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A Comparison of Current and Proposed Vehicle Labeling Programs

by

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Notice

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I. Purpose

The purpose of this report is to describe (1) the current labeling program, (2) the proposed labeling program, and (3) to provide an analysis of the differences between the two programs. The analysis will address several options available within the proposed labeling program.

Except to briefly describe how the fuel economy data are used in the corporate average fuel economy (CAFE) calculations and in the determination of the Gas Guzzler Tax, this document will not address these areas of the fuel economy program.

II. Current Labeling Program Description

The data from the present EPA fuel economy testing program are used in three ways: (1) to generate fuel economy label values for use by consumers, (2) to determine manufacturers' compliance with CAFE requirements, and (3) to generate data from which the IRS can establish manufacturers' Gas Guzzler Tax liability. (EPA and Department Of Energy have a combined responsibility to make available to the public in the Gas Mileage Guide (the Guide) the fuel economy values displayed on the labels which are affixed to each new car.)

The EPA responsibilities for the above functions are to (1) administer the testing program that generates the fuel economy data, (2) determine necessary procedures and verify the calculation of fuel economy values for labels, the Guide, and CAFE and, (3) provide IRS with fuel economy data in order for them to determine a manufacturers tax liability.

A. Test Procedure

A fuel economy test comprises data obtained from two separate test procedures; the urban cycle[1,2] and the highway cycle[3,4]. The urban cycle (or city cycle) is intended to simulate city type driving conditions, i.e , stop and starts, with intermediate vehicle speeds. The highway cycle does not include any stop or starts within the cycle, does not have "quick" changes in speed, but represents higher speeds of in-use operation characteristic of open country roads, in the range of 40 to 50 mph.

1. Urban Cycle· A complete urban test cycle consists of a "soak" period of at least 12 hours prior to the test at a laboratory ambient temperature between 68 and 86°F. During this soak period the engine is not started. After the soak, the vehicle is placed on a chassis dynamometer and the sampling equipment attached, a technician starts and "drives" the vehicle for a distance of 7.5 miles matching the vehicle speed with the speed on a pre-printed chart. Upon completion of the simulated 7.5 mile trip the engine is shut off for a period of ten minutes, as one might after arriving at the store, office, etc. The engine is restarted and the operator drives the vehicle over the first 3.6 miles of the driving schedule again. The total distance driven is 11.1 miles During the 11.1 miles, 21 stop and starts are made and a maximum speed of 56 miles per hour (mph) is reached. The average speed over the complete cycle is 21 mph which includes the idle time during periods when the vehicle is stopped.

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1. Kruse and Huls, "Development of the Federal Urban Driving Schedule", U.S. Environmental Protection Agency, SAE Paper 730553, May 1973.

2. Huls, "Evaluation of Federal Light-Duty Mass Emissions Regulations", U.S. Environmental Protection Agency, SAE Paper 730554, May 1973

3. Kruse and Paulsell, "Development of a Highway Driving Cycle for Fuel Economy Measurements", U.S. Environmental Protection Agency, Internal EPA Report, March, 1974

4. Austin, Hellman, and Paulsell, "Passenger Car Fuel Economy During Non-Urban Driving", SAE Paper 740542, August 1974

The first part of the driving cycle is commonly referred to as the "cold start test" as the vehicle has not been operated for a minimum of 12 hours. The first part of the second cycle is known as the "hot start test" as the engine has only been shut off for a maximum of 10 minutes.

2. Highway Cycle: The highway cycle consists of one test cycle of 10.2 miles with no intermediate stop or starts. The maximum speed during this cycle is 60 mph with an average speed of 49 mph. When possible, the highway cycle is conducted within three hours of the urban cycle. If it is not possible to conduct the highway procedure within three hours of the urban cycle, the vehicle is preconditioned by operating the vehicle over one cycle (7.5 miles) of the urban test procedure.

3. Data Obtained: During each driving cycle the level of exhaust emissions are determined for hydrocarbons (HC), carbon monoxide (CO), carbon dioxide (CO_2), and oxides of nitrogen (NO_x). From these raw data, exhaust emission levels can be expressed in grams of pollutant per mile and the fuel economy in gallons of fuel per mile. The weight of pollutants and volume of fuel are determined from the chemical composition of the exhaust gases using a carbon balance chemical equation. The distance is obtained from the driving schedule.

4. Standards: Each fuel economy test comprises of data from both the urban and highway cycles The urban cycle is the same cycle used to determine compliance with the exhaust emission standards. In order for any fuel economy data to be accepted, the emission levels measured on the urban cycle must not exceed the applicable emission standards. There are no emission standards for the highway cycle.

B. Types of Fuel Economy Labels

The EPA is responsible for specifying, by rule, the form and content of the fuel economy labels and the manner in which they are affixed. The Energy Policy and Conservation Act[5] requires that manufacturers have fuel economy labels installed on each car and light truck it produces for sale in the United States. Dealers are required to keep that label on the vehicle until it is delivered to the consumer. Each label must include the following information: (1) the EPA estimated fuel economy of the automobile, (2) the estimated annual fuel cost associated with the operation of the automobile, (3) the range of fuel economy of comparable automobiles and, if applicable, (4) a Gas Guzzler Tax statement. All of the above information is to be determined according to rules prescribed by the Administrator.

The single fuel economy value that is depicted on the current label is called the "estimated mpg." The value is determined by combining numerous city test values as described, in more detail, in section III of this report. There are currently two types of fuel economy labels that manufacturers may have approved. These are the general label and the specific label.

1. General Label/Model Type Label: The general label displays a fuel economy estimate for a model type. The term model type, covers many unique vehicles which are similar in body style, engine, and transmission. These vehicles can be different in other ways that affect fuel economy thus the name "general" label. For example, differences such as weight, axle ratio, etc., will be found

5. Public Law 94-163, 89 Stat. 871, December 22, 1975

within a model type. The model type fuel economy value is calculated from fuel economy data collected from different vehicle designs and averaged. This calculation procedure is an average of the vehicle data, taking into account the anticipated sales of each vehicle used to generate the data. That is, it is a sales-weighted average. (The procedure for sales weighting is described in more detail in section III of this report.). The general label values are determined once for each model year, and are not changed during that model year.

2. Specific Label· A specific label contains the fuel economy of a unique vehicle configuration. EPA only allows the use of the specific labels early in the model year. Usually, manufacturers use specific labels when they believe data are not available to calculate a representative general label value. However, once the general label value is available, it must be used; any specific label within that model type can no longer be used. One reason for this is to keep manufacturers from affixing specific labels on only the best vehicles while using the more average general label value on the worst vehicles.

C. Terms Used in Labeling Program

Before beginning the description of the actual process, it is helpful to understand the basic terminology EPA uses in describing and grouping the various vehicle models and designs. EPA begins by sorting a vehicle manufacturer's product line into (a) model types, (b) base levels, (c) vehicle configurations, and (d) vehicle subconfigurations. Some of the definitions[6] used in the calculation procedures are·

6. A complete listing of definitions used in the fuel economy program can be found in 40 CFR 600 002-80.

1. Model Type: EPCA established the term "model type" as the classification of vehicles for the purpose of averaging for CAFE values. EPA defined model type on the basis of vehicle characteristics readily recognized by consumers and important from a fuel economy perspective (e.g., the general name of the vehicle, engine, and transmission).

Definition: a model type is defined as a unique combination of car line, basic engine, and transmission class. (See Table I)

A car line denotes a group of vehicles within a make or car division which are similar in construction (such as Chevrolet Camaro). The level of decor or opulence is not considered when establishing a car line. Features such as roof line, number of doors, seats or windows, generally do distinguish characteristics of a car line. Station wagons, however, are considered distinct car lines from sedans. The basic engine classification includes the number of engine cylinders, engine displacement, and the fuel system. The transmission class is determined by whether it is a manual, automatic, or semi-automatic, along with the number of forward gears (such as three speed or four speed).

Table 1 (next page) contains a simplified description of a ficticious manufacturer's product line which will be used in sample calculation making use of the basic definitions. Each line in the table represents a vehicle that could be purchased from a dealer. In this example the basic engine and transmission class are the same for the entire product line. The model types in this product line are represented in Table II.

TABLE I

Example Data

Car Line	Basic Engine[1]	Transmission Class[2]	Transmission Config[3]	Inertia Weight	Engine Code	Axle Ratio	Road Load Horsepower	Equivalent Test Weight	Sales	Measured Fuel Economy City	Measured Fuel Economy Highway	Index[4]
Swift	300-2V	M4	M4 a	3500	1	2.73	9.8	3500	12,000	***	***	1A
Swift	300-2V	M4	M4 b	3500	2	2.43	8.9	3375	3,000	16.6	22.2	1B
Cardinal	300-2V	M4	M4 b	3500	2	2.73	10.4	3625	12,000	***	***	1C
Cardinal	300-2V	M4	M4 c	3500	3	3.08	10.4	3500	14,000	***	***	1D
Cardinal	300-2V	M4	M4 a	4000	1	3.08	9.5	3875	3,000	***	***	2A
Bluebird	300-2V	M4	M4 c	4000	3	3.08	10.6	4000	10,000	14.7	17.5	2B
Cardinal	300-2V	M4	M4 c	4000	3	3.36	10.4	4000	6,000	***	***	2C
Bluebird	300-2V	M4	M4 c	4000	3	3.36	10 9	4250	15,000	14.0	16.3	2D

-------Model Type--------------

----------Base Level------------------

----------------------Vehicle Configuration--------------

--Vehicle Subconfiguration----------

*** Untested

Note: Each term in the heading is defined either in Section II of the text or below.

1 300 - 2V = 300 CID with a 2 venturi carburetor.

2 Manual and Automatic Transmissions would be in different classes.

3.a. The base level is made up of the transmission class not configuration. The vehicle configuration and vehicle subconfiguration include transmission configurations.

3.b. Codes a, b, and c represent the final transmission gear ratio:
a = 1.00
b = 1.05
c = 1.10

4 The index references will be used in the text of this report as a short hand method of identifying a specific vehicle description.

Table II

Model Types for Example Data

Index* for Model Types	Car Line	Basic Engine	Transmission Class
A	Swift	300-2V	M-4
B	Cardinal	300-2V	M-4
C	Bluebird	300-2V	M-4

*An index will be supplied so that when referencing a specific item in a table in this report the line of information can be identified.

The present labeling program would combine the data such that each vehicle within a model type will have a fuel economy label with the same fuel economy value even though there are different axle ratios, engine codes, etc.

2. Base Level: Another major level of description is the base level. The purpose of the base level is to segment a manufacturer's product line based on those major design differences affecting fuel economy in order to specify testing requirements and calculate model type values.

Definition: a base level is a unique combination of basic engine, inertia weight class and transmission class.

The terms basic engine and transmission class have been previously defined. An inertia weight class means the class, which is a group of test weights, into which a vehicle is grouped based on its loaded vehicle weight in accordance with the provisions of 40 CFR Part 86.

An excerpt of the table depiciting the relationship between loaded vehicle weight, equivalent test weight and inertia weight is shown below:

Loaded Vehicle[7] Weight-Pounds	Equivalent[8] Weight-Pounds	Inertia Weight Class-pounds
*	*	*
*	*	*
3,313 to 3,437	3,375	3,500
3,438 to 3,562	3,500	3,500
3,563 to 3,687	3,625	3,500
*	*	*
*	*	*

The complete relationship is found in 40 CFR 86.129-80.

Referring then to the example data in Table I, the product line is made up of two base level. That is, since each vehicle has the same basic engine (300-2V) and the same transmission class (M4), the differences in their inertia weights determine base levels. Since there are only two different inertia weights listed in this product line there can be only two base levels.

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7. Means the vehicle curb weight plus 300 pounds to simulate a driver and passenger.

8. Means the weight within an inertia weight class which is used for the dynamometer testing of a vehicle. (Since dynamometers are not infinitely variable incremental settings have to be specified.)

Table III

Base Levels in Example Data

Index for Base Level	Inertia Weight	Index Referred from Table I
I	3,500 pounds	1A through 1D
II	4,000 pounds	2A through 2D

3. Vehicle Configuration: Design differences within base levels can still have an affect on fuel economy. Therefore, for the purpose of describing unique test vehicles, base levels are further subdivided into vehicle configurations.

Definition: a vehicle configuration is defined as a unique combination of inertia weight class, basic engine, and transmission class (all of which determine a base level) plus engine code, transmission configuration, and axle ratio.

An engine code goes beyond the definition of basic engine by isolating different variations of carburetor, distributor, and other key engine and emission control system component calibrations. Similarly, transmission configuration considers shift calibrations and other design factors that determine the performance of the transmission.

4. Subconfiguration: Two more vehicle parameters are used to describe a vehicle for the purpose of fuel economy testing equivalent test weight and road-load horsepower. Equivalent test weights are the subdivisions of inertia weight class which most closely approximates the weight of the actual test vehicle. Road-load horsepower is horsepower required to

overcome vehicle engine friction, driveline friction, and air resistance in order to keep a vehicle rolling at a constant speed. While EPA has informally used the term subconfiguration, this term will be formally defined in a new fuel economy regulation to mean the unique combination of equivalent test weight and road-load horsepower within a vehicle configuration.

