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Evaluation of Methods and Costs to Mark Vehicle Parts for Theft Prevention: Volume I

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16. Abstract (Limit: 200 words)

The purpose of this project was to provide cost data and information for use in determining the total cost to the consumer for anti-theft parts marking for the 1987 model year.

All cost evaluation information has been compiled from components used in the manufacturing of anti-theft tags and application by manufacturers on required components of vehicles.

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ABSTRACT

Pioneer Engineering and Manufacturing conducted a study of imported and domestic 1987 model year automobiles to determine what anti-theft marking methods were used and the costs associated therewith. The vehicle sample consists of 23 domestic models (of 34 designated by NHTSA as high theft vehicles) and 24 import models (of 42 designated as high theft). Tamper resistance of adhesive tag marking methods was evaluated and cost to the consumer for adhesive tags and metal stamp markings was determined.

PREFACE

This two-volume report covers work conducted under a contract that was part of a comprehensive program for evaluating the effectiveness of Federal Motor Vehicle Safety Standards (FMVSS) in terms of costs and benefits. The purpose of this study was to determine the total per vehicle cost to the consumer for anti-theft marking (Volume I) and to assess their tamper resistance (Volume II).

All cost information was arrived at by adding the cost of anti-theft tags to the direct labor and variable manufacturing overhead cost of applying them to identified vehicle components. Pioneer has conducted numerous cost analyses for NHTSA and other companies in the industrial sector; the methodology used for conducting this study and for determining the estimated cost has been developed and perfected by fourteen of years experience in this type of work and is discussed in detail in Appendix "A". Experienced manufacturing engineers who possess first-hand knowledge of automotive industry design, manufacturing and cost estimating practices staffed this project.

Pioneer acknowledges the contributions of its staff, the automotive manufacturers, manufacturers of identification tags and application and inspection systems, state and local municipalities, and metropolitan Detroit auto dealers. Special acknowledgment is given to Mr. Warren LaHeist, the Contract Technical Manager, for his contributions and helpful reviews throughout the program.

1.0 INTRODUCTION--Volume I (of 2)

The primary objective of this study was to determine manufacturing and consumer costs for applying anti-theft identification markings to automotive components. A second objective was to assess tamper resistance of the adhesive labels used for this purpose. Title VI, Theft Prevention Standard (49 CFR 541) identifies vehicles and parts requiring identification markings. The Standard also states that markings are to be permanent.

Pioneer investigated the various marking systems employed and determined costs associated with them. These costs included:

Material purchase price
Development of identification information
Data processing
Application of data to the tag
Tag application (if applicable)
Part stamping (if applicable)
Effects on part assembly to the vehicle

Based on these findings variable, wholesale and consumer costs were developed.

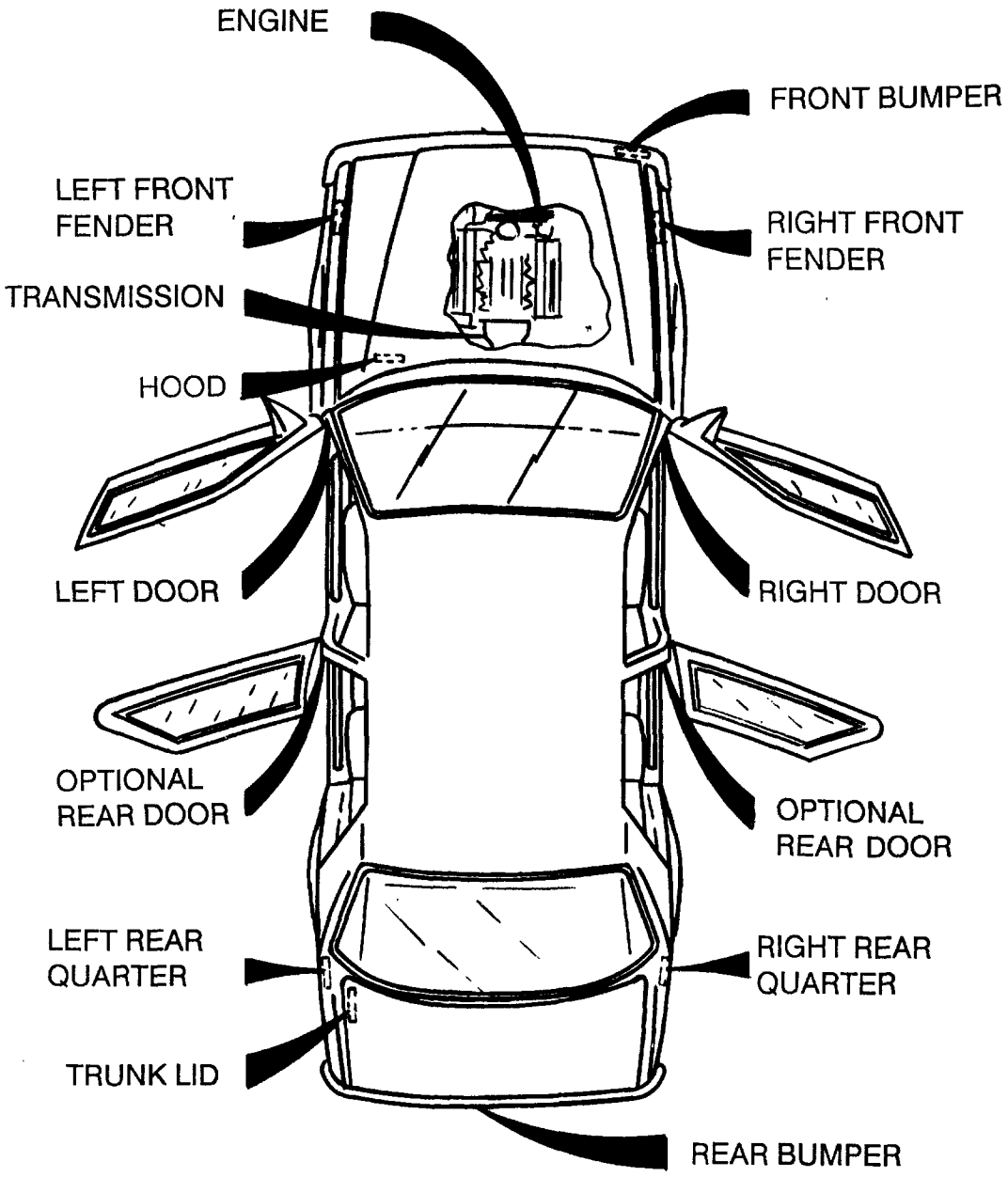
The survey of vehicles for anti-theft tags consisted of a visual review of the twelve areas adhesive tags are employed (ten areas in two-door vehicles) and the two areas where an alpha-numeric identification code is stamped per Standard 49 CFR 541 (Figures 1 and 2). The parts identified by adhesive tags are:

Hood	Right Rear Door
Front Bumper	Left Rear Door
Front Right Hand Quarter Panel	Right Rear Quarter Panel
Front Left Hand Quarter Panel	Left Rear Quarter Panel
Right Front Door	Deck Lid
Left Front Door	Rear Bumper

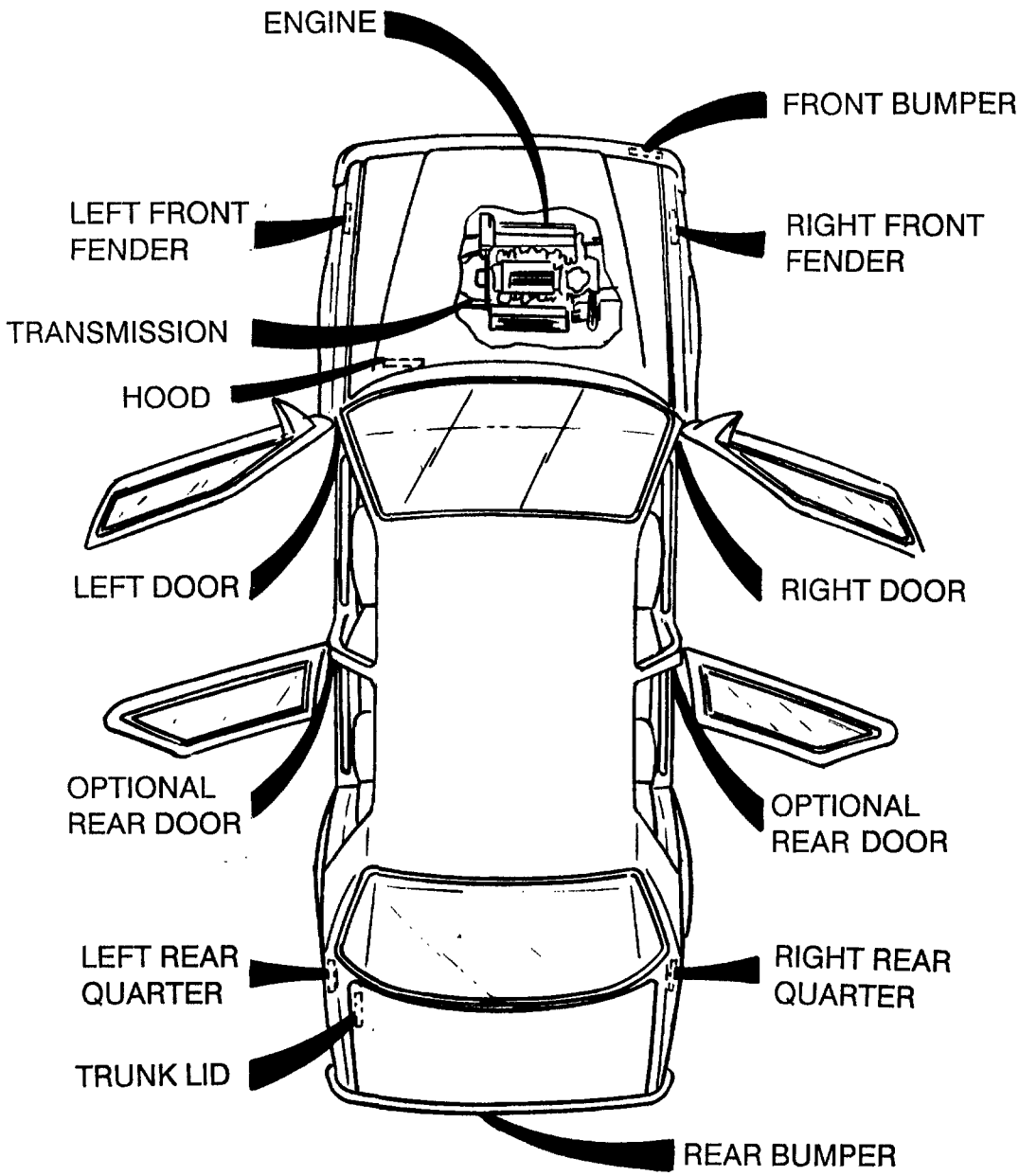
The parts marked with permanent stampings, either directly or to a metal tag riveted to the part, are:

Engine	Transmission

The sample selection includes 82% of the 1987 model year domestic vehicles designated as high-theft, and 85% of 1987 model year import vehicles designated as high-theft. The domestic sample represents a balance of General Motors, Ford, Chrysler and Volkswagen (of America) models; the import sample represents a balance of Japanese and European models. Samples were further selected based on volume sales by model,



ANTI-THEFT TAG PLACEMENT
REAR WHEEL DRIVE
FIGURE 1



ANTI-THEFT TAG PLACEMENT
FRONT WHEEL DRIVE
FIGURE 2

with 100% being equal to the total number of 1987 model year vehicles sold that have been identified by NHTSA as high-theft. As agreed upon, a minimum of 80% of the subject vehicle models, domestic and import were sampled.

Manufacturing costs were determined through "Micro-Analysis" (explained further in Section 4.1), which develops values for:

Material specification and cost
Labor content and cost
Burden
Tooling and equipment costs

For the purposes of this study, only variable manufacturing costs were developed. Variable costs are associated with the actual production of the part--those costs that would not be incurred if one part were not produced. Variable costs include direct labor, direct material and variable burden. Costs elements for fixed burden (taxes, insurance, depreciation, etc.) G&A, profit and distribution were accounted for through "Macro-Analysis" (explained in Section 4.2).

Volume II of this study reports the results of the removal testing of the adhesive anti-theft tags.

2.0 DISCUSSION

2.1 VEHICLE SELECTION

The methodology for developing the vehicle sample list for both domestic and import vehicles is standard in all Pioneer studies for NHTSA. The number of cars sold for each nameplate during the 1987 model year is represented by the factory-to-dealer vehicle sales for the period October 1, 1986 through September 30, 1987. The data were extracted from the trade publication *Automotive News*. Tables 1 and 2 show a complete list of all NHTSA designated high-theft rate vehicles sold in 1987. Sales figures and percentages of sales are also listed; those selected for this study are indicated.

The vehicle size classification used in this study is also based on past NHTSA work. It is derived entirely from wheelbase size, as follows:

Size Classification	Wheelbase Size
Mini*	Less than 94.0"
Sub-compact	94.0" to 99.9"
Compact	99.9" to 103.0"
Intermediate	103.0" to 109.0"
Large	Greater than 109.0"

*None of the domestic vehicles samples met the criteria for this classification.

The first objective of this study was to determine manufacturing and consumer costs for applying identification markings to parts on vehicles that are most susceptible to theft. A second objective was to assess the tamper resistance of the marking tags employed.

Domestic and imported high-theft vehicles sampled and their associated sales figures are listed in Tables 3 and 5. Tables 4 and 6 show the sample distribution for each vehicle size classification as a percentage of total vehicle fleet and indicate the number of models of each size that are represented in this study.

2.2 DATA ACQUISITION

Pioneer personnel conducted surveys and made observations at metropolitan Detroit area automobile assembly plants, dealerships and rental agencies to establish the use and placement of these markings. Some tags were visible; others were not visibly accessible without causing damage to the vehicles. Examples of tags not visible are: rear

quarter panels--markings are on the inside of the sheet metal within the luggage compartment that is covered by a lining and carpet; and front and rear bumpers where coverings, moldings and air deflectors prevent easy viewing.

Regulatory agencies across the United States were queried to learn what, if any, additional personnel, equipment or other costs have been incurred in enforcement. Of the agencies that responded several felt that they would incur minimal additional costs, while others predicted no new cost to put the program in place. All responding agencies showed concern for the auto-theft problems in their jurisdiction, all responses were positive, and all were cooperative with some offering additional information in the way of case histories and examples of current situations. The consensus of these responses was that while the effective time period may vary, the overall program impact should be an effective deterrent. These responses are on file and are available upon request from Pioneer.

Commercial product literature and samples were gathered from the two known U.S. manufacturers of adhesive anti-theft tags, Avery and 3M.

DOMESTIC
VEHICLES DESIGNATED BY NHTSA
TO RECEIVE ANTI-THEFT MARKINGS

MAKE	MODEL	SAMPLED ?	1987 SALES	% HIGH-THEFT VEHICLES SOLD
Buick	Electra	No	82,939	3.7%
Buick	LeSabre	Yes	153,158	6.8%
Buick	Riviera	No	19,838	0.9%
Cadillac	Coup De Ville	Yes	208,241	9.2%
Cadillac	Eldorado	No	20,587	0.9%
Cadillac	Seville	Yes	22,304	1.0%
Chevrolet	Camaro	Yes	24,339	1.1%
Chevrolet	Nova	Yes *	140,664	6.2%
Chrysler	Fifth Avenue (3)	Yes	61,406	2.7%
Chrysler	Laser	No	8,071	0.4%
Chrysler	LeBaron GTS (4)	Yes	38,595	1.7%
Chrysler	Lebaron J	No	60,604	2.7%
Dodge	600 (2)	Yes	39,327	1.7%
Dodge	Aries (1)	Yes	101,161	4.5%
Dodge	Daytona	No	33,065	1.5%
Dodge	Diplomat (3)	Yes	16,881	0.7%
Dodge	Lancer (4)	Yes	28,118	1.2%
Ford	Mustang	Yes	163,392	7.2%
Ford	Thunderbird (7)	Yes	126,767	5.6%
Lincoln	Continental	No	16,534	0.7%
Lincoln	Mark VII	Yes	28,093	1.2%
Lincoln	Town Car	Yes	136,085	6.0%
Mercury	Capri	No	1,958	0.1%
Mercury	Cougar (7)	Yes	101,480	4.5%
Oldsmobile	88	Yes	184,402	8.1%
Oldsmobile	98	No	75,680	3.3%
Oldsmobile	Toronado	No	17,430	0.8%
Plymouth	Caravelle (2)	Yes	37,866	1.7%
Plymouth	Gran Fury (3)	Yes	9,782	0.4%
Plymouth	Reliant (1)	Yes	105,841	4.7%
Pontiac	Bonneville	Yes	21,773	1.0%
Pontiac	Fiero	Yes	47,156	2.1%
Pontiac	Firebird	No	77,635	3.4%
Volkswagen	Golf	Yes	55,367	2.4%
			2,266,539	100%

* Numbers in parentheses indicate paired vehicles (identical except for minor variations in trim)

TABLE 1

IMPORTED VEHICLES DESIGNATED BY NHTSA TO RECEIVE ANTI-THEFT MARKINGS

MAKE	MODEL	SAMPLED ?	1987 SALES	% HIGH-THEFT VEHICLES SOLD
Acura	Legend	Yes	32,955	4.7%
Audi	4000CS Quattro (1)	No	2,739	0.4%
Audi	5000CS Turbo Quatro (1)	Yes	3,648	0.5%
Audi	Coupe GT	No	1,003	0.1%
BMW	318i (2)	No	242	0.0%
BMW	325 (2)	Yes	48,774	6.9%
BMW	524 TD (3)	Yes	467	0.1%
BMW	528e (3)	Yes	9,699	1.4%
BMW	535i/535iS (3)	Yes	6,117	0.9%
BMW	635CSI	No	1,894	0.3%
BMW	735/L-7	No	7,016	1.0%
Isuzu	Impulse	No	7,441	1.1%
Jaguar	XJ6	Yes	14,131	2.0%
Jaguar	XJS	No	4,049	0.6%
Maserati	Maserati	No	715	0.1%
Mazda	626	Yes	70,578	10.0%
Mercedes Benz	190	Yes	16,378	2.3%
Mercedes Benz	300 (7)	Yes	20,898	3.0%
Mercedes Benz	300SDL Turbo (7)	Yes	5,992	0.9%
Mercedes Benz	420SEL	No	12,080	1.7%
Mercedes Benz	560SEC (8)	Yes	1,602	0.2%
Mercedes Benz	560SEL (8)	Yes	6,144	0.9%
Mercedes Benz	560SL (8)	Yes	10,030	1.4%
Mercury	Mercur	No	10,634	1.5%
Mitsubishi	Cordia	No	3,737	0.5%
Mitsubishi	Tredia	No	5,540	0.8%
Porsche	911 Cabriolet (4)	Yes	2,046	0.3%
Porsche	911 Coupe (4)	Yes	3,747	0.5%
Porsche	911 Turbo (4)	Yes	1,276	0.2%
Porsche	928S	No	1,916	0.3%
Saab	900 Turbo (5)	Yes	7,822	1.1%
Saab	900 (5)	Yes	12,117	1.7%
Saab	9000 Turbo (6)	No	7,111	1.0%
Saab	9000S (6)	No	2,065	0.3%
Saab	900S (5)	Yes	12,438	1.8%
Subaru	XT	No	17,497	2.5%
Toyota	Camry	Yes	131,085	18.6%
Toyota	Celica	Yes	70,627	10.0%
Toyota	Corolla	Yes	92,341	13.1%
Toyota	MR2	Yes	17,127	2.4%
Volkswagon	Cabriolet	No	12,964	1.8%
Volkswagon	Scirocco	No	7,083	1.0%
			703,761	100%

* Numbers in parentheses indicate paired vehicles having a high degree of similarity with a large number of interchangable components

TABLE 2

DOMESTIC
VEHICLES SELECTED FOR SAMPLING
FROM FMVSS LIST

MAKE	MODEL	1987 SALES	% HIGH-THEFT VEHICLES SOLD
Buick	LeSabre	153,158	6.8%
Cadillac	Coup De Ville	208,241	9.2%
Cadillac	Seville	22,304	1.0%
Chevrolet	Camaro	24,339	1.1%
Chevrolet	Nova	140,664	6.2%
Chrysler	Fifth Avenue (3)	61,406	2.7%
Chrysler	LeBaron GTS (4)	38,595	1.7%
Dodge	600 (2)	39,327	1.7%
Dodge	Aries (1)	101,161	4.5%
Dodge	Diplomat (3)	16,881	0.7%
Dodge	Lancer (4)	28,118	1.2%
Ford	Mustang	163,392	7.2%
Ford	Thunderbird (7)	126,767	5.6%
Lincoln	Mark VII	28,093	1.2%
Lincoln	Town Car	136,085	6.0%
Mercury	Cougar (7)	101,480	4.5%
Oldsmobile	88	184,402	8.1%
Plymouth	Caravelle (2)	37,866	1.7%
Plymouth	Gran Fury (3)	9,782	0.4%
Plymouth	Reliant (1)	105,841	4.7%
Pontiac	Bonneville	21,773	1.0%
Pontiac	Fiero	47,156	2.1%
Volkswagen	Golf	55,367	2.4%
		1,852,198	81.7%

* Numbers in parentheses indicate paired vehicles (identical except for minor variations in trim

