FINAL REPORT

U.S. Department of Transportation
Research and Special Programs Administration
Transportation Systems Center
Kendall Square
Cambridge, MA 02142

ANALYSIS OF STALLING PROBLEMS

Simon Prensky

November 1986

SPONSOR: Clarke B. Harper, NEF-11
Office of Defects Investigation
Associate Administrator for Enforcement
National Highway Traffic Safety Administration

This document contains information subject to change. This is considered an informal technical document for working level communication and dissemination of preliminary information within the cited project. Distribution is effected by and the responsibility of the TSC Project Manager with the approval of the Associate Director.

APPROVED FOR DISTRIBUTION: ______________________
Chief, Operator Performance
and Safety Analysis Division

____
Associate Director for
Research and Analysis

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

A systematic examination of stalling problems was conducted using all of the data currently available to NHTSA. Computer-based methods were developed which will be suitable for analyzing similar safety defects. The extent to which stalling causes loss of control was analyzed. Vehicles and engine systems which have high rates of stalling complaints were identified. High complaint rates do not necessarily imply a safety-related defect, but should be viewed as one indicator that a problem might exist.

The work was performed by the U.S. Department of Transportation, Research and Special Programs Administration, Transportation Systems Center, Cambridge, Massachusetts, under the sponsorship of the U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Defects Investigation, Washington, DC.

Programming and analytical support for this project was provided by Ping Hu of the Service Development Corporation (SDC). He was responsible for designing and coding all Statistical Analysis System (SAS) programs used to analyze the complaints and registration data, and for preparing Appendices 1 and 2 of the report.

The author also wishes to acknowledge the contributions of Clarke Harper of NHTSA's Office of Defects Investigation for providing many valuable suggestions on the content and focus of the study; E. Donald Sussman of TSC for his review of the work; and Robin Barnes for typing the manuscript.

EXECUTIVE SUMMARY

The National Highway Traffic Safety Administration (NHTSA) Office of Defects Investigation (ODI) collects consumer complaints concerning alleged vehicle safety defects for the purpose of analyzing and investigating significant problem areas. It also influences recalls of vehicles with specific safety-related defects.

This analysis addresses general stalling as a potential safety problem. Since 1975, NHTSA has received over 17,000 consumer complaints associated with stalling problems, and has conducted several investigations of vehicle stalling problems, including the 1982 Volvo, 1976-1982 VW Rabbits, and the 1976-1977 Aspen/Volare.

The purpose of this project was to: (1) review the data available to NHTSA for patterns which could yield insight concerning the safety implications of stalling; (2) identify high-risk stalling situations; and (3) attempt to identify high-risk vehicles/components.

Two approaches were undertaken to examine the safety implications of stalling problems. First, complaints and accident rates per 100,000 vehicles registered were compared to a sample of investigations, some of which were closed without action, and some of which resulted in recalls. Additionally, complaint data from the automated file and from hard copy accident records were analyzed to determine which vehicle characteristics and stalling circumstances were related to serious safety problems (i.e., accidents and injuries). The major findings from the safety analysis indicate that:

- The number of complaints registered per year since 1980 is lower than the peak years of 1975-1978. The rate of complaints per 100,000 registered vehicles has not changed significantly from earlier periods.

- Overall, the rate of stalling complaints is comparable to the rate of complaints for other safety defect investigations. The rate of stalling-related accidents is lower than that in most investigations that have led to recalls.

- Stalling incidents that occur without warning, at high speeds, or upon acceleration are associated with stalling-related accidents more frequently than other types of stalling problems. For example, loss of power steering or brakes due to stalling is cited as a common accident cause.

Vehicles with high rates of stalling complaints were identified by dividing the total numbers of stalling complaints for each vehicle model by the number of these vehicles registered in 1984, the latest year where detailed registration data were available. Vehicle makes with complaint rates that were significantly higher than the average for all vehicle makes were identified. An analysis was conducted on vehicles sold in model years after 1980 as well as for the entire 1975-1985 time period.

Engine systems with high rates of complaints were identified in a similar manner; however, this analysis was restricted to complaint data that included valid vehicle identification numbers (VIN or Vindicator Classification). The "engine code" digit contained in the VIN numbers and the vehicle's model year were used to classify engines into different types (number of cylinders, displacement, carburetion, fuel type) and subtypes (other less pronounced engine differences probably associated with emission control changes). The number of complaints for each engine divided by the number of vehicles with that engine that were registered in 1984 was used as a measure of complaint frequency.

Stalling complaints by manufacturer are shown in the following table:

Stalling Complaints by Manufacturer
(1975-1985)

	Number of Complaints	Complaints Per 100,000 Registrations
Chrysler	5,766	48.5
GM	4,907	9.7
Ford	2,621	11.5
AMC	434	18.3
Foreign-European	1,563	19.3
Foreign-Japanese	911	6.4
Trucks and Other	1,215	3.8
TOTAL	17,417	12.3

Specific vehicle makes with the highest rates of complaints are the Aspen/Volare, Dart, Monaco, Pacer and Omni/Horizon (1975-1985 period); and the Aries/Reliant, Omni/Horizon, Phoenix/Citation/Skylark, Thunderbird, and Escort/Lynx (post-1980 model years).

Engine systems with particularly high rates of consumer complaints include the Chrysler 6 cylinder - 225 cubic inch (1 and 2 barrel), the GM 4 cylinder - 97 cubic inch (1 barrel), the Chrysler 4 cylinder - 105 cubic inch (2 barrel), the Chrysler 8 cylinder - 400 cubic inch (2 and 4 barrel), the Audi 4 cylinder - 1.5 and 1.9 liter engines, and several small VW 4 cylinder engines.

Even with the use of all available data elements, it was not possible to conclusively establish the entire range of stalling circumstances and conditions which might constitute serious safety hazards. A list of additional data elements (see below) and methodology that would facilitate the identification of important defect-related safety problems is provided.

Data Elements Potentially Associated With Stalling Accidents

1. Weather conditions
2. Time of day
3. Ambient temperature
4. Time from start to first stalling incident
5. Vehicle in motion
6. Vehicle speed
7. Vehicle under acceleration
8. Loss of power steering or power brakes
9. Delay in restarting
10. Stalling with or without warning
11. Vehicle mileage
12. Road type (stalling location)
13. Driver characteristics

1.0 INTRODUCTION

1.1 Background

The National Highway Traffic Safety Administration (NHTSA) Office of Defects Investigation (ODI) collects consumer complaints concerning alleged vehicle safety defects for the purpose of analyzing and investigating significant problem areas. It also influences recalls of vehicles with specific safety-related defects.

This analysis addresses stalling as a potential safety problem. Stalling is a ubiquitous consumer complaint, with almost every model and type of vehicle subject to at least occasional stalling problems. Since 1975, NHTSA has received over 17,000 consumer complaints associated with stalling. Vehicle manufacturers, consumer protection agencies, and others probably receive at least as many complaints. NHTSA has conducted several investigations of stalling problems including the 1982 Volvo, 1976-1982 VW Rabbits, and the 1976-1977 Aspen/Volare.

In this project, a quantitative analysis of stalling problems was conducted using all of the data currently available to NHTSA. In addition, computer-based methods were developed which should be suitable for analyzing similar alleged safety defects. The initial task was to determine the extent to which stalling might be safety-related. Subsequently, the vehicles and engine systems which have high rates of stalling complaints were identified.

Two approaches were undertaken to examine the safety implications of stalling problems. First, complaints and accident rates per 100,000 vehicles registered were compared to a sample of investigations, some of which were closed without action and some of which resulted in recalls. Additionally, complaint data from the automated file and from hard-copy accident records were analyzed to determine which vehicle characteristics and stalling circumstances were related to serious safety problems (i.e., accidents and injuries). The results of these analyses are presented in Section 2.

The identification of vehicles with high rates of stalling complaints was accomplished by dividing the total numbers of stalling complaints for each vehicle model by the number of these vehicles registered in 1984, the latest year for which detailed registration data were available. Vehicle makes with complaint rates that were significantly higher than the average for all vehicle makes were identified. This analysis was conducted for vehicles sold in model years after 1980 as well as for the entire 1975-1985 time period.

To identify high complaint rate engine systems, it was necessary to segment the complaint data file into those with valid Vehicle Identification Numbers (VIN) and those which either did not have a VIN number or whose VIN numbers did not match a list of valid codes. Only about 40 percent of complaints were determined to have valid VIN numbers. The "engine code" digit on the VIN numbers (domestic autos only) and the vehicle's model year were used to classify engines into different types (number of cylinders, displacement, carburetion, fuel type) and subtypes (other less pronounced engine differences, probably associated with emission control changes). Again, the number of complaints for each engine divided by the number of vehicles with that engine that were registered in 1984 was used as the measure of complaint frequency. Engine systems with high rates of complaints are identified in Section 3.0 and in Appendix 1.

Section 4.0 reviews an analysis of service bulletin data. The purpose of this task was to find an automated method of identifying manufacturers' service bulletins related to stalling problems.

The second Appendix contains a description and listing of the SAS programs used to analyze the stalling data. These programs, with minor modification, can be used to perform analyses on other data extracted from the NHTSA Complaint Data System.

1.2 Data

Two major data sources were used in the investigation of stalling complaints. These were the NHTSA complaint data (both automated and hard-copy files) and the 1984 Polk vehicle registration data base.

Automated complaint data are compiled from letters sent to NHTSA from consumers who wish to protest or describe problems with their vehicle's performance. Many complaints are sent in on forms supplied by NHTSA specifically for this purpose (see Figure 1.1), but a significant proportion of complaints are received in letters that come

Figure 1.1
Vehicle Owners Questionnaire

Form Approved: O.M.B. No. 2127-0008

US Department of Transportation National Highway Traffic Safety Administration — **VEHICLE OWNER'S QUESTIONNAIRE**	**The Privacy Act of 1974** Public Law 93-579 This information is requested pursuant to authority vested in the National Highway Traffic Safety Act and subsequent amendments. You are under no obligation to respond to this questionnaire. Your response may be used to assist the NHTSA in determining whether a manufacturer should take appropriate action to correct a defect. If the NHTSA proceeds with administrative enforcement or litigation against a manufacturer, your response, or a statistical summary thereof, may be used in support of the agency's action.
FOR HQ USE ONLY — ODI NO. / HL NO.	

OWNER

LAST NAME	FIRST NAME & MIDDLE INITIAL		TELEPHONE NO. *(Area Code)* Work – Home –
STREET ADDRESS	CITY	STATE	ZIP CODE

VEHICLE INFORMATION

VEHICLE MAKE & MODEL	MODEL YEAR	BODY STYLE	VEHICLE IDENTIFICATION NO.

ENGINE SIZE *(CID/CC/L)* ____ ☐ FUEL INJECTION ☐ GAS ☐ DIESEL	MILEAGE	DATE PURCHASED ____ ☐ NEW ☐ USED	DEALER'S NAME AND ADDRESS	AIR CONDITIONED ☐ Yes ☐ No
VEHICLE SPEED AT FAILURE ____ ☐ Parked	NO. CYLINDERS ____	POWER STEERING ☐ Yes ☐ No / POWER BRAKES ☐ Yes ☐ No	TRANSMISSION ☐ MANUAL *(Speed)* ☐ 3 ☐ 4 ☐ 5 ☐ AUTOMATIC TYPE ____	

FAILED COMPONENT(S)/PART(S) INFORMATION

COMPONENT/PART NAME(S)	LOCATION ☐ Left ☐ Right ☐ Front ☐ Rear	FAILED PART(S) ☐ ORIGINAL ☐ REPLACEMENT	MILEAGE(S) AT FAILURE(S)	NO. OF FAILURES

DATE(S) OF FAILURE(S)	DESCRIPTION OF FAILURE(S)

FAILED TIRE INFORMATION

MANUFACTURER	TIRE NAME	SIZE	TYPE FAILURE	
CONSTRUCTION ☐ Belted ☐ Bias ☐ Radial	FAILED TIRE ☐ Original ☐ Replacement	BELT MATERIAL ☐ Steel ☐ Fiberglass ☐ Aramid ☐ Rayon	LOCATION ☐ Right Front ☐ Right Rear ☐ Left Front ☐ Left Rear ☐ Spare	DOT IDENTIFICATION NO. *

*The identification number consists of about ten letters and numerals following the letters DOT usually located near the rim flange on the side opposite the whitewall or on either side of a blackwall tire.

APPLICABLE ACCIDENT INFORMATION

ACCIDENT ☐ Yes ☐ No	NO. INJURIES	NO. FATALITIES	

DESCRIPTION OF ACCIDENT

SIGNATURE OF OWNER	DATE

directly from consumers or are referred to NHTSA through some intermediary (e.g., State Attorney General's Offices). A list of the variables contained in the stalling data file extracted from the NHTSA Complaint Data Base is listed in Table 1.1.

Automated data are coded from responses to specific questions on the form or extracted from the narratives. Generally, much more complete data are available from respondents who use the Vehicle Owner's Questionnaire. However, even for these, potentially useful information may be omitted because responses are incomplete or unclear. These deficiencies complicate the analysis of the circumstances surrounding occurrences of stalling and accidents resulting from stalling incidents.

The other important source of data is the 1984 state vehicle registrations compiled by R.L. Polk. These data are categorized in two ways: by vehicle make and model, and by engine system. Both classifications are broken down by model year. 1984 registrations were used because they are the latest available. Vehicle registration data are used to normalize (i.e., put on the same basis) complaint and accident counts. Using a single year's registrations simplifies calculations, even though some error is introduced when comparing complaint or accident rates for relatively new cars and vehicles which were produced many years ago. Because some of the older cars may have been scrapped by 1984, their calculated complaint or accident rates may be somewhat overestimated.

1.3 Findings

The study's major findings are summarized as follows:

- The number of complaints registered annually since 1980 is lower than the peak years of 1976-1978, even after correcting for delayed reporting of problems. The rate of complaints per 100,000 registered vehicles has not changed significantly from earlier periods.

- Overall, the rate of stalling complaints is comparable to the rates of complaints for other safety investigations. The rates of stalling-related accidents is lower than that in most investigations that have lead to recalls.

- Evidence indicates that stalling incidents that occur without warning at high speeds, or upon acceleration, may be more dangerous than other types of stalling problems. Loss of power steering or brakes is also cited as a common accident cause.

- Stalling problems primarily affect newer vehicles (about 50 percent of complaints are for automobiles that have less than 10,000 miles) and have occurred frequently prior to the time that a complaint was filed.

- Certain specific vehicle makes and engine systems have much higher rates of stalling complaints than others. Chrysler and Volkswagen vehicles generally have the highest rates of stalling complaints.

- Insufficient data exist in the Automated Complaint Data Base to determine if particular circumstances or conditions are associated with serious stalling-related safety problems.

Table 1.1: Stalling File Description

Variable	Description
ODINO	Record number
FAILDATE	Failure date
MFCODE	Vehicle manufacturing code
VIN	VIN number
CYLS	Number of cylinders
CARB	Number of carburetor barrels
PBRAKES	Power brakes
PSTEER	Power steering
ATRANS	Automatic transmission
ARCOND	Air conditioning
CIDENG	Cubic inch displacement
YEARTXT	Model year
COMPNO	Failed component type
FAULTC	Causing fault code
FAULTR	Resulting fault code
HAZARD	Warning of failure
MILES	Mileage at failure
ACCID	Accident
INJURED	Number of injuries
DEATHS	Number of deaths
ENVIRON	Weather - daylight code
DRIVCON	Road type - speed code
MOTION	Vehicle in motion
LOSS	Loss of control
FIRE	Fire
CSUMMARY	Summary (text)

2.0 SAFETY ANALYSIS OF STALLING COMPLAINTS

2.1 Stalling Complaints and Accident Rates

Over the ten-year period from 1975 through 1985, there were 17,417 complaints registered into the NHTSA Complaint Data Base for which stalling has been identified as a fault code (cause or result). Of these, 459 have been associated with accidents, with 119 injuries and five fatalities.

The number of foreign and domestic vehicles and light trucks registered in the United States in 1984 (the latest year available) is as follows:

Domestic vehicles	87,900,000
Imported vehicles	22,700,000
Light trucks	30,800,000
TOTAL	141,400,000

For complaints received between 1975 and 1985, the overall rate of stalling complaints per 100,000 vehicles registered is 12.3, and the rate of stalling-related accidents is 0.03.

The rates of stalling complaints per 100,000 vehicles registered by vehicle manufacturer is listed in Table 2.1. While the overall average rate of stalling complaints is 12.3, several manufacturers have experienced much higher rates of complaints. The highest include Chrysler, AMC, and some European-produced vehicles. On the other end of the spectrum, Ford, GM, and many of the Japanese-produced vehicles have the lowest overall rates of stalling complaints. A more detailed analysis of complaints by vehicle models and engine system is presented in Section 3.0.

Figure 2.1 shows that the number of stalling complaints varies by the vehicle model year. The maximum number of complaints was received for model year 1977, with a generally decreasing number of complaints since that time. Complaints for the several latest model years are incomplete, because a sizeable proportion of complaints are not generated until many miles are driven (see Figure 2.2).

