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Technology Assessment Program

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1983 MODEL YEAR PATROL VEHICLE TESTING

A Program of the National Institute of Justice
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Technology Assessment Program Information Center

1983 Model Year Patrol Vehicle Testing

October 1982

U.S. Department of Justice
National Institute of Justice
Office of Development, Testing, and Dissemination

Conducted by the

MICHIGAN STATE POLICE
EAST LANSING, MICHIGAN
COLONEL GERALD L. HOUGH, DIRECTOR

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DEDICATED IN MEMORY OF
LIEUTENANT MILLER J. RICHTER

The Michigan State Police Vehicle Evaluation and Purchasing Program was initiated in 1976 through the efforts of numerous persons including Lt. Miller Richter. Lt. Richter's assistance in the development of the program and his leadership as a test driver were instrumental in its growth from a single state purchasing program to one of national prominence within the law enforcement community.

On September 9, 1982, during the annual practice session held prior to the test, Lt. Richter suffered a fatal heart attack. His contributions, insight and dedication to the program exemplify the best traditions of the Michigan Department of State Police.

This book is dedicated in memory of Lt. Miller Richter who will be greatly missed as a husband, father, fellow officer and friend.

PREFACE

You will find on the following pages the data collected and conclusions reached in our evaluation of 1983 police patrol package vehicles. It gives us a great deal of satisfaction to share this information with you because one way the ultimate value of our efforts can be measured is by the number of law enforcement agencies who find it useful.

We would encourage you to review the information contained in this document after first giving careful consideration to your own specific needs. The factors which we base our scores upon, particularly in the acceleration and top speed categories, are tailored to our needs which may be vastly different from your own. For example, a vehicle which fails to meet our 0-100 mph acceleration requirement might be very adequate for use by a department whose need is for quick acceleration to 60 or 70 mph.

A total of 15 police package cars were tested this year with 5 of these vehicles, including the Chevrolet Impala (350-4V), Chevrolet Malibu (305-4V), Dodge Diplomat (318-4V), Ford LTD Crown Victoria S (351-VV), and Plymouth Gran Fury (318-4V), competing against the Michigan State Police specifications. The Ford Mustang (302-4V), Ford Fairmont (140-1V), and Plymouth Reliant (2.6L-2V) were tested for acceleration, top speed, braking and vehicle dynamics. The Chevrolet Impala (229-2V), Dodge Diplomat (225-1V), Ford LTD Crown Victoria S (302-CFI), and Ford Fairmont (200-1V) were tested only for acceleration. Three Canadian vehicles were also tested for acceleration and top speed: Chevrolet Impala (Canadian 350-4V), Chevrolet Malibu (Canadian 305-4V), and Plymouth (Gran Fury) Caravelle (Canadian 318-propane fuel).

In past years we have provided our actual and adjusted bid prices at the end of the vehicle evaluation report. At the time of this writing, our bids have not been opened and in the interest of getting this report into your hands at the earliest possible time, we decided not to wait for our bid prices before going to print. However, the individual category scores and the final scores are provided and should be adequate to meet your needs.

Finally, we would like to express our appreciation for the cooperation of the many law enforcement agencies who have shown continuing interest in the evaluation program; to the vehicle manufacturers who have been very helpful in many ways, not the least of which is in supplying test cars; to the Technology Assessment Program Information Center (TAPIC) of the International Association of Chiefs of Police (IACP) and to the National Institute of Justice (NIJ) for their continued interest and support. We are indeed happy to be able to share this information with you. If you require any further assistance, either in additional explanation or clarification of the program or in discussing how our data might be adaptable to your needs, please feel free to contact us or TAPIC by phone or mail.

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ABOUT THE TECHNOLOGY ASSESSMENT PROGRAM

The Technology Assessment Program is sponsored by the Office of Development, Testing, and Dissemination of the National Institute of Justice (NIJ), U.S. Department of Justice. The program responds to the mandate of the Justice System Improvement Act of 1979, which created NIJ and directed it to encourage research and development to improve the criminal justice system and to disseminate the results to federal, state, and local agencies.

The Technology Assessment Program is an applied research effort that determines the technological needs of justice system agencies, sets minimum performance standards for specific devices, tests commercially available equipment against those standards, and disseminates the standards and the test results to criminal justice agencies nationally and internationally.

The program operates through an Advisory Council, Standards Laboratory and Information Center.

The **Technology Assessment Program Advisory Council (TAPAC)**, consisting of nationally recognized criminal justice practitioners from federal, state, and local agencies, assesses technological needs and sets priorities for research programs and items to be evaluated and tested.

The **Law Enforcement Standards Laboratory (LESL)** at the National Bureau of Standards develops voluntary national performance standards for compliance testing to ensure that individual items of equipment are suitable for use by criminal justice agencies. The standards are based upon laboratory testing and evaluation of representative samples of each item of equipment to determine the key attributes, develop test methods, and establish minimum performance requirements for each essential attribute. In addition to the highly technical standards, LESL also produces user guides that explain in nontechnical terms the capabilities of available equipment.

The **Technology Assessment Program Information Center (TAPIC)**, operated by the International Association of Chiefs of Police (IACP), supervises a national compliance testing program conducted by independent agencies. The standards developed by LESL serve as performance benchmarks against which commercial equipment is measured. The facilities, personnel, and testing capabilities of the independent laboratories are evaluated by LESL prior to testing each item of equipment, and LESL helps the Information Center staff review and analyze data. Test results are published in Consumer Product Reports designed to help justice system procurement officials make informed purchasing decisions.

All publications issued by the National Institute of Justice, including those of the Technology Assessment Program, are available from the National Criminal Justice Reference Service (NCJRS), which serves as a central information and reference source for the nation's criminal justice community. For further information, or to register with NCJRS, write to the National Institute of Justice, National Criminal Justice Reference Service, Box 6000, Rockville, Maryland 20850.

Paul Cascarano, Assistant Director
National Institute of Justice

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INTRODUCTION

This report, for the 1983 model year, is the fifth in a series of publications that presents the results of testing police patrol vehicles. The first report, which concerned the 1979 vehicle model year, was prepared as the result of recommendations of the Transportation Committee of the Technology Assessment Program Advisory Council (TAPAC), which recognized that police departments have an urgent need for valid performance data to serve as a basis for patrol vehicle procurement decisions.

The Michigan State Police (MSP) has established a procurement policy that requires manufacturers to submit sealed bids for vehicles that will meet formal vehicle specifications, following which the specific vehicles offered under that bid action are subjected to testing and the ergonomics and communications design characteristics are evaluated. Upon completion of the test program, the results are weighted to reflect the relative importance of each attribute as related to MSP operational requirements and the individual bids are adjusted to reflect overall performance. The contracts are awarded on the basis of the adjusted price.

The MSP testing program is conducted annually, and the Technology Assessment Program Information Center (TAPIC) of the International Association of Chiefs of Police has made arrangements with MSP to reproduce the test results and distribute them to all interested police departments. This year, TAPIC provided the MSP with a small contract to help defray the additional cost of testing four and six cylinder engine vehicles, which otherwise would not have been included in the test program.

This report presents most of the test results from the MSP in summary form. However, certain of the detailed data are included in appendices for those wishing to study the test results in detail. Similarly, the bid adjustment information calculated by MSP is included as one example of a method to compare bids. As of the date of this publication, MSP had not opened the vehicle bids, therefore the final adjusted bid prices are not included in table 8. It should be noted, however, that the weighting factors used by MSP are unique to its needs, and other departments wishing to employ this or a similar method are urged to carefully consider their own needs and to alter the weighting factors accordingly. Also, the weighting factors must reflect changing procedures or other influencing factors; for example, during the evaluation of bids for the 1980 model year, MSP assigned a weighting factor of only 10 percent to acceleration, and ergonomics and communications were rated separately with a combined weighting factor of 15 percent.

A TAPIC staff representative was present during the MSP testing program to observe the testing, and to obtain firsthand knowledge of the deatiled effort to enable TAPIC to answer questions from the readers of this report so that MSP will not be burdened with requests for information. The MSP vehicle testing program was conducted in a professional manner and TAPIC feels that the test data are suitable for police departments to use as a basis for procurement decisions.

BID SPECIFICATIONS

The State of Michigan, Department of Management and Budget, Purchasing Division prepares, on an annual basis, a detailed specification for police patrol cars that is used as the basis for sealed bids from the manufacturers. The Michigan specification is presented solely to identify the manner in which the 1983 model year vehicles that were tested by MSP were configured, and to provide information on the various requirements established by the State of Michigan for patrol vehicles. Other police departments may find items within the Michigan specification that are inconsistent with their own operational needs, and are encouraged to develop a specification reflecting the manner in which patrol vehicles are operated in their own jurisdiction. The Michigan specification is reproduced in Appendix A.

MANUFACTURER SPECIFICATIONS

Table 1 provides a summary of the specifications for the vehicles that were tested by MSP for model year 1983, compiled from manufacturer brochures for vehicles available with police packages. Individual data sheets for each of the vehicles are presented in Appendix B.

