federal register

TUESDAY, SEPTEMBER 24, 1974
WASHINGTON, D.C.
Volume 39 ■ Number 186
PART II

FEDERAL TRADE COMMISSION

■

AUTOMOBILE FUEL ECONOMY CLAIMS

Notice of Public Hearing and Opportunity to Submit Data, Views, or Arguments Concerning Rulemaking Proceeding

FEDERAL TRADE COMMISSION

[16 CFR Ch. I]

AUTOMOBILE FUEL ECONOMY CLAIMS

Notice of Public Hearing and Opportunity To Submit Data, Views or Arguments Concerning Rulemaking Proceeding

The Federal Trade Commission, pursuant to the Federal Trade Commission Act, 15 U.S.C. 41 et seq., and the provisions of Part I, Subpart B of the Commission's Procedures and Rules of Practice, 16 CFR 1.11, et seq., and Section 553 of Subchapter II, Chapter 5, Title 5, U.S. Code (Administrative Procedure) hereby serves notice that it is initiating a rulemaking proceeding to consider the feasibility of developing a Trade Regulation Rule pertaining to the advertising and promotion of automobile fuel economy in interstate commerce.

This rulemaking proceeding is being initiated by the Commission after preliminary investigation by the Commission's staff into advertising and testing practices presently engaged in by the automobile industry. In addition, during the course of the investigation, Consumers Union filed a petition requesting a Trade Regulation Rule prescribing a uniform fuel economy test for new cars.

A. *The importance of fuel economy information.* Fifty-five percent of all energy consumed in this country by the transportation sector in 1970 was consumed by automobiles.[1] The cost of this consumption is primarily borne by the consuming public in its purchases of gasoline. Shortages of the winter of 1973–1974 and the ensuing substantial rises in price have made the level of gasoline consumption a critical issue for the American public, both in terms of the cost of obtaining gasoline for individual consumers and in terms of the cost to society of the depletion of the nation's resources.

In order for consumers to be able to distinguish among competing cars on the basis of fuel economy, they need adequate, accurate information. Traditional assumptions or "rules of thumb" about fuel economy are not a substitute for relevant and comparable numerical information with respect to fuel economy. For example, the apparent size of a car is not, contrary to public misconception, the best determinant of fuel economy; rather weight is more important[2] and weight cannot be visually measured. Also, the consumer cannot rely on previous experience even with small cars to determine fuel economy because the weights of small cars have been increasing steadily in the last few years.[3] Some "small" cars popularly called compacts actually weigh as much as cars that are commonly referred to as "intermediate" or "standard" due to the addition of heavy optional equipment such as eight cylinder engines, air conditioning, etc.[4] It is also becoming more difficult to purchase the smaller cars without heavy, gas-consuming optional equipment, so that even the smaller cars are becoming less efficient.[5] The consumer who buys a "small" car strictly on apparent size expecting "small car" fuel economy may not have his expectations fulfilled.

Prior to 1974, advertising was the principal source of information regarding fuel economy, and this consisted of a few general claims. In August 1973, the U.S. Environmental Protection Agency (hereinafter referred to as "EPA") in cooperation with most manufacturers and importers, announced a voluntary fuel economy labeling program.[6] Cooperating companies (which included most but not all companies) agreed to post labels on their cars which displayed a range of expectable mileage calculated by EPA for the weight class of the cars to which the specific car being sold belonged. For the first time the consumer was exposed to information derived from a uniform test as to the relative fuel economies of various classes of cars. Thus the consumer was provided with a rough yardstick for comparing the performance of various classes of cars in making his purchase decision.

Labeling, however, even if present on all cars (which is not the case), and even if a source of specific fuel economy information (which is also not the case), cannot cure legal deficiencies in the advertising of fuel economy. Claims concerning fuel economy have now emerged as a major feature of automobile advertising, raising substantial issues of deception and unfairness.

B. *Current developments in the advertising of fuel economy.* It is evident that as 1974 progressed, the number of fuel economy claims in automobile advertisements increased dramatically, reflecting the growing importance of fuel economy information to prospective new car purchasers. The staff of the Commission has conducted a review of 915 different automobile advertisements randomly collected by the staff in the course of its monitoring functions since the introduction of 1973 model year automobiles.[7] This review has revealed that from January to March, 1974, 61 percent of all car advertisements made some sort of economy claim, an increase of 243 percent over the equivalent period of 1973 and an increase of 174 percent over just the last four months of 1973 (the first four months of the current model year for domestic automobiles). This trend in fuel economy claims is illustrated by the rate of increase in such claims in the last months of 1973 and first three months of 1974. Not only had the sheer number of such claims multiplied enormously, but the specificity of the claims also rose. Advertisements in which a specific miles per gallon figure was claimed increased from 5 percent of the ads run in the September to December 1973 period, to 7.6 percent, 12.9 percent and 35 percent of those run in January, February and March of 1974 respectively.

This increase in specific claims was accompanied by a proliferation of ads in which the test method on which the claim purportedly was based was referred to or described to some degree in the advertisement. Only one advertisement citing the test method used was counted between September 1972 and November 1973, but in March of this year, 35 percent of the automobile advertisements made some reference to a specific test method said to have generated the claimed fuel economy data.

The utility to consumers of the test information in the ads is open to sereous question. The tests are not comparable. Some tests used were conducted on interstate highways at or near the speed limit; others were on test tracks, at varying speeds, still others were simply termed "city", "suburban" or "highway" tests without further description. Test drivers ran the range from professional drivers, to employees of the manufacturer, to celebrities. Although the type of car tested is not always disclosed, cars varied by number of cylinders, type of transmission, and other features which affect fuel economy. Other advertisements failed to note the average speed of the car tested, or the number of stops per mile, or the degree to which the car was warmed up. The disclosures were not sufficient to enable the consumer to determine the relevance of the claimed fuel economy figures to his own likely experience with the advertised car and they confirmed that variations in the tests render comparison by the consumer of competing mileage claims impossible.

These difficulties cannot be entirely overcome solely through the efforts of the variety of independent organizations which have published test results that differed with the advertising claims and usually with each other. Consumers Union,[8] the publishers of "Road and Track Magazine", and numerous other interested groups have issued mileage reports on different automobiles which differed from advertising claims made for the autos, from one another's figures and

[1] Senate Committee on Commerce, Report on S. 2176, "The Fuels and Energy Conservation Act of 1973", S. Rep. No. 93–526, 93d Cong., 1st Sess. 8 (November 16, 1973).

[2] See "Automobile Fuel Economy: Contributing Factors and Advertising Disclosures, An Analysis by the Staff of the Federal Trade Commission", at § IIIA.

[3] "Fuel Economy Labeling Program", EPA Press Release, (August 23, 1973).

[4] Weights of various automobiles equipped with a variety of optional equipment were published by the U.S. E.P.A. in conjunction with "New Motor Vehicles and Engines; Air Pollution Control", 1974 Model Year Test Results, 39 FR 7664, 7665 et seq. (February 27, 1974).

[5] See, e.g., "Flint", "The Energy Crisis Spurs Demand for Small Cars * * *," "New York Times", April 7, 1974 section 11, col. 1.

[6] 38 FR 22944 (August 27, 1973).

[7] The survey included 915 different advertisements (i.e., although an advertisement may have appeared several times in several different magazines or on different networks, it was only counted once in each medium) taken from a variety of national magazines, newspapers and the television and radio networks. All four of the principal domestic producers and various foreign manufacturers were represented in the sample.

[8] See, "Consumer Reports", April 1974, at 313.

from figures published by EPA,[9] due to the differences in test methods.

The general confusion resulting from this state of affairs has been the subject of several recent articles in the popular press including one entitled, "Gas Mileage: Whom Do You Believe" in the April 1974 issue of "Consumer Reports."[10]

C. *Deception and unfairness in the advertising of fuel economy.* Advertised mileage claims raise significant issues of unfairness and deception under section 5 of the Federal Trade Commission Act.[11] The Commission has repeatedly recognized that when the seller describes the attributes of a product he must, in order to avoid deception, describe the product in terms relevant to the ordinary experience of consumers.[12] The Commission's recently issued Rule on "Power Output Claims for Amplifiers Utilized in Home Entertainment Products" provides that "[n]o performance characteristics * * * shall be represented or disclosed if they are not obtainable as represented or disclosed when the equipment is operated by the consumer in the usual and normal manner * * *"[13] To the extent that mileage claims may exaggerate the mileage that can be expected by a consumer under ordinary or typical driving situations, such claims are deceptive.[14] Moreover, as the Commission has recognized in other areas, economy claims can constitute implicit comparisons to the cost of competing products.[15] Where mileage claims are based on test conditions that are relatively favorable to the advertised car, the failure to reveal results that may be relatively less favorable to the advertised car may constitute a failure to reveal a material fact, thereby rendering the advertisement deceptive.[16] Indeed, the very disparity between the various tests being cited as the bases for mileage claims is itself a source of potential deception in that consumers may compare at least certain advertised mileage figures for competing cars on the erroneous assumption that the mileage figures are the result of a standard test.[17]

The absence of any recognized standard upon the basis of which consumers can evaluate the gas mileage of the cars they buy may be unfair as well as deceptive. The Trade Regulation Rules relating to Posting of Minimum Octane Numbers[18] Care Labeling of Textile Wearing Apparel[19] and Incandescent Bulbs supra, all recognize the inherent unfairness of denying to consumers information that enables them to distinguish between products of differing value and benefit, and to relate such products to their own needs and preferences. While consumer preferences and requirements with respect to automobiles vary widely, the Commission believes that a substantial portion of the consuming public is vitally concerned about the mileage it will receive under the types of driving ordinarily engaged in.