D. Determination of the General Label Value:

The minimum amount of test data required to determine a general label value is data from at least one vehicle configuration within each base level. If data from more than one configuration is available within a base level, the base level fuel economy is determined by a sales-weighted average of all the tested configuration fuel economies. Each model type may contain several different base levels since a model type can span several different inertia weight classes. That is,

Model Type = basic engine, transmission class, and carline

Base Level = basic engine, transmission class, and inertia weight class

The difference between model type and base level is carline and inertia weight class. Thus, if there is more than one inertia weight class within a carline the model type will have more than one base level. The base level fuel economy values within each model type are sales weighted and averaged to obtain the model type fuel economy values. These are the fuel economy values printed on the vehicle fuel economy labels.

1. Calculation Procedure

a. Vehicle Configuration's Fuel Economy: If there is only one set of city and highway fuel economy values (highway values are not included on the label) for a vehicle configuration, then these data (rounded to the nearest tenth mpg) represent the vehicle configuration's fuel economy. If there had been more than one vehicle tested within a configuration, these data would be harmonically averaged and the resultant value would represent the vehicle configuration's fuel economy.

The term harmonically averaged, in mathematical terms, is:

$$H = \frac{1}{\frac{1}{N} \sum_{j=1}^{N} \frac{1}{x_j}} = \frac{N}{\sum_{j=1}^{N} \frac{1}{x_j}}$$

Where $\sum^{N} x_j$ is used to denote the sum of all x_j's from $j=1$ to $j=N$

The harmonic average of 2, 4, 8 is:

$$H = \frac{3}{\frac{1}{2} + \frac{1}{4} + \frac{1}{8}} = 3.43$$

The harmonic average is used instead of the arithmatic average because the average of the individual vehicle fuel economy values does not equal the average fuel economy for the vehicles as a group. For example

Car A first goes 100 miles and uses 10 gallons of fuel, thus achieving 10 mpg.

Car A then goes 100 miles and uses 5 gallons of fuel, thus achieving 20 mpg.

The average fuel economy is equal to total miles driven by the total fuel consumed or:

$$\frac{100 + 100}{10 + 5} = \frac{200}{15} = 13\ 33$$

The average of the individual vehicle fuel economy values is:

$$\frac{10 + 20}{2} = 15 \text{ mpg} \qquad \text{(arithmatic average)}$$

The harmonic average of the individual fuel consumptions yields:

$$\frac{2}{\frac{1}{10} + \frac{1}{20}} = 13.3 \text{ mpg; the true average fuel economy.}$$

b. Base Level Fuel Economy: The fuel economy of each base level is comprised of the average fuel economy of each tested vehicle configuration within the base level. These data are "weighted" in proportion to the projected sales of the vehicle subconfiguration. That is, within the same base level, if the fuel economy from one vehicle configuration is very high but with very few sales and the fuel economy from another vehicle configuration is not as high but represents a larger proportion of sales, the fuel economy from the base level would be "weighted" such that average fuel economy would be nearer the lower value. For example:

Vehicle configuration A = 30 mpg	sales =	100
Vehicle configuration B = 22 mpg	sales =	9,900
Total sales of a base level =		10,000

$$\text{Base level fuel economy} = \frac{1}{\frac{100}{10,000}\ \frac{1}{30} + \frac{9,900}{10,000}\ \frac{1}{22}}$$

$$= 22.0588 \text{ mpg}$$

Sales weighting is necessary to ensure the best representation of the fuel economy of the vehicles within the base level.

In base level I (ref. Tables I and III), there is only one tested configuration, therefore, base level I's fuel economy = 16 6 mpg city and 22.2 mpg highway.

In base level II there are two configurations tested (ref. Subconfiguration Index 2B and 2D of Table I). Since there is more than one tested configuration, the base level fuel economy will be determined according to the general equation:

$$\text{Base level fuel econ.} = \frac{1}{\begin{bmatrix}\text{Fraction of}\\ \text{total sales of}\\ \text{configurations}\\ \text{teseted repre-}\\ \text{sented by}\\ \text{configuration}\\ \text{No 1 sales}\end{bmatrix}\left(\frac{1}{\begin{matrix}\text{Configuration}\\ \text{No. 1 fuel}\\ \text{economy}\end{matrix}}\right) + \begin{bmatrix}\text{Fraction of}\\ \text{total sales of}\\ \text{configurations}\\ \text{tested repre-}\\ \text{sented by}\\ \text{configuration}\\ \text{No. 2 sales}\end{bmatrix}\left(\frac{1}{\begin{matrix}\text{Configuration}\\ \text{No. 2 fuel}\\ \text{economy}\end{matrix}}\right) + .}$$

Within base level 2, index 2B represents vehicles of one configuration. Indexes 2C and 2D represent vehicles of a second configuration, but different subconfigurations within that second configuration. Each of these configurations is represented by test data, so the total sales of each will be used to determine the base level fuel economy.

Sales of tested configuration No. 1 (2B)	=	10,000
Sales of tested configuration No. 2 (2C + 2D)	=	21,000
Total Tested Configuration/Base Level Sales	=	31,000

$$\text{No. 1 sales fraction} = \frac{10,000}{31,000} = 0.3226$$

$$\text{No. 2 sales fraction} = \frac{21,000}{31,000} = 0.6774$$

Configuration No. 1 fuel economy	=	14.7 city	and	17.5 highway
Configuration No. 2 fuel economy	=	14.0 city	and	16.3 highway

$$\text{Base Level II's fuel economy} = \frac{1}{(0.3226)\,\frac{1}{14.7} + (0.6774)\,\frac{1}{14.0}} = 14.2184 \text{ mpg}$$

(Similarly the highway value = 16.6687 mpg)

Table IV

Base Level* Fuel Economy

	City	Highway
A =	16.6	22.2
B =	14.2184	16.6687

*ref. Table III

Note: Data depicted to one decimal place are from actual tests.

Data depicted to four places represent averaged data.

c. Model Type Fuel Economy: When only one base level exists within a model type, the base level fuel economy, rounded to the nearest whole mpg, is the model type fuel economy. In the example product line of Table I, two model types exist with only one base level; model type A (ref Table II) with the Swift car line and, model type C with the Bluebird car line. Model type B, with the Cardinal car line, contains two base levels. In order to determine model type B's fuel economy, divide the model type sales fraction of each base level within the model type by the fuel economy of the base level. That is;

Within Model type B base level I sales = 26,000 and base level II sales = 9,000. Total model type B sales = 35,000.

Model B's sales fraction of Base level I $= \frac{26,000}{35,000} = 0.7429$

Model B's sales fraction, base level II $= \frac{9,000}{35,000} = 0.2571$

Therefore, model type B's city fuel economy is:

$$\frac{1}{\frac{0.7429}{16.6} + \frac{0.2571}{14.2184}} = 15.9146 \text{ mpg}$$

(Similarly the highway value = 20.4549 mpg)

Table V

General Label Fuel Economy

Model type[1]	Fuel Economy	
	City[2]	Highway[3]
A	17	22
B	16	20
C	14	17

1. ref. Table II

2. The city value is the only one displayed on the vehicle labels and is called the "estimated mpg."

3. The highway value is not displayed on the vehicle label, but since this value is used in other EPA calculations for CAFE requirements it is available and manufacturers frequently advertise this value in addition to the city value.

Thus, each Swift would have a fuel economy label depicting an estimated mpg of 17; each Cardinal = 16, and each Bluebird = 14. (All label values are rounded to whole numbers.)

III. Modified Labeling Program

A. Background

As described in Section II, each value on a fuel economy label represents the fuel economy estimate of vehicles of the same general design, called model types. Specifically, the model type includes vehicles which have the same basic engine and transmission class (defined in Section II.C), and are in the same car line.

The current general label often does not reflect design differences which exist within the classification of model types. Differences in axle ratios, weight, and engine calibration can have a significant affect on the fuel efficiency of a particular vehicle. Under the current labeling program, however, the vehicles with these differences receive the same label value. If we were to test each subconfiguration to determine the effect of these differences, over 6,000 additional tests would have to be performed, an increase of 500 percent over current number of tests. An increase in testing of this magnitude could not be justified in either the resources required to perform the tests or the associated rise in vehicle cost.

Even though it is not feasible to test each subconfiguration, a method is available to mathematically adjust test data for several design differences and produce data applicable to the untested subconfigurations. EPA has developed[9] equations to adjust actual test data for differences in axle ratios, ETW's, and RLHP. Referring back to table I, there were only three fuel economy values for the example product line Using the adjusting equations, each vehicle subconfiguration would be represented, by either test values or adjusted test values. Subsection B of this section will describe in detail how the calculations are to be made.

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9. Murrell, "Technical Support Report for Regulatory Action Light-Duty Vehicle Fuel Economy Labeling," U.S. Environmental Protection Agency, EPA/AA/CTAB/FE-81-6, October, 1980

B. Description of Calculation Procedure and Equations

With the calculation procedure described in this report each vehicle subconfiguration described in a manufacturer's product line will have fuel economy data; either actual data or data derived by adjusting the actual data for differences between tested and untested vehicle subconfigurations within the same basic engine and transmission class. Although we were able to derive adjustment equations for axle ratio, RLHP, and ETW; we were not able to derive equations to adjust for differences between engine codes nor between transmissions configurations. Therefore, when there exists an untested engine code and transmission configuration combination within subconfigurations, the actual test data with the same basic engine and transmission class combination will be adjusted for any differences in axle ratio, RLHP, and ETW between the tested and untested subconfiguration. The results are then harmonically averaged together. This average value will then become the adjusted fuel economy value for that untested engine code and transmission configuration combination.

The simplest case is to adjust an untested subconfiguration that has the same engine code and transmission configuration as does a subconfiguration with actual test data. (See example 1 below.) If there exists two or more subconfigurations with test data having the same engine code and transmission configuration as the untested subconfiguration, each of these tested subconfiguration will be adjusted to the untested subconfiguration and the resultant adjusted data would be harmonically averaged (see example 2 below). If the untested subconfiguration also has an untested engine code and transmission configuration combination, each tested subconfiguration having the same basic engine and transmission class will be adjusted, and the sales weighted harmonic average would then represent the untested subconfiguration (see example 3 below).

The basic adjustment equation is:

$$FE_{Adj} = FE_T + dFE_{Axle} + dFE_{ETW} + dFE_{HP}$$

Where:

FE_{Adj} = adjusted fuel economy

FE_T = Tested fuel economy (i.e., actual data)

dFE_{Axle} = Change in fuel economy due to differences in axle ratios

dFE_{ETW} = Change in fuel economy due to differences in ETW

dFE_{RLHP} = Change in fuel economy due to differences in RLHP

The difference in fuel economy (dFE) is found as follows:

$$dFE = FE_u - F_T = FE_T\left(\frac{2(S)(dX)}{2(\overline{X}) - S(dX)}\right)$$

Where:

FE_u = untested fuel economy

FE_T = tested fuel economy

dX = difference between untested and tested parameter, e.g., if the tested subconfigurations had an axle ratio of 2.76 and the untested was 2 56; $dX = X_u - X_T$ or $dX = 2.56 - 2.76 = -0.20$

$\overline{X}$ = average of parameter specifications, i.e., Axle ratio ($\overline{AR}$), Equivalent Test Weight ($\overline{ETW}$), Road Load Horsepower ($\overline{RLHP}$); e.g. for axle ratios of 2.76 and 2.56, $\overline{X} = (2.76 + 2.56)/2 = 2.66$

(Note: Tested is always subtracted from untested parameter value.)

S = sensitivity factor, where:

For Axle,

$$S_{Axle}^{City} = 1.025 - 0.437(\overline{AR}) \quad \text{(without overdrive)}$$

$$S_{Axle}^{City} = 1.028 - 0.376(\overline{AR}) \quad \text{(with overdrive)}$$

$$S_{Axle}^{Hwy} = 0.578 - 0.380(\overline{AR}) \quad \text{(without overdrive)}$$

$$S_{Axle}^{Hwy} = 0.580 - 0.327(\overline{AR}) \quad \text{(with overdrive)}$$

For Equivalent Test Weight,

$$S_{ETW}^{City} = -0.657 + 9.542(10^{-5})\overline{W} + 3.512(10^{-10})\overline{W}^2$$

$$S_{ETW}^{Hwy} = -0.626 + 1.024(10^{-4})\overline{W} + 8.174(10^{-10})\overline{W}^2$$

For Road-Load Horsepower,

$$S_{RLHP}^{City} = -0.247 + 0.756(10^{-2})\overline{RLHP}$$

$$S_{RLHP}^{Hwy} = -0.483 + 1.325(10^{-2})\overline{RLHP}$$

C. Actual Calculations

1. In the example data in Table I, engine code 2 with transmission configuration b has one subconfiguration tested (ref. index 1B) and one subconfiguration untested (ref. index 1C). To calculate the adjusted city fuel economy value, the following procedure is used:

Example 1: Adjust city data from tested subconfiguration 1B to determine fuel economy of untested subconfiguration 1C.

