GUIDELINES FOR THE EVALUATION OF EVIDENCE SUBMITTED IN SUBSTANTIATION OF ADVERTISING CLAIMS MADE BY THE AUTOMOTIVE INDUSTRY

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Final Report

to

Consumer Interests Foundation
1625 Eye Street, N.W., Suite 923
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16. Abstract

A methodology is developed for the critical evaluation of evidence presented to substantiate advertising claims in the automotive field. Two taxonomies are specified, one for claims and another for evidence, and the two are then related to indicate what an evaluator might consider as admissable and adequate. Specific examples, hypothetical but realistic, are discussed with regard to four broad types of claims. Finally, the technical and administrative procedures for applying the guidelines are outlined.

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I. INTRODUCTION

Advertising is taking on an increasingly important role in the lives of the American buying public. While the initial, and perhaps still primary, purpose of advertising was to sell products, it is generally conceded that it is incumbent upon advertisers to provide the additional function of informing the public, not only of the availability of their products, but also of their value, usefulness and performance to potential buyers. This shift in attitude has been acknowledged by the public and the producers alike, and it is gradually acquiring a substantial basis in law.

Congress and the Federal Trade Commission recognized some years ago that a laissez-faire posture would not serve to discharge their responsibilities with regard to protecting the public interest. "Caveat Emptor" has become an inadequate counterforce to meet the skills of advertising experts and the modern technology available for the dissemination of their materials. Misleading and deceitful practices, it was feared, could well transform a valuable customer information source into an instrument for coercion and manipulation.

As one facet of the exercise of governmental control to protect the consumer from false, misleading or deceptive advertising, the FTC has been empowered to order manufacturers to provide substantiating evidence in support of the claims they have made. They have done so, and responses have been received from a wide variety of industries. The initial exchange of material led to confusion on the part of all concerned. Charges against the industries ranged from their being able to substantiate only a small portion of the claims to their having supplied material that was hopelessly complex and overly technical in its nature. Much of the material was evaluated by independent organizations, sometimes hastily with a view toward

sensationalism, other times in great detail by competent technical groups. There had been established no criteria upon which to base these evaluations, and the question of what constitutes adequate substantiation remains even now an open one. This is the question we are attempting to answer in this study, and our investigations will deal exclusively with the automobile industry.

II. SCOPE OF THE PROJECT

The objective of this project is the development of guidelines for the evaluation of material submitted by automobile manufacturers in substantiation of their advertising claims. Since the FTC regulation stipulates that the evidence must be available before a claim is presented to the public, such guidelines will also serve to guide the industry in its decisions as to whether to proceed with particular ads or not. With the aid of a taxonomy of both claims and evidence, we will generate the overall concepts necessary to the performance of the evaluation process, and the application of these principles will be demonstrated in a number of hypothetical but realistic examples.

Our intent is to provide examples of good practice, although in the process of doing this it will be necessary to show why evidence that is less than good is inadequate by the standards established. We realize that the ultimate determination of a claim being misleading or deceptive must result from a legal procedure and our work represents a prelude to such a procedure, not a substitute for it. The questions we will ask about substantiating evidence for claims have to do with whether they meet the standards of good practice with regard to relevancy, adequacy, and completeness. The implications of our evaluation will not be considered beyond the point of assessing the substantiating evidence, nor will we concern ourselves with possible remedial or punitive action which might or should be taken against those who fail to meet the standards of substantiation.

We have noted the concern expressed in some recent documents that some of the substantiating evidence supplied has been over-technical in its nature. Automotive design is primarily an engineering activity, and it is reasonable to expect manufacturers to proclaim their excellence in the engineering aspects of their products. Evidence to support their claims

in this regard must necessarily contain the relevant engineering data. Reducing this information to terms whereby it can be understood by the lay public would tend to lessen its value for evaluative pruposes, and the industry cannot be expected to educate the public on technical matters. We must, therefore, rely on the judgment and advice of technicians with regard to the relevance of technical terms to the claims at hand, the adequacy of procedures and instrumentation for the conduct of tests, the appropriateness of analogies made to the engineering domain, the effectiveness of specific sampling procedures used in surveys, and other such matters beyond the competence of the non-technically educated person. Our standards for evaluation may be interpretable in any specific instance only by technical experts in the areas covered.

While the understanding of the technical material submitted as substantiating evidence for advertising claims may be limited to technical experts in the relevant fields, it appears that in the interest of protecting and informing the public another step must be taken. Namely, after the material has been technically evaluated and understood, it must be interpreted. That is to say, the expert should be required to render an opinion as to the quality of the substantiation, and this opinion must be in terms comprehensible to the public. Included in the term "public" is not merely the consumer himself, but members of law making and regulating bodies who can use these opinions as a basis for their legislative decisions.

III. TAXONOMY OF CLAIMS AND SUBSTANTIATING EVIDENCE

The language of advertising is designed to appeal to the potential buying public, and as such, may not be directly susceptible to proof because of its lack of specificity. Frequently, a translation has to be made to define exactly what claim has been made by a specific ad and to put that claim into technical language so that evidence can be matched against it. The translation process generally involves judgment since alternative (and often mutually inconsistent) translations may be derived from the same statement. The translation of vague or ambiguous terms will always be arbitrary and in the final analysis will most likely be based on precedent.

With the translated claim in hand, one must then develop a set of measurement procedures. Again, these procedures will be based, in part, upon judgment. However, as guidelines we have available the well-established practices of such organizations as the U.S. Standards Institute and the Society of Automotive Engineers. In every case, these procedures must be adapted to the particular claim in question.

To facilitate the first two steps in the evaluation process just described, we have developed a taxonomy for both the content of advertising claims and the kinds of evidence which might be offered in support of them. A list of the items appears in Table I and a detailed discussion of each of the items follows.

A1. Physical Magnitude (absolute) - Claims of this type have to do with measurable physical properties of the automobile or any of the equipment contained in it. Included in this category are linear dimensions such as wheel base, volumetric statements about engine displacement or trunk capacity, and vehicle weight.

TABLE I

TAXONOMY OF AUTOMOBILE ADVERTISING CLAIMS AND THEIR SUBSTANTIATION

A. Claims
   1. Physical Magnitude (absolute)
   2. Physical Magnitude (relative)
   3. Price (absolute)
   4. Price (relative)
   5. Economy
   6. Performance
   7. Style and Beauty
   8. Safety (direct statement)
   9. Safety (inferred from equipment)
   10. Comfort
   11. Handling
   12. Prestige
   13. Warranty
   14. Use by Notable Personalities

B. Substantiation
   1. Engineering Test Data
   2. Design Specifications
   3. Unsolicited Testimonials
   4. Experimental Comparisons (objective)
   5. Experimental Comparisons (subjective)
   6. References to Public Press
   7. Controlled Subjective Evaluations
   8. Opinion Survey
   9. Reference to Consumer Testing Organizations
   10. Endorsement by Individuals or Groups
   11. Market Surveys

A2. Physical Magnitude (relative) - Comparative statements about the relative dimensions of the advertised vehicle and other vehicles are the subject of this category. Adjectives such as greater, shorter, heavier, etc., are generally used in these claims, but the comparison may be made to an implied standard or in the case of "big enough for a tall man."

A3. Price (absolute) - A statement is made here about the cost of the vehicle in dollars to the consumer, usually accompanied by qualifying remarks concerning what options are included and the fact that certain charges are added to the quotation depending on location.

A4. Price (relative) - This kind of claim compares the price of the vehicle to others in the same class indicating that the initial cost is lower than the competitor's, or compares the vehicle to one of the same price indicating that more is offered for the same money.

A5. Economy - As distinct from claims about price, this category deals with the cost of operating the vehicle after the initial purchase is made and usually deals with items such as fuel consumption and frequency of maintenance.

A6. Performance - Items in this claim category are concerned with the engineering characteristics of the vehicle in objective quantities. Statements about acceleration, turn radius, stopping distance, and the like are included here whether they are made in absolute or relative terms.

A7. Style & Beauty - Both relative and absolute statements about the aesthetic qualities of the vehicle are included here, and the claims either directly or indirectly reflect some aspect of subjective judgment.

A8. Safety (direct statement) - This category involves a statement about the safety characteristics of the vehicle either from the point of view of making accidents less probable or of protecting the occupants should they occur.

A9. Safety (inferred) - The emphasis of the claim here is on some feature or features of the automobile from which the potential consumer is expected to attribute augmented or improved safety in the operation of the vehicle.

