17	1.123	1.119	.985
18	1.073	1.070	.990
19	1.027	1.025	.996
20	.983	.984	1.002
21	.943	.944	1.007
22	.906	.908	1.013
23	.871	.874	1.019
24	.838	.842	1.025
25	.808	.813	1.030
26	.779	.785	1.036
27	.753	.759	1.042
28	.728	.735	1.047
29	.705	.713	1.053
30	.683	.692	1.059
31	.663	.673	1.064
32	.645	.654	1.070
33	.627	.638	1.076
34	.611	.622	1.081
35	.596	.607	1.087
36	.582	.594	1.093
37	.569	.581	1.099
38	.557	.570	1.104
39	.545	.559	1.110
40	.535	.549	1.116
41	.526	.540	1.121
42	.517	.532	1.127
43	.509	.524	1.133
44	.502	.518	1.138
45	.495	.512	1.144

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TABLE 41

SPEED CORRECTION FACTORS FOR HEAVY-DUTY DIESEL TRUCKS
FOR LOW ELEVATION
ALL YEARS

SPEED	HC	CO	NOX
5.0	1.603	1.193	1.427
6.0	1.464	1.149	1.329
7.0	1.364	1.117	1.258
8.0	1.290	1.093	1.205
9.0	1.232	1.074	1.164
10.0	1.186	1.059	1.131
11.0	1.148	1.047	1.105
12.0	1.116	1.037	1.082
13.0	1.089	1.029	1.063
14.0	1.066	1.021	1.047
15.0	1.046	1.015	1.033
16.0	1.029	1.009	1.021
17.0	1.014	1.004	1.010
18.0	1.000	1.000	1.000
19.0	.962	.939	1.027
20.0	.927	.884	1.051
21.0	.896	.834	1.072
22.0	.867	.789	1.092
23.0	.841	.748	1.110
24.0	.818	.710	1.126
25.0	.796	.675	1.142
26.0	.775	.643	1.156
27.0	.757	.613	1.169
28.0	.739	.586	1.181
29.0	.723	.560	1.192
30.0	.708	.536	1.202
31.0	.694	.514	1.212
32.0	.681	.493	1.221
33.0	.668	.473	1.230
34.0	.657	.454	1.238
35.0	.646	.437	1.246
36.0	.635	.420	1.253
37.0	.625	.404	1.260
38.0	.616	.390	1.266
39.0	.607	.376	1.272
40.0	.599	.362	1.278
41.0	.591	.349	1.284
42.0	.583	.337	1.289
43.0	.576	.326	1.294
44.0	.569	.315	1.299
45.0	.562	.304	1.303

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TEMPERATURE ADJUSTMENT FACTORS
AND
HOT/COLD VEHICLE OPERATION ADJUSTMENT FACTORS

The ambient temperature adjustment factor (z_{ipt}), and the hot/cold vehicle operation adjustment factors (r_{iptw}-noncatalyst) and (r_{iptwx}-catalyst) were taken directly from Supplement 5 except as noted for 1976-77 light-duty trucks.

Emission factors for the various motor vehicle types are based on data from the standard Federal test which is assumed to be at 75°F. With the use of the temperature adjustment factors and the hot/cold start-up operation adjustment factors, emission factors can be corrected for the existing ambient temperatures between 20°F and 80°F. For temperatures outside this range, use the appropriate endpoint correction factor.

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TABLE 42

LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK**
TEMPERATURE ADJUSTMENT FACTORS
AND
HOT/COLD VEHICLE OPERATION CORRECTION FACTORS

Pollutant and controls	*20°F to 80°F Equations for Temperature Adjustment Factor, $(z_{ipt})^{ab}$	Equations for Hot/cold vehicle operation Correction factors	
		g(t)	f(t)
Carbon monoxide			
Noncatalyst	-0.0127t + 1.95	-	0.0045t + 0.02
Catalyst	-0.0743t + 6.58	$e^{0.035t} - 5.24$	$e^{0.036t} - 4.14$
Hydrocarbons			
Noncatlyst	-0.0113t + 1.81	-	0.0079t + 0.03
Catalyst	-0.0304t + 3.25	0.0018t + 0.0095	0.0050t - 0.0409
Nitrogen oxides			
Noncatalyst	-0.0046t + 1.36	-	-0.0068t + 1.64
Catalyst	-0.0060t + 1.52	-0.0010t + 0.858	0.0010t + 0.835

[a]Temperature (t) is expressed in °F. In order to apply the above equations, °C must first be converted to °F (F=9/5C + 32). Similarly °Kelvin (K) must be converted to °F (F=9/5(K-273.16) + 32).

[b]The equation for z_{ipt} enable the correction of FTP emmision factors for ambient temperature. The equation for f(t) and g(t) are given and are used in the calculation of r_{iptw}. If the variable r_{iptw} is used, z_{ipt} must be used also.

where: z_{ipt} = the temperature adjustment factor for the ith model year vehicles for pollutant (p) and ambient temperature (t). (Applied to light-duty autos and light-duty trucks only.)

Heavy-duty gas and heavy-duty diesel use 1.0

*Note: for temp <20°F use 20°F
for temp >80°F use 80°F

**Note: Catalyst temperature and hot/cold operation adjustment factors applied to all post-1974 light-duty autos. 1975 light-duty trucks are noncatalyst. 1976 and 1977 light-duty trucks have weighted, temperature and hot/cold adjustment factors with catalyst functions accounting for 2/3, and noncatalyst functions 1/3. All post-1977 light-duty trucks use catalyst functions.

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LIGHT-DUTY AUTO AND LIGHT-DUTY TRUCK**
HOT/COLD VEHICLE OPERATION ADJUSTMENT FACTORS
(LIMITS 20°F TO 80°F)

For catalyst vehicles, emissions during the hot start phase of operation (vehicles start-up after a short-less then 1 hour - engine-off period) are greater than vehicle emissions during the hot stabilized phase. Therefore, the adjustment factor is a function of the percentage of cold operation, the percentage of hot start operation, and the ambient temperature (t).

$$r_{iptw} = \frac{w + (100-w)f(t)}{20 + 80\ f(t)} \qquad \text{Noncatalyst}$$

$$r_{iptwx} = \frac{w + x\ f(t) + (100-w-x)g(t)}{20 + 27\ f(t) + 53\ g(t)} \qquad \text{Catalyst}$$

where:

r_{iptw}/r_{iptwx} = (noncatalyst/catalyst) the hot/cold vehicle operation adjustment factor for the ith model year vehicles for pollutant (p), ambient temperature (t), percentage cold start operation (w), and percentage hot start operation (x). (Applied to light-duty autos and light-duty trucks only.)

w = % cold start

x = % hot start

t = ambient temp*°F

For f(t) and g(t) see Table 42 for hot/cold vehicle operation correction factors.

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Heavy-duty gas and heavy-duty diesel use 1.0.

* Note: for temp <20°F use 20°F
for temp >80°F use 80°F

** Note: Catalyst temperature and hot/cold operation adjustment factors applied to all post-1974 light-duty autos. 1975 light-duty trucks are noncatalyst. 1976 and 1977 light-duty trucks have weighted, temperature and hot/cold adjustment factors with catalyst functions accounting for 2/3 and noncatalyst functions 1/3. All post-1977 light-duty trucks use catalyst functions.

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CRANKCASE AND EVAPORATIVE HYDROCARBON EMISSION RATES

The crankcase and evaporative hydrocarbon emission rates were taken directly from Supplement 5.

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TABLE 43

CRANKCASE AND EVAPORATIVE HYDROCARBON EMISSION RATES
AP-42, SUPP 5
g/mi

	Light-Duty Auto		Light-Duty Truck		Heavy-Duty Gas Trucks	
Model Year	LDA CC	LDA Evap.	LDT CC	LDT Evap.	HDG CC	HDG Evap.
≤1960	4.1	2.53	4.6	3.6	5.7	5.8
61	0.8	2.53	2.4	3.6	5.7	5.8
62	0.8	2.53	2.4	3.6	5.7	5.8
63	0.8	2.53	2.4	3.6	5.7	5.8
64	0	2.53	0	3.6	0	5.8
65	0	2.53	0	3.6	0	5.8
66	0	2.53	0	3.6	0	5.8
67	0	2.53	0	3.6	0	5.8
68	0	2.53	0	3.6	0	5.8
69	0	2.53	0	3.6	0	5.8
70	0	1.78	0	3.1	0	5.8
71	0	1.78	0	3.1	0	5.8
72	0	1.76	0	3.1	0	5.8
73	0	1.76	0	3.1	0	5.8
74	0	1.76	0	3.1	0	5.8
75	0	1.76	0	3.1	0	5.8
76	0	1.76	0	3.1	0	5.8
77	0	1.76	0	3.1	0	5.8
78	0	1.76	0	3.1	0	5.8
79	0	1.76	0	3.1	0	5.8
>79	0	0.5	0	0.5	0	5.8
Supp 5 Table	D.1-26	D.1-27	D.2-15	D.2-15	D.4-14	D.4-14

Note: Not applicable to heavy-duty diesel trucks.

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HYDROCARBON REACTIVITY FACTORS

The hydrocarbon reactivity factors were developed by the California Air Resources Board (5) and are presented here to represent the percentage of total hydrocarbons that have moderate to high reactivity. Reactivity is defined as follows:

Class I:	low reactivity	organic compounds yielding little, if any, ozone under urban conditions.
Class II:	moderate reactivity	organic compounds which give an intermediate yield of ozone within the first day of solar irradiation.
Class III:	high reactivity	organic compounds which give very high yields of ozone with a few hours of irradiation.

