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Technical Support Report for Regulatory Action

CATEGORY SELECTION FOR TRANSIENT HEAVY-DUTY CHASSIS AND ENGINE CYCLES

by

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Notice

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Standards Development and Support Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
Office of Air and Waste Management
U.S. Environmental Protection Agency

Abstract

The Emission Control Technology Division (ECTD) of EPA has generated heavy-duty transient engine and chassis cycles representative of the truck operational data collected during the CAPE-21 survey. This report summarizes the considerations and decision process used in arriving at the final vehicle categories for which heavy-duty transient cycles were developed.

Statistical comparisons between various operational parameters were primarily relied upon in selecting the valid category combinations. It was possible to reduce the original number of vehicle categories from 28 to 9 for engine cycles and from 28 to 5 for chassis cycles.

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I. Introduction and Background

As part of its advanced regulation development program, the Emission Control Technology Division (ECTD) of EPA is generating transient engine and chassis cycles. The prime objective of this cycle development effort is to produce transient cycles with operation patterns characteristic of actual truck usage in the urban environment. The resulting cycles will be used to measure emission levels and fuel economy of heavy-duty (H-D) engines.

The data base being used in generating the transient cycles is the CAPE-21 truck operational data. In the CAPE-21 survey, forty-four (44) trucks and three (3) bases were surveyed in Los Angeles (LA), and forty-four (44) trucks and four (4) buses were surveyed in New York City (NY). For the vehicles surveyed, speed (MPH), engine rpm, road and traffic descriptions, and engine power were recorded at approximately one (1) second intervals. These data were collected while the trucks performed their normal functions during a typical day.

In both cities (LA and NY), gasoline-fueled and diesel engine equipped vehicles were sampled. For each engine type, the following vehicle configurations were selected: 2 axle, 3 axle, tractor-trailer and bus. (Figure 1 shows pictorially the different vehicle configurations.) In total, there were fourteen different truck categories sampled in the CAPE-21 truck survey. These categories are listed in Table 1. For each of the categories listed in Table 1, the operational data were broken down into three types: freeway (F), non-freeway (N-F), and combined (freeway and non-freeway). For further information, Table 2 lists the number of trucks and buses sampled in the CAPE-21 survey for each of the categories shown in Table 1.

In order to avoid an unreasonable number of engine and chassis cycles (56 engine and chassis cycles could result if no category combinations were considered), the possibility of category combinations was examined. If possible, it would be highly desirable to have as few resulting cycles as possible.

The purpose of this report is to document the considerations and decision process used in arriving at the final categories for which H-D transient engine and chassis cycles were developed.

II. Summary

Objective

The objective of this report is to document the considerations and decision process used in selecting final vehicle categories for which heavy-duty (H-D) transient engine and transient chassis cycles were developed.

FIGURE 1

VEHICLE CONFIGURATION

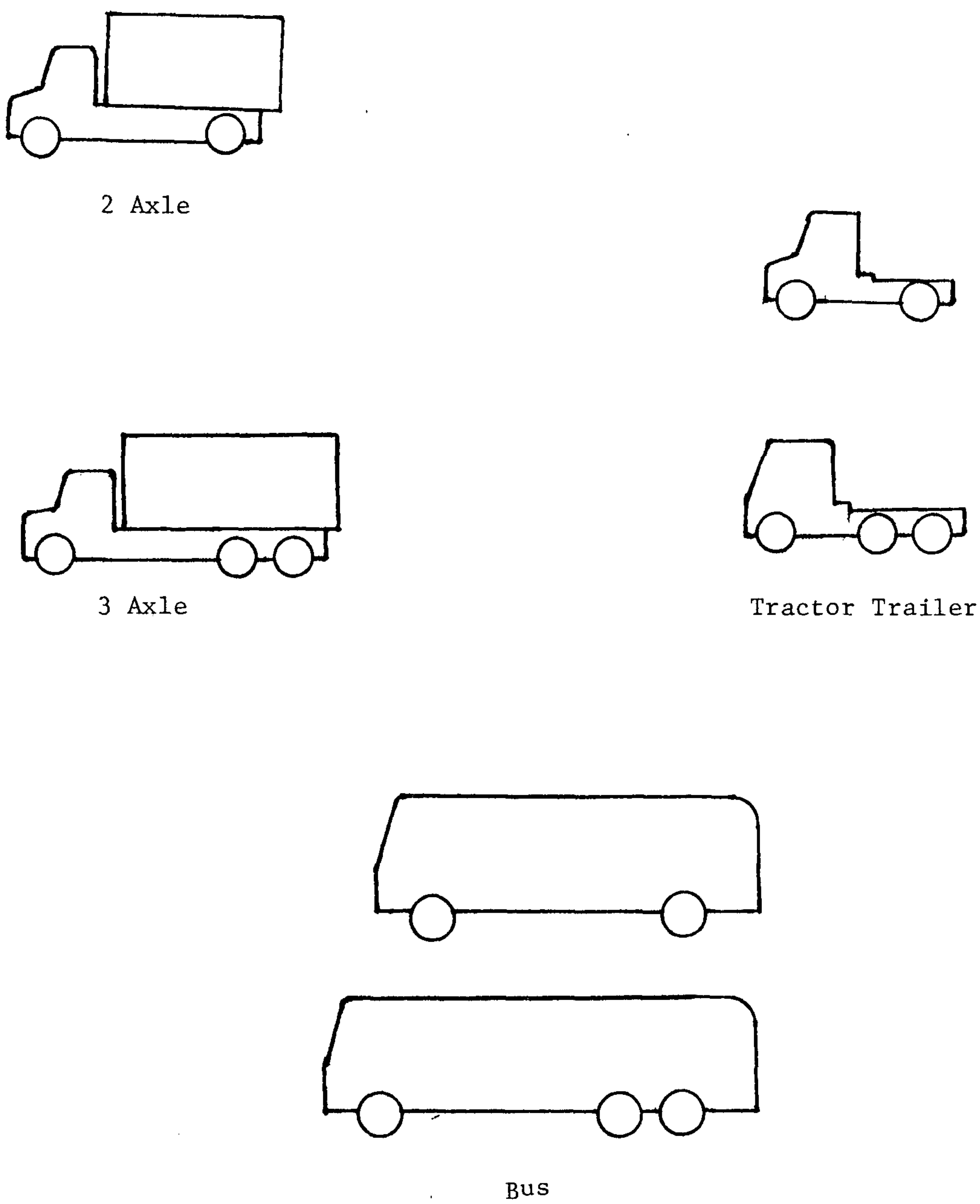

TABLE 1

TRUCK CATEGORIES SAMPLED IN THE CAPE-21 SURVEY

City	Vehicle Configuration	Engine Type
LA	2 axle	Gasoline
LA	3 axle	Gasoline
LA	Tractor-Trailer	Gasoline
NY	2 axle	Gasoline
NY	3 axle	Gasoline
NY	Tractor-Trailer	Gasoline
LA	2 axle	Diesel
LA	3 axle	Diesel
LA	Tractor-Trailer	Diesel
NY	2 axle	Diesel
NY	3 axle	Diesel
NY	Tractor-Trailer	Diesel
LA	Bus	Diesel
NY	Bus	Diesel

TABLE 2

NUMBER OF TRUCKS AND BUSES SAMPLED
IN THE CAPE-21 SURVEY

City and Fuel Type	Vehicle Configuration			
	2 Axle	3 Axle	Tractor-Trailer	Bus
Los Angeles, Gasoline	19	1	7	-
Los Angeles, Diesel	1	5	11	3
New York, Gasoline	26	1	3	-
New York, Diesel	1	5	8	4

Results

The approach taken in analyzing and selecting possible truck categories was to perform Z-tests and Aspin-Welch T-tests on differences between means for various parameters (mean, median, standard deviation, etc.) of %RPM, %POWER, and MPH. The following chassis cycle and engine cycle categories were selected based on the results of the statistical analysis and the use of engineering judgment.

Chassis Cycle Categories

Los Angeles gas and diesel trucks, non-freeway
New York gas and diesel trucks, non-freeway
Los Angeles gas and diesel trucks, freeway
New York gas and diesel trucks, freeway
Los Angeles and New York diesel busses, combined.

Engine Cycle Categories

Los Angeles gas trucks, non-freeway
Los Angeles gas trucks, freeway
New York gas trucks, non-freeway
New York gas trucks, freeway
Los Angeles diesel trucks, non-freeway
Los Angeles diesel trucks, freeway
New York diesel trucks, non-freeway
New York diesel trucks, freeway
Los Angeles and New York diesel buses, combined.

Conclusions

The categories selected above do represent a significant reduction in the total categories possible, and therefore reduce the overall complexity of the heavy-duty cycle development effort. The statistical analysis did not totally justify all category combinations (e.g. Los Angeles gasoline vehicles). However, engineering judgment and common sense provided adequate basis for selecting those categories not supported by statistical considerations.

III. Discussion

A. Data Analysis

The general approach taken in analyzing possible truck category combinations was to perform Z-tests and Aspin-Welch T-tests on differences between means for various parameters. For % RPM[1], % POWER[2], and MPH the means of the following parameters were examined:

- mean
- median
- standard deviation
- % zero speed
- % acceleration
- % cruise
- % deceleration
- % idle
- % motoring (% POWER data only)

Some of the parameters above may not be entirely clear to the reader. Therefore, those parameters which may fall in this category are defined below.

Parameter	Definition
% zero speed	the percent of operation when exactly "zero" MPH occurred
% acceleration	the percent of operation involving a positive change (increase) in the parameter being examined (MPH, % RPM, or % POWER)
% cruise	the percent of operation when no change occurs in the parameter being examined (MPH, %RPM, or % POWER)
% deceleration	the percent of operation involving a negative change (decrease) in the parameter being examined (MPH, % RPM, or % POWER)
% idle	for the road speed data it is the percent of operation when road speed (MPH) falls between 0 and 1 MPH ($0 \leq MPH < 1$) and for the % RPM data it is the percent of operation when exactly "zero" % RMP occurs

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[1] $$\%RPM = \frac{RPM - RPM_{IDLE}}{RPM_{RATED} - RPM_{IDLE}} \times 100$$

[2] Normalized to maximum value at each rpm.

It should be pointed out that only mean values of the parameters listed earlier were compared. For example, the mean of the medians for % RPM for a particular truck category would simply be the mean (average) of all the individual truck % RPM median values (for all trucks in the category). With this type of averaging procedure, each truck (or bus) is weighted equally. A truck with an unusually large amount of data would not weight the average more than a truck with a small amount of data.

To reiterate, Z-tests and Aspin-Welch T tests[3] were used in the category analysis extensively. Specifically, these statistical tests are used to determine whether a difference between truck categories exists (for the parameter in question). Olson Laboratories, EPA's heavy-duty cycle development contractor, performed all of the necessary significance tests. The results supplied by Olson will be presented and discussed later. These results, in conjunction with engineering judgment, provide the basis upon which combination of categories can be justified.

B. Results

The detailed results of the significance tests are presented in Appendix I. Significance tests (tests of differences between means) were performed at two different levels of significance (α): .01 and .05.

The test of differences between means at the larger significance level (.05) provides a more stringent statistical test. In other words, the test performed at a larger significance level will provide results that give one more assurance that the means may not be different, if the null hypothesis of equal means is not rejected.

The results of the test of differences between means, summarized in Appendix I, are presented in matrix form. Along the top and side of the matrix the various truck and bus categories are listed. A matrix of this type will provide a "box" some place in the body of the matrix for each possible category comparison. Of course, the matrix will be symmetric about the diagonal. Additionally, in the top half of the matrix, the "boxes" are split in half. This maneuver, plus the fact that the matrix is symmetric, enables one matrix to be used three times, independently.

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[3] The Aspin-Welch T-test is a modification of the standard T-test. Unlike the standard T-test, the Aspin-Welch significance test does not require equal variances.

One complete matrix is used for each parameter (e.g., mean of MPH means, mean of MPH medians, etc.). Freeway, non-freeway, and combined (freeway plus non-freeway) operation are all illustrated in the same matrix. Whenever a significant difference occurs, an "S" is placed in the appropriate "box." A dash (-) is placed in the "box" if a significant difference was not demonstrated. The blocked-out "boxes" indicate that the sample sizes were inadequate for a significance test to be performed. The results of the Z- and Aspin-Welch T-tests of differences between means of means, medians, and standard deviations (for % RPM, % POWER, and MPH) for the various category comparisons are depicted in this fashion. The remaining parameters are handled somewhat differently.

The remaining parameters of interest are shown below:

REMAINING PARAMETERS

% RPM	% POWER	MPH
% acceleration	% acceleration	% zero speed
% cruise	% cruise	% acceleration
% deceleration	% deceleration	% cruise
% idle	% motoring	% deceleration
		% idle

The approach taken for summarizing the results of the significance tests for these parameters was simply to note the number of significant differences arising among these parameters and placing the number in the appropriate "box" for the category in question (the same basic matrix representation as discussed earlier still applies). If no significant difference was found for a particular category comparison, a dash (-) was placed in the "box." The numbers appearing in the matrices could range from 1 to 4 for % RPM and % POWER and 1 to 5 for MPH. With this type of representation, the differentation between parameters is lost; however, these parameters do not have the same relative importance as the mean, median, and standard deviation. Of prime importance is how many significant differences appear among these parameters, and this information is reflected in the matrix.