TABLE 3

DOMESTIC VEHICLE SAMPLE DISTRIBUTION

SUBCOMPACT	COMPACT	INTERMEDIATE	LARGE
Chevrolet Nova	Plymouth Reliant (1)	Plymouth Caravelle (2)	Plymouth Gran Fury (3)
Volkswagen Golf	Dodge Aries (1)	Chrysler LeBaron GTS (4)	Chrysler Fifth Avenue (3)
Pontiac Fiero	Ford Mustang	Dodge Lancer (4)	Dodge Diplomat (3)
		Cadillac Seville	Pontiac Bonneville

TABLE 4

CLASS	SUBCOMPACT	COMPACT	INTERMEDIATE	LARGE	TOTAL
(1) No. of Hi Theft Vehicles in Class	284,323	534,930	496,939	950,347	2,266,539
(2) No. of Vehicles in Sample	243,187	394,733	422,550	791,728	1,852,198
(3) Class, % Hi Theft (1)/2,266,539	12.54%	23.60%	21.93%	41.93%	100.00%
(4) Sample, % Hi Theft (2)/2,266,53	10.73%	17.42%	18.64%	34.93%	81.72%
(5) Sample as % Class (2)/(1)	85.53%	73.79%	85.03%	83.31%	
(6) No. of models in Hi Theft	5	7	12	10	34
(7) No. of models in Sample	3	4	8	8	23

	GENERAL MOTORS	FORD	CHRYSLER	VOLKSWAGEN (U.S.)	TOTAL
No. of Models in Hi Theft	14	7	12	1	34
No. of Models in Sample	8	5	9	1	23

IMPORTED
VEHICLES SELECTED FOR SAMPLING
FROM FMVSS LIST

MAKE	MODEL	1987 SALES	% HIGH-THEFT VEHICLES SOLD
Mercedes Benz	190	16,378	2.3%
Mercedes Benz	300 (7)	20,898	3.0%
Mercedes Benz	300SDL Turbo (7)	5,992	0.9%
BMW	325 (2)	48,774	6.9%
Audi	5000CS Turbo Quatro (1)	3,648	0.5%
BMW	524 TD (3)	467	0.1%
BMW	528e (3)	9,699	1.4%
BMW	535i/535iS (3)	6,117	0.9%
Mercedes Benz	560SEC (8)	1,602	0.2%
Mercedes Benz	560SEL (8)	6,144	0.9%
Mercedes Benz	560SL (8)	10,030	1.4%
Mazda	626	70,578	10.0%
Saab	900 Turbo (5)	7,822	1.1%
Saab	900 (5)	12,117	1.7%
Saab	900S (5)	12,438	1.8%
Porsche	911 Cabriolet (4)	2,046	0.3%
Porsche	911 Coupe (4)	3,747	0.5%
Porsche	911 Turbo (4)	1,276	0.2%
Toyota	Camry	131,085	18.6%
Toyota	Celica	70,627	10.0%
Toyota	Corolla	92,341	13.1%
Acura	Legend	32,955	4.7%
Toyota	MR2	17,127	2.4%
Jaguar	XJ6	14,131	2.0%
		598,037	85%

* Numbers in parentheses indicate paired vehicles having a high degree of similarity with a large number of interchangable components

TABLE 5

IMPORTED VEHICLE SAMPLE DISTRIBUTION

MINI	SUBCOMPACT	COMPACT	INTERMEDIATE	LARGE
Porsche 911 Cabriolet (4)	Mazda 626	BMW 325 (2)	Acura Legend	Jaguar XJ6
Porsche 911 Coupe (4)	Mercedes Benz 560SL (8)	Toyota Camry	Audi 5000CS Turbo Quatro (	Mercedes Benz 300 (7)
Porsche 911 Turbo (4)	Saab 900 Turbo (5)		BMW 524 TD (3)	Mercedes Benz 300SDL Turbo (7)
Toyota MR2	Saab 900 (5)		BMW 528e (3)	Mercedes Benz 560SEC (8)
	Saab 900S (5)		BMW 535i/535iS (3)	Mercedes Benz 560SEL (8)
	Toyota Celica		Mercedes Benz 190	
	Toyota Corolla			

TABLE 6

Class	MINI	SUBCOMPACT	COMPACT	INTERMEDIATE	LARGE	TOTAL
(1) No. of Hi Theft Vehicles in Class	24,196	335,873	195,498	80,333	67,862	703,761
(2) No. of Vehicles in Sample	24,196	275,953	179,859	69,264	48,766	598,037
(3) Class, % Hi Theft (1)/2,266,539	3.44%	47.73%	27.78%	11.41%	9.64%	100.00%
(4) Sample, % Hi Theft (2)/2,266,53	3.44%	39.21%	25.56%	9.84%	6.93%	84.98%
(5) Sample as % Class (2)/(1)	100.00%	82.16%	92.00%	86.22%	71.86%	
(6) No. of models in Hi Theft	4	16	6	9	7	42
(7) No. of models in Sample	4	7	2	6	5	24

	JAPAN	GERMANY	ITALY	SWEDEN	U.K.	TOTAL
No. of Models in Hi Theft	10	24	1	5	2	42
No. of Models in Sample	6	14	0	5	1	24

3.0 COST SUMMARY

Costs for the two door and four door models are based on studies conducted at U.S. factories. Since all vehicles are labeled at time of assembly in specified locations it was assumed that costs are similar for domestic and imported models.

All costs are calculated in 1987 dollars.

	Variable Manufacturing Cost	Consumer Cost
Four-Door		
Lowest Cost Domestic	$2.46	$4.03
Highest Cost Domestic	$2.82	$4.62
Lowest Cost Import	$2.46	$4.03
Highest Cost Import	$3.31	$5.43
Two-Door		
Lowest Cost Domestic	$2.47	$4.05
Highest Cost Domestic	$2.82	$4.62
Lowest Cost Import	$2.16	$3.54
Highest Cost Import	$2.57	$4.21

4.0 COST ANALYSIS

The primary objective of this NHTSA study is to determine the costs to manufacturers as well as to purchasers of passenger cars, in complying with the Vehicle Theft Prevention Standard. The Motor Vehicle Theft Law Enforcement Act of 1984 requires that this cost information be obtained and included in the five year report to Congress.

4.1 MICRO-ANALYSIS

The cost of purchasing and applying tags was developed through Micro-Analysis, a process used by Pioneer on previous NHTSA studies.

The analysis assumes that each part is manufactured and installed by efficient, high volume methods with equipment typically used by large U.S. vehicle manufacturers and their suppliers. This procedure develops a much more accurate estimate of manufacturing cost than other "shortcut" methods based on material weight or other component part characteristics.

By performing an analysis of each part, Micro-Analysis identifies the following basic elements of variable manufacturing cost:

Material: The materials used for this study were the adhesive tags which are purchased by automobile manufacturers from Avery and 3M. Following is a list of the automanufacturers and the labels they use:

Automaker	Label
Chrysler Corporation	Avery
Ford Motor Company	3M
General Motors Corporation	Avery
BMW	German Made
All Other Imports	3M

Labor: The processes used to apply markings (adhesive labels, metal tags and metal part stampings) to designated locations were analyzed by manufacturing process engineers to identify required operations. This analysis determines the amount of time necessary to process them through the various operations. Total time multiplied by current labor rates generates the net labor content of the part cost.

1987 MICRO-ANALYSIS RESULTS

MANUFACTURER	MATERIAL	LABOR	BURDEN	SCRAP	VARIABLE MFG CST
GENERAL MOTORS (4 DR	1.32	0.48	0.72	0.00	2.52
GENERAL MOTORS (2 DR	1.10	0.40	0.60	0.00	2.10
CHRYSLER (4 DR)	1.32	0.46	0.68	0.00	2.46
CHRYSLER (2 DR)	1.10	0.38	0.57	0.00	2.05
FORD (4 DR)	1.62	0.48	0.72	0.00	2.82
FORD (2 DR)	1.35	0.40	0.60	0.00	2.35

EQUIPMENT COST: $2,000 each manufacturer per workstation

NOTE: Costs for the two door and four door models are representative of domestic and imported vehicles--all vehicles are labeled at time of assembly in specified locations. Therefore, it has been assumed for the purposes of this study that costs for applying anti-theft tags on domestic and imported vehicles are similar.

TABLE 7

Burden: The process analysis of each tag also includes determination of the equipment type required for each operation plus the cycle time required to perform the operation. Time required on each piece of equipment (commonly called occupancy time), multiplied by the burden rate for the equipment generates the burden cost applicable to each operation. The sum of these constitutes the manufacturing burden cost for all operations related to tag application.

The total *variable manufacturing cost* for each part is the sum of the *material, labor* and *variable burden* elements determined by Micro-Analysis.

The individual process elements, as determined by Micro-Analysis, are recorded for each tag. The worksheets, with the process data, are computer compiled from cost factors (such as labor rates and burden rates) contained in a data bank. This data processing capability effectively eliminates the potential for routine mathematical errors and greatly reduces the processing time. Printout sheets for this study are provided in Appendix "B."

Engines and Transmissions

Prior to the Theft Prevention Standard's requirement that 12 to 14 major passenger car parts, including engines and transmission, be marked with the VIN, Federal regulations did not require passenger car engines and transmissions to be marked. The automotive industry had established its own practice of marking engines and transmissions with the total VIN, a VIN derivative, or some other identifying number. The Theft Prevention Standard allowed manufacturers who were identifying engines and transmissions with the VIN derivative as of October 24, 1984 to continue to do so, otherwise manufacturers had to mark engines and transmissions with the full 17 digit VIN. Engines and transmissions are marked on the transfer line, at the country of origin.

The results of the Micro-Analysis are summarized in Table 7.

4.2 1987 MACRO-ANALYSIS

To calculate the consumer price of a component, it is first necessary to determine the cost to the retail dealer. This price consists of the component's variable manufacturing cost plus manufacturing related cost elements such as fixed burden, administration, research and development, profit, etc. The difference between variable manufacturing cost and wholesale price for a given manufacturer can be determined through Macro-Analysis. This process analyzes corporate financial statements--such as annual reports and 10K reports filed with the Securities and Exchange Commission--to separate ele-

1987 MACRO-ANALYSIS RESULTS

	FORD		GENERAL MOTORS		CHRYSLER	
TOTAL CONSOLIDATED CORPORATE SALES (IN MILLIONS)	$71,643.40	100.00%	$101,781.90	100.00%	$29,076.40	100.00%
1.0 COSTS OF OPERATION	$58,495.10	81.65%	$87,204.40	85.68%	$23,737.70	81.64%
2.0 DEPRECIATION	$1,814.20	2.53%	$3,417.50	3.36%	$463.70	1.59%
3.0 AMORTIZE SPECIAL TOOLS	$1,353.20	1.89%	$2,694.50	2.65%	$411.50	1.42%
4.0 SELLING & ADMINISTRATION	$3,281.40	4.58%	$5,896.10	5.79%	$1,643.30	5.65%
5.0 RETIREMENT PLANS	$498.30	0.70%	---	---	$470.30	1.62%
6.0 OPERATING INCOME	$6,201.20	8.66%	$2,569.40	2.52%	$2,179.70	7.50%
7.0 INTEREST EXPENSE	---	---	---	---	$170.20	0.59%
	========	======	========	======	========	======
	$71,643.40	100.00%	$101,781.90	100.00%	$29,076.40	100.00%

VARIABLE MANUFACTURING COST	$50,708.10	$67,184.30	$20,159.00
% MANUFACTURING VARIABLE COST	70.778%	66.008%	69.331%
FACTOR VARIABLE COST	1.4128	1.5149	1.4423

TOTAL CORPORATE SALES	$202,501.70
TOTAL VARIABLE MFG COST	$138,051.40
AVERAGE FACTOR VARIABLE COST	1.4667
AVERAGE % MFG VARIABLE COST	68.173%

TABLE 8

ments of variable manufacturing cost from the income received through the sale of manufactured goods. The ratio of *income from sales* to *variable costs* can then be applied to the estimated variable manufacturing cost for a component to provide a wholesale price estimate.

This ratio of variable manufacturing cost to wholesale price varies among industries and between companies within an industry. For this contract, the 1987 10K reports were evaluated for the companies that dominate the North American market--Ford, General Motors, and Chrysler.

This analysis established an average wholesale and estimated manufacturing cost. The variable cost portion of income from sales as determined through Macro-Analysis studies are illustrated in Table 8 based on 1987 values. The results of the analysis can be summarily stated as follows:

$$\frac{\text{Wholesale Price}}{\text{Variable Cost}} = \frac{\$202{,}501.70}{\$139{,}130.01} = 1.4555$$

A separate analysis based on figures from the *Automotive News 1988 Statistical Issue* established the average dealer profit margin as 13.1%.

The determination of consumer cost as it relates to variable cost is as follows:

[Consumer Cost] - [Dealer Cost] = Wholesale Cost
[Wholesale Cost] - [Corporate Cost] = Variable Cost

The following ratios apply in the development of the final consumer cost.

Consumer Cost = 1.131 x [Wholesale Cost]
Wholesale Cost = 1.45 x [Variable Cost]

Multiplying consumer cost by wholesale cost produces a figure which is the ratio of variable cost to consumer cost:

1.131 x 1.45 = 1.639

Consumer Cost = [Variable Cost] x 1.639

5.0 MARKING LOCATIONS

Parts selected by NHTSA to receive anti-theft markings are those which have been found to be frequently repaired or costly to replace. Vehicles are marked with their assigned vehicle identification number (VIN) at the time of assembly. All replacement parts are identified by a label that bears the marks "R" for replacement part and "DOT" for Department of Transportation. The manufacturer may add the corporate logo.

FMVSS 49 CFR 541 requires that the markings be permanent.

The standard states

> . . . labels are [to be] placed to provide protection from damage as a result of normal maintenance and exposure conditions while still being visible to investigators without further disassembly once the parts are removed from the vehicle.

These locations are illustrated graphically and with photographs in Appendix "C." The survey conducted showed that parts are marked in the same locations--U.S. cars only are used in these illustrations.

APPENDIX "A"

COST METHODOLOGY

MANUFACTURING COSTING METHODOLOGY

The methodology used in the development of manufacturing costs follow the standard cost estimating procedures used by Pioneer. This methodology is discussed below.

INITIAL EVALUATIONS

Manufacturing engineers analyze the part or assembly and list each of the manufacturing processes, or operations required to complete the fabrication cycle from the raw material to the finished product.

DETAILED PROCESSING AND COST ESTIMATING

Process engineers and cost estimators, under the direction of manufacturing engineers, conduct a detailed process and cost analysis for each part and assembly. All information developed during this analysis is recorded on the form shown in Figure 1. A Process/Cost Sheet is made out for each part and subassembly. The results are summarized to obtain the total assembly cost.

Two costs are developed in this process, variable cost and manufacturing cost. The variable cost contains only those costs associated with the manufacture of the part or assembly. Manufacturing cost consists of the variable cost plus fixed burden costs.

An example of the process and cost estimating process shown in Figure 1 is discussed in the following paragraphs. This is the manufacturing process sheet for forming a bumper face bar. The process sheet entries include all operations from straightening the sheet steel to the final forming of the bumper.

The column headings and other items of interest on the process sheet are:

- **OPER (Upper left corner)** — Each operation is coded in this column. For this part seven distinct operations are required and are coded 10 through 70.
- **VOL** — The production volume at which the items are being costed.
- **REQ** — The number of pieces per year required of the piece being costed. It is a product of VOL (Volume Per Year) and P/A (Pieces Per Assembly).
- **OPERATION DESCRIPTION** — Each distinct operation is described.
- **TYPE OF EQUIPMENT** — Capital Equipment employed in each operation.
- **M/P** — Number of men required for each operation.

ESTIMATING DEPARTMENT OPERATION SHEET

DRAWING DATE _____

VOL. 300,000 P/A REQ. 300,000

OPER	OPERATION DESCRIPTION	TYPE OF EQUIPMENT	M/P	PCS/HR. / MINS.	LABOR COST / LABOR RATE	OCC HOURS		BURDEN RATE	BURDEN COST	VAR COST / MFG COST	DIE MODEL $(000)	TOOLING $(000)H
10	Flex Roll & Apply Drawing	Flex		480	.1628		V	32.217	.0670	.2298	-0-	-0-
	Compound	Roll	4	.500	.3255	.00208	M	93.389	.1942	.3570		
20	Rough Blank	300 Ton		400	.0977		V	"	.0805	.1782	-0-	9
		Press	2	.300	.3255	.00250	M	"	.2335	.3312		
30	Draw (Use Automatic Unloader)	Toggle		400	.0488		V	"	.0805	.1293	7.5	72
		Press	1	.150	.3255	.00250	M	"	.2335	.2823		
40	Cam From Top & Bottom, Pierce Parking Lite	84x120"		400	.0977		V	"	.0805	.1782	-0-	62
	Openings & (9) Holes on Front Surface	SS Press	2	.300	.3255	.00250	M	"	.2335	.3312		
50	Cam Trim Both Ends, Flange (2) P/L	"		400	.0488		V	"	.0805	.1293	-0-	50
	Openings		1	.150	.3255	.00250	M	"	.2335	.2823		
60	Fin. Flg. (2) Openings, Pierce (2) Pkg. Slots			400	.0488		V	"	.0805	.1293	4.0	48
	& Cam Pierce, Bottom Attaching Holes		1	.150	.3255	.00250	M	"	.2335	.2823		
70	Finish Cam Cup Engs			400	.0977		V	"	.0805	.1782	4.5	43
			2	.300	.3255	.00250	M	"	.2335	.3312		
							V					
							M					
							V					
							M					
							V					
							M					
							V					
							M					
							V					
							M					
	NEXT OPER.						V					
	NEXT ASSY.						M					

SHT	COIL	GAGE	QUAL	MAT'L		PCS	ROUGH WT
X		121	DQ	HR	33" x 91" =	2	48.0724
				.950	Fine Grain		
					$.1571 X 48.0724 lbs.		7.5522
					(11.57# of Scrap	-	.1736
					@ .015 = .1736		7.3786
					Scrap Credit)		

COST PER LB .1571 MAT'L COST 7.3786

PART NAME
FACE BAR - FRONT BUMPER (1) REQUIRED

SKETCH - REMARKS VOLUME	TOOL COST	
TRY-OUT		
	284,160	00
	MACH. & FACILITIES	
EQUIP	2,050,000	00
INSTALLATION	164,000	00
FREIGHT	61,500	00
TOTAL	$2,275,500	00

TOTAL VAR LABOR & BURD	1.1523
TOTAL MFG LABOR & BURD	2.1975
MATERIAL	7.3786
SCRAP 1%	.0738
SET UP	
OTHER	
MARK UP 10%	
TOTAL VAR. COST	8.7047
TOTAL TRANS. COST	9.6499

$26.5 $284

KEY ☐ NON KEY ☐ VOL _____ UPC _____

PART NO 22010

T&FC / PP JOB NO. 2744 PEM-3-80-A PROCESS ENG V.H. DATE 3-10-81 SHT NO. 1

Figure 1

- **PCS PER HR/MINS**

  PCS/HR is the pieces produced per hour per operation.

  MINS is the minutes per piece to process one piece through each operation.

- **LABOR COST/RATE**

  LABOR COST is the direct labor dollars per piece.

  LABOR RATES is the direct labor dollars per minute (including fringes).

- **OCCU. HOURS**

  The time, in hours, that it takes to process the part through the operation. For example, if the production rate is 400 pieces per hour, the occupancy hours is one hour divided by 400 pieces per hour or .0025 hours per piece.

- **BURDEN RATE**

  There are two burden rate entries, "V" for Variable Burden Rate and "M" for Manufacturing Burden Rate. "V" includes set-up costs, in-bound freight, perishable production tools, and other miscellaneous costs that vary with volume changes. "M" includes variable and fixed burden. Fixed burden covers taxes, insurance, depreciation on capital equipment and building, maintenance costs that do not vary with volume. See Figure 6 for a more definitive list of burden factors for both variable and fixed.

- **BURDEN COST**

  Per piece burden cost is calculated by multiplying each burden rate by the occupancy hours.

- **VAR COST/MFG COST**

  VAR COST is the variable burden plus direct labor cost. MFG COST is the cost of each operation including direct labor, variable burden, and fixed burden.

- **DIE MODELS**

  Unique die models required for each operation.

- **TOOLING**

  Dies, fixtures and other special tooling required for each operation. Tooling and equipment costs are summarized in the lower middle section of the Process/Cost Sheet.

- **MATERIAL**

  Material is noted and cost calculated in the special box located on the lower left corner of the sheet. Column headings in this area are self-explanatory. The type of

material is determined in several ways; i.e., by specification on drawing, by chemical analysis, by contacting appropriate technical personnel responsible for material selection. Once the correct material specification is obtained appropriate sources are contacted to obtain the cost per pound of the material in the form and quantity required to produce the part.

●TOOLING COST SUMMARY

The total tooling cost for a given part is summarized in the lower middle section of the Process/Cost Sheet. The tooling cost is reported as a lump sum, leaving specific amortization up to the client. Tooling is an expense item and may be amortized in the year of use. Competitive economics, however, may preclude this move, so that a more extended amortization period may be used. Since this is a variable subject to the client's marketing strategy, tooling amortization is not a standard entry on these sheets. As a general rule, the automotive firms amortize major tools and dies over a three year period. Pioneer has reported consumer costs which include the amortized tooling cost, usually in summary documents, if requested by the client.

●EQUIPMENT COSTS

The lower middle section of the Process/Cost Sheet summarizes cost of equipment, equipment installation and freight, and the cost of all pieces of equipment required to meet the production schedule. For instance, if the annual requirement is 300,000 units, and shops work two shifts (4000 hours, or 250 days times 16 hours per day), the planning rate of production per operation is 93 units per hour (300,000/4,000/.8, inherent delay factor), and if the equipment selected for the particular process can only produce 50 pieces per hour, it is assumed that two such processes, or pieces of equipment, will be installed to meet the schedule.

