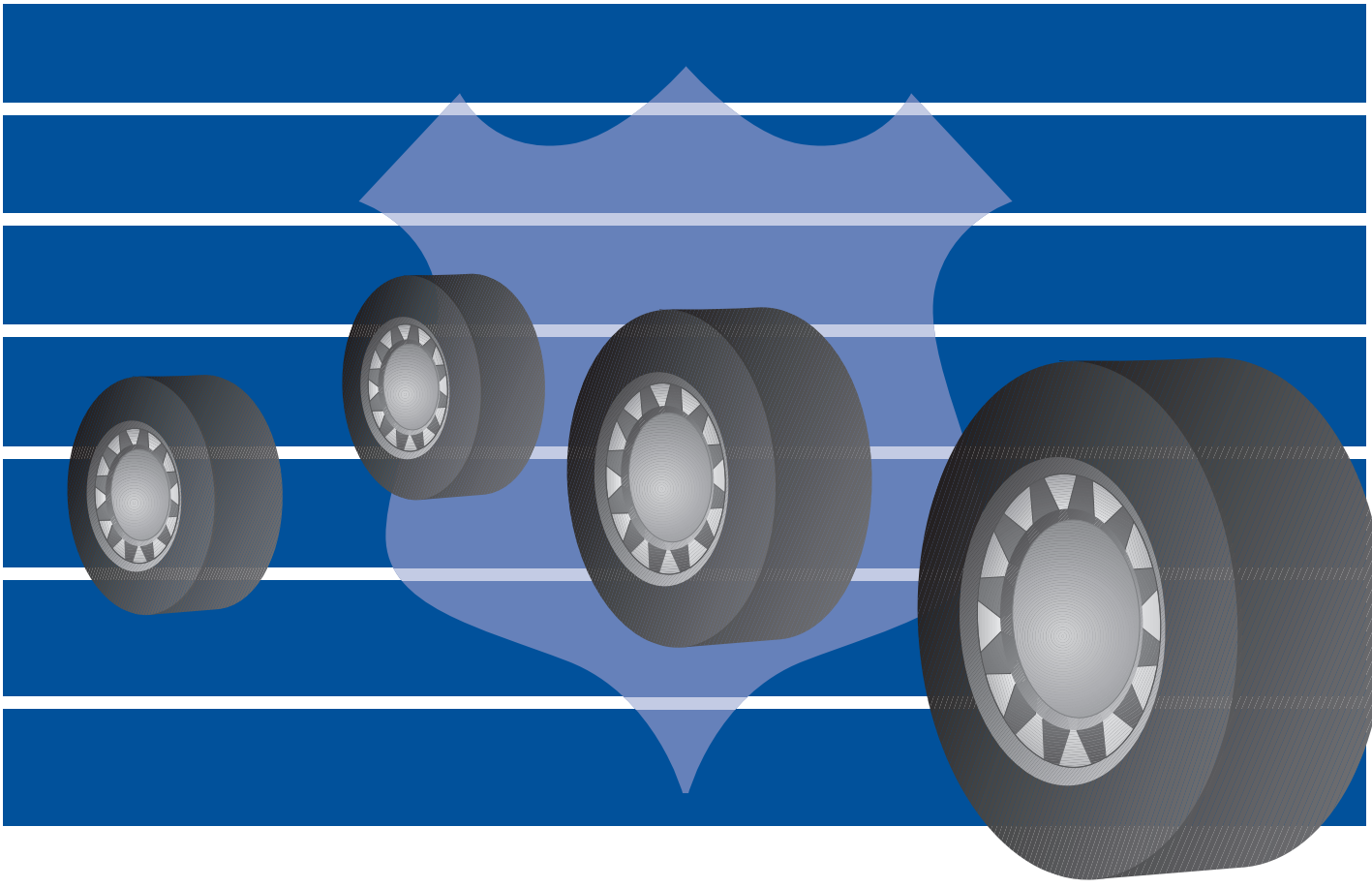
U.S. Department of Justice
Office of Justice Programs
National Institute of Justice

Equipment Performance Report: 1997 Patrol Vehicle Tires



National Institute of Justice
National Law Enforcement and Corrections Technology Center

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Equipment Performance Report: 1997 Patrol Vehicle Tires

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National Institute of Justice

Jeremy Travis
Director

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I.

The National Institute of Justice's National Law Enforcement and Corrections Technology Center is pleased to present the results of its second comprehensive evaluation of patrol vehicle tires. When the project was first visualized, the goal was to provide law enforcement agencies across the country with information that would help them make more informed decisions about which tires would be best for their patrol vehicle fleets.

This report contains a large amount of data generated throughout the evaluation, which was conducted under a variety of test conditions. Score sheets compare the tires' performance in various categories but do not identify any overall "winner" or "loser." Because driving conditions in different parts of the country vary so widely, individual agencies are left with the task of identifying the most suitable tires for their patrol vehicles based on their own driving conditions and needs. It is important that agencies place the appropriate weight on those portions of the test data most representative of the conditions they may encounter. For example, the tire that best meets the needs of a law enforcement agency in the desert Southwest, which has a typically dry climate, may be different than what would be best for an agency in the Pacific Northwest, where wet weather is the norm. In addition, the most suitable tire may depend on the make and model of the patrol vehicle—the best tire for use on a Ford Crown Victoria may be different from the best tire for a Chevrolet Caprice.

The major manufacturers of police tires were asked to participate and submit samples of tires for evaluation. Three companies donated tires for testing. The three tire brands tested were Bridgestone/Firestone, General, and Goodyear.

Each brand of tire was tested on two vehicles: a Ford Crown Victoria and a Chevrolet Caprice. These two cars were selected for use as test vehicles because they represent the vast majority of police cars currently in use and which will, we believe, continue to be the primary patrol vehicles over the next 2 to 3 years.

The following tire models were tested:

Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A

The size and load/speed ratings were the same for each model tested, P225/70R–15 100V. (It should be noted that the Firestone Firehawk PV40 was a preproduction tire that did not have the complete name or uniform tire quality grading (UTQG) information on the sidewall.)

Each test procedure was described as completely as possible. Two changes to the planned test methodology were required. First, in the wet stopping distance test, the brake applications were made at 45 miles per hour rather than 60 miles per hour due to space limitations. Second, as a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation. As a result, there are no data for Ford Crown Victoria on either the high-speed handling or for the tire wear that would have resulted from that portion of the test procedure.

For the dry serpentine and stopping distance tests, the pavement surface of the test course was common asphalt with a coefficient of friction typical of many public roads. For the wet serpentine tests, the same surface was simply wetted down between each run by a water truck. This resulted in a *wet* pavement surface without any standing water. In the dry and wet static circle and wet stopping distance tests, a polished concrete surface with a low coefficient of friction was used. This test surface, when wet, had a constant 3/8 to 1/2 inch of standing water and provided a good test of the ability of the various tires to resist hydroplaning and stay in contact with the pavement.

The results presented in this report were calculated on a computer spreadsheet program with an infinite number of decimal places. Some calculations made on an adding machine or calculator will result in slightly different totals.

Acknowledgments

This patrol vehicle tire evaluation is the result of a recommendation made by the National Law Enforcement and Corrections Technology Advisory Council (LECTAC). LECTAC consists of criminal justice officials from Federal, State, and local agencies who assess equipment needs and set priorities for developing equipment standards, guides, test reports, and other publications. The Council felt that an evaluation of police tires was crucial to addressing the informational needs of law enforcement agencies in procuring equipment critical to the operation of their patrol vehicle fleets. It is hoped that this evaluation will assist the agencies to select, in a cost-effective manner, the best tires for their fleets.

The National Institute of Justice's National Law Enforcement and Corrections Technology Center (NLECTC) thanks the Institute of Police Technology and Management at the University of North Florida, which cosponsored the evaluation and provided drivers, lodging, and other crucial logistical support.

NLECTC would also like to thank the St. Augustine Technical Center (SATC) for providing a test facility in St. Augustine, Florida, that was well equipped to meet the needs for this evaluation, and for the much needed assistance so willingly provided by SATC personnel during the testing process.

Our thanks goes as well to the St. Johns County, Florida, Sheriff's Office for their support and assistance.

Also greatly appreciated is the use of the road course at the Federal Law Enforcement Training Center in Glynco, Georgia, and the assistance of its personnel during the portion of the program that was conducted there.

NLECTC thanks the Ford Motor Company and the Chevrolet Division of General Motors Corporation for the use of "police package" cars and police wheels for this evaluation. The companies that submitted the tires for testing deserve recognition and thanks as well: Bridgestone/Firestone, Inc.; General Tire Company; and Goodyear Tire and Rubber Company.

About NIJ

The National Institute of Justice (NIJ), a component of the Office of Justice Programs, is the research and development agency of the U.S. Department of Justice. NIJ was established to prevent and reduce crime and to improve the criminal justice system. Specific mandates established by Congress in the Omnibus Crime Control and Safe Streets Act of 1968, as amended, and the Anti-Drug Abuse Act of 1988 direct the National Institute of Justice to:

- *Sponsor special projects, and research and development programs* that will improve and strengthen the criminal justice system and reduce or prevent crime.
- *Conduct national demonstration projects* that employ innovative or promising approaches for improving criminal justice.
- *Develop new technologies* to fight crime and improve criminal justice.
- *Evaluate the effectiveness of criminal justice programs* and identify programs that promise to be successful if continued or repeated.
- *Recommend actions* that can be taken by Federal, State, and local governments as well as by private organizations to improve criminal justice.
- *Carry out research on criminal behavior*.
- *Develop new methods of crime prevention* and reduction of crime and delinquency.

The National Institute of Justice has a long history of accomplishments, including the following:

- Basic research on career criminals that led to development of special police and prosecutor units to deal with repeat offenders.
- Research that confirmed the link between drugs and crime.
- The research and development program that resulted in the creation of police body armor that has meant the difference between life and death to hundreds of police officers.
- Pioneering scientific advances such as the research and development of DNA analysis to positively identify suspects and eliminate the innocent from suspicion.
- The evaluation of innovative justice programs to determine what works, including drug enforcement, community policing, community anti-drug initiatives, prosecution of complex drug cases, drug testing throughout the criminal justice system, and user accountability programs.
- Creation of a corrections information-sharing system that enables State and local officials to exchange more efficient and cost-effective concepts and techniques for planning, financing, and constructing new prisons and jails.
- Operation of the world's largest criminal justice information clearinghouse, a resource used by State and local officials across the Nation and by criminal justice agencies in foreign countries.

The Institute Director, who is appointed by the President and confirmed by the Senate, establishes the Institute's objectives, guided by the priorities of the Office of Justice Programs, the Department of Justice, and the needs of the criminal justice field. The Institute actively solicits the views of criminal justice professionals to identify their most critical problems. Dedicated to the priorities of Federal, State, and local criminal justice agencies, research and development at the National Institute of Justice continues to search for answers to what works and why in the Nation's war on drugs and crime.

About the Program

The Law Enforcement Standards and Testing Program is sponsored by the Office of Science and Technology 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 for improving the criminal justice system and to disseminate the results to Federal, State, and local agencies.

The Law Enforcement Standards and Testing 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 nationwide and internationally.

The program operates through the following:

- The **Law Enforcement and Corrections Technology Advisory Council** (LECTAC), 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 **Office of Law Enforcement Standards** (OLES) at the National Institute of Standards and Technology develops voluntary national performance standards for compliance testing to ensure that individual items of equipment are suitable for use by criminal justice agencies. The equipment standards developed by OLES are based upon laboratory evaluation of commercially available products in order to devise precise test methods that can be universally applied by any qualified testing laboratory and to establish minimum performance requirements for each attribute of a piece of equipment that is essential to how it functions. OLES-developed standards can serve as design criteria for manufacturers or as the basis for equipment evaluation. The application of the standards, which are highly technical in nature, is augmented through the publication of technical reports and user guides. Individual jurisdictions may use the standards in their own laboratories to test equipment, have equipment tested on their behalf using the standards, or cite the standards in procurement specifications.
- The **National Law Enforcement and Corrections Technology Center** (NLECTC), operated by a grantee, supervises a national compliance testing program conducted by independent laboratories. The standards developed by OLES serve as performance benchmarks against which commercial equipment is measured. The facilities, personnel, and testing capabilities of the independent laboratories are evaluated by OLES prior to testing each item of equipment. In addition, OLES helps NLECTC staff review and analyze data. Test results are published in consumer product reports designed to help justice system procurement officials make informed purchasing decisions.

Publications on standards are available at no charge through the National Law Enforcement and Corrections Technology Center. Some documents are also available online through the Internet/World Wide Web. To request a document or additional information, call 800–248–2742 or 301–519–5060, or write:

- **National Law Enforcement and Corrections Technology Center**
  P.O. Box 1160
  Rockville, MD 20849–1160

  E-mail: nlectc@aspensys.com

  World Wide Web address: *http://www.nlectc.org*

A1 Technology Center

The National Institute of Justice (NIJ), responding to recommendations by the law enforcement and corrections community, has converted its Technology Assessment Program Information Center (TAPIC) into the National Law Enforcement and Corrections Technology Center (NLECTC), which is composed of the national center, four regional centers, the Border Research and Technology Center (BRTC), the Office of Law Enforcement Standards (OLES), and the Office of Law Enforcement Technology Commercialization (OLETC).

These facilities are part of a new law enforcement and corrections information network that will make it easier for agencies and departments to locate new products and for industry to identify law enforcement and corrections requirements.

NLECTC's major responsibilities and goals are:

- To work with OLES to establish voluntary standards for selected law enforcement and corrections equipment and manage voluntary compliance testing programs.
- To develop critical product data bases for law enforcement and corrections that include information such as who manufactures what, what the points of contact are, what testing or evaluation information is available, and which other law enforcement agencies use the product and can discuss its effectiveness.
- To assist law enforcement and corrections in understanding what technologies are available, how they can be used, and what advantages they offer.
- To evaluate products, such as body armor, firearms, vehicle tires, and handcuffs.
- To conduct field demonstrations of new law enforcement and corrections technologies.
- To collect law enforcement and corrections needs and requirements information for use by industry in developing affordable technologies for law enforcement and corrections.
- To disseminate information about its resources and services through newsletters, product bulletins, consumer product lists, articles in criminal justice periodicals, exhibits and presentations at criminal justice conferences, and online access.
- To coordinate the Law Enforcement and Corrections Technology Advisory Council (LECTAC), which is composed of nationally recognized professionals from Federal, State, and local criminal justice and corrections agencies. LECTAC helps NIJ set priorities for developing new equipment standards, for testing available products, and for establishing future program initiatives for NLECTC.