Since the amount of information presented in Appendix I is somewhat overwhelming, an attempt was made to condense it into a more useful form. Figures 2 through 7 are the end result of this effort. To illustrate the use of these figures, Figure 2 will be used an example. Figure 2 summarizes the significance tests ($\alpha = .01$) performed on various category combinations for the non-freeway data. Again, the summary is presented in matrix form. The comparative parameters are listed on the vertical axis. On the horizontal axis are listed the various category combination comparisons of interest. For example, the category combination LA gas would represent the category comparisons shown below:

FIGURE 2

NON-FREEWAY OPERATION (α = .01)

COMPARATIVE PARAMETERS	LA Gas	LA Gas/NY Gas	LA Gas/LA Diesel	LA Gas/NY Diesel	LA Gas/LA Bus	LA Gas/NY Bus	NY Gas	NY Gas/LA Diesel	NY Gas/NY Diesel	NY Gas/LA Bus	NY Gas/NY Bus	LA Diesel	LA Diesel/NY Diesel	LA Diesel/LA Bus	LA Diesel/NY Bus	NY Diesel	NY Diesel/LA Bus	NY Diesel/NY Bus	LA Bus/NY Bus
Speed (MPH):																			
Means	✓	×	✓	×	✓	×	✓	×	✓	✓	✓	✓	×	✓	×	✓	×	✓	✓
Medians	✓	×	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	×	✓	×	✓	✓
Standard Deviations	✓	×	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	×	✓	×	✓	✓
% Zero, % Accel, % Cruise % Decel, & % Idle	✓	×	✓	×	×	×	✓	×	✓	×	×	✓	✓	×	×	✓	×	×	×
% RPM:																			
Means	×	×	×	×	×	✓	✓	×	✓	×	✓	✓	×	×	×	✓	×	✓	✓
Medians	✓	×	×	×	✓	×	✓	×	✓	×	✓	✓	×	✓	×	✓	×	✓	×
Standard Deviations	×	×	×	✓	×	✓	✓	×	×	×	✓	✓	×	×	✓	✓	✓	✓	✓
% Accel, % Cruise, % Decel, & % Idle	✓	×	×	×	✓	×	✓	×	✓	×	×	✓	×	✓	×	✓	×	×	×
% Power:																			
Means	✓	×	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	×	×	✓	✓	×	✓	✓
Medians	✓	×	✓	×	✓	×	✓	✓	✓	✓	×	✓	✓	✓	×	✓	✓	✓	✓
Standard Deviations	✓	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓
% Accel, % Cruise, % Decel, & % Motoring	✓	×	×	✓	×	×	✓	×	✓	×	×	✓	×	×	×	✓	×	×	×

(The column headings fall under the spanning heading CATEGORY COMBINATIONS.)

FIGURE 3

FREEWAY OPERATION (α = .01)

COMPARATIVE PARAMETERS	LA Gas	LA Gas/NY Gas	LA Gas/LA Diesel	LA Gas/NY Diesel	LA Gas/LA Bus	LA Gas/NY Bus	NY Gas	NY Gas/LA Diesel	NY Gas/NY Diesel	NY Gas/LA Bus	NY Gas/NY Bus	LA Diesel	LA Diesel/NY Diesel	LA Diesel/LA Bus	LA Diesel/NY Bus	NY Diesel	NY Diesel/LA Bus	NY Diesel/NY Bus	LA Bus/NY Bus
	CATEGORY COMBINATIONS																		
Speed (MPH):																			
Means	√	×	√	×	√	√	√	×	√	×	√	√	×	√	√	×	×	√	√
Medians	√	×	√	×	√	√	√	×	√	×	√	√	×	√	√	×	×	√	√
Standard Deviations	√	√	√	√	√	√	√	√	√	√	√	√	×	×	√	√	√	√	√
% Zero, % Accel, % Cruise, % Decel, & % Idle	√	×	√	×	×	×	√	×	√	×	×	√	×	×	×	×	×	×	√
% RPM:																			
Means	√	×	×	√	×	√	√	×	√	×	√	√	×	×	√	√	×	√	√
Medians	√	×	×	×	×	√	√	×	√	×	√	√	×	×	√	√	×	√	√
Standard Deviations	√	√	√	×	×	×	√	×	×	√	×	√	×	×	×	√	×	√	×
% Accel, % Cruise, % Decel, & % Idle	√	×	×	×	×	×	√	×	×	×	√	√	×	×	√	√	×	×	√
% Power:																			
Means	×	×	×	×	×	√	√	√	√	×	√	√	√	×	√	√	×	√	√
Medians	×	×	×	×	×	√	√	√	√	×	√	√	√	×	√	√	×	√	√
Standard Deviations	×	×	×	×	×	√	√	×	√	×	√	√	×	×	√	√	√	√	√
% Accel, % Cruise, % Decel, & % Motoring	×	×	×	×	×	×	√	×	√	√	×	×	√	×	×	√	√	×	√

FIGURE 4

COMBINED OPERATION (FREEWAY AND NON-FREEWAY) (α = .01)

COMPARATIVE PARAMETERS	LA Gas	LA Gas/NY Gas	LA Gas/LA Diesel	LA Gas/NY Diesel	LA Gas/LA Bus	LA Gas/NY Bus	NY Gas	NY Gas/LA Diesel	NY Gas/NY Diesel	NY Gas/LA Bus	NY Gas/NY Bus	LA Diesel	LA Diesel/NY Diesel	LA Diesel/LA Bus	LA Diesel/NY Bus	NY Diesel	NY Diesel/LA Bus	NY Diesel/NY Bus	LA Bus/NY Bus
Speed (MPH):																			
Means	✓	×	✓	×	✓	×	✓	×	✓	✓	✓	✓	×	✓	×	✓	✓	✓	✓
Medians	✓	×	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	×	✓	×	✓	✓
Standard Deviations	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	×	✓	×	✓	✓	×	✓
% Zero, % Accel, % Cruise, % Decel, & % Idle	✓	×	✓	×	×	×	✓	×	✓	×	×	✓	×	×	×	✓	×	×	✓
% RPM:																			
Means	✓	×	×	×	✓	×	✓	×	✓	×	✓	✓	×	×	×	✓	×	✓	✓
Medians	×	×	×	×	✓	×	✓	×	✓	×	×	✓	×	×	×	✓	×	✓	✓
Standard Deviations	×	×	×	✓	×	✓	✓	×	×	×	✓	✓	✓	×	✓	✓	×	✓	✓
% Accel, % Cruise, % Decel, & % Idle	✓	×	✓	×	✓	×	✓	×	✓	×	×	✓	×	✓	×	✓	×	×	✓
% Power:																			
Means	✓	×	✓	×	✓	×	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Medians	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	✓	✓	×	✓	✓	✓	✓
Standard Deviations	×	×	×	×	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
% Accel, % Cruise, % Decel, & % Motoring	✓	×	×	✓	×	×	✓	×	✓	×	✓	×	×	×	×	✓	×	×	×

FIGURE 5

NON-FREEWAY OPERATION

(α = .05)

COMPARATIVE PARAMETERS	LA Gas	LA Gas/NY Gas	LA Gas/LA Diesel	LA Gas/NY Diesel	LA Gas/LA Bus	LA Gas/NY Bus	NY Gas	NY Gas/LA Diesel	NY Gas/NY Diesel	NY Gas/LA Bus	NY Gas/NY Bus	LA Diesel	LA Diesel/NY Diesel	LA Diesel/LA Bus	LA Diesel/NY Bus	NY Diesel	NY Diesel/LA Bus	NY Diesel/NY Bus	LA Bus/NY Bus
	CATEGORY COMBINATIONS																		
Speed (MPH):																			
Means	✓	×	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	×	✓	×	✓	×
Medians	×	×	✓	×	×	×	✓	×	✓	×	✓	✓	×	✓	×	✓	×	✓	×
Standard Deviations	✓	×	✓	×	✓	×	✓	×	✓	×	×	✓	×	✓	×	✓	×	✓	×
% Zero, % Accel, % Cruise % Decel, & % Idle	×	×	✓	×	×	×	✓	×	✓	×	×	✓	×	×	×	✓	×	×	×
% RPM:																			
Means	×	×	×	×	×	×	✓	×	✓	×	×	✓	×	×	×	✓	×	✓	×
Medians	✓	×	×	×	✓	×	✓	×	✓	×	×	✓	×	✓	×	✓	×	✓	×
Standard Deviations	×	×	×	×	×	×	✓	×	×	×	×	✓	×	×	×	✓	×	✓	✓
% Accel, % Cruise, % Decel, & % Idle	×	×	×	×	✓	×	✓	×	✓	×	×	✓	×	✓	×	✓	×	×	×
% Power:																			
Means	✓	×	×	×	×	✓	✓	✓	✓	×	✓	✓	×	×	✓	✓	×	✓	×
Medians	✓	×	×	×	×	×	✓	✓	✓	×	×	✓	✓	×	×	✓	×	✓	✓
Standard Deviations	✓	×	×	×	✓	✓	✓	✓	×	✓	✓	×	×	×	✓	✓	×	✓	✓
% Accel, % Cruise, % Decel, & % Motoring	✓	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	✓	×	×	×

FIGURE 6

FREEWAY OPERATION

(α = .05)

COMPARATIVE PARAMETERS	LA Gas	LA Gas/NY Gas	LA Gas/LA Diesel	LA Gas/NY Diesel	LA Gas/LA Bus	LA Gas/NY Bus	NY Gas	NY Gas/LA Diesel	NY Gas/NY Diesel	NY Gas/LA Bus	NY Gas/NY Bus	LA Diesel	LA Diesel/NY Diesel	LA Diesel/LA Bus	LA Diesel/NY Bus	NY Diesel	NY Diesel/LA Bus	NY Diesel/NY Bus	LA Bus/NY Bus
Speed (MPH):																			
Means	√	×	×	×	√	×	√	×	√	×	√	√	×	√	×	×	×	√	×
Medians	√	×	√	×	√	×	√	×	×	×	√	√	×	√	×	×	×	√	×
Standard Deviations	√	√	×	×	×	√	√	×	×	√	√	×	×	×	√	√	√	×	√
% Zero, % Accel, % Cruise % Decel, & % Idle	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
% RPM:																			
Means	×	×	×	×	×	√	√	×	√	×	√	√	×	×	×	√	×	√	√
Medians	×	×	×	×	×	√	√	×	×	×	√	√	×	×	×	√	×	×	√
Standard Deviations	√	√	×	×	×	×	√	×	×	√	×	×	×	×	×	√	×	√	×
% Accel, % Cruise, % Decel, & % Idle	√	×	×	×	×	×	√	×	×	×	×	√	×	×	×	√	×	×	×
% Power:																			
Means	×	×	×	×	×	√	×	×	√	×	√	√	√	×	√	√	×	√	√
Medians	×	×	×	×	×	√	√	×	√	×	√	√	√	×	√	√	×	√	√
Standard Deviations	×	×	×	×	×	√	√	×	√	×	√	√	×	×	√	√	√	√	√
% Accel, % Cruise, % Decel, & % Motoring	×	×	×	×	×	×	√	×	√	√	×	×	×	×	×	√	√	×	×

FIGURE 7

COMBINED OPERATION (FREEWAY AND NON-FREEWAY) (α = .05)

COMPARATIVE PARAMETERS	LA Gas	LA Gas/NY Gas	LA Gas/LA Diesel	LA Gas/NY Diesel	LA Gas/LA Bus	LA Gas/NY Bus	NY Gas	NY Gas/LA Diesel	NY Gas/NY Diesel	NY Gas/LA Bus	NY Gas/NY Bus	LA Diesel	LA Diesel/NY Diesel	LA Diesel/LA Bus	LA Diesel/NY Bus	NY Diesel	NY Diesel/LA Bus	NY Diesel/NY Bus	LA Bus/NY Bus
Speed (MPH):																			
Means	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	×	×	×	✓	×	×	✓
Medians	✓	×	✓	×	✓	×	✓	×	✓	×	✓	✓	×	×	×	✓	×	✓	×
Standard Deviations	✓	×	✓	×	✓	×	✓	×	×	✓	×	✓	×	✓	×	×	✓	×	✓
% Zero, % Accel, % Cruise, % Decel, & % Idle	✓	×	✓	×	×	×	✓	×	✓	×	×	✓	×	×	×	✓	×	×	×
% RPM:																			
Means	×	×	×	×	×	×	✓	×	✓	×	✓	✓	×	×	×	✓	×	✓	✓
Medians	×	×	×	×	×	×	✓	×	✓	×	×	✓	×	×	×	✓	×	✓	×
Standard Deviations	×	×	×	×	×	✓	✓	×	×	×	×	✓	✓	×	✓	✓	×	✓	✓
% Accel, % Cruise, % Decel, & % Idle	×	×	×	×	×	×	✓	×	✓	×	×	✓	×	×	×	✓	×	×	×
% Power:																			
Means	✓	×	×	×	✓	×	✓	×	✓	✓	✓	✓	×	✓	×	✓	×	✓	×
Medians	✓	×	✓	×	✓	×	✓	×	✓	✓	×	✓	✓	✓	×	✓	✓	✓	✓
Standard Deviations	×	×	×	×	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓
% Accel, % Cruise, % Decel, & % Motoring	✓	×	×	✓	×	×	✓	×	×	×	×	×	×	×	×	✓	×	×	×

	LA 2A Gas	LA 3A Gas	SA TT Gas
LA 2A Gas			
LA 3A Gas			
LA TT Gas			

In the body of the matrix, a check (√) indicates that no significant differences were found for any comparisons within the category being examined (e.g., LA gas). An "X" indicates that at least one significant difference appeared. If one wanted to know if NY gas, non-freeway, for example, would be an appropriate category, he would simply examine the "boxes" under NY gas on Figure 2. For this example, checks appear in all the boxes, thus no significant differences were found when comparing NY 2 axle gas, NY 3 axle gas, and NY tractor trailer gas trucks. Consequently, it would be appropriate to combine all NY gas truck, non-freeway data into one category. This category combination would be valid for the speed (MPH), % RPM, and % POWER data.