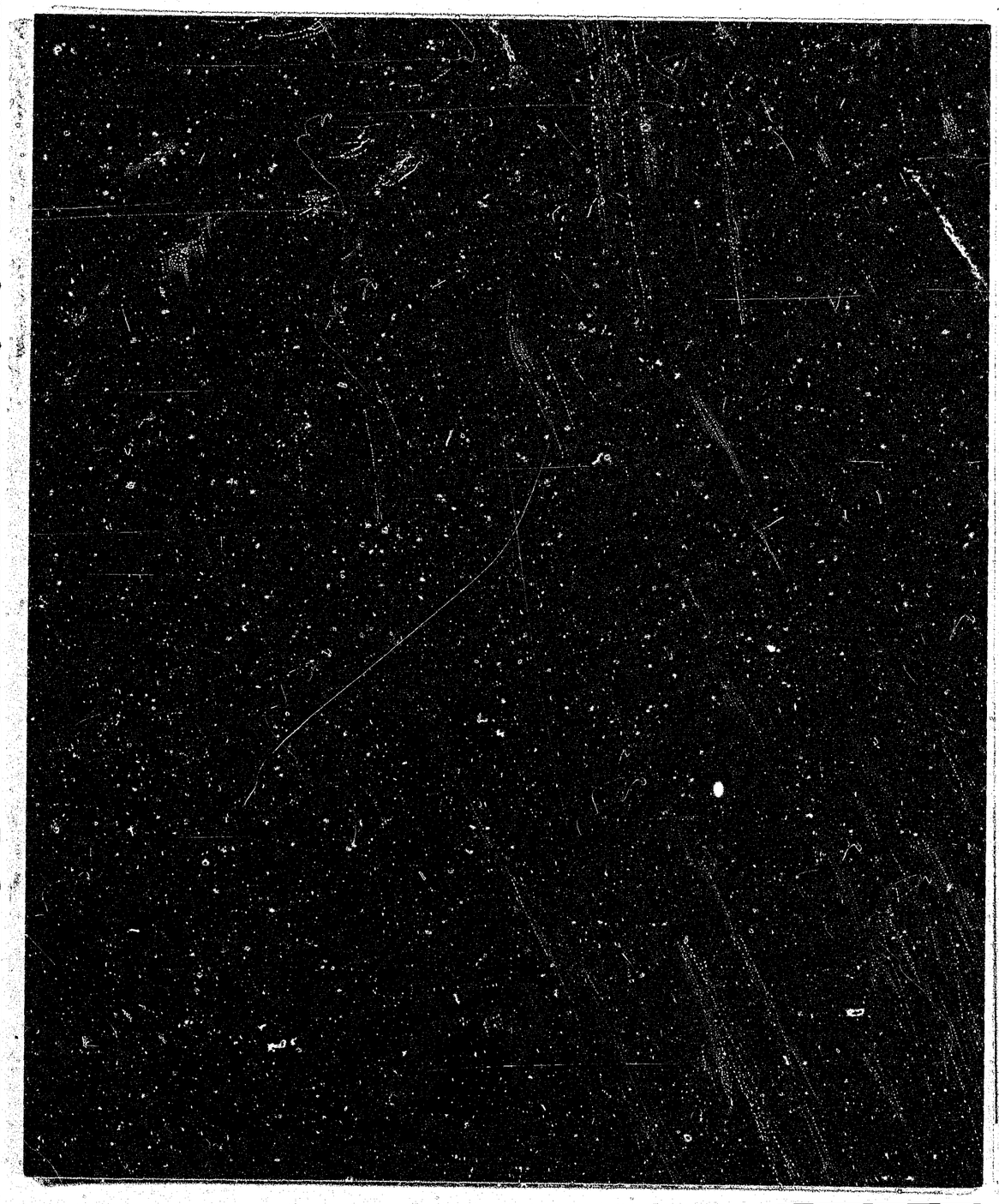


Table 1
INFORMATIONAL HARDWARE DESCRIPTION SUMMARY

MAKE, MODEL:	Chevrolet Impala	Dodge Diplomat	Ford LTD-CV-S	Chevrolet Malibu	Plymouth Gran Fury	Ford LTD-CV-S	Chevrolet Impala	Dodge Diplomat	Ford Fairmont	Ford Fairmont	Plymouth Reliant	Ford Mustang
ENGINE DISPLACEMENT—CU. IN.	350	318	351	305	318	302	229	225	200	140	156	302
ENGINE DISPLACEMENT—LITERS	5.7	5.2	5.8	5.0	5.2	5.0	3.8	3.7	3.3	2.3	2.6	5.0
CARBURETOR-BBL	4	4	2VV*	4	4	CFI**	2	1	1	1	2	4
HORSEPOWER (S.A.E. NET)***	155	165	165	145	165	130	110	90	92	90	93	175
TORQUE LBS ***	265	240	290	240	240	240	170	165	156	122	132	245
COMPRESSION RATIO	8.2	8.5	8.3	8.6	8.5	8.4	8.6	8.4	8.6	9.1	8.2	8.4
AXLE RATIO	3.08	2.94	2.73	2.73	2.94	3.08	2.73	2.94	2.73	3.08	3.02	3.08
TURNING CIRCLE (CURB TO CURB)-FT.	38.7	40.7	39.2	37.2	40.7	39.2	38.7	40.7	39.5	39.5	34.8	37.4
TRANSMISSION—MODEL NUMBER	700R4	A727	PKAAS5	350C	A727	PKAAS5	250C	A904	PEN-C	82DT	A470	RUG-EM
TRANSMISSION—LOCK UP TORQUE CONVERTER	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No
TRANSMISSION—OVERDRIVE	Yes	No	Yes	No	No	Yes	No	No	No	No	No	Yes
TIRE SIZE	P225/ 70R15	P215/ 70R15	P225/ 70R15	P205/ 70R14	P215/ 70R15	P225/ 70R15	P205/ 75R15	P215/ 70R15	P205/ 70R14	P205/ 70R14	P185/ 70R14	P205/ 70R14
BRAKE—FRONT—TYPE	Disc	Disc	Disc	Disc	Disc	Disc	Disc	Disc	Disc	Disc	Disc	Disc
BRAKE—REAR—TYPE	Drum	Drum	Drum	Drum	Drum	Drum	Drum	Drum	Drum	Drum	Drum	Drum
OVERALL LENGTH—INCHES	212.2	205.7	209.3	192.7	205.7	209.3	212.2	205.7	204.3	204.3	176.0	179.1
OVERALL HEIGHT—INCHES	56.4	55.3	54.7	55.7	55.3	54.7	56.4	55.3	55.5	55.5	52.7	51.9
WEIGHT—TEST—LBS.	3993	3887	4059	3516	3881	3892	3713	3688	2872	2979	2659	2970
WHEELBASE—INCHES	116.0	112.7	114.3	108.1	112.7	114.3	116.0	112.7	105.5	105.5	100.1	100.4
HEAD ROOM—FRONT—INCHES	39.5	39.3	37.9	38.5	39.3	37.9	39.5	39.3	39.3	39.3	38.6	37.2
HEAD ROOM—REAR—INCHES	38.2	37.7	37.2	37.6	37.7	37.2	38.2	37.7	37.7	37.7	37.8	35.9
LEG ROOM—FRONT—INCHES	42.2	42.5	42.1	42.8	42.5	42.1	42.2	42.5	42.7	42.7	42.2	41.7
LEG ROOM—REAR—INCHES	39.1	36.6	40.7	38.0	36.6	40.7	39.1	36.6	37.8	37.8	35.9	29.7
SHOULDER ROOM—FRONT—INCHES	60.5	56.0	61.6	56.7	56.0	61.6	60.5	56.0	55.7	55.7	55.4	55.8
SHOULDER ROOM—REAR—INCHES	60.5	55.9	61.6	57.1	55.9	61.6	60.5	55.9	55.7	55.7	55.9	54.3
HIP ROOM—FRONT—INCHES	55.0	53.5	61.0	52.2	53.5	61.0	55.0	53.5	57.2	57.2	55.6	55.9
HIP ROOM—REAR—INCHES	55.3	53.2	56.9	55.6	53.2	56.9	55.3	53.2	57.0	57.0	56.2	47.1
INTERIOR VOLUME—FRONT—CU. FT.	58.1	54.1	57.0	54.1	54.1	57.0	58.1	54.1	53.0	53.0	52.1	N/A
INTERIOR VOLUME—REAR—CU. FT.	52.2	44.6	54.0	47.2	44.6	54.0	52.2	44.6	43.0	43.0	43.4	N/A
INTERIOR VOLUME—COMBINED—CU. FT.	110.3	98.7	111.0	101.3	98.7	111.0	110.3	98.7	96.0	96.0	95.5	84.0
INTERIOR VOLUME—TRUNK—CU. FT.	20.9	15.6	22.4	16.6	15.6	22.4	20.9	15.6	17.0	17.0	15.0	8.0
E.P.A. MILEAGE—CITY—MPG	15	14	14	18	14	17	19	19	19	21	24	17
E.P.A. MILEAGE—HIGHWAY—MPG	25	21	24	26	21	26	27	25	24	31	30	28
E.P.A. MILEAGE—COMBINED MPG	18	16	17	21	16	20	22	21	21	24	26	21

* VV - Variable Venturi
**CFI - Central Fuel Injection
***See individual data sheets in Appendix B for engine RPM.

VEHICLE DYNAMICS TESTING

The performance of a vehicle during high speed pursuit is dependent upon all of its operational characteristics including acceleration, braking, suspension, and steering. Further, individual differences between drivers can also influence the overall pursuit capability of a vehicle/driver system.

Because high speed pursuit handling is of major concern, a test procedure developed by the Michigan State Police was utilized which permits a fair evaluation of each test vehicle relative to the other vehicles in the test group. Rather than attempt to evaluate each handling characteristic separately, each vehicle is driven at high speeds over a 1.635-mile long, racing-type course containing hills, curves, and corners. The course simulates actual driving conditions encountered in pursuit situations in the field, with the exception of other traffic, and provides a simultaneous evaluation of all pertinent handling characteristics. In order to accomodate variations between drivers, each vehicle was driven by 4 different drivers 4 times, resulting in 16 timed laps.

This test quickly identifies whether the manufacturer of the vehicle offers a balanced package in terms of blending the suspension components, acceleration capabilities, and braking characteristics, because serious deficiencies in the vehicles would result in greatly increased times to travel over the course. For example, if the vehicle's cornering or braking capabilities are totally inadequate, the vehicle would be subject to either mechanical failure or loss of control. All of the 1983 model year vehicles tested successfully completed the required 16 laps.

The vehicle dynamics test results are presented in table 2. In each case, the test driver attempted to complete the course in the minimum time possible. Thus, the figure for comparison purposes is the average elapsed time, as the objective is to complete the course in the shortest time possible. While the average times for the 4 laps for each driver are listed in table 2, the average elapsed time for each test vehicle is calculated by averaging the 12 lowest elapsed times of the 16 reported lap times. Since vehicle dynamics is considered by the MSP to be a critical performance characteristic, a weighting factor of 25 percent has been assigned to these test results.

Table 2

PRELIMINARY HANDLING EVALUATION (VEHICLE DYNAMICS TESTING)

VEHICLES	DRIVERS*	LAP 1	LAP 2	LAP 3	LAP 4	AVERAGE
Chevrolet Impala (350-4V)	Floate	1:31.01	1:30.98	1:30.78	1:30.86	
	Ring	1:32.50	1:32.68	1:32.69	1:33.16	
	Olsen	1:33.09	1:32.82	1:33.11	1:33.35	
	Steendam	1:33.35	1:33.72	1:32.82	1:33.63	
OVERALL AVERAGE						1:32.21
Chevrolet Malibu (305-4V)	Floate	1:31.38	1:31.37	1:31.12	1:31.16	
	Ring	1:31.74	1:31.78	1:31.89	1:31.63	
	Olsen	1:34.12	1:33.98	1:33.48	1:35.35	
	Steendam	1:33.70	1:33.68	1:33.17	1:33.18	
OVERALL AVERAGE						1:32.13
Dodge Diplomat (318-4V)	Floate	1:31.98	1:32.05	1:32.36	1:31.54	
	Ring	1:33.92	1:34.83	1:34.60	1:34.40	
	Olsen	1:36.35	1:35.42	1:36.84	1:34.73	
	Steendam	1:34.05	1:34.33	1:34.15	1:34.39	
OVERALL AVERAGE						1:33.54
Ford Fairmont (140-1V)	Floate	1:36.32	1:36.36	1:36.10	1:35.71	
	Ring	1:38.17	1:38.39	1:37.88	1:37.08	
	Olsen	1:40.54	1:40.97	1:39.84	1:39.48	
	Steendam	1:39.46	1:40.07	1:39.47	1:37.77	
OVERALL AVERAGE						1:37.68
Ford LTD Crown Victoria S (351-VV)	Floate	1:29.59	1:29.42	1:29.58	1:28.94	
	Ring	1:30.53	1:30.49	1:30.35	1:30.56	
	Olsen	1:32.63	1:33.21	1:31.89	1:31.90	
	Steendam	1:32.20	1:32.14	1:31.65	1:32.30	
OVERALL AVERAGE						1:30.59
Ford Mustang (302-4V)	Floate	1:27.11	1:26.57	1:26.52	1:26.53	
	Ring	1:30.93	1:30.88	1:29.89	1:29.30	
	Olsen	1:29.26	1:29.41	1:28.80	1:29.03	
	Steendam	1:29.57	1:28.81	1:29.47	1:28.90	
OVERALL AVERAGE						1:28.31
Plymouth Gran Fury (318-4V)	Floate	1:31.85	1:31.96	1:31.91	1:32.04	
	Ring	1:33.01	1:33.24	1:32.65	1:33.14	
	Olsen	1:35.23	1:34.76	1:33.76	1:34.82	
	Steendam	1:33.08	1:33.47	1:32.55	1:32.74	
OVERALL AVERAGE						1:32.64
Plymouth Reliant (2.6L-2V)	Floate	1:33.95	1:33.87	1:33.92	1:34.20	
	Ring	1:34.80	1:34.42	1:34.35	1:34.14	
	Olsen	1:36.34	1:37.13	1:36.28	1:35.70	
	Steendam	1:35.69	1:35.59	1:35.18	1:34.80	
OVERALL AVERAGE						1:34.58

All times in minutes, seconds, and hundredths of a second, e.g., 1:34.96 = 1 minute, 34 seconds, and 96/100 of a second.
All tests conducted on Michigan International Speedway road course.
Shaded areas indicate times deleted for overall averaging purposes.
*The drivers are Michigan State Police officers trained as vehicle test drivers.

ACCELERATION AND TOP SPEED TESTING

The acceleration and top speed of each test vehicle are determined through the use of a fifth wheel in conjunction with an electronic speed meter and a multifunction timer. Strip chart recordings of the instantaneous vehicle speed and distance traveled as a function of time are also produced during the tests.

Each vehicle is accelerated from a standing stop to 100 mph during four acceleration sequences, two northbound and two southbound, to allow for wind direction. For each of the four acceleration runs, the time is recorded at which each 10-mph increment of speed is attained, for speeds from 20 to 100 mph. The four times for each speed interval are then averaged.

Following the fourth acceleration run, the test vehicle is subjected to continued acceleration, and two additional items of data are recorded: the distance required to reach a speed of 100 mph, and the maximum speed that is attained in a distance of 14 miles from the start of the run.

Figures 1, 2, and 3 present a plot of the speed of each test vehicle as a function of time for eight cylinder engine, four and six cylinder engine, and eight cylinder Canadian engine vehicles, respectively. Note that the acceleration characteristics of the Chevrolet Impala 350, Chevrolet Malibu 305, Dodge Diplomat 318, and Plymouth Gran Fury 318 in figure 1 were so similar that they cannot be distinguished on the scale of the graph.

For all 15 of the test vehicles, the average time required for each vehicle to reach the designated speeds is presented in table 3, together with the top speed, and time required to attain a speed of 90 or 100 mph.

Table 3 also presents data for the average time to travel a quarter mile during the acceleration runs and the instantaneous speed at the quarter mile point, obtained from the strip chart recordings. In reviewing this data, it will become apparent that the time required to travel a quarter mile is not directly proportional to the instantaneous speed of the vehicle at the quarter mile point. This apparent anomaly is a consequence of the fact that a vehicle does not accelerate at a uniform rate. Consequently, a vehicle that accelerates rapidly at lower speeds with a more gradual increase in acceleration at higher speeds may not achieve as high a speed at the quarter mile distance as one that does not accelerate as rapidly at low speeds but accelerates more rapidly at higher speeds. The Plymouth Gran Fury 318 required 19.10 seconds to attain a speed of 76.50 mph at the quarter mile. In contrast, the Chevrolet Impala Canadian 350 took only 18.30 seconds to obtain the identical speed of 76.50 mph at the end of the quarter mile.

The data obtained by the MSP during the acceleration testing is used by the MSP in two ways. The minimum elapsed times required to reach speeds of 60, 80, and 100 mph from a stop are specified in the MSP purchase specification. If a test vehicle requires more time than specified to reach any of these speeds, the vehicle is eliminated from further consideration in the procurement action.

Those wishing to compare the vehicle performance with the MSP specification will find the acceleration data for each vehicle and the MSP specification requirements tabulated in Appendix C.

The second use of the acceleration data concerns the process of bid adjustment. Those vehicles that meet the minimum specification requirements for acceleration are retained in the bid, and the top speed becomes one of the factors used to compare the vehicles. A weighting factor of 15 percent has been assigned to the top speed by the MSP.