A10. Comfort - Items in this category appeal to the potential consumer by emphasizing the comfort of the ride in the vehicle or other aspects of the luxury afforded by the particular product.

A11. Handling - Claims of this variety concentrate on the ease with which the vehicle can be driven and the conformance of the vehicle handling characteristics with the driver's ability to operate it.

A12. Prestige - Claims which appeal to an increase in the social or material status of the individual who owns the automobile being advertised fall into this category, and the emphasis is often on the pride of ownership derived from its purchase.

A13. Warranty - These claims concentrate on the manufacturers' guarantees of the consumer's satisfaction with the continued adequate performance of his purchase and on the company's reputation for upholding these promises.

A14. Use by Notable Personalities - The appeal to the consumer in these claims resides in their respect or admiration for those who are claiming to use and be satisfied with the particular product.

B1. Engineering Test Data - Evidence of this sort is comprised of rigorous scientific information gathered under controlled conditions in the field or in a laboratory. The testing environment as well as the specific procedures used are described in exacting (and necessarily technical) detail.

B2. Design Specifications - Engineering drawings and specification sheets may be submitted as evidence in support of advertising claims and it may be assumed that if these are official company documents, the products have been manufactured as indicated.

B3. Unsolicited Testimonials - The spontaneous endorsements of individuals who have used and liked the products may be used in conjunction with claims made in advertising.

B4. Experimental Comparisons (objective) - In the case of these claims comparative tests were performed to measure differences in response characteristics between the advertised vehicles and one or more others. The technical aspects of the experimental conditions are of great importance and must be presented in rigorous detail.

B5. Experimental Comparisons (subjective) - This category is similar to the previous one except that the measurements in this case are based on subjective judgments rather than on engineering data. Not only must the experimental conditions be adequately described, but also the qualifications of the judges.

B6. References to Public Press - The advertiser here quotes from public documents to support a claim he has made. The important point here is that evidence should be provided bearing on the qualifications of the source to have made the statement that was quoted.

B7. Controlled Subjective Evaluations - The claims in this category present the evaluations of judges with regard to the product being advertised. Evidence should be concerned with the capabilities of the subjects as well as with the method used in their selection.

B8. Opinion Survey - The evidence for claims made on the basis of surveys of consumer opinions should provide careful methodological substantiation including details of the sampling procedure, the interviewers who performed the study and the entire questionnaire employed.

B9. Reference to Consumer Testing Organization - In quoting the results produced by other organizations, the competence of these must be established and the complete context within which specific statements were made must be presented.

B10. Endorsement by Individuals or Groups - Persons (representing either themselves or larger organizations) who are paid to acclaim the virtue of a product must be able to substantiate their qualifications and their intentions for doing so.

B11. Market Surveys - Evidence presented in this form must show the relevance of the sample to the population at which the claim is directed and it must also contain an adequate description of the method used to produce the results quoted.

While each cell of the 11 x 14 matrix of evidence and claims is a theoretical possibility, it is obvious that certain of them do not have to be considered seriously. Statements about style and beauty, for example, would hardly require substantiating evidence in the form of engineering test data, and we would not expect unsolicited testimonials to be offered to support claims made for stopping distance achieved by a new braking system.

Each class of substantiating evidence may be ranked with respect to its relevance to a given claim. Four categories of relevance have been adopted to serve our needs, namely:

1. Necessary,
2. Desirable, but not sufficient,
3. Possible supporting weight,
4. Probably irrelevant.

Table II presents a substantiation/claims matrix with numbers, corresponding to the above tabulated relevance categories, used to indicate our opinion as to where substantiating evidence for each of the claims should lie. Note that category 4—probably irrelevant—has been omitted in the table for ease of reading. Once a claim has been categorized, Table II serves to tell the examiner what he should expect (and what he should not expect) in the way of substantiating evidence for a given claim.

A correlation of the kind of evidence required with the type of claim made, while a necessary start for the evaluation process, is not enough. Once the evaluator is satisfied that he has the right categories of information on which to base his conclusions, he then has the problem of dealing with the specific content of that information. Note that the substantiation data presented may fall into the realm of what those who are concerned with the legal aspects of advertising claims may label as "false or misleading." Although the final resolution of any assertion with regard to these matters must rest with the courts, it appears that the evaluator can be given some guidelines as to what to look for as he examines the content of substantiating evidence.

To aid in this process, we have developed another taxonomy, which we call a "Taxonomy of Deception." This phrase does not imply that the practice of deception is in any way intentional or even conscious on the part of the advertiser, rather it is

	1 Phys Mag (Abs)	2 Phys Mag (Rel)	3 Price (Abs)	4 Price (Rel)	5 Economy	6 Preformance	7 Style/Beauty	8 Safety (Direct)	9 Safety (Infer)	10 Comfort	11 Handling	12 Prestige	13 Warrenty	14 Notable Pers
1 Eng Test Data	2	2			1	1		1	1					
2 Design Specs	1	1	1					2	2				2	
3 Unsolic Test							2					2		2
4 Exp Comp (Obj)		2			3					1	1			
5 Exp Comp (Sub)		2								1	1		3	
6 Ref - Pub Press			3	3	3	3							2	
7 Subj Eval				2			1					1		
8 Opin Survey							2			2	2	2	2	
9 Ref - Test Org	3	3	3	2	2	2		2	2					
10 Endorsement					3		2							1
11 Mkt Survey			2	1			3						2	

TABLE II

RELEVANCE OF SUBSTANTIATING EVIDENCE TO CLAIMS

designed to make the evaluator aware of the criteria by which he should judge the evidence at hand. Table III presents the characteristics of substantiating evidence which might lead to a higher estimation of the claim's validity than may be justified by the data. A discussion of each of the items in the list follows.

TABLE III

TAXONOMY OF DECEPTION

1. False facts
2. Real but insignificant differences
3. Statistically significant but meaningless differences
4. False analogies or distinctions
5. Irrelevant analogies or distinctions
6. Association with inappropriate persons
7. Association with inappropriate products
8. Implied inference or causation which has not been tested
9. Inappropriate performance criteria

1. False Facts- "False" here applies not only to the quotation of non-existent numbers, but to the reliability with which they can be accepted, even if they are true in the usual sense of the word. The credibility of the source must be considered as well as the adherence to procedures and methodologies generally employed in the production of the facts presented. The falsity of facts is extremely difficult to prove, but the evaluator should keep in mind that numbers are not always to be taken at their face value.

2. Real But Insignificant Difference - Insignificant, here, is used in the statistical sense, in that we very well may have numbers which are different and show a comparative

advantage of one product over another. The difference may be attributable, however, to random variations in the measurement process rather than to anything inherent in the products.

3. Statistically Significant But Meaningless Differences - In this instance, the differences between products is real and stable. However, the impact on the consumer is so small as to make the claim meaningless in considering whether to select one product over another.

4. False Analogies or Distinctions - Relationships or comparisons may be made in a claim which convey impressions which have no basis in fact. The equivalence of "European" with a high degree of luxury and comfort, for example, may be true for some products, but not necessarily the one for which the claim is made.

5. Irrelevant Analogies or Comparisons - In this case, the analogy or comparison may be true in the situation in which it was first made, but may not apply to the claim at hand. Instances of this include the combining of characteristics about a product to give the impression that the whole is something more than the sum of its parts when, in fact, there is no evidence for that conclusion.

6. Association with Inappropriate Persons - The use of notable persons to endorse a product is an example of this item. Whereas the person may be eminently qualified in his own profession, the carryover of his expertise to the area of the product being advertised must be examined carefully, before accepting his statements about it.

7. Association with Inappropriate Products - The "halo" effect is often employed to make one product appear

to take on the known desirable characteristics of another. Care should be taken to segregate what is true from what is present only from the association.

8. Implied or Inferred Causation - Evaluation of substantiating evidence must be done with careful attention paid to the possibility of arguments of the non-sequitor variety. A statement or conclusion does not necessarily follow from a set of facts which have been presented, expecially when the two portions of the argument are about different aspects of the product.

9. Inappropriate Performance Criteria - In any experimental testing there can be generalizations made from the results of the tests to the performance of the product, and the evaluator should ascertain that the performance measurements taken will allow extrapolation to the actual situations in which the products are intended to be used.

The following sections of this report treat some example claims in the motor vehicle field. The intent is to edify the reader with respect to some of the subtleties that are involved in evaluating evidence which might be submitted in substantiation of claims made by automobile manufacturers. As mentioned previously, the claims are hypothetical but realistic and have been chosen to exemplify necessary and good practice for the field.