Trijonis and Arledge (6) offer the following comments:

Organic emission reactivity refers to the potential of an organic to participate in atmospheric reactions which result in photochemical smog. The particular smog symptom of interest here is photochemical oxidant for which a short-term National Ambient Air Quality Standard has been established. Oxidant producing potential as known to vary widely among specific organic compounds. This variation is significant because it introduces the option of selective organic emission control as a possibly advantageous alternative to the less flexible approach of indiscriminate control.

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TABLE 44

AIR RESOURCES BOARD
REACTIVITY CLASSIFICATION OF ORGANIC COMPOUNDS

Class I (Low Reactivity)	Class II (Moderate Reactivity)	Class III (High Reactivity)
C_1-C_2 Paraffins	Mono-tert-alkyl-benzenes	All other aromatic hydrocarbons
Acetylene	Cyclic Ketones	All Olefinic hydrocarbons (including partially halogenated)
Benzene	Alkyl acetates	Aliphatic aldehydes
Benzaldehyde	2-Nitropropane	Branched alkyl Ketones
Acetone	C_3+ Paraffins	Cellosolve acetate
Methanol	Cycloparaffins	Unsaturated Ketones
Tert-alkyl alcohols	n-alkyl Ketones	Primary & secondary C_2+ alcohols
Phenyl acetate	N-methyl pyrrolidone	Diacetone alcohol
Methyl benzoate	N,N-dimethyl acetamide	Ethers
Ethyl Amines	Alkyl Phenols*	Cellosolves
Dimethyl formamide	Methyl phthalates**	Glycols*
Perhalogenated Hydrocarbons		C_2+ Alkyl phthalates**
Partially halogenated paraffins		Other Esters**
Phthalic Anhydride**		Alcohol Amines**
Phthalic Acids**		C_3+ Organic acids + di acid**
Acetonitrile*		C_3+ di acid anhydrides**
Acetic Acid		Formin** (Hexa methylene-tetramine)
Aromatic Amines		Terpenic hydrocarbon
Hydroxyl Amines		Olefin oxides**
Naphthalene*		
Chlorobenzenes*		
Nitrobenzenes*		
Phenol*		

*Reactivity data are either non-existent or inconclusive, but conclusive data from similar compounds are available; therefore, rating is uncertain but reasonable.

**Reactivity data are uncertain.

SOURCE: [52]

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TABLE 45

HYDROCARBON REACTIVITY FACTORS

GASOLINE-POWERED VEHICLES
(LDA, LDT, and HDG)

Emission Source	Reactivity Factor (Weight fraction of total organic gases that are reactive)
Exhaust	.887
Evaporative	.965
Crankcase	.928

DIESEL-POWERED VEHICLES
(HDD)

Emission Source	Reactivity Factor (Weight fraction of total organic gases that are reactive)
Exhaust	.974

Note: For reactivity factors listed, no distinction is made between catalytic and noncatalytic vehicles since insufficient data exists to warrant such.

Source: (5)

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REFERENCES

1. Air Resources Board, Evaluation and Planning Unit, "EMFAC3 Technical Support Document", March 31, 1976.

2. U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards, "Compilation of Air Pollutant Emission Factors", AP-42 (Second Edition), Research Triangle Park, North Carolina, April,1973.

3. U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards, "Supplement No. 5 for Compilation of Air Pollutant Emission Factors", AP-42 (Second Edition), Research Triangle Park, North Carolina, December,1975.

4. California Department of Transportation, Division of Structures and Engineering Services, Office of Transportation Laboratory, "Motor Vehicle Emission Factors for Estimates of Highway Impact on Air Quality", CA-DOT-TL-7082-11-76-24, Sacramento, California, March,1976.

5. California Air Resources Board, Technical Resources Unit/ Land Use Planning Program, "Emission and Air Quality Assessment", Report No. ARB/EP-76001, Sacramento, California, April,1976.

6. Trijonis, J. C., and Arledge, K. W., "Impact of Reactivity Criteria on Organic Emission Control Strategies in the Metropolitan Los Angeles AQCR-Interim Report" - TRW Renondo Beach, California, March,1975.

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APPENDIX

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EMFAC3 USER'S INSTRUCTIONS

EMFAC3 is resident on Teale Data Center's IBM 370/168 as an interactive FORTRAN program. The program is identified as 'PIA.EMFAC3.INTERAC.CLIST' on the Time Sharing Option (TSO) system. A BASIC version is available for use on Caltran's TENET system. The TENET program can be accessed by the basic mode command LINK "5;LAB;EMFAC".

Both of these interactive programs are nearly identical in input and output formats. Each question appearing at the terminal is discussed below:

(1) JOB TITLE = ?

Any title can be typed in for a run. It will appear at the top of each page of output.

(2) OUTPUT OPTIONS: ENTER 1 FOR COMPOSIT FACTORS ONLY OR
ENTER 2 FOR MORE DETAILED FACTORS?

The format for option 1 is seen on page 79. The option 2 output is on page 81.

(3) PERCENT OF HDV THAT ARE DIESEL POWERED.
ENTER 10 FOR VEHICLE WEIGHTED STATE AVERAGE OR
ENTER 33 FOR MILEAGE WEIGHTED STATE AVERAGE?

Any desired percentage between 0-100 can be input. If the output emission factor is to be applied to vehicle miles travelled (VMT) in an area, then 33% should be used. Even though diesels comprise only 10% of the total number of HDVs, they drive 33% of the total mileage driven by HDVs.

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(4) PERCENT OF LDV THAT ARE LIGHT DUTY TRUCKS.
ENTER 14 FOR VEHICLE OR MILEAGE WEIGHTED STATE AVERAGE?

Again, any desired value between 0 and 100 can be input. Current California estimates show that 14% of the LDVs are LDTs. The LDTs also drive 14% of the total mileage driven by LDVs. (LDT$\leq$8500-lbs.)

(5) ELEVATION LESS THAN 3500 FEET (YES OR NO)?

Only low elevation factors are available at this time. The main purpose of this question is to remind the user that only low elevation factors are being output.

(6) ENTER AMBIENT TEMPERATURE (F)
USE 75 FOR FTP AVERAGE?

The ambient temperature associated with the emissions in question should always be entered here. Emissions are best estimated on an hourly basis. The use of 75 degrees F will cause a temperature correction factor of about 1.0 to be used.

The range of ambient temperatures for corrections is 20°F to 80°F. The program will use appropriate endpoint correction values for input temperatures outside the allowable range.

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(7) ENTER NUMBER OF YEARS, PREDICTION YEARS?

The first entry is the number of inventory years the user wants emission factors for. After this entry, type a comma or a space, then list each inventory year separating each entry with a comma or space. Inventory years are limited to 1973 through 2010. Contact the ARB's Modeling Section for years outside this range. In all cases, the inventory year may be entered by subtracting 1900 (i.e. - enter 75 for 1975, or enter 100 for 2000).

(8) NUMBER OF CALCULATIONS FOR EACH YEAR?

The user should input the number of combinations of % cold starts, % hot starts, % HDV, and average speed needed for the run.

(9) ENTER % COLD STARTS, % HOT STARTS, % HDV, AND AVERAGE SPEED FOR: (USE 20% COLD STARTS AND 27% HOT STARTS FOR FTP AVERAGES)

The terminal will request entries for each calculation desired according to the user response to question number 8. The FTP average values for cold and hot starts should be used unless other specific percentages are known. The entry for % HDV should reflect the percentage of mileage driven by HDVs (HDG+HDD). This number typically varies from 0 to 15% depending on the area and time of day.

The last input is the average vehicle speed.

A sample program execution follows, to familiarize the user with the format of the inputs and outputs.

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```
BASIC
>LINK "5:LAB:EMFAC"
   NEW EMISSION FACTOR PROGRAM NAMING SCHEME*

                EMISSION FACTOR PROGRAMS

             OLD NAME          NEW NAME       PROGRAM DATES

              OLDEMFAC           EMFAC1         PRE-8/19/75
              EMFAC              EMFAC2         8/19/75 TO 4/30/76
                                 EMFAC3         4/30/76 TO PRESENT

   ENTER 1 TO LINK EMFAC1 OR
   ENTER 2 TO LINK EMFAC2 OR
   ENTER 3 TO LINK EMFAC3?3

         ***** EMFAC3  APRIL 1976  P. ALLEN (916) 445-9799 *****

            THIS PROGRAM USES AP-42 SUPPLEMENT 5 METHODOLOGY
              WITH MODIFICATIONS PERTINENT TO CALIFORNIA
              DESIGNED FOR INVENTORY YEARS 1973 TO 2010.

