



Michigan State Police Tests 2000 Patrol Vehicles

Patrol vehicles are one of the most critical purchases that a law enforcement agency makes. For both large and small agencies, patrol vehicle purchases frequently represent the second largest expenditure, after personnel, in their annual operating budgets. The selection of the right vehicle that balances both the agencies' budgetary and performance requirements has become an increasingly challenging task for police fleet administrators. Many agencies are painfully aware of the consequences that result from being "penny wise and pound foolish," where vehicles with inadequate performance, such as regular production passenger vehicles not specifically designed for police service, are selected because they cost less than "police-package" vehicles. While some agencies have had limited success with nontraditional police vehicles, most agencies find that the increased maintenance costs resulting from such vehicles breaking down under the stress of police service quickly offsets any initial "savings."

For more than 20 years, the Michigan State Police (MSP) has conducted extensive evaluations of the performance capabilities of each new model year's police vehicles as part of its annual vehicle procurement process. Since 1981, the National Institute of Justice (NIJ), through its National Law Enforcement and Corrections Technology Center (NLECTC), has sponsored these tests through a partnership with MSP. By disseminating these results to State and local law enforcement agencies, NIJ helps these agencies select vehicles that maximize their budgets and ensures that evaluated vehicles provide reliable and safe performance under the increased demands of police service.

The 2000 model year patrol vehicles were evaluated from September 18 through 20, 1999. For the purposes of the MSP evaluation, police-package vehicles

are those that are designed and manufactured for use in the full spectrum of law enforcement patrol service, including high-speed pursuits. A "special-service" vehicle is a vehicle that may be used by law enforcement agencies for specialized use (e.g., off-road, inclement weather, K-9, or commercial vehicle enforcement), but is not designed or manufactured to be used in pursuit situations. By creating this distinction, it is hoped that it will be easier for agencies to realistically assess the capabilities of each vehicle.

Each vehicle is subjected to six major tests and evaluations. The results are weighted to reflect the relative importance of each attribute as related to MSP operational requirements. Table 1 lists the tests and point scores. MSP scores each vehicle's overall performance, reviews the manufacturer's bid price, and calculates a final score for each vehicle using a sophisticated formula that combines the overall performance score and the manufacturer's price.

Eight police-package vehicles and two special-service vehicles were submitted for evaluation. Table 2 provides a complete listing and description of each vehicle. This NLECTC bulletin contains a

Table 1 Tests and scoring

Test	Points
Vehicle dynamics	30
Acceleration	20
Top speed	15
Braking	20
Ergonomics and communications	10
Fuel economy	5
Total	100

synopsis of the test results; a detailed report also is available. Page 7 of this bulletin contains information on how to obtain the report.

It should be noted that the MSP vehicle specifications, test categories, and scoring reflect MSP needs. If your department employs this or a similar method, consider your own needs carefully and alter the weighting factors accordingly.

What's new for 2000

Chevrolet: For the 2000 model year, there are significant changes to Chevrolet's police vehicle lineup. The Lumina and Tahoe police-package vehicles have been discontinued and replaced by the all-new Impala sedan. The Impala debuts as the replacement for the full-size Caprice, Chevrolet's popular police vehicle that was discontinued after the 1996 model year. The front-wheel-drive Impala represents a significant departure from the traditional rear-wheel-drive configuration of police-package vehicles, but Chevrolet's engineers state that they have spent considerable time designing a vehicle that will meet the durability and performance demands required by the law enforcement community. While the Impala has a shorter wheelbase and overall length than the Caprice, its interior room is comparable to that of the Caprice. The Impala is powered by GM's 200-horsepower 3.8L V6 engine, last used in the Lumina police package. Other standard features include 4-wheel independent suspension, 4-wheel Antilock Braking System (ABS) disc brakes, traction control, and a tire pressure monitoring system.

Ford Motor Company submitted three different models for testing (pictured from left to right): the Expedition, the Explorer, and the Police Interceptor.

Chevrolet is once again offering the Camaro, available with an automatic transmission or an optional six-speed manual transmission, for highway and traffic enforcement use. There are no significant styling or mechanical changes from last year's version.