IV. EXAMPLE CLAIMS IN THE AUTOMOTIVE INDUSTRY

A. MOTOR VEHICLE RIDE CLAIMS AND SUBSTANTIATION

Let us consider "comfort" as an example quality or attribute that is often addressed in motor vehicle advertising claims. We wish to show, as a preliminary exercise, how advertising claims with respect to this attribute can have varying degrees of meaningfulness. Further, we wish to submit a variety of claim substantiations that, in our judgment, range from the "ridiculous to the sublime." In other words, we intend to present, by way of examples, material that can be considered as ranging from being non-substantive to substantive with respect to substantiating a "comfort" claim.

The attribute of "ride" comfort has been selected because it permits us to deal with a motor vehicle performance quality than can be assessed, in principle, by the application of available technology but which assessment, in practice, is handicapped by a lack of carefully defined assessment criteria. It should be clear that in those instances where measurements of performance have been identified and accepted through a voluntary standardization process it becomes reasonably straightforward to document a claim, particularly if this claim is couched in terms of accepted measures and criteria. In the case of ride comfort, we are dealing with a borderline topic. On the one hand, there is the ease of measuring and quantifying the amount of vibration to which passengers are subjected during transport operations. On the other hand, there is the difficulty of quantifying the comfort (or discomfort) sensations of the passengers who are subjected to a vibration environment. Whereas research has been conducted to relate various vibration variables and measures to human sensations and reactions, the available knowledge does not, by any means, provide reliable methods for converting physical vibration quantities into equivalent psychophysical quantities of comfort.

As discouraging as the above might seem, consider the attribute of motor vehicles called "handling." Not only is this attribute characterized by a lack of commonly accepted measures and criteria, its assessment is handicapped by the lack of a measurement technology producing numerics which engineers are universally ready to accept as meaningful. Consider also that "handling," by definition, involves the driver as an active element in a control process, whereas "ride," by definition, involves drivers and passengers as inactive or passive elements that are subjected to a vibration environment. Notwithstanding the lack of a "handling" definition and measurement science, there is a "handling" art, and "handling" claims are commonly made. At this point, however, we shall eschew this "can of worms" and shall treat "ride," a performance attribute which can be assessed directly by the humans involved and less directly by means of physical sensors producing signals that can be recorded, stored, and analyzed.

EXAMPLE RIDE CLAIMS. In making a ride claim, the advertiser, in theory, suggests that the vehicle has been designed and built so as to minimize the vibration environment within the passenger compartment. The ad will claim that the physical vibration levels are low, either on a relative or absolute scale, or that humans find the comfort level to be to their liking, again on a relative or absolute scale. In effect, the vehicle (its tires, suspension, and seating) is being judged on its effectiveness as a mechanical filter, where the excitation or disturbance derives from the profile of the road and the response consists of the motions of the vehicle occupant. With the vehicle viewed in this light, namely, as a filter, it is necessary that the effectiveness of this filter be viewed in light of the full range of disturbances to which a vehicle may be subjected and in light of the varying sensitivity of humans to the various forms and levels of vibrational energy to which he is exposed. Since the human occupant is, in effect, a dynamic system comparable to the motor vehicle,

his body constitutes a frequency-sensitive filter transforming the physical vibration environment into "ride" sensations. In summary, a ride claim that implies that a vehicle has been designed and built to create a comfortable environment within the passenger compartment should speak to the effectiveness of the vehicle as a "filter" over a realistic range of disturbances in the context of an appreciation of the complex relationahip between comfort (as a sensation) and the resulting motion of the passenger. Alternatively, the claim can speak to "comfort levels" attained over a broad spectrum of uneven road surfaces selected to challenge the filtering effectiveness of the vehicle's tires, suspension, and seating to an adequate degree, as subjectively assessed by a panel of evaluators.

The above remarks suggest that a meaningful ride or comfort claim would normally include specifics that the lay purchaser is not likely to understand. Consequently, the writer of advertising copy is highly motivated to simplify the claim by omitting the qualifiers that make clear either the limitations or the generality of the claim. This requirement to use the language of the lay listener generally degrades the meaningfulness of the claim from the point of view of the knowledgeable critic. From the point of view of the lay consumer, the claim may, indeed, seem meaningful.

Therein lies the paradox—should one assess the substance of a claim and its substantiation from the point of view of the knowledgeable technician or should one make such an assessment recognizing that there are limits to the information that can be appreciated by the general public? In the examples to follow, greater demands are placed on substantiation than on the claim itself, since substantiations are addressed to parties that are able to bring the appropriate expertise to bear.

Consider the nine claims in Table IV. All use the term "ride" in a manner which the lay consumer would interpret as

comfort or as meaning isolation from road disturbances. However, none of these statements are worded in a manner permitting a discriminating reader to discern what is actually meant by "ride." Irrespective of whether the lay consumer is inclined to (1) believe that the advertiser knows whereof he speaks or (2) treat such claims with a grain of salt, the fact remains that these claims are broad in scope and substantive in their implications. It must be emphasized that their substantive character derives from what is implied by the claim rather than from what is actually stated. Depending on one's point of view, these claims are either positive and substantial or they are a collection of words devoid of precise meaning.

TABLE IV

Our car was judged by a panel of experts to have a better ride than a luxury car costing $300.0 more.

Our car's ride is better than that of two of Europe's most luxurious automobiles.

The ride in our car is unsurpassed, even by those in cars costing twice as much.

For quality of ride, our car can't be beaten.

Our car provides a luxury ride at an economy price.

Regardless of price, the ride quality of our car cannot be bettered.

Actual road tests prove beyond doubt that the ride in our car matches or exceeds that of the world's most expensive cars.

Test drivers agree—our car's ride is the best they've ever experienced.

Car A is smoother riding than all other cars in its price range.

In Table V, five ride claims are cited using phrases that are more specific than "ride" but are nevertheless couched in words which the lay consumer would understand. In four of the five, mention is made of tests that have presumably led to the making of the claim.

TABLE V

Tests show that Car A provides a more comfortable environment when traversing all kinds of rough road surfaces.

Our tests show that Car A, when driven over a large variety of rough roads, exhibits less vibration than all other cars in its size and price bracket. Furthermore, ride juries judge Car A to provide more comfort, on the average, than competing cars when these cars are operated at highway speeds with light and heavy loads on roads ranging from smooth to very rough.

No other car gives a ride as smooth and as comfortable as the Phoenix, irrespective of load, speed, and character of the road surface.

We have made measurements which show that the front and rear suspension of the Phoenix isolate passengers from road shock and vibration 25% more effectively than the suspension of the highly-touted Magnum.

Everybody knows that big cars ride better than small cars. What they probably do not realize is that our intermediate car, the Phoenix, rides better than so-called full-size luxury cars as indicated by acceleration measurements, both at the front and rear seat locations, and backed up by the judgment of ride panels.

Consequently, it is reasonable to expect that if the tests had been (1) actually made, (2) made correctly, and (3) relevant, it would be most straightforward to provide substantiating data if such were requested. The adequacy of data or calculations

submitted to substantiate these claims would depend on the breadth of the claim and the employment of procedures recognizing that "ride" is a dynamic phenomenon whose quality depends on a multitude of factors such as the speed of the car and the amplitude and frequency of the irregular road profile.

Probably the best guideline for making meaningful claims, which avoid terms and concepts that are familiar only to a technical audience, is to indicate that testing or analyses have produced numbers serving as a basis for a claim couched in either relative or absolute terms. Such a guideline would automatically discipline an ad writer from developing claims that have no basis in fact. If the manufacturer's tests showed, in fact, that its vehicle did not possess superior ride qualities relative to its competition in the market place, advertising copy would have to be generated that avoided comparing Vehicle A with its competition.

EXAMPLE SUBSTANTIATION OF RIDE CLAIMS. Consider the second claim in Table IV—"Our car's ride is better than that of two of Europe's most luxurious automobiles." Although much could be made of the speciousness of this claim in that it appeals to the notion that European manufacturers are generally without peers in the design and construction of high quality vehicles, we shall stick to the technical issues that are involved. The claim as it stands cannot be evaluated on technical grounds unless "our car" is identified.