●PART OR ASSEMBLY COST SUMMARY

Costs for producing the part are totaled in the lower right side of the form. The entries are:

TOTAL VARIABLE LABOR AND BURDEN -
Direct labor plus variable burden.

TOTAL MANUFACTURING LABOR AND BURDEN -
Direct labor, variable burden and fixed burden.

MATERIAL -
Total material cost.

SCRAP -
An allowance for scrap based on experience (% of Var. Cost).

MARKUP -
Since this is a part involving inter-divisional transfer, a markup is included.

TOTAL VARIABLE COST -
The sum of items (a), (c) and (d).

TOTAL TRANSFER COST -
The sum of (b), (c), (d) and (e). This part is obviously a very high material sensitive part since approximately 70% of the transfer cost is reflected in the cost of steel.

All subassembly and final assembly costs will also be developed on these process sheets.

A work flow chart illustrating the methodology used to build up assembly cost is presented in Figure 2.

Figure 3 presents a flow diagram of the cost build-up from basic cost items through consumer costs.

COST METHODOLOGY VIA COMPUTER PROGRAM

To permit more expeditious data processing, Pioneer uses a computer program to make all of the calculations discussed above.

Using the computer requires that the manufacturing engineer process the part being costed, select the equipment required, and define the operation cycle time. Figure 4 illustrates the Process/Cost Sheet prepared by the manufacturing engineer for the computer method. Note the equipment code specified for each operation. From this information the computer selects the appropriate labor and burden rates, as well as equipment costs. Using the cycle time specified on the Process/Cost Sheet for the given equipment code, the computer calculates the labor cost, occupancy hours, variable burden and manufacturing burden; it is also programmed to determine the multiples of a given machine required for an operation to produce the required number of pieces per hour. This is particularly important where costs are determined for a series of different production rates, where a process may not change from one rate to another, but only

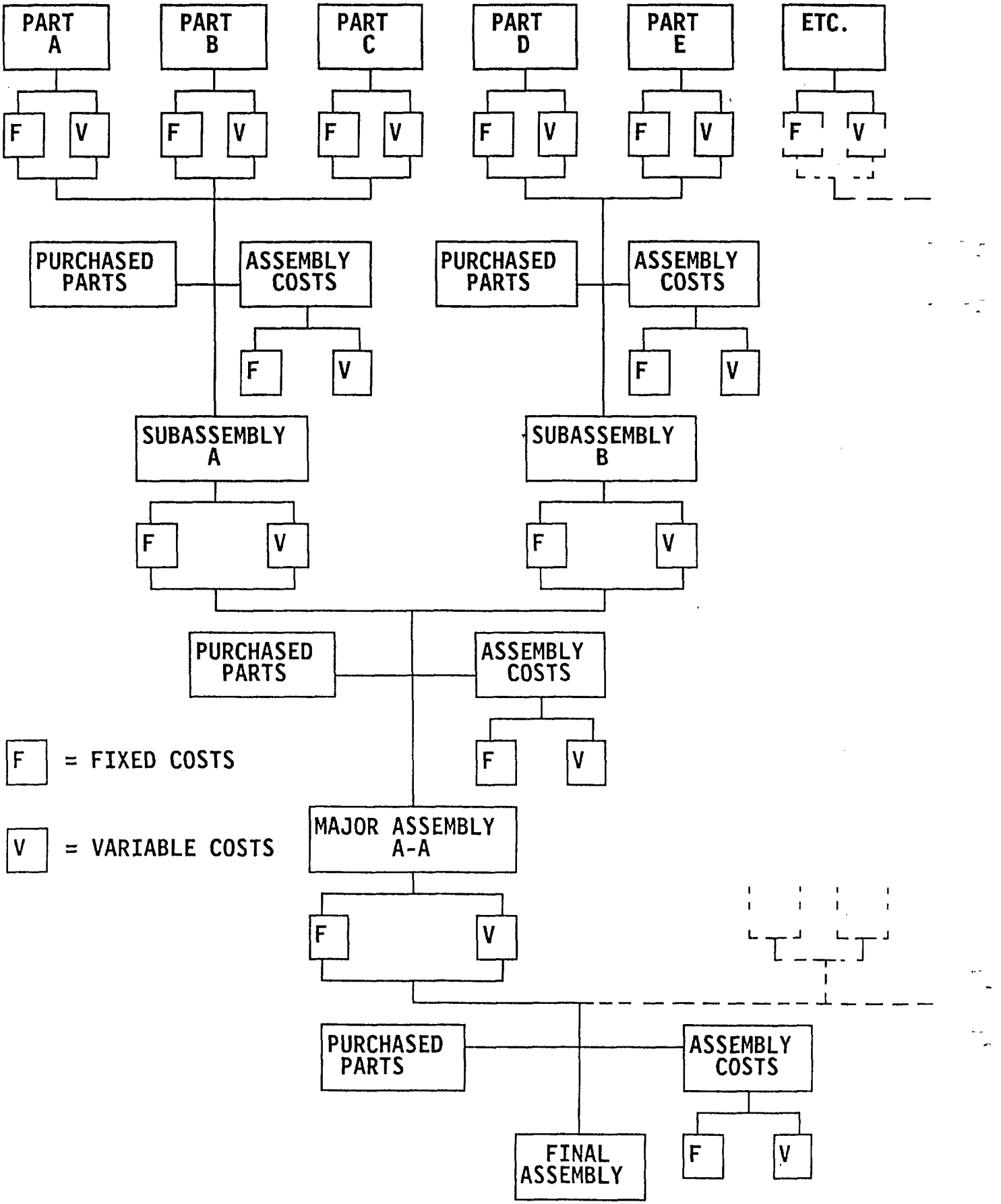

PART A
PART B
PART C
PART D
PART E
ETC.
F
V
PURCHASED PARTS
ASSEMBLY COSTS
SUBASSEMBLY A
SUBASSEMBLY B
MAJOR ASSEMBLY A-A
FINAL ASSEMBLY
F = FIXED COSTS
V = VARIABLE COSTS

FIGURE 2

DETERMINATION OF MANUFACTURING AND CONSUMER COST

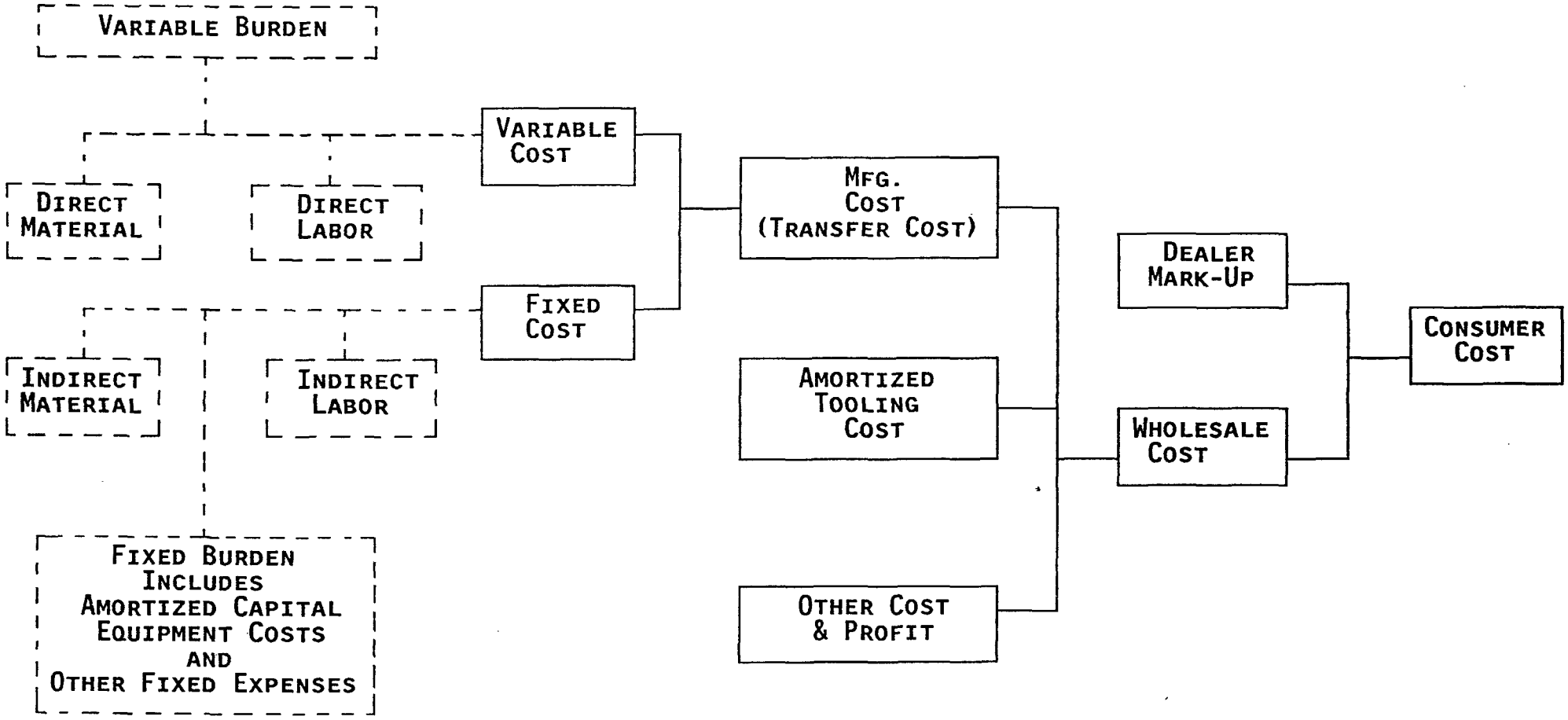


FIGURE 3

ESTIMATING DEPARTMENT OPERATION SHEET

DRAWING DATE N.A.

OPER	OPERATION DESCRIPTION (VOL. 400,000 P/A 1 REQ. 400,000)	TYPE OF EQUIPMENT	M / P	PCS/HR. / MINS.	LABOR COST / LABOR RATE	OCC HOURS	BURDEN RATE	BURDEN COST	VAR COST / MFG COST	DIE MODEL $(000)	TOOLING $100/UN
10	ROUGH BLANK FROM SHEET	801					V				
	AUTO LOAD & EJECK		1	.12			M				
20	DRAW COMPLETE	801					V				
	AUTO LOAD AND EJECT		1	.16			M				
	TURN PANEL OVER						V				
	AUTO ROLLOVER FIXT.		0	.16			M				
30	TRIM BINDER STOCK - PIERCE LOCK	801					V				
	& HANDLE HOLES - AUTOLOAD & EJECT		0	.16			M				
40	FORM HEM FLANGE - 3 SIDES & BELT	801					V				
	FLANGE - AUTO LOAD & EJECT		0	.16			M				
50	FINISH FORM BELT FLANGE	801					V				
	AUTO LOAD & EJECT		1	.16			M				
							V				
							M				
							V				
							M				
							V				
							M				
							V				
							M				
							V				
							M				
							V				
							M				
	NEXT OPER.						V				
	NEXT ASSY.						M				

SHT	COIL	GAGE	QUAL	MAT'L		PCS	ROUGH WT
✓		032	DQ	CRS	34.9 x 52.7	1	16.64
					RINGRO METAL		

COST PER LB .2935 MAT'L COST $4.91

PART NAME: DOOR - OUTER PANEL - IN/WHITE

SKETCH - REMARKS

VOLUME

TRY-OUT

INSTALLATION

FREIGHT

HAND. EQUIP.

TOOL COST

MACH. & FACILITIES

TOTAL VAR LABOR & BURD	
TOTAL MFG LABOR & BURD	
MATERIAL	
SCRAP 1%	
SET UP	
OTHER	
MARK UP 10%	
TOTAL VAR. COST	
TOTAL TRANS. COST	

KEY ☐ NON KEY ☐

VOL

UPC

PART NO

T&FC / PP

JOB NO. E-909

PEM-3-80-A

PROCESS ENG VH

DATE 1-27-81

DET NO.

Figure 4

one machine may satisfy the requirement instead of two at a greater requirement. The scrap material costs are computed and the total cost is calculated. The computer format sheet is illustrated in Figure 5.

Use of the computer permits error free accumulation of the total cost of a product, eliminating manual build-up or subassembly to final assembly costs. Other cost data manipulations and extractions are possible using the computer which are cost prohibitive if attempted manually.

BURDEN RATE DERIVATION

Pioneer does its cost estimating using the "Asset Center" burden approach as opposed to the more common, less demanding technique of deriving manufacturing cost by applying departmental or plant wide burden as a percentage of direct labor cost. The "Asset Center" approach is not normally used by most companies because it requires a more refined and sophisticated data collection system, the complexity of which is shunned by comptrollers. It is, however, more accurate and for this and many other reasons is the approach used by Pioneer. The following paragraphs review some of the philosophical rationale for using "Asset Center" burden rates.

Classically burden rates are historically determined-the burden rates for this year's projected costs are based on what was accumulated last year. The resultant burden rates are closely guarded secrets by most companies. The question could easily be asked, then, how does Pioneer-a consultant house-come to possess burden rates, especially in an "Asset Center" format?

Pioneer has been applying the "Asset Center" costing methodology for well over a decade. The costing personnel is, and has been, composed of individuals who have had significant, in depth, experience in costing and manufacturing, especially in the automotive industry. This depth of exposure has been harnessed to quantify the factors contributing to the operation of a nominal manufacturing facility. This process is tedious and time consuming, requiring a number of iterations to verify the choice of coefficients. The results are variable and manufacturing burden rates that are representative of a reasonably well managed production facility. These rates are for obvious reasons considered proprietary.

The evidence of the sufficiency of the burden rates has been two-fold. First, Pioneer has had the opportunity to compare its costs for various items directly with those produced for various companies by their personnel. These comparisons have been made on the level of labor, material, and burden cost, not merely an end item summary.

Second, Pioneer routinely does purchases analyses, that is, checking the cost being paid for purchased items. Where a Pioneer cost estimate is below the purchase cost, Pioneer has gone out to qualified vendors for new quotations. Literally millions of dollars have been saved by Pioneer clients where Pioneer costs have indicated that the purchase price should be lower than that being paid.

VOLUME- 400,000 P/A- 1
PART #- 1 DESC- DOOR - OUTER PANEL - IN/WHITE UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	DIE MODEL	TOOL $000
010	ROUGH BLANK FROM SHEET AUTO LOAD & EJECT	8D1	1.00	.12	.0381 .3174	.0020 V	66.12	.1322	.1703	0	.0
020	DRAW COMPL. AUTO LOAD, EJECT & TURNOVER	8D1	1.00	.16	.0508 .3174	.0027 V	66.12	.1785	.2293	0	.0
030	TRIM BINDER STK. & PIERCE LK. & HDL. HLS	8D1	.00	.16	.0000 .3174	.0027 V	66.12	.1785	.1785	0	.0
040	FORM HEM FLANGE 3 SIDES & BELT FLANGE	8D1	.00	.16	.0000 .3174	.0027 V	66.12	.1785	.1785	0	.0
050	FIN. FORM BELT FLANGE COMPLETE	8D1	1.00	.16	.0508 .3174	.0027 V	66.12	.1785	.2293	0	.0

ANNUAL REQ-	400,000		LAB MIN -	.4400	0
MAT CODE -			LABOR $ -	.1397	.0
COST/LB -	.294		BURDEN V-	.8462	
SCRAP FAC -	.0%				
ROUGH WT -	16.69		SCRAP -	.0000	TOTAL VAR 5.8928
FINAL WT -	10.40	OTHER- .00	MATERIAL-	4.9069	

Figure 5

As a result, Pioneer has gained confidence in the reliability of its "Asset Center" burden rates.

Figure 6 lists the factors that have been considered in the determination of the Pioneer burden rates. The ratio of application of these costs between fixed and variable burden are not shown inasmuch as this is considered proprietary.

COST METHODOLOGY VARIANCE

Estimating, as the name implies, is not an exact science, rigidly controlled by natural laws. There are variables. The variables are:

1. The method of manufacture of the part.
2. The skill of the estimator.
3. The applicable labor and burden rates used by the estimator.
4. The estimating methodology.

Each of these variables is capable of producing differences in cost estimates of the same part.

Much of estimating is based on judgment. The first variable, method of manufacture, is judgment dominated. How a part is to be made is conditioned by the estimator's background and work experiences. For example, because one estimator's background is stamping intensive, chances are his judgments (opinions), reflecting a higher degree of skill, will produce a highly reliable estimate of a sheet metal part. The same man, estimating a machined part, will not produce as reliable an estimate.

In many cases there is no single, best way to make a part. When the production volume is large enough to justify a double tool-up, for example, some manufacturers will deliberately tool the same part differently in order to gain operating experience in their search of optimum methods. For example: Today, door panels-both inner and outer-are produced singly by one automotive company, and doubly (two-at-a-time) by a competitor. In each case, production volumes are similar. What factors prompted these dissimilar tool-ups? Presumably, both methods were considered by each process engineer before the final choice. Each had to consider the "economics" of both methods. Is one "more right" than the other? What this illustrates is the flexibility inherent in the estimating process.

Some men, cautious by nature, will play it safe and "throw in two or three more operations".[1] This generosity is, in turn, compounded by the multiplier effect-three to five times-when the burden cost is applied.

From these examples, it is easy to see how estimating variances can occur in the first two variables.

[1]Operations = Steps in the manufacturing sequence.

PIONEER ENGINEERING & MANUFACTURING

BURDEN FACTORS

FIXED	VARIABLE
Salaries & Fringes	Salaries & Fringes
Maintenance Repair (Grounds & External Bldg.)	Maintenance Repair (Internal Bldg. & Production Equip.)
Welding Equipment	Welding Equipment
Material Handling	Material Handling
Non-Capitalized Project Expense	Power Tools
Preproduction Expense (set up as a fixed cost)	Expense Tools
	Set-Up
Dies (Maintenance)	Dies
Operating Supplies	Operating Supplies
Office Supplies	Office Supplies
	Welding Supplies
Janitor Supplies	Janitor Supplies
Misc. Supplies	Misc. Supplies
Heating	
Transportation	Transportation
Electric Power & Light (based on min. rate x usage set by utility)	Electric Power & Light
	Fuel
Water	Water
Communications (Wats)	
Plant Protection	
	Other Purchased Services (i.e. Kelly Girls)
Non-Production Freight	Non-Productive Freight
Company Car & Travel Expense	
Executive Fringes & Services	
State & Local Taxes	
Insurance	
Depreciation	
Pensions & Leaseholds	

Figure 6

The third variable, labor and burden rates, is the most abused element in cost estimating. The reason is that most estimators are excellent mechanics and engineers, know manufacturing techniques, but are poor financiers-most have only a rudimentary comprehension of how burden rates and burden costs are developed and applied. Their principal interest is in developing the manufacturing sequence, and specifying the equipment and tooling. Of second importance (interest) is the selection of the proper labor and burden rates. This step, performed almost casually by most estimators, is perhaps the most important in the estimating process because of the multiplier effect (most estimators calculate the burden cost of an operation by multiplying the direct labor cost by a burden percentage factor, usually two to eight times the labor cost).

Most manufacturing operations involve a single machine, such as a punch press, run by a single operator. To illustrate how the typical estimator develops a cost estimate, assume such a machine, run by a single operator, performing a forming operation, a sheet metal parts, 300 parts per hour are produced in this operation. The direct labor, therefore, is .2 minutes per part (60/300). Assuming a direct labor cost of $10.00 per hour, the labor cost for this operation comes to:

$$\frac{.2 \times \$10.00}{60} = \$0.33$$

The next step is the calculation of the burden or factory overhead. Estimating departments have a schedule of burden rates, a specific rate for a specific machine, developed by the plant comptroller.

One of the methods used in calculating burden is to multiply the direct labor cost for a given operating by a percentage factor: i.e., 300%, 400%, etc. These percentage factors are developed from historical data accumulated over a number of accounting periods. These factors usually are based on data covering a whole department (sometimes on data which is not broken down below that of a whole plant). Consequently, the factors can be influenced by departmental conditions not specifically related to the operation itself. Burden rates based on historical data can very easily include inefficiencies that get lost in the overall departmental or plant operation.

Burden costs developed as a percentage of labor are still related to the type of equipment. It should be noted that labor can vary relative to a piece of equipment depending upon the complexity of the part and specific operation performed, but the burden remains the same. As an illustration of this and expanding on the example discussed above:

Labor Cost ($.033) x Burden Factor (300%) = $.099.

The combined labor and burden cost for this operation, then is $.033 + $.099 = $.132.

Assume in our example that a second man, a helper, is required to man the stamping press. The labor cost now becomes $.006 per operation per part. The unwary estimator will often assume that the burden cost should then be 300% x .066, or $.198.

This is obviously false since the overhead doesn't double simply because another man has been added. Only the incremental costs, in this situation, associated with addition of the second man should be added to the base cost calculated earlier. The estimator should "up the cost" of the operation by only the direct labor cost of the second man ($.033). The burden cost would remain as it was when one man operated the press. The new cost for the press operation, now manned by an operator and a helper is:

$$\$.033 + \$.033 + \$.099 = \$.165.$$

Another problem which occurs frequently in estimating is the application of burden to an unmanned manufacturing operation. For example, assume a sequence of six press operations required to make a stamping. The first, or blanking operation, required two operators to remove the blank, dope it with lubricant and insert it in the draw die of the following operation, making sure that the two blanks have not stuck together (a double blank could wreck the draw die). The next three operations are loaded and unloaded mechanical, the part is even inverted between operations thee and four, all without operator intervention. The final operation, a cam-piercing operation, requires one operator who removes the part, applies a dab of paint for identification and hangs the part onto a conveyor.