Tables 3 through 11 list various summary statistics associated with the CAPE-21 data base. Means of means, medians, and standard deviations are listed. Also, corresponding standard deviations are shown in parentheses. These statistics are broken into truck categories, city type, and road type.

Table 12 shows the number of records in each category. Table 13 presents the same information as in Table 12, but in normalized fashion. That is, each number is given in percent of the total. This table will give the reader a feel for the size of each individual truck category as compared to the entire data base.

Finally, summary statistics for the following parameters are given in Appendix II:

<u>% RPM</u>	<u>% POWER</u>	<u>MPH</u>
% acceleration	% acceleration	% zero
% cruise	% cruise	% acceleration
% deceleration	% deceleration	% cruise
% idle	% motoring	% deceleration
		% idle

Again, means and standard deviations of the above parameters are presented. These statistics are considered of secondary importance when compared to those in Tables 3 through 11. Regardless, they are given in an attempt for completeness. It should be pointed out that the statistics in

TABLE 3

CAPE-21 % RPM SUMMARY STATISTICS - MEANS OF MEANS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	55 (9)*	24 (9)	34 (12)	44 (13)	15 (8)	18 (8)
3 Axle	77 (-)	39 (-)	50 (-)	49 (-)	17 (-)	20 (-)
Tractor Trailer	69 (11)	34 (6)	51 (13)	53 (29)	23 (23)	27 (29)
Diesel:						
2 Axle	81 (-)	44 (-)	61 (-)	41 (-)	16 (-)	16 (-)
3 Axle	81 (6)	43 (12)	62 (14)	55 (26)	27 (13)	32 (16)
Tractor Trailer	84 (8)	49 (5)	66 (8)	56 (14)	23 (10)	31 (18)
Diesel Buses	60 (4)	35 (3)	37 (6)	53 (13)	25 (6)	25 (6)

*standard deviation

TABLE 4

CAPE-21 % RPM SUMMARY STATISTICS - MEANS OF MEDIANS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	61 (9)*	23 (12)	36 (17)	47 (14)	8 (9)	11 (10)
3 Axle	80 (-)	38 (-)	69 (-)	52 (-)	1 (-)	5 (-)
Tractor Trailer	73 (11)	31 (9)	61 (17)	51 (43)	20 (34)	25 (42)
Diesel:						
2 Axle	84 (-)	52 (-)	78 (-)	41 (-)	1 (-)	1 (-)
3 Axle	87 (4)	42 (28)	70 (26)	57 (36)	15 (12)	24 (28)
Tractor Trailer	87 (8)	53 (19)	80 (7)	64 (17)	6 (13)	18 (30)
Diesel Buses	62 (3)	37 (7)	40 (11)	63 (11)	2 (3)	2 (3)

*Standard deviation

TABLE 5

CAPE-21 % RPM SUMMARY STATISTICS - MEANS OF STANDARD DEVIATIONS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	18 (5)*	21 (5)	23 (4)	22 (8)	19 (6)	21 (6)
3 Axle	13 (-)	36 (-)	36 (-)	19 (-)	23 (-)	24 (-)
Tractor Trailer	19 (5)	32 (6)	31 (5)	22 (5)	25 (14)	24 (11)
Diesel:						
2 Axle	13 (-)	38 (-)	35 (-)	34 (-)	25 (-)	25 (-)
3 Axle	22 (7)	38 (2)	35 (7)	30 (3)	32 (9)	34 (7)
Tractor Trailer	14 (5)	39 (4)	34 (8)	28 (7)	29 (8)	31 (8)
Diesel Buses	21 (1)	30 (2)	30 (2)	35 (4)	31 (5)	31 (5)

*Standard deviation

TABLE 6

CAPE-21 % POWER SUMMARY STATISTICS - MEANS OF MEANS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	56 (14)*	33 (9)	42 (14)	50 (11)	23 (9)	25 (9)
3 Axle	54 (-)	24 (-)	34 (-)	74 (-)	28 (-)	33 (-)
Tractor Trailer	69 (7)	32 (7)	49 (9)	51 (20)	22 (18)	27 (25)
Diesel:						
2 Axle	55 (-)	16 (-)	36 (-)	41 (-)	19 (-)	19 (-)
3 Axle	55 (9)	27 (12)	42 (15)	44 (21)	22 (13)	25 (15)
Tractor Trailer	48 (12)	27 (6)	39 (12)	48 (22)	16 (8)	23 (16)
Diesel Buses	69 (5)	36 (5)	39 (9)	43 (33)	20 (10)	20 (10)

*Standard deviation

TABLE 7

CAPE-21 % POWER SUMMARY STATISTICS - MEANS OF MEDIANS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	59 (18)*	25 (14)	43 (23)	51 (19)	9 (8)	11 (9)
3 Axle	53 (-)	5 (-)	25 (-)	87 (-)	4 (-)	5 (-)
Tractor Trailer	80 (9)	17 (8)	50 (18)	49 (42)	13 (17)	25 (37)
Diesel:						
2 Axle	58 (-)	5 (-)	34 (-)	36 (-)	4 (-)	4 (-)
3 Axle	57 (15)	17 (19)	38 (27)	45 (26)	12 (17)	18 (22)
Tractor Trailer	47 (16)	15 (9)	34 (18)	54 (30)	7 (7)	15 (24)
Diesel Buses	82 (10)	18 (7)	28 (16)	54 (50)	4 (0)	4 (0)

*Standard deviation

TABLE 8

CAPE-21 % POWER SUMMARY STATISTICS - MEANS OF STANDARD DEVIATIONS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	26 (4)*	33 (4)	32 (4)	33 (6)	31 (6)	32 (5)
3 Axle	28 (-)	32 (-)	34 (-)	31 (-)	38 (-)	40 (-)
Tractor Trailer	32 (3)	36 (5)	38 (2)	35 (8)	30 (8)	31 (8)
Diesel:						
2 Axle	26 (-)	21 (-)	31 (-)	37 (-)	31 (-)	31 (-)
3 Axle	30 (3)	31 (4)	33 (3)	30 (6)	28 (7)	29 (6)
Tractor Trailer	26 (4)	31 (4)	31 (4)	30 (8)	25 (6)	28 (8)
Diesel Buses	34 (1)	39 (5)	39 (5)	30 (18)	28 (12)	28 (12)

*Standard deviation

TABLE 9

CAPE-21 SPEED (MPH) SUMMARY STATISTICS - MEANS OF MEANS

TRUCK TYPE	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	43 (6)*	17 (4)	26 (8)	30 (9)	9 (4)	11 (5)
3 Axle	46 (-)	12 (-)	22 (-)	37 (-)	10 (-)	13 (-)
Tractor Trailer	44 (5)	15 (3)	29 (8)	33 (17)	11 (10)	14 (16)
Diesel:						
2 Axle	47 (-)	13 (-)	28 (-)	16 (-)	6 (-)	6 (-)
3 Axle	44 (6)	15 (4)	29 (8)	24 (11)	9 (5)	12 (6)
Tractor Trailer	47 (5)	17 (3)	32 (8)	31 (5)	9 (3)	14 (7)
Diesel Buses	46 (2)	17 (3)	20 (6)	21 (12)	8 (2)	8 (2)

*Standard deviation

TABLE 10

CAPE-21 SPEED (MPH) SUMMARY STATISTICS - MEANS OF MEDIANS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	48 (5)*	16 (7)	27 (12)	32 (10)	6 (5)	7 (6)
3 Axle	49 (-)	8 (-)	18 (-)	39 (-)	4 (-)	5 (-)
Tractor Trailer	48 (4)	11 (3)	32 (15)	31 (27)	6 (10)	12 (19)
Diesel:						
2 Axle	51 (-)	11 (-)	28 (-)	13 (-)	1 (-)	1 (-)
3 Axle	50 (6)	10 (7)	33 (15)	26 (14)	5 (4)	7 (7)
Tractor Trailer	51 (5)	13 (6)	34 (14)	33 (7)	3 (3)	9 (12)
Diesel Buses	50 (2)	16 (5)	20 (6)	24 (14)	5 (3)	5 (3)

*Standard deviation

TABLE 11

CAPE-21 SPEED (MPH) SUMMARY STATISTICS - MEANS OF STANDARD DEVIATIONS

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	14 (4)*	14 (2)	18 (2)	13 (4)	10 (3)	12 (3)
3 Axle	12 (-)	14 (-)	20 (-)	13 (-)	14 (-)	16 (-)
Tractor Trailer	13 (3)	15 (4)	19 (2)	14 (5)	13 (7)	14 (8)
Diesel:						
2 Axle	10 (-)	12 (-)	21 (-)	14 (-)	9 (-)	9 (-)
3 Axle	14 (3)	14 (2)	20 (2)	13 (6)	11 (5)	13 (3)
Tractor Trailer	10 (4)	15 (4)	19 (3)	16 (3)	11 (3)	15 (3)
Diesel Buses	14 (1)	13 (1)	15 (3)	11 (3)	9 (2)	9 (2)

*Standard deviation

TABLE 12

NUMBER OF RECORDS* IN EACH CATEGORY

TRUCK TYPE	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	327561	559258	886819	152914	1180897	1333811
3 Axle	18445	45462	63907	3835	34189	38024
Tractor Trailer	192473	200812	393285	20642	162718	183360
Diesel:						
2 Axle	15943	19344	35287	1861	125974	127835
3 Axle	217492	150314	367806	65720	287200	352920
Tractor Trailer	243402	259971	503373	116731	425779	542510
Diesel Buses	41555	253845	295400	3282	541393	544675

* 1 Record = .864 sec.

TABLE 13

AMOUNT OF OPERATION AS PERCENT OF THE TOTAL

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	37%	63%	100%	11%	89%	100%
3 Axle	29%	71%	100%	10%	90%	100%
Tractor Trailer	49%	51%	100%	11%	89%	100%
ALL GAS	40%	60%	100%	11%	89%	100%
Diesel:						
2 Axle	45%	55%	100%	1%	99%	100%
3 Axle	59%	41%	100%	19%	81%	100%
Tractor Trailer	48%	52%	100%	22%	78%	100%
ALL DIESEL	53%	47%	100%	18%	82%	100%
Diesel Buses	14%	86%	100%	1%	99%	100%
ALL TRUCKS	45%	55%	100%	14%	86%	100%
ALL TRUCKS & BUSES	42%	58%	100%	12%	88%	100%

Appendix II, in addition to statistics listed in Tables 3 through 11, were used directly in the testing of differences between means of various category comparisons.

C. Interpretation of Results

In essence, Figures 2 through 7 were used as the basis for selecting possible category combinations. The data in Tables 3 through 13 were also relied upon in marginal cases. The mean, median, and standard deviation were considered the most important parameters listed in Figures 2 through 7. If a difference appeared in one of these parameters, in most cases the category combination being considered was judged not appropriate. The remaining parameters (% zero, % acceleration, etc.) were of secondary importance and did not eliminate consideration of a category combination if a significant difference showed up among them. However, if a difference did appear, the data listed in Tables 3 through 13 were closely scrutinized before a final conclusion was reached.

It was decided for both chassis and engine cycle categories that the freeway and non-freeway data would not be combined (except for buses). This decision will enable separate "highway" (freeway) and "city" (non-freeway) emission and fuel economy values to be quoted if the need arises. Combined operation was considered for the buses because of the small amount of freeway operation for this category (refer to Tables 12 and 13).

The same cycle categories for both chassis cycles and engine cycles was not an absolute requirement. Therefore, chassis cycle and engine cycle category selection are addressed separately. The similarity between the two will then be discussed and the final conclusion stated.

Chassis Cycle Category Selection

As stated earlier combined operation will not be considered (except for the buses); therefore, Figures 4 and 7 are not of interest in this analysis. Figures 2, 3, 5, and 6, however, will be closely examined.

For chassis cycle category selection, the speed (MPH) parameters are of importance. When no significant differences appear among the speed parameters for the category in question, a valid chassis cycle category (refer to Figures 2, 3, 5, and 6) is indicated. The valid category combination choices (as demonstrated by no significant differences) are summarized below. Possible choices at two significance levels (α = .01 and .05) are presented.

VALID CATEGORY COMBINATIONS

α* = .01		α = .05	
Non-freeway	Freeway	Non-freeway	Freeway
LA gas	LA gas	----	LA gas
NY gas	NY gas	NY gas	----
LA diesel	LA diesel	LA diesel	----
NY diesel	----	NY diesel	----
LA gas & LA diesel	LA gas & LA diesel	LA gas & LA diesel	----
NY gas & NY diesel	NY gas & NY diesel	NY gas & NY diesel	----
----	LA bus & NY bus	----	----

The category combination for which a difference(s) appeared only among % zero, % acceleration, % cruise, % deceleration, and idle are listed below. These categories are classified as possible category combinations. If necessary, the data in Tables 3 through 13 can be relied upon to substantiate these category combinations. Engineering judgment will have to be relied upon for any resulting conclusion, though.

OTHER POSSIBLE CATEGORY COMBINATIONS

α = .01		α = .05	
Non-freeway	Freeway	Non-freeway	Freeway
LA gas & LA bus	LA gas & LA bus	----	----
----	LA gas & NY bus	----	----
NY gas & NY bus	NY gas & NY bus	----	NY gas & NY bus
LA diesel & LA bus	----	LA diesel & LA bus	----
----	LA diesel & NY bus	----	----
NY diesel & NY bus	NY diesel & NY bus	NY diesel & NY bus	----
LA bus & NY bus	----	----	----

Figures 4 and 7 demonstrate that the LA and NY bus combined is a valid category at a significance level of .01, but not at .05.