Figure 1

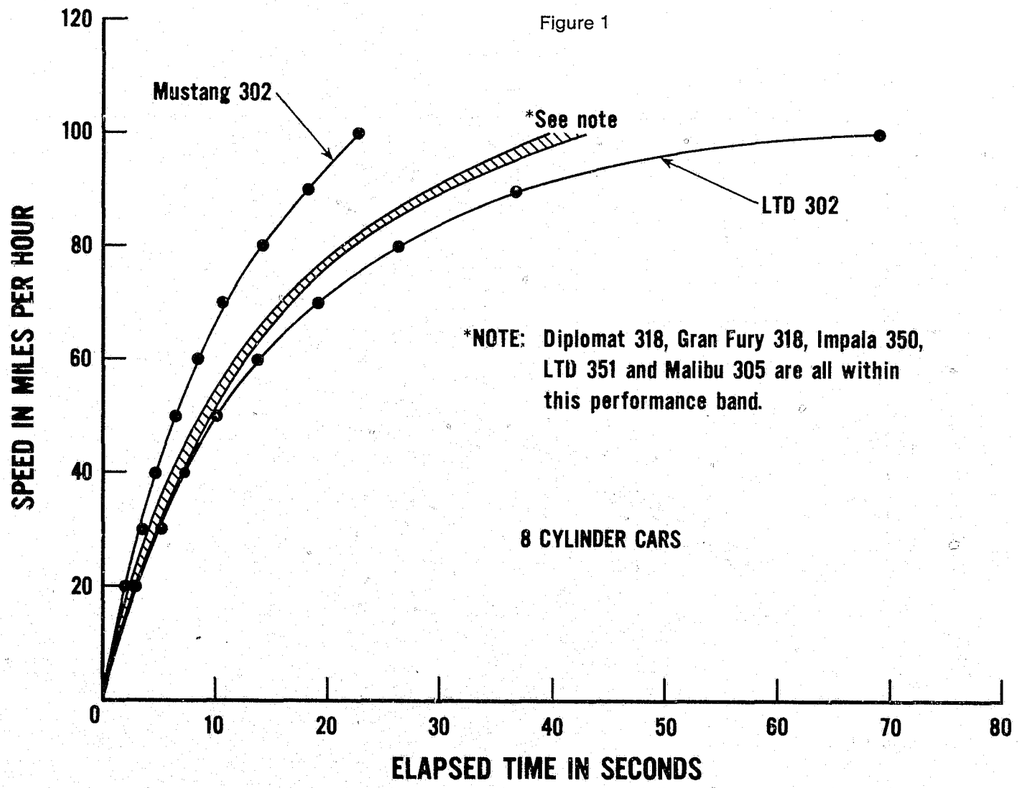


Figure 2

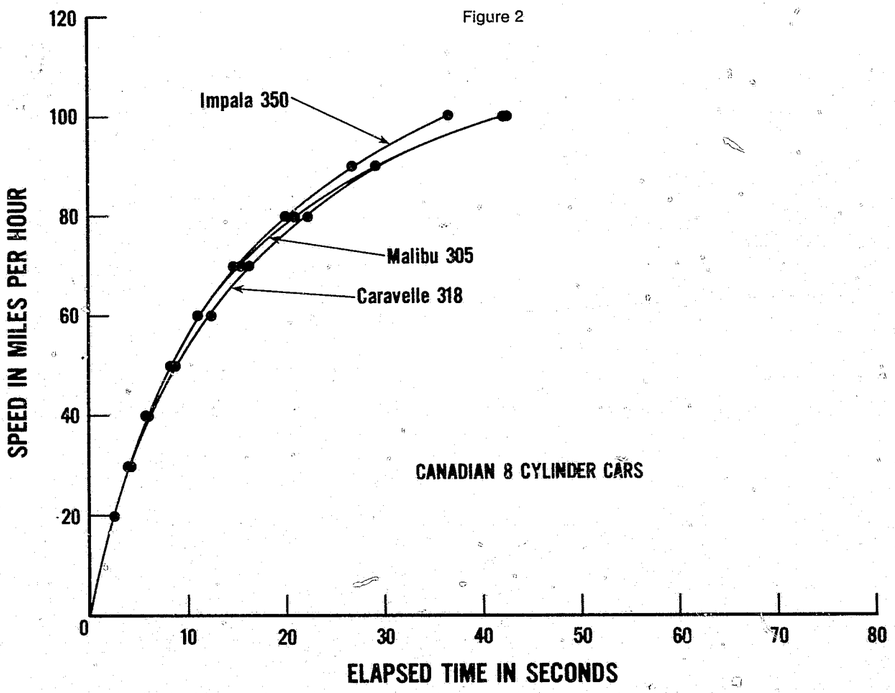
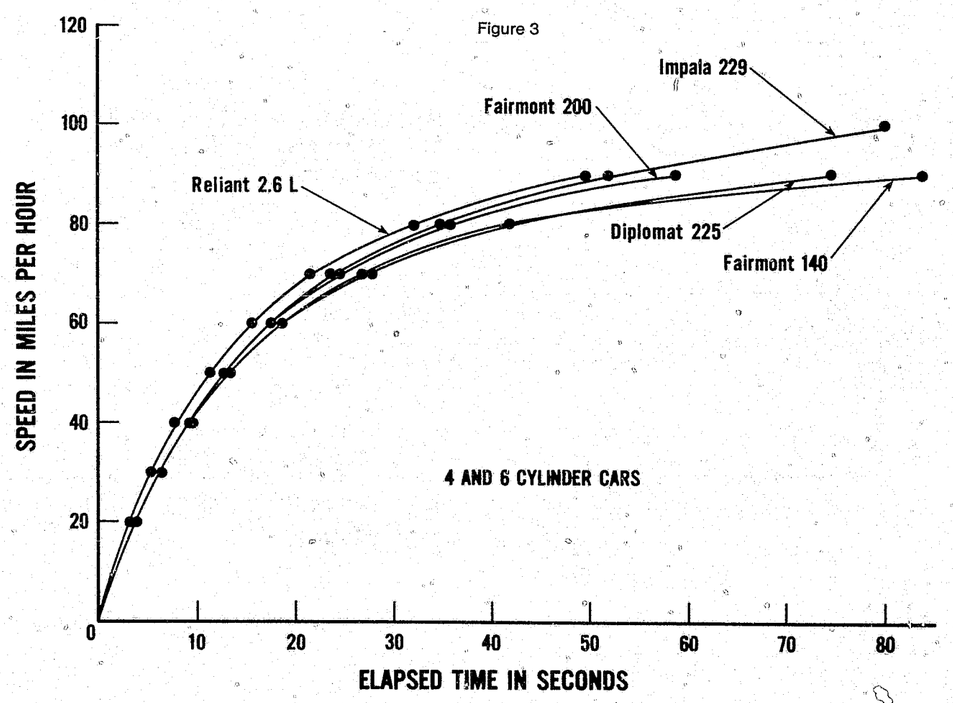


Figure 3



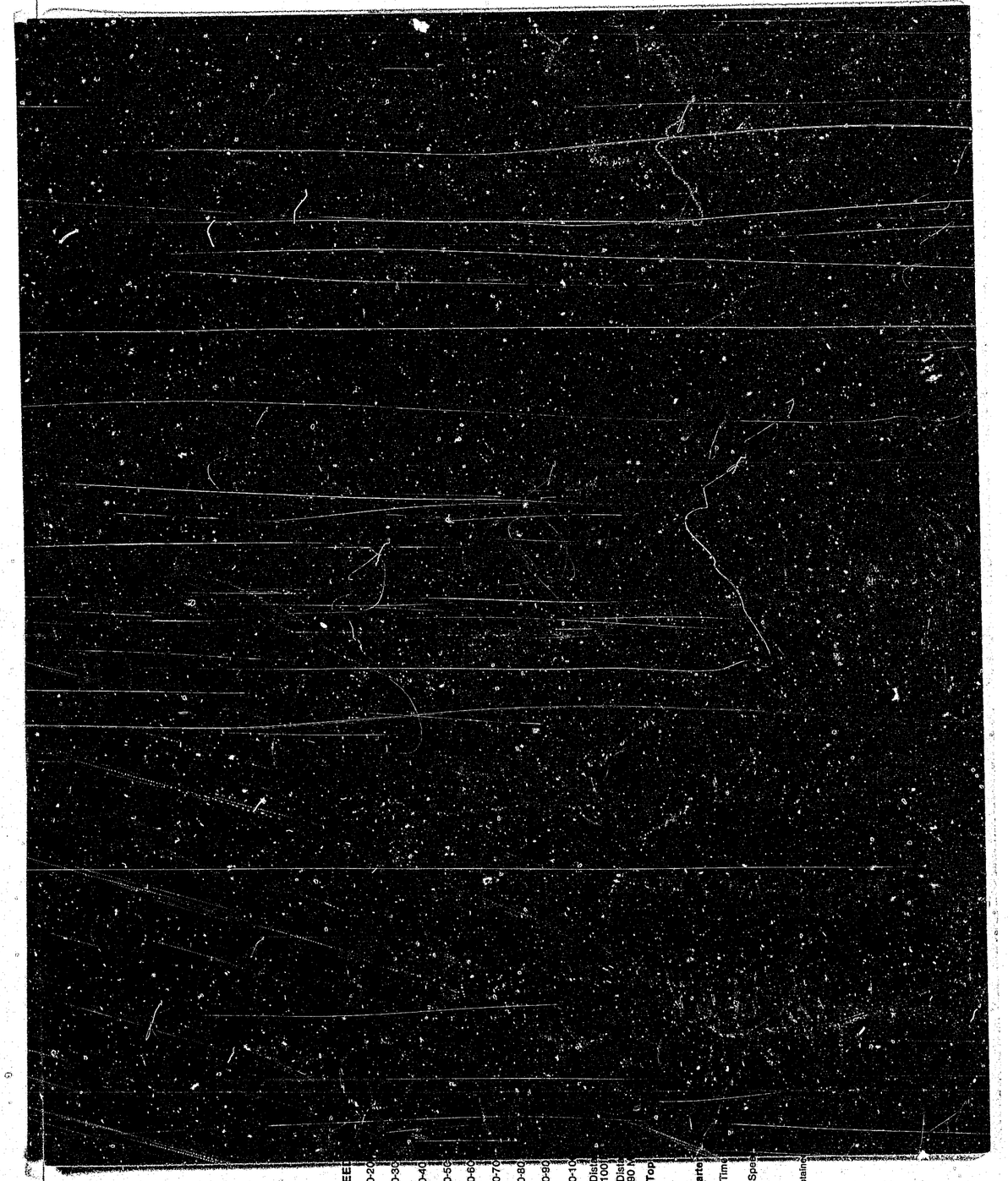


Figure 2

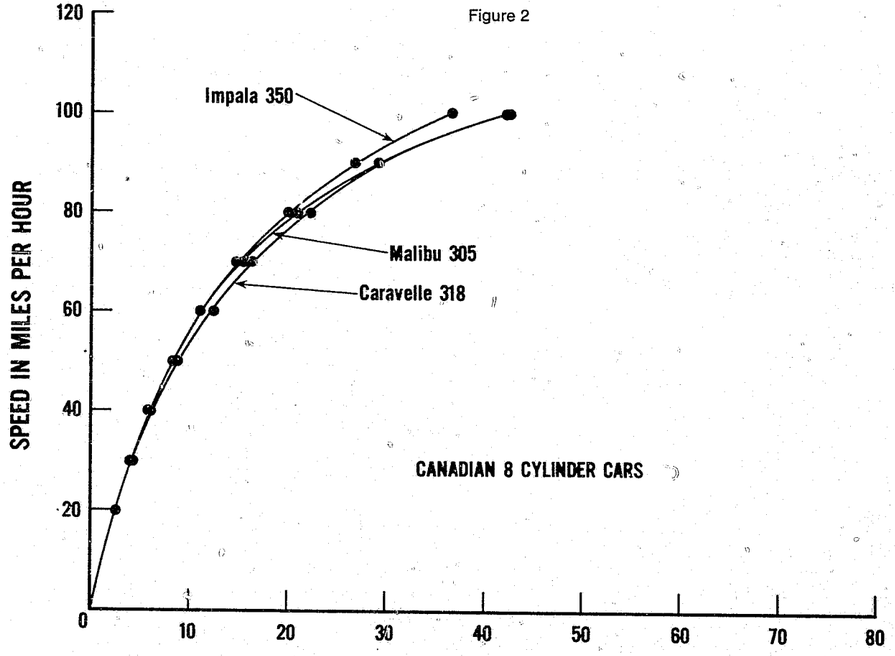
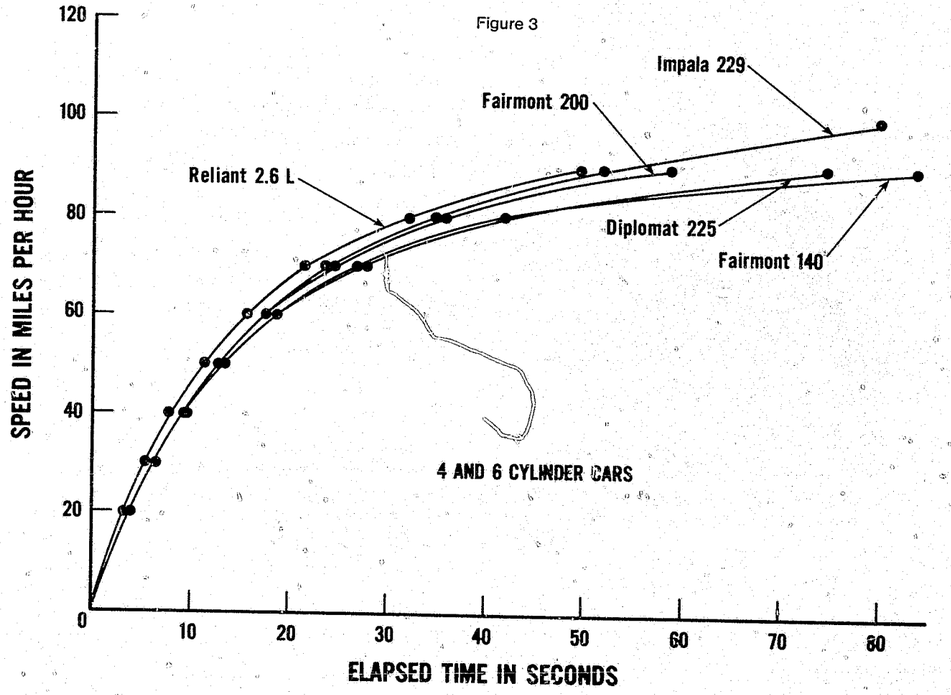