In summary, the Federal Trade Commission is aware that there are presently in existence many different non-uniform test procedures proffered by advertisers of automobiles as a basis for advertised fuel economy claims. Because the results obtained from such disparate test procedures cannot be compared by consumers, either among competing cars or to the mileage obtained by the prospective purchaser's presently owned car, such advertisements may unfairly and deceptively deny to consumers information which will enable them to compare advertised automobiles on the basis of fuel economy—and to relate available fuel economies to their own needs and preferences. Moreover, because it appears that many of the tests used to generate fuel economy figures bear an insufficient relation to typical driving patterns, advertisements containing such figures may have the tendency and capacity to deceive consumers as to the fuel economy they would experience with the advertised automobile.

For these reasons, the Commission is commencing this proceeding. Moreover, because of the complexity of the subject matter, the Commission is simultaneously publishing a staff analysis which has been neither adopted, nor disapproved by it, to acquaint interested parties with the analysis made by its staff to date. It is believed that such publication will facilitate comments by interested parties relating to the prevention of deception and unfairness in the advertising and promotion of fuel economy claims. Additionally, the Commission deems it useful to set forth the following questions to which it is particularly interested in receiving comment:

1. What are the test procedures currently used which generate figures for claims of automobile fuel economy in advertising and promotion?

2. What elements in these test procedures have been included in order to approximate actual consumer driving patterns? What available data exists as to actual consumer driving patterns?

3. Can there be devised a single test procedure for determining fuel economy under typical driving conditions, the results of which should be required to appear in the advertising or other forms of promotion of cars?

4. If a single test procedure is to be used to generate automobile fuel economy figures to be used in advertising and other promotion efforts, what should such a test be? Specifically, should such a test procedure be a road, track or laboratory test procedure?

5. Should such a single test procedure be designed to generate one or more fuel economy result(s), representative of expectable mileage in (a) city and (b) open highway driving modes? or an (c) "overall" expectable fuel economy figure? How are "city" and "highway" driving to be defined?

6. Who should actually conduct the testing of individual cars according to the procedure? If manufacturers are to conduct the tests, how can the results be adequately checked and confirmed?

7. With regard to advertisements that do not specify the precise car (with reference to the major variables affecting gas mileage e.g., engine size, weight, transmission, axle ratio, options) being advertised, (a) what mileage figure should be used, and how should that figure be derived? (b) Should the mileage figure be computed on the basis of a representative sample of cars within the model, and make, advertised? (i) If so, how is that sample to be selected? (ii) Should all available combinations of options be tested and, if so, should the test result for each combination be disclosed?

8. Should more than one test procedure for determining fuel economy under typical driving conditions be devised, the results of which should be required to appear in advertising or promotion of fuel economy? If so, what should such test procedures be? For example, should a laboratory test be utilized to measure fuel economy in city driving and a road test for fuel economy in highway driving? Consider specifically the issues numbered 5 and 6 above.

9. If a certain test procedure or procedures are to be prescribed by the Federal Trade Commission, should the results of the procedure(s) be the sole permitted basis for fuel economy claims in advertising and promotion, or should advertising and promotional materials be permitted to include fuel economy figures derived from other test procedures so long as they also include figures from the prescribed test procedure?

10. Without regard to claims made in advertising, should every automobile offered for sale be accompanied, at point of purchase, by a disclosure indicating the anticipated fuel economy of such automobile under typical driving conditions? If so, how should such a mileage figure be expressed and by what means should it be disclosed?

The Commission is advised that Congress is presently considering the question of assigning to a Federal agency the responsibility for the testing of fuel economy. The Commission does not consider this circumstance to be a reason for delaying an informational hearing pertaining to the advertising and promotion of fuel economy. If during the pendency of this proceeding a final decision is reached concerning responsibility for fuel economy testing, the

[9] 39 FR. 7666 et seq. (February 27, 1974).

[10] At 307. See also, "Picking a Car in a Pinch", The Marzella, Consumers Get Little Mileage from Tests", St. Petersburg "*Times*", March 13, 1974, § D, at 1, col. 1. One Mercedes advertisement which has appeared in numerous periodicals notes the "welter of conflicting figures you're seeing these days."

[11] 15 U.S.C. 45.

[12] See, the Trade Regulation Rule relating to extension ladders, 16 CFR Part 418, and the Trade Regulation Rule Relating to Sleeping Bags, 16 CFR Part 400.

[13] 39 FR 15387, 15388 (May 3, 1974).

[14] Cf. In re Berns Air King Corp., 76 F.T.C. 319 (1969).

[15] See, In re Dolcin Corp., 53 F.T.C. 387, 400 (1956).

[16] See, "Statement of Basis and Purpose for Incandescent Light Bulb Rule", 16 CFR Part 409.

[17] Cf., In re Berns Air King, 76 F.T.C. 319 (1969); In re American Tire Co., 77 F.T.C. 1169 (1970).

[18] 16 CFR Part 422.

[19] 15 CFR Part 423.

Commission will consider whether a modification of the present proceeding is warranted. If such a decision is reached after the completion of this proceeding, the record developed herein will, in addition to aiding the Commission in the discharge of its consumer protection functions, be available to any other Federal agency having responsibilities relating to fuel economy.

All interested parties are given notice of opportunity to orally present data, views or comments with respect to the issues at a public hearing to be held commencing at 10 a.m., e.d.t., Nov. 25, 1974, in Room 532 of the Federal Trade Commission Building, 6th and Pennsylvania Avenue NW., Washington, D.C.

Any person desiring to orally present his views at the hearing should so inform the Special Assistant Director for Rulemaking, Federal Trade Commission, Washington, D.C. 20580 not later than November 18, 1974, and state the estimated time required for his oral presentation. Reasonable limitations upon the length of time allotted to any person may be imposed. To the extent practicable, persons wishing to file written presentations in excess of two pages should submit twenty copies of such proposed statements to the Special Assistant Director for Rulemaking 48 hours before the first day of the hearing.

Written comments may also be submitted no later than November 25, 1974, to the Special Assistant Director for Rulemaking.

The data, views or arguments presented and written comments submitted with respect to the practices in question will be available for examination by interested parties in Room 130 of the Division of Legal and Public Records, Federal Trade Commission, Washington, D.C. and will be considered by the Commission.

Issued: September 24, 1974.

[SEAL] CHARLES A. TOBIN, *Secretary.*

AUTOMOBILE FUEL ECONOMY: CONTRIBUTING FACTORS AND ADVERTISING DISCLOSURES

AN ANALYSIS BY THE STAFF OF THE FEDERAL TRADE COMMISSION

This Analysis Is a Staff Document and the Conclusions Contained Herein Have Neither Been Accepted Nor Rejected by the Commission.

INTRODUCTION

INTRODUCTION

A. *Scope and limitations of the analysis.* The Commission believes it to be useful to publish this staff analysis of issues relating to the advertising of automobile fuel economy in order to apprise interested parties of the current consideration and understanding of the staff of the Commission of the very complex issues involved in the prevention of deception and unfairness in such advertising. Such publication is intended to enhance the ability of interested parties to comment on the issues contained herein and in the Notice of Initiation of Rulemaking Proceeding Concerning Automobile Fuel Economy Claims published simultaneously also in the FEDERAL REGISTER. It must be read with two caveats in mind. First, it has been prepared by the Staff of the Commission for the Commission's use, but the conclusions contained herein have neither been accepted or rejected by the Commission.

Second, although the preliminary inquiry of the Commission's staff into automobile fuel economy has been substantial, this analysis is not considered to be complete or exhaustive. The staff of the Commission has availed itself of the expertise of the technical staffs of the Department of Transportation's Transportation Systems Center in Cambridge, Massachusetts (hereinafter referred to as "DOT") and the Environmental Protection Agency's Motor Vehicle Emissions Laboratory in Ann Arbor, Michigan (hereinafter referred to as "EPA"). In addition, reference has been made to numerous technical papers and other materials, including testimony and documents submitted to Congress and state legislatures. Input has also been received from both foreign and domestic automobile manufacturers, independent testing organizations, and the Society of Automotive Engineers' Fuel Economy Measurement Procedures Task Force (hereinafter referred to as the "SAE Task Force"). However, new data is continuously being generated, and, after analysis by the staff, it will be presented to and considered by the Commission in connection with future actions in this area.

B. *The need for fuel economy testing and information.* Under actual driving conditions all drivers do not experience the same fuel economy in all different cars. If it were otherwise, there would be no need for the development of fuel economy data to enable comparisons between automobiles, since they would all be the same in this respect. However, fuel economy experience does vary and this information is relevant and may be critically important to the consumer's purchase decision. In order to generate this data, testing becomes necessary, and in order either to devise a test or to evaluate the validity of the data generated by a test, it becomes necessary to inquire into the reasons why drivers experience varying rates of fuel consumption.

The first step in this inquiry therefore will be to identify those variables or factors which significantly contribute to variations in fuel consumption rates and, where possible, to quantify the degree of contribution. After this is determined, the interrelationships of the various factors must be analyzed. Thus data based on past experience, from both actual driving experience and from tests designed to measure the reasons for fuel economy variance between cars, must first be analyzed before any conclusions can be drawn as to tests which are intended to project the fuel economy possible with a given vehicle under various conditions.

