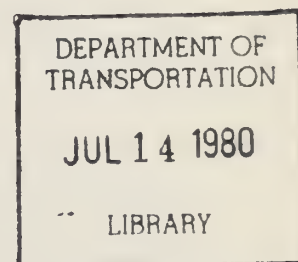


TL  
242  
.H382  
v.3

# **COST EVALUATION FOR NINE FEDERAL MOTOR VEHICLE STANDARDS VOLUME III FMVSS 122**

**M. R. Harvey  
J. A. Lesczhik  
R. F. McLean**

**De Lorean Motor Company  
2401 Elliott Street  
Troy, Michigan 48084**



**Contract No. DOT-HS-8-02015  
Contract Amt. \$332,007**



**NOVEMBER 1979  
FINAL REPORT**

This document is available to the U.S. public through the  
National Technical Information Service,  
Springfield, Virginia 22161

Prepared For  
**U.S. DEPARTMENT OF TRANSPORTATION  
National Highway Traffic Safety Administration  
Washington, D.C. 20590**

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

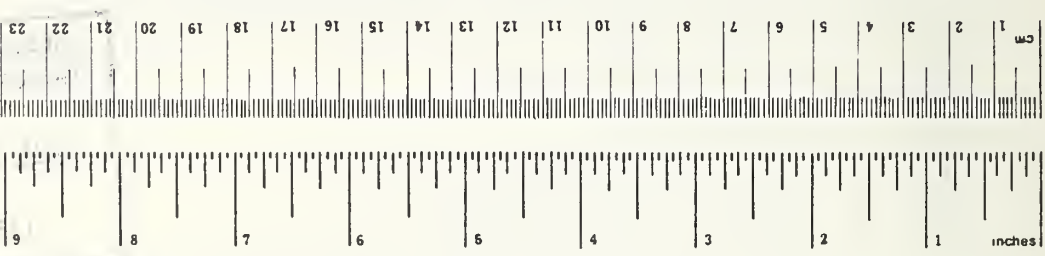
17C  
242  
1138  
V.3

1. Report No. DOT-HS 805 317		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle COST EVALUATION FOR NINE FEDERAL MOTOR VEHICLE SAFETY STANDARDS Vol. III				5. Report Date NOVEMBER 1979	
				6. Performing Organization Code	
7. Author(s) M.R. HARVEY, J.A. LESCZHIK, R.F. McLEAN				8. Performing Organization Report No.	
				10. Work Unit No. (TRAIS)	
9. Performing Organization Name and Address DE LOREAN MOTOR COMPANY RESEARCH & ENGINEERING DIVISION 2401 ELLIOTT STREET TROY, MICHIGAN 48084				11. Contract or Grant No. DOT-HS-8-02015	
				13. Type of Report and Period Covered FINAL REPORT 10/78 - 11/79	
12. Sponsoring Agency Name and Address DEPARTMENT OF TRANSPORTATION NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION 400 SEVENTH STREET, S.W. WASHINGTON, D.C. 20590				14. Sponsoring Agency Code	
				15. Supplementary Notes	
16. Abstract The consumer cost was established for the implementation cost of each of nine Federal Motor Vehicle Safety Standards. The standards study are: <ul style="list-style-type: none"> <li>FMVSS 105 Hydraulic Brake Systems in Passenger Cars</li> <li>FMVSS 108 Side Marker Lamps</li> <li>FMVSS 122 Motorcycle Brake Systems</li> <li>FMVSS 202 Head Restraints</li> <li>FMVSS 207 Seating Systems</li> <li>FMVSS 213 Child Seating Systems</li> <li>FMVSS 220 School Bus, Rollover Protection</li> <li>FMVSS 221 School Bus, Joint Strength</li> <li>FMVSS 222 School Bus, Seating and Crash Protection</li> </ul> For each standard a representative sample of makes and models of vehicles or components was established. The components required to meet the standard were purchased and their costs estimated. The first year of the imposition of the standard and the year immediately preceding it were emphasized. By analysis, the consumer costs attributed to the standard for each make and model or components were determined. A weighted average was developed from the samples and applied to the total industry volumes to determine the consumer cost for the implementation of each standard. The weighted average of weight variance due to the implementation of the standard was also determined. The before and after cost variance was not applied to FMVSS-213 Child Seating Systems and the FMVSS-122 Motorcycle Brake Systems.					
17. Key Words CONSUMER COST, VARIABLE COST, WHOLE-SALE COST, SAFETY STANDARDS NUMBERS: 105,108,122,202,207,213,220,221,222 IMPLEMENTATION COST			18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161		
19. Security Classif. (of this report) UNCLASSIFIED		20. Security Classif. (of this page) UNCLASSIFIED		21. No. of Pages 36	22. Price