To receive more information or to add your name to the NLECTC mailing list, call 800–248–2742 or 301–519–5060, or write:

National Law Enforcement and Corrections Technology Center
P.O. Box 1160
Rockville, MD 20849–1160

The NLECTC e-mail address is *nlectc@aspensys.com.*

A1 Technology Center

The following is a list of NLECTC regional and affiliated facilities that assist NIJ in fulfilling its mission.

NLECTC–Northeast
26 Electronic Parkway
Rome, NY 13441–4514
(p) 888–338–0584
(f) 315–330–4315
E-mail: *nlectc_ne@rl.af.mil*

NLECTC–Southeast
7325 Peppermill Parkway
North Charleston, SC 29418
(p) 800–292–4385
(f) 803–207–7776
E-mail: *nlectc-se@awod.com*

NLECTC–Rocky Mountain
2050 East Iliff Avenue
Denver, CO 80208
(p) 800–416–8086
(f) 303–871–2500
E-mail: *nlectc@du.edu*

NLECTC–West
P.O. Box 92957
Mail Station M1/300
Los Angeles, CA 90009–2957
(p) 310–336–2222
(f) 310–336–2227
E-mail: *nlectc@aero.org*

Border Research and Technology Center
1250 Sixth Avenue
Suite 130
San Diego, CA 92101–8800
(p) 619–685–1491
(f) 619–685–1484
E-mail: *brtcchrisa@aol.com*

Office of Law Enforcement Standards
National Institute of Standards and Technology
Building 225
Room A323
Gaithersburg, MD 20899
(p) 301–975–2757
(f) 301–948–0978
E-mail: *oles@nist.gov*

Office of Law Enforcement Technology Commercialization
316 Washington Avenue
Wheeling, WV 26003
(p) 800–678–6882
(f) 304–243–2131
E-mail: *oletc@nttc.edu*

The Office of Law Enforcement Standards (OLES) was established as a matrix management organization in 1971 through a Memorandum of Understanding between the Departments of Justice and Commerce based upon the recommendations of the President's Commission on Crime. OLES's mission is to apply science and technology to the needs of the criminal justice community, including law enforcement, corrections, forensic science, and the fire service. While its major objective is to develop minimum performance standards, which are promulgated as voluntary national standards, OLES also undertakes studies leading to the publication of technical reports and user guides.

The areas of research investigated by OLES include clothing, communication systems, emergency equipment, investigative aids, protective equipment, security systems, vehicles, weapons, and analytical techniques and standard reference materials used by the forensic science community. The composition of OLES's projects varies depending upon priorities of the criminal justice community at any given time and, as necessary, draws upon the resources of the National Institute of Standards and Technology.

OLES assists law enforcement and criminal justice agencies in acquiring, on a cost-effective basis, the high-quality resources they need to do their jobs. To accomplish this, OLES:

- Develops methods for testing equipment performance and examining evidentiary materials.
- Develops standards for equipment and operating procedures.
- Develops standard reference materials.
- Performs other scientific and engineering research as required.

Since the program began in 1971, OLES has coordinated the development of nearly 200 standards, user guides, and advisory reports. Topics range from performance parameters of police patrol vehicles, to performance reports on various speed-measuring devices, to soft body armor testing, to analytical procedures for developing DNA profiles.

The application of technology to enhance the efficiency and effectiveness of the criminal justice community continues to increase. The proper adoption of the products resulting from emerging technologies and the assessment of performance of equipment, systems, methodologies, etc., used by criminal justice practitioners constitute critical issues having safety and legal ramifications. The consequence of inadequate equipment performance or inadequate test methods can range from inconvenient to catastrophic. In addition, these deficiencies can adversely affect the general population when they increase public safety costs, preclude arrest, or result in evidence found to be inadmissible in court.

Table of Contents

The statistical techniques used in this analysis were standard parametric methods. As such, they assume a normally distributed base population. Although testing for normality was not done, there is no reason to believe that the data presented in this report should not follow such a distribution.

In all cases, the objective of the analysis was to determine if significant differences existed between two or more populations of measurements as represented by experimental sampling. To determine this, a One-Way Analysis of Variance (ANOVA) was performed in all cases where more than two populations were analyzed. Following the ANOVA, two-sample T-tests were performed to assess specific differences between pairs. In most cases, independence of observations was assumed.

In all cases, a 95-percent confidence limit was used to define significance.

In some cases, data transformations were employed to reduce irrelevant and unrelated variation. These transformations were performed in consultation with persons knowledgeable regarding the experimental design and the types of testing being performed. Care was taken not to bias the results of the analysis during the transformations of data.

Where the evaluation shows minor performance differences between the tires on a given test but analysis of the data indicates the differences are not statistically significant, a specific notation has been made on the overall score page for that test, and detailed explanations are given in Appendix I—Analysis To Determine Statistical Significance.

Appendix I was compiled by Carl Davis, who analyzed the data to determine their statistical significance.

The following test equipment was used in the static circle, stopping distance, serpentine, high-speed handling, and treadwear portions of the evaluation program.

DATRON TECHNOLOGY, INC.
33533 West Twelve Mile Road, Suite 180
Farmington Hills, MI 48331
DLS Smart Sensor–Optical Noncontact Speed and Distance Sensor

CHRONOMIX CORPORATION
650F Vaqueros Avenue
Sunnyvale, CA 94086–3580
Compusport 737 Multi-Function Printing Timer

MICRO SWITCH
Division of Honeywell
Freeport, IL 61032
Modulated LED Control (photoelectric microswitch) Model FE–MLS–3B

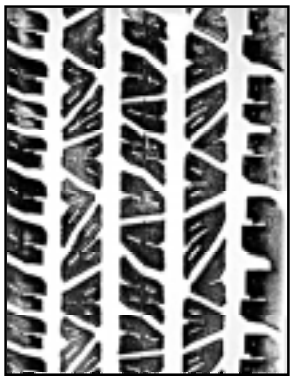
ALGE–TELESIGNAL TX/RX
Phoenix Sports Technology
1344 Route 100 S.
P.O. Box 774
Trexlertown, PA 18087
Alge Sports Timing Telesignal Transmitter—Model TX
Alge Sports Timing Telesignal Receiver—Model RX

BELL PRO POLICE
Box 927
Rantol, IL 61866
Bell MC–500VBL76 Nascar Style Driving Helmets

MTI CORPORATION
965 Corporate Boulevard
Aurora, IL 60504
Mitutoyo Digital Tread Depth Gauge-Model 700–105

Tested on both test vehicles

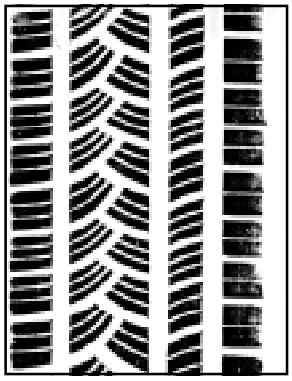
Firestone Firehawk PV40



P225/70R–15 100V M&S
Tread – 2 plies Polyester/2 plies Steel/1 ply Nylon
Sidewall 2 plies Polyester
Max Load 1753 lbs. (795 kg)
Max Inflation 44 psi (300 kpa)

U.S. Government mandated ratings:		
	Treadwear	320
	Traction	A
	Temperature	A

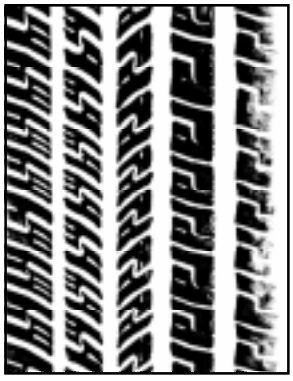
General XP–2000 V4



P225/70R–15 100V M&S
Tread 6 plies – 2 Steel/2 Polyester/2 Nylon
Sidewall 2 plies Polyester
Max Load 1753 lbs. (795 kg)
Max Inflation 44 psi (300 kpa)

U.S. Government mandated ratings:		
	Treadwear	320
	Traction	A
	Temperature	A

Goodyear Eagle RS–A



P225/70R–15 100V M&S
Tread 6 plies – 2 Polyester Cord/2 Steel Cord/2 Nylon Cord
Sidewall 2 plies Polyester Cord
Max Load 1753 lbs. (795 kg)
Max Inflation 44 psi (300 kpa)

U.S. Government mandated ratings:		
	Treadwear	260
	Traction	A
	Temperature	A

Static Circle Test
Dry Pavement Surface

Test Objective

Determine the road-holding performance characteristics of the test tires in a steady-state turning situation on a dry pavement surface. The course used has a flat polished concrete surface on which a circle has been created using pylons. The circle measures 636 feet in circumference. The driver is allowed 2 laps to accelerate and stabilize the vehicle at the highest speed possible while remaining within the marked lane. Once the vehicle is stabilized, the following 8 laps are timed, and the average of the timed laps is used to determine the final score for this portion of the evaluation, which is expressed in lateral "G" attained—lateral "G" being the measurement of the resistance of lateral movement before the tire loses adhesion and the vehicle begins to slip. Deficiencies in tire adhesion, or the tendency of the tire to slip sideways under hard, steady-state cornering maneuvers, will result in slower speeds, longer lap times, and a relatively lower overall score on this portion of the evaluation.

Test Methodology

Following a 2-lap tire warmup, each test vehicle equipped with the make and model of tire to be evaluated makes a minimum of 8 timed laps around the static circle course. The final score for each tire on this portion of the evaluation is the average of the 8 timed laps and is expressed as lateral "G" attained.

Formulas

To determine the lateral "G" attained, multiply pi times the diameter of the test circle and divide by the lap time. Square this quotient, divide by the radius of the circle, and divide by 1 G.

Example:

(3.14159 x 202.445 ft. ÷ lap time) x (3.14159 x 202.445 ÷ lap time) ÷ 101.223 ft. ÷ 32.2 ft./sec.
(pi) (diameter) (radius) (1 G)

To determine speed, divide the circumference of the test circle by the lap time, then divide by 1.4667 ft./sec.

Example:

636 ft. ÷ lap time ÷ 1.4667 ft./sec.

Static Circle Test
Dry Pavement Surface (636 feet in circumference)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	14.335	30.25	0.604
2	14.368	30.18	0.601
3	14.371	30.17	0.601
4	14.408	30.10	0.598
5	14.342	30.23	0.603
6	14.348	30.22	0.603
7	14.379	30.16	0.600
8	14.392	30.13	0.599
Average	14.368	30.18	0.601
Final score (lateral "G")			**0.601**

Static Circle Test
Dry Pavement Surface (636 feet in circumference)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	13.936	31.12	0.639
2	13.896	31.21	0.643
3	13.927	31.14	0.640
4	13.880	31.24	0.644
5	13.940	31.11	0.639
6	13.883	31.23	0.644
7	13.851	31.31	0.647
8	13.899	31.20	0.642
Average	13.902	31.19	0.642
Final score (lateral "G")			**0.642**

Static Circle Test
Dry Pavement Surface (636 feet in circumference)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	14.316	30.29	0.606
2	14.441	30.03	0.595
3	14.485	29.94	0.591
4	14.448	30.01	0.595
5	14.365	30.19	0.601
6	14.427	30.06	0.596
7	14.502	29.90	0.590
8	14.378	30.16	0.600
Average	14.420	30.07	0.597
Final score (lateral "G")			**0.597**

Static Circle Test
Dry Pavement Surface (636 feet in circumference)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	14.263	30.40	0.610
2	14.239	30.45	0.612
3	14.305	30.31	0.606
4	14.218	30.50	0.614
5	14.288	30.35	0.608
6	14.532	29.84	0.588
7	14.327	30.27	0.605
8	14.251	30.43	0.611
Average	14.303	30.32	0.607
Final score (lateral "G")			**0.607**

Static Circle Test
Dry Pavement Surface (636 feet in circumference)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	14.353	30.21	0.602
2	14.341	30.24	0.603
3	14.472	29.96	0.593
4	14.401	30.11	0.598
5	14.336	30.25	0.604
6	14.308	30.31	0.606
7	14.448	30.01	0.595
8	14.505	29.89	0.590
Average	14.396	30.12	0.599
Final score (lateral "G")			**0.599**

Static Circle Test
Dry Pavement Surface (636 feet in circumference)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	13.828	31.36	0.649
2	13.791	31.44	0.653
3	13.962	31.06	0.637
4	13.929	31.13	0.640
5	13.923	31.14	0.640
6	13.993	30.99	0.634
7	13.832	31.35	0.649
8	13.914	31.16	0.641
Average	13.897	31.20	0.643
Final score (lateral "G")			**0.643**