What cost does the estimator assign to each operation? If he is using the burden percentage method, there is no problems with the first and final operations since these have operators. The estimator simply calculates the direct labor cost for each of these, then multiplies these by the burden percentage rates to obtain the burden cost, making sure, of course, that he has not doubled the burden cost in the first operation which has two operators.

The problem arises when the estimator tries to apply his formula to those operations which are unmanned. There is no direct labor cost, nothing he can multiply by his burden percentage rate. The unwary estimator will frequently assume that since there is no labor cost there can be no burden cost.

We know this to be false since all of the burden elements-with the exception of fringe benefits-are still there whether an operator is present or not.

Another method of burden cost calculation used by Pioneer is the "Burden Center" concept. Whereas the "Burden Percentage" method covers a full department, sometimes an entire plant, the "Burden Center" approach considers a much smaller entity: a single machine plus only those expenses directly associated with the operation of the machine. These expenses are both variable (expenses which vary with product volume changes) and fixed (expenses which are unaffected by volume changes).

Typical variable expenses considered in burden would be (this is not a complete list):

- -- Indirect Labor
- -- Perishable Tools
- -- Fuel
- -- Maintenance
- -- Fringe Benefits
- -- Utilities

Typical fixed and non-variable expenses would be:

- -- Taxes
- -- Amortization
- -- Some Clerks & Janitors
- -- Insurance
- -- Some Supervision
- -- Some Utility Bills

A pro rata share of each of these elements is assigned to each burden center. The result is a carefully developed, localized cost for a specific machine or other asset, reflecting only those expenses unique to that machine. These costs are stated in "dollars per machine hour" giving rise to the expression: Machine Hour Rate.

"Burden Center" rates can be generated by historical data, or they can be developed from equipment specifications and requirements for power, lubrication, light, heat, indirect labor, average maintenance, material handling, and other costs required to keep the equipment operating. The latter method of burden development is beneficial when developing costs for a new plant or facility where historical data has not been developed. Another advantage in the latter approach is that nominal burden costs can be developed around nominal equipment production rates.

Costs developed around nominal production rates for a piece of equipment are an important consideration when assessing production costs. For example, a piece of equipment has a theoretical production rate for which it is designed. This theoretical rate may not be achieved because of inherent equipment and human operational conditions. However, "nominal" rates have been established through experience of an acceptable "efficient" plant. Well managed plants can achieve these nominal rates. All costs analyses should be developed around burden rates based on "nominal" production standards. Costs developed with burden rates established with other than nominal standards should not be used for comparison because they include variances in production inefficiencies and do not have a common base. Pioneer costs are established around nominal production rates.

There are other cost methodologies. One such method uses the cost-per-pound approach. Under this method, the parts of a car, for example, are grouped by classes of material: steel stampings, castings, forging, molded plastics, etc. The cost of each part is divided by its finished weight, and a cost-per-pound obtained: a "meat market" approach. Pioneer does not endorse this method because of its dependence on a

straight-line relationship between weight and cost. For example, if a seven-pound brake drum cost $3.50, will a nine-pound drum cost $4.50? ($.50 per pound). Unlikely. The labor and burden will remain essentially the same for each size of drum, but the material cost, obviously, will be different. In spite of its imprecision, the method has some utility: as a "rough-and-dirty" indicator of approximate cost, as a crude verification that the estimate is "in the ball park".

APPENDIX "B"

MICRO-ANALYSIS COST SHEETS

APPENDIX "B"
VEHICLE COST STUDY

NOTE: All costs represent
1987 dollars.

GENERAL MOTORS
4 DOOR

NHTSA ANTI-THEFT TAGS--GM 4-DOOR

LV	PART #	DESC - TRUNCATED	SUB-ASSEMBLY COST	PURCH PARTS COST	* * * * * MANUFACTURED PARTS * * * * * ASSEMBLY COST	MATERIAL COST	LABOR COST	BURDEN COST	SCRAP COST	M-TOTAL COST	** TOTAL * COST *
00	1000	GM ANTI-THEFT TAGS (4-DOO		1.32			.48	.72		1.20	2.52
01	21508-01	TAG INSTALLATION (4-DOOR					.48	.72		1.20	1.20
01	21508-00	TAG (12 @ $0.110 EA)		1.32							1.32
TAL	1000	GM ANTI-THEFT TAGS (4-DOO		1.32			.48	.72		1.20	2.52

EQUIPMENT - 1A DESCRIPTION - SMALL PARTS & BENCH ASM.

VOLUME	PART NUMBER	OPR	DESCRIPTION	ANNUAL	OCC HRS	TOT HRS	EQUIPMENT COST	TOTAL EQUIP COST
250,000	21508-01	010 TAG	INSTALLATION (4-DOOR MODEL)	250,000	.0125	3125.0		
250,000	21508-01	020 TAG	INSTALLATION (4-DOOR MODEL)	250,000	.0125	3125.0		
							1,000	2,000

TOTAL EQUIPMENT COST 2,000

VOLUME- 250000 INDENTED BILL OF MATERIAL

PARENT	COMPONENT	DESCRIPTION	QTY	MFG COST	ASSY COST
1000		GM ANTI-THEFT TAGS (4-DOOR MODEL)		2.52	.00
1	21508-01	TAG INSTALLATION (4-DOOR MODEL)	1.0	1.20	
1	21508-00	TAG (12 @ $0.110 EA)	1.0	1.32	
		TOTAL FOR GM ANTI-THEFT TAGS (4-DOOR MODEL)		2.52	.00

RTG21X PROJECT - 8L BILL OF MATERIAL WITH COST 11.28.32 3/16/89
JOB NR. - 21508

VOLUME - 250,000 PART - 1000 DESC - GM ANTI-THEFT TAGS (4-DOOR MODEL) CAPTIVE

COMPONENT	DESC - TRUNCATED / TOOLING	QTY / WEIGHT	MATERIAL	LAB MIN	LABOR $	BURDEN	SCRAP	MARK-UP	TOT COST
21508-01	TAG INSTALLATION (4-	1	.000	1.50	.48	.34V	.00V		.82 *
CAPTIVE	.0	.0000				.72M	.00M	.00	1.20
21508-00	TAG (12 @ $0.110 EA)	1	1.320	.00	.00	.00V	.00V		
PURCHASED	.0	.0000				.00M	.00M	.00	1.32 *
COMPONENT TOTAL COST		.0000	1.32	1.50	.48	.34V	.00V		2.14
	.0					.72M	.00M	.00	2.52
ASSEMBLY COST			.00	.00	.00	.00V	.00V		.00
	.0					.00M	.00M	.00	.00
TOTAL COST		.0000	1.32	1.50	.48	.34V	.00V		2.14
						.72M	.00M	.00	2.52

TOOLING .0

EQUIPMENT 2,000

INDENTED BILL OF MATERIAL

PROJECT NAME	ASM. NAME	VOLUME
NHTSA ANTI-THEFT RFID TAGS	SII ANTI-THEFT TAGS	250,000

— PART NAME —	— PART NO. —	QTY	ASM	REMARKS
0 1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8			
	1000	1		
	21508-01	1		
	21508-00	1		

	JOB NO.	ENGINEER	DATE	ASM. NO.	PAGE
DU	21508	HD	03/23/98	1000	PAGE 1 OF 1

PEM 12-83 DF

RTG014 PROJECT - 8L MANUFACTURING COST ANALYSIS 11.28.57 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 1000 DESC- GM ANTI-THEFT TAGS (4-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ- 250,000 LAB MIN - .00
MAT CODE - ASSEMBLY ECON YR-LOC LABOR $ - .00
COST/LB - .000 PT TYPE - CAPTIVE BURDEN V- .00 TOOL $000 .0
SCRAP FAC - .0% MARK-UP FAC- 0.0% BURDEN M- .00
ROUGH WT - .0000 MARK-UP - .0000 SCRAP - .00 TOTAL VAR .00
FINAL WT - .0000 OTHER - .000 MATERIAL- .000 TOTAL MFG .00

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	1000	GM ANTI-THEFT TAGS	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___ %	___ %	▭ / ▭ (C crossed)

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
						SKETCH

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE	PAGE	PART NO.
		1973		11	HD	02/23/88	1 OF 1	1000

PEM 6-83 DF

VOLUME- 250,000 P/A- 1
PART #- 21508-01 DESC- TAG INSTALLATION (4-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING
010		1A	1.0	.750	.24	.0125	13.73	.17V	.41V	.0
					.3177		28.70	.36M	.60M	
020		1A	1.0	.750	.24	.0125	13.73	.17V	.41V	.0
					.3177		28.70	.36M	.60M	

ANNUAL REQ-	250,000			LAB MIN -	1.50		
MAT CODE -	ASSEMBLY	ECON YR-LOC		LABOR $ -	.48		
COST/LB -	.000	PT TYPE -	CAPTIVE	BURDEN V-	.34	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.72		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	.82
FINAL WT -	.0000	OTHER -	.000	MATERIAL-	.000	TOTAL MFG	1.20

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	21508-01	TAG INSTALLATION	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___ %	___ %	☐ / ☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
10	REMOVE TAG FROM BACKING SHEET VERIFY NUMBER WITH VIN	1A	1	~~1.0~~		
	WIPE AREA BEFORE PLACING ADHESIVE TAG ON ~~(8)~~ 6 LOCATIONS ON CAR			.75		
	— 2ND OPERATOR —					
20	REMOVE TAGS FROM BACKING SHEET VERIFY NUMBER WITH VIN	1A	1	1.0		SKETCH
	WIPE AREA BEFORE PLACING ADHESIVE TAG ON (6) LOCATIONS OF CAR					

NEXT ASM.	DWG. DATE	JOB NO		ENGINEER	DATE	PAGE	PART NO.
		21508	DH	HD	08/23/93	1 OF 1	21508-01

PEM 6-83 DF

RTG014 PROJECT - 8L MANUFACTURING COST ANALYSIS 11.28.57 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-00 DESC- TAG (12 @ $0.110 EA) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000			LAB MIN -	.00		
MAT CODE -	PAPER	ECON YR-LOC		LABOR $ -	.00		
COST/LB -	.000	PT TYPE -	PURCHASED	BURDEN V-	.00	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.00		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	1.32
FINAL WT -	.0000	OTHER -	1.320	MATERIAL-	1.320	TOTAL MFG	1.32

GENERAL MOTORS
2 DOOR

NHTSA ANTI-THEFT TAGS--GM 2-DOOR

LV	PART #	DESC - TRUNCATED	SUB-ASSEMBLY COST	PURCH PARTS COST	* * * * * MANUFACTURED PARTS * * * * * * ASSEMBLY COST	MATERIAL COST	LABOR COST	BURDEN COST	SCRAP COST	M-TOTAL COST	** TOTAL * COST *
00	1000	GM ANTI-THEFT TAGS (2-DOO		1.10			.40	.60		1.00	2.10
01	21508-01	TAG INSTALLATION (2-DOOR					.40	.60		1.00	1.00
01	21508-00	TAG (10 @ $0.110 EA)		1.10							1.10
TOTAL	1000	GM ANTI-THEFT TAGS (2-DOO		1.10			.40	.60		1.00	2.10

PIONEER ENGINEERING
EQUIPMENT WHERE USED

3/14/89

RTGX11 PROJECT- 8T 21508
JOB NR.- 21508

16.59.04

EQUIPMENT - 1A DESCRIPTION - SMALL PARTS & BENCH ASM.

VOLUME	PART NUMBER	OPR	DESCRIPTION	ANNUAL	OCC HRS	TOT HRS	EQUIPMENT COST	TOTAL EQUIP COST
250,000	21508-01	010	TAG INSTALLATION (2-DOOR MODEL)	250,000	.0125	3125.0		
250,000	21508-01	020	TAG INSTALLATION (2-DOOR MODEL)	250,000	.0083	2075.0		
							1,000	2,000

TOTAL EQUIPMENT COST 2,000

RTG21X PROJECT - 8T BILL OF MATERIAL WITH COST 11.32.05 3/16/89
JOB NR. - 21508

VOLUME - 250,000 PART - 1000 DESC - GM ANTI-THEFT TAGS (2-DOOR MODEL) CAPTIVE

COMPONENT	DESC - TRUNCATED / TOOLING	QTY / WEIGHT	MATERIAL	LAB MIN	LABOR $	BURDEN	SCRAP	MARK-UP	TOT COST	
21508-01	TAG INSTALLATION (2-	1	.000	1.25	.40	.28V	.00V		.68	*
CAPTIVE	.0	.0000				.60M	.00M	.00	1.00	
21508-00	TAG (10 @ $0.110 EA)	1	1.100	.00	.00	.00V	.00V			
PURCHASED	.0	.0000				.00M	.00M	.00	1.10	*
COMPONENT TOTAL COST		.0000	1.10	1.25	.40	.28V	.00V		1.78	
	.0					.60M	.00M	.00	2.10	
ASSEMBLY COST			.00	.00	.00	.00V	.00V		.00	
	.0					.00M	.00M	.00	.00	
TOTAL COST		.0000	1.10	1.25	.40	.28V	.00V		1.78	
						.60M	.00M	.00	2.10	

TOOLING .0

EQUIPMENT 2,000

INDENTED BILL OF MATERIAL

PROJECT NAME	ASM. NAME	VOLUME
NHTSA ANTI-THEFT AUTO TAGS	GM ANTI-THEFT TAGS	250,000

— PART NAME —	— PART NO. —	QTY	ASM	REMARKS
	1000	1		
	21508-01	1		
	21508-00	1		

		JOB NO.	ENGINEER	DATE	ASM. NO.	
	DU	21508	HD	03/23/88	1000	PAGE 1 OF 1

PEM 12-83 DF

RTG014 PROJECT - 8T MANUFACTURING COST ANALYSIS 11.32.29 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 1000 DESC- GM ANTI-THEFT TAGS (2-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000					LAB MIN -	.00			
MAT CODE -	ASSEMBLY	ECON YR-LOC				LABOR $ -	.00			
COST/LB -	.000	PT TYPE	- CAPTIVE			BURDEN V-	.00		TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-			0.0%	BURDEN M-	.00			
ROUGH WT -	.0000	MARK-UP	-		.0000	SCRAP -	.00		TOTAL VAR	.00
FINAL WT -	.0000	OTHER	-		.000	MATERIAL-	.000		TOTAL MFG	.00

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	1000	GM ANTI-THEFT TAGS	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___ %	___ %	☐ / ☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
						SKETCH

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE	PAGE	PART NO.
		21003		211	HD	08/23/83	1 OF 1	1000

PEM 6-83 DF

RTG014 PROJECT - 8T MANUFACTURING COST ANALYSIS 11.32.29 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-01 DESC- TAG INSTALLATION (2-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING
010		1A	1.0	.750	.24	.0125	13.73	.17V	.41V	.0
					.3177		28.70	.36M	.60M	
020		1A	1.0	.500	.16	.0083	13.73	.11V	.27V	.0
					.3177		28.70	.24M	.40M	

ANNUAL REQ-	250,000			LAB MIN -	1.25		
MAT CODE -	ASSEMBLY	ECON YR-LOC		LABOR $ -	.40		
COST/LB -	.000	PT TYPE -	CAPTIVE	BURDEN V-	.28	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.60		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	.68
FINAL WT -	.0000	OTHER -	.000	MATERIAL-	.000	TOTAL MFG	1.00

ESTIMATING DEPARTMENT — OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	21508-01	TAG INSTALLATION	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE (V / C)
	060					___ %	___ %	V ☐ C ☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
	1ST OPERATOR					
10	REMOVE TAG FROM BACKING SHEET VERIFY NUMBER WITH VIN	1A	1	~~1.0~~		
	WIPE AREA BEFORE PLACING ADHESIVE TAG ON ~~(8)~~ (6) LOCATIONS ON CAR			.750		
	2ND OPERATOR					
20	REMOVE TAGS FROM BACKING SHEET VERIFY NUMBER WITH VIN	1A	1	~~1.0~~		SKETCH
	WIPE AREA BEFORE PLACING ADHESIVE TAG ON ~~(6)~~ 4 LOCATIONS OF CAR			~~.50~~		

NEXT ASM.	DWG. DATE	JOB NO			ENGINEER	DATE	PAGE	PART NO.
		2150B		DU	HD	08/23/93	1 OF 1	21508-01

PEM 6-83 DF

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RTG014 PROJECT - 8T MANUFACTURING COST ANALYSIS 11.32.29 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-00 DESC- TAG (10 @ $0.110 EA) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000			LAB MIN -	.00		
MAT CODE -	PAPER	ECON YR-LOC		LABOR $ -	.00		
COST/LB -	.000	PT TYPE -	PURCHASED	BURDEN V-	.00	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.00		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	1.10
FINAL WT -	.0000	OTHER -	1.100	MATERIAL-	1.100	TOTAL MFG	1.10

PURCHASED PARTS LIST - JOB NO. 21508

VOLUME	PART NO.	PART NAME	PCS. REQ'D	MAT'L. CODE	COST/ PIECE	FIN.WT. / PIECE	TOOLING COST	✓ VEN.	✓ HOUSE	COMMENTS
250.0	21508-00	~~1AG (14 @ $0.110 EA)~~	1	029	~~1.540~~					
		10			1.10					

CHRYSLER MOTORS
4 DOOR

NHTSA ANTI-THEFT TAGS--CHRYSLER 4-DOOR

LV	PART #	DESC - TRUNCATED	SUB-ASSEMBLY COST	PURCH PARTS COST	ASSEMBLY COST	* * * * * MANUFACTURED PARTS * * * * * * MATERIAL COST	LABOR COST	BURDEN COST	SCRAP COST	M-TOTAL COST	** TOTAL * COST *
00	1000	CHRYSLER ANTI-THEFT TAGS		1.32			.46	.68		1.14	2.46
01	21508-02	TAG INSTALLATION					.46	.68		1.14	1.14
01	21508-00	TAG (12 @ $0.110 EA)		1.32							1.32
TOTAL	1000	CHRYSLER ANTI-THEFT TAGS		1.32			.46	.68		1.14	2.46

EQUIPMENT - 1A DESCRIPTION - SMALL PARTS & BENCH ASM.

VOLUME	PART NUMBER	OPR	DESCRIPTION	ANNUAL	OCC HRS	TOT HRS	EQUIPMENT COST	TOTAL EQUIP COST
250,000	21508-02	010	TAG INSTALLATION	250,000	.0120	3000.0		
250,000	21508-02	020	TAG INSTALLATION	250,000	.0120	3000.0		
							1,000	2,000

TOTAL EQUIPMENT COST 2,000

VOLUME- 250000 INDENTED BILL OF MATERIAL

PARENT	COMPONENT	DESCRIPTION	QTY	MFG COST	ASSY COST
1000		CHRYSLER ANTI-THEFT TAGS (4-DOOR MODEL)		2.46	.00
1	21508-02	TAG INSTALLATION	1.0	1.14	
1	21508-00	TAG (12 @ $0.110 EA)	1.0	1.32	
		TOTAL FOR CHRYSLER ANTI-THEFT TAGS (4-DOOR MODEL)		2.46	.00

VOLUME - 250,000 PART - 1000 DESC - CHRYSLER ANTI-THEFT TAGS (4-DOOR MODEL) CAPTIVE

COMPONENT	DESC - TRUNCATED / TOOLING	QTY / WEIGHT	MATERIAL	LAB MIN	LABOR $	BURDEN	SCRAP	MARK-UP	TOT COST
21508-02 CAPTIVE	TAG INSTALLATION .0	1 .0000	.000	1.44	.46	.32V .68M	.00V .00M	.00	.78 * 1.14
21508-00 PURCHASED	TAG (12 @ $0.110 EA) .0	1 .0000	1.320	.00	.00	.00V .00M	.00V .00M	.00	1.32 *
COMPONENT TOTAL COST		.0000	1.32	1.44	.46	.32V .68M	.00V .00M	.00	.78 2.46
ASSEMBLY COST			.00	.00	.00	.00V .00M	.00V .00M	.00	.00 .00
TOTAL COST		.0000	1.32	1.44	.46	.32V .68M	.00V .00M	.00	.78 2.46

TOOLING .0

EQUIPMENT 2,000

INDENTED BILL OF MATERIAL

PROJECT NAME	ASM. NAME	VOLUME
NHTSA ANTI-THEFT AUTO TAGS	CHRYSLER ANTI-THEFT TAGS	250,000

— PART NAME —	— PART NO. —	QTY	ASM	REMARKS
	1000	1		
	21508-02	1		
	21508-00	1		

	JOB NO.	ENGINEER	DATE	ASM. NO.	PAGE OF
DU	21508	HD	08/23/83	1000	PAGE 1 OF 1

PEM 12-83 DF

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RTG014 PROJECT - 8N MANUFACTURING COST ANALYSIS 11.31.34 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 1000 DESC- CHRYSLER ANTI-THEFT TAGS (4-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000					LAB MIN -		.00		
MAT CODE -	ASSEMBLY	ECON YR-LOC				LABOR $ -		.00		
COST/LB -	.000	PT TYPE	- CAPTIVE			BURDEN V-		.00	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-			0.0%	BURDEN M-		.00		
ROUGH WT -	.0000	MARK-UP	-		.0000	SCRAP -		.00	TOTAL VAR	.00
FINAL WT -	.0000	OTHER	-		.000	MATERIAL-		.000	TOTAL MFG	.00

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	1000	CHRYSLER ANTI-THEFT TAGS	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V C
	060					___ %	___ %	☐ ☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
						SKETCH

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE		PART NO.
		21508		DU	HD	08/23/88	PAGE 1 OF 1	1000