DEPARTMENT OF  
 TRANSPORTATION  
  
 JUL 14 1980  
  
 LIBRARY

# METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures		Approximate Conversions from Metric Measures	
When You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>			
inches	*2.5	centimeters	cm
feet	30	centimeters	cm
yards	0.9	meters	m
miles	1.6	kilometers	km
<b>AREA</b>			
square inches	6.5	square centimeters	cm <sup>2</sup>
square feet	0.09	square meters	m <sup>2</sup>
square yards	0.8	square meters	m <sup>2</sup>
square miles	2.8	square kilometers	km <sup>2</sup>
acres	0.4	hectares	ha
<b>MASS (weight)</b>			
ounces	28	grams	g
pounds	0.45	kilograms	kg
short tons (2000 lb)	0.9	tonnes	t
<b>VOLUME</b>			
teaspoons	5	milliliters	ml
tablespoons	15	milliliters	ml
fluid ounces	30	milliliters	ml
cups	0.24	liters	l
pints	0.47	liters	l
quarts	0.95	liters	l
gallons	3.8	liters	l
cubic feet	0.03	cubic meters	m <sup>3</sup>
cubic yards	0.76	cubic meters	m <sup>3</sup>
<b>TEMPERATURE (exact)</b>			
Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
<b>TEMPERATURE (exact)</b>			
Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



\* 1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price \$2.25, SD Catalog No. C13.10-286.

## ABSTRACT

### FMVSS 122 MOTORCYCLE BRAKE SYSTEMS

Under Contract DOT-HS-8-02015 the Contractor conducted a program to determine if implementation consumer cost and weight variance resulted from the establishment of the standard in January 1974. Five models of motorcycle brake systems were examined. The same components existed for both the implementation year and the year prior to implementation. A further check indicated that the standard was being met for several years prior to the implementation date. The Honda Model 350 changed to a Model 360. The change in components were believed by the Contractor to be due to design requirements rather than the standard.

It was concluded that the cost of implementation of the standard in January 1974 was zero. A summary of cost data was presented for each model studied.





## PREFACE

The Contractor, the De Lorean Motor Company, in the presentation of the Final Report on the Cost Evaluation for Nine Federal Motor Vehicle Standards has divided this report into six major categories. Each volume contains the complete study related to the designated standard or standards. The Contractor acknowledges the contribution of its staff, the automotive manufacturing community and the automotive dealers. Special acknowledgement is made to the Contract Technical Manager, Mr. Robert Lemmer of the National Highway Traffic Safety Administration, Department of Transportation, for his contributions and timely reviews throughout the program.

The cost estimating techniques employed in the study are based on automotive industry practice and have been previously used on other programs by the Contractor. The following listing includes recent and current programs using essentially the same estimating procedures and techniques as those employed in this study:

- Contract NHTSA-DOT-HS-7-01770

Development of a Motor Vehicle Materials Historical, High-Volume Industrial Processing Rates Cost Data Bank - Ford F-100 Truck

FMVSS 201 Study of passenger car requirements as applied to light trucks and vans.

FMVSS 203 and 204 Study of passenger car requirements as applied to light trucks and vans.

- Contract NHTSA-DOT-HS-8-01767  
Cost Evaluation of Four Federal Motor Vehicle  
Safety Standards  
  
Cost Review of Pedestrian Safety Modifications

- Contract NHTSA-DOT-HS-9-02258  
Cost Evaluation of Three Federal Motor Vehicle  
Safety Standards

- Renault USA, INC.  
Consumer Cost Estimate of Subcompact Vehicles

- De Lorean Motor Company  
Manufacturing Cost Studies of Components of  
Lightweight Vehicles.

- Contract NHTSA-DOT-HS-9-02112  
Preliminary incremental cost estimate for the  
implementation of the extension of FMVSS 105 to  
light trucks, vans and MVTs.

Study the cost and weight change for passenger car  
pedestrian initial impact protection implementation.

Product feasibility, consumer cost and implementation  
schedule analysis for implementing brake inspect-  
ability requirements.

Cost data developed on this program for automotive  
standards are based on 1979 Model Year Economics and 1978  
macro-analysis of automotive and component manufacturers.