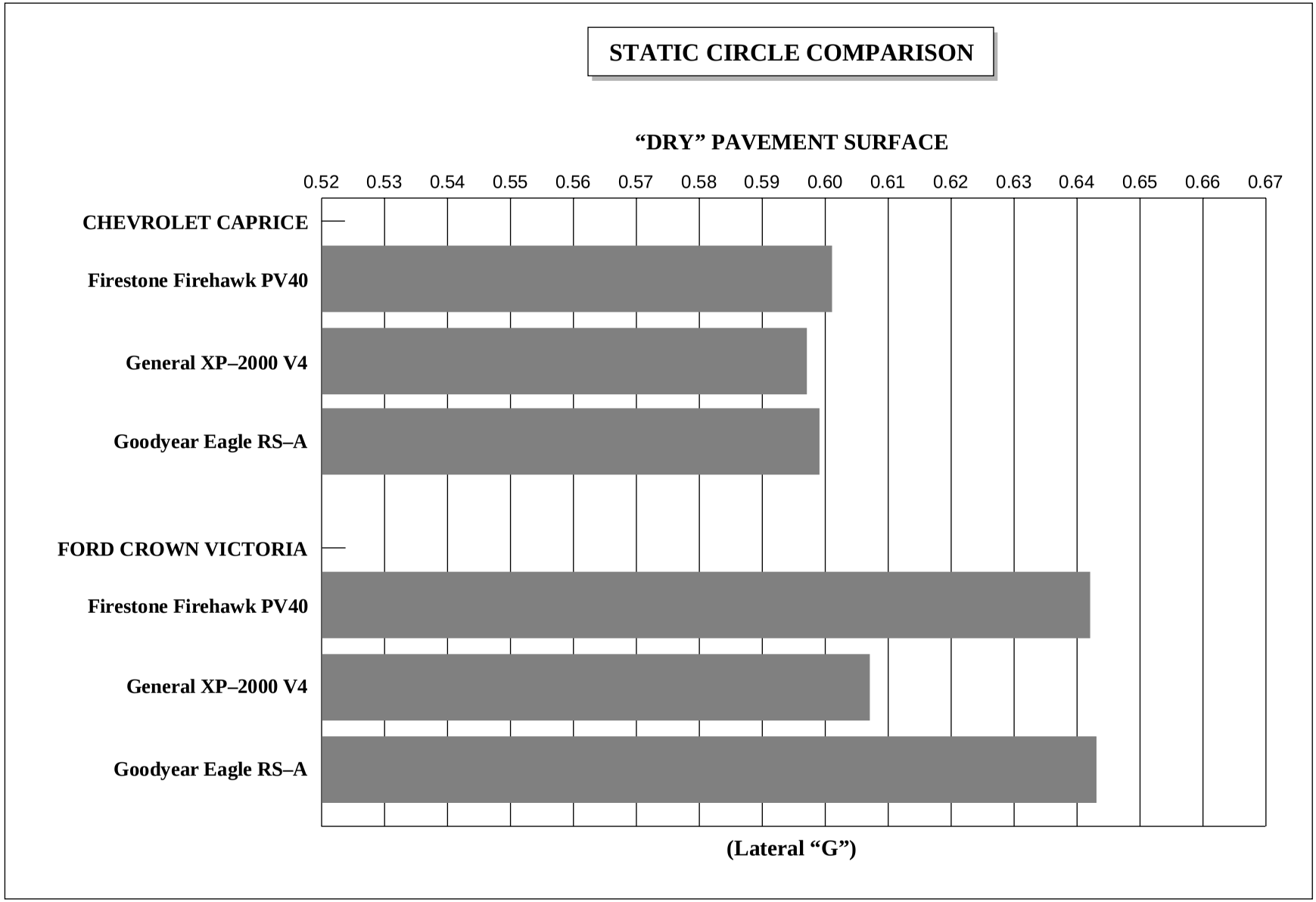
Static Circle Test
Dry Pavement Surface (636 feet in circumference)
Overall Scores

	Elapsed time (seconds)	Average speed (mph)	Lateral "G"	Percent difference*
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**				
Firestone Firehawk PV40**	14.368	30.18	0.601	0.00%
General XP–2000 V4**	14.420	30.07	0.597	0.36%
Goodyear Eagle RS–A**	14.396	30.12	0.599	0.19%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**				
Firestone Firehawk PV40***	13.902	31.19	0.642	0.04%
General XP–2000 V4***	14.303	30.32	0.607	2.92%
Goodyear Eagle RS–A***	13.897	31.20	0.643	0.00%

* The percent difference is obtained by subtracting the elapsed time of the tire of interest from the elapsed time of the best scoring tire (lowest score is best) and dividing that number by the elapsed time of the best scoring tire.

** Analysis showed no statistically significant difference between the three brands of tires tested on the Chevrolet Caprice in this test (see Appendix I).

*** Analysis showed no statistically significant difference between the Firestone and the Goodyear on the Ford Crown Victoria; however, there is a statistically significant difference between both of them and the General in this test (see Appendix I).


STATIC CIRCLE COMPARISON
"DRY" PAVEMENT SURFACE
0.52
0.53
0.54
0.55
0.56
0.57
0.58
0.59
0.60
0.61
0.62
0.63
0.64
0.65
0.66
0.67
CHEVROLET CAPRICE
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
FORD CROWN VICTORIA
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
(Lateral "G")

Static Circle Test
Wet Pavement Surface

Test Objective

Determine the road-holding performance characteristics of each test tire in a steady-state turning situation on a wet pavement surface having a constant 3/8 to 1/2 inch of water depth. The course used has a flat polished concrete surface on which a circle has been created using pylons. The circle measures 636 feet in circumference. The driver is allowed 2 laps to accelerate and stabilize the vehicle at the highest speed possible while remaining within the marked lane. Once the vehicle is stabilized, the following 8 laps are timed, and the average of the timed laps is used to determine the final score for this portion of the evaluation, which is expressed in lateral "G" attained. Deficiencies in tire adhesion, or the tendency of the tire to slip sideways under hard, steady-state cornering maneuvers, will result in slower speeds, longer lap times, and a relatively lower overall score on this portion of the evaluation.

Test Methodology

Following a 2-lap tire warmup, each test vehicle equipped with the make and model of tire to be evaluated makes a minimum of 8 timed laps around the static circle course. The final score for each tire on this portion of the evaluation is the average of the 8 timed laps and is expressed in lateral "G" attained.

Formulas

To determine the lateral "G" attained, multiply pi times the diameter of the test circle and divide by the lap time. Square this quotient, divide by the radius of the circle, and divide by 1 G.

Example:

(3.14159 x 202.445 ft. ÷ lap time) x (3.14159 x 202.445 ÷ lap time) ÷ 101.223 ft. ÷ 32.2 ft./sec.
(pi) (diameter) (radius) (1 G)

To determine speed, divide the circumference of the test circle by the lap time, then divide by 1.4667 ft./sec.

Example:

636 ft. ÷ lap time ÷ 1.4667 ft./sec.

Static Circle Test
Wet Pavement Surface (636 feet in circumference)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	20.473	21.18	0.296
2	20.821	20.83	0.286
3	20.993	20.66	0.282
4	21.301	20.36	0.274
5	20.784	20.86	0.287
6	20.972	20.68	0.282
7	20.954	20.69	0.283
8	20.953	20.70	0.283
Average	20.906	20.74	0.284
Final score (lateral "G")			**0.284**

Static Circle Test
Wet Pavement Surface (636 feet in circumference)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	19.121	22.68	0.339
2	19.294	22.47	0.333
3	19.299	22.47	0.333
4	19.197	22.59	0.337
5	19.736	21.97	0.319
6	20.002	21.68	0.310
7	20.442	21.21	0.297
8	20.627	21.02	0.292
Average	19.715	22.01	0.319
Final score (lateral "G")			**0.319**

Static Circle Test
Wet Pavement Surface (636 feet in circumference)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	18.465	23.48	0.364
2	18.285	23.71	0.371
3	18.799	23.07	0.351
4	18.871	22.98	0.348
5	19.515	22.22	0.326
6	18.834	23.02	0.350
7	19.059	22.75	0.342
8	18.719	23.17	0.354
Average	18.818	23.05	0.350
Final score (lateral "G")			**0.350**

Static Circle Test
Wet Pavement Surface (636 feet in circumference)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	18.794	23.07	0.351
2	19.278	22.49	0.334
3	19.809	21.89	0.316
4	19.244	22.53	0.335
5	18.995	22.83	0.344
6	19.096	22.71	0.340
7	18.760	23.11	0.353
8	18.761	23.11	0.353
Average	19.092	22.72	0.340
Final score (lateral "G")			**0.340**

Static Circle Test
Wet Pavement Surface (636 feet in circumference)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	19.483	22.26	0.327
2	20.772	20.88	0.288
3	19.875	21.82	0.314
4	20.049	21.63	0.309
5	20.627	21.02	0.292
6	20.420	21.24	0.298
7	19.845	21.85	0.315
8	20.790	20.86	0.287
Average	20.233	21.44	0.303
Final score (lateral "G")			**0.303**

Static Circle Test
Wet Pavement Surface (636 feet in circumference)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Matuszak**

Run number	Elapsed time (seconds)	Speed (mph)	Lateral "G"
1	19.360	22.40	0.331
2	19.021	22.80	0.343
3	19.096	22.71	0.340
4	19.600	22.12	0.323
5	19.863	21.83	0.315
6	19.343	22.42	0.332
7	19.283	22.49	0.334
8	19.879	21.81	0.314
Average	19.431	22.32	0.329
Final score (lateral "G")			**0.329**

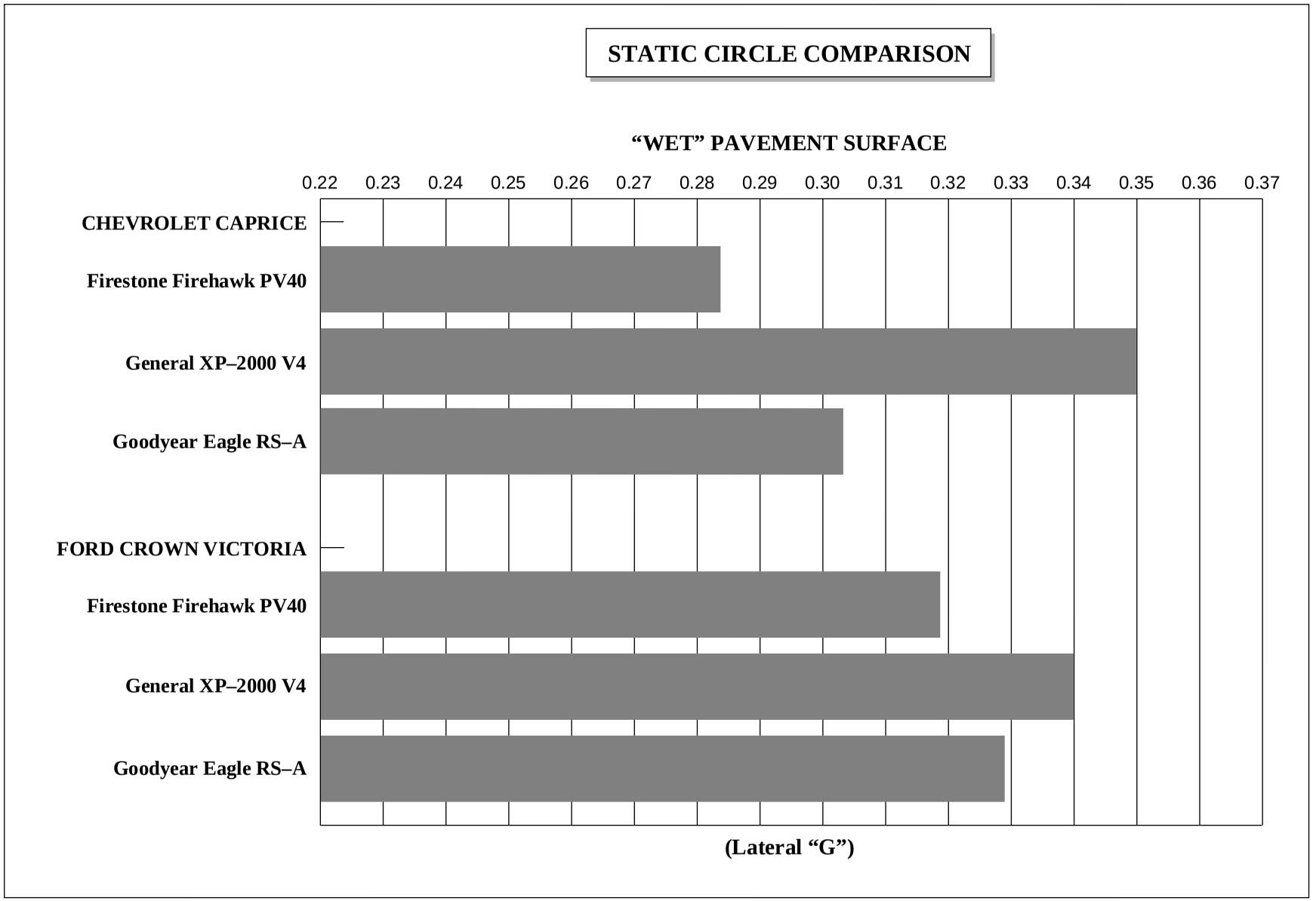
Static Circle Test
Wet Pavement Surface (636 feet in circumference)
Overall Scores

	Elapsed time (seconds)	Average speed (mph)	Lateral "G"	Percent difference*
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**				
Firestone Firehawk PV40**	20.906	20.74	0.284	11.10%
General XP–2000 V4**	18.818	23.05	0.350	0.00%
Goodyear Eagle RS–A**	20.233	21.44	0.303	7.52%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**				
Firestone Firehawk PV40***	19.715	22.01	0.319	3.26%
General XP–2000 V4***	19.092	22.72	0.340	0.00%
Goodyear Eagle RS–A***	19.431	22.32	0.329	1.78%

* The percent difference is obtained by subtracting the elapsed time of the tire of interest from the elapsed time of the best scoring tire (lowest score is best) and dividing that number by the elapsed time of the best scoring tire.

** Analysis showed no statistically significant difference between the Firestone and the Goodyear on the Chevrolet Caprice; however, there is a statistically significant difference between both of them and the General in this test (see Appendix I).

*** While the results are very close, analysis showed a marginal, but statistically significant, difference between the Firestone and the General on the Ford Crown Victoria; however, there is no statistically significant difference between the Firestone and the Goodyear, or between the Goodyear and the General in this test (see Appendix I).


STATIC CIRCLE COMPARISON
"WET" PAVEMENT SURFACE
0.22
0.23
0.24
0.25
0.26
0.27
0.28
0.29
0.30
0.31
0.32
0.33
0.34
0.35
0.36
0.37
CHEVROLET CAPRICE
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
FORD CROWN VICTORIA
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
(Lateral "G")

Serpentine Test
Dry Pavement Surface

Test Objective

Determine each tire's transient response characteristics and performance on a dry pavement surface. The course used is straight and flat with 550 feet asphalt and 150 feet concrete. Pylons are set in a straight line and spaced 100 feet apart. The approach speed is 60 mph, and the driver is required to weave through the pylons while maintaining speed as close to the approach speed as possible. (See illustration below.) Serious deficiencies in transient response will result in longer elapsed times, slower speeds, and a lower overall score on this portion of the evaluation.