PEM 6-83 DF

89

RTG014 PROJECT - 8N MANUFACTURING COST ANALYSIS 11.31.34 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-02 DESC- TAG INSTALLATION UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING
010		1A	1.0	.720	.23	.0120	13.73	.16V	.39V	.0
					.3177		28.70	.34M	.57M	
020		1A	1.0	.720	.23	.0120	13.73	.16V	.39V	.0
					.3177		28.70	.34M	.57M	

ANNUAL REQ-	250,000			LAB MIN -	1.44		
MAT CODE -	ASSEMBLY	ECON YR-LOC		LABOR $ -	.46		
COST/LB -	.000	PT TYPE -	CAPTIVE	BURDEN V-	.32	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.68		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	.78
FINAL WT -	.0000	OTHER -	.000	MATERIAL-	.000	TOTAL MFG	1.14

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	21508-02	TAG INSTALLATION	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___ %	___ %	☐ / ☒

OPER	OPERATION DESCRIPTION	EQUIP CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
10	REMOVE TAG FROM BACKING SHEET	1A	1	1.0		
	VERIFY NUMBER WITH V.I.N WIPE AREA BEFORE			.72		
	PLACING ADHESIVE TAG ON 6 LOCATIONS ON CAR					
	8					
	— 2ND OPERATOR —					
20	REMOVE TAGS FROM BACKING SHEET	1A	1	1.0		SKETCH
	VERIFY NUMBER WITH VIN WIPE AREA BEFORE PLACING ADHESIVE TAG ON 6 LOCATIONS OF CAR			.72		

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE		PART NO.
		21508		DU	HD	08/23/88	PAGE 1 OF 1	21508-02

PEM 6-83 DF

RTG014 PROJECT - 8N MANUFACTURING COST ANALYSIS 11.31.34 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-00 DESC- TAG (12 @ $0.110 EA) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000					LAB MIN -	.00			
MAT CODE -	PAPER	ECON YR-LOC				LABOR $ -	.00			
COST/LB -	.000	PT TYPE -	PURCHASED			BURDEN V-	.00		TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-			0.0%	BURDEN M-	.00			
ROUGH WT -	.0000	MARK-UP -			.0000	SCRAP -	.00		TOTAL VAR	1.32
FINAL WT -	.0000	OTHER -			1.320	MATERIAL-	1.320		TOTAL MFG	1.32

PURCHASED PARTS LIST - JOB NO. 21508

VOLUME	PART NO.	PART NAME	PCS. REQ'D	MAT'L. CODE	COST/ PIECE	FIN.WT. / PIECE	TOOLING COST	✓ VEN.	✓ HOUSE	COMMENTS
250.0	21508-00	TAG (12 @ $0.110 EA)	1	029	1.320					

CHRYSLER MOTORS
2 DOOR

NHTSA ANTI-THEFT TAGS--CHRYSLER 2-DOOR

LV	PART #	DESC - TRUNCATED	SUB-ASSEMBLY COST	PURCH PARTS COST	* * * * * MANUFACTURED PARTS * * * * * * ASSEMBLY COST	MATERIAL COST	LABOR COST	BURDEN COST	SCRAP COST	M-TOTAL COST	** TOTAL * COST *
00	1000	CHRYSLER ANTI-THEFT TAGS		1.10			.38	.57		.95	2.05
01	21508-02	TAG INSTALLATION					.38	.57		.95	.95
01	21508-00	TAG (10 @ $0.110 EA)		1.10							1.10
TOTAL	1000	CHRYSLER ANTI-THEFT TAGS		1.10			.38	.57		.95	2.05

PIONEER ENGINEERING
EQUIPMENT WHERE USED

3/14/89

RTGX11 PROJECT- 8V 21508
JOB NR.- 21508

16.59.24

EQUIPMENT - 1A DESCRIPTION - SMALL PARTS & BENCH ASM.

VOLUME	PART NUMBER	OPR	DESCRIPTION	ANNUAL	OCC HRS	TOT HRS	EQUIPMENT COST	TOTAL EQUIP COST
250,000	21508-02	010	TAG INSTALLATION	250,000	.0120	3000.0		
250,000	21508-02	020	TAG INSTALLATION	250,000	.0080	2000.0		
							1,000	2,000

TOTAL EQUIPMENT COST 2,000

RTG036 PROJECT - 8V PIONEER ENGINEERING 11.18.11 PAGE 1
JOB NR. - 21508
VOLUME- 250000 INDENTED BILL OF MATERIAL

PARENT	COMPONENT	DESCRIPTION	QTY	MFG COST	ASSY COST
1000		CHRYSLER ANTI-THEFT TAGS (2-DOOR MODEL)		2.05	.00
1	21508-02	TAG INSTALLATION	1.0	.95	
1	21508-00	TAG (10 @ $0.110 EA)	1.0	1.10	
		TOTAL FOR CHRYSLER ANTI-THEFT TAGS (2-DOOR MODEL)		2.05	.00

VOLUME - 250,000 PART - 1000 DESC - CHRYSLER ANTI-THEFT TAGS (2-DOOR MODEL) CAPTIVE

COMPONENT	DESC - TRUNCATED TOOLING	QTY WEIGHT	MATERIAL	LAB MIN	LABOR $	BURDEN	SCRAP	MARK-UP	TOT COST
21508-02 CAPTIVE	TAG INSTALLATION .0	1 .0000	.000	1.20	.38	.27V .57M	.00V .00M	.00	.65 * .95
21508-00 PURCHASED	TAG (10 @ $0.110 EA) .0	1 .0000	1.100	.00	.00	.00V .00M	.00V .00M	.00	1.10 *
COMPONENT TOTAL COST		.0000	1.10	1.20	.38	.27V .57M	.00V .00M	.00	1.75 2.05
ASSEMBLY COST			.00	.00	.00	.00V .00M	.00V .00M	.00	.00 .00
TOTAL COST		.0000	1.10	1.20	.38	.27V .57M	.00V .00M	.00	1.75 2.05

TOOLING .0

EQUIPMENT 2,000

INDENTED BILL OF MATERIAL

PROJECT NAME	ASM. NAME	VOLUME
NHTSA ANTI-THEFT LWD TAGS	CHRYSLER ANTI-THEFT TAGS	250,000

— PART NAME —	— PART NO. —	QTY	ASM	REMARKS
	1000	1		
	21508-02	1		
	21508-00	1		

	JOB NO.	ENGINEER	DATE	ASM. NO.	PAGE OF
DU	[illegible]03	[illegible]	08/23/22	1000	PAGE 1 OF 1

PEM 12-83 DF

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RTG014 PROJECT - 8V MANUFACTURING COST ANALYSIS 11.34.23 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 1000 DESC- CHRYSLER ANTI-THEFT TAGS (2-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000					LAB MIN -	.00			
MAT CODE -	ASSEMBLY	ECON YR-LOC				LABOR $ -	.00			
COST/LB -	.000	PT TYPE -	CAPTIVE			BURDEN V-	.00		TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-			0.0%	BURDEN M-	.00			
ROUGH WT -	.0000	MARK-UP -			.0000	SCRAP -	.00		TOTAL VAR	.00
FINAL WT -	.0000	OTHER -			.000	MATERIAL-	.000		TOTAL MFG	.00

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	1000	CHR SHIELD - ANTI-THEFT USE	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___%	___%	☐ / ☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
						SKETCH

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE	PAGE	PART NO.
		21503		DLI	HD	02/23/93	1 OF 1	1000

PEM 6-83 DF

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RTG014 PROJECT - 8V MANUFACTURING COST ANALYSIS 11.34.23 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-02 DESC- TAG INSTALLATION UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING
010		1A	1.0	.720	.23	.0120	13.73	.16V	.39V	.0
					.3177		28.70	.34M	.57M	
020		1A	1.0	.480	.15	.0080	13.73	.11V	.26V	.0
					.3177		28.70	.23M	.38M	

ANNUAL REQ-	250,000			LAB MIN -	1.20		
MAT CODE -	ASSEMBLY	ECON YR-LOC		LABOR $ -	.38		
COST/LB -	.000	PT TYPE	- CAPTIVE	BURDEN V-	.27	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.57		
ROUGH WT -	.0000	MARK-UP	- .0000	SCRAP -	.00	TOTAL VAR	.65
FINAL WT -	.0000	OTHER	- .000	MATERIAL-	.000	TOTAL MFG	.95

ESTIMATING DEPARTMENT — OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	21508-02	TAG INSTALLATION	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___%	___%	☐ / ☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
10	REMOVE TAG FROM BACKING SHEET	1A	1	1.0		
	VERIFY NUMBER WITH V.I.N WIPE AREA BEFORE			.72		
	PLACING ADHESIVE TAG ON 6 LOCATIONS ON CAR					
	— 2ND OPERATION —					
20	REMOVE TAGS FROM BACKING SHEET	1A	1	~~1.0~~		SKETCH
	VERIFY NUMBER WITH VIN WIPE AREA BEFORE PLACING			.48		
	ADHESIVE TAG ON ~~6~~ 4 LOCATIONS OF CAR					

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE		PART NO.
		21508		DU	HD	08/23/88	PAGE 1 OF 1	21508-02

PEM 6-83 DF

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RTG014 PROJECT - 8V MANUFACTURING COST ANALYSIS 11.34.23 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-00 DESC- TAG (10 @ $0.110 EA) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000					LAB MIN -	.00			
MAT CODE -	PAPER	ECON YR-LOC				LABOR $ -	.00			
COST/LB -	.000	PT TYPE -	PURCHASED			BURDEN V-	.00		TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-			0.0%	BURDEN M-	.00			
ROUGH WT -	.0000	MARK-UP -			.0000	SCRAP -	.00		TOTAL VAR	1.10
FINAL WT -	.0000	OTHER -			1.100	MATERIAL-	1.100		TOTAL MFG	1.10

PURCHASED PARTS LIST - JOB NO. 21503

VOLUME	PART NO.	PART NAME	PCS. REQ'D	MAT'L. CODE	COST/ PIECE	FIN.WT. / PIECE	TOOLING COST	✓ VEN.	✓ HOUSE	COMMENTS
10.0	21503-00	TAG (10 @ $0.110 EA)	1	229	1.100					

FORD
4 DOOR

NHTSA ANTI-THEFT TAGS--FORD 4-DOOR

LV	PART #	DESC - TRUNCATED	SUB-ASSEMBLY COST	PURCH PARTS COST	* * * * * MANUFACTURED PARTS * * * * * * ASSEMBLY COST	MATERIAL COST	LABOR COST	BURDEN COST	SCRAP COST	M-TOTAL COST	** TOTAL * COST *
00	1000	FORD ANTI-THEFT TAGS(4-DO		1.62			.48	.72		1.20	2.82
01	21508-02	TAG INSTALLATION (4-DOOR					.48	.72		1.20	1.20
01	21508-00	TAG (12 @ $0.135 EA)		1.62							1.62
TOTAL	1000	FORD ANTI-THEFT TAGS(4-DO		1.62			.48	.72		1.20	2.82

EQUIPMENT - 1A DESCRIPTION - SMALL PARTS & BENCH ASM.

VOLUME	PART NUMBER	OPR	DESCRIPTION	ANNUAL	OCC HRS	TOT HRS	EQUIPMENT COST	TOTAL EQUIP COST
250,000	21508-02	010	TAG INSTALLATION (4-DOOR MODEL)	250,000	.0125	3125.0		
250,000	21508-02	020	TAG INSTALLATION (4-DOOR MODEL)	250,000	.0125	3125.0		
							1,000	2,000

TOTAL EQUIPMENT COST 2,000

VOLUME- 250000 INDENTED BILL OF MATERIAL

PARENT	COMPONENT	DESCRIPTION	QTY	MFG COST	ASSY COST
1000		LINCOLN ANTI-THEFT TAGS (4-DOOR MODEL)		2.82	.00
1	21508-02	TAG INSTALLATION (4-DOOR MODEL)	1.0	1.20	
1	21508-00	TAG (12 @ $0.135 EA)	1.0	1.62	
		TOTAL FOR LINCOLN ANTI-THEFT TAGS (4-DOOR MODEL)		2.82	.00

VOLUME- 250000 INDENTED BILL OF MATERIAL

PARENT	COMPONENT	DESCRIPTION	QTY	MFG COST	ASSY COST
1000		GM ANTI-THEFT TAGS (2-DOOR MODEL)		2.10	.00
1	21508-01	TAG INSTALLATION (2-DOOR MODEL)	1.0	1.00	
1	21508-00	TAG (10 @ $0.110 EA)	1.0	1.10	
		TOTAL FOR GM ANTI-THEFT TAGS (2-DOOR MODEL)		2.10	.00

VOLUME - 250,000 PART - 1000 DESC - FORD ANTI-THEFT TAGS(4-DOOR MODEL) CAPTIVE

COMPONENT	DESC - TRUNCATED TOOLING	QTY WEIGHT	MATERIAL	LAB MIN	LABOR $	BURDEN	SCRAP	MARK-UP	TOT COST	
21508-02 CAPTIVE	TAG INSTALLATION (4- .0	1 .0000	.000	1.50	.48	.34V .72M	.00V .00M	.00	.82 1.20	*
21508-00 PURCHASED	TAG (12 @ $0.135 EA) .0	1 .0000	1.620	.00	.00	.00V .00M	.00V .00M	.00	1.62	*
COMPONENT TOTAL COST		.0000	1.62	1.50	.48	.34V .72M	.00V .00M	.00	2.44 2.82	
ASSEMBLY COST			.00	.00	.00	.00V .00M	.00V .00M	.00	.00 .00	
TOTAL COST		.0000	1.62	1.50	.48	.34V .72M	.00V .00M	.00	2.44 2.82	

TOOLING .0

EQUIPMENT 2,000

INDENTED BILL OF MATERIAL

PROJECT NAME	ASM. NAME	VOLUME
NHTSA ANTI-THEFT AUTO TAGS	FORD ANTI-THEFT TAGS	230,000

— PART NAME —	— PART NO. —	QTY	ASM	REMARKS
	1000	1		
	21508-02	1		
	21508-00	1		

	JOB NO.	ENGINEER	DATE	ASM. NO.	
DU	21503	HD	02/21/83	1000	PAGE 1 OF 1

PEM 12-83 DF

VOLUME- 250,000 P/A- 1
PART #- 1000 DESC- FORD ANTI-THEFT TAGS(4-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ-	250,000			LAB MIN -	.00		
MAT CODE -	ASSEMBLY	ECON YR-LOC		LABOR $ -	.00		
COST/LB -	.000	PT TYPE	- CAPTIVE	BURDEN V-	.00	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.00		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	.00
FINAL WT -	.0000	OTHER -	.000	MATERIAL-	.000	TOTAL MFG	.00

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250.000	1000	FORD ANTI-THEFT TAGS	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___ %	___ %	

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
						SKETCH

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE		PART NO.
		21502		DJ	HD	08/23/83	PAGE 1 OF 1	1000

PEM 6-83 DF

RTG014 PROJECT - 8M MANUFACTURING COST ANALYSIS 11.29.53 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-02 DESC- TAG INSTALLATION (4-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING
010		1A	1.0	.750	.24	.0125	13.73	.17V	.41V	.0
					.3177		28.70	.36M	.60M	
020		1A	1.0	.750	.24	.0125	13.73	.17V	.41V	.0
					.3177		28.70	.36M	.60M	

ANNUAL REQ-	250,000			LAB MIN -	1.50		
MAT CODE -	ASSEMBLY	ECON YR-LOC		LABOR $ -	.48		
COST/LB -	.000	PT TYPE -	CAPTIVE	BURDEN V-	.34	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.72		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	.82
FINAL WT -	.0000	OTHER -	.000	MATERIAL-	.000	TOTAL MFG	1.20

FORD

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	21508-02	TAG INSTALLATION	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___%	___%	☐ / ☒

OPER	OPERATION DESCRIPTION — 1ST OPERATOR	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
10	REMOVE TAG FROM BACKING SHEET	1A	1	1.0		3-M "CONFIRM" ADHESIVE TAG'S
	VERIFY NUMBER WITH V.I.N. WIPE AREA BEFORE			.75		
	PLACING ADHESIVE TAG ON					
	~~8~~ 6 LOCATIONS ON CAR					
	— 2ND OPERATOR —					
20	REMOVE TAGS FROM BACKING SHEET	1A	1	1.0		— SKETCH —
	VERIFY NUMBER WITH V.I.N. WIPE AREA BEFORE					
	PLACING ADHESIVE TAG ON 6 LOCATIONS OF CAR					

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE	PAGE	PART NO.
		21509		DU	HD	08/23/88	1 OF 1	21508-02

PEM 6-83 DF

RTG014 PROJECT - 8M MANUFACTURING COST ANALYSIS 11.29.53 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-00 DESC- TAG (12 @ $0.135 EA) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ- 250,000 LAB MIN - .00
MAT CODE - PAPER ECON YR-LOC LABOR $ - .00
COST/LB - .000 PT TYPE - PURCHASED BURDEN V- .00 TOOL $000 .0
SCRAP FAC - .0% MARK-UP FAC- 0.0% BURDEN M- .00
ROUGH WT - .0000 MARK-UP - .0000 SCRAP - .00 TOTAL VAR 1.62
FINAL WT - .0000 OTHER - 1.620 MATERIAL- 1.620 TOTAL MFG 1.62

PURCHASED PARTS LIST - JOB NO. 21508

VOLUME	PART NO.	PART NAME	PCS. REQ'D	MAT'L. CODE	COST/ PIECE	FIN.WT. / PIECE	TOOLING COST	✓ VEN.	✓ HOUSE	COMMENTS
250.0	21508-00	TAG (12 @ ¢ 0.135 EA)	1	029	1.620					

97

FORD
2 DOOR

NHTSA ANTI-THEFT TAGS--FORD 2-DOOR

LV	PART #	DESC - TRUNCATED	SUB-ASSEMBLY COST	PURCH PARTS COST	* * * * * MANUFACTURED PARTS * * * * * * ASSEMBLY COST	MATERIAL COST	LABOR COST	BURDEN COST	SCRAP COST	M-TOTAL COST	** TOTAL * COST *
00	1000	FORD ANTI-THEFT TAGS (2-D		1.35			.40	.60		1.00	2.35
01	21508-02	TAG INSTALLATION (2-DOOR					.40	.60		1.00	1.00
01	21508-00	TAG (10 @ $0.135 EA)		1.35							1.35
TOTAL	1000	FORD ANTI-THEFT TAGS (2-D		1.35			.40	.60		1.00	2.35

PIONEER ENGINEERING
EQUIPMENT WHERE USED

3/14/89

TGX11 PROJECT- 8U 21508
JOB NR.- 21508

16.59.14

EQUIPMENT - 1A DESCRIPTION - SMALL PARTS & BENCH ASM.