Chevrolet is not offering its Tahoe sport-utility vehicle in either a police-package or special-service package for this model year. However, it is possible that the Tahoe may return for the 2001 model year as a special-service package.

Ford: For the 2000 model year, Ford's Police Interceptor features several new mechanical features intended to enhance overall performance and handling. A new aluminum, metal-matrix drive shaft has been incorporated to improve top speed and acceleration. The rear springs have been improved to increase handling per-

Table 2 **Vehicles tested**

Category	Vehicle	Engine
Police	Chevrolet Camaro (Automatic)	5.7L (350 cid) SFI
Police	Chevrolet Camaro (6-speed manual)	5.7L (350 cid) SFI
Police	Chevrolet Impala	3.8L (231 cid) SFI
Police	DaimlerChrysler Jeep Cherokee (2-wheel drive)	4.0L (242 cid) PFI
Police	DaimlerChrysler Jeep Cherokee (4-wheel drive)	4.0L (242 cid) PFI
Police	Ford Police Interceptor	4.6L (281 cid) SFI
Special Service	Ford Expedition (4-wheel drive)	5.4L (329 cid) SFI
Special Service	Ford Explorer (2-wheel drive)	4.0L (245 cid) PFI
Police	Volvo S-70 T5 Sedan	2.3L (142 cid) PFI Turbo
Police	Volvo V-70 T5 Wagon	2.3L (142 cid) PFI Turbo

cid = Cubic inch displacement SFI = Sequential port fuel injection
PFI = Multipoint fuel injection L = Liter
Turbo = Turbocharged



Photo courtesy of Michigan State Police.

Chevrolet Motor Division of General Motors Corporation submitted two models for testing: the Camaro (tested in two different versions—a six-speed manual transmission and an automatic transmission, pictured on the left and the right) and the Impala (center).



Photo courtesy of Michigan State Police.

formance. Additionally, the 2000 Police Interceptor features a 130-mph speed limiter and a standard “one-touch” driver’s window that fully lowers the driver’s window with a touch of the window control button. In response to numerous requests from the law enforcement community prompted by officer safety considerations, Ford has eliminated the “auto-off” parking brake feature, which automatically releases the parking brake when the gear selector is shifted out of “park.” Ford also is offering an optional headliner without the built-in front map light. There are no major styling or appearance changes to the Police Interceptor from last year’s model. As in past years, the Police Interceptor will be offered in both a gasoline-powered, fuel-injected version and a compressed natural gas (CNG) version. (Note: Ford elected not to test the commercially available version of the CNG Police Interceptor this year.)

The Ford Explorer (2-wheel drive) and Expedition (4-wheel drive) are available as a special-service package, and have no major performance or mechanical changes from the 1999 model year.

DaimlerChrysler Jeep: The DaimlerChrysler Jeep Cherokee is once again offered in both 2-wheel- and 4-wheel-drive versions. A larger (124 amp) alternator has been added, and engine refinements have improved the fuel economy to 16 miles per gallon (MPG) city and 22 MPG highway for the 2-wheel-drive model and 16 MPG city and 21 MPG highway for the 4-wheel-drive model. The 2000 Cherokee also features new, higher metallic composition brake pads, which Jeep engineers state will enhance braking performance.

Volvo: The S-70 sedan and V-70 wagon both feature several performance enhancements for 2000. Working

with the California Highway Patrol, Volvo engineers developed a new chassis tuning design for the police-package vehicle. Both Volvos also feature “high-performance spin control,” which electronically adjusts the throttle, balancing engine torque to actual wheel friction to prevent excessive wheel spinning during rapid acceleration. The 2000 Volvos also feature 16-inch Auto-bahn brakes with Electronic Brake Force Distribution (EBD), which Volvo engineers state will ensure stability under braking into turns.

Vehicle dynamics testing

Objective: To determine high-speed pursuit handling characteristics. The 1.635-mile road racing course contains hills, curves, and corners; except for the absence of traffic, it simulates actual pursuit conditions. The evaluation measures each vehicle’s blending of suspension components, acceleration capabilities, and braking characteristics.

