PART5
Information Sheet #1:
Fleet Average Fugitive Dust; Fugitive Dust Emission Factors; Particle Size Cutoff Limitations
October 19, 1994

US EPA, NVFEL, AQAB, 2565 Plymouth Road, Ann Arbor, Michigan 48105 (313) 668-4325

I.   Introduction

PART5 Information Sheets are a series of documents intended to give users detailed information about techniques that can be used to more accurately model highway mobile source particulate emissions and avoid potential errors. When referring to PART5 in this and other Information Sheets, we will mean the latest officially released version of the PART model, unless otherwise specifically noted. At the time of this Information Sheet, the latest version of the model was PART5, released July 29, 1994.

All of the PART5 Information Sheets will be made available on the Technology Transfer Network (TTN) bulletin board system (BBS) in the OMS section. Any micro-computer with a modem can be used to download the files. The phone number for the TTN BBS is (919) 541-5742. All files are made available to users as soon as they answer a few registration questions. The TTN BBS can be called at any time, 24 hours a day, 7 days a week, except Monday mornings from 8 a.m. to noon (EST) when the system is down for maintenance.

If you would like to be added to our PART5 mailing list, please fill out the information described in the last section of this Information Sheet. This only needs to be done once. You do not need to send in this information if you are already on our mailing list.

This is a revision of the Information Sheet #1 dated September 27, 1994, that corrects two minor errors.

II.   Problem Description

Three problems or areas of confusion have surfaced since the release of the PART5 model:

A.   Calculation of Fleet Average Fugitive Dust

This problem was noted in the PART5 release memo (August 1, 1994) regarding the appropriateness of breaking down the fugitive dust calculations into vehicle classes based on average weight. After investigation it has been determined that fugitive dust must be calculated as a fleet average using an arithmetic average vehicle weight of all vehicles on the road. It is inappropriate to calculate fugitive dust emissions by class using different class weights as is currently possible with PART5. This is true for fugitive dust calculations for both paved and unpaved roads.

The same was found to be true of average number of vehicle wheels by vehicle class. The algorithm for fugitive dust emissions for unpaved roads is based on an arithmetic average number of wheels of all vehicles on the road. Thus, it is not appropriate to calculate emissions by class with different average number of wheels among the vehicle classes.

B.   Fugitive Dust Calculation Includes Tailpipe, Brake-wear and Tire-wear Particulate

As is stated in AP42, section 11.2.1, 9/88 (unpaved roads), and draft AP42, section 11.2.x, 3/93 (paved roads), the fugitive dust calculations are based on roadside measurements of ambient particulate near the vehicles. These measurements are used to calculate a fleet average vehicle gram/mile emission factor. This type of measurement is inclusive of all forms of particulate generated from the vehicles traveling on the road. The AP42 algorithms for fugitive dust are incorporated in PART5 with little modification. Therefore, PART5 fugitive dust calculations include tailpipe, brake-wear, and tire-wear emissions and ambient background particulate concentrations formed by secondary transformations from mobile source emissions. A method of subtracting tailpipe, brake-wear and tire-wear emissions from the fugitive dust is described below to avoid double-counting.

In most cases the fleet average fugitive dust emission factors for both paved and unpaved roads is more than one order of magnitude larger than the sum of exhaust PM, brake-wear, and tire-wear emissions. In some extreme cases (i.e. maximum days of precipitation, low particle size cutoff and silt loading - factors which minimize fugitive dust) the difference is only one order of magnitude. It is in these cases, that it is especially important for the PART5 model user to be aware that the fugitive dust emission factor includes all particulate emissions, including the exhaust PM, brake-wear, and tire-wear emissions printed in PART5. EPA will do further review to determine if more work is needed.

PART5 Information Sheet #1

C.   Particle Size Cutoff

A problem was found in the input for particle size cutoff in PART5. The User's Guide states that the minimum acceptable particle size cutoff is 1.0 micron for all pollutants except fugitive dust, for which the minimum is 2.5 microns. An interpolation error in the program was uncovered which raises the effective minimum value to 2.5 microns for all pollutants except brake-wear, which has an effective minimum value of 7.0 microns.

This problem will not affect analyses and inventories which are based on the current particulate matter standard of 10 microns. Since most inventories and analyses are performed with a 10 micron particle size, the model will not be updated at this time, but will be corrected for this problem in the next released version of PART5. In the meantime, users should not do runs with particle sizes of less than 2.5 microns (or less than 7.0 microns for brake-wear emissions). When 2.5 microns is input as the particle size cutoff, the brake-wear emission factor is mistakenly based on an effective particle size cutoff of 7.0 microns. Brake-wear emissions printed in the output should be reduced by 47% to reflect a particle size cutoff of 2.5 microns.

