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AUTOMOTIVE MAINTENANCE DATA BASE

FOR MODEL YEARS 1976-1979

PART I

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FINAL REPORT

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16. Abstract

An update of the existing data base was developed to include life cycle maintenance costs of representative vehicles for the model years 1976-1979. Repair costs as a function of time are also developed for a passenger car in each of the compact, subcompact and mid-size body classes.

In addition, a cost comparison of engine and transmission repairs is made for a typical domestic full size passenger car and representative imported passenger car over the projected vehicles' lifetime of 100,000 miles.

This information will assist the Department of Transportation in evaluating automotive maintenance trends and the impact of technological advances and Federal regulations on vehicle maintenance requirements and costs.

The data used in establishing repair frequencies for component parts was generated from all known available sources, considered to be applicable and from direct inputs of knowledgeable personnel in the industry. Repair costs were documented from published sources.

Repair study of engines and transmissions indicates most should last the 100,000 mile vehicle lifetime. There are some indications, however, that imported L4 engines may not be as durable as domestic V8 engines.

Cost of repair by body class shows the subcompact vehicles are 6% less costly to maintain than compacts and 21% less costly than mid-size over the 100,000 mile lifetime. Eighty percent of all repair costs occur after the fifth year of operation.

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PREFACE

A major portion of this contract effort concerns the development of a Repair and Service Maintenance Data Base to update and enlarge a data base that had been previously developed for the U. S. Department of Transportation, Transportation Systems Center. In addition, some analysis of the data was made relative to repair cycles and costs for typical vehicle engines and transmissions, and a scenario was developed relating when, as a function of time, unscheduled maintenance repairs were performed during an assumed 100,000 mile, ten-year vehicle lifetime. The work was done under the guidance of Mr. James Kakatsakis and Mr. Ron Cook, Technical Monitors; and Mrs. Diane Erwin of DOT/TSC. The Project Director for the Datalog Division of the Chilton Company was Mr. James Milne with Mr. Harry Eissler as the Principal Investigator, assisted by Mr. Charles Cantwell, Mr. Robert Day, and Mr. James Schofield.

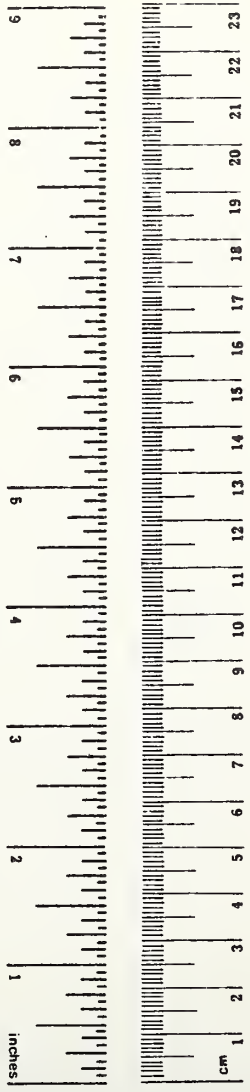
This report covers the methodology used in generating the maintenance data base, as well as a computer printout of the detailed costs by vehicle and repair facility. Data was supplied to DOT/TSC on magnetic tape based on the contract requirement. This report also includes the analysis of typical engine and transmission repairs, as well as the scenario of repairs as a function of time. The report is divided into two parts: Part I includes the main text and Appendix A, B, C, and D; Part II includes Appendix E and F.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

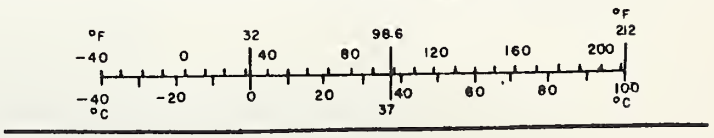
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	squere yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teespoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	querts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yerds	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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1.0 SUMMARY

This data base, encompassing 169 representative 1976 through 1979 model year automobiles, is an update to the existing data base developed under Contract Number DOT/TSC-1047. The combined data bases contain maintenance cost data for a total of 381 representative automobiles for the model years 1970-1979.

The failure frequencies of unscheduled maintenance items are found to be directly affected by a variety of uncontrollable factors such as weather conditions, topography, driver habits, maintenance procedures, etc. Each of these factors can materially alter component life expectancy and probably have a greater influence on the failure frequency differences that occur between vehicle manufacturers and models than the design or manufacturer of the individual components.

Additionally, no reliable data was found to exist that would support the theory that component life expectancy is materially different between vehicle body classes and/or manufacturers, makes or models. Although there are obvious differences in components' weight, strength, size, etc., between manufacturers and models, it is assumed that the life expectancy of a given component among all models would be essentially the same -- since they are designed to satisfy the requirements of the model in which they are installed.

The data used to establish frequency of repair, component costs and labor costs for this study were generated from all known sources available considered to be credible and applicable and from direct inputs of knowledgeable industry personnel. Thorough documentation is provided.

Average vehicle unscheduled maintenance cost, as a function of time, was also developed from the data that was available. It was determined that about 20% of the total life cycle (10-year/100,000 miles) unscheduled maintenance costs occurred during the first five years of operation. The remaining 80 percent of all repair costs occur after the first five years with the sixth and tenth years being the most costly.

In addition, this study includes a comparative yearly and life cycle maintenance cost comparison for each of three body classes; subcompact, compact and mid-sized. The average subcompact is shown to be the least expensive to repair over the assumed 10-year/100,000 mile life cycle. The average compact, while only six percent more costly to maintain than the subcompact, is shown to be 15 percent less costly to maintain than the mid-sized vehicle.

Also included in this report is a comparative analysis of engine and transmission repairs. This analysis compares the cost of repair of a domestic 350 CID V8 engine with automatic transmission to an imported 70 CID L4 engine and four-speed manual

transmission. Both engines are shown to be highly durable with the majority of either engine capable of exceeding 100,000 miles in normal service with proper maintenance being performed. However, there are indications that the V8 may be slightly more durable than the L4, particularly in the valve component area. Both transmissions are indicated to be as durable, of not more durable, than the engines if the transmissions are also properly maintained. Additionally, engine and transmission life expectancy is shown to be greatly influenced by driver habits and owner maintenance practices.

The information contained in this report will assist the Department of Transportation in evaluating automotive maintenance trends and the inpact of technological advances and federal regulations on vehicle maintenance requirements and costs.

2.0 INTRODUCTION

2.1 BACKGROUND

An historical passenger and non-passenger automobile maintenance data base, spanning the model years 1970 through 1975 and including 212 domestic and imported vehicles representative of the U. S. vehicle population, was developed for DOT/TSC under contract Number DOT/TSC-1047. This data base detailed scheduled and unscheduled maintenance costs for each of the vehicles broken down by type of servicing facility, i.e., independent repair garages, car dealers, service station or specialty shop. The purpose of this data base was to provide DOT/TSC a means to study the trends in automotive maintenance requirements and costs and to analyze how these costs vary with weight, body class and other vehicle parameters.

Considering the accelerated state of change in the automotive industry due to the impact of federal safety, emissions and fuel economy regulations, DOT/TSC found it necessary to update and enlarge the existing data base to allow continuing evaluation and analysis of automotive maintenance trends. This contract, therefore, updates the data base to include 169 domestic and imported vehicles for the model years 1976 through 1979. It also expands the data base by including selected vehicles with technological innovations which will enhance DOT's ability to assess the impact of technological advances and fuel economy, environmental and safety regulations on vehicle maintenance requirements and costs.

2.2 OBJECTIVES

The basic objective of this contract was to update and enlarge the existing automotive maintenance data base in terms of the number of vehicles included, numbers of maintenance items for which cost information is required and the span of model years covered.

Another objective was to develop a repair frequency and cost comparison for selected engine and transmission components of a typical domestically manufactured full-size passenger car equipped with a 300-400 cubic inch V8 engine and automatic transmission and a typical imported passenger car equipped with a 70-120 cubic inch L4 engine and manual transmission. The comparison was to be made over a projected vehicle lifetime of 100,000 miles and ten years. This special analysis for engines and transmissions was necessary since these systems were not included as part of the data bases that were developed. In establishing those components that would require maintenance over the average life of a vehicle for the data base, it was assumed that the engine and transmission for most vehicles would last for the 100,000 mile or ten-year period if normal scheduled maintenance was performed.

The final objective of this contract was to develop a scenerio of typical lifetime repair costs as a function of time for a passenger car in each of the compact, subcompact and mid-size body classes. The maintenance costs were to be established by year and accumulated over ten years in order to evaluate differences that might exist between the three body classes.

2.3 SCOPE

In the development of the data base a series of parameters were established as follows:

1) The vehicles to be included would be representative of the U.S. population, but their selection would also be based on the following criteria:

   - total production volume,
   - continuation of models from the previous data base,
   - at least one vehicle per body class for the U.S. manufacturers with the predominant options,
   - vehicles with new technological features,
   - most popular model of top five foreign imports based on sales volume, and
   - non-passenger automobiles with high past or potential future sales volumes in the less than 8500 lbs. weight category.

2) The scheduled maintenance (defined as the periodic maintenance specified by the manufacturer) and the unscheduled maintenance items (defined as any repair, replacement or adjustment of parts not specified in scheduled maintenance) to be included would be representative of almost all (95%) maintenance that would be required over the life of the vehicle -- exclusive of internal engine or transmission repair and/or repairs required due to an accident.

3) The frequency of scheduled maintenance repairs by vehicle would be established based on the vehicle's manufacturer's maintenance schedule as recommended in the owner's manual.

4) The frequency of unscheduled maintenance repairs by vehicle would be established based on available information considered applicable for normal or average component failures. The sources for these failure rates were to be fully documented and supported.

5) The costs of both scheduled and unscheduled maintenance were to be established for each of the following establishments that would normally perform the work.

   - Franchised car dealers.

   - Service stations.

   - Independent garages.

   - Specialty shops or mass merchandisers.

6) To determine costs, the labor rate used would be representative of the U.S. in constant 1978 dollars and would be applicable to each service facility category.

7) Costs of component part replacement would be based on published price lists from sources most likely to supply the specific servicing facility. For example, the automobile manufacturers might be dominant parts suppliers to car dealers, but independent garages and service stations would be more likely to purchase their replacement parts from independent automotive jobbers and wholesalers.

In establishing the cost of repair for a typical engine and transmission the scope was limited to the 1970 model year with a domestic standard size and a foreign subcompact passenger vehicle being selected for comparison. Repair frequencies and costs were to be determined for internal parts of the engines and transmissions, as well as for the clutch with a manual transmission.

To develop the scenerio of maintenance costs as a function of time, for the three body classes of vehicles over a ten-year vehicle lifetime, it was also necessary to indicate a range of costs for vehicles in each of the classes that would deviate from the average. For example, ten (10) mid-size body vehicles might be included in this analysis. The maintenance costs used in the scenerio would be the average of all ten. Recognizing there may be some major differences among the ten vehicles, it was necessary to establish a low and high range of costs within each class for the scenerio to demonstrate the extent of these differences.

2.4 LIMITATIONS

As was determined in the previous contract (DOT/TSC-1047), to develop an historical automotive maintenance data base there are a number of limitations and/or constraints in data availability that are also applicable to this updated version of the data base. Therefore, a number of assumptions had to be made in generating comparable information.

Probably one of the most significant limitations was the assumption that all scheduled maintenance is performed according to the manufacturers' recommendations throughout the life of the vehicle. Should this not actually be fact, the impact on unscheduled maintenance costs could be quite severe.

Another significant limitation is the assumption that all parts requiring replacement are replaced with parts of original equipment quality, and original equipment tires are replaced by tires of the same quality, size and type. Any significant variation from this procedure by a typical vehicle's owner(s) could drastically alter unscheduled maintenance costs.

The cost of parts to perform the individual repairs covered in this data base are the manufacturers' "suggested" retail prices and are assumed to be the prices normally charged by the various types of service establishments. This may not be the case at all service facilities.

The unscheduled maintenance frequency of repair/replacement factors used in this study are the same for all vehicles as no "hard" data is available to determine repair frequency differences between models and/or manufacturers.

The frequency factors are also highly variable, even within the same model car, because of differences in driver habits, topography, weather conditions, vehicle use and the physical conditions of the roads on which the vehicles operate.

Finally, the labor guides used to determine labor hours charged for repairs are meant as guidelines and occasionally shops will charge by time spent or "competitive repair package" price.

However, in spite of these limitations, the data base does provide overall averages by year, body type, etc., that can be used in comparative analysis.

3.0 DATA BASE METHODOLOGY

This section describes the methodology employed to select vehicles for inclusion in this data base and how the various parameters used to characterize those vehicles were developed. The vehicles finally selected for this data base covering the model years 1976 through 1979 are shown in Exhibits I-A through I-D.

3.1 VEHICLE SELECTION METHODOLOGY

To obtain a realistic approximation of the cost to repair typical 1976 through 1979 passenger and non-passenger automobiles (light duty trucks with a gross vehicle weight rating $\leq$ 8500 lbs), the vehicles characterized in this study must be representative of the U. S. 1976 through 1979 passenger and non-passenger automobile fleet. Therefore, a strict list of selection criteria was used to develop the list of vehicles included in this data base. The criteria used to select vehicles for inclusion is as follows:

- High sales/production volume.
- Continuity of models with those used in the previous data base when possible.
- At least one vehicle per each body class for each domestic manufacturer and all vehicles characterized by their predominent options, i.e., engine size, transmission type, and whether equipped with power steering, power brakes and/or air conditioning.
- All vehicles with new technological features such as lock up converters, turbo-chargers, diesel engines, electronic controls and/or fuel injection to be included.
- The most popular model of the top five imported automobile manufacturers based on sales volume.
- Non-passenger automobiles with high past or potential future high sales volume in the less than 8500 lb weight category.

3.1.1 Sales Volume

The sales volumes of various models were determined from the model year sales tabulations found in Ward's Automotive Yearbook. Those vehicles exhibiting high sales volume were identified and extracted for use in the preliminary vehicle list. All manufacturers were represented by a large number of vehicles at this point.

3.1.2 Vehicle Continuity

The new preliminary vehicle list was compared with the vehicle list used in the previously developed data base to assure continuity of vehicle models where possible. Where market changes caused a gross decrease in model sales volume, the vehicles were dropped from the lists. Where production of specific models terminated after the 1977 model year, the vehicles were retained in the data base for the applicable years. Any vehicle that terminated production at the end of the 1976 model year was dropped. Only models having high sales volumes were retained in the vehicle lists.

3.1.3 Body Class Representation

The vehicles contained in the preliminary vehicle list were checked by manufacturer to be sure each manufacturer was represented by at least one vehicle from each of the body classes marketed by that manufacturer. The body classes used in this survey are as follows:

- Luxury
- Standard
- Intermediate/Mid-size
- Compact
- Subcompact
- Truck
- Van
- Luxury Intermediate

Due to the downsizing program currently taking place in the industry, the EPA designation of body class was used to determine vehicle placement.

The selected vehicles were then characterized with their predominent options, again using Ward's Yearbooks as the primary source of sales information.

3.1.4 New Technological Features

Vehicles not already listed with significant technologically new features were added to the preliminary vehicle lists. The vehicles that were added to the list and their technological innovation are as follows:

- Cadillac Seville	Fuel injection
- Lincoln Versaille	Variable venturi carburetor
- Oldsmobile 88	Diesel engine
- Volkswagen Rabbit	Diesel engine
- Buick Regal	Turbo-charger
- Plymouth Horizon	Front wheel drive, lean burn ignition system

Selection of these vehicles was based on discussion with Chilton Company personnel and various conversations with manufacturers to determine technological advances.

3.1.5 Most Popular Imported Models

The most popular model of the five top imported automobile manufacturers was determined from sales tabulations in Ward's Automotive Year Book and added to the vehicle lists after being characterized by their predominant options. The list of the most popular imported models was then compared to the list of imports in the previous data base to see if continuity was being maintained. Because of market forces, the Datsun 610, selling only 35,000 units out of Datsun's total, was replaced by the Datsun B210 with sales of 150,000 units. The Mazda was dropped because it no longer was considered to have new technology and its sales volume was extremely low.

3.1.6 Non-Passenger Automobiles ≤ 8500 Pounds

The domestic non-passenger automobiles were selected for inclusion in the vehicle lists and compared for continuity in the same manner as domestic passenger cars. This resulted in the addition of a Dodge Tradesman B200 van, a Ford Econoline 150 van, a Chevrolet G10 van, and a Ford F150 pickup truck. All of the domestic non-passenger automobiles added had very high sales volume and all non-passenger automobiles contained in the previous vehicle lists were continued in the current vehicle lists.

Finally, any new passenger or non-passenger automobile with potentially high future sales volume was included in the vehicle lists. This resulted in the inclusion of the Chevrolet Citation, Datsun 310 and Ford Fiesta.

4.0 SCHEDULED MAINTENANCE METHODOLOGY

Scheduled maintenance is defined as the periodic maintenance specified by the manufacturer to keep the vehicle in proper running condition throughout the life cycle of the vehicle. To establish a comprehensive list of the recommended scheduled items and the mileage intervals recommended by the manufacturers, the owners' manuals and/or service manuals for the individual vehicles were used.

In previous years a given manufacturer's recommended maintenance schedule was generally the same for all of the manufacturer's vehicles. In the 1976 through 1979 model years, however, due to two distinctly different and very strict emissions regulations, there now are several different schedules within each manufacturing group. The maintenance schedule specified for the 49 state's emissions cycle is used for all of the vehicle configurations in this study.

The performance of some scheduled maintenance items is recommended at several different mileage intervals, such as - check at 5,000 miles and at every 15,000 mile interval thereafter. This is noted accordingly in order to assign appropriate maintenance costs. In some cases an item is scheduled on a time interval only. For comparison purposes the time interval is factored when this occurs, according to the manufacturers' particular maintenance schedule, to correspond with an appropriate mileage interval.

Most of the manufacturers' maintenance schedules only indicate performance up to 50,000 miles. It was presumed, for the purposes of this study, that the items should/would continue to be serviced on the same schedule during the 50,000 through 100,000 mile interval, e.g., if the oil is to be changed every 7,500 miles up to the 50,000 mile mark, it will continue to be changed every 7,500 miles until the vehicle reaches 100,000 miles.

Occasionally a manufacturer will recommend that an item be checked and only replaced if necessary. On these instances the check appears in the scheduled maintenance and the replacement of the item appears in unscheduled maintenance if applicable.

As a general practice, the repair industry has adopted a policy of grouping certain related items into "packages" when the items are scheduled to be performed at the same time or mileage. The vehicle owner is then charged a package price which is generally less expensive than the total costs that would be incurred if each item were individually performed and charged.

The most common instances of "package" service are safety inspections and emission control servicing. We therefore combined related safety items into safety packages and related emissions

items into emissions packages to properly reflect "real world" servicing costs.

It should be noted that most manufacturers classify tune-ups as emission control items which results in their being included in an emission control package.

The selection criteria used to determine proper placement of an item in the various safety or emissions group is the manufacturers scheduled mileage, i.e., all items in Safety I are scheduled to occur at the same mileage interval. A complete list of the items contained in each manufacturer's safety and emissions groups is shown in Appendix D.

Table 4-1 is a listing of all of the scheduled maintenance items for which data is recorded in this report. It should be noted, however, that not all of the items are listed as a scheduled maintenance item by every or any manufacturer.

Table 4-2 shows an example of a typical manufacturer's chart of scheduled maintenance.

TABLE 4-1. SCHEDULED MAINTENANCE ITEMS

ID Number	Maintenance Item
1011	Oil
1021	Oil Filter
1031	Fuel Filter
1041	Transmission Fluid (Oil)
1051	Transmission Filter
1061	Air Cleaner
1071	Rear Axle Oil
1081	Power Steering Oil
1091	Coolant Replacement
1101	Cooling System Flush
1111	Chassis Lubrication
1121	Front End Lube
1131	Body Lube
1141	Universal Joint Lube
1151	PCV Valve
1161	ECS Cannister/Charcoal Cannister/(Cannister/Filter)
1171	Crank Breather Element
1181	Fuel Vapor Check Valve
1191	EGR/Elem
1201	Catalytic Converter
1211	Air Pump Filter
1221	Distributor Cam Lubricator
1231	Adjust Transmission Bands
1241	Rotate Tires/Balance
1251	Engine Compression
1262	Drive Belts
1272	Cooling System Hoses
1282	Repack Wheel Bearings (Repack Front Bearings)
1292	Brake Hoses
1302	Brake Fluid
1312	Piston Cups, Master/Wheel Cylinder (Brake Cylinder Overhaul
1322	Spark Plugs
1332	Distributor Points
1342	Distributor Cap and Rotor
1361	Safety 1
1371	Safety 2
1381	Safety 3
1392	Emissions 1
1402	Emissions 2
1412	Emissions 3
1422	Tune-up 1
1432	Tune-up 2
1442	Tune-up 3
1451	Check Valve Lash
19A2	Emissions 5
19B2	Air Induction Valve Filter
19C2	Retorque Bolts (Head)
19D2	Oxygen Sensor

Table 4-1 (cont.)

SCHEDULED MAINTENANCE ITEMS

ID Number	Maintenance Items
19E2	Vac Bleed Valve
19F2	Spark Delay Valve
19G2	Vacuum Transmitting Valve
19H2	Brake Lining Check
19I2	Emissions 4
19J2	Air Conditioning Check
19K1	Adjust Clutch Free Play
19L1	Check Injection
19M1	Check Alignment
19N1	Safety IV
19O1	Check Axle Fluid
19P1	Clean Air Filter
19Q1	Check Coolant Protection & Condition
19R1	Lube Parking Brake & Clutch Cable
19S1	Check Air Cleaner Temp. Control
19T1	Adjust Rear Wheel Bearing
19U1	Check Manual Steering Seals
19V1	Check Drive Boots & Output Shaft Seals
19W1	Replace Ventilation Flow Valve
19X1	Check Fuel Tank, Lines, Cap
19Y1	Check Carb. Choke & Hoses

TABLE 4-2. VEHICLE MAINTENANCE SCHEDULE

COMPLETE VEHICLE MAINTENANCE SCHEDULE I — 1978 MODELS

This Maintenance Schedule is applicable to all engines which do not contain the letter "U" in the engine identification code (which begins with the numeral "8") shown in the upper left corner of the underhood "Vehicle Emission Control Information" label (Example 820S2E)

WHEN TO PERFORM SERVICES	ITEM NO.	SERVICE	OWNER'S SERVICE LOG — MILES (KILOMETRES) INSERT MONTH, DAY, AND MILEAGE (i.e. MAY/5/9812) IN COLUMN CLOSEST TO MILEAGE WHEN SERVICE IS PERFORMED					
			7,500 (12 000 km)	15,000 (24 000 km)	22,500 (36 000 km)	30,000 (48 000 km)	37,500 (60 000 km)	45,000 (72 000 km)
SECTION A — LUBRICATION AND GENERAL MAINTENANCE								
Every 12 Months or 7,500 Miles (12 000 km)	A-1	Chassis Lubrication	●	●	●	●	●	●
	A-2	*Fluid Levels Check	●	●	●	●	●	●
	A-3	*Engine Oil Change	●	●	●	●	●	●
	A-4	Clutch Pedal Check	●	●	●	●	●	●
See Explanation	A-5	*Oil Filter Change	●		●		●	
	A-6	Tire Rotation	●		●		●	
	A-7	Rear Axle Lube Change						
Every 12 Months or 15,000 Miles (24 000 km)	A-8	*Cooling System Check		●		●		●
Every 30 000 Miles (48 000 km)	A-9	Wheel Bearing Repack				●		
	A-10	Manual Steering Gear Check				●		
	A-11	Clutch Cross Shaft Lubrication				●		
Every 60,000 Miles (96 000 km)	A-12	Auto. Trans. Fluid & Filter Change						
SECTION B — SAFETY MAINTENANCE								
Every 12 Months or 7,500 Miles (12 000 km)	B-1	Owner Safety Checks	●	●	●	●	●	●
	B-2	Tire, Wheel and Disc Brake Check	●	●	●	●	●	●
	B-3	*Exhaust System Check	●	●	●	●	●	●
	B-4	Suspension and Steering Check	●	●	●	●	●	●
	B-5	Brake and Power Steering Check	●	●	●	●	●	●
Every 12 Months or 15,000 Miles (24 000 km)	B-6	*Drive Belt Check		●		●		●
	B-7	Drum Brake and Parking Brake Check		●		●		●
	B-8	Throttle Linkage Check		●		●		●
	B-9	Underbody Flush & Check		●		●		●
	B-10	Bumper Check		●		●		●
SECTION C — EMISSION CONTROL MAINTENANCE								
At First 6 Months or 7,500 Miles (12 000 km). Then at 18 Month/22,500 Mile (36 000 km) Intervals as Indicated in Log	C-1	Thermo Controlled Air Cleaner Check	●		●			●
	C-2	Carburetor Choke Check	●		●			●
	C-3	Engine Idle Speed Adjustment	●		●			●
	C-4	EFE System Check	●		●			●
	C-5	Carburetor Mounting Torque	●		●			●
	C-6	Vacuum Advance System and Hoses Check	●		●			●
Every 12 Months or 15,000 Miles (24 000 km)	C-7	Fuel Filter Replacement		●		●		●
	C-8	PCV System Check		●		●		●
		—PCV Valve and Filter Service				●		
Every 22,500 Miles (36 000 km)	C-9	Spark Plug Wires Check			●			●
	C-10	Idle Stop Solenoid and/or Dashpot Check			●			●
	C-11	Spark Plug Replacement			(2)			●
	C-12	Engine Timing Adjustment & Distributor Check			●			●
	C-13	Carburetor Vacuum Break Adjustment			(3)			(3)
Every 24 Months or 30,000 Miles (48 000 km)	C-14	ECS System Check and Filter Replacement				●		
	C-15	Fuel Cap, Tank and Lines Check				●		
Every 30,000 Miles (48 000 km)	C-16	Air Cleaner Element Replacement				(1)		

Note: Engine Code is the fifth digit of Vehicle Identification Number

● Also A Safety Service

* Also An Emission Control Service

(1) All Except L4 Engine Which Requires This Service Every 50 000 Miles (80 000 km)

(2) All Except Engine Family 820N4EH Which Requires This Service at 45 000 Miles (72 000 km)

(3) Applies To The Following Engines and Vehicle Identification Number Engine Codes: V8 305 Code U, V8-305 Code H, V8-350 Code L and V8 301 Code Y

Your 1978 Pontiac has been certified to meet emission standards at either high or low altitude as designated on the underhood Vehicle Emission Control Information Label. Vehicle operation will be optimum at the altitude designated on the Label but will be satisfactory at all altitudes.

The exhaust emission control systems used on 1978 model GM vehicles are not designed for conversion to allow the vehicles to meet emission standards when operated at other than the altitude designated on the Label. However, for some GM vehicles, conversion to meet emission standards at other than the designated altitude is possible and is permitted by government regulations. Information regarding conversion of your vehicle, if permitted, can be obtained from: Customer Services Department, Pontiac Motor Division, Central Office, One Pontiac Plaza, Pontiac, Michigan 48053. Telephone No. (313) 857-1318. Include your Vehicle Identification Number in your request.

5.0 UNSCHEDULED MAINTENANCE METHODOLOGY

Unscheduled maintenance is defined as any repair, adjustment, replacement, etc., not specifically recommended by the manufacturers. Additionally, these repairs, adjustments, etc., will not necessarily be performed on every vehicle. The list of potential unscheduled maintenance items could literally include all the structural and non-structural components of any given vehicle. However, the contract specifically excludes accident damage, thus excluding structural parts. Additionally, since scheduled maintenance is assumed to be performed according to schedule, no engine, transmission or rear axle assembly failures will occur in the assumed 100,000 mile/10-year vehicle life.

Realistically, therefore, the list of unscheduled maintenance items developed for use in this contract had to be representative of 85 to 90% of the total unscheduled repairs/replacement performed in the U.S., excluding body and drive train repairs. The list of unscheduled maintenance items shown in Table 5-1, was derived by following a three step selection process.

5.1 UNSCHEDULED MAINTENANCE ITEM SELECTION METHODOLOGY

For continuity purposes, the list of unscheduled maintenance items from the previously developed data base was used as a preliminary list for this data base. This list was then reviewed to determine what additional items, if any, should be added to the vehicle lists. Special consideration was given to items added to vehicles because of the many technologically new systems appearing on 1976 through 1979 model vehicles. The following items were added to the preliminary unscheduled maintenance items list.

- fuel injection pump
- fuel injection nozzle
- electric fuel pumps (chassis/engine mounted)
- fuel injection control box
- ignition system control box
- glow plugs
- rotate tires
- electric fuel pumps (tank mounted)

A review of replacement parts market data from a variety of published sources; including the U. S. Census of Manufacturers, Frost and Sullivan studies, and *Motor Age* magazine; was conducted to determine if the actual sales volume or usage of a given part warranted its addition to the new unscheduled maintenance item list. No additional items were deemed necessary and the final list was approved by the technical monitor.

5.1.1 Frequency Factor Development

Developing "wear out" rates or frequency of repair factors is somethat more complex than it initially appears. These intervals

TABLE 5-1. UNSCHEDULED MAINTENANCE ITEMS

ID Number	Maintenance Item
2501	Oil Pump
2511	Carburetor
2521	Fuel Pump
2531	Power Steering Pump
2542	Hoses & Belts
2551	Generator/Alternator
2561	Starter
2571	Water Pump
2581	Radiator
2592	Wheel Bearings
2601	Shock Absorbers
2611	Ball Joints
2352	Front End Align
2621	Universal Joints
2631	Front Brakes - Shoes
2641	Front Brakes - Drums
2651	Rear Brakes - Shoes
2661	Rear Brakes - Drums
2672	Master Cylinder
2682	Wheel Cylinder
2692	Brake Hose
2302	Brake Fluid
2701	Brake Booster
2711	Steering Tie Rod Ends
2721	Exhaust Pipe
2731	Muffler
2741	Tailpipe
2751	W/S Washer & Pump
2761	Wiper Blades
2771	Battery
2781	Voltage Regulator
2792	Distributor Cap
2802	Rotor
2812	Points & Condenser
2822	Spark Plugs
2832	Spark Plug Wires
2841	A/C Compressor Assembly
2851	A/C Receiver
2861	Power Windows/Seats
2871	Heater Core
2881	Lamps/Bulbs/Flasher
2891	Tires
2901	SS Shock Absorbers
2911	SS Ball Joints
2921	SS Front End Align
2931	SS Brake Job
2941	SS Exhaust System

Table 5-1 (cont.)

ID Number	Maintenance Item
295l	SS Tune-up
296l	SS King Pins & Bushings
297l	King Pin & Bushings
29Al	Fuel Injection Pumps
29Bl	Fuel Injection Nozzles
29Cl	Electric Fuel Pumps (Chassis)
29Dl	Fuel Injection Control Box
29El	Ignition System Control Box
29Fl	Glow Plugs
29Gl	Rotate Tires
29Hl	Elect Pump (Tank)

or frequency of repair factors can be altered or affected by numerous uncontrollable variables such as driver habits, number of drivers per vehicle, weather, road conditions, average trip length, general topography, traffic density, and/or preventative (scheduled) maintenance practices. All of these variables can contribute to limiting or extending the "life" of a particular part or component. Brake pad/shoe life, for example, is known to vary extensively among similar cars, with different drivers, in different geographical areas and with traffic density. Battery life, as another example, is not only dependent on time and weather conditions, but can be affected by the condition of other vehicle electrical components.

In addition, efforts in this contract, as well as efforts in the previous contract, show that:

- No "hard data" is available to support the concept that average wear-out rates for component parts differ significantly among manufacturers or models.

- All component parts of a given vehicle are designed and sized to perform satisfactorily on that vehicle and are scaled according to vehicle size and weight. Therefore, the frequency of repair rates should be the same for all vehicles regardless of body classification.

- Unscheduled maintenance data, available from a variety of fleet sources, is not representative of the vehicle population since fleet driving patterns and maintenance parameters are not typical of the real world.

- Most potential extended life maintenance data appears to fall into two categories. They are either not credible or they are based on outdated sales information.

It had been assumed that the 1977 Census of Manufacturers data would be available during the course of this contract to provide current "hard" parts sales information. When it became obvious that the Census data would not be available, the frequency factors developed for the previous maintenance data base were used with the permission of the technical monitor. In developing those frequency of repair factors, it was assumed that the wear-out rates of similar components or maintenance items was the same for all vehicles included in this study.

To establish overall credibility for the frequency of repair factors, aftermarket parts sales figures of actual component parts related to the number of vehicles (passenger cars and light trucks) on the road. The following formula was used to develop the individual repair frequencies:

$$\frac{\text{No. of Parts Sold}}{\text{No. of Vehicles}} = \text{Parts/Vehicle} \times 10 \text{ years} = \text{Frequency Factor}$$

Three basic "hard data" sources were used - the 1972 Census of Manufacturers; Hunter Publishing Company, 1975 Service Job Analysis; and Frost & Sullivan's Automotive Aftermarket studies. The weaknesses of each of these sources, however, should be recognized.

The development of the individual repair frequencies follow:

a. Oil Pumps

The 1972 Census of Manufacturers reports 2.9 million oil pumps being shipped in total. Although the quantity shipped to the aftermarket is not available, we estimate that almost all OEM oil pumps are shipped as part of the engine and, therefore, the entire 2.9 million pumps are primarily going into the aftermarket. With 117 million vehicles using 2.9 million oil pumps in 1972, it is estimated 2.5% of them replaced an oil pump. Assuming no reason for this relationship to change by 1978, a factor of .3 was used to represent the 10-year life cycle.

b. Carburetor

It was assumed that rebuilt carburetors would be used for all unscheduled maintenance except in cases where a rebuilt was not available. There are two published sources of data on carburetor replacements (new and rebuilt), both of which are considered "soft." Hunter Publishing, 1975 Service Job Analysis reports a total of 4,082,000 new/rebuilt carburetors being installed in 1975. This amounts to about 3% of the 125,000,000 gasoline engined vehicles on the road. Frost and Sullivan, based on their projections of the special reports to FTC in 1967 (which they indicated may be understated), reports total wholesale sales of $55,800,000 for carburetors. Considering an average wholesale price of $18 each, the unit market would be about 3.1 million, or less than the Hunter data.

The missing element appears to be carburetor kits that are used for rebuilding by the repair shop in place of a rebuilt unit. Frost and Sullivan further projects a market of $36.6 million for carburetor kits in 1975. At an average wholesale price of $5 each, a total of 7.3 million kits were sold. Considering only the Frost and Sullivan data, therefore, approximately 3.1 million complete units were sold plus 7.3 million kits for a total market of 10.4 million carburetor service jobs.