If no changes were made in cars from one year to the next, this type of projection might not be necessary. All that would be necessary would be an accurate compilation of fuel economy data for vehicles already on the road, and since they would be the same as those subsequently offered for sale, potential purchasers would know the fuel economy of the car they were considering buying. But cars do change, so information based on past experience is not necessarily relevant to new cars and it is not possible to compile enough data based on a broad range of actual driving experiences between the time a new model is developed and the time it is sold. Consequently, tests are needed by which information can be generated rapidly enough so that it is available to prospective purchasers during the applicable model year.

Tests, however, can not duplicate actual driving conditions for all drivers. Rather, tests simulate actual driving conditions of some kind. To understand the correlation of a test simulation to real driving, the manner in which the factors affecting fuel economy have been accounted for in the test procedure must be examined.

Thus, for each of the most significant variables affecting fuel economy, this inquiry will entail a three stage analysis. First, we will review the extent to which each variable affects fuel economy independent of other variables. Second, the analysis will focus on the manner in which each variable itself is affected by other variables in actual driving. Finally, the meaning of all this in connection with testing for fuel economy will be discussed, particularly as it relates to the consumer's ability to compare his present car or competing automobiles to one being advertised.

I. TYPES OF VARIABLES AFFECTING AUTOMOBILE FUEL ECONOMY

To facilitate the analysis of the variables which most significantly affect the rate at which gasoline is consumed, it is useful to group them into three broad categories as follows:

A. *Driving condition variables.* Some of the factors which cause drivers to experience differing rates of fuel consumption relate to the conditions under which the driving takes place. These include ambient conditions (such as temperature, presence or absence of precipitation, and altitude), road conditions (e.g., type of road surface and the grade or incline of the road) and driving environment or mode (i.e., whether the vehicle is cold or warmed-up and whether driving is done under city, suburban or highway conditions or some combination of these, whether actual or simulated). Varying these conditions among tests will result in different rates of fuel consumption even if the driver, his driving performance and the vehicle remain identical.

These driving condition factors are discussed in Section 11 of this analysis.

B. *Differences between automobiles.* This category includes all those variables affecting fuel economy that distinguish cars from one another, whether the cars are different makes or models, or different varieties of the same model. While many differences in cars can potentially affect fuel economy, certain differences between cars will not be considered. Since this analysis is primarily concerned with how the factors affecting fuel economy relate to the advertising of new cars, there will be no discussion of changes in fuel economy due to the age or state of tune of the car or the inflation of the tires. For new cars, these factors are presumed to be according to specifications or constant. Nor are idiosyncratic differences between otherwise identical cars considered since these could not possibly be accounted for or disclosed in advertising due to the fact that every car would have to be tested and accompanied by its own disclosure.

If the driving conditions alluded to in subsection A, above, and the driver and his performance are constant, differences between cars (such as size, weight, engine power and size, and axle ratio) will yield differences, often significant, in fuel economy. These factors are discussed in Section III of this analysis.

C. *Differences among drivers.* Even if the car and driving conditions are identical, different drivers are likely to have different fuel economy experience due solely to the manner in which the car is operated and maintained. The driver who fails to keep his car in tune and his tires properly inflated is wasting gasoline. Similarly, anyone who idles for a long time when the car is cold or races the engine right after starting is unnecessarily wasting gasoline.[1] Consequently, a person who exhibits these habits will realize fewer miles per gallon of gasoline than someone who does not.

The manner in which a car is driven will also affect fuel economy. For example, drivers who habitually accelerate away from stops more rapidly than is normally necessary can use as much as 15% more gasoline than would drivers who accelerate more gently.[2]

This analysis is not addressed to this last category of variables since the driving habits of any driver are unique to him and solely under his control and therefore cannot be reasonably controlled in a test designed to provide fuel economy information to the public at large. Just as idiosyncratic differences between vehicles could not reasonably be subject to testing, differences between drivers can only be tested by testing with each driver.

By controlling the other variables, tests can provide useful information for comparing cars, thus permitting consumer choice between cars on the basis of fuel economy and creating incentives for manufacturers to improve the fuel economy of their products. The issue then is choice between cars, not between drivers. Manufacturers cannot control the habits of drivers, but cars can be improved. Thus, factors unrelated to the performance of the car itself, as opposed to the performance of the driver, are not within the scope of this analysis.

Consequently, this inquiry is limited to those driving condition—and vehicle—related factors which most significantly affect fuel economy and which could either be quantified (so that their values might be related to real driving conditions in order to provide a means of evaluating test results), or which could be specified (to provide a test yielding reasonable and relevant data to the greatest number of consumers).

Of these two types of factors, the most difficult to control are driving conditions. It is in the selection of these variables that the degree of correlation, if any, of the test results to actual driving conditions is determined. Variations among vehicles are most important in the manner of either selecting a test sample or of disclosing the nature of the vehicle tested. Naturally, every individual car cannot be tested; the costs would be enormous and it would be unnecessary. Thus, a sample must be chosen from all the cars which might be tested and it is in the selection of this sample that differences between cars must be taken into account either by disclosing enough significant data about the precise vehicle to which the test relates or by carefully selecting enough vehicles to form a representative sample.

Footnotes at end of analysis, p. 34391.

The following discussion is therefore organized as follows: A discussion of the most significant variables or factors by category, as set out above, followed by an analysis of how these factors relate to test procedures, either as the bases of disclosures or as sources of test specifications.

II. EFFECTS OF DRIVING CONDITION VARIABLES ON FUEL ECONOMY

Introduction. The discussion in this section concerns the effects of the total driving environment on fuel economy and the relationship of the individual components of the driving conditions to advertised fuel economy claims. The total driving environment is composed of three types of conditions which are as follows:

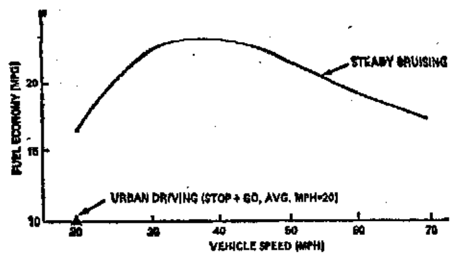
(a) *The driving cycle.* The general type of driving being done (e.g., city, suburban, highway, etc.) is reflected in the average speed; frequency, rate and size of speed changes; frequency of stopping, trip length and engine starting condition (i.e., warmed-up or "hot" starts versus starts at the ambient temperature or "cold" starts). These variables can be assigned any value within the mechanical capabilities of the automobile, but by assigning values based on studies of actual driving patterns, it is possible to define different types of driving in terms of these factors.[3] The components of the driving cycle are discussed in subsection A of this section.

(b) *Ambient conditions.* Location, season and weather affect fuel economy. The significant factors in location and weather are temperature, humidity, wind, precipitation and altitude which are dealt with in subsection B of this section.

(c) *Road conditions.* The type of road surface, road grade (incline) and road curvature all can affect fuel economy. These variables are briefly discussed in subsection C of this section.

A. *The driving cycle*—1. *Speed.* The effect of speed on fuel economy under real-driving conditions is very difficult to assess since other factors are always at play. Nevertheless, it is clear that speed contributes significantly to the rate of fuel consumption. This can be shown by tests, not duplicable by most drivers under real driving conditions, which isolate speed as the only variable. These tests involve driving a car at various unwavering speeds under otherwise identical conditions. When tests of this type are performed, and the fuel economy at the various constant speeds is plotted on a graph, a curve of the type shown in Figure 1 is generated for an average car.[4] From this graph it can be seen that peak fuel economy at constant speed is realized at about 40 miles per hour ("mph") and most cars peak at between 30 and 40 mph.[5] Such peak economy, however, is not realizable by the average driver, and the actual fuel economy a driver would realize in real driving would fall below the curve shown in Figure 1, even if the cars were identical.

FIGURE 1
FUEL ECONOMY VS. VEHICLE SPEED



FUEL ECONOMY VS. VEHICLE SPEED

	SPEED	FUEL ECONOMY
URBAN DRIVING	20 MPH	10 MPG
CRUISE	20 MPH	16.5 MPG
	30 MPH	22.0 MPG
	40 MPH	22.5 MPG
	50 MPH	21.5 MPG
	60 MPH	19.5 MPG
	70 MPH	17.3 MPG

Source: U.S. Environmental Protection Agency, Office of Air and Water Programs, Mobile Source Air Pollution Control, *A Report on Automotive Fuel Economy,* at 26 (October 1973).

For example, while the fuel economy of the car represented in Figure 1 at a constant 20 mph was 16.5 miles per gallon ("mpg"), under real driving conditions this speed would be an average speed in typical city stop and go driving. The resulting fuel economy at that average speed in such conditions would be only 10 mpg. This 65% variance between a constant and average speed of 20 mph, depending upon whether it is the result of steady or stop and go driving, is attributable to speed transients (acceleration and deceleration) which are encountered under actual driving conditions and which increase fuel consumptions,[6] due largely to the extra fuel consumed by accelerating from stops.[7] These fluctuations result from a variety of factors which cannot be avoided under most real driving conditions, e.g., traffic, other necessary stops, varying speed limits, differences in road grade and curvature, and shifting wind direction and speed.[8]

These differences between constant speed driving and real driving are most pronounced in city driving, but even under driving conditions which are characterized by fewer speed changes, the fuel economy realized is typically lower than at constant speeds.