The tables above demonstrate that at a significance level of .01, LA gas and LA diesel, and NY gas and NY diesel are valid categories for chassis cycles. At α = .05, both categories remain valid for the non-freeway data, but not the freeway data. It should be pointed out that even though LA gas and LA diesel proves to be a valid category at the .05 level, the category consisting of only LA gas does not. This fact

*significance level

makes any other combinations with LA gas (e.g., LA gas and LA diesel) inappropriate. However, the data in Tables 9, 10, and 11 indicate that for the freeway data (and non-freeway data) the means of means, medians, and standard deviations are quite close. Although these categories are not supported by the statistical tests at $\alpha = .05$, they do appear reasonable. Furthermore, they are valid at the .01 level and the means of the various parameters appear similar from an engineering standpoint.

It appears from the statistical test results that if there is any hope to reduce the number of categories listed in Table 1, a significance level of .01 will have to be deemed adequate. This applies not only for the chassis cycle selection, but also to the engine cycle selection. Bearing this fact in mind, the following categories can be considered appropriate for chassis cycles.

LA gas and diesel trucks, non-freeway
NY gas and diesel trucks, non-freeway
LA gas and diesel trucks, freeway
LA gas and diesel trucks, freeway
LA and NY diesel buses, combined

With the exception of the bus category, the above categories were used in the generation of chassis cycles. It was decided not to combine LA buses and NY buses in one category. Instead, chassis cycles were generated for both LA buses and NY buses, separately. Due to the small amount of bus freeway operation, the freeway and non-freeway data were combined.

Engine Cycle Category Selection

Like the chassis cycle category analysis, Figures 2, 3, 5, and 6 are relied upon to identify possible engine category combinations for the trucks. These figures summarize significant differences in the non-freeway and freeway data separately for various category combinations. For the buses only, the freeway and non-freeway data were combined. This decision was justified by the very small amount of freeway operation by the buses (refer to Tables 12 and 13). The impact of this decision is that the only category combination that can possibly be considered for the LA buses and NY buses is combining them. The buses cannot be combined with any of the truck categories, since it was jointly decided, to maintain differentiation between the freeway and non-freeway data in the truck category combinations.

% RPM and % POWER are the parameters of prime importance during engine cycle category selection. As for the chassis cycles, when no significant differences appear among the parameters in question, a valid engine cycle category is possible. The chart below summarizes the conclusions reached from Figures 2, 3, 5, and 6.

VALID CATEGORY COMBINATIONS

% RPM Only

α = .01 Non-freeway	α = .01 Freeway	α = .05 Non-freeway	α = .05 Freeway
----	LA gas	----	----
NY gas	NY gas	NY gas	NY gas
LA diesel	LA diesel	LA diesel	----
NY diesel	NY diesel	NY diesel	NY diesel

% POWER Only

α = .01 Non-freeway	α = .01 Freeway	α = .05 Non-freeway	α = .05 Freeway
LA gas	----	LA gas	----
NY gas	NY gas	NY gas	----
LA diesel	----	----	----
NY diesel	NY diesel	NY diesel	NY diesel
NY gas & NY diesel	NY gas & NY diesel	----	NY gas & NY diesel

Since for engine cycles % RPM and % POWER are of equal importance, a possible category combination should have no significant differences in both parameters. The chart below lists those category combinations which meet this requirement.

VALID CATEGORY COMBINATIONS

% RPM and % POWER

α = .01 Non-freeway	α = .01 Freeway	α = .05 Non-freeway	α = .05 Freeway
NY gas	NY gas	NY gas	----
LA diesel	----	----	----
NY diesel	NY diesel	NY diesel	NY diesel

The category combinations for which no significant difference appeared among the means, medians, and standard deviations are shown below:

POSSIBLE CATEGORY COMBINATIONS

% RPM and % POWER

α = .01		α = .05	
Non-freeway	Freeway	Non-freeway	Freeway
NY gas	NY gas	NY gas	----
LA diesel	LA diesel	----	----
NY diesel	NY diesel	NY diesel	NY diesel

By loosening the criteria for category combination only one additional prospect shows up: LA diesel. This result is an indication that there is no real hope to further combine truck categories. At least it appears that NY gas, NY diesel, and LA diesel are valid categories for both freeway and non-freeway operation. For mere congruency one would wish that the LA gas trucks could be combined into one category, but there are some drastic differences among the % RPM and % POWER parameters for the LA gas trucks (2 axle, 3 axle, and tractor trailer). Tables 4 though 9 illustrate this fact.

No sound argument can be made, from a statistical standpoint, for combining LA gas trucks. However, from a practical standpoint one could argue for combining LA gas trucks. If the LA gas trucks weren't combined an unnecessarily complex and long test procedure would result. Another important consideration is the limited nature of the CAPE-21 data base itself (refer to Table 2). Only a small sample of trucks were tested in total; consequently very small samples exist for most of the individual truck categories listed in Figure 2. Not only do these small sample sizes reduce one's confidence in the data, but also jeopardize the representativeness of the data.

The statistical tests on the means, medians, and standard deviations of % RPM demonstrate that the freeway data for the LA gas trucks may be combined (at α = .01). Also the statistical tests indicate that the non-freeway data for those trucks can be combined when % POWER is evaluated alone. From a practical viewpoint, it is probably worthwhile to make LA gas a category even though the statistical analysis doesn't totally support such a decision. Table 14 summarizes the averages of the means, medians, and standard deviations for 2 axle, 3 axle, and tractor trailer LA gas trucks. This table should give the reader a feel for the magnitude of the differences among the categories that are accepted when LA gas trucks are combined.

Figures 4 and 7 were used to determine if the LA diesel buses and NY diesel buses could be legitimately combined. At a significance level of .01 the LA buses and NY buses had no significant differences in the

TABLE 14

CAPE-21 SUMMARY STATISTICS FOR LOS ANGELES GASOLINE TRUCKS

% RPM

TRUCK TYPE	STATISTIC					
	MEAN		MEDIAN		STANDARD DEVIATION	
	ROAD TYPE		ROAD TYPE		ROAD TYPE	
	Freeway	Non-Freeway	Freeway	Non-Freeway	Freeway	Non-Freeway
2 Axle	55	24	61	23	18	21
3 Axle	77	39	80	38	13	36
Tractor Trailer	69	34	73	31	19	32

% POWER

TRUCK TYPE	STATISTIC					
	MEAN		MEDIAN		STANDARD DEVIATION	
	ROAD TYPE		ROAD TYPE		ROAD TYPE	
	Freeway	Non-Freeway	Freeway	Non-Freeway	Freeway	Non-Freeway
2 Axle	56	33	59	25	26	33
3 Axle	54	24	53	5	28	32
Tractor Trailer	69	32	80	17	32	36

various % RPM and % POWER parameters. Therefore, LA buses and NY buses would be a reasonable category combination.

In brief summary, the following categories are deemed appropriate for engine cycles:

LA gas trucks, non-freeway
LA gas trucks, freeway
NY gas trucks, non-freeway
NY gas trucks, freeway
LA diesel trucks, non-freeway
LA diesel trucks, freeway
NY diesel trucks, non-freeway
NY diesel trucks, freeway
LA and NY diesel buses, combined

In the generation of engine cycles, these categories were used with the exception of LA and NY buses. LA and NY buses were not combined, since it was decided to maintain the city stratification throughout the engine cycle categories. Also, it should be noted that the statistical analysis does not support the combining of all the LA trucks. This combination was selected based on practical considerations.

D. Summary and Conclusions

The approach taken in analyzing and selecting possible truck category combinations was to perform Z-tests and Aspin-Welch T-tests on differences between means for various parameters (mean, median, standard deviation, etc.) of % RPM, % POWER, and MPH. In conjunction with the statistical analysis, engineering judgment was exercised where appropriate.

The end result of the analysis was possible categories for transient H-D engine and chassis cycles. The chassis cycle categories selected are listed below.

Chassis Cycle Categories

LA gas and diesel trucks, non-freeway
NY gas and diesel trucks, non-freeway
LA gas and diesel trucks, freeway
LA gas and diesel trucks, freeway
LA and NY diesel buses, combined

The engine cycle categories selected are shown below:

Engine Cycle Categories

LA gas trucks, non-freeway
LA gas trucks, freeway
NY gas trucks, non-freeway
NY gas trucks, freeway
LA diesel trucks, non-freeway
LA diesel trucks, freeway
NY diesel trucks, non-freeway
NY diesel trucks, freeway
LA and NY diesel buses, combined

It should be noted that the combination of the LA gas trucks was supported by practical considerations more than by statistical considerations.

It is worthwhile noting that for chassis cycle categories the stratifying parameters are city type (LA and NY) and road types (freeway and non-freeway). Engine type was not an influencing variable. This fact implies that traffic flow is the sole factor controlling H-D vehicle driving patterns.

For the engine cycle categories, engine type does appear as an influencing factor of H-D vehicle driving patterns. This is not surprising, since gasoline and diesel engines have inherent design differences.

In conclusion, the above categories selected for engine and chassis cycles are, in general, supported by statistical considerations. However, the statistical tests do have limitations. In particular, the tests used assumed normality. Most of the truck and bus data, in reality, were not normal. This characteristic indicates that non-parametric statistical tests should have been used in the category analysis. In any event, engineering judgment and common sense were used to a large degree jointly with the available statistical test results to arrive at reasonable categories. The categories selected do represent a significant reduction in the total categories possible, and reduce the overall complexity of the H-D cycle development effort.

APPENDIX I

RESULTS OF ASPIN-WELCH T-TESTS

AND Z-TESTS OF DIFFERENCES

BETWEEN MEANS

SPEED (MPH) – (MEANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– / –	– / –	S / S	– / –	– / –	– / –	– / –	– / S	S / S	S / S	S / S	– / –	S / S
LA 3A GAS	–	■	– / –	– / –	■	– / –	■	– / –	– / –	■	– / S	– / S	– / –	– / –
LA TT GAS	–	–	■	S / S	– / –	– / –	– / –	– / –	– / –	S / S	– / S	S / S	– / –	S / S
NY 2A GAS	S	S	S	■	– / –	– / –	– / –	S / S	S / S	– / –	– / –	– / –	S / S	– / –
NY 3A GAS	–	■	–	–	■	– / –	■	– / –	– / S	■	– / –	– / –	– / S	– / –
NY TT GAS	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –
LA 2A DIESEL	–	■	–	S	■	–	■	– / –	– / –	■	– / S	– / S	– / –	S / S
LA 3A DIESEL	–	–	–	S	S	–	–	■	– / –	S / S	– / S	S / S	– / –	S / S
LA TT DIESEL	–	–	–	S	S	–	–	–	■	S / S	S / S	S / S	– / –	S / S
NY 2A DIESEL	S	■	S	–	■	–	■	S	S	■	– / –	– / S	S / S	– / –
NY 3A DIESEL	S	–	S	–	–	–	S	S	S	–	■	– / –	S / S	– / –
NY TT DIESEL	S	–	S	–	–	–	–	S	S	–	–	■	S / S	– / –
LA BUSES DIESEL	–	–	–	–	–	–	–	–	S	S	–	–	■	S / S
NY BUSES DIESEL	S	S	S	–	S	–	S	S	S	–	–	S	–	■

Legend: N / F — N = NON-FREEWAY, F = FREEWAY (above diagonal); below diagonal = COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

SPEED (MPH) - (MEANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	- / -	- / -	S / S	- / -	- / -	- / -	- / -	- / -	S / S	- / -	S / S	- / -	S / -
LA 3A GAS	-	■	- / -	- / -	■	- / -	■	- / -	- / -	■	- / -	- / S	- / -	- / -
LA TT GAS	-	-	■	S / S	- / -	- / -	- / -	- / -	- / -	S / S	- / -	S / S	- / -	S / -
NY 2A GAS	S	-	S	■	- / -	- / -	- / -	- / S	S / S	- / -	- / -	- / -	- / S	- / -
NY 3A GAS	-	■	-	-	■	- / -	■	- / -	- / -	■	- / -	- / -	- / S	- / -
NY TT GAS	-	-	-	-	-	■	- / -	- / -	- / -	- / -	- / -	- / -	- / -	- / -
LA 2A DIESEL	-	■	-	S	■	-	■	- / -	- / -	■	- / -	- / S	- / -	- / -
LA 3A DIESEL	-	-	-	S	-	-	-	■	- / -	- / S	- / -	- / S	- / -	- / -
LA TT DIESEL	-	-	-	S	-	-	-	-	■	S / S	- / S	S / S	- / -	S / -
NY 2A DIESEL	-	■	S	-	■	-	■	S	S	■	- / -	- / S	S / S	- / -
NY 3A DIESEL	S	-	S	-	-	-	S	S	S	-	■	- / -	- / -	- / -
NY TT DIESEL	S	-	S	-	-	-	-	S	S	-	-	■	- / S	- / -
LA BUSES DIESEL	-	-	-	-	-	-	-	-	-	-	-	-	■	- / -
NY BUSES DIESEL	S	S	S	-	-	-	S	S	S	-	-	-	-	■

N / F — N: NON-FREEWAY, F: FREEWAY; COMBINED (below diagonal)

(S - DENOTES A SIGNIFICANT DIFFERENCE)

SPEED (MPH) – (MEDIANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– / –	S / –	S / S	S / –	– / –	– / –	– / –	– / –	S / S	S / S	S / S	– / –	S / S
LA 3A GAS	–	■	– / –	– / –	■	– / –	■	– / –	– / –	■	– / –	– / S	S / –	– / –
LA TT GAS	–	–	■	S / S	S / S	– / –	– / –	– / –	– / –	S / S	S / S	S / S	– / –	S / S
NY 2A GAS	S	–	S	■	– / –	– / –	– / –	– / S	S / S	– / S	– / –	– / –	– / S	– / –
NY 3A GAS	–	■	–	–	■	– / –	■	– / S	– / S	■	– / –	– / –	S / S	– / –
NY TT GAS	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –
LA 2A DIESEL	–	■	–	S	■	–	■	– / –	– / –	■	– / –	– / S	– / –	– / –
LA 3A DIESEL	–	–	–	S	–	–	–	■	– / –	– / S	– / S	– / S	– / –	– / S
LA TT DIESEL	–	–	–	S	S	–	–	–	■	S / S	S / S	S / S	– / –	S / S
NY 2A DIESEL	S	■	S	–	■	–	■	S	S	■	– / –	– / S	S / S	– / –
NY 3A DIESEL	S	–	S	–	–	–	S	S	S	–	■	– / –	S / S	– / –
NY TT DIESEL	S	–	S	–	–	–	–	S	S	–	–	■	S / S	– / –
LA BUSES DIESEL	–	–	–	–	S	–	–	–	S	S	S	–	■	S / S
NY BUSES DIESEL	S	S	S	–	–	–	S	S	S	–	–	–	S	■