Tested index 1B: Axle = 2.43, RLHP = 8.9, ETW = 3375, FE_T = 16.6

Untested index 1C: Axle = 2.73, RLHP = 10.4, ETW = 3625, FE_{Adj} = ?

STEP 1: Correct for differences

a. Correct for axle differences

$dX = 2.73 - 2.43 = 0.30$

$\overline{X} = (2.43 + 2.73)/2 = 2.58$

$FE_T = 16.6$ mpg

$S = 1.025 - 0.437(\overline{AR}) = -0.1025$

$$dFE_{Axle} = FE_T \left(\frac{2(S)(dX)}{2(\overline{X}) - S(dX)} \right) = 16.6 \left(\frac{2(-0.1025)(0.30)}{2(2.58) - (0.1025)(0.30)} \right)$$

$dFE_{Axle} = -0.1966$ mpg

b. Correct for RLHP differences

$dX = 10.4 - 8.9 = 1.5$

$\overline{X} = (8.9 + 10.4)/2 = 9.65$

$FE_T = 16.6$ mpg

$S = -0.247 + 0.756(10^{-2})\overline{RLHP} = -0.1740$

$$dFE_{RLHP} = FE_T \left(\frac{2(S)(dX)}{2(X) \overline{-} S(dX)} \right) = 16.6 \left(\frac{2(-0.1740)(1.5)}{2(9.65) - (-0.1740)(1.5)} \right)$$

$= -0.4431$ mpg

c. Correct for ETW differences

$dX = 3625 - 3375 = 250$

$\overline{X} = 3,500$

$FE_T = 16.6$ mpg

$S = -0.657 + 9.542(10^{-5})\overline{W} + 3.512(10^{-10})\overline{W}^2 = -0.3187$

$$dFE_{ETW} = FE_T \left(\frac{2(S)(dX)}{2(\overline{X}) - S(dX)} \right) = 16.6 \left(\frac{2(-0.3187)(250)}{2(3,500) - (-0.3187)(250)} \right)$$

$= -0.3737$ mpg

STEP 2: Combine correction factors

$$FE_{Adj} = FE_T + dFE_{Axle} + dFE_{RLHP} + dFE_{ETW}$$
$$= 16.6 + (-0.1966) + (-0.4431) + (-0.3737)$$
$$= 15.5866 \text{ mpg}$$

2. In the example data in Table I, engine code 3 has two tested subconfigurations (ref: index 2B and 2D) and two untested subconfiguration (ref. index 1D and 2C). To calculate the adjusted city fuel economy value, the following procedure is used·

The first step is to adjust the data from the tested subconfigurations for any differences between them and the untested subconfigurations in axle ratio, road-load horsepower (RLHP), and equivalent test weights (ETW). (The actual order is not important.) Since there is more than one tested subconfiguration with the same engine code, the adjusted data will be harmonically averaged.

Example 2: Calculate the city fuel economy for subconfiguration 1D*.

Untested vehicle 1D has an engine code of 3 and a transmission configuration c. Since there are two tested subconfigurations with the same engine code and transmission configuration, 2B and 2D, each one is to be adjusted for any differences in axle, ETW, or RLHP that exists between it and vehicle 1D. (Note that 2B and 2D are <u>not</u> in the same base level as 1D, but can still be used to derive data for 1D since they are in the same basic engine and transmission class as 1D.) The data will be harmonically averaged and the results will be used to represent 1D. The calculation procedures are as follows:

*This identification can be found under the column headed "Index" in Table I.

Adjust 2B for difference between it and 1D.

Tested Index 2B. Axle = 3.08 RLHP = 10.6 Test Wt. = 4000 FE = 14.7 mpg

Untested Index 1D: Axle = 3.08 RLPH = 10.4 Test Wt. = 3500 FE = ?

STEP 1 Correct for differences between 2B and 1D

a. Correct for Difference in Axle: No difference, No Correction

b. Correct for Difference in RLHP

$dX = 10.4 - 10\ 6 = -0.2$ $\qquad S^{city}_{RLHP} = -0.247 + 0.756(10^{-2})\ \overline{X}$

$\overline{X} = (10.6 + 10.4)/2 = 10.5$ $\qquad = -0.1676$

$$dFE_{RLHP} = 14.7\left(\frac{2(-0.1676)(-0.2)}{2(10.5) - (-0.1676)(-0.2)}\right) = 0.0470 \text{ mpg}$$

c. Correct for difference in ETW

$dX = 3,500 - 4,000 = -500$

$\overline{X} = (4,000 + 3,500)/2 = 3,750$

$FE_{2B} = 14.7$

$$S^{city}_{ETW} = -0.657 + 9.542(10^{-5})\overline{X} + 3.512(10^{-10})\overline{X}^2 = -0.2942$$

$$dFE_{ETW} = 14.7\left(\frac{2\ (-0.2942)(-500)}{2\ (3,750) - (-0.2942)(-500)}\right) = 0.5882 \text{ mpg}$$

STEP 2: Combine correction factors

$$FE^{city}_{1D\ from\ 2B} = FE_{2B} + dFE_{axle} + dFE_{RLHP} + dFE_{ETW}$$

$$= 14.7 + 0.0 + 0.0470 + 0.5882$$

$$= 15.3352 \text{ mpg}$$

STEP 3: Correct for differences between 2D and 1D

Tested Index 2D: Axle = 3.36 RLHP = 10.9 Test Wt. = 4250 FE = 14.0
Untested Index 1D: Axle = 3.08 RLHP = 10.4 Test Wt. = 3500 FE = ?

a. Correct for differences in Axle:

$dX = -0.28$ $S = -0.247 + 0.756(10-2)$

$= -0.3821$

$\overline{X} = 3.22$

$FE_{2D} = 14.0$

$$dFE_{axle} = 14.0 \frac{2(-0.3821)\ (-0.28)}{2(3.22) - (-0.3821)(-0.28)} = 0.4731 \text{ mpg}$$

b. Correct for differences in RLHP

$dX = -0.5$ $S = -0.247 + 0.756(10^{-2})\ \overline{X}$

$\overline{X} = 10.65$

$FE = 14.0$

$$dFE_{RLHP} = 14.0 \frac{2(-0.1665)\ (-0.5)}{2(10.65) - (-0.1665)\ (-0.5)} = 0.1099 \text{ mpg}$$

c. Correct for differences in ETW

$dX = 750$ $\quad\quad S = -0.657 + 9.542(10^{-5})\overline{W} + 3.512(10^{-10})\overline{W}^2$

$\overline{X} = 3875$ $\quad\quad = -0.2820$

$FE = 14.0$

$dFE_{ETW} = 0.7855$

Step 4: Combine correction factors

$$FE^{city}_{1D\ from\ 2D} = 14.0 + 0.4731 + 0.1099 + 0.7855 = 15.3684\text{ mpg.}$$

Step 5: Average the adjusted values from 2B + 2D to get the harmonic estimate of 1D.

$$\text{City } \overline{FE}_{1D} = \frac{N}{\frac{1}{FE}} = \frac{2}{\frac{1}{FE_{1D-2B}} + \frac{1}{FE_{1D-2D}}}$$

$$= \frac{2}{\frac{1}{15.3352} + \frac{1}{15.3684}} = 15.3518\text{ mpg}$$

3. In the example data in Table I, the combination of engine code 1 and transmission configuration (a) (Ref· indexes 1A and 2A) is not represented by any data. To calculate the fuel economy for either of these subconfigurations the following procedure is used·

Adjust each test data in the same basic engine, transmission class as the untested subconfiguration, for differences in ETW, Axle, and RLHP between it and the untested subconfiguration. If there is more than one tested vehicle within an engine code, basic engine, and transmission configuration combination, the adjusted data are harmonically averaged. The adjusted subconfiguration values and any harmonic average value are then sales weighted together based on the total projected sales of the basic engine, engine code, and transmission configuration combinations.

Example 3: Calculate the city fuel economy value for untested subconfiguration 1A which has an untested combination of engine code (code 1) and transmission configuration (a). The tested subconfigurations in the same basic engine and transmission class are 1B, 2B, and 2D. Adjust each tested subconfiguration for differences in axle, RLHP, and ETW between the tested subconfiguration and the untested subconfiguration.

STEP 1: Correct for differences between 1A and 1B

Adjustment of subconfiguration 1B.

FE of 1A from 1B: $FE_{1A-1B} = FE_{1B} + dFE_{axle} + dFE_{RLHP} + dFE_{ETW}$

Using method of FE described in the previous example:

$$FE = 16.6 + (-0.1966) + (-0.2794) + (-0.1949)$$
$$= 15.9291 \text{ mpg}$$

STEP 2: Correct for differences between 1A and 2B

Adjustment of subconfiguration 2B

$$FE = 14.7 + 0.4395 + 0.1972 + 0.5882$$
$$= 15.9249$$

STEP 3: Correct for differences between 1A and 2D

Adjustment of subconfiguration 2D

$$FE = 14.0 + 0.9143 + 0.2534 + 0.7855$$
$$= 15.9531 \text{ mpg}$$

STEP 4: Harmonic average those adjusted values with the same combination of engine code and transmission configuration in this example 2B and 2D with engine code 3 and transmission configuration c.

$$\overline{FE}_{3-c} = \frac{2}{\frac{1}{15.9249} + \frac{1}{15.9531}} = 15.9390 \text{ mpg}$$

STEP 5. Calculate the sales weighted harmonic average of the tested engine codes in the same basic engine, transmission class, as the untested subconfiguration.

a. Sum the sales for each tested engine code and transmission class combination.

1. For tested engine code 2 and transmission configuration b (tested in subconfiguration 1B)

Subconfiguration with engine code 2 and Transmission Configuration b		Sales
1B *		3,000
1C		12,000
	$Total_{2-b}$	15,000

2. For tested combination of engine code 3 and transmission configuration c (tested by subconfiguration 2B and 2D).

Subconfiguration		Sales
1D		14,000
2B *		10,000
2C		6,000
2D *		15,000
	$Total_{3-c}$	45,000

b. Sum all sales of tested engine codes and transmission cofigurations:

$$Total_{tested} = Total_{2-b} + Total_{3-c}$$
$$= 15,000 + 45,000$$
$$= 60,000$$

* Tested subconfiguration

c. Calculate the sales weighted harmonic average.

$$FE_{1A} = \frac{1}{\Sigma \left(\frac{Sales_{comb.}}{Total\ Sales}\right) + \left(\frac{1}{FE_{comb.}}\right)} = \frac{1}{\left(\frac{Sales_{2-b}}{Total\ Sale}\right)\left(\frac{1}{FE_{2-b}}\right) + \left(\frac{Sales_{3-c}}{Total\ Sales}\right)\left(\frac{1}{FE_{3-c}}\right)}$$

$$= \frac{1}{\left(\frac{15000}{60000}\right)\left(\frac{1}{15.9291}\right) + \left(\frac{45000}{60000}\right)\left(\frac{1}{15.9390}\right)}$$

$$= 15.9365 \text{ mpg}$$

The resultant city fuel economy value for the untested combination of engine code 1 and transmission configuration (a) with the subconfiguration parameters described by index 1A is 15.9365.

D. Completed Calculation of Fuel Economy Values

Using the procedure outlined in the two preceeding examples, values for the remaining city and all the highway values are calculated and shown in the following completed table, Table VI.

Example Data

Car Line	Basic Engine [1]	Transmission Class [2]	Transmission Config. [3]	Inertia Weight	Engine Code	Axle Ratio	Road Load Horsepower	Equivalent Test Weight	Sales	Tested and Adjusted Fuel Economy City	Tested and Adjusted Fuel Economy Highway	Index [4]
Swift	300-2V	M4	M4 a	3500	1	2.73	9.8	3500	12,000	15.9365	19.8127	1A
Swift	300-2V	M4	M4 b	3500	2	2 43	8.9	3375	3,000	16.6	22.2	1B [5]
Cardinal	300-2V	M4	M4 b	3500	2	2.73	10.4	3625	12,000	15.5866	19.5877	1C
Cardinal	300-2V	M4	M4 c	3500	3	3.08	10.4	3500	14,000	15.3518	18.1827	1D
Cardinal	300-2V	M4	M4 a	4000	1	3.08	9.5	3875	3,000	15.1045	18.3934	2A
Bluebird	300-2V	M4	M4 c	4000	3	3.08	10.6	4000	10,000	14.7	17.5	2B [5]
Cardinal	300-2V	M4	M4 c	4000	3	3.36	10.4	4000	6,000	14.2982	16.7057	2C
Bluebird	300-2V	M4	M4 c	4000	3	3.36	10.9	4250	15,000	14.0	16.3	2D [5]

-----Model Type------------

--------Base Level-----------------
----------------------Vehicle Configuration----------
---Vehicle Subconfiguration-------

Note: Each term in the heading is defined either in Section II of the text or below.

1. 300 - 2V = 300 CID with a 2 venturi carburetor.

2. Transmissions with and without overdrive would be in different classes as would automatic and manual.

3 a. The base level is made up of the transmission class not configuration. The vehicle configuration and vehicle subconfiguration include transmission configurations.