Methodology: Each vehicle is driven 16 timed laps by four drivers. The final score is the average of the 12 fastest laps.

Table 3 shows the average results of the vehicle dynamics test.

Acceleration and top-speed testing

Acceleration

Qualification test objective: To determine the ability of each vehicle to accelerate from a standing

start to 60 mph within 10 seconds, 80 mph within 17.2 seconds, and 100 mph within 28.2 seconds.

Competitive test objective: To determine acceleration time to 100 mph.

Methodology: Using a Datron noncontact optical sensor in conjunction with a personal computer, each vehicle is driven through four acceleration sequences—two northbound and two southbound—to allow for wind direction. The average of the four is the score on the competitive test.

Top speed

Qualification test objective: To determine the vehicle’s ability to reach 110 mph within 1 mile, and 120 mph within 2 miles.

Competitive test objective: To determine the actual top speed (up to 150 mph) attained within 14 miles from a standing start.

Methodology: Following the fourth acceleration run, the vehicle continues to accelerate to the top speed attainable within 14 miles from the start of the run. The highest speed attained within the 14 miles is the vehicle’s score on the competitive test. Table 4 summarizes the acceleration and top-speed test results.

Braking testing

Brake test objective: To determine the deceleration rate attained by each test vehicle on 12, 60-to-0 mph impending skid (threshold) stops, with ABS in operation if the vehicle is so equipped. Each vehicle will be scored on the average deceleration rate it attains.

Brake test methodology: Each vehicle will make two decelerations at specific, predetermined points on the test road from 90-to-0 mph at 22 ft/sec², with the driver using a decelerometer to maintain the deceleration rate. Immediately after these “heat-up” stops are completed, the vehicle will be turned around and will make six measured 60-to-0 mph impending skid (threshold) stops with ABS in operation, if the vehicle

Table 3 Results of vehicle dynamics testing

Make/Model	Average*
Chevrolet Camaro (Automatic) 5.7L SFI	1:20.49
Chevrolet Camaro (6-speed manual) 5.7L SFI	1:20.56
Chevrolet Impala 3.8L SFI	1:25.49
DaimlerChrysler Jeep Cherokee (2-wheel drive) 4.0L PFI	1:25.82
DaimlerChrysler Jeep Cherokee (4-wheel drive) 4.0L PFI	1:27.58
Ford Police Interceptor 4.6L SFI	1:25.71
Ford Expedition (4-wheel drive) 5.4L SFI	**
Ford Explorer (2-wheel drive) 4.0L PFI	**
Volvo S-70 T5 Sedan 2.3L PFI Turbo	1:23.42
Volvo V-70 T5 Wagon 2.3L PFI Turbo	1:23.80

NOTE: Times are in minutes, seconds, and hundredths of a second; i.e., 1:29.74 = 1 minute, 29 seconds, and 74/100 of a second.

* Average of the 12 fastest laps.

** The vehicle manufacturer has indicated that these vehicles are neither designed for nor intended to be used as pursuit vehicles. Therefore, these vehicles were not subjected to vehicle dynamics testing.

The Jeep Division of the DaimlerChrysler Corporation submitted the Cherokee (pictured at right) in both a 2-wheel-drive and a 4-wheel-drive version.



Photo courtesy of Michigan State Police.