Table 2.1

Stalling Complaints By Manufacturer
(1975 - 1985)

Manufacturer	Compl'ts	Reg's (100 K)	Compl't Rate
DODGE-DOMESTIC	2317	45.12	51.35
PLYMOUTH-DOMESTIC	2451	48.82	50.20
FIAT	181	3.78	47.88
AUSTIN	7	0.15	46.67
CHRYSLER/IMPERIAL	998	25.03	39.87
TRIUMPH	62	1.61	38.51
ROLLS ROYCE	5	0.16	31.25
AUDI	110	4.26	25.82
SAAB	43	1.77	24.29
CAPRI	50	2.09	23.92
VOLVO	184	7.9	23.29
JAGUAR	21	0.98	21.43
MG	49	2.38	20.59
AMC	434	23.67	18.34
VOLKSWAGON	649	36.37	17.84
RENAULT	31	1.77	17.51
ALFA ROMEO	7	0.41	17.07
FORD-IMPORT	44	2.59	16.99
MITSUBISHI	8	0.5	16.00
BMW	60	3.9	15.38
PEUGEOT	17	1.18	14.41
SUBARU	125	8.94	13.98
MERCURY	640	46.18	13.86
LINCOLN	170	12.79	13.29
BUICK	1020	82.84	12.31
DODGE-IMPORT	65	5.3	12.26
OLDSMOBILE	1051	97.73	10.75
FORD-DOMESTIC	1811	169.71	10.67
PONTIAC	773	74.76	10.34
PORSHE	22	2.2	10.00
CADILLAC	317	32.93	9.63
MAZDA	100	10.52	9.51
HONDA	237	26.08	9.09
CHEVROLET	1746	218.53	7.99
NISSAN/DATSUN	240	39.8	6.03
ISUZU	3	0.59	5.08
MERCEDES	21	7.36	2.85
TOYOTA	125	46.8	2.67
OPEL	5	2.37	2.11
PLYMOUTH-IMPORT	3	3.67	0.82
OTHERS	1215	310.46	3.91
TOTAL	17417	1414	12.32

Figure 2.1

NUMBER OF STALLING COMPLAINTS

BY MODEL YEAR

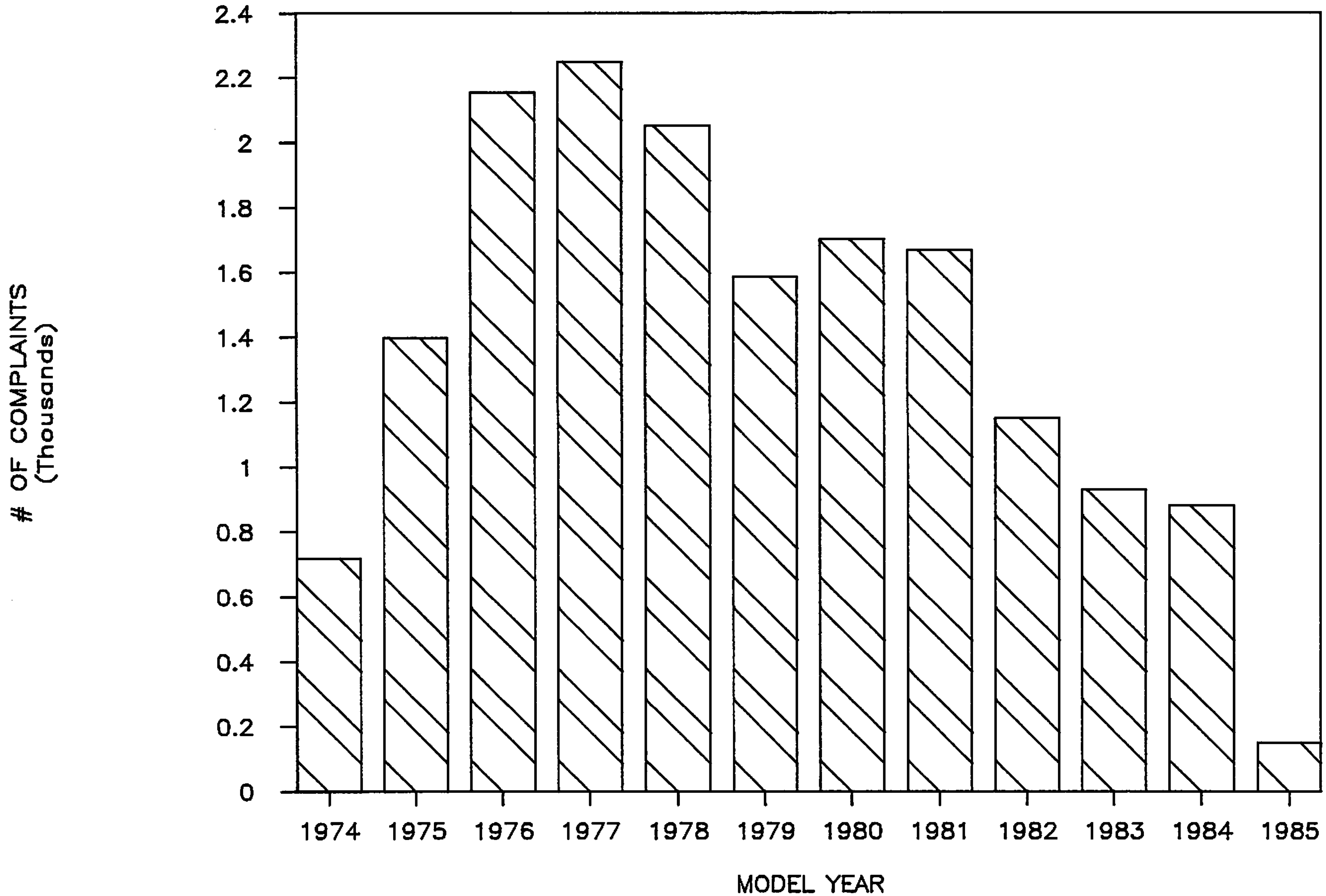
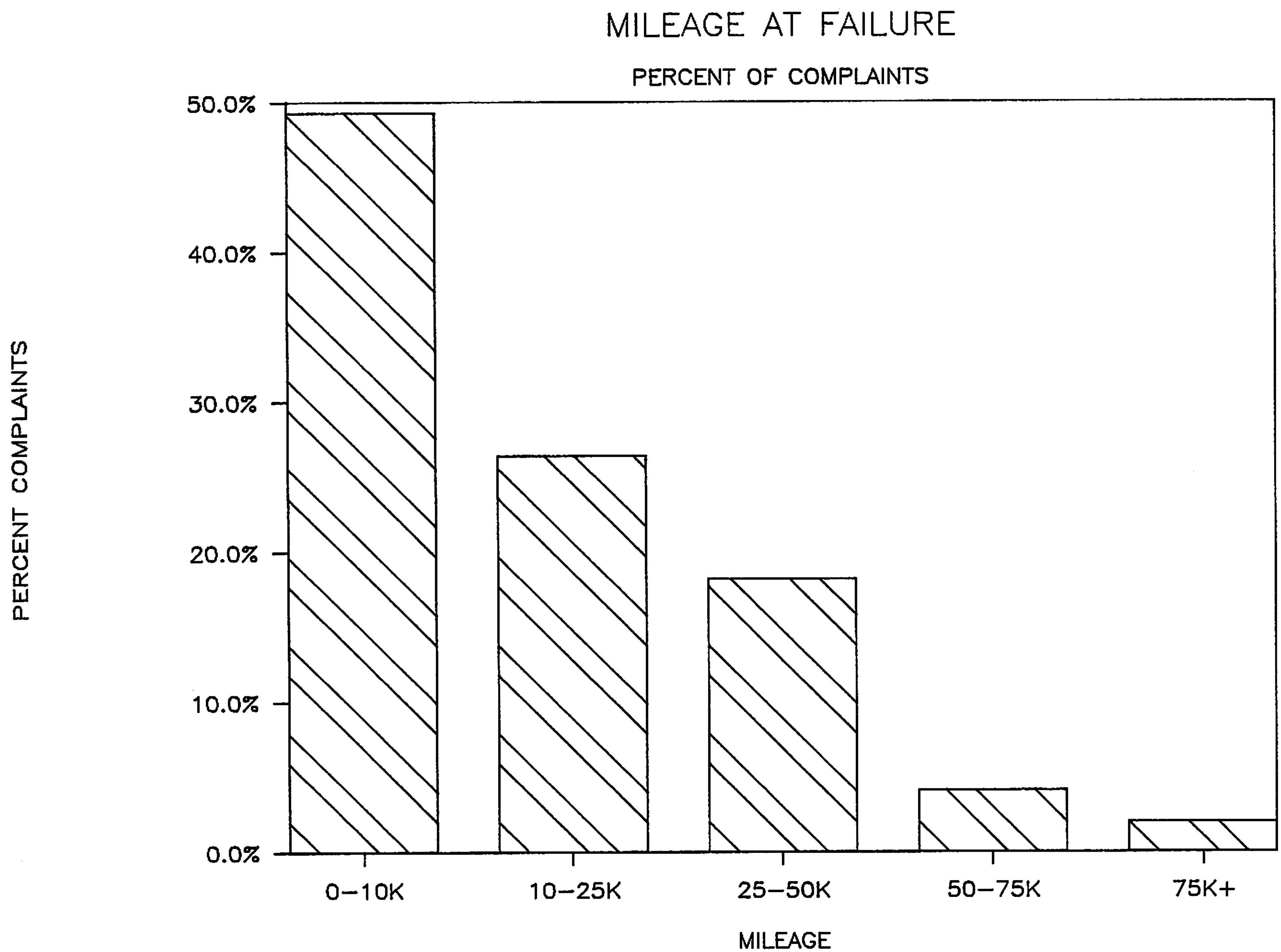


Figure 2.2


MILEAGE AT FAILURE
PERCENT OF COMPLAINTS
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
PERCENT COMPLAINTS
0-10K
10-25K
25-50K
50-75K
75K+
MILEAGE

If the complaints for model years between 1982 and 1984 were adjusted to reflect incomplete reporting of stalling problems (assuming reporting trends did not change drastically by vehicle age), then complaint rates could be from 40 to 100 percent higher than those compiled to date. Thus, the correct complaint rates for the mid-1980s might not be dissimilar from those experiences from 1979 through 1981, but would still be lower than those from 1976 through 1978.

Table 2.2 and Figures 2.3 and 2.4 show how the rate of stalling complaints compares with other selected safety investigations, some of which have been closed without further action and some of which have led to recalls. Overall, the stalling complaint rate is in the midst of the safety investigations listed in the table; it is higher than most investigations that have been closed and lower than most investigations that have resulted in recalls.

The highest stalling complaint rate for any particular vehicle make is about five times the overall rate of complaints for all vehicle makes combined (see Section 3.1). This indicates that particular stalling cases may have as high a complaint rate as recorded for many of the safety investigations that have resulted in recalls.

The rate of stalling-related accidents is lower than most of the safety investigations that have led to recalls, with the exception of Cases 6 (Chevette carburetor fires) and 9 (Volvo stalling). The small number of accidents recorded for most safety investigations makes the rate of accidents an unreliable indicator of the seriousness of defect safety implications.

2.2 Automated Data Analysis

This section reviews the safety-related data available for stalling complaint records in the NHTSA Complaint Data Base. Cross tabulations of many of these variables with the incidence of accidents and injury were conducted in order to determine if any particular failure condition or vehicle type was more likely to be associated with safety problems. The next several figures summarize the results of these analyses.

Figure 2.5 shows the distribution of component failures. Carburetor problems account for about 45 percent of all stalling complaints. Cooling systems, fuel systems, and electrical problems are the next most frequently cited failed components for stalling

Table 2.2

Complaint and Accident Rates for Representative Safety Investigations

		Case	Disposition	Number of Vehicles	Failures	Accidents/ Injuries	Failures Rate/100K	Accident Rate/100K
1.	1976-1982	Rabbit stalling/fires	recall	930,000	600	49	64.5	5.3
2.	1980-1981	GM 'X' Body cold power steering	closed	1,851,116	1,111	11	60.0	0.6
3.	1980-1982	Peugeot brake booster	closed	20,800	11	1	52.9	4.8
4.	1976-1977	Aspen/Volare stalling	recall	1,655,108	680	18	41.1	1.1
5.	1982	Volvo stalling	recall	31,420	6	0	19.1	0.0
6.	1975-1980	Mercedes 450 sudden acceleration	recall	54,056	8	3	14.8	5.5
7.	1975-1985	Stalling overall		141,400,000	17,417	459	12.3	0.3
8.	1978-1980	GM 'A' Body axle separation	recall	3,100,000	265	43	8.5	1.4
9.	1980-1982	Chevette carburetor fire	recall	491,736	32	1	6.5	0.2
10.	1980-1982	GM 'X' Body hatch gas cylinder	closed	1,279,180	88	16	6.9	1.3
11.	1980-1981	GM 'X' Body transaxle lockup	closed	1,651,767	53	3	3.2	0.2
12.	1986-1981	GM 'B' Body axle separation	closed	6,144,900	184	9	3.0	0.1
13.	1981-1982	Escort door glass	closed	395,685	6	2	1.5	0.5
14.	1977-1980	Honda brake pad	closed	1,056,827	14	10	1.3	0.9

Figure 2.3

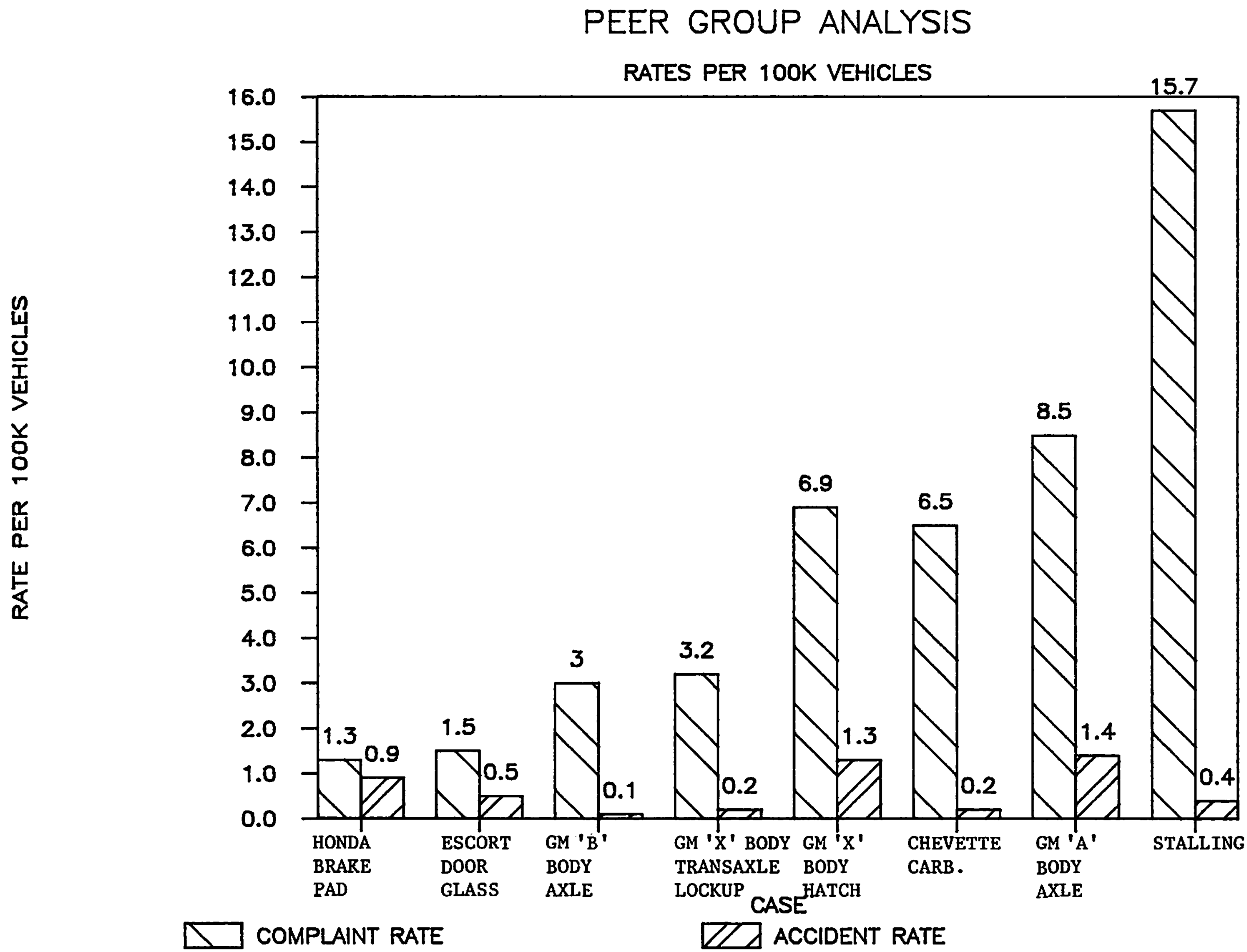
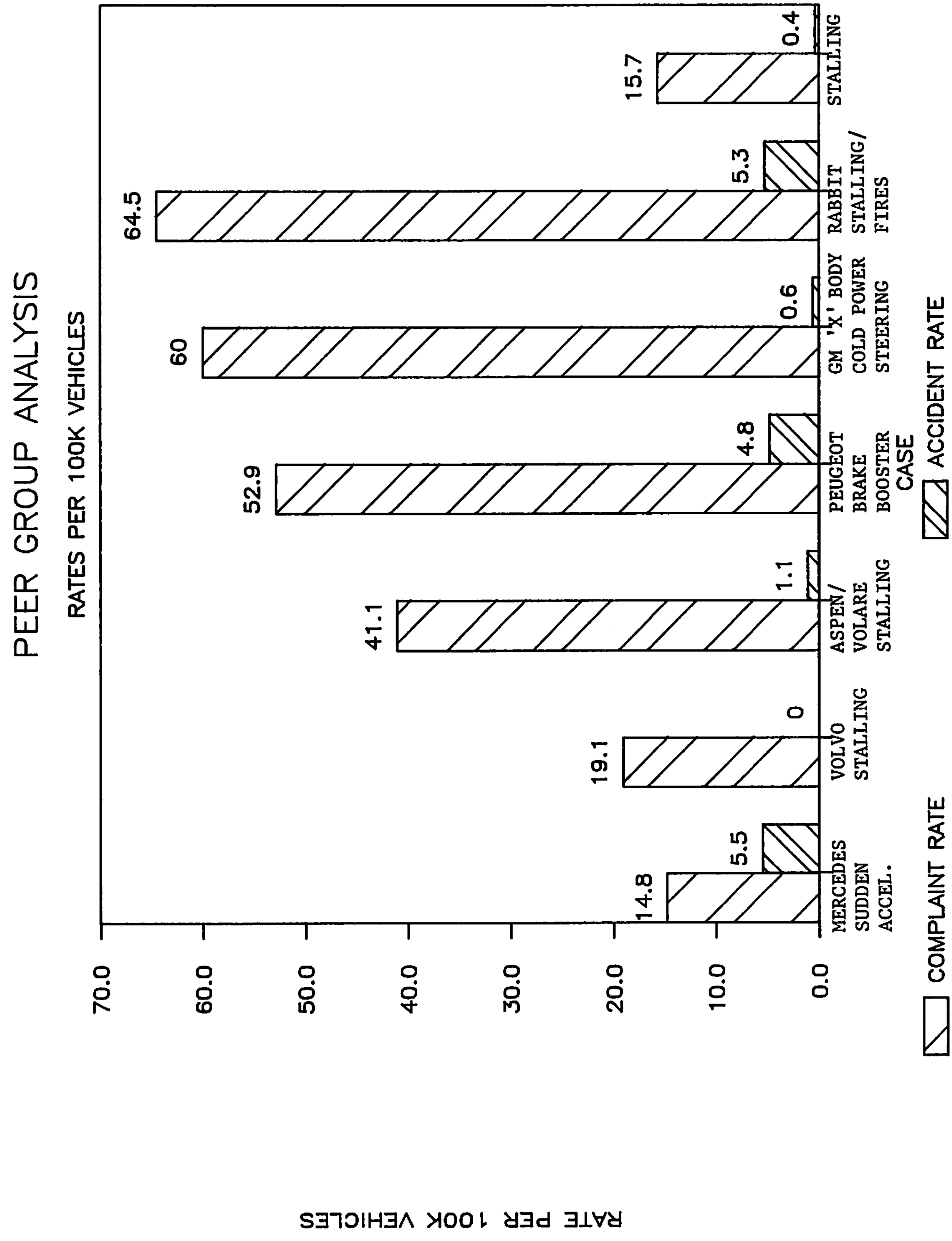
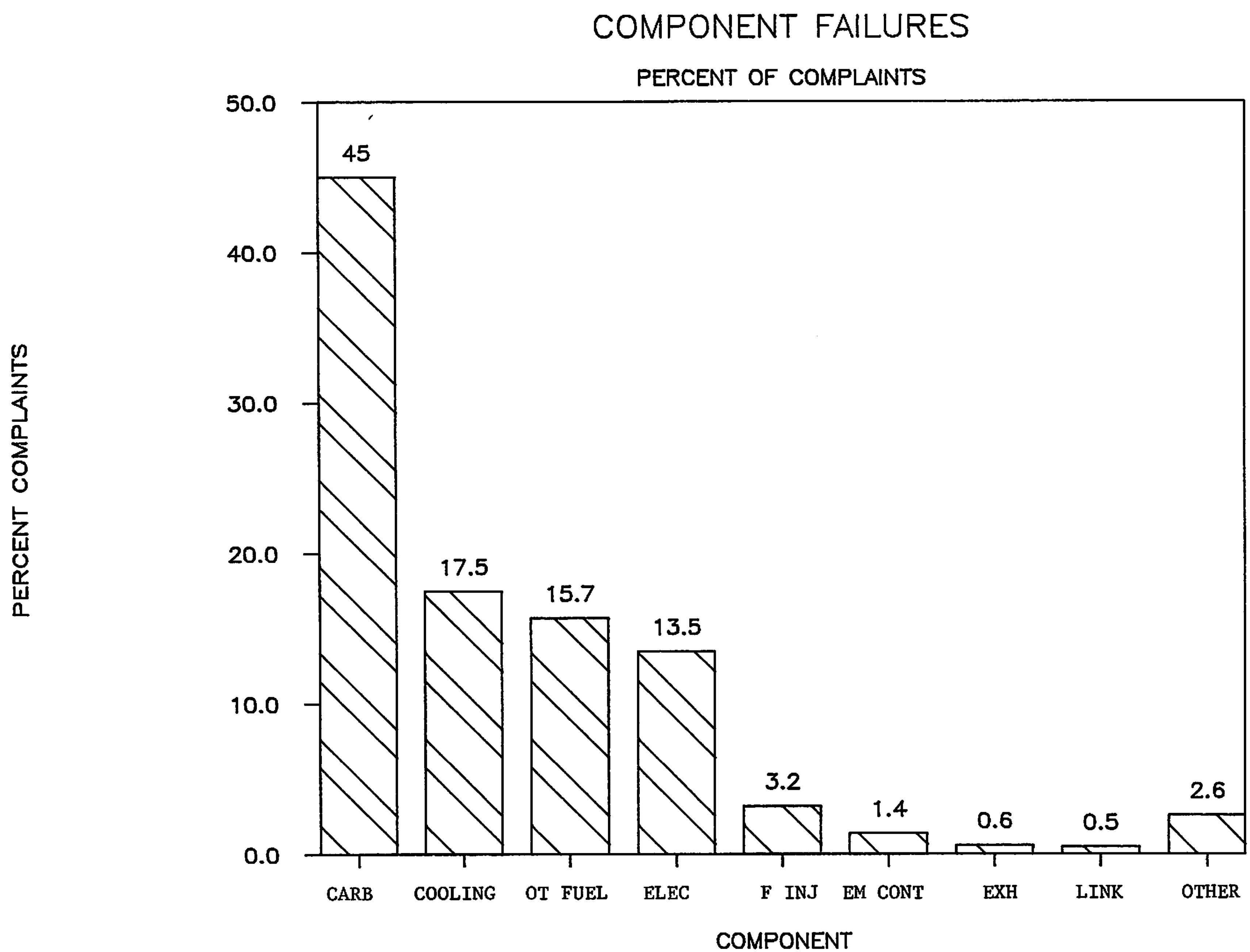