Figure 3



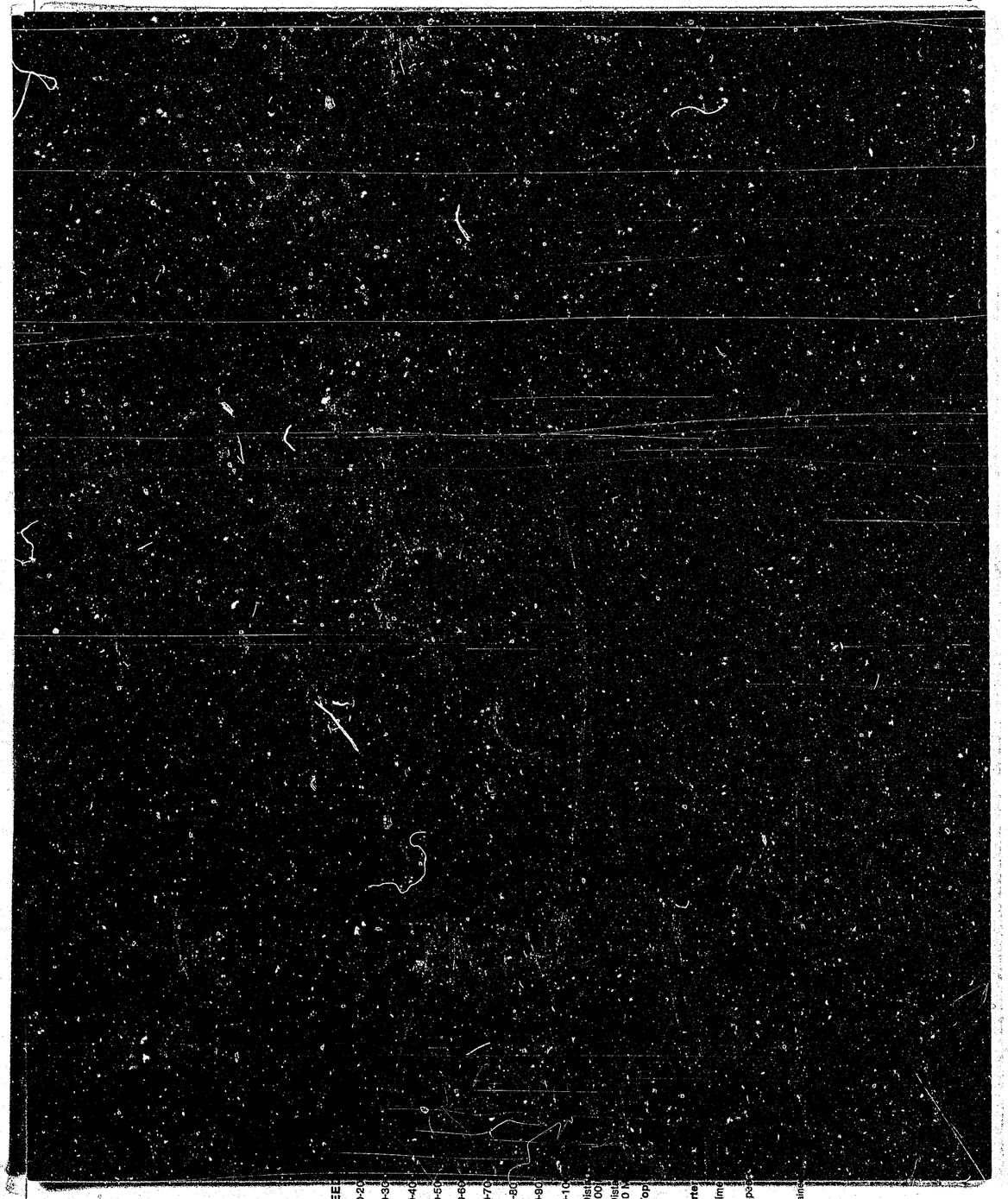


Table 3

SUMMARY OF ACCELERATION AND TOP SPEED TESTING

SPEED	EIGHT CYLINDER ENGINES							CANADIAN EIGHT CYLINDER ENGINES			FOUR AND SIX CYLINDER ENGINES				
	Chevrolet Impala (350-4V)	Chevrolet Malibu (305-4V)	Dodge Diplomat (318-4V)	Ford LTD Crown Victoria S (302-CFI)	Ford LTD Crown Victoria S (351-VV)	Ford Mustang (302-4V)	Plymouth Gran Fury (318-4V)	Chevrolet Impala (Canadian) (350-4V)	Chevrolet Malibu (Canadian) (305-4V)	Plymouth Caravelle (Canadian) (318 Propane)	Chevrolet Impala (229-2V)	Dodge Diplomat (225-1V)	Ford Fairmont (140-1V)	Ford Fairmont (200-1V)	Plymouth Reliant (2.6L-2V)
0-20 MPH (Sec)	2.51	2.64	3.08	2.80	2.88	2.33	3.16	2.54	2.55	2.63	3.81	3.56	3.60	3.65	3.25
0-30 MPH (Sec)	4.09	4.27	5.09	4.72	4.79	3.40	5.13	4.08	4.17	4.21	6.38	5.89	6.21	6.21	5.31
0-40 MPH (Sec)	6.09	6.23	7.15	7.14	6.74	4.69	7.05	5.91	6.08	6.12	9.17	9.07	9.17	9.12	7.68
0-50 MPH (Sec)	8.69	8.59	9.53	10.14	9.14	6.42	9.27	8.30	8.57	8.93	12.60	13.26	12.98	12.76	11.14
0-60 MPH (Sec)	11.67	11.71	12.81	13.94	12.22	8.32	12.38	11.03	11.59	12.14	17.40	18.75	18.40	17.68	15.49
0-70 MPH (Sec)	16.08	15.70	16.71	19.06	16.26	10.70	16.26	14.75	15.38	16.26	23.51	27.70	26.89	24.39	21.21
0-80 MPH (Sec)	22.09	21.70	22.09	26.34	21.35	14.23	21.05	20.04	20.91	22.11	34.75	41.77	41.95	35.74	32.00
0-90 MPH (Sec)	30.14	29.90	30.13	36.76	28.94	18.16	29.19	26.79	29.09	29.31	51.57	74.32	83.57	58.49	49.43
0-100 MPH (Sec)	42.51	40.73	40.46	69.01	39.81	22.71	39.68	36.65	42.74	42.45					
Distance to reach 100 MPH (Miles)*	.84	.79	.77	1.49	.77	.41	.76	.71	.85	.84					
Distance to reach 90 MPH (Miles)*											.91	1.43	1.65	1.07	.90
Top Speed (MPH)	115.00	116.30	118.80	104.40	117.90	132.00	120.00	107.10	112.50	113.60	104.30	96.50	95.80	97.70	102.80
Quarter Mile (average)*															
Time (Sec)	18.55	18.78	19.30	19.93	18.83	16.68	19.10	18.30	18.35	18.95	21.50	22.03	21.83	21.93	19.70
Speed (MPH)	73.50	75.00	75.50	71.25	75.25	86.25	76.50	76.50	75.75	74.25	67.00	63.50	65.00	66.25	68.00

*Obtained from Strip Chart Recordings of Acceleration Runs

BRAKE TESTING

The braking characteristics of vehicles are of major importance when the vehicles are intended for pursuit service. A braking test was conducted to provide a basis for comparing the vehicles of the different manufacturers of police vehicles.

Only 8 of the 15 tested vehicles were subjected to the brake testing. The following vehicles were not tested for braking because they were not equipped with a police package (although these cars can be ordered with the same braking system that was tested on their sister cars): Chevrolet Impala (229-2V); Dodge Diplomat (225-1V); Ford Fairmont (200-1V); and Ford LTD Crown Victoria S (302-CFI). In addition, the three Canadian vehicles which were submitted for acceleration testing because they have a different emissions package, were not subjected to brake testing as their braking system is identical to their U.S. counterparts and their testing would be redundant.

The brake testing was conducted using a fifth wheel in conjunction with electronic digital speed and distance meters to determine the initial velocity at the beginning of the deceleration, and the distance required to come to a complete stop during an impending skid from 60 to 0 mph.

Each vehicle was subjected to 11 braking tests conducted in 3 phases. Phase I consisted of stopping the vehicle 4 times with a controlled deceleration rate of 22 ft/sec^2 from 90 to 0 mph. During these stops, the driver used a decelerometer to maintain the proper deceleration rate. These four stops were accomplished to cause the brakes to heat up. Since the stops were made at a controlled rate, the resulting data did not represent the maximum braking capability of the vehicle, and was not reported. Following the four 90 mph stops, the vehicle was stopped in an impending skid from 60 mph and the deceleration rate was calculated from the initial velocity and the stopping distance.

The brakes were allowed a period of four minutes to cool, and the procedures outlined above were repeated as phase II.

Immediately upon completion of the phase II test sequence, the vehicle was subjected to one 60-to-0 mph full four-wheel lock stop (phase III) to determine the ability of the vehicle to stop in a straight line within its lane. The phase III data were recorded as observational information only. All of the vehicles tested performed in an acceptable manner during phase III testing.

The deceleration rates calculated for the phase I and II 60-to-0 mph stops are presented in table 4 and figure 4. Figure 4 shows the stopping distance from 60 mph calculated from the average deceleration rate for each vehicle. The average of the two deceleration rates for each vehicle is used for comparison of the vehicles, and is assigned a weighting factor of 10 percent.

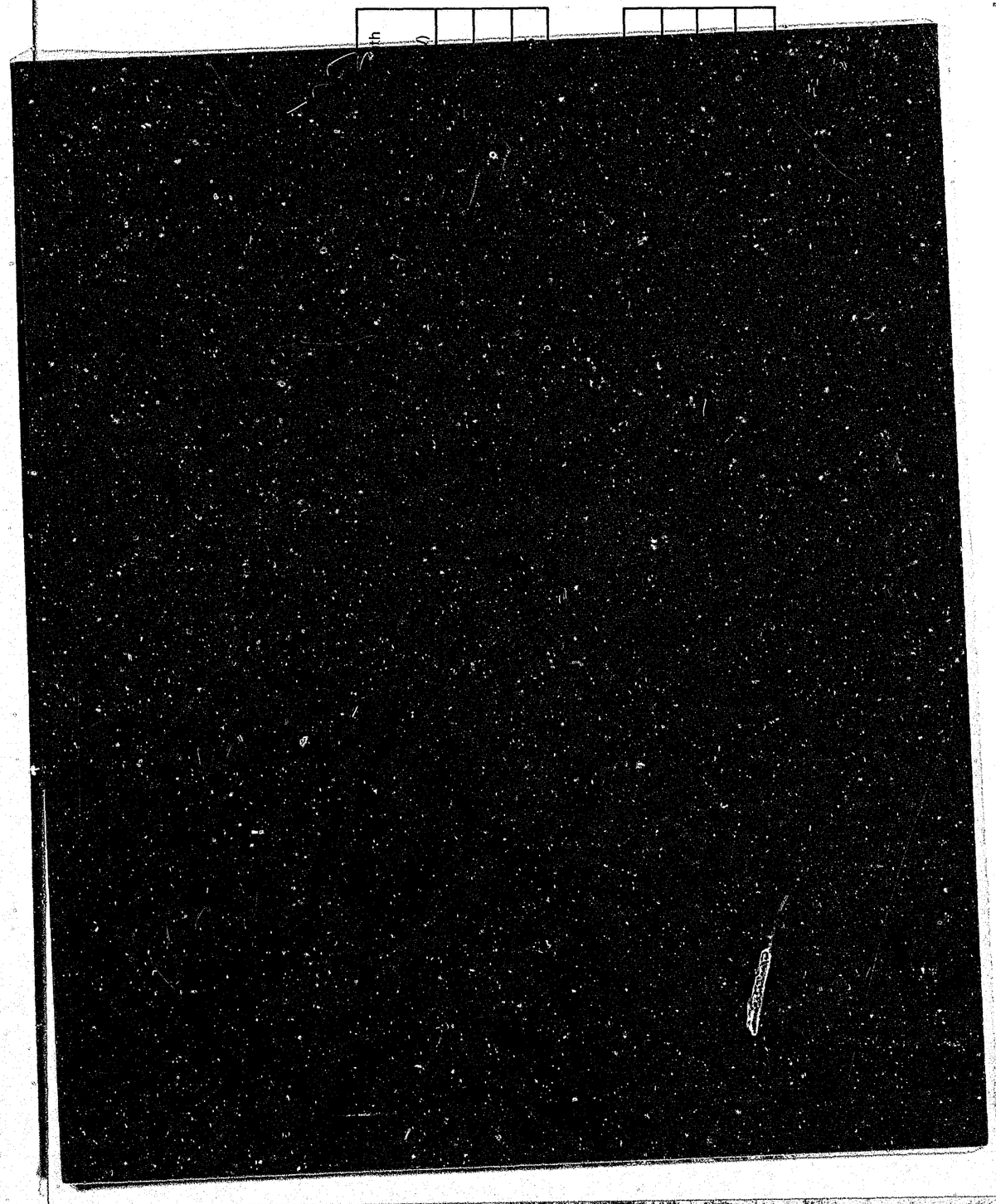
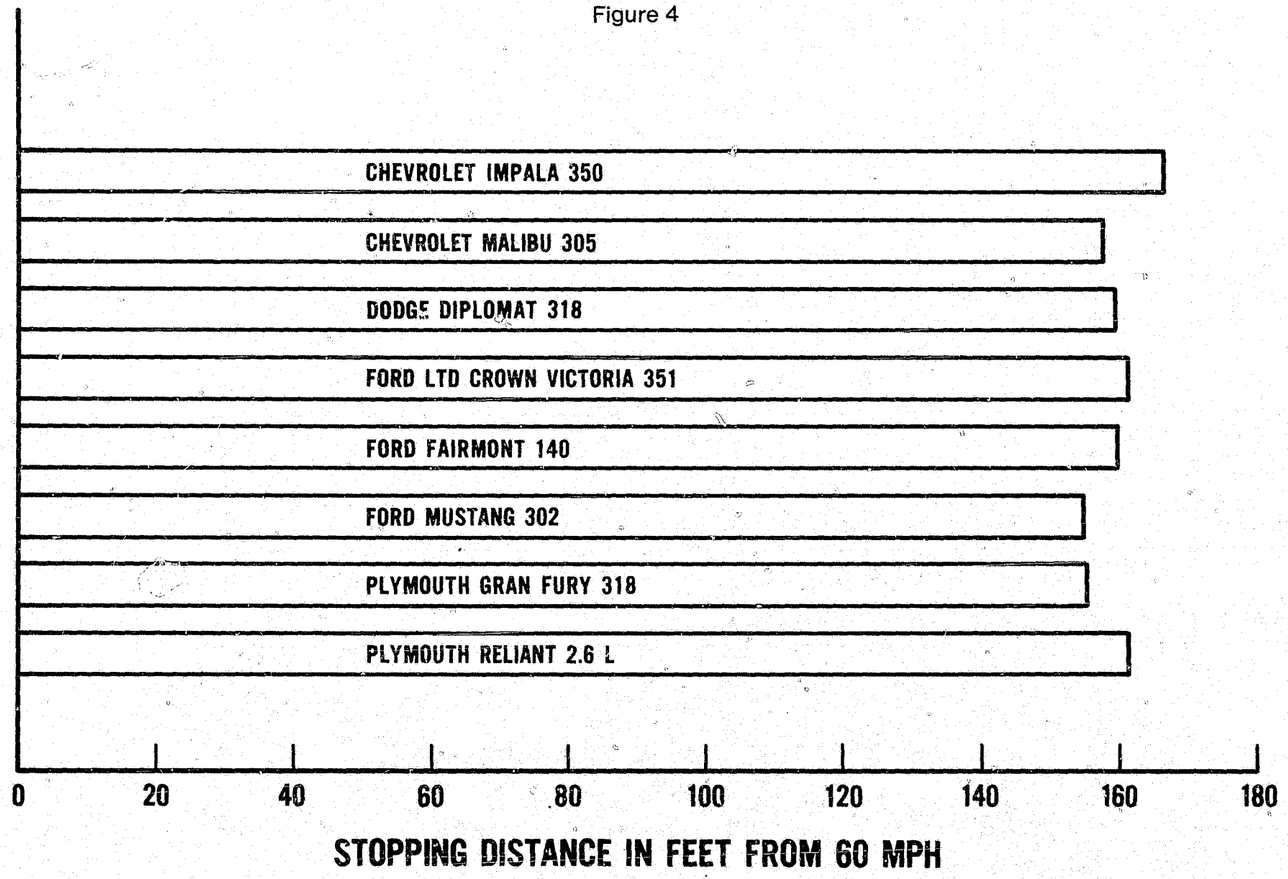


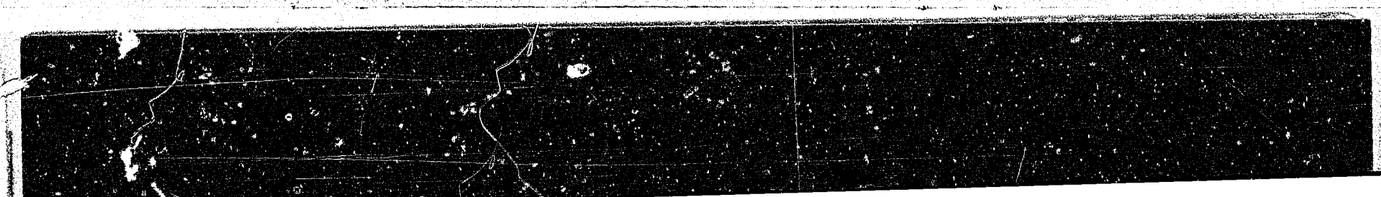
Table 4

SUMMARY OF BRAKE TESTING

BRAKING Phase I	Chevrolet Impala (350-4V)	Chevrolet Malibu (305-4V)	Dodge Diplomat (318-4V)	Ford Fairmont (140-1V)	Ford LTD Crown Victoria S (351-VV)	Ford Mustang (302-4V)	Plymouth Gran Fury (318-4V)	Plymouth Reliant (2.6L-2V)
Initial Speed (MPH)	60.20	60.40	60.70	60.30	60.30	60.20	60.70	60.50
Stopping Distance (Ft)	167.60	159.00	166.00	160.20	163.70	151.30	158.10	164.90
Deceleration Rate (Ft/Sec^2)	23.258	24.679	23.874	24.413	23.891	25.764	25.067	23.875
Phase II								
Initial Speed (MPH)	60.50	60.10	59.70	60.80	60.60	60.60	60.20	60.50
Stopping Distance (Ft)	169.80	159.70	155.50	165.50	164.00	163.40	157.40	163.70
Deceleration Rate (Ft/Sec^2)	23.186	24.327	24.653	24.025	24.085	24.174	24.765	24.050
Deceleration Rate (Average) (Ft/Sec^2)	23.222	24.503	24.264	24.219	23.988	24.969	24.916	23.963

Figure 4


CHEVROLET IMPALA 350
CHEVROLET MALIBU 305
DODGE DIPLOMAT 318
FORD LTD CROWN VICTORIA 351
FORD FAIRMONT 140
FORD MUSTANG 302
PLYMOUTH GRAN FURY 318
PLYMOUTH RELIANT 2.6 L
0
20
40
60
80
100
120
140
160
180
STOPPING DISTANCE IN FEET FROM 60 MPH



ERGONOMICS AND COMMUNICATIONS

The physical design and construction of a vehicle can impact upon the ability of an officer to perform his duties, and is a major concern with respect to the installation of required communications equipment.