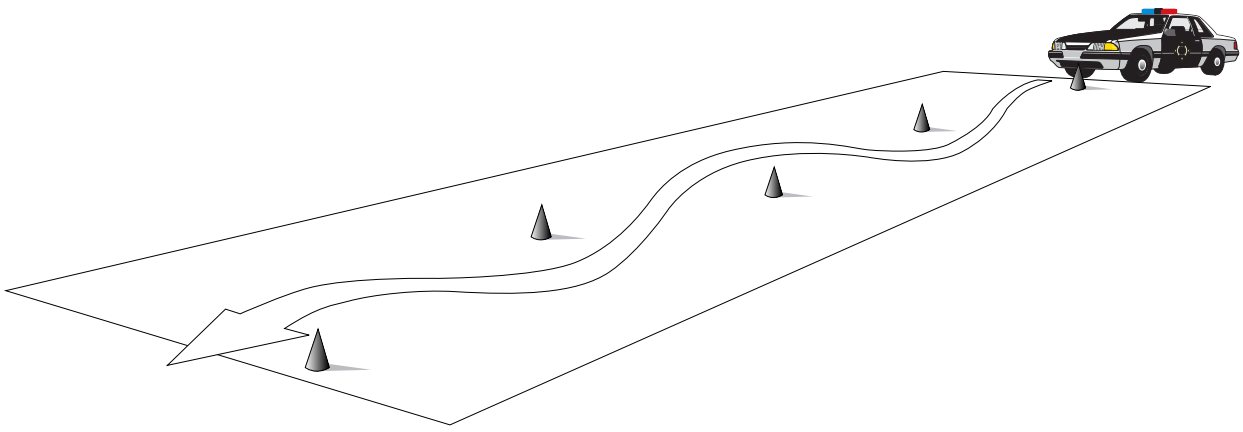
Test Methodology

Following a 2-mile tire warmup, each test vehicle equipped with the make and model of tire to be evaluated is driven through the serpentine course a minimum of 15 times. The average is for all 15 runs, while the final score for each tire is the average of the fastest 12 runs.

Formula

To determine the vehicle's speed, divide the length of the course (700 ft.) by 1.4667 ft./sec., then divide by the elapsed time.

Example:
700 ft. ÷ 1.4667 ft./sec. ÷ elapsed time
(length of course)



Serpentine Test
Dry Pavement Surface (700 feet)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	8.992	53.08
	2	9.306	51.29
	3	8.756	54.51
	4	8.995	53.06
	5	8.989	53.09
	6	8.903	53.61
	7	8.783	54.34
	8	8.987	53.11
	9	8.716	54.76
	10	8.793	54.28
	11	8.866	53.83
	12	8.805	54.20
	13	8.933	53.43
	14	8.867	53.82
	15	8.604	55.47
	Average*	8.886	53.72
Final score**		**8.834**	**54.04**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Dry Pavement Surface (700 feet)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	8.670	55.05
	2	9.028	52.86
	3	9.027	52.87
	4	8.979	53.15
	5	8.903	53.61
	6	9.017	52.93
	7	9.195	51.90
	8	8.848	53.94
	9	9.171	52.04
	10	9.064	52.65
	11	9.008	52.98
	12	9.150	52.16
	13	8.991	53.08
	14	9.131	52.27
	15	9.392	50.82
	Average*	9.038	52.82
Final score**		**8.985**	**53.13**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Dry Pavement Surface (700 feet)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	9.348	51.05
	2	9.121	52.33
	3	9.236	51.67
	4	9.271	51.48
	5	9.332	51.14
	6	9.025	52.88
	7	9.219	51.77
	8	9.033	52.84
	9	9.017	52.93
	10	9.013	52.95
	11	9.067	52.64
	12	9.157	52.12
	13	9.147	52.18
	14	9.158	52.11
	15	9.409	50.72
	Average*	9.170	52.05
Final score**		**9.122**	**52.32**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Dry Pavement Surface (700 feet)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	8.843	53.97
	2	9.057	52.70
	3	9.038	52.81
	4	9.057	52.70
	5	9.265	51.51
	6	9.101	52.44
	7	9.045	52.77
	8	9.045	52.77
	9	9.054	52.71
	10	8.961	53.26
	11	8.810	54.17
	12	9.558	49.93
	13	9.026	52.88
	14	8.942	53.37
	15	9.116	52.35
	Average*	9.061	52.69
Final score**		**8.998**	**53.04**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Dry Pavement Surface (700 feet)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	9.116	52.35
	2	9.266	51.51
	3	8.984	53.12
	4	9.169	52.05
	5	9.462	50.44
	6	8.974	53.18
	7	9.166	52.07
	8	9.127	52.29
	9	9.256	51.56
	10	9.130	52.27
	11	8.918	53.52
	12	9.206	51.84
	13	9.249	51.60
	14	9.098	52.46
	15	9.150	52.16
	Average*	9.151	52.16
Final score**		**9.107**	**52.41**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Dry Pavement Surface (700 feet)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	9.017	52.93
	2	9.634	49.54
	3	9.472	50.39
	4	9.418	50.68
	5	9.420	50.66
	6	9.393	50.81
	7	9.535	50.05
	8	9.621	49.61
	9	9.992	47.76
	10	9.474	50.38
	11	9.664	49.39
	12	9.598	49.73
	13	9.267	51.50
	14	9.607	49.68
	15	9.718	49.11
	Average*	9.522	50.15
Final score**		**9.455**	**50.50**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

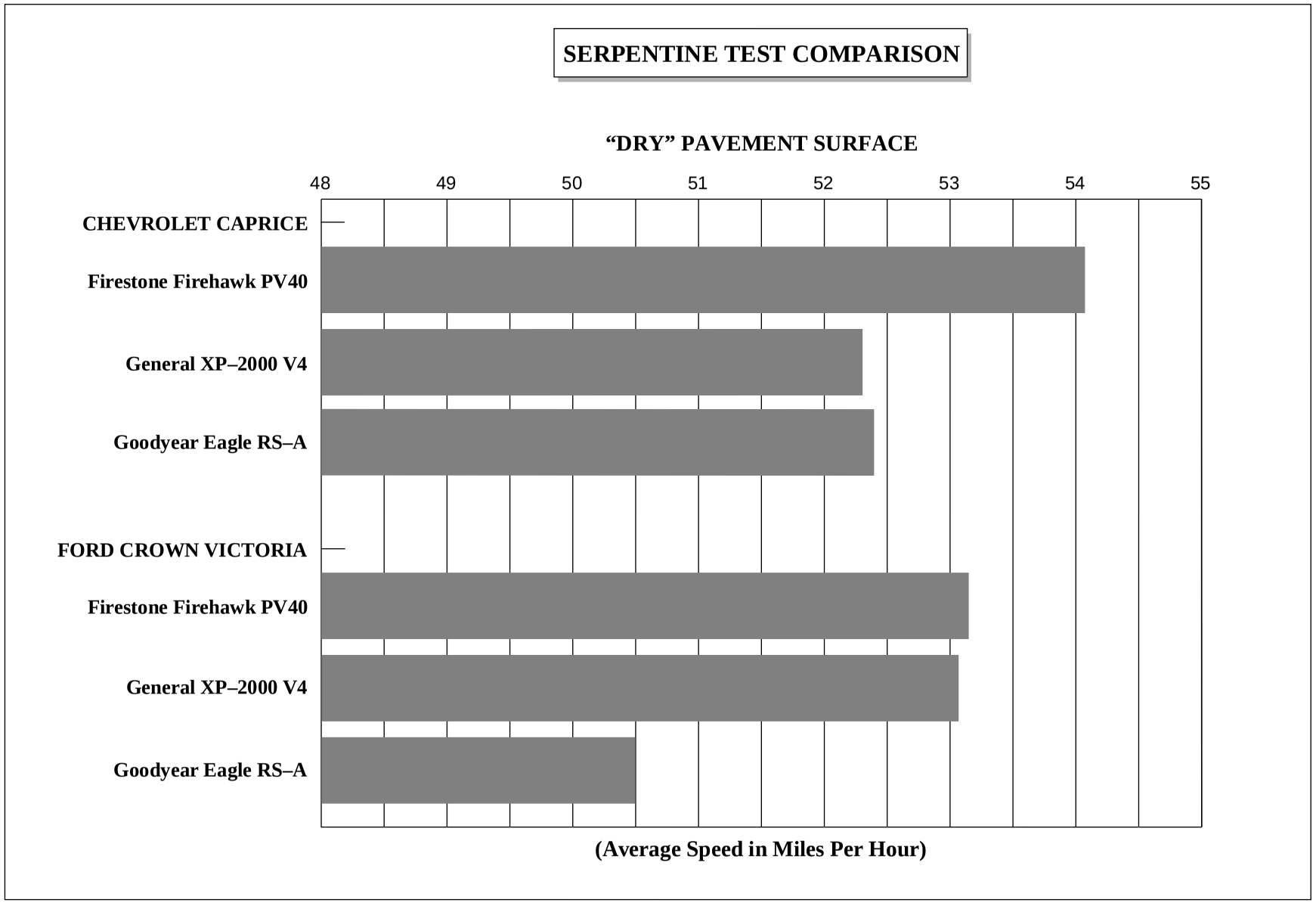
Serpentine Test
Dry Pavement Surface (700 feet)
Overall Scores

	Elapsed time (seconds)	Average speed (mph)	Percent difference*
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40**	8.834	54.04	0.00%
General XP–2000 V4**	9.122	52.32	3.26%
Goodyear Eagle RS–A**	9.107	52.41	3.09%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40***	8.985	53.13	0.00%
General XP–2000 V4***	8.998	53.04	0.14%
Goodyear Eagle RS–A***	9.455	50.50	5.23%

* The percent difference is obtained by subtracting the elapsed time of the tire of interest from the elapsed time of the best scoring tire (lowest score is best) and dividing that number by the elapsed time of the best scoring tire.

** Analysis showed no statistically significant difference between the General and the Goodyear on the Chevrolet Caprice; however, there is a statistically significant difference between both of them and the Firestone in this test (see Appendix I).

*** Analysis showed no statistically significant difference between the Firestone and the General on the Ford Crown Victoria; however, there is a statistically significant difference between both of them and the Goodyear in this test (see Appendix I).


SERPENTINE TEST COMPARISON
"DRY" PAVEMENT SURFACE
48
49
50
51
52
53
54
55
CHEVROLET CAPRICE
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
FORD CROWN VICTORIA
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
(Average Speed in Miles Per Hour)

Serpentine Test
Wet Pavement Surface

Test Objective

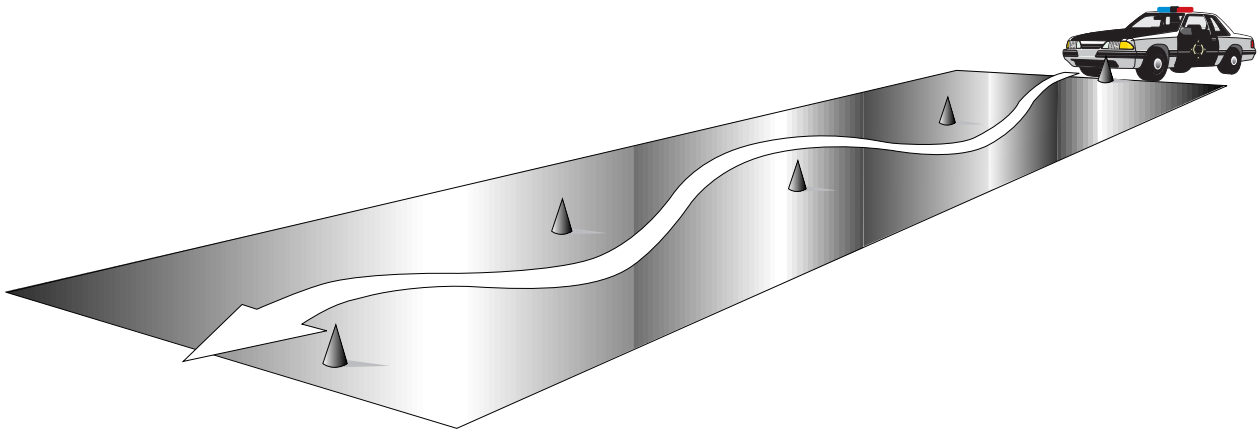
Determine each tire's transient response characteristics and performance on a wet pavement surface. The course used is straight and flat with approximately 400 feet asphalt and 100 feet concrete. Pylons are set in a straight line and spaced 60 feet apart. The approach speed is 35 mph, and the driver is required to weave through the pylons while maintaining speed as close to the approach speed as possible. (See illustration below.) Serious deficiencies in transient response during wet pavement maneuvering will result in longer elapsed times, slower speeds, and a lower overall score on this portion of the evaluation.

Test Methodology

Following a 2-mile tire warmup, each test vehicle equipped with the make and model of tire to be evaluated is driven through the serpentine course a minimum of 15 times. The average is for all 15 runs, while the final score for each tire is the average of the fastest 12 runs.