PEER GROUP ANALYSIS
RATES PER 100K VEHICLES
RATE PER 100K VEHICLES
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1.3
0.9
1.5
0.5
3
0.1
3.2
0.2
6.9
1.3
6.5
0.2
8.5
1.4
15.7
0.4
HONDA BRAKE PAD
ESCORT DOOR GLASS
GM 'B' BODY AXLE
GM 'X' BODY TRANSAXLE LOCKUP
GM 'X' BODY HATCH
CHEVETTE CARB.
GM 'A' BODY AXLE
STALLING
CASE
COMPLAINT RATE
ACCIDENT RATE

Figure 2.4



PEER GROUP ANALYSIS
RATES PER 100K VEHICLES
RATE PER 100K VEHICLES
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
14.8
5.5
19.1
0
41.1
1.1
52.9
4.8
60
0.6
64.5
5.3
15.7
0.4
MERCEDES SUDDEN ACCEL.
VOLVO STALLING
ASPEN/ VOLARE STALLING
PEUGEOT BRAKE BOOSTER
GM 'X' BODY COLD POWER STEERING
RABBIT STALLING/ FIRES
STALLING
CASE
COMPLAINT RATE
ACCIDENT RATE

Figure 2.5


COMPONENT FAILURES
PERCENT OF COMPLAINTS
PERCENT COMPLAINTS
50.0
40.0
30.0
20.0
10.0
0.0
45
17.5
15.7
13.5
3.2
1.4
0.6
0.5
2.6
CARB
COOLING
OT FUEL
ELEC
F INJ
EM CONT
EXH
LINK
OTHER
COMPONENT

complaints. It is often difficult to identify the component that caused the stalling problem from the information provided by complaint letters. Therefore, the breakdown of component failures should be evaluated with caution.

Table 2.3 shows the relationship between failed component type and the incidence of accidents and injuries. With the exception of throttle linkage failures, from one to three percent of stalling-related component failures resulted in accidents or injuries. About six percent of throttle linkage failures resulted in accidents. However, these accounted for only six accident complaints.

Figure 2.6 shows the distribution of the variable indicating vehicle movement at the time of the stalling incident. Stalling occurs overwhelmingly while the vehicles are in motion. Interestingly, the data in Table 2.4 seems to imply that a higher percent of stopped vehicles are involved in accidents than for those in motion. This anomaly could possibly be explained if the motion variable was coded to indicate whether the vehicle was moving at the time of the accident, not at the time of the stalling occurrence.

A large percentage of stalling accidents occur while the stalled vehicle is stopped. For those such accidents where information is available, about 60 percent are rear-end or side collisions (see Figure 2.7). These occur when the stalled vehicle is struck by another vehicle, in most cases after it has stopped in a dangerous location. Therefore, it is not possible to conclusively determine from the data collected whether motion in stalling incidents is a dangerous failure characteristic or not.

Another variable that could potentially clarify the relationship between vehicle movement and safety consequences is driving conditions (DRIVCON), which indicates speed and road type at the time of the stalling accident. Data limitations prevented meaningful analysis, as only a minor percent of stalling complaints contained useful data. Table 2.5 summarizes the information available concerning speed of the vehicle at failure.

Table 2.3

Accident and Injury Incidence By Component Failed

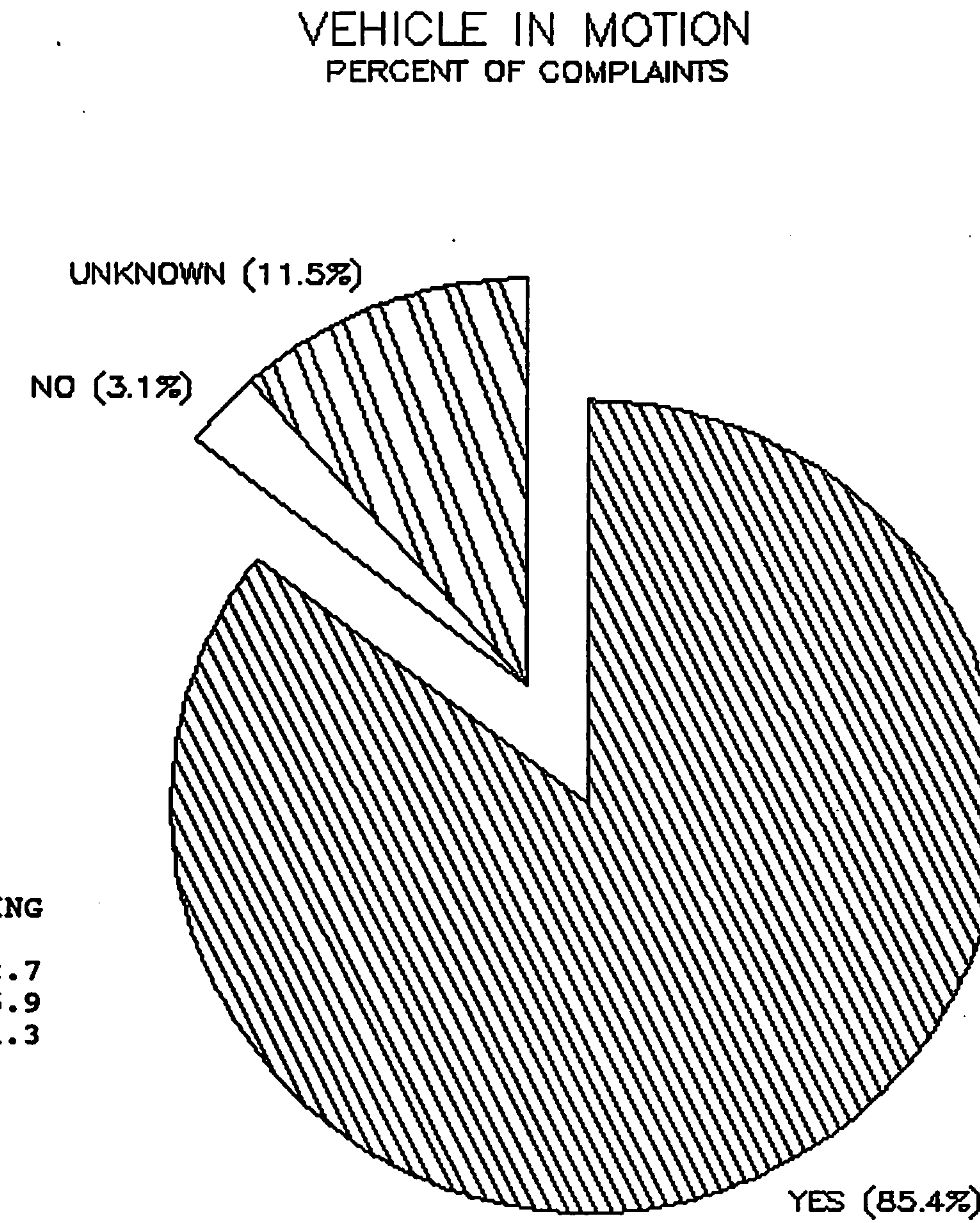
FREQUENCY PERCENT ROW PCT COL PCT	NO ACDNT	NO INJ	INJURY	FATALITY	TOTAL
ENGINE/COOLING S	2964	60	20	3	3047
	17.02	0.34	0.11	0.02	17.49
	97.28	1.97	0.66	0.10	
	17.48	17.91	16.81	60.00	
FUEL CARBURETION	7647	145	49	1	7842
	43.91	0.83	0.28	0.01	45.02
	97.51	1.85	0.62	0.01	
	45.09	43.28	41.18	20.00	
FUEL SYS	2641	68	20	0	2729
	15.16	0.39	0.11	0.00	15.67
	96.78	2.49	0.73	0.00	
	15.57	20.30	16.81	0.00	
ENGINE ELEC SYS	2304	37	18	0	2359
	13.23	0.21	0.10	0.00	13.54
	97.67	1.57	0.76	0.00	
	13.59	11.04	15.13	0.00	
OTHERS	429	11	10	1	451
	2.46	0.06	0.06	0.01	2.59
	95.12	2.44	2.22	0.22	
	2.53	3.28	8.40	20.00	
EXHAUST	98	2	0	0	100
	0.56	0.01	0.00	0.00	0.57
	98.00	2.00	0.00	0.00	
	0.58	0.60	0.00	0.00	
FUEL INJECTION	556	5	0	0	561
	3.19	0.03	0.00	0.00	3.22
	99.11	0.89	0.00	0.00	
	3.28	1.49	0.00	0.00	
EMISSION CONTROL	232	3	0	0	235
	1.33	0.02	0.00	0.00	1.35
	98.72	1.28	0.00	0.00	
	1.37	0.90	0.00	0.00	
THROTTLE LINKAGE	87	4	2	0	93
	0.50	0.02	0.01	0.00	0.53
	93.55	4.30	2.15	0.00	
	0.51	1.19	1.68	0.00	
TOTAL	16958	335	119	5	17417
	97.36	1.92	0.68	0.03	100.00

Table 2.4

Accident and Injury Incidence By Vehicle Motion

FREQUENCY / PERCENT / ROW PCT / COL PCT	NO ACDNT	NO INJ	INJURY	FATALITY	TOTAL
MOVING	14475	288	104	5	14872
	83.11	1.65	0.60	0.03	85.39
	97.33	1.94	0.70	0.03	
	85.36	85.97	87.39	100.00	
UNKNOWN	1982	20	5	0	2007
	11.38	0.11	0.03	0.00	11.52
	98.75	1.00	0.25	0.00	
	11.69	5.97	4.20	0.00	
STOPPED	501	27	10	0	538
	2.88	0.16	0.06	0.00	3.09
	93.12	5.02	1.86	0.00	
	2.95	8.06	8.40	0.00	
TOTAL	16958	335	119	5	17417
	97.36	1.92	0.68	0.03	100.00

Figure 2.6



PERCENT INVOLVING ACCIDENTS	
YES	2.7
NO	6.9
UNKNOWN	1.3

Figure 2.7

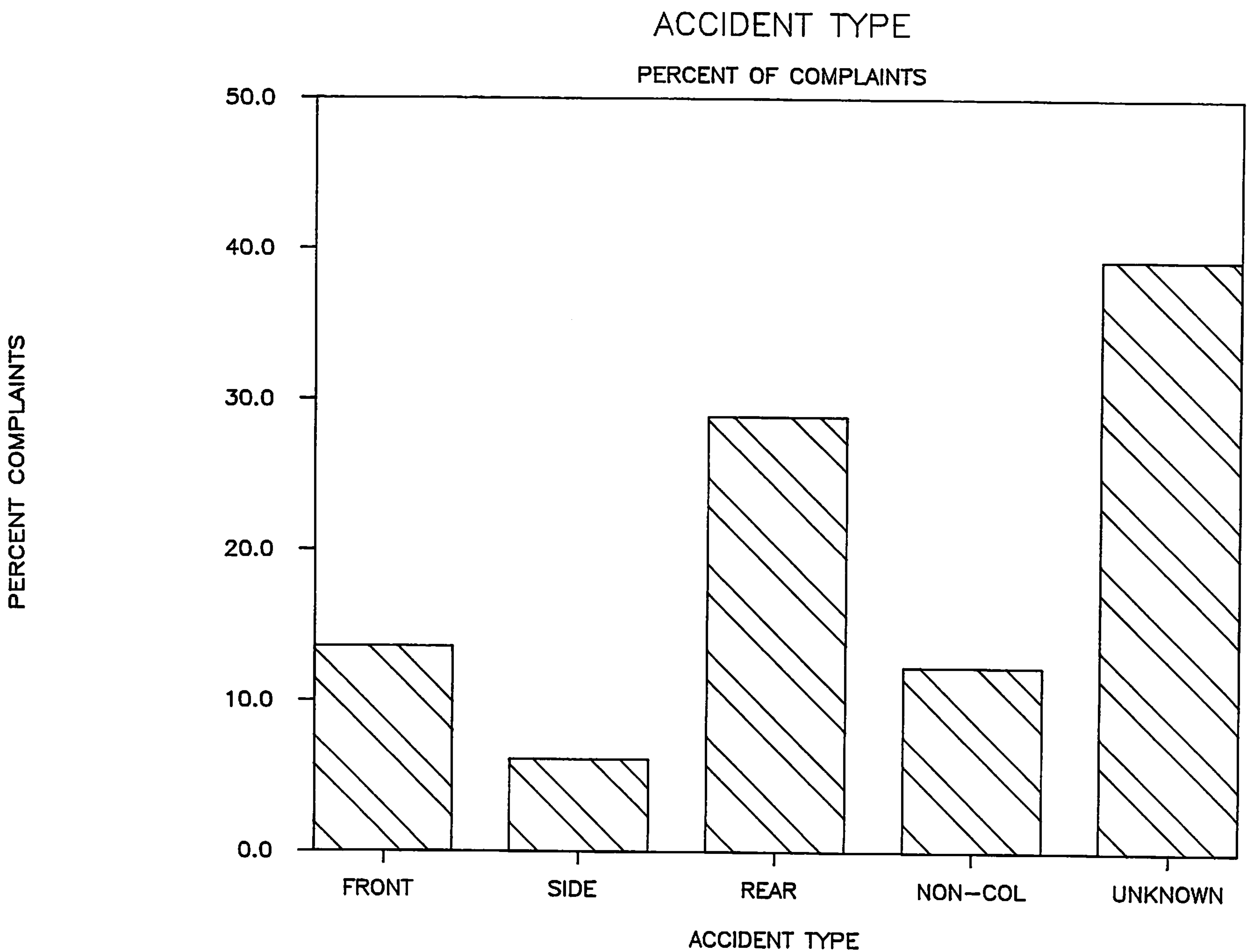

ACCIDENT TYPE
PERCENT OF COMPLAINTS
PERCENT COMPLAINTS
50.0
40.0
30.0
20.0
10.0
0.0
FRONT
SIDE
REAR
NON-COL
UNKNOWN
ACCIDENT TYPE

Table 2.5

Vehicle Speed

	Number of Observations	Percent of Total
Stopped	27	0.2
1-20	47	0.3
21-40	47	0.3
41+	86	0.5
Unknown or not recorded	17,210	98.7
TOTALS	17,417	100.0

Although probably not directly linked to any particular stalling causes, the environmental conditions (i.e., daylight and precipitation) at the time of the incident might be associated with the probability of an accident given that a stalling incident has occurred. Here, too, there are insufficient data to draw any reliable conclusions about environmental effects (see Table 2.6).

Table 2.6

Environmental Conditions

Condition	Number of Complaints	Percent of Total
Day	9	.1
Night	5	.05
Twilight	10	.1
Unknown	17,393	99.8
Clear	1	.05
Rain	24	.1
Fog	1	.05
Sleet/snow	10	.1
Unknown	17,381	99.8

Figures 2.8 and 2.9 show the distributions of two variables associated with loss of control of the vehicle at the time of the stalling incident. Most drivers either suffered no loss or only a partial loss of control of the vehicle due to stalling. However, for those who had a total loss of control, nearly half were involved in accidents. In addition, the 4.8 percent of drivers who had no warning of the stalling incident before it occurred were involved in accidents approximately 13 times more other than those who had some warning prior to their stalling incident (see Table 2.7).