The MSP has designed a form that identifies 24 ergonomic characteristics of importance to the patrol officers' environment, and 3 items critical to the installation of communications equipment. A minimum of four officers are assigned to independently and individually score each vehicle on comfort and instrumentation by using the forms, and personnel from the departmental radio installation and garage units rate the vehicles based upon the relative difficulty of the necessary communication installation.

Each factor is graded on a scale of 1 to 10, with 1 representing "totally unacceptable," 5 representing "average," and 10 representing "superior." The scores for each factor for each vehicle are averaged to minimize personal prejudice for or against a given vehicle. The ergonomics and communications data are presented in table 5.

The average scores for each factor are totaled and used as one of the bid adjustment factors with a weighting of 10 percent.

ERGONOMICS AND COMMUNICATIONS

Table 5

EVALUATED ON A SCALE OF 1 (WORST) TO 10 (BEST)

	CHEVROLET IMPALA 350-4V	DODGE DIPLOMAT 318-4V	FORD LTD-CV-S 351-vv	CHEVROLET MALIBU 305-4V	PLYMOUTH GRAN FURY 318-4V
1. ERGONOMICS					
SEATS					
Front					
Padding	4.50	7.25	8.00	4.25	7.25
Depth of Bench	5.50	6.25	7.50	5.63	6.25
Angle of Back	6.38	6.88	8.00	6.13	6.88
Adjustability	6.00	6.25	7.25	5.50	6.25
Seat to Wheel Relationship	6.00	6.88	7.75	6.38	6.88
Seat to Pedal Relationship	6.25	7.25	7.75	6.50	7.25
Rear					
Leg Room	6.38	5.75	7.50	4.63	5.75
CONTROLS AND INSTRUMENTATION					
Vehicle Controls					
Pedals — Size and Relationship	6.38	6.63	6.50	6.00	6.63
Steering Wheel Position	6.00	7.63	7.63	5.75	7.63
Heater/AC Controls Location	5.38	8.00	5.63	5.38	8.00
Instrumentation					
Clarity	6.25	7.38	6.63	7.88	7.38
Placement	6.25	7.00	6.63	7.75	7.00
VISIBILITY					
Front	7.00	7.75	8.00	7.00	7.75
Left Side	6.50	6.63	6.63	6.50	6.63
Left Rear Quarter	5.75	6.75	5.75	5.88	6.75
Right Side	5.88	6.13	6.25	6.00	6.13
Right Rear Quarter	5.63	6.25	5.38	5.50	6.25
Rear	6.00	7.13	6.63	5.50	7.13
HEATER/AIR CONDITIONER					
Operation					
Blower Range	8.00	7.50	7.75	8.00	7.50
Temperature	7.38	7.38	7.50	7.50	7.38
Vent Placement	7.63	7.00	7.63	6.50	7.00
Vent Adjustability	6.88	6.38	6.88	6.13	6.38
WINDOWS AND DOORS					
Windows					
Seal	7.13	7.75	8.25	7.13	7.75
Position of Crank	6.13	6.75	6.63	7.38	6.75
Doors					
Ease of Entry and Exit—Front	7.00	6.63	7.50	6.63	6.63
Ease of Entry and Exit—Rear	6.25	6.13	7.38	4.88	6.13
2. COMMUNICATIONS					
DASH ACCESSIBILITY	8.60	5.20	4.60	8.40	5.20
ENGINE ACCESSIBILITY	8.80	5.60	8.40	8.20	5.60
TRUNK ACCESSIBILITY	6.60	6.20	5.00	6.20	6.20
TOTALS	188.43	196.31	202.93	185.11	196.31

FUEL ECONOMY

Fuel consumption is a major consideration for any police department. The MSP does not perform tests to determine fuel consumption, but rather utilizes the published Environmental Protection Agency (EPA) data. These data are valid and reliable in a comparison sense, while not necessarily being an accurate prediction of actual economy.

The EPA estimated miles-per-gallon figures (given to the nearest 0.1 miles per gallon), as presented in table 6, are used as the final factor in the bid adjustment process. A weighting factor of 25 percent has been assigned to fuel economy.

Table 6

ESTIMATED EPA FIGURES

VEHICLES MAKE/MODEL		EPA Miles Per Gallon*		
		CITY**	HIGHWAY	COMBINED
Chevrolet Impala	350-4V	15 (14.8)	25	18
Chevrolet Malibu	305-4V	18 (17.8)	26	21
Dodge Diplomat	318-4V	14 (14.0)	21	16
Ford LTD Crown Victoria S	351-V V	14 (14.0)	24	17
Ford Mustang	302-4V	17***	28***	21***
Plymouth Gran Fury	318-4V	14 (14.0)	21	16
Chevrolet Impala	229-2V	19 (18.6)	27	22
Dodge Diplomat	225-1V	19 (18.7)	25	21
Ford Fairmont	140-1V	21 (20.9)	31	24
Ford Fairmont	200-1V	19 (18.6)	24	21
Ford LTD Crown Victoria S	302-CFI	17 (16.6)	26	20
Plymouth Reliant	2.6L-2V	24 (23.6)	30	26

*For vechicles available in the United States; data on Canadian vechiles not available
**City mileage estimate developed from EPA Test Car Data List.
***Figures supplied by Ford Motor Corporation

MICHIGAN STATE POLICE
PATROL VEHICLE WEIGHTING AND SCORING
FOR MODEL YEAR 1983

The MSP procedure for the final award of the contract for police vehicles involves several steps. First, any vehicle that fails to meet the minimum requirements of the purchase specification, as determined by inspection and testing, is eliminated from consideration.

For each vehicle that meets the minimum requirements, the raw data for each of the six factors tested and evaluated are entered onto a score sheet. Finally, the test/evaluation results are used to calculate an adjusted bid price that reflects the extent to which each vehicle scores above or below the average score of all of the vehicles. The contract is then awarded to the minimum bid as adjusted.

In adjusting the bid, MSP has established, by policy, the fact that as an agency they are willing to pay as much as five percent more than the average price of all bids received for a vehicle that scores well. Thus, the bid adjustment is simply five percent of the average. Since the bid adjustment has the net effect of reducing the bid price (i.e., superior performance is equivalent to a lower bid), the five percent adjustment factor is entered as a negative quantity (-$).

Table 7 presents the final results of the bid adjustments calculated by MSP for the 1983 model year. The score for each vehicle is entered as the top number in each column: (1) the vehicle dynamics score is the average time in seconds that the vehicle required to complete the 12 fastest laps of the pursuit course, (2) the acceleration score is the time in seconds that the vehicle required to reach a speed of 100 mph, (3) the brake deceleration score is the average deceleration rate in ft/sec^2, (4) the top speed is the maximum speed in mph that the vehicle obtained, (5) the ergonomics and communications score is the total point value assigned to the vehicle on the score sheet, and (6) the fuel economy score is the city mileage estimate published by the Environmental Protection Agency (EPA) in miles per gallon (given to the nearest 0.1 mile per gallon).

For each vehicle, the second entry in each column is the weighted Z(WTD Z) score. To calculate this the following steps are required:

1. The average score ($\overline{X}$) for all vehicles for a given factor (column such as vehicle dynamics) and the standard deviation (S) of all scores for that factor are calculated.

2. The average score for all vehicles ($\overline{X}$) is subtracted from the score of the individual vehicle (X), and the result divided by the standard deviation,

$$\left(\frac{X-\overline{X}}{S}\right)$$

3. The value calculated in step 2 above is multiplied by the weighting factor.

Once the weighted Z factor has been calculated for each of the six scores, the WTD Z for all factors are added to obtain the total score for the vehicle (total WTD Z), which is multiplied by the five percent bid adjustment in dollars and added to the actual bid to obtain the adjusted bid.

The procedure for making the above calculations manually is described in Appendix D. Those wishing to make such calculations should recognize that the data presented in table 8 were processed by the MSP using a computer. The processing was done using a greater number of significant figures than those reported in this report; consequently, calculations of the bid adjustment using only three figures for the WTD Z scores will not agree precisely with the bid adjustments shown in the table.

In addition, it must be noted that the calculation of the WTD Z for the vehicle dynamics and acceleration scores requires that the sign of the value calculated using the stated formula must be reversed. This is the result of the fact that for these two vehicle scores only, the minimum time represents the best performance—unless the sign is reversed, the vehicle with the fastest speeds would receive a penalty since their speeds are less than the average speed of all of the vehicles tested.

At the time of publication, the MSP had not opened their bids. Therefore, table 8 does not have the bid data included. The bid adjustment procedure, when used by the MSP for the 1982 model year, did not alter the vehicle selection. During the procurement of the 1980 model year vehicles, MSP purchased vehicles that were not the low bid until the bid price was adjusted to reflect the overall performance of all test vehicles.

Table 7

MICHIGAN STATE POLICE
COMPETITIVE PATROL VEHICLE EVALUATION

	25% VEHICLE DYNAMICS (secs)	15% ACCELERATION (secs)	10% BRAKING RATE (ft/sec ^{2})	15% TOP SPEED (mph)	10% ERGONOMICS & COMMUNI-CATIONS (points)	25% FUEL ECONOMY (city EPA)
CAR MAKE/ MODEL	RAW SCORES	RAW SCORES	RAW SCORES	RAW SCORES	RAW SCORES	RAW SCORES
CHEVROLET IMPALA 350-4V	92.21	42.51	23.23	115.0	188.43	14.8
CHEVROLET MALIBU 305-4V	92.13	40.73	24.51	116.3	185.11	17.8
DODGE DIPLOMAT 318-4V	93.54	40.46	24.26	118.8	196.31	14.0
FORD LTD CVS 351-VV	90.59	39.81	23.99	117.9	202.93	14.0
PLYMOUTH GRAN FURY 318-4V	92.64	39.68	24.92	120.0	196.31	14.0

Table 8

MICHIGAN STATE POLICE
COMPETITIVE PATROL VEHICLE EVALUATION

	25% VEH DYN SEC	15% ACCEL SEC	10% BRAKE DECEL FT/S²	15% TOP SPEED MPH	10% ERGO/ COM PTS	25% FUEL ECON CITY EPA	TOTAL SCORE	BID 5.00% ADJ*	ACTUAL BID*	ADJUSTED BID*
CAR MAKE/ MODEL	SCORE & WTD Z	SCORE & WTD Z	SCORE & WTD Z	SCORE & WTD Z	SCORE & WTD Z	SCORE & WTD Z	TOTAL WTD DEV			
CHEVROLET IMPALA 350-4V	92.21 0.003	42.51 -0.277	23.23 -0.168	115.00 -0.220	188.43 -0.085	14.80 -0.020	-0.767			
CHEVROLET MALIBU 305-4V	92.13 0.024	40.73 -0.014	24.51 0.058	116.30 -0.110	185.11 -0.138	17.80 0.489	0.310			
DODGE DIPLOMAT 318-4V	93.54 -0.344	40.46 0.026	24.26 0.014	118.80 0.101	196.31 0.039	14.00 -0.156	-0.319			
FORD LTD-CV-S 351-VV	90.59 0.426	39.81 0.122	23.99 -0.034	117.90 0.025	202.93 0.144	14.00 -0.156	0.528			
PLYMOUTH GRAN FURY 318-4V	92.64 -0.109	39.68 0.142	24.92 0.130	120.00 0.203	196.31 0.039	14.00 -0.156	0.249			

APPENDIX A

MICHIGAN STATE VEHICLE SPECIFICATION

STATE OF MICHIGAN
DEPARTMENT OF MANAGEMENT AND BUDGET
PURCHASING DIVISION

Specifications for

Mich. 3905-0010
September 1982

POLICE CARS: PATROL
4-Door Sedan

Wheelbase 105.5" Minimum

BID REQUIREMENTS:

Prior to bidding, a car dealer, manufacturer, or his representative, will be required to furnish a "police package" vehicle for test purposes. All test vehicles shall be 1983 models which are equipped with the drive train, suspension, and brake components, as well as tires and interior appointments and instrumentation, as called for in the specification requirements on all vehicles in this requisition. Submitters of vehicles shall declare in writing any deviations from the specifications at the time of delivery of these test cars. Interior and exterior colors shall be the manufacturer's option. One extra set of four (4) wheels and tires shall be supplied with each car submitted for testing. Vehicles submitted shall have undergone sufficient break-in to permit extended periods of maximum acceleration and high speed driving. Brakes on the test car shall have been burnished prior to delivery.

Test cars shall be delivered to the Michigan Department of State Police Headquarters, 714 South Harrison Road, East Lansing, Michigan, no later than 5:00 p.m., September 13, 1982.

These test vehicles will be subjected to a series of initial performance qualifications tests. Each vehicle successfully completing these tests will then be subjected to six (6) competitive performance and acceptability tests. The State of Michigan shall not be responsible for any damage during the tests, or the condition of the vehicle when returned to the submitter after testing. Furthermore, all cars tested will be at the owner's risk for any damage occurring to the vehicles for any reason.

The test vehicles will be tested and driven under the supervision of the Michigan Department of State Police, and will be tested and driven by employees of the department or personnel designated by the department.

Vehicles used for testing will be returned to the submitter no later than one (1) month following the completion of performance testing.

SPECIFICATIONS:

Model - 1983 Current New

TO BE STANDARD FACTORY EQUIPPED INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING:

Air Conditioning: Factory installed, system must be designed to prevent component damage due to high speed driving.

Alternator System: Transistorized regulator, 80 amp minimum output capacity, minimum curb idle output of 45 amps (at manufacturer's recommended idle speed). Shall be of heavy duty design capable of surviving patrol car operation. Output ratings are for typical underhood ambient temperatures and not S.A.E. rating method.

Antenna: Standard AM type, externally mounted or in the windshield type acceptable (radio not to be included).

Ash Trays: Front seat ash tray to be on instrument panel. Rear seat ash trays shall be made inoperative.

Battery: 12 volt, largest size available, minimum 455 cold cranking amps.

Body Side Molding: Vehicle to be equipped with body side molding. Molding on front doors to be deleted. No holes to be on doors for moldings.

Brakes: Power assisted, low pedal position. Disc type in front; drum type in rear. Four wheel disc brakes acceptable.

Cigarette Lighter: To be located on instrument panel.

Cooling System: Vehicle to have maximum size cooling system available, incorporating "coolant recovery" system, factory installed.

Differential: Heavy duty, limited slip required.

Engine: Cubic inch displacement to be at manufacturer's option providing that the car will meet or exceed the vehicle performance requirements found elsewhere in this specification.

Floor Mat: Heavy duty rubber, front and rear. Trunk mat, full floor.

Gauges: To be equipped with ammeter or voltmeter, water temperature, and oil pressure gauges, located in instrument cluster. Any other installation location to be approved by the Michigan State Police.

Glass: All windows shall be heat absorbing (tinted) type.

Headlights: To be equipped with Quartz-Halogen headlights.

Keys: Four (4) keys to be furnished with each car.

License Plate Brackets: Vehicle shall be equipped with a front license plate bracket.

