



National Law Enforcement and Corrections Technology Center

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National Institute of Justice
Jeremy Travis, Director

Michigan State Police Tests 1997 Patrol Vehicles

The National Law Enforcement and Corrections Technology Center (NLECTC), of the National Institute of Justice (NIJ), provides law enforcement agencies with practical information on equipment and technology. A pioneer in researching new technologies, NIJ, through NLECTC, encourages and helps agencies to maximize their budgets, ensure reliability of product performance, and safeguard their employees. The advancements that emerge from the annual Michigan State Police Patrol Vehicle Tests validate the success of these efforts.

Every year, the Michigan State Police (MSP) tests new patrol vehicles as part of its procurement policy. This year, from September 21 through 23, the MSP tested six special service package cars (two Camaros, two Cherokees, and two Explorers) and five police patrol package cars. This NLECTC bulletin contains a synopsis of the test results; a detailed report is also available.

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 |

Table 2
Vehicles tested

| Vehicle | Engine |
|--|--------------------|
| Chevrolet Camaro (automatic) | 5.7L (350 cid) SFI |
| Chevrolet Camaro (6-speed manual) | 5.7L (350 cid) SFI |
| Chevrolet Lumina | 3.1L (191 cid) SFI |
| Chevrolet Tahoe (2-wheel drive) | 5.7L (350 cid) SFI |
| Chrysler Jeep Cherokee (2-wheel drive) | 4.0L (242 cid) PFI |
| Chrysler Jeep Cherokee (4-wheel drive) | 4.0L (242 cid) PFI |
| Ford Crown Victoria | 4.6L (281 cid) PFI |
| Ford Crown Victoria (CNG) | 4.6L (281 cid) PFI |
| Ford Explorer (4-wheel drive) | 5.0L (302 cid) PFI |
| Ford Explorer (4-wheel drive) | 4.0L (245 cid) PFI |
| Volvo 850 Turbo | 2.3L (142 cid) PFI |

cid = Cubic inch displacement
PFI = Multiport fuel injection

CNG = Compressed natural gas
SFI = Sequential port fuel injection

L = Liter

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.

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. Table 2 lists the vehicles alphabetically.

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 at least 12 timed laps by at least three drivers. The final score is the average of the fastest of at least 9 timed laps.

Table 3
Results of vehicle dynamics testing

| Make/Model | Average* |
|---|----------|
| Chevrolet Camaro (automatic) 5.7L SFI | 1:19.75 |
| Chevrolet Camaro (6-speed manual) 5.7L SFI | 1:20.36 |
| Chevrolet Lumina 3.1L SFI | 1:30.06 |
| Chevrolet Tahoe (2-wheel drive) 5.7L SFI | 1:26.25 |
| Chrysler Jeep Cherokee (2-wheel drive) 4.0L PFI | 1:24.84 |
| Chrysler Jeep Cherokee (4-wheel drive) 4.0L PFI | 1:25.95 |
| Ford Crown Victoria 4.6L PFI | 1:25.97 |
| Ford Crown Victoria (CNG) 4.6L PFI | 1:29.44 |
| Ford Explorer 5.0L PFI (4-wheel drive) | 1:29.35 |
| Ford Explorer 4.0L PFI (4-wheel drive) | 1:29.46 |
| Volvo 850 Turbo 2.3L PFI | 1:23.41 |

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 time for fastest 12 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 10.0 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 non-contact 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 times is used to derive scores on the competitive test.

Top speed

Qualification test objective: To determine the vehicle's ability to reach 110 mph with-

in 1 mile, and 120 mph within 2 miles.

Competitive test objective: To determine the actual top speed obtained 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 tests.

Braking test

Qualification test objective: To determine the acceptability of each vehicle's braking performance for pursuit service. The ability of the vehicle to make a panic stop within its own lane and evidence of brake fade are evaluated, as well as the ability to achieve an average score of 25.0 ft/sec² on two impending stops (threshold stops from 60 mph).