For example, if "our car" is a typical full-size American passenger car, then the claim could constitute a comparison of "apples" and "oranges". Even the most luxurious European automobiles are significantly smaller (both weight and size) than the full-size American car. Consequently, a comparison between the two does not evidence a superiority of design and engineering in the American vehicle, but rather takes advantage of the ride benefits deriving from size. The laws of physics that are at

work to give the larger vehicle a more comfortable ride than is exhibited by the smaller vehicle when both traverse the same irregular road are exemplified, in the extreme, by the "ride" motions that are produced when crossing the ocean in a canoe or in the Queen Mary. Thus, our example claim may be quite true, yet constitute braggadocio that would not be detected unless the listener is technically informed. However, it is this kind of claim that advertisign skill must generate if it is not possible to boast about "our car's" ride performance when comparing it with its competition in its size and weight class.

The above remarks notwithstanding, substantiation of this claim should proceed along lines that recognize the sensitivity of the vehicle's ride response to the amplitude and frequency of the road disturbance. For example, whereas "our car" may exhibit a ride reflecting a high degree of vibration isolation when operated over roads of limited roughness, in comparison with the two European cars, it may prove inferior when traversing chuckholes and the like. Such a reversal in performance could derive from the fact that motor vehicles are very nonlinear in their ability to provide isolation (i.e., mechanical filtering) of road disturbances. If the European cars were designed, for example, with suspensions that could travel through larger excursions before encountering the so-called "bump stop", tests could show that their ride was inferior to "our car" on roads with roughness level "A", whereas on roads with roughness level "B" (i.e., a higher level of roughness) the European cars prove to be superior in their isolation qualities.

Thus irrespective of whether ride comparisons are made on the basis of subjective evaluation or on the basis of objective measurements, it is desirable that the testing procedure be such that the nonlinear, or discontinuous, characteristics of motor vehicle suspensions be adequately challenged. This requirement means that it is not adequate to conduct a ride test over any

stretch of road at one specific speed but rather that test stretches of road be selected and identified as to the challenge that they present to the tire-suspension-body mounts-seating system serving as a mechanical filter to isolate the occupant from the road disturbance. It is necessary to recognize that the vehicle filter is characterized by numerous resonances, each deriving from the natural frequencies of oscillation of the large number of oscillatory degrees of freedom present in the total system. These resonances are challenged to different degrees by different kinds of roads. Consequently, a substantiation of a ride claim should speak to the varying kinds of roads that were employed in the tests and should quantify the profile of these roads in a suitable manner (e.g., by means of the spectral density of the road profile).

As discussed earlier, data in support of a ride claim should consist of objective measurements or of subjective opinion, gathered, of course, in a manner such as to make these subjective evaluations as objective as possible. The ultimate substantiation would include both types of data.

The physics of the ride phenomenon suggest that objective ride data be gathered in the following manner:

(1) Install appropriate accelerometers in the head and torso of anthropomorphic dummies to measure accelerations in the three principal directions.

(2) Place these instrumented dummies in the front and rear seats of the test vehicle.

(3) Gather recordings of the acceleration experienced by these dummies in constant speed runs made over a range of speeds over each of the roads selected on the basis of their challenge to the various resonances in the system and to the travel limits of the suspensions involved.

(4) Compare the acceleration measurements obtained in the vehicles under test, where consideration is given to the available information of psychophysical scales permitting the transformation of acceleration data, in a frequency-amplitude (or power) format, into an equivalent comfort scale.

It should be clear that the use of acceleration measurements implies that it is this physical variable which the human occupant senses, creating his "ride" sensations. To the degree that there may be some reluctance to accept this hypothesis as being proved, a viable alternative is to collect subjective opinion following, of course, procedures that serve to maximize the reliability of the data. Two provisos are deemed to be of primary importance. First, there should be sufficient subjects to give the findings adequate statistical significance and, second, the subjective evaluations should be gathered in the form of paired comparisons. In other words, procedures should not be used that ask a subject to select the better riding car from a variety of test experiences. The subject should be exposed to an identical test experience (namely, one speed and one road) in each of two vehicles and asked to identify the car providing the greatest degree of comfort for a specific test situation. Data gathered in this manner are viewed as being viable and relevant to the substantiation of a ride claim. Execution of tests involving paired subjective comparisons and measured accelerations that are mutually supportive of each other can be viewed as the ultimate in substantiating a ride claim.

B. MOTOR VEHICLE HANDLING CLAIMS AND SUBSTANTIATION

Any advertising claim which attributes superior handling quality to a particular vehicle is essentially addressing the matter of controllability by the driver through his steering and braking inputs. To a lesser degree, accelerator control

can also influence turning or cornering performance, but generally only in a degrading fashion, such that vehicle controllability in response to accelerator inputs is never a component of handling quality claims. In addition to steering and braking control quality, handling claims also address vehicle controllability when it is challenged by external disturbances from winds and road irregularities. Claims for handling qualities are often intended to imply a carry-over to the safety characteristics of the vehicle.

A vehicle can be said to possess good handling qualities if the desired path can be easily attained, at the hands of the heterogeneous driving population, for all reasonably expectable driving conditions.

Most advertising claims on this subject address the matter of the subjective judgment which a driver makes concerning the "ease" of vehicle control. These judgments are based on the driver's sensations of vehicle motion. The influence of vehicle dynamic properties on the ease of handling is generally unknown within the current state of the art, and although the industry does see fit, on occasion, to make objective measurements of these properties, it typically uses an expert driver's judgment as the principal determinant of handling quality. The emphasis placed on subjective evaluation in the vehicle development process precludes the making of claims which assert objectively measurable properties. We do not know, at this point in time, how most vehicle response properties are related to ease of control.

In keeping with the industry's vehicle development philosophy, claims constitute a meaningful declaration of handling quality if they are based upon a structured test wherein subjects are permitted to evaluate a vehicle's ease of control over some prescribed course or in the presence of winds or road irregularities. To repeat, the method by which handling quality is currently characterized is based on subjective judgment because of constraints

in technology which render objective vehicle property measurements useless for this purpose.

Certain claims which skirt a simple subjective judgment often involve qualitative statements regarding selected properties assumed to play a role in ease of control. Such references as "quick steering," "precise steering," "smooth braking," "good roadholding," and the like, in a claim suggest or imply:

1) that a measurable quantity for the performance function exists, and

2) that there is a demonstrable relationship between the properties mentioned and overall control.

Claims of specific handling properties lead the reader to assume that (1) some objective definition for the stated property had been adopted, (2) an objective measurement scheme had been formulated, and (3) this scheme had been applied to provide data. What will not be clear to the lay reader, but would be apparent to the technical specialist, is that specific engineering innovations may have been promoted as if objective criteria were available, while in reality the adoption of a trivial definition for the selected property accounts for the specificity of these claims.

The three-point objective measurement method discussed above, by which the comparative value of the defined property is established and tested, may be applied to subjective tests as well, thereby assuring that:

a) the defined property exists,

b) it is measurable,

c) the claimed comparative superiority in the value of that property has been tested, and

d) the selected definition indeed specifies a property which is meaningful to ease of control.

Three basic categories of handling performance can be identified within which one might choose to make a claim of a specific handling performance feature, namely:

1) steering control quality,

2) braking control quality,

3) insensitivity of control to external disturbances.

In discussing each of these areas in turn, we will identify the maneuvering conditions in which the relevant qualities are brought to bear, the design properties which influence the character of a vehicle's performance, and the relationship by which such properties might be expected to influence ease of control, and therefore the safe operation of the vehicle.

STEERING CONTROL QUALITY. The response of pneumatic-tired vehicles to steering control actions plays a great role in the task of pathkeeping or tracking. At highway speeds the driver continually corrects the steering wheel position, causing small changes in front-wheel angle, giving rise to corrective forces between the tire and the road.

The steering-system design is of importance because it determines the level of steering torque needed to achieve the desired steering wheel rotation. Steering systems with large amounts of internal friction tend to confound lane tracking because effort must be expended to overcome "drag" torques as well as to steer the front wheels. In addition to the physical effort required, the stiffness of the steering linkage and its degree of lash can influence driver sensations of steering quality. Claims are often made which note the use of "rack and pinion" steering as a handling improvement. If driver judgments actually confirm such claims, it is due to the increased system stiffness and the reduced amount of lash which can accrue from such designs.

The tire also plays an important role in determining the

lane tracking control quality of a motor vehicle. In response to steering actions, forces and moments are developed between the tire and the road which, for low level "non-emergency" maneuvering, are a function of the transverse stiffness of the carcass and tread. Frequently, claims are made that imply that radial ply tires significantly improve the steering-related qualities of the automobile. However, the cornering and roadholding properties of the motor vehicle are influenced by a host of tire construction features to a degree that it is misleading to imply that radial ply tires are better than other kinds of tires.