Light: Combination dome and map, mounted on headliner on longitudinal centerline of vehicle approximately 25" from windshield garnish molding. Dome light controlled by rotating headlight switch to maximum C.C.W. position. Operation to be independent of other lights. Door jamb switches to be made inoperative. Map lights, controlled by individual integral switches, to direct a restricted beam of light to the driver and/or to the front seat passenger. Exact mounting position to be approved by the Michigan State Police.

Light: Engine and trunk compartments equipped with mercury switch.

Locks: Power door locks to be standard, factory installed. Power system to be operative from front driver and front passenger position. All locks on the car to be keyed alike, a different key for each car.

Mirrors, Rearview:

Inside: Day/night type.

Outside: Installed on left-hand and right-hand doors. Rectangular design approximate size 5" x 3"; minimum viewing area of 15 square inches. Left side to be remote controlled type. Right and left side mirrors to be conventional type (not convex).

Paint Color: To be same as Dulux 93-032.

Pilot Inspection: Prior to the initial delivery of patrol vehicles, the manufacturer shall schedule a pilot model inspection in order to determine compliance with the specifications. The inspection shall be conducted at the point of vehicle assembly or a location mutually agreed upon. The manufacturer shall be responsible for all costs incurred (not to exceed six representatives from the State of Michigan).

Radio Noise Suppression: Vehicle shall be equipped with standard AM and police radio noise suppression package.

Radio Speaker(s): A permanent magnet speaker(s), either oval or round, to be mounted in the speaker opening(s) provided on the dash of the unit. Speaker(s) to be of a quality equal to automotive grade. Speaker leads connected to the speaker terminals, not grounded, shall be long enough to extend one foot beyond the center of the lower edge of the dash.

- One speaker installation - Voice coil impedance 8 ohms, power handling capacity 8 watts, minimum.

- Two speaker installation - Voice coil impedance 3.2 ohms, power handling capacity 8 watts, minimum.

Rear Window Defogger: Electrical grid type. Control to be within convenient reach of driver, control switch to be clearly marked as to function.

Remote Control Rear Deck Lid Release: Control to be within convenient reach of the driver; in glove box not acceptable. Electric system wired independently of ignition switch. Bowden cable system not acceptable.

Roof Top Reinforcement and Special Wiring: Install a steel plate at least 1/8" thick x 10" wide, to the underside of the top, centered on the longitudinal centerline of the roof panel. Plate is to extend from the windshield header to the first top cross member support and is to be welded at both ends. Drill one 1/2" hole through roof panel and reinforcing plate, approximately 19" from windshield molding on longitudinal centerline. Exact placement of hole to be approved by the Michigan State Police. Feed at least three insulated stranded wires (minimum of one #12 and two #16) through hole in roof and route directly to either side of top at a right angle to the longitudinal centerline, thence to corner post and down the inside of corner post. Wires to extend 18" above roof hole and a minimum of 36" beyond where they emerge at bottom of corner post. Top hole to be taped to prevent entry of water. Wires to be concealed between headlining and roof panel.

Seat Assembly, Front: Split bench type, 60 (passenger side)/40 (driver's side) preferable, individually adjustable fore and aft, heavy duty interior construction designed for rugged police use, comfortable foam-padded seat cushions and backs.

Seat Belts: Driver and right front passenger shoulder belt assembly to incorporate tension reliever and automatic release mechanism.

Service Manuals: Vendor to supply three (3) service manuals at time of first vehicle delivery.

Spare Tire: Tire and wheel to be mounted in trunk. Tire shall meet Michigan Specification 5260-S1, July 27, 1982.

Speedometer: Shall be calibrated to within ± 3 mph accuracy. Scale graduations to be linear and of 2 mph increments, 0-120 mph scale minimum.

Spotlights: Unity Model #225 (equipped with aircraft landing lamp 4537-2) to be mounted on left- and right-hand "A" Pillar. Left and right spotlights to be wired independent of ignition and individually fused with 10 amp capacity. Installation to be approved by the Michigan State Police.

Steering: Power steering, manufacturer to provide steering gear which affords maximum firm "feel" and fast return characteristics; designed for high speed pursuit type driving.

Steering Wheel: Tilt type steering wheel required, round with anti-slip surface.

Suspension System, Police: To include heavy-duty springs, front and rear, in combination with heavy-duty shock absorbers, and front and rear heavy-duty stabilizer bars.

Technical Service Bulletin: Manufacturer to supply three (3) copies of all technical service bulletins covering vehicles purchased under this contract.

Tires: Tires to be Goodyear, Rayon Police Radials per State of Michigan Specification 5260-S1, July 27, 1982.

Tools: Wheel wrench and jack.

Transmission: To be 3- or 4-speed fully automatic, heaviest duty available. Must incorporate low gear lockout to prevent manual shifting.

Upholstery: Seats to be upholstered in cloth, or combination of cloth and vinyl (blue). All vinyl not acceptable.

Wheels: Heavy duty construction designed for police use. To be equipped with sealing type metal valve caps.

Windshield Washers: Automatic type.

Windshield Wipers: Multiple speed electric.

Wiring, Special: One 14 gauge insulated wire running from center under dash to rear center trunk area, leaving 4 feet of this wire extending under the dash and 3 feet extending in the trunk for mounting rear shelf lights. Flexible conduit not acceptable.

QUALIFICATION TESTING

In order to qualify for bidding, all vehicles submitted by manufacturers must meet each of the following performance standards:

1. ACCELERATION

   0 - 60 MPH ---- 14.5 seconds or less
   0 - 80 MPH ---- 26.0 seconds or less
   0 - 100 MPH ---- 48.5 seconds or less

   Each vehicle will make four acceleration runs, and the times for the four runs will be averaged.

2. BRAKES

   a. Test vehicles will be required to make four consecutive stops from 90 mph with a constant deceleration rate of 22 ft. per sec./per sec. maintained from 90 to 0 mph. Immediately following this brake heat-up procedure, a controlled impending skid stop will be made from 60 mph.

   b. After a four-minute wait, test "a" will be repeated. Immediately following, each vehicle is required to complete a panic (all wheel lock) stop from 60 mph. Evidence of brake fade and ability of the vehicle to stop in a straight line within its own lane will be evaluated.

APPENDIX B

MANUFACTURER VEHICLE SPECIFICATIONS

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	CHEVROLET	IMPALA	1BL69
ENGINE DISPLACEMENT	350 CU. IN.	5.7 LITERS	
CARBURETOR-EXHAUST	4 BBL	Single Exhaust	
HORSEPOWER @ RPM (S.A.E. NET)	155 @ 3600		
TORQUE LBS. @ RPM	265 @ 1600		
COMPRESSION RATIO	8.2:1		
AXLE RATIO	3.08:1		
STEERING	Power, Integral, Recirculating Ball Nut		
TURNING CIRCLE (CURB TO CURB)	38.7 ft.		
TIRE SIZE	P225/70R15		
SUSPENSION TYPE — FRONT	Independent, SLA Type With Coil Springs		
SUSPENSION TYPE — REAR	Link Type, 2 Upper and 2 Lower With Coil Springs		
BRAKE—FRONT	TYPE Disc	SWEPT AREA 273.0 SQ. IN.	
BRAKE—REAR	TYPE Drum	SWEPT AREA 138.2 SQ. IN.	
OVERALL LENGTH	212.2 in.		
OVERALL HEIGHT	56.4 in.		
WEIGHT	CURB LBS.	TEST 3993 LBS.	
WHEELBASE	116.0 in.		
HEAD ROOM — FRONT	39.5 in.		
HEAD ROOM — REAR	38.2 in.		
LEG ROOM — FRONT	42.2 in.		
LEG ROOM — REAR	39.1 in.		
SHOULDER ROOM — FRONT	60.5 in.		
SHOULDER ROOM — REAR	60.5 in.		
HIP ROOM — FRONT	55.0 in.		
HIP ROOM — REAR	55.3 in.		
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 15	HIGHWAY M.P.G. 25	COMBINED M.P.G. 18

INTERIOR VOLUME

Interior	
Front	58.1 cu ft
Rear	52.2 cu ft
Combined	110.3 cu ft
Trunk	20.9 cu ft

TRANSMISSION
MODEL NUMBER 700 R4
LOCK UP TORQUE CONVERTER YES X NO
OVERDRIVE YES X NO

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INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	DODGE		DIPLOMAT		G-L-41	
ENGINE DISPLACEMENT	318	CU. IN.	5.2			LITERS
CARBURETOR-EXHAUST	4 BBL		Single Exhaust			
HORSEPOWER @ RPM (S.A.E. NET)	165 @ 4000					
TORQUE LBS. @ RPM	240 @ 2000					
COMPRESSION RATIO	8.5:1					
AXLE RATIO	2.94:1					
STEERING	Power - Firm (15.7:1 Gear Ratio)					
TURNING CIRCLE (CURB TO CURB)	40.7 ft.					
TIRE SIZE	P215/70R15					
SUSPENSION TYPE — FRONT	Independent, Lateral, Non-Parallel Control Arms With Transverse Torsion Bars, Heavy Duty Shocks					
SUSPENSION TYPE — REAR	Semi-Elliptical Leaf Springs, Heavy Duty Shocks					
BRAKE—FRONT	TYPE Disc		SWEPT AREA 204.5			SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA 165.9			SQ. IN.
OVERALL LENGTH	205.7 in.					
OVERALL HEIGHT	55.3 in.					
WEIGHT	CURB	LBS.	TEST 3887			LBS.
WHEELBASE	112.7 in.					
HEAD ROOM — FRONT	39.3 in.					
HEAD ROOM — REAR	37.7 in.					
LEG ROOM — FRONT	42.5 in.					
LEG ROOM — REAR	36.6 in.					
SHOULDER ROOM — FRONT	56.0 in.					
SHOULDER ROOM — REAR	55.9 in.					
HIP ROOM — FRONT	53.5 in.					
HIP ROOM — REAR	53.2 in.					
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 14		HIGHWAY M.P.G. 21		COMBINED M.P.G. 16	

INTERIOR VOLUME

Interior		
Front	54.1	cu ft
Rear	44.6	cu ft
Combined	98.7	cu ft
Trunk	15.6	cu ft

TRANSMISSION
MODEL NUMBER A727
LOCK UP TORQUE CONVERTER YES X NO
OVERDRIVE YES NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	FORD		LTD CROWN VICTORIA (CV) - S		P43	
ENGINE DISPLACEMENT	351W H.O.	CU. IN.	5.8			LITERS
CARBURETOR-EXHAUST	Ford 7200 VV*		Dual Exhaust			
HORSEPOWER @ RPM (S.A.E. NET)	165 @ 3600					
TORQUE LBS. @ RPM	290 @ 2200					
COMPRESSION RATIO	8.3:1					
AXLE RATIO	2.73:1					
STEERING	Recirculating Ball - Power Steering With Integral Gear					
TURNING CIRCLE (CURB TO CURB)	39.2 ft.					
TIRE SIZE	P225/70R15					
SUSPENSION TYPE — FRONT	Independent Parallel "A" Arms With Coil Springs					
SUSPENSION TYPE — REAR	4-Bar Link With Coil Springs					
BRAKE—FRONT	TYPE Disc		SWEPT AREA 228.7			SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA 157.1			SQ. IN.
OVERALL LENGTH	209.3 in.					
OVERALL HEIGHT	54.7 in.					
WEIGHT	CURB	LBS.	TEST 4059			LBS.
WHEELBASE	114.3 in.					
HEAD ROOM — FRONT	37.9 in.					
HEAD ROOM — REAR	37.2 in.					
LEG ROOM — FRONT	42.1 in.					
LEG ROOM — REAR	40.7 in.					
SHOULDER ROOM — FRONT	61.6 in.					
SHOULDER ROOM — REAR	61.6 in.					
HIP ROOM — FRONT	61.0 in.					
HIP ROOM — REAR	56.9 in.					
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 14		HIGHWAY M.P.G. 24		COMBINED M.P.G. 17	

INTERIOR VOLUME

Interior		
Front	57	cu ft
Rear	54	cu ft
Combined	111	cu ft
Trunk	22.4	cu ft

TRANSMISSION 4-Speed Automatic Overdrive (AOD)
MODEL NUMBER PKA-AS5
LOCK UP TORQUE CONVERTER YES X NO
OVERDRIVE YES X NO

*(2) Variable Venturis

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	CHEVROLET		MALIBU		1GW69	
ENGINE DISPLACEMENT	305	CU. IN.	5.0		LITERS	
CARBURETOR-EXHAUST	4 BBL		Single Exhaust			
HORSEPOWER @ RPM (S.A.E. NET)	145 @ 4000					
TORQUE LBS. @ RPM	240 @ 1600					
COMPRESSION RATIO	8.6:1					
AXLE RATIO	2.73:1					
STEERING	Power, Integral, Recirculating Ball Nut					
TURNING CIRCLE (CURB TO CURB)	37.2 ft.					
TIRE SIZE	P205/70R14					
SUSPENSION TYPE — FRONT	Independent, SLA With Coil Springs					
SUSPENSION TYPE — REAR	Link Type, 2 Upper and 2 Lower With Coil Springs					
BRAKE—FRONT	TYPE Disc		SWEPT AREA 191.7		SQ. IN.	
BRAKE—REAR	TYPE Drum		SWEPT AREA 116.1		SQ. IN.	
OVERALL LENGTH	192.7 in.					
OVERALL HEIGHT	55.7 in.					
WEIGHT	CURB	LBS.	TEST 3516		LBS.	
WHEELBASE	108.1 in.					
HEAD ROOM — FRONT	38.5 in.					
HEAD ROOM — REAR	37.6 in.					
LEG ROOM — FRONT	42.8 in.					
LEG ROOM — REAR	38.0 in.					
SHOULDER ROOM — FRONT	56.7 in.					
SHOULDER ROOM — REAR	57.1 in.					
HIP ROOM — FRONT	52.2 in.					
HIP ROOM — REAR	55.6 in.					
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 18		HIGHWAY M.P.G. 26		COMBINED M.P.G. 21	

INTERIOR VOLUME

Interior		
Front	54.1	cu ft
Rear	47.2	cu ft
Combined	101.3	cu ft
Trunk	16.6	cu ft

TRANSMISSION
MODEL NUMBER 350c
LOCK UP TORQUE CONVERTER YES X NO
OVERDRIVE YES NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	PLYMOUTH		GRAN FURY		B-L-41	
ENGINE DISPLACEMENT	318	CU. IN.	5.2		LITERS	
CARBURETOR-EXHAUST	4 BBL		Single Exhaust			
HORSEPOWER @ RPM (S.A.E. NET)	165 @ 4000					
TORQUE LBS. @ RPM	240 @ 2000					
COMPRESSION RATIO	8.5:1					
AXLE RATIO	2.94:1					
STEERING	Power - Firm (15.7:1 Gear Ratio)					
TURNING CIRCLE (CURB TO CURB)	40.7 ft.					
TIRE SIZE	P215/70R15					
SUSPENSION TYPE — FRONT	Independent, Lateral, Non-Parallel Control Arms With Transverse Torsion Bars, Heavy Duty Shocks					
SUSPENSION TYPE — REAR	Semi-Elliptical Leaf Springs, Heavy Duty Shocks					
BRAKE—FRONT	TYPE Disc		SWEPT AREA 204.5		SQ. IN.	
BRAKE—REAR	TYPE Drum		SWEPT AREA 165.9		SQ. IN.	
OVERALL LENGTH	205.7 in.					
OVERALL HEIGHT	55.3 in.					
WEIGHT	CURB	LBS.	TEST 3881		LBS.	
WHEELBASE	112.7 in.					
HEAD ROOM — FRONT	39.3 in.					
HEAD ROOM — REAR	37.7 in.					
LEG ROOM — FRONT	42.5 in.					
LEG ROOM — REAR	36.6 in.					
SHOULDER ROOM — FRONT	56.0 in.					
SHOULDER ROOM — REAR	55.9 in.					
HIP ROOM — FRONT	53.5 in.					
HIP ROOM — REAR	53.2 in.					
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 14		HIGHWAY M.P.G. 21		COMBINED M.P.G. 16	