For standards related to other than automotive manufacturers, the data is based on 1979 year economics and macro-analysis factors applicable to the manufacturers. Dealer discount on related automotive products was established at 16.97% for the industry. A dealer discount of 25% was applied to the motorcycle related products. The child seats dealer discounts varied from 40% to 50%. Distributor cost where applicable is reflected in the dealer wholesale cost.

In reviewing this report, the reader is cautioned that the application of an average cost per pound factor that can be developed from the data presented could result in serious cost errors. Cost data can only effectively be developed by using manufacturing processing personnel applying automotive cost estimating technology. For any cost factor to be effective the designs, size, construction, and manufacturing techniques must be nearly the same. In this report a considerable variation can be noted in the cost and weight of what appears to be similar components. Only a detailed review of these components would explain the variation.



## PROGRAM INDEX

- VOLUME I - FMVSS 105 HYDRAULIC BRAKE SYSTEMS ON PASSENGER CARS
- VOLUME II - FMVSS 108 LAMPS, REFLECTIVE DEVICES AND ASSOCIATED EQUIPMENT
- VOLUME III - FMVSS 122 MOTORCYCLE BRAKE SYSTEMS
- VOLUME IV - FMVSS 202 HEAD RESTRAINTS
- FMVSS 207 SEATING SYSTEMS
- VOLUME V - FMVSS 213 CHILD SEATING SYSTEMS
- VOLUME VI - FMVSS 220 SCHOOL BUS, ROLLOVER PROTECTION
- FMVSS 221 SCHOOL BUS, JOINT STRENGTH
- FMVSS 222 SCHOOL BUS, SEATING AND CRASH PROTECTION



TABLE OF CONTENTS

VOLUME III

FMVSS 122 MOTORCYCLE BRAKE SYSTEMS

	PAGE
INTRODUCTION	1
INTEGRATED COST SAMPLING PLAN	11
COST EVALUATION	13
CONCLUSION	14
APPENDIX A - SUMMARY OF COMPONENT COST AND WEIGHT DATA	
APPENDIX B - PHOTOGRAPHS OF SYSTEMS STUDIED	





COST EVALUATION OF NINE FEDERAL MOTOR VEHICLE STANDARDS  
VOLUME III FMVSS 122 MOTORCYCLE BRAKE SYSTEMS

INTRODUCTION

Under Contract DOT-HS-8-02015, the Contractor conducted a program that developed the consumer cost of selected motorcycle brake systems and determined that the brake systems employed by the selected manufacturers were not altered by FMVSS 122 when it became effective in January 1974.

An Integrated Cost Sampling Plan was developed, approved by the Contract Technical Manager, and followed to obtain if any, changes in cost and weight of the brake system due to implementation of the standard.

Specimen vehicles were selected that represented high volume, a variety of engine sizes, and major manufacturers. Components and assemblies required of each brake system were purchased. Automotive industry type teardown and manufacturing cost estimating techniques were applied to develop cost and weight data for the implementation analysis.

Appendix A of this report represents a summary of cost elements and weight of components involved in the study. In Figure 1 and 1A elements of component cost are shown. The boxes with the solid lines contain data derived from the cost and weight processing of components of the systems studied. Those with dotted boxes are cost elements considered in the estimating processing

and the summarized results are contained in the costs in Appendix A.

In this study, the consumer cost is the summation of the variable cost, corporation other cost and profit and dealer markup. The variable cost is considered as those costs that vary with the volume of production and consist of the cost of direct material, direct labor and variable burden. The Other Cost and Profit consist of those items identified in Figure 1 and 1A and are:

- Indirect Material
- Indirect Labor
- Fixed Burden
- Tooling Cost
- Engineering and Warranty Cost
- Selling and Administration Cost
- Other Corporate Costs
- Corporation Profits
- Distributor Cost

The Dealer Markup consists of the dealer expense and profit.

The costs included in Appendix A are variable cost, dealer wholesale, dealer mark-up, and consumer cost.

The variable costs of production of components are those incremental costs associated with that component. The major categorical contributors to variable costs are direct labor, direct materials, and variable burden. Other minor contributors to variable cost such as setup costs, where applicable, are included in the variable burden rate.