The one driving environment in which speed fluctuations might be minimized would be highway driving and even here, some of the factors resulting in speed fluctuations, such as passing of other cars, hills and curves and even driver inadvertence, will probably be present. Additional speed deviation would result from passing, but even if the driver conscientiously attempted to maintain a constant speed, some "hunting" around the desired speed would typically occur, so that at 50 mph, for example, a speed deviation of 5 mph or more might be experienced. These fluctuations would cause fuel economy to differ considerably from that generated by constant speed tests at highway speeds.

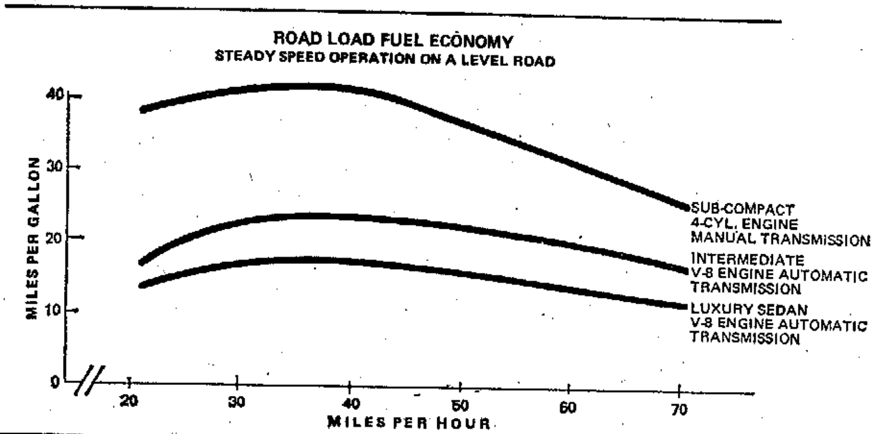
Straying from 50 mph but staying in a range of 45–55 mph—a not unrealistic driving pattern—entails a total speed variance of 10 mph. At these speeds, a single 10 mph deceleration each mile could result in increased fuel consumption of 15%.[9] One slow-down of 20 mph per mile, as might be encountered after passing, could increase fuel consumption 25%.[10] The substantial impact on fuel economy from seemingly insignificant departures from constant speed clearly illustrates the significance of the difference between constant speed test driving and actual driving which occurs within a range of speeds yielding an average speed.

Therefore, mileage figures generated by a test conducted at a constant 55 mph,[11] the speed closest to the range in which consumers can drive in a manner most closely approximating steady speed, would be misleading to consumers for two reasons.

First, as shown above, even on the highway, real driving involves fuel economy-robbing speed changes, so that the constant 55 mph test figure would be unrealistically high.[12]

Second, a constant 55 mph test might be biased against smaller cars. It can be seen by referring to Figure 2 that at 55 mph, a small car can obtain an approximately 15% lower rate of fuel economy than the optimum fuel economy achieved at approximately 35 mph; while the intermediate car's rate of fuel economy is reduced only about half as much, approximately 8% from the optimum achieved at 35 mph. Such a test tends to misleadingly deemphasize the difference in fuel economies between smaller and larger cars which is so noticeable at the lower speed ranges. The lower speed ranges more closely approximate the city type driving patterns most experienced by the majority of the driving population.[13] (While 35 mph steady speed driving is not a good approximation of the stop and go type driving pattern experienced in city driving, it may be reasonably expected that due to the predominantly inertial effects during stop and go driving, there would be an even greater gap between larger and smaller cars if the comparison was made under that circumstance.)

Figure 2
Road Load Economy
Versus Driving Speed



Source: G. J. Huebner, Jr., and D. J. Gasser, "General Factors Affecting Vehicle Fuel Consumption," (paper presented at National Automobile Engineering Meeting, Society of Automotive Engineers, Detroit, Michigan, May 15, 1973.)

In summary then, the results of steady speed tests ordinarily cannot be duplicated by consumers.[14]

Though consumers' driving speed patterns could possibly be approximated by assigning average speeds to their experiences, knowing this alone would not provide enough information to design or evaluate a valid testing procedure. Even an average speed figure is potentially deceptive unless more is known. Speeds in a range of zero to 70 mph can average 30 mph, but so can a range of 25–35 mph. The latter, however, would probably result in better fuel economy, since the speed changes would be smaller and much of the driving would be in most cars' optimal speed range.

Thus to control or evaluate the effect of speed in a test, at least the speed range, as well as the average speed, would have to be specified or disclosed. However, even this would be insufficient, since fuel economy is also affected by other driving cycle factors which interrelate with speed under actual driving conditions often in known ratios. These are discussed below.

Footnotes at end of analysis, p. 34391.

2. *Acceleration, deceleration and stopping.* Real driving takes place in a range of speeds from a stop (zero mph) to speeds in excess of the maximum speed limit (55 mph). In moving through this range, periods of acceleration and deceleration occur at varying rates. All driving also includes some periods of time during which the engine is running but the car is not moving ("idling"), whether it is a few seconds at the beginning and end of trips or more substantial periods of time typical of city driving.[15] Idling, acceleration and deceleration all result in increased fuel consumption.

Naturally, since fuel is being consumed, but no mileage is being accumulated, the fuel economy during idling is zero mpg. The degree to which periods of idle affect overall fuel economy depends on the length of such periods as a proportion of total engine running time.

The degree to which acceleration and deceleration increase gasoline consumption depends upon the size of the speed change, the speed from which the change took place[16] and the rate of speed change.[17]

In a study for the National Research Council,[18] it was reported that at 50 mph, a single speed decrease (deceleration) of 10 mph during each mile traveled increased fuel consumption by as much as 15%.[19] Decelerations of 20 mph and 30 mph from the same base speed—as might result from passing another car—resulted in increased consumption of up to 25% and 30% respectively.[20] Thus as the size of the speed change increased, so did the rate of fuel consumption.

The rate of speed change also affects the rate of gasoline use to the extent that habitual rapid acceleration may result in a 15% higher rate of fuel consumption than an acceleration at a more gentle rate,[21] as noted earlier in the discussion of driver-related variables.

When acceleration and deceleration involve one or more full stops, fuel consumption increases even more[22] due to idling while the car is stopped, the amount of speed change involved in going to or from a full stop and the necessity of overcoming the inertia of the vehicle's weight.

Thus speeding up, slowing down and stopping are significant factors in fuel economy. Typical values for these factors under various driving conditions can be measured by analyzing the values for these factors actually experienced in real driving as determined in tests done on actual roads of various types. For example, in several studies, the frequency of stopping and the duration of stops have been measured for various driving conditions. In a study done on various routes in five urban areas, idle time was found to constitute from 13–18% of total engine running time.[23] The five-city composite (weighted for the number of vehicles registered in the five cities) yielded idle time of just over 13%.[24]

Frequency of idle time (expressed as a number of stops per mile) varies significantly depending upon the type of driving. Urban driving ranges from one to three stops per mile.[25] Suburban driving involves one to two stops per mile[26] and highway driving is typified from 0.1 to 0.5 stops per mile.[27] See Figure 3.

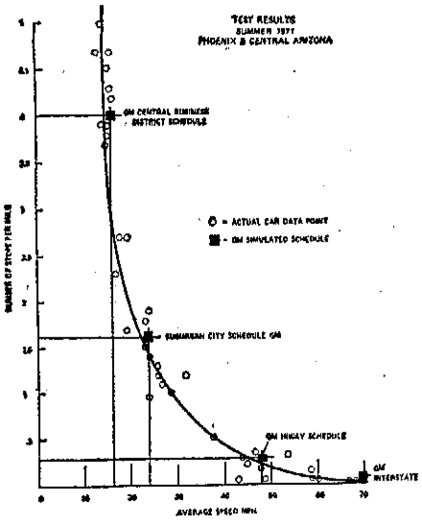
By controlling the number of stops per mile in a test procedure, fuel economy data generated will either be raised or lowered, depending on the stopping rate chosen. As can be seen from the stops per mile data noted above, the empirical data show ranges of stop frequency, depending upon the type of driving studied.[28]

The speed ranges and average speeds found by various investigators in empirical investigations of different types of driving were as follows:[29]

	Range	Average
City driving	0–30 mph	16–20 mph.
Suburban driving	0–40 mph	24 mph.
Highway driving	0–70 mph	47–50 mph.

These speeds can be seen to correlate with stop frequency on the curve in Figure 3 which is the curve presented by the President of General Motors Corporation in recent hearings before the Senate Committee on Public Works. See, supra, note 12. Data independently developed in different geographic areas by EPA showed values for stops per mile vs. average speed which are in agreement with this curve,[30] which suggests that the curve is valid for areas other than those in which the testing was done.

FIGURE 3



Source: Hearings on Compliance with Title II (Auto Emission Standards) of the Clean Air Act before the Senate Committee on Public Works, 93d Cong., 1st Sess., at 192 (Nov. 1973). This graph appeared in Attachment 7 to the statement of E.N. Cole, President, General Motors Corporation.

By specifying the average speed, number of stops per mile and the range of speeds for a test, it is possible to control acceleration and deceleration rates within reasonably confined limits. By examining the values for these factors employed in a test, it is possible to determine what type of driving the test most represents and, if the degree of agreement with the values given in Figure 3 and above is known, just how representative a test is as to these factors can be evaluated.

To illustrate this, some sample figures can be examined. If a test was designed with an average speed of 16 mph and 4 stops per mile, with a range of speeds from 0–30 mph, it would be clear, to anyone familiar with the proper mix of factors, that this represents city driving. If, however, the upper limit of the speed range were increased, or the number of stops per mile decreased, the test might not generate fuel economy data representative of normal driving of any kind, even though the average speed remained the same.