INTERIOR VOLUME

Interior		
Front	54.1	cu ft
Rear	44.6	cu ft
Combined	98.7	cu ft
Trunk	15.6	cu ft

TRANSMISSION
MODEL NUMBER A727
LOCK UP TORQUE CONVERTER YES X NO
OVERDRIVE YES NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	FORD	LTD CROWN VICTORIA (CV) - S		P43	
ENGINE DISPLACEMENT	302 CU. IN.	5.0 LITERS			
CARBURETOR-EXHAUST	CFI	Single Exhaust			
HORSEPOWER @ RPM (S.A.E. NET)	130 @ 3200				
TORQUE LBS. @ RPM	240 @ 2000				
COMPRESSION RATIO	8.4:1				
AXLE RATIO	3.08:1				
STEERING	Recirculating Ball - Power Steering With Integral Gear				
TURNING CIRCLE (CURB TO CURB)	39.2 ft.				
TIRE SIZE	P225/70R15				
SUSPENSION TYPE — FRONT	Independent Parallel "A" Arms With Coil Springs				
SUSPENSION TYPE — REAR	4-Bar Link With Coil Springs				
BRAKE—FRONT	TYPE Disc	SWEPT AREA 228.7 SQ. IN.			
BRAKE—REAR	TYPE Drum	SWEPT AREA 157.1 SQ. IN.			
OVERALL LENGTH	209.3 in				
OVERALL HEIGHT	54.7 in				
WEIGHT	CURB LBS.	TEST 3892 LBS.			
WHEELBASE	114.3 in.				
HEAD ROOM — FRONT	37.9 in.				
HEAD ROOM — REAR	37.2 in.				
LEG ROOM — FRONT	42.1 in.				
LEG ROOM — REAR	40.7 in.				
SHOULDER ROOM — FRONT	61.6 in.				
SHOULDER ROOM — REAR	61.6 in.				
HIP ROOM — FRONT	61.0 in.				
HIP ROOM — REAR	56.9 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 17	HIGHWAY M.P.G. 26		COMBINED M.P.G. 20	

INTERIOR VOLUME

Interior		
Front	57	cu ft
Rear	54	cu ft
Combined	111	cu ft
Trunk	22.4	cu ft

TRANSMISSION 4-Speed Automatic Overdrive (AOD)
MODEL NUMBER PKA-AS5
LOCK UP TORQUE CONVERTER YES X NO
OVERDRIVE YES X NO

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	CHEVROLET	IMPALA		1BL69	
ENGINE DISPLACEMENT	229 CU. IN.	3.8 LITERS			
CARBURETOR-EXHAUST	2 BBL	Single Exhaust			
HORSEPOWER @ RPM (S.A.E. NET)	110 @ 4000				
TORQUE LBS. @ RPM	170 @ 2000				
COMPRESSION RATIO	8.6:1				
AXLE RATIO	2.73:1				
STEERING	Power, Integral, Recirculating Ball Nut				
TURNING CIRCLE (CURB TO CURB)	38.7 ft.				
TIRE SIZE	P205/75R15				
SUSPENSION TYPE — FRONT	Independent, SLA Type With Coil Springs				
SUSPENSION TYPE — REAR	Link Type, 2 Upper and 2 Lower With Coil Springs				
BRAKE—FRONT	TYPE Disc	SWEPT AREA 237.0 SQ. IN.			
BRAKE—REAR	TYPE Drum	SWEPT AREA 138.2 SQ. IN.			
OVERALL LENGTH	212.2 in.				
OVERALL HEIGHT	56.4 in.				
WEIGHT	CURB LBS.	TEST 3713 LBS.			
WHEELBASE	116.0 in.				
HEAD ROOM — FRONT	39.5 in.				
HEAD ROOM — REAR	38.2 in.				
LEG ROOM — FRONT	42.2 in.				
LEG ROOM — REAR	39.1 in.				
SHOULDER ROOM — FRONT	60.5 in.				
SHOULDER ROOM — REAR	60.5 in.				
HIP ROOM — FRONT	55.0 in.				
HIP ROOM — REAR	55.3 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 19	HIGHWAY M.P.G. 27		COMBINED M.P.G. 22	

INTERIOR VOLUME

Interior		
Front	58.1	cu ft
Rear	52.2	cu ft
Combined	110.3	cu ft
Trunk	20.9	cu ft

TRANSMISSION
MODEL NUMBER 250c
LOCK UP TORQUE CONVERTER YES X NO
OVERDRIVE YES NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	DODGE		DIPLOMAT		G-L-41
ENGINE DISPLACEMENT	225	CU. IN.	3.7		LITERS
CARBURETOR-EXHAUST	1 BBL		Single Exhaust		
HORSEPOWER @ RPM (S.A.E. NET)	90 @ 3600				
TORQUE LBS. @ RPM	165 @ 1600				
COMPRESSION RATIO	8.4:1				
AXLE RATIO	2.94:1				
STEERING	Power - Firm (15.7:1 Gear Ratio)				
TURNING CIRCLE (CURB TO CURB)	40.7 ft.				
TIRE SIZE	P215/70R15				
SUSPENSION TYPE — FRONT	Independent, Lateral, Non-Parallel Control Arms With Transverse Torsion Bars, Heavy Duty Shocks				
SUSPENSION TYPE — REAR	Semi-Elliptical Leaf Springs, Heavy Duty Shocks				
BRAKE—FRONT	TYPE Disc		SWEPT AREA 204.5		SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA 165.9		SQ. IN.
OVERALL LENGTH	205.7 in.				
OVERALL HEIGHT	55.3 in.				
WEIGHT	CURB	LBS.	TEST 3688		LBS.
WHEELBASE	112.7 in.				
HEAD ROOM — FRONT	39.3 in.				
HEAD ROOM — REAR	37.7 in.				
LEG ROOM — FRONT	42.5 in.				
LEG ROOM — REAR	36.6 in.				
SHOULDER ROOM — FRONT	56.0 in.				
SHOULDER ROOM — REAR	55.9 in.				
HIP ROOM — FRONT	53.5 in.				
HIP ROOM — REAR	53.2 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 19		HIGHWAY M.P.G. 25		COMBINED M.P.G. 21

INTERIOR VOLUME

Interior		
Front	54.1	cu ft
Rear	44.6	cu ft
Combined	98.7	cu ft
Trunk	15.6	cu ft

TRANSMISSION
MODEL NUMBER A904 Wide Ratio
LOCK UP TORQUE CONVERTER YES____ NO X
OVERDRIVE YES____ NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	FORD		FAIRMONT FUTURA		P-36
ENGINE DISPLACEMENT	200	CU. IN.	3.3		LITERS
CARBURETOR-EXHAUST	1 BBL		Single Exhaust		
HORSEPOWER @ RPM (S.A.E. NET)	92 @ 3800				
TORQUE LBS. @ RPM	156 @ 1800				
COMPRESSION RATIO	8.6:1				
AXLE RATIO	2.73:1				
STEERING	Rack and Pinion				
TURNING CIRCLE (CURB TO CURB)	39.5 ft.				
TIRE SIZE	P205/70R14				
SUSPENSION TYPE — FRONT	Hybrid McPherson Strut				
SUSPENSION TYPE — REAR	4-Bar Link With Coil Spring				
BRAKE—FRONT	TYPE Disc		SWEPT AREA 176.6		SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA 110.0		SQ. IN.
OVERALL LENGTH	204.3 in.				
OVERALL HEIGHT	55.5 in.				
WEIGHT	CURB	LBS.	TEST 2872		LBS.
WHEELBASE	105.5 in.				
HEAD ROOM — FRONT	39.3 in.				
HEAD ROOM — REAR	37.7 in.				
LEG ROOM — FRONT	42.7 in.				
LEG ROOM — REAR	37.8 in.				
SHOULDER ROOM — FRONT	55.7 in.				
SHOULDER ROOM — REAR	55.7 in.				
HIP ROOM — FRONT	57.2 in.				
HIP ROOM — REAR	57.0 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 19		HIGHWAY M.P.G. 24		COMBINED M.P.G. 21

INTERIOR VOLUME

Interior		
Front	53	cu ft
Rear	43	cu ft
Combined	96	cu ft
Trunk	17	cu ft

TRANSMISSION 3-Speed Automatic (C512) - Locking Torque Converter
MODEL NUMBER PEN-C
LOCK UP TORQUE CONVERTER YES X NO____
OVERDRIVE YES____ NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	FORD		FAIRMONT FUTURA		P-36
ENGINE DISPLACEMENT	140	CU. IN.	2.3		LITERS
CARBURETOR-EXHAUST	1 BBL		Single Exhaust		
HORSEPOWER @ RPM (S.A.E. NET)	90 @ 4600				
TORQUE LBS. @ RPM	122 @ 2600				
COMPRESSION RATIO	9.1:1				
AXLE RATIO	3.08:1				
STEERING	Rack and Pinion				
TURNING CIRCLE (CURB TO CURB)	39.5 ft.				
TIRE SIZE	P205/70R14				
SUSPENSION TYPE — FRONT	Hybrid McPherson Strut				
SUSPENSION TYPE — REAR	4-Bar Link With Coil Spring				
BRAKE—FRONT	TYPE Disc		SWEPT AREA	176.6	SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA	110.0	SQ. IN.
OVERALL LENGTH	204.3 in.				
OVERALL HEIGHT	55.5 in.				
WEIGHT	CURB	LBS.	TEST	2979	LBS.
WHEELBASE	105.5 in.				
HEAD ROOM — FRONT	39.3 in.				
HEAD ROOM — REAR	37.7 in.				
LEG ROOM — FRONT	42.7 in.				
LEG ROOM — REAR	37.8 in.				
SHOULDER ROOM — FRONT	55.7 in.				
SHOULDER ROOM — REAR	55.7 in.				
HIP ROOM — FRONT	57.2 in.				
HIP ROOM — REAR	57.0 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 21		HIGHWAY M.P.G. 31		COMBINED M.P.G. 24

INTERIOR VOLUME

Interior		
Front	53	cu ft
Rear	43	cu ft
Combined	96	cu ft
Trunk	17	cu ft

TRANSMISSION 3-Speed Automatic (03)
MODEL NUMBER 82DT-AMA
LOCK UP TORQUE CONVERTER YES ____ NO X
OVERDRIVE YES ____ NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	PLYMOUTH		RELIANT		P-L-41
ENGINE DISPLACEMENT	156	CU. IN.	2.6		LITERS
CARBURETOR-EXHAUST	2 BBL		Single Exhaust		
HORSEPOWER @ RPM (S.A.E. NET)	93 @ 4500				
TORQUE LBS. @ RPM	132 @ 2500				
COMPRESSION RATIO	8.2:1				
AXLE RATIO	3.02:1				
STEERING	High Effort Power - Rack and Pinion (14:1 Gear Ratio)				
TURNING CIRCLE (CURB TO CURB)	34.8 ft.				
TIRE SIZE	P185/70R14				
SUSPENSION TYPE — FRONT	Anti-Sway Bar - Heavy Duty Iso-Strut				
SUSPENSION TYPE — REAR	Anti-Sway Bar - Heavy Duty Coil, Heavy Duty Shocks				
BRAKE—FRONT	TYPE Disc		SWEPT AREA	197.8	SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA	85.2	SQ. IN.
OVERALL LENGTH	176.0 in.				
OVERALL HEIGHT	52.7 in.				
WEIGHT	CURB	LBS.	TEST	2659	LBS.
WHEELBASE	100.1 in.				
HEAD ROOM — FRONT	38.6 in.				
HEAD ROOM — REAR	37.8 in.				
LEG ROOM — FRONT	42.2 in.				
LEG ROOM — REAR	35.9 in.				
SHOULDER ROOM — FRONT	55.4 in.				
SHOULDER ROOM — REAR	55.9 in.				
HIP ROOM — FRONT	55.6 in.				
HIP ROOM — REAR	56.2 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 24		HIGHWAY M.P.G. 30		COMBINED M.P.G. 26

INTERIOR VOLUME

Interior		
Front	52.1	cu ft
Rear	43.4	cu ft
Combined	95.5	cu ft
Trunk	15.0	cu ft

TRANSMISSION
MODEL NUMBER A470
LOCK UP TORQUE CONVERTER YES ____ NO X
OVERDRIVE YES ____ NO X

INFORMATIONAL HARDWARE DESCRIPTION

MAKE, MODEL, & SALES CODE NO.	FORD		MUSTANG		P-26,28
ENGINE DISPLACEMENT	302 H.O.	CU. IN.	5.0		LITERS
CARBURETOR-EXHAUST	4 BBL		Single Exhaust		
HORSEPOWER @ RPM (S.A.E. NET)	175 @ 4600				
TORQUE LBS. @ RPM	245 @ 2400				
COMPRESSION RATIO	8.4:1				
AXLE RATIO	3.08:1				
STEERING	Rack and Pinion				
TURNING CIRCLE (CURB TO CURB)	37.36 ft.				
TIRE SIZE	P205/70R14				
SUSPENSION TYPE — FRONT	Hybrid McPherson Strut - Coil Springs				
SUSPENSION TYPE — REAR	4-Bar Link With Coil Springs				
BRAKE—FRONT	TYPE Disc		SWEPT AREA	176.6	SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA	110.0	SQ. IN.
OVERALL LENGTH	179.1 in				
OVERALL HEIGHT	51.9 in				
WEIGHT	CURB	LBS.	TEST	2970	LBS.
WHEELBASE	100.4 in.				
HEAD ROOM — FRONT	37.2 in.				
HEAD ROOM — REAR	35.9 in.				
LEG ROOM — FRONT	41.7 in.				
LEG ROOM — REAR	29.7 in.				
SHOULDER ROOM — FRONT	55.8 in.				
SHOULDER ROOM — REAR	54.3 in.				
HIP ROOM — FRONT	55.9 in.				
HIP ROOM — REAR	47.1 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G. 17		HIGHWAY M.P.G. 28		COMBINED M.P.G. 21

INTERIOR VOLUME

Interior		
Front	N/A	cu ft
Rear	N/A	cu ft
Combined	84	cu ft
Trunk	8	cu ft

TRANSMISSION Manual 4-Speed Overdrive
MODEL NUMBER RUG-EM
LOCK UP TORQUE CONVERTER YES ____ NO X
OVERDRIVE YES X NO ____

INFORMATIONAL HARDWARE DESCRIPTION

CANADIAN

MAKE, MODEL, & SALES CODE NO.	CHEVROLET		IMPALA		1BL69
ENGINE DISPLACEMENT	350	CU. IN.	5.7		LITERS
CARBURETOR-EXHAUST	4 BBL		Single Exhaust		
HORSEPOWER @ RPM (S.A.E. NET)	165 @ 4000				
TORQUE LBS. @ RPM	260 @ 2000				
COMPRESSION RATIO	8.2:1				
AXLE RATIO	3.08:1				
STEERING	Power, Integral, Recirculating Ball Nut				
TURNING CIRCLE (CURB TO CURB)	38.7 ft.				
TIRE SIZE	P225/70R15				
SUSPENSION TYPE — FRONT	Independent, SLA Type With Coil Springs				
SUSPENSION TYPE — REAR	Link Type, 2 Upper and 2 Lower With Coil Springs				
BRAKE—FRONT	TYPE Disc		SWEPT AREA	237.0	SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA	138.2	SQ. IN.
OVERALL LENGTH	212.2 in.				
OVERALL HEIGHT	56.4 in				
WEIGHT	CURB	LBS.	TEST	3839	LBS.
WHEELBASE	116.0 in.				
HEAD ROOM — FRONT	39.5 in.				
HEAD ROOM — REAR	38.2 in.				
LEG ROOM — FRONT	42.2 in.				
LEG ROOM — REAR	39.1 in.				
SHOULDER ROOM — FRONT	60.5 in.				
SHOULDER ROOM — REAR	60.5 in.				
HIP ROOM — FRONT	55.0 in.				
HIP ROOM — REAR	55.3 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G.		HIGHWAY M.P.G.		COMBINED M.P.G.