Unlike the Census of Manufacturers where data is reported for automotive use only (SIC 3711), we suspect that the information provided to the FTC in 1967 by the component manufacturers may have been for all of their sales including off-road (SIC 3254, 3531, 3533, 3537). Accordingly, we adjusted the market volume figure downward by 10% - from 10.4 million to 9.4 million - to apply to the automotive market only. With 125 million gas engined vehicles on the road in 1975, 7.5% had either a new or rebuilt carburetor installed. The replacement factor of .75 was used over a 10-year period.

c. Fuel Pumps

Although both new and rebuilt fuel pumps are used to effect repairs, only new pumps are used for unscheduled maintenance because of their dominance in the market place. The 1972 Census of Manufacturers reports 7.9 million new fuel pumps being shipped to the aftermarket. In addition, 2.5 million rebuilt units are reported to be shipped through all channels. Since it is doubtful that rebuilt units would be used at the OEM level, it is assumed that these 2.5 million rebuilt units would be shipped to the aftermarket - making the total aftermarket unit sales 10.4 million in 1972.

Frost and Sullivan forecasts that unit shipments have declined approximately 3.7% per year from 1972 to 1975 because of the improved quality of OEM pumps. This, therefore, would provide an estimated total replacement market of 9.5 million units in 1975. With a total of 130 million vehicles on the road in 1975, it is estimated that 7.3% or 9.5 million of them replaced a fuel pump. Over a 10-year period, therefore, a factor of .73 would apply.

d. Starters/Alternators/Generators

The only published data that could be found relative to the market for starters, generators, or alternators was the 1975 Service Job Analysis from Hunter Publishing Co. This data reports that 11,579,000 new or rebuilt starters were installed in 1975 and 5,148,000 generators. Direct contact with the major aftermarket manufacturers in these areas (Champion Parts, Raylock Corporation and Arrow Automotive) basically confirms the market for starters as being about 11.6 million units but reports the generator/alternator market at about the same volume - as opposed to the 5 million reported by Hunter. Based on the available information, and using our own experience, we estimate both markets to be about 11.6 million units in 1975 - assuming the data reported by Hunter for generators was due to a sampling error.

The 11.5 million unit total replacement market includes some 10 million trucks and buses over 10,000 GVW. Because of the high mileage associated with this group, we estimate that their use of starters, generators and alternators would be greater than the light duty truck or passenger car market - thereby reducing the market to some 10 million units of each for the passenger vehicle market. With 120 million cars and light trucks using 10 million starters and alternators in 1975, we estimated that 8.3% of them had a replacement installed. Over a 10-year period, therefore, the factor would be .8.

e. Water Pump

The 1972 Census of Manufacturers reports sales of 6.6 million new water pumps to the aftermarket. In addition, 6.2 million rebuilt units were sold. Assuming all rebuilt units would be sold to the aftermarket, the total number of replacement units sold in 1972 was 12.8 million units. With 117 million total vehicles using 12.8 million water pumps in 1972, it was estimated that 11% of them replaced a water pump. Assuming no reason for this relationship to change, a factor of 1.0 was used for the 10-year period.

f. Radiator

Maintenance costs for radiators is difficult to allocate based on available information. The 1972 Census of Manufacturers reports 800,000 radiators being sold into the aftermarket. It is assumed that most of these were for replacement in vehicles involved in accidents. Hunter's 1975 Service Job Analysis reports 11,923,000 repair jobs performed on radiators. These repair jobs could range from a reverse flush/minor "in-car" repair to a complete recore. These repairs would have a broad range of costs in both parts and labor and would vary by vehicle based on size and accessory equipment, such as air conditioning.

Based on Hunter information all vehicles will have approximately one radiator repair over the 10-year period. In order to achieve a representative average cost of all repairs not influenced by accident damage, and taking into consideration that any repair made to the radiator probably would supplant a scheduled cooling system service, we applied a flat $50 cost plus the specific time to remove and replace the radiator for all vehicles and reduced the frequency factor from 1.0 to .5. This is a somewhat different approach than was previously used because the 800,000 radiators replaced due to accident will put-off or negate the need for radiator repair on 8 million vehicles during the 10-year period and are probably part of the 11 million reported repairs. The most common radiator repair is a thorough off car cleaning costing approximately $35 or less with many small leaks (top and bottom tanks) being repaired on the vehicle. Also, a percentage of the reported "repairs" would probably be in car cleaning/reverse flusher and, as such, it would take the place of a scheduled cooling system flush/coolant replacement cycle.

g. Shock Absorbers

The shock absorber picture is somewhat complex because the industry does not believe shocks are sold for cars over 10-year old. (Statistics indicate sales for cars over 10-years old are negligible) Thus the vehicle population purchasing shock absorbers is less than the total vehicle population. The population of cars 10-years old or less was 93,200,000 for 1975, compared to the total population of 107 million. Total sales figures indicate 45 to 50 million shocks were sold for use on these 93.2 million cars and light trucks. This gives a frequency of 5.2, but this was adjusted to 5.0 because a percentage of shocks sold are of the load leveler/helper variety and are being installed because of a special vehicle application or change in vehicle use.

h. Ball Joints

Hunter's 1975 Service Job Analysis reports 10,193,000 repair jobs performed for ball replacements, or about 10% of the vehicles every year. This is equivalent to all vehicles over a 10-year period or a frequency factor of 1.0. Since the repair industry tends to replace ball joints in pairs, two load carrying ball joints were priced for this item.

i. Front End Alignments

The Hunter Service Job Analysis reports 31 million front end alignment jobs being performed. This is equivalent to about 25% of the vehicles being serviced each year or each vehicle being serviced approximately twice in its lifetime (100,000 miles). The frequency factor used was 2.0.

j. Universal Joints

The 1972 Census of Manufacturers reports 10.3 million universal joint repair kits being shipped into the aftermarket, as well as 600,000 new universal joints, or about one universal joint per vehicle. This compares to the 1975 Hunter Service Job Analysis information of 13.5 million replacements with the increase of vehicles in 1975 as compared to 1972. The frequency factor used, therefore, was 1.0.

k. Brake Shoes/Pads

The 1975 Hunter Service Job Analysis reports 60.8 million (wheels) brake shoes relined and 16.9 million (wheels) disc pads replaced. This is equivalent to about 35 million axle sets (2 wheels) of replacement brake shoes/pads in 1975. No other "hard" data could be found to confirm these statistics. The Hunter data is based on jobs performed in all repair facilities except mass merchandisers, specialty brake shops or the "do-it-yourself" market. Brake lining repair is a service activity that is performed to a large degree through repair facilities not covered by the Hunter study. To adjust the market size accordingly, therefore, we estimate these facilities perform an additional 25-30% of the brake lining repairs - increasing the total market to about 50 million axle sets annually. Therefore, over 100,000 miles, the average vehicle would use about five axle sets of brake shoes/pads. Based upon interviews with manufacturers and experience in the repair industry, it was determined that these five axle sets would be used with three sets on the front axle and two sets on the rear axle.

l. Brake Drums/Discs

Much of the service work performed on brake drums involves "turning" or "grinding" rather than actual replacement. The Census data, therefore, is not adequate to determine maintenance costs. The 1975 Hunter data reports a total of 40 million service jobs being performed on brake drums - either new replacements or "turned." This is equivalent to 10 million vehicles having all four drums repaired in 1975 - or all vehicles having all four drums repaired over a 10-year period.

m. Wheel Cylinders

The 1972 U.S. Census of Manufacturers reports 5.5 million wheel cylinders being shipped to the automotive aftermarket. This data, however, is not indicative of the maintenance performed on wheel cylinders since the majority of repairs are made with rebuilding kits. Hunter's 1975 Job Analysis reports 35.5 million jobs performed

in replacing or overhauling wheel cylinders/calipers. This is equivalent to servicing all four wheel cylinders on about 10 million vehicles - or once for all vehicles over a 10-year period. Costs used in computing wheel cylinder/caliper repairs are based on two caliper/rebuilding kits and two rear-wheel cylinders.

n. Master Cylinders

The master cylinder market, according to major industry sources, was 4 million units annually for 1975. Over a 10-year period this equates to a frequency factor of 0.40.

o. Batteries

For 1975, 30.3 million batteries were placed in 107 million vehicles for a frequency factor of 2.8. Sales information was obtained from the Battery Council International, Gould Battery, General Battery, and other information in Chilton files. Battery life expectancy, however, is greatly influenced by weather conditions and will vary widely by region of the country.

p. Brake Fluid

Because of the down-sizing efforts in the industry and the high percentage of small imported vehicles in the U.S. fleet, the average hydraulic brake system contains about 1-1¼ pints of fluid. This system should be bled completely at time of cylinder repair. Considering that wheel cylinders will be replaced/overhauled once in 100,000 miles, approximately 1-1¼ pints of brake fluid will be used. In addition, it is expected that approximately ¼ pint will be used to top off fluid levels because of extended maintenance intervals. Considering these factors, we estimate the average vehicle uses 1½ pints of brake fluid in 100,000 miles.

q. Spark Plugs

Although spark plugs were listed as an unscheduled maintenance item in the previous data base, spark plugs are a scheduled maintenance item for all vehicles in this data base.

r. Tires

The replacement intervals for tires were developed by vehicle based on several assumptions. It was assumed that all tires are replaced with the same type (bias, radial, belted) and size supplied as original equipment. It was also assumed that the tires will run the mileage guaranteed by Sears for the size, quality and type tire supplied as original equipment. This resulted in the following frequency factors:

- Bias ply - 16.00 (16 tires/10 years)
- Bias belted - 12.00 (12 tires/10 years)
- Radial - 8.00 (8 tires/10 years)

All of the frequency factors developed for tires assume:

- Proper inflation is maintained.
- No manufacturing defect exists in the OEM tire causing early failure.
- SNOW TIRES, used on some vehicles only in certain regions of the country, are not included.

Because of the difference in replacement internals by tire types, it is virtually impossible to substantiate these intervals with market figures. This is particularly true of the 1977 through 1979 period as the radial tire is occupying an ever-increasing share of the replacement market.

Sears mileage guarantee and pricing from the 1978 Fall/Winter Catalog was used because:

- Sears is one of the few manufacturers to still offer a mileage guarantee.
- Sears is one of the top three replacement tire marketers and there is less than a two percentage point share of market spread between the top three retailers.

s. Mufflers

The 1972 Census of Manufacturers reports 32.5 million mufflers being shipped to the automotive aftermarket. Frost and Sullivan projected an increase to 37.8 million in 1975. This would be equivalent to about 30% of the vehicles replacing a muffler in 1975 or all vehicles replacing a muffler an average of three times over a 10-year period.

t. Exhaust Crossover/Tail Pipes

Based on the 1972 Census of Manufacturers, 42.3 million pipes (used in exhaust systems) were shipped to the automotive aftermarket. Using Frost and Sullivan's projections, the market in 1975 would have grown to about 45 million units. This would be equivalent to four pipes/vehicle over a 10-year period.

Based on other independent estimates we received on the total market, the figure of 45 million appeared somewhat low. Recognizing that industry practice frequently involves replacement of a tail pipe at the same time a muffler is replaced, we estimate 30 million tail pipes are replaced, or about three per vehicle, over a 10-year period. In addition, we estimate, based on an industry contact, that two exhaust and/or crossover pipes are replaced over a 10-year period, which would make the total market 50 million pipes rather than the 42.3 million reported in the Census.

u. Ignition Parts (Distributor Caps, Rotors, Voltage Regulators, Spark Plug Wires)

The only published "hard data" that could be found in this area included a number of parts as a group or category. Frost and Sullivan projected a total wholesale market of $390 million in 1975 for this category - which is equivalent to 1 billion at retail. Based on contacts with manufacturers, we estimated the frequency of replacement for these components as follows:

- Voltage regulator 1.0
- Distributor cap 1.0
- Rotor 4.0
- Spark plug wires 1.0

v. Lamps/Bulbs/Flashers, etc.

These components were included as a group with an arbitrary fixed cost of $10 and 0.5 hours labor charge for total replacement over the 10-year/100,000 mile period. It is predicated on one sealed beam ($5.12), one flasher ($3.45) and two turn signal ($1.40) bulbs. This figure is based on input from industry contacts and NAPA list prices for parts.

w. Brake Boosters, Power Steering/Seats, Washer Pumps, Heater Cores, AC Compressors and Condensors/Receivers, Hose and Belts, Tie Rod Ends, Power Windows, Fuel Injection Components, Electric Pumps, etc.

Replacement or service intervals on these items were based on discussions with industry experts. No "hard data" to support them could be found, largely because their failure rates are so small.

6.0 MATERIAL COSTS AND LABOR HOUR REQUIREMENTS METHODOLOGY

The development of specific cost data for each of the scheduled and unscheduled maintenance items was necessary to enable DOT/TSC to analyze vehicle maintenance costs by servicing facility type and by year. Data had to be gathered relative to parts costs, labor hour requirements to effect repair, and the labor hour dollar rate normally charged by each of the four servicing facilities being considered -- franchised car dealers, gasoline service stations, independent repair garages and specialty shops.

The necessary reference materials were gathered and numbered, and a master reference source list was created. Specific data can easily be traced to its source through the use of this master list. Since the approach in developing this information varies, each of the subject areas are discussed in the following paragraphs.

6.1 MATERIAL COST DATA

Recognizing that the various servicing facilities frequently obtain replacement parts from a variety of sources at different prices, it was necessary to establish costs for each facility that reflected the average "real world" situation.

6.1.1 Franchised Car Dealer Purchase Patterns

Although franchised car dealers purchase parts from a number of sources, they usually purchase and inventory parts supplied by their particular vehicle manufacturer, i.e., Ford dealers buy from Ford, Chevrolet dealers buy from General Motors, etc. The retail parts' costs for dealers, therefore, were derived from the parts and price books supplied to the dealers by their respective vehicle manufacturers.

Price books pertinent to the mid- to late-1978 calendar year were used throughout the study to assure pricing parity between all manufacturers' products. The individual part numbers were also recorded during the assembly of the raw data, even though this was not a requirement, so that pricing could be easily traced.

6.1.2 Service Station Material Cost Data

Service stations normally purchase their parts from local jobbers or distributors in addition to their oil company's somewhat limited parts affiliation. Traditionally, service stations do not maintain high parts inventory levels and as a result tend to use the parts' jobbers heavily. Material cost data for this type of facility was, therefore, developed using two primary parts sources. The two sources are the Atlas Supply Company and the National Automotive Parts Association (NAPA) jobbers.

The Atlas Supply Company is the aftermarket supplier to Exxon, American Oil and Standard Oil companies and is considered to be representative of the oil company affiliated parts supplier. Atlas parts and price catalogs applicable to the late-1978 period were used to develop material cost information for the parts from their line.

The NAPA is the largest independent, aftermarket parts distribution group and is, therefore, considered representative of typical aftermarket parts suppliers. NAPA parts and price catalogs for the pertinent time frame were used to establish materials costs for the parts not normally supplied by Atlas.

6.1.3 Independent Repair Garage Material Cost

Independent repair garages without manufacturing or oil company affiliations normally purchase their parts from local parts jobbers or distributors such as NAPA. Materials costs for this type of repair facility, therefore, were developed from NAPA parts and price catalogs for the mid- to late-1978 time frame. NAPA was used for the reasons previously stated in the discussion of service station material costs.

6.1.4 Specialty Shop Material Costs

Specialty shops purchase their parts either from a local distributor, if the shop is an independent, or through a parent company, if the shop is part of a franchised chain such as Midas Muffler. Actual costs of parts are frequently difficult to assess since most of their retail pricing is based on "package" or "Menu" pricing such as:

- A tune-up for $39.95
- Replace muffler for $31.00
- A brake job for $59.95

Rather than attempt to break out the cost of parts and labor for specialty shops, costs are combined in the data base. The total package costs were developed by reviewing newspaper ads and through direct inputs from the franchising companies for each of the repair areas, i.e., brakes, exhaust, tune-up, front end alignment, shock absorbers, etc.

6.1.5 Special Material Cost Considerations

In a further attempt to make the data as reflective as possible of actual conditions, the following materials parts cost adjustments were made.

- When a part was not available for an imported vehicle from the sources indicated, cost information was developed from World Parts.

- Recognizing the impact of advertising and the good business sense of the industry, national brand pricing on highly competitive items, such as antifreeze, was used since the majority of service facilities use a national brand -- even though they may have their own company brand available.

- For replacement of the proprietary parts of a car manufacturer, it was assumed that the service station and/or independent repair shop would purchase these parts from the car dealer. Therefore, the material costs for these parts were derived from the vehicle manufacturers' parts/price books.

- The market for rebuilt parts, i.e., alternators, starters, water pumps, etc., has become a major factor in the repair industry. Since selected items, such as those mentioned, are used more frequently than new items, the costs indicated for all servicing facility types are for rebuilt rather than new parts, if available.

NAPA is a major supplier of rebuilt parts and was used as the price source. All material costs are presented on the data tape in mid- to late-1978 dollars.

6.1.6 Labor Hour Requirements

The amount of time necessary to perform individual repairs varies somewhat with the repair industry and ranges from the use of a published labor guide to strictly the amount of actual time spent on the particular repair. By far the most prevalent method of determining labor requirements is the use of a published, other than car manufacturer sourced, labor guide. Chilton Company's "Labor Guide and Parts Manual" is one of the most widely used and, therefore, is the reference source employed to determine labor hour requirements.

Certain vagaries of labor hour requirements must, however, be understood in order to have a more realistic understanding of these labor guides and general industry practices. The manuals normally provide labor time requirements for individual maintenance operations, but when two or more operations are performed at the same time, the total labor hour requirements are reduced accordingly. For example, the labor hour requirement for an oil change is 0.3; the requirement for an oil filter is also 0.3 hours. When these two operations are performed at the same time, however, the combined labor hour requirement is only 0.3 hours.

Similarly, many service facilities will not charge labor for performing some basic maintenance tasks such as changing oil and/or filter because of either competitive pressures or the profit on the required parts is adequate. Additionally, there

exists a "double standard" in labor hours charged to replace certain items. For example, a fuel filter replacement may be charged for if it is performed as a single repair, but may not be charged for when done in combination with a tune-up. The extent of these variances from times indicated in the labor guides will be determined from various available Chilton surveys.

The labor manuals also include a series of "package rates" for performing a specified list of services such as an emissions control tune-up at 1.8 hours for a V-8 engine; a 10-point safety check at 1.0 hours and a minor engine tune-up at 1.8 hours for a V-8 engine. These combined rates were used when it was appropriate. In cases where these package rates did not correspond directly with the manufacturer's recommended schedule for emission check or tune-up, the rates will be adjusted accordingly by identifying the different elements and assigning labor times to them based on time records accumulated in Chilton's files and/or professional judgement.

As indicated in the materials cost section (6.1.5), the specialty shops usually offer "package prices" which include labor and parts. They do not break down that portion of the cost related to labor. Their advantage in the market often is their ability to offer a lower total price because they become specialists in a given repair activity and can consequently perform a repair faster than the manuals indicate. Therefore, labor hours for specialty shops were not used in making cost analysis of the repair activities.

6.1.7 Labor Rates Per Hour

The hourly labor rates charged by the repair industry varies considerably by type of repair establishment, by geographical area of the country, and by urban and rural communities. To establish an average national labor rate per hour for car dealers, independent repair shops, and service stations; a copy of the current Chilton survey of labor rates and selected repair practices was used.

The survey is geographically representative of the continental United States as the repair facilities surveyed were randomly selected from *Motor Age* circulation lists. The types of repair facilities included in the survey were luxury car dealers, domestic non-luxury car dealers, imported car dealers (top four imports), independent repair shops, and gasoline service stations. Careful selection was used to provide a statistically representative sample of each type of facility. The survey report indicates the composite average national labor rate for the five facility types surveyed to be $15.40. The metropolitan area rate is $16.70 and the non-metropolitan rate is $12.70. The average national labor rates charged by facility type is reported as follows:

- Luxury domestic car dealers	$23.00
- Non-luxury domestic car dealers	21.50

- Imported car dealers (top 4 imports)	$18.00
- Gasoline service stations	14.50
- Independent repair shops	15.00

When analyzing the cost of vehicle repair by facility type, several items must be taken into consideration. The first is that many service stations, independent repair shops, and domestic new car dealers do not provide full service for imported vehicles for a variety of reasons and these vehicles appear to be returned to the car dealer for a much longer period of time than are domestic vehicles. The second item is that the captive imports, Dodge Colt and Ford Fiesta, should be computed at the domestic non-luxury labor rate when a comparison of dealer servicing costs versus gasoline station or independent repair is made because they are sold through domestic dealers. Also, gasoline stations and to a lesser degree, independent repair garages may not have the capability to perform all of the scheduled and unscheduled maintenance services covered in this report.

6.1.8 Data Collection and Processing

Data accumulated during this project was collated and recorded on magnetic tape. The data has been delivered on nine (9) track unlabeled tape at a recording density of 800 BPI, conforming to the EBCDIC transmission code. As specified by the contract, each tape has been accompanied by a printout of the data, a structure definition sheet and a file description. The definition sheet (Table 6-1), structure definition sheet and file description (Table 6-2) and shown on the following pages.

The actual data collected during the course of this project, formated as shown in Table 6-3, is contained in Appendix E. The sample format provided in Table 6-3 is complete with description/definition of headings and also references to other explanatory sources in this report which describe the various parameters of the data.

The Transportation Systems Center (TSC), through the use of various computer programs, has summarized the labor and material costs for each vehicle in the data bank for each of the garage facilities. A sample format of the summary data is presented in Table 6-4. The summary of costs for each vehicle by repair facility type is contained in Appendix F.

The cost summary shown in Appendix F includes the labor and material costs for the scheduled and unscheduled maintenance. Once the garage facility is selected, the scheduled cost is computed as follows:

1. For each maintenance item, divide the mileage interval (in thousands) into 100 to obtain the number of times (n) it would be done in a 100 thousand mile lifetime. The fractions are dropped.

2. Multiply the factor (n) by the appropriate material cost (DLR.MAT., SS MAT or IND.MAT) to obtain the scheduled material cost.

3. Multiply the factor (n) by the labor hours and by the appropriate labor rate to obtain the scheduled labor cost.

4. After obtaining all these products for each of the maintenance items, they are added to give the total scheduled costs.

A similar procedure is followed to compute the unscheduled costs. The only difference is in Step 1, where the multiplications factor is given as a whole number or decimal for the unscheduled maintenance items. It should be noted that the unscheduled costs in Appendix F are different from the costs discussed in Section 8.1.1. The costs in Appendix F reflect a "National Average" instead of a failure of all unscheduled items.

TABLE 6-1. FIELD DEFINITIONS AND CODE TABLES

Field No.

01) VEHICLE IDENTIFICATION CODE, comprised of 15 digits, indicating the unique identification number assigned to each vehicle, the manufacturer, model year, body class, engine size, engine configuration and number of cylinders and transmission type.

The codes and their placement follow:

Column No.

1-2 Unique vehicle identification number.

3-7 Manufacturers' code.

GM - General Motors
Ford - Ford Motor Co.
Chrys - Chrysler Corp.
AMC - American Motors
Volks - Volkswagen
Toyot - Toyota
Datsu - Datsun
Honda - Honda

8 Model Year.

1 - 1970
2 - 1971
3 - 1972
4 - 1973
5 - 1974
6 - 1975
7 - 1976
8 - 1977
9 - 1978
10 - 1979

9 Body Class.

1 - L - Luxury Std.
2 - S - Standard
3 - I - Intermediate
4 - C - Compact
5 - SC - Subcompact
6 - M - Minicompact (not used)
7 - T - Truck
8 - V - Van
9 - LI - Luxury intermediate

10-12 Engine C.I.D.

Table 6-1 (cont.)

Field No.	Column No.	
	13	Cylinder Configuration. 1 - V 2 - L 3 - H 4 - R (rotary)
	14	Number of Cylinders. 1 - 8 2 - 6 3 - 4 4 - 1 (rotary)
	15	Type of Transmission 1 - Automatic 2 - Manual
02)	16-19	Vehicle Weight in Lbs.
03)	20-24	Vehicle Price in Dollars.
04)	25-29	Maintenance I.D. No. and Info. Source.
	25	Type of Maintenance. 1 - Scheduled 2 - Unscheduled
	26	Blank Space.
	27-28	Maintenance Task or Item.
	29	Indication of Possible Additional Information under other Maintenance Items. 1 - Sole source of information, no need to look further. 2 - Possibility of additional data under another category
05)	30-35	Occurrence designation.
	30-31	Type of Occurrence. M.I. - Coded for Mileage Interval for scheduled maintenance. F.F. - Coded for Frequency Factor for unscheduled maintenance.

Table 6-1 (cont.)

Field No.	Column No.	
	32-35	Occurrence Designation. Mileage Interval - Recommended schedule for performance of maintenance tasks (i.e., 12 means every 12,000 miles). Frequency Factor - Average number of times maintenance item will have to be performed during vehicle life (3.0 means requiring repair or replacement 3 times during the vehicle life).
	34	Fixed Decimal Point.
06)	36-41	Dealer Material Cost in Dollars and Cents with Column 39 a Fixed Decimal Point.
07)	42-47	Service Station Material Cost in Dollars and Cents with Column 45 a Fixed Decimal Point.
08)	48-53	Independent Repair Shop Material Cost in Dollars and Cents with Column 51 a Fixed Decimal Point.
09)	54-57	Labor Hours in 10th of an hour with Column 56 a Fixed Decimal Point.
10)	58-63	Specialty Shop Total Repair Cost in Dollars and Cents with Column 61 a Fixed Decimal Point.
11)	64-69	Indicated Occurrence.
	64	1 - One-time occurrence 2 - Staggered occurrence
	65	Fixed Hyphen.
	66-69	First Time of Occurrence in Thousands of Miles.
12)	70-73	Cycle Stagger in Thousands of Miles. Field 12 will be used only when the regularly scheduled repair interval is different than the first occurrence for the repair and a "2" is recorded in Column 64.

TABLE 6-2. STRUCTURE DEFINITIONS AND CODE TABLES

Chilton COMPANY MANAGEMENT INFORMATION SERVICES

SYSTEM NAME		SYSTEM STEP NO.
SYSTEM STEP NAME: TAPE REFORMAT	DATE:	☐ NEW ☐ REVISED

FILE DESCRIPTION

FILE NAME: TSC VEHICLE MAINTENANCE DATA BASE	RECORD SIZE: 73	FILE ID: $ BYPASS
ORGANIZATION: MAGNETIC TAPE - SEQUENTIAL	FILE SEQUENCE: Positions 1-2, FLD 04	BLOCK SIZE: 730

FIELD TYPE: A-Alphanumeric N-Numeric P-Packed X-Hexidecimal

FIELD	SUB FIELD	FIELD NAME	POSITIONS FROM	POSITIONS TO	NO. BYTES	FLD TYP	DEC POS	NO. DIGIT	REMARKS
01		Veh ID Code	01	15	15	A	-	-	
02		Veh Weight	16	19	4	N	-	4	Lbs.
03		Price	20	24	5	N	-	5	Dollars
04		Maint. ID No.	25	29	5	A	-	4	
	A	Maint. Type	25	25	1	N	-	1	
	B	Blank	26	26	1	A	-	-	
	C	ID No.	27	28	2	N	-	2	
	D	Inf. Source	29	29	1	N	-	1	
05		Occurrence Desig.	30	35	6	A	1	3	
	A	Occurrence Type	30	31	2	A	-	-	
	B	Cycle	32	35	4	N	1	3	Miles or Freq. Rate
06		Dealer Mat. Cost	36	41	6	N	2	5	Dollars & Cents
07		Serv. Mat. Cost	42	47	6	N	2	5	Dollars & Cents
08		I.R. Mat. Cost	48	53	6	N	2	5	Dollars & Cents
09		Labor Hours	54	57	4	N	1	3	
10		SS Total Cost	58	63	6	N	2	5	Dollars & Cents
11		Indicated Occurrence	64	69	6	A	1	4	Type of Cycle & Miles
	A	One Time Occurrence	64	64	1	N	-	1	
	B	Hyphen	65	65	1	A	-	-	
	C	First Cycle	66	69	4	N	1	3	Thousand Miles
12		Cycle Stagger	70	73	4	N	1	3	Thousand Miles

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TABLE 6-3. SCHEDULED MAINTENANCE

MFG	MODEL YEAR	VEHICLE	BODY CLASS	CID	CONFIG	CYLIN	TRANS	VEHICLE I.D. NUMBER (SEE EXHIBIT IA, IB, IC, ID)
GMC	1977	CHEVROLET NOVA	CR	250	L	6	AUTO	15

ITEM		MAINTENANCE ITEM NO.	TYPE S IS SCHEDULED MAINT. & NS IS UNSCHEDULED MAINT.**	MILEAGE INTERVAL	DEALER GARAGE MATERIAL COST	SERVICE STATION GARAGE MATERIAL COST	INDEPENDENT GARAGE MATERIAL COST	LABOR HOURS	SPEC TOTAL COST	
---- COOLING										
COOLING SYSTEM FLUSH		(10)	S	30.000	1.60	1.60	1.60	0.400	0.00	
COOLANT REPLACEMENT		(9)	S	30.000	6.00	6.00	6.00	0.400	0.00	
---- POWERTRAIN AND EMISSIONS CONTROL										
TRANSMISSION FLUID(OIL)		(4)	S	60.000	6.12	6.12	6.12	0.700	0.00	
TRANSMISSION FILTER		(5)	S	60.000	4.65	3.90	3.98	0.200	0.00	
OIL FILTER		(2)	S	7500/15000	6.05	6.66	7.85	0.300	0.00	*STAG
OIL		(1)	S	7.500	5.00	5.00	5.00	0.000	0.00	
EMISSIONS 4	REFER TO APPENDIX D	(101)	S	30.000	7.31	7.75	8.12	0.500	0.00	
EMISSIONS 3	REFER TO APPENDIX D	(41)	S	22.500	0.00	0.00	0.00	0.900	0.00	
EMISSIONS 2	REFER TO APPENDIX D	(40)	S	15.000	2.56	3.20	1.63	0.400	0.00	
SPARK PLUGS	REFER TO APPENDIX D	(32)	S	45.000	11.40	13.02	13.80	0.400	0.00	
EMISSIONS 1	REFER TO APPENDIX D	(39)	S	7500/25500	0.00	0.00	0.00	0.600	0.00	*STAG
---- CHASSIS										
SAFETY 2	REFER TO APPENDIX D	(37)	S	15.000	0.00	0.00	0.00	0.800	0.00	
SAFETY 1	REFER TO APPENDIX D	(36)	S	7.500	0.00	0.00	0.00	0.800	0.00	
REPACK WHEEL BEARINGS(FRONT BRNGS)		(28)	S	30.000	4.00	4.00	4.00	1.800	0.00	
ROTATE TIRES/BALANCE		(24)	S	7500/15000	0.00	0.00	0.00	0.500	0.00	*STAG
CHASSIS LUBRICATION		(11)	S	7.500	0.00	0.00	0.00	0.500	0.00	

NOTE: ALL COST BASED ON 1978 DOLLARS.

*STAG - This note indicates a staggered mileage interval. Example 7500/15000 infers that the first occurrence is at 7500 miles and every 15000 miles after 7500.

**Note: This column is labeled frequency factor as described in Section 5.1 for the unscheduled maintenance items.

TABLE 6-4. LIFE CYCLE COST FOR DEALER GARAGE WHERE MAINTENANCE IS PERFORMED (SEE SECTION 6.1.7 FOR THE DIFFERENT LABOR RATES.)

6-FEB-80 18:00 11.1

SUBSET SELECTION CRITERIA

VID BET 1 10 YEAR BET 76 79

			VEHICLE IDENTIFICATION NUMBER (SEE EXHIBITS I-A, I-B, I-C & I-D)	1	3	4	5	6	7	10
YEAR										
1976	SCHEDULED	MAT.		267.10	250.23	305.40	263.85	270.35	314.30	262.87
		LABOR		1087.90	1212.10	657.80	1044.90	567.60	1094.80	1083.60
		TOTAL		1355.00	1462.33	963.20	1308.75	837.95	1409.10	1346.47
	NONSCHED	MAT.		2610.96	2827.49	2874.86	2323.23	2430.37	2351.74	2256.99
		LABOR		1314.57	1270.06	1451.41	1131.22	1285.27	1242.80	1124.66
		TOTAL		3925.53	4097.55	4326.27	3454.45	3715.64	3594.55	3381.65
	TOTAL	MAT.		2878.06	3077.72	3180.26	2587.08	2700.73	2666.04	2519.86
		LABOR		2402.46	2482.16	2109.21	2176.12	1852.87	2337.60	2208.26
		TOTAL		5280.53	5559.88	5289.47	4763.20	4553.60	5003.65	4728.12
			TOTAL LIFECYCLE COST FOR VID 1, 1976							
1977	SCHEDULED	MAT.		241.20	249.95	230.10	263.85	232.50	266.40	262.75
		LABOR		1062.60	1212.10	492.20	1044.90	488.05	1032.70	1057.80
		TOTAL		1303.80	1462.05	728.30	1308.75	720.55	1299.10	1320.55
	NONSCHED	MAT.		2335.18	2657.40	2788.96	2245.49	2402.95	2337.67	2272.50
		LABOR		1317.79	1224.06	1451.42	1096.82	1285.27	1242.81	1124.67
		TOTAL		3652.96	3881.46	4240.37	3342.31	3688.22	3580.48	3397.16
	TOTAL	MAT.		2576.38	2907.35	3025.06	2509.34	2635.45	2604.07	2535.25
		LABOR		2380.39	2436.16	1943.61	2141.72	1773.32	2275.51	2182.46
		TOTAL		4956.76	5343.51	4988.67	4651.06	4408.77	4879.58	4717.71

7.0 TASK 5 - ENGINE AND TRANSMISSION REPAIR COST AND FREQUENCY COMPARISON

7.1 PURPOSE

The purpose of this task is to develop estimates of the frequency of repair, lifetime in miles and costs to repair the engines and transmissions of typical passenger automobiles. The scope of this task is limited to a 1970 model year, domestic full-size passenger automobile with automatic transmission (V8 engine of 300-400 cubic inch displacement) and to a typical imported sub-compact passenger automobile with a manual transmission (four cylinder engine of 70-120 cubic inch displacement).

It should be noted that engines and transmissions were not included in the data base that was developed since it was assumed that these items would not require unscheduled maintenance over a 100,000 mile lifetime with scheduled maintenance being performed. The principal effort in this task, therefore, was to determine differences that might exist between the two body classes comparing a domestic and imported vehicle in a "real-world" situation.

7.2 LIMITATIONS

The information presented in this section was developed subject to certain limitations. The most severe limitation is that no "hard" data exists relating to the actual failure point, in miles, of various engine components. Additionally, engine and transmission failure occur on such a limited scale, are so varied in type and are repaired in such a variety of manners that they are virtually impossible to track. Furthermore, individual component parts and/or assemblies fit several model year vehicles so that sales volume figures of specific components cannot be related to failure frequencies for a given model year. The average 1970 passenger automobile has long since passed from its original owner, and possibly the second, and historical service records are virtually non-existent. And finally, high mileage fleet maintenance records which have been investigated are not considered to be representative of "normal" average vehicle use or maintenance and thus are not applicable to this study.

7.3 METHODOLOGY

The methodology used to develop the information required by the various parameters of this task are discussed under separate headings in the following paragraphs.