Competitive test objective: To determine the deceleration rate on two 60-to-0 mph

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 Lumina 3.1L SFI | Chevrolet Tahoe (2-wheel drive) 5.7L SFI | Chrysler Jeep Cherokee (2-wheel drive) 4.0L PFI | Chrysler Jeep Cherokee (4-wheel drive) 4.0L PFI | Ford Crown Victoria 4.6L PFI | Ford Crown Victoria (CNG) 4.6L PFI | Ford Explorer (4-wheel drive) 5.0L PFI | Ford Explorer (4-wheel drive) 4.0L PFI | Volvo 850 Turbo 2.3L PFI |
|------------------|---------------------------------------|--|---------------------------|--|---|---|------------------------------|------------------------------------|--|--|--------------------------|
| 0 - 20 | 1.56 | 1.75 | 2.21 | 1.85 | 2.00 | 1.98 | 2.08 | 2.81 | 2.20 | 1.96 | 2.04 |
| 0 - 30 | 2.51 | 2.63 | 3.69 | 3.13 | 3.35 | 3.35 | 3.51 | 4.81 | 3.69 | 3.39 | 3.16 |
| 0 - 40 | 3.57 | 3.68 | 5.44 | 4.85 | 4.83 | 4.91 | 5.36 | 6.83 | 5.48 | 5.03 | 4.37 |
| 0 - 50 | 4.80 | 5.01 | 8.08 | 6.79 | 7.06 | 7.23 | 7.48 | 9.26 | 7.89 | 6.96 | 6.02 |
| 0 - 60 | 6.40 | 6.51 | 11.09 | 9.42 | 9.50 | 9.88 | 10.05 | 12.51 | 10.60 | 9.40 | 8.02 |
| 0 - 70 | 8.15 | 8.58 | 14.69 | 12.74 | 12.49 | 13.16 | 13.20 | 16.36 | 14.17 | 12.52 | 10.06 |
| 0 - 80 | 10.26 | 10.70 | 19.74 | 16.54 | 17.45 | 18.59 | 17.63 | 20.82 | 19.33 | 16.25 | 12.88 |
| 0 - 90 | 13.09 | 13.31 | 26.95 | 21.29 | 23.28 | 24.48 | 22.66 | 27.58 | 25.65 | 22.32 | 16.59 |
| 0 - 100 | 16.21 | 16.33 | 36.11 | 28.90 | 31.37 | 35.53 | 28.99 | 37.70 | 43.13 | 30.15 | 20.64 |
| Top Speed in mph | 156 | 157 | 113 | 121 | 111 | 111 | 129 | 107 | 113 | 106 | 145 |

impending skid stops. Vehicles are scored on their average deceleration rate attained in comparison with the other vehicles in the test group.

Methodology: Each vehicle is first required to make four decelerations at 22 feet per second squared from 90-to-0 mph, with the driver using a decelerometer to maintain the deceleration rate. The vehicle then makes a 60-to-0 mph impending skid.

The exact initial velocity at the beginning of the deceleration and the exact distance required to make the stop are recorded by means of a fifth wheel with electronic digital speed and distance meters. From these figures, the average deceleration rate for the stops is calculated. Following a 4-minute cooling period, this sequence is repeated. The second sequence is followed by one 60-to-0 mph panic stop to determine the ability of the vehicle to stop in a straight line within its lane and to detect evidence of brake fade.

Table 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 Motor Transport Division, Police Car Prep Section, 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 6

shows the results of the ergonomics and communications test. (Only one of each model was tested since the interior dimensions are essentially the same.)

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 are scored based on estimates for city fuel economy to the nearest 1/10th mile per gallon developed from data supplied by the vehicle manufacturers. Table 7 shows the estimated EPA fuel economy.

If you would like a copy of the full report, write or call the National Law Enforcement and Corrections Technology Center, Box 1160, Rockville, MD 20849-1160, 800-248-2742, or 301-251-5060.