3.b. Code a, b, and c represent the final transmission gear ratio:
a = 1.00
b = 1 05
c = 1.10

4. The index references will be used in the text of this report as a short hand method of identifying a specific vehicle description.

5. Tested subconfigurations

D. Model Type Label Determinations; Values and Level of Detail Within Product Line

Now that each subconfiguration is represented by a fuel economy value, either by actual test data or by adjusted data, label values can be determined. More data are now available but, the fundamental process of combining the data remains the same. However, there is no longer a need to calculate configuration and base level averages. Instead, we will directly average (according to sales) from the vehicle's subconfiguration fuel economy. This analysis presents five levels of detail within a product line by which labels could be determined, all making use of the same fuel economy values (i.e., test data or adjusted data for all subconfigurations). They are:

Alternatives	Reference Code
1. Modified Model Type Labels	A
2. Modified Model Type + Axle	B
3. Modified Model Type + Axle + ETW	C
4. Modified Model Type + Axle + ETW + RLHP	D
5. Modified Model Type + Subconfiguration	E

Using the data from Table VI, the procedure to calculate fuel economy label values directly from subconfiguration is as follows:

1. Modified Model Type Labels: This level of detail is the same as the current labeling program. However, there is one significant difference; each subconfiguration will now be represented by data. Using the model type classification containing the Swift car line of Table VI, a model type value would be:

Car line	Sales	Fuel Economy City	Fuel Economy Highway	Reference Code*
Swift	12,000	15.9365	19.8127	1A
Swift	3,000	16.6	22.2	1A
Total	15,000			

$$\text{Model Type Label Value} = \frac{1}{\left(\frac{12{,}000}{15{,}000}\right)\left(\frac{1}{15.9365}\right) + \left(\frac{3{,}000}{15{,}000}\right)\left(\frac{1}{16.6}\right)}$$

= 16.0649 mpg

= 16 (city) rounded to the nearest whole mpg.

Similarly the model type classification containing the Cardinal car line is equal to 15.2168 or 15 mpg (city) and the Bluebird car line is equal to 14.2718 or 14 mpg (city).

Note: Only the model classifications containing the Swift and Bluebird car lines contain actual test data. All of the data used to represent the model type classification containing the Cardinal car line are adjusted fuel economy values.

2. Modified Model Type + Axle Labels: Under this alternative, within a model type each unique axle ratio will receive a separated label value. In the above sample calculation there are only two subconfigurations within the model type classification and, each of these subconfigurations have a unique axle. Therefore, the model type + axle label value will be the subconfiguration fuel economy value, rounded to a whole mpg.

Car line	Axle	Sales	Fuel Economy Data City	Fuel Economy Data Highway	Label Values City	Label Values Highway	Index
Swift	2 73	12,000	15.9365	19.8127	16	20	1A
Swift	2.43	3,000	16.6	22.2	17	22	1B

*from Table VI

The model type values for the classification containing the Cardinal car line would be:

Car line	Axle	Sales	Fuel Economy City	Fuel Economy Highway	Label Values City	Label Values Highway	Index
Cardinal	2.73	12,000	15.5866	19.5877	16	20	1C
Cardinal	3.08	17,000	15.3076	18.2195	15	18	1D and 2A
Cardinal	3.36	6,000	14.2982	16.7057	14	17	2C

3. Modified Model Type + Axle + ETW· Since the Swift and Bluebird carelines contain only one ETW within each combination of model type and axle ratio, further differentiation by ETW will not change their label values. The number of labels for the model type classification containing the Cardinal car line would, however, increase by one when separating on the basis of axle and ETW. That is, for indexes 1D and 2A both subconfigurations have the same axle but differenct ETW's. Therefore, instead of combining these data, as was done at the axle level of detail, each fuel economy value will now represent a specific fuel economy label.

4. Modified Model Type + Axle + ETW + RLHP: From the example data in Table VI the number of labels will not increase when adding RLHP since no combination of modified model type + axle + ETW has more than one RLHP. This is due only to our selection of subconfiguration descriptions.

5. Modified Model type + Subconfiguration. (A unique label for each subconfiguration within a carline): Our example labels would not change for the same reasons as cited in 4 above.

Table VII page 38 depicts the label values that would be assigned under each of the alternatives discussed above. The data that make up this table was derived from the example data of Table VI. The normal complexities of a product line were not shown in order that the calculation procedure could be emphasized. We have, however, taken the 1981 product line for nine manufacturers (American Motors, Chyrsler, Ford, General Motors, Fiat, Nissan, Toyo Kogyo, Toyota, and Volkswagon) and performed the subject calculations. An analysis of that data is presented in section III of this report.

Table VII

Fuel Economy Values for Current and Proposed Labels--MPG

Model Type[1]	Present Model Type[2] city/highway	Modified Model Type city/highway	Model Type-Axle city/highway	Model Type-Axle-ETW city/highway	Model Type-Axle-ETW-RLHP city/highway	Model Type-Subconfiguration city/highway
A (actual test data in this model type: 16.0/22.2)	16/22 (1A&1B*)	16/20 (1A&1B*)	16/20 (1A*) 17/22 (1B*)	16/20 (1A*) 17/22 (1B*)	16/20 (1A*) 17/22 (1B*)	16/20 (1A*) 17/22 (1B*)
B (no actual test data in this model type)	16/20 (1C,1D,2A & 2C*)	15/18 (1C,1D,2A & 2C*)	16/20 (1C*) 15/18 (1D&2A*) 14/17 (2C*)	16/20 (1C*) 15/18 (1D*) 15/18 (2A*) 14/17 (2C*)	16/20 (1C 15/18 (1D*) 15/18 (2A*) 14/17 (2C*)	16/20 (1C*) 15/18 (1D*) 15/18 (2A*) 14/17 (2C*)
C (actual test data in this model type: 14.7/17.5, 14.0/16.3)	14/17 (2B&2D*)	14/17 (2B&2D*)	15/18 (2B*) 14/16 (2D*)	15/18 (2B*) 14/16 (2D*)	15/18 (2B*) 14/16 (2D*)	15/18 (2B*) 14/16 (2D*)

* Index(s) References

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[1] Refer to Table II for description of car lines within a model type.

[2] Refer to Table VI

IV. Impact of Modified Labeling Program on the 1981 General Label Data Base.

1. Background

The previous section of this report described the modified labeling program and how to use the adjustment equations. The section will analyze the effect of the modified labeling program on the actual product line of nine manufacturers. The 1981 general label data base is the source of the data and the 1981 general label value is the reference point for all comparisons. (Note that this comparison does not include the use of an EPA to in-use correction factor.) It compares only the differences that would occur due to the modified label calculation method. For example, when the modified label value is calculated it is compared to the present label value as follows:

(Modified label value) - (Current label value) = Difference

The "sign" of the resultant difference indicates the direction the current label value would be adjusted to arrive at the new adjusted label value. That is, a -1 mpg difference indicates the modified label value would be 1 mpg less than the current label value.

The data base was comprised of 1981 product lines for nine manufacturers; four domestic manufacturers and five foreign manufacturers They are

Domestic	Foreign
American Motors	Fiat
Chrysler	Nissan
Ford	Toyo Kogyo
General Motors	Toyota
	Volkswagon

As in the example calculations in section III, all subconfigurations were represented by fuel economy test data or adjusted fuel economy data prior to calculating the label values. Label values were calculated for the five different levels of labeling detail described previously. The manufacturer provided EPA with the total 1981 projected sales for each subconfiguration at the time their vehicles were labeled. We used these sales to determine the number of vehicles which would be labeled with a different fuel economy value if the modified label program were adopted. Label values, rounded to the whole numbers, were used to determine these differences.

Three specific comparisons of the current to the modified labeling system have been made. The comparisons were compiled for all nine manufacturers, and also split into the domestic and the foreign manufacturers. (No attempt was made to separate foreign built vehicles with a domestic model name or, a foreign manufacturers product line which incorporated vehicles built in America.) The three specific comparisons made are:

1. Total number of vehicle labels required at each level of detail.

2. Percent of sales for an absolute fuel economy difference at various levels of detail.

3. Percent of sales for each 1 mpg fuel economy difference at various levels of detail.

The tables describing these comparisons are in Appendix A for all nine manufacturers, Appendix B for the domestic manufacturers, and Appendix C for the foreign manufacturers. Appendix D contains percent sales for each of the manufacturers at differences in label fuel economy values and Appendix E contains the various manufacturer's difference in the total number of labels at each level of labeling detail.

2. Analysis of data

The following general observations are made and are applicable to each level of labeling detail.

a. Cars:

- About 30 percent of all cars would receive different estimates of city fuel economy.
- About 25 percent of all cars would have an estimate of city fuel economy 1 mpg different from the current label value.
- About 5 percent of all cars would have an estimate of city fuel economy 2 mpg or more from the current label value.
- From 5 to 10 percent of all cars would have a label (city) value recalculated at a higher fuel economy value than the present.
- About 45 percent of all cars would receive different estimates of highway fuel economy (currently calculated but not displayed on the label).
- About 35 percent of all cars would have an estimate of highway fuel economy 1 mpg different from the value presently calculated.
- About 10 percent of all cars would have an estimate of highway fuel economy 2 mpg or more from the calculated highway value.
- From 15 to 20 percent of all cars would have a recalculated highway fuel economy value higher than the present value.
- The range of city fuel economy differences for cars is -3 mpg to +2 mpg.

- The range of highway fuel economy differences for cars is -6 mpg to +5 mpg.

b. Trucks:

- About 30 percent of all trucks would receive different estimates of city fuel economy.
- About 25 percent of all trucks would have an estimate of city fuel economy 1 mpg different from the current label value.
- Less than 5 percent of all trucks would have an estimate of city fuel economy 2 mpg or more from the current label value.
- Less than 5 percent of all trucks would have a label value recalculated at higher fuel economy values than present.
- About 40 percent of all trucks would receive different estimates of highway fuel economy (currently calculated but not displayed on the vehicle label).
- About 30 percent of all trucks would have an estimate of highway fuel economy 1 mpg different from the value currently calculated.
- About 10 percent of all trucks would have an estimate of highway fuel economy 2 mpg or more from the currently calculated highway.
- About 10 percent of all trucks would have a recalculated highway value higher than the present value.
- The range of city fuel economy differences for trucks is from -8 mpg to +3 mpg.
- The range of highway fuel economy differences for trucks is from -10 mpg to +4 mpg.

3. Discussion

In reviewing the data (Appendix A through Appendix E) the effect the modified label calculation would have on different stratifications of these data are apparent. Two apparent stratifications are; cars versus trucks and foreign versus domestic.

The car versus truck stratification is reflected by the number of labels necessary for each labeling alternative. That is, going from the present labeling program to the model type + axle label alternative would increase the number of car labels by 94, more than a 15 percent increase over the current 616. The same alternative would increase the number of truck labels by 287, more than a 64 percent increase over the current 449. Going from the present program to the most detailed level of labeling (i.e., car line + vehicle subconfigurations) would increase the number of car labels by 1187 (about 3 times the current number of labels) and truck labels by 2023 (over 5 times the current number of labels). (These data are applicable for the nine manufacturers evaluated.)

In referring to Appendixes A through C, it is apparent that the increase in labeling detail will also increase the label fuel economy values of trucks to a greater extent than those values of cars. This is not an unexpected trend in that manufacturer make available a larger number of options for trucks that effect fuel economy than for cases e.g., a wide range of axle ratios, lower geared transmissions, and severe service (heavy duty) options, the latter often increase the weight of the vehicle.

Within the stratification of cars and trucks there exists another level of stratification, domestic and foreign manufactured cars and trucks. This trend is again the result of the number of fuel economy influencing options offered by the different manufacturers, e.g., the foreign manufacturers usuallly offer only a single axle, transmission gearing, or limited weight adding option for each model type. For example, for the manufacturers evaluated, the number of labels needed for cars at the model type plus axle level of labeling detail increased by 90 for the four domestic manfacturers (a 19 percent increase over the present label requirements) while a total of only 4 additional labels would be needed for the five foreign manufacturers (a 3 percent increase). Similarly, for truck's the increase was 285 for the domestic manufacturers (a 71 percent increase) while only 2 additional labels were needed for the foreign manufacturers (a 4 percent increase). For the greatest level of detail, an increase of 799 car labels would be needed for the domestic manufacturers (an increase over the current number of labels by a factor of 2.8) and 388 labels for the foreign manufacturers (a factor of 3.75) over the present label requirements. At the same level of labeling detail for trucks an increase of 1941 labels would be required for the domestic manufacturers (a factor of 5.8) and 82 labels for the foreign manufacturers (a factor of 2.7).

The increase in the number of labels is primarily due to the options available from each manufacturer and not a result of technology. There will be a cost to the manufacturers to generate and apply these new labels, however, the consumer will benefit. That is, the label value will be a more vehicle specific value and the accuracy of the label value will be improved For example, assuming 10 million new car sales a year, about 3 million cars (30 percent) of the present label values would change by incorporating any one of the labeling alternatives. With about 2 million of these new cars with revised labels having the fuel economy estimate revised to a lower value.