N\F: N – NON-FREEWAY; F – FREEWAY

Below diagonal: COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

SPEED (MPH) - (MEDIANS)

ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	N: – F: –	N: – F: –	N: S F: S	N: – F: –	N: – F: –	N: – F: –	N: – F: –	N: – F: –	N: – F: S	N: S F: –	N: S F: S	N: – F: –	N: S F: –
LA 3A GAS	–	■	N: – F: –	N: – F: –	■	N: – F: –	■	N: – F: –	N: – F: –	■	N: – F: –	N: – F: –	N: – F: –	N: – F: –
LA TT GAS	–	–	■	N: S F: S	N: S F: –	N: – F: –	N: – F: –	N: – F: –	N: – F: –	N: S F: S	N: – F: –	N: S F: S	N: – F: –	N: – F: –
NY 2A GAS	S	–	S	■	N: – F: –	N: – F: –	N: – F: –	N: – F: S	N: S F: S	N: – F: –	N: – F: –	N: – F: –	N: – F: S	N: – F: –
NY 3A GAS	–	■	–	–	■	N: – F: –	■	N: – F: –	N: – F: S	■	N: – F: –	N: – F: –	N: S F: S	N: – F: –
NY TT GAS	–	–	–	–	–	■	N: – F: –	N: – F: –	N: – F: –	N: – F: –	N: – F: –	N: – F: –	N: – F: –	N: – F: –
LA 2A DIESEL	–	■	–	S	■	–	■	N: – F: –	N: – F: –	■	N: – F: –	N: – F: S	N: – F: –	N: – F: –
LA 3A DIESEL	–	–	–	–	–	–	–	■	N: – F: –	N: – F: S	N: – F: –	N: – F: S	N: – F: –	N: – F: –
LA TT DIESEL	–	–	–	S	–	–	–	–	■	N: – F: S	N: S F: –	N: S F: S	N: – F: –	N: S F: –
NY 2A DIESEL	–	■	–	–	■	–	■	–	–	■	N: – F: –	N: – F: S	N: S F: S	N: – F: –
NY 3A DIESEL	S	–	S	–	–	–	S	–	S	–	■	N: – F: –	N: – F: –	N: – F: –
NY TT DIESEL	S	–	S	–	–	–	–	–	S	–	–	■	N: – F: S	N: – F: –
LA BUSES DIESEL	–	–	–	–	S	–	–	–	–	S	–	–	■	N: – F: –
NY BUSES DIESEL	S	S	S	–	–	–	S	–	S	–	–	–	–	■

F ← FREEWAY; N ← NON-FREEWAY; COMBINED (below diagonal)

(S - DENOTES A SIGNIFICANT DIFFERENCE)

SPEED (MPH) - (STANDARD DEVIATIONS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	-/-	-/-	S/-	-/-	-/-	-/-	-/-	-/S	S/-	-/-	S/-	-/-	S/-
LA 3A GAS	-	■	-/-	-/-	■	-/-	■	-/-	-/-	■	-/-	-/-	-/S	S/-
LA TT GAS	-	-	■	S/-	-/-	-/-	-/-	-/-	-/S	-/-	-/-	S/S	-/-	S/-
NY 2A GAS	S	S	S	■	-/-	-/-	-/-	S/-	S/S	-/-	-/-	-/S	S/-	-/-
NY 3A GAS	-	■	S	-	■	-/-	■	-/-	-/-	■	-/-	-/-	-/-	S/-
NY TT GAS	-	-	-	-	-	■	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
LA 2A DIESEL	-	■	-	S	■	-	■	-/-	-/-	■	-/-	-/S	-/S	-/-
LA 3A DIESEL	-	-	-	-	S	-	-	■	-/S	S/-	-/-	S/-	-/-	S/-
LA TT DIESEL	-	-	-	S	-	-	-	-	■	-/-	-/-	S/S	-/S	S/-
NY 2A DIESEL	S	■	S	-	■	-	■	S	S	■	-/-	-/-	S/-	-/-
NY 3A DIESEL	S	-	S	-	-	-	S	S	S	-	■	-/-	-/-	-/-
NY TT DIESEL	S	-	S	S	-	-	S	S	S	S	-	■	-/-	-/S
LA BUSES DIESEL	-	-	-	-	-	-	-	-	-	-	-	-	■	S/-
NY BUSES DIESEL	S	S	S	-	S	-	S	S	S	-	S	S	-	■

N/F: N = NON-FREEWAY, F = FREEWAY (above diagonal); COMBINED (below diagonal)

(S - DENOTES A SIGNIFICANT DIFFERENCE)

SPEED (MPH) – (STANDARD DEVIATIONS)

ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– / –	– / –	S / –	– / –	– / –	– / –	– / –	– / –	S / –	– / –	– / –	– / –	– / –
LA 3A GAS	–	■	– / –	– / –	■	– / –	■	– / –	– / –	■	– / –	– / –	– / –	– / –
LA TT GAS	–	–	■	S / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –	S / –
NY 2A GAS	S	–	S	■	– / –	– / –	– / –	S / –	S / –	– / –	– / –	– / –	S / –	– / –
NY 3A GAS	–	■	–	–	■	– / –	■	– / –	– / –	■	– / –	– / –	– / –	– / –
NY TT GAS	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –
LA 2A DIESEL	–	■	–	–	■	–	■	– / –	– / –	■	– / –	– / –	– / S	– / –
LA 3A DIESEL	–	–	–	S	–	–	–	■	– / –	S / –	– / –	– / –	– / –	S / –
LA TT DIESEL	–	–	–	S	–	–	–	–	■	– / –	– / –	– / S	– / S	S / –
NY 2A DIESEL	S	■	S	–	■	–	■	S	S	■	– / –	– / –	S / –	– / –
NY 3A DIESEL	–	–	–	–	–	–	–	S	–	–	■	– / –	– / –	– / –
NY TT DIESEL	–	–	S	–	–	–	–	S	S	–	–	■	– / –	– / –
LA BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	■	– / –
NY BUSES DIESEL	S	S	S	–	S	–	S	S	S	–	–	S	–	■

FREEWAY (F) / NON-FREEWAY (N) — COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

SPEED (MPH) - (% ZERO, % ACCEL, % CRUISE, % DECEL AND % IDLE COMPARISONS)
ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS (α = .05)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	- / -	2 / -	5 / 3	- / 3	- / 1	- / -	- / -	- / 2	4 / 2	1 / 1	4 / 3	2 / -	3 / 2
LA 3A GAS	-	■	- / 1	- / -	■	- / 1	■	- / -	- / -	■	- / -	- / 1	4 / 3	1 / 2
LA TT GAS	-	-	■	1 / 4	2 / 3	- / 1	- / -	- / -	- / -	2 / 3	- / 1	- / 3	4 / -	2 / 2
NY 2A GAS	3	-	3	■	- / -	- / -	- / -	- / -	3 / 5	- / 2	- / -	- / -	4 / 2	2 / 2
NY 3A GAS	-	■	2	-	■	- / 1	■	- / 3	- / 5	■	- / -	- / -	4 / 4	2 / 1
NY TT GAS	-	-	1	-	-	■	- / 1	- / 1	- / 1	- / -	- / -	- / -	- / -	- / 1
LA 2A DIESEL	-	■	-	1	■	1	■	- / -	- / -	■	- / -	- / -	3 / 3	5 / 2
LA 3A DIESEL	-	-	-	2	-	-	-	■	- / 2	- / 2	- / -	- / 1	2 / -	2 / 2
LA TT DIESEL	-	-	-	3	3	1	-	-	■	2 / 2	1 / 1	3 / 5	3 / 2	3 / 2
NY 2A DIESEL	2	■	2	-	■	-	■	2	3	■	- / -	- / 2	4 / 2	4 / 2
NY 3A DIESEL	-	-	1	-	-	-	-	-	2	-	■	- / -	3 / -	1 / 1
NY TT DIESEL	3	-	3	-	-	-	1	-	3	-	-	■	4 / 1	2 / 2
LA BUSES DIESEL	2	2	3	4	4	-	3	2	3	4	2	4	■	3 / 1
NY BUSES DIESEL	5	4	5	3	2	-	5	2	5	4	2	3	2	■

ANY NUMBERS APPEARING IN CHART DENOTE THE FREQUENCY OF SIGNIFICANT DIFFERENCES AMONG THE PARAMETERS (% ACCEL, % ZERO, % CRUISE, % DECEL AND % IDLE)

F — FREEWAY
N — NON-FREEWAY
COMBINED

SPEED (MPH) – (% ZERO, % ACCEL, % CRUISE, % DECEL, AND % IDLE COMPARISONS)
ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS		–/–	–/–	4/3	–/2	–/–	–/–	–/–	–/–	4/2	–/–	4/2	2/–	3/2
LA 3A GAS	–		–/–	–/–		–/1		–/–	–/–		–/–	–/–	4/2	–/2
LA TT GAS	–	–		–/4	–/3	–/–	–/–	–/–	–/–	2/2	–/–	–/2	3/–	–/2
NY 2A GAS	3	–	3		–/–	–/–	–/–	–/–	2/4	–/–	–/–	–/–	4/2	2/2
NY 3A GAS	–		2	–		–/–		–/–	–/1		–/–	–/–	4/4	2/1
NY TT GAS	–	–	–	–	–		–/1	–/–	–/–	–/–	–/–	–/–	–/–	–/–
LA 2A DIESEL	–		–	1		–		–/–	–/–		–/–	–/–	3/2	2/2
LA 3A DIESEL	–	–	–	–	–	–	–		–/–	–/2	–/–	–/–	1/–	–/2
LA TT DIESEL	–	–	–	3	2	–	–	–		–/2	–/–	–/2	2/–	1/2
NY 2A DIESEL	2		2	–		–		–	2		–/–	–/1	4/2	4/2
NY 3A DIESEL	–	–	–	–	–	–	–	–	–	–		–/–	1/–	–/–
NY TT DIESEL	1	–	1	–	–	–	–	–	3	–	–		4/–	2/1
LA BUSES DIESEL	–	1	2	3	4	–	2	–	2	4	1	1		2/–
NY BUSES DIESEL	5	3	4	2	2	–	5	–	5	4	–	2	–	

ANY NUMBERS APPEARING IN CHART DENOTE THE FREQUENCY OF SIGNIFICANT DIFFERENCES AMONG THE PARAMETERS (% ACCEL, % ZERO, % CRUISE, % DECEL, AND % IDLE)

N/F: F – FREEWAY; N – NON-FREEWAY

COMBINED

% RPM (MEANS)

ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	–/S	S/S	S/S	–/–	–/–	S/S	S/S	S/S	–/–	–/–	–/–	S/–	–/–
LA 3A GAS	–	■	–/–	S/S	■	–/–	■	–/–	–/–	■	–/–	–/–	–/S	S/–
LA TT GAS	S	–	■	S/S	S/–	–/–	–/–	–/S	S/S	S/S	–/–	S/–	–/–	S/–
NY 2A GAS	S	S	S	■	–/–	–/–	S/S	S/S	S/S	–/–	–/–	–/–	S/S	S/–
NY 3A GAS	–	■	S	–	■	–/–	■	S/S	S/S	■	–/–	–/–	S/S	–/–
NY TT GAS	–	–	–	–	–	■	–/–	–/–	–/–	–/–	–/–	–/–	–/–	–/–
LA 2A DIESEL	S	■	–	S	■	–	■	–/–	/–	■	–/–	S/–	S/S	S/S
LA 3A DIESEL	S	–	–	S	S	–	–	■	–/–	S/S	–/–	S/S	–/S	S/S
LA TT DIESEL	S	S	S	S	S	–	–	–	■	S/S	S/–	S/S	S/S	S/S
NY 2A DIESEL	–	■	S	–	■	–	■	S	S	■	–/–	–/–	S/S	–/–
NY 3A DIESEL	–	–	–	–	–	–	–	S	S	–	■	–/–	–/–	–/–
NY TT DIESEL	–	–	S	–	–	–	–	S	S	–	–	■	–/–	–/–
LA BUSES DIESEL	–	S	–	S	S	–	S	S	S	S	–	–	■	S/–
NY BUSES DIESEL	S	S	S	–	–	–	S	S	S	–	–	–	–	■

N/F: N = NON-FREEWAY, F = FREEWAY; values below the diagonal: COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% RPM (MEANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	-/-	S/-	S/S	-/-	-/-	-/S	-/S	S/S	-/-	-/-	-/-	S/-	-/-
LA 3A GAS	-	■	-/-	S/-	■	-/-	■	-/-	-/-	■	-/-	-/-	-/S	-/-
LA TT GAS	-	-	■	S/S	S/-	-/-	-/-	-/-	S/-	S/-	-/-	-/-	-/-	-/-
NY 2A GAS	S	S	S	■	-/-	-/-	S/S	S/S	S/S	-/-	-/-	-/-	S/S	-/-
NY 3A GAS	-	■	-	-	■	-/-	■	-/S	S/S	■	-/-	-/-	S/S	-/-
NY TT GAS	-	-	-	-	-	■	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
LA 2A DIESEL	-	■	-	S	■	-	■	-/-	-/-	■	-/-	-/-	S/S	S/-
LA 3A DIESEL	S	-	-	S	S	-	-	■	-/-	-/S	-/-	-/S	-/S	-/-
LA TT DIESEL	S	-	-	S	S	-	-	-	■	S/S	-/-	S/S	S/S	S/-
NY 2A DIESEL	-	■	S	-	■	-	■	S	S	■	-/-	-/-	S/S	-/-
NY 3A DIESEL	-	-	-	-	-	-	-	-	S	-	■	-/-	-/-	-/-
NY TT DIESEL	-	-	-	-	-	-	-	S	S	-	-	■	-/-	-/-
LA BUSES DIESEL	-	-	-	-	S	-	S	-	S	S	-	-	■	-/-
NY BUSES DIESEL	-	S	S	-	-	-	S	S	S	-	-	-	-	■

Legend: cells below the diagonal = COMBINED; cells above the diagonal are split N / F (N = NON-FREEWAY, F = FREEWAY).