Formula

To determine the vehicle's speed, divide the length of the course (500 ft.) by 1.4667 ft./sec., then divide by the elapsed time.
Example:
500 ft. ÷ 1.4667 ft./sec. ÷ elapsed time
(length of course)



Serpentine Test
Wet Pavement Surface (500 feet)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	10.264	33.21
	2	10.157	33.56
	3	10.656	31.99
	4	10.287	33.14
	5	10.023	34.01
	6	10.340	32.97
	7	9.934	34.32
	8	10.103	33.74
	9	10.480	32.53
	10	10.191	33.45
	11	10.282	33.16
	12	9.824	34.70
	13	10.530	32.37
	14	10.693	31.88
	15	10.383	32.83
	Average*	10.276	33.19
Final score**		**10.189**	**33.47**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Wet Pavement Surface (500 feet)

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	10.649	32.01
	2	10.607	32.14
	3	10.718	31.81
	4	10.205	33.41
	5	10.561	32.28
	6	10.343	32.96
	7	10.264	33.21
	8	10.283	33.15
	9	10.444	32.64
	10	10.217	33.37
	11	10.545	32.33
	12	10.156	33.57
	13	10.331	33.00
	14	10.498	32.47
	15	10.427	32.69
	Average*	10.417	32.74
Final score**		**10.356**	**32.92**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Wet Pavement Surface (500 feet)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	10.563	32.27
	2	10.419	33.72
	3	11.046	30.86
	4	10.446	32.63
	5	10.780	31.62
	6	10.576	32.23
	7	10.777	31.63
	8	10.683	31.91
	9	10.726	31.78
	10	10.892	31.30
	11	10.325	33.02
	12	10.766	31.66
	13	10.511	32.43
	14	10.706	31.84
	15	10.787	31.60
	Average*	10.667	31.97
Final score**		**10.607**	**32.15**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Wet Pavement Surface (500 feet)

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	10.983	31.04
	2	10.735	31.76
	3	10.957	31.11
	4	11.053	30.84
	5	10.951	31.13
	6	11.065	30.81
	7	10.934	31.18
	8	10.527	32.38
	9	10.759	31.69
	10	10.342	32.96
	11	11.007	30.97
	12	10.420	32.72
	13	10.574	32.24
	14	10.399	32.78
	15	10.114	33.71
	Average*	10.721	31.82
Final score**		**10.641**	**32.06**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Wet Pavement Surface (500 feet)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	10.682	31.91
	2	10.704	31.85
	3	10.700	31.86
	4	10.837	31.46
	5	10.724	31.79
	6	10.759	31.69
	7	10.529	32.38
	8	10.500	32.47
	9	10.506	32.45
	10	10.581	32.22
	11	10.719	31.80
	12	10.426	32.70
	13	10.242	33.28
	14	10.477	32.54
	15	10.563	32.27
	Average*	10.597	32.18
Final score**		**10.552**	**32.31**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

Serpentine Test
Wet Pavement Surface (500 feet)

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

Driver	Run number	Elapsed time (seconds)	Speed (mph)
Matuszak	1	10.753	31.70
	2	10.260	33.23
	3	10.063	33.88
	4	10.334	32.99
	5	10.547	32.32
	6	10.086	33.80
	7	10.421	32.71
	8	10.521	32.40
	9	10.310	33.07
	10	10.579	32.22
	11	10.579	32.22
	12	10.382	32.84
	13	10.388	32.82
	14	10.556	32.29
	15	10.449	32.63
	Average*	10.415	32.74
Final score**		**10.360**	**32.91**

* Calculated from all 15 runs

** Calculated from the fastest 12 runs

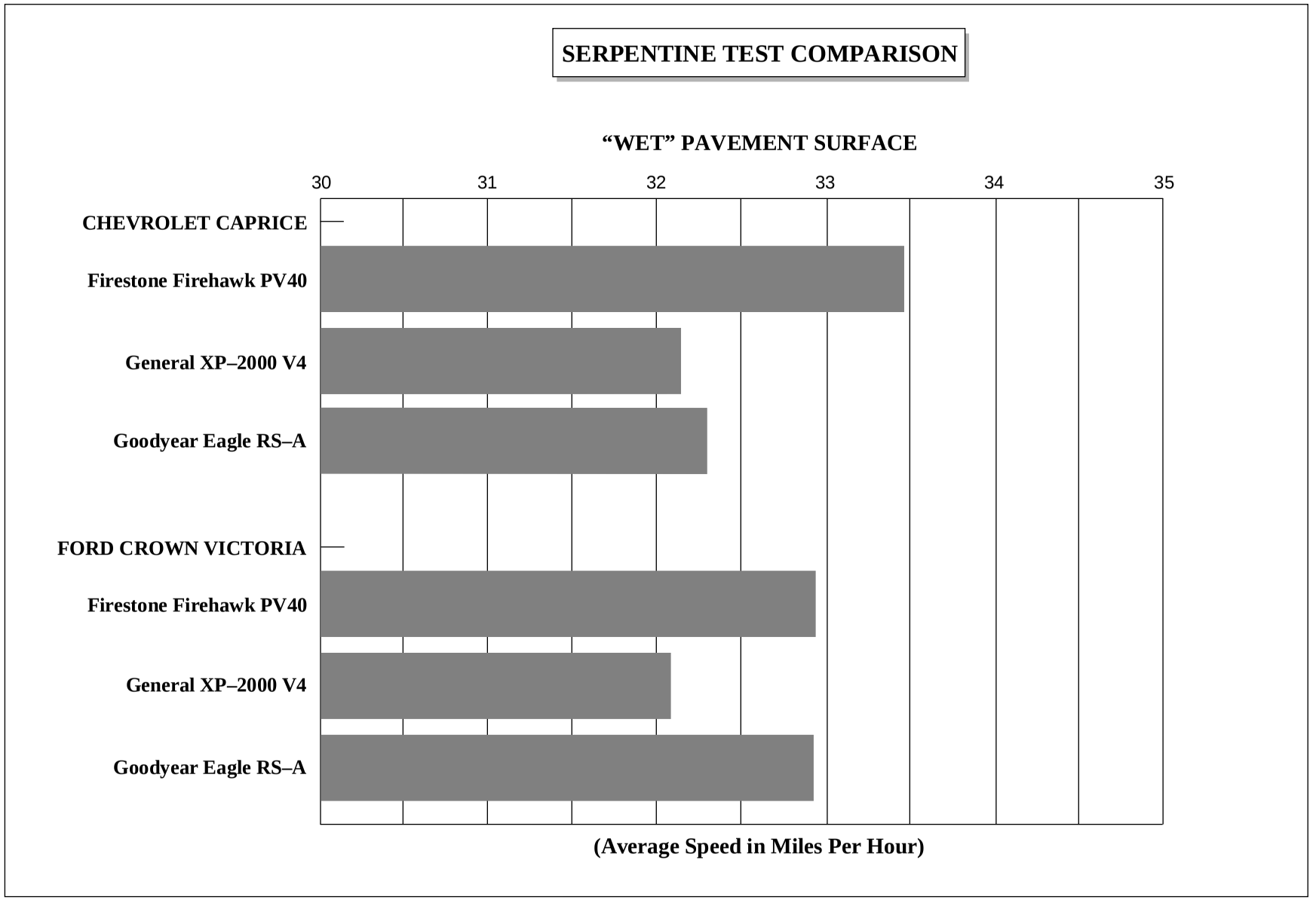
Serpentine Test
Wet Pavement Surface (500 feet)
Overall Scores

	Elapsed time (seconds)	Average speed (mph)	Percent difference*
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40**	10.189	33.47	0.00%
General XP–2000 V4**	10.607	32.15	4.10%
Goodyear Eagle RS–A**	10.552	32.31	3.56%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40***	10.356	32.92	0.00%
General XP–2000 V4***	10.641	32.06	2.75%
Goodyear Eagle RS–A***	10.360	32.91	0.04%

* The percent difference is obtained by subtracting the elapsed time of the tire of interest from the elapsed time of the best scoring tire (lowest score is best) and dividing that number by the elapsed time of the best scoring tire.

** Analysis showed no statistically significant difference between the General and the Goodyear on the Chevrolet Caprice; however, there is a statistically significant difference between both of them and the Firestone in this test (see Appendix I).

*** Analysis showed no statistically significant difference between the Firestone and the Goodyear on the Ford Crown Victoria; however, there is a statistically significant difference between both of them and the General in this test (see Appendix I).


SERPENTINE TEST COMPARISON
"WET" PAVEMENT SURFACE
30
31
32
33
34
35
CHEVROLET CAPRICE
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
FORD CROWN VICTORIA
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
(Average Speed in Miles Per Hour)

Stopping Distance Test Dry Pavement Surface

Test Objective

Determine the performance characteristics of the test tires in a simulated "panic" stop of a patrol vehicle on a dry pavement surface. The course used has a straight, flat, granite asphalt surface. A center lane marks where the braking maneuvers are to be done. The approach speed is just over 60 mph. The test vehicle is in Anti-Lock Brake System (ABS) mode when the driver applies the brakes as close to 60 mph as possible. Both the exact speed at brake application and the distance from brake application to complete stop are electronically recorded. Average deceleration rate is then determined. Deficiencies in tire adhesion will result in longer stopping distances and a relatively lower score on this portion of the evaluation.

Test Methodology

Following a 1-mile tire warmup, each test vehicle equipped with the make and model of tire to be evaluated makes a minimum of six measured panic stops, with the ABS in operation. The final score for each tire on this portion of the evaluation is the average of the six measured stops.

Formula

To determine the deceleration rate, translate the initial speed into ft./sec. by multiplying the initial speed by 1.4667. Square this ft./sec. product and divide the resulting square by twice the listed stopping distance.

Example:

1. 60.50 mph x 1.4667 = 88.735 ft./sec.
2. 88.735 ft./sec. x 88.735 ft./sec. = 7,873.90 $ft.^2/sec.^2$
3. 7,873.90 $ft.^2/sec.^2$ ÷ (157.00 ft. x 2) = 25.08 $ft./sec.^2$

Stopping Distance Test
Dry Pavement Surface

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	61.9	149.2	27.59
2	61.9	148.9	27.66
3	60.8	144.8	27.49
4	60.6	145.2	27.21
5	60.3	143.3	27.26
6	61.2	147.1	27.42
Average score	61.1	146.4	**27.44**
(Calculated stopping distance from 60 mph)			**141.1 feet**

Stopping Distance Test
Dry Pavement Surface

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	60.3	148.8	26.26
2	62.0	149.1	27.72
3	59.1	139.7	26.87
4	60.0	142.9	27.12
5	60.7	148.1	26.80
6	60.3	148.3	26.35
Average score	60.4	146.2	**26.85**
(Calculated stopping distance from 60 mph)			**144.2 feet**

Stopping Distance Test
Dry Pavement Surface

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	58.7	137.3	26.96
2	62.2	158.9	26.15
3	61.0	153.7	26.03
4	60.5	150.4	26.19
5	59.9	146.7	26.34
6	60.0	145.2	26.69
Average score	60.4	148.7	**26.39**
(Calculated stopping distance from 60 mph)			**146.7 feet**

Stopping Distance Test
Dry Pavement Surface

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	60.4	154.9	25.31
2	59.1	152.6	24.60
3	61.8	161.6	25.44
4	62.0	169.4	24.42
5	60.7	156.4	25.32
6	60.3	155.4	25.17
Average score	60.7	158.4	**25.04**
(Calculated stopping distance from 60 mph)			**154.6 feet**

Stopping Distance Test
Dry Pavement Surface

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	60.2	144.3	27.02
2	60.4	147.9	26.55
3	60.1	146.7	26.50
4	*	*	*
5	60.3	143.1	27.38
6	61.6	156.1	26.17
Average score	60.5	147.6	**26.72**
(Calculated stopping distance from 60 mph)			**144.9 feet**

* Data from stop #4 were not captured by the computer

Stopping Distance Test
Dry Pavement Surface

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	60.4	152.8	25.65
2	60.8	157.7	25.22
3	62.8	169.2	25.04
4	61.3	165.0	24.47
5	61.4	164.7	24.64
6	59.4	154.7	24.50
Average score	61.0	160.7	**24.92**
(Calculated stopping distance from 60 mph)			**155.4 feet**

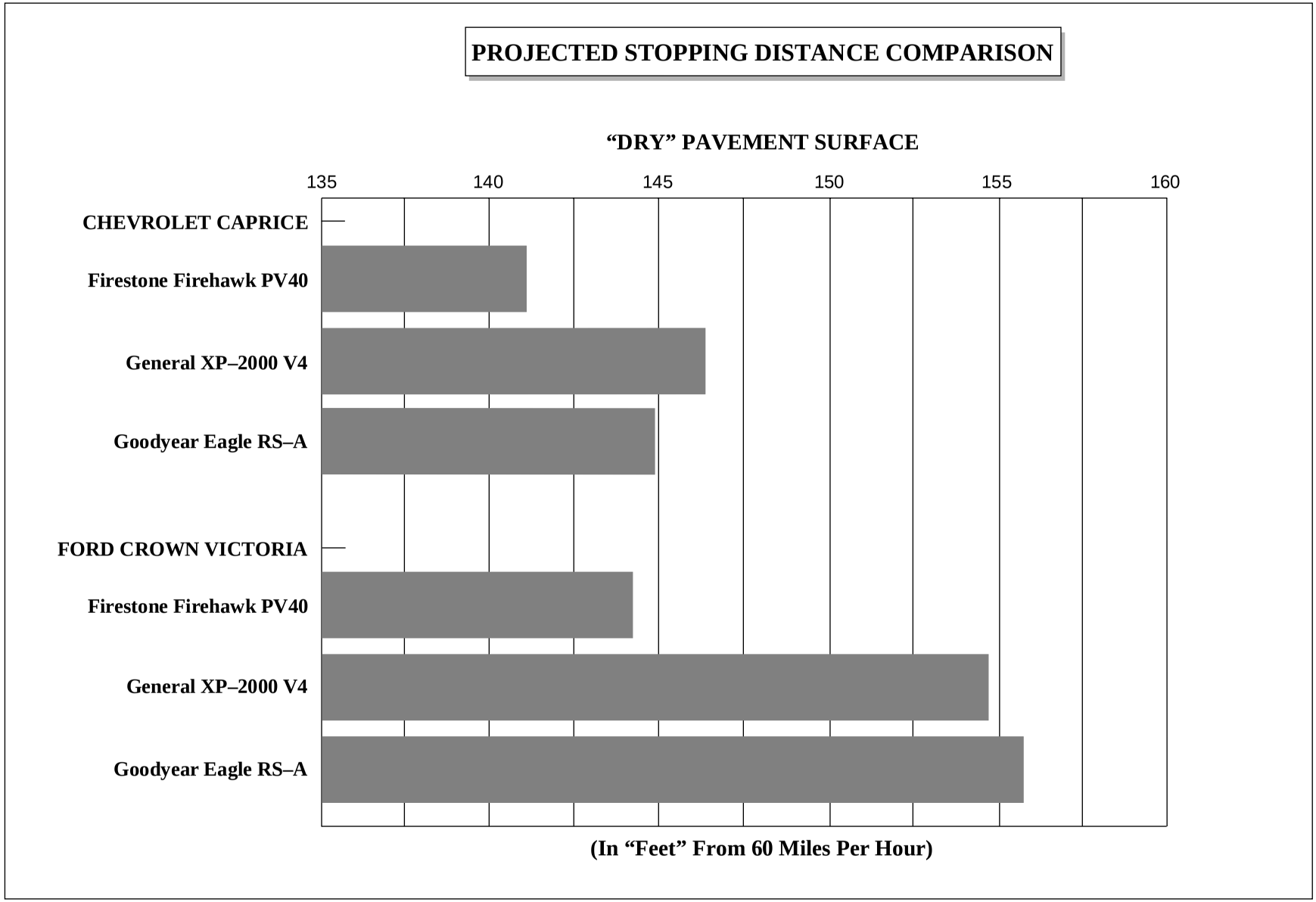
Stopping Distance Test
Dry Pavement Surface
Overall Scores

	Average deceleration rate (ft./sec.^{2})	Stopping distance* (ft.)	Percent difference**
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40***	27.44	141.1	0.00%
General XP–2000 V4***	26.39	146.7	3.83%
Goodyear Eagle RS–A***	26.72	144.9	2.62%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40***	26.85	144.2	0.00%
General XP–2000 V4***	25.04	154.6	6.74%
Goodyear Eagle RS–A***	24.92	155.4	7.19%

* Calculated stopping distance from 60 mph. Both vehicles are equipped with ABS.