VOLUME	PART NUMBER	OPR	DESCRIPTION	ANNUAL	OCC HRS	TOT HRS	EQUIPMENT COST	TOTAL EQUIP COST
250,000	21508-02	010	TAG INSTALLATION (2-DOOR MODEL)	250,000	.0125	3125.0		
250,000	21508-02	020	TAG INSTALLATION (2-DOOR MODEL)	250,000	.0083	2075.0		
							1,000	2,000

TOTAL EQUIPMENT COST 2,000

VOLUME- 250000 INDENTED BILL OF MATERIAL

PARENT	COMPONENT	DESCRIPTION	QTY	MFG COST	ASSY COST
1000		LINCOLN ANTI-THEFT TAGS (2-DOOR MODEL)		2.35	.00
1	21508-02	TAG INSTALLATION (2-DOOR MODEL)	1.0	1.00	
1	21508-00	TAG (10 @ $0.135 EA)	1.0	1.35	
		TOTAL FOR LINCOLN ANTI-THEFT TAGS (2-DOOR MODEL)		2.35	.00

VOLUME - 250,000 PART - 1000 DESC - FORD ANTI-THEFT TAGS (2-DOOR MODEL) CAPTIVE

COMPONENT	DESC - TRUNCATED TOOLING	QTY WEIGHT	MATERIAL	LAB MIN	LABOR $	BURDEN	SCRAP	MARK-UP	TOT COST
21508-02 CAPTIVE	TAG INSTALLATION (2- .0	1 .0000	.000	1.25	.40	.28V .60M	.00V .00M	.00	.68 * 1.00
21508-00 PURCHASED	TAG (10 @ $0.135 EA) .0	1 .0000	1.350	.00	.00	.00V .00M	.00V .00M	.00	1.35 *
COMPONENT TOTAL COST		.0000	1.35	1.25	.40	.28V .60M	.00V .00M	.00	2.03 2.35
ASSEMBLY COST			.00	.00	.00	.00V .00M	.00V .00M	.00	.00 .00
TOTAL COST		.0000	1.35	1.25	.40	.28V .60M	.00V .00M	.00	2.03 2.35

TOOLING .0

EQUIPMENT 2,000

INDENTED BILL OF MATERIAL

PROJECT NAME	ASM. NAME	VOLUME
NHTSA ANTI-THEFT AUTO TAGS	FORD ANTI-THEFT TAGS	250,000

— PART NAME —	— PART NO. —	QTY	ASM	REMARKS
	1000	1		
	21508-02	1		
	21508-00	1		

	JOB NO.	ENGINEER	DATE	ASM. NO.	PAGE OF
DU	21508	HD	08/23/88	1000	PAGE 1 OF 1

PEM 12-83 DF

RTG014 PROJECT - 8U MANUFACTURING COST ANALYSIS 16.14.38 4/18/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 1000 DESC- FORD ANTI-THEFT TAGS (2-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

ANNUAL REQ- 250,000
MAT CODE - ASSEMBLY
COST/LB - .000
SCRAP FAC - .0%
ROUGH WT - .0000
FINAL WT - .0000

ECON YR-LOC
PT TYPE - CAPTIVE
MARK-UP FAC- 0.0%
MARK-UP - .0000
OTHER - .000

LAB MIN - .00
LABOR $ - .00
BURDEN V- .00
BURDEN M- .00
SCRAP - .00
MATERIAL- .000

TOOL $000 .0
TOTAL VAR .00
TOTAL MFG .00

ESTIMATING DEPARTMENT OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	1000	FORD ANTI-THEFT TAGS	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V / C
	060					___ %	___ %	☐ / ☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
						SKETCH

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE		PART NO.
		21508		DH	HD	08/23/83	PAGE 1 OF 1	1000

PEM 6-83 DF

RTG014 PROJECT - 8U MANUFACTURING COST ANALYSIS 11.33.27 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-02 DESC- TAG INSTALLATION (2-DOOR MODEL) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING
010										
		1A	1.0	.750	.24	.0125	13.73	.17V	.41V	.0
					.3177		28.70	.36M	.60M	
020										
		1A	1.0	.500	.16	.0083	13.73	.11V	.27V	.0
					.3177		28.70	.24M	.40M	

ANNUAL REQ-	250,000			LAB MIN -	1.25		
MAT CODE -	ASSEMBLY	ECON YR-LOC		LABOR $ -	.40		
COST/LB -	.000	PT TYPE -	CAPTIVE	BURDEN V-	.28	TOOL $000	.0
SCRAP FAC -	.0%	MARK-UP FAC-	0.0%	BURDEN M-	.60		
ROUGH WT -	.0000	MARK-UP -	.0000	SCRAP -	.00	TOTAL VAR	.68
FINAL WT -	.0000	OTHER -	.000	MATERIAL-	.000	TOTAL MFG	1.00

FORD

ESTIMATING DEPARTMENT — OPERATION SHEET

VOLUME	PART NO.	PART NAME	PCS. REQ.
250,000	21508-02	TAG INSTALLATION	1

PPG/UPG NO.	MATL. CODE	COST/LB.	OTHER COST	RGH. WT.	FIN. WT.	SCRAP	MARK-UP	EQUIP. RATE V	EQUIP. RATE C
	060					___%	___%	☐	☒

OPER	OPERATION DESCRIPTION	EQUIP. CODE	M/P	LABOR MINS.	TOOLING $(000)	MATERIAL SPECS & BACK-UP DATA
10	REMOVE TAG FROM BACKING SHEET	1A	1	.75		3-M "CONFIRM" ADHESIVE TAG'S
	VERIFY NUMBER WITH V.I.N.					
	WIPE AREA BEFORE					
	PLACING ADHESIVE TAG ON					
	6 LOCATIONS ON CAR					
	— 2ND OPERATOR —					
20	REMOVE TAGS FROM BACKING SHEET	1A	1	.500		SKETCH
	VERIFY NUMBER WITH V.I.N.					
	WIPE AREA BEFORE					
	PLACING ADHESIVE TAG ON					
	4 LOCATIONS OF CAR					

NEXT ASM.	DWG. DATE	JOB NO.			ENGINEER	DATE		PART NO.
		21508		DU	HD	08/23/88	PAGE 1 OF 1	21508-02

PEM 6-83 DF

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RTG014 PROJECT - 8U MANUFACTURING COST ANALYSIS 11.33.27 3/16/89
JOB NR. - 21508

VOLUME- 250,000 P/A- 1
PART #- 21508-00 DESC- TAG (10 @ $0.135 EA) UPG-

OPER	OPERATION DESCRIPTION	EQUIP	M P	STD MIN	LAB COST LAB RATE	OCC HRS	BURDEN RATE	BURDEN COST	VAR COST MFG COST	TOOLING

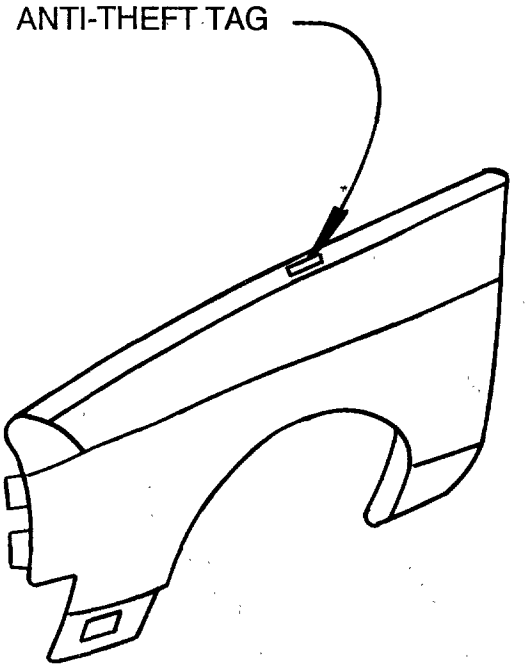
ANNUAL REQ- 250,000 LAB MIN - .00
MAT CODE - PAPER ECON YR-LOC LABOR $ - .00
COST/LB - .000 PT TYPE - PURCHASED BURDEN V- .00 TOOL $000 .0
SCRAP FAC - .0% MARK-UP FAC- 0.0% BURDEN M- .00
ROUGH WT - .0000 MARK-UP - .0000 SCRAP - .00 TOTAL VAR 1.35
FINAL WT - .0000 OTHER - 1.350 MATERIAL- 1.350 TOTAL MFG 1.35

PURCHASED PARTS LIST - JOB NO. 21508

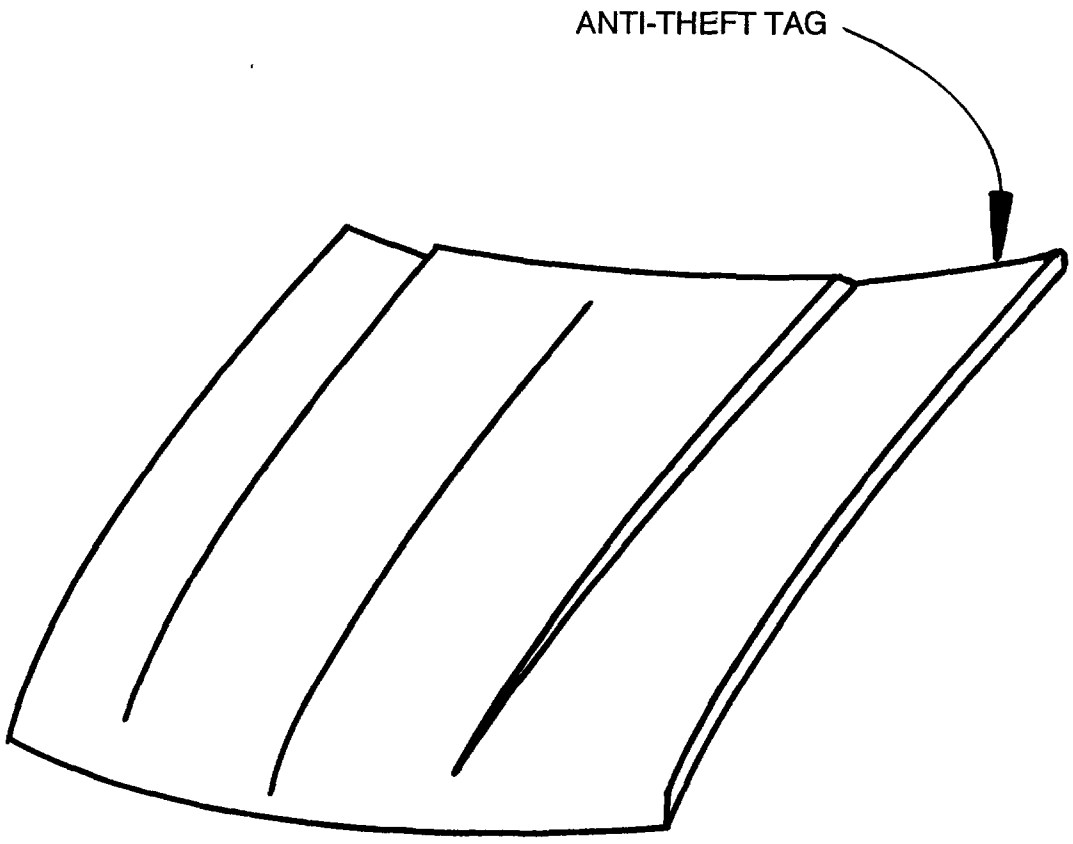
VOLUME	PART NO.	PART NAME	PCS. REQ'D	MAT'L. CODE	COST/ PIECE	FIN.WT. / PIECE	TOOLING COST	✓ VEN.	✓ HOUSE	COMMENTS
250.0	21508-00	TAG (10@ $0.135 EA)	1	029	1.350					

APPENDIX "C"

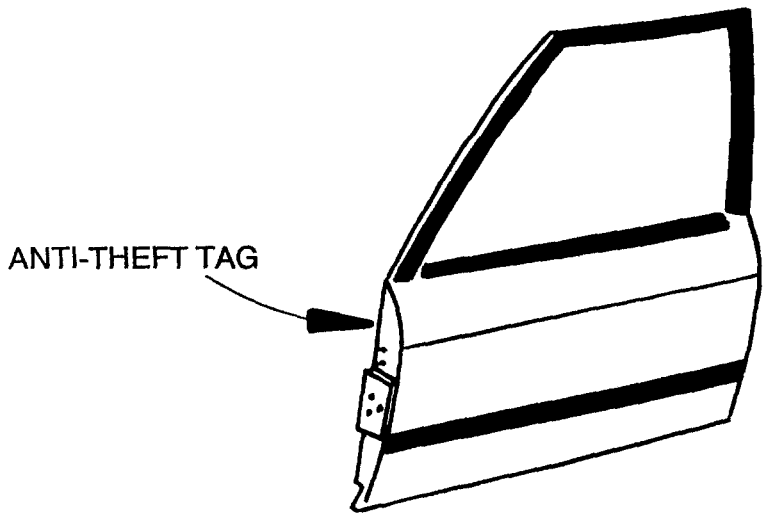
MARKING LOCATIONS



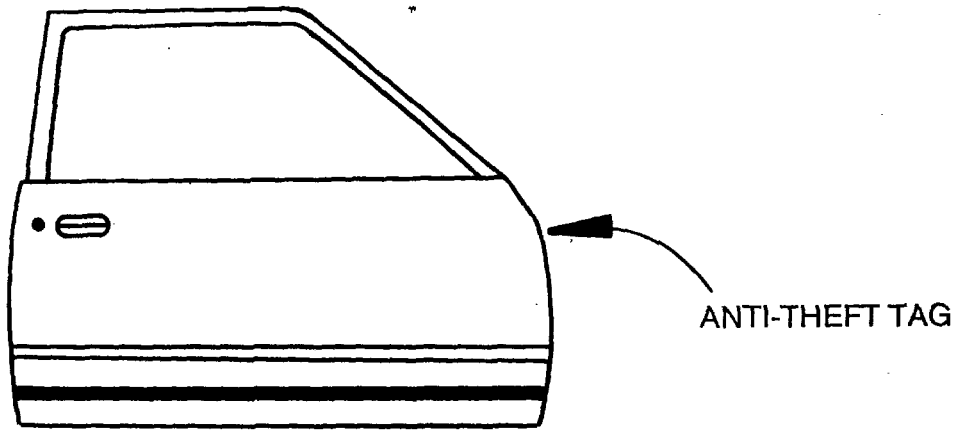
OLDS DELTA 88, BUICK LASABRE
LEFT FRONT FENDER



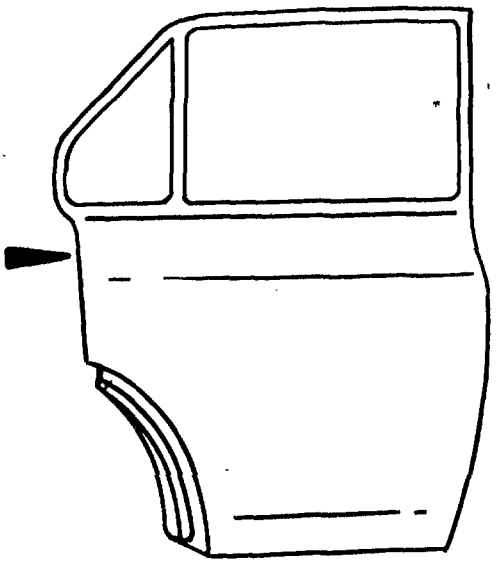
CHEVROLET CAMARO
HOOD



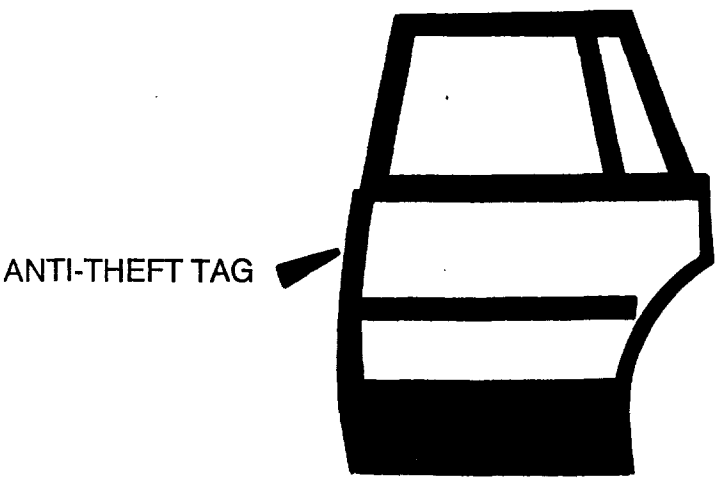
**AUDI 5000S, 5000CS TURBO,
5000CS TURBO QUATRO
FRONT DOOR**



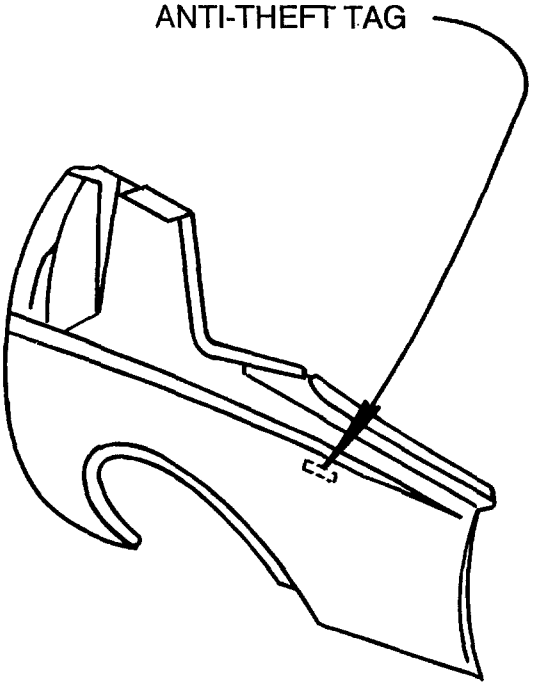
FORD T-BIRD, MERCURY COUGAR
LINCOLN TOWN CAR, MARK VII
FRONT DOOR



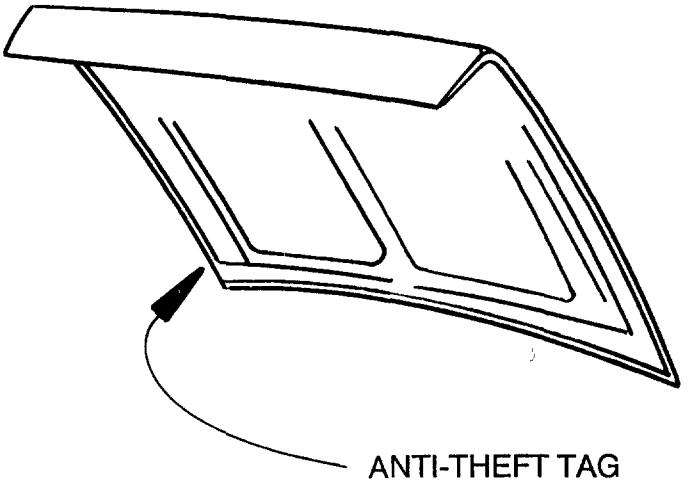
JAGUAR XJ6
REAR DOOR



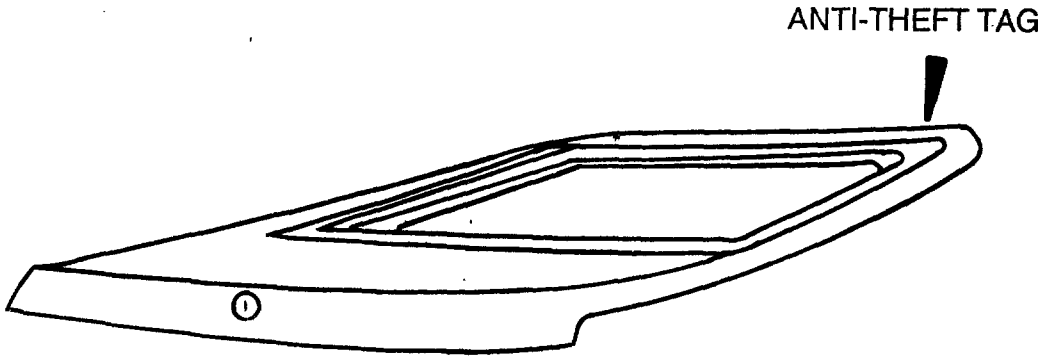
OLDS DELTA 88, BUICK LASABRE
REAR DOOR



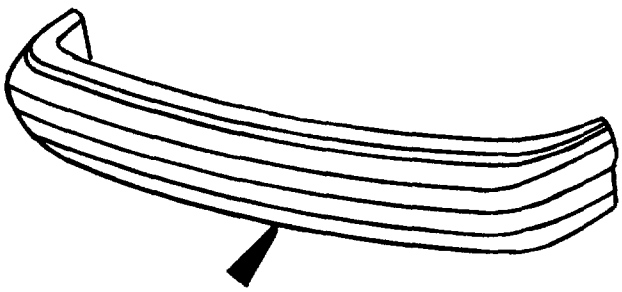
OLDS DELTA 88, BUICK LASABRE
LEFT REAR QUARTER PANEL