   JOB TITLE = ?SUPP 5 TEST RUN #2

   OUTPUT OPTIONS: ENTER 1 FOR COMPOSITE FACTORS ONLY OR
                   ENTER 2 FOR MORE DETAILED FACTORS?1

   PERCENT OF HDV THAT ARE DIESEL POWERED.
   ENTER 10 FOR VEHICLE WEIGHTED STATE AVERAGE OR
   ENTER 33 FOR MILEAGE WEIGHTED STATE AVERAGE?10

   PERCENT OF LDV THAT ARE LIGHT DUTY TRUCKS.
   ENTER 14 FOR VEHICLE OR MILEAGE WEIGHTED STATE AVERAGE?14

   ELEVATION LESS THAN 3500 FEET(YES OR NO)?YES

   ENTER AMBIENT TEMPERATURE (F)
   USE 75 FOR FTP AVERAGE?72

   ENTER NUMBER OF YEARS,PREDICTION YEARS?1,75

   NUMBER OF CALCULATIONS FOR EACH YEAR = ?3

   ENTER % COLD STARTS, % HOT STARTS, % HDV, AND AVERAGE SPEED FOR:
   (USE 20% COLD STARTS AND 27% HOT STARTS FOR FTP AVERAGES)

   CALC. 1      ?20,27,5,5
   CALC. 2      ?20,27,5,25
   CALC. 3      ?20,27,5,45
```


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SUPR 5 TEST RUN #2

EMFAC3
DATE: 08/03/76

ALTITUDE LESS THAN 3500 FEET

PREDICTED CALIFORNIA VEHICLE EMISSION FACTORS FOR INVENTORY YEAR 1975
AT AN AMBIENT TEMPERATURE OF 72 DEGREES FAHRENHEIT

VEHICLE DISTRIBUTION (%)				HOT STARTS (%)	COLD STARTS (%)	AVERAGE SPEED (MPH)	COMPOSITE EMISSION FACTOR (GRAMS/MILE)			
AUTO	LD TRK	GAS HD	DSL				THC	RHC	CO	NOX
81.7	13.3	4.5	.5	27	20	5.0	16.5	14.8	199.6	4.4
81.7	13.3	4.5	.5	27	20	25.0	6.8	6.2	44.8	4.1
81.7	13.3	4.5	.5	27	20	45.0	5.3	4.9	25.7	4.7

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```
-SHARING SYSTEM  1329  07/28/76 32

-LOGIN
PASSWORD?

-BASIC
>LINK "5;LAB;EMFAC"
   NEW EMISSION FACTOR PROGRAM NAMING SCHEME*

                EMISSION FACTOR PROGRAMS

              OLD NAME          NEW NAME       PROGRAM DATES

               OLDEMFAC          EMFAC1         PRE-8/19/75
               EMFAC             EMFAC2         8/19/75 TO 4/30/76
                                 EMFAC3         4/30/76 TO PRESENT


   ENTER 1 TO LINK EMFAC1 OR
   ENTER 2 TO LINK EMFAC2 OR
   ENTER 3 TO LINK EMFAC3?3

         ***** EMFAC3  APRIL 1976  P. ALLEN (916) 445-9799 *****

            THIS PROGRAM USES AP-42 SUPPLEMENT 5 METHODOLOGY
              WITH MODIFICATIONS PERTINENT TO CALIFORNIA
              DESIGNED FOR INVENTORY YEARS 1973 TO 2010.

   JOB TITLE = ?SUPP 5 TEST RUN


   OUTPUT OPTIONS: ENTER 1 FOR COMPOSITE FACTORS ONLY OR
                   ENTER 2 FOR MORE DETAILED FACTORS?2

   PERCENT OF HDV THAT ARE DIESEL POWERED.
   ENTER 10 FOR VEHICLE WEIGHTED STATE AVERAGE OR
   ENTER 33 FOR MILEAGE WEIGHTED STATE AVERAGE?10

   PERCENT OF LDV THAT ARE LIGHT DUTY TRUCKS.
   ENTER 14 FOR VEHICLE OR MILEAGE WEIGHTED STATE AVERAGE?14


   ELEVATION LESS THAN 3500 FEET(YES OR NO)?YES

   ENTER AMBIENT TEMPERATURE (F)
   USE 75 FOR FTP AVERAGE?72

   ENTER NUMBER OF YEARS,PREDICTION YEARS?1,75

   NUMBER OF CALCULATIONS FOR EACH YEAR = ?3

   ENTER % COLD STARTS, % HOT STARTS, % HDV, AND AVERAGE SPEED FOR:
   (USE 20% COLD STARTS AND 27% HOT STARTS FOR FTP AVERAGES)

   CALC. 1      ?20,27,5,5
   CALC. 2      ?20,27,5,25
   CALC. 3      ?20,27,5,45
```


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SUPP 5 TEST RUN

EMFAC3
DATE: 07/28/76

ALTITUDE LESS THAN 3500 FEET
TEMPERATURE = 72.0 DEGREES FAHRENHEIT
INVENTORY YEAR = 1975 AVERAGE SPEED = 5.0 MPH

LIGHT DUTY: 20.0% COLD START, 27.0% HOT START, 53.0% HOT STABILIZED

HEAVY DUTY: ASSUMED 100% HOT STABILIZED OPERATION

VEHICLE DISTRIBUTION: 81.7 %LDA, 13.3 %LDT, 4.5 %HDG, .5 %HDD

COMPOSITE EMISSION FACTOR
(GRAMS/MILE)

	THC	RHC	NOX	CO
EXHAUST	14.16	12.56	4.43	199.60
CRANKCASE	.09	.08		
EVAPORATIVE	2.25	2.18		
TOTAL EMISSIONS	16.50	14.82	4.43	199.60

TEMPERATURE = 72.0 DEGREES FAHRENHEIT
INVENTORY YEAR = 1975 AVERAGE SPEED = 25.0 MPH

LIGHT DUTY: 20.0% COLD START, 27.0% HOT START, 53.0% HOT STABILIZED

HEAVY DUTY: ASSUMED 100% HOT STABILIZED OPERATION

VEHICLE DISTRIBUTION: 81.7 %LDA, 13.3 %LDT, 4.5 %HDG, .5 %HDD

COMPOSITE EMISSION FACTOR
(GRAMS/MILE)

	THC	RHC	NOX	CO
EXHAUST	4.43	3.94	4.10	44.76
CRANKCASE	.09	.08		
EVAPORATIVE	2.25	2.18		
TOTAL EMISSIONS	6.78	6.19	4.10	44.76

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SUPP 5 TEST RUN

EMFAC3
DATE: 07/28/76

ALTITUDE LESS THAN 3500 FEET
TEMPERATURE = 72.0 DEGREES FAHRENHEIT
INVENTORY YEAR = 1975 AVERAGE SPEED = 45.0 MPH

LIGHT DUTY: 20.0% COLD START, 27.0% HOT START, 53.0% HOT STABILIZED

HEAVY DUTY: ASSUMED 100% HOT STABILIZED OPERATION

VEHICLE DISTRIBUTION: 81.7 %LDA, 13.3 %LDT, 4.5 %HDG, .5 %HDD

COMPOSITE EMISSION FACTOR
(GRAMS/MILE)

	THC	RHC	NOX	CO
EXHAUST	2.96	2.63	4.69	25.65
CRANKCASE	.09	.08		
EVAPORATIVE	2.25	2.18		
TOTAL EMISSIONS	5.30	4.89	4.69	25.65

>QUIT
-LOGO
1339 07/28/76

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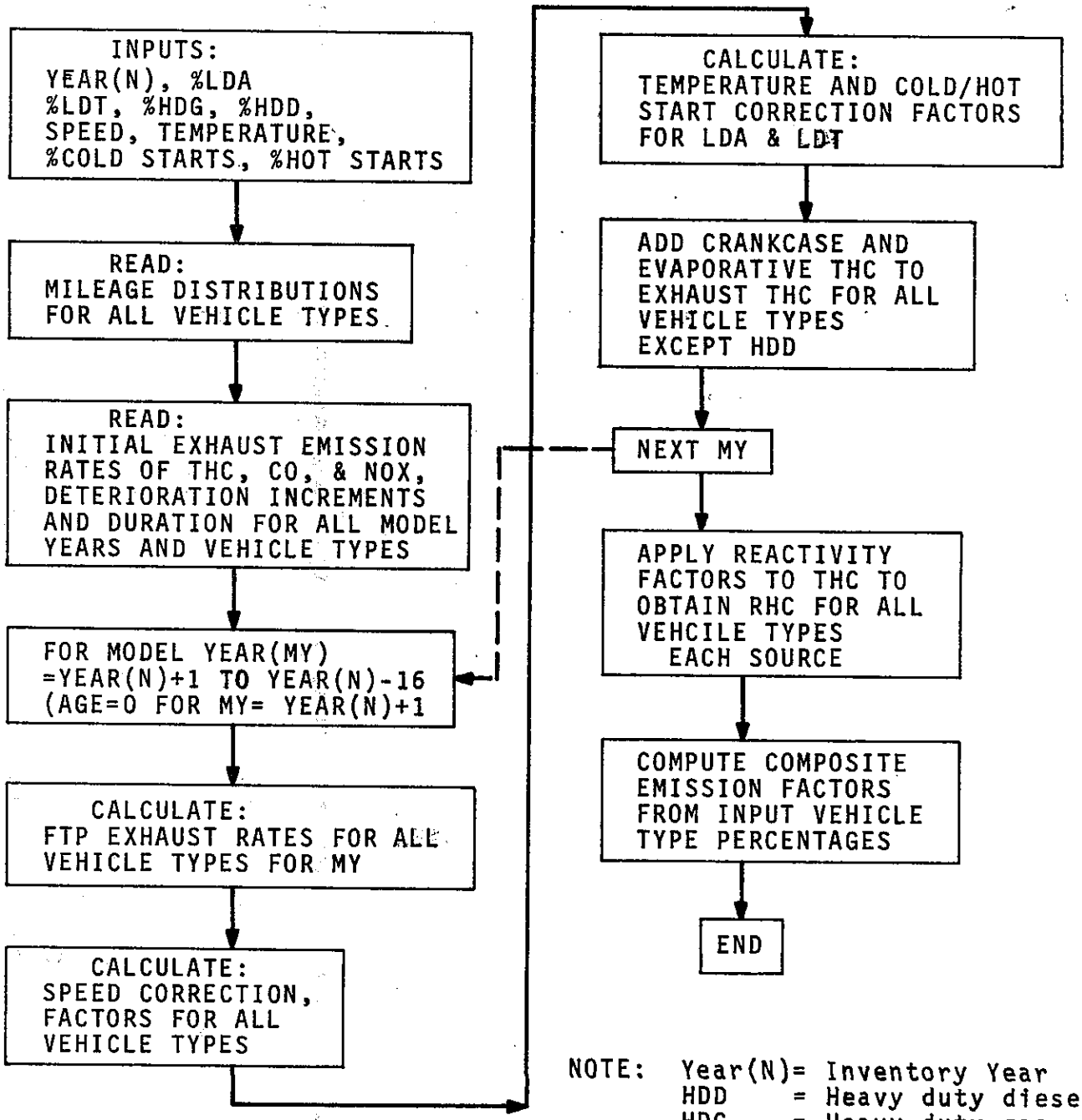
GENERALIZED EMFAC3 FLOWCHART