7.3.1 Vehicle Selection

The selection process used to determine the typical 1970 model domestic full-size V8 passenger automobile and the typical imported subcompact four cylinder passenger automobile involved several individual steps. The 1971 edition of Wards Automotive Yearbook, reporting 1970 model vehicle sales, was used to determine the most popular domestic and imported vehicles that suited the parameters of this task. Additionally, to facilitate comparison the vehicle selection was limited to those vehicles having a conventional drive train layout (water cooled engine in front, transmission attached to engine and the differential separate and mounted in the rear of the vehicle).

The domestic vehicle selected was the full-size 1970 Chevrolet equipped with a 350 cubic inch V8 engine and automatic transmission, since this was the most popular domestic vehicle/engine combination. This vehicle was equipped with air conditioning and power steering since the majority of the 1970 Chevrolets were sold with these options.

The most popular imported vehicle in 1970 was the Volkswagen Type I (Beetle), but because of its unconventional drivetrain (air cooled engine in the rear and transaxle assembly also mounted in the rear) the Volkswagen was replaced by the 1970 Toyota Corolla 1200. The selected Toyota Corolla is equipped with a 73 CID L-4 engine and manual four-speed transmission and no other options.

7.3.2 Frequency of Repairs and Lifetime

The terms "life" and "lifetime," when referring to engines and transmissions, can cause some confusion when discussing how long these components last. For the purpose of this discussion the "lifetime" of an engine or transmission is the time in years or distance traveled in miles that the unit is no longer usable or rebuildable. When the engine or transmission "life" is discussed, the meaning is the time of usage until the unit is in need of major repairs. With these major repairs a new "life" begins and the "lifetime" is extended. Thus, if an engine needs valve work, bearings and rings at 110,000 miles, its "life" is 110,000 miles. Its potential "lifetime" is probably over 300,000 miles because the engine can normally be rebuilt at least twice.

For most automobiles major engine or transmission repairs would be made only once in the vehicle lifetime, if at all. A vehicle may be driven over 100,000 miles and finally scrapped without ever having experienced major engine or transmission repairs. At the time it is scrapped it may not even then need major engine or transmission repairs, but may have become shabby, worn, unable to pass inspection, have little cash value, and so is finally discarded. In fact, though the project scope limits this study to 1970 model vehicles, too few of these have had major repairs to

establish a definite repair frequency trend. In addition to this there is very little, if any, hard data on individual vehicles that have been driven over 100,000 miles, except for high mileage groups such as taxi fleets. This is because many vehicles with over 100,000 miles use are several years old, and have changed hands one or more times and their service records have not been kept continuously throughout their lifetimes. There are, of course, some vehicles with 100,000 miles with the same owner with service records which would be most informative to a study such as this. However, any attempt to identify a representative sample of these vehicles is beyond the scope of this contract.

The information available from high mileage fleets that have been investigated previously does not represent normal vehicle usage or maintenance and therefore is not applicable to this study. For these reasons, estimates of frequency of repair for the subject 1970 vehicles are forecasts based on as much data as is available and includes subjective opinions of automotive industry specialists.

Total market sales of engine components were investigated by referencing the 1972 Census of Manufacturers Industry Series for Motor Vehicles and Equipment. This information is limited because information is presented for only main, rod and camshaft bearings.

From the census listings the total domestic shipments for replacements of the parts that were listed were broken down into the number of engines that could be serviced and that number compared to the national vehicle fleet. Component usage is specified for all types of vehicles and is not listed separately for automobiles. As an example, this census information shows that 28.5 million halves of main bearings and 44.6 million halves of rod bearings were shipped for replacement use. If we assume an average engine has ten main bearing halves and 12 rod bearing halves, then main bearings for approximately 2.8 million engines and rod bearings for approximately 3.7 million engines were shipped. Rebuilders indicate that main bearings are not always changed with rod bearings, and the numbers would bear this out. These numbers, divided by the 113 million 1972 vehicle population would indicate 2.5% would replace main bearings and 3.3% would replace rod bearings. These operations usually occur only with major engine repairs.

The main problem, however, is that there is no way to establish when in the vehicle lifetime these repairs took place. All of these repairs could have been made on cars that had more than 100,000 miles on them or are over 10-years old; and over 10 million cars over 10-years old existed in 1972. That number has increased since that time.

Over the last 10 years cars of all ages were scrapped at an annual average rate of nearly seven million per year, while the average yearly production has been significantly higher. Registrations of cars over 10-years old topped 16.5 million as of July 1977.

Another problem is that the component manufacturers have no way of knowing the end use of the engine for which they have made replacement parts. Many of these engines are used for stationary, off-road, or marine use and hence should not be counted.

To develop better estimates of when major engine and transmission repairs were made in a vehicle life cycle, direct contacts were made with the many companies and organizations in the business of supplying the aftermarket with parts and services required to meet the public's needs for major repairs of engines and transmissions. Also contacted were the major trade associations dealing with rebuilders and suppliers, vehicle manufacturers' engineers, component manufacturers, and a car leasing firm known to maintain complete records. A complete list of those contacted appears in the appendix.

Since it is impossible to develop an absolute life mileage cycle for major engine and transmission repairs, the information acquired from these component and vehicle manufacturers, associations, dealers, service outlets, users and the 1972 census was utilized, along with inputs from automotive specialists, to establish a table giving estimated engine and transmission repair frequencies in terms of percent of vehicles requiring repairs at specified mileages (Table 7-1). This table applies to the two representative 1970 vehicles, the domestic V8 with automatic transmission and the import L4 with manual transmission. Because of the subjectivity of the table, mileage increments were limited to 20,000 miles and percentages were specified in increments of five percent of the cars that would need these major repairs in their lifetime. The table reflects major engine, transmission and valve repair frequencies.

The information available from the above sources did not allow definite distinctions to be made between the replacement cycles of the various internal engine components such as valves, pistons, rings and bearings. Many of these parts are changed during a major rebuild, even if another part failure initiated the rebuild, i.e., bearings were replaced when rings had failed.

Because of these limitations, no chart was constructed to show these components separately. Most rebuilds would include replacement of various combinations of these parts. Information relating to particular component life is discussed and component costs are listed in the section relating to repair costs.

7.3.3 Costs to Repair

The development of cost-to-repair information was more objective in nature than that for frequency-of-repair.

7.3.3.1 Engine Repairs. When an engine wears out and is no longer considered serviceable or a breakage has occurred in a major component, there are a number of choices of repair procedures which the owner may make. A new or rebuilt complete engine may be installed. Alternative approaches are to completely recondition or overhaul the existing

engine or to install a new or rebuilt short block and rework the existing cylinder head or heads.

A common repair that is not as complex as overhauling the complete engine is a valve reconditioning. This involves removing and disassembling the cylinder head(s) and resurfacing the valve and valve seat faces and possibly replacing or refurbishing the valve guides. This work is required when valve guides or seats begin to leak and power drops.

All of these repairs may be performed by a variety of service facilities, but experience shows that major engine repair is usually done by a new car dealer service department or an independent repair shop, many of which specialize in these types of repair. Previous studies[1] indicate that the largest share of engine overhauls are performed by independent repair shops, including specialty shops; the next larger portion is performed by new vehicle dealers; and only about 15 percent are performed by service stations.

Major retail chains such as Sears, with a varied catalog and retail store offering, supply rebuilt engines and components to the do-it-yourself (DIY) market, and certain major stores install rebuild engines and short blocks in their service departments.

Costs vary by type of service facility, due to differences in parts costs from a variety of suppliers and differences in labor rates. In order to examine some of the variations in repair costs for major engine repairs, a number of tables were prepared which show parts, labor and total costs for specified repairs made by various facilities to the representative 1970 vehicles selected. Engine repairs examined include: installation of a complete rebuilt engine, complete engine reconditioning, installation of a short block and rework of cylinder head(s), and performing valve reconditioning.

Facilities examined include a new car dealer, an independent garage and Sears, a major retail chain. Prices for parts supplied to the new car dealer were taken from the Chevrolet or Toyota dealer price books as appropriate. NAPA (National Automobile Parts Association, an auto parts and equipment jobber organization) prices were used for the parts supplied to the independent garage for the domestic vehicle repairs, and World Parts prices were used for independent garage imported vehicle repairs. These suppliers are major nationwide parts distributors. Sears parts prices were used for Sears repairs and supplemented by jobber prices where required. Although the parts sources used as typical are well-known and reputable sources, there is no simple way to determine if the parts supplied by them are equal to, inferior to, or superior to original equipment parts. It is assumed, however, since these are successful suppliers, that parts supplied are of a high quality level.

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[1] *Hunter's Service Job Analysis 1975*. Stanford Research Institute Study - Where Service is Performed, 1970.

In some cases certain service facilities did not carry all of the parts needed to do the specified repairs. In these cases these parts were assumed to be supplied from a logical supplier. As an example, Chevrolet does not carry a complete rebuilt engine in their parts system. For the purpose of establishing a cost for installing a rebuilt engine in a domestic dealership, a jobber rebuilt engine price was used with the balance of the necessary parts being dealer parts. When this situation occurs, this fact is noted in the table footnotes. The tables also indicate what the repair operation entails and what parts are required.

Two tables were also prepared displaying the required parts for all engine repair operations discussed and the parts costs by supplier. Antifreeze and oil, which may vary slightly by price and grade among many similar suppliers, were priced at a common current 1978 level for a quality product and remains the same for all service facilities.

Labor rates applied are national average labor rates for various types of facilities, as determined by a 1978 Chilton survey. The average rates are: $21.50 per hour for domestic non-luxury new car dealers, $18.00 per hour for new car dealers handling the top four import makes (Toyota, Datsun, Volkswagen and Honda), and $15.00 per hour for independent garages. Service stations averaged $14.50 per hour labor cost, but were not included in the tables as a separate service supplier. Because of the low percentage of major repairs made by service stations (less than 20%) and because gas station parts suppliers (the automotive jobbers) are traditionally the same as for independent garages, service stations were not represented separately. The only total repair cost difference would be $.50 less per hour of labor for the service stations compared to the independent repair shop, since parts prices are the same.

7.3.3.2 Transmission Repair. In order to discuss transmission or clutch repairs, the parts to be replaced must be established. The RFP for this project did not establish specific parts to be considered in this analysis, presumably because of the wide variety and combination that might be required to repair any one transmission or clutch. To keep this information meaningful and practical, the most common major repairs to an automatic transmission are specified. The replacement of the complete clutch packs, plates and discs in the Turbo Hydramatic 350 transmission was chosen for the 1970 domestic vehicle. This operation requires disassembly of the transmission and replacement of gaskets, screen and fluid. The common manual transmission repairs to the import vehicle were specified as replacement of the clutch disc, pressure plate and throwout bearing.

Parts and labor costs for transmission repairs are developed in the same manner as for major engine repairs, and the same parts suppliers are used.

Tables showing the results are displayed in the next section.

7.4 RESULTS

The information that was collected and analyzed is summarized and discussed in this section. The frequency of repair and life values for engine and transmission major repairs are discussed initially and presented in table form. The repair costs to the selected 1970 domestic and import engines and transmissions are discussed and detailed following the frequency text.

7.4.1 Frequency of Repair and Lifetime

In general, it can be expected that the lifetime of an engine or transmission will exceed the vehicle lifetime as long as major destruction of the block or main case does not occur and worn parts are replaced in a rebuild. Most engine blocks and transmissions can safely be rebuilt twice if exposed to only normal wear and tear. This would allow these units to outlast the car except for the most unusual circumstances.

Many vehicles are driven 120-150 thousand miles without performing major engine or transmission overhauls, while a few (normally with abuse) might require major repairs before 50,000 miles. The decision to make major repairs to an engine or transmission is influenced greatly by the condition (hence value) of the car at the time the repair is required. If the vehicle has had exceptional care and has not been subjected to corrosive conditions, the decision to rebuild may be made even on a high mileage car (100-120 thousand miles). If, on the other hand, the car has suffered major corrosion or physical damage at 90,000 miles, the decision may be made to scrap the car rather than make needed major engine or transmission repairs. Further, a car with the same corrosion problems at 120,000 miles might be used for another 20,000 miles if no major mechanical problems occur. Well over 10% of the vehicles registered (16.5 million in 1977) are over 10-years old and most of those have over 100,000 miles of service. Most would also be with subsequent rather than original owners. The trend in recent years has been to keep cars longer before trade-in or scrapping, apparently due to the increases in cost and extended financing terms offered.

Table 7-1 presents a completely subjective estimate based on all available data sources of when major engine and transmission repairs occur and to what portion of the subject vehicles (a 1970 350 CID, V8 domestic car and a 1970 1200 cc, L4 import car) these failures occur during the life cycle of the auto.

Note that this table expresses mileage in 20,000 mile increments and the minimum percentage shown is 5 percent. These increments are limited because of the subjective nature of the information. Failures were not noted until it was estimated that at least 5 percent of the vehicles that would require major engine or transmission repairs in their lifetime had experienced failures up to that point. Thus, the information in the table that indicates the estimate that 5 percent

TABLE 7-1. ESTIMATED MAJOR ENGINE AND TRANSMISSION REPAIRS IN PERCENT[1] OF VEHICLES[2] REQUIRING MAJOR REPAIRS IN LIFETIME BY MILEAGE FOR TWO DESIGNATED VEHICLES

	Percent[1] of Vehicles @							
	20	40	60	80	100	120	140	Above 140
	(Thousand Miles)							
1970 Domestic 350 CID V8[3]								
Engine - Major repairs				5	15	40	40	
Valve job - Cylinder head work			5	10	15	40	30	
Major automatic transmission repairs			5	10	15	35	30	5
1970 Import 1200 CC L4[4]								
Engine - Major repairs			5	30	55	10		
Valve job - Cylinder head work		30	60	10				
Major manual transmission repairs			5	10	10	30	35	10

[1] Minimum % shown is 5%
[2] Excludes taxi and police
[3] Typical 1970 domestic V8
[4] Typical 1970 import L4

of the 1970 domestic 350 CID, V8 engines would require a major rebuild by 80,000 miles means that prior to 80,000 miles no more than 5 percent of the engines would fail or require major repairs. This may have been 1 percent at 50,000 miles, 1 percent at 60,000 miles, 1 percent at 70,000 miles and 2 percent at 80,000 miles, but only is listed in the table when a 5 percent level is reached.

On the other hand, there were or will be some 1970 domestic engines that exceed 140,000 miles before requiring a major rebuild or valve work. The fact that the "Above" column is blank for major engine repairs only indicates that the estimate was that this number would not reach 5 percent. Certainly some cars would be scrapped after going beyond 140,000 miles, but would not be reflected in this table if a major engine or transmission repair were not required.

The percentages expressed are of the cars that require major engine or transmission repairs in their lifetime. If this requirement comes late in the vehicle life (after 100,000 miles, for example), the repairs may not be performed and the car may be scrapped at that time.

Taxis and police cars are not included in these figures since they exist in sufficient quantity to distort the data and would mostly fall into the category above 140,000 miles.

It is interesting to note some facts regarding scrap rates and mileages of vehicles over a 10-year period.[2] In July 1968 (one year-count) there were 8,122,000 1967 model vehicles. In July 1977 there were 4,416,000 (ten year-counts). At eight year-counts there were 6,113,000; at six year-counts there were 7,120,000. That indicates that 75 percent of the one year-count vehicles survived eight years and nearly 55 percent survived ten years. In 1978 it was observed that 1967 model year cars traveled 13,200 miles each, per year. This would indicate that in eight years the average 1967 model car has traveled over 100,000 miles, and 75 percent of these are still on the road. Many cars are scrapped for reasons other than major engine or transmission problems (accidents, corrosion, chassis wear). This information would seem to support the assumption used in the basic study, that with normal maintenance few major engine or transmission problems are encountered in 100,000 miles. The missing 25 percent would also include the taxis and police cars and other high-mileage fleet cars that go 200,000 miles in two years and are probably scrapped before eight years.

7.4.1.1 Domestic/Import Engine Repairs. The chart indicates a longer projected engine usage before rebuild for the 350 domestic engine than for the import engine. The general concensus of expert opinion is that the domestic engine can be normally expected to run 110-120 thousand miles over a 10-year period if not exposed to undue abuse and with normal maintenance care. "Real world" maintenance is normally less than the recommended scheduled maintenance which

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[2] MVMA Motor Vehicle Facts and Figures '78, pages 34 and 61.

contributes to earlier engine failure. All available information helps support the fact that the import engine would usually require rebuilding by 100,000 miles.

This particular import engine was initially built in 1970 and valve reconditioning was commonly required by 60/70,000 miles. Subsequent development, and the introduction of harder valves and seats for use with unleaded fuels, has resulted in extended valve life beyond that of the initial versions.

It is common for small engines in import cars, most of which are equipped with solid valve lifters, to require regular adjustments of valve lash. This is not required of most domestic cars since they are equipped with hydraulic lifters which automatically maintain the proper adjustment. If the smaller engines are not adjusted on schedule, and possibly many are not, valve seat leakage can occur prematurely. Valve reconditioning is often required sooner on these smaller import engines than on normal domestic hydraulic lifter equipped engines.

The table reflects the expectations for rebuild of the particular engines selected, and while the domestic engine cycles might be more readily extrapolated to include other years and even makes, the same cannot be said of the import engine information. Subsequent import engines of that type may be expected to travel further before a valve reconditioning is required.

If an engine failure occurs above, say, 80,000 miles, there is a greater likelihood that a lower cost popular import car would be scrapped at that point than there would be for a domestic car in the same condition. This is because the engine repairs could still involve a significant cost; and the value of the car, being less initially, would not justify repair costs. This situation is currently changing due to the increased initial cost of all cars.

7.4.1.2 Transmission Repairs. Estimates of major transmission repairs versus miles of service are also shown in Table 7-1 for the domestic automatic transmission and the import manual 4-speed unit. In general, both transmissions are considered to give long service life in normal service without abuse.

Automatic transmissions are likely to last over 100,000 miles if the oil is not overheated and fluid and filter screen are changed every 25,000 miles or so. Transmission clutch plate manufacturers say that the part numbers on the plates should be readable after 100,000 miles if the oil has not been overheated. These numbers can be removed with a pencil eraser when new. Since a certain amount of abuse occurs, repairs are estimated to begin by 60,000 miles, but experience with many transmissions running to 150,000 miles causes the 5 percent estimate for over 140,000 miles shown in the table.

The basic manual transmission will normally last beyond 100,000 miles and withstand a great deal of abuse before requiring

major repairs. With abuse, the synchronizer rings will wear more rapidly than normal, and this will make shifting gradually more difficult. Eventually, metal particles in the gearbox can cause bearing wear, and operating noise may increase. Actual breakage is not common unless severe abuse is encountered.

The clutch disc and pressure plate are also vulnerable to abuse. If engagement of the clutch is not made smoothly, the clutch disc can slip. This creates excessive heat and can eventually cause clutch disc lining failure and checking of the pressure plate and flywheel faces. Transmission failures indicated in the table do not include clutch repairs, as they vary considerably, but repair costs that are discussed later only relate to clutch repairs.

7.4.1.3 Observations and Comments. During the course of investigating this subject matter, many observations and comments were made by the various industry professionals who contributed information. Some of the more specific observations are related here.

One universal comment was that the life of an engine or transmission depended upon a number of factors other than just the mileage operated. Oil change frequency, previously mentioned as being an important factor relative to engine life, was also considered to be important to automatic transmission life. Some other important factors mentioned are:

- Driver habits.
- Climate.
- Road conditions.
- Terrain.
- Drive cycle (urban/rural).
- Maintenance.
- Component quality (original and used in rebuild).
- Other operating conditions (dusty, etc.).
- Owner care.

These factors influence the vehicle experiences indicated in Table 7-1. Were it not for these variables, the table would be more concise.

The subject 1970 domestic engine was generally considered to be capable of going beyond 100,000 miles before requiring major engine work. In fact, taxi and police fleets count on engines in domestic cars to go well beyond 100,000 miles with proper maintenance.

Industry engineers expect engine life of 150,000 to 200,000 miles without having the heads off in high mileage service, such as taxi work, if the oil is changed at 2,000 to 2,500 mile intervals.

Oil change intervals in rapid high mileage service does affect engine life. The normal running time in hours for change intervals of 5,000 to 7,500 miles is 150 to 300 ignition hours. Some fleet cars (in police or similar service) that have oil changed at 4,000 mile intervals can run up 400 ignition hours between oil changes. In this kind of service, problems are often encountered by the 100,000 mile mark because of the severity of use and the extended engine operating time between oil changes.

Skilled fleet operators learn to recognize this type of extreme operating condition, and as a result can extend engine life well beyond 100,000 miles, if the fleets will benefit from this, by changing oil at appropriate operating time intervals.

No definitive information was provided or discovered that pinpointed a specific percentage of failures at a certain mileage. In fact, no estimates were offered to indicate any percent of failure versus mileage information. Various sources offered subjective opinions, based on their field experience, as to when engine and transmission failures generally occur on the subject vehicles.

A major lease fleet management concern that keeps thorough records of vehicle component failures on vehicles that are recycled at 50,000 to 60,000 miles could offer no information on engine or transmission failures up to that point. Their records only reflected component failure and any engine failures that may have occurred could not be identified without searching through thousands of vehicle maintenance forms. The indication is that very few failures occur in the popular domestic cars leased by this company.

One piston ring manufacturer, who also operates a franchise engine rebuilding service, observes that it is not uncommon on high mileage engines that require rebuilding to find only one bad piston of a set of 6 or 8 pistons. They also found that there is less than a 50 percent chance that engines needing to be rebuilt will require main bearings. In addition, they believe that a second re-ring job is rarely performed on the same engine and that domestic engine life is commonly 100,000 to 150,000 miles. They also felt that of 1,000 engines that ran 100,000 miles, 30 percent would need a complete rebuild, while more might need only rings.

Import engine longevity, they felt, was perhaps 80% of domestic engines because of smaller sizes and higher rpm levels. For example, an examination of the relative rpm's and piston speeds of the import engine and the domestic 350 CID engine shows that the import engine operates at about 76% greater rpm and about 25% greater piston speed at the same road speed. This would tend to support the premise that the import engine would wear faster.

At 60 mph the domestic engine in a full-size vehicle is operating at 2225 rpm, and the average piston speed is 1290 ft./min.

At 60 mph the import engine is turning at 3735 rpm, and the average piston speed is 1618 ft./min. Rpm and piston speed calculations are based on the following:

	Domestic	Import
Tire size	F 78-14	600x12
Static loaded radius (of tire)	13.0	11.4
Axle ratio	2.73	4.22
Bore/stroke	4.0x3.48	2.95x2.60
Transmission slip	(AT) 5%	(M) 0

A predominant bearing manufacturer stated that bearings (rod and main) should last the life of the car if maintained properly, i.e., the oil and filters are changed regularly at proper intervals. Others also stressed the importance of changing oil and filters to engine life.

Comments from several rebuilders varied somewhat but indicated that miles traveled before engine rebuild were usually over 80,000. One estimated rebuilds are required somewhere between 85,000 and 135,000 miles, while another said cylinder head work may be required sometime after 50,000 miles and rings and pistons after 80,000 miles. Another estimated that average lifetime (before rebuild) was 100,000 to 150,000 miles.

Transmission rebuilders recommended regular oil and screen changes to extend automatic transmission life. However, a representative of one auto maker indicates their experience shows the usual transmission longevity to be over 100,000 miles, if oil is not overheated (over 250° F) and if the oil is not disturbed. If changed once, then regular changes need to be made thereafter to insure equal life. While this reflects their experience, they do not claim to understand why this may be true.

A nationwide transmission repair chain indicates transmissions requiring major repairs show up after from 60 to 90 thousand miles service, but states that major improvements since 1975 have increased longevity. The key to long life, in their opinion, is regular fluid changes (25,000 miles).

Another major company says they have seen automatic transmissions needing overhaul work from 8,000 to 150,000 miles. External factors play a major role in when rebuilds are required.

An import car dealer says many rebuilds are not performed when needed. When the car is ready for major engine or transmission repairs (80,000 to 100,000 miles), it is traded in. Not many rebuilds

are performed. Most of the cars in need of major rebuilds would go to the junkyard, based on their experience. They also feel domestic cars have from 10 to 20 percent longer life.

One transmission part manufacturer believes any transmission will go as long as the engine and often 10 to 20 percent more. Another says if the oil is not overheated in service, the part number printed on the automatic transmission clutch plates will still be there after 100,000 miles.

Other similar comments, observations and opinions were acquired, but the above comments represent the most significant ones.

7.4.2 Costs to Repair

This section discusses the costs to make selected major engine and transmission repairs on a popular 1970 domestic and imported car. The cars, previously selected, are a 1970 Chevrolet with a 350 CID, V8 engine and automatic transmission, and a 1970 Toyota Corolla with a 1200 cc L4 engine and manual transmission.

Costs vary with the type of service facility utilized to do the work because of variations in labor cost and parts supplier costs. Costs to perform the selected repair work are shown for a new car dealer (domestic or import), an independent repair shop and a major retail chain. This represents a variety of repair facilities, and although there are more types of facilities, costs will be similar. For instance, repairs made at service stations would average about 50 cents per labor hour less than the cost shown here for independent garages. Parts prices would be the same.

Costs for repairs consist of parts cost plus labor cost for the work being performed. Some assumptions are made in determining the costs for repairs. These are noted below and are justified in the methodology section where necessary.

- Labor rates are from a 1978 national Chilton survey and represent the national average.

- Labor rates used are:

Domestic non-luxury new car dealer	$21.50/hr.
Independent garage	15.00/hr.
Major retail chain (same as independent garage)	15.00/hr.
Import (VW, Toyota, Datsun, Honda only) (New car dealer)	18.00/hr.

- Labor times are from *Chilton's Labor Guide and Part Manual.*

- Labor cost is the product of labor rate and labor time.

- Chevrolet dealer parts prices are used for the domestic new car dealer repairs, unless otherwise noted in table footnotes.

- Toyota dealer parts prices are used for the import new car dealer repairs, unless otherwise noted in table footnotes.

- Where the manufacturers price book does not show a list price, the price used is 1.5 times dealer cost.

- NAPA jobber parts prices are used for the independent garage repairs to the domestic car, unless otherwise noted.

- World Parts jobber parts prices are used for the independent garage repairs to the import car, unless otherwise noted.

- Sears parts prices are used for the major retail chain repairs to either car (domestic or import), unless otherwise noted.

- Total cost is the sum of parts costs and labor costs for the operations described.

Several tables follow, along with some discussion of each, that show costs for specified repair operations by various facility types. The table title defines the basic operation. The tables show labor hours required, labor rates by service facility type, and separate parts and labor costs, as well as the total for each facility type. The sub-operations, defining the work that is performed, are listed beneath the table, and the parts required for the work are also listed. Footnotes denote any special comments regarding parts sources or labor prices. In some cases involving import car repairs, the major retail chain is not shown as a repair source because they do not supply the necessary parts.

Also shown are tables listing all of the parts supplied for these major repairs by source and giving list price as paid by the consumer when repairs are made.

7.4.2.1 Engine Repairs. The first set of tables shows costs for making major engine repairs. Tables 7-2 through 7-6 cover repairs to the selected domestic car engine, including a listing of parts costs from various sources. Tables 7-7 through 7-11 provide the same information for the import car engine.

When an engine fails, a variety of approaches can be used to repair it. The first three tables in each set present costs for three approaches as repaired by various facilities. The first approach (Table 7-2, domestic; and 7-7, import) is the installation of a complete rebuilt engine assembly which includes removal and replacement (R and R) of the engine, transferring necessary parts from the old engine to the rebuilt unit, changing filters, and

tuning-up the engine including points, condenser, rotor, distributor cap, PCV valve, and spark plugs. Oil and antifreeze are also included.

The second approach (Table 7-3, domestic; and 7-8, import) is to completely recondition the existing engine. This is done by removing the engine, disassembling it, and replacing gaskets, pistons, rings and pins, intake and exhaust valves, rod and main bearings, filters, reboring cylinders, cleaning carbon from cylinder heads (head), grinding valve seats, and reinstalling the engine. Also included is an engine tune-up, e.g., installing new points, condenser, rotor, cap, spark plugs, PCV valve, and replacing the oil and anti-freeze.

The third approach (Tables 7-4, domestic; and 7-5, import) is to install a rebuilt short-block assembly and rework the cylinder heads. This requires removing and replacing the engine, transferring all parts not supplied with the short-block assembly, having the heads serviced at an automotive machine shop, and tuning-up the engine. The head work consists of disassembling the heads, grinding valves and seats, cleaning carbon, checking springs, replacing valve stem seals and reassembly. New gaskets are installed, as are filters and tune-up parts, oil and antifreeze.

It is not uncommon after long periods of use for valve seats to deterioriate and cause loss of power. To repair this problem requires removal of the cylinder heads, grinding the valves and seats, cleaning carbon, renewing the necessary gaskets and performing a minor engine tune-up (no new parts). Since this is a semi-major engine repair, costs for valve reconditioning are shown in Tables 7-5, domestic; and 7-10, import.

Tables 7-6 and 7-11 show the parts required for all of the engine repairs considered here.

In each case, the total cost of the same repairs is greatest at the new car dealers, followed by the independent garage, and least if repaired at the retail chain. Some factors must be mentioned, however, in analyzing these costs.

The domestic new car dealer does not have a rebuilt engine assembly available through their parts system. The cost shown in Table 7-2 is for a rebuilt engine assembly supplied by a national jobber. In practice, a dealer would acquire an engine from a jobber or rebuilder if he were to do this work and if he could not get one through his factory parts channel.

The retail chain store repair cost shown in this table is a flat repair charge quoted by the Harrisburg, PA, Sears store. Most stores of this chain would not perform the installation work, but the parts cost comparison is of interest. Most of the rebuilt engines sold by this retail chain would be installed by the automobile owners

themselves. In Table 7-3 the cost shown for rebuilding an engine by a major retail chain consists of the retail chain parts prices, supplemented by jobber supplied values, and labor at $15 per hour. In actual practice, the chain would normally not perform this type of work.

In Table 7-4 two costs are shown for new car dealer service. The domestic new car dealer does not have a rebuilt short block in their parts system, but does have a new short block. Costs for a new short block and repairs using a jobber supplied rebuilt short block are both shown for comparison. The head work cost is the list cost to have heads reconditioned by a specialty machine shop after they have been removed from the engine.

If the work was performed on site, the cost should be similar for that part of the work. Table 7-5 compares costs for performing valve reconditioning separately, including removal and replacement of the head.

Table 7-6 shows the list parts costs from three sources, domestic new car dealer, domestic parts jobber and retail chain. These list prices represent what the consumer pays for these parts as a portion of service work by the dealer or independent garage. If he were to purchase these parts "over-the-counter" from these sources, the jobber supplied parts would cost less, by about 10 to 15 percent, but the prices from the others would be the same.

It is interesting to note that the jobber prices, in many cases, are higher than the new car dealer price for the same part. In many cases the retail chain prices are much lower than the other sources. The price for chain store piston rings ($13.99) is for cast iron rings, but their chrome ring set is only $17.99, which is also much less than the new car dealer or jobber costs which are also for chrome rings sets. A comparison of quality was not possible.

When the new car dealer parts costs were determined from the manufacturers' parts and price books, it was noted that the exhaust valve price was unusually high at $17.55 compared to the normal dealer and aftermarket price of around $7.00. Other parts' sources priced the exhaust valves for this engine at nearly the same price as the intake valves. But while the manufacturer's price on the intake valve was conventional at $6.55, the exhaust valve was priced at $17.55 in their November 1978 price book. The price in the prior (May 1978) price book was also high at $16.10. The manufacturer's cost for an oversize exhaust valve for the same engine is $7.65 in the November 1978 price book. Although there is no explanation for the higher price, a parts cost penalty of over $80 is incurred for this one item when a rebuild is performed by a dealer.

In examining the import car engine repair costs, some other facts are of interest.

Neither the import car dealer nor the import parts jobber supply a rebuilt engine for the import car. So Table 7-7 shows the cost for a retail chain supplied unit for all three facilities. In actual practice only a limited number of retail chain stores would perform this work. Since the major parts cost (the rebuilt engine) is the same for all three repair sources, the total costs vary less than 3%.

Table 7-8 shows engine rebuild costs for the import car 1200 c.c. engine. Note that the new car dealer cost for parts is slightly less than those supplied from the jobber. This is offset by the increased labor costs, however.

Short block assemblies were available only from the dealer and only as new units. That cost was used for Table 7-9. No costs were shown for a major retail chain in this table or in Table 7-10 (valve reconditioning) since the major parts were not available from the chain source.

Table 7-11 shows the cost of all parts required for the import engine repairs discussed, from the import dealer, jobber and chain. Many dealer parts prices are higher than the jobber prices, exceptions being pistons and the common electrical tune-up parts and filters. The net result is a slightly lower dealer cost for all the parts required to rebuild an engine.

7.4.2.2 Transmission Repairs. Tabulated information regarding transmission repair costs is presented in Tables 7-12 through 7-16. Automatic transmission repairs to the representative domestic vehicle include replacement of all clutch plates and discs, gaskets, rings, seals, filter screen and oil. Manual transmission repairs include only replacement of the clutch disc, pressure plate and throwout bearing on the import car.

Table 7-12 indicates the costs to replace the clutch plates and discs in the 1970 domestic automatic transmissions. Costs for the parts required, from various sources, are shown in Table 7-15.

By comparison, the cost of installing a chain store rebuilt automatic transmission in the selected 1970 domestic car is shown in Table 7-13. This rebuilt unit is supplied to the chain by an independent rebuilder. All bushings, o-rings, clutch plates, seals, band linings and gaskets are always replaced. The case and other parts are inspected for soundness and replaced if necessary. This cost is higher than having the transmission overhauled, as specified, by the three service facility types studied.

It is also of interest to note that the motorist seeking major automatic transmission repairs can find numerous specialty shops which will supply "rebuilt" transmissions or will overhaul the motorist's own unit. These rebuilds vary in both cost and content and are not directly comparable to the work specified in the table.

Three major specialty transmission repair franchises estimate the average cost for replacing all clutch and disc plates, bands, screen, gaskets, and oil in a domestic automatic transmission is $275 to $300, with a six-month guarantee. A complete rebuild with all bushings and all replaceable parts renewed costs from $450 to $500.

One of these franchisers offers a rebuilt unit with a guarantee for as long as you own your car that costs $350. That rebuild includes replacement of clutches and bands, as well as selected bushings and metal seals and requires a once-a-year, no cost, fluid and screen change to be made at the servicing franchise.

Other, more local, multi-outlet transmission specialty shops offer rebuilt automatic transmissions on an exchange basis for $175 plus fluid. Another charges $240 plus fluid and includes an exchange torque converter. These rebuilders overhaul your old transmission by replacing only parts that need to be replaced plus a minimum of gaskets and seals, thus saving parts costs.

Table 7-14 shows the cost of replacing the clutch assembly, disc and throwout bearing by a dealer and an independent repair shop. Chain store costs were not included because the chain did not sell parts for this import service job. Parts cost are listed in Table 7-16.