Appendixes D depicits the number of vehicles (percent of sales) which would have their label values change by +1, 0, and -1 mpg for each level of labeling detail. (The percent of sales does not equal 100 percent as their are levels which would change by more than 1 mpg.) In reviewing the effect of increasing the level of labeling detail for all car manufacturers and then for all truck manufacturers it is apparent that there is an overall improvement in the labeling accuracy for trucks for each of the first three alternatives. For cars, the improvement in accuracy is not as significant as the level of labeling detail is increased. However, in evaluating the impact of these labeling alternatives for individual manufacturers, it is apparent that each manufacturer is affected differently. One manufacturer (American Motors) would have the largest percentage of vehicles relabeled with a higher city value. Ford, Chrysler, Nissan, and Toyota would have a significant number of vehicles which would have label values decreased by 1 mpg. The foreign trucks would be the least effected by any of these labeling alternatives with very few changes in label fuel economy values or the number of different labels required.

Appendix A

Domestic and Foreign Manufacturers

Table Nos.	Title
A-1 and A-2	Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Differences within Each Level of Labeling; City and Highway Label Differences.
A-3 and A-4	Sales Percentages for Absolute Label Differences Versus Percent Sales: City and Highway Label Differences.
	Fuel Economy Differences Versus Percent Sales;
A-5	Modified Model Type Label Value - Current Label Value; City
A-6	Modified Model Type Label Value - Current Label Value; Highway
A-7	Modified Model Type + Axle Label Value - Current Label Value; City
A-8	Modified Model Type + Axle Label Value - Current Label Value; Highway
A-9	Modified Model Type + Axle + ETW Label Value - Current Label Value; City
A-10	Modified Model Type + Axle + ETW Label Value - Current Label Value; Highway
A-11	Modified Model Type + Axle + ETW + RLHP Label Value - Current Label Value; City
A-12	Modified Model Type + Axle + ETW + RLHP Label Value - Current Label Value; Highway
A-13	Modified Model Type + Subconfiguration Label Value - Current Label Value; City
A-14	Modified Model Type + Subconfiguration Label Value - Current Label Value; Highway

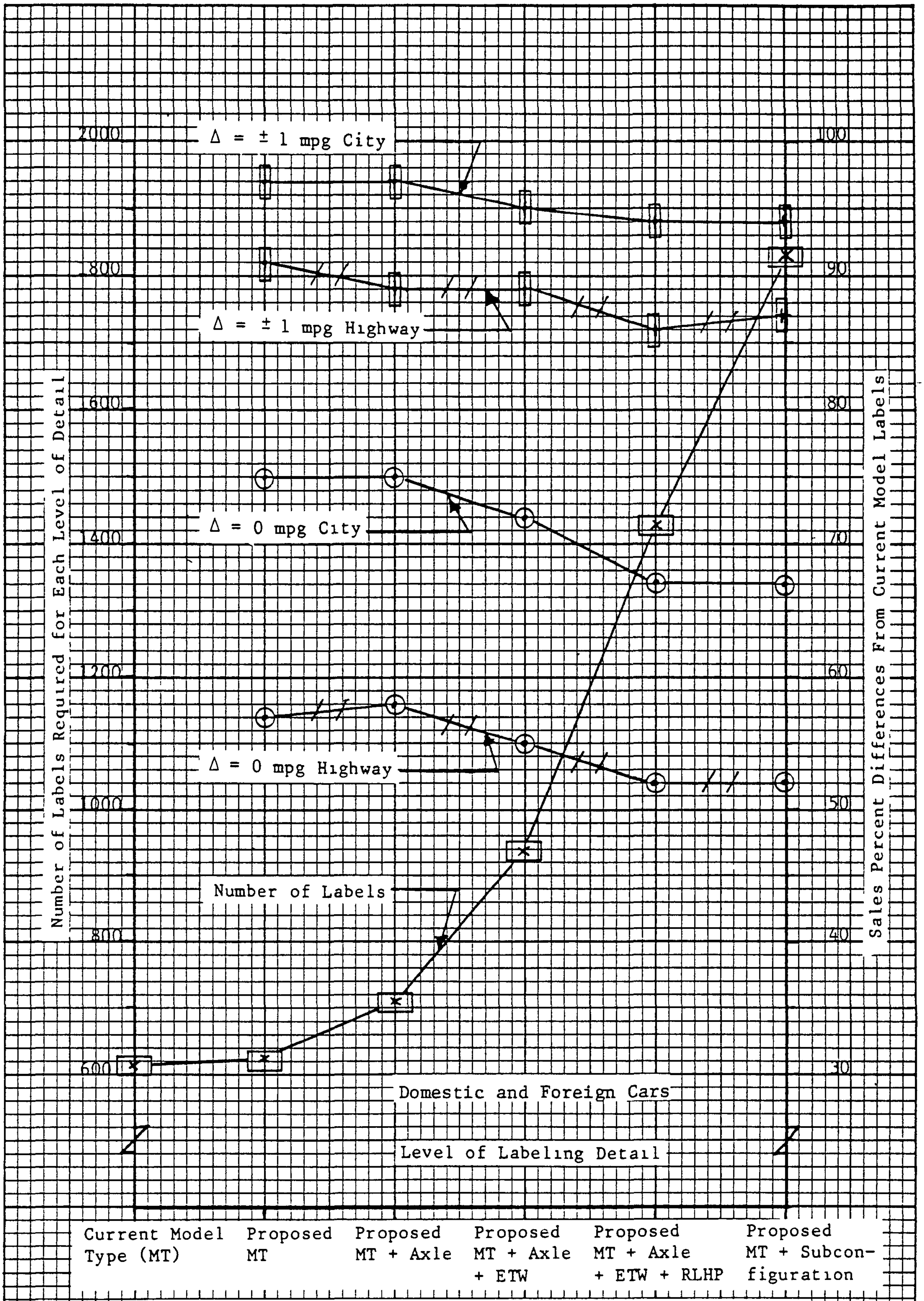

Table No. A-1 Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Within Each Level of Detail

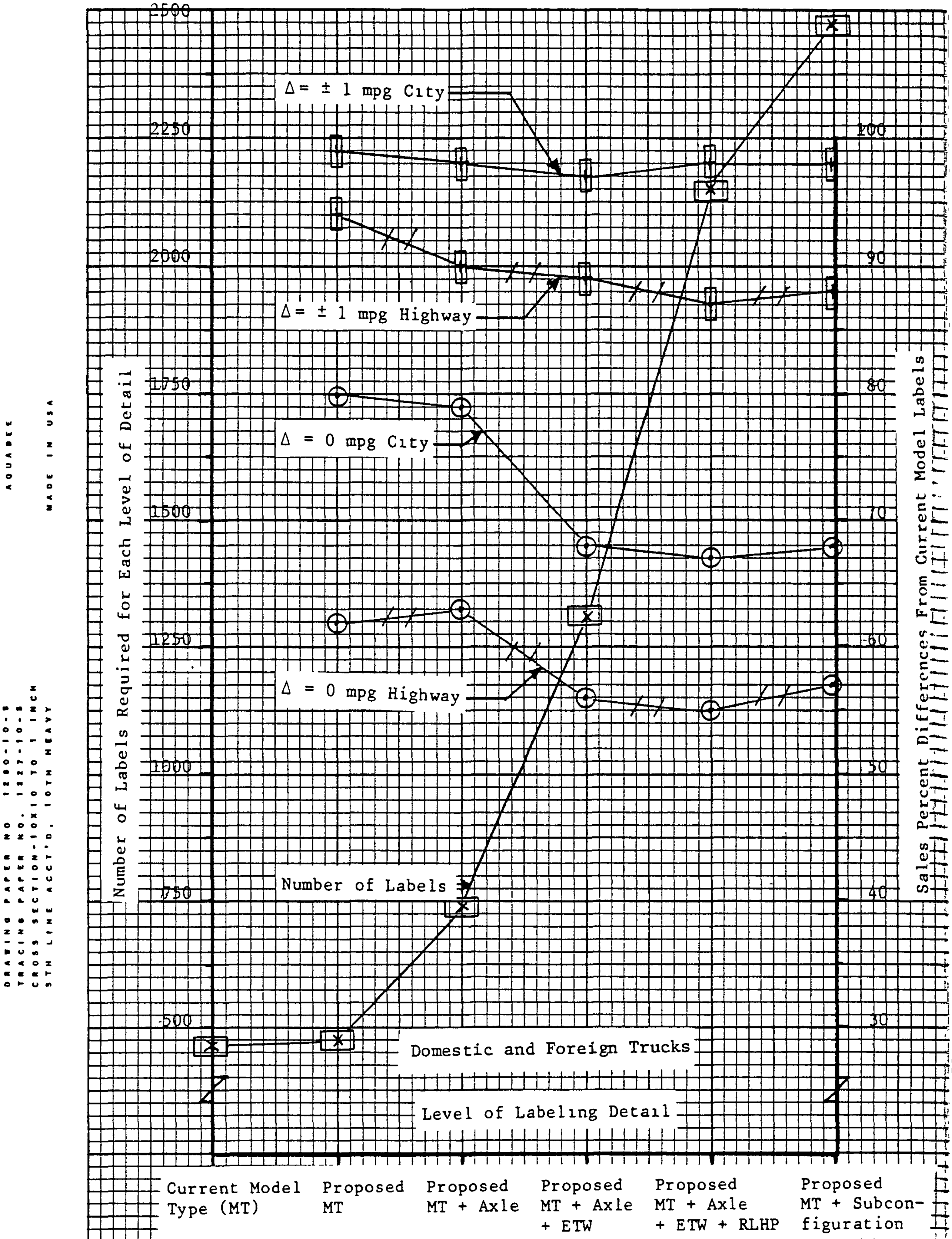

Table No. A-2 Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Within Each Level of Detail

Table A-3 Domestic and Foreign, Cars

Absolute Label Differences versus Percent Sales

I. City

Label	Δmpg	% Sales
A	0	75
	1	22
	2	3
B	0	75
	1	22
	2	3
C	0	72
	1	23
	2	5
	≥3	0
D	0	67
	1	27
	2	5
	≥3	1
E	0	67
	1	27
	2	5
	≥3	1

II. Highway

Label	Δmpg	% Sales
A	0	57
	1	34
	2	4
	≥3	5
B	0	58
	1	31
	2	6
	≥3	5
C	0	55
	1	34
	2	5
	≥3	6
D	0	52
	1	34
	2	8
	≥3	6
E	0	52
	1	35
	2	8
	≥3	5

A = Modified Model Type Label

B = Modified Model Type + Axle Label

C = Modified Model Type + Axle + ETW Label

D = Modified Model Type + Axle + ETW + RLHP Label

E = Modified Model Type + Subconfiguration Label

0 means fraction < 0.5

Table A-4 Domestic and Foreign, Trucks

Absolute Label Differences versus Percent Sales

I. City

Label	Δmpg	% Sales
A	0	80
	1	19
	2	1
	3	0
B	0	79
	1	19
	2	2
	≥3	0
C	0	68
	1	29
	2	2
	≥3	1
D	0	67
	1	31
	2	2
	≥3	0
E	0	68
	1	30
	2	2
	≥3	0

II. Highway

Label	Δmpg	% Sales
A	0	62
	1	32
	2	3
	>3	3
B	0	63
	1	27
	2	8
	≥3	2
C	0	56
	1	33
	2	8
	≥3	3
D	0	55
	1	32
	2	9
	≥3	4
E	0	57
	1	31
	2	9
	≥3	3

A = Modified Model Type Label

B = Modified Model Type + Axle Label

C = Modified Model Type + Axle + ETW Label

D = Modified Model Type + Axle + ETW + RLHP Label

E = Modified Model Type + Subconfiguration Label

0 means fraction < 0.5

Table A-5 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model type Label Minus current Label Value

CARS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
2.49	-2	X
17.53	-1	XXXXXXXXX
75.15	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.35	+1	XX
0.48	+2	X
100.00		

TRUCKS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
0.22	-3	X
1.08	-2	X
18.41	-1	XXXXXXXXX
79.77	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
0.51	+1	X
0 01	+2	X
100.00		

Table A-6 Domestic and Foreign

Fuel Economy Differences Versus Percentage Sales; Modified Model Type Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
2.10	-4	X
2.39	-3	X
2.67	-2	X
18.23	-1	XXXXXXXXX
57.36	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
15.77	+1	XXXXXXXX
1.22	+2	X
0.26	+3	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.10	-6	X
0.44	-5	X
0.26	-4	X
1.60	-3	X
3.38	-2	XX
29.57	-1	XXXXXXXXXXXXXXX
62.43	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.17	+1	X
0.05	+2	X
100.00		

Table A-7 Domestic and Foreign

Fuel Economy differences Versus Percent Sales; Modified
Model Type + Axle Label Minus Current Label Value

CARS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
2.35	-2	X
18.12	-1	XXXXXXXXX
74.82	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.10	+1	XX
0.61	+2	X
100.00		

TRUCKS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
0.03	-8	X
0.01	-5	X
0.01	-4	X
0.15	-3	X
1.94	-2	X
17.62	-1	XXXXXXXXX
78.63	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1.58	+1	X
0.03	+2	X
100.00		