ELEMENTS OF CONSUMER COST

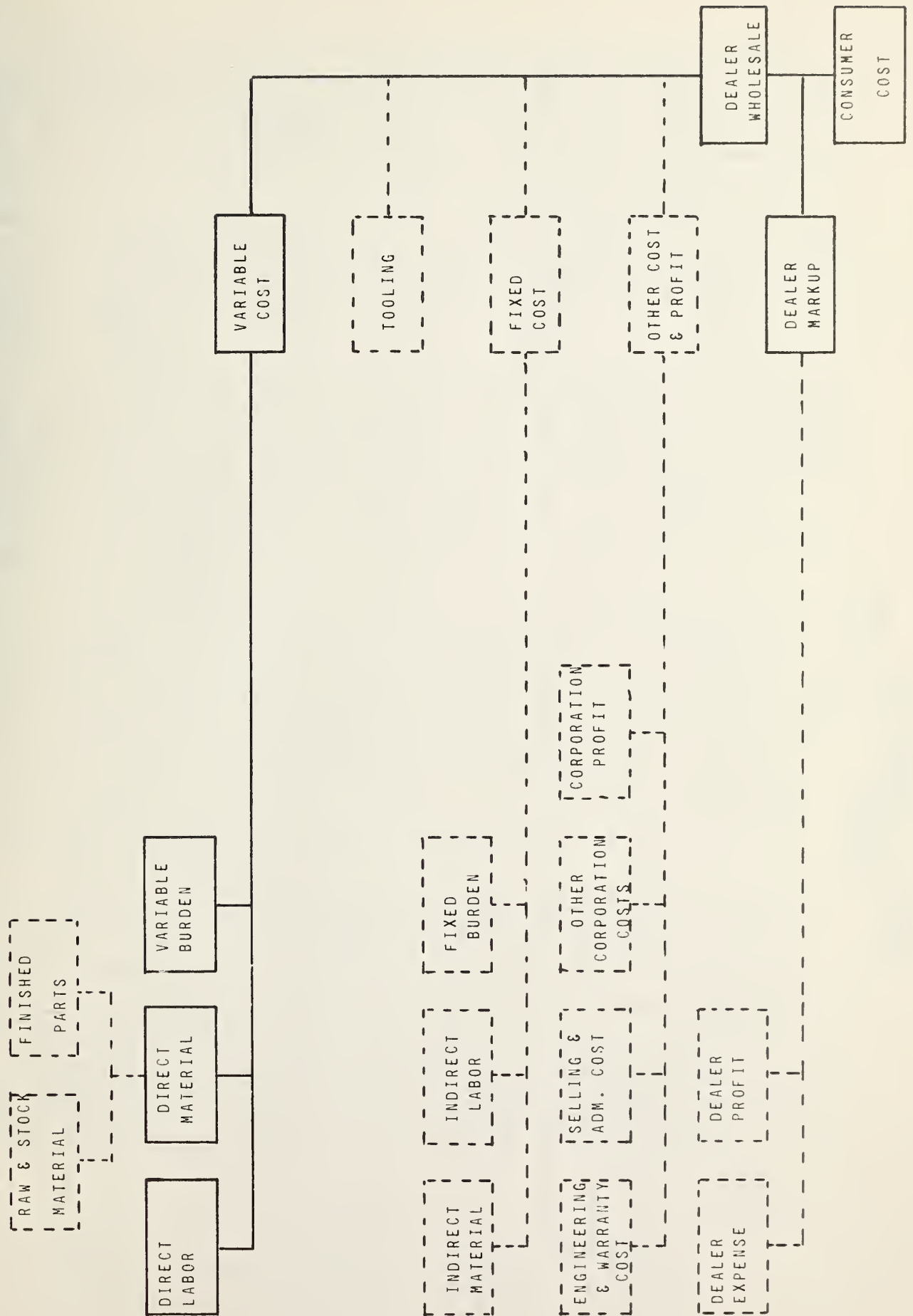


FIGURE 1

ELEMENTS OF CONSUMER COST  
 FMVSS 122 MOTORCYCLE BRAKE SYSTEMS  
 (IMPORTS)