Table 4 Results of acceleration* and top-speed testing

Speed (mph)	Chevrolet Camaro (Automatic) 5.7L SFI	Chevrolet Camaro (6-speed manual) 5.7L SFI	Chevrolet Impala 3.8L SFI	DaimlerChrysler Jeep Cherokee (2-wheel drive) 4.0L PFI	DaimlerChrysler Jeep Cherokee (4-wheel drive) 4.0L PFI	Ford Police Interceptor 4.6L SFI	Ford Expedition (4-wheel drive) 5.4L SFI	Ford Explorer (2-wheel drive) 4.0L PFI	Volvo S-70 T5 Sedan 2.3L PFI Turbo	Volvo V-70 T5 Wagon 2.3L PFI Turbo
0-20	1.49	1.62	2.05	1.97	2.07	1.81	2.06	2.10	2.34	2.43
0-30	2.38	2.48	3.28	3.31	3.49	3.04	3.76	3.73	3.33	3.43
0-40	3.29	3.39	4.65	4.79	5.03	4.69	5.56	5.78	4.39	4.55
0-50	4.38	4.56	6.59	7.07	7.56	6.50	7.73	8.31	5.75	5.98
0-60	5.80	5.77	8.99	9.52	10.24	8.75	10.93	11.55	7.48	7.75
0-70	7.29	7.40	11.63	12.61	13.70	11.68	14.35	15.59	9.33	9.64
0-80	8.97	9.06	14.85	17.41	19.30	15.33	18.81	21.99	11.54	12.06
0-90	11.30	11.07	19.40	23.26	25.94	19.89	27.17	30.49	14.63	15.23
0-100	13.92	13.57	24.92	31.08	35.32	26.09	37.36	49.02	17.86	18.56
Top Speed in mph	160	159	124	111	108	129	106	104	153	152

* Figures represent the average of four runs.

Table 5 Results of braking test

	Chevrolet Camaro (Automatic) 5.7L SFI	Chevrolet Impala 3.8L SFI	DaimlerChrysler Jeep Cherokee (2-wheel drive) 4.0L PFI	DaimlerChrysler Jeep Cherokee (4-wheel drive) 4.0L PFI	Ford Police Interceptor 4.6L SFI	Ford Expedition (4-wheel drive) 5.4L SFI	Ford Explorer (2-wheel drive) 4.0L PFI	Volvo S-70 T5 Sedan 2.3L PFI Turbo	Volvo V-70 T5 Wagon 2.3L PFI Turbo
Phase I									
Avg. initial speed (mph)*	60.3	60.4	60.3	60.3	60.4	60.3	60.5	60.2	60.4
Avg. stopping distance (ft)*	138.28	144.20	153.77	154.30	144.63	168.80	185.10	133.17	132.32
Avg. deceleration rate* (ft/sec sqd)	28.25	27.17	25.44	25.32	27.17	23.20	21.32	29.26	29.69
Phase II									
Avg. initial speed (mph)*	60.4	60.2	60.2	60.3	60.5	60.4	60.3	60.1	60.4
Avg. stopping distance (ft)*	136.27	143.97	151.48	155.70	146.73	170.85	166.65	132.78	130.47
Avg. deceleration rate* (ft/sec sqd)	28.82	27.09	25.73	25.15	26.87	22.95	23.49	29.29	30.11
Average Deceleration Rate (ft/sec sqd)**	28.53	27.13	25.58	25.23	27.02	23.07	22.40	29.28	29.90
Projected stopping distance from 60 mph based on average deceleration rate (ft)	135.7	142.7	151.4	153.5	143.3	167.8	172.8	132.3	129.5

All vehicles have antilocking braking systems.

* Figures represent the average of six measured stops.

**Calculated from the average deceleration rate (ft/sec sqd) of all 12 measured stops.

is so equipped, at specific, predetermined points. Following a 4-minute heat soak, the entire sequence will be repeated. The exact initial velocity at the beginning of each of the 60-to-0 mph decelerations and the exact distance required to make each stop will be recorded by means of a fifth wheel in conjunction with electronic speed and distance meters. The data resulting from the 12 stops will be used to calculate the average deceleration rate, which is the vehicle's score for this test. Table 5 (page 5) shows the results of the braking test.

Ergonomics and communications

Objectives: To rate the vehicle's ability to provide a suitable environment for patrol officers to perform their job, to accommodate the required communications and emergency warning equipment, and to assess the relative difficulty of installing the equipment.

Methodology: A minimum of four officers independently and individually score each vehicle on comfort and instrumentation. Personnel from the Communications Division who are responsible for new car preparation conduct the communications portion of the evaluation based on the relative difficulty of the necessary installations. Each factor is graded on a 1-to-10 scale, with 1 representing totally unacceptable and 10 representing superior. The scores are averaged to minimize personal prejudice. Table 6a shows a comparison of the exterior and interior dimensions of the vehicles evaluated. Table 6b shows the results of the ergonomics and communications test. (Only one of each model was tested since the interior dimensions are essentially the same.)