Suspension system properties and the weight distribution between the forward and rearward axles are additional design factors significantly influencing steering control during lane-tracking operations. Consequently, the assurance of steering control quality in lane tracking maneuvers requires that the total vehicle and its tires be designed as a tire-vehicle system. It is not adequate to state that radial tires or rack and pinion steering or torsion bar suspension make Car A a superior handling vehicle. Car A could be dangerously unsafe and virtually uncontrollable despite some one outstanding feature, if all the other characteristics did not combine appropriately to produce a vehicle system of high control quality.

Tests of the total vehicle-tire system are necessary, then, to substantiate any claim of steering control quality, since the total vehicle exhibits steering response characteristics that derive from a combination of many design properties. Ideally, such tests should be objective tests. However, the current state of the art in measuring steering control quality dictates, in all probability, that tests of a more subjective nature be conducted.

One approach to an objective test serving to substantiate a claim in the area of steering control might be the following procedure. A number of expert drivers guide each of two vehicles whose steering control quality is to be compared through a course

requiring severe and difficult steering maneuvers. The vehicles are kept at the same constant speed by means of mechanical governors as they are driven through the test course, and the drivers are instructed to keep the vehicles as close as possible to a clearly defined path. The experimental design may be complicated by using a number of speed levels and by employing varying levels of difficulty in different sections of the test track. Electronic instrumentation continually records the distance from the mid-line of the vehicle to the center of the path and the measure used for comparison purposes is the cumulative mean squared deviation resulting from each subsection of the test. "Better" steering quality would be defined as a statistically significant difference in the proper direction between the deviation scores produced by the two vehicles.

To substantiate a claim which stated, for example, "rack and pinion steering makes our car handle far better," a test of a more subjective nature might be employed. Two vehicles are built, aloke in every respect except that one has been equipped with the rack and pinion steering touted in the advertisement and the other has a conventional steering mechanism. Both mechanisms are in perfect mechanical condition. A sample of drivers is selected to represent the range of driving skills presumed to exist in the general population and the subjects are asked to drive the two cars successively through a specified course in the manner and at the speed at which they would normally drive. The order in which the vehicles are assigned to a single subject is counterbalanced to eliminate learning effects, and the drivers are ignorant of the fact that a difference exists between the two automobiles, except for some obvious means of identification such as their color. Following the tests, each subject is questioned about his opinion as to many characteristics of the the two vehicles. Critical questions having to do with steering quality would include such things as "Did one of the cars seem to be safer to handle?",

"Which car seemed easier to steer?", and the like. Control data on irrelevant criteria are gathered to insure that other differences between the vehicles were not introduced inadvertently. A statistically significant difference in the proportion of subjects preferring one car over the other would be evidence for a claim of superiority.

BRAKING CONTROL QUALITY. Performance qualities generally included under the heading of "braking performance" include smoothness of deceleration as brake pedal effort is increased, resistance to changes in braking effectiveness due to climatic or operational conditions, including thermal fade, and the ability to achieve large amounts of braking without loss of directional control. Like steering control, an adequate assessment of braking quality requires a total system measurement.

Design factors playing an important role in braking are the brake elements, the tires, and the distribution of mass in the vehicle. In addition, braking performance can be markedly altered by use of special valves in the brake line to distribute braking force among the four wheels in an optimum manner. Recently, automatic wheel anti-lock systems have been designed which transcend a driver's ability to achieve maximum emergency stopping performance. The effectiveness of these systems is objectively measurable and their impact on safety performance is demonstrable. Since the purpose of antilock systems is to override the driver's role as a modulator of brake effort, a subjective evaluation of the resulting stopping performance would be meaningless. Instead, the substantiation of a claim with respect to the peak braking capability of a given motor vehicle should include a vehicle test, comparable to that specified in FMVSS 122, establishing in terminology standard throughout the industry the performance parameters of the vehicle/braking system in question.

The overall "smoothness" or effectiveness of a brake system

derives from the sum total of the system properties that determine the forces required at the brake pedal to stop the vehicle. Certain advertisements have suggested, for example, that disc brakes have more uniform braking characteristics than drum brakes. Such a claim, citing the presence of disc brakes and further suggesting that smooth braking results, could be substantiated in the same manner as that outlined in the previous section on steering quality. A standard stopping test could be devised and drivers run through it using cars identical in every respect except for the braking systems. In this instance, however, corroborating evidence would be collected in the form of deceleration curves and stopping distances that are achieved by the systems under consideration.

Claims made with respect to the thermal sensitivity or fade performance of a particular brake system can be substantiated using the test procedures defined in SAE J843, Fade and Recovery Test, or by chassis and brake dynamometer measurements. Note that this aspect of performance is objectively definable and measurable. Although highly skilled and experienced drivers can presumably detect the characteristic in question, subjective evaluations are deemed to be inappropriate as substantiating evidence.

INSENSITIVITY OF CONTROL TO EXTERNAL DISTURBANCES. The principal external disturbance to which advertising claims are often directed is road roughness. Undulations in road profile can have a degrading influence on the ability of a driver to exercise control over a vehicle either in steering or braking maneuvers due to the resulting variations in the normal force between the tire and road. When a loaded tire runs over a single bump, for example, the instantaneous force at tire-road contact point initially increases, and then, as the wheel moves upward, the tire-road contact force decreases and oscillations in this normal force ensue, diminishing with time. These fluctuations in normal force result in a net loss in the braking and cornering

force that can be exerted by the tire. Consequently, it is desirable that suspension systems be designed so that these oscillations diminish quickly. However, improvements in the "roadholding" capability of a vehicle can degrade the "ride" quality requiring that a compromise be struck.

Independent suspensions render advantages to roadholding performance in general, and the roadholding-conscious European designers have favored the use of such designs. As is the case in other areas of performance, citing the use of four-wheel independent suspension does not adequately substantiate a claim of improved roadholding. Rather total systems tests that include the role played by tires, steering system, and suspension are in order. Further, since roadholding characteristics affect steering and braking control quality, roadholding claims, at minimum, should be substantiated through subjective comparisons obtained on a suitable rough road course that requires simultaneous steering and braking inputs from the driver. In these subjective evaluations, care must be taken to eliminate any influence of vehicle ride quality on the information sought with respect to handling characteristics. Vehicles that differ only in their suspension systems could be subjectively evaluated over a standard course possessing varying degrees of roughness, and the data collectec could be used as substantiating evidence, together with objective data that show the actual change in vertical load experienced by the tires when the vehicle is operated over a given test course.

C. MOTOR VEHICLE PERFORMANCE CLAIMS AND THEIR SUBSTANTIATION

The term performance, when applied to the automobile, includes virtually all things which the vehicle does. We will, however, limit our discussion here to such properties as acceleration performance, top speed, stopping distance, and the like.

Over time, the automotive community has developed a number of simple and effective measures to describe acceleration and braking performance. On occasion, advertising copy will employ these quantitative, numerical descriptions of vehicle performance, and to the extent that these measures are employed correctly, the task of claim substantiation is greatly simplified. However, qualitative descriptors also receive a great deal of use, especially in those areas where carefully defined, numerical descriptors are lacking and evaluation of evidence offered in these cases causes greater difficulty.

Performance claims, either with respect to braking or engine performance, are intended to convince the prospective buyer that the automobile under discussion is a better performer than its competition. Claims are made that the vehicle can accomplish a given acceleration task, either in specific or general terms, with some given level of quality, either absolute or relative. To evaluate such a claim, it must be understood that no vehicle performs exactly according to its own specifications, but exhibits some degree of variability about a mean or a threshold of any measure. When undertaking any performance test, a vehicle is subject to a wide variety of influential factors, some of which derive from the properties of the vehicle itself, other, from properties of the environment or from its usage history (e.g., preparation or recent activity), while still others are related to the driver's skill. "Vehicle" performance, as considered by the lay community, is actually vehicle-driver-environment system performance—a very complex phenomenon. Consequently, to insure that any statement made with respect to a specific performance measure constitutes a meaningful reflection of the performance of a vehicle, adequate consideration must be given to the conditions under which the tests were conducted.

Acceleration claims, to a large extent, deal with relatively basic physical measures with which the lay consumer is generally

familiar. "...Zero to sixty miles per hour in eight seconds," or "...stops from sixty miles per hour in three hundred feet" are phrases of relative technical precision, readily understood by non-technical people. Some advertisements, however, depart from this practice with statements such as "...fast acceleration" and "...quick stops" characterizing many performance claims. The use of such qualitative terms not only cloud the meaning of the claim but cannot be defended on the grounds of greater consumer understanding or appreciation.