Table 2.7

Accident Rates and the Degree of Warning of the Stalling Incident

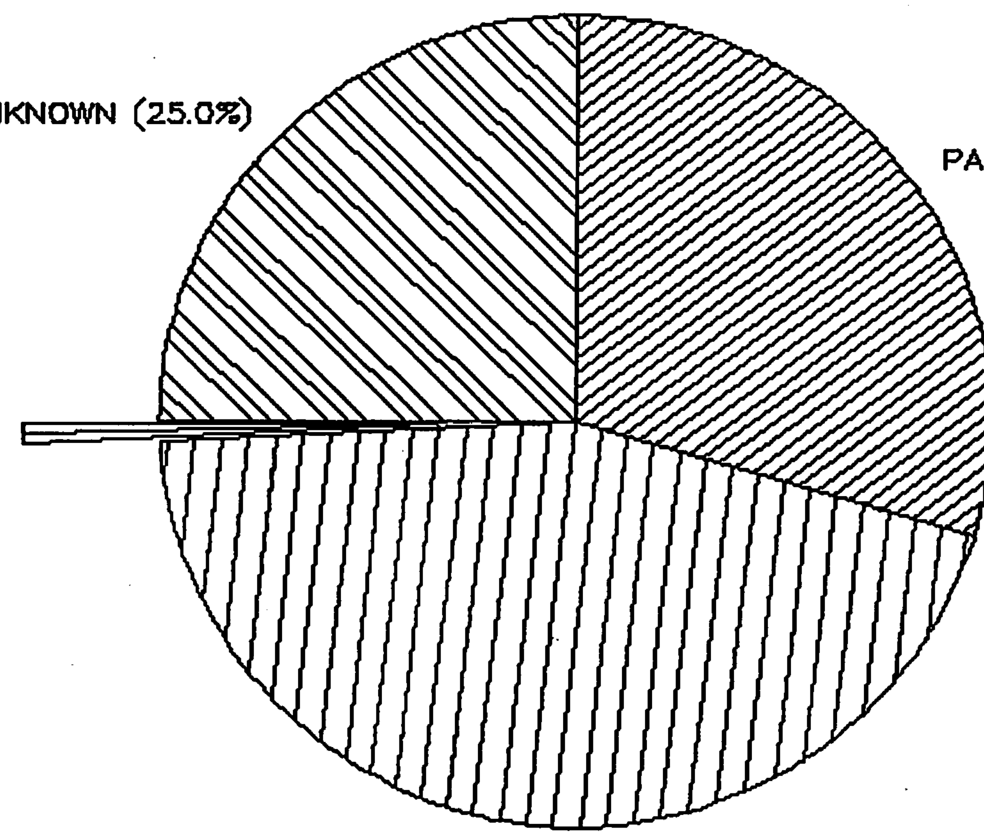
Degree of Warning	Percent of Incidents Involving an Accident	Percent of Incidents
With warning	3.2	7.2
No warning	20.0	4.8
Deterioration	1.4	88.0
Total	1.5	100

Table 2.8 shows the relationship between accident occurrence and vehicle mileage at the time of the stalling incident. For nearly 60 percent of complaints, mileage is unknown. For those vehicles with useable mileage data, there does not appear to be any consistent relationship between mileage and the likelihood of an accident. Since most persons filing stalling complaints (see Section 2.3) cite frequent stalling problems, sometimes more than once a day, the concept of a single vehicle mileage when vehicle stalling incidents occur is not a particularly useful one. In addition, stalling problems seem to be difficult for repair shops to diagnose and remedy, so problems often last over many months or years. It is not clear how coders handled complaint letters which refer to many stalling instances over a long time period. Therefore, caution should be used in assessing these data.

Temperature (both hot and cold) has been linked to certain types of stalling failures. Table 2.9 contains information relating the month of failure to the incidence of accidents caused by stalling. The seasonal distribution of complaints shows a moderate skewing of stalling complaints to summer months, with the June through September months having 36.7 percent of complaints (December through March months account for

Figure 2.8

LOSS OF CONTROL
PERCENT OF COMPLAINTS

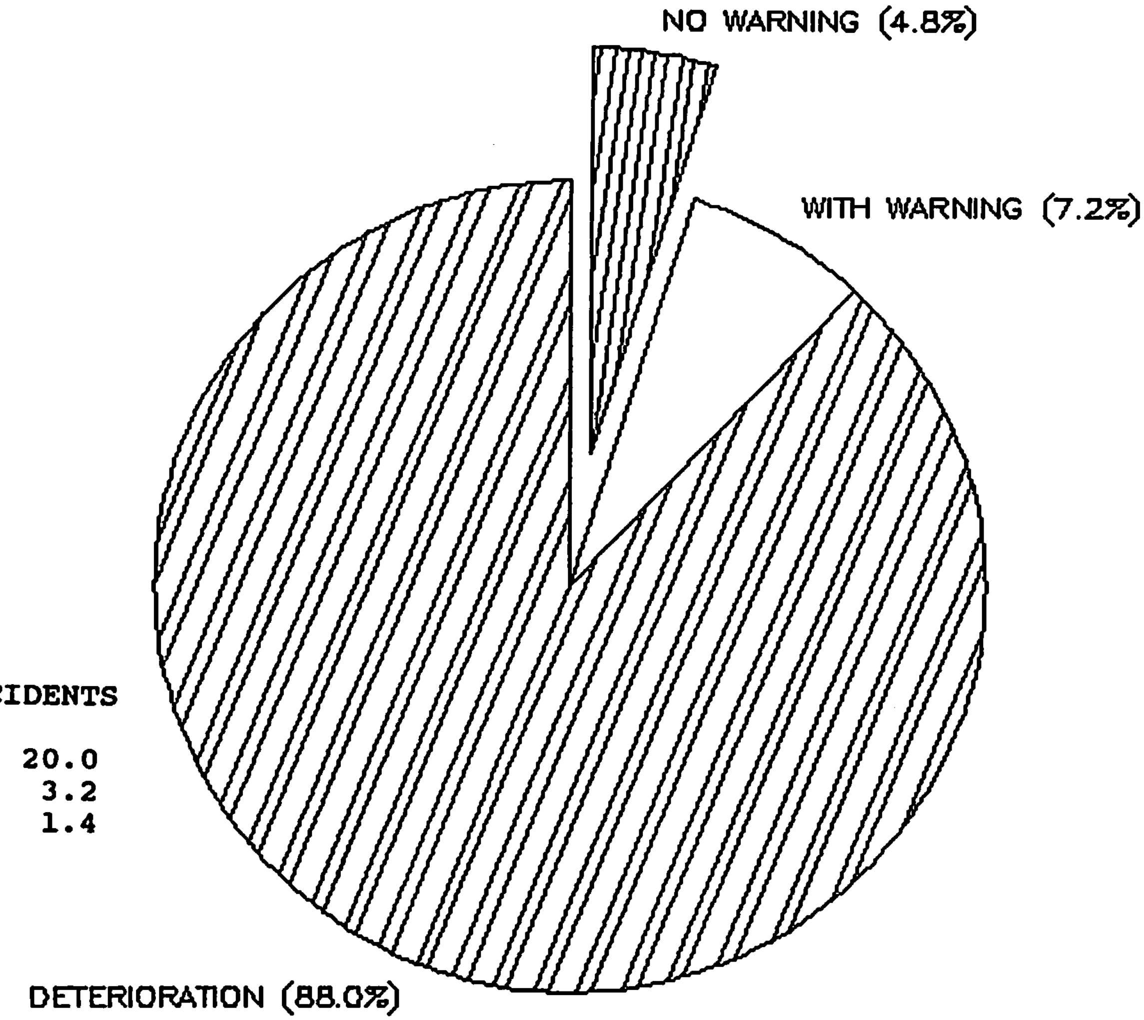


PERCENT INVOLVING ACCIDENTS

PARTIAL LOSS	3.8
NO LOSS	1
TOTAL LOSS	47.7
UNKNOWN	1.6

Figure 2.9

LOSS OF CONTROL
PERCENT OF COMPLAINTS



PERCENT INVOLVING ACCIDENTS

NO WARNING	20.0
WITH WARNING	3.2
DETERIORATION .	1.4

Table 2.8

Accident and Injury Incidence By Vehicle Mileage at Failure

FREQUENCY PERCENT ROW PCT COL PCT	NO ACDNT	NO INJ	INJURY	FATALITY	TOTAL
UNKNOWN	10118 58.09 97.52 59.67	185 1.06 1.78 55.22	69 0.40 0.67 57.98	3 0.02 0.03 60.00	10375 59.57
1 TO 10K	3355 19.26 96.57 19.78	88 0.51 2.53 26.27	31 0.18 0.89 26.05	0 0.00 0.00 0.00	3474 19.95
10K TO 25K	1822 10.46 97.85 10.74	25 0.14 1.34 7.46	15 0.09 0.81 12.61	0 0.00 0.00 0.00	1862 10.69
50K TO 75K	272 1.56 96.11 1.60	11 0.06 3.89 3.28	0 0.00 0.00 0.00	0 0.00 0.00 0.00	283 1.62
25K TO 50K	1256 7.21 97.74 7.41	23 0.13 1.79 6.87	4 0.02 0.31 3.36	2 0.01 0.16 40.00	1285 7.38
OVER 75K	135 0.78 97.83 0.80	3 0.02 2.17 0.90	0 0.00 0.00 0.00	0 0.00 0.00 0.00	138 0.79
TOTAL	16958 97.36	335 1.92	119 0.68	5 0.03	17417 100.00

Table 2.9

Accident and Injury Incidence By Month of Failure

FREQUENCY PERCENT ROW PCT COL PCT	NO ACDNT	NO INJ	INJURY	FATALITY	TOTAL
UNK	17	0	0	0	17
	0.10	0.00	0.00	0.00	0.10
	100.00	0.00	0.00	0.00	
	0.10	0.00	0.00	0.00	
01	1504	33	10	0	1547
	8.64	0.19	0.06	0.00	8.88
	97.22	2.13	0.65	0.00	
	8.87	9.85	8.40	0.00	
02	1311	19	10	0	1340
	7.53	0.11	0.06	0.00	7.69
	97.84	1.42	0.75	0.00	
	7.73	5.67	8.40	0.00	
03	1461	36	10	0	1507
	8.39	0.21	0.06	0.00	8.65
	96.95	2.39	0.66	0.00	
	8.62	10.75	8.40	0.00	
04	1262	15	11	0	1288
	7.25	0.09	0.06	0.00	7.40
	97.98	1.16	0.85	0.00	
	7.44	4.48	9.24	0.00	
05	1300	32	12	1	1345
	7.46	0.18	0.07	0.01	7.72
	96.65	2.38	0.89	0.07	
	7.67	9.55	10.08	20.00	
06	1618	29	10	0	1657
	9.29	0.17	0.06	0.00	9.51
	97.65	1.75	0.60	0.00	
	9.54	8.66	8.40	0.00	
07	1573	29	8	0	1610
	9.03	0.17	0.05	0.00	9.24
	97.70	1.80	0.50	0.00	
	9.28	8.66	6.72	0.00	
08	1642	27	10	0	1679
	9.43	0.16	0.06	0.00	9.64
	97.80	1.61	0.60	0.00	
	9.68	8.06	8.40	0.00	
09	1408	28	11	0	1447
	8.08	0.16	0.06	0.00	8.31
	97.30	1.94	0.76	0.00	
	8.30	8.36	9.24	0.00	
10	1330	24	7	1	1362
	7.64	0.14	0.04	0.01	7.82
	97.65	1.76	0.51	0.07	
	7.84	7.16	5.88	20.00	
11	1232	31	4	1	1268
	7.07	0.18	0.02	0.01	7.28
	97.16	2.44	0.32	0.08	
	7.27	9.25	3.36	20.00	
12	1300	32	16	2	1350
	7.46	0.18	0.09	0.01	7.75
	96.30	2.37	1.19	0.15	
	7.67	9.55	13.45	40.00	
TOTAL	16958	335	119	5	17417
	97.36	1.92	0.68	0.03	100.00

33.1 percent of complaints). There is, however, no consistent pattern to stalling accidents by season which would indicate that stalling at any time of year is inherently more dangerous than at other times.

As can be seen in Table 2.10, approximately six percent of the stalling complaints involved a fire. About one-third of these (33 incidents) were recorded as being associated with an accident. Fires have been previously found to be dangerous safety problems; stalling incidents involving fire are considered separate failure modes by NHTSA.

2.3 Hard-Copy Accident Data Analysis

In an attempt to gain greater insight into the causation and circumstances surrounding dangerous stalling incidents, a sample of about 20 percent of accident-related stalling complaints was selected from the consumer complaint files. A detailed review was conducted of the hard-copy documentation associated with each case. Table 2.11 summarizes the findings of this review.

The amount of useful information contained in the complaint hard-copy data files is quite variable. While most cases include the vehicle owner's questionnaire or an informative description of the automotive problems encountered, others contain barely enough information to identify the vehicle make involved. It is not surprising, therefore, that it was not possible to clearly identify the circumstances surrounding many stalling incidents from the documentation available. The estimates presented in Table 2.11 should be considered as lower bounds on the true percentages of stalling types.

Data from the analysis of stalling complaints indicate that stalling at highway speeds or accelerating into an intersection or highway may be associated with stalling incidents that result in accidents. Likewise, the more frequent the stalling problems, the more likely that one or more may result in an accident. In addition, loss of power steering or brakes is frequently cited as the immediate cause of stalling accidents.

Table 2.10

Accident and Injury Incidence By Reported Fire

FREQUENCY / PERCENT / ROW PCT / COL PCT	NO ACDNT	NO INJ	INJURY	FATALITY	TOTAL
NO FIRE	14197	255	94	2	14548
	81.51	1.46	0.54	0.01	83.53
	97.59	1.75	0.65	0.01	
	83.72	76.12	78.99	40.00	
UNKNOWN	2692	58	16	1	2767
	15.46	0.33	0.09	0.01	15.89
	97.29	2.10	0.58	0.04	
	15.87	17.31	13.45	20.00	
FIRE	69	22	9	2	102
	0.40	0.13	0.05	0.01	0.59
	67.65	21.57	8.82	1.96	
	0.41	6.57	7.56	40.00	
TOTAL	16958	335	119	5	17417
	97.36	1.92	0.68	0.03	100.00

Table 2.11

Characteristics of Stalling Accidents Derived From Hard-Copy Documents

Characteristic	Percent of Complaints
No accident or accident not due to stalling	16
Stalling on highway or at highway speeds	15
Stalling in intersection	19
Frequent stalling problems	60
Stalling associated with acceleration	21
Power steering/power brake failure	20

Analysis of data contained in the automated data file shows that stalling incidents that occur without warning or where there is a complete loss of control are more likely to be associated with accidents. As discussed previously, insufficient data were available on other variables (e.g., speed) to draw conclusions as to their relationship with stalling accidents.

The fact that 16 percent of the accident-related stalling complaints investigated did not involve an accident caused by a stalling problem indicates that the rates of stalling accidents calculated in Section 2.1 are probably overstated. If this sample is representative of all stalling complaints, then the overall rate of stalling accidents per 100,000 vehicles could be as low as 0.28 instead of 0.32. Since the number of stalling accidents reported for each vehicle make is quite small (averaging only a few in a ten-year period), the misspecification of a single stalling-related accident could potentially make a substantial difference in the estimates of that vehicle's accident rate. Because of this, heavy reliance on stalling-related vehicle accident rates for the purpose of making decisions on whether to initiate a safety investigation does not seem prudent.

2.4 Data Deficiencies

Other information might help clarify which stalling incidents have profound safety consequences. Some of this information is contained in the complaints data (hard-copy and automated), but much of it is not currently collected. The following list of data elements are potentially associated with the incidence of stalling-related accidents.

Table 2.12

Data Elements Potentially Associated With Stalling Accidents

1. Weather conditions
2. Time of day
3. Ambient temperature
4. Time from start to first stalling incident
5. Vehicle in motion? (yes, no)
6. Vehicle speed
7. Vehicle under acceleration
8. Loss of power steering or power brakes
9. Delay in restarting
10. Stalling with or without warning
11. Vehicle mileage
12. Road type (stalling location)
13. Driver characteristics

If the information listed in Table 2.12 were collected for a sufficiently large sample of stalling accidents, it might be possible to determine the extent to which each variable reflects the possibility that a stalling complaint will be associated with an accident. Several statistical techniques (including discriminant analysis) are applicable to this type of analysis. However, a considerable amount of data collection activity would be necessary to develop a data base complete enough to be useful for these types of analyses.

3.0 IDENTIFICATION OF VEHICLES AND ENGINE SYSTEMS WITH HIGH ACCIDENT AND COMPLAINT RATES

3.1 Vehicle Makes

The purpose of this section is to identify vehicle makes that have high complaint and stalling-related accident rates per 100,000 vehicles registered. Two time periods are considered: all complaints received between 1975 and 1985; and complaints received and vehicles produced in model years from 1980 to 1985. These later complaints are indicative of more recent stalling problems which might potentially lead to new safety investigations.

There is considerable variation among vehicle makes in the rates of stalling complaints and stalling-related accidents. The average rates of complaints and stalling-related accidents per 100,000 vehicles (foreign, domestic, and light trucks) for the two time periods is shown below.

Table 3.1
Average Complaint and Accident Rates

	Number of Accidents	Number of Complaints	Registered Vehicles (1984)	Complaints Per 100,000 Vehicles	Accidents Per 100,000 Vehicles
1975-1985	459	17,417	141,400,000	12.3	0.32
Post-1980 Model Years	148	6,486	48,000,000	13.3	0.30

The average rate of stalling accidents has remained nearly constant while the rate of complaints for post-1980 vehicles is slightly higher (eight percent) than for the entire ten-year period.

Since it would be expected that some older vehicles would have been retired from the fleet by 1984, the rates of complaints and accidents per vehicle produced would be somewhat higher than the rates calculated here. However, it was felt that using the latest registration figures available to normalize complaint and stalling accidents gives the best overall picture of current safety concerns.

Table 3.2 contains only data for those vehicle makes that had four or more stalling-related accidents during the 1975-1985 time period. These account for 65 percent of all stalling-related accidents and 59 percent of all stalling complaints. The table was restricted to these vehicle types because it was felt that vehicle types with three or less accidents over a ten-year period were statistically insignificant. About 25 vehicle makes have complaint rates that are significantly higher* than the average in the 1975-1985 data. These are listed on the top of Table 3.2 (down to and including the Ford Fairmont).

Many of these vehicles also have elevated accident rates. Exceptions are the Reliant, Rabbit, Citation, and the Monterey/Marquis and Thunderbird which do not have significantly** higher accident rates than expected. Many of the vehicle makes with high accident and complaint rates have been involved in previous safety investigations or recalls. These include the Aspen/Volare, Pacer, Omni/Horizon, and Rabbit.

Table 3.3 and Figures 3.1 through 3.4 display stalling accident and complaint data for vehicles sold in model years subsequent to 1980. The vehicle types listed are restricted to those that have had three or more reported stalling-related accidents. The data are in descending order according to complaint rate.

The top eleven vehicle makes have significantly higher complaint rates than the average (down to and including the Buick Century/Regal). All these vehicles are also on the list of vehicle types with complaint rates significantly higher than average for the 1975-1985 data. Most also have higher than expected accident rates, with the exceptions being the Citation and the Century/Regal.

*The normal approximation to the poisson distribution was used to test statistical significance. Actual complaints which are more than three standard deviations higher than expected are considered significantly higher than average.