If a driver must maintain a specified average speed, and must also stop a prescribed number of times, and cannot exceed a certain speed, he cannot accelerate too gently between stops or the average speed will not be attained for the entire test. Similarly, increasing the upper limit of the speed range in this example would permit gentler acceleration (since a higher speed could be averaged in) and might permit periods of relatively steady speed driving in the optimum speed range (30–40 mph).

Thus average speed, stopping rate and speed range can be specified in a manner intended to correlate to real driving under various conditions. Similarly, when the values assigned to these factors in a test procedure are known, the degree to which it represents some type of real driving can be assessed. However, knowing the values assigned to these factors—speed, acceleration, deceleration and stopping—does not necessarily mean that the data generated by the test can be evaluated in terms of real driving experience since still more factors, apart from the general type of driving, can affect fuel economy, as is discussed in the sections below.

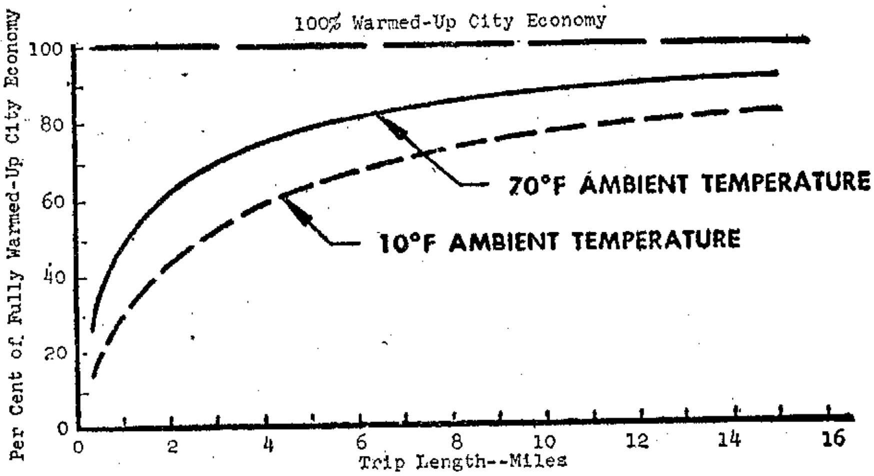
Footnotes at end of analysis, p. 34391.

3. *Trip length and cold vs. warmed-up starting.* Although there is some dispute over this point, it appears that the effect of cold starting (and the subsequent period during which the vehicle is warming up) is to significantly decrease fuel economy. The degree to which cold starting affects overall fuel economy decreases as trip length increases, since an increasingly larger proportion of the test is conducted with the engine warmed up.

The graph in Figure 4, infra, shows the effect on fuel economy of cold starting, expressed as a percentage of fully warmed-up ("hot start") fuel economy for different trip lengths. The national average for trip length is 8.9 miles[31] and at the point on the curve corresponding to this trip length, the difference in fuel economy between starting cold and starting warmed up is about 14% (at 70° F). This suggests that the choice between cold start and hot start has a significant bearing on the relevance of test results to typical consumer expectance.

FIGURE 4

WARM-UP ECONOMY



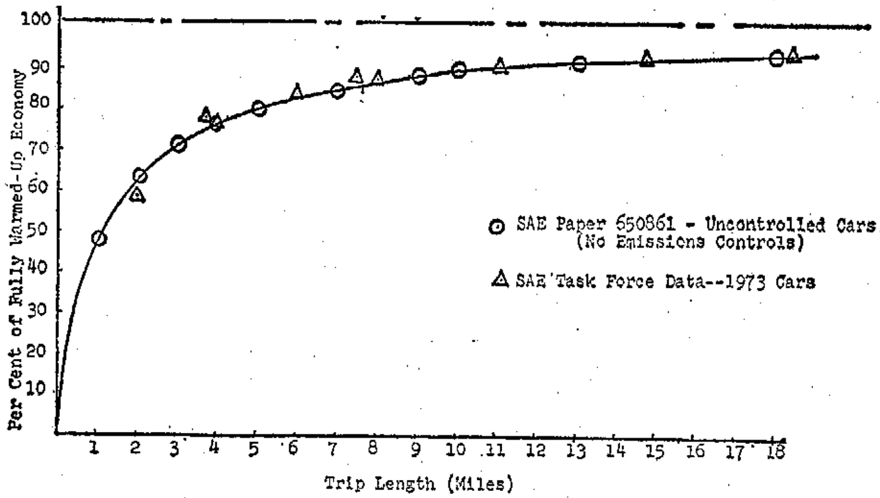
Source: Derived from C.E. Scheffler and G.W. Niepoth, General Motors Corporation, Customer Fuel Economy Estimated from Engineering Tests, Society of Automotive Engineers paper No. 650861, at 10 (1965).

Some of the experts with whom the Commission's staff conferred expressed the view that this 14% fuel economy penalty would be only typical of vehicles manufactured without emissions controls, i.e., those manufactured in model years prior to 1968. They reason that the advent of emission controls necessitated design changes in automobiles which reduce the effect of the warm-up period on fuel economy. Specifically, the time during which the choke is on has been reduced since "choking" (i.e., reducing the air-fuel mixture thus increasing the amount of fuel relative to air fed to the engine) tends to increase emissions as well as reducing fuel economy.

But in the Society of Automotive Engineers paper from which Figure 4 is reproduced,[32] it was reported that choking apparently is not the determining factor causing the increase in fuel consumption during the warm-up period.[33] Rather, the report cites frictional losses due to cold components and lubricants and the need to bring the entire vehicle to stable operating temperature as causes of fuel economy loss during warm-up. These factors operate to reduce fuel economy irrespective of the action of the choke.[34]

The data upon which these conclusions and the graph in Figure 4 are based were developed prior to 1968, but it is supported by more recent information from several sources. Figure 5 shows the same curve as Figure 4 with more recent data based on tests performed on 1973 model year vehicles by the SAE Task Force referred to at the beginning of this analysis. The circles represent data points reported in the paper Figure 4 is taken from; the triangles represent data points generated by the SAE Task Force's tests. This new data indicates that there has been virtually no change since the advent of emissions controls.

FIGURE 5



Source: Prepared informally for the staff of the Federal Trade Commission by the staff of the U.S. Environmental Protection Agency's Ann Arbor Laboratory (March 1974).

Preliminary figures in a draft report dated January 1974,[35] prepared for DOT and EPA showed smaller fuel economy penalties attributed to cold starting, but these were nevertheless significant. The mean penalty reported for a trip of 7.5 miles was 8.2% and the penalties ranged up to 17.9% for trips of the same length. Consequently, it appears that cold starting is a significant factor affecting fuel economy.

Nevertheless, there remain important questions concerning whether the use of cold starts in fuel economy testing is practicable and even if so, whether the incorporation of cold starts in a test procedure is necessary. The potential problem with the practicability of cold starting in tests goes to the question of repeatability. Some of the experts consulted expressed the opinion that cold start tests yield results which cannot be repeated from test to test, which might indicate that use of cold starting in tests introduces a factor which cannot be sufficiently controlled to generate valid test data.

Investigating this contention, the Commission staff compared cold start test results obtained on identical cars in identical cold start tests as reported in the 1974 draft report noted above.[36] The average variance between the two cold starts performed was 4%[37] (or 0.43 MPG) with no two tests on the same car differing by as much as one MPG. When these data are considered along with the fact that cold start tests performed on 1973 cars by the SAE Task Force shown in Figure 5 fell almost precisely on the curve generated in 1965 shown in Figure 4 and 5, it appears that the small variability in cold start testing is outweighed by the gain in relevance to consumer experience obtained by the use of cold start test data, thereby enhancing the credibility of the data as a basis for advertising claims or for other promotional disclosures to consumers.

One further criticism of cold start testing should be noted. It is contended that although the short trips which are most typified by cold running represent the largest portion of all trips, most vehicles miles traveled are accumulated during long trips. Data supplied to the Commission staff by DOT indicates that the majority of trips made in this country are under 5 miles long, but that these trips account for just over 11% of the vehicle miles accumulated.[38] The significance attached to this by some critics of cold start testing is that fuel consumption is a function of aggregate vehicle miles travelled, not of average trip length alone. By using cold starts in tests, this argument goes, the effect of cold starts on a national basis is exaggerated. However, gasoline consumption is not directly proportional to vehicle mile accumulation, since cold starting during the shorter trips results in significantly higher gasoline consumption, and because longer trips tend to be made under conditions more favorable to good fuel consumption (fewer stops per mile, highway cruising, etc.).[39] Thus, the argument comes full circle, and the indication is that cold starting does significantly contribute to this country's fuel consumption. Although not all trips begin cold, "The majority of day-to-day driving is composed of a succession of relatively short trips, and typically includes some degree of vehicle warm-up *each time* car is driven." (Italics added.)[40]

Ideally, the degree to which cold starting affects the test data should reflect actual driving. Most driving involves some warming up as noted above, but not all starts are cold. In a comprehensive study done in the Los Angeles area, it was found that average car use involved 4.7 trips per day.[41] One of these trips begins after overnight disuse so it is a cold start. Another begins after inactivity of a considerable period (such as during work for a commuting vehicle).[42] Thus, two out of 4.7 starts were made when the vehicle was completely cold or virtually so.[43] From this it is easily calculated that about 43% of all trips began with cold starts in Los Angeles. On a national basis however, the ratio of cold starts to hot starts may be even higher, since the national average for daily trips is four in metropolitan areas.[44] It would be reasonable to assume that this still includes two cold starts daily, yielding a one-to-one ratio for cold starts to hot starts.