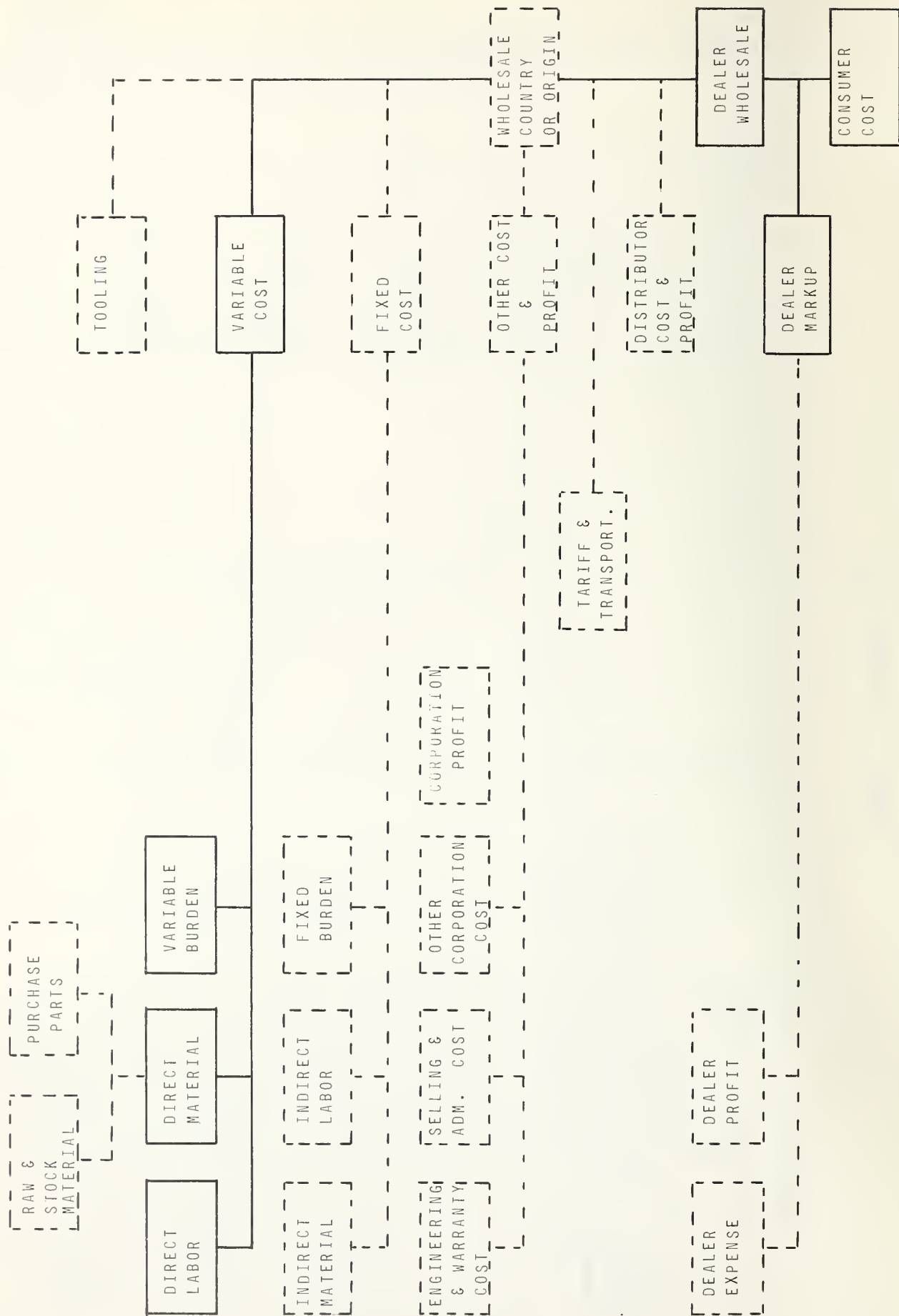


FIGURE 1A

Direct labor costs are determined as an average rate depending on the worker classification required to perform the tasks identified in the process study (e.g., punch press operator, drill press operator, machinist). Average labor rates are determined from Union records, Department of Labor statistics, or a combination thereof. Labor fringe benefits and standard allowance for less than 100 percent labor efficiency are included in the average labor rate.

For each component, the process analysis identified the operation, type of equipment, pieces per hour, number of men, and number of machines. This data when extended by information from the data bank and all component operations summarized will produce the total direct labor cost per component.

Direct material costs are those costs associated with the purchase of all material required in the production process. Accordingly, direct material costs include the cost of not only the material in the finished component, but also that of the material scrapped minus salvage price, due to material removal or incorrectly worked components that cannot be salvaged.

Variable burden costs are estimated charges that attempt to account for all other expenses due to the production process and that vary directly with the production volume and that contribute to the cost of sales. Examples of sources of such expenses include, but are not limited to, perishable tools (e.g., drill bits, spot welding tips), fuel and power requirements and direct supervision and clerical. The total of all expenses that

vary with the production quantity is estimated, based on a production planning volume. The sum of these expenses is then apportioned to each component on some logical scheme. The amount of apportionment is known as a variable burden rate.

Several methods of applying variable burden have been popularly accepted in the past as well as during current times. Total costs that are apportioned on the number of pieces produced, or material usage, misrepresent true costs whenever parts of different sizes or complexities are produced. Costs apportioned on direct labor misrepresent true costs in a highly automated production process.