**The poisson test of statistical significance was used.

Table 3.2
Stalling Complaints, 1975 - 1985

Vehicle Make	Accidents	Compl'ts	Reg's. (100K)	Accident Rate*	Compl't Rate*	Accidents/ Compl't
ASPEN	21	687	7.12	2.95	96.49	0.03
VOLARI	30	880	9.31	3.22	94.52	0.03
DART	13	574	8.42	1.54	68.17	0.02
MONACO	4	108	1.62	2.47	66.67	0.04
PACER	4	118	1.9	2.10	62.11	0.03
OMNI	6	371	6.17	0.97	60.13	0.02
HORIZON	5	412	7.05	0.71	58.44	0.01
LEBARON	5	333	5.74	0.87	58.01	0.01
VALIANT	12	566	10.29	1.17	55.00	0.02
RELIANT	3	287	5.59	0.54	51.34	0.01
AIRES	3	217	4.42	0.68	49.09	0.01
PHOENIX	5	182	3.81	1.31	47.77	0.03
CORDOBA	6	299	6.47	0.93	46.21	0.02
AUDI FOX/100	4	63	1.64	2.44	38.41	0.06
FURY	6	180	4.83	1.24	37.27	0.03
RABBIT	4	434	11.96	0.33	36.29	0.01
CENTURY/REGAL	17	399	12.29	1.38	32.47	0.04
OMEGA	4	188	6.01	0.67	31.28	0.02
CITATION	4	359	11.68	0.34	30.74	0.01
SKYLARK	7	353	12.21	0.57	28.91	0.02
NEWPORT	6	128	4.54	1.32	28.19	0.05
LYNX	4	60	3.02	1.32	19.87	0.07
MONTERAY/MARQUIS	5	231	11.8	0.42	19.58	0.02
ESCORT	7	217	11.21	0.62	19.36	0.03
FAIRMONT	8	209	13.24	0.60	15.79	0.04
THUNDERBIRD	6	197	13.74	0.44	14.34	0.03
ELDORADO	5	73	5.38	0.93	13.57	0.07
LINCOLN-MARK	5	73	5.64	0.89	12.94	0.07
LTD	11	334	29.53	0.37	11.31	0.03
CONTINENTAL	4	73	6.52	0.61	11.20	0.05
MALIBU	11	240	22.81	0.48	10.52	0.05
FIREBIRD	5	103	9.84	0.51	10.47	0.05
CUTLASS	19	505	50.02	0.38	10.10	0.04
DELTA 88	5	192	21.71	0.23	8.84	0.03
MUSTANG	9	136	18.84	0.48	7.22	0.07
NOVA	7	124	18.51	0.38	6.70	0.06
CAMERO	5	96	16.92	0.30	5.67	0.05
MONTE CARLO	10	133	25.22	0.40	5.27	0.07
CATELINA/BONNEVILLE	7	82	15.97	0.44	5.13	0.09
BLAZER	4	31	6.85	0.58	4.53	0.13

*Per 100K.

Table 3.3

Stalling Complaints, Model Years 1980 - 1985

Vehicle Make	Accidents	Compl'ts	Reg's (100K)	Accident Rate*	Compl't Rate*	Accidents/ Compl't
RELIANT	3	287	5.59	0.54	51.34	0.01
OMNI	4	225	4.45	0.90	50.56	0.02
AIRES	3	217	4.42	0.68	49.09	0.01
HORIZON	3	230	4.92	0.61	46.75	0.01
PHOENIX	5	129	3.08	1.62	41.88	0.04
CITATION	4	352	11.25	0.36	31.29	0.01
THUNDERBIRD	6	114	4.36	1.38	26.15	0.05
SKYLRK	6	208	8	0.75	26.00	0.03
LYNX	4	59	3.02	1.32	19.54	0.07
ESCORT	7	216	11.21	0.62	19.27	0.03
CENTURY/REGAL	3	173	9.07	0.33	19.07	0.02
ELDORADO	5	49	2.57	1.95	19.07	0.10
FIREBIRD	4	55	3.55	1.13	15.49	0.07
FAIRMONT	4	81	6.24	0.64	12.98	0.05
CUTLASS	11	245	21.23	0.52	11.54	0.04
MUSTANG	4	71	6.54	0.61	10.86	0.06
DELTA 88	3	75	8.23	0.36	9.11	0.04
LINCOLN-MARK	3	12	1.34	2.24	8.95	0.25
BLAZER	4	22	4.84	0.83	4.55	0.18
RANGER/F-SERIES	3	97	22.2	0.13	4.37	0.03

*Per 100K.

Figure 3.1

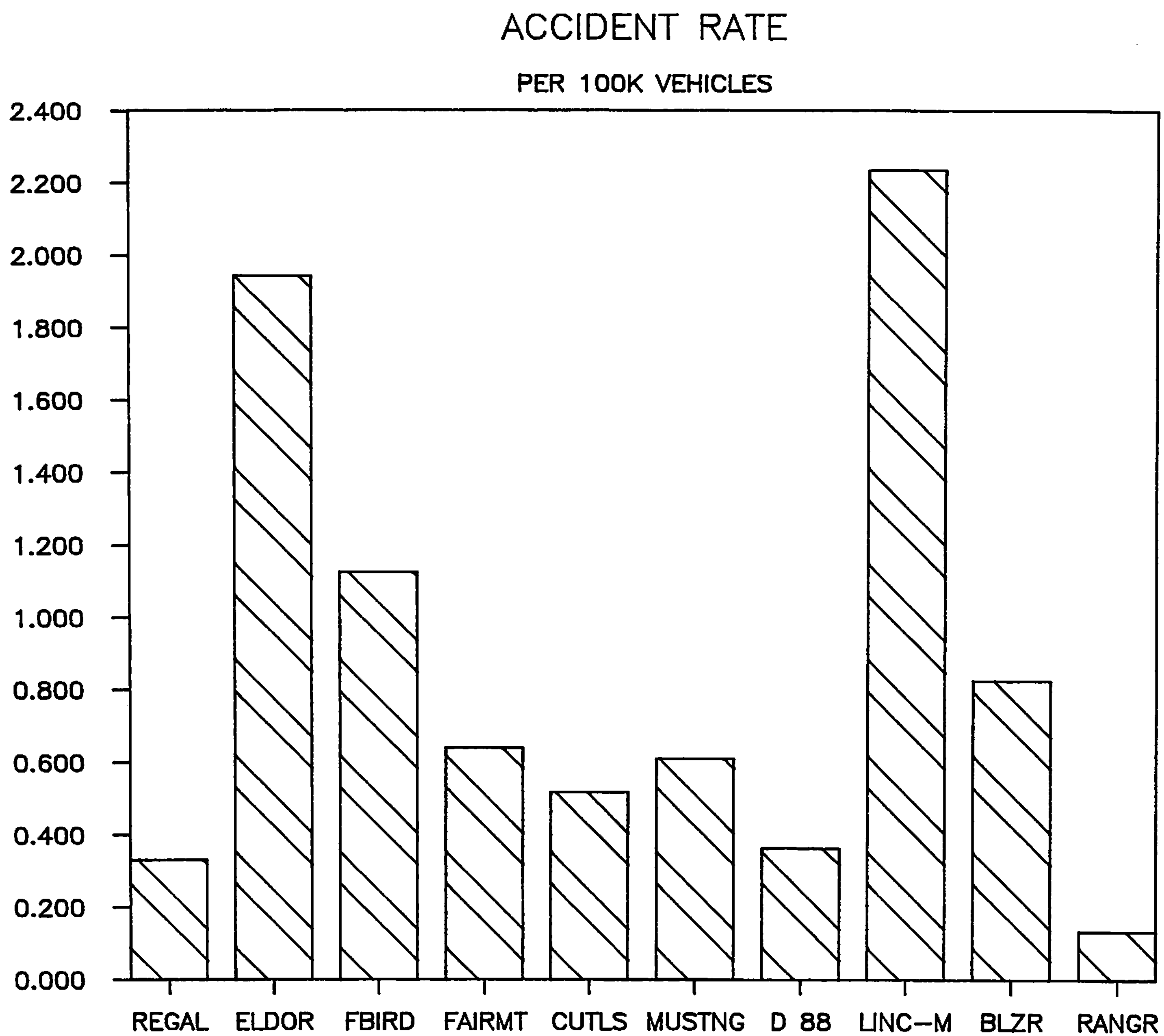

ACCIDENT RATE
PER 100K VEHICLES
2.400
2.200
2.000
1.800
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
REGAL
ELDOR
FBIRD
FAIRMT
CUTLS
MUSTNG
D 88
LINC-M
BLZR
RANGR

Figure 3.2

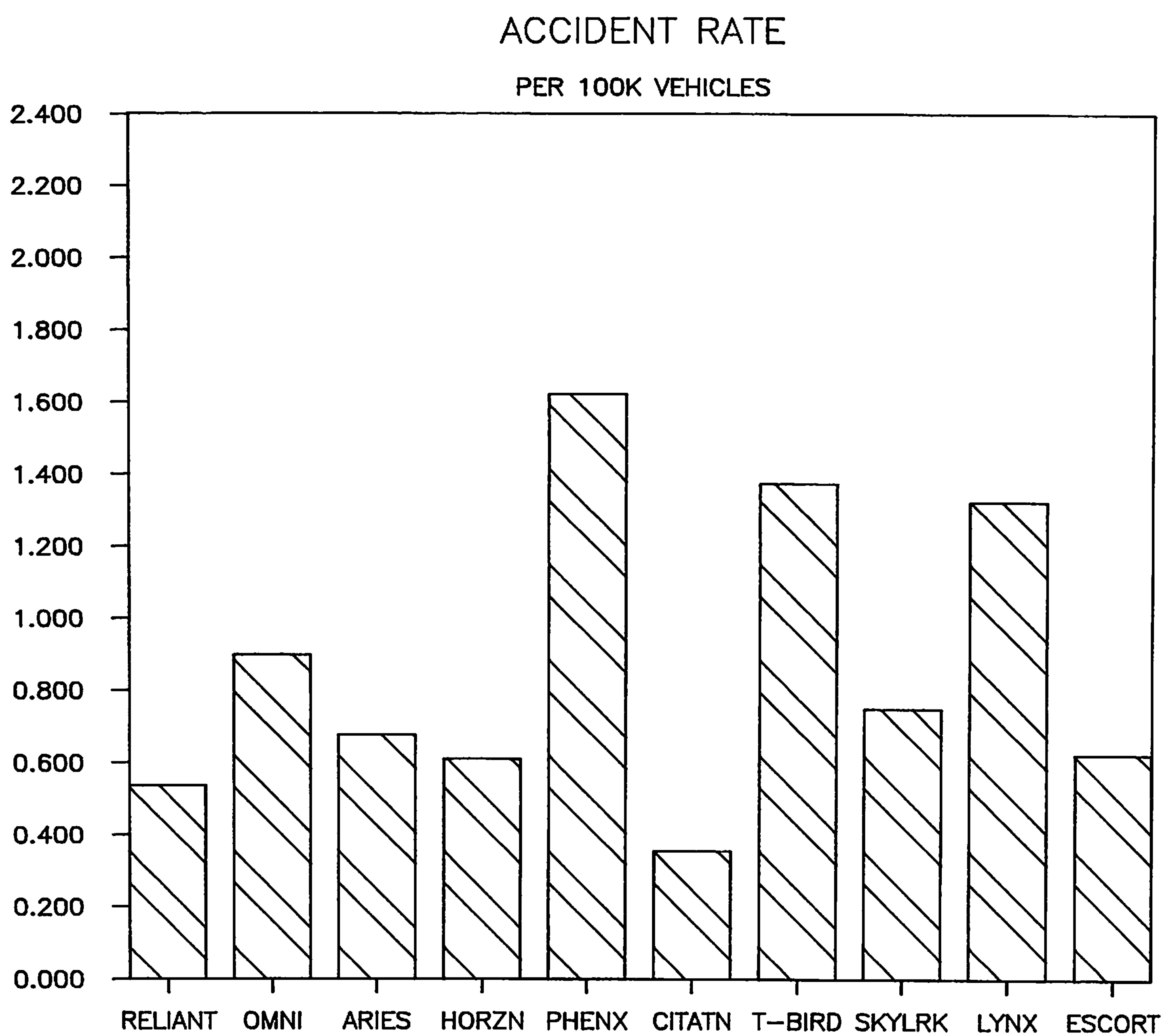

ACCIDENT RATE
PER 100K VEHICLES
2.400
2.200
2.000
1.800
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
RELIANT
OMNI
ARIES
HORZN
PHENX
CITATN
T-BIRD
SKYLRK
LYNX
ESCORT

Figure 3.3

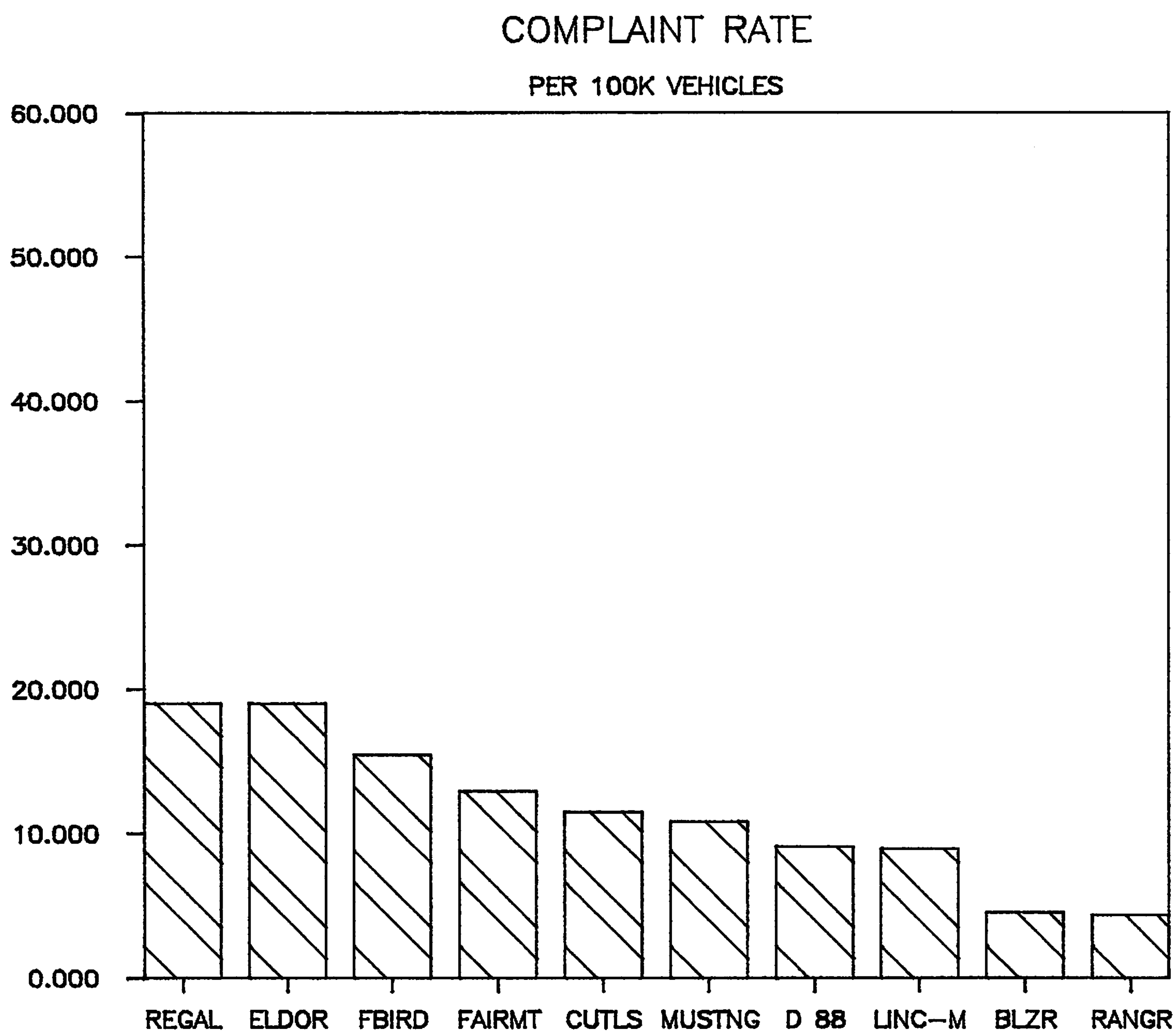
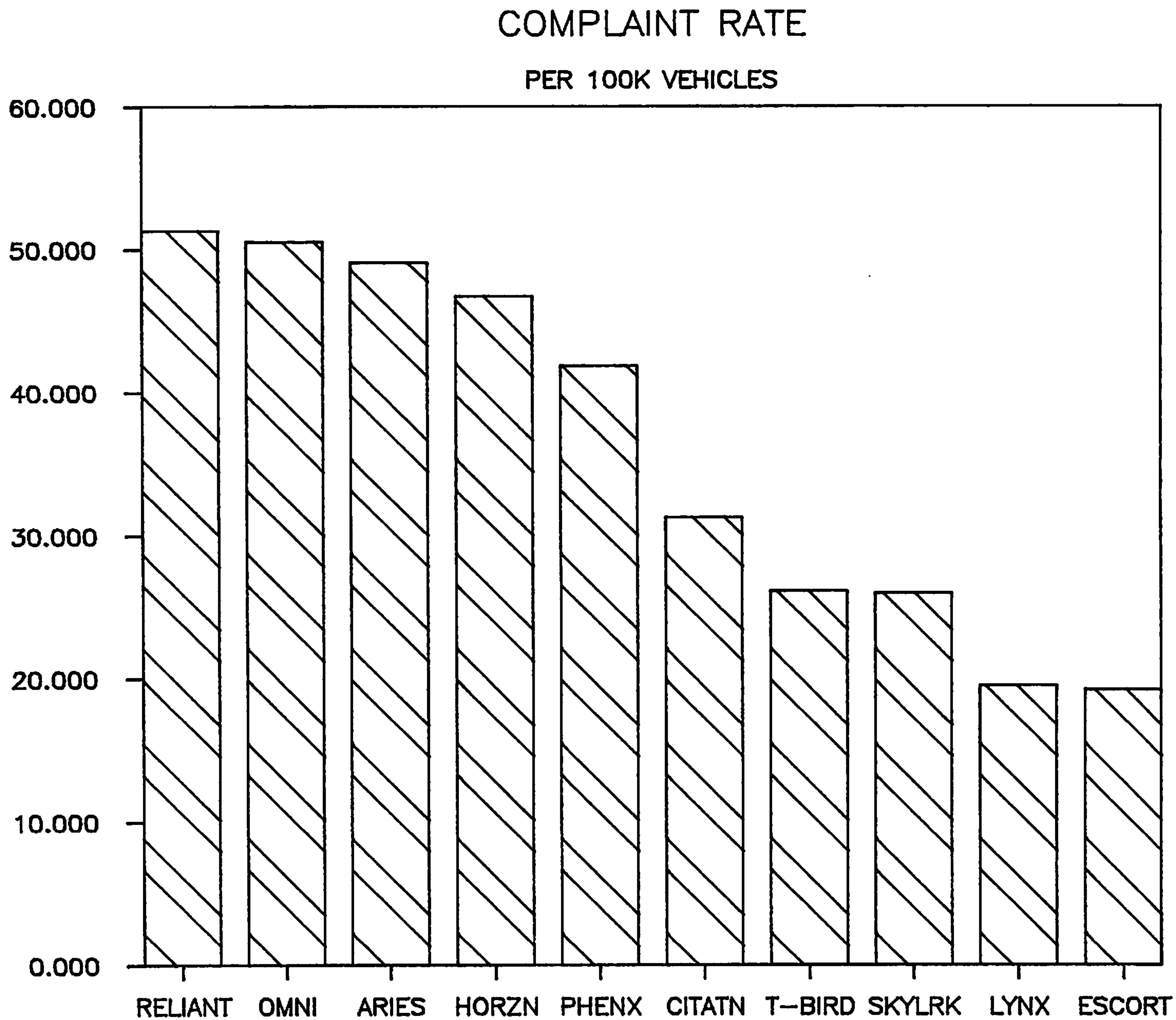

COMPLAINT RATE
PER 100K VEHICLES
60.000
50.000
40.000
30.000
20.000
10.000
0.000
REGAL
ELDOR
FBIRD
FAIRMT
CUTLS
MUSTNG
D 88
LINC-M
BLZR
RANGR

Figure 3.4


COMPLAINT RATE
PER 100K VEHICLES
60.000
50.000
40.000
30.000
20.000
10.000
0.000
RELIANT
OMNI
ARIES
HORZN
PHENX
CITATN
T-BIRD
SKYLRK
LYNX
ESCORT

3.2 Engine Systems (Domestic Vehicles)

The purpose of this section is to identify engine systems with high stalling complaint and accident rates. As with vehicle types, complaint rates are calculated by dividing the number of complaint records (in this case summed over engine systems) by the applicable number of 1984 registrations for that engine system.