** The percent difference is obtained by subtracting the average deceleration rate of the tire of interest from the average deceleration rate of the best scoring tire (highest score is best) and dividing that number by the average deceleration rate of the best scoring tire.

*** Analysis showed no statistically significant difference between the General and the Goodyear on either the Chevrolet Caprice or the Ford Crown Victoria; however, there is a statistically significant difference between both of them and the Firestone on both cars in this test (see Appendix I).


PROJECTED STOPPING DISTANCE COMPARISON
"DRY" PAVEMENT SURFACE
135
140
145
150
155
160
CHEVROLET CAPRICE
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
FORD CROWN VICTORIA
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
(In "Feet" From 60 Miles Per Hour)

Stopping Distance Test Wet Pavement Surface

Test Objective

Determine the performance characteristics of the test tires in a simulated “panic” stop of a patrol vehicle on a wet pavement surface having a constant 3/8 to 1/2 inch of water depth. The course used has a flat polished concrete surface. Pylons are set up to mark where the braking maneuvers are done. The approach speed is just over 45 mph. The vehicle is in ABS mode when the driver applies the brakes as close to 45 mph as possible. Both the exact speed at brake application and the distance from brake application to complete stop are electronically recorded. Average deceleration rate is then determined. Deficiencies in tire adhesion will result in longer stopping distances and a relatively lower score on this portion of the evaluation.

Test Methodology

Following a 1-mile tire warmup, each test vehicle equipped with the make and model of tire to be evaluated makes a minimum of six measured panic stops, with the ABS in operation. The final score for each tire on this portion of the evaluation is the average of the six measured stops.

Formula

To determine the deceleration rate, translate the initial speed into ft./sec. by multiplying the initial speed by 1.4667. Square this ft./sec. product and divide the resulting square by twice the listed stopping distance.

Example:

1. 45.7 mph x 1.4667 = 67.028 ft./sec.
2. 67.028 ft./sec. x 67.028 ft./sec. = 4,492.75 $ft.^2/sec.^2$
3. 4,492.75 $ft.^2/sec.^2$ ÷ (145.9 ft. x 2) = 15.39 $ft./sec.^2$

Stopping Distance Test
Wet Pavement Surface

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	42.0	171.2	11.09
2	48.5	194.4	13.02
3	44.0	164.1	12.69
4	47.0	177.6	13.40
5	43.6	160.8	12.70
6	44.9	164.6	13.14
Average score	45.0	172.1	**12.67**
(Calculated stopping distance from 60 mph)			**171.9 feet**

Stopping Distance Test
Wet Pavement Surface

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	44.7	199.8	10.74
2	49.0	212.4	12.15
3	44.5	202.5	10.50
4	47.2	207.4	11.56
5	46.7	183.9	12.76
6	46.8	199.8	11.77
Average score	46.5	201.0	**11.58**
(Calculated stopping distance from 60 mph)			**188.1 feet**

Stopping Distance Test
Wet Pavement Surface

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	45.9	145.3	15.57
2	46.8	148.6	15.88
3	43.5	139.8	14.58
4	46.5	169.2	13.75
5	48.9	167.6	15.31
6	46.1	142.6	16.03
Average score	46.3	152.2	**15.19**
(Calculated stopping distance from 60 mph)			**143.4 feet**

Stopping Distance Test
Wet Pavement Surface

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	45.7	145.9	15.39
2	45.0	151.1	14.41
3	44.7	139.5	15.41
4	46.0	143.3	15.90
5	46.7	153.0	15.36
6	44.5	137.7	15.44
Average score	45.4	145.1	**15.32**
(Calculated stopping distance from 60 mph)			**142.2 feet**

Stopping Distance Test
Wet Pavement Surface

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	47.0	171.2	13.87
2	43.9	153.2	13.51
3	45.8	160.4	14.04
4	46.2	157.3	14.58
5	45.5	160.6	13.89
6	45.8	150.8	14.95
Average score	45.7	158.9	**14.14**
(Calculated stopping distance from 60 mph)			**154.0 feet**

Stopping Distance Test
Wet Pavement Surface

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**
DRIVER: **Jacob**

Run number	Initial speed (mph)	Stopping distance (ft.)	Deceleration rate (ft./sec.^{2})
1	45.1	175.2	12.48
2	45.9	184.9	12.24
3	44.1	169.2	12.37
4	48.0	170.5	14.51
5	46.6	169.2	13.81
6	44.4	160.2	13.24
Average score	45.7	171.5	**13.11**
(Calculated stopping distance from 60 mph)			**166.1 feet**

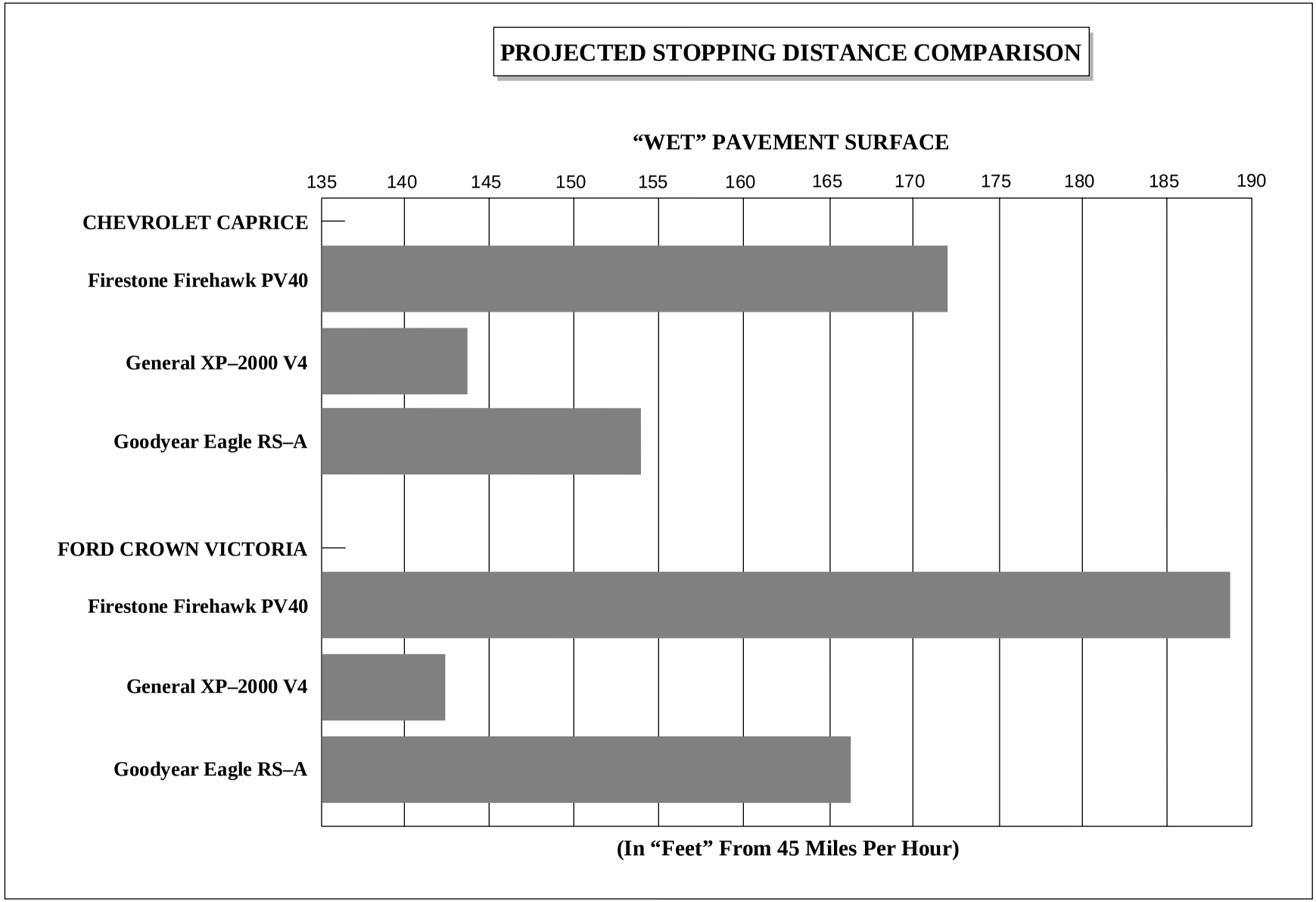
Stopping Distance Test
Wet Pavement Surface
Overall Scores

	Average deceleration rate (ft./sec.^{2})	Stopping distance* (ft.)	Percent difference**
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40***	12.67	171.9	16.59%
General XP–2000 V4***	15.19	143.4	0.00%
Goodyear Eagle RS–A***	14.14	154.0	6.91%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40***	11.58	188.1	24.41%
General XP–2000 V4***	15.32	142.2	0.00%
Goodyear Eagle RS–A***	13.11	166.1	14.43%

* Calculated stopping distance from 45.0 mph. Both vehicles are equipped with ABS.

** The percent difference is obtained by subtracting the average deceleration rate of the tire of interest from the average deceleration rate of the best scoring tire (highest score is best) and dividing that number by the average deceleration rate of the best scoring tire.

*** Analysis showed statistically significant differences between each of the three tires on both the Chevrolet Caprice and the Ford Crown Victoria in this test (see Appendix I).


PROJECTED STOPPING DISTANCE COMPARISON
"WET" PAVEMENT SURFACE
135
140
145
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155
160
165
170
175
180
185
190
CHEVROLET CAPRICE
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
FORD CROWN VICTORIA
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
(In "Feet" From 45 Miles Per Hour)

High-Speed Handling Test

Test Objective

Determine each tire's high-speed pursuit handling characteristics and performance on a 1.43-mile (7,553 feet) road-racing type course. The course contains high-speed curves, low-speed corners, and straightaways and, with the exception of other traffic, simulates actual pursuit conditions in the field. This evaluation is a test of the tire manufacturers' success in blending the transient response, cornering, and rapid deceleration characteristics of a tire. Serious deficiencies in any of these critical areas will result in longer lap times and a lower overall score on this portion of the evaluation.

Test Methodology

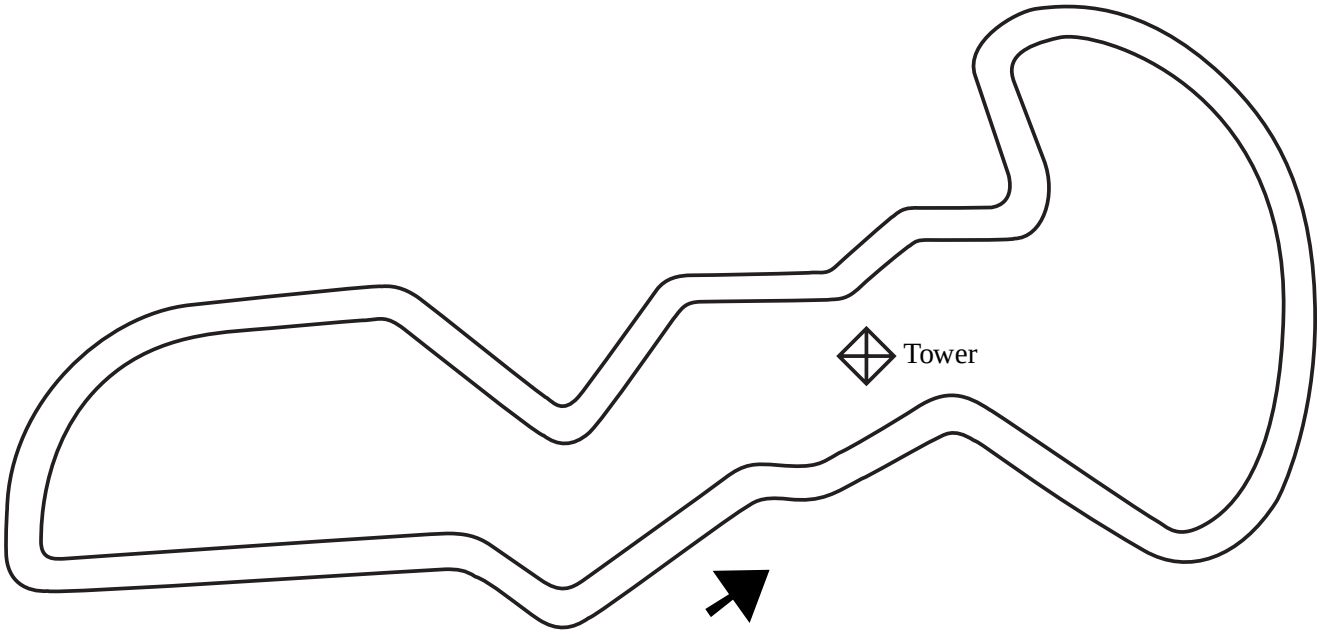
Following 2 warmup laps, each test vehicle equipped with the make and model of tire to be evaluated is driven over the course by 3 drivers, for at least 12 timed laps. The final score for each tire will be the average of the fastest 3 laps by each of the drivers, for a total of 9 laps.