NOTE: Year(N)= Inventory Year
HDD = Heavy duty diesel
HDG = Heavy duty gas
LDA = Light duty autos
LDT = Light duty trucks
CO,NO_X
THC,RHD= emission factors in grams/mile

THC = Reactive and Non/reactive Hydrocarbons

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EMFAC3 PROGRAM LISTING

JULY 7, 1976

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```
1000 REM              ****** EMFAC3     APRIL 1976 ******
                    PROGRAMMED BY P. ALLEN (916) 445-9799 FOR THE
                          CALIFORNIA AIR RESOURCES BOARD

1020 PRINT;'        ***** EMFAC3  APRIL 1976  P. ALLEN (916) 445-9799 **
***'
1030 PRINT
1040 PRINT;'          THIS PROGRAM USES AP-42 SUPPLEMENT 5 METHODOLOGY'
1041 PRINT;'            WITH MODIFICATIONS PERTINENT TO CALIFORNIA '
1042 PRINT;'            DESIGNED FOR INVENTORY YEARS 1973 TO 2010.'
1050 PRINT
1060 REM
                              MATRIX TABLES

1070 REM    M      = WEIGHTED ANNUAL TRAVEL DISTRIBUTION
            C      = CO EMISSION RATES
            N      = NOX EMISSION RATES
            H      = THC EMISION RATES
         CCEV      = CRANKCASE AND EVAPORATIVE EMISSION RATES
1150 REM
                              VARIABLE DEFINITIONS (INCOMPLETE)
                              *********************************

1151 REM    TIT$ = JOB TITLE
           HDVD = %HDD/%HDV
           LDT  = %LDT/%LDV
           EL$  = YES  IF ELEVATION < 3500'
1152 REM    T$   = LESS OR GREATER (ELEVATION)
           TEMP = AMBIENT TEMPERATURE  F
           CS(NC) = % COLD STARTS
           NY(1) = NUMBER OF PREDICTION YEARS
1153 REM    YR(I) = ARRAY OF PREDICTION YEARS
           NC   = NUMBER OF CALCULATIONS PER PREDICTION YEAR
           HDV(I) = %HDV OF TOTAL TRAFFIC
           SPD(I) = SPEED ASSOCIATED WITH HDV(I)
1154 REM
           M$   = GRAMS PER MILE   OR GRAMS PER MINUTE
           M    = 1 FOR G/MILE OR 2 FOR G/MINUTE
           P1   = FRACTION OF LDA TO TOTAL TRAFFIC
1155 REM    P2   =     "        LDT        "      "
           P3   =     "        HDG        "      "
           P4   =     "        HDD        "      "

1156 REM    C1   = MILEAGE WEIGHTED FRACTION OF LDA TO TOTAL MILEAGE
           C2   =              "                LDT       "
```


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```
          C3    =                "                    HDG        "
          C4    =                "                    HDD        "
 1160 PF$ = CHAR(127)
 1161 FOR II = 1 TO 5
 1162 PF$ = PF$ + PF$
 1163 NEXT II
 1164 PF$ = CHAR(12) + PF$
1200 DIM M(0:17,4),F(57:80,3,4,4),CCEV(60:80,3,2)
 1210 OPEN '440:PARAQM:EMFILE3',1,INPUT,OLD,BINARY,RANDOM
1220 MAT INPUT FROM 1 AT 1:M
1222 MAT INPUT FROM 1 AT 2:F,CCEV
1226 CLOSE 1
1228 REM
                ******** READ USER INPUTS ********

 1230 PRINT:'JOB TITLE = ':
 1240 INPUT TIT$
 1242 PRINT
 1243 GOTO 1251
 1244 PRINT:'DO YOU PREFER OUTPUT IN GRAMS/MILE (1) OR'
 1246 PRINT:'GRAMS/MINUTE (2) ? (ENTER 1 OR 2)':
 1247 INPUT XM
 1248 IF XM#1 OR XM#2 THEN PRINT:'PLEASE INPUT 1 OR 2': ELSE
      GOTO 1252
 1250 GOTO 1247
 1251 XM = 1
 1252 IF XM = 1 THEN M$='MILE)' ELSE M$='MINUTE)'
1253 PRINT
1254 PRINT:'OUTPUT OPTIONS: ENTER 1 FOR COMPOSITE FACTORS ONLY OR'
1255 PRINT:'                ENTER 2 FOR MORE DETAILED FACTORS':
1256 INPUT FO
1257 PRINT
1258 PAGE = 0
 1260 PRINT:'PERCENT OF HDV THAT ARE DIESEL POWERED.'
1270 PRINT:'ENTER 10 FOR VEHICLE WEIGHTED STATE AVERAGE OR'
1271 PRINT:'ENTER 33 FOR MILEAGE WEIGHTED STATE AVERAGE':
 1280 INPUT HDVD
 1290 IF HDVD<=100 THEN 1310 ELSE PRINT:
      'PLEASE INPUT VALUE LESS THAN OR EQUAL TO 100':
 1300 GOTO 1280
 1310 HDVD = .01*HDVD
 1312 PRINT
 1330 PRINT:'PERCENT OF LDV THAT ARE LIGHT DUTY TRUCKS.'
1340 PRINT:'ENTER 14 FOR VEHICLE OR MILEAGE WEIGHTED STATE AVERAGE':
 1350 INPUT LDT
 1360 IF LDT<=100 THEN 1380 ELSE PRINT:
       'PLEASE INPUT VALUE LESS THAN OR EQUAL TO 100':
 1370 GOTO 1350
 1380 LDT = .01*LDT
 1382 PRINT
 1390 PRINT
 1400 PRINT:'ELEVATION LESS THAN 3500 FEET(YES OR NO)':
 1410 INPUT EL$
 1420 IF EL$ ='YES' OR EL$ = 'NO' THEN 1440 ELSE PRINT:
       'PLEASE ANSWER YES OR NO':
 1430 GOTO 1410
 1440 IF EL$ = 'YES' THEN T$ = 'LESS' ELSE T$ = 'GREATER'
 1442 IF EL$ = 'YES' THEN EL = 2 ELSE EL = 3
 1443 IF EL = 3 THEN PRINT:'NO HIGH ELEVATION FACTORS AVAILABLE YET'
```


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```
 14IF EL = 3 THEN 1390
 1450 PRINT
 1460 PRINT;'ENTER AMBIENT TEMPERATURE (F)'
 1462 PRINT;'USE 75 FOR FTP AVERAGE':
 1470 INPUT TEMP
 1480 TEMP = MAX(TEMP,20)
 1481 TEMP = MIN(TEMP,80)
 1530 PRINT
 1540 PRINT;'ENTER NUMBER OF YEARS,PREDICTION YEARS':
 1545 MAT INPUT NY(1),YR$(NY(1))
1548 DIM YR(100)
 1551 FOR I = 1 TO NY(1)
1552 YR(I) = VAL(YR$(I))
1553 IF YR(I)>1900 THEN YR(I) = YR(I)-1900
1554 IF YR(I)<73 OR YR(I)>110 THEN PRINT IN FORM "3B 'VALID RANGE = '
        '1973(73) TO 2010(110)....YOUR INPUT NO. ' 2% ' = ' 5% /":I,YR$
(I)
1555 IF YR(I) < 73 OR YR(I) > 110 THEN 1530
 1558 NEXT I
 1560 PRINT
 1570 PRINT;'NUMBER OF CALCULATIONS FOR EACH YEAR = ':
 1575 INPUT NC
 1580 PRINT
 1590 DIM HDV(NC),SPD(NC),CS(NC),HS(NC)
 1600 PRINT;'ENTER % COLD STARTS, % HOT STARTS, % HDV, AND AVERAGE SPEE
D FOR:'
 1602 PRINT;'(USE 20% COLD STARTS AND 27% HOT STARTS FOR FTP AVERAGES)'
 1605 PRINT
 1610 FOR I = 1 TO NC
 1620 PRINT;'CALC. ':I:TAB(15):
 1630 INPUT CS(I), HS(I), HDV(I), SPD(I)
 1640 IF HDV(I) <=100 THEN 1660 ELSE PRINT;
        'INVALID INPUT....TRY AGAIN'
 1650 GOTO 1620
 1660 HDV(I) = .01*HDV(I)
 1681 IF SPD(I)>45 THEN PRINT IN FORM"3B
     'SPEED CORRECTION CAN BE MADE UP TO 45 MPH ONLY' /":
 1682 IF SPD(I) < 5 THEN PRINT IN FORM"3B
       'SPEED CORRECTION CANNOT BE MADE LOWER THAN 5 MPH' /":
 1683 IF SPD(I) < 5 OR SPD(I) > 45 THEN PRINT IN FORM"3B
       'YOUR INPUT HAS BEEN RESET.....PROCESSING CONTINUES' /":
 1684 SPD(I) = MAX(SPD(I),5)
 1685 SPD(I) = MIN(SPD(I),45)
 1686 NEXT I
 1709 REM
                        ***** BEGIN OUTPUT *****
                    NEW PAGE FOR EACH PREDICTION YEAR