On the other hand, there exist areas where a meaningful, technical definition of a performance claim is difficult. For instance, braking is not only characterized by the length or quickness of the stop, but also by the controllability and stability of directional behavior evidenced during the braking maneuver. Ideally, a vehicle should remain controllable by normal steering wheel inputs during braking. Furthermore, it should remain stable, i.e., it should tend to travel in a straight direction as opposed to spinning. Controllability and stability are relatively complex phenomenon and do not yield to simple, straightforward measurement techniques, much less to quantitative language that is readily understood by the consumer. Consequently, terms such as "safe, straight stops", or "stops without swerving", appear regularly in advertising copy, presumably because more technically descriptive data would be confusing or cannot be obtained.

Although they may not be simple, effective or universally accepted, measurement techniques generally have been developed for every acceleration characteristic worth advertising. In substantiating a claim, tests, from which the stated qualitative or quantitative measures derive, should be explicitly described so that a technical evaluation of these claims is possible.

In an attempt to illustrate the concepts we have covered, a variety of example claims are presented and compared in Table VI. Claims in the table appear in pairs. The first claim in each

pair is considered a vague description of the phenomenon in question, aimed at a consumer audience. The second statement in each pair is intended to be an expanded version of the claim, pinpointing in greater detail the engineering basis for the evaluation.

TABLE VI

The A-Car accelerates from 0 to 50 miles per hour in 8 seconds.

> Regardless of power train options, the A-Car can accelerate from 0 to 50 miles per hour in 8 seconds with only a driver aboard.

The braking system on the new B-Car provides quick, safe, straight line stops.

> With its new braking system, professional test drivers can consistently stop the B-Car from 60 mph in 5 seconds on our dry test track. During these stops, they can maintain the car in a straight, 12-foot wide lane.

The new C-Car stops faster than previous C-Cars.

> In every one of the many different stopping tests we perform on our cars, the new C-Car stops faster than previous C-Cars.

The D-Cars' braking systems are failsafe.

> The D-Car's braking system is designed so that, if the front brakes fail, the rear brakes are unaffected, and vice versa.

The D-Car brake system provides quick, safe stops in either dry or rainy weather.

> Theoretically, the length of a perfect stop depends on road friction. On typical roads, wet and dry, the D-Car can perform at 75% efficiency when compared to such theoretically perfect stops. It can do this without skidding any wheels, thus avoiding loss of control.

The A-Car, with its new V-8, provides better highway performance than other models.

> In tests for high speed acceleration, the kind you need to step out and pass at highway speeds, A-Cars equipped with the new V-8, perform better than identical cars equipped with other available engines.

In reviewing the evidence offered in support of any acceleration claim, we would suggest these basic guidelines:

1. Evidence from testing procedures should be based on fact as established by sound engineering practice and analyses.

2. The terms used in substantiating evidence should be well defined, using language whose meaning is clear and unambiguous.

3. When appropriate, the evidence presented should favor quantitative statements over qualitative statements.

4. Supporting data from testing procedures should be qualified to the extent that its realm of applicability is clear.

5. The substantiating evidence should make clear to what extent the performance capability claimed is truly a function of the vehicle rather than of other influencing factors.

ACCELERATION CLAIM SUBSTANTIATION. An acceleration claim must first be interpreted before we can define exactly what data are required for substantiation. If the claim has been made in general and vague terms, it must be reduced to engineering terms that are specific enough so that it can be tested against the data. This interpretation, as mentioned in the first section of this report, will be a matter of judgment.

For example, consider this claim from Table VI:

> The braking system of the new B-Car provides quick, safe, straight-line stops.

The substantiation of this claim must contain a good deal more than just data. Before any data can be considered useful, answers must be provided to questions such as: "What numerical value

constitutes the threshold of 'quick' and why?" "Is 'quick' the same regardless of the road surface on which the car is operated?" "Are these stops 'safe' on all road surfaces, for instance, on glare ice?" Consequently, substantiation for such a claim should first of all contain a well-structured, rational presentation aimed at answering such questions. The arguments presented may gain support from references to the technical literature which provide standards for both terminology and testing procedures used to collect the data. Evaluation of such arguments must fall ultimately to the judgment of the reviewing body.

An acceptable presentation of a properly interpreted claim, should make the basic nature of the required substantiating data readily apparent. Stopping distance claims, for example, require stopping distance measures. The question remains as to whether the data presented are adequate and/or valid.

Acceptable procedures or techniques for the conduct of tests on automotive performance are described in the technical literature. If data offered as substantiating evidence are derived from tests which differ from "standard" or "recommended" practice, an evaluation will have to be made to establish the acceptability of the methods actually used.

We have already noted that performance measurements are always subject to small, virtually undefinable, changes in either the vehicle, its environment, or its control inputs. For instance, in braking tests, even when great care is taken to insure that the road and tire condition, brake temperatures, initial speed, brake pedal inputs, and other factors are exactly the same from test to test, the measured stopping distance will still vary. The level of this variation reflects the repeatability or the reliability of the test technique, and sufficient data should be gathered to indicate their degree of variability. Data obtained in <u>one</u> test of <u>one</u> vehicle should not be automatically assumed to be representative of a given vehicle model line.

Our discussion so far has assumed that substantiating evidence would be in the form of test data. Analytical work may also be presented as substantiation, and evidence of this kind should be evaluated in the light of firmly established, accepted methods used in automotive engineering. For example, engineering analyses resulting in mathematical formuli can be employed using numerical parameters for an individual vehicle to draw inferences about the performance of that vehicle. The analysis should be evaluated on the validity of the analytical formulation as well as on the meaningfulness and precision of the conclusions drawn. Adequate substantiation must insure that all assumptions be accurately stated and evidence of their validity for the particular case at hand must be presented.

D. ECONOMY OF OPERATION CLAIMS

The prospective automobile buyer has several reasons for selecting and purchasing a particular vehicle, among them prestige, status, reliability, styling, performance, size and economy of operation. There are apparent tradeoffs among these reasons in that a buyer seeking status would more than likely be willing to sacrifice economy and vice versa. It is likely, however, that both the status seeker and the buyer interested in minimizing costs would be concerned about reliability—if only for reasons of convenience.

In appealing to those buyers interested in economy of operation, advertisers frequently refer to those segments of vehicle operating cost most immediately felt in the owner's pocketbook, even though these may not be the major costs associated with vehicle ownership.

Economy of vehicle operation can be thought of as the minimization of the total costs accruing to the car owner as the result of purchase, operation, insurance, maintenance, repair, and depreciation of his automobile. A recent study has shown

that a $3400 car driven 100,000 miles over a ten-year life span produces the following breakdown of cost per mile:

Operating Cost Item	Cost/Mile
Original Vehicle Cost Depreciation	3.4¢
Maintenance, Accessories, Parts & Tires	2.1¢
Garaging, Parking & Tolls	1.8¢
Gas & Oil (Excluding Taxes)	1.7¢
Insurance	1.4¢
State & Federal Taxes	1.2¢
TOTAL	11.6¢

Clearly, the major cost of automobile ownership results from depreciation. Although gas and oil costs are fourth on the list, thay are frequently the primary subject of automobile economy advertising claims. Maintenance, ease of repair, etc., are less frequently mentioned, possibly because they pose a conflict to the automobile company since repairs mean additional profits to automobile dealerships. (The major way in which advertisements refer to depreciation costs is by reference to resale value. Resale value, while apparently an objective measure, has historically been manipulated by automobile dealers and can be influenced substantially by car condition, extras, and block sales by large fleet owners.) Advertising claims in the areas of depreciation, maintenance, repair and fuel costs represent separate subjects for discussion and are treated separately below.

DEPRECIATION - RESALE VALUE. Among the many attitudes that vehicle manufacturers have tried to instill in the mind of the consumer is the idea that a car is an investment rather than a consumable purchase. This attitude stresses the fact that some of the money paid for a car will be returned to the buyer at a later time when he sells it or trades it in on a new model. This resale or trade-in value, then, forms an important part of a purchasing decision, since the true cost of the automobile must take into account what the consumer will be left with some time in the future.