Table A-8 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales: Modified Model Type + Axle Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.01	-6	X
0.03	-5	X
2.26	-4	X
2.23	-3	X
4.69	-2	XX
14.96	-1	XXXXXXX
57.82	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
16.31	+1	XXXXXXXX
1.31	+2	X
0.26	+3	X
0.12	+4	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.03	-10	X
0.01	-8	X
0.05	-6	X
0.51	-5	X
0.49	-4	X
1.36	-3	X
8.28	-2	XXXX
18.99	-1	XXXXXXXXX
62.59	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
7.56	+1	XXXX
0.13	+2	X
100.00		

Table A-9 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type + Axle + ETW Label Minus Current Label Value

CARS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
0.53	-3	X
3.12	-2	XX
17.88	-1	XXXXXXXXX
71.96	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.98	+1	XX
1.53	+2	X
100.00		

TRUCKS-CITY

0.03	-8	X
0.01	-5	X
0.01	-4	X
0.17	-3	X
1.96	-2	X
25.33	-1	XXXXXXXXXXXXX
68.36	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.10	+1	XX
0.03	+2	X
0.00	+3	
100.00		

Table A-10 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type+Axle+ETW Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.01	-6	X
0.03	-5	X
1.94	-4	X
3.23	-3	XX
2.71	-2	X
18.76	-1	XXXXXXXXX
55.23	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
15.09	+1	XXXXXXXX
2.51	+2	X
0.31	+3	X
0.18	+4	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.03	-10	X
0.01	-8	X
0.04	-7	X
0.02	-6	X
0.50	-5	X
0 50	-4	X
2.03	-3	X
7.99	-2	XXXX
20.76	-1	XXXXXXXXXX
55.55	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.18	+1	XXXXXX
0.38	+2	X
0 01	$\geq$3	X
100.00	(Max +4)	

Table A-11 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type + Axle + ETW + RLHP Label Minus Current Label Value

CARS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
0.53	-3	X
3.25	-2	XX
18.29	-1	XXXXXXXXX
67.24	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
9.14	+1	XXXXX
1.55	+2	X
100.00		

TRUCKS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
0.03	-8	X
0.01	-5	X
0 01	-4	X
0.17	-3	X
2.15	-2	X
26.30	-1	XXXXXXXXXXXXX
66.51	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.78	+1	XX
0.03	+2	X
0.01	+3	X
100.00		

Table A-12 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type + Axle + ETW + RLHP Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.01	-6	X
0.03	-5	X
2.06	-4	X
3.21	-3	XX
3.46	-2	XX
20.13	-1	XXXXXXXXXX
52.32	0	XXXXXXXXXXXXXXXXXXXXXXXXXX
13.93	+1	XXXXXXX
4.14	+2	XX
0.57	+3	X
0.13	+4	X
0.01	+5	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.03	-10	X
0.01	-8	X
0.04	-7	X
0.02	-6	X
0.50	-5	X
0.50	-4	X
2.43	-3	X
8.76	-2	XXXX
18.91	-1	XXXXXXXXX
54.96	0	XXXXXXXXXXXXXXXXXXXXXXXXXXX
13.38	+1	XXXXXXX
0.45	+2	X
0.01	≥3	X
100 00	(Max +4)	

Table A-13 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type + Subconfiguration Label Minus Current Label Value

CARS-CITY

Percent Sales	Modified - Current Label Differences-mpg	
0.53	-3	X
3.25	-2	XX
18.38	-1	XXXXXXXXX
66.92	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
9.36	+1	XXXXX
1.55	+2	X
100.00		

TRUCKS-CITY

0.03	-8	X
0.01	-5	X
0.01	-4	X
0.17	-3	X
2.22	-2	X
25.03	-1	XXXXXXXXXXXXX
67.76	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.73	+1	XX
0.03	+2	X
0.01	+3	X
100.00		

Table A-14 Domestic and Foreign

Fuel Economy Differences Versus Percent Sales: Modified Model Type + Subconfiguration Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.01	-6	X
0.05	-5	X
2.04	-4	X
3.21	-3	XX
3.49	-2	XX
20.29	-1	XXXXXXXXXX
51.52	0	XXXXXXXXXXXXXXXXXXXXXXXXXX
14.64	+1	XXXXXXX
4.04	+2	XX
0.57	+3	X
0.13	+4	X
0.01	+5	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Modified - Current Label Differences-mpg	
0.03	-10	X
0.01	-8	X
0.04	-7	X
0.01	-6	X
0.49	-5	X
0 51	-4	X
2.35	-3	X
8.95	-2	XXXX
17.32	-1	XXXXXXXXX
56.53	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
13.30	+1	XXXXXXX
0.45	+2	X
0.00	≥3 (Max +4)	
100.00		

Appendix B

Domestic Manufacturers

American Motors, Chrysler, Ford, and General Motors

Table Nos.	Title
B-1 and B-2	Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Differences within Each Level of Labeling; City and Highway Label Differences.
B-3 and B-4	Sales Percentages for Absolute Label Differences versus Percent Sales; City and Highway Label Differences. Fuel Economy Differences versus Percent Sales;
B-5	Modified Model Type Label value - Current Label Value; City
B-6	Modified Model Type Label Value - Current Label Value; Highway
B-7	Modified Model Type + Subconfiguration Label Values - Current Label Value, City
B-8	Modified Model Type + Subconfiguration Label Values - Current Label Value; Highway

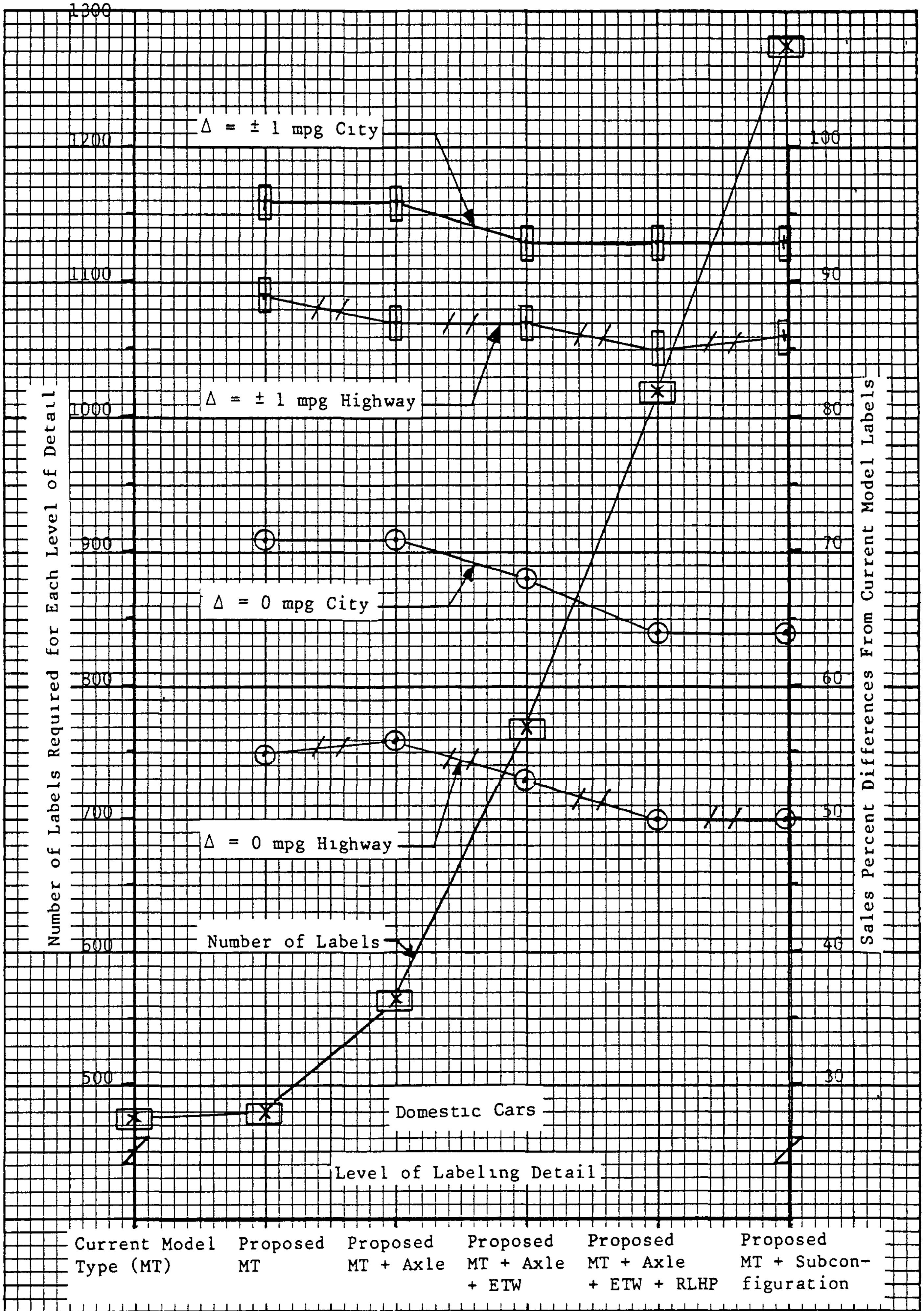

Table No. B-1 Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Within Each Level of Detail

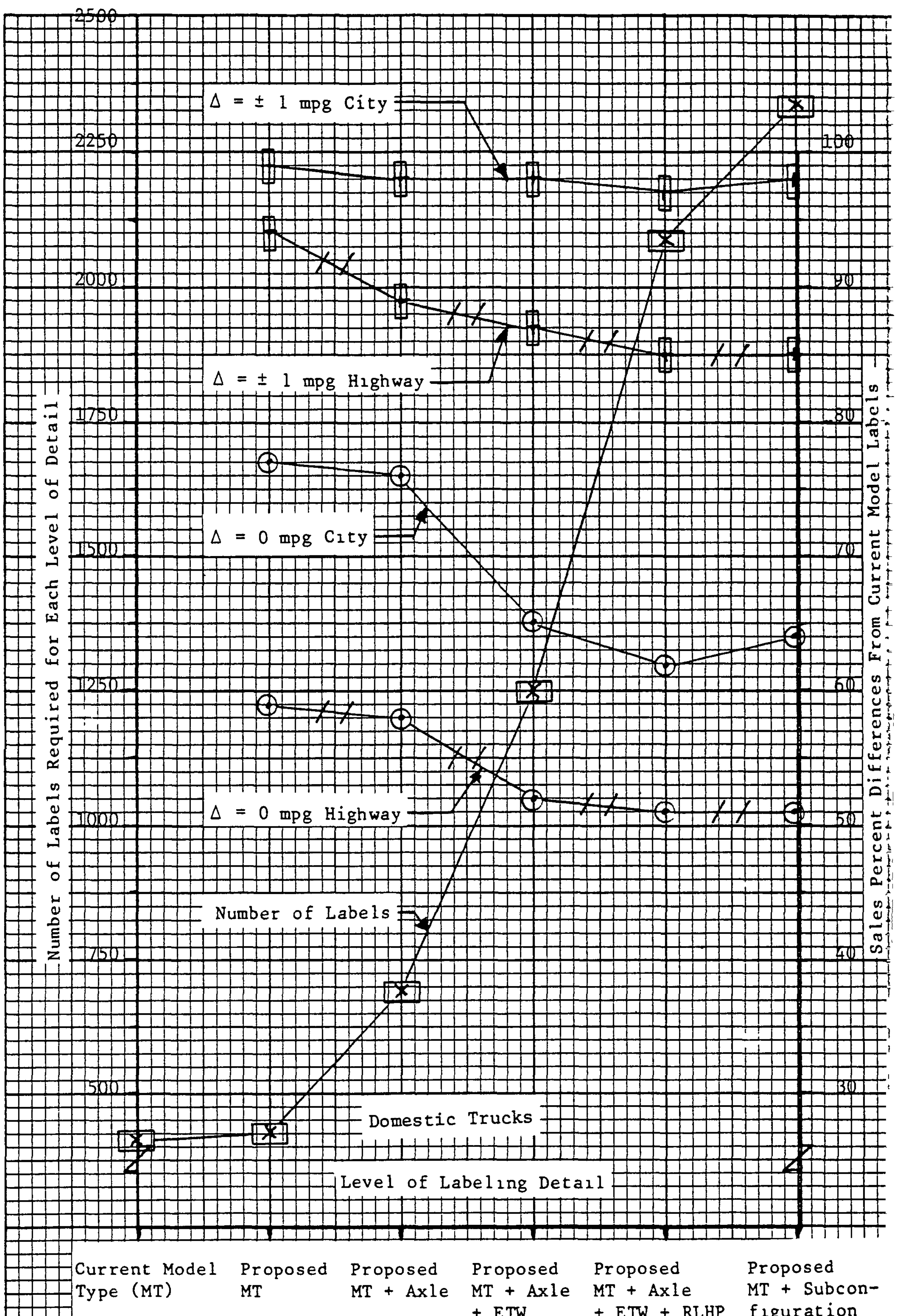

Table No. B-2 Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Within Each Level of Detail