Table 6a Summary of exterior and interior dimensions

Make/Model	Length (inches)	Height (inches)	Wheelbase (inches)	Weight (lbs)	Head Room (front)	Head Room (rear)	Leg Room (front)	Leg Room (rear)	Shoulder Room (front)
Chevrolet Camaro	193.2	51.3	101.1	3480	37.2	35.3	43.0	26.8	57.4
Chevrolet Impala	200.1	57.4	110.5	3590	39.2	36.8	42.2	38.4	59.0
DaimlerChrysler Jeep Cherokee	165.3	63.2	101.4	3460 (c) 3621 (d)	37.8	38.0	41.4	35.0	54.7
Ford Police Interceptor	212.0	56.8	114.7	4039	39.4	38.0	42.5	39.6	60.8
Ford Expedition (4WD)	204.6	74.3	119.0	5569	39.8	39.8	40.8	38.9	63.9
Ford Explorer (2WD)	188.5	67.5	111.9	3939	39.9	39.3	42.4	36.8	57.1
Volvo S-70 T5 Sedan	185.4	55.7	104.9	3320	39.1	37.8	41.4	35.2	57.1
Volvo V-70 T5 Wagon	186.2	56.2	104.9	3448	39.1	37.8	41.4	35.2	57.1

Make/Model	Shoulder Room (rear)	Hip Room (front)	Hip Room (rear)	Interior, Front (cubic feet)	Interior, Rear (cubic feet)	Interior, Combined (cubic feet)	Trunk Capacity (cubic feet)	Fuel Capacity (gallons)
Chevrolet Camaro	55.8	52.8	44.4	53.1	28.8	81.9	12.9 (a)	15.5
Chevrolet Impala	58.9	56.8	55.7	56.5	48.2	104.7	17.6 (b)	17.0
DaimlerChrysler Jeep Cherokee	54.7	54.8	44.3	50.3	42.8	93.1	32.9 (e)	20.2
Ford Police Interceptor	60.3	57.1	59.0	58.2	51.1	109.3	20.6	19.0
Ford Expedition (4WD)	64.4	61.5	52.3	62.5	55.8	118.3	62.5 (f)	26.0
Ford Explorer (2WD)	57.0	51.9	51.7	55.9	48.0	103.9	42.6 (g)	21.0
Volvo S-70 T5 Sedan	56.3	55.2	55.2	55.3	45.5	100.8	14.7 (h)	19.3
Volvo V-70 T5 Wagon	56.3	55.2	55.2	55.3	43.3	98.6	37.1 (i)	19.3

(a) - Behind 2nd seat; with 2nd seat down = 32.8 cu. ft.

(b) - With compact spare tire.

(c) - For Jeep Cherokee 2WD.

(d) - For Jeep Cherokee 4WD.

(e) - Behind 2nd seat; with 2nd seat down = 69.0 cu. ft.

(f) - Behind 2nd seat; with 2nd seat down = 118.3 cu. ft.

(g) - Behind 2nd seat; with 2nd seat down = 81.6 cu. ft.

(h) - With rear seat down = 33.2 cu. ft.

(i) - Behind 2nd seat; with 2nd seat down = 67.0 cu. ft.

Fuel economy

Objective: To determine fuel economy potential. The scoring data are valid and reliable for comparison but may not necessarily be an accurate prediction of the car's actual fuel economy.

Methodology: The vehicles' scores are based on estimates of city fuel economy to the nearest one-tenth of a mile per gallon from data supplied by the vehicle manufacturers. Table 7 shows the estimated Environ-

mental Protection Agency (EPA) fuel economy ratings, rounded to the nearest whole number for city, highway, and combined driving conditions.

If you would like a copy of the full report, write or call the National Law Enforcement and Corrections Technology Center, P.O. Box 1160, Rockville, MD 20849-1160, 800-248-2742, or 301-519-5060; or download it from JUSTNET, <http://www.nlectc.org>.