TABLE 7-2. INSTALL COMPLETE REBUILT ENGINE FOR 1970 350 CID V8 DOMESTIC CAR (AT+AC+PS)

LABOR HOURS - 10.8

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
21.50	New Car Dealer	815[1]	232	1,047
15.00	Independent Garage	825[2]	162	987
Flat Charge	Major Retail Chain	788[3]	150[4]	938

Install rebuilt engine includes: R&R engine, transfer all parts not supplied with engine, tune-up engine.

PARTS REQUIRED: Rebuilt engine, oil filter, air filter, distributor cap, rotor, points, condenser, PCV valve, spark plugs, oil, antifreeze.

---

[1]Jobber rebuilt engine + dealer parts.
[2]All parts from jobber.
[3]All parts from retail chain.
[4]Flat charge, chain store, Harrisburg, PA.

TABLE 7-3. COMPLETE ENGINE RECONDITION COSTS FOR 1970, 350 CID V8 DOMESTIC CAR (AT+AC+PS)

LABOR HOURS - 37.2

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
21.50	New Car Dealer	671[1]	800	1,471
15.00	Independent Garage	541[2]	558	1,099
15.00	Major Retail Chain	284[3]	558	842

Engine recondition includes: R&R engine, rebore cylinders, install new pistons, rings, pins, rod and main bearings, intake and exhaust valves, clean carbon, grind seats, and tune-up.

PARTS REQUIRED: Rings, gaskets, pistons with pins, valves-intake and exhaust, rod bearings, main bearings, oil filter, air filter, distributor cap, rotor, points, condenser, PCV valve, spark plugs, oil, antifreeze.

---

[1]Dealer parts.
[2]Jobber parts.
[3]Chain parts plus jobber valves.

TABLE 7-4. INSTALL SHORT BLOCK AND REWORK HEADS FOR 1970, 350 CID, V8 DOMESTIC CAR (AT+AC+PS)

LABOR HOURS - 15.7

		$ - COSTS			
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	HEAD WORK	TOTAL
21.50	New Car Dealer	976[1]	338	55[6]	1,370
		624[2]	338	55	1,018
15.00	Independent Garage	634[3]	290	55	924
Flat Charge	Major Retail Chain	621[4]	200[5]	55	876

Install short block includes: R&R engine, transfer all parts and units not supplied with short block assembly, tune-up engine.

Head work includes: Disassemble, grind valves and seats, clean carbon, check springs, new valve stem seals, reassemble.

PARTS REQUIRED: Short block assembly, oil filter, air filter, distributor cap, rotor, points, condenser, PCV valve, spark plugs, oil, antifreeze.

---

[1]Dealer new short block + dealer parts.
[2]Jobber rebuilt short block + dealer parts.
[3]Jobber parts.
[4]Chain parts.
[5]Flat charge, chain, Harrisburg, PA.
[6]Average of four auto machine shops, Philadelphia, PA, area.

TABLE 7-5. VALVE JOB FOR 1970, 350 CID V8
DOMESTIC CAR (AT+AC+PS)

LABOR HOURS - 13.8

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
21.50	New Car Dealer	15[1]	297	312
15.00	Independent Garage	23[2]	207	230
15.00	Major Retail Chain	12[3]	207	219

Valve job includes: R&R heads, clean carbon, grind valves, minor engine tune-up.

PARTS REQUIRED: Gaskets and seals

---

[1]Dealer parts
[2]Jobber parts
[3]Chain parts

TABLE 7-6. ENGINE REPAIR PARTS COST FOR 1970, 350 CID V8 DOMESTIC CAR

	Car Dealer	Jobber	Chain
Gaskets (top only)	$20.38	$22.71	$11.99
Gaskets (full set)	26.65	36.13	19.90
Intake Valves (8)	52.40	52.40	(52.40)[1]
Exhaust Valves (8)	140.40	51.04	(51.04)[1]
Piston (8)	244.00	224.80	79.12
Rings (set)	74.40	74.98	13.99
Main Bearings (set)	39.45	34.82	14.99
Rod Bearings (set)	37.60	35.28	15.99
Oil Filter (1)	4.80	6.60	2.89
Air Filter (1)	6.45	7.89	2.29
Distributor Cap (1)	6.23	7.38	4.39
Rotor/Points/Condenser (set)	7.71	10.12	4.89
PCV Valve (1)	1.96	1.96	1.96
Spark Plugs (8)	15.20	18.40	5.84
Oil (5 Qts.)	6.50[2]	6.50[2]	6.50[2]
Antifreeze (2 gal.)	8.00[2]	8.00[2]	8.00[2]
Rebuilt Engine	(758.00)[3]	758.00	751.00[4]
Rebuilt Short Block Assy.	(567.00)[3]	567.00	599.00[4]
New Short Block Assy.	919.00	-	-

[1]Not supplied by chain - jobber prices.
[2]Common price - all sources.
[3]Not supplied by dealer - jobber prices.
[4]Quoted at Harrisburg, PA, store.

TABLE 7-7. INSTALL COMPLETE REBUILT ENGINE FOR 1970, 1200 c.c., L4 IMPORT CAR

LABOR HOURS - 7.6

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
18.00	New Car Dealer	938[1]	137	1,075
15.00	Independent Garage	953[2]	114	1,067
15.00	Major Retail Chain	935[3]	114	1,049

Install rebuilt engine include: R&R engine, transfer all parts not supplied with engine, tune-up engine.

PARTS REQUIRED: Rebuilt engine, oil filter, air filter, distributor cap, rotor, points condenser, PCV valve, spark plugs, oil, antifreeze.

---

[1]Chain rebuilt engine + dealer parts
[2]Chain rebuilt engine + jobber parts
[3]Chain parts

TABLE 7-8. COMPLETE ENGINE RECONDITION COSTS FOR 1970, 1200 c.c., L4 IMPORT CAR

LABOR HOURS - 18.3

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
18.00	New Car Dealer	268[1]	329	597
15.00	Independent Garage	276[2]	274	550
15.00	Major Retail Chain	210[3]	275	485

Engine recondition includes: R&R engine, rebore block, install new pistons, rings, pins, rod and main bearings, valves, remove carbon from head, grind seats, and tune-up.

PARTS REQUIRED: Pistons, pins, rings, gaskets, valves - intake & exhaust, rod and main bearings, oil filter, air filter, distributor cap, rotor, points, condenser, PCV valve, spark plugs, oil, antifreeze.

---

[1]Dealer parts
[2]Jobber parts
[3]Chain parts + jobber pistons and valves

TABLE 7-9. INSTALL SHORT BLOCK AND REWORK HEAD FOR 1970, 1200 c.c., L4 IMPORT CAR

LABOR HOURS - 11.2

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
18.00	New Car Dealer	546[1]	232	738
15.00	Independent	560[2]	198	758

Install short block includes: R&R engine, transfer all parts and units not supplied with short block assembly, tune-up engine.

Head work includes: Disassemble, grind valves and seats, clean carbon, check springs, new valve stem seals, reassemble.

PARTS REQUIRED: Short block assembly, oil filter, air filter, distributor cap, rotor, points, condenser, PCV valve, spark plugs, oil, antifreeze.

---

[1]Dealer new short block + dealer parts
[2]Dealer new short block + jobber parts

TABLE 7-10. VALVE JOB FOR 1970, 1200 c.c., L4 IMPORT CAR

LABOR HOURS - 7-7

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
18.00	New Car Dealer	21[1]	140	161
15.00	Independent	12[2]	116	128

Valve job includes: R&R cylinder head, clean carbon, grind valves and seats, minor engine tune-up.

PARTS REQUIRED: Gaskets and seals.

---

[1]Dealer parts
[2]Jobber parts

TABLE 7-11. ENGINE REPAIR PARTS COST FOR 1970, 1200 c.c., L4 IMPORT CAR

	Car Dealer	Jobber	Chain
Gaskets (top only)	$20.38	$12.04	$ -
Gaskets (full set)	32.35	27.18	16.99[1]
Intake Valves (4)	19.20	14.72	(14.72)[2]
Exhaust Valves (4)	34.60	26.12	(26.12)[2]
Piston (4)	58.32	79.48	(79.48)[2]
Rings (set)	32.48	27.14	15.51[1]
Main Bearings (set)	36.98	33.28	18.49
Rod Bearings (set)	21.58	20.80	9.99[1]
Oil Filter (1)	4.06	5.17	2.79
Air Filter (1)	2.58	6.26	3.99
Distributor Cap (1)	2.16	5.40	1.89
Rotor/Points/Condenser (set)	4.74	8.44	4.39
PCV Valve (1)	5.48	5.48	1.99
Spark Plugs (4)	4.00	7.12	4.76
Oil (4 Qts.)	5.20[3]	5.20[3]	5.20[3]
Antifreeze (1 gal.)	4.00[3]	4.00[3]	4.00[3]
Rebuilt Engine	(906.00)[4]	(906.00)[4]	906.00
Rebuilt Short Block Assy.	513.41	(513.41)[5]	(513.41)[5]

[1]Contained in kit at $42.49.
[2]Not supplied by chain - jobber parts.
[3]Common price - all sources.
[4]Not supplied by dealer or jobber - chain prices.
[5]Not supplied by jobber or chain - dealer prices.

TABLE 7-12. RECONDITION AUTOMATIC TRANSMISSION CLUTCH PLATES AND DISCS FOR 1970, 350 CID V8 DOMESTIC CAR

LABOR HOURS - 8.9

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
21.50	New Car Dealer	101[1]	191	292
15.00	Independent Garage	95[2]	134	229
15.00	Major Retail Chain	53[3]	134	187

Recondition automatic transmission includes: R&R transmission & replace forward & direct, intermediate, and low & reverse clutch plates and discs, gaskets, rings and seals.

PARTS REQUIRED: Low and reverse plates (5) and discs (5), intermediate plates (3) and discs (3), forward and direct plates and discs (10), filter screen, gaskets, seals, rings, oil.

---

[1]Dealer parts
[2]Jobber parts
[3]Chain parts

TABLE 7-13. INSTALL REBUILT AUTOMATIC TRANSMISSION FOR 1970, 350 CID V8 DOMESTIC CAR

LABOR HOURS - 4.2

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
15.00	Major Retail Chain	297[1]	63	360

Install rebuilt automatic transmission includes: R&R transmission, transfer necessary parts.

PARTS REQUIRED: Rebuilt transmission, oil.

---

[1]Cost reflects $60 credit for core (old transmission) plus shipping costs.

TABLE 7-14. REPLACE CLUTCH ASSEMBLY AND THROWOUT BEARING FOR 1970, 1200 c.c., L4 IMPORT CAR

LABOR HOURS - 3.0

		$ - COSTS		
$/HR LABOR RATE	REPAIR FACILITY	PARTS	LABOR	TOTAL
18.00	New Car Dealer	82[1]	54	136
15.00	Independent Garage	93[2]	45	138

Replace clutch assembly and throwout bearing includes: R&R transmission, R&R parts.

PARTS REQUIRED: Clutch disc, clutch pressure plate, throwout bearing.

---

[1] Dealer parts
[2] Jobber parts

TABLE 7-15. TRANSMISSION REPAIR PARTS COSTS FOR 1970, 350 CID, V8 DOMESTIC CAR WITH AUTOMATIC TRANSMISSION

Part	Car Dealer	Jobber	Chain
Overhaul Kit - Transmission Discs, Plates, Gaskets, Seals, Rings	$91.34	$83.95	$41.99
Oil Filter Screen	5.34	4.89	3.99
Transmission Fluid - 5 qt.	4.10	6.50	6.50
Rebuilt Transmission	-	-	290.00[1]

[1]$310 less $60 credit for old unit plus $40 shipping (2 ways)

TABLE 7-16. CLUTCH REPAIR PARTS COST FOR 1970, 1200 c.c., L4 IMPORT CAR WITH MANUAL TRANSMISSION

Part	Car Dealer	Jobber
Clutch Disc	$22.68	$29.04
Pressure Plate	42.22	50.68
Throw-Out Bearing	17.38	12.78

8.0 TASK 6 - UNSCHEDULED MAINTENANCE COSTS AS A FUNCTION OF TIME

8.1 INTRODUCTION

Task 6 of this contract requires the development of three comparative scenarios relating when, as a function of time, the unscheduled maintenance items are replaced/repaired or performed during the assumed 10-year/100,000 mile lifetime. They also provide comparative analysis of the cost of unscheduled maintenance by year and for the cumulative life cycle of a typical vehicle with average repair records in three distinct 1978 body classes; compact, subcompact and mid-size. Recognizing that there may be substantial differences in yearly and cumulative costs for each vehicle, a range of costs for those deviating from the average was to be developed for each of the body classes. These comparative studies are intended to demonstrate how the costs of unscheduled maintenance are distributed by year over the life of a typical vehicle and to establish repair cost relationships between the individual vehicles in the various body classes.

8.1.1 Limitations and Assumptions

The information presented in these scenarios is based on some assumptions and subject to certain limitations. The primary limitation of this study is that the frequency of failure and mileage interval (when failure occurs) is based on averages of all vehicles for all unscheduled maintenance components. All of these items have a broad life cycle range as a result of uncontrollable variables such as driver habits, weather conditions, topography, etc. Subsequently, although a particular item on average is indicated to fail four times in a 10-year/100 thousand mile life cycle, individual vehicles may experience a failure of that component as much as eight times or not at all over the vehicle life cycle. Similarly, the failures may occur at virtually any mileage interval for the same reasons.

Another major limitation in the development of these scenarios is the items indicated to fail on only one out of every three or four vehicles during the assumed 10-year/100 thousand mile life cycle. The reasons for their failure and the point in time they fail are obscure and difficult to assess. For the purposes of this study, each vehicle included is assumed to experience a failure of all unscheduled maintenance items and, therefore, these scenarios are somewhat inflated and cannot be projected to the repair industry on a national basis. In addition, no "hard" data exists to determine failure frequency differences between manufacturers, models or body classes. The cost differences that do exist, therefore, are strictly the result of parts and labor cost variables among the different vehicles.

Finally, the frequency of repair/replacement factors were extracted from the data base and converted into functions of time/mileage for use in these scenarios and represent average component failures of vehicles that receive "real world" preventative (scheduled) maintenance rather than the factory recommended scheduled maintenance as was used in developing the data base. It is generally accepted by industry experts that factory recommended scheduled maintenance is not followed throughout the life of the vehicle in all areas which could result in premature component failure.

8.2 METHODOLOGY

The unscheduled maintenance year and cumulative costs presented in this section were developed by a multi-step process described in the following paragraphs.

8.2.1 Failure Point in Time Determination

The point in time when an unscheduled maintenance item will fail was determined by converting the frequency factors developed in Task 4 to mileage/time intervals through the use of mathematical calculations, discussions with industry sources and professional judgement.

For example, muffler replacement is shown as having a frequency factor of 3.0. To convert that frequency factor to an "average" year of occurrence, the assumed 100 thousand mile life cycle is divided by the frequency factor of 3.0 -- indicating that each replacement will occur on the average at approximately 33,000 mile intervals.

$$\frac{100{,}000 \text{ miles}}{3.0 \text{ factor}} = 33{,}333 \text{ mile intervals}$$

This extrapolates to muffler replacement at 33 thousand, 66 thousand, and 99 thousand miles which puts the replacement point in the 4th (30-40 thousand), 7th (60-70 thousand) and 10th (90-100 thousand) years. Both industry sources and professional judgement indicates that in actual on-road use, mufflers can fail anywhere from 15,000 miles and up, depending on driver habits and environmental conditions. Since mufflers do not appear to have a specific point of failure in actual use, the mathematically determined points are used to position muffler failures during the vehicle life cycle.

The only repair frequency factor conversions that were not, at least in part, developed through mathematical calculations were those that indicated an extremely infrequent failure occurrence such as a failure on three out of every ten vehicles over the assumed 10-year life cycle. These factors were positioned in time by discussions with industry experts and professional judgement and are strictly subjective.

8.2.2 Development of Cumulative and Yearly Repair Costs

Each of the unscheduled maintenance frequency factors were converted to a point in time/mileage interval and positioned in the appropriate year(s) of failure occurrence. A calculation form was developed for each of the vehicles included in the data base (29), in each of the three body classes being studied (Exhibit II). The material and labor costs developed in Task 4 of this contract were recorded for each vehicle in each body class. The yearly cost of operation and cumulative total life cycle (10-year) costs were then determined by simple addition.

The yearly life cycle costs were then averaged, by year, for all vehicles in each of the three body classes. A graph, depicting average yearly repair costs by body class was constructed and the cumulative life cycle costs of this "average" vehicle plotted on the same graph.

Figures 8-1, 8-2 and 8-3 show the average yearly and cumulative life cycle costs for typical 1978 subcompact, compact and mid-size passenger cars.

In addition, an analysis was made to determine those vehicles in each of the three body classes having the widest deviations from the average yearly costs and cumulative life cycle costs (Figures 8-4, 8-5 and 8-6).

It should be noted that the deviations in costs that occur are due to the variance of parts and labor costs between the least and most expensive to repair vehicles since the repair frequency is constant for all vehicles in this analysis.

8.2.3 Development of Average Repair Costs by Maintenance Item Type

To facilitate the development of average unscheduled item repair/replacement costs, a matrix was developed for each of the three body classes. The matrix is shown in Table 8-1 and indicates the body class, maintenance item, approximate mileage and year of replacement, and the average repair cost of each unscheduled maintenance item. The unscheduled maintenance material and labor cost data shown in the matrix was extrapolated from the data used in developing the previously described graphs.

The difference between the material presented in the graphs and the material presented in the matrix is that the graphs show average repair costs for all vehicles in each body class, and the matrix shows average repair item costs.

8.3 UNSCHEDULED MAINTENANCE LIFE CYCLE COSTS BY BODY CLASS

The average unscheduled maintenance life cycle costs by body class are presented on three graphs, Figures 8-1, 8-2, and 8-3.

Both the average yearly unscheduled maintenance costs and the cumulative total average costs are indicated.

Figure 8-1 displays the projected unscheduled maintenance life cycle costs for the average subcompact vehicle. It is readily apparent that the first three years are relatively maintenance free, with the average vehicle incurring only $123.17 in repair costs. During the fourth and fifth years, unscheduled repair costs average approximately $335.00 per year primarily due to the replacement of tires, brakes, exhaust system components and cooling system rubber parts. The projected unscheduled maintenance costs rise considerably during the sixth year of operation and reflect the repair/replacement of various fuel system components, electrical items, suspension components, a universal joint and the water pump. The maintenance performed during the eighth and ninth years, roughly parallels the maintenance performed during the third and fourth years, except the various systems are more extensively repaired. In the tenth year unscheduled maintenance costs are somewhat higher than those of the sixth year because additional major components such as the power steering pump are being repaired/replaced.

The projected cumulative life cycle unscheduled maintenance costs for an average subcompact is $3,393.92 over the 10-year/ 100,000 mile period.

Figures 8-2 and 8-3 represent the projected unscheduled maintenance yearly and cumulative life cycle costs of average compact and mid-size vehicles. Table 8-2 illustrates the close similarity of unscheduled maintenance costs for these "average" vehicles in the three body classes. The repair costs projected for the "average" compact are $215.48 higher than those projected for the "average" subcompact and the projected repair costs of the "average" mid-size vehicle are $726.18 higher than the "average" subcompact. Compacts and mid-size vehicles cost more to repair than subcompacts largely because they generally have more optional equipment and their tires are proportionately more expensive.

8.3.1 Extremes of Life Cycle Costs by Body Class

Figures 8-4, 8-5, and 8-6 depict the extremes of life cycle costs within each body class. The type of tires installed as original equipment, serviceability features (the ease of repair/replacement), and the amount of optional equipment normally found on the individual vehicle have the greatest inpact on yearly unscheduled maintenance costs.

Tables 8-3, 8-4 and 8-5 display the unscheduled maintenance costs of each vehicle included in this study. The significant difference between the cost extremes of the mid-size vehicles occurs because the high cost and low cost vehicles are aimed at two entirely different market segments and their retail purchase prices are grossly different.

8.3.2 Unscheduled Maintenance Item Average Costs by Body Class

Table 8-1 shows the average cost(s) and year(s) of failure occurrence for the individual unscheduled maintenance items in this study. The costs of the individual items are not additive because all vehicles do not have all of the items or some of the items are used in place of other items on particular vehicles.

This table also indicates the approximate time of failure, in miles, for the individual unscheduled maintenance items. Each maintenance item is discussed in detail in the following paragraphs and any qualifications pertaining to their failure point are indicated.

a. Oil Pumps

Oil pumps, as a rule, do not fail in normal vehicle service. The few oil pumps that do fail (frequency factor .3), fail very late in the vehicles' assumed life and their repair/replacement cost is indicated to fall in the 90-100,000 mile range. No hard data could be found to indicate a specific point of failure and vehicles habitually exceed 100,000 miles without oil pump failure. The average cost of an oil pump replacement is $89.70 for subcompacts, $91.96 for compacts and $79.14 for mid-size vehicles. The mid-size oil pump is the lowest cost because several mid-size V8 engines have externally mounted oil pumps and, as they are easier to repair, the labor charges are considerably less than for internally mounted pumps.

b. Carburetors

Carburetors, affected by a variety of uncontrollable factors, require repair once in a vehicle's lifetime on about 75% of the vehicles. The repair appears to be required most often in the 50-60 thousand mile range, although some vehicles apparently require or receive multiple carburetor repairs. The replacement/repair interval is placed at 55,000 miles arbitrarily, because it is the mid-point of the 50-60 thousand mile range.

c. Fuel Pumps

Fuel Pumps, like carburetors, have a failure rate of less than one per vehicle and it is extremely difficult to determine a specific failure point. The fuel pump can fail at virtually any point in a vehicle's life and at least 25% do not fail at all in the 10-year 100,000 mile life cycle. Driving conditions/habits and general maintenance practices (replacement of filters) appear to affect fuel pump life to some extent. Unfortunately, they are also often damaged in front end collisions so that the frequency factor of .73 may be somewhat inflated. It is generally conceded that they will last at least 5-years/50,000 miles and frequently much longer. They are placed in the sixth year because this appears to be when they fail, if they fail. Typically their replacement can occur at any point throughout the vehicle's life.

d. Power Steering Pumps

Sales figures, indicating a frequency of .3, combined with the fact that power steering pumps are often damaged in frontal accidents

indicate that the pump is virtually trouble free. Very high mileage, 90,000 plus, is often mentioned for the pumps life expectancy. Their repair/replacement costs are placed in the tenth year because of their trouble-free reputation and the fact that most of them do not fail.

e. Under Hood Hoses and Belts

The positioning of the replacement costs of hoses and belts was accomplished strictly by mathematical conversion. These components are sensitive to under hood temperature, maintenance practices, and driving habits. The cost per vehicle is dependent on hose and belt size as well as the number of each present. More hoses and belts are probably replaced because of repair convenience, as preventative measures, or through package repairs than most other vehicle part(s). Their replacement costs appear in the fourth, seventh and tenth years but their actual replacement interval can vary substantially by vehicle.

f. Alternators

Alternators are a major electrical component that require repair/replacement less than once during a vehicle's lifetime. Driver habits and general maintenance practices pertaining to other vehicle electrical components influence the alternators' replacement rate. They can be damaged in frontal accidents or by misconnected jumper cables and because of their ease of replacement and easy availability are probably replaced more often than necessary, particularly by do-it-yourselfers. However, because of their .8 frequency factor and the fact that regulators are commonly installed with them, the alternators' repair/replacement cost is placed in year six. This component appears to have problems on individual vehicles within any given manufacturer, yet will be totally trouble-free on seemingly identical vehicles.

g. Starters

Like the alternator, the starter is sensitive to driver habits and the state of other vehicle electrical components and general vehicle maintenance. Vehicles that are properly maintained and not exposed to excessive starter operation do not appear to experience starter problems. Because of the 0.8 frequency factor and its ties to the other electrical components on the vehicle, the starter's replacement cost is arbitrarily placed in the sixth year.

h. Water Pumps

Water pumps, with a frequency factor of 1.0, fail once during a vehicle's lifetime. An unknown percentage fail as a result of frontal vehicle collision or are replaced because of improper cooling system diagnosis. They appear to fail most frequently above 50,000 miles, although the failure range spans the entire vehicle lifetime and often does not occur on individual vehicles. Vehicles having improperly maintained cooling systems may be prime prospects for water pump replacement.

i. Radiator Repair

Few actual radiators are installed in vehicles for reasons other than collision damage. Radiators are normally subjected to some form

of repair, for a variety of reasons. These repairs range from reattaching mounting brackets to replacement of the cooling core (tubed and finned area of the radiator). The cost is wide ranging and the time of occurrence is dependent on vehicle age, cooling system maintenance, and road conditions (vibration). All vehicles appear to incur some form of repair, most often at high mileage. An average repair cost of $50 plus the labor to remove and reinstall the radiator was used on all vehicles and indicated to occur in the eighth year of operation (75K miles).

j. Wheel Bearing Repack

The repacking of front wheel bearings is done three times over a vehicle's lifetime. Converting the frequency factor to mileage places the repacking operation in the fourth, seventh and tenth years. A charge of $4 is used on all vehicles to cover the cost of front grease seal replacement which often occurs at the same mileage.

k. Shock Absorbers

The replacement interval of shock absorbers is extremely difficult to position in time because they are traditionally replaced in several different ways; as a single unit, in pairs, and/or in full sets of four units. Shock absorbers can be damaged in accidents, are often replaced unnecessarily because of improper diagnosis, and are subject to impulse purchase/replacement. Mathematically, shock absorbers are replaced singly at five separate intervals throughout the vehicle's lifetime. The years of replacement are the second, fourth, sixth, eighth and tenth. The actual replacement cycle on individual vehicles over the 100,000 mile life cycle can vary from no replacement to a full set of four every 30,000 miles, depending on topography, driver habits, misdiagnosis and owner sales resistance.

l. Front End Alignment

Front end alignment is a service that up until very recently had to be sold to vehicle owners. Vehicles can operate without immediate perceptible problems over a relatively wide band of adjustment. As a result, market figures indicated the average vehicle to receive two front end alignment adjustments over the 10-year/100,000 mile life cycle. These adjustments would occur in the fifth and tenth years mathematically. On an individual vehicle basis, depending on the owner's sales resistance, awareness of fuel economy, tire wear and road conditions, the actual number of times alignment is performed can vary from none to ten times.

m. Ball Joints

As a general practice, ball joints are replaced in pairs. Generally however, the load carrying joints wear more quickly than the non-load carrying joints. As ball joints are only replaced once in a vehicle's lifetime, in this study two load carrying joints were priced to establish a realistic cost factor. The time of replacement is the sixth year, but in the "real world" would be variable from vehicle to vehicle depending on road conditions, general maintenance and whether a "state inspection system" is in operation.

n. Universal Joints

Universal joints generally fail once in a vehicle's lifetime. This failure appears to occur in the sixth year (50 to 60 thousand miles). In actual service, many vehicles will exceed 100,000 miles and never require a universal joint replacement, while others will require or receive the replacement of two universal joints. Improperly driven manual transmissioned vehicles, heavily loaded vehicles and vehicles exposed to habitual rapid acceleration appear to be more prone to universal joint failure than the average vehicle.

o. Front Brakes, Disc Pads or Shoes

The life expectancy of front brake shoes/pads appears to be anywhere from 10 to 50 thousand miles depending on driver habits, topography, vehicle load and the mode of vehicle operation (city, highway, etc.). Mathematically, and in the opinion of industry experts, average front brake shoes/pads will wear out in 32 to 37 thousand miles. This places the replacement cycle in the fourth, seventh and tenth years.

p. Machine Disc Rotors and/or Brake Drums

Service market data indicates that a vehicle will have all four brake drums/rotors machined once in its lifetime. As a general industry practice, both drums or discs on one axle will be machined or "cut" at the same time to prevent the possibility of a brake imbalance. It appears that in normal service the brake drums/rotors will be cut at the time of the second brake relining or the seventh year for front brake drums/rotors and tenth year for rear brake drums.

q. Rear Brake Shoes

Rear brake shoe life expectancy is dependent on the same variables as front brake shoe life. They, however, are not normally subject to equivalent braking force because of vehicle weight transfer during braking. Rear brake shoes, therefore, last longer than front brake shoes with the average vehicle replacing two sets in its lifetime. Replacement of rear brake shoes will most likely occur in the fifth and tenth year of vehicle life, lasting somewhere between 40 and 50 thousand miles unless abused.

r. Brake Master Cylinders

Master cylinders fail on only about 40% of the vehicles over the 10-year/100,000 mile lifetime. Master cylinder failure is extremely hard to place in time or mileage because of the low failure rate and the fact that vehicle mileage has little to do with a master cylinder's life expectancy. Master cylinders can fail at any time during the third through tenth years or not at all. For the purposes of this scenario they are placed in the ninth year to correspond with the normally high mileage associated with their failure.

s. Wheel Cylinders/Calipers

Market figures indicate that all vehicles will have all four of their wheel cylinders/calipers overhauled/replaced once during the vehicle's lifetime. This overhaul/replacement appears to most occur at the time of the second front brake shoe replacement which occurs in the seventh year. As the four wheel cylinder/calipers may be

either overhauled, replaced or any combination thereof, the cost shown is for overhauling the calipers and replacing the wheel cylinders.

t. Brake Hoses

Brake hoses will be replaced on approximately 80% of the vehicles over a 10-year/100,000 mile lifetime. Normally they are not replaced because of actual failure, but because inspection during a brake repair or normal service interval reveals surface cracks in the casings which may lead to hose failure. They are replaced most often during a brake cylinder/caliper repair and this usually occurs in the seventh year of vehicle operation, if replacement does occur.

u. Steering Tie Rod Ends

Steering tie rod ends appear to be replaced once on every vehicle over the 10-year/100,000 mile life. In actual service, they may never be replaced on some vehicles while others may replace two sets. Their replacement seems to most often occur in the sixth year of operation.

v. Exhaust System: Exhaust Pipe, Muffler and Tail Pipe

Exhaust system component life is highly dependent on vehicle drive cycles and weather conditions rather than mileage. On the average, two exhaust pipes, three mufflers and three tail pipes will be installed on every vehicle during the 10-year/100,000 mile life cycle. The mufflers and tailpipes mathematically would be replaced in the fourth, seventh and tenth years, while the exhaust pipe will be replaced in the fifth and tenth years.

w. Wiper Blade Refills

The frequency factor of 4.0 indicates each vehicle will replace a pair of wiper blade refills four times during its life cycle. Mathematically, the replacement will occur in the third, fifth, eighth and tenth years.

x. Batteries

Approximately 2.8 batteries are required by each vehicle over the 10-year/100,000 mile life cycle. Average life expectancy of all automotive batteries is approximately 42 months. This places the replacement in the fourth, seventh and tenth years.

y. Voltage Regulators

Voltage regulators, like some other vehicle electrical components, are affected by the condition of associated electrical parts and operating conditions. On average, the voltage regulator requires replacement once during a vehicle's lifetime. The most common point of failure appears to be the sixth year of operation, although the range of failure is from two or three during a vehicle's lifetime to none during a vehicle's lifetime.

z. Distributor Cap, Rotor and Plug Wires

Market sales figures and industry experts indicate one distributor cap, four rotors and one set of ignition wires will be replaced on each vehicle during the 10-year/100,000 mile life cycle. The rotor

will be replaced during the third, sixth, eighth and tenth years while the distributor cap and wires will be replaced during the eighth year. This will vary considerably from car to car depending on a wide variety of uncontrollable factors including the parts sales orientation of the mechanic.

aa. Tires

Tire life can be seriously shortened by improper inflation pressures, improper vehicle maintenance (out of alignment) and driver habits. Therefore, actual in-service vehicle tire life can vary greatly from car to car. Three different types of tires are used in this scenario. The assumption is made that the OEM tires will be replaced by the same type tire throughout the vehicle's life cycle. These three types of tires have significantly different wear-out rates as well as handling and traction characteristics.

Bias ply tires, the lowest price tire, have a life expectancy of approximately 24,500 miles. A vehicle equipped with bias ply tires will replace four sets in the 10-year/100,000 mile life cycle. The replacements will occur in the third, fifth, eighth and tenth year of operation.

Bias belted tires, the mid-priced tire, has a life expectancy of about 33,000 miles in average service. The average vehicle will replace three sets in its lifetime. The approximate years of replacement will be the fourth, seventh and tenth.

Radial ply tires, the most expensive of the three types, are also the longest wearing. They will be replaced twice during a vehicle's lifetime. The years of replacement are projected to be the fifth and tenth. The approximate life of a radial tire appears to be 49,000 miles in average service.

bb. Air Conditioning Compressors/Driers/Condensers, Heater Cores, Fuel Injection Pumps/Nozzles/Control Boxes, Electric Fuel Pumps, Glow Plugs and Ignition Control Boxes

These items either fail infrequently or are newly released and therefore it was not possible to establish specific failure points using industry sales figures and mathematical calculations. Their time placement in this scenario was derived from discussion with industry experts and is, at best, subjective.