Table B-3 Domestic, Cars

Absolute Label Differences Versus Percent Sales

I. City

Label	Δmpg	% Sales
A	0	71
	1	25
	2	4
B	0	71
	1	25
	2	4
C	0	68
	1	25
	2	6
	3	1
D	0	64
	1	29
	2	6
	3	1
E	0	64
	1	29
	2	6
	≥3	1

II. Highway

Label	Δmpg	% Sales
A	0	55
	1	34
	2	5
	≥3	6
B	0	56
	1	31
	2	7
	≥3	6
C	0	53
	1	34
	2	6
	≥3	7
D	0	50
	1	35
	2	8
	≥3	7
E	0	50
	1	36
	2	8
	≥3	6

A = Modified Model Type Label

B = Modified Model Type + Axle Label

C = Modified Model Type + Axle + ETW Label

D = Modified Model Type + Axle + ETW + RLHP Label

E = Modified Model Type + Subconfiguration Label

Table B-4 Domestic, Trucks

Absolute Label Differences Versus Percent Sales

I. City

Label	Δmpg	% Sales
A	0	77
	1	22
	2	1
	3	0
B	0	76
	1	22
	2	2
	≥3	0
C	0	65
	1	33
	2	2
	≥3	0
D	0	62
	1	35
	2	2
	≥3	1
E	0	64
	1	34
	2	2
	≥3	0

II. Highway

Label	Δmpg	% Sales
A	0	59
	1	35
	2	4
	≥3	2
B	0	58
	1	30
	2	10
	≥3	2
C	0	52
	1	35
	2	10
	≥3	3
D	0	51
	1	34
	2	11
	≥3	4
E	0	51
	1	34
	2	11
	≥3	4

A = Modified Model Type Label

B = Modified Model Type + Axle Label

C = Modified Model Type + Axle + ETW Label

D = Modified Model Type + Axle + ETW + RLHP Label

E = Modified Model Type + Subconfiguration Label

0 means fraction < 0.5

Table B-5 Domestic

Fuel Economy Differences Versus Percent Sales; Modified Model Type Label Minus Current Label Value

CARS-CITY

Percent Sales	Differences in Fuel Economy	
3.01	-2	XX
20.39	-1	XXXXXXXXXX
71.38	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.63	+1	XX
0.59	+2	X
100.00		

TRUCKS-CITY

Percent Sales	Differences in Fuel Economy	
0.25	-3	X
0.92	-2	X
21.40	-1	XXXXXXXXXXX
76.82	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
0.60	+1	X
0.01	+2	X
100.00		

Table B-6 Domestic

Fuel Economy Differences Versus Percent Sales: Modified Model Type Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
2.54	-4	X
2.85	-3	X
3.17	-2	XX
19.01	-1	XXXXXXXXXX
55.34	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
15.46	+1	XXXXXXXX
1.31	+2	X
0.32	+3	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
0.11	-6	X
0.52	-5	X
0.30	-4	X
1.53	-3	X
3.79	-2	XX
32.24	-1	XXXXXXXXXXXXXXXX
58.90	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
2.55	+1	X
0.06	+2	X
100.00		

Table B-7 Domestic

Fuel Economy Differences Versus Perent Sales; Modified Model Type + Subconfiguration Label Minus Current Label Value

CARS-CITY

Percent Sales	Differences in Fuel Economy	
0.65	-3	X
3.77	-2	XX
21.02	-1	XXXXXXXXXXX
64.01	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
8.70	+1	XXXX
1.85	+2	X
100.00		

TRUCKS-CITY

Percent Sales	Differences in Fuel Economy	
0.01	-4	X
0.20	-3	X
2.25	-2	X
28.17	-1	XXXXXXXXXXXXXX
63.85	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
5.48	+1	XXX
0.03	+2	X
0.01	+3	X
100.00		

Table B-8 Domestic

Fuel Economy Differences Versus Percent Sales; Modified Model Type + Subconfiguration Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
0.01	-6	X
0.06	-5	X
2.47	-4	X
3.67	-3	XX
3.65	-2	XX
22.06	-1	XXXXXXXXXXX
49.58	0	XXXXXXXXXXXXXXXXXXXXXXXXX
13.80	+1	XXXXXXX
3.90	+2	XX
0.80	+3	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
0.04	-7	X
0.03	-6	X
0.58	-5	X
0.60	-4	X
2.41	-3	X
10.32	-2	XXXXX
19.33	-1	XXXXXXXXXX
51.41	0	XXXXXXXXXXXXXXXXXXXXXXXXXX
14.75	+1	XXXXXXX
0.52	+2	X
0.01	≥3 (Max +4)	X
100.00		

Appendix C

Foreign Manufacturers

Fiat, Nissan, Toyo Kogyo, Toyota, Volkswagon

Table Nos.	Title
C-1 and C-2	Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Differences within Each Level of Labeling, City and Highway Label Differences.
C-3 and C-4	Sales Percentages for Absolute Label Differences versus Percent Sales, City and Highway Label Differences.
	Fuel Economy Differences versus Percent Sales;
C-5	Modified Model Type Label value - Current Label Value; City
C-6	Modified Model Type Label Value - Current Label Value; Highway
C-7	Modified Model Type + Subconfiguration Label Values - Current Label Value, City
C-8	Modified Model Type + Subconfiguration Label Values - Current Label Value; Highway

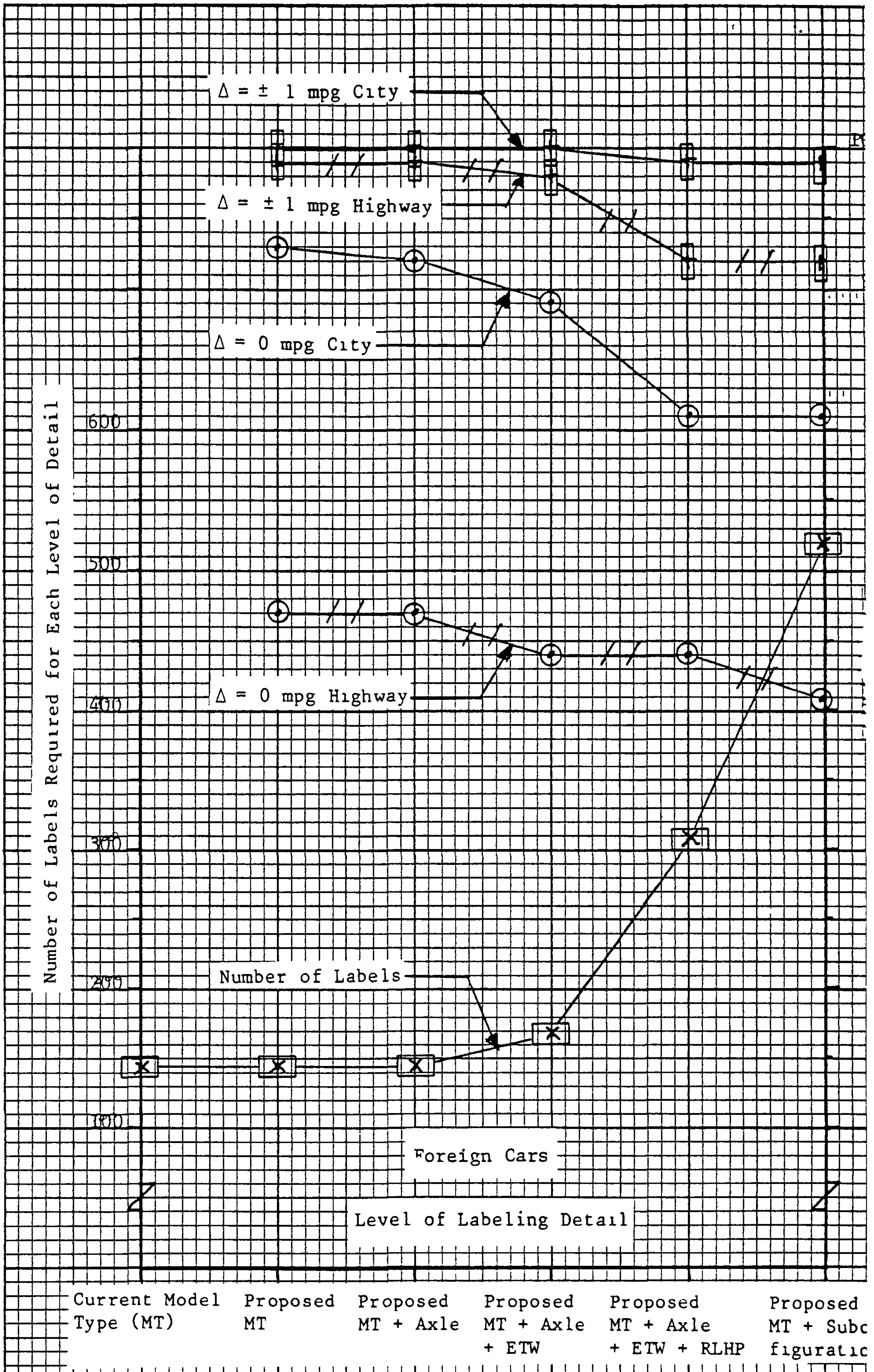

Table No. C-1 Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Within Each Level of Detail

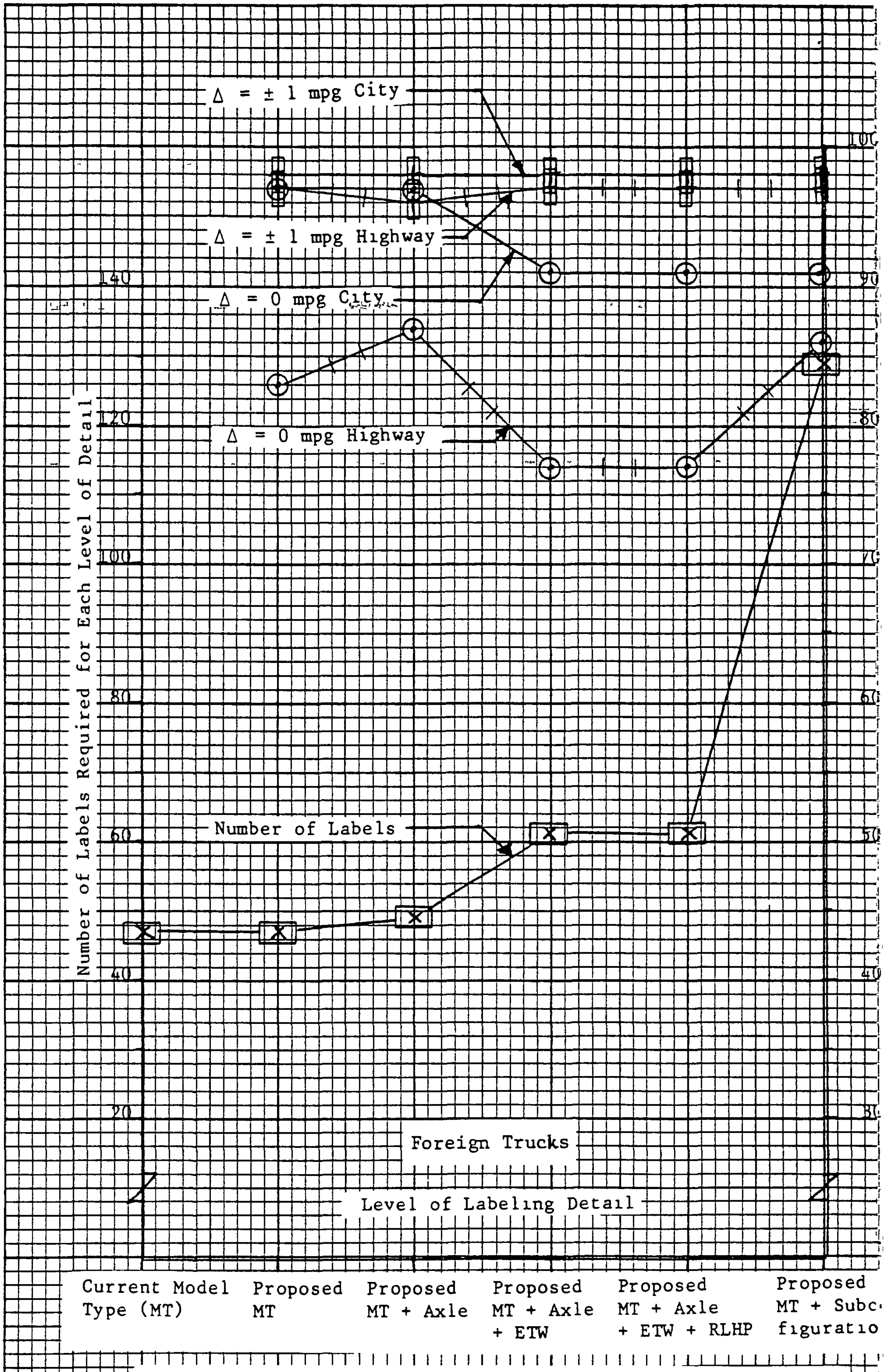

Table No. C-2 Relationship of the Number of Labels Required for Each Level of Label Detail with Sales Percent Within Each Level of Detail