 1710 FOR I = 1 TO NY(1)
 1730 PRINT PF$
 1740 PRINT SPACE(40-ROUND(.5*(LENGTH(TIT$)))):TIT$
1755 PRINT; 'EMFAC3'
 1760 PRINT;'DATE: ':TDATE
 1770 PRINT
 1780 PRINT;'ALTITUDE ':T$:' THAN 3500 FEET'
1784 IF FO = 2 THEN GOTO 2050
 1790 PRINT
 2000 PRINT IN FORM"3B 'PREDICTED CALIFORNIA VEHICLE EMISSION FACTORS'
      ' FOR INVENTORY YEAR' 5% /":1900+YR(I)
```


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```
202 PRINT IN FORM"3B 'AT AN AMBIENT TEMPERATURE OF ' 3%
      ' DEGREES FAHRENHEIT' //":TEMP
2010 PRINT IN FORM"4B 'VEHICLE DISTRIBUTION      HOT    COLD'
     '    AVERAGE' 3B 'COMPOSITE EMISSION FACTOR' /":
2020 PRINT IN FORM"14B '(%)' 11B 'STARTS' B 'STARTS' 3B 'SPEED' 9B
      '(GRAMS/' 7% ":M$
2030 PRINT IN FORM"4B 'AUTO LD TRK  GAS HD DSL ' 2B '(%)' 4B '(%)' 4B
      '(MPH)' 5B 'THC     RHC     CO      NOX' /":
2040 PRINT
2050 REM
                    BEGIN USER DEFINED FUNCTION TO
                    COMPUTE EXHAUST EMISSION RATES

2055 DEF FNEX(AGE,MY,F,TYPE,POLU)
2056 DIM F(57:80,3,4,4)
2057 REAL AGE,MY
2058 INTEGER TYPE,POLU
2060 K2 = AGE - 1
2065 IF AGE = 0 THEN K2 = 0
2070 EMY = MY
2075 IF MY < 58 THEN EMY = 57
2080 IF MY > 79 THEN EMY = 80
2085 IF AGE > F(EMY,POLU,TYPE,3) THEN EX = F(EMY,POLU,TYPE,4)
      ELSE EX = F(EMY,POLU,TYPE,1) + K2 * F(EMY,POLU,TYPE,2)
2090 RETURN EX
2100 END
2500 REM
                *** CALCULATE VEHICLE TYPE WEIGHTING FACTORS ***

2510 FOR J = 1 TO NC
2520 IF J=1 THEN 2540
2530 IF HDV(J) - HDV(J-1) THEN PRINT
2540 LDV = 1-HDV(J)
2550 P2 = LDT*LDV
2560 P1 = LDV - P2
2570 P4 = HDVD * HDV(J)
2585 P3 = HDV(J)-P4
2590 P5 = MTC          !

                  *** INITIALIZE POLLUTANTS & SET MATRIX POSITIONS***

2700 THC,RHC,CO,NOX,AH1,AH2,AN1,AN2,AC1,AC2,TC1,TC2,TN1,TN2,TH1,TH2,
        HGC,HGN,HGH,HDC,HDN,HDH = 0
2705 ACC1,TCC2,GCC3,AEV1,TEV2,GEV3 = 0
2710 FOR K = 0 TO 17
2720 TCA1,TCA2,TNA1,TNA2,THA1,THA2,TCT1,TCT2,TNT1,TNT2,THT1,THT2,
          CHDG,NHDG,HHDG,CHDD,NHDD,HHDD = 0
2730 MY = YR(I) -K +1
2735 AGE = YR(I) - MY + 1
2740 C1 = P1*M(K,1), C2 = P2*M(K,2)
2750 C3 = P3*M(K,3), C4 = P4*M(K,4)
2800 REM
                          *** LIGHT DUTY AUTOS ****

2805 REM            ** EXHAUST & DETERIORATION **

2810 IF C1 = 0 THEN 3300
2840 IF MY < 75 THEN 2850 ELSE 2870
2850 THA1 = C1 * FNEX(AGE,MY,F,1,3)
```


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```
2870WA1 = C1 * FNEX(AGE,MY,F,1,1)
2856 TNA1 = C1 * FNEX(AGE,MY,F,1,2)
 2860 GOTO 3000
2870 THA2 = C1 * FNEX(AGE,MY,F,1,3)
2873 TCA2 = C1 * FNEX(AGE,MY,F,1,1)
2876 TNA2 = C1 * FNEX(AGE,MY,F,1,2)
 3000 REM
 3100 REM
                    *** AMBIENT TEMPERATURE CORRECTION ***

 3110 CT1 = (-0.0127 * TEMP + 1.95)
 3112 TCA1 = TCA1 * CT1
 3115 CT2 = (-.0743 * TEMP + 6.58)
 3117 TCA2 = TCA2 * CT2
 3120 NT1 = (-0.0046 * TEMP + 1.36)
 3122 TNA1 = TNA1 * NT1
 3125 NT2 = (-.006 * TEMP + 1.52)
 3127 TNA2 = TNA2 * NT2
 3130 HT1 = (-0.0113 * TEMP + 1.81)
 3132 THA1 = THA1 * HT1
 3140 HT2 = (-.0304 * TEMP + 3.25)
 3142 THA2 = THA2 * HT2
 3150 REM
                 *** PERCENT COLD START CORRECTION ***

 3160 CHC1 = ((CS(J) + (100-CS(J)) * (.0045 * TEMP + .02))/
              (20 + 80*(.0045 * TEMP + .02)))
 3162 TCA1 = TCA1 * CHC1
 3165 CHC2=((CS(J) +HS(J) *(EXP((.036*TEMP)- 4.14)) + (100 - CS(J) - HS
(J)) *
              (EXP((.035*TEMP)- 5.24)))/(20 + 27*(EXP((.036*TEMP)- 4.14)
) +
              53 * (EXP((.035*TEMP)- 5.24))))
 3167 TCA2 = TCA2 * CHC2
 3170 CHN1 = ((CS(J) + (100 - CS(J)) * (-.0068 * TEMP + 1.64))/
              (20 + 80 * (-.0068 * TEMP + 1.64)))
 3172 TNA1 = TNA1 * CHN1
 3175 CHN2 = ((CS(J) + HS(J) * (.001 * TEMP + .835) + (100-CS(J)-HS(J))
*
              (-.001 * TEMP + .858))/(20 + 27 * (.001 * TEMP + .835) + 5
3 *
              (-.001 * TEMP + .858)))
 3177 TNA2 = TNA2 * CHN2
 3180 CHH1 = ((CS(J) + (100-CS(J)) * (.0079 * TEMP + .03))/
             (20 + 80*(.0079 * TEMP + .03)))
 3182 THA1 = THA1 * CHH1
 3190 CHH2 = ((CS(J) + HS(J)*(.005 * TEMP - .0409) + (100-CS(J)-HS(J))*
             (.0018 * TEMP + .0095))/(20 + 27*(.005 * TEMP - .0409) +
             53*(.0018 * TEMP + .0095)))
 3192 THA2 = THA2 * CHH2
 3200 REM
                     *** SPEED CORRECTION ***

 3210 IF EL$ = 'YES' THEN GOSUB 10000 ELSE GOSUB 11000
 3220 TCA1 = SLDC * TCA1
 3225 TCA2 = SLDC * TCA2
 3230 TNA1 = SLDN * TNA1
 3235 TNA2 = SLDN * TNA2
 3240 THA1 = SLDH * THA1
```


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```
3250 THA2 = SLDH * THA2
3300 REM
            ********* LIGHT DUTY TRUCKS  *********

3305 IF C2 = 0 THEN 3580
3310 REM                    ** EXHAUST & DETERIORATION **

3320 IF MY < 76 THEN 3325 ELSE 3340
3325 TCT1 = C2 * FNEX(AGE,MY,F,2,1)
3330 TNT1 = C2 * FNEX(AGE,MY,F,2,2)
3335 THT1 = C2 * FNEX(AGE,MY,F,2,3)
3336 GOTO 3450
3340 TCT2 = C2 * FNEX(AGE,MY,F,2,1)
3345 TNT2 = C2 * FNEX(AGE,MY,F,2,2)
3350 THT2 = C2 * FNEX(AGE,MY,F,2,3)
3450 REM
                        AMBIENT TEMPERATURE CORRECTION

3455 IF MY = 76 OR MY = 77 THEN GOSUB 14000 ELSE 3460
3456 GOTO 3530
3460 TCC1 = (-0.0127 * TEMP + 1.95)
3462 TCT1 = TCT1 * TCC1
3465 FCC2 = (-.0743*TEMP+6.58)
3467 TCT2 = TCT2 * FCC2
3470 TCN1 = (-0.0046 * TEMP + 1.36)
3472 TNT1 = TNT1 * TCN1
3475 TCN2 = (-.006 * TEMP+1.52)
3477 TNT2 = TNT2 * TCN2
3480 TCH1 = (-0.0113 * TEMP + 1.81)
3482 THT1 = THT1 * TCH1
3485 TCH2 = (-.0304 * TEMP+3.25)
3487 THT2 = THT2 * TCH2
3490 REM
                      PER CENT COLD START CORRECTION

3500 HCC1 = ((CS(J) + (100-CS(J)) * (.0045 * TEMP + .02))/
            (20 + 80*(.0045 * TEMP + .02)))
3502 TCT1 = TCT1 * HCC1
3505 HCC2 =((CS(J) +HS(J) *(EXP((.036*TEMP)- 4.14)) + (100 - CS(J) - HS
(J)) *
            (EXP((.035*TEMP)- 5.24)))/(20 + 27*(EXP((.036*TEMP)- 4.14)
) +
            53 * (EXP((.035*TEMP)- 5.24))))
3507 TCT2 = TCT2 * HCC2
3510 TCN1 = ((CS(J) + (100 - CS(J)) * (-.0068 * TEMP + 1.64))/
            (20 + 80 * (-.0068 * TEMP + 1.64)))
3512 TNT1 = TNT1 * TCN1
3515 TCN2 = ((CS(J) + HS(J) * (.001 * TEMP + .835) + (100-CS(J)-HS(J))
*
            (-.001 * TEMP + .858))/(20 + 27 * (.001 * TEMP + .835) + 5
3 *
            (-.001 * TEMP + .858)))
3517 TNT2 = TNT2 * TCN2
3520 TCH1 = ((CS(J) + (100-CS(J)) * (.0079 * TEMP + .03))/
           (20 + 80*(.0079 * TEMP + .03)))
3522 THT1 = THT1 * TCH1
3525 TCH2 = ((CS(J) + HS(J)*(.005 * TEMP - .0409) + (100-CS(J)-HS(J))*
           (.0018 * TEMP + .0095))/(20 + 27*(.005 * TEMP - .0409) +
           53*(.0018 * TEMP + .0095)))
```