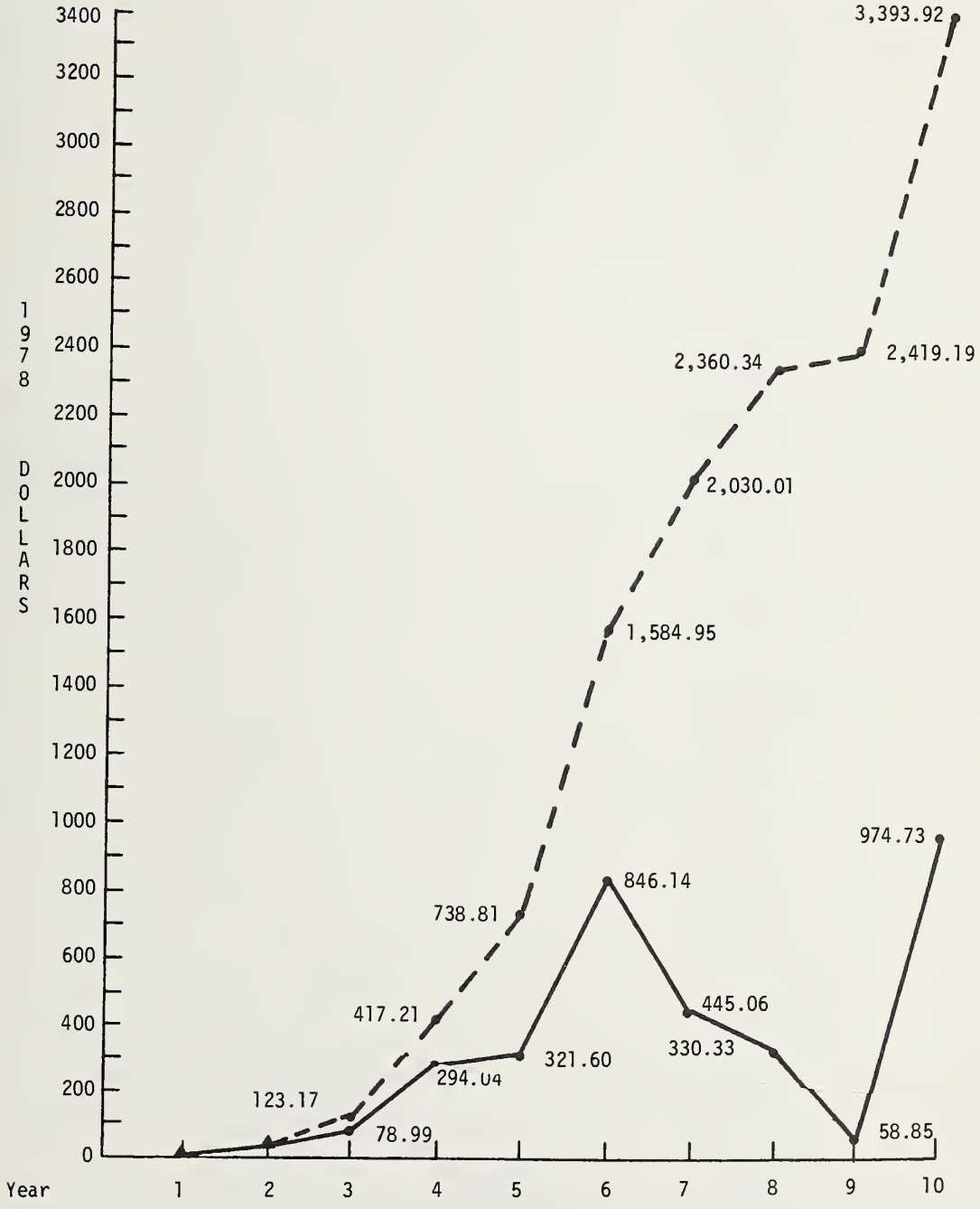

FIGURE 8-1. YEARLY UNSCHEDULED MAINTENANCE COSTS FOR THE AVERAGE SUBCOMPACT AUTOMOBILE AND THE 10-YEAR CUMULATIVE TOTAL

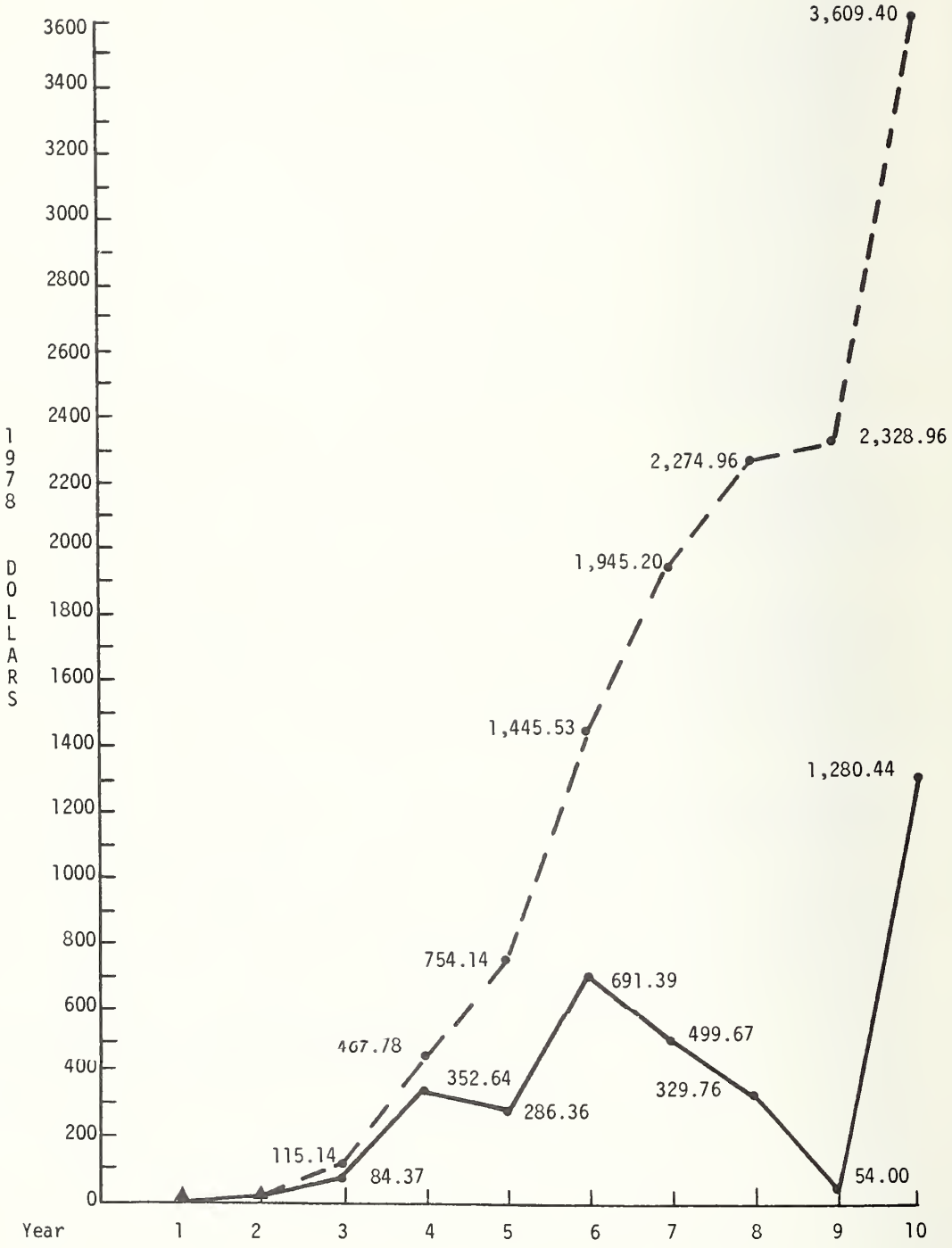

FIGURE 8-2. AVERAGE YEARLY UNSCHEDULED MAINTENANCE COSTS OF 1978 COMPACT AUTOMOBILES AND 10-YEAR CUMULATIVE AVERAGE

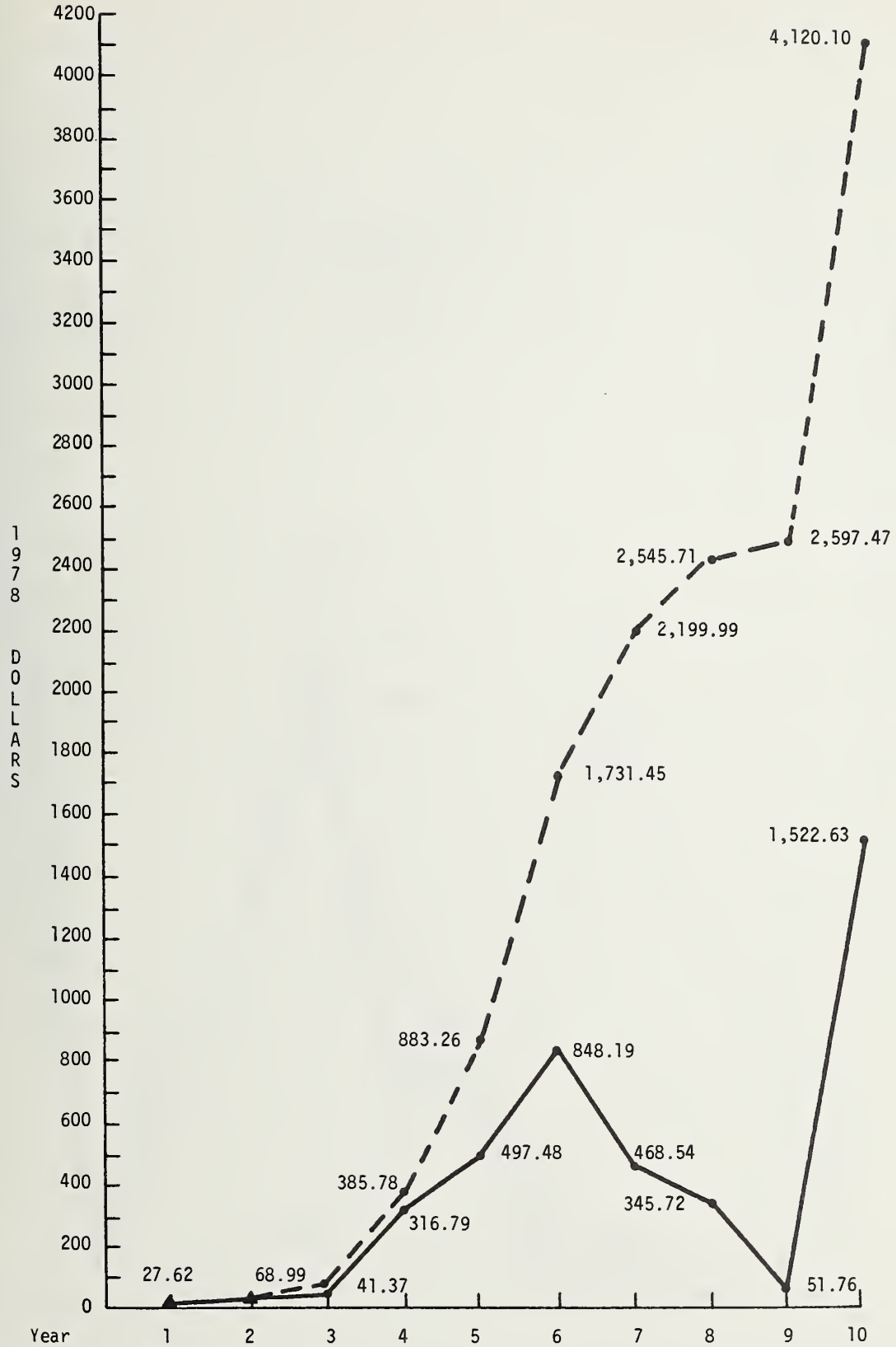

FIGURE 8-3. YEARLY UNSCHEDULED MAINTENANCE COSTS FOR THE AVERAGE 1978 MID-SIZE AUTOMOBILE AND THE 10-YEAR CUMULATIVE TOTAL

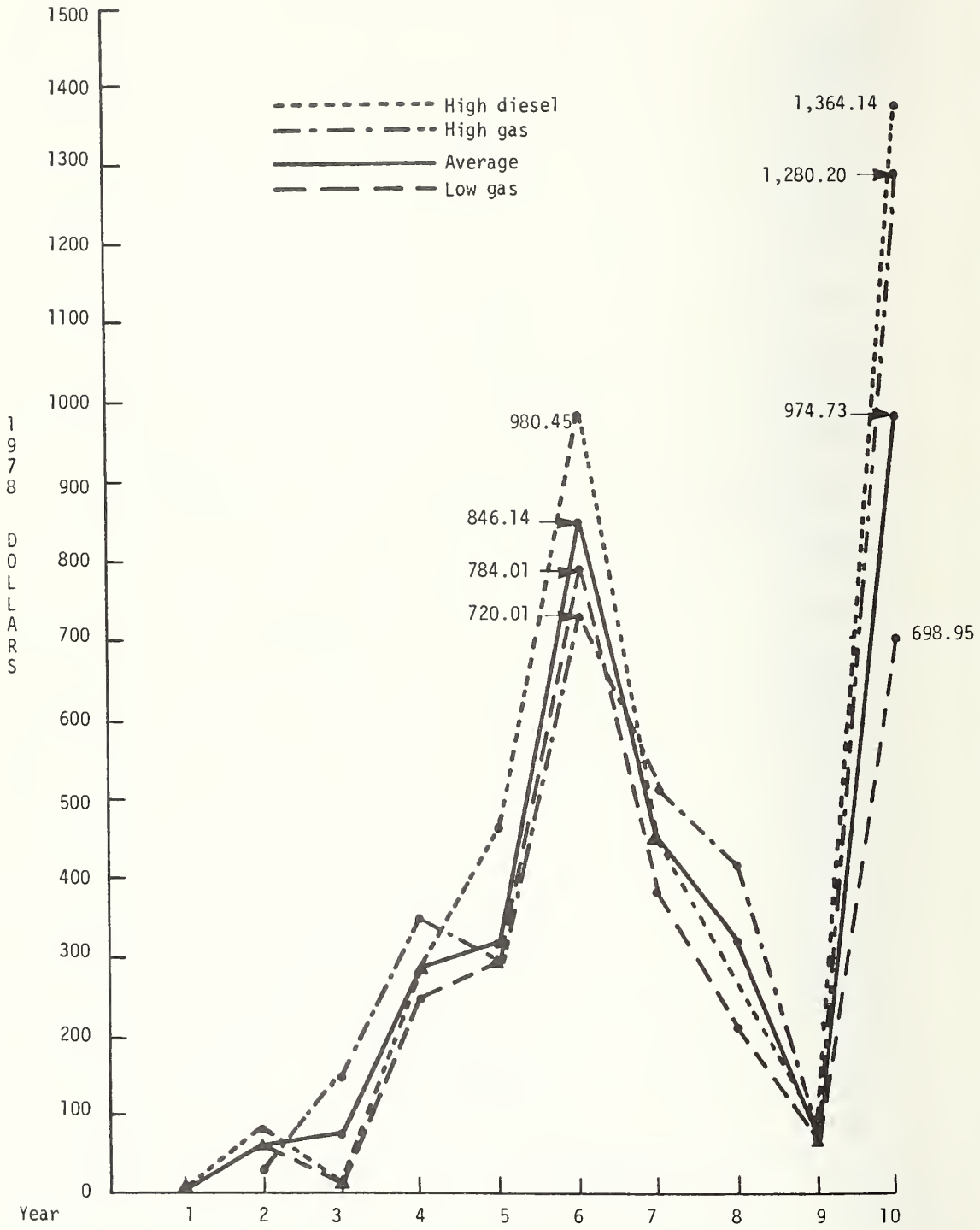

FIGURE 8-4. AVERAGE YEARLY UNSCHEDULED MAINTENANCE COSTS OF SUBCOMPACT AUTOMOBILES AND THE EXTREMES OF DEVIATION ABOVE AND BELOW THAT AVERAGE

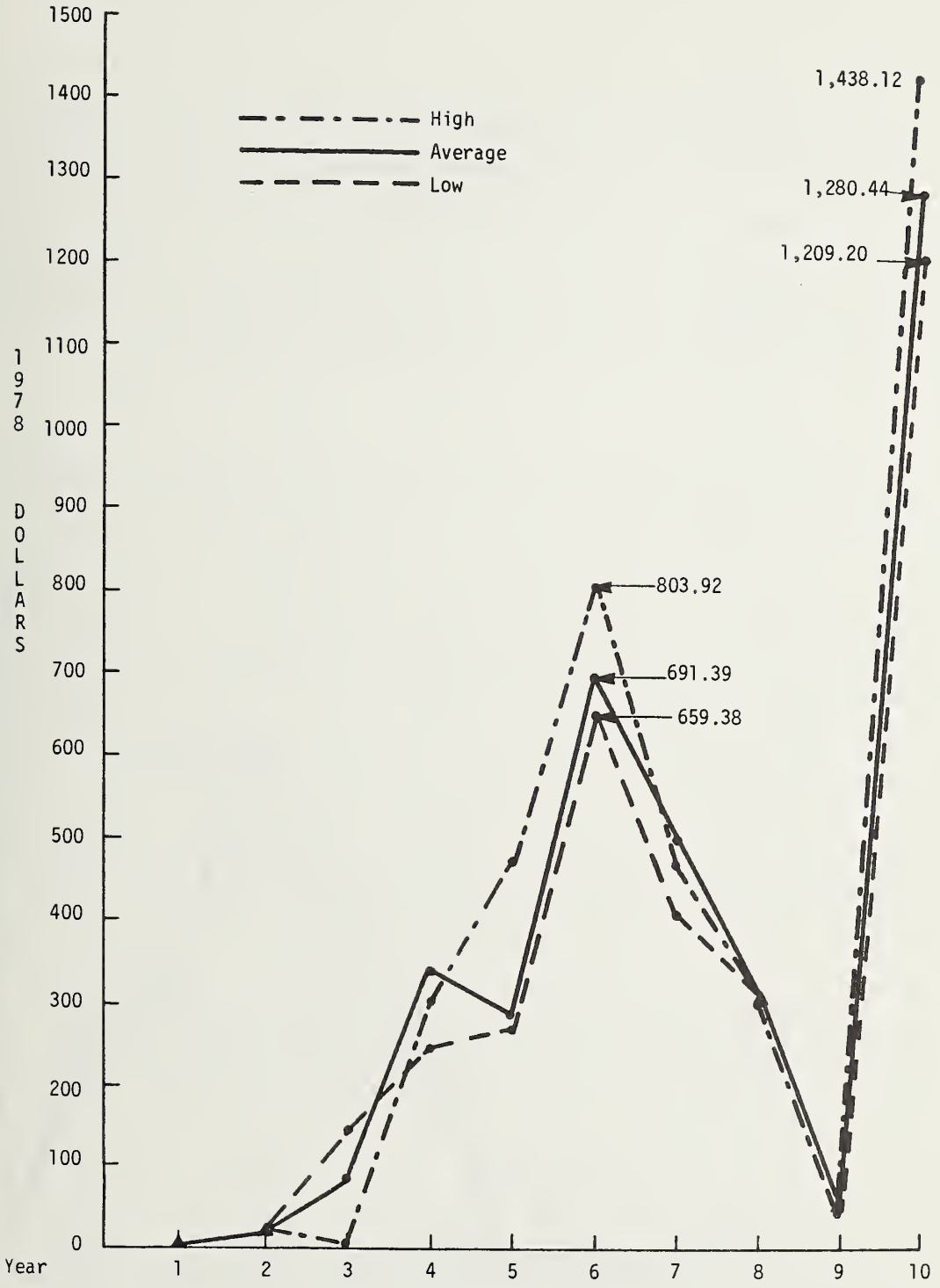

FIGURE 8-5. YEARLY UNSCHEDULED MAINTENANCE COSTS OF THE AVERAGE 1978 COMPACT AUTOMOBILE AND THE EXTREMES OF DEVIATION ABOVE AND BELOW THAT AVERAGE

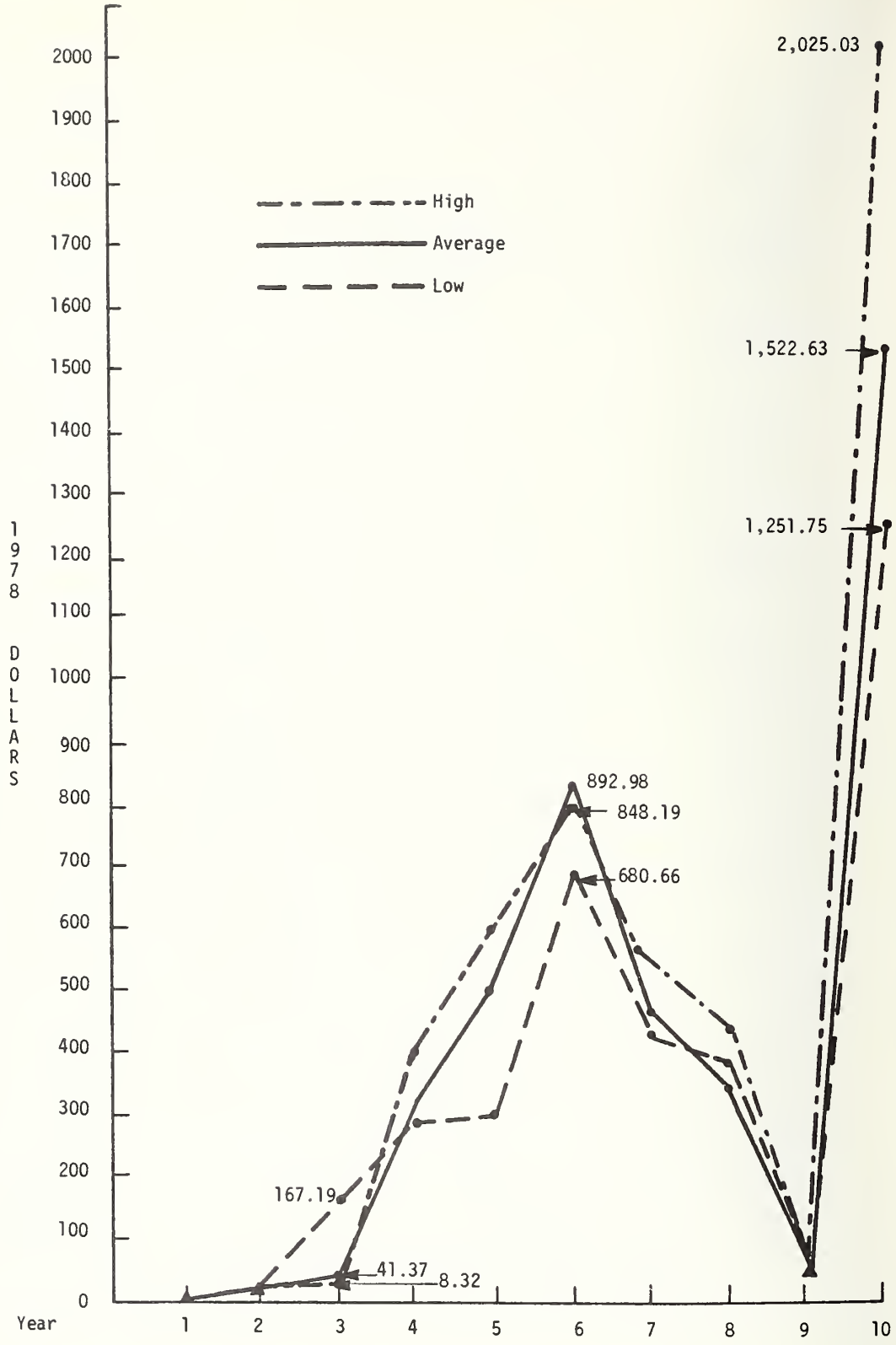

FIGURE 8-6. YEARLY UNSCHEDULED MAINTENANCE COSTS OF MID-SIZE AUTOMOBILES AND THE EXTREMES OF DEVIATION ABOVE AND BELOW THAT AVERAGE

TABLE 8-1. AVERAGE COST OF UNSCHEDULED MAINTENANCE REPAIRS BY BODY CLASS AND YEAR OF OCCURRENCE

Unscheduled Maintenance Item	Item Number	Approximate Mileage X 1,000	Year(s) of Occurrence	Subcompact Average Cost	Compact Average Cost	Mid-Size Average Cost
Oil Pump	2501	93	10	89.70	91.96	79.14
Carburetor	2511	55	6	136.43	108.33	151.68
Fuel Pump	2521	59	6	51.53	43.51	42.54
Power Steer. Pump	2531	93	10	91.53	95.98	102.48
Hoses & Belts	2542	33/66/99	4,7,10	78.41	86.85	97.26
Alternator	2551	52	6	129.48	85.76	110.95
Starter	2561	52	6	135.48	66.90	85.96
Water Pump	2571	59	6	66.09	69.42	89.77
Radiator	2581	75	8	70.98	79.74	77.27
Wheel Bearing	2592	33/66/99	4,7,10	34.10	Scheduled	Scheduled
Shock Absorber	2601	19/38/57/76/93	2,4,6,8,10	43.61	30.77	27.62
Front End Alignment	2352	49/98	5,10	23.09	39.06	113.08
Ball Joints	2611	51	6	54.05	100.64	42.28
Universal Joint	2621	51	6	76.70	34.00	39.44
Front Brake Pads	2631	33/66/99	4,7,10	44.32	56.64	59.05
Front Brake Rotors	2641	66	7	36.28	38.70	39.24
Rear Brake Shoes	2651	49/98	5,10	54.78	56.48	60.79
Rear Brake Drums	2661	98	10	20.15	21.50	25.48
Master Cylinder	2672	83	9	58.85	54.00	51.76
Wheel Cylinder	2682	66	7	100.33	89.25	90.01
Brake Hoses	2692	66	7	54.30	45.49	47.34
Brake Fluid	2302	66	7	4.50	4.50	4.50
Brake Booster	2701	94	10	135.49	105.74	116.59
Tie Rod Ends	2711	59	6	63.61	69.88	75.48
Exhaust Pipe	2721	49/98	5,10	74.67	58.11	91.42
Muffler	2731	33/66/99	4,7,10	80.65	57.55	76.91

TABLE 8-1 (Cont.)

Unscheduled Maintenance Item	Item Number	Approximate Mileage X 1,000	Year(s) of Occurrence	Subcompact Average Cost	Compact Average Cost	Mid-Size Average Cost
Tail Pipe	2741	33/66/99	4,7,10	25.97	31.94	61.10
W/S Washer Pump	2751	59	6	26.36	23.57	25.08
Wiper Refills	2761	24/48/72/96	3,5,8,10	5.81	5.03	4.77
Battery	2771	32/64/96	4,7,10	34.00	34.00	34.00
Voltage Regulator	2781	59	6	39.00	35.93	43.28
Distributor Cap	2792	72	8	16.54	16.78	20.78
Rotor	2802	24/58/72/96	3,6,8,10	2.77	2.00	2.76
Spark Plug Wires	2832	72	8	26.03	30.61	57.13
A/C Compressor	2841	99	10	150.23	163.45	199.26
A/C Receiver	2851	99	10	95.28	87.40	101.79
Heater Core	2871	75	8	97.69	84.95	113.85
Lamps/Bulbs/Flasher	2881	59	6	20.08	20.75	20.90
Fuel Injection Pumps	29A1	99	10	289.00	-	-
Fuel Inj. Nozzles	29B1	75	8	29.35	-	-
Fuel Inj. Cont. Box	29D1	95	10	-	-	214.10
Electric Fuel Pump	29C1	95	10	-	-	135.20
Glow Plugs	29F1	48/98	5,10	18.50	-	-
Ignition Control Box	29E1	99	10	95.67	88.12	95.11
Rotate Tires	29G1	46/92	5,10	10.75	10.75	11.00
Tires, Radial	2891	49/98	5,10	193.09	280.32	326.34
Tires, Belted	2891	33/66/99	4,7,10	-	186.00	-
Tires, Bias	2891	24/25/49/73/75/98	3,5,8,10	131.95	154.77	169.22
Points & Condenser	2812	19/39/59/79/99	2,4,6,8,10	7.35	-	-
Power Windows/Seats	2861	55	6	-	-	86.63
Elec. Fuel Pump(tank)	29M1	55	6	-	-	59.18

TABLE 8-2. AVERAGE UNSCHEDULED MAINTENANCE COST COMPARISON BY BODY CLASS

Year	Subcompact	Compact	Mid-Size
1	0	0	0
2	44.18	30.77	27.62
3	78.99	84.37	41.37
4	294.04	352.64	316.79
5	321.60	286.36	497.48
6	846.14	691.39	848.19
7	445.06	499.67	468.54
8	330.33	329.76	345.72
9	58.85	54.00	51.76
10	974.73	1,280.44	1,522.63
Total	3,393.92	3,609.40	4,120.10
Difference Above Subcompact	-	215.48	726.18

TABLE 8-3. AVERAGE UNSCHEDULED MAINTENANCE COSTS OF 1978 SUBCOMPACT AUTOMOBILES AND EXTREMES OF DEVIATION ABOVE AND BELOW THAT AVERAGE

ID #	Manufacturer	Model	Projected Unscheduled Maint. Costs
50	Chrysler	Horizon	2,745.78
26	Ford	Pinto	3,193.65
29	AMC	Gremlin	3,200.28
34	Honda	Civic CVCC	3,244.00
49	Ford	Fiesta	3,311.09
32	Datsun	B210	3,322.88
24	General Motors	Chevette	3,360.87
28	Chrysler	Colt	3,410.59
30	Volkswagen	Rabbit (gas)	3,466.93
25	General Motors	Monza	3,488.95
31	Toyota	Corolla	3,613.83
17	Ford	Mustang II	3,801.38
51	Volkswagen	Rabbit (diesel)	3,960.83
	Average Vehicle		3,393.93

Yearly Costs

Year	Lowest Cost #50	Average Cost	High Cost		Cumulative Average Cost
			Gasoline #17	Diesel #51	
1	0	0	0	0	0
2	51.23	44.18	25.70	63.05	44.18
3	7.10	78.99	142.03	8.20	123.17
4	257.67	294.04	367.72	287.95	417.21
5	283.42	321.60	284.13	467.94	738.81
6	784.01	846.14	720.75	980.45	1,584.95
7	388.07	445.06	507.87	440.90	2,030.01
8	212.18	330.33	419.08	277.65	2,360.34
9	63.15	58.85	53.90	70.55	2,419.19
10	698.95	974.73	1,280.20	1,364.14	3,393.92
Projected Total	2,745.78	3,393.92	3,801.38	3,960.83	

TABLE 8-4. AVERAGE UNSCHEDULED MAINTENANCE COSTS OF 1978 COMPACT AUTOMOBILES AND EXTREMES OF DEVIATION ABOVE AND BELOW THAT AVERAGE

ID #	Manufacturer	Model	Projected Unscheduled Maint. Costs
21	American Motors	Concord	3,370.37
15	General Motors	Nova	3,473.15
47	American Motors	Pacer	3,488.00
20	Chrysler Corp.	Volare	3,618.17
18	Ford	Fairmont	3,853.14
48	Ford	Granada	3,853.60
	Average Vehicle		3,609.40

Yearly Costs

Year	Lowest Cost #21	Average Cost	High Cost #48	Cumulative Average Cost
1	0	0	0	0
2	24.27	30.77	25.70	30.77
3	150.38	84.37	6.85	115.14
4	255.53	352.64	309.77	467.78
5	273.50	286.36	471.87	754.14
6	659.38	691.39	803.92	1,445.53
7	410.96	499.67	450.67	1,945.20
8	336.28	329.76	299.25	2,274.96
9	50.87	54.00	47.45	2,328.96
10	1,209.20	1,280.44	1,438.12	3,609.40
Projected Total	3,370.37	3,609.40	3,853.60	

TABLE 8-5. AVERAGE UNSCHEDULED MAINTENANCE COSTS OF 1978 MID-SIZE AUTOMOBILES AND EXTREMES OF DEVIATION ABOVE AND BELOW THAT AVERAGE

ID #	Manufacturer	Model	Projected Unscheduled Maint. Costs
14	AMC	Matador	3,596.44
11	General Motors	Grand Prix	3,744.80
10	General Motors	Malibu	3,821.94
53	General Motors	Cutlass	3,846.10
13	Chrysler	Fury	3,954.89
12	Ford	LTD II	4,112.16
52	Ford	Thunderbird	4,123.79
46	General Motors	Regal (turbo)	4,185.21
39	Ford	Versailles	4,771.02
40	General Motors	Seville	5,044.78
	Average Vehicle		4,120.11

Yearly Costs

Year	Lowest Cost #14	Average Cost	High Cost #40	Cumulative Average Cost
1	0	0	0	0
2	25.77	27.62	38.48	27.62
3	167.19	41.37	8.32	68.99
4	292.74	316.79	414.25	385.78
5	303.73	497.48	608.86	883.26
6	680.66	848.19	892.98	1,731.45
7	431.75	468.54	564.17	2,199.99
8	392.92	345.72	442.84	2,545.71
9	49.93	51.76	49.85	2,597.47
10	1,251.75	1,522.63	2,025.03	4,120.10
Projected Total	3,596.44	4,120.10	5,044.78	

EXHIBIT I-A. 1979 VEHICLE LIST

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '79	ACCESSORY OPTIONS
1	GM	(Lux) Standard	Buick	Electra/225	V8 350	A3	4070	339951	8602	PS/PD/AC
3	GM	(Lux) Standard	Cadillac	de Ville	V8 425	A3	4344	291307	11493	PS/PD/AC
4	FMC	(Lux) Standard	Lincoln	Continental	V8 400	A3	4843	160688	11200	PS/PD/AC
5	GM	Standard	Chev	Impala	V8 305	A3	3806	612397	6465	PS/PD/AC
6	FMC	Standard	Ford	LTD	V8 351	A3	3726	441440	6773	PS/PD/AC
7	CHRY	Standard	Chrysler	Newport	V8 360	A3	3695	66589	7256	PS/PD/AC
10	GM	Intermediate	Chev	Malibu	V8 267	A3	3289	358636	5775	PS/PD/AC
11	GM	Spec Intermed.	Pontiac	Grand Prix	V8 301	A3	3395	228444	6519	PS/PD/AC
12	FMC	Intermediate	Ford	LTD II	V8 302	A3	4004	58000	6255	PS/PD/AC
15	GM	Compact	Chev	Nova	L6 250	A3	3403	100000	4856	PS/PD/AC
18	FMC	Intermediate	Ford	Fairmount	L6 200	A3	2886	425701	5155	PS/PD/AC
20	CHRY	Compact	Plymouth	Volare	L6 225	A3	3319	382232	4835	PS/PD/AC
21	AMC	Compact	AMC	Concord	L6 258	A3	3125	79178	5343	PS/PD/AC
55	GM	Subcompact	Chev	Chevette	L4 98	A3	2109	310289	3914	AC
25	GM	Spec Subcompact	Chev	Monza	L4 151	A3	2704	138832	3813	PS
26	FMC	Subcompact	Ford	Pinto	L4 140	A3	2490	215153	4129	PS/PD
28	CHRY	Subcompact	Dodge	Colt	L4 97.5	A3	2119	67920	4710	PD

EXHIBIT I-A. 1979 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '79	ACCESSORY OPTIONS
29	AMC	Subcompact	AMC	Spirit	L6 232	A3	2589	18820	4634	PS/AC
30	VW	Subcompact	VW	Rabbit	L4 88.9	M4	1779	248770	5257	PD
31	TOY	Subcompact	TOY	Corolla	L4 96.9	M5	2196		4563	PD
32	DATS	Subcompact	Datsun	210	L4 85.2	M4	1970	193081	4589	PD
34	HONDA	Subcompact	Honda	Civic	L4 90.8	M4	1757	168000	4029	
35	GM	Truck, PU (T1)	GM	C-10	V8 350	A3	3847	540000	6544	PS/PD/AC
36	GM	Truck, PU (T1)	GM	C-20	V8 350	A3	4339	190000	7377	PS/PD/AC
37	FMC	Truck, PU (T1)	Ford	F-100	L6 300	M3	3568	205000	6003	PS/PD/AC
38	FMC	Truck, PU (T1)	Ford	F-250	V8 351	A3	3853	185000	6879	PS/PD/AC
39	FMC	(Lux) Intermed.	Lincoln	Versailles	V8 302	A3	3834	8931	12939	PS/PD/AC
40	GM	(Lux) Intermed.	Cadillac	Seville	V8 350	A3	4289	56985	15646	PS/PD/AC
41	FMC	Truck, PU	Ford	F-150	V8 351	A3	3725	340000	6707	PS/PD/AC
42	GM	Van	Chev	G-10	V8 350	A3	3887	150000	6793	PS/PD/AC
43	FMC	Van	Ford	E-150	V8 351	A3	3748	130000	6389	PS/PD/AC
44	CHRO	Van	Dodge	B-200	V8 318	A3	3668	209000	6496	PS/PD/AC
45	GM	Standard	Olds	Delta Diesel	V8 350	A3	4041	33841	7490	PS/PD/AC
46	GM	Intermediate	Buick	Regal Turbo	V6 231	A3	3403	185047	7156	PS/PD/AC