Table C-3 Foreign, Cars

Absolute Label Differences Versus Percent Sales

I. City

Label	Δmpg	% Sales
A	0	93
	1	7
B	0	92
	1	8
C	0	89
	1	11
D	0	81
	1	18
	2	1
E	0	81
	1	18
	2	1

II. Highway

Label	Δmpg	% Sales
A	0	67
	1	32
	2	1
	≥3	0
B	0	67
	1	32
	2	1
	≥3	0
C	0	64
	1	34
	2	1
	≥3	1
D	0	64
	1	28
	2	7
	≥3	1
E	0	61
	1	31
	2	7
	≥3	1

A = Modified Model Type Label

B = Modified Model Type + Axle Label

C = Modified Model Type + Axle + ETW Label

D = Modified Model Type + Axle + ETW + RLHP Label

E = Modified Model Type + Subconfiguration Label

0 means fraction < 0.5

Table C-4 Foreign, Trucks

Absolute Label Differences versus Percent Sales

I. City

Label	Δmpg	% Sales
A	0	97
	1	1
	2	2
B	0	97
	1	1
	2	2
	≥3	0
C	0	91
	1	7
	2	2
	≥3	0
D	0	91
	1	7
	2	2
	≥3	0
E	0	91
	1	7
	2	2
	≥3	0

II. Highway

Label	Δmpg	% Sales
A	0	83
	1	14
	2	1
	≥3	2
B	0	87
	1	9
	2	1
	≥3	3
C	0	77
	1	20
	2	1
	≥3	2
D	0	77
	1	20
	2	1
	≥3	2
E	0	86
	1	11
	2	1
	≥3	2

A = Modified Model Type Label

B = Modified Model Type + Axle Label

C = Modified Model Type + Axle + ETW Label

D = Modified Model Type + Axle + ETW + RLHP Label

E = Modified Model Type + Subconfiguration Label

0 means fraction < 0.5

Table C-5 Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type Label Minus current Label Value

CARS-CITY

Percent Sales	Differences in Fuel Economy	
3.92	-1	XX
93.03	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
3.05	+1	XX
100.00		

TRUCKS-CITY

2.01	-2	X
1.04	-1	X
96.95	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
100.00		

Table C-6 Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
0.21	-3	X
0.30	-2	X
14.50	-1	XXXXXXX
67.00	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
17.20	+1	XXXXXXXXX
0.79	+2	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
2.01	-3	X
1.04	-2	X
14.06	-1	XXXXXXX
82.89	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
100.00		

Table C-7 Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type + Subconfiguration Label Minus Current Label Value

CARS-CITY

Percent Sales	Differences in Fuel Economy	
0.77	-2	X
5 83	-1	XXX
80.76	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12.53	+1	XXXXXX
0.11	+2	X
100.00		

TRUCKS-CITY

Percent Sales	Differences in Fuel Economy	
0.18	-8	X
0.06	-5	X
2.01	-2	X
6.89	-1	XXX
90.53	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
0.33	+1	X
100.00		

Table C-8 Foreign

Fuel Economy Differences Versus Percent Sales; Modified Model Type + Subconfiguration Label Minus Current Label Value

CARS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
0.01	-5	X
0.01	-4	X
1.02	-3	X
2.69	-2	X
11.90	-1	XXXXXX
60.77	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
18.60	+1	XXXXXXXXX
4.73	+2	XX
0.27	+3	X
100.00		

TRUCKS-HIGHWAY

Percent Sales	Differences in Fuel Economy	
0.18	-10	X
0.06	-8	X
2.01	-3	X
1.04		X
5.63	-1	XXX
86 18	0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.90	+1	XX
100.00		

Appendix D

Individual Manufacturers' Fuel Economy Differences for Each Level of Labeling Detail

Table Nos.	Title
D-1	Affect of Modified Label Program on the American Motors' Product Line
D-2	Affect of Modified Label Program on the Chrysler Product Line
D-3	Affect of Modified Label Program on the Ford Product Line
D-4	Affect of Modified Label Program on the General Motors Product Line
D-5	Affect of Modified Label Program on the Fiat Product Line
D-6	Affect of Modified Label Program on the Nissan Product Line
D-7	Affect of Modified Label Program on the Toyo Kogyo Product Line
D-8	Affect of Modified Label Program on the Toyota Product line
D-9	Affect of Modified Label Program on the Volkswagon Product Line

Table D-1 American Motors Corporation

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	10.5	0.9	11 5	0.7	32.0	20.7	32.0	20.7	32.0	20.7
0	87.3	92 5	86.4	92.0	64.9	57.2	64.9	57.2	64.9	57.2
+1	--	4.3		4.2	0.9	19.2	0.9	19.2	0.9	19.2

TRUCKS

-1	3.0	32.7	11.8	2.7	11.8	6.4	11.8	6.4	11.8	6.4
0	94.1	57.0	82.8	97.9	81.0	74.4	81.0	76.4	81.0	76.4
+1	2 2	6.8	3.8	7.2	4.2	6.2	4.2	6.2	4.2	6.2

Note: 0 means fraction <0 01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-2

Chrysler

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
CARS										
-1	36.3	26.4	36.1	25.9	29.1	25.7	27.3	26.2	28.5	26.4
0	56.4	44.4	55.9	44.4	55.9	44.3	57.8	36.3	56.7	36.0
+1	7.1	6.7	7.4	6.7	7.7	7.1	7.4	12.4	7.5	12.6
TRUCKS										
-1	26.5	46.5	24.0	30.1	30.5	28.6	29.0	20.0	26.3	19.8
0	70.0	42.4	71.6	45.0	64.4	45.7	64.6	50.9	67.4	51.0
+1	0.1	3.9	1.1	12.9	25.0	12.3	2.6	12.0	2.4	11.8

Note: 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-3

Ford

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	19.2	9 0	22.6	10.0	19 0	20.4	23.1	24.9	23.8	25.7
0	73.2	60.0	73.7	59.8	75.0	46.5	65.9	33.8	65.5	37.4
+1	7.6	23.2	2.7	21.5	5.0	24.1	10 0	26.4	9.7	27.6
					TRUCKS					
-1	33.4	28.7	24.7	21.6	25.3	20.6	25.2	18.4	25.4	18.4
0	63.6	63.0	60.9	52.0	54 9	53.3	57.0	49.7	57.0	49.8
+1	0.8	0.3	9.2	8.8	15.1	10.1	13.0	13.0	12.8	12.9

Note: 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-4

General Motors

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	14.9	19.3	15.1	12.5	17.1	16.3	17.1	19.5	17.2	19.6
0	76.2	57.3	75.9	58.5	71.5	58.4	66.5	57.7	66.4	57.7
+1	3.0	17.1	3.5	18.7	4.0	15.0	9.1	10.6	9.1	10.6

TRUCKS

Δ in mpg from original label	A City	A Highway	B City	B Highway	C City	C Highway	D City	D Highway	E City	E Highway
-1	17.6	21.0	18.0	15.2	29.9	18.6	33.6	21.5	32.6	21.0
0	81.7	72 3	80.5	67.4	64.9	53.2	58.9	28.0	59.7	48.4
+1	0 7	1 3	0.8	5.8	4.7	16 1	6.8	18.8	6.8	18.8

Note: 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-5

Fiat

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	25.6	--	25.6	--	25.6	--	14.9	3.2	14.9	3.2
0	74.4	74.4	74 4	74 4	74.4	74.4	81.8	81.8	81.8	81.8
+1	--	25.6	--	25 6	--	25.6	3.2	14.9	3.2	14.9

TRUCKS

Δ in mpg from original label	A City	A Highway	B City	B Highway	C City	C Highway	D City	D Highway	E City	E Highway
-1	--	--	--	--	--	--	--	--	--	--
0	--	--	--	--	--	--	--	--	--	--
+1	--	--	--	--	--	--	--	--	--	--

Note: 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-6

Nissan

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	2.7	28.4	2.7	28 4	6.3	30.2	8.2	17.4	4.6	17.4
0	97.3	70.0	96 1	68.8	87.6	67.0	68.0	58.4	70.6	57.4
+1	--	1.7	12.0	1.7	6.1	1.7	21.5	15.5	22.5	16.5

TRUCKS

-1	--	13.6	--	--	16.1	16.1	16.1	16.1	16.1	16.1
0	100.0	86.4	99.3	99.3	82.3	74.0	82.3	74.0	82.3	74.0
+1	--	--	--	--	0.9	9.1	0.9	9.1	0.9	9.1

Note: 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-7

Toyo Kogyo

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	--	9.9	--	9.9	1.8	19.6	1.8	15.4	1.8	15.4
0	100.0	90.1	100.0	90.1	98.2	80.4	98.2	84.6	98.2	84.6
+1	--	--	--	--	--	--	--	--	--	--

TRUCKS

-1	--	7.5	--	7.5	--	5.0	--	5.0	0.2	2.4
0	100.0	92.5	100.0	92.5	100.0	95.0	100.0	95.0	98.9	97.6
+1	--	--	--	--	--	--	--	--	0.9	--

Note: 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-8

Toyota

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	5 6	7.7	6.7	8.8	6.7	8.8	10.3	7.6	8.7	9.3
0	91.0	48.8	90.0	47.7	89.8	47.7	83.4	52.0	83.3	45.7
+1	3.4	40.1	3.4	40.1	3.6	40.1	6.0	23.8	7.6	28.8

TRUCKS

-1	2.2	19.5	2.2	19.5	2.2	19.5	2.2	19.5	2.2	--
0	93.5	74.0	93.5	74.0	93.5	74.0	93.5	74.0	93.5	93.5
+1	--	--	--	--	--	--	--	--	--	--

Note: 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Table D-9

Volkswagon

CARS

Δ in mpg from original label	A		B		C		D		E	
	City	Highway	City	Highway	City	Highway	City	Highway	City	Highway
-1	--	8.1	--	8.1	1.5	8.6	1.5	8.6	2.9	5.3
0	87.5	79.2	87.5	79.2	86.1	79.3	86.1	79.3	81.3	74.8
+1	12.5	11.9	12.5	11.9	12.4	11.3	12.4	11.3	15.8	17.7

TRUCKS

-1	--	--	--	--	2.4	0.3	2.4	0.3	2.4	0.3
0	100.0	100.0	100.0	100.0	97.6	87.9	97.9	87.9	97.6	87.9
+1	--	--	--	--	--	11.8	--	11.8	--	11.8

Note 0 means fraction <0.01
-- means no sales in that category

A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Appendix E

Table E-1 Number of Labels Required Versus Level of Labeling Detail for Each Manufacturer

Manufacturer	A'			A			B			C			D			E		
	Total	Cars	Trucks	Total	Cars	Trucks	Total	Cars	Trucks	Total	Cars	Trucks	Total	Cars	Trucks	Total	Cars	Trucks
American Motors	62	24	38	62	24	38	91	30	61	135	43	92	137	43	94	142	43	99
Chrysler	213	91	122	237	95	142	309	107	202	519	147	372	1236	310	926	1351	376	975
Ford	235	135	100	235	135	100	328	157	171	569	220	349	849	325	524	1088	386	702
General Motors	367	225	142	369	227	142	524	271	253	798	362	436	986	445	541	1036	469	567
Fiat	14	14	0	14	14	0	14	14	0	16	16	0	20	20	0	20	20	0
Nissan	59	47	12	59	47	12	63	49	14	73	55	18	139	121	18	225	178	47
Toyo Kogyo	24	20	4	24	20	4	24	20	4	32	24	8	40	32	8	72	56	16
Toyota	57	38	19	57	38	19	59	40	19	61	42	19	121	102	19	281	231	50
Volkswagon	34	22	12	34	22	12	34	22	12	48	32	16	48	32	16	60	44	16
Total Counts	1065*	616	449	1091	622	469	1446	710	736	2251	941	1310	3576	1430	2146	4275	1803	2472

* Difference in the number of labels between A' and A due to finer level of detail describing transmission, e.g., lockup and "creeper" transmissions are separated out in A.

A' = Current Model Type Label
A = Modified Model Type Label
B = Modified Model Type + Axle Label
C = Modified Model Type + Axle + ETW Label
D = Modified Model Type + Axle + ETW + RLHP Label
E = Modified Model Type + Subconfiguration Label

Appendix F

Individual Model Types' Fuel Economy Differences at Each Level of Labeling Detail

The following pages contain the actual 1981 model types for the manufacturers studied in this analysis. Each manufacturer is grouped separately. Within a manufacturer, each basic engine is sorted separately, cars first, followed by trucks. Within each basic engine, the different model types are shown within their current label values (city/highway). In the row beside each model type are the five different levels of labeling in increasing order of detail. The columns contain the city and highway difference between the current label values and the level of labeling detail of that column. The difference is equal to the proposal minus the current value. The percent of sales breakdown for that model type at each level of is also given. The last column also contains a code (*T) to indicate which subconfiguration(s) was actually tested to generate the label values for that vehicle using the current model types calculation method.

***Because this appendix is a large volume, it may be obtained only through the Public Docket (No A-80-32) in Washington, D C.