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```
3525 PLT2 = THT2 * TCH2
3530 REM
                    SPEED CORRECTION

3540 IF EL$ = 'YES' THEN GOSUB 10000 ELSE GOSUB 11000
3550 TCT1 = SLDC*TCT1
3555 TCT2 = SLDC*TCT2
3560 TNT1 = SLDN*TNT1
3565 TNT2 = SLDN * TNT2
3570 THT1 = SLDH * THT1
3575 THT2 = SLDH * THT2
3580 REM
                    ******* HEAVY DUTY GAS *******

3585 IF C3 = 0 THEN 3670
3590 REM                    EXHAUST & DETERIORATION

3600 CHDG = C3 * FNEX(AGE,MY,F,3,1)
3610 NHDG = C3 * FNEX(AGE,MY,F,3,2)
3620 HHDG = C3 * FNEX(AGE,MY,F,3,3)
3630 REM
                    SPEED CORRECTION

3638 IF EL$ = 'YES' THEN GOSUB 12000 ELSE GOSUB 13000
3640 CHDG = SHDC * CHDG
3650 NHDG = SHDN * NHDG
3660 HHDG = SHDH * HHDG
3670 REM
                    ******* HEAVY DUTY DIESEL ******

3675 IF C4 = 0 THEN 4000
3680 REM                    EXHAUST & DETERIORATION

3690 CHDD = C4 * FNEX(AGE,MY,F,4,1)
3700 NHDD = C4 * FNEX(AGE,MY,F,4,2)
3710 HHDD = C4 * FNEX(AGE,MY,F,4,3)
3720 REM
                    SPEED CORRECTION

3730 GOSUB 15000
3740 CHDD = SHDC * CHDD
3750 NHDD = SHDN * NHDD
3760 HHDD = SHDH * HHDD
4000 REM
                    *********** CRANKCASE AND EVAPORATIVE ******

4002 REM CC1 = LIGHT DUTY AUTO CRANKCASE THC
         CC2 = LIGHT DUTY TRUCK      "       "
         CC3 = HEAVY DUTY GAS TRUCK  "       "
4004 REM EV1 = LIGHT DUTY AUTO EVAPORATIVE THC
         EV2 = LIGHT DUTY TRUCK EVAPORATIVE THC
         EV3 = HEAVY DUTY GAS TRUCK EVAPORATIVE THC
4006 REM
                CRANKCASE AND EVAPORATIVE FROM DIESELS ARE ZERO

4007 AMY = MY
4008 IF MY < 60 THEN AMY = 60
4009 IF MY > 79 THEN AMY = 80
4010 CC1 = C1 * CCEV(AMY,1,1)
```


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```
4012 CC2 = C2 * CCEV(AMY,2,1)
4014 CC3 = C3 * CCEV(AMY,3,1)
4016 EV1 = C1 * CCEV(AMY,1,2)
4018 EV2 = C2 * CCEV(AMY,2,2)
4020 EV3 = C3 * CCEV(AMY,3,2)
4100 REM
                    SUM MODEL YEAR CONTRIBUTIONS FOR EACH VEHICLE TYPE
                                    AND POLLUTANT

4110 AC1 = AC1 + TCA1
4112 AC2 = AC2 + TCA2
4114 AN1 = AN1 + TNA1
4116 AN2 = AN2 + TNA2
4118 AH1 = AH1 + THA1
4120 AH2 = AH2 + THA2
4122 TC1 = TC1 + TCT1
4124 TC2 = TC2 + TCT2
4126 TN1 = TN1 + TNT1
4128 TN2 = TN2 + TNT2
4130 TH1 = TH1 + THT1
4132 TH2 = TH2 + THT2
4134 HGC = HGC + CHDG
4136 HGN = HGN + NHDG
4138 HGH = HGH + HHDG
4140 HDC = HDC + CHDD
4142 HDN = HDN + NHDD
4144 HDH = HDH + HHDD
4170 ACC1 = ACC1 + CC1
4172 TCC2 = TCC2 + CC2
4174 GCC3 = GCC3 + CC3
4180 AEV1 = AEV1 + EV1
4182 TEV2 = TEV2 + EV2
4184 GEV3 = GEV3 + EV3
4190 NEXT K
4200 IF FO = 2 THEN GOTO 4220
4201 THC = AH1+AH2+TH1+TH2+HGH+HDH+ACC1+TCC2+GCC3+AEV1+TEV2+GEV3
4203 RHC =.887*(AH1+TH1)+.887*(AH2+TH2)+.887*HGH+.974*HDH+
        .965*(AEV1+TEV2+GEV3)+.928*(ACC1+TCC2+GCC3)
4205 CO = AC1 + AC2 + TC1 + TC2 + HGC + HDC
4207 NOX = AN1 + AN2 + TN1 + TN2 + HGN + HDN
4210 PRINT IN FORM"3B 3%.% B 3%.% B 3%.% B 3%.% 4B  3% 4B 3% 5B 2%.%
  3B 3%.% 2B 3%.% 2B 3%.% 2B 3%.% /":100*P1,100*P2,100*P3,100*P4,HS(J)
,CS(J),
          SPD(J),THC,RHC,CO,NOX
4215 GOTO 4500
4220  THC = AH1+AH2+TH1+TH2+HGH+HDH
4225 ETHC = AEV1 + TEV2 + GEV3
4230 CTHC = ACC1 + TCC2 + GCC3
4235  RHC =.887*(AH1+TH1)+.887*(AH2+TH2)+.887*HGH+.974*HDH
4240 CRHC = .928*(ACC1+TCC2+GCC3)
4245 ERHC = .965*(AEV1+TEV2+GEV3)
4250 CO = AC1 + AC2 + TC1 + TC2 + HGC + HDC
4255 NOX = AN1 + AN2 + TN1 + TN2 + HGN + HDN
4260 XTHC = THC + CTHC + ETHC
4265 XRHC = RHC + CRHC + ERHC
4270 PRINT IN FORM "3B 'TEMPERATURE = ' %%.% B 'DEGREES FAHRENHEIT' /":
TEMP
4275 PRINT IN FORM "3B 'INVENTORY YEAR = ' 4% 5B 'AVERAGE SPEED = '
        %%.% B 'MPH' //":YR(I)+1900,SPD(J)
```


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```
428 PRINT IN FORM "3B 'LIGHT DUTY:'3%.% '% COLD START,' 3%.%
        '% HOT START,' 3%.% '% HOT TRANSIENT' /":CS(J),HS(J),
          (100-(CS(J) + HS(J)))
4285 PRINT IN FORM "3B 'HEAVY DUTY: ASSUMED 100% HOT TRANSIENT OPERATIO
N' //":
4290 PRINT IN FORM "3B 'VEHICLE DISTRIBUTION:' B 3%.% B '%LDA,' B
         3%.% B '%LDT,' B 3%.% B '%HDG,' B 3%.% B '%HDD' //":
        100*P1,100*P2,100*P3,100*P4
4295 PRINT IN FORM "28B 'COMPOSITE EMISSION FACTOR' ":
4300 PRINT IN FORM "34B '(GRAMS/MILE)'/":
4305 PRINT IN FORM "25B 'THC' 6B 'RHC' 6B 'NOX' 6B 'CO' //":
4310 PRINT IN FORM "8B 'EXHAUST' 8B 3%.2% 3B 3%.2% 3B 3%.2% 3B 3%.2% /"
:THC,
         RHC,NOX,CO
4315 PRINT IN FORM "7B 'CRANKCASE' 7B 3%.2% 3B 3%.2% /":CTHC,CRHC
4320 PRINT IN FORM "6B 'EVAPORATIVE' 6B 3%.2% 3B 3%.2% //":ETHC,ERHC
4325 PRINT IN FORM "4B 'TOTAL EMISSIONS' 4B 3%.2% 3B 3%.2% 3B 3%.2%
            3B 3%.2% / ":XTHC,XRHC,NOX,CO
4330 PRINT CHAR(10)
4335 PRINT CHAR(10)
4336 PRINT
4340 PAGE = PAGE + 1
4342 IF J = NC THEN 4360
4345 IF PAGE = 2 THEN 4350 ELSE 4500
4350 DO 1730:1780
4360 PAGE = 0
4500 NEXT J
4525 NEXT I
 5000 END
10000 REM
                                LDV SPEED CORRECTION SUBROUTINE
                                      ELEV <= 3500 FEET
                                        15<= SPEED <= 45
10005 IF SPD(J) < 15 THEN GOTO 10500
10010 REM INPUTS: SPD(J), MY