EXHIBIT I-A. 1979 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB. WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '79	ACCESSORY OPTIONS
47	AMC	Compact	AMC	Pacer	L6 258	A3	3228	18717	5763	PS/PD/AC
48	FMC	Compact	Ford	Granada	L6 250	A3	3360	315670	5491	PS/PD/AC
49	FMC	Subcompact	Ford	Fiesta	L4 97.6	M4	1770	76001	4198	
50	CHRY	Subcompact	Plymouth	Horizon	L4104.7	A3	2167	166828	4441	
51	VW	Subcompact	VW	Rabbit Diesel	L4 89.7	M4	2042	17000	5783	PD
52	FMC	Spec Intermed.	Ford	Thunderbird	V8 302	A3	4308	370954	6824	PS/PD/AC
53	GM	Intermediate	Olds	Cutlass	V8 260	A3	3408	507171	6026	PS/PD/AC
59	FMC	Subcompact	Ford	Mustang	L4 140	M4 TURB	2705	50000	5308	PS/PD/AC
56	GM	(Lux) Intermed.	Cadillac	Eldorado	V8 350	A3	3895	10000	14240	PS/PD/AC
57	DAT	Subcompact	Datsun	310	L4 85.2	M4	1985	95000	4829	
58	GM	Compact	Chevy	Citation	V6 171	A3	2561	250000	4861	PS/PD/AC
54	FMC	Subcompact	Ford	Mustang	L4 140	A3	2634	210168	5073	PS/PD/AC

EXHIBIT I-B. 1978 VEHICLE LIST

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
1	GM	(Lux) Standard	Buick	Electra 225	V8 350	A3	3975	348293	7900	PS/PD/AC
3	GM	(Lux) Standard	Cadillac	de Ville	V8 425	A3	4368	270781	10668	PS/PD/AC
4	FMC	(Lux) Standard	Lincoln	Continental	V8 460	A3	4836	100477	10166	PS/PD/AC
5	GM	Standard	Chev	Impala	V8 305	A3	3815	673214	6037	PS/PD/AC
6	FMC	Standard	Ford	LTD	V8 400	A3	4543	375866	6255	PS/PD/AC
7	CHRY	Standard	Chrysler	Newport	V8 400	A3	4592	83046	6404	PS/PD/AC
10	GM	Intermediate	Chev	Malibu	V8 305	A3	3315	372119	5541	PS/PD/AC
11	GM	Spec Intermed.	Pontiac	Grand Prix	V8 301	A3	3391	214861	6102	PS/PD/AC
12	FMC	Intermediate	Ford	LTD II	V8 351	A3	4257	176235	5589	PS/PD/AC
13	CHRY	Intermediate	Plymouth	Fury	V8 318	A3	3983	87569	5190	PS/PD/AC
14	AMC	Intermediate	AMC	Matador	V8 360	A3	3991	16636	5629	PS/PD/AC
15	GM	Compact	Chev	Nova	L6 250	A3	3418	323023	4844	PS/PD/AC
54	FMC	Spec Subcompact	Ford	Mustang II	L4 140	A3	2878	201917	4549	PS/PD/AC
18	FMC	Intermediate	Ford	Fairmont	L6 200	A3	2886	403806	4819	PS/PD/AC
20	CHRY	Compact	Plymouth	Volare	L6 225	A3	3390	254527	4841	PS/PD/AC
21	AMC	Compact	AMC	Concord	L6 258	A3	3224	118518	4362	PS/AC

EXHIBIT I-B. 1978 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
55	GM	Subcompact	Chev	Chevette	L4 97.6	A3	2128	278673	4475	PD/AC
25	GM	Spec Subcompact	Chev	Monza	L4 140	A3	2860	135744	4483	PS/AC
26	FMC	Subcompact	Ford	Pinto	L4 140	A3	2511	203704	3883	PS
28	CHRY	Subcompact	Dodge	Colt	L4 97.4	A3	2066	66988	4404	PD
29	AMC	Subcompact	AMC	Gremlin	L6 232	A3	2669	27112	4288	PS/AC
30	VW	Subcompact	VW	Rabbit	L4 88.9	M4	2042	15100	5200	PD
31	TOY	Subcompact	Toyota	Corolla	L4 96.9	M5	2200	259344	4163	PD
32	DATS	Subcompact	Datsun	B210	L4 85.2	M4	1864	173081	4068	PD
34	HONDA	Subcompact	Honda	Civic CVCC	L4 90.8	M4	1761	148000	3549	
35	GM	Truck, PU (T1)		C10	V8 350	A3	3819	526000	5574	PS/PD/AC
36	GM	Truck, PU (T1)		C20	V8 350	A3	4253	189000	5569	PS/PD
37	FMC	Pickup (T1)		F100	L6	M3	3570	197000	4221	
38	FMC	Pickup (T1)		F250	V8 351	A3	4108	181000	5450	PS/PD
39	FMC	(Lux) Intermed.	Lincoln	Versailles	V8 302	A3	3913	15284	12529	PS/PD/AC
40	GM	(Lux) Intermed.	Cadillac	Seville	V8 350	A3	4289	54375	14276	PS/PD/AC
41	FMC	Pickup		F150	V8 351	A3	4102	338000	5316	PS/PD/AC

EXHIBIT I-B. 1978 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
42	CHEV	Van		G10 Van	V8 350	A3	3818	148000	5190	PS/PD
43	FORD	Van		E150 Econo-line	V8 351	A3	3916	129000	5247	PS/PD
44	CHRY	Van		B200 Tradesman	V8 318	A3	3668	205000	5091	PS/PD
45	GM	STD	Olds	Delta 88 Diesel	V8 350	A3	4041		6409	
46	GM	Intermediate	Buick	Regal Turbo	V8 260	A3	3248		6397	
47	AMC	Compact	AMC	Pacer	L6 258	A3	3302	28535	5103	PD/PS/AC
48	FMC	Compact	Ford	Granada	V8 302	A3	3478	277375	5433	PS/PD/AC
49	FMC	Subcompact	Ford	Fiesta	L4 97.5	M4	1761	92520	3958	
50	CHRY	Compact	Plymouth	Horizon	L4 104.7	M4	2228	83170	4292	
51	VW	Subcompact	VW	Rabbit Diesel	L4 89.7	M4	3092	15000	5044	PD
52	FMC	Spec Intermed.	Ford	Thunder-bird	V8 302	A3	4147	347280	6193	PS/PD/AC
53	GM	Intermediate	Olds	Cutlass	V8 305	A3	3408	511533	5656	PS/PD/AC

EXHIBIT I-C. 1977 VEHICLE LIST

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
1	GM	(Lux) Standard	Buick	Electra 225	V8 350	A3	3945	377428	7849	PS/PD/AC
3	GM	(Lux) Standard	Cadillac	de Ville	V8 425	A3	4354	264784	10456	PS/PS/AC
4	FMC	(Lux) Standard	Lincoln	Continental	V8 460	A3	5052	95600	10214	PS/PD/AC
5	GM	Standard	Chevrolet	Impala	V8 305	A3	3848	661661	5880	PS/PD/AC
6	FMC	Standard	Ford	LTD	V8 400	A3	4628	415597	6125	PS/PD/AC
7	CHRY	Standard	Chrysler	Newport	V8 400	A3	4599	127282	6190	PS/PD/AC
10	GM	Intermediate	Chevrolet	Chevelle	V8 305	A3	4002	328216	5346	PS/PD/AC
11	GM	Spec Intermed.	Pontiac	Grand Prix	V8 301	A3	4038	288430	5959	PS/PD/AC
12	FMC	Intermediate	Ford	LTD II	V8 351	A3	4335	208713	5459	PS/PD/AC
13	CHRY	Intermediate	Plymouth	Fury	V8 318	A3	4082	101977	5322	PS/PD/AC
14	AMC	Intermediate	AMC	Matador	V8 360	A3	4070	30847	5729	PS/PD/AC
15	GM	Compact	Chevrolet	Nova	L6 250	A3	3409	365264	4800	PS/PD/AC
54	FMC	Spec Subcompact	Ford	Mustang II	L4 140	A3	2860	141212	4843	PS/PD/AC
18	FMC	Intermediate	Ford	Maverick	L6 250	A3	3226	90064	4647	PS/PD/AC

EXHIBIT I-C. 1977 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
20	CHRY	Compact	Plymouth	Volare	L6 225	A3	3489	328532	4814	PS/PD/AC
21	AMC	Compact	AMC	Hornet	L6 258	A3	3160	61180	4698	PS/AC
55	GM	Subcompact	Chevrolet	Chevette	L4 9706	A3	2139	136760	4211	PD/AC
25	GM	Spec Subcompact	Chevrolet	Monza	L4 140	A3	2882	73348	4939	PS/AC
26	FMC	Subcompact	Ford	Pinto	L4 140	A3	2529	191360	3950	PS
28	CHRY	Subcompact	Dodge	Colt	L4 97.5	A3	2280	118024	3839	PD
29	AMC	Subcompact	AMC	Gremlin	L6 232	A3	2920	31714	4058	PS/AC
30	VW	Subcompact	VW	Rabbit	L4 97	M4	2042	151530	4362	PD
31	TOY	Subcompact	Toyota	Corolla	L4 96.9	M5	2300	259344	3295	PD
32	DATS	Subcompact	Datsun	B210	L4 85.2	M4	2020	173081	3571	PD
34	HONDA	Subcompact	Honda	Civic CVCC	L4 90.8	M4	1761	147648	3179	
35	GM	Truck, PU (Tl)		C10	V8 350	A3	3869	525791	5583	PS/PD/AC
36	GM	Truck, PU (Tl)		C20	V8 350	A3	4333	189150	5954	PS/PD
37	FMC	Pickup (Tl)		F100	L6 300	M3	3568	197822	4227	
38	FMC	Pickup (Tl)		F250	V8 351	A3	4069	180612	5469	PS/PD

EXHIBIT I-C. 1977 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
39	FMC	(Lux) Intermed.	Lincoln	Versailles	V8 351	A3	3924	15434	12529	PS/PD/AC
40	GM	(Lux) Intermed.	Cadillac	Seville	V8 350	A3	4300	45060	14161	PS/PD/AC
41	FMC	Pickup (T1)		F150	V8 351	A3	4022	337068	5901	PS/PD/AC
42	CHEV	Van (T2)		G10 Van	V8 350	A3	3771	147377	5044	PS/PD
43	FMC	Van (T2)		E-150 Econoline	V8 351	A3	3928	111239	5305	PS/PD
44	CHRY	Van		B200 Tradesman	V8 318	A3	3668	204984	5278	PS/PD
47	AMC	Compact	AMC	Pacer	L6 258	A3	3271	58264	4995	PS/PD/AC
48	FMC	Compact	Ford	Granada	V8 302	A3	3439	361220	5424	PS/PD/AC
49	FMC	Subcompact	Ford	Fiesta	L4 97.5	M4	1761	40549	3958	
51	VW	Subcompact	VW	Rabbit Diesel	L4 89.5	M4	3092	13176	5044	PD
52	FMC	Spec Intermed.	Ford	Thunder-bird	V8 351	A3	4388	295779	5902	PS/PD/AC
53	GM	Intermediate	Olds	Cutlass	V8 350	A3	4056	632742	5642	PS/PD/AC

EXHIBIT I-D. 1976 VEHICLE LIST

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
1	GM	(Lux) Standard	Buick	Electra 225	V8 455	A3	4788	282040	7833	PS/PD/AC
3	GM	(Lux) Standard	Cadillac	de Ville	V8 500	A3	5273	214674	10376	PS/PD/AC
4	FMC	(Lux) Standard	Lincoln	Continental	V8 460	A3	5225	64973	10408	PS/PD/AC
5	GM	Standard	Chevrolet	Impala	V8 350	A3	4453	423856	5813	PS/PD/AC
6	FMC	Standard	Ford	LTD	V8 400	A3	4685	359414	5979	PS/PD/AC
7	CHRY	Standard	Chrysler	Newport	V8 400	A3	4722	77320	6189	PS/PD/AC
10	GM	Intermediate	Chevrolet	Chevelle	V8 350	A3	4119	333243	5266	PS/PD/AC
11	GM	Intermediate	Pontiac	Grand Prix	V8 350	A3	4282	228091	5939	PS/PD/AC
12	FMC	Intermediate	Ford	Torino	V8 351	A3	4345	172572	5246	PS/PD/AC
13	CHRY	Intermediate	Plymouth	Fury	V8 318	A3	4121	86139	5370	PS/PD/AC
14	AMC	Intermediate	AMC	Matador	V8 304	A3	3947	41513	5162	PS/PD/AC
15	GM	Compact	Chevrolet	Nova	L6 250	A3	3465	334728	4722	PS/PD/AC
54	FMC	Spec Subcompact	Ford	Mustang II	L4 140	A3	2940	172365	4878	PS/PD/AC
18	FMC	Intermediate	Ford	Maverick	L6 250	A3	3188	126423	4622	PS/AC
20	CHRY	Compact	Plymouth	Volare	L6 225	A3	3402	255008	4734	PS/PD/AC
21	AMC	Compact	AMC	Hornet	L6 258	A3	3150	71577	4558	PS/AC

EXHIBIT I-D. 1976 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
55	GM	Subcompact	Chevrolet	Chevette	L4 97.6	A3	2108	187817	4280	PD/AC
25	GM	Spec Subcompact	Chevrolet	Monza	L4 140	A3	2906	80905	5057	PS/AC
26	FMC	Subcompact	Ford	Pinto	L4 140	A3	2657	275222	4099	PS
28	CHRY	Subcompact	Dodge	Colt	L4 97.5	A3	2225	74204	4480	PD
29	AMC	Subcompact	AMC	Gremlin	L6 232	A3	2875	52941	4134	PS/AC
30	VW	Subcompact	VW	Rabbit	L4 96.9	M4	1782	112056	4239	PD
31	TOY	Subcompact	Toyota	Corolla	L4 96.9	M4	2360	187321	3683	PD
32	DATS	Subcompact	Datsun	B210	L4 8512	M4	2055	147643	3633	PD
34	HONDA	Subcompact	Honda	Civic CVCC	L4 90.8	M4	1758	132286	3347	PD
35	GM	Truck, PU (T1)		C10	V8 350	A3	3925	458424	5407	PS/PD/AC
36	GM	Truck, PU (T1)		C20	V8 350	A3	4417	172419	5283	PS/PD
37	FMC	Truck, PU (T1)		F100	L6 300	M4	3587	225154	4275	
38	FMC	Truck, PU (T1)		F250	V8 360	A3	4151	189631	5240	PS/PD
40	GM	(Lux) Intermed.	Cadillac	Seville	L6 350	A3	4349	43772	13976	PS/PD/AC

EXHIBIT I-D. 1976 VEHICLE LIST (CONTINUED)

VID	CORP	BODY CLASS	MAKE	MODEL	ENGINE TYPE & DISPLACE-MENT	TRANS TYPE & NO. GEARS	CURB WT. INCLUDING OPTIONS	TOTAL MODEL PROD.	RETAIL PRICE IN '78 $	ACCESSORY OPTIONS
41	FMC	Pickup (T1)		F150	V8 360	A3	4132	200174	5870	PS/PD/AC
42	CHEV	Van (T2)		G10 Van	V8 350	A3	3775	125695	4768	PS/PD
43	FMC	Van (T2)		E-150 Econoline	V8 351	A3	4019	167830	5093	PS/PD
44	CHRY	Van (T2)		B200 Tradesman	V8 318	A3	3668	107003	5090	PS/PD
47	AMC	Compact	AMC	Pacer	L6 258	A3	3209	117244	4894	PS/AC
48	FMC	Compact	Ford	Granada	V8 460	A3	3643	421449	5393	PS/PD/AC
52	FMC	Spec Standard	Ford	Thunder-bird	V8 460	A3	5046	47949	8725	PS/PD/AC
53	GMC	Intermediate	Olds	Cutlass	V8 350	A3	4028	500129	5629	PS/PD/AC

EXHIBIT II. VEHICLE MAINTENANCE CALCULATION FORM

V.I. Year 1 thru 5

Year	Maint. #	Dealer Mat.	Dealer Lab.	Gas Stat.Mat	Gas Stat.Lab	Ind. Mat	Ind. Lab
1							
2	2601						
3	2761						
	2802						
4	2542						
	2592						
	2601						
	2631						
	2731						
	2741						
	2771						
5	2352						
	2651						
	2721						
	2761						

EXHIBIT II. VEHICLE MAINTENANCE CALCULATION FORM (CONTINUED)

V.I. Year 6 thru 7

Year	Maint. #	Dealer Mat.	Dealer Lab.	Gas Stat.Mat.	Gas Stat.Lab.	Ind.Mat.	Ind.Lab.
6	2511						
	2521						
	2551						
	2561						
	2571						
	2601						
	2611						
	2621						
	2711						
	2751						
	2781						
	2802						
	2861						
	2881						
7	2542						
	2592						
	2631						
	2641						
	2682						
	2692						
	2302						
	2731						
	2741						
	2771						

EXHIBIT II. VEHICLE MAINTENANCE CALCULATION FORM (CONTINUED)

Year 8 thru 10

Year	Maint. #	Dealer Mat.	Dealer Lab.	Gas Stat.Mat.	Gas Stat. Lab.	Ind.Mat.	Ind.Lab.
8	2581						
	2601						
	2761						
	2792						
	2802						
	2832						
	2871						
9	2672						
10	2501						
	2531						
	2542						
	2592						
	2601						
	2352						
	2631						
	2651						
	2661						
	2701						
	2721						
	2731						
	2741						
	2761						
	2771						
	2802						
	2841						
	2851						
	2891						

APPENDIX A

REPORT OF NEW TECHNOLOGY

The methodology of the work performed under this contract is similar to that which had been used in developing a data base for DOT/TSC under a previous contract. The effort in this contract, however, did update and expand the available data base to assist DOT in making policy decisions.

APPENDIX B

SCHEDULED MAINTENANCE SOURCE LIST

100 AMC Concord, Gremlin,- 1978 - AMC Maintenance Schedule
Matador, Pacer Pn. 3232650

101 AMC Hornet, Gremlin,- 1977 - Owners Manual P. 91 Pn. 3229929
Matador, Pacer

102 AMC Hornet, Gremlin,- 1976 - Owners Manual P. 98 Pn. 3227601
Matador, Pacer

103 Buick Electra, Regal (Turbo) - 1978 - Buick Maintenance Sched. 1
Pn. 1257710

104 Buick Electra, Regal (Turbo) - 1978 - Buick Maintenance Sched. II
Pn. 1257712

105 Buick Electra - 1977 - Buick Maintenance Sched. I
Pn. 1254715A

106 Buick Electra - 1977 - Buick Maintenance Sched. II
Pn. 1254721A

107 Buick Electra - 1976 - Buick Chassis Service Manual
P. OC-2

108 Cadillac Deville,- 1978 - Cadillac Service Manual Supplement
Seville P. OB-9 Catalog No. S-1551

109 Cadillac Deville,- 1977 - Cadillac Service Manual P OB-2 &
Seville OB-3 Pn. 1099915

110 Cadillac Deville,- 1976 - Cadillac Shop Manual P. 0-12
Pn. 1099881
Seville,- 1976 - Shop Manual 1099843

111 Chevrolet Chevette - 1978 - Chevette Shop Manual P. OB-6
& OB-7 No. ST 357-78

112 Chevrolet Chevette - 1976 - Chevette Shop Manual P. OB-6
No. ST-357-76

113 Chevrolet Monza - 1978 - Monza Shop Manual P. OB 6
No. ST 300-78

114 Chevrolet Monza - 1977 - Vega & Monza Shop Manual P. OB-7
No. ST 300-77

115 Chevrolet Monza - 1976 - Vega & Monza Service & Overhaul Manual
Supplement P. O-11 No. ST 300-76

116 Chevrolet Impala, Nova,- 1978 - Chevrolet Service Manual
Malibu P. OB-9 & OB-10 No. ST-329-78

117 Chevrolet Impala, Nova,- 1977 - Passenger Car Maintenance
Malibu, Chevette Schedule I Pn. 460216A

118 Chevrolet Impala, Nova,- 1977 - Passenger Car Maintenance
Malibu, Chevette Schedule II Pn. 460256A

119 Chevrolet Impala, Nova - 1976 - Passenger Car Maintenance
Malibu Schedule Pn. 360266A

120 Chevrolet Trucks C-10, G-10 - 1978
C-20

121 Chevrolet Trucks C-10, G-10 - 1978
C-20

122 Chevrolet Trucks C-10 - 1978
C-20

123 Chevrolet Trucks C-10, G-10 - 1977 - Light-Duty Truck Maintenance
C-20 Schedule Pn. 460227A
124 Chevrolet Trucks C-10, G-10 - 1977 - Light-Duty Truck Maintenance
C-20 Schedule II Pn. 460228B
125 Chevrolet Trucks C-10, - 1977 - Light-Duty Truck with Heavy-Duty
C-20 Emission System Maintenance
Schedule Pn. 460229A
126 Chevrolet Trucks C-10, G-10 - 1976 - Light-Duty Truck Maintenance
C-20 Schedule Pn. 360268A
127 Chevrolet Trucks C-10, G-10 - 1976 - Light-Duty Truck Maintenance
C-20 Schedule Pn. 360287A
128 Chevrolet Trucks C-10 - 1976 - 1974 Light-Duty Truck Service
C-20 Manual P. 0-11 No. ST 330-74
129 Chevrolet Trucks C-10 - 1976 - 1976 Light-Duty Truck Service and
C-20 Overhaul Manual Supplement P. 0-6
No. ST-330-76
130 Chrysler Newport - 1978 - Owners Manual P.50 Pn. 81-270-8103
131 Chrysler Newport - 1977 - Owners Manual P.47 Pn. 81-270-7101
132 Chrysler Newport - 1977 - Warranty Brochure P. 6 Pn. 81-270-7107
133 Chrysler Newport - 1976 - Owners Manual P. 47 Pn. 81-270-6001
134 Datsun B210 - 1978 - Owners Manual OM8E-B21OU1
135 Datsun B210 - 1977 - Owners Manual P. 64 Pn. OM7E-B21OU4
136 Datsun B210 - 1976 - Owners Manual P. 58 Pn. OM6E-B21OU1
137 Dodge Colt - 1978 - Chassis-Body Service Manual P. 0-4
Pn. 81-070-8705
138 Dodge Colt - 1977 - Service Manual P.O-1 Pn. 81-070-7703
139 Dodge Colt - 1976 - Service Manual P.O-3 Pn. 81-370-6375
140 Dodge Van Tradesman B-200 - 1978 - Chassis-Body Service Manual
P.O-30 Pn. 81-370-8114
141 Dodge Van Tradesman B-200 - 1977 - Service Manual P. O-30
Pn. 81-370-7012
142 Dodge Van Tradesman B-200 - 1976 - Operators Manual P. 27
Pn. 81-370-5403
143 Ford Fairmont - 1978 - Owners Manual P. 6 No. FPS365-32378-A
144 Ford Fiesta - 1978 - Owners Manual P. 4 No. FPS365-316-78-B
145 Ford Granada - 1978 - Owners Manual P. 6 No. FPS365-22178-A
146 Ford Granada - 1977 - Owners Manual P. 6 No. FPS365-22177-A
147 Ford Granada - 1976 - Owners Manual P. 6 No. FPS365-22176-A
148 Ford LTD - 1978 - Owners Manual P. 6 No. FPS365-10278-A
149 Ford LTD - 1977 - Owners Manual P. 6 No. FPS365-10277-A
150 Ford LTD - 1976 - Owners Manual P. 8 No. FPS365-10276-A
151 Ford LTD II - 1978 - Owners Manual P. 6 No. FPS365-31078-A
152 Ford LTD II - 1978 - Owners Manual P. 6 No. FPS365-31077-A
153 Ford Torino - 1976 - Owners Manual P. 8 No. FPS365-10476-A
154 Ford Mustang II - 1978 - Owners Manual P. 5 No. FPS365-10578-A
155 Ford Mustang II - 1977 - Owners Manual P. 6 No. FPS365-10577-A
156 Ford Mustang II - 1976 - Owners Manual P. 6 No. FPS365-10576-A
157 Ford Pinto - 1978 - Owners Manual P. 6 No. FPS365-10378-B
158 Ford Pinto - 1977 - Owners Manual P. 6 No. FPS365-10377-A
159 Ford Pinto - 1976 - Owners Manual P. 6 No. FPS365-10376-A
160 Ford Thunderbird - 1978 - Owners Manual P. 7 No. FPS365-10178-A
161 Ford Thunderbird - 1977 - Owners Manual P. 7 No. FPS365-10177-A
162 Ford Thunderbird - 1976 - Owners Manual P. 8 No. FPS365-10176-A

163 Ford Truck F100, F250 - 1978 - Owners Manual P. 125 & 133
F150 No. FPS365-10978-A
164 Ford Truck F100, F250 - 1977 - Owners Manual P. 111 & 116
F150 No. FPS365-10977-A
165 Ford Truck F100, F250 - 1976 - Vol. 5 Shop Manual P. 50-02-9,
F150 50-02-10, 50-02-11
No. FPS365-127-76D
166 Ford Truck F100, F250 - 1976 - Vol. 5 Shop Manual P. 50-29-24,
F150 50-29-26, 50-29-27
No. FPS365-127-76D
167 Ford Van Econoline E-150 - 1978 - Owners Manual P. 117 & 125
No. FPS365-10878-A
168 Ford Van Econoline E-150 - 1977 - Owners Manual P. 111
No. FPS365-10877-A
169 Ford Van Econoline E-150 - 1976 - Owners Manual P. 93
No. FPS365-10876-A
170 Honda CVCC - 1978 - Owners Manual 3165719-A310007711
171 Honda CVCC - 1977 - Owners Manual A20007706
172 Honda CVCC - 1976 - Service Manual/Owners Manual
173 Lincoln Continental - 1978 - Owners Manual P. 6 No. FPS365-11478-A
174 Lincoln Continental - 1977 - Owners Manual P. 6 No. FPS365-11477-A
175 Lincoln Continental - 1976 - Owners Manual P. 8 No. FPS365-11476-A
176 Lincoln Versailles - 1978 - Owners Manual P. 6 No. FPS365-31378-A
177 Lincoln Versailles - 1977 - Shop Manual P. 50-02-2, 50-29-2 &
50-29-3 No. FPS365-31477-A
178 Oldsmobile Cutlass, - 1978 - Oldsmobile Chassis Service Manual
Delta 88 Diesel P. OB-4 & OB-5 & OB-6
179 Oldsmobile Cutlass - 1977 - Oldsmobile Service Manual 1977 P. 0-9
180 Oldsmobile Cutlass - 1976 - Oldsmobile Service Manual 1976 P. O-7
181 Plymouth Fury, - 1978 - Owners Manual P. 44 Pn. 81-270-8105
Volare
182 Plymouth Fury, - 1977 - Owners Manual P. 50 Pn. 81-270-7102
Volare
183 Plymough Fury, - 1976 - Owners Manual P. 51 Pn. 81-270-6002
Volare
184 Plymouth Horizon - 1978 - Owners Manual P. 50 Pn. 81-270-8106
185 Pontiac Grand Prix - 1978 - Pontiac Service Manual P. OB-7 &
OB-8 No. S-7804F
186 Pontiac Grand Prix - 1977 - Pontiac Service Manual P. OB-2 &
OB-3 No. S-7704F
187 Pontiac Grand Prix - 1976 - Pontiac Service Manual Supplement
Sep. 1975 P. 0-3 No. S-7604
188 Toyota Corolla - 1978 - Owners Manual 9737A
189 Toyota Corolla - 1977 - Owners Manual 9727A
190 Toyota Corolla - 1976 - Owners Manual P. 42 Pub. No. 9704A
191 Volkswagen Diesel Rabbit - 1978 - Warranty Brochure - P. 14
No. USA 0.00.556.352.23
192 Volkswagen Rabbit - 1978 - Warranty Brochure, P. 16
No. USA 0.00.556.351.23
193 Volkswagen Rabbit - 1977 - Warranty Brochure P. 15
No. USA 0.00.556.338.23
194 Volkswagen Rabbit - 1976 - Warranty Brochure P. 13
No. USA 0.00.556.286.23
195 Chilton's Professional Labor Guide & Parts Manual - 1978
196 Chilton's Professional Emission Diagnostic and Safety Manual
1974 and Supplements thru No. 6 July 1977 ISBN:0-8019-6554-X

197 Chilton's Professional Truck and Van Service Manual 1978
ISBN:0-8019-6708-2
198 Chilton's Professional Import Automotive Service Manual 1977
No. 6580
199 Atlas/Exxon 1978 Parts Catalog (NE-E-SE-C-W Regions)
Effective Date: 15 Aug. 1978
200 NAPA 1978 Quick Reference Truck Parts Catalog No. 19
May 15, 1978
201 NAPA 1978 Quick Reference Automotive Parts Catalog No. 50
July 1978
202 VW of America Parts Price List (Retail) June 1, 1978
No. W52-008-132-1
203 Datsun Parts Price List No. N-30 Effective 1 Jan 1978
Part No. 99999-10000-30
204 Toyota Dealer Parts Price List Effective 10/1/77
Toyota Motor Sales U.S.A. Inc.
205 Chrysler Corporation Master Parts Price List Effective 2 Oct 78
No. 81-690-0774 Rev.
206 Chevrolet Dealer Parts and Accessories Price Schedule
Effective 1 Oct 78
207 Oldsmobile Parts and Accessories Price Schedule
Effective 1 Oct 78
208 Pontiac Dealer Parts and Accessories Price Schedule
Effective 1 Oct 78
209 Buick Dealer Parts and Accessories Price Schedule
Effective 1 Oct 78
210 Cadillac Parts and Accessories Numerical Price List
Effective 1 Oct 78
211 GMC Truck and Coach Truck Dealer Parts and Accessories
Price Schedule DL78, Effective 1 July 78
212 AMC Parts Price List, Effective 1 Oct 78, No. F94064
213 Ford Price List (Parts and Accessories) for Ford Dealers
Effective 1 May 78, FPS-3636-A
214 Parts and Accessories Price List for Lincoln-Mercury
Dealers, Effective 1 May 78, FPS-4230
215 Honda Parts Price List
216 Buick Electra 225 Parts Book 1976-79 Effective April 1978
Buick Price Book Parts Div.#46 Effect. July 78 Parts Div.#41
217 Cadillac Deville Parts Book 1976-79 Effective July 1978
Cad. Price Book Parts Div.#66 Effect. July 78 Parts Div.#61
218 World Parts 1978 Parts Cat. WP4000-78
219 Chevrolet Parts Book 1976-78 Effective April 1978 Parts Div.#10
Chev. Price Book Parts Div.#16 Effect. July 1978
220 Pontiac Parts Book 1976-78 Effective April 78 Parts Div.#21
Pontiac Price Book Parts Div.#26 Effect. July 78
221 Oldsmobile Parts Book 1976-78 Effective July 78 Parts Div.#31
Oldsmobile Price Book Parts Div.#36 July 78
222 Chrysler Parts Book 1978 81-690-1382 PB-255 March 78
223 Chrysler Parts Book 1977 81-690-1377 PB-252 Feb 78
224 Chrysler Parts Book 1976 81-690-1306 Jan 77
225 Dodge Colt & Plym. Arrow Parts Book 1978-79 81-690-1396
Effective Aug 78
226 Dodge Colt & Plym. Arrow Parts Book 1977-76-81-690-1328
Effective April 77

227 AMC Parts Book 1973-78 Eff. May 78 #F14078R2
228 Honda Parts Book 1973 Y A23007710 Vol.#1
229 Honda Parts Book 1975-76 HC60079 P8145 April 1976
230 Datsun Fiche #C0180U Effective Sept. 1978
231 Toyota Fiche #41123-78 Effective Aug. 1978
232 Volkswagen Fiche #734.010.21 1978-77 Fiche #734.005.21 1976
233 Dodge Truck Parts Book 1978 81-690-1395 PB125 Aug. 1978
234 Chevrolet Truck Parts Book 1973-78 Part Div. #78TL Oct. 1978
235 1977 Ford Maverick Owner's Manual #FPS 365-10677-A
236 1976 Ford Maverick Owner's Manual #FPS 365-10676-A
237 1976 Ford Truck F100-F350 Owner's Manual #FPS 365-10976-A
238 Sears Fall/Winter 1978 Catalog H (prices in catalog)
239 Atlas 1978 Edition-Application Information
Price - NE-E-SE-C-W Regions Effective Aug. 15, 1978
240 World Parts 1978 Catalog WP4000-78
241 World Parts Price - 467D Effective Sept. 15, 1978
242 Ford Car Book
243 Ford Car Fiche FPS 8094-M Sept. 1978
244 Ford Truck Fiche FPS 8095-M Sept. 1978*
245 Ford Truck Book August 1978 *(used to supplement truck fiche)
246 Ford Price - Sept. 1, 1978
247 Lincoln/Mercury Car Fiche FPS 8095-M Sept. 1978
248 Lincoln/Mercury Price - May 1, 1978
249 NAPA Filters Catalog No. CA-01-77 1977
250 NAPA Catalog Supplement CA-03-79 1979
251 NAPA Filter Price List 179-1A March 6, 1978
252 NAPA Champion Plug Catalog No. 5 1978
253 NAPA Water Pumps WP-19A Aug. 1978
254 NAPA Water Pumps Price 1033 WP-1A Nov. 6, 1978
255 NAPA Micro Test Auto Trans. Parts MTT77AT Nov. 1977
256 NAPA Micro Test Auto Trans. Parts Price MTT78-1A Aug. 28, 1978
257 NAPA Quick Reference Auto Cat. #50 July 1978
258 NAPA Quick Reference Truck Cat. #19 May 15, 1978
259 NAPA Brake System Parts BSP-3 Sept. 1978
260 NAPA Brake System Parts Price 293-1A July 10, 1978
261 NAPA Raylock Lined Brake Shoes Price B-RS-278-1A Feb. 11, 1978
262 NAPA Raylock Lined Brake Shoes Price D-BS-776-1A Aug. 28, 1976
263 NAPA Engine Parts EN-M37A June 1978
264 NAPA Engine Parts Price 1046EN-1A Nov. 6, 1978
265 NAPA Perfect Circle Price PL-0202-78A Nov. 6, 1978
266 NAPA Monmouth Bearings Price 783-2 March 20, 1978
267 NAPA Victor Gasket MG-300-78 1978
268 NAPA Victor Gasket Price PL-3003-78A Oct. 2, 1978
269 NAPA Modac Belts and Hoses M77J-A Jan. 3, 1977
270 NAPA Modac Supplement 474-2078-ABS May 1978
271 NAPA Modac Price 474-5130 #1A Sept. 5, 1978
272 NAPA Shocks (Master Catalog) 6214 June 1978
273 NAPA Shocks (Master Catalog) Price #2 Aug. 14, 1978
274 NAPA Echlin #112 April 1978
275 NAPA Echlin Supplement #112A Aug. 1978
276 NAPA Echlin Supplement Price 1078-1A Oct. 16, 1978

277 NAPA Chassis Parts CH-M27-A April 1977
278 NAPA Chassis Parts Supplement CH-M28A March 1978
279 NAPA Chassis Parts Price 1037CH-1A Oct. 30, 1978
280 NAPA Balkamp Service Items BA77AP Dec. 1976
281 NAPA Balkamp Service Items Price BA781AP-2 Sept. 11, 1978
282 NAPA Soundmaster Car DK-78P Nov. 1977
283 NAPA Soundmaster Truck DK78TR Nov. 1977
284 NAPA Soundmaster Price 645-1A July 17, 1978
285 NAPA Fuel Pump (AC) 43A-100 April 1978
286 NAPA Fuel Pump (AC) 43A-30 Nov. 1, 1978
287 AMC Price Book Effective Oct. 78 #F94064
288 Datsun Price Book #N30 Effective Jan. 1978
289 Toyota Price Book Effective Dec. 1978
290 Volkswagen Price Book #W52-008-133-1 Effective Oct. 78
291 Dodge Truck Parts Book 1974-77 81-690 1372 PB125 Jan. 78
292 Dodge Truck Price Book 81-690-1367 Dec. 1977
293 Chevrolet Truck Price Book Parts Div. #16 Effective July 1978
294 NAPA Rayloc Power Steering Pumps PSP878 Aug. 1978
295 NAPA (rebuilt) Rayloc Power Steering Pumps Price PSP-1178-1A Nov78
296 NAPA Rayloc Water Pumps W475 April 1975
297 NAPA Rayloc Water Pumps Price W-878-1A Aug. 12, 1978
298 NAPA Rayloc Fuel Pumps FP-878 Aug. 1978
299 NAPA Rayloc Fuel Pumps Price FP-378-1A March 25, 1978
300 NAPA Cherokee Carburetors 100-04-08 1978
301 NAPA Cherokee Carburetors Price 104-00-12 March 26, 1978
302 NAPA Cherokee Crankshaft Kits 77-1 March 1, 1978
303 NAPA Rogers-Mustang CSR-778-2 July 4, 1978
304 NAPA Garden State Motors (remanufactured engines) 1976
305 NAPA Garden State Motors Price Nov. 13, 1978
306 Chrysler Price Book #816900774 Oct. 1978
307 Sears Import Catalog Series GD
308 Ward's Tabulations of Imported Vehicle Sales, Ward's Automotive Year Book
309 1977 Ward's Automotive Year Book, Pages 106 & 107
310 1978 Ward's Automotive Year Book, Pages 106 & 107
311 1972 Census of Manufacturers - U.S. Dept. of Commerce
312 Hunter Publishing Co., 1975 Service Job Analysis
313 Frost & Sullivan's 1975 Automotive Aftermarket Studies
314 1971 Ward's Automotive Year Book

APPENDIX C

INDUSTRY SPECIALISTS

List of industry specialists contacted for information relating to Task 5.