Thus, to properly account for cold starting and warm up, fuel economy test data should include at least a 43% contribution from cold starting. This can be done by running the test in two segments, one cold and one "hot" and releasing the test results as a harmonic average of the results from the two segments.[45]

B. *Ambient conditions*—1. *Temperature.* As temperature falls, fuel economy becomes poorer. For example, at 50 mph, every 10°F. drop in temperature results in a fuel economy reduction of 2%.[46]

Due to wide fluctuations in temperature, tests cannot be representative of all driving at all temperatures. Usually, the ambient temperature range is specified for outdoor tests. For indoor tests, ambient temperature can be closely controlled. Thus, by specifying or controlling temperature, there will be no variance between tests due to temperature fluctuation.

2. *Humidity.* High humidity tends to reduce fuel economy somewhat since there is a higher percentage of water vapor in the air-gasoline vapor mixture in the engine and water vapor does not contribute to combustion. This can be accounted for by specifying humidity tolerances for testing out of doors. When tests are performed in a laboratory which is heated in the winter and air conditioned during the summer, humidity tends to be relatively low and deviates less and therefore contributes less to test variance.

3. *Precipitation.* Rain severely reduces fuel economy, and since the rate and volume of rainfall cannot be controlled, outdoor tests are never conducted in the rain. Naturally, this restricts time available for testing, a problem not experienced in indoor testing.

4. *Wind.* Wind significantly affects fuel economy in degrees reflecting the direction of the car relative to the wind direction and the wind velocity. The effect of wind resistance, which is a product of wind speed and vehicle speed, is covered in the following section's discussion of vehicle size.

Outdoor tests usually specify maximum wind speed and are run in two directions in an attempt to nullify wind effects. Obviously, this is not an issue in indoor testing.

5. *Altitude.* At high altitudes (over 2,000 ft.) fuel economy decreases somewhat.[47] Tests ordinarily are conducted at altitudes lower than this, so the tests are somewhat inaccurate as reflections of the fuel economy which would be realized by that part of the population which primarily drives at high altitudes.

C. *Road conditions*—1. *Road surface.* Fuel economy is significantly better on smooth paved roads than on dirt or broken surface roads.[48] Since most roads are paved, testing is done either on a paved road or in a manner which simulates a smooth road.

2. *Road curvature and grade.* Road curvature and grade also affect fuel economy. Road curvature increases gasoline consumption depending upon the degree of curvature.[49] Tests are either conducted on a straight course or a course with relatively gentle curvature. For example, a car going up a 7% grade at 50 mph is penalized 55% in its fuel economy compared to a car going 50 mph on a level road. On a 3% grade the fuel economy penalty is about 32%.[50] Therefore, it is clear that tests should be conducted on a level surface.

D. *Summary—driving condition variables.* The most significant driving condition variables are speed, amount and rate of deceleration and acceleration, frequency of stopping, duration of stops (idling time), engine starting condition (cold or warmed-up), trip length, ambient conditions and road conditions.

Footnotes at end of analysis, p. 34391.

As a general rule when these factors are isolated from one another, the following relationships to fuel economy can be seen:

1. When plotted against speed, fuel economy peaks between 30 and 40 mph forming a characteristic curve for most cars; better fuel economy is realized at constant speeds;
2. Fuel economy decreases as the size, rate and number of accelerations or decelerations increase;
3. Fuel economy decreases as the rate and duration of stops increase;
4. Fuel economy when measured from a cold start is less than that measured when the car is warmed-up;
5. Fuel economy increases as trip length increases.

Under real driving conditions, these variables are not independent of one another, but exist in clearly defined relationships to one another and their values vary depending upon the general driving environment (i.e., city, suburban, highway) as follows:

1. Average speed increases as trip length increases;
2. Average speed and stopping frequency are related in that as average speed increases, the number of stops per mile decreases and this tends to control the rate and frequency of accelerations and decelerations;
3. The size of accelerations is reflected by the range of speeds and the average speed together with stopping frequency;
4. The effect of cold starting decreases as trip length increases;
5. The more constant speed is, the better fuel economy is and the degree of speed constancy depends on acceleration, deceleration and stops so that driving at higher speeds on the highway tends to produce better fuel economy. As average speed decreases, highway conditions are not represented so that stopping and speed changes increase while length of trip decreases.

III. VEHICLE-RELATED VARIABLES

In selecting a new car, the consumer chooses between general types of automobiles (luxury, standard, intermediate, compact or subcompact, etc.), between packages of options and between models. Inevitably the choices the consumer makes lead to better or worse fuel economy, depending upon some of the particular characteristics of the car and the optional equipment selected. The differences among cars which affect fuel economy and which consumers can control in their purchase selection are the subject of this section.

These variables include weight, horsepower, the size of the engine (expressed in terms of total displacement), compression ratio, rear axle ratio and various accessories. All of these variables are explained and discussed below.

A. *Vehicle size.* The size of an automobile affects fuel economy in two ways. The weight of the vehicle increases both the power needed to move the car and the inertial resistance of the car to speed changes, particularly accelerations from stops. The exterior size of the car also may affect fuel economy, depending on its design, because the larger a car is, generally, the larger is the area of the front of the car (the cross sectional frontal area). At high speeds, increase in the cross sectional frontal area increases the resistance to movement from the air, i.e., wind resistance or aerodynamic drag, affecting fuel economy to varying degrees depending upon speed and streamlining; at low speeds, however, this effect is insignificant.[51]

Vehicle weight is the single most important difference between automobiles in terms of gasoline consumption at any speed.[52] A 500 pound increase in vehicle weight, with all other factors equal, has been estimated to result in an average 14% fuel economy loss with a difference of 100% between a 2500 and 5000 lb. car.[53] Consumers Union tests indicated a decrease of 0.5 mpg for every 500 lb. increase in weight.[54]

Footnotes at end of analysis, p. 34391.

In addition to the effect of the weight itself, heavier cars also usually need power options and larger more powerful engines, which additionally increase gasoline consumption.[55]

B. *Horsepower*. As the power of an engine increases, it tends to consume more gasoline.[56] One study reported that fuel economy decreased by one mpg for every 120 horsepower increase in engine output.[57] However, power must be considered together with vehicle weight, since an underpowered, heavy car will perform relatively poorly on the highway, thereby losing the usual fuel economy advantage of highway over city driving.[58]

Thus, the horsepower of a car is significant, but to judge the car's performance on a test involving some but not all driving conditions, e.g., highway but not city, the power to weight ratio must be known. Without this knowledge, it might falsely be assumed that the mpg number generated by a highway test would be considerably lower in the city and vice versa.

C. *Engine size (displacement)*. Engine size is commonly noted merely in terms of the number of cylinders, but different engines with the same number of cylinders vary in size due to differences in the effective volume of the cylinders. Therefore, a more realistic and accurate measurement of engine size is "displacement". Displacement is a measure of the maximum volume of a cylinder (when the piston is furthest from the tip of the cylinder) or, the volume of the cylinder through which the piston acts. The total of all of the cylinders is the engine displacement, usually expressed in cubic inches (C.I.D.) or litres in the metric system.

As displacement increases, fuel economy decreases,[59] in a ratio of 0.2 mpg per 10% engine displacement increase.[60] Thus, a larger engine consumes more gasoline.

Additional fuel economy loss is attributable to larger engines due to their weight. The difference between a six and eight cylinder engine is often well over 100 lbs.[61]

D. *Compression ratio.* Compression ratio is a ratio of the volume of the air and gasoline mixture in the cylinder before compression by the piston to the volume after compression. Thus, if the initial volume is ten times the volume after compression, the ratio is 10:1. Higher compression engines are generally more efficient. A 10% increase in compression ratio improves fuel economy by half an mpg in urban driving,[62] (although it also increases the octane requirements of the engine.)[63]

Thus, vehicles with high compression ratios may be more efficient and burn relatively less gasoline, but the fuel to power them costs more per gallon since high octane fuel is more expensive. There is a trade off here which the consumer would have to evaluate.

E. *Axle ratio.* The axle ratio is the number of revolutions of the drive shaft as the ratio to the number of revolutions of the rear wheels. The range of ratios available is from about 2.7 to 4.1.[64]

Several different axle options might be available for the same model car. For example, a higher ratio is often needed if the car is going to be used for towing a trailer, but a 10% reduction in axle ratio can improve fuel economy by more than 2%[65] or 0.1 mpg for an intermediate size car in urban traffic.[66]

Weight, engine horsepower and displacement, type of transmission, and the compression and axle ratios account for 90% of the variances in fuel economy between automobiles. Vehicle size alone accounts for 80% of the difference in urban driving taking into account the way heavier vehicles are actually sold, i.e., with larger more powerful engines.[67]

In addition to these factors, which might be considered descriptive of the basic car, optional equipment can increase fuel consumption both through the power drained when the equipment is in use and due to the increased weight of the car attributable to the equipment. The values attributed to the increase in power consumption caused by the most significant accessories and convenience devices are shown in Table 1.