Thus, in making a claim about the resale price or value of a given product, advertisers are appealing to the desire of the consumer to make a good investment. They wish to convey the feeling that somehow the money put into their automobile is safer or more liquid than it would be if the consumer were to purchase a different manufacturer's product. Examples of claims which might be made with regard to price or value at the time of trade-in or resale are given in Table VII. None of these claims are particularly hard to interpret. The implication in all of them is that the value (in terms of money which can be retrieved) of the advertised automobile lasts longer than it does for its competitor's products. We shall proceed directly, then, to a discussion of the problems surrounding the material which might be supplied as evidence in substantiation of any claims similar to the ones shown here.

TABLE VII

Leaders in their field in resale value.

Highest resale value of any compact.

Built-in value, that remains until you sell.

A survey confirms, our car has the highest trade-in value of any other car in the field.

Dealers agree, our car is worth more as a trade-in than any of the other medium-sized models.

Our car has over 75 advantages to keep it from getting old before its time.

We must ask first about the resale price itself, that is, the actual numbers of dollars the owner of the vehicle receives if he sells it outright either through the used car market or in a private sale. A survey might be made of the classified advertising section of a sample of newspapers throughout the country to compare equivalent age automobiles of different manufacture. The asking price is obviously not any indication of the true market value, and it would probably be necessary to contact the seller to get at the actual transfer price. This might lead to an upward bias in that the seller of a car is not likely to admit that be received less for it than he thought it was worth, and it might be advisable to use equal numbers of both buyers and sellers in the sample under the assumption that the conflicting biases would cancel one another.

One of the largest sources of information about the resale prices of used cars is, of course, the used-car dealer. These businesses acquire cars from both individuals and new-car dealers who have taken them in trade. This marketplace is totally responsive to the supply and demand expressed by car buyers and sellers and as a whole can be considered as representing a true picture of value within which to compare the relative merits of various brands. The so-called "Blue Book" represents the consensus of this market for different geographical areas, listing the "average" wholesale and retail prices for most makes and models of cars, that is, what sellers can expect to receive and what buyers will expect to pay for a typical car in any particular category. This publication can be used as a guide but would be, in and of itself, far from adequate as the totality of substantiating evidence for a claim about resale value.

The word "average" as applied to the price has problems associated with it because of the numerous interpretations that are possible. It could mean the average price of the particular cars in a certain model line or it could mean the price of a

vehicle considered to be in average condition. In practice, these amount to the same thing, implying that for a particular make and model of the same year (and presumably of approximately the same mileage) there will be a distribution of prices for individual items. Care must be taken in evaluating the evidence for substantiation to ensure that reasonable interpretations have been assigned to statistical terms, such as average.

An important facet about any data used to support a claim about resale price is the stability of the numbers presented, and any discussion should address the matter of variability. The range, the lowest and highest values evidenced in the data, is probably the most readily understandable measure to a non-technical audience, but substantiating evidence should include a more adequate description of the distribution under discussion, enough, for example, to allow the application of tests for the significance of any differences mentioned. The used car market, then, is an excellent information source for the kind of data needed to provide adequate substantiation of claims regarding resale prices of automobiles if careful attention is paid to the form in which the data are presented.

With respect to the alternative form of claiming a car to be a good investment, i.e., trade-in value, it is not an easy task to ferret out the true measures involved. We must look, of course, to new-car dealers for this information. A transaction involving the purchase of a new car with the buyer's old car forming a portion of the payment is subject to financial manipulation which may serve to obscure the true value of both vehicles. An inflated trade-in value may be allowed for the used car only to be made up in the charging of the full retail price for the new vehicle, or conversely, the new car may be offered at a very low price because of a limited allowance made for the trade-in. To the dealer what matters is the net amount he receives from the entire transaction, and the way in which his profit is realized

is of secondary importance. However, with respect to establishing evidence of high trade-in values for used cars, we must ensure that realistic estimates of trade-in values are obtained from new car dealers. One way to accomplish this would be to assign a "real" sales price to the new car as the cost to the dealer plus a certain percentage of that cost as profit, and calculate the trade-in value from this figure rather than from the stated sales price.

The use of surveys to gather evidence supporting claims about resale or trade-in prices requires strict adherence to good methodological practice. Unless otherwise stated, a statement about value is interpreted to include all cars, at all geographical locations, and survey sampling procedures must be such as to justify generalization to the entire population. Where a stratified sampling technique forms a part of the substantiating evidence, assurances will be sought that the strata were established so that the sample reflects the proportion in the general population of the items of interest. The most important requirement from the point of view of evaluation is that whatever the procedure for selecting the sample, it be fully disclosed so that its adequacy may be ascertained. The entire market survey procedure, in fact, must be made available to the evaluators of the substantiating material, since the effectiveness of the procedure as a whole depends heavily on the contribution of each element in the process.

Mention must be made also of the use of the term value when used to substantiate advertising claims. The absolute dollar amount recovered by the trade-in or sale of a used automobile is meaningless when compared to the same figure of a different car unless the initial costs of the two vehicles were the same. The high resale value derived from a European luxury car, for example, should not be used as a comparison with the price obtained for an American compact. It is the relative figures which must be compared, the proper numbers being the actual depreciation of

the vehicle in dollars or the resale price as a percentage of the original cost. For this reason, it is essential that accurate descriptions of both figures be made available.

Throughout this discussion we have been dealing with the consideration of comparisons between two or more items within the context of a fluctuating market. An overriding methodological requirement in the evaluation of any data should be the application of statistical significance tests. To have substantiated a claim, the evidence must show that a difference exists over and above the random variations which can be attributed to the market by itself. A firm basis for the evaluation can be derived only from an understanding of both the sampling procedures used to obtain the data and the statistical properties of the data themselves.

MAINTENANCE AND REPAIR. Typical claims related to maintenance and repair might take the following form:

Maintenance

1. The Bullet has a sealed lubrication system, so you don't spend a cent on chassis lubes.
2. The Bullet is low on service costs.
3. The Bullet needs half the oil changes of any other compact and 1/6 of the lube jobs.
4. You get an air filter on the Bullet that lasts more than twice as long as the old kind.

Repair

1. I bought a Bullet because I read that it has the best repair record of any compact.
2. The Bullet has a five-year/50,000 mile guarantee on the drive train that removes the worry from your driving.

Of the four claims cited for maintenance attributes, three indicate specific ways in which improved equipment purportedly lowers maintenance costs. The other is a rather general statement which hinges upon the meaning which is attached to the word "low."

Evidence submitted to substantiate any of the claims for improved maintainability characteristics would most likely fall into two categories: (1) a survey of dealer and/or owner repair records, and (2) data from tests performed on the components in question, either in the laboratory or in actual on-the-road service.

In examining a substantiation using maintenance records, the evaluator should be concerned that the sampling is adequate to warrant a generalization to the entire population, where such is implied. When a comparison has been made to older models produced by the same manufacturer to identify improvements brought about by some change, data must be available on both populations of cars. The interpretation of a specific claim may often be unambiguous enough to allow a yes or no decision as to the adequacy of the substantiating data, but inconsistency in some of the data gathered may require the application of statistical tests. The evidence presented should be amenable to the required inferential procedures.

Evidence from laboratory tests can be considered as adequate proof of a claim's validity only if it can be shown that the laboratory environment approximates as closely as possible the conditions which the product will encounter in actual use. Likewise, on-the-road service testing is required to take into account the varying geographic and climatic conditions which the advertised product will be exposed to in its normal life. Should the phrase "in normal use" be included in any claim, supporting evidence must state in objectively measurable terms what is included in the "normal" range of operating environments.

FUEL COSTS. Unlike the other cost factors, fuel costs (i.e., fuel consumption) can be objectively determined by scientific

testing. Unfortunately, standard test procedures do not exist for such tests in the United States. Consequently, fuel consumption values that are quoted in ads represent all manner of test conditions and are virtually meaningless on an absolute scale. Test procedures are so loose, in fact, that two cars evaluated by the same test procedure by two different organizations would almost always produce widely differing results.

Typical claims are listed as follows:

1. Many Bullet owners get over 20 miles per gallon of gasoline.
2. You can expect to get 30 miles per gallon from your Bullet.
3. In our highway tests, the Bullet has been getting in the neighborhood of 25 miles per gallon with standard engine and transmission.
4. The new Bullet is designed to run efficiently on no-lead gas without sacrificing performance.
5. The new Bullet can do 0-60 in 14 seconds and still deliver 25 miles per gallon of gas.
6. The Bullet has averaged over 25 miles per gallon of gasoline in simulated city and suburban driving.