Engine Rebuilders Association Glenview, IL	M. Templin
A-1 Remanufacturing, Inc. Philadelphia, PA	M. Beretta Product Manager
Federal Mogul Detroit, MI	Bob Sturk, Engineering Barry Schwaub
Specialty Equipment Manufacturers Assoc. Los Angeles, CA	M. Ethridge Kim Nye
ABC Automotive Lansdale, PA	Art Fretz Engineering
APD Automatic Transmission Parts, Inc. Atlanta, GA	David Kitchen
ARC Rebuilders, Inc. Astoria, NY	
Automotive Engine Co. Coos Bay, OR	Les Walker
Atlantic Engine Rebuilding Soute Date, CA	M. Wayne
Automotive Parts Rebuilders, Inc. Denver, CO	A. Kay
Badger Engine Rebuilders, Inc. Madison, WI	Milford Olsen
Beasley Motor Rebuilders Altoona, PA	
Noble Motor Rebuilders Easton, MD	
AAMCO Transmission Bridgeport, PA	Frank Slocum
Cottman Transmission Fort Washington, PA	Jim Corkran Frank Latch, Tech. Spec.
Muskegon Piston Ring Muskegon, MI	Allan Swartz Director of Engineering

Champion Parts Rebuilders Oak Brook, IL	
Speed Craft Enterprises (Toyota + other dealer) Devon, PA	Harry Fenimore
Chester - Mack Toyota Chester, PA	
Automatic Transmission Parts, Inc. Morton Grove, IL	Sam Rogak
Borg Warner Corporation, Auto Parts Div. Franklin Park, IL	Buster Urbach
E.I. DuPont de Nemours and Co. Auto Specialty Products Division Wilmington, DE	
McQuay Norris St. Louis, MO	Phil Wood
Engine Dynamic Parts Corporation Grand Haven, MI	J.A. Markovicz V.P., Sales
Borg Warner Corporation Warner Gear Division	M. Weaver
Cottman Transmission Dealer DeKalb St. Norristown, PA	
Cottman Transmission Dealer McDade Blvd. Folsom, PA	
Ammco Transmission Dealer North Main Street Norristown, PA	
Ammco Transmission Dealer Lancaster Pike Paoli, PA	
Atlantic Transmission Dealer Kensington Ave. Philadelphia, PA	
Kenco Transmission Lancaster Ave. Philadelphia, PA	
Kozak's Transmission Center 9602 Bustleton Ave. Philadelphia, PA	

P.H.&H. - Fleet Management Consultants Baltimore, MD	Wilson Chapman Pat Schmalzer
Chevrolet Engineering Warren, MI	Fleet Service Engineers
Chevrolet Engineering Milford, MI	Fleet Service Engineers
Grappone Toyota Concord, NH	Stan Halinan
H. Holcombe, Owner Bethesda, MD	

APPENDIX D

SCHEDULED MAINTENANCE PACKAGES

Manufacturer	Page
AMC	D-1
Chrysler Corporation	D-5
Datsun	D-18
Ford Motor Company	D-24
General Motors	D-49
Honda	D-72
Toyota	D-78
Volkswagen	D-85

AMC

1979 AMC PACER
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check drive belts
Check carb. idle speed & fast idle

TUNE UP I

Check adjust idle speeds
Check idle mixture
Check choke system
Set ignition timing
Check vacuum fittings hoses
Replace fuel filter
Check drive belts

TUNE UP II

Check/adjust idle speeds
Check idle mixture
Check choke system
Set ignition timing
Check vacuum fittings, hoses & connections
Replace fuel filter
Check drive belts
Replace air cleaner filter
Lubricate heat valve
Clear PCV filter
Replace PCV valve
Replace canister air filter
Replace spark plugs
Inspect A.I.R. hoses
Inspect EGR lines & hoses
Check coil & spark plug wires
Check dist. cap & rotor
Check dist. vacuum & cent. advance
Check transmission controlled spark
Check fuel tank lines and connections
Check thermo controlled air cleaner

SAFETY I

Check spare tire
Check fluid levels

SAFETY II

Lube body
Check brake linings, hoses etc.
Check exhaust system
Check battery

SAFETY III

Check steering and suspension

1978 AMERICAN MOTORS
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust drive belts
Check/adjust idle speed

TUNE UP I

Check air pump hoses
Replace air filter
Check operation of choke linkage
Check spark plug wires
Check distributor advance
Check distributor cap and rotor
Check drive belts
Clean oil filter cap
Replace fuel filter
Check fuel system and lines
Replace charcoal canister filter
Lube exhaust manifold heat riser
Check/Set idle speed and misture
Timing check/set
Check PCV hoses
Replace PCV valve
Replace spark plugs
Check thermostatic air cleaner hoses
Check trans. controlled spark system
Check vacuum fittings, EGR hoses

TUNE UP I

(All) Check drive belts
(All) Replace fuel filter
(V8) Check idle mixture
(V8) Check curb/fast idle
(V8) Check ignition timing

SAFETY I

Inspect front & rear lining
Check adjusting mechanism
Check system for leaks
Check lines, hoses for wear
Check parking brake operation
Check overall brake operation
Check Steering linkage for wear, leaks
Check shocks for wear, leaks, looseners
Check tire condition
Check overall suspensions/steering systems
Lube front disc abutment surfaces
Adjust parking brake
Adjust tire pressure
Adjust clutch free play

1977 AMERICAN MOTORS
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust drive belts
Check/adjust idle speed

EMISSIONS II

Replace fuel filter
Check drive belts

EMISSIONS III

Inspect air pump hoses
Replace air filter
Check choke linkage
Check coil, spark plug wires
Check distributor cap & rotor
Check vacuuming & centrifugal advance
Check drive belts
Clean oil filter cap
Replace fuel filter
Check fuel system tank & line
Replace charcoal canister filter
Lube exhaust manifold heat valve
Check/adjust idle speed and mixture
Check/adjust timing
Check PCV hoses
Replace PCV valve
Replace spark plugs
Check TAC system
Check trans controlled spark system
Check vacuum fittings, EGR hoses

SAFETY I

Inspect brake system
Adjust parking brake
Check brake hoses, lines & connections
Check steering and suspension

1976 AMC
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust idle speeds (curb & fast)
Check/adjust drive belts

EMISSIONS II

Replace fuel filter
Check adjust drive belts

EMISSIONS III

Inspect air pump system
Replace air filter
Check choke linkage
Check coil & spark plug wires
Check distributor advances
Check distributor cap and rotor
Check drive belts
Clean engine oil cap
Replace fuel filter
Check fuel system tank and lines
Replace charcoal canister & filter
Lube exhaust manifold heat valve
Check and set idle speed and mixture
Check/adjust timing
Clean PCV hoses
Replace PCV valve
Replace spark plugs
Check thermostatic air cleaner
Check trans. controlled spark
Check vacuum fittings & EGR hoses

SAFETY I

Inspect brake linings
Check hoses, lines & fittings
Adjust parking brake
Check steering gear linkage

CHRYSLER CORPORATION

1979 CHRYSLER NEWPORT & PLYMOUTH VOLARE
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Lube choke shaft
Lube fast idle cam

EMISSIONS II

Check idle speed & mixture
Check rubber and plastic components
Adjust lifters (6 cylinder)

EMISSIONS III

Check PCV valve

EMISSIONS IV

Check automatic choke
Replace auto choke
Clean crankcase air cleaner
Replace fuel filter
Check ignition cables
Lube heat control valve
Replace PCV valve
Replace spark plugs
Replace canister filter

SAFETY I

Inspect drive belts
Check cooling system

SAFETY II

Inspect brake linings
Lube ball joints, steering linkage, & tie rods

1978 CHRYSLER CORPORATION
SCHEDULED MAINTENANCE PACKAGES
1978 NEWPORT, VOLARE, FURY

EMISSIONS I

Lube carb choke shaft
Lube fast idle cam

EMISSIONS II

Check cooling system
Check/adjust valves (6 cyl)
Check emissions hoses
Adjust idle mixture

EMISSIONS III

Check PCV valve

EMISSIONS IV

Check auto choke
Replace air filter
Check/clean EGR filter
Replace fuel filter
Check ignition cables
Check manifold heat control valve
Replace PCV valve
Replace charcoal canister filter
Replace spark plugs

SAFETY I

Check exhaust system
Check brake fluid level
Check power steering hoses and brake hoses
Check suspension & steering system
Check in-joints

SAFETY II

Check brake lining

1977 CHRYSLER CORPORATION
SCHEDULED MAINTENANCE PACKAGES
1977 NEWPORT, FURY, VOLARE

EMISSIONS I

Lube carb choke shaft
Lube fast idle cam

EMISSIONS II

Check cooling system
Adjust valves (6 cyl)
Check emission hoses
Adjust idle mixture

EMISSIONS III

Check PCV valve

EMISSIONS IV

Check auto choke
Replace air filter
Clean crankcase filter
Replace fuel filter
Check ignition wires
Check manifold heat valve
Replace P.C.V. valve
Replace spark plugs
Replace charcoal canister filter

SAFETY I

Check brake fluid level
Check brake and power steering hoses
Check exhaust system

SAFETY II

Check brake linings

1976 CHRYSLER CORPORATION
SCHEDULED MAINTENANCE PACKAGES
1976 NEWPORT, FURY, VOLARE

EMISSIONS I

Lube carb choke shaft
Lube fast idle cam

EMISSIONS II

Check cooling system

EMISSIONS III

Adjust valves (6 cyl)
Check emission hoses
Replace charcoal canister filter
Adjust idle mixture
Check PCV valve

EMISSIONS IV

Check auto choke
Replace air filter
Clean crankcase filter
Replace fuel filter
Check ignition cables
Check manifold heat valve
Replace PCV valve
Replace spark plugs

SAFETY I

Exhaust system check
Check brake fluid level
Check brake & power steering hoses

SAFETY II

Check brake linings

1979 DODGE COLT
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Retorque head bolts
Check valve clearance
Check idle speed & mixture
Check ignition timing
Check drive belts

EMISSIONS II

Torque head bolts
Check valve clearance
Check idle speed and mixture
Check ignition timing
Replace points and condenser
Lube distributor parts
Replace spark plugs
Check distributor cap and rotor
Retorque exhaust manifold bolts
Check choke linkage
Replace fuel filter
Check crankcase emission control system
Check air intake valves
Check evaporative control system
Check cooling system
Check rubber and plastic component
Check fuel cut off system

EMISSIONS III

Check drive belts
Check air filter

EMISSIONS IV

Replace air filter
Check fuel system
Replace canister

SAFETY I

Check master cylinder
Check brake hoses
Check brake pads
Check rear brake linings
Check steering gear
Adjust clutch
Check trans and rear axle fluids
Check exhaust system
Check ball joints and steering linkage
Lube hinges
Lube hood cables and latches
Rotate tires

1978 DODGE COLT
SCHEDULED MAINTENANCE PACKAGES

EMISSION I

Check drive belts

EMISSIONS II

Check valve clearance
Check timing & dwell
Check idle speed & dash pot
Adjust idel mixture
Torque cylinder head bolts

EMISSIONS III

Torque exhaust manifold bolts
Check choke mechanism
Replace fuel filter
Check heated air intake valve
Replace points & condenser
Replace spark plugs
Check ignition wiring
Check distributor cap & rotor
Check crankcase ventilation system
Check ECS system
Check secondary air system
Check EGR system
Check cooling system
Check rubber & plastic components
Clean/change air filter

EMISSIONS IV

Clean air filter

EMISSIONS V

Check fuel system
Replace air filter
Replace ECS canister

SAFETY I

Check exhaust system
Check steering free-play
Check parking brake
Check hoses
Check brake disc pads
Check master cylinder
Check ball joint & steering linkage

1977 DODGE COLT
SCHEDULED MAINTENANCE PACKAGES

EMISSION I

Check drive belts

EMISSIONS II

Check valve clearance
Check timing and dwell
Check idle speed & dashpot
Adjust idle muxture
Torque cylinder head bolts

EMISSIONS III

Torque exhaust manifold bolts
Check choke mechanism
Replace fuel filter
Check heared air intake
Replace points and condenser
Replace spark plugs
Check ignition wiring
Check distributor cap & rotot
Check crankcase vent system
Check ECS system
Check EGR system
Check cooling system
Check rubber & plastic components

EMISSIONS IV

Clean air cleaner

EMISSIONS V

Check fuel system for leaks
Replace air filter
Replace ECS canister

SAFETY I

Check exhaust system
Check steering system free play
Check parking brake
Check brake hoses, pads & master cylinder
Check ball joints & steering linkage

SAFETY II

Check rear brake lining & cylinders
Replace master cylinder fluid

1976 DODGE COLT
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check drive belts
Check valve clearance
Check timing & dwell
Check idle speed & dashpot
Adjust idle mixture
Torque cylinder head bolts

EMISSIONS II

Torque thermal reactor bolts
Torque exhaust manifold bolts
Check choke mechanism
Replace fuel filter
Check heated air intake valve
Replace points and condenser
Replace spark plugs
Check ignition wiring
Check distributor cap and rotor
Check crankcase ventilation system
Check ECS system
Check secondary air system
Check EGR system
Check cooling system
Check rubber & plastic components

EMISSIONS III

Clean air cleaner

EMISSIONS IV

Check fuel system for leaks
Replace air filter
Change ECS canister

SAFETY I

Check exhaust system
Check steering free play (1)
Check parking brake

SAFETY II

Check brake hose
Check disc brake pad
Check master cylinder

SAFETY III

Check rear brake lining & cylinders

1979 DODGE VAN
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Lube choke shaft
Lube fast idle cam

EMISSIONS II

Check cooling system
Check/adjust idle speed
Inspect fuel system rubber and plastic parts

EMISSIONS III

Check/adjust auto. choke
Replace air cleaner
Replace fuel filter
Check ignition system
Lube manifold heat control valve
Replace PCV valve
Replace spark plugs
Replace vapor canister filter

EMISSIONS IV

Check PCV valve

SAFETY I

Lube steering linkage
Lube u-joints & slip joints
Lube front suspension
Check front wheel bearings
Inspect brake linings

1978-1977 DODGE VAN
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Lube choke shaft
Check cooling system
Lube fast idle cam
Check PCV valve & hoses
Check crankcase inlet air filter
Clean air filter

EMISSIONS II

Adjust ignition timing
Check automatic choke
Replace fuel filter
Check valves
Check emissions hoses
Replace charcoal canister filter
Check drive belts
Replace spark plugs
Lube manifold heat valve
Check ignition system
Check idle speed/mixture

EMISSIONS III

Replace air filter
Replace PCV valve

SAFETY I

Check master cylinder fluid level
Check steering linkage, ball joints
Check power steering fluid level
Clean brake pedal linkage
Lube parking brake lever

SAFETY II

Check brake hoses
Lube throttle linkage

1976 DODGE VAN
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Lube idle cam
Check emissions hoses

EMISSIONS II

Check crankcase inlet air filter

EMISSIONS III

Check PCV valve & hoses
Clean air filter

EMISSIONS IV

Adjust ignition timing
Check automatic choke
Replace fuel filter
Check idle speed/mixture
Check ignition system
Lube manifold heat valve
Replace spark plugs
Check drive belts

EMISSIONS V

Replace air cleaner
Replace PCV valve

SAFETY I

Lube power brake hub & bell crank
Check level in master cylinder
Check steering linkage and ball joints
Check power steering fluid levels

SAFETY II

Check brake linings

1979 PLYMOUTH HORIZON
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Lube choke shaft
Lube fast idle cam

EMISSIONS II

Check automatic choke
Check idle mixture & speed
Check ignition wires
Check ignition timing
Replace spark plugs
Check rubber & plastic hoses

EMISSIONS III

Replace air filter
Replace PCV valve

EMISSIONS IV

Check PCV valve
Check valve lash

SAFETY I

Check drive belts

SAFETY II

Check front brakes
Check cooling system

SAFETY III

Check rear brakes
Lube tie rods & linkage

1978 PLYMOUTH HORIZON
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check drive belts
Lube carb choke shaft
Lube fast idle cam & pivot pin

EMISSIONS II

Check automatic choke
Check idle speed & mixture
Check ignition timing
Replace spark plugs
Check ignition cables
Check valve lock
Check emission hoses

EMISSIONS III

Replace PCV valve
Replace air filter

EMISSIONS IV

Check PCV
Check cooling system

SAFETY I

Check steering linkage & universal joint seals
Check exhaust system
Check master cylinder level
Check brake and power steering hoses
Lube hood lock safety catch
Check power steering level

SAFETY II

Check brake linings

DATSUN

1979 DATSUN 210
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Adjust valve clearance
Adjust drive belts
Adjust idle speed
Adjust idle mixture
Check fuel shut-off system w/cat. conv.

EMISSION II

Check cooling system hoses
Check vacuum hoses
Adjust choke mechanism
Check air cleaner automatic temperature control
Adjust ignition timing
Replace spark plugs
Inspect ignition wiring

EMISSIONS III

Inspect ventilation hoses
Inspect vapor lines
Inspect fuel relief valve

SAFETY I

Inspect steering gear box, linkage and suspension

SAFETY II

Check fluid levels
Check disc brake pads, lube locks, hinges, and hood locks
Inspect foot brake, parking brake and clutch

SAFETY III

Inspect brake linings and components
Inspect seat belts and components

SAFETY IV

Inspect brake booster hoses & valve

1979 DATSUN 310
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Adjust valve clearance
Adjust drive belts
Check/adjust idle speed
Check/adjust idle mixture

EMISSIONS II

Adjust valve clearance
Inspect drive belts
Check cooling system hoses & connections
Check vacuum hoses & connections
Check/adjust engine idle speed
Check/adjust idle mixture
Adjust choke mechanism
Check air cleaner automatic temperature control
Adjust ignition timing
Replace spark plug
Check ignition wires

EMISSIONS III

Replace fuel filter
Check fuel lines, connections & hoses
Replace air filter
Replace AIR pump air cleaner
Replace PCV filter and valve
Check ventilation hoses
Check vapor lines
Check fuel tank vacuum valve
Replace carbon canister filter

SAFETY I

Check steering box, linkage, suspension and drive shaft

SAFETY II

Check fluid levels, brake, clutch, steering
Check disc brake pads
Check foot brake, parking brake, and clutch free play
Lube locks, hinges & hood latches

1979 DATSUN 310

SAFETY III

Replace brake fluid
Check drum brake linings
Check steering box, linkgage, suspension & drive shaft
Check seat bolts

SAFETY IV

Check brake vacuum booster hoses and connectors
Replace transmission oil

1978 DATSUN B-210
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Adjust valves
Check/adjust drive belts
Adjust curb idle and mixture
Check fuel shut off

EMISSIONS II

Check cooling system
Check fittings & hoses
Adjust choke
Check air cleaner temp. control
Replace spark plugs
Adjust timing
Check ignition wires

EMISSIONS III

Check fuel lines
Check vent hoses
Check vapor lines
Check relief valve

SAFETY I

Check steering and suspension

SAFETY II

Check fluids
Check brake hose & clutch linkage
Check fornt disc pads
Check operation of foot brakes and parking brake

SAFETY III

Check rear brakes and components

1977 DATSUN B-210
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Adjust valves
Check drive belts
Adjust idle mixture & speed
Adjust choke
Adjust throttle opener
Check fuel shut off valve

EMISSIONS II

Check fuel tank vacuum relief valve
Check fuel lines

EMISSIONS III

Check cooling system
Check vacuum fitting hoses
Check air cleaner auto. temperature control
Adjust timing
Replace ignition points
Replace spark plugs
Check distributor cap, rotor, condenser
Check vapor lines

EMISSIONS IV

Check ignition wiring
Check vacuum switching valve
Check ventilation hoses

SAFETY I

Check steering linkage

SAFETY II

Check front disc pads
Check parking brake
Check brake & clutch operation
Check fuel & exhaust system

SAFETY III

Check drums & linings

1976 DATSUN B-210
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Adjust valves
Check drive belts
Adjust idle mixture & speed
Adjust choke
Check throttle opener

EMISSIONS II

Check fuel lines
Check fuel tank vacuum relief valve

EMISSIONS III

Check cooling system
Check vacuum fittings
Check air cleaner auto. temp control
Adjust timing
Replace points
Replace spark plugs
Check distributor cap, rotor, and condenser
Check EGR system
Check vapor lines
Check EGR warning system

EMISSIONS IV

Check ignition wiring
Check vacuum switching valve
Change spark delay valve
Check ventilation hoses

SAFETY I

Check steering linkage

SAFETY II

Check disc brake pads
Check parking brake
Check brake and clutch operation
Check fuel & exhaust system
Check clutch free play

SAFETY III

Check drums & linings

FORD MOTOR COMPANY

1979 FORD FAIRMONT, GRANADA
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check idle speed

EMISSIONS II

Check drive belts
Replace spark plugs
Check thermactor valve
Check choke system

EMISSIONS III

Replace PCV
Check idle mixture

SAFETY I

Inspect exhaust system & shields
Inspect brake linings, hoses & lines
Lube front suspension and steering linkage
Check master cylinder level

1978 FORD FAIRMONT, PINTO, MUSTANG II
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check idle speeds

EMISSIONS II

Replace spark plugs
Check drive belts
Replace PCV valve
Check idle mixture
Check choke system
Check thermactor delay valve

EMISSIONS III

Replace crankcase filter
Replace air filter

SAFETY I

Check exhaust system heat shields
Tube steering linkage
Check brake lining, lines & hoses
Check master cylinder fluid level

1979 FORD FIESTA
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check drive belt
Check curb & fast idle speed

EMISSIONS II

Check valve clearance
Check drive belt
Replace spark plugs
Clean curb and fast idle speeds
Check choke
Check thermactor delay valve

EMISSIONS III

Replace carb. air cleaner
Replace crankcase emissions filter

1978 FORD FIESTA SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Fast idle, adjust
Check drive belt
Check valve clearance
Check curb idle

EMISSIONS II

Replace spark plugs
Clean PCV valve
Check carb bowl vent
Check choke system

EMISSIONS III

Replace carb. air cleaner
Replace crankcase emission filter

SAFETY I

Check brake linings
Lube parking brake cables

SAFETY II

Check brake lines & hoses

1979 FORD F100
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check idle speed

EMISSIONS II

Replace spark plugs
Check drive belts
Replace PCV valve
Check idle mixture
Check choke system
Check thermactor valve
Check and lube heat valve

SAFETY I

Lube slip yoke
Lube front axle pins
Inspect & lube clutch linkage
Lube steering linkage

SAFETY II

Inspect exhaust heat shield
Inspect brake linings
Inspect disc brake pads, rotors, calipers
Check master cylinder fluid level

1978 FORD F-100 SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check engine idle speed

EMISSIONS II

Replace spark plugs
Check drive belts
Replace PCV valve
Check full idle misture
Check choke system
Check thermactor delay valve

EMISSIONS III

Replace carb. air cleaner
Replace crankcase filter
Check/Lube exhaust heat valve

SAFETY I

Lube u-joints & slip yoke
Lube front axle spindles
Inspect & lube clutch lingings
Lube steering linkings

SAFETY II

Inspect exhaust system heat shields
Inspect drum brake linings, lines & hoses
Inspect disc brake pads, line & hoses
Check master cylinder fluid level

1977 FORD F-100 SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust fast idle
Check/adjust TSP off-speed
Check ignition timing

EMISSIONS II

Check idle speed

EMISSIONS III

Replace spark plugs
Check drive belts
Check idle mixture
Check choke system
Check thermactor delay valve

EMISSIONS IV

Check fuel vapor system
Check air cleaner temp. control

SAFETY I

Inspect exhaust system
Inspect clutch linkages

SAFETY II

Check master cylinder fluid level
Inspect disc pads, rotors calipers
Inspect drums, linings, lines & connections

1976 FORD F-100 SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check ignition timing
Check TSP off-speed

EMISSIONS II

Check idle speed (curb)
Check idle speed (fast)

EMISSIONS III

Replace spark plugs
Check drive belts
Replace PCV valve
Check idle mixture
Check choke system
Replace air cleaner
Replace crankcase emissions filter
Check thermactor delay valve
Check air cleaner temp. control
Check fuel vapor system
Lube exhaust control valve
Check spark plug wires
Check distributor cap
Check spark control delay valve
Check PCV system hoses & tubes
Check evaporation Emission control

SAFETY I

Inspect exhaust system

SAFETY II

Check master cylinder fluid level

SAFETY III

Inspect disc, pads, rotors, & calipers
Inspect drums, lining, lines, & connections

1979 FORD TRUCK E150, F150, F250
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust fast idle
Check/adjust curb idle

EMISSIONS II

Replace spark plugs
Check fuel mixture
Check drive belts
Replace PCV valve
Check choke system
Check thermactor valve

SAFETY I

Lube u-joints & slip yoke
Lube front axle pins
Lube steering linkage

SAFETY II

Check master cylinder
Inspect exhaust system
Inspect disc brake pads, rotors
piston boots and calipers
Inspect brake linings, lines and hoses

1978 FORD E-150
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check timing
Check TSP off speed

EMISSIONS II

Adjust curb idle speed
Check decelerator throttle control

EMISSIONS III

Adjust fast idle speed

EMISSIONS IV

Replace spark plugs
Lube exhaust control valve
Check drive belts
Check choke system
Check air cleaner temp control
Check thermactor system
Clean crankcase breather cap
Check EGR system
Clean & check PCV hoses & tubes

EMISSIONS V

Replace PCV valve
Check fuel vapor system
Replace crankcase filter
Replace carb air cleaner

SAFETY I

Check exhaust system shields, fasteners
Check master cylinder fluid level
Check disc brake linings, rotor, calipers
Check drums, brakes, lining, lines & hoses

1977 FORD E-150 SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check ignition timing
Check TSP off-speed

EMISSIONS II

Adjust idle speed curb
Check decelerator control

EMISSIONS III

Clean & check P.C.V. hoses & tubes
Replace spark plugs
Lube exhaust control valve
Check drive belts
Check choke system
Check air cleaner temperature control
Check thermactor system
Clean crankcase breather cap
Check EGR system

EMISSIONS IV

Replace PCV valve
Replace crankcase filter
Check fuel vapor system
Replace carb air filter

SAFETY I

Check exhaust system heat shields

SAFETY II

Check master cylinder fluid level
Check disc pads, rotors, calipters
Check drums, linings, lines & hoses

1976 FORD E-150
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check TSP off-speed

EMISSIONS II

Adjust curb idle speed
Check vacuum throttle position
Adjust fast idle speed

EMISSIONS III

Replace spark plugs
Lube exhaust control valve
Check drive belts
Check choke system
Check air cleaner temp. control
Check thermactor system
clean crankcase breather cap
Check EGR system
Lube distributor shaft bushing
Check ignition system
Check spark plug wires
Check distributor cap and rotor
Check idle mixture
Check ignition timing

EMISSIONS IV

Check carb. air cleaner
Check PCV system hoses & tubes

EMISSIONS V

Replace PCV valve
Check fuel vapor system
Replace crankcase filter
Replace carb. air cleaner

SAFETY I

Check exhaust system heat shields
Check disc pads, rotors & calipers

SAFETY II

Check drums, linings, lines & hoses

1977 FORD SCHEDULED MAINTENANCE PACKAGES

F150/F250 LIGHT DUTY TRUCK
HEAVY DUTY SCHEDULE

EMISSIONS I

Check TSP off-speed
Check ignition timing

EMISSIONS II

Check curb idle speed
Check decelerator throttle control system

EMISSIONS III

Check fast idle speed

EMISSIONS IV

Replace spark plugs
Lube exhaust control valve
Check drive belts
Check choke system
Check air cleaner temperature control
Check thermactor system
Clean crankcase breather
Clean EGR system
Check PCV hoses & tubes

EMISSIONS V

Replace PCV valve
Replace air cleaner
Replace crankcase filter
Inspect fuel vapor system
Clean PCV hoses & tubes

SAFETY I

Check exhaust system shields & fasteners

SAFETY II

Check master cylinder fluid level
Check disc brake lining, rotors, calipers
Check drum linings, lines, hoses

1976 FORD SCHEDULED MAINTENANCE PACKAGES
F150/F250 LIGHT DUTY TRUCK
HEAVY DUTY SCHEDULE

EMISSIONS I

Check TSP off-speed

EMISSIONS II

Check vacuum throttle positioner
Check curb idle speed
Check fast idle speed

EMISSIONS III

Change spark plugs
Lube exhaust control valve
Check drive belts
Check choke system
Check air cleaner temp. control
Check Thermactor system
Check ignition timing
Clean crankcase breather cap
Clean EGR system
Lube distributor shaft bushing
Check spark plug wires
Check distributor cap & rotor
Check idle mixture

EMISSIONS IV

Clean carburetor air cleaner
Check PCV system hoses & tubes

EMISSIONS V

Replace PCV valve
Replace air cleaner
Replace crankcase tubes
Inspect fuel vapor system
Clean PCV hoses & tubes

SAFETY I

Check exhaust system shields
Check disc brake linings, rotors & calipers

1979 FORD LTD
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check idle speed

EMISSIONS II

Replace spark plugs
Check drive belts
Check choke system
Check thermactor delay valve

EMISSIONS III

Replace PCV valve
Check idle fuel mixture
Check idle speed

SAFETY I

Inspect exhaust heat shield
Inspect brake lining, hoses & lines
Lube front suspension & steering linkage
Check brake master cylinder fluid level

1978 FORD LTD SCHEDULED MAINTENANCE PACKAGES

F150/250
HEAVY DUTY SCHEDULE

EMISSIONS I - 6,000 Miles

Check TSP off-speed
Check ignition timing

EMISSIONS II - 6,000/15,000 Miles

Check curb idle speed
Check decelerator throttle control system

EMISSIONS III

Check fast idle speed

EMISSIONS IV - 15,000 Miles

Replace spark plugs
Tube exhaust control valve
Check drive belts
Check choke system
Check air cleaner temperature control
Check thermactor system
Clean crankcase breather cap
Clean EGR system
Check PCV valve & hoses

EMISSIONS V - 30,000 Miles

Replace PCV valve
Replace carburetor air cleaner
Replace crankcase filter
Inspect vapor system
Clean PCV system hoses & tubes

SAFETY I

Check exhaust system shields
Check brake Master Cylinder fluid level
Check disc brake lining, rotor, caliper
Check drum brake linings lines, hoses

1979 FORD MUSTANG TURBO
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust curb idle

EMISSIONS II

Check drive belts
Check thermactor delay valve
Replace spark plugs
Check choke system

SAFETY I

Inspect exhaust system & heat shields
Inspect brake linings hoses and lines
Lube front suspension & steering linkage
Check master cylinder fluid level

1979 FORD PINTO & MUSTANG
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check idle speeds

EMISSIONS II

Replace spark plugs
Check drive belt condition & tension
Check choke system
Check thermactor delay valve

SAFETY I

Inspect exhaust shields & systems
Inspect brake linings, lines & hoses
Lube front suspension & steering linkage
Check master cylinder fluid level

1976 FORD PINTO, MUSTANG II
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check timing
Adjust TSP off speed

EMISSIONS II

Check fast idle speed
Check curb idle speed
Check/adjust fuel deceleration valve

EMISSIONS III

Replace fuel filter

EMISSIONS IV

Check spark delay valve
Check distributor cap
Check spark plug wires
Check charcoal canister
Check & celan PCV system hose & tubes
Replace PCV valve
Check/lube exhaust control valve
Check fuel vapor system
Check air cleaner temperature control
Check thermactor delay valve
Replace crankcase filter
Replace carburetor air filter
Check choke system
Check idle fuel mixture
Check drive belts
Replace spark plugs

SAFETY I

Check exhaust system heat shields

SAFETY II

Tube steering linkage
Check brake linings, lines & hoses
Check Master Cylinder fluid level

1979 FORD THUNDERBIRD, LTD II
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check idle speed

EMISSIONS II

Replace spark plugs
Check drive belts
Check choke system
Check thermactor delay valve

EMISSIONS III

Check idle speed
Check idle fuel mixture
Replace PCV valve

SAFETY I

Inspect exhaust system & heat shields
Inspect brake linings, hoses & lines
Lube front suspension & steering linkage
Check master cylinder fluid level