III.   Remedy

A.   Calculation of Fleet Average Fugitive Dust

To use the PART5 model to calculate fugitive dust emission factors, the user must input an overall fleet average weight and an overall fleet average number of wheels. Only one fleet average weight and one fleet average number of wheels must be input to PART5 to calculate the proper fugitive dust values.

A reasonable value for average vehicle weight for the fleet is 6000 lbs. Users should determine the appropriate weight for their application by determining the average weight for each class and then calculating the fleet average weight by combining the individual weights times the number of vehicles of that type (that is, Σ_{class} veh wt_{class} * number $\text{veh}_{\text{class}}$). **This single value representing the fleet average weight must then be used as input for each "vehicle class" average weight** in the scenario section of the PART5 input file (see PART5 User's Guide, chapter 3).

The same process must be applied to determine a fleet average number of wheels. The input **must include a WHEELFLG = 2 in line 2 of the scenario input section. A line 7 must be entered, repeating a single value representing the fleet average number of wheels for each "vehicle class".**

PART5 Information Sheet #1

A sample of a PART5 input file (scenario section) showing the proper input for fugitive dust emission calculations, assuming the fleet average weight is 6000 lbs. and the fleet average number of wheels is 4, is provided below:

1 1994 1 19.6 : region. year, speed cycle, speed
04.3 05.1 **2**   : unpaved silt%, ind. silt g/m^2, **WHEELFLG**
140   : number of precipitation days
scenario 1   : scenario name
10.   -- Particle size cutoff
6000 6000 6000 06000 6000 6000 6000 6000 06000 06000 06000 06000
04 04 04 04 04 04 04 04 04 04 04 04

Note that the WHEELFLG must be set to 2 and lines 6 and 7 must repeat a single number, the fleet average weight and the fleet average number of wheels, respectively.

The output will have emission factors printed in each vehicle class column. These numbers should be identical. The user should understand that this number represents a fleet average paved or unpaved road dust emission factor, and can not be broken into individual vehicle classes.

B.   Fugitive Dust Calculation Includes Tailpipe, Brake-wear and Tire-wear Particulate

If the PART5 user wishes to calculate fugitive dust separately from exhaust PM, brake-wear, and tire-wear, the latter values will need to be subtracted from fugitive dust. **To separate fugitive dust, the "All Vehicle, Exhaust PM", "All Vehicle, Brake", and "All Vehicle, Tire" emission factors must be subtracted from both the unpaved roads and paved roads fugitive dust emission factors**. The fugitive dust emission factors printed (when the user follows input instructions under 'A' of this information sheet) represent a fleet average emission rate, therefore it is appropriate to subtract only the fleet average emission factors, which are found in the "All Vehicle" column of the PART5 output. It is inappropriate to subtract individual vehicle class values of "Exhaust PM", "Brake", and "Tire" from fugitive dust.

C.   Particle Size Cutoff

Do not run the PART5 model with a particle size cutoff of less than 2.5 microns. Do not utilize brake-wear emission factors with a particle size cutoff of less than 7.0 microns. This aspect of PART5 will be corrected at a later date. If a particle size cutoff of 2.5 microns is necessary the user may reduce the brake-wear particulate emission (effective particle size cutoff of 7.0 microns) by 47%.

For users who are able to recompile the program, and want to correct the particle size cutoff,

PART5 Information Sheet #1

the appropriate changes in the source code are as follows:

SUBROUTINE PARSIZ

July 29, 1994 version:

```
124085        DO 20 I = 2,MXSIZE
124086          IF (PSDIST (I,1,ISRC) .GE. PSCALC)
124087    *     NPTR = I
124088  20    CONTINUE
124089        SLOPE = (PSDIST (NPTR,2,ISRC) - PSDIST (NPTR-1,2,ISRC)) /
```

Corrected version, with additions in **bold**:

```
124085        DO 20 I = 2,MXSIZE
124086          IF (PSDIST (I,1,ISRC) .GE. PSCALC) THEN
124087          NPTR = I
124088          GO TO 30
124089          ENDIF
124090  20    CONTINUE
124091  30    SLOPE = (PSDIST (NPTR,2,ISRC) - PSDIST (NPTR-1,2,ISRC)) /
```

PART5 Information Sheet #1

IV.   Other Information Sheets

This is the first issued information sheet since the initial release of the PART5 model.

If you would like to be on our PART5 user mailing list please fill out the following information and send it to:

> PART5 User Mailing List (AQAB)
> U.S. EPA, National Vehicle and Fuel Emissions Laboratory,
> Emission Planning & Strategies Division,
> Air Quality Analysis Branch
> 2565 Plymouth Road
> Ann Arbor, Michigan 48105

Name(s) of user(s):_____

Company/Affiliation:_____

Address:_____

City/State/Zip:_____

Phone Number:_____

Fax Number:_____

Equipment (IBM compatible, mainframe/mini, Macintosh, Other):_____

```
 Do NOT send in your name and address more than once.
      Please, send only one name per address.
```

PART5 Information Sheet #1