TABLE 1.—*Effect of engine accessori es and convenienc devices*

Reference[1]	Type of Accessory	Fuel Economy Penalty (urban operation)
(11)	Power steering, air conditioning, generator.	7.7 percent.
(12)	Air conditioning	13 percent (85° ambient).
(12)	Power Steering	About 1 percent.
(12)	Automatic transmission.	14 percent to 15.5 perceht.
(14)	Air conditioning	9 percent (70°F ambient).
(14)	Automatic transmission.	5 percent to 6 percent.
This paper	do	0 percent to 6 percent.

1 References cited in paper.

Source: Austin and Hellman, "Passenger Car Fuel Economy—Trends and Influencing Factors," Society of Automotive Engineers paper No. 730790, 1973 at 17.

IV. DISCLOSURE OF TEST CONDITIONS IN ADVERTISING

Introduction. In the preceding two sections of this analysis, the discussion focused on the contributions of various factors to an automobile's rate of gasoline consumption. Briefly, the most significant of these factors are as follows:

1. Speed (average and range).
2. Acceleration and Deceleration (rate and number of mph increase or decrease and frequency of speed changes).
3. Stopping frequency.
4. Trip length.
5. Engine starting condition (cold or "hot").
6. Temperature.
7. Humidity.
8. Precipitation.
9. Wind.
10. Altitude.
11. Road surface.
12. Road curvature.
13. Road grade.
14. Vehicle size.
15. Vehicle weight.
16. Engine horsepower.
17. Engine displacement.
18. Compression ratio.
19. Axle ratio.

In this section, the possibility of disclosing the values of these variables in tests used to support advertising claims is discussed. With respect to disclosure of conditions, two alternatives warrant discussion. The first is disclosure of a few of the key test conditions. The second is disclosure of key features of the vehicle which was tested.

A. *Disclosure of test conditions.* The first approach taken to disclosure of test conditions was to examine the possibility that just disclosure of only one or two significant facts would permit consumers to relate advertised fuel economy claims to the type of driving they personally do. If this were possible, consumers might be able to do the following:

(1) Make a general decision as to the validity of the advertising claim;

(2) Decide whether they would get more or fewer mpg's based on a comparison of the way they drive to the way the test was conducted;

(3) Estimate with reasonable accuracy the number of mpg's they should add or subtract from the advertised claims to adjust it to the type of driving they do;

(4) Compare the advertised car's fuel economy to that of the car they already own;

(5) Compare the advertised car to other cars' mileage being advertised.

It soon became apparent that estimates of this sort—based upon disclosure of factors but without drawing any conclusions for consumers as to the impact on fuel economy of deviations of specified amounts from the disclosed factors—were not likely to be made with a sufficient degree of accuracy.

In order to determine whether disclosure of just a few conditions would be adequate, the Commission's staff reviewed advertisements in which such disclosures were already made. Examples of advertising [68] disclosure and their limitations follow:

(a) Car A, weighing 2750 lbs claims to get 29.8 mpg, when driven at a steady speed of 55 mph in the Arizona desert, with the engine warmed up. A consumer who equated this 55 mph figure with "highway driving", would be mistaken, for the reasons discussed in sec. II.A.1. supra. Ordinary consumers do not, and cannot, drive at steady speeds, and to the extent that their speed fluctuates, either through "hunting" or passing, they reduce their fuel economy significantly.

(b) Car B, weighing 4500 lbs claims 17.6 mpg at 55 mph and 12.8 mpg at an average speed of 24 mph, with 1.6 stops per mile. As noted, the exaggeration in the first figure may well escape a consumer who is familiar with 55 mph speed limits. The second figure, which may appear to a consumer to approximate city driving, is really a suburban driving figure, as shown by Figure 3, supra. But even if the consumer were somehow alerted by the average speed or number of stops per mile to the fact that the mileage derived from this test does not approximate city driving, he would not be able to determine what mileage could be achieved in city driving.

That comparison between one test and another may be dangerous is illustrated by an attempt to predict the mileage obtainable by a car A at 24 mph with 1.6 stops per mile. If the consumer were to use car B's experience as his guide, he might expect a reduction of fuel economy of about 25%, to about 22.4 mpg. If so, his estimate would be off by over 4 miles per gallon, or about 15%. The ad from which example A is derived claimed 26.5 mpg at an average speed of 24 mph with 1.6 stops per mile.

(c) Car C, weighing 4500 lbs, claims to get 16.4 mpg at an average speed of 37 mph, with speed ranges from 0–55, over a 73 mile trip in conditions ranging from urban to suburban to highway. Although somewhat more conditions are disclosed than in examples (a) or (b), the consumer who wished to know what sort of mileage could be expected either in highway driving or city driving would not be aided by these disclosures. As discussed in Section II above, disclosure of average speed or even speed range by itself is insufficient, since the significant effects of acceleration, deceleration, and stops are ignored. But even if the number of stops per mile were disclosed (e.g., 0.5) and the consumer were able to relate this to some aspect of his driving experience (e.g. highway), he could still not do more than guess as to what mileage this car could achieve under urban conditions. As the prior example shows, reliance on experience with other cars, or even the consumer's present car, to arrive at a "discount factor" can be quite misleading.

Footnotes at end of analysis, p. 34391.

Disclosure of more factors will of course give the consumer a better picture of how the advertised figure was derived and may give at least some idea of how that test compares with his own driving patterns. Such additional disclosures, however, will not be adequate to permit meaningful comparisons between two advertised cars.

To illustrate the problems that might occur if five significant factors were disclosed in advertising, four examples should suffice. Table 2, infra, shows the values that might be found in four different ads involving four different cars and four different tests; a highway test, a city test and two arbitrary tests not representative of real driving.

TABLE 2

Factor [1]	(1) City driving	(2) Highway driving	(3) Conditions disclosed but not characterized	(4) Conditions disclosed but not characterized
Average speed (in mph)	16	48	37	20.
Speed range (in mph)	0–30	0–55	0–55	0–35.
Stops per mile	4	0.3	1	2.
Trip length	8	10	73	20.
Starting condition (hot or cold)	Cold	Hot	Hot	Cold.

[1] To simplify the problem, it is assumed that ambient conditions and road conditions are optimal. Acceleration and deceleration are not included since a very lengthy disclosure would be needed to cover these factors; it would appear to be impossible for a consumer to drive and at the same time monitor the frequency and rate (i.e. gentleness or harshness) of his own accelerations and decelerations and, in any case, stopping frequency would frequently provide an indication of at least the most costly accelerations and decelerations in terms of fuel economy. Thus, this chart does not show all of the significant test conditions. It merely shows the most significant test conditions which might be disclosed in advertising.

If a consumer wished to adjust the fuel economy figure in any one of these ads to estimate fuel economy in some other mode, it is extremely unlikely that he would be able to do so. (The other mode might be the consumer's own driving pattern which he had monitored, or it might be a mode as expressed in another ad, e.g. "city driving.")

If a consumer who had taken the trouble to monitor his own driving was comparing these advertisements, he might see that the first was a reasonably representative city test and the second a reasonably representative highway test, but how would he judge the other two? Test 3 is essentially the test discussed above as Advertisement No. C except that the number of stops per mile were not given in the advertisement and the figure in the chart is therefore fictitious. Test 4 is a test with a mixture of characteristics.

Comparing the city test to the second arbitrary test shows a slight increase in the average speed and the upper limit of the speed range and a decrease in the number of stops per mile. The trip length is longer, but might not seem unusually long to the consumer. The number of stops per mile is about what would be expected at an average speed of 20 mph.[69] The arbitrary test would yield higher numbers than the city test since the overall effect of the cold start is minimized by the trip length, and the lower stop frequency and higher upper limit of the speed range would permit much of the driving to be done in the optimal speed range of 30–35 mph. Yet, even if the consumer knew all of this, he would still not know by how much to adjust the number generated by this arbitrary test to arrive at a city number since warm-up characteristics of cars differ and it is difficult to quantify how much of an improvement these changes would make.

Furthermore, even if the consumer in question takes the time to determine the characteristics of his own driving and finds that about a third of his driving is on the highway, a third downtown and a third in the suburbs, how could he adjust this test's results to his driving? Even for a knowledgeable consumer who knew that he should adjust the advertised claim downward, the amount of the adjustment would still be only a guess. And there would still be no means of determining the relative ranking of advertised cars. To do so requires nothing less than data for a number of cars all run on the same test and it should be a test which represents real driving and which contemplates all the significant variables as to which automobiles differ so that particularly poor or particularly good performance in some portion of driving (such as accelerating or warming up) is measured and included in the final mpg figure.

B. *Disclosure of vehicle information.* To the extent that the advertised car matched the car the consumer would want, the claim would be relevant if based upon a test approximating typical driving conditions. However, there are dozens of combinations of options for each model. Thus an advertisement for a given car with randomly selected options would only be relevant to some prospective purchasers. If for example, a purchaser was in the market for an eight cylinder car with a high axle ratio suitable for towing a trailer, air conditioning and automatic transmission, and an advertisement for a car claimed a given fuel economy for eight cylinder, low axle ratio with a three speed standard transmission, the figure in the advertisement would be higher than the consumer would realize under the same driving conditions as the one in which the advertised car was tested. Even if the consumer knew about and understood these variations, it would be difficult for him to quantify the differences so as to enable him to "discount" the advertised figure.