Formula

To determine the average speed, divide the number of feet in the road course by the overall average, then divide by 1.4667 ft./sec.

Example:
7,553 ft. ÷ overall average ÷ 1.4667 ft./sec.

Test Facility Diagram
Federal Law Enforcement Training Center
Highway Response Course—Range #7
Brunswick, Georgia



1.43 Miles

High-Speed Handling Test

CAR: **Chevrolet Caprice**

Tire	Jacob (seconds)	Matuszak (seconds)	VanDenBerg (seconds)	Overall average* (seconds)	Average speed (mph)
Firestone	92.846	87.860	85.201		
Firehawk PV40	93.136	87.692	85.723		
P225/70R–15	92.777	86.603	85.762		
	91.574	87.598	85.882		
Average:	**92.583**	**87.438**	**85.642**	**88.420**	**58.24**
General	94.369	90.309	85.995		
XP–2000 V4	93.372	90.819	87.315		
P225/70R–15	93.930	89.461	87.257		
	93.478	89.328	87.180		
Average:	**93.787**	**89.979**	**86.937**	**90.034**	**57.20**
Goodyear	93.257	88.509	85.385		
Eagle RS–A	92.342	88.493	86.124		
P225/70R–15	92.211	88.118	86.101		
	92.395	89.591	87.593		
Average:	**92.551**	**88.678**	**86.301**	**88.853**	**57.96**

* Overall averages calculated from the best 3 laps for each driver (9 laps total).

High-Speed Handling Test
Overall Scores

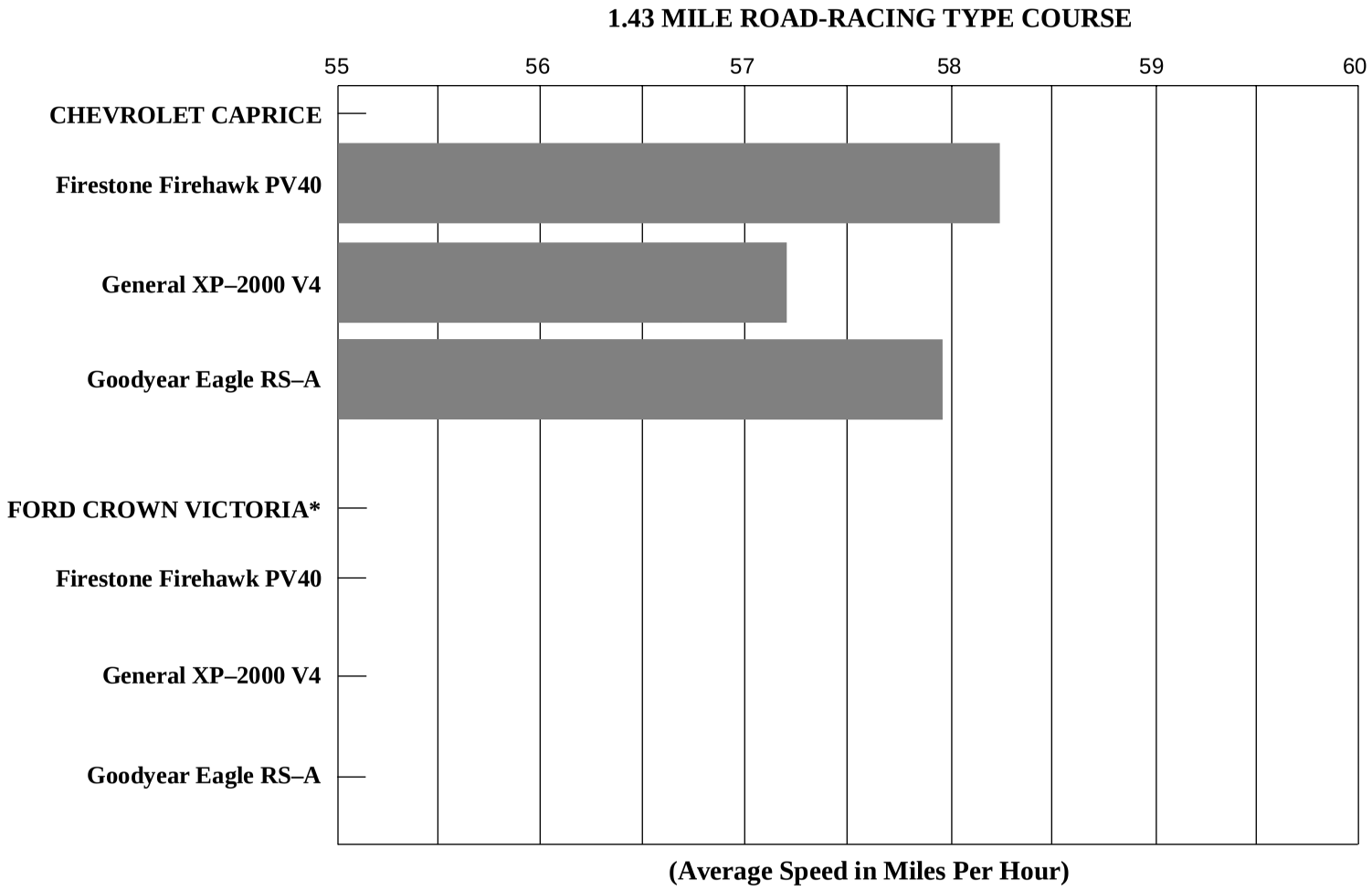
	Average lap time (seconds)	Average speed (mph)	Percent difference*
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40***	88.420	58.24	0.00%
General XP–2000 V4***	90.034	57.20	1.83%
Goodyear Eagle RS–A***	88.853	57.96	0.49%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**			
Firestone Firehawk PV40	**	**	**
General XP–2000 V4	**	**	**
Goodyear Eagle RS–A	**	**	**

* The percent difference is obtained by subtracting the average lap time of the tire of interest from the average lap time of the best scoring tire (lowest score is best) and dividing that number by the average lap time of the best scoring tire.

** As a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation process.

*** Analysis showed no statistically significant difference between the Firestone and the Goodyear on the Chevrolet Caprice; however, there is a statistically significant difference between both of them and the General in this test (see Appendix I).

HIGH-SPEED HANDLING COMPARISON



*As a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation process.

Tire Wear Measurements

Test Objective

Determine each tire's wear characteristics when subjected to the entire performance evaluation. Tread depth measurements are taken of the new right front tire of each test set of each brand, model, and size of tire tested. (New, for the purpose of this evaluation, means after a specific break-in procedure, but before any testing.) The right front tire was chosen for these measurements because it typically exhibits the most wear in the test situations used in this evaluation. Tread depth measurements are taken for a second time prior to the final test phase, which is the high-speed handling evaluation. Finally, measurements are taken for a third time at the conclusion of the high-speed handling evaluation, which completes the testing.

Test Methodology

Following a specific tire break-in routine, but before any testing is done, tread depth measurements are taken of the new right front tire of each brand, model, and size of tires tested. The measurements are taken in four (4) places across the tread of the tire, from outside to inside, and in four (4) areas around the circumference of the tire, 90 degrees apart, for a total of at least 16 measurements per right front tire. These same right front tires are again measured prior to the high-speed handling and for a third time at the conclusion of the high-speed handling, which is the final test phase, to determine the total amount of tread depth lost during the entire test procedure. The average tread depth total is the average of all of the individual tread depths measured on a given tire. The final score for each tire will be the average tread depth of the right front tire that was worn away during the testing process.

The tire wear measurements shown in this report resulted from extremely severe operating conditions. As such, they may not be an accurate predictor of achievable tire mileage when used in normal police patrol service and should not be used to extrapolate actual tire life.

Tread Depth Measurements

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

		Groove 1	Groove 2	Groove 3	Groove 4	Overall Average
Following Break-In Procedure	Position 1	0.295	0.345	0.347	0.288	
	Position 2	0.295	0.348	0.343	0.294	
	Position 3	0.295	0.342	0.342	0.294	
	Position 4	0.292	0.347	0.346	0.291	
	Averages	**0.294**	**0.346**	**0.345**	**0.292**	**0.319**
Before High-Speed Handling	Position 1	0.266	0.295	0.292	0.245	
	Position 2	0.270	0.294	0.285	0.240	
	Position 3	0.264	0.293	0.287	0.242	
	Position 4	0.260	0.298	0.292	0.247	
	Averages	**0.265**	**0.295**	**0.289**	**0.244**	**0.273**
After High-Speed Handling	Position 1	0.239	0.276	0.274	0.233	
	Position 2	0.235	0.273	0.269	0.231	
	Position 3	0.231	0.274	0.274	0.236	
	Position 4	0.230	0.268	0.269	0.233	
	Averages	**0.234**	**0.273**	**0.272**	**0.233**	**0.253**

Total Treadwear Resulting From Test Procedure **0.066**

Tread Depth Measurements

TIRE: **Firestone Firehawk PV40**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

		Groove 1	Groove 2	Groove 3	Groove 4	Overall Average
	Position 1	0.295	0.346	0.341	0.289	
Following	Position 2	0.290	0.340	0.343	0.288	
Break-In	Position 3	0.294	0.341	0.343	0.292	
Procedure	Position 4	0.295	0.339	0.342	0.290	
	Averages	**0.294**	**0.342**	**0.342**	**0.290**	**0.317**
	Position 1	0.267	0.310	0.305	0.258	
Before	Position 2	0.270	0.311	0.310	0.255	
High-Speed	Position 3	0.264	0.310	0.302	0.252	
Handling	Position 4	0.267	0.309	0.303	0.251	
	Averages	**0.267**	**0.310**	**0.305**	**0.254**	**0.284**
	Position 1					
After	Position 2					
High-Speed	Position 3					
Handling*	Position 4					
	Averages					

Total Treadwear Resulting From Test Procedure **0.033**

* As a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation process.

Tread Depth Measurements

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

		Groove 1	Groove 2	Groove 3	Groove 4	Overall Average
	Position 1	0.306	0.311	0.337	0.302	
Following	Position 2	0.308	0.313	0.341	0.308	
Break-In	Position 3	0.311	0.313	0.337	0.310	
Procedure	Position 4	0.311	0.310	0.342	0.308	
	Averages	**0.309**	**0.312**	**0.339**	**0.307**	**0.317**
	Position 1	0.286	0.281	0.287	0.272	
Before	Position 2	0.287	0.280	0.305	0.272	
High-Speed	Position 3	0.292	0.282	0.304	0.270	
Handling	Position 4	0.292	0.278	0.292	0.272	
	Averages	**0.289**	**0.280**	**0.297**	**0.272**	**0.285**
	Position 1	0.265	0.252	0.272	0.246	
After	Position 2	0.265	0.259	0.277	0.254	
High-Speed	Position 3	0.270	0.255	0.278	0.252	
Handling	Position 4	0.268	0.250	0.276	0.253	
	Averages	**0.267**	**0.254**	**0.276**	**0.251**	**0.262**

Total Treadwear Resulting From Test Procedure **0.055**

Tread Depth Measurements

TIRE: **General XP–2000 V4**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

		Groove 1	Groove 2	Groove 3	Groove 4	Overall Average
	Position 1	0.302	0.308	0.332	0.297	
Following	Position 2	0.297	0.305	0.332	0.297	
Break-In	Position 3	0.306	0.308	0.337	0.299	
Procedure	Position 4	0.300	0.300	0.330	0.304	
	Averages	**0.301**	**0.305**	**0.333**	**0.299**	**0.310**
	Position 1	0.284	0.284	0.307	0.274	
Before	Position 2	0.281	0.273	0.303	0.271	
High-Speed	Position 3	0.288	0.284	0.310	0.268	
Handling	Position 4	0.285	0.280	0.303	0.276	
	Averages	**0.285**	**0.280**	**0.306**	**0.272**	**0.286**
	Position 1					
After	Position 2					
High-Speed	Position 3					
Handling*	Position 4					
	Averages					

Total Treadwear Resulting From Test Procedure **0.024**

* As a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation process.

Tread Depth Measurements

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Chevrolet Caprice**

		Groove 1	Groove 2	Groove 3	Groove 4	Overall Average
	Position 1	0.296	0.341	0.343	0.294	
Following	Position 2	0.295	0.341	0.344	0.291	
Break-In	Position 3	0.298	0.341	0.343	0.291	
Procedure	Position 4	0.295	0.339	0.341	0.290	
	Averages	**0.296**	**0.341**	**0.343**	**0.292**	**0.318**
	Position 1	0.268	0.310	0.306	0.248	
Before	Position 2	0.273	0.311	0.305	0.256	
High-Speed	Position 3	0.274	0.312	0.310	0.260	
Handling	Position 4	0.271	0.306	0.310	0.259	
	Averages	**0.272**	**0.310**	**0.308**	**0.256**	**0.286**
	Position 1	0.256	0.286	0.286	0.239	
After	Position 2	0.257	0.290	0.289	0.243	
High-Speed	Position 3	0.255	0.292	0.292	0.249	
Handling	Position 4	0.250	0.292	0.291	0.247	
	Averages	**0.255**	**0.290**	**0.290**	**0.245**	**0.270**

Total Treadwear Resulting From Test Procedure **0.048**

Tread Depth Measurements

TIRE: **Goodyear Eagle RS–A**
SIZE: **P225/70R–15 100V**
CAR: **Ford Crown Victoria**

		Groove 1	Groove 2	Groove 3	Groove 4	Overall Average
	Position 1	0.290	0.337	0.341	0.281	
Following	Position 2	0.293	0.341	0.343	0.285	
Break-In	Position 3	0.291	0.345	0.344	0.289	
Procedure	Position 4	0.290	0.337	0.340	0.287	
	Averages	**0.291**	**0.340**	**0.342**	**0.286**	**0.315**
	Position 1	0.273	0.316	0.313	0.261	
Before	Position 2	0.276	0.314	0.314	0.258	
High-Speed	Position 3	0.272	0.313	0.311	0.260	
Handling	Position 4	0.272	0.314	0.311	0.260	
	Averages	**0.273**	**0.314**	**0.312**	**0.260**	**0.290**
	Position 1					
After	Position 2					
High-Speed	Position 3					
Handling*	Position 4					
	Averages					

Total Treadwear Resulting From Test Procedure **0.025**

* As a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation process.