Engine systems are identified only for those complaint records that have valid Vehicle Identification Numbers, and for which an engine code is available. This limits the analyst to domestically-produced vehicles, because foreign manufacturers do not uniformly use engine codes in their VIN numbers and light truck VIN numbers do not always uniquely identify a specific engine system. As a consequence of these limitations, the total number of complaints analyzed in this section is reduced to 6,363 records (44 percent of the total). The complaint rates calculated for engine systems are, therefore, not directly comparable with complaint rates calculated in Section 3.1. The average rate of complaints (with valid VIN numbers) for all engines on domestic automobiles for the years 1975-1985 is 6,363/87,900,000 = 7.2 complaints per 100,000 vehicles.

Table 3.4 lists complaint data by manufacturing division for engine systems with ten or more complaints and a complaint rate greater than the average of all engines. A complete list of all complaints is contained in Appendix 1. Table 3.5 collapses these data over divisions, listing all complaints filed company-wide for specific engines.

It is noteworthy that many of the highest complaint rate engine systems are manufactured by Chrysler, with the highest being the six-cylinder, 225 cubic-inch, one-barrel carburetor engine. This single engine accounted for over 1,000 complaints (16 percent of all complaints with valid VIN numbers), and had a complaint rate of nearly 50 per 100,000 vehicles registered (nearly seven times the average stalling complaint rate).

Table 3.4

Engine System Complaint Rates by Manufacturing Division

Make/Division	Engine	Codes	Complaints	Registrations (100,000)	Complaint Rate
AMC	6-258-1V	A	49	3.79	12.9
	4-085-T	D	17	2.29	7.4
	8-304-2V	H	24	1.83	13.1
Buick	6-231-2V	A,C,2	226	20.4	11.1
	6-173-2V	X,Z,7	48	3.68	13.0
	4-151-2V	5	33	2.16	15.2
Cadillac	8-350-F	B,R	23	2.17	10.6
	8-350-FS	N	13	1.27	10.3
	8-368-F	9	14	1.86	7.5
Chevrolet	6-196-2V	C,M	59	3.50	16.9
	4-097-1V	E,J	87	4.01	21.7
	4-112-2V	G	13	1.21	7.6
	4-151-2V	V,5,9	93	7.11	13.1
	6-173-2V	X,Z,1,7	88	9.86	8.9
Oldsmobile	6-231-2V	A,C	133	15.16	8.8
	8-350-FS	N	75	4.61	16.3
	6-173-2V	X,7	22	1.35	16.2
	4-151-2V	5	15	1.33	11.3
Pontiac	6-231-2V	A,C	118	9.58	12.3
	4-112-2V	G	11	.86	12.7
	4-151-2V	V,5	56	4.43	12.7
	6-173-2V	X,Z,1,7	25	2.82	8.9
Lincoln	8-460-4V	Z	19	5.94	3.2
Ford	6-232-T	3	33	1.81	18.2
	4-098-F	5	10	.18	55.2
Mercury	6-232-T	3	16	.96	16.7

The engine specifications are composed of three sets of values separated by "dashes". The first value is the number of cylinders. The second is the displacement in cubic inches (the number is followed by an "L" if the displacement is in liters). The third value describes the fuel system: a number followed by a "V" is the number of carburetor barrels, "F" = gas fuel injection, "B" = gas turbo, "T" = throttle body injection, "FS" = fuel injected diesel, "X" = turbocharged diesel, "H" = high performance, "J" = California certified engine, "D" = dual carburetors.

Table 3.4

Engine System Complaint Rates by Manufacturing Division (Cont.)

Make/Division	Engine	Codes	Complaints	Registrations (100,000)	Complaint Rate
Chrysler	4-135-2V	B,C	22	1.18	18.7
	6-225-1V	C,E	13	1.03	12.7
	4-155-2V	D,G	20	1.18	11.0
	8-318-2V	G,K,P	71	5.50	12.9
	8-360-2V	K	30	2.73	11.0
	8-400-2V	M	47	2.21	21.3
	8-400-4V	N	96	3.09	31.1
	8-440-4V	T	22	2.12	10.4
Dodge	4-105-2V	A,B	78	3.79	20.6
	4-135-2V	B,C,8	82	6.53	12.6
	6-225-1V	C,E,H	470	8.83	53.2
	6-225-2V	D	64	2.99	21.4
	8-318-2V	G,P	219	10.39	21.1
	8-360-2V	K	45	2.41	18.7
	8-400-2V	M	12	.79	15.1
	8-400-4V	N	18	.39	46.4
Plymouth	4-105-2V	A	110	4.58	24.0
	4-135-2V	B,C	98	6.82	14.4
	6-225-1V	C,H	537	11.01	48.8
	6-225-2V	D	90	3.67	24.6
	6-198-1V	B	12	.54	22.1
	8-318-2V	G,K	188	10.00	18.8
	8-360-2V	K	26	2.60	10.0
	8-400-2V	M	15	.86	17.4

Table 3.5

Engine System Complaint Rates by Manufacturer

	Engine	Number of Complaints	Rate/100K
AMC	6-258-IV	49	12.9
	6-085-T	17	7.4
	8-304-2V	24	13.1
GM	4-151-2V	197	13.1
	6-173-2C	183	10.3
	6-231-2V	523	9.1
	4-112-2V	26	8.3
	8-350-FS	107	13.1
	4-097-1V	87	21.7
	6-196-2V	64	17.9
	8-350-F	23	10.6
Ford	6-232-TD	49	17.7
	4-098-F	26	7.5
Chrysler	4-135-2V	202	13.9
	6-225-1V	1020	48.9
	6-225-2V	163	23.2
	8-318-2V	478	18.5
	8-360-2V	101	13.0
	8-400-2V	74	19.2
	8-400-4V	115	13.4
	8-400-4V,H	35	14.2
	4-105-2V	188	20.0
	4-155-2V	34	8.5

3.3 Engine Systems (Foreign Vehicles)

Tables 3.6 and 3.7 show the complaints rates for foreign made vehicles by engine system. The first table is for the entire period, 1975 through 1985, while the second table restricts the analysis to vehicle model years since 1980.

Because foreign manufacturers do not consistently use an engine code as part of their Vehicle Identification Numbers, it was necessary to use the classification derived from the Vindicator program to identify specific engine types. This is not as satisfactory as using VIN number engine codes, as was done for domestic vehicles, because distinguishing individual engines is more difficult using the Vindicator designations than engine codes. For example, the Vindicator engine series often makes no distinction between fuel injected engine systems and those employing carburetion.

Overall, engine systems identified as having high complaint rates include several manufactured by VW, Audi, and Renault. For the post-1980 period, the complaint rates are generally lower with Renault, Volvo, and Mitsubishi, with VW engines having the highest rates of complaints.

Table 3.6

Complaints on Foreign Automobiles by Engine Type*

(1975-1985)

	Engine	Number of Complaints	Registrations (100,000)	Complaints per 100K Vehicle
Nissan	4-1.6L-2V	5	5.12	1.0
	4-2.0L	6	1.45	4.1
Mazda	4-1.5L-2V	7	1.96	3.6
VolVo	4-2L (F or 1VD)	5	1.84	2.7
	4-2.1L	20	1.25	16.0
Audi	4-1.9L-F (or 2V)	13	.58	22.4
	4-1.5L-2V	16	.25	64.0
	5-2.14L-F	15	1.60	9.4
Mitsubishi	4-1.6L-2V	21	4.85	4.3
	4-2.0L-2V	9	.73	1.23
Honda	4-1.25L-2V	20	2.31	8.6
	4-1.5L-3V	23	7.88	2.9
	4-1.6L-3V	22	1.78	12.4
	4-1.75L-3V	11	10.11	1.1
	4-1.8L-3V	5	2.38	2.1
MG	4-110	9	1.36	6.6
Subaru	4-1.8L-2V	16	4.59	2.5
Renault	4-1.4L-T (or F)	24	2.39	10.0
	4-1.6L-F	5	.42	11.9
VW	4-1.68L-F	5	.34	14.7
	4-1.58L	39	1.28	30.5
	4-F**	164	5.26	31.2
	4-1.45L-F	52	1.49	32.7
	4-1.59L-D	5	1.94	2.6
	4-1.72L-F	18	2.86	6.3

The engine specifications are composed of three sets of values separated by "dashes". The first value is the number of cylinders. The second is the displacement in cubic inches (the number is followed by an "L" if the displacement is in liters). The third value describes the fuel system: a number followed by a "V" is the number of carburetor barrels, "F" = gas fuel injection, "B" = gas turbo, "T" = throttle body injection, "FS" = fuel injected diesel, "X" = turbocharged diesel, "H" = high performance, "J" = California certified engine, "D" = dual carburetors.

*Only for Engines with five or more complaints.

**Engine size not specified (1977-1980).

Table 3.7

Complaints on Foreign Automobiles By Engine Type*

Model Years Since 1980

	Engine	Number of Complaints	Registrations (100,000)	Complaints per 100K Vehicle
Nissan	4-1.6L-2V	5	3.79	1.3
	4-2.0L-2V	6	1.46	4.1
	4-1.5L-2V	4	4.19	1.0
Toyota	4-1.5L	4	5.46	0.7
Mazda	4-1.5L-2V	7	1.96	3.6
Volvo	4-2.1L-F	14	1.25	11.2
	4-2.3L	3	1.07	2.8
Audi	5-21L	7	1.15	6.1
Mitsubishi	4-2.6L-2V	8	.97	8.2
Honda	4-1.5L-3V	7	4.81	1.5
	4-1.75L-3V	11	8.40	1.3
	4-1.8L	5	2.39	2.1
Subaru	4-1.6L-2V	3	1.51	2.0
	4-1.8L-2V	16	4.59	3.5
Renault	4-1.4L-F	24	2.39	10.0
	4-1.6L-F	5	.40	12.5
VW	4-1.6L-F	3	.44	6.8
	4-1.45L-F	21	24.6	8.5
	4-1.6L-D	5	1.94	2.6
	4-1.7L-F	18	2.87	6.3

*For engines with three or more complaints.

4.0 ANALYSIS OF SERVICE BULLETINS

An analysis of the NHTSA Service Bulletin file was conducted to determine whether vehicles with serious stalling problems could be identified from manufacturer-issued service bulletins associated with stalling defects.

NHTSA maintains a file of all service bulletins issued by manufacturers concerning changes in maintenance procedures, recalls, and other information sent to vehicle service organizations. There are over 40,000 service bulletins covering the period since 1975.

Unfortunately, there is no easy method for categorizing service bulletins by type of problem (e.g. to identify which service bulletins are associated with stalling). The method employed was to search (by automated means) the text field which summarizes the information contained in the service bulletin for the phrase 'STALL.' Service bulletins which refer to stalling were identified and printed. Table 4.1 shows the results of this analysis. Only 186 stalling-related service bulletins were identified; most of these (83 percent) were for Ford products. This distribution is not in any way similar to the distribution of stalling complaints analyzed in Section 3.0 (which is skewed toward Chrysler vehicles). For these reasons, it does not appear that useful information can be obtained through this method of analyzing service bulletins.

Table 4.1

Stalling-Related Service Bulletins

By Manufacturing Division

Vehicle Make	Number of Service Bulletins	Percent of Total
Chrysler	1	0.5
Dodge	1	0.5
Plymouth	1	0.5
Ford	67	36.4
Lincoln	11	16.0
Mercury	52	28.3
Ford Truck	24	13.0
Buick	2	1.1
Cadillac	1	0.5
Oldsmobile	1	0.5
Pontiac	4	2.2
BMW	1	0.5
VW	6	3.3
Honda	6	3.3
Mazda	1	0.5
Volvo	1	0.5
Saab	2	1.1
motor cycles	2	1.1
Detroit Diesel	1	0.5

APPENDIX 1

DETAILED STALLING COMPLAINT DATA BY ENGINE CODE

AMC

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
6,258,1	A	49	379,367	12.9
4.151,2	B	3	92,243	3.3
6,258,2	C	29	598,549	4.8
4,085,T	D	17	229,287	7.4
6,232,1	E	29	487,922	5.9
4,085,FJ	E	6	10,448	57.4
4,121,2	G	1	29,149	3.4
8,304,2	H	24	182,742	13.1
8,360,2	N	8	88,519	9.0

BUICK

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
6,231,2	A	134	1,572,704	8.5
	C	91	460,484	19.8
	2	1	3,832	26.1
Total		226	2,037,121	11.1
6,196,2	C	5	8,137	61.4
6,250,1	D	1	14,159	7.1
6,181,2	E	13	239,530	5.4
4,112,2	G	1	33,497	3.0
6,231,2B	G	1	2,213	45.2
8,350,2	H	31	704,074	4.4
8,305,4	H	1	29,899	3.3
	Y	12	566,525	2.1
Total		13	596,424	2.2
8,350,4	J	4	583,367	0.7
	L	1	8,613	11.6
	R	2	115,698	1.7
	X	5	284,083	1.8
Total		12	991,761	1.2
8,403,4	K	3	194,330	1.5
8,350,FS	N	8	88,782	9.0
8,350,4J	R	1	33,313	3.0
8,265,2	S	1	40,385	2.5
6,263,FS	T	1	10,296	9.7
8,455,4	T	1	365,165	0.3
8,305,2	U	6	133,114	4.5
8,301,4	W	1	76,999	1.3
6,713,2	X	10	231,684	4.3
	Z	2	7,737	25.8
	7	36	138,994	27.9
Total		48	368,415	13.0

BUICK (cont.)

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
8,301,2	Y	11	277,649	4.0
4,112,T	0	3	79,228	3.8
6,231,4B	3	9	71,949	12.5
6,252,4	4	2	236,876	0.8
4,151,2	5	33	217,588	15.2
6,231,FB	9	1	2,693	37.1
1985 Models				
	W	1		
	3	2		
	8	1		

CADILLAC

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
8,350,F	B	12	132,357	9.1
	R	11	84,521	13,0
Total		23	216,878	10.6
8,350,FS	N	13	126,590	10.3
8,425,4	S	17	728,486	2.3
8,500,4	S	7	450,449	1.6
8,425,F	T	3	13,419	22.4
6,252,4	4	2	47,742	4.2
8,363,4	6	3	98,636	3.0
8,250,F	8	5	156,615	3.2
8,250,T	8	2	441,827	0.5
8,368,F	9	14	185,918	7.5

CHEVROLET

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,140,1	A	7	103,403	6.8
4,140,?	B	1	52,059	1.9
4,140,2	B	17	512,203	3.3
4,098,2	D	10	438,195	2.3
	0	19	403,315	4.7
	9	23	637,848	3.6
Total		54	1,479,375	3.6
6,196,2	C	15	89,594	16.7
6,250,1	D	54	1,157,084	4.7
4,122,F	E	1	1,062	94.2
4,098,1	E	68	337,572	20.1
	J	19	63,002	30.2
Total		87	400,574	21.7
8,262,2	G	5	92,587	5.4
8,305,2	G	10	525,038	1.9
	Q	9	307,433	2.9
	U	67	2,104,072	3.2
Total		86	2,936,643	2.9
4,112,2	G	13	171,308	7.6
8,305,4	G	6	43,699	13.7
	H	14	1,048,068	1.3
Total		20	1,091,767	1.8
8,350,2	H	8	2,259,098	0.4
	V	10	497,275	2.0
Total		18	2,656,373	0.7

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,085,1	I	5	76,637	6.5
8,350,4	J	1	108,879	0.9
	L	9	1,185,434	0.8
	4	2	19,643	10.2
	8	2	51,548	3.9
Total		14	1,365,504	1.0
8,267,2	J	26	684,143	3.8
6,231,2	K	17	788,964	2.2
	9	9	198,016	4.5
	A	20	249,086	8.0
Total		46	1,236,066	3.7
6,200,2	M	44	260,054	16.9
8,350,FS	N	7	80,722	8.7
4,122,T	P	8	431,014	1.9
8,400,2	R	3	494,229	0.6
4,151,T	R	5	299,547	1.7
	2	4	34,643	11.5
Total		9	334,190	2.7
6,263,FS	T	1	4,143	24.1
8,400,4	U	3	297,961	1.0
4,151,2	V	9	247,771	3.6
	5	82	462,622	17.7
	9	2	324	617.3
Total		93	710,717	13.1
6,173,2	X	22	515,187	4.3
	Z	1	18,794	5.3
	1	2	159,092	0.6
	7	63	292,715	21.5
Total		88	985,788	8.9

CHEVROLET (cont.)

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
8,305,T	7	4	21,841	18.3
8,350,T	8	1	21,101	4.7
8,350,TD	8	1	30,034	3.3
1985 Models				
	P	1		
	R	1		
	W	1		
	X	1		
	8	2		

OLDSMOBILE

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
6,231,2	A	82	1,385,752	5.9
	C	51	130,108	39.2
Total		133	1,515,860	8.8
6,250,1	D	1	55,447	1.8
6,181,2	E	14	208,720	6.7
8,260,2	F	60	1,132,069	5.3
	8	1	49,299	2.0
Total		61	1,181,368	5.2
8,305,4	H	8	168,637	4.7
	Y	21	1,081,950	1.9
Total		29	1,250,587	2.3
8,301,2	Y	1	55,240	1.8
8,350,4	J	1	4,384	22.8
	K	5	762,700	0.7
	L	1	102,716	1.0
	R	35	1,343,202	2.6
Total		42	2,213,002	1.9
8,403,4	K	8	277,652	2.9
8,350,FS	N	75	461,123	16.3
4,122,T	P	1	20,930	4.8
8,260,FS	P	5	7,423	40.4
4,151,T	R	1	271,426	0.4
8,350,4J	R	1	73,151	1.4
8,455,4	S	1	16,180	6.2
	T	2	434,526	0.5
Total		3	450,70	0.7

PONTIAC

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,140,1	A	1	10,821	9.2
6,231,2	A	83	858,073	9.7
	C	35	100,448	34.8
Total		118	958,521	12.3
4,140,2	B	4	68,888	5.8
4,980,2	C	2	80,513	2.5
6,250,1	D	5	101,221	4.9
8,260,2	F	2	58,796	3.4
4,112,2	G	11	86,459	12.7
8,305,4	G	3	12,527	23.9
	H	4	255,817	1.6
Total		7	268,344	2.6
8,403,4	K	1	115,252	0.9
8,350,4	L	1	1,087	5.2
	P	3	83,288	3.6
	X	1	60,530	1.7
Total		5	162,905	3.1
8,350,2	M	5	547,950	0.9
8,350,FS	N	4	60,031	6.7
8,400,2	N	1	77,558	1.3
	R	5	353,557	1.7
Total		7	431,115	1.6
4,151,T	R	1	200,328	5.0
8,265,2	S	9	89,788	10.0
8,301,4B	T	1	28,021	3.6
8,400,4	T	2	140,743	1.4
	8	5	387,356	1.3
Total		7	528,099	1.3

PONTIAC (cont.)