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% RPM (MEDIANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	— \ S	— \ S	S \ S	— \ —	— \ —	S \ S	— \ S	S \ S	S \ S	— \ —	S \ —	— \ —	S \ —
LA 3A GAS	—	■	— \ —	S \ S	■	— \ —	■	— \ S	— \ —	■	— \ —	S \ —	— \ S	S \ —
LA TT GAS	S	—	■	S \ S	S \ S	— \ —	S \ —	— \ S	S \ S	S \ S	S \ —	S \ —	— \ —	S \ —
NY 2A GAS	S	S	S	■	— \ —	— \ —	S \ S	— \ S	S \ S	— \ —	— \ —	— \ S	S \ S	S \ —
NY 3A GAS	—	■	S	—	■	— \ —	■	— \ S	S \ S	■	— \ —	— \ —	S \ S	— \ —
NY TT GAS	—	—	—	—	—	■	— \ —	— \ —	— \ —	— \ —	— \ —	— \ —	— \ —	— \ —
LA 2A DIESEL	S	■	—	S	■	—	■	— \ —	— \ —	■	S \ —	S \ —	— \ S	S \ —
LA 3A DIESEL	S	—	—	S	S	—	—	■	— \ —	— \ S	— \ —	S \ S	— \ S	S \ S
LA TT DIESEL	S	—	S	S	S	—	—	—	■	S \ S	S \ —	S \ S	— \ S	S \ S
NY 2A DIESEL	S	■	S	—	■	—	■	S	S	■	— \ —	— \ —	S \ S	— \ S
NY 3A DIESEL	—	—	S	—	—	—	—	S	S	—	■	— \ —	S \ —	— \ —
NY TT DIESEL	—	—	S	—	—	—	S	S	S	—	—	■	S \ —	— \ —
LA BUSES DIESEL	—	S	—	S	S	—	S	—	S	S	—	—	■	S \ —
NY BUSES DIESEL	S	S	S	S	—	—	S	S	S	—	—	—	S	■

N \ F — F: FREEWAY; N: NON-FREEWAY; COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% RPM (MEDIANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	—/—	—/—	S/S	—/—	—/—	—/—	—/S	S/S	—/—	—/—	S/—	—/—	S/—
LA 3A GAS	—	■	—/—	S/—	■	—/—	■	—/—	—/—	■	—/—	—/—	—/S	S/—
LA TT GAS	S	—	■	S/S	S/—	—/—	—/—	—/—	S/—	S/S	—/—	S/—	—/—	S/—
NY 2A GAS	S	S	S	■	—/—	—/—	S/S	—/S	S/S	—/—	—/—	—/—	—/S	—/—
NY 3A GAS	—	■	S	—	■	—/—	■	—/S	S/S	■	—/—	—/—	S/S	—/—
NY TT GAS	—	—	—	—	—	■	—/—	—/—	—/—	—/—	—/—	—/—	—/—	—/—
LA 2A DIESEL	—	■	—	S	■	—	■	—/—	—/—	■	S/—	S/—	—/S	S/—
LA 3A DIESEL	—	—	—	S	—	—	—	■	—/—	—/S	—/—	—/S	—/S	—/—
LA TT DIESEL	S	—	—	S	S	—	—	—	■	S/S	S/—	S/S	—/S	S/—
NY 2A DIESEL	—	■	S	—	■	—	■	S	S	■	—/—	—/—	S/S	—/—
NY 3A DIESEL	—	—	—	—	—	—	—	—	—	—	■	—/—	—/—	—/—
NY TT DIESEL	—	—	S	—	—	—	—	S	S	—	—	■	S/—	—/—
LA BUSES DIESEL	—	—	—	—	S	—	S	—	—	S	—	—	■	S/—
NY BUSES DIESEL	S	S	S	S	—	—	S	S	S	—	—	—	—	■

N/F: F ← FREEWAY; N ← NON-FREEWAY; COMBINED (below the diagonal)

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% RPM (STANDARD DEVIATIONS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	S / –	S / –	– / –	– / –	– / –	S / –	S / –	S / S	– / S	– / S	S / S	S / –	S / S
LA 3A GAS	S	■	– / –	S / –	■	– / –	■	– / –	– / –	■	– / S	– / S	S / S	– / S
LA TT GAS	S	–	■	S / –	– / –	– / –	– / –	S / –	S / –	– / S	– / S	– / S	– / –	– / S
NY 2A GAS	–	S	S	■	– / –	– / –	S / –	S / –	S / S	– / –	S / S	S / –	S / –	S / S
NY 3A GAS	–	■	–	–	■	– / –	■	S / –	S / –	■	– / S	– / –	S / –	– / S
NY TT GAS	–	–	–	–	–	■	– / –	– / –	– / –	– / S	– / –	– / –	– / –	– / S
LA 2A DIESEL	S	■	–	S	■	–	■	– / –	– / –	■	– / S	– / S	S / S	– / S
LA 3A DIESEL	S	–	–	S	–	–	–	■	– / S	S / –	– / –	S / –	S / –	– / S
LA TT DIESEL	S	–	–	S	–	–	–	–	■	S / S	– / S	S / S	S / S	S / S
NY 2A DIESEL	–	■	–	–	■	–	■	–	–	■	– / –	– / –	S / S	– / –
NY 3A DIESEL	S	–	–	S	–	–	–	–	–	–	■	– / –	– / S	– / –
NY TT DIESEL	S	–	–	S	–	–	–	–	–	–	–	■	– / S	– / –
LA BUSES DIESEL	S	S	–	S	S	–	S	–	–	S	–	–	■	– / S
NY BUSES DIESEL	–	–	–	S	–	–	–	–	–	–	–	–	–	■

Key (diagram): F – FREEWAY; N – NON-FREEWAY (upper cells split diagonally, shown here as N / F); COMBINED (lower cells)

(S - DENOTES A SIGNIFICANT DIFFERENCE)

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%RPM (STANDARD DEVIATIONS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	N: S, F: –	N: S, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: S, F: –	N: S, F: –	N: S, F: –	N: –, F: S	N: –, F: S	N: –, F: S	N: S, F: –	N: –, F: S
LA 3A GAS	S	■	N: –, F: –	N: S, F: –	■	N: –, F: –	■	N: –, F: –	N: –, F: –	■	N: –, F: S	N: –, F: –	N: S, F: S	N: –, F: S
LA TT GAS	S	–	■	N: S, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: S	N: –, F: S	N: –, F: –	N: –, F: –	N: –, F: S
NY 2A GAS	–	–	S	■	N: –, F: –	N: –, F: –	N: S, F: –	N: S, F: –	N: S, F: S	N: –, F: –	N: –, F: S	N: S, F: –	N: S, F: –	N: –, F: S
NY 3A GAS	–	■	–	–	■	N: –, F: –	■	N: S, F: –	N: S, F: –	■	N: –, F: S	N: –, F: –	N: S, F: –	N: –, F: S
NY TT GAS	–	–	–	–	–	■	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –
LA 2A DIESEL	S	■	–	–	■	–	■	N: –, F: –	N: –, F: –	■	N: –, F: S	N: –, F: –	N: S, F: S	N: –, F: S
LA 3A DIESEL	–	–	–	S	–	–	–	■	N: –, F: –	N: S, F: –	N: –, F: –	N: –, F: –	N: –, F: –	N: –, F: –
LA TT DIESEL	S	–	–	S	–	–	–	–	■	N: S, F: S	N: –, F: S	N: –, F: S	N: S, F: S	N: –, F: S
NY 2A DIESEL	–	■	–	–	■	–	■	–	–	■	N: –, F: –	N: –, F: –	N: –, F: S	N: –, F: –
NY 3A DIESEL	–	–	–	–	–	–	–	–	–	–	■	N: –, F: –	N: –, F: S	N: –, F: –
NY TT DIESEL	–	–	–	S	–	–	–	–	–	–	–	■	N: –, F: –	N: –, F: –
LA BUSES DIESEL	S	S	–	S	S	–	S	–	–	S	–	–	■	N: –, F: S
NY BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	–	■

(S - DENOTES A SIGNIFICANT DIFFERENCE)

%RPM (%ACCEL, %CRUISE, %DECEL, AND %IDLE COMPARISONS)
ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS (α = .05)

Upper-triangle cells are split diagonally: the upper-right number is F (FREEWAY) and the lower-left number is N (NON-FREEWAY). In the table these are written F / N. Lower-triangle cells are COMBINED. Diagonal and shaded cells are left blank.

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS		– / 2	– / –	4 / 3	– / 2	– / –	2 / 2	2 / –	3 / 3	4 / 2	3 / 1	4 / 2	3 / –	1 / 3
LA 3A GAS	1		– / 1	– / 1		– / –		– / –	– / –		– / –	– / –	2 / –	– / 2
LA TT GAS	–	–		1 / 3	– / 2	– / –	– / –	– / –	– / –	3 / 2	1 / 1	2 / 2	– / –	– / 3
NY 2A GAS	2	–	2		– / –	– / –	– / 1	1 / –	2 / 4	3 / –	2 / –	– / –	2 / 1	1 / 3
NY 3A GAS	1		2	–		– / –		– / –	1 / 1		2 / –	– / –	3 / 2	1 / 3
NY TT GAS	–	–	–	–	–		– / –	– / –	– / –	2 / –	– / –	– / –	– / –	– / –
LA 2A DIESEL	2		–	–		–		– / –	– / –		– / –	– / 1	3 / –	– / 3
LA 3A DIESEL	–	–	–	1	–	–	–		– / –	4 / –	– / –	1 / –	– / –	– / 1
LA TT DIESEL	2	–	–	3	2	–	–	–		4 / 2	2 / –	2 / 3	1 / –	2 / 2
NY 2A DIESEL	2		2	–		–		2	2		– / –	– / –	4 / 2	1 / 3
NY 3A DIESEL	1	–	2	–	–	–	–	1	2	–		– / –	1 / –	– / –
NY TT DIESEL	2	–	2	–	–	–	–	2	2	–	–		2 / 1	– / 2
LA BUSES DIESEL	2	–	1	2	3	–	–	1	–	3	–	2		1 / 2
NY BUSES DIESEL	4	2	3	3	3	–	2	4	3	3	–	2	2	

ANY NUMBERS APPEARING IN CHART DENOTE THE FREQUENCY OF SIGNIFICANT DIFFERENCES AMONG THE PARAMETERS (%ACCEL, %CRUISE, %DECEL, AND %IDLE)

F ← FREEWAY
N ← NON-FREEWAY
COMBINED

%RPM (% ACCEL, % CRUISE, % DECEL AND % IDLE COMPARISONS)
ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	–/–	–/–	4/2	–/–	–/–	2/–	–/–	3/2	4/2	2/–	–/2	1/–	–/3
LA 3A GAS	–	■	–/–	–/–	■	–/–	■	–/–	–/–	■	–/–	–/–	1/–	–/2
LA TT GAS	–	–	■	1/1	–/1	–/–	–/–	–/–	–/–	2/2	–/–	–/2	–/–	–/2
NY 2A GAS	2	–	2	■	–/–	–/–	–/1	–/–	2/2	3/–	–/–	–/–	1/1	–/3
NY 3A GAS	–	■	2	–	■	–/–	■	–/–	–/–	■	–/–	–/–	1/1	–/3
NY TT GAS	–	–	–	–	–	■	–/–	–/–	–/–	1/–	–/–	–/–	–/–	–/–
LA 2A DIESEL	–	■	–	–	■	–	■	–/–	–/–	■	–/–	–/–	2/–	–/3
LA 3A DIESEL	–	–	–	–	–	–	–	■	–/–	4/–	–/–	–/–	–/–	–/–
LA TT DIESEL	–	–	–	2	1	–	–	–	■	4/2	–/–	1/3	1/–	–/2
NY 2A DIESEL	2	■	2	–	■	–	■	–	2	■	–/–	–/–	4/1	1/2
NY 3A DIESEL	–	–	–	–	–	–	–	–	–	–	■	–/–	–/–	–/–
NY TT DIESEL	2	–	2	–	–	–	–	–	2	–	–	■	–/1	–/–
LA BUSES DIESEL	–	–	–	–	1	–	–	–	–	3	–	–	■	–/1
NY BUSES DIESEL	4	2	2	3	3	–	2	1	3	2	–	–	–	■

(Cells above the diagonal are split diagonally: F = FREEWAY / N = NON-FREEWAY. Cells below the diagonal: COMBINED.)