10020 REM OUTPUTS: SLDH, SLDC, SLDN

10030 IF MY < 66 THEN IMY = 65 ELSE IMY = MY
10040 IF MY > 70 THEN IMY = 71
10045 SYR = IMY-64
10050 ON SYR GOTO 10060,10080,10080,10100,10120,10140,10160
10060 A1 = .953, B1 = -.0600, X1 = .000581,
      A2 = .967, B2 = -.0607, X2 = .000578,
      A3 = .808, B3 = .0098
10070 GOTO 10170
10080 A1 = .957, B1 = -.0598, X1 = .000563,
      A2 = .981, B2 = -.0622, X2 = .000619,
       A3 = .844, B3 = .00798
10090 GOTO 10170
10100 A1 = 1.070, B1 = -.0663, X1 = .000598,
      A2 = 1.047, B2 = -.0652, X2 = .000601,
      A3 = .808, B3 = .00569
10110 GOTO 10170
10120 A1 = 1.005, B1 = -.0627, X1 = .00058,
      A2 = 1.259, B2 = -.0772, X2 = .00066,
      A3 = 0.915, B3 = .00432
10130 GOTO 10170
10140 A1 = .901, B1 = -.057, X1 = .000559,
```


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```
      A2 = 1.267, B2 = -.0772, X2 = .00064,
      A3 = .843, B3 = .00798
10150 GOTO 10170
10160 A1 = .943, B1 = -.0592, X1 = .000567,
      A2 = 1.241, B2 = -.0752, X2 = .000609,
      A3 = .843, B3 = .00804
10170 SLDH = EXP(A1 + (B1*SPD(J)) + (X1 * SPD(J)**2))
10180 SLDC = EXP(A2 + (B2 * SPD(J)) + (X2 * SPD(J)**2))
10190 SLDN = A3 + B3 * SPD(J)
10200 RETURN
10500 REM
                        LDV SPEED CORRECTION SUBROUTINE
                              ELEV <= 3500 FEET
                                5 <= SPEED <= 15

10510 REM INPUTS: SPD(J),MY
10520 REM OUTPUTS: SLDH,SLDC,SLDN
10530 IF MY < 66 THEN IMY = 65 ELSE IMY = MY
10540 IF MY > 70 THEN IMY = 71
10545 SYR = IMY-64
10550 ON SYR GOTO 10560,10580,10580,10600,10620,10640,10660
10560 A1 = .506, B1 = 9.912,
      A2 = .439, B2 = 11.394,
      A3 = 1.147, B3 = -.0125
10570 GOTO 10670
10580 A1 = .718, B1 = 5.567,
      A2 = .697, B2 = 5.192,
      A3 = 1.267, B3 = -.0196
10590 GOTO 10670
10600 A1 = .368, B1 = 12.958,
       A2 = .350, B2 = 13.598,
       A3 = 1.071, B3 = -.0067
10610 GOTO 10670
10620 A1 = .348, B1 = 13.010,
      A2 = .143, B2 = 17.140,
      A3 = 1.137, B3 = -.01
10630 GOTO 10670
10640 A1 = .521, B1 = 9.940,
      A2 = .141, B2 = 17.308,
       A3 = 1.215, B3 = -.0167
10650 GOTO 10670
10660 A1 = .451, B1 = 11.527,
      A2 = -.00777, B2 = 20.965,
      A3 = 1.234, B3 = -.0186
10670 SLDH = A1 + (B1/SPD(J))
10680 SLDC = A2 + (B2/SPD(J))
10690 SLDN = A3 + (B3*SPD(J))
10700 RETURN
11000 REM              LDV SPEED CORRECTION SUBROUTINE
                              ELEV > 3500 FEET
                                15<= SPEED <= 45
11005 IF SPD(J) < 15 THEN GOTO 11500
11010 REM INPUTS: SPD(J), MY

11020 REM OUTPUTS: SLDH, SLDC, SLDN

11030 IF MY < 68 THEN IMY = 67 ELSE IMY = MY
11040 IF MY > 70 THEN IMY = 71
11045 SYR = IMY-66
```


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```
1105 ON SYR GOTO 11060,11080,11100,11120,11140
11060 A1 = .883, B1 = -.0558, X1 = .000552,
      A2 = .721, B2 = -.0457, X2 = .000456,
      A3 = .602,B3 = .02027
11070 GOTO 11150
11080 A1 = .722, B1 = -.0463, X1 = .00048,
      A2 = .662, B2 = -.0423, X2 = .000433,
      A3 = .642, B3 = .01835
11090 GOTO 11150
11100 A1 = .706, B1 = -.0455, X1 = .000484,
      A2 = .628, B2 = -.0404, X2 = .000426,
      A3 = .726, B3 = .01403
11110 GOTO 11150
11120 A1 = .840, B1 = -.0533, X1 = .000533,
      A2 = .835, B2 = -.0524, X2 = .000498,
      A3 = .614, B3 = .01978
11130 GOTO 11150
11140 A1 = .787, B1 = -.0499, X1 = .000499,
      A2 = .894, B2 = -.0554, X2 = .000499,
      A3 = .697, B3 = .01553
11150 SLDH = EXP(A1 + (B1*SPD(J)) + (X1 * SPD(J)**2))
11160 SLDC = EXP(A2 + (B2 * SPD(J)) + (X2 * SPD(J)**2))
11170 SLDN = A3 + B3 * SPD(J)
11180 RETURN
11500 REM
```

LDV SPEED CORRECTION SUBROUTINE
ELEV > 3500 FEET
5<= SPEED <= 15

```
11510 REM INPUTS: SPD(J),MY
11520 REM OUTPUTS: SLDH,SLDC,SLDN
11530 IF MY < 68 THEN IMY = 67 ELSE IMY = MY
11540 IF MY > 70 THEN IMY = 71
11545 SYR = IMY - 66
11550 ON SYR GOTO 11560,11580,11600,11620,11640
11560 A1 = .545, B1 = 8.896,
      A2 = .606, B2 = 8.458,
      A3 = 1.569, B3 = -.0424
11570 GOTO 11650
11580 A1 = .5975, B1 = 7.425,
      A2 = .535, B2 = 9.537,
      A3 = 1.409, B3 = -.0303
11590 GOTO 11650
11600 A1 = .603, B1 = 7.073,
      A2 = .544, B2 = 9.744,
      A3 = 1.363, B3 = -.0284
11610 GOTO 11650
11620 A1 = .520, B1 = 9.069,
     A2 = .422, B2 = 12.19,
     A3 = 1.349, B3 = -.0279

11630 GOTO 11650
11640 A1 = .620, B1 = 7.702,
      A2 = .402, B2 = 13.1308,
     A3 = 1.133, B3 = -.013
11650 SLDH = A1 + (B1/SPD(J))
11660 SLDC = A2 + (B2/SPD(J))
11670 SLDN = A3 + (B3*SPD(J))
11680 RETURN
```


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```
12000 REM                    HDV SPEED CORRECTION SUBROUTINE
                                   ELEV <= 3500 FEET
                                    15<=SPEED<=45

12005 IF SPD(J) < 15 THEN GOTO 12500
12010 REM INPUTS: SPD(J), MY
12020 REM OUTPUTS: SHDH,SHDC,SHDN
12030 IF MY < 70 THEN IMY = 69 ELSE IMY = MY
12040 IF MY >= 70 THEN IMY = 70
12045 SYR = IMY - 68
12050 ON SYR GOTO 12060,12080
12060 A1 = .953, B1 = -.06, X1 = .000581,
      A2 = .967, B2 = -.0607, X2 = .000578,
      A3 = .808, B3 = .0098
12070 GOTO 12090
12080 A1 = 1.070, B1 = -.0603, X1 = .000598,
      A2 = 1.047, B2 = -.0652, X2 = .000601,
      A3 = .80 , B3 = .00569
12090 SHDH = EXP(A1 + (B1*SPD(J)) + (X1 * SPD(J)**2))
12100 SHDC = EXP(A2 + (B2 * SPD(J)) + (X2 * SPD(J)**2))
12110 SHDN = A3 + B3 * SPD(J)
12120 RETURN
12500 REM
                         HDV SPEED CORRECTION SUBROUTINE
                               ELEV <= 3500 FEET
                                5<=SPEED<=15
12510 REM INPUTS: SPD(J),MY
12520 REM OUTPUTS: SHDH,SHDC,SHDN
12530 IF MY < 70 THEN IMY = 69 ELSE IMY = MY
12540 IF MY >= 70 THEN IMY = 70
12545 SYR = IMY - 68
12550 ON SYR GOTO 12560,12580
12560 A1 = .506, B1 = 9.012,
      A2 = .439, B2 = 11.394,
      A3 = 1.147, B3 = -.0125
12570 GOTO 12590
12580 A1 = .368, B1 = 12.958,
      A2 = .350, B2 = 13.598,
      A3 = 1.071, B3 = -.0067

12590 SHDH = A1 + (B1/SPD(J))
12600 SHDC = A2 + (B2/SPD(J))
12610 SHDN = A3 + (B3*SPD(J))
12620 RETURN
13000 REM
                         HDV SPEED CORRECTION SUBROUTINE
                               ELEV > 3500 FEET
                                15<=SPEED<=45

13005 IF SPD(J) < 15 THEN GOTO 13500
13010 REM INPUTS: SPD(J), MY

13020 REM OUTPUTS: SHDH,SHDC, SHDN
13030 IF MY < 70 THEN IMY = 69 ELSE IMY = MY
13040 IF MY >= 70 THEN IMY = 70
13045 SYR = IMY-68
13050 ON SYR GOTO 13060,13080
13060 A1 = .803, B1 = -.0558, X1 = .000552,
      A2 = .721, B2 = -.0457, X2 = .000456,
```


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```
        A3 = .602, B3 = .02027
13070 GOTO 13090
13080 A1 = .722, B1 = -.0463, X1 = .00048,
        A2 = .602, B2 = -.0423, X2 = .000433,
        A3 = .642, B3 = .01835
13090 SHDH = EXP(A1 + (B1*SPD(J)) + (X1 * SPD(J)**2))
13100 SHDC = EXP(A2 + (B2 * SPD(J)) + (X2 * SPD(J)**2))
13110 SHDN = A3 + B3 * SPD(J)
13120 RETURN
13500 REM
```

HDV SPEED CORRECTION SUBROUTINE
ELEV > 3500 FEET
5<=SPEED<=15