INTERIOR VOLUME

Interior		
Front	58.1	cu ft
Rear	52.2	cu ft
Combined	110.3	cu ft
Trunk	20.9	cu ft

TRANSMISSION
MODEL NUMBER 350c
LOCK UP TORQUE CONVERTER YES X NO ____
OVERDRIVE YES ____ NO X

INFORMATIONAL HARDWARE DESCRIPTION

CANADIAN

MAKE, MODEL, & SALES CODE NO.	CHEVROLET		MALIBU		1GW69
ENGINE DISPLACEMENT	305	CU. IN.	5.0		LITERS
CARBURETOR-EXHAUST	4 BBL		Single Exhaust		
HORSEPOWER @ RPM (S.A.E. NET)	145 @ 4000				
TORQUE LBS. @ RPM	240 @ 1600				
COMPRESSION RATIO	8.6:1				
AXLE RATIO	2.73:1				
STEERING	Power, Integral, Recirculating Ball Nut				
TURNING CIRCLE (CURB TO CURB)	37.2 ft.				
TIRE SIZE	P205/70R14				
SUSPENSION TYPE — FRONT	Independent, SLA With Coil Springs				
SUSPENSION TYPE — REAR	Link Type, 2 Upper and 2 Lower With Coil Springs				
BRAKE—FRONT	TYPE Disc		SWEPT AREA	191.7	SQ. IN.
BRAKE—REAR	TYPE Drum		SWEPT AREA	116.1	SQ. IN.
OVERALL LENGTH	192.7 in.				
OVERALL HEIGHT	55.7 in.				
WEIGHT	CURB	LBS.	TEST	3443	LBS.
WHEELBASE	108.1 in.				
HEAD ROOM — FRONT	38.5 in.				
HEAD ROOM — REAR	37.6 in.				
LEG ROOM — FRONT	42.8 in.				
LEG ROOM — REAR	38.0 in.				
SHOULDER ROOM — FRONT	56.7 in.				
SHOULDER ROOM — REAR	57.1 in.				
HIP ROOM — FRONT	52.2 in.				
HIP ROOM — REAR	55.6 in.				
E.P.A. MILEAGE ESTIMATE	CITY M.P.G.		HIGHWAY M.P.G.		COMBINED M.P.G.

INTERIOR VOLUME

Interior		
Front	54.1	cu ft
Rear	47.2	cu ft
Combined	101.3	cu ft
Trunk	16.6	cu ft

TRANSMISSION
MODEL NUMBER 350c
LOCK UP TORQUE CONVERTER YES X NO ____
OVERDRIVE YES ____ NO X

APPENDIX C

VEHICLE ACCELERATION DATA

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 8 mph WIND DIRECTION 320° TEMPERATURE 52°

MAKE & MODEL Chevrolet Impala (350-4V) BEGINNING TIME 9:48 AM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60	14.5 Seconds	11.15	11.74	11.83	11.96	11.67
0-80	26.0 Seconds	20.88	23.03	21.67	22.78	22.09
0-100	48.5 Seconds	38.44	46.40	40.35	44.85	42.51

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .84 mile TOP SPEED ATTAINED 115.0 MPH

ACCELERATION

WIND VELOCITY 6 mph WIND DIRECTION 330° TEMPERATURE 53°

MAKE & MODEL Dodge Diplomat (318-4V) BEGINNING TIME 10:22 AM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60	14.5 Seconds	12.61	13.00	12.76	12.85	12.81
0-80	26.0 Seconds	21.22	22.87	21.29	22.99	22.09
0-100	48.5 Seconds	36.79	43.86	38.03	43.16	40.46

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .77 mile TOP SPEED ATTAINED 118.8 MPH

***Michigan State Police minimum requirements**

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 8 mph WIND DIRECTION 350° TEMPERATURE 54°

MAKE & MODEL Ford LTD Crown Victoria S (351-VV) BEGINNING TIME 10:52 AM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60	14.5 Seconds	11.91	12.62	12.21	12.15	12.22
0-80	26.0 Seconds	20.75	22.46	20.56	21.64	21.35
0-100	48.5 Seconds	37.29	43.10	36.79	42.07	39.81

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .77 mile TOP SPEED ATTAINED 117.9 MPH

ACCELERATION

WIND VELOCITY 10 mph WIND DIRECTION 340° TEMPERATURE 56°

MAKE & MODEL Chevrolet Malibu (305-4V) BEGINNING TIME 11:20 AM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60	14.5 Seconds	11.24	11.76	11.80	12.04	11.71
0-80	26.0 Seconds	20.56	22.88	20.78	22.57	21.70
0-100	48.5 Seconds	38.29	43.96	37.95	42.71	40.73

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .79 mile TOP SPEED ATTAINED 116.3 MPH

***Michigan State Police minimum requirements**

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 13 mph WIND DIRECTION 350° TEMPERATURE 56°

MAKE & MODEL Plymouth Gran Fury (318-4V) BEGINNING TIME 11:47 AM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60	14.5 Seconds	12.15	12.61	12.11	12.64	12.38
0-80	26.0 Seconds	19.66	21.65	20.54	22.35	21.05
0-100	48.5 Seconds	36.73	41.84	36.37	43.77	39.68

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .76 mile TOP SPEED ATTAINED 120.0 MPH

ACCELERATION

WIND VELOCITY 4 mph WIND DIRECTION 330° TEMPERATURE 59°

MAKE & MODEL Ford LTD Crown Victoria S (302-CFI) BEGINNING TIME 1:06 PM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60	14.5 Seconds	14.27	13.91	13.85	13.72	13.94
0-80	26.0 Seconds	26.19	26.62	25.43	27.13	26.34
0-100	48.5 Seconds	61.93	92.24	54.59	67.26	69.01

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM 1.49 miles TOP SPEED ATTAINED 104.4 MPH

***Michigan State Police minimum requirements**

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 14 mph WIND DIRECTION 330° TEMPERATURE 58°

MAKE & MODEL Ford Mustang (302-4V) BEGINNING TIME 12:20 PM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60	14.5 Seconds	8.62	8.13	8.21	8.32	8.32
0-80	26.0 Seconds	14.68	14.02	13.86	14.34	14.23
0-100	48.5 Seconds	22.61	22.80	21.70	23.71	22.71

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .41 mile TOP SPEED ATTAINED 132.0 MPH

ACCELERATION

WIND VELOCITY 7 mph WIND DIRECTION 300° TEMPERATURE 52°

MAKE & MODEL Plymouth Reliant (2.6L-2V) BEGINNING TIME 9:16 AM

SPEEDS	TIME REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		15.03	16.11	14.96	15.85	15.49
0-80		30.63	34.87	29.05	33.45	32.00
0-90		45.90	53.30	45.53	52.97	49.43

TOP SPEED

DISTANCE TO REACH 90 MPH MINIMUM .90 mile TOP SPEED ATTAINED 102.8 MPH

*Michigan State Police minimum requirements

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 4 mph WIND DIRECTION 330° TEMPERATURE 59°

MAKE & MODEL Chevrolet Impala (229-2V) BEGINNING TIME 1:36 PM

SPEEDS	TIME REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		17.17	17.40	17.63	17.39	17.40
0-80		34.24	35.00	35.08	34.66	34.75
0-90		50.36	54.19	49.46	52.26	51.57

TOP SPEED

DISTANCE TO REACH 90 MPH MINIMUM .91 mile TOP SPEED ATTAINED 104.3 MPH

ACCELERATION

WIND VELOCITY 7 mph WIND DIRECTION 290° TEMPERATURE 60°

MAKE & MODEL Dodge Diplomat (225-1V) BEGINNING TIME 2:02 PM

SPEEDS	TIME REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		18.87	19.10	18.63	18.41	18.75
0-80		41.43	43.29	39.82	42.52	41.77
0-90		66.01	88.90	60.00	82.35	74.32

TOP SPEED

DISTANCE TO REACH 90 MPH MINIMUM 1.43 miles TOP SPEED ATTAINED 96.5 MPH

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 6 mph WIND DIRECTION 330° TEMPERATURE 61°
MAKE & MODEL Ford Fairmont (200-1V) BEGINNING TIME 2:35 PM

SPEEDS	TIME REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		17.82	17.69	17.64	17.56	17.68
0-80		35.97	36.79	34.15	36.03	35.74
0-90		57.28	60.98	53.85	61.84	58.49

TOP SPEED

DISTANCE TO REACH 90 MPH MINIMUM 1.07 miles TOP SPEED ATTAINED 97.7 MPH

ACCELERATION

WIND VELOCITY 4 mph WIND DIRECTION 320° TEMPERATURE 50°
MAKE & MODEL Ford Fairmont (140-1V) BEGINNING TIME 8:35 AM

SPEEDS	TIME REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		18.18	19.15	17.83	18.43	18.40
0-80		41.17	44.36	40.05	42.20	41.95
0-90		67.70	100.85	65.92	99.79	83.57

TOP SPEED

DISTANCE TO REACH 90 MPH MINIMUM 1.65 miles TOP SPEED ATTAINED 95.8 MPH

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 8 mph WIND DIRECTION 330° TEMPERATURE 62°
MAKE & MODEL Canadian Chevrolet Impala (350-4V) BEGINNING TIME 4:30 PM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		10.72	10.91	11.10	11.39	11.03
0-80		19.36	20.01	19.82	20.95	20.04
0-100		37.21	35.66	36.67	37.06	36.65

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .71 mile TOP SPEED ATTAINED 107.1* MPH

ACCELERATION

WIND VELOCITY 10 mph WIND DIRECTION 280° TEMPERATURE 60°
MAKE & MODEL Canadian Chevrolet Malibu (305-4V) BEGINNING TIME 3:39 PM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		11.67	11.62	11.43	11.62	11.59
0-80		20.20	21.29	20.28	21.85	20.91
0-100		40.43	44.25	41.52	44.77	42.74

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .85 mile TOP SPEED ATTAINED 112.5 MPH

***Michigan State Police minimum requirements**

*Vehicle reached a top speed of 107.1 mph. The top speed then steadily decreased due to mechanical difficulties.

ACCELERATION & TOP SPEED TESTS

TEST LOCATION Chrysler Proving Grounds DATE September 18, 1982

ACCELERATION

WIND VELOCITY 10 mph WIND DIRECTION 270° TEMPERATURE 62°

MAKE & MODEL Canadian Plymouth Caravelle (318-4V) BEGINNING TIME 4:08 PM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60		12.44	12.08	11.82	12.22	12.14
0-80		22.76	22.41	21.18	22.08	22.11
0-100		43.74	42.31	38.98	44.77	42.45

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM .84 mile TOP SPEED ATTAINED 113.6 MPH

ACCELERATION

WIND VELOCITY _____ WIND DIRECTION _____ TEMPERATURE _____

MAKE & MODEL _____ BEGINNING TIME _____ PM

SPEEDS	TIME* REQUIREMENT	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE
0-60						
0-80						
0-100						

TOP SPEED

DISTANCE TO REACH 100 MPH MINIMUM _____ TOP SPEED ATTAINED _____ MPH

*Michigan State Police minimum requirements

APPENDIX D

BID ADJUSTMENT PROCEDURES

BID ADJUSTMENT

The Michigan State Police Policy Development and Evaluation Section has established a formal procedure that is used to adjust the bid price of police patrol vehicles to reflect the relative performance of a given vehicle with respect to all vehicles that are tested and evaluated during the annual competitive bidding for vehicles. By policy, MSP limits the amount of the adjustment of five percent of the average bid price for each type of vehicle to be purchased (full or mid size).

The bid adjustment procedure relies upon standard statistical analysis of the scores (level of performance) achieved by each vehicle during the testing and evaluation of a variety of attributes that are critical to the MSP operational use of patrol vehicles. This is accomplished by (1) calculating the "Z" value for each specified evaluation factor (attribute), and (2) multiplying that resulting Z factor by a weighting factor to obtain a weighted Z(WTD Z). Specifically:

$$Z = \frac{X_i - \overline{X}}{S}$$

where: X_i = Score of specific vehicle for a given evaluation factor

$\overline{X}$ = The mean of all vehicle scores for a given evaluation factor

and $$S = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(X_i - \overline{X})^2}$$

Given that three vehicles have scores of 363, 248, and 289 for a particular evaluation factor, the calculation of Z follows the procedure below. It is easiest to set up the intermediate calculations using several columns.

i	X_i	$X_i - \overline{X}$	$(X_i - \overline{X})^2$	$Z = \frac{X_i - \overline{X}}{S}$
1	363	63	3969	(63÷48) = 1.31
2	248	-52	2704	(-52÷48) = -1.08
3	289	-11	121	(-11÷48) = -0.23
	$\Sigma X_i = 900$		$\frac{1}{3}\Sigma = 6794 \div 3 = 2265$	

$$\overline{X} = \frac{\Sigma X_i}{N} = 900 \div 3$$

$$\overline{X} = 300$$

$$S = \sqrt{2265} = 48$$

The value of Z for each score is then multiplied by the weighting factor, which ranges from 10 to 25 percent. For the weighting factor 10 percent, the weighted Z (WTD Z) for each of the above vehicle's scores is:

1.31 x 0.10 = 0.131

-1.08 x 0.10 = -0.108

-0.23 x 0.10 = -0.023

The above process is used to calculate the WTD Z factors for each vehicle evaluation factor, which are then added together to obtain the total WTD Z. The total WTD Z is then multiplied by the five percent bid adjustment (in -$) to calculate the amount that the manufacturer's bid would be adjusted to reflect the scores of the vehicle during testing.

END