This study utilizes a burden rate applied on occupancy time in a given machine, or station, performing a task during the production process. Burden rates are calculated on basis of a combination of machine or station complexity, cycle time, area occupied, and other considerations that more realistically reflect the true rate of apportionment of total variable expenses.

The cost development process and teardown procedure requires that each component be weighed, tagged with identification data, and analyzed for general type of material and manufacturing method utilized. Experienced personnel qualified by many years of production processing were employed to develop the basic data. The processing method, specific manufacturing operation, type of equipment, pieces per hour, number of men, number of machines, general type of material, rough weight of



material and tooling costs were all elements of data furnished by the process engineer. A finite estimating and processing technique utilizes this basic data plus model year economics and volumes contained in a data bank to extend the data into consumer cost.

The data bank contained approximately six hundred operation rates and over sixty materials utilized in the automotive type industry and covers twelve model year economics. In this study, the terms "Model Year Economics" and "Model Year Production Volumes" are utilized. The term model year directly related to a designated year of a vehicle design. Normally in the United States, the model year starts in retail sales approximately in September. The volume is related to the number of vehicles produced of a specific design year vehicle. The term economics relates to the average cost elements involved in the production of a specific car year. The model production years normally are not related to the calendar year or a corporation fiscal year. For this study, the Contract Technical Manager designated the Model Year Economics to be 1979.

The Dealer Wholesale Cost for this study was developed by use of the Macro-Analysis Method. A factor expressing the relationship of the variable cost to the Dealer Wholesale Cost was obtained from studying financial data related to the specific industry or manufacturer of the product. The macro-analysis study utilized data obtained from public files, annual financial reports, the 10K Report filed annually by the United States manufacturers and previous cost studies of similar

products. The variable cost multiplied by the factor will produce the dealer wholesale cost.

Although other methods can be used to derive a dealer wholesale cost, it is believed by the Contractor that the variable cost macro-analysis factor method produces an acceptable average dealer wholesale cost. The macro-analysis factor includes:

- A. Indirect labor - these costs are determined by apportioning the total estimated wages for indirect labor over the planned production volume. Indirect labor is comprised of, but not limited to, supervision and management, clerical, janitorial, plant security, etc. The total labor cost is not affected by variations in the production rate.
- B. Indirect materials - these costs are determined by apportioning the total estimated costs for all material necessary for the proper functioning of the manufacturing plant and not related to the finished product over the planned production volume. Indirect materials are comprised of, but not limited to, stationery and office supplies, janitorial supplies, maintenance supplies, first aid and medical supplies, etc.
- C. Fixed Burden - is determined by apportioning the remaining estimated expenses related to the operation of a manufacturing plant over the planned production volume. All such expenses

are conveniently accumulated categorically as burden. Such expenses are comprised of, but not limited to, property taxes, insurance cost, depreciation charges on buildings and capital equipment, etc.

- D. Tooling Cost - is determined by apportioning the total expense by special tooling to manufacture a component over the entire life production volume of that component. This cost factor could vary as the component or sub-component could have several years application beyond the study period of a program. Further, the component or sub-component could be extended over several product lines. Thus the years of amortization and production volumes could have a definite bearing on the tooling cost of the component. With this knowledge, the process engineer would be required to use judgment in the application of the amortization and volume factor.
- E. Other Cost and Profit - includes items of engineering cost, warranty costs, selling and administrative costs, corporate burden and taxes (excluding factory burden and taxes), corporate depreciation and maintenance (excluding factory depreciation and maintenance), and other corporate costs and profit.

The dealer wholesale cost could be derived by the method of applying individual detailed cost factors

stated above to the variable cost. This would produce a very accurate dealer wholesale cost. However, the data to accomplish this would not be available publicly or could it be expected that such confidential data would be made available for study groups.

Dealer Markup is the summation of all costs incurred in the operation of a dealership (salaries, taxes, depreciation, advertising, maintenance, etc.) and the dealer's profit. The Contractor was cognizant of a potential problem in attempting to arrive at an equitable dealer markup to apply in the cost calculations. The United States dealer is an independent business man over whom the manufacturer can exercise only limited controls. Although manufacturers have suggested retail prices, the dealer is actually free to bargain with each customer to establish the selling price for a vehicle. For this study it is assumed that the dealer's markup is based upon the full suggested price and is reflected in the consumer cost of the system or components studied.

Appendix B contains photographs for each system studied. These photographs provide a quick overview of the various systems.