1978 FORD SCHEDULED MAINTENANCE PACKAGES

GRANADA, LINCOLN VERSAILLES, LINCOLN CONTINENTAL,

LTD, LTD II, THUNDERBIRD

EMISSIONS I

Check idle speed

EMISSIONS II

Replace spark plugs
Check drive belts
Adjust idle mixture (fast)
Check choke system
Check thermactor delay valve

SAFETY I

Check exhaust system heat shields
Check brake linings, lines & hoses
Check fluid in Master Cylinder
Tube steering linkage

1977 FORD SCHEDULED MAINTENANCE PACKAGES

GRANADA, LTD, LTD II, THUNDERBIRD, VERSAILLES, LINCOLN CONTINENTAL, TORINO, MAVERICK

EMISSIONS I

Check initial timing
Check TSP off-speed
Check idle speed (fast)

EMISSIONS II

Check curb idle speed

EMISSIONS III

Check thermactor delay valve
Check ckoke system
Adjust fast idle mixture
Check drive belts
Replace spark plugs

EMISSIONS IV

Check fuel vapor system
Check air cleaner temperature control

SAFETY I

Check exhaust system heat shield

SAFETY II

Check Master Cylinder fluid level
Check brake linings, lines & hoses
Lubricate steering linkage

1976 FORD SCHEDULED MAINTENANCE PACKAGES

GRANADA, LTD, LTD II, THUNDERBIRD, TORINO,
LINCOLN CONTINENTAL, MAVERICK

EMISSIONS I

Check initial timing
Check TSP off-speed

EMISSIONS II

Check curb idle speed
Check idle speed (fast)

EMISSIONS III

Replace spark plugs
Check drive belts
Replace PCV valve
Adjust idle mixture
Check choke system
Replace air cleaner
Replace crankcase filter
Check thermactor delay valve
Check air cleaner temperature control
Check fuel vapor system
Tube exhaust manifold control valve
Check PCV/system
Clean PCV hoses & tubes
Check charcoal canister
Check spark plug wires
Check distributor cap
Check spark delay valve

SAFETY I

Check exhaust heat shields

SAFETY II

Tube steering linkage
Check brake linings, lines & hoses
Check fluid level in Master Cylinder

1979 LINCOLN CONTINENTAL
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust idle speed

EMISSIONS II

Check drive belts
Replace spark plugs
Replace PCV valve
Check idle mixture & speed
Check choke

SAFETY I

Inspect exhaust system & heat shields
Inspect brake linings, lines and hoses
Lube front suspension
Lube steering linkage
Check master cylinder

1979 LINCOLN VERSAILLES
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check idle speed

EMISSIONS II

Replace spark plugs
Check drive belts
Replace PCV valve
Check idle mixture
Check choke
Check thermactor delay valve

SAFETY I

Inspect exhaust system and heat shields
Inspect brake lining, lines and hoses
Lube front suspension and steering linkage
Check brake master cylinder

GENERAL MOTORS

SCHEDULED MAINTENANCE PACKAGES
1978 GENERAL MOTORS SCHEDULE I

1978 CHEVROLET, CHEVETTE, MONZA, OLDSMOBILE,
PONTIAC, CHEVROLET LIGHT TRUCK

EMISSIONS I - 7,500/22,500 Miles

Check carburetor choke
Check thermostatic controlled air cleaner
Adjust idle speed
Check fuel evaporation system
Torque carburetor mounting
Check vacuum advance

EMISSIONS II - 15,000 Miles

Replace fuel filter
Check PCV system

EMISSIONS III - 22,500 Miles

Check spark plug wires
Check idle stop solenoid/dashpot
Check timing & distributor
Adjust vacuum break
Replace spark plugs (except 6 cylinder)
Check differential vacuum delay & separator valve

EMISSIONS IV - 30,000 Miles

Replace PCV
Replace air cleaner (except 4 cylinder)
Replace charcoal canister filter
Check fuel tank and lines

SAFETY I

Check tires & wheels
Check disc brakes & power steering
Check exhaust system
Check suspension, steering

SAFETY II

Check drive belts
Check drum brakes and parking brake
Check/flush underbody
Check bumper
Check throttle linkage

SCHEDULED MAINTENANCE PACKAGES
1977 GENERAL MOTORS SCHEDULE I

CHEVROLET, CHEVETTE, MONZA, CHEVROLET LIGHT TRUCK,
OLDSMOBILE, BUICK, PONTIAC

EMISSIONS I - 7,500/22,500 Miles

Check carburetor choke
Check thermostatic controlled air cleaner
Adjust idle speed
Check fuel evaporation system
Torque carburetor mounting
Check vacuum advance

EMISSIONS II - 15,000 Miles

Replace fuel filter
Check PCV system

EMISSIONS III - 22,500 Miles

Check spark plug wires
Check idle stop solenoid
Check timing and distributor
Adjust vacuum break
Replace spark plugs (except L-6)

EMISSIONS IV

Replace PCV valve
Replace air cleaner
Replace charcoal canister filter

SAFETY I

Check disc brakes, tires and wheel
Check exhaust system
Check suspension, steering
Check brake & power steering hoses & belts
Check fluid levels

SAFETY II

Check drive belts
Check drum & parking brake
Check throttle linkage
Check and flush underbody
Check bumper

SCHEDULED MAINTENANCE PACKAGES
1976 GENERAL MOTORS SCHEDULE I

CHEVROLET, CHEVETTE, MONZA, CHEVROLET LIGHT TRUCK,
OLDSMOBILE, BUICK, PONTIAC

EMISSIONS I - 7,500/22,500 Miles

Check carburetor choke
Check thermostatic controlled air cleaner
Adjust idle speed
Check fuel evaporation system
Torque carburetor mounting
Check vacuum advance

EMISSIONS II - 15,000 Miles

Replace fuel filter
Check PCV system

EMISSIONS III - 22,500 Miles

Check spark plug wires
Check idle stop solenoid/dashpot
Check timing and distributor
Replace spark plugs
Check differential vacuum delay and separator valve

EMISSIONS IV - 30,000 Miles

Replace PCV valve and filter
Replace air cleaner (except 4 cylinder)
Replace charcoal canister filter
Check fuel cap, tank and lines

SAFETY I

Check tires, wheels and disc brakes
Chekc exhaust system
Check suspension and steering
Check brake & power steering hoses
Check fluid levels
Check drive belts

SAFETY II

Check drum and parking brakes
Check throttle linkage
Flush underbody
Check bumper

SCHEDULED MAINTENANCE PACKAGES
1978 GENERAL MOTORS SCHEDULE II

EMISSIONS I -7,500/30,000 Miles

Check carburetor choke
Check thermostatically controlled air cleaner
Adjust idle speed
Check fuel evaporation system
Torque carburetor mounting

EMISSIONS II - 15, 000 Miles

Check vacuum advance
Replace fuel filter
Check PCV sysyem
Check spark plug wires
Replace PCV valve and filter

EMISSIONS III - 30,000 Miles

Check idle speed solenoid and dashpot
Check distributor and timing
Adjust vacuum break
Replace spark plug
Replace air cleaner
Replace charcoal canister
Check fuel cap, tank and lines
Check differential delay and separator valve

SAFETY I

Check tires, wheels, disc brake
Check exhaust system
Check suspension, steering
Check brake and power steering systems
Check fluid levels

SAFETY II

Check drum and parking brakes
Check drive belts
Check throttle linkage
Check/flush underbody
Check bumper

SCHEDULED MAINTENANCE PACKAGES
1977 GENERAL MOTORS SCHEDULE II

EMISSIONS I - 7,500/30,000 Miles

Check carburetor choke
Check thermostatically controlled air cleaner
Adjust idle speed
Check fuel evaporation system
Torque carburetor mounting

EMISSIONS II - 15,000 Miles

Check vacuum advance
Replace fuel filter
Check PCV system
Check spark plug wires

EMISSIONS III - 30,000 Miles

Replace PCV valve and filter
Check idle stop solenoid/dashpot
Check timing and distributor
Adjust vacuum break
Replace spark plugs
Replace air cleaner
Replace charcoal canister filter
Check fuel cap, tank and lines
Check differential delay and separator valve

SAFETY I

Check tires, wheels, disc brakes
Check exhaust system
Check suspension, steering
Check brake and power steering system
Check fluid levels

SAFETY II

Check drum and parking brakes
Check drive belts
Check throttle linkage
Check/flush underbody
Check bumper

SCHEDULED MAINTENANCE PACKAGES
1976 GENERAL MOTORS SCHEDULE II

EMISSIONS I - 7,500/30,000 Miles

Check carburetor choke
Check thermostatically controlled air cleaner
Check adjust idle speed
Check fuel evaporative system
Torque carburetor mounting

EMISSIONS II

Check vacuum advance
Replace fuel filter
Check PCV system

EMISSIONS III

Replace PCV valve
Check PCV valve
Check idle stop solenoid/dashpot
Check timing & distributor
Replace spark plugs
Replace air cleaner
Replace charcoal canister filter
Check fuel cap, tank and lines

SAFETY I

Check tires, wheels, disc brakes
Check exhaust system
Check suspension, steering
Check brake and power steering system
Check fluid levels

SAFETY II

Check drum and parking brakes
Check drive belts
Check throttle linkage
Check/flush underbody
Check bumper

1979 BUICK ELECTRA 225 & REGAL TURBO
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo. controlled air cleaner
Adjust idle speed
Check EFE system (evaporation)
Torque carb. mounting

EMISSIONS II

Check choke & hoses

EMISSIONS III

Check vacuum advance system
Replace fuel filter
Check PCV system
Check spark plug wires
Oxygen sensors

EMISSIONS IV

Service & Replace PCV valve & filter
Check idle solenoid dashpot
Replace spark plug
Check timing & vacuum break
Replace ESC filter
Check fuel cap tank & lines
Replace air filter

SAFETY I

Check tires, wheels and disc brake system
Check exhaust system
Check suspension & steering
Check brakes and power steering

SAFETY II

Check drive belts
Check drum brakes
Check throttle linkage
Check bumper

1979 CADILLAC EXCEPT SEVILLE
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo controlled air cleaner
Check choke
Check/adjust carb. idle speed
Check EFE system
Check carb. or EFI body and torque
Check vacuum advance system and hoses

EMISSIONS II

Check fuel tank lines and cap

EMISSIONS III

Replace fuel filter
Check PCV system
Check fuel tank lines and cap

EMISSIONS IV

Check spark plug wires
Replace spark plugs
Check/adjust engine timing & dist.

EMISSIONS V

Replace PCV valve
Replace PCV filter
Check ECS system and replace filter

SAFETY I

Check tires, wheels and disc brakes
Check exhaust system
Check steering and suspension
Check brake and power steering

SAFETY II

Check drive belts
Check drum and parking brake
Check throttle linkage
Check bumper

SCHEDULED MAINTENANCE PACKAGES
1978-1976 GENERAL MOTORS SCHEDULE I

CADILLAC de VILLE

EMISSIONS I - 7,500 Miles

Check exhaust system

EMISSIONS II - 7,500/22,500 Miles

Check thermostatic controlled air cleaner
Check carburetor choke system
Check/adjust idle speed
Check EFE system
Torque carburetor mountings
Check vacuum advance system

EMISSIONS III - 15,000 Miles

Replace fuel filter
Check PCV system, service filter
Check drive belts

EMISSIONS IV - 22,500 Miles

Check spark plug wires
Replace spark plugs
Adjust timing, check distributor

EMISSIONS V - 30,000 Miles

Replace PCV valve
Replace air cleaner
Check ECS system, replace filter
Check fuel cap, tank, lines

SAFETY I - 7,500 Miles

Check tires, wheels and disc brakes
Check suspension and steering
Check brake and power steering

SAFETY II

Check throttle linkage
Check/flush underbody
Check bumpers
Check drum brakes & parking brake

1979 CADILLAC SEVILLE
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo controlled air cleaner
Adjust engine idle speed
Torque throttle body

EMISSIONS II

Check vacuum advance system and hoses
Replace fuel filter
Check PCV valve sys.
Check spark plug wires
Check fuel tank, lines and caps

EMISSIONS III

Replace PCV valve & filter
Replace air cleaner
Replace spark plugs
Replace ECS filter and check system
Check engine timing and check dist.

SAFETY I

Check tires, wheels and disc brakes
Check exhaust system
Check steering and suspension
Check brake and power steering systems

SAFETY II

Check drive belts
Check drum and parking brakes
Check throttle linkage
Check bumper

SCHEDULED MAINTENANCE PACKAGES
GENERAL MOTORS SCHEDULE II

1978-77 CADILLAC SEVILLE

EMISSIONS I

Check exhuast system

EMISSIONS II

Check/adjust idle speed
Torque throttle body mounting

EMISSIONS III

Check vacuum advance system
Replace fuel filter
Check PCV system, service filter
Check drive belts

EMISSIONS IV

Replace PCV valve & filter
Check spark plug wires
Replace spark plug wires
Adjust timing and check distributor
Check ECS system & replace filter
Check fuel cap, tank and lines
Replace air cleaner

SAFETY I

Check tires, wheels and disc brakes
Check steering and suspension
Check brake and power steering

SAFETY II

Check drum brakes and parking brake
Check throttle linkage
Check/flush underbody
Check bumper

1976 CADILLAC SEVILLE
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check exhaust system

EMISSIONS II

Check thermostatic vacuum switch
Check air cleaner hoses and connections
Check/adjust idle speed
Torque throttle body mounting

EMISSIONS III

Check vacuum advance system
Check PCV system, service filter
Check drive belts
Check thermostatic vacuum switch

EMISSIONS IV

Check air cleaner, hoses and connections
Check adjust idle speed
Torque throttle body mounting
Replace fuel filter
Check spark plug wires
Replace spark plugs
Adjust timing, check distributor

EMISSIONS V

Replace PCV valve and filter
Check ECS system, replace filter
Check fuel cap, tank and lines
Replace air cleaner

SAFETY I

Check tires, wheels and disc brakes
Check steering and suspension
Check brake and power steering

SAFETY II

Check drum brake and parking brake
Check throttle linkage
Check/flush underbody
Check bumper
Check headlight

1979 CHEVROLET CHEVETTE
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo-controlled air cleaner
Check choke and hoses
Adjust idle speed
Torque carb. mounting
Check vacuum advance system & hoses

EMISSIONS II

Replace fuel filter
Check PCV system

EMISSIONS III

Check spark plug wires
Check idle solenoid or dash pot
Replace spark plugs
Adjust timing and check dist.
Check vacuum break

EMISSIONS IV

Replace air cleaner
Check ECS system & replace filter
Check fuel caps, tank and lines
Replace PCV valve

SAFETY I

Check tires, wheels and disc brakes
Check exhaust system
Check steering and suspension
Check brake system

SAFETY II

Check drive belts
Check drum and parking brake
Check throttle linkage
Check bumpers

1980 CHEVROLET CITATION
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo. controlled air cleaner
Check engine idle speed
Check EFE system
Torque carb. mounting

EMISSIONS II

Replace fuel filter
Check spark plug wires

EMISSIONS III

Check carburetor choke and hoses
Check vacuum advance system and hoses

EMISSIONS IV

Check idle stop solenoid & dashpot
Check engine timing & adjust dist.
Check engine idle speed
Torque carb. mounting
Replace spark plugs
Replace air cleaner
Check thermo-controlled air cleaner
Replace PCV valve
Check ECS system
Replace canister filter
Check EFE system
Change catalyst

SAFETY I

Check tires, wheels & disc. brakes
Check exhaust system
Check suspension & steering
Check brakes & steering

SAFETY II

Check drive belts
Check drum & parking brakes
Check throttle linkage
Check bumpers
Check fuel tank, lines and cap

1979 CHEVROLET IMPALA, MALIBU, NOVA
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo controlled air cleaner
Check choke and hoses
Adjust idle speed
Check EFE system
Torque carb. mounting
Check vacuum advance system and hoses

EMISSIONS II

Replace fuel filter
Check PCV valve and system

EMISSIONS III

Check spark plug wires
Check idle stop solenoid or dash pot
Replace spark plugs
Adjust timing and check dist.
Check vacuum break

EMISSIONS IV

Replace air cleaner
Check ECS system and filter
Check fuel tank, cap and lines
Replace PCV valve

SAFETY I

Check tires, wheels and disc brakes
Check exhaust system
Check suspension and steering
Check brake and power steering system systems

SAFETY II

Check drive belts
Check drum and parking brake
Check throttle linkage
Check bumper

1979 CHEVROLET LIGHT DUTY TRUCKS
C10, C20, G10
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo controlled air cleaner
Torque carb mounting
Check choke and hoses
Check EFE system
Check vacuum advance and hoses
Adjust idle speed

EMISSIONS II

Replace fuel filter
Check PCV valve

EMISSIONS III

Check curb idle solenoid
Check spark plug wires
Replace spark plugs
Adjust timing & check dist.
Check vacuum break

EMISSIONS IV

Replace PCV filter
Replace PCV valve
Replace air filter
Check ECS system & replace filter
Check fuel caps, tank and lines

SAFETY I

Check tires, wheels and disc brakes
Check exhaust system
Check suspension and steering
Check power steering and brakes

SAFETY II

Check drive belts
Check drum and parking brake
Check throttle linkage
Check bumpers

1979 CHEVROLET MONZA
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo controlled air cleaner
Check auto choke and hoses
Adjust idle speed
Check EFE system
Torque carb. mounting

EMISSIONS II

Check vacuum advance system & hoses
Replace fuel filter
Check PCV system

EMISSIONS III

Check spark plug wires
Check idle stop solenoid & dash pot
Replace spark plugs
Adjust timing and check dist.
Check vacuum break

EMISSIONS IV

Replace PCV valve
Replace air cleaner
Check ECS system & replace filter
Check fuel tank, cap and lines

SAFETY I

Check tires, wheels and disc brakes
Check exhaust system
Check suspension and steering
Check brake and power steering systems

SAFETY II

Check drive belts
Check drum and parking brakes
Check throttle linkage
Check bumper

SCHEDULED MAINTENANCE PACKAGES
1978-77 GENERAL MOTORS LDT HEAVY DUTY EMISSIONS SCHEDULE

CHEVROLET C20 LIGHT TRUCK

EMISSIONS I - 6,000/12,000 Miles

Check carburetor choke and hoses
Check/adjust idle speed
Torque carburetor mounting

EMISSIONS II - 12,000 Miles

Check thermostatically controlled air cleaner
Check manifold heat valve
Replace spark plug
Check/adjust timing and check distributor
Check EGR system
Replace carburetor fuel filter
Adjust idle mixture
Check throttle return control
Check idle stop solenoid
Check PCV system
Replace air cleaner
Check spark plug wires

EMISSIONS III

Check ECS system
Check fuel cap, lines & tank

SAFETY I

Check tires and wheels
Check exhaust system
Check drive belts
Check steering and suspension
Check power steering and brakes
Check disc brakes

Safety II

Check drum brakes & parking brake
Check throttle linkage
Check underbody
Check cooling system hoses

SCHEDULED MAINTENANCE PACKAGES
GENERAL MOTORS LDT HEAVY DUTY SCHEDULE

1976 CHEVROLET C20 LIGHT TRUCK

EMISSIONS I - 6,000/12,000 Miles

Check carburetor choke
Torque carburetor mounting
Check/adjust idle speed
Check thermostatically controlled air cleaner
Check manifold heat valve
Check/adjust timing and check distributor
Adjust idle mixture

EMISSIONS II - 12,000 Miles

Check EGR system
Replace fuel filter
Check throttle return control
Check idle stop solenoid
Check PCV system
Replace air cleaner
Check thermal vacuum switch
Check vacuum advance solenoid
Check transmission control switch

EMISSIONS III - 24,000 Miles

Check ECS system
Check fuel cap, lines, tank
Check engine compression
Check AIR system

SAFETY I - 6,000 Miles

Check tires and wheels
Check exhaust system
Check drive belts
Check steering & suspension system
Check power steering & brakes
Check disc brakes

SAFETY II

Check drum brakes & parking brakes
Check throttle linkage
Check underbody
Check cooling system hoses
CHeck headlights

1979 OLDSMOBILE CUTLASS (Schedule 11)
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermostatically controlled air cleaner
Check/adjust idle speed
Check EFE system
Torque carb. bolts

EMISSIONS II

Check carb. choke & hoses

EMISSIONS III

Check vacuum advance and hoses
Replace fuel filter
Clean PCV filter
Check spark plug wires

EMISSION IV

Replace PCV valve
Check idle stop and dash pot
Replace spark plugs
Check engine timing
Check vacuum brake
Check ECS system
Check fuel tank caps and lines
Replace air cleaner

SAFETY I

Check tires, wheels & disc brakes
Check exhaust system
Check steering and suspension system
Check brakes and power steering

SAFETY II

Check drive belts
Check drum & parking brakes
Check throttle linkage
Check bumpers

1979 OLDSMOBILE DELTA 88 DIESEL
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Adjust engine idle speed

EMISSIONS II

Check crankcase ventilation system

SAFETY I

Owners safety check
Check tires, wheels and disc brakes
Check exhaust system
Check suspension
Check brakes & steering

SAFETY II

Check drive belts
Check drum and parking brakes
Check throttle linkage
Check bumpers

SCHEDULED MAINTENANCE PACKAGES
1978 GENERAL MOTORS SCHEDULE III

OLDSMOBILE DIESEL

EMISSIONS I

Adjust idle speed

EMISSIONS II

Check crankcase vent system

SAFETY I

Check tires, wheels, disc brakes
Check exhaust system
Check suspension system & steering
Check brake and power steering system
Check fluid levels

SAFETY II

Check drum and parking brakes
Check drive belts
Check throttle linkage
Flush underbody
Check bumper

1979 PONTIAC GRAND PRIX
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check thermo-controlled air cleaner
Check choke and hoses
Adjust idle speed
Check EFE system
Torque carb. mounting
Check vacuum advance system & hoses

EMISSIONS II

Replace fuel filter
Check PCV valve

EMISSIONS III

Check spark plug wires
Check idle solenoid and dash pot
Replace spark plugs
Adjust timing and check dist.
Check vacuum break

EMISSIONS IV

Replace PCV valve and filter
Check ECS system and replace filter
Check fuel cap, tank and lines
Replace air filter

SAFETY I

Check tires, wheels & disc brakes
Check exhaust system
Check steering and suspension
Check power brakes and steering

SAFETY II

Check drive belts
Check drum and parking brakes
Check throttle linkage
Check bumpers

HONDA

1979 HONDA CIVIC CVCC
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check charcoal canister

EMISSIONS II

Check crankcase emissions
Check evaporation emission controls

TUNE-UP I

Check valve clearance
Check ignition timing
Check idle speed
Check idle C.O.
Adjust alternator belt

TUNE-UP II

Check valve clearance
Check ignition timing
Check idle speed
Check idle C.O.
Replace spark plugs
Replace points
Check ignition wiring
Check choke operation
Replace air cleaner
Check dist. cap & roter
Check inlet air temperature control
Check throttle control unit
Check timing ignition control

SAFETY I

Check clutch pedal
Adjust rear brakes
Check front pads
Check brake hoses, lines and connections
Check parking brake
Check exhaust pipe and muffler condition
Check master cylinder fluid level

SCHEDULED MAINTENANCE PACKAGES

1978 HONDA CIVIC CVCC

EMISSIONS I

Check charcoal canister

EMISSIONS II

Check evaporative emissions control devices
Check crankcase emission control systems

TUNE-UP I

Check idle speed & mixture
Check valve clearance
Set ignition timing

TUNE-UP II

Adjust idle speed & mixture
Adjust valve clearance
Check drive belt
Replace air filter
Check intake air temperature control system
Check throttle control unit
Check choke mechanism
Adjust ignition timing
Replace ignition points
Replace spark plugs
Check distributor cap & rotor
Check ignition wiring
Check ignition timing control system

SAFETY I

Adjust parking brake
Adjust rear brake
Check brake hoses & lines
Check master cylinder fluid
Check front brake pads
Check clutch pedal travel
Check exhaust system

SAFETY II

Check steering

SAFETY III

Check rear brake lining

SAFETY IV

Check fuel tank lines & connections
Clean vacuum booster air filter

SCHEDULED MAINTENANCE PACKAGES

1977 HONDA CIVIC CVCC

EMISSIONS I

Check charcoal canister

EMISSIONS II

Check idle cut off valve
Check two way valve
Check crankcase emission control system

TUNE-UP I

Check idle speed & mixture
Check valve clearance
Check ignition timing

TUNE-UP II

Check idle speed & mixture
Check valve clearance
Check drive belts
Replace air filter
Check intake air temperature control
Check throttle control unit
Check choke mechanism
Adjust ignition timing
Replace ignition points
Replace spark plugs
Check distributor cap & rotor
Check ignition wiring
Check ignition timing control system
Check start control system

SAFETY I

Adjust parking brake
Adjust rear brake
Check brake hoses & lines
Check master cylinder fluid
Check front pads
Check clutch pedal travel
Check exhaust system

SAFETY II

Check steering, tie rods, rack guides, steering box

SAFETY III

Check rear brake linings

SAFETY IV

Check fuel tank, lines, connections
Clean vacuum booster air filter

SCHEDULED MAINTENANCE PACKAGES

1976 HONDA CIVIC CVCC

EMISSIONS I

Check throttle controller, speed sensor and control valve

EMISSIONS II

Check charcoal canister

EMISSIONS III

Check crankcase emissions system
Check idle cut-off valve
Check two way valve
Check start controls
Check air intake control
Check ignition time control

TUNE-UP I

Check valve clearance
Check ignition timing
Check idle speed and CO
Adjust alternator belt

TUNE-UP II

Check valve clearance
Check timing
Check idle speed & CO
Replace spark plugs
Replace points
Check ignition wiring
Check choke operation
Replace air cleaner

TUNE-UP III

Check coolant
Replace cap & rotor

SAFETY I

Check clutch pedal travel
Adjust rear brakes
Check front pads
Check brake hoses, lines, etc.
Check master cylinder fluid level
Adjust parking brake
Check exhaust system
Check coolant fan operation

SAFETY II

Check steering, tie rods, rack guides, steering gearbox grease

SAFETY III

Check rear brakes
Clean vacuum booster air filter
Check front wheel alignment

SAFETY IV

Check fuel tank, lines, connections

TOYOTA

1979 TOYOTA COROLLA
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check PCV system
Check charcoal canister
Check fuel evaporation control system

EMISSIONS II

Replace PCV valve
Check AIR injection valve
Check air suction system
Replace charcoal canister

SAFETY I

Check brake, clutch & parking pedals
Check brake pads
Check brake lines & hoses
Check brake fluid levels
Check ball joint dust covers
Check transmission and differential levels

SAFETY II

Check drum linings
Check steering wheel linkage and oil level

SAFETY III

Replace fuel cap gasket
Check fuel vapor lines and connections

TUNE-UP I

Adjust valve clearance
Check drive belts
Check vacuum lines, hoses and connections
Check exhaust system
Adjust idle speed and mixture
Adjust choke
Check air cleaner
Check hot air intake
Check throttle positioner system
Check auxiliary acceleration pump
Check mixture control system
Check deceleration fuel cut system
Replace spark plugs
Check ignition wiring
Inspect spark control system

1979 TOYOTA COROLLA

TUNE-UP II

Replace drive belts
Replace air cleaner
Check ignition timing
Check dist.cap & rotor
Check distributor advance mechanism

1978 TOYOTA SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check carbon canister
Check fuel vapor system
Check PCV valve & system
Check air suction filter

EMISSIONS II

Replace PCV valve
Check air injection system hoses
Check air pump

SAFETY I

Check brake & clutch pedal
Check parking brake
Check front brake pads & discs
Check brake hoses
Check brake fluid
Check ball joints & dust covers
Check exhaust system

SAFETY II

Check rear brakes
Check steering linkage
Check emergency locking retractor system
Check seat belt warning system

SAFETY III

Check fuel tank, cap & lines
Replace fuel tank cap seal

TUNE-UP I

Check belts
Adjust valve clearance
Replace spark plugs
Check ignition wiring
Check spark control system
Check air cleaner
Check inlet air temperature control valve
Adjust choke systems
Adjust idle speed
Adjust idle mixture

TUNE-UP I (cont.)

Check throttle positioner
Check accelerator pump
Check fuel mixture control
Check deceleration fuel cut system
Check vacuum fittings, hoses and connections

TUNE-UP II

Check distributor advance
Check distributor cap & rotor
Check timing

1977 TOYOTA SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check, clean PCV system
Inspect air injection system
Check carbon canister
Check fuel vapor storage system

SAFETY I - 6,000/6,500 Miles

Check brake clutch and parking brake
Check front brake pads
Check brake lines & hoses
Check brake fluid level
Check ball joint covers
Check transmission & differential fluid levels
Check emergency locking retractors

SAFETY II

Check rear brake lining
Check steering linkage & oil level
Check seat belt warning system
Check exhaust system
Check electrical harness & connections
CHeck nuts & bolts on chassis

TUNE-UP I

Check valve clearance
Check drive belts
Check vacuum hoses & connections
Adjust idle speed
Adjust idle mixture
Check choke system
Check air filter
Check inlet air temperature control valve
Check throttle positioner system
Check auxiliary accelerator pump
Check mixture control system
Check deceleration fuel cut system
Check dwell
Check timing
Replace ignition points
Replace spark plugs
Check ignition wiring
Check distributor cap & rotor
Check distributor advance
Check spark control system

1976 TOYOTA SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I - 12,500 Miles

Check crankcase vent hoses
Check oil filler cap
Check air injection system hoses
Check carbon canister
Check fuel vapor hoses

EMISSIONS II

Check PCV valve

EMISSIONS III

Change PCV valve
Check air pump
Change vacuum transmitting valve

SAFETY I

Check emergency locking retractor
Check brake and clutch pedals
Check parking brake
Check front brake pads & discs
Check brake lines & hoses

SAFETY II

Check ball joints & covers
Check rear brake lining & drums
Check steering linkage & oil
Check seat belt warning system
Check exhaust system
Check wiring harness & connections
Check body nuts & bolts

TUNE-UP I

Check valve clearance
Check drive belts
Check engine bolts
Check vacuum fittings, hoses & connections
Adjust idle speed
Adjust idle mixture
Check/adjust choke system
Check air cleaner
Check inlet air temperature control valve
Check throttle delay system
Check auxiliary accelerator pump
Adjust dwell angle

TUNE-UP I (cont.)

Adjust ignition timing
Replace ignition points
Replace spark plugs
Check ignition wirings
Check distributor cap & rotor
Check distributor advance
Check vacuum delay system

TUNE-UP II

Check engine compression
Check fuel tank cap, lines, connections
Replace fuel tank cap gasket

VOLKSWAGEN

1979 VOLKSWAGEN RABBIT
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check/adjust belts
Check cooling system
Adjust valves
Check fuel tank, lines, and connections
Check exhaust system
Check/adjust engine idle speed and CO
Check valve cover for leaks

EMISSIONS II

Check belts
Adjust valve clearance
Check compression
Replace spark plugs
Replace ignition points
Adjust dwell & timing
Check vacuum lines, ignition wires, cap and rotor

EMISSION III

Clean air filter

SAFETY I

Check brake system
Check brake lining & pads
Check brake pressure regulator
Check wheels and tires
Check tie rod dust boots and seals
Check steering play
Check steering and drive shafts
Adjust headlights
Check fluid levels

SAFETY II

Check brake warning system

1979 VOLKSWAGEN RABBIT DIESEL
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check belts
Adjust valve clearance
Check fuel tank, lines, and connections
Torque cylinder head bolts
Check engine idle speed and CO
Check cooling system hoses

EMISSIONS II

Drain fuel filter

EMISSIONS III

Check drive belts
Adjust valve clearance
Replace fuel filter
Check crankcase vent hoses
Check fuel tank, lines & connections
Check engine for oil leaks
Check engine speed & CO
Check cylinder head for leaks

SAFETY I

Check brake system for damage and leaks
Chekc brake lining and pads
Check brake pressure regulator
Check tires and wheels
Check dust seals on ball joints
Check tie rods & tie rod ends
Check play in steering
Check steering driveshaft boot
Adjust headlights
Check exhaust system
Check clutch play and adjust
Check fluid levels

SAFETY II

Check brake warning switch

SCHEDULED MAINTENANCE PACKAGES

1978 VOLKSWAGEN RABBIT & RABBIT DIESEL

EMISSIONS I

Check belts
Check cooling system and hoses
Torque head bolts (Diesel only)
Check fuel lines, tank and connections
Check/adjust valves
Check exhaust system
Check/adjust idle speed and mixture
Check valve cover for leaks
Change oil (Diesel only)
Change oil filter (Diesel only)

EMISSIONS II

Check drive belts
Check cooling system and hoses
Check fuel lines, tank and connections
Check/adjust valves
Check exhaust system
Check/adjust idle speed & mixture
Clean air filter
Check compression
Replace fuel filter
Check crankcase vent filter
Check valve cover for leaks
Replace spark plugs
Replace points
Check/adjust timing
Check vacuum hoses
Check ignition wires, distributor cap and rotor
Check EGR system

SAFETY I

Check brake lining
Check pedal travel
Check/adjust parking brake
Check brake fluid level
Check wheels
Check steering play
Adjust headlights & check safety belt warning system

1977 VOLKSWAGEN RABBIT & RABBIT DIESEL
SCHEDULED MAINTENANCE PACKAGES

EMISSIONS I

Check belts
Check cooling system
Torque cylinder head bolts
Adjust valve
Check fuel tank, lines & connections
Check exhuast system
Check/adjust idle speed & mixture
Check valve cover for leaks
Change oil (Diesel only)
Change oil filter (Diesel only)

EMISSIONS II

Check belts
Adjust valves
Check fuel tank, lines & connections
Check exhaust system
Check/adjust idle speed and mixture
Check valve cover for leaks
Clean air filter
Check engine compression
Replace fuel filter
Check crankcase vent hose
Replace spark plugs
Replace points
Adjust timing
Check ignition wire, distributor cap & rotor
Check EGR system

SAFETY I

Check brake system
Check brake lining
Check brake fluid
Check wheels
Check steering play
Adjust headlights
Check seat belt warning system

1976 VOLKSWAGEN RABBIT
SCHEDULED MAINTENANCE SCHEDULES

EMISSIONS I

Check drive belts
Check cooling system & hoses
Torque cylinder head bolts
Adjust valves
Check fuel tank, lines and connections
Check exhaust system
Check engine idle speed and mixture
Check valve cover for leaks
Change oil
Change oil filter

EMISSIONS II

Check drive velts
Adjust valves
Check fuel lines, tank and connections
Check exhaust system
Check/adjust idle speed and mixture
Check valve cover for leaks
Check engine compression
Check crankcase vent hose
Replace spark plugs
Replace points
Adjust timing
Check ignition wires, distributor cap and rotor
Check EGR system
Clean crankcase vent control valve

EMISSIONS III

Replace air cleaner
Replace fuel filter
Check air pump hoses & control valves
Replace catalytic converter

SAFETY I

Check brake system, linings and fluid
Check wheels
Check steering play
Adjust headlights and check safety belt warning system

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