ANY NUMBERS APPEARING IN CHART DENOTE THE FREQUENCY OF SIGNIFICANT DIFFERENCES AMONG THE PARAMETERS (% ACCEL, % CRUISE, % DECEL, AND % IDLE)

% POWER (MEANS)

ASPIN-WELCH & Z TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– / –	– / S	S / –	– / –	– / –	– / –	– / –	S / –	– / –	– / –	S / –	– / S	– / –
LA 3A GAS	–	■	– / S	– / –	■	– / –	■	– / –	– / –	■	– / –	– / –	S / S	– / –
LA TT GAS	–	–	■	S / S	– / –	– / –	S / S	– / S	– / S	S / S	– / –	S / S	– / –	– / –
NY 2A GAS	S	–	S	■	– / S	– / –	– / –	– / –	– / –	– / –	– / –	– / –	S / S	– / –
NY 3A GAS	–	■	S	–	■	– / –	■	– / S	– / S	■	– / –	– / –	– / –	– / –
NY TT GAS	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –
LA 2A DIESEL	–	■	–	–	■	–	■	– / –	– / –	■	– / –	– / –	S / S	– / –
LA 3A DIESEL	–	–	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / S	– / –
LA TT DIESEL	–	–	S	S	–	–	–	–	■	– / –	– / –	S / –	– / S	– / –
NY 2A DIESEL	–	■	S	–	■	–	■	–	–	■	– / –	– / –	S / S	– / –
NY 3A DIESEL	–	–	S	–	–	–	–	–	–	–	■	– / –	– / –	– / –
NY TT DIESEL	S	–	S	–	–	–	–	–	S	–	–	■	S / S	– / –
LA BUSES DIESEL	–	–	–	–	–	–	–	–	–	S	–	–	■	S / –
NY BUSES DIESEL	S	–	S	–	–	–	–	S	S	–	–	–	S	■

(Lower-left triangle: COMBINED. Upper-right triangle cells split diagonally: N = NON-FREEWAY / F = FREEWAY)

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% POWER (MEANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS (α = .01)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	–/–	S/–	–/S	–/–	–/–	–/–	–/–	–/–	–/–	–/–	–/S	–/–	–/–
LA 3A GAS	–	■	–/–	–/–	■	–/–	■	–/–	–/–	■	–/–	–/–	S/–	–/–
LA TT GAS	–	–	■	S/S	–/–	–/–	–/–	–/–	S/–	S/–	–/–	–/S	–/–	–/–
NY 2A GAS	S	–	S	■	–/–	–/–	–/–	–/–	–/–	–/–	–/–	–/–	S/–	–/–
NY 3A GAS	–	■	–	–	■	–/–	■	–/–	–/–	■	–/–	–/–	–/–	–/–
NY TT GAS	–	–	–	–	–	■	–/–	–/–	–/–	–/–	–/–	–/–	–/–	–/–
LA 2A DIESEL	–	■	–	–	■	–	■	–/–	–/–	■	–/–	–/–	S/S	–/–
LA 3A DIESEL	–	–	–	–	–	–	–	■	–/–	–/–	–/–	–/–	–/–	–/–
LA TT DIESEL	–	–	–	S	–	–	–	–	■	–/–	–/–	–/S	S/–	–/–
NY 2A DIESEL	–	■	S	–	■	–	■	–	–	■	–/–	–/–	S/S	–/–
NY 3A DIESEL	–	–	–	–	–	–	–	–	–	–	■	–/–	–/–	–/–
NY TT DIESEL	–	–	S	–	–	–	–	–	–	–	–	■	–/S	–/–
LA BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	■	–/–
NY BUSES DIESEL	–	–	S	–	–	–	–	–	–	–	–	–	–	■

F ← FREEWAY

N ← NON-FREEWAY

COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% POWER (MEDIANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– / –	– / S	S / –	– / –	– / –	– / –	– / –	S / –	– / –	– / –	S / –	– / S	S / –
LA 3A GAS	–	■	– / S	– / –	■	– / –	■	– / –	– / –	■	– / –	– / –	S / S	S / S
LA TT GAS	–	–	■	S / S	– / –	– / –	– / S	– / S	– / S	– / S	– / S	S / S	– / –	S / –
NY 2A GAS	S	–	S	■	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / S	S / –
NY 3A GAS	–	■	S	–	■	– / –	■	– / –	– / S	■	– / –	– / –	S / –	– / –
NY TT GAS	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –
LA 2A DIESEL	–	■	–	S	■	–	■	– / –	– / –	■	– / –	– / –	S / S	S / –
LA 3A DIESEL	–	–	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / S	– / –
LA TT DIESEL	–	–	–	S	–	–	–	–	■	– / –	– / –	– / –	– / S	S / –
NY 2A DIESEL	–	■	S	–	■	–	■	–	–	■	– / –	– / –	S / S	– / –
NY 3A DIESEL	–	–	S	–	–	–	–	–	–	–	■	– / –	– / S	– / –
NY TT DIESEL	S	–	S	–	–	–	–	–	–	–	–	■	– / S	– / –
LA BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	■	– / –
NY BUSES DIESEL	S	S	S	S	S	–	S	S	S	–	–	–	–	■

Key: N (lower-left of a divided cell) = NON-FREEWAY; F (upper-right of a divided cell) = FREEWAY; cells below the diagonal = COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% POWER (MEDIANS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS (α = .01)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	N – / F –	N – / F S	N S / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N S / F –	N – / F –	N S / F –
LA 3A GAS	–	■	N – / F S	N – / F –	■	N – / F –	■	N – / F –	N – / F –	■	N – / F –	N – / F –	N – / F S	N S / F –
LA TT GAS	–	–	■	N – / F S	N – / F –	N – / F –	N – / F S	N – / F –	N – / F S	N – / F S	N – / F –	N – / F –	N – / F –	N S / F –
NY 2A GAS	S	–	S	■	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F S	N S / F –
NY 3A GAS	–	■	–	–	■	N – / F –	■	N – / F –	N – / F –	■	N – / F –	N – / F –	N – / F –	N – / F –
NY TT GAS	–	–	–	–	–	■	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –
LA 2A DIESEL	–	■	–	–	■	–	■	N – / F –	N – / F –	■	N – / F –	N – / F –	N – / F S	N – / F –
LA 3A DIESEL	–	–	–	–	–	–	–	■	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –	N – / F –
LA TT DIESEL	–	–	–	S	–	–	–	–	■	N – / F –	N – / F –	N – / F –	N – / F S	N S / F –
NY 2A DIESEL	–	■	S	–	■	–	■	–	–	■	N – / F –	N – / F –	N – / F S	N – / F –
NY 3A DIESEL	–	–	–	–	–	–	–	–	–	–	■	N – / F –	N – / F –	N – / F –
NY TT DIESEL	–	–	S	–	–	–	–	–	–	–	–	■	N – / F –	N – / F –
LA BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	■	N – / F –
NY BUSES DIESEL	S	S	S	S	S	–	S	–	S	–	–	–	–	■

F ← FREEWAY
N ← NON-FREEWAY
COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% POWER (STANDARD DEVIATIONS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– / –	S / –	S / –	– / –	– / –	– / S	– / –	– / –	S / –	– / –	– / S	S / –	– / –
LA 3A GAS	–	■	– / –	– / –	■	– / –	■	– / –	– / –	■	– / –	– / –	S / –	– / –
LA TT GAS	S	S	■	– / S	– / –	– / –	– / S	– / –	S / S	– / –	– / –	– / S	– / –	– / –
NY 2A GAS	–	–	S	■	– / –	– / –	– / –	– / –	S / –	– / –	– / –	– / –	– / –	– / –
NY 3A GAS	S	■	–	–	■	– / –	■	– / –	– / –	■	– / –	– / S	S / –	– / –
NY TT GAS	–	–	–	–	–	■	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –
LA 2A DIESEL	–	■	S	–	■	–	■	– / S	– / S	■	– / –	– / –	S / S	– / –
LA 3A DIESEL	–	–	S	–	S	–	–	■	– / –	S / –	– / –	– / –	S / –	– / –
LA TT DIESEL	–	–	S	–	S	–	–	–	■	S / –	– / –	– / S	S / –	– / –
NY 2A DIESEL	–	■	S	–	■	–	■	–	–	■	– / –	– / –	– / –	– / –
NY 3A DIESEL	–	–	S	–	–	–	–	–	–	–	■	– / –	– / –	– / –
NY TT DIESEL	–	–	S	–	–	–	–	–	–	–	–	■	– / S	– / –
LA BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	S	■	–
NY BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	–	■

Key: below the diagonal – COMBINED; above the diagonal, split cells – F = FREEWAY (upper), N = NON-FREEWAY (lower)

(S - DENOTES A SIGNIFICANT DIFFERENCE)

% POWER (STANDARD DEVIATIONS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS (α = .0)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– \ –	– \ S	– \ S	– \ –	– \ –	S \ –	– \ –	– \ –	– \ S	– \ –	– \ –	– \ S	– \ –
LA 3A GAS	–	■	– \ –	– \ –	■	– \ –	■	– \ –	– \ –	■	– \ –	– \ –	– \ S	– \ –
LA TT GAS	S	–	■	– \ –	– \ –	– \ –	S \ –	– \ –	– \ S	– \ –	– \ –	S \ –	– \ –	– \ –
NY 2A GAS	–	–	S	■	– \ –	– \ –	– \ –	– \ –	– \ S	– \ –	– \ –	– \ –	– \ –	– \ –
NY 3A GAS	–	■	–	–	■	– \ –	■	– \ –	– \ –	■	– \ –	– \ –	– \ S	– \ –
NY TT GAS	–	–	–	–	–	■	– \ –	– \ –	– \ –	– \ –	– \ –	– \ –	– \ –	– \ –
LA 2A DIESEL	–	■	S	–	■	–	■	– \ –	– \ –	■	– \ –	– \ –	S \ S	– \ –
LA 3A DIESEL	–	–	S	–	S	–	–	■	– \ –	– \ S	– \ –	– \ –	– \ –	– \ –
LA TT DIESEL	–	–	S	–	–	–	–	–	■	– \ S	– \ –	– \ –	– \ S	– \ –
NY 2A DIESEL	–	■	S	–	■	–	■	–	–	■	– \ –	– \ –	– \ –	– \ –
NY 3A DIESEL	–	–	–	–	–	–	–	–	–	–	■	– \ –	– \ –	– \ –
NY TT DIESEL	–	–	S	–	–	–	–	–	–	–	–	■	– \ –	– \ –
LA BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	■	– \ –
NY BUSES DIESEL	–	–	–	–	–	–	–	–	–	–	–	–	–	■

N \ F — N: NON-FREEWAY; F: FREEWAY; lower-left of diagonal: COMBINED

(S - DENOTES A SIGNIFICANT DIFFERENCE)

%POWER (%ACCEL, %CRUISE, %DECEL, AND %MOTORING COMPARISONS)

ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .05$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– \ 3	– \ –	2 \ 2	– \ 1	– \ –	1 \ 3	1 \ 2	2 \ 4	1 \ –	– \ –	– \ 2	2 \ 1	2 \ 1
LA 3A GAS	–	■	– \ 2	– \ 2	■	– \ –	■	– \ 2	– \ –	■	– \ 2	– \ 2	2 \ 3	1 \ 2
LA TT GAS	–	–	■	– \ 2	– \ 1	– \ –	1 \ 1	– \ –	2 \ 2	– \ 1	– \ –	– \ –	1 \ 1	– \ 1
NY 2A GAS	1	–	1	■	– \ –	– \ –	– \ 1	– \ 1	2 \ 1	– \ –	1 \ –	– \ –	1 \ –	– \ 1
NY 3A GAS	–	■	–	–	■	– \ –	■	– \ 1	2 \ –	■	– \ –	– \ –	2 \ –	1 \ 1
NY TT GAS	–	–	–	–	–	■	1 \ –	– \ –	1 \ –	– \ –	– \ –	– \ –	1 \ –	– \ –
LA 2A DIESEL	–	■	1	–	■	–	■	– \ 1	– \ –	■	1 \ 1	– \ 1	1 \ 3	2 \ 2
LA 3A DIESEL	–	1	–	1	2	–	1	■	1 \ 2	– \ –	– \ –	– \ –	1 \ –	– \ 1
LA TT DIESEL	3	–	2	2	1	1	–	2	■	2 \ –	1 \ –	2 \ 2	– \ 1	2 \ 2
NY 2A DIESEL	–	■	–	–	■	–	■	2	1	■	– \ –	– \ –	3 \ –	2 \ 1
NY 3A DIESEL	–	–	–	1	–	–	–	–	1	–	■	– \ –	1 \ –	– \ 1
NY TT DIESEL	–	–	–	–	–	–	–	–	1	–	–	■	2 \ –	– \ 1
LA BUSES DIESEL	2	3	1	1	2	1	3	2	1	3	1	1	■	1 \ 1
NY BUSES DIESEL	2	3	1	–	1	–	3	1	3	2	1	–	2	■

ANY NUMBERS APPEARING IN CHART DENOTE THE FREQUENCY OF SIGNIFICANT DIFFERENCES AMONG THE PARAMETERS (%ACCEL, % CRUISE, % DECEL, AND % MOTORING)

N \ F : F = FREEWAY, N = NON-FREEWAY

COMBINED (below the diagonal)

% POWER (% ACCEL, % CRUISE, % DECEL, AND % MOTORING COMPARISONS)
ASPIN-WELCH & Z } TEST OF DIFFERENCES BETWEEN MEANS ($\alpha = .01$)