PLYMOUTH GRAN FURY, CARAVELLE
DODGE 600, DIPLOMAT
CHRYSLER FIFTH AVENUE
DECK LID

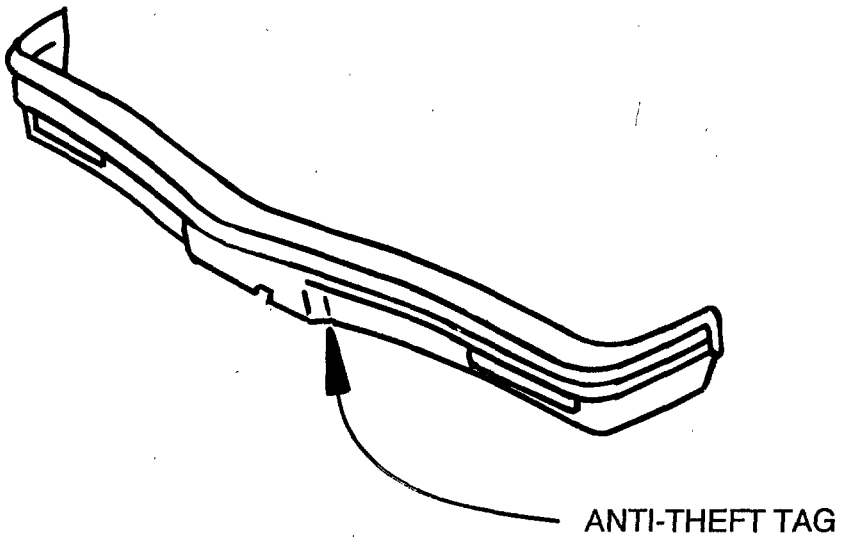


FORD MUSTANG
REAR HATCH

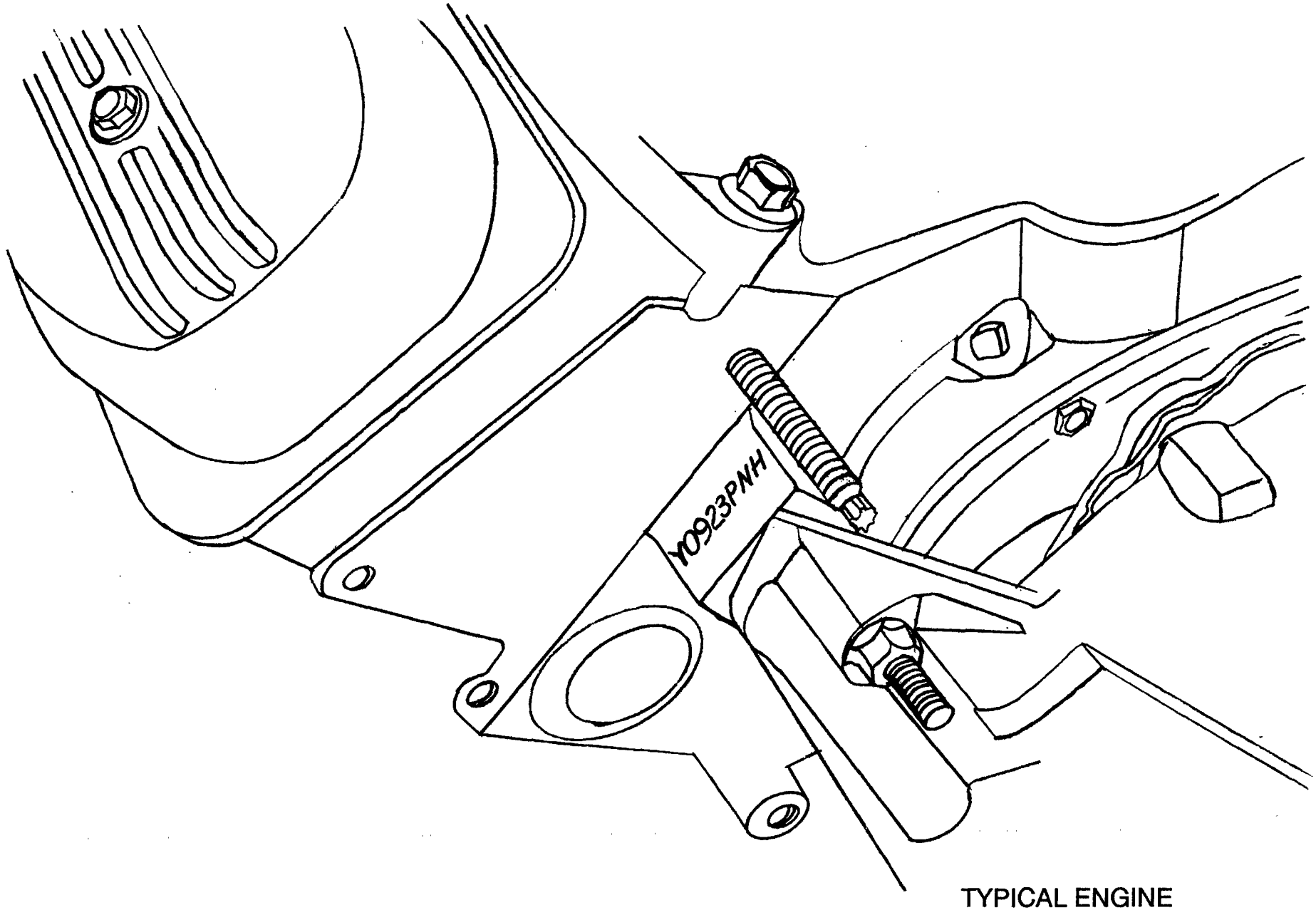


ANTI-THEFT TAG

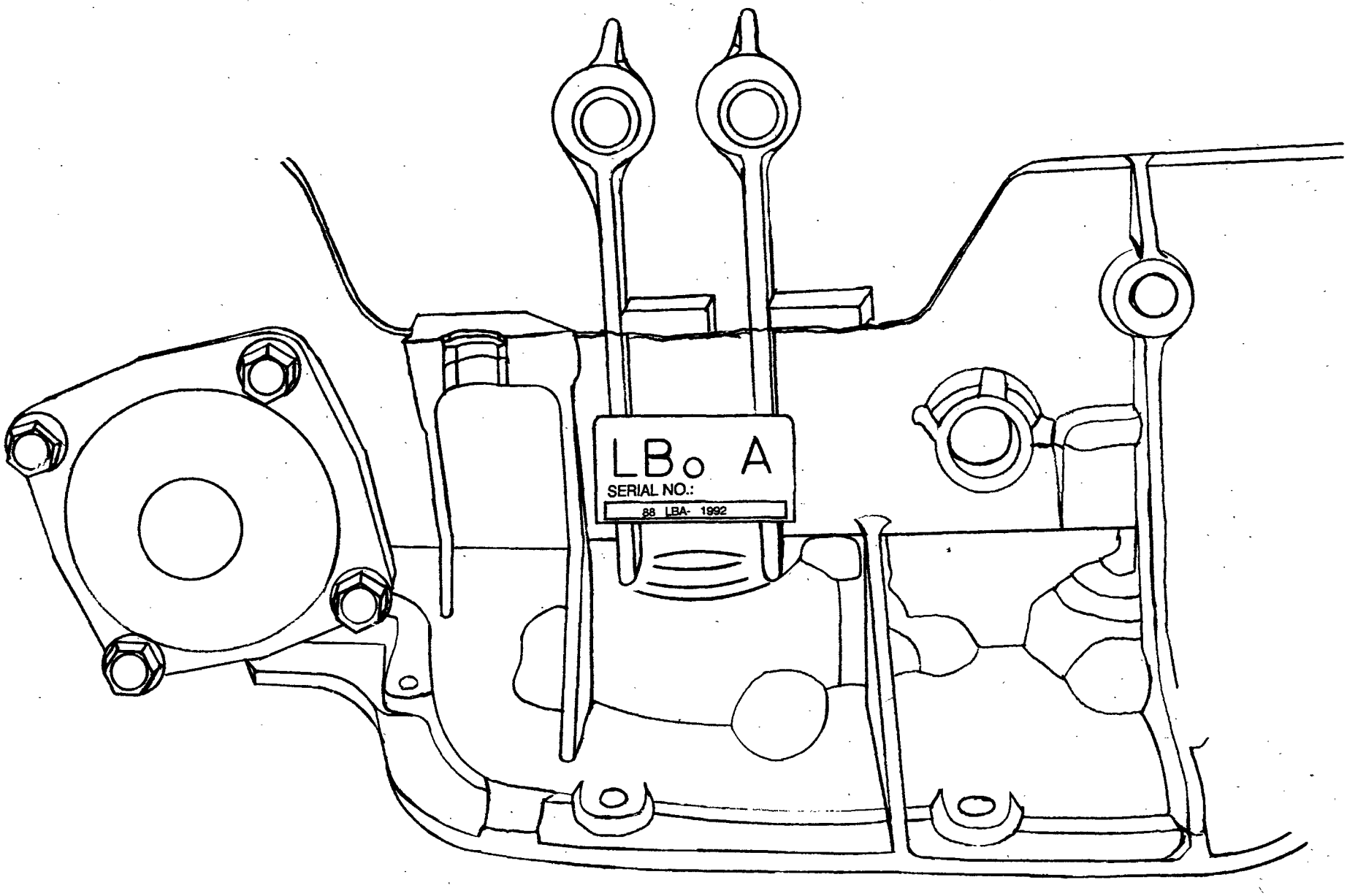
PLYMOUTH RELIANT, DODGE ARIES
REAR BUMPER



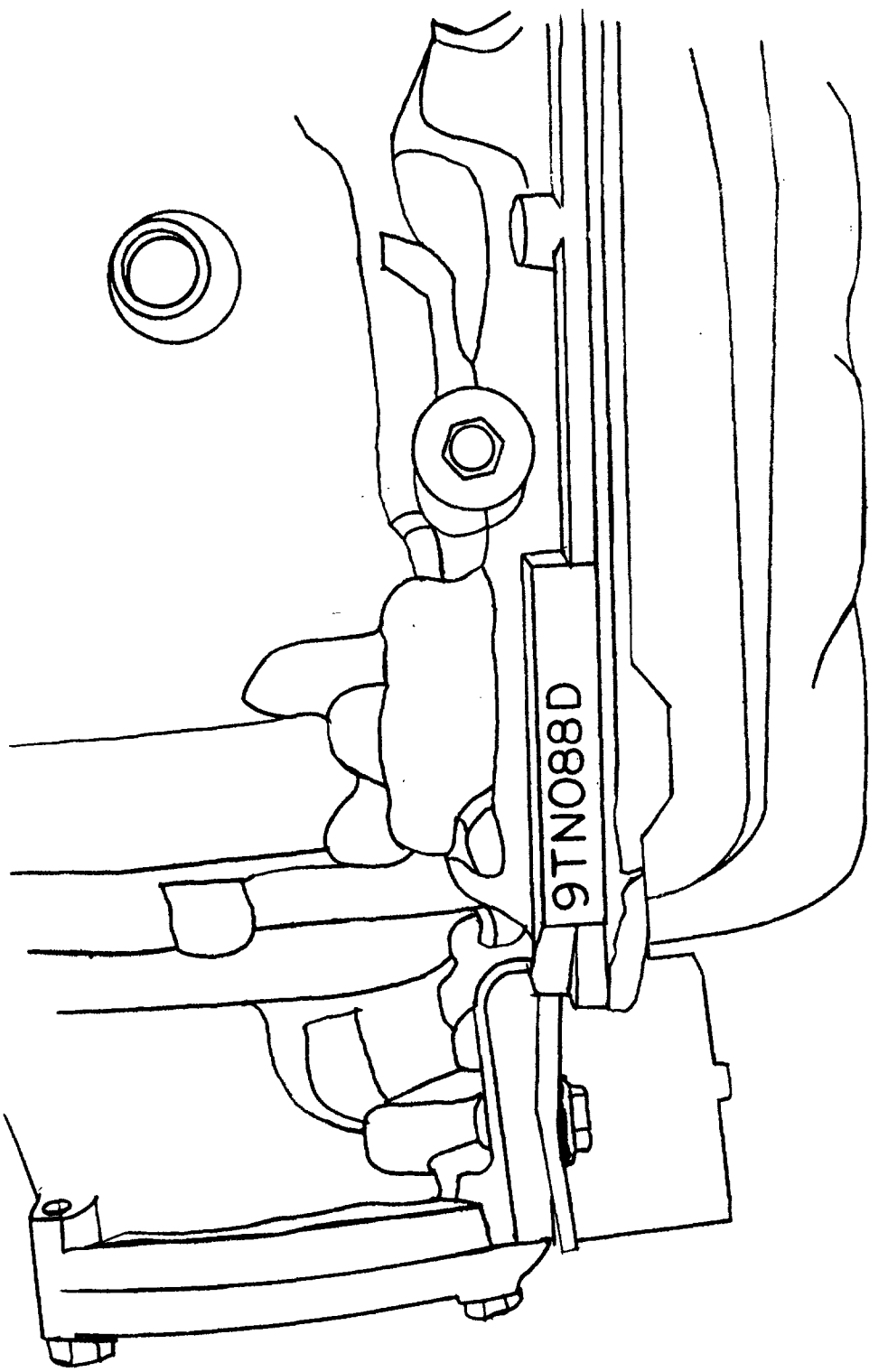
PONTIAC BONNEVILLE, CADILLAC SEVILLE,
COUPE DEVILLE, BUICK LASABRE,
OLDS DELTA 88
FRONT BUMPER



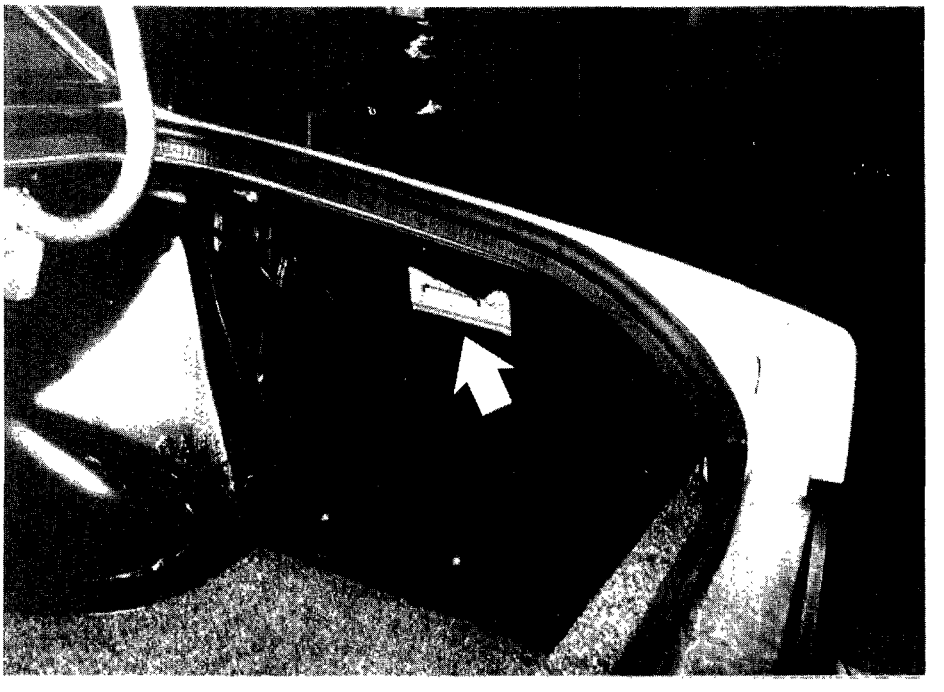
TYPICAL ENGINE
STAMPING LOCATION



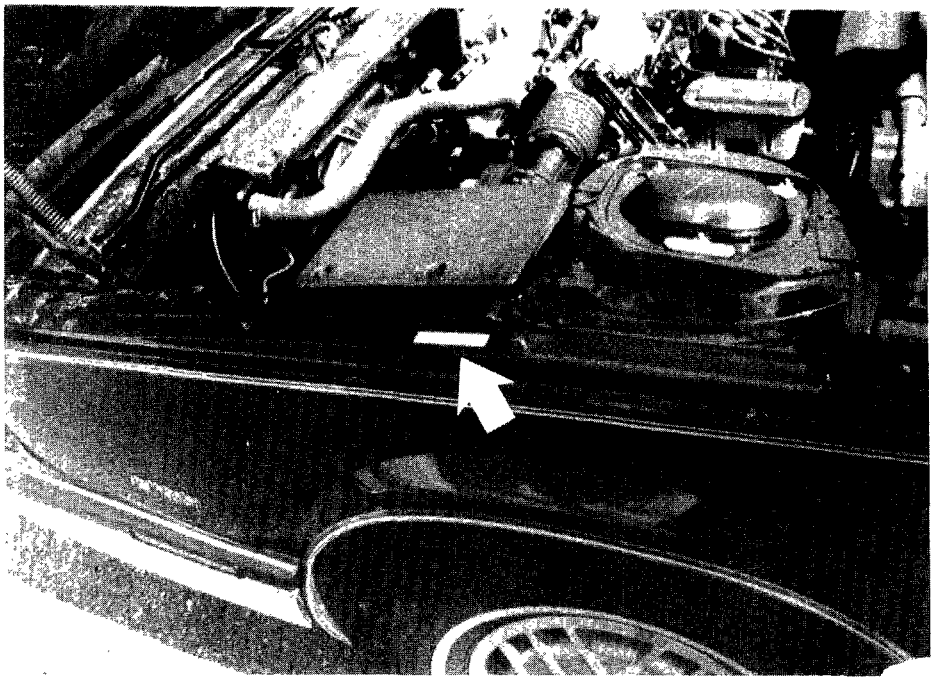
TYPICAL TRANSMISSION
STAMPED LABEL LOCATION



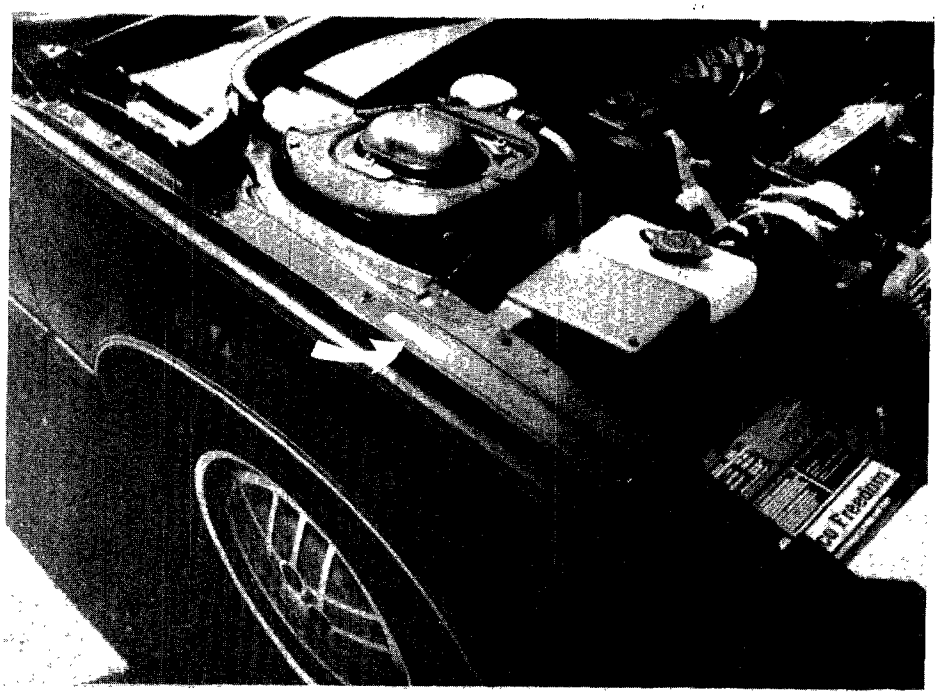
TYPICAL TRANSMISSION
STAMPING LOCATION



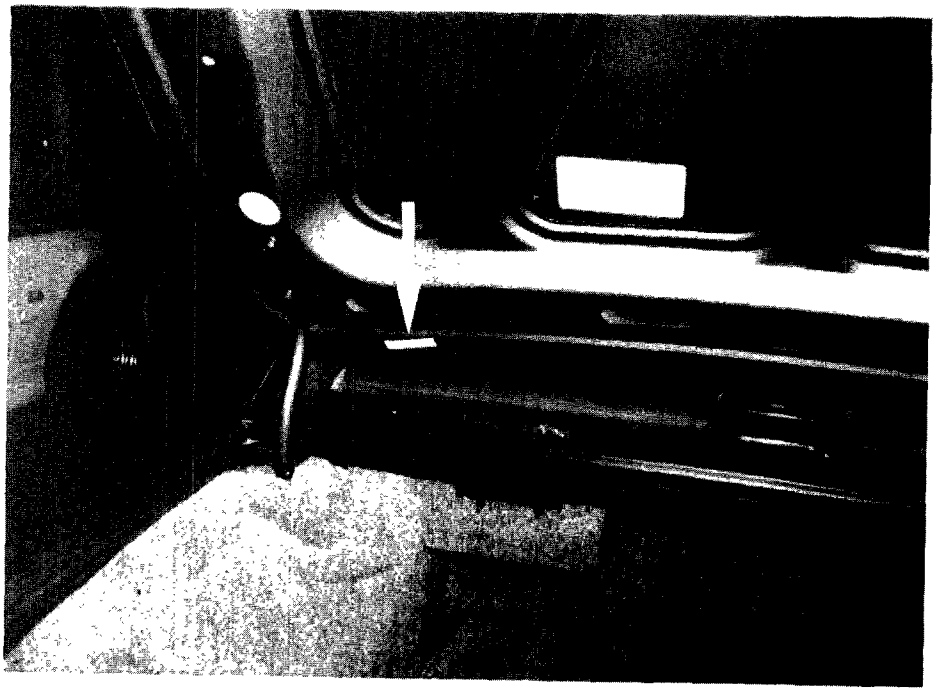
1987 BUICK LESABRE
RIGHT REAR QUARTER PANEL