```
13510 REM INPUTS: SPD(J),MY
13520 REM OUTPUTS: SHDH,SHDC,SHDN
13530 IF MY < 70 THEN IMY = 69 ELSE IMY = MY
13540 IF MY >= 70 THEN IMY = 70
13545 SYR = IMY - 68
13550 ON SYR GOTO 13560, 13580
13560 A1 = .545, B1 = 8.896,
        A2 = .606, B2 = 8.458,
        A3  =  1.569, B3 = -.0424
13570 GOTO 13590
13580 A1 = .598, B1 = 7.425,
        A2 = .535, B2 = 9.537,
        A3 = 1.409, B3 = -.0303
13590 SHDH = A1 + (B1/SPD(J))
13600 SHDC = A2 + (B2/SPD(J))
13610 SHDN = A3 + (B3*SPD(J))
13620 RETURN
14000 REM
```

SUBROUTINE TO CORRECT 76 & 77 LDT MY'S FOR
TEMPERATURE AND COLD START/HOT START

```
14010 TCC1 = (-0.0127 * TEMP + 1.95)
14020 FCC2 = (-.0743*TEMP+6.58)
14030 STFC = (TCC1 + 2*FCC2)/3
14040 TCT2 = TCT2 * STFC
14050 TCN1 = (-0.0046 * TEMP + 1.36)
14060 TCN2 = (-.006 * TEMP+1.52)
14070 STFN = (TCN1 + 2*TCN2)/3
14080 TNT2 = TNT2 * STFN
14090 TCH1 = (-0.0113 * TEMP + 1.81)
14100 TCH2 = (-.0304 * TEMP+3.25)
14110 STFH = (TCH1 + 2*TCH2)/3
14120 THT2 = THT2 * STFH
14130 HCC1 = ((CS(J) + (100-CS(J)) * (.0045 * TEMP + .02))/
              (20 + 80*(.0045 * TEMP + .02)))
14140 HCC2=((CS(J) +HS(J) *(EXP((.036*TEMP)- 4.14)) + (100 - CS(J) - HS
(J)) *
              (EXP((.035*TEMP)- 5.24)))/(20 + 27*(EXP((.036*TEMP)- 4.14)
) +
              53 * (EXP((.035*TEMP)- 5.24))))
14150 SCHC = (HCC1 + 2*HCC2)/3
14160 TCT2 = TCT2 * SCHC
14170 TCN1 = ((CS(J) + (100 - CS(J)) * (-.0068 * TEMP + 1.64))/
              (20 + 80 * (-.0068 * TEMP + 1.64)))
14180 TCN2 = ((CS(J) + HS(J) * (.001 * TEMP + .835) + (100-CS(J)-HS(J))
```


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```
*
              (-.001 * TEMP + .858))/(20 + 27 * (.001 * TEMP + .835) + 5
3 *
              (-.001 * TEMP + .858)))
14190 SCHN = (TCN1 + 2*TCN2)/3
14200 TNT2 = TNT2 * SCHC
14210 TCH1 = ((CS(J) + (100-CS(J)) * (.0079 * TEMP + .03))/
             (20 + 80*(.0079 * TEMP + .03)))
14220 TCH2 = ((CS(J) + HS(J)*(.005 * TEMP - .0409) + (100-CS(J)-HS(J))*
             (.0018 * TEMP + .0095))/(20 + 27*(.005 * TEMP - .0409) +
             53*(.0018 * TEMP + .0095)))
14230 SCHH = (TCH1 + 2*TCH2)/3
14240 THT2 = THT2 * SCHH
14250 RETURN
15000 REM
                                HEAVY DUTY DIESEL SPEED CORRECTION
                                          ALL SPEEDS

15010 REM: INPUTS: SPD(J)
15020 REM OUTPUTS: SHDH,SHDC,SHDN
15030 IF SPD(J) > 18 THEN 16000
15040 SHDC = (8.61+(18/SPD(J)-1)*.64)/8.61
15050 SHDH = (1.38 + (18/SPD(J)-1)*.32)/1.38
15060 SHDN = (6.27+(18/SPD(J)-1)*1.03)/6.27
15070 RETURN
16000 SHDC = ((18/(42*SPD(J)))*((60-SPD(J))*8.61+(SPD(J)-18)*5.4))/8.61
16010 SHDH = ((18/(42*SPD(J)))*((60-SPD(J))*1.38+(SPD(J)-18)*2.25))/1.3
8
16020 SHDN = ((18/(42*SPD(J)))*((60-SPD(J))*6.27+(SPD(J)-18)*28.3))/6.2
7
16030 RETURN
-#
-QUIT
EH?
-LOGO
 1455  07/07/76
CPU MINS -  0.198
TERMINAL MINS -  35.30
FILE MODULES - 14
----------------
```


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EMFAC3 DATA FILE

JULY 7, 1976

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```
001 .0101 .0106 .0000 .0000
002 .1667 .1908 .0552 .0763
003 .1755 .1861 .1102 .1495
004 .1411 .1417 .1007 .1312
005 .1183 .1129 .1007 .1242
006 .0992 .0915 .0832 .0968
007 .0851 .0790 .0818 .0897
008 .0690 .0584 .0613 .0627
009 .0521 .0438 .0603 .0564
010 .0357 .0304 .0507 .0446
011 .0215 .0178 .0481 .0391
012 .0060 .0050 .0329 .0248
013 .0048 .0044 .0303 .0208
014 .0039 .0037 .0258 .0173
015 .0030 .0032 .0219 .0133
016 .0020 .0026 .0180 .0092
017 .0009 .0021 .0148 .0046
018 .0049 .0159 .1044 .0398
019 78,1,16,94,125,0,0,125,238,0,0,238,28.7,0,0,28.7
020 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
021 7.2,.1,16,8.8,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
022 79,1,16,95,125,0,0,125,238,0,0,238,28.7,0,0,28.7
023 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
024 7.3,.1,16,8.9,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
025 80,1,16,96,125,0,0,125,238,0,0,238,28.7,0,0,28.7
026 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
027 7.4,.1,16,9,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
028 81,1,16,97,125,0,0,125,238,0,0,238,28.7,0,0,28.7
029 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
030 7.5,.1,16,9.1,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
031 82,1,16,98,125,0,0,125,238,0,0,238,28.7,0,0,28.7
032 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
033 7.6,.1,16,9.2,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
034 83,1,16,99,125,0,0,125,238,0,0,238,28.7,0,0,28.7
035 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
036 7.7,.1,16,9.3,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
037 84,1,15,99,125,0,0,125,238,0,0,238,28.7,0,0,28.7
038 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
039 7.8,.1,15,9.3,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
040 85,1,14,99,125,0,0,125,238,0,0,238,28.7,0,0,28.7
041 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
042 7.9,.1,14,9.3,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
043 86,1,13,99,125,0,0,125,238,0,0,238,28.7,0,0,28.7
044 3.34,0,0,3.34,4.2,0,0,4.2,6.8,0,0,6.8,20.9,0,0,20.9
045 8,.1,13,9.3,17,0,0,17,35.4,0,0,35.4,5.2,0,0,5.2
046 74,1,11,85,45.5,3.5,12,87.5,238,0,0,238,28.7,0,0,28.7
047 3.61,0,0,3.61,4.9,0,0,4.9,6.8,0,0,6.8,20.9,0,0,20.9
048 2.3,.6,11,9,2.3,.8,12,11.9,35.4,0,0,35.4,5.2,0,0,5.2
049 75,1,10,85,49,3.5,11,87.5,238,0,0,238,28.7,0,0,28.7
050 3.61,0,0,3.61,4.9,0,0,4.9,6.8,0,0,6.8,20.9,0,0,20.9
051 2.9,.6,10,9,3.1,.8,11,11.9,35.4,0,0,35.4,5.2,0,0,5.2
```


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```
05"5*6,3,10,82.6,52.5,3.5,10,87.5,238,0,0,238,28.7,0,0,28.7
053 4.32,0,0,4.32,4.9,0,0,4.9,6.8,0,0,6.8,20.9,0,0,20.9
054 3.8,.6,10,9.3,3.9,.8,10,11.9,35.4,0,0,35.4,5.2,0,0,5.2
055 53.4,3,10,83.4,53.8,3.5,10,88.8,238,0,0,238,28.7,0,0,28.7
056 5.08,0,0,5.08,5.3,0,0,5.3,6.8,0,0,6.8,20.9,0,0,20.9
057 3.3,.5,10,8.3,3.5,.6,10,9.5,35.4,0,0,35.4,5.2,0,0,5.2
058 48.5,2.5,10,73.5,48.5,2.5,10,73.5,188,0,0,188,28.7,0,0,28.7
059 4.35,0,0,4.35,5.2,0,0,5.2,12.5,.056,9,13,20.9,0,0,20.9
060 3.8,.5,10,8.8,3.6,.6,10,9.6,13.6,.1,8,14.4,5.2,0,0,5.2
061 48.5,2.5,10,73.5,51,2.5,9,73.5,188,0,0,188,28.7,0,0,28.7
062 3.83,0,0,3.83,4.6,0,0,4.6,12.5,.056,9,13,20.9,0,0,20.9
063 3.5,.4,10,7.5,3.7,.5,10,8.7,13.6,.1,8,14.4,5.2,0,0,5.2
064 47,2,10,67,54.3,2.19,10,76.2,188,0,0,188,28.7,0,0,28.7
065 3.81,0,0,3.81,4.4,0,0,4.4,12.5,.056,9,13,20.9,0,0,20.9
066 3.6,.3,10,6.6,3.8,.41,10,7.9,13.6,.1,8,14.4,5.2,0,0,5.2
067 37,2,10,57,42.8,2.2,10,64.8,188,0,0,188,28.7,0,0,28.7
068 3.1,.2,10,5,4.4,.2,10,6.4,12.5,.056,9,13,20.9,0,0,20.9
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