## INTEGRATED COST SAMPLING PLAN

The Contractor developed an Integrated Cost Sampling Plan that provided for the selection of specimens that were high volume models for major motorcycle manufacturers with engine sizes varying from 175cc to 1200cc. Table 1 indicates the manufacturer and model selected.

TABLE 1

### FMVSS MOTORCYCLE BRAKE SYSTEM

MAKES AND MODELS OF MOTORCYCLES FOR WHICH BRAKE SYSTEMS WERE PURCHASED AND STUDIED

MANUFACTURER	ENGINE SIZE	
	1973 MODEL	1974 MODEL
HONDA	350cc	360cc
KAWASAKI	175cc	175cc
KAWASAKI	500cc	500cc
YAMAHA	350cc	350cc
HARLEY-DAVIDSON	1200cc	1200cc

The selection of specimen models was from major motorcycle manufacturers. Table 2 indicates the manufacturers' market share of the industry based on 1978 vehicle registrations.

TABLE 2  
MANUFACTURERS' MARKET SHARE OF THE INDUSTRY  
BASED ON 1978 VEHICLE REGISTRATION\*

MANUFACTURER	% OF INDUSTRY
HONDA	35.6
YAMAHA	26.6
KAWASAKI	15.3
HARLEY-DAVIDSON	6.4
BALANCE OF MANUFACTURERS	16.7

\* This includes new 1977 and 1978 models registered in 1978 through November. Data in Table 2 compiled by R.L. Polk & Co.

The plan required the procurement of brake components in the specimen models for both 1973 and 1974. The consumer cost and weight differential, if any, between the two systems would be considered attributable to the implementation of the standard.



## COST EVALUATION

The FMVSS 122 was essentially based on SAE recommendations for motorcycle brake performance. Since the SAE recommendation dates back to 1971, most motorcycle manufacturers had altered their brake systems before FMVSS 122 became effective in January 1974. All specimen vehicles except the Honda 350 indicated that both the 1973 and 1974 models had the same brake components. Research of system components for several years prior to 1974 also indicated the same components were used. In 1974, a Honda 360 replaced the Honda 350 and there were component changes resulting in a consumer cost and weight increase. It is believed by the Contractor that the brake system component changes in the Honda vehicle was based on a model design upgrading and increased engine size.

Appendix A presents a Summary of Cost and Weight Data for the Motorcycle Specimens Studied. Cost and weight data was obtained as described in the Introduction. As no cost or weight variance existed between the components of the year of implementation and several years prior, it was concluded that the implementation cost and weight variance was zero.

Appendix B presents photographs of the brake systems studied.

## CONCLUSION

Based upon the components studied of the various systems, it was concluded that FMVSS 122 was complied with prior to the implementation date of January 1974. It was further concluded that the implementation was completed several years prior to January 1974. It was concluded based upon the findings of this study that the cost of implementation of FMVSS in January 1974 resulted in a zero variance in consumer cost and weight.

APPENDIX A

SUMMARY OF COMPONENT COST AND WEIGHT DATA

FMVSS 122 MOTORCYCLE BRAKE SYSTEMS SUMMARY OF COMPONENT COST AND WEIGHT DATA

Item	Qty'd Per Vehicle	Material	Weight	Total Tooling (\$000)	COST PER VEHICLE \$						
					VARIABLE COST			Total	Wholesale Cost	Dealer Markup	Consumer Cost
					Material	Labor	Burden				
1973 HONDA CB 350	1	VAR	23.1501	3520	49,6158	2,7547	.3473	52,7178	103,2215	34,4072	137,6287
1974 HONDA CB 360 (REPLACE CB 350 for 1974)	1	VAR	23.4752	3575	52,6081	2,9638	.3390	55,9109	109,4735	36,4912	145,9647
1973 & 1974 KAWASAKI 500cc	1	VAR	25.9428	3120	54,8049	3,2086	.4434	58,4568	114,4584	38,1528	152,6112
1973 & 1974 KAWASAKI 175cc	1	VAR	13.2753	2195	30,0597	1,6936	.3390	32,0923	62,8367	20,9456	83,7823
1973 & 1974 YAMAHA 350cc	1	VAR	25.1919	2975	53,6129	3,3872	.3390	57,3391	112,2700	37,4233	149,6933
1973 & 1974 HARLEY-DAVIDSON 1200cc	1	VAR	33.3338	2985	69,2458	3,6655	.3913	73,3026	124,3384	41,4401	165,7845