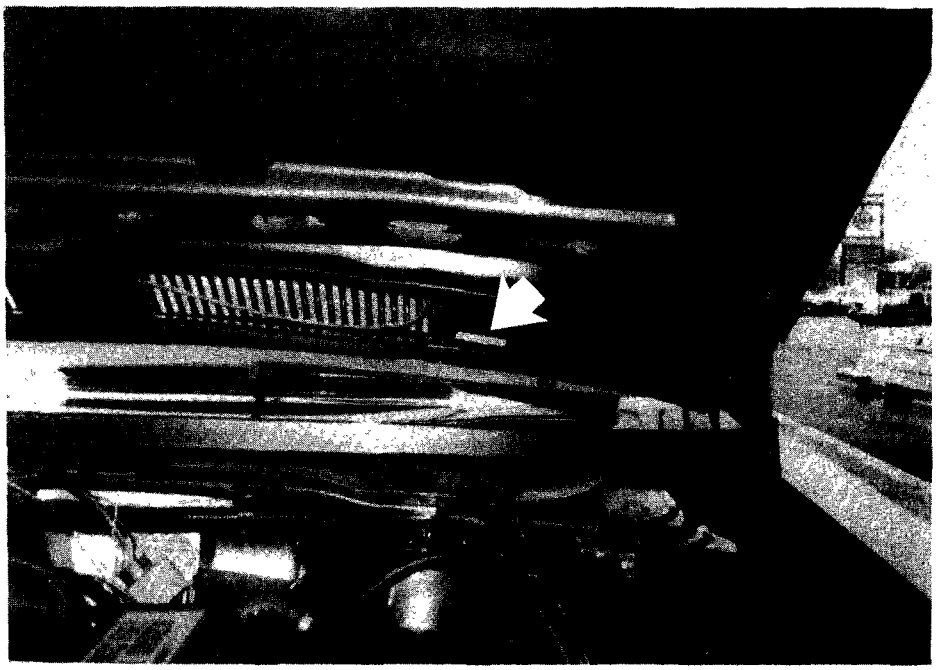
1987 BUICK LESABRE
FRONT LEFT FENDER



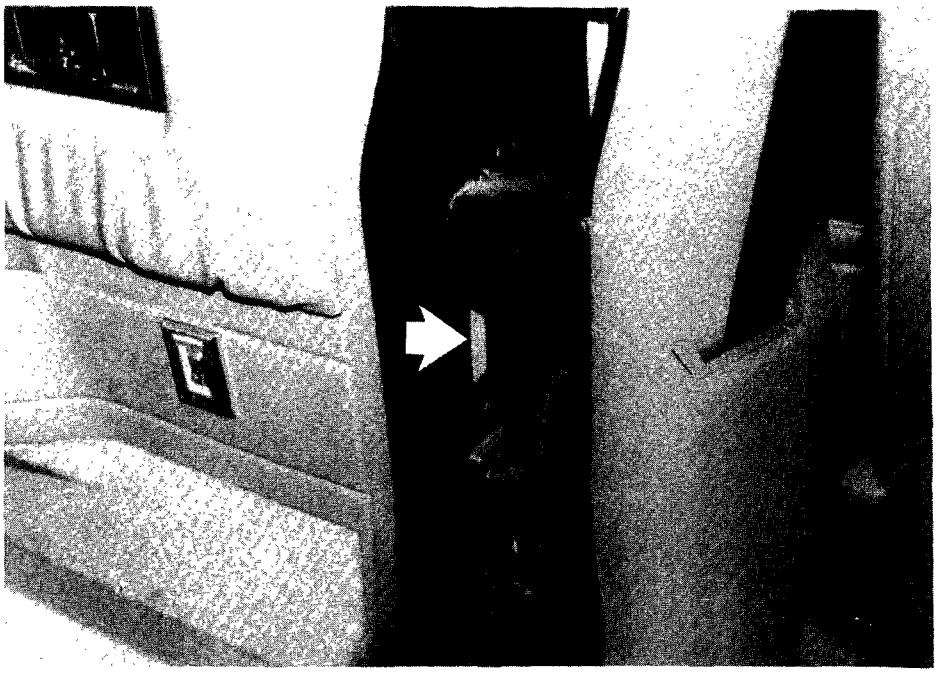
1987 BUICK LESABRE
RIGHT FRONT FENDER



1987 PONTIAC BONNEVILLE
DECK LID

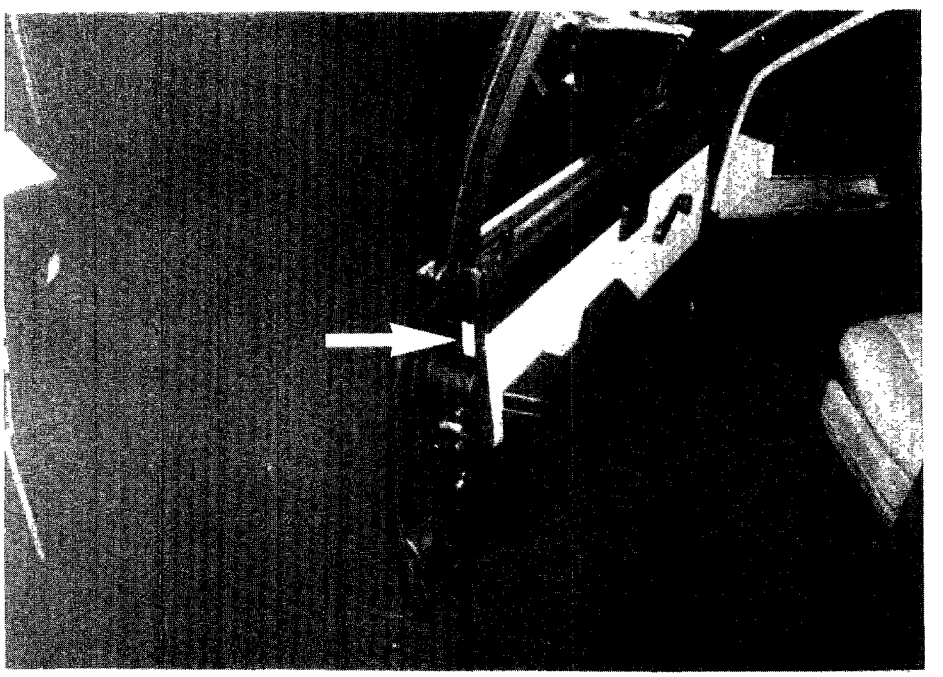


1987 CHRYSLER FIFTH AVENUE
HOOD

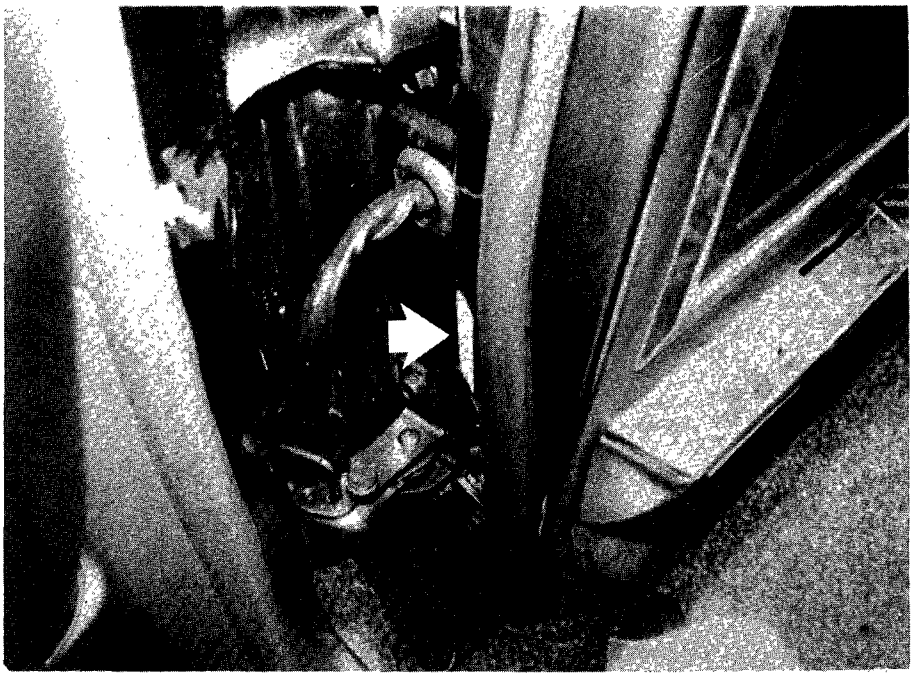


1987 CHRYSLER LEBARON GTS
LEFT REAR PASSENGER DOOR

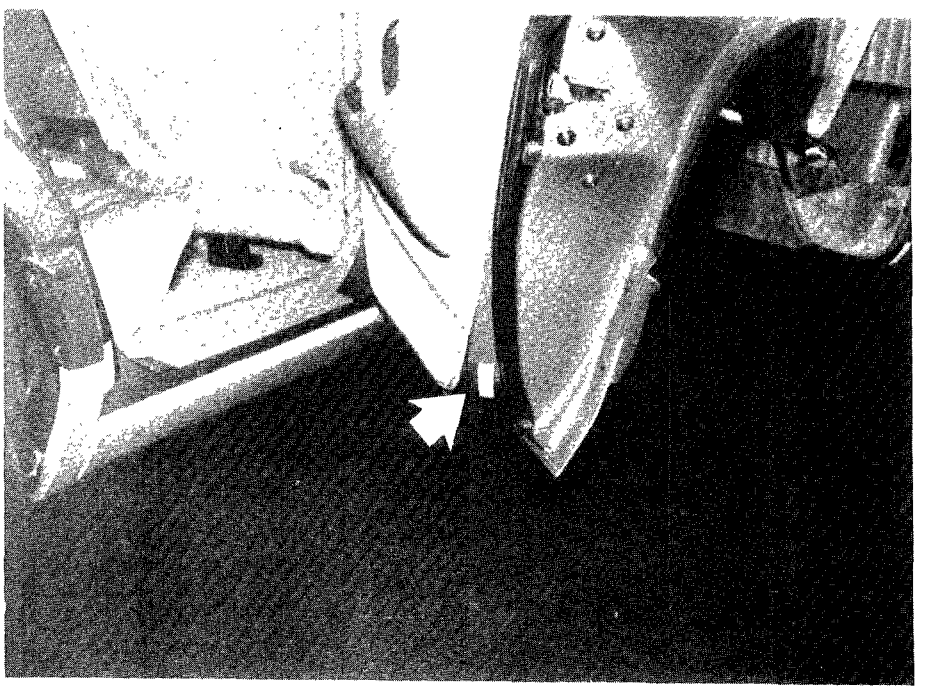
1987 CHRYSLER FIFTH AVENUE
FRONT DOOR DRIVER SIDE



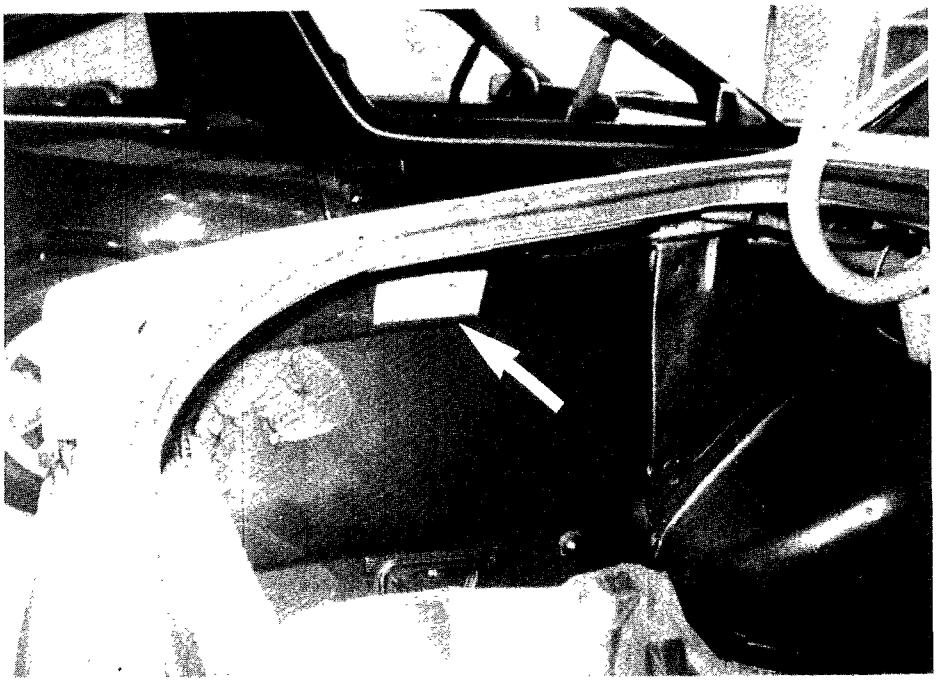
1987 CHEVROLET NOVA
FRONT DOOR DRIVER SIDE



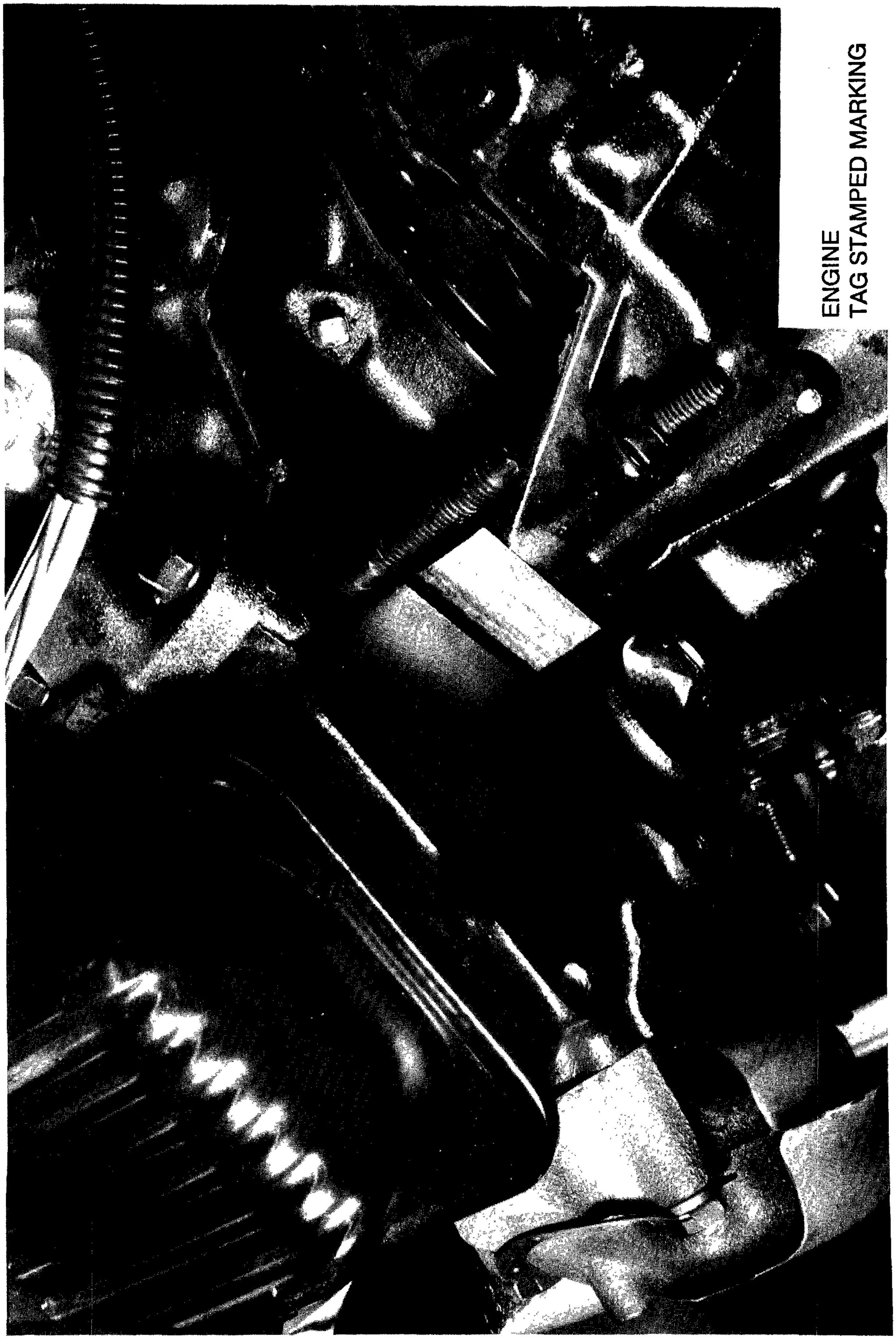
1987 CHRYSLER FIFTH AVENUE
RIGHT FRONT PASSENGER DOOR



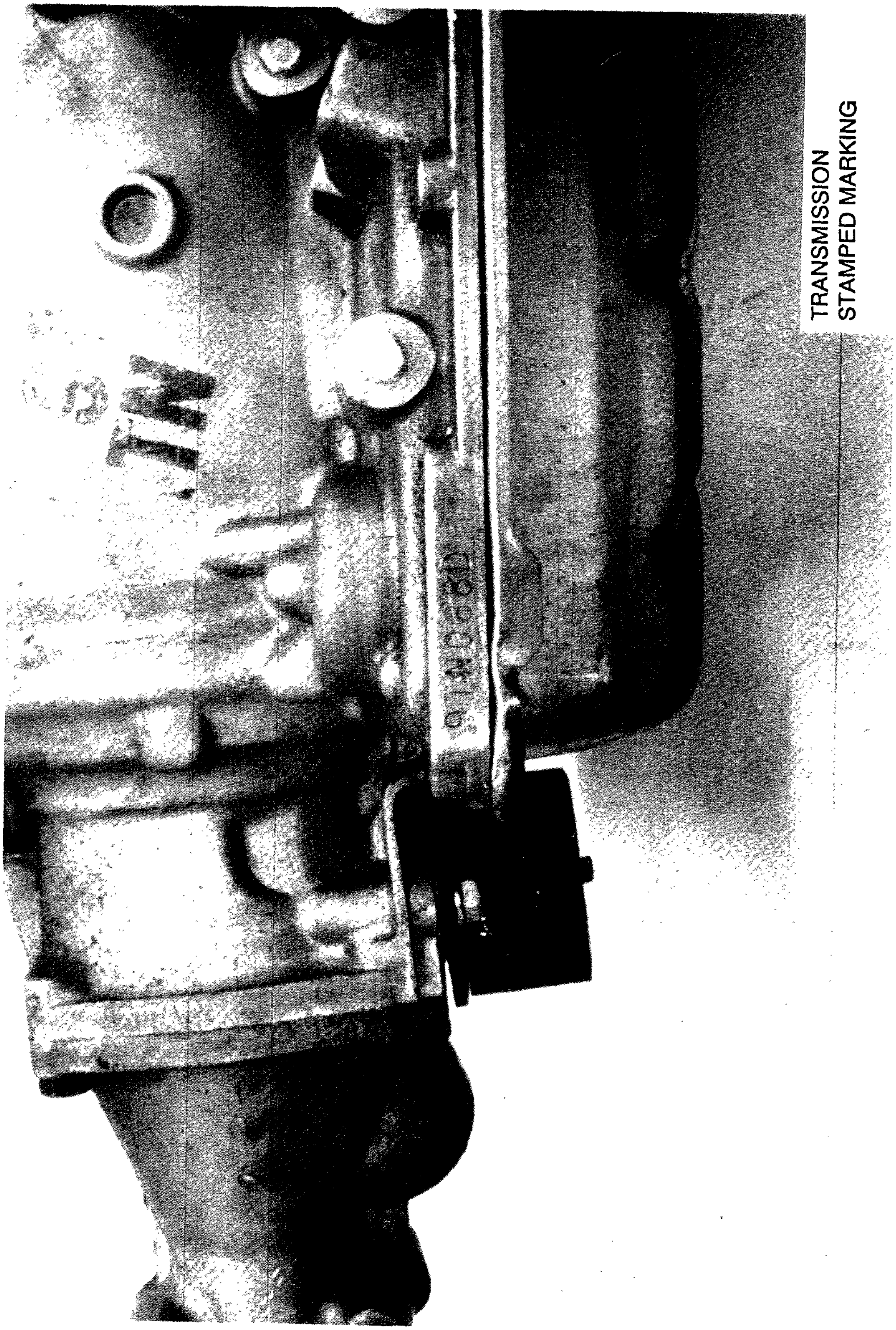
1987 PONTIAC BONNEVILLE
RIGHT REAR PASSENGER DOOR



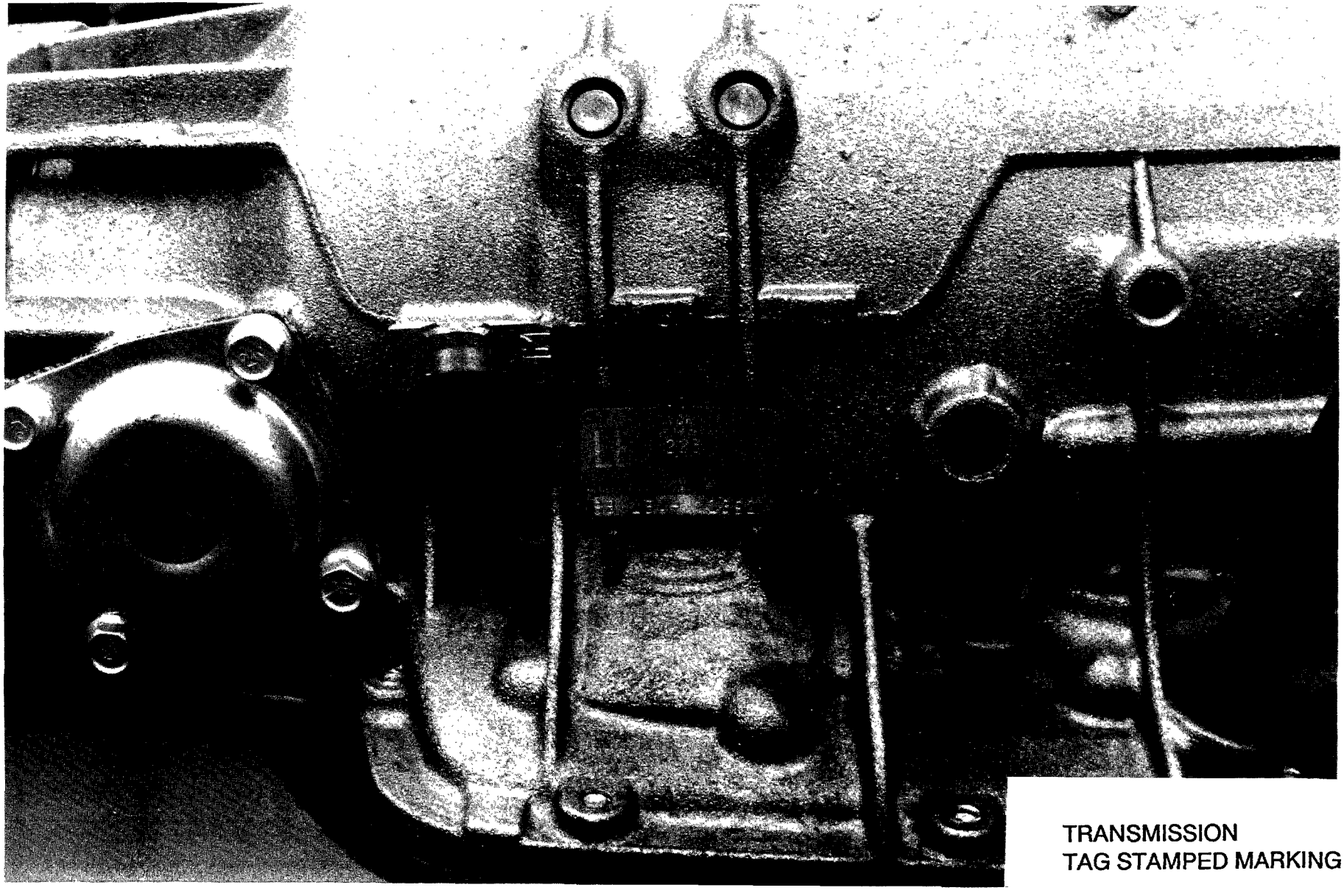
1987 PLYMOUTH CARAVELLE
LEFT REAR QUARTER PANEL



ENGINE
TAG STAMPED MARKING



TRANSMISSION
STAMPED MARKING



TRANSMISSION
TAG STAMPED MARKING