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
8,305,2	U	9	170,6562	5.3
4,151,2	V	14	288,466	4.9
	5	42	154,131	27.2
Total		56	442,597	12.7
8,301,4	W	5	257,610	1.9
8,455,4	W	1	120,220	0.8
6,173,2	X	6	132,481	4.5
	Z	1	20,710	4.8
	1	1	66,118	1.5
	7	17	62,574	27.2
Total		25	281,883	8.9
8,301,2	Y	16	812,527	2.0
4,112,T	0	5	153,697	3.3
5,252,4	4	1	48,726	2.1
1985 Models				
	F	1		
	G	2		
	H	1		
	X	1		

LINCOLN

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
8,460,4	A	19	494,261	3.2
8,302,2	F	7	31,401	22.3
8,302,T	F	3	153,835	2.0
8,302,TD	F	4	179,632	2.2
8,351,2	H	2	9,440	21.2

FORD

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,140,2	A	11	673,812	1.6
	Y	27	1,533,690	1.8
Total		38	2,207,502	1.7
8,460,4	A	15	216,891	6.9
6,200,1	G	22	684,829	3.2
	T	36	846,628	4.3
	X	1	115,643	0.9
Total		59	1,647,100	3.6
6,250,1	C	1	60,814	1.6
	L	34	1,154,794	2.9
Total		35	1,215,608	2.9
8,255,2	D	32	182,973	1.1
8,302,2	F	79	2,406,982	3.3
8,302,TD	F	32	277,067	11.5
8,351,2	G	3	60,185	5.0
	H	55	2,392,460	2.3
Total		58	2,452,645	2.4
8,302,4	M	1	20,701	4.8
4,140,1	R	15	237,004	6.3
8,400,2	S	25	1,366,588	1.8
4,139,2B	W	4	23,968	16.7
4,122,2	X	2	451,231	0.4
6,169,2	Z	13	382,499	3.4
4,098,2	2	62	858,028	7.2
	4	11	349.133	3.2
6,232,2	3	6	187,859	3.2

FORD (cont.)

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
6,232,TD	3	33	181,351	18.2
4,098,F	5	10	18,118	55.2
1985 Models				
	A	3		
	F	1		
	X	11		
	2	2		
	3	6		
	4	1		

MERCURY

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,139,2	A	3	169,048	1.8
	Y	2	183,711	1.1
Total		5	352,759	1.4
8,460,4	A	10	221,649	4.5
6,200,1	B	4	227,474	1.8
	T	7	201,501	3.5
	X	2	35,818	5.6
Total		13	464,793	2.8
8,460,4H	C	1	651	153.6
8,255,2	D	3	71,039	4.2
8,302,TD	F	11	220,852	5.0
8,302,2	F	19	761,953	2.5
8,351,2	H	13	711,272	1.8
6,250,1	L	10	320.741	3.1
8,429,4	N	2	83,615	2.4
4,140,1	R	9	67,367	13.4
8,400,2	S	13	329,920	3.9
4,140,FB	W	1	3,537	3.9
6,169,2	Z	7	48,407	14.5
4,098,2	2	15	246,098	6.1
	4	1	81,385	1.2
Total		16	327,483	4.9
6,232,2	3	5	91,696	5.5
6,232,TD	3	16	96,021	16.7
1985 Models				
	F	1		
	X	3		
	3	1		

<u>DODGE</u>

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,105,2	A	77	372,230	20.7
	B	1	6,298	15.9
Total		78	378,528	20.6
4,097,2	A	1	13,385	7.5
4,135,2	B	46	289,349	15.9
	C	33	350,847	9.4
	8	3	12,754	23.5
Total		82	652,950	12.6
6,198,1	B	5	20,509	24.4
6,225,1	C	457	849,900	53.8
	E	11	25,621	42.9
	H	2	7,270	27.5
Total		470	882,791	53.2
6,225,2	D	64	299,276	21.4
4,156,2	D	4	74,854	5.3
	G	2	41,102	4.9
Total		6	115,956	5.2
4,135,T	D	2	33,191	6.0
4,135,FB	E	2	20.893	9.6
8,318,2	G	218	1,024,355	21.3
	P	1	14,517	6.9
8,318,4	H	4	30,599	13.1
	N	1	9,604	10.4
Total		5	40,203	12.4

DODGE (cont.)

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
8,340,4	H	1	16,359	6.1
8,350,4	J	2	13,054	15.3
8,360,4J	J	1	8,163	12.3
8,360,2	K	45	241,225	18.7
8,360,2	M	12	79,221	15.1
8,400,4	N	18	38,830	46.4
8,440,4	T	1	10,639	9.4
8,440,4H	U	3	10,572	28.4
1985 Models				
	C	5		
	E	1		
	G	1		

CHRYSLER

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,135,2	B	9	40,511	22.2
	C	13	77,100	16.9
Total		22	117,611	18.7
6,225,1	C	6	61,397	9.8
	E	7	41,188	17.0
Total		13	102,585	12.7
4,156,2	D	2	46,695	6.4
	G	17	134,344	12.7
Total		20	181,039	11.0
6,225,2	D	9	36,586	24.6
4.135,T	D	4	49,226	8.1
4,135,FB	E	2	28,741	7.0
8,318,2	G	62	341,120	18.2
	K	5	176,434	6.5
	P	4	132,926	3.0
Total		71	550,480	12.9
8,318,4	H	4	24,139	16.6
8,360,4	J	8	44,069	18.2
8,360,4J	J	5	26,682	18.7
8,318,F	J	5	8,541	58.5
8,360,2	K	30	272,768	11.0
8,400,2	M	47	220,561	21.3
8,400,4	N	96	308,884	31.1
8,400,4H	P	1	2,534	39.5
8,440,4	T	22	211,979	10.4
1985 Models				
	G	1		

PLYMOUTH

Engine	Code	Complaints	All 1984 Registrations	Rate of Complaints/100K Registration
4,104,2	A	110	457,974	24.0
4,097,2	A	1	15,173	6.6
4,135,2	B	42	323,770	16.1
	C	46	358,162	12.8
Total		98	681,932	14.4
6,125,1	C	535	1,098,312	48.7
	H	2	3,049	65.6
Total		537	1,101,361	48.8
4,156,2	D	6	82,435	7.3
	G	2	20,456	9.8
Total		8	102,891	7.8
6,225,2	D	90	366,569	24.6
6,198,1	B	12	54,263	22.1
8,318,2	G	187	997,648	18.7
	K	1	2,174	46.0
Total		188	999,822	18.8
8,318,4	H	1	15,906	6.3
8,360,2	K	26	260,136	10.0
8,360,4H	L	2	13,352	15.0
8,400,2	M	15	86,277	17.4
8,400,4	N	1	17,865	5.6
8,440,4H	U	19	13,309	67.6
1985 Models				
	C	5		

APPENDIX 2

SAS PROGRAMS

This section provides documentation for all the software programs generated during the course of this project. These programs are divided into two categories: (1) SAS and Fortran programs; and (2) NIH system utility programs. A description in detail of each program is provided along with a copy of each sample program used in the project. This documentation is most beneficial when it is used along with the SAS USER'S GUIDE and NIH WYLBER COMMAND USER'S GUIDE.

PROGRAM DIRECTORY

PART 1: SAS AND FORTRAN PROGRAMS

Program #1: To convert the consumer complaint data to SAS format.

Program #2: To convert the complaint names and addresses to SAS format.

Program #3: To convert the service bulletin data to SAS format.

Program #4: To convert the Polk data from a NIH standard tape to SAS format.

Program #5: To generate the vehicle identification data from the VINDICATOR data base on NIH system.

Program #6: To convert the vehicle identification data generated from the VINDICATOR to SAS format.

Program #7: To merge the vehicle identification data SAS file with the consumer complaint data and create a new SAS file in which all the records have valid VIN.

Program #8: To generate a number of one-way to n-way frequency and cross-tabulation summary tables on various attributes in the consumer complaint data.

Program #9: To generate two-way summary table in list format of car engine code and model year for various manufacturers from the consumer complaint data.

Program #10: To generate two-way summary tables in the list format of (1) car engine code by car make; and (2) car series number by car make from the consumer complaint data.

Program #11: To generate the number of registration table by engine code for each particular car manufacturer.

Program #12: To calculate the complaint rates (number of complaints/number of registrations) by car make and engine code.

Program #13: To calculate the accident rates (number of accidents/number of complaints) by manufacturer code.

Program #14: To generate four two-way cross-tabulation tables which are (1) power brakes by xaccid; (2) power steering by xaccid; (3) either power brakes or power steering by xaccid; and (4) neither power brake nor power steering by xaccid.

Program #15: This program will search for any specified pattern of characters or words in the SAS data file and generate a new data set with those records that match the specified characters or words.

PART 2: NIH SYSTEM UTILITY PROGRAMS

Program #1: Copy from foreign tape to NIH library tape.

Program #2: Copy from NIH library tape to hard disk.

Program #3: Print out data file from NIH library tape.

Program #4: Print out SAS data file from hard disk.

Program #5: To get information about the physical characteristics of a SAS data set.

Program #6: To get information about the physical characteristics of a magnetic tape.

PART 1: SAS AND FORTRAN PROGRAMS

Program #1

Purpose: To convert the consumer complaint data to SAS format.

Sample Program: To execute the program it is required to provide data on the following parameters. (The data following the columns are those used in the sample program.)

Input data file: stalling . one . data
Input volume: DOTNH2
Output SAS file: OCTDAT
Output volume: DOTNH3

```
//YPRWST1 JOB (WST1,884,E),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.STALLING.ONE.DATA,UNIT=FILE,
//  VOL=SER=DOTNH2,DISP=OLD
//OUT DD DSN=WST1YPR.OCTDAT,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//  DCB=(RECFM=U,DSORG=DA),
//  SPACE=(TRK,(50,10),RLSE)
//SYSIN DD *
OPTIONS NOOVP PS=88;
DATA OUT.OCTDAT;
  INFILE IN;
  INPUT ODINO $ 1-6 LDATE $ 7-12 YEARTXT $ 13-16
    VEHCAT $ 17-18 MFGCODE $ 19-28 BODY $ 29-30
    VIN $ 31-50 GVW $ 51-55 HP $ 56-58 CYLS $ 59
    CARB $ 60 PBRAKES $ 61 PSTEER $ 62 ATRANS $ 63
    AIRCOND $ 64 SPEEDC $ 65 NEWUSE $ 66 WHLBASE $ 67-69
    CIDENG $ 70-74 PURDATE $ 75-80 TWOSTAGE $ 81
    XCOMPNO $ 82-89 XLOC $ 90-91 XRPFMNO $ 92-98
    XHARZARD $ 106 XFAULTC $ 107-108 XFAULTR $ 109-110
    XPARTID $ 111-120 XORGREP $ 121 XWARREP $ 122
    XMILES $ 123-128 XFAILDAT $ 129-134 XOCCUR $ 135-136
    XACCID $ 137 XACCTYPE $ 138 XINJURED $ 139-140
    XDEATHS $ 141-142 XPDMG $ 143 XENVIRON $ 144
    XDRIVCON $ 145 XFAILTYP $ 146 XMOTION $ 147 XLOSS $ 148
    XFIRE $ 149 XCSUM1 $ 150-229 XCSUM2 $ 230-309 SUMARY $ 310-339
    DATEA $ 340-345 SOURCE $ 346;
  IF ODINO='      ' THEN DELETE;
PROC PRINT;
```

Program #2

```
//YPRWST1 JOB (WST1,884,C),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.STALLING.NAMES,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//OUT DD DSN=WST1YPR.SSADD,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//  DCB=(RECFM=U,DSORG=DA),
//  SPACE=(TRK,(50,10),RLSE)
//SYSIN DD *
OPTIONS NOOVP PS=88;
DATA JUNK;
  INFILE IN;
  INPUT ODINO $ 1-6 LASTNAME $ 7-18 FRSTNAME $ 19-30 PREFIX $ 31-32
    STREET $ 33-54
    CITY $ 55-64 STATE $ 65-66 ZIP $ 67-75 LDATE $ 76-81 SOURCE $ 82-83;
  KEEP ODINO LASTNAME FRSTNAME PREFIX STREET CITY STATE ZIP LDATE SOURCE;
DATA LOOK;
  SET JUNK;
  IF ODINO='      ' THEN DELETE;
PROC PRINT;
DATA OUT.SSADD;
  SET LOOK;
```

Program #3

Purpose:	To convert the service bulletin data to SAS format.
Sample Program:	To execute the program, the data on the following parameters are required.

Input data file: OSERVBUL
Input volume: DOTNH2
Output SAS file: SERVBUL
Output volume: DOTNH3

Program #3

```
//YPRWST1 JOB (WST1,884,E),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YOB.OSERVBUL,UNIT=FILE,
//  VOL=SER=DOTNH2,DISP=OLD
//OUT DD DSN=WST1YPR.SERVBUL,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//  DCB=(RECFM=U,DSORG=DA),
//  SPACE=(TRK,(550,10),RLSE)
//SYSIN DD *
DATA OUT.SERVBUL;
  INFILE IN;
  INPUT NO $ 1-12 BULREP $ 13-24 SEQNO $ 25-27 TYPE $ 28-32
    COMPNO $ 33-40 LOCATION $ 41-42 MANCODE $ 43-52 SUM1 $ 53-132
    SUM2 $ 133-212 SUM3 $ 213-292 SUM4 $ 293-352 DATE $ 353-359;
PROC PRINT;
```

Program #4

Purpose: To convert the Polk data from a NIH standard tape to SAS format.

Sample Program: To execute the program, the data on the following parameters are required.

Library tape number: 05510
Library tape density: 6250/9 track
Input data file: SIDATA2
Input data record length: 80
Input data block size: 6400
Output data file: POLK2
Output volume: DOTNH3

Program #4

```
//YPRWST1 JOB (WST1,884,B,,8),HU,REGION=550K
/*TITLE HU
/*MESSAGE 005510,R
/*ROUTE XEQ 9T6250
/*ACCESS WXB1IEA
/*ROUTE PRINT R158
/*NOTIFY YPR
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//STEP1 EXEC SAS
//SET DD DSN=WST1YPR.POLK2,DISP=(NEW,KEEP),UNIT=FILE,
// VOL=SER=DOTNH3,SPACE=(TRK,(50,10),RLSE)
//HU DD DSN=SIDATA2,DISP=OLD,UNIT=9T6250,
//  VOL=SER=005510,LABEL=(2,SL),
//  DCB=(LRECL=80,BLKSIZE=6400)
//SYSIN DD *
DATA SET.POLK2;
INFILE HU;
  INPUT MA $ 6-7 YR $ 8-9 CSA $ 12-14 BSC $ 15-16
    NC $ 17-18 ID $ 19-22 E $ 23 C $ 24 H $ 25 F $ 28
    COUNT $ 31-36 SEQNO 69-78;
PROC PRINT;
```

Program #5

Purpose: To generate the vehicle identification data from the VINDICATOR data base on NIH system.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: Input1
Input volume: DOTNH3
Output data file: Output1
Output volume: DOTNH3

Note: Please consult with the VINDICATOR User's Guide on the input and output data format.

Program #5

```
//YPRTST1  JOB  (WST1,884,B),HU
//S1  EXEC  FORVCOMP,OPTIONS='LANGLVL(66)'
//COMP.SYSIN DD *
C****
C**** TEST PROGRAM
C****
      INTEGER*4 CODE/4/,CHECK/1/,INARG(6),OUTARG(72)
      INTEGER*4 IYR,MAKE,PLATE(2)
C****
 50   READ(3,55,END=100) IYR,MAKE,(PLATE(I),I=1,2),(INARG(J),J=2,6)
 55   FORMAT(A2,1X,A4,1X,2A3,1X,4A4,A1)
C****
      INARG(1)=0
      CALL VNDCTR(CODE,CHECK,INARG(1),OUTARG(1))
C****
      WRITE(21,59) (INARG(J),J=2,6),(OUTARG(J),J=1,13)
 59   FORMAT(4A4,A1,I5,3I6,9I7)
      GOTO 50
C****
 100  STOP
      END
//S2  EXEC  FORVLKGO,LIBNAME='WQR1CTE.SUBSYS.LOAD',
//      LIBDISK=FILE09
//LOAD.SYSLIN DD
//      DD *
  INCLUDE SYSLIB(VNDCTR85)
  ENTRY MAIN
//GO.FT03F001 DD DSN=WST1YPR.INPUT1,
//      UNIT=FILE,VOL=SER=DOTNH3,DISP=SHR
//GO.VBASE DD DSN=WQR1CTE.SUBSYS.V85BASE,UNIT=FILE,
//      VOL=SER=FILE09,DCB=BUFNO=1,DISP=SHR
//GO.FT21F001 DD DSN=WST1YPR.OUTPUT1,
//      VOL=SER=DOTNH3,SPACE=(TRK,(500,10),RLSE),UNIT=FILE,
//      DCB=(RECFM=FB,LRECL=132,BLKSIZE=4000),DISP=(,KEEP,DELETE)
```

Program #6

Purpose: To convert the vehicle identification data generated from the VINDICATOR to SAS format.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: Output1
Input volume: DOTNH3
Output data file: VINDIC2
Output volume: DOTNH3

Note: Please consult with the VINDICATOR User's Guide on the input and output data format.

Program #6

```
//YPRWST1 JOB (WST1,884,B),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.OUTPUT1,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//OUT DD DSN=WST1YPR.VINDIC2,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//  DCB=(RECFM=U,DSORG=DA),
//  SPACE=(TRK,(50,10),RLSE)
//SYSIN DD *
OPTIONS NOOVP PS=88;
DATA OUT.VINDIC2;
  INFILE IN;
  INPUT VIN $ 1-17 IERR 18-22 AMBSW 23-28 ALTSW 29-34
    MAKE 35-40 SERIES 55-61 MODEL 62-68 BODY 69-75
    ENGINE 83-89 TRANS 90-96 WEIGHT 97-103;
PROC PRINT;
```

Program #7

Purpose: To merge the vehicle identification data SAS file with the consumer complaint data and create a new SAS file in which all the records have valid VIN.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: OCTDAT (consumer complaint data)
VINDICS (vehicle identification data)
Input volume: DOTNH3
Output data file: OCTVIN
Output volume: DOTNH3

Program #7

```
//YPRWST1 JOB (WST1,884,B),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.OCTDAT,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//IN2 DD DSN=WST1YPR.VINDIC3,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//OUT DD DSN=WST1YPR.OCTVIN,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//  DCB=(RECFM=U,DSORG=DA),
//  SPACE=(TRK,(500,10),RLSE)
//SYSIN DD *
OPTIONS NOOVP PS=88;
DATA ONE;
  SET IN.OCTDAT;
  IF VIN NE '                    ';
PROC SORT;
  BY VIN;
DATA TWO;
  SET IN2.VINDIC3;
  IF VIN NE '                 ';
PROC SORT;
  BY VIN;
DATA THREE;
  MERGE ONE(IN=A) TWO;
  BY VIN;
  IF A;
PROC SORT;
  BY ODINO;
DATA OUT.OCTVIN;
  SET THREE;
  IF IERR=0 AND AMBSW=0 AND ALTSW=0;
PROC PRINT;
```

Program #8

Purpose: To generate a number of one-way and n-way frequency and cross-tabulation summary tables on various attributes in the consumer complaint data.

These attributes include:

(1) The number of fatality and injury
(2) The nature of accidents and environments
(3) Car model year
(4) The nature of the defects
(5) The nature of the loss resulting from the accidents, etc.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: OCTDAT
Input volume: DOTNH3

Note: Please consult with the consumer complaint data user's guide for the list of all attributes.