The amount by which equipment changes affect fuel economy varies. Adding an automatic transmission to a small car may reduce its fuel economy about 6%[70] or 1.5 mpg for a car which gets 25 mpg while; adding it to a larger car will likely result in a much smaller reduction in fuel economy. Changing from a six to an eight cylinder engine will have an effect, but the degree of change in fuel economy depends upon the relative weights, displacement and horsepower of the two engines. The difference between the most efficient combination of equipment and the least efficient in city driving was 3 mpg for the large car noted in Advertisement 2-above, but it was almost 7 mpg for the subcompact car in Advertisement 3. Thus the number of mpg's to be discounted for the addition of a larger engine or air conditioning or automatic transmission depends upon the car. Consequently, there is no good rule of thumb for the consumer to follow.

Disclosure of variables relating to the driving conditions or features of the car used in the test, without also disclosing the quantitative impact on mpg of specified deviations from those conditions or features, will not ordinarily provide adequate information to consumers. This conclusion does not mean that in particular advertisements the failure to disclose information bearing upon the relevance to the consumer of the claimed mpg may not render the advertisement deceptive or unfair. Such disclosure might, for example, in certain circumstances serve to apprise the consumer that he would not realize the advertised fuel economy.

V. CONCLUSION

This discussion has been intended to set forth staff's present understanding of the major considerations bearing upon a sound technical underpinning for the avoidance of deception and unfairness in fuel economy claims for automobiles. It is expected that interested parties will, by reason of publication of this analysis, be better able to comment upon the issues currently before the staff, to bring to the staff's attention further issues not reflected in this analysis, and to contribute to an informed and effective rulemaking.

Issued: September 24, 1974.

[SEAL] CHARLES A. TOBIN, *Secretary.*

FOOTNOTES—ANALYSIS

[1] Ford Motor Company, Customer Service Division, *Car Owning Made Easier*, at 69 (1973).

[2] U.S. Environmental Protection Agency, Office of Air and Water Programs, Mobile Source Air Pollution Control, *A Report on Automotive Fuel Economy*, at 29 (1973) [hereinafter cited as the EPA Report].

[3] Obviously, driving conditions can be characterized in other ways than by these factors. City driving for example might be typified by a certain traffic density or number of traffic lights, but it is the effects of these characteristics on driving which are accounted for by the variables in the driving cycle.

[4] EPA Report, supra note 2, at 26.

[5] *Id.* at 26; Cf., Claffey, *Running Costs of Motor Vehicles as Affected by Road Design and Traffic*, National Cooperative Highway Research Program Report No. 111, Highway Research Board, Division of Engineering, National Research Council, National Academy of Sciences—National Academy of Engineering, at 51 et seq. (1971) [hereinafter cited as Claffey]; G. Huebner and D. Gasser, *Energy and the Automobile—General Factors Affecting Vehicle Fuel Consumption*, Society of Automotive Engineers Paper No. 730518 in *Energy and the Automobile*, Society of Automotive Engineers Special Publication No. 383, at 25 (1973) [hereinafter cited as Huebner]. The authors of the latter paper are employed by Chrysler Corporation.

[6] C. Scheffler and G. Niepoth, *Customer Fuel Economy Estimated from Engineering Tests*, Society of Automotive Engineers Paper No. 650861, at 5 (1965) [hereinafter cited as Scheffler] (The authors are employed by General Motors.)

[7] Cf., Scheffler at 5.

[8] See, Claffey supra note 5.

[9] Id. at 51 (Table A–14).

[10] Id. at 52 (Table A–18).

[11] Many of the advertising claims monitored by the staff were in fact based on just such a test.

[12] See, *Hearings on "Compliance with Title II (Auto Emission Standards) of the Clean Air Act"* before the Senate Comm. on Public Works, *93 Cong.*, 1st Sess., at 186, 192 (Nov. 1973) (Attachment 7 to the statement of E. N. Cole, President, General Motors Corporation) [hereinafter cited as the Clean Air Act Hearings]; See also, the discussion of stopping frequency and Figure 3, infra.

[13] See, U.S. Dep't of Transportation, Federal Highway Administration, Office of Highway Planning, Program Management Division, *Estimated Motor Vehicle Travel in the United States and Related Data—1972*, Table VM–1 (1973). [hereinafter cited as the VM–1 Table].

[14] Clean Air Act Hearings, supra note 11, at 186.

[15] Scott Research Laboratories, Inc., *Vehicle Operations Survey*, Coordinating Research Council—APRAC Project No. CAPE 10–68 (1–70) at Table 4–2 (1971) [hereinafter cited as Vehicle Operations Survey]

[16] Claffey supra note 5, at 51 et seq. (Charts A–14 to A–21).

[17] EPA Report, supra note 2, at 29.

[18] Claffey, supra note 5.

[19] Id. at 52 (Chart A–18).

[20] Id. at 52 (Charts A–17 and A–18).

[21] EPA Report, supra note 2, at 29.

[22] Cf., Claffey, supra note 5, at 51 *et seq.*

[23] Vehicle Operations Survey, supra note 15 Table 4–2.

[24] Id.

[25] Clean Air Act Hearing, supra note 11 at 186; See also Federal Test Procedure, 40 C.F.R. Section 85 (1973).

[26] Clean Air Act Hearings, at 186.

[27] Id.; R. Kruse and C. Paulsell, Development of a Highway Driving Cycle for Fuel Economy Measurements, Mar. 1974 [Available from EPA].

[28] Clean Air Act Hearings, at 192.

[29] Id. at 186: Vehicle Operations Survey, supra note 16, Table 4–1; Federal Test Procedure, 40 C.F.R. § 85.075 (1973) [hereinafter cited as the 1975 FTP].

[30] The FTP, developed in Los Angeles, has an average speed of 19.5 mph with 2.4 stops per mile. The 1975 EPA Highway Schedule developed in Michigan has an average speed of 49 mph with 0.2 stops per mile. Both tests show values consistent with the curve in Figure 3.

[31] U.S. Dep't of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Study* [hereinafter cited as the NPTS], Report No. 3, "Seasonal Variations of Automobile Trips and Travel," at 13 (1972).

[32] Scheffler, supra note 6.

[33] Id., at 2.

[34] Id.

[35] Energy Conservation Systems Section, Dep't of Automotive Research, Southwest Research Institute, *A Study of Technological Improvements to Automobile Fuel Consumption* (contract DOT–TSC–628) at Appendix D. Note: This is a Jan. 1974 draft of a report prepared for D.O.T. and E.P.A. containing preliminary information subject to change [Hereinafter cited as the SWRI Draft Report].

[36] Id.

[37] In each case the variance was calculated at a percentage of the smaller test result, thus maximizing the percentage difference.

[38] Data derived from the NPTS, supra note 31.

[39] Id.

[40] Scheffler, supra note 6, at 1.

[41] D. H. Kearin and R. L. Lamoureaux, System Development Corp., *A Survey of Average Driving Patterns in the Los Angeles Urban Area*, Coordinating Research Council Air Pollution Research Advisory Committee Project No. CAPE–10 (1969) [hereinafter cited as Kearin].

[42] Huls, *Evolution of Federal Light—Duty Mass Emission Regulations*, Society of Automotive Engineers Paper No. 730554, at 12 (1973). (The author is employed by the EPA.)

[43] Id.

[44] NPTS, supra note 31, Report No. 7, *Household Travel in the United States*, at 20 (1972).

[45] Unlike the simple arithmetic means, the harmonic average would account for the different weighting of "hot" and cold starts. For example, if the values designated were 43% cold and 57% hot, the overall mpg would equal:

$$\frac{1}{\frac{.43}{\text{mpg (cold)}} + \frac{.57}{\text{mpg (hot)}}}$$

[46] EPA Report, supra note 2, at 30. See also, Scheffler, supra note 6, at 5, 11.

[47] SWRI Draft Report, supra note 35, at Appendix G.

[48] EPA Report, supra note 2, at 31.

[49] Claffey supra note 5, at 6.

[50] EPA Report, supra note 2, at 31.

[51] SWRI Draft Report, supra note 35, at 329; T. Austin and K. Hellman, *Passenger Car Fuel Economy—Trends and Influencing Factors*, Society of Automotive Engineers Paper No. 730790 at 16 (1973) (The authors are employed by EPA.)

[52] Austin and Hellman, supra, at 20; Huebner, supra note 5, at 26; Senate Committee on Commerce, Report on S. 2176, *"The National Fuels and Energy Conservation Act of 1973* S. Rep. No. 93–526, 93 Cong., 1st Sess. 9 (1973) [hereinafter cited as the Senate Report on S. 2176].

[53] Senate Report on S. 2176, supra, at 9.

[54] "Options: The Gasoline Trade—Off", *Consumer Reports*, Apr. 1974, at 304.

[55] Senate Report on S. 2176, supra note 52, at 10.

[56] Scheffler, supra note 6, at 5.

[57] Id.

[58] Id.

[59] "Options: The Gasoline Trade-Off," Consumer Reports, Apr. 1974, at 304.

[60] Heubner, supra note 5, at 27.

[61] See, e.g., "Options: The Gasoline Trade-Off," Consumer Reports, Apr. 1974, at 304.

[62] Heubner, supra note 5, at 27.

[63] Id.

[64] See, 39 Fed. Reg. 7664 et seq. (Feb. 27, 1974) wherein the axle ratios of tested cars were listed.

[65] EPA Report, supra note 2, at 14.

[66] Heubner, supra note 5, at 28.

[67] Id., at 26.

[68] This data is drawn from actual ads.

[69] See Figure 3, supra: Clean Air Act Hearings, supra note 11, at 192.

[70] Austin, supra note 49, at 15.

[FR Doc.74–21564 Filed 9–23–74;8:45 am]