Table 5
Results of braking test

| | Chevrolet Camaro (automatic) 5.7L SFI | Chevrolet Lumina 3.1L SFI | Chevrolet Tahoe (2-wheel drive) 5.7L SFI | Chrysler Jeep Cherokee (2-wheel drive) 4.0L PFI | Chrysler Jeep Cherokee (4-wheel drive) 4.0L PFI | Ford Crown Victoria 4.6L PFI | Ford Crown Victoria (CNG) 4.6L PFI | Ford Explorer (4-wheel drive) 5.0L PFI | Ford Explorer (4-wheel drive) 4.0L PFI | Volvo 850 Turbo 2.3L PFI |
|---|---------------------------------------|---------------------------|--|---|---|------------------------------|------------------------------------|--|--|--------------------------|
| Phase I | | | | | | | | | | |
| Initial speed (mph) | 60.00 | 60.70 | 60.20 | 60.30 | 60.20 | 60.80 | 60.30 | 60.50 | 60.30 | 60.40 |
| Stopping distance (ft) | 136.40 | 160.00 | 163.60 | 142.50 | 146.50 | 139.20 | 151.80 | 155.10 | 163.20 | 144.60 |
| Deceleration rate (ft/sec sqd) | 28.39 | 24.77 | 23.84 | 27.45 | 26.61 | 28.56 | 25.76 | 25.38 | 23.96 | 27.14 |
| Phase II | | | | | | | | | | |
| Initial speed (mph) | 59.40 | 60.90 | 60.70 | 60.10 | 59.70 | 60.10 | 60.60 | 60.30 | 60.30 | 60.40 |
| Stopping distance (ft) | 135.70 | 158.70 | 164.20 | 144.10 | 150.80 | 137.40 | 157.20 | 151.10 | 159.60 | 143.30 |
| Deceleration rate (ft/sec sqd) | 27.97 | 25.14 | 24.14 | 26.96 | 25.42 | 28.28 | 25.13 | 25.88 | 24.50 | 27.38 |
| Average Deceleration Rate (ft/sec sqd) | 28.18 | 24.96 | 23.99 | 27.21 | 26.02 | 28.42 | 25.45 | 25.63 | 24.23 | 27.26 |
| Stopping distance from 60 mph based on average deceleration rate (ft) | 137.4 | 155.1 | 161.4 | 142.3 | 148.8 | 136.2 | 152.1 | 151.1 | 159.8 | 142.0 |

All vehicles have anti-locking brake systems.

Table 6
Results of ergonomics and communications test

| Vehicle | Score* |
|---------------------------|--------|
| Chevrolet Camaro | 157.67 |
| Chevrolet Lumina | 184.03 |
| Chevrolet Tahoe | 218.16 |
| Chrysler Jeep Cherokee | 181.89 |
| Ford Crown Victoria | 190.56 |
| Ford Crown Victoria (CNG) | 187.53 |
| Ford Explorer | 193.37 |
| Volvo 850 Turbo | 162.91 |

* 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 visibility front and back. The higher the number, the better the vehicle scored.

Table 7
Fuel economy

| Make/Model | City EPA miles per gallon |
|---|---------------------------|
| Chevrolet Camaro (automatic) 5.7L (350 cid) SFI | 17.0 |
| Chevrolet Camaro (6-speed manual) 5.7L (350 cid) SFI | 16.4 |
| Chevrolet Lumina 3.1L (191 cid) SFI | 19.6 |
| Chevrolet Tahoe (2-wheel drive) 5.7L (350 cid) SFI | 13.5 |
| Chrysler Jeep Cherokee (2-wheel drive) 4.0L (242 cid) PFI | 15.5 |
| Chrysler Jeep Cherokee (4-wheel drive) 4.0L (242 cid) PFI | 14.9 |
| Ford Crown Victoria 4.6L (281 cid) PFI | 16.2 |
| Ford Crown Victoria (CNG) 4.6L (281 cid) PFI* | 17.3 |
| Ford Explorer (4-wheel drive) 5.0L (302 cid) PFI | 13.5 |
| Ford Explorer (4-wheel drive) 4.0L (245 cid) PFI | 15.1 |
| Volvo 2.3L 850 Turbo (142 cid) PFI | 19.2 |

* EPA mileage estimate is in gasoline equivalent.

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