These claims are all relatively general, and to evaluate evidence in support of any of them, data must state precisely values for the following variables:

1. ambient conditions (temperature, barametric pressure, wind velocity, etc.)
2. vehicle weight
3. vehicle speed
4. vehicle load

5. steadiness of travel (stopping, starting, consistency by speed)
6. carburetor setting controlling fuel/air mixture ratio
7. road smoothness and grade
8. tire inflation pressure
9. type of fuel

Standard procedure in making tests, for example, is to carry out the tests under existing ambient conditions and then to correct the data for some set of standard conditions. Since no standard conditions have been universally agreed upon, it is possible to pick these "standard conditions" so as to virtually produce whatever result is desired. The comparison of two cars on the basis of a fuel consumption test requires that the same unambiguous testing procedures have been used to measure performance. A jumping off point for a standard test procedure would be the German Test Procedure for Fuel Consumption (Ermittlung des Kraftstoffverbrauchs von Kraftfahrzeugen (ausser Zugmaschinen)), DIN 70030.

In the absence of such a standard test, a detailed description of the actual procedure must be presented, and if the test is of a comparative nature, it must have been designed to treat both vehicles identically. In cases where driving conditions have been simulated, arguments must be presented bearing on the relationship between the simulated environment and actual driving conditions.

V. SUMMARY AND CONCLUSIONS

It has been our purpose in this report to delineate the technological basis for the evaluation of evidence presented in the substantiation of advertising claims dealing with the motor vehicle. We have suggested that the methodology for evaluation consists of four phases: (1) interpreting the claim, (2) defining the required measures, (3) describing adequate procedures for the measurement process, and (4) rendering an opinion on the result.

Evaluation, as the word implies, involves subjective judgment, and claims may, at times, be open to multiple interpretations. The objective of the first stage in the evaluation process is to reduce the words of the claim to engineering terms, acceptable to the scientific community and precise and unambiguous enough to be subjected to rigorous testing.

It is then necessary to define measures appropriate to the terms created from the statements made in the claim. The fact that some of the measures will be of a subjective nature in no way detracts from their scientific quality. Criterion values for the measures must be defined using, where possible, relevant engineering standards, so that meaningful comparisons can be made between the numerical quantities of concern.

The third step requires the establishment of test and/or measurement procedures capable of resolving any questions arising from the terms of the claim. These will be ideal procedures, against which substantiating evidence can be compared, and they should be based on the accepted practices of the fields to which the claim applies.

The final stage consists of transforming the engineering analysis of the problem into words understandable to a non-technical audience. A comparison would be made and the differences, if any, explained between the substantiating evidence for the

claim and the ideal engineering solution.

The main body of the report deals with examples of claim categories and indicates within each, the technological considerations necessary to the evaluation of substantiating evidence. The discussions revolve around the design of procedures for creating satisfactory substantiation, with an aim toward developing guidelines for what can be considered good practice in the field.

Each of the claim categories discussed treats separately the evidence offered in substantiation of the statements made. From these several analyses there emerges a generalized formulation for the treatment of any claim and the evidence offered in support of it. Figure 1 is a schematic representation of the procedure employed in the evaluation.

We enter the process at the top of the figure by being given a claim. Stage 1 involves the interpretation and classification of the claim into one of the many categories available, defining what the claim actually states and which realm of technical methodology is to be applied to it. These categories are the fourteen items described in Table II.

The second stage of the evaluation procedure consists of two parallel operations. The first is assembling the evidence offered to substantiate the claim by its maker, while the second is the formulating of the ideal evidence which could be mustered. This second body of information will be different for each of the claim categories and the sources for its construction (the technical literature consulted, the expert judgment required, etc.) will change according to the category. The eleven items listed along the side of Table II indicate where to look to generalize this information. Once created, however, these collections of ideal forms of evidence across categories of claims represent a relatively permanent tool to be used in the evaluation process as they will alter only with advances in technology such as the development

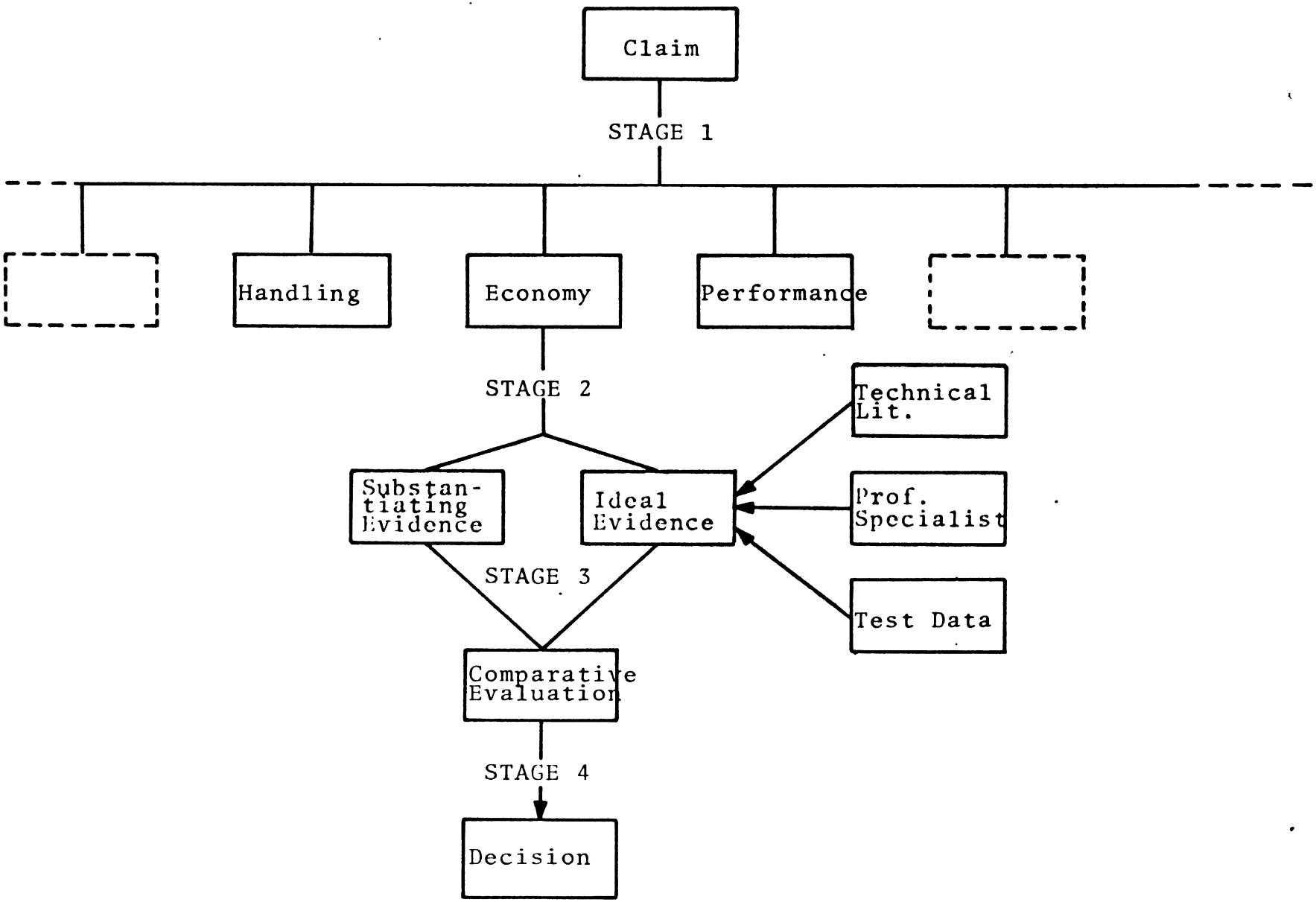

Figure 1. Evaluation Procedure.

of new testing procedures or new instrumentation.

A scientific analysis of the similarities and differences between the actual and ideal evidence forms the third stage of the process. The output of this portion of the process is a comparative evaluation, in scientific language, of the discrepancies between what was offered as evidence and what should have been.

The decision (or the verdict) is the output of the fourth and final stage of the evaluation procedure. It is the result of translating the scientific comparison into a reasonable and understandable statement intelligible to a non-technical audience.

The setting up of the machinery to perform evaluations of evidence in substantiation of advertising claims along the lines described herein will, in our opinion, provide a regulatory agency with a managable and workable tool for accomplishing this difficult task. The methodology described for evaluating evidence in support of claims also provides guidance to the manufacturing and selling organizations that generate advertising copy to promote their product. It is hoped that this report will, in particular, be helpful to the motor vehicle industry in identifying some of the substantiation difficulties that are peculiar to the motor vehicle and to the state of technology that is available to define and measure various aspects of motor vehicle performance.