APPENDIX B

PHOTOGRAPHS

## MOTORCYCLES

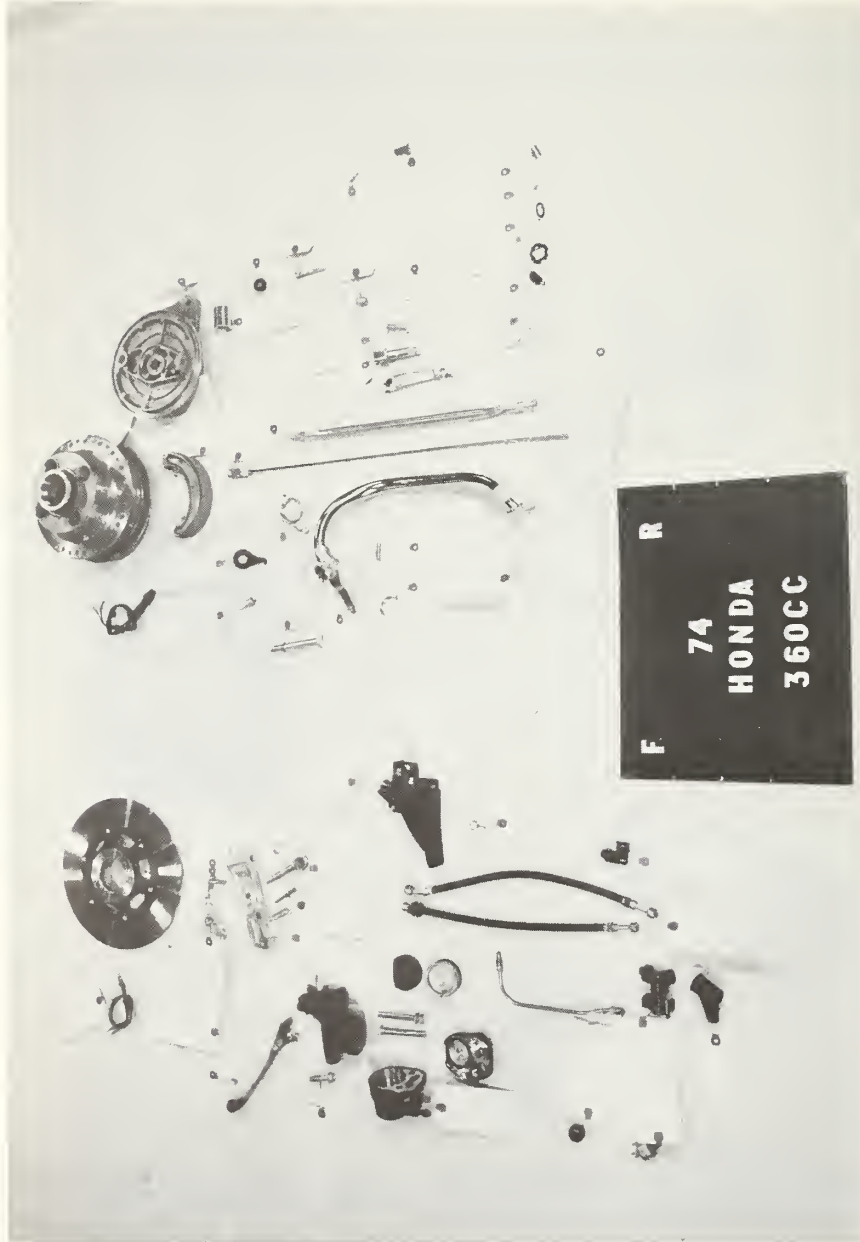
## TABLE OF CONTENTS

	PAGE
HONDA	
1973 HONDA 350cc	3
1974 HONDA 360cc	4
KAWASAKI	
1973 KAWASAKI HID 500	5
1973-74 KAWASAKI 175cc	6
YAMAHA	
1973 YAMAHA RD 350	7
HARLEY DAVIDSON	
1973 HARLEY DAVIDSON FLH 1200cc	8





1973 HONDA  
350CC FRONT AND REAR BRAKES



1974 HONDA  
360CC FRONT AND REAR BRAKES



1973 KAWASAKI  
HID500 FRONT AND REAR BRAKES



1973-74 KAWASAKI  
175CC FRONT AND REAR BRAKES



1973 YAMAHA  
RD350 FRONT AND REAR BRAKES



1973 HARLEY DAVIDSON  
FLH1200 FRONT AND REAR BRAKES

☆ U.S. GOVERNMENT PRINTING OFFICE: 1980 O— 624-729/1734 REGION 3-1

TL 242 .H38

Harvey, M.

Cost evaluation  
federal m

Form DOT F 1720  
FORMERLY FORM DO



DOT LIBRARY



00092280