	LA 2A GAS	LA 3A GAS	LA TT GAS	NY 2A GAS	NY 3A GAS	NY TT GAS	LA 2A DIESEL	LA 3A DIESEL	LA TT DIESEL	NY 2A DIESEL	NY 3A DIESEL	NY TT DIESEL	LA BUSES DIESEL	NY BUSES DIESEL
LA 2A GAS	■	– / 1	– / –	1 / 2	– / 1	– / –	– / –	– / –	2 / 4	1 / –	– / –	– / 1	1 / 1	– / 1
LA 3A GAS	–	■	– / –	– / 2	■	– / –	■	– / 1	– / –	■	– / –	– / –	2 / 3	1 / 2
LA TT GAS	–	–	■	– / 1	– / 1	– / –	1 / –	– / –	1 / 2	– / –	– / –	– / –	1 / –	– / –
NY 2A GAS	1	–	–	■	– / –	– / –	– / 1	– / 1	– / –	– / –	– / –	– / –	1 / –	– / 1
NY 3A GAS	–	■	–	–	■	– / –	■	– / 1	1 / –	■	– / –	– / –	2 / –	1 / 1
NY TT GAS	–	–	–	–	–	■	1 / –	– / –	1 / –	– / –	– / –	– / –	1 / –	– / –
LA 2A DIESEL	–	■	–	–	■	–	■	– / 1	– / –	■	– / –	– / –	1 / 1	2 / 1
LA 3A DIESEL	–	1	–	–	–	–	1	■	– / –	– / –	– / –	– / –	– / –	– / 1
LA TT DIESEL	2	–	1	1	1	–	–	–	■	1 / –	1 / –	1 / –	– / –	2 / 1
NY 2A DIESEL	–	■	–	–	■	–	■	2	1	■	– / –	– / –	3 / –	2 / 1
NY 3A DIESEL	–	–	–	–	–	–	–	–	1	–	■	– / –	1 / –	– / 1
NY TT DIESEL	–	–	–	–	–	–	–	–	1	–	–	■	– / –	– / –
LA BUSES DIESEL	1	2	1	1	2	1	3	2	1	2	1	–	■	1 / –
NY BUSES DIESEL	1	3	–	–	–	–	3	–	1	2	–	–	1	■

ANY NUMBERS APPEARING IN CHART DENOTE THE FREQUENCY OF SIGNIFICANT DIFFERENCES AMONG THE PARAMETERS (% ACCEL, % CRUISE, % DECEL, AND % MOTORING)

F — FREEWAY
N — NON-FREEWAY
COMBINED

APPENDIX II

%RPM, %POWER, AND MPH

SUMMARY STATISTICS

CAPE-21 SPEED (MPH) SUMMARY STATISTICS--MEANS OF % ZERO

TRUCK TYPE	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	4 (6)*	22 (11)	16 (13)	7 (7)	38 (18)	35 (18)
3 Axle	1 (--)	35 (--)	25 (--)	5 (--)	44 (--)	40 (--)
Tractor Trailer	2 (2)	30 (6)	17 (5)	19 (28)	49 (26)	46 (30)
Diesel:						
2 Axle	0 (--)	23 (--)	13 (--)	25 (--)	55 (--)	55 (--)
3 Axle	4 (2)	29 (17)	18 (14)	15 (23)	46 (23)	43 (24)
Tractor Trailer	1 (2)	25 (12)	14 (9)	8 (7)	44 (16)	37 (17)
Diesel Buses	2 (1)	19 (4)	17 (5)	10 (12)	34 (5)	34 (5)

*Standard Deviation

CAPE-21 SPEED (MPH) SUMMARY STATISTICS--MEANS OF % ACCELERATION

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	14 (8)*	25 (5)	21 (5)	22 (10)	18 (7)	18 (7)
3 Axle	14 (--)	22 (--)	20 (--)	34 (--)	17 (--)	19 (--)
Tractor Trailer	15 (7)	21 (7)	19 (7)	18 (6)	15 (10)	15 (9)
Diesel:						
2 Axle	16 (--)	22 (--)	20 (--)	15 (--)	11 (--)	11 (--)
3 Axle	14 (9)	19 (6)	16 (8)	21 (10)	17 (6)	16 (5)
Tractor Trailer	15 (8)	22 (7)	19 (6)	24 (8)	17 (4)	19 (4)
Diesel Buses	23 (6)	32 (2)	31 (4)	37 (0)	25 (1)	25 (2)

*Standard Deviation

CAPE-21 SPEED (MPH) SUMMARY STATISTICS--MEANS OF % CRUISE

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE:	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	69 (15)*	32 (7)	45 (13)	50 (21)	24 (12)	27 (13)
3 Axle	75 (--)	22 (--)	37 (--)	32 (--)	24 (--)	25 (--)
Tractor Trailer	71 (12)	32 (9)	51 (15)	35 (14)	21 (9)	24 (14)
Diesel:						
2 Axle	73 (--)	37 (--)	53 (--)	44 (--)	24 (--)	24 (--)
3 Axle	70 (18)	37 (14)	53 (21)	42 (20)	20 (11)	25 (17)
Tractor Trailer	72 (15)	35 (8)	53 (13)	46 (14)	24 (11)	28 (12)
Diesel Buses	59 (9)	24 (5)	28 (10)	33 (3)	17 (5)	17 (5)

*Standard Deviation

CAPE-21 SPEED (MPH) SUMMARY STATISTICS--MEANS OF % DECELERATION

TRUCK TYPE	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	12 (6)*	20 (3)	17 (4)	21 (10)	16 (7)	17 (7)
3 Axle	11 (--)	20 (--)	17 (--)	29 (--)	15 (--)	16 (--)
Tractor Trailer	12 (6)	16 (6)	14 (6)	28 (20)	13 (8)	13 (8)
Diesel:						
2 Axle	11 (--)	15 (--)	13 (--)	14 (--)	9 (--)	9 (--)
3 Axle	12 (8)	14 (5)	12 (7)	20 (9)	16 (6)	15 (5)
Tractor Trailer	12 (7)	16 (8)	14 (7)	22 (7)	15 (3)	16 (4)
Diesel Buses	16 (2)	24 (1)	23 (2)	19 (14)	22 (2)	22 (2)

*Standard Deviation

CAPE-21 SPEED (MPH) SUMMARY STATISTICS--MEANS OF % IDLE

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	4 (6)*	22 (11)	17 (13)	8 (7)	42 (17)	39 (17)
3 Axle	1 (--)	35 (--)	25 (--)	5 (--)	44 (--)	40 (--)
Tractor Trailer	2 (2)	31 (6)	17 (5)	19 (28)	52 (25)	48 (30)
Diesel:						
2 Axle	0 (--)	26 (--)	14 (--)	26 (--)	56 (--)	56 (--)
3 Axle	4 (2)	29 (17)	19 (15)	17 (28)	48 (22)	45 (24)
Tractor Trailer	1 (2)	26 (12)	15 (9)	8 (7)	44 (16)	37 (17)
Diesel Buses	2 (0)	20 (5)	18 (6)	11 (11)	36 (4)	36 (4)

*Standard Deviation

CAPE-21 % RPM SUMMARY STATISTICS--MEANS OF % ACCELERATION

TRUCK TYPE	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	5 (2)*	12 (3)	9 (2)	7 (3)	10 (3)	9 (3)
3 Axle	7 (--)	15 (--)	13 (--)	5 (--)	7 (--)	7 (--)
Tractor Trailer	7 (4)	13 (3)	11 (3)	5 (4)	9 (6)	8 (4)
Diesel:						
2 Axle	11 (--)	18 (--)	15 (--)	16 (--)	9 (--)	9 (--)
3 Axle	8 (3)	13 (3)	10 (3)	11 (3)	11 (4)	10 (4)
Tractor Trailer	8 (2)	15 (3)	12 (3)	12 (7)	10 (4)	10 (4)
Diesel Buses:	8 (1)	16 (3)	14 (2)	14 (9)	14 (1)	14 (1)

*Standard deviation

CAPE-21 % RPM SUMMARY STATISTICS--MEANS OF % CRUISE

TRUCK TYPE	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	86 (8)*	49 (8)	62 (13)	74 (12)	33 (11)	37 (11)
3 Axle	85 (--)	32 (--)	47 (--)	83 (--)	33 (--)	38 (--)
Tractor Trailer	82 (9)	44 (7)	61 (8)	66 (24)	29 (13)	34 (21)
Diesel:						
2 Axle	77 (--)	32 (--)	53 (--)	42 (--)	20 (--)	21 (--)
3 Axle	79 (9)	39 (12)	59 (18)	55 (23)	26 (13)	31 (17)
Tractor Trailer	84 (5)	41 (6)	61 (10)	64 (19)	25 (9)	34 (17)
Diesel Buses	80 (2)	40 (8)	45 (9)	54 (24)	21 (4)	21 (4)

*Standard Deviation

CAPE-21 % RPM SUMMARY STATISTICS--MEANS OF % DECELERATION

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	4 (2)*	10 (3)	8 (2)	7 (3)	9 (3)	9 (3)
3 Axle	7 (--)	15 (--)	13 (--)	6 (--)	7 (--)	7 (--)
Tractor Trailer	7 (4)	11 (2)	10 (3)	8 (4)	9 (6)	8 (4)
Diesel:						
2 Axle	11 (--)	15 (--)	13 (--)	16 (--)	9 (--)	9 (--)
3 Axle	8 (3)	13 (3)	10 (3)	12 (3)	11 (4)	10 (4)
Tractor Trailer	7 (2)	13 (4)	10 (3)	12 (7)	10 (4)	10 (4)
Diesel Buses	7 (1)	13 (4)	12 (3)	10 (2)	14 (1)	14 (1)

*Standard Deviation

CAPE-21 % RPM SUMMARY STATISTICS--MEANS OF % IDLE

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	5 (5)*	29 (11)	21 (12)	12 (9)	48 (14)	44 (13)
3 Axle	1 (--)	37 (--)	26 (--)	6 (--)	53 (--)	49 (--)
Tractor Trailer	4 (3)	33 (5)	19 (6)	20 (29)	52 (25)	49 (29)
Diesel:						
2 Axle	1 (--)	35 (--)	20 (--)	26 (--)	61 (--)	61 (--)
3 Axle	5 (4)	36 (16)	22 (16)	22 (26)	52 (21)	48 (23)
Tractor Trailer	1 (2)	31 (11)	17 (9)	13 (8)	55 (12)	47 (16)
Diesel Buses	5 (0)	31 (5)	29 (8)	21 (12)	51 (4)	51 (4)

*Standard Deviation

CAPE-21 % POWER SUMMARY STATISTICS--MEANS OF % ACCELERATION

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	16 (4)*	16 (3)	16 (3)	18 (4)	15 (4)	15 (4)
3 Axle	29 (--)	16 (--)	20 (--)	19 (--)	14 (--)	15 (--)
Tractor Trailer	17 (5)	16 (3)	17 (4)	18 (10)	14 (7)	14 (7)
Diesel:						
2 Axle	26 (--)	16 (--)	20 (--)	19 (--)	13 (--)	13 (--)
3 Axle	21 (3)	16 (3)	18 (2)	20 (4)	16 (7)	17 (7)
Tractor Trailer	22 (4)	17 (4)	19 (4)	17 (6)	14 (6)	14 (6)
Diesel Buses	16 (4)	14 (0)	14 (1)	15 (5)	13 (3)	13 (3)

*Standard Deviation

CAPE-21 % POWER SUMMARY STATISTICS--MEANS OF % CRUISE

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	59 (12)*	51 (10)	54 (10)	43 (14)	50 (15)	49 (14)
3 Axle	32 (--)	44 (--)	41 (--)	44 (--)	61 (--)	59 (--)
Tractor Trailer	56 (13)	52 (9)	53 (10)	41 (29)	59 (17)	58 (17)
Diesel:						
2 Axle	35 (--)	40 (--)	38 (--)	45 (--)	66 (--)	66 (--)
3 Axle	47 (8)	53 (9)	51 (8)	48 (10)	60 (19)	59 (17)
Tractor Trailer	36 (8)	41 (7)	39 (5)	44 (10)	58 (13)	56 (12)
Diesel Buses	43 (4)	43 (5)	43 (5)	49 (16)	56 (4)	56 (4)

*Standard Deviation

CAPE-21 % POWER SUMMARY STATISTICS--MEANS OF % DECELERATION

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	18 (5)*	19 (3)	18 (4)	20 (4)	16 (4)	16 (4)
3 Axle	29 (--)	19 (--)	22 (--)	17 (--)	13 (--)	13 (--)
Tractor Trailer	18 (5)	17 (4)	18 (4)	20 (12)	14 (7)	14 (7)
Diesel:						
2 Axle	29 (--)	18 (--)	23 (--)	20 (--)	12 (--)	12 (--)
3 Axle	20 (3)	16 (3)	18 (2)	20 (4)	16 (7)	16 (7)
Tractor Trailer	23 (4)	16 (4)	19 (4)	17 (5)	14 (6)	14 (6)
Diesel Buses	18 (2)	13 (3)	13 (4)	12 (0)	13 (3)	13 (3)

*Standard Deviation

CAPE-21 % POWER SUMMARY STATISTICS--MEANS OF % MOTORING

	CITY					
	LOS ANGELES			NEW YORK		
	ROAD TYPE			ROAD TYPE		
TRUCK TYPE	Freeway	Non-Freeway	Combined	Freeway	Non-Freeway	Combined
Gasoline:						
2 Axle	8 (4)*	14 (6)	11 (5)	19 (10)	19 (12)	19 (12)
3 Axle	9 (--)	20 (--)	17 (--)	20 (--)	12 (--)	13 (--)
Tractor Trailer	9 (3)	15 (3)	13 (3)	21 (8)	13 (4)	13 (4)
Diesel:						
2 Axle	10 (--)	26 (--)	19 (--)	16 (--)	9 (--)	9 (--)
3 Axle	11 (3)	16 (10)	13 (6)	12 (6)	8 (9)	8 (7)
Tractor Trailer	19 (10)	26 (7)	23 (9)	21 (15)	14 (12)	16 (14)
Diesel Buses	23 (10)	29 (3)	29 (3)	24 (21)	18 (2)	18 (2)

*Standard Deviation