Program #8

```
//YPRWST1 JOB (WST1,884,E),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.OCTDAT,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//SYSIN DD *
OPTIONS NOOVP PS=88;
PROC FORMAT;
  VALUE $COMP 0=UNKNOWN
    05000000-05999999=ENGINE/COOLING SYS
    06000000-06116010=FUEL SYS
    06130000-06160000=FUEL SYS
    06120000-06125000=EMISSION CONTROL
    06500000-06540000=EMISSION CONTROL
    06200000-06260000=FUEL CARBURETION
    06300000-06351100=FUEL INJECTION
    06400000-06470000=THROTTLE LINKAGES CONTROL
    06600000-06652000=EXHAUST
    08000000-08560100=ENGINE ELEC SYS
    OTHER=OTHERS;
  VALUE $MIL 0=0
    000001-010000=1 TO 10K
    010001-025000=10K TO 25K
    025001-050000=25K TO 50K
    050001-075000=50K TO 75K
    075001-999999=OVER 75K
    OTHER=UNKNOWN;
  VALUE $MAK 0=UNKNOWN
    0001010000-0001019999=AMC
    0001020000-0001029999=JEEP
    0002010400-0002010402=IMPERIAL
    0002010000-0002010399=CHRYSLER
    0002010403-0002019999=CHRYSLER
    0002020000-0002020299=DODGE DOM
    0002020300-0002020308=DODGE IMP
    0002020400-0002021800=DODGE DOM
    0002021900-0002022000=DODGE IMP
    0002029900=DODGE DOM
    0002030000-0002031501=PLYMOTH DOM
    0002031600-0002031800=PLYMOTH IMP
    0003010000-0003011204=FORD DOM
    0003011300-0003011302=FORD IMP
    0003011400-0003019999=FORD DOM
    0003030100-0003030110=CAPRI
    0003030200-0003039999=MERCURY
    0003030000=MERCURY
    0002040000-0002049999=DODGE TRUCK
    0002050000-0002059999=PLYMOTH TRUCK
    0003020000-0003029999=LINCOLN
    0003040000-0003049999=FORD/ENGLISH
    0003050000-0003059999=FORD TRUCK
    0003060000-0003069999=ENGLISH FORD TRUCK
    0004010000-0004019999=BUICK
    0004020000-0004029999=CADILLAC
    0004030000-0004039999=CHEVROLET
    0004040000-0004049999=OLDSMOBILE
    0004050000-0004059999=PONTIAC
    0004060000-0004069999=GMC
    0004070000-0004079999=CHEVY TRUCK
    1102010000-1102010400=AUSTIN
```

```
      1102010500=AUSTIN HEALEY
      1102020000-1102020600=TRIUMPH
      1102030000-1102030600=JAGUAR
      1102050000-1102050103=ROVER
      1102060000-1102060104=M G
      1104000000-1104999999=LOTUS
      1106000000-1106999999=ROLLS ROYCE
      1107000000-1107999999=TVR
      1301000000-1301999999=PEUGEOT
      1304000000-1304999999=RENAULT
      1401000000-1401999999=OPEL
      1403000000-1403999999=BMW
      1404000000-1404011002=MERCEDES
      1404500000-1404500208=M B TRUCK
      1405000000-1405011200=VW
      1405015000-1405015061=VW TRUCK
      1405020000-140529900=AUDI
      1405030000-1405030464=PORSHE
      1501000000-1501999999=ALFA ROMEO
      1502000000-1502999999=FERRARI
      1503000000-1503999999=FIAT
      1601000000-1601010500=SUBARU
      1601500100-1601500101=SUBARU TRUCK
      1602000000-1602999999=HONDA
      1603000000-1603010300=ISUZU
      1603015100-1603016200=ISUZU TRUCK
      1604000000-1604020400=NISSAN
      1604500000-1604509800=NISSAN TRUCK
      1605000000-1605011003=MAZDA
      1605500100-1605500300=MAZDA TRUCK
      1606000000-1606010802=TOYOTA
      1606500000-1606500600=TOYOTA TRUCK
      1607000000-1607999999=SUZUKI
      1608000000-1608000301=MITSUBISHI
      1608500101-1608500501=MITSU TRUCK
      1701000000-1701012001=VOLVO
      1701500000-1701500301=VOLVO TRUCK
      1702000000-1702999999=SAAB
      2003900000-2003910103=INT
      OTHER=OTHERS;
DATA ONE;
  SET IN.OCTDAT;
  LETTER1=PUT(XCOMPNO,$COMP.);
  LETTER2=PUT(MFGCODE,$MAK.);
  LETTER3=PUT(XMILES,$MIL.);
  MONTH=SUBSTR(XFAILDAT,3,2);
  IF MONTH<1 OR MONTH>12 THEN MONTH='UNK';
  IF XACCID NE 'Y' THEN INJ='NO ACDNT';
  IF XACCID='Y' AND (XINJURED='00' OR XINJURED='  ') AND XDEATHS NE '01'
   THEN INJ='NO INJ';
  IF (XINJURED NE '00' AND XINJURED NE '  ') AND  XDEATHS NE '01'
   THEN INJ='INJURY';
  IF XDEATHS='01' THEN INJ='FATALITY';
  IF XMOTION='N' THEN MOTION='STOPPED';
  IF XMOTION='U' THEN MOTION='UNKNOWN';
  IF XMOTION='Y' THEN MOTION='MOVING';
  IF XFIRE='N' THEN FIRE='NO FIRE';
  IF XFIRE='U' THEN FIRE='UNKNOWN';
  IF XFIRE='Y' THEN FIRE='FIRE';
  OUTPUT;
```

```
   OUTPUT;
 PROC FREQ ORDER=DATA;
   TABLES LETTER1*INJ;
 PROC SORT NODUP;
   BY ODINO;
 PROC FREQ ORDER=DATA;
   TABLES XDEATHS;
   TABLES INJ;
   TABLES YEARTXT;
   TABLES XACCTYPE;
   TABLES XINJURED;
   TABLES XPDMG*INJ;
   TABLES XENVIRON*INJ;
   TABLES XDRIVCON*INJ;
   TABLES MOTION*INJ;
   TABLES XLOSS*INJ;
   TABLES FIRE*INJ;
   TABLES XHARZARD*INJ;
   TABLES LETTER3*INJ;
   TABLES LETTER3*YEARTXT;
 PROC SORT;
   BY MONTH;
 PROC FREQ ORDER=DATA;
   TABLES MONTH*INJ;
```

Program #9

Purpose: To generate two-way summary table in list format of car engine code and model year for various manufacturers from the consumer complaint data.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: OCTVIN
Input volume: DOTNH3
MFGCODE: 2020000 to 2029900
Output data file: COMECH
Output volume: DOTNH3

Note: Please consult with the consumer complaint data user's guide for manufacturer code (MFGCODE).

Program #9

```
//YPRWST1 JOB (WST1,884,E),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
/* UNNUMBERED
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.OCTVIN,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//OUT DD DSN=WST1YPR.COMECH,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//  DCB=(RECFM=U,DSORG=DA),
//  SPACE=(TRK,(50,10),RLSE)
//SYSIN DD *
DATA OUT.COMECH;
  SET IN.OCTVIN;
  IF VIN='                    ' THEN DELETE;
  IF MFGCODE<2020000 THEN DELETE;
  IF MFGCODE>2029900 THEN DELETE;
  IF YEARTXT<1969 THEN DELETE;
  IF YEARTXT>1980 THEN E=SUBSTR(VIN,8,1);
  IF YEARTXT<1981 THEN E=SUBSTR(VIN,5,1);
OUTPUT;
  PROC FREQ;
    TABLES E*YEARTXT/LIST;
```

Program #10

Purpose: To generate two-way summary tables in list format of (1) car engine code by car make; and (2) car series number by car make from the consumer complaint data.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: OCTVIN
Input volume: DOTNH3

Program #10

```
//YPRWST1 JOB (WST1,884,E),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
/* UNNUMBERED
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.OCTVIN,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//SYSIN DD *
DATA ONE;
  SET IN.OCTVIN;
  IF YEARTXT>1979;
PROC FREQ;
  TABLES MAKE*ENGINE/LIST;
  TABLES MAKE*SERIES/LIST;
```

Program #11

Purpose:	To generate the number of registration table by engine code for each particular car manufacturer.
Sample Program:	To execute the program, the data on the following parameters are required.
	Input data file: POLKG (Polk data file) Input volume: DOTNH3 Output data file: POECH Output volume: DOTNH3
Note:	Please consult with the Polk Data User's Guide for car model codes.

Program #11

```
//YPRWST1 JOB (WST1,884,B),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.POLKG,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//OUT DD DSN=WST1YPR.POECH,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//  DCB=(RECFM=U,DSORG=DA),
//  SPACE=(TRK,(50,10),RLSE)
//SYSIN DD *
DATA OUT.POECH;
  SET IN.POLKG;
  IF MA='BC' OR MA='BE' OR MA='BI' OR MA='BP'
    OR MA='IB' OR MA='IL' OR MA='IM' OR
    MA='JT' OR MA='JV' OR MA='JW' OR MA='JX'
    OR MA='KB' OR MA='TD' OR MA='TL';
PROC FREQ;
  TABLES E/MISSING;
  WEIGHT COUNT;
```

Program #12

Purpose: To calculate the complaint rates (number of complaints/number of registrations) by car make and engine code. The input data files for this program are those output data files generated by Program #9 (the number of complaints) and Program #11 (the number of registrations).

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: COMEAM (the frequency of complaints)
POEAM (the number of registrations)
Input volume: DOTNH3
Output data file: J261
Output volume: DOTNH3

Program #12

```
//YPRWST1 JOB (WST1,884,B),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//   EXEC SAS
//IN1 DD DSN=WST1YPR.COMEAM,UNIT=FILE,
//   VOL=SER=DOTNH3,DISP=OLD
//IN2 DD DSN=WST1YPR.POEAM,UNIT=FILE,
//   VOL=SER=DOTNH3,DISP=OLD
//OUT DD DSN=WST1YPR.J261,UNIT=FILE,
//   VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//   DCB=(RECFM=U,DSORG=DA),
//   SPACE=(TRK,(50,10),RLSE)
//SYSIN DD *
DATA ONE;
  SET IN1.COMEAM;
  C1=COUNT;
  DROP COUNT PERCENT;
  OUTPUT;
DATA TWO;
  SET IN2.POEAM;
  C2=COUNT;
  DROP COUNT PERCENT;
  OUTPUT;
DATA OUT.J261;
  MERGE ONE TWO;
  BY E;
  CRATE=C1/C2;
  OUTPUT;
PROC PRINT;
```

Program #13

Purpose: To calculate the accident rates (number of accidents/number of complaints) by manufacture code. The input data files are (1) the one-way frequency table by manufacturer code from the consumer complaint data file; and (2) the one-way frequency table by manufacturer code from only those consumer complaint records with accident involved (i.e., xaccid = 'Y').

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: COMP1 (the frequency of complaints)
ACCID1 (the number of accidents)
Input volume: DOTNH3

Program #13

```
//YPRWST1 JOB (WST1,884,B),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
/* UNNUMBERED
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.COMP1,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//IN1 DD DSN=WST1YPR.ACCID1,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//SYSIN DD *
DATA ONE;
  SET IN.COMP1;
  C1=COUNT;
  KEEP MFGCODE C1;
PROC SORT;
  BY MFGCODE;
DATA TWO;
  SET IN1.ACCID1;
  C2=COUNT;
  KEEP MFGCODE C2;
PROC SORT;
  BY MFGCODE;
DATA THREE;
  MERGE ONE(IN=A) TWO;
  BY MFGCODE;
  IF A;
DATA FOUR;
  SET THREE;
  RATE=C2/C1;
  OUTPUT;
PROC PRINT;
```

Program #14

Purpose: To generate four two-way cross-tabulation tables which are (1) power brakes by xaccid; (2) power steering by xaccid; (3) either power brakes or power steering by xaccid; and (4) neither power brake nor power steering by xaccid. These summary tables may indicate the relationship between power options and accidents.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: OCTDAT (consumer complaint data)
Input volume: DOTNH3

Program #14

```
//YPRWST1 JOB (WST1,884,B),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
/* UNNUMBERED
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.OCTDAT,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//SYSIN DD *
DATA ONE;
  SET IN.OCTDAT;
  IF PBRAKES='Y' OR PSTEER='Y' THEN POWER='Y';
  IF PBRAKES NE 'Y' AND PSTEER NE 'Y'  THEN NPOWER='Y';
PROC FREQ;
  TABLES PBRAKES*XACCID;
  TABLES PSTEER*XACCID;
  TABLES POWER*XACCID;
  TABLES NPOWER*XACCID;
```

Program #15

Purpose: This program will search for any specified pattern of characters or words in the SAS data file and generate a new data set with those records that match the specified characters or words.

Sample Program: To execute the program, the data on the following parameters are required.

Input data file: SERVBUL
Input volume: DOTNH3
Output data file: CLEANDAT
Output volume: DOTNH3
Word: STALL

Program #15

```
//YPRWST1 JOB (WST1,884,E),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//   EXEC SAS
//IN1 DD DSN=WST1YPR.SERVBUL,UNIT=FILE,
//   VOL=SER=DOTNH3,DISP=OLD
//OUT DD DSN=WST1YPR.CLEANDAT,UNIT=FILE,
//   VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//   DCB=(RECFM=U,DSORG=DA),
//   SPACE=(TRK,(150,10),RLSE)
//SYSIN DD *
OPTIONS NOOVP PS=88;
DATA OUT.CLEANDAT;
  SET IN1.SERVBUL;
  WORD = ' STALL';
  X1 = INDEX(SUM1,WORD);
  X2 =INDEX(SUM2,WORD);
  X3=INDEX(SUM3,WORD);
  X4=INDEX(SUM4,WORD);
  IF X1 NE 0 OR X2 NE 0 OR X3 NE 0 OR X4 NE 0;
  PROC PRINT;
```

PART 2: NIH SYSTEM UTILITY PROGRAMS

Utility Program #1

Purpose: Copy from foreign tape to NIH library tape. This program is used to load data from a magnetic tape to a standard NIH library tape.

Sample Program: To execute the program, the data on the following parameters are required. (The data following the columns are those used in the sample program.)

Foreign tape title: NIHSPS
Input data file: POLKDU.DAT
Foreign/library tape density: 6250 bpi/9 track
Input data record length: 80
Input data block size: 80
Library tape number: 084622
Output data file: SIDATA2
Output data record length: 80
Output data block size: 80

Utility Program #1

```
//YPRWST1 JOB (WST1,884,B,30,14),HU,REGION=500K
/*MESSAGE 084622,W
/*MESSAGE NIHSP3,RS
/*TITLE HU
/*ROUTE XEQ 9T6250
/*ACCESS WXB1IEA
/*ROUTE PRINT R158
/*NOTIFY IEA
/*NOPURGE
/*AFTER JOB 811
//*
//*
//STEP1 EXEC COPY
//COPY.SYSUT1  DD  DSN=POLKDU.DAT,UNIT=9T6250,
//  VOL=SER=NIHSP3,LABEL=(1,NL),
//  DCB=(LRECL=80,BLKSIZE=80)
//COPY.SYSUT2  DD  DSN=SIDATA2,UNIT=9T6250,
//  VOL=SER=084622,LABEL=(2,SL),
//  DCB=(LRECL=80,BLKSIZE=80)
```

Utility Program #2

Purpose: Copy from NIH library tape to hard disk. This program will load data from a standard NIH library tape to a hard disk for easy access and fast processing time.

Sample Program: To execute the program, the data on the following parameters are required.

Standard tape title: 005510
Input data file: SIDATA1
Library tape density: 6250 bpi/9 track
Input data record length: 80
Input data block size: 6400
Output data file: POKD6
Output data record length: 80
Output data block size: 6400
Output volume name: DOTNH3

Utility Program #2

```
//YPRWST1 JOB (WST1,884,B,30,14),HU,REGION=500K .
/*MESSAGE 005510,R
/*TITLE HU
/*ROUTE XEQ 9T6250
/*ACCESS WXB1IEA
/*ROUTE PRINT R158
/*NOTIFY YPR
/*NOPURGE
//*
//*
//STEP1 EXEC COPY
//COPY.SYSUT1  DD  DSN=SIDATA1,UNIT=9T6250,
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400),
//   VOL=SER=005510,LABEL=(1,SL)
//COPY.SYSUT2 DD DSN=WST1YPR.POKD6,UNIT=FILE,
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400),
//   VOL=SER=DOTNH3,DISP=(NEW,KEEP),
//   SPACE=(TRK,(50,10),RLSE)
```

Utility Program #3

Purpose: Print out data file from NIH library tape.

Sample Program: To execute the program, the data on the following parameters are required.

Standard tape title: 005510

Input data file: SIDATA1

Standard tape density: 6250 bpi/9 track

Input data record length: 80

Input data block size: 6400

Utility Program #3

```
//YPRWST1 JOB (WST1,884,B,30,14),HU,REGION=500K
/*MESSAGE 005510,R
/*TITLE HU
/*ROUTE XEQ 9T6250
/*ACCESS WST1YPR
/*ACCESS WXB1IEA
/*ROUTE PRINT R158
/*NOTIFY YPR
/*NOPURGE
//STEPNAME EXEC PRINT
//PRINT.SYSUT1 DD UNIT=9T6250,DISP=(OLD,KEEP),
//       DSN=SIDATA1,VOL=(PRIVATE,SER=005510),
//       LABEL=(1,SL),
//       DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400)
```

Utility Program #4

Purpose:	Print out SAS data file from hard disk.
Sample Program:	To execute the program, the data on the following parameters are required.

Input SAS data file: OCTVIN
Input volume: DOTNH3

Utility Program #4

```
//YPRWST1 JOB (WST1,884,A),PING
/*NOTIFY YPR
/* ROUTE OUTPUT HOLD
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YPR.OCTVIN,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//SYSIN DD *
DATA JUNK;
  SET IN.OCTVIN;
PROC PRINT;
```

Utility Program #5

Purpose:	To get information about the physical characteristics of a SAS data set (i.e., where and how it is stored, its size, and when it was created, the variables in the data set, and their types, lengths, formats and labels).
Sample Program:	To execute the program, the data on the following parameters are required.

Input data file: COMBD11
Input data volume: DOTNH3

Utility Program #5

```
//YPRWST1 JOB (WST1,884,E),PING
/*NOTIFY YPR
/* ROUTE PRINT R158
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//  EXEC SAS
//IN DD DSN=WST1YOB.COMBD11,UNIT=FILE,
//  VOL=SER=DOTNH3,DISP=OLD
//SYSIN DD *
PROC CONTENTS DATA=IN.COMBD11;
```

Utility Program #6

Purpose:	To get information about the physical characteristics of a magnetic tape (i.e., data record length, data block size, number of files, data file size, etc.).
Sample Program:	To execute the program, the data on the following parameters are required.

Standard tape number: 005510
Standard tape density: 6250 bpi/9 track

Utility Program #6

```
//YPRWST1 JOB (WST1,884,B,30,14),HU,REGION=500K
/*MESSAGE 005510,R
/*ACCESS WXB1IEA
/*TITLE HU
/*ROUTE XEQ 9T6250
/*ROUTE PRINT R158
/*NOTIFY YPR
/*NOPURGE
//PROCLIB DD DSN=ZABCRUN.PROCLIB,DISP=SHR
//STEP1 EXEC TAPEMAP,DSNUM=ALL,TAPE=005510
```