Table 6b Results of ergonomics and communications test

Vehicle	Score*
Chevrolet Camaro	159.35
Chevrolet Impala	213.75
DaimlerChrysler Jeep Cherokee	173.56
Ford Police Interceptor	213.58
Ford Expedition	208.36
Ford Explorer	199.78
Volvo S-70 T5 Sedan	176.92
Volvo V-70 T5 Wagon	176.63

*Scores are the total points the automobile received for each of 29 attributes the MSP considers important in determining the acceptability of the vehicle as a patrol car—for example, front seat adjustability, clarity of instrumentation, and front and back visibility. The higher the number, the better the vehicle scored.

Table 7 Fuel economy

Make/Model	EPA miles per gallon		
	City	Highway	Combined
Chevrolet Camaro (Automatic) 5.7L (350 cid) SFI	17	27	20
Chevrolet Camaro (6-speed manual) 5.7L (350 cid) SFI	18	29	22
Chevrolet Impala 3.8L (231 cid) SFI	20	29	23
DaimlerChrysler Jeep Cherokee (2-wheel drive) 4.0L (242 cid) PFI	16	22	18
DaimlerChrysler Jeep Cherokee (4-wheel drive) 4.0L (242 cid) PFI	16	21	18
Ford Police Interceptor 4.6L (281 cid) SFI	16	21	18
Ford Expedition (4-wheel drive) 5.4L (329 cid) SFI	12	16	14
Ford Explorer (2-wheel drive) 4.0L (245 cid) PFI	16	21	18
Volvo S-70 T5 Sedan 2.3L (142 cid) PFI Turbo	19	27	22
Volvo V-70 T5 Wagon 2.3L (142 cid) PFI Turbo	19	27	22

Pictured from left to right are the Volvo S-70 T5 Sedan and the Volvo V-70 T5 Wagon, which were also evaluated during this year's testing.



Photo courtesy of Michigan State Police.

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The National Institute of Justice is a component of the Office of Justice Programs, which also includes the Bureau of Justice Assistance, Bureau of Justice Statistics, Office of Juvenile Justice and Delinquency Prevention, and Office for Victims of Crime.

New Publications/Videos

The following publications/videos are available from the National Law Enforcement and Corrections Technology Center-National:

A Comprehensive Evaluation of 1999 Patrol Vehicle Tires. This bulletin summarizes results of the National Institute of Justice's comprehensive evaluation of patrol vehicle tires, conducted in April 1999.

Equipment Performance Report: 1999 Patrol Vehicle Tires. This report presents the complete results of the National Institute of Justice's 1999 comprehensive evaluation of patrol vehicle tires. The report contains a large amount of data generated by the evaluation, which was conducted under a variety of test conditions.

TechBeat, Summer 1999. Articles in this issue of *TechBeat* discuss innovative ways to detect contraband, and Law Enforcement Online (LEO), an intranet that allows law enforcement personnel to communicate securely with one another.

TechBeat, Spring 1999. This *TechBeat* features the use of surveillance cameras to combat crime, plans to convert an old prison into a training facility for public safety personnel, and preparing computer systems for Year 2000 compliance.

Autoloading Pistols for Police Officers: NIJ Standard-0112.03. This standard establishes performance requirements and test methods for pistols to be used by law enforcement officers. It is a general revision of and supersedes NIJ Standard-0112.02 dated January 1995, and addresses new pistol designs, calibers, revised procedures for verifying head space, and general revision of the testing procedures.

"Why Can't We Talk?" When Lives Are at Stake. This videotape examines the issues and problems surrounding interoperability and public safety radio communications. Learn why planning, designing, and funding public safety wireless communications systems are critical activities for ensuring the public welfare.

The following publications/videos will be available soon:

Keeping Track of Electronic Monitoring. This bulletin will give an indepth look at current and upcoming home monitoring devices, system components, buy/lease factors and options, and recommendations for establishing an electronic monitoring program.

To obtain any of the above publications or videotapes, write NLECTC, P.O. Box 1160, Rockville, MD 20849-1160 or telephone 800-248-2742. Publications can also be downloaded from JUSTNET at <http://www.nlectc.org>.

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