Tire Wear Measurements
Overall Comparisons

	After Break-In (inch)	Before Handling Tests (inch)	After Handling Tests (inch)	Average Wear Measured* (inch)	Total Treadwear** (percent)
CAR: **Chevrolet Caprice** TIRE SIZE: **P225/70R–15 100V**					
Firestone Firehawk PV40	0.319	0.273***	0.253****	0.066	20.69%
General XP–2000 V4	0.317	0.285***	0.262****	0.055	17.35%
Goodyear Eagle RS–A	0.318	0.286***	0.270****	0.048	15.09%
CAR: **Ford Crown Victoria** TIRE SIZE: **P225/70R–15 100V**					
Firestone Firehawk PV40	0.317	0.284***	*****	0.033	10.41%
General XP–2000 V4	0.310	0.286***	*****	0.024	7.74%
Goodyear Eagle RS–A	0.315	0.290***	*****	0.025	7.94%

* To determine the average wear measured, subtract the "after handling tests" tread depth from the "after break-in" tread depth. The resulting figure is the total amout of tread wear experienced during the entire test sequence. (In the case of the Ford Crown Victoria, which was unable to complete the high-speed handling testing, the "before handling tests" tread depth measurements were used in place of the "after all tests" measurements for the calculation.)

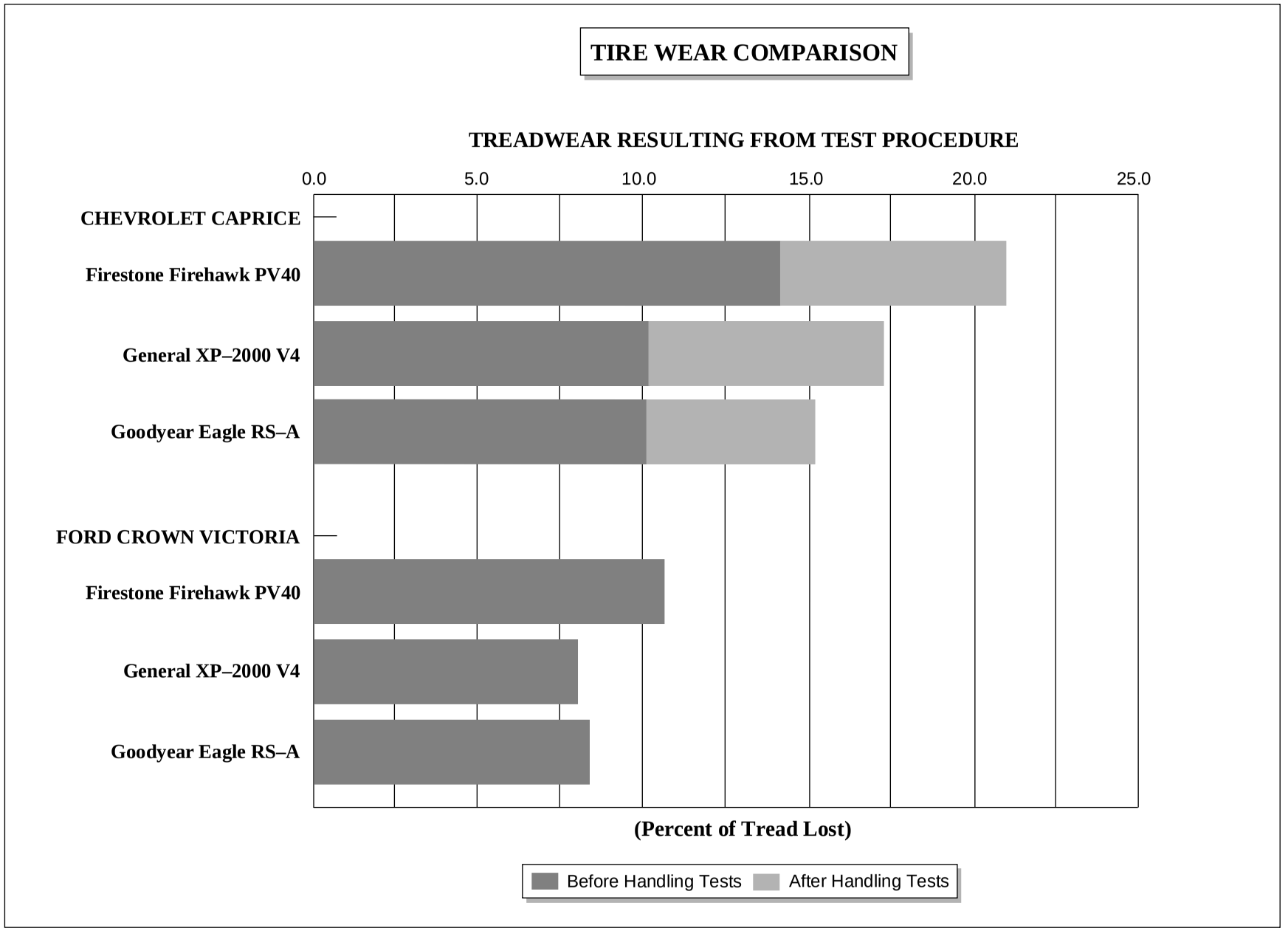
Example: 0.317 inch – 0.262 inch = 0.055 inch

** To determine "total treadwear" percent, divide the "average wear measured" figure by the "after break-in" tread depth

*** In tread depth measurements taken "before handling tests," analysis showed no statistically significant difference between the General and the Goodyear on either the Chevrolet Caprice or the Ford Crown Victoria; however, there is a statistically significant difference between both of them and the Firestone on both cars for this measurement (see Appendix I).

**** In tread depth measurements taken "after handling tests," analysis showed statistically significant differences between each of the three tires on the Chevrolet Caprice (see Appendix I).

***** As a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation process.


TIRE WEAR COMPARISON
TREADWEAR RESULTING FROM TEST PROCEDURE
0.0
5.0
10.0
15.0
20.0
25.0
CHEVROLET CAPRICE
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
FORD CROWN VICTORIA
Firestone Firehawk PV40
General XP–2000 V4
Goodyear Eagle RS–A
(Percent of Tread Lost)
Before Handling Tests
After Handling Tests

Overall Scores

All Test Categories

The following two pages contain the overall scores from each of the various test categories. They are presented this way to assist the reader in making direct comparisons of the performance of the tires under various test conditions and on different makes and models of cars.

To most fairly compare the performance of the various tires, we have shaded some of the results to indicate when two or more tires are statistically equal. Hence, when two of the three tires on a given test are within a shaded box, they should be viewed as having equal scores on that test, even though their numerical scores show a small difference.

Likewise, when all three tires are within a shaded box, there is essentially no difference between them, and they should be viewed as having equal scores on that test. (The reader should note that the tires within a shaded box may be equally better or equally worse on that test than the tire not in a shaded box.) In those categories where none of the scores are shaded, there are significant differences between each of the three tires tested.

Overall Scores—All Test Categories

CAR: **Chevrolet Caprice**
TIRE SIZE: **P225/70R–15 100V**

Tire	Static circle dry (lateral "G")	Static circle wet (lateral "G")	Serpentine evaluation dry (mph)	Serpentine evaluation wet (mph)	Stopping distance dry (feet)	Stopping distance wet (feet)	High-speed handling (seconds)	Treadwear from testing (percent)
Firestone Firehawk PV40	0.601	0.284	54.04	33.47	141.1	171.9	88.420	20.69
General XP–2000 V4	0.597	0.350	52.32	32.15	146.7	143.4	90.034	17.35
Goodyear Eagle RS–A	0.599	0.303	52.41	32.31	144.9	154.0	88.853	15.09

Overall Scores—All Test Categories

CAR: **Ford Crown Victoria**
TIRE SIZE: **P225/70R–15 100V**

Tire	Static circle dry (lateral "G")	Static circle wet (lateral "G")	Serpentine evaluation dry (mph)	Serpentine evaluation wet (mph)	Stopping distance dry (feet)	Stopping distance wet (feet)	High-speed handling (seconds)	Treadwear from testing (percent)
Firestone Firehawk PV40	0.642	0.319	53.13	32.92	144.2	188.1	*	10.41**
General XP–2000 V4	0.607	0.340	53.04	32.06	154.6	142.2	*	7.74**
Goodyear Eagle RS–A	0.643	0.329	50.50	32.91	155.4	166.1	*	7.94**

* As a result of damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation process.

**Treadwear on the Ford Crown Victoria tires is less because they were not subjected to the high-speed handling tests.

The test results may be used in two ways. First, they may be used "as is" to determine the tires that best meet the needs of your department. In this case, you should emphasize some portions of the evaluation to reflect the needs of your department. Second, the overall test results may be used to adjust the manufacturer's bid price for these tire brands.

The following pages contain a scoring and bid adjustment system that you may find useful in making decisions about your patrol vehicle tires.

All the data used in the example are fictitious. Likewise, the category weights used are arbitrary. They should be adjusted to represent the actual conditions your agency faces and those factors important to you. The category weights should total 100. The example given is biased toward a dry climate, in which one may encounter wet roads infrequently. It could as easily have been biased toward wet road conditions, as might be encountered in the Pacific Northwest.

Scoring/Bid Adjustment Methodology

Step I—Raw Scores

Raw scores are developed, through testing, for each tire in each of the eight evaluation categories. The raw scores are expressed in terms of percentage of lateral G's, speed in mph, stopping distance in feet, time, or remaining tread depth.

Static circle -dry- (lateral "G")	Static circle -wet- (lateral "G")	Serpentine -dry- (speed)	Serpentine -wet- (speed)	Stopping distance -dry- (feet)	Stopping distance -wet- (feet)	High-speed handling (sec.)	Remaining tread depth (%)
0.763	0.702	63.92	34.12	151.64	159.44	91.724	0.982

Step II—Deviation Factor

In each evaluation category, the best tire's score establishes the benchmark against which each of the other test tire's score is compared. In the static circle and serpentine tests and the tire wear measurement section the highest score is best, whereas the lowest score is best in the stopping distance and high-speed handling tests. The best scoring tire in each test category receives a "deviation factor" of 0. The deviation factor is then calculated for the other tires by determining the absolute difference between each tire's raw score and the best score in the category. This difference is then divided by the best score, resulting in the "deviation factor."

Tire make and model	Serpentine -dry-
Tire A	63.92 0.021
Tire B	64.88 0.006
Tire C	65.26 0

Example:

Best score (Tire C)		Other tire score (Tire A)		Absolute difference		Best score		Deviation factor (Tire A)
65.26	–	63.92	=	1.34	÷	65.26	=	0.021

Step III—Weighted Category Score

The weighted category score of each tire is determined by multiplying the deviation factor (as determined in Step II) by the category weight.

Weighted Score	20	
Serpentine -dry- (speed)		
Raw score	63.92	
Deviation factor	0.021	0.021 x 20 = 0.420
Weighted category score	0.420	

Step IV—Total Weighted Score

The total weighted score for each tire is the sum of the eight weighted category scores for that tire.

	15	5	20	5	15	5	30	5	
Tire	Static circle -dry- (lateral "G")	Static circle -wet- (lateral "G")	Serpentine -dry- (speed)	Serpentine -wet- (speed)	Stopping distance -dry- (feet)	Stopping distance -wet- (feet)	High-speed handling (time)	Tread depth worn (%)	Total weighted score
Tire A	0.763	0.702	63.92	34.12	151.64	159.44	91.724	20.47	
	0.023	0	0.021	0	0.039	0.007	0.004	0.125	
	0.345	0	0.420	0	0.585	0.035	0.120	0.625	2.130

Step V—Bid Adjustment Figure

The bid adjustment figure that we chose to use in this example is 6 percent of the lowest bid price received. (This figure is arbitrary and may be adjusted upward or downward.) In this step and the following two steps, the lowest bid price received was $57.50 per tire, which results in a bid adjustment figure of $3.45.

Step VI—Actual Dollar Adjustment

The actual dollar adjustment for a tire is determined by multiplying that tire's total weighted score by the bid adjustment figure.

Total weighted score	x	Bid adjustment figure	=	Actual dollar adjustment
2.130	x	$3.45	=	$7.35

Step VII—Adjusted Bid Price

The actual dollar adjustment amount for each tire is added to that tire's actual bid price. The tire with the adjusted low bid price would be purchased, provided all other bid conditions are met. (The amount paid for the purchased tires is the actual bid price.)

Actual dollar adjustment	+	Actual dollar bid price	=	Adjusted bid price
$7.35	+	$59.95	=	$67.30

Summary of Static Circle Results

The static circle test was conducted under both wet and dry pavement surface conditions. For each condition, a number of combinations were tested using a single driver, two cars, and tires from three manufacturers. Each tire and car combination generated nine data points, each of which represents a lap around the static circle.

The base measurement for each data point is the elapsed time required to navigate one lap around the static circle. Based on the size of the circle and the elapsed time, a determination of lateral "G" force is made. G-force is probably more recognizable to the readers of this report, and as such, this analysis includes basic statistics on this derived measure. However, the statistical analysis used to determine if there are significant differences in the data set was done on the base measurement, elapsed time.

For each combination of car and surface condition an Analysis of Variance (ANOVA) was conducted. This determines if there is a significant difference between populations (tire brands), but not necessarily where it is. T-tests were subsequently run between pairs to determine specific differences. All analyses were done using a 95-percent level of significance.

Dry Static Circle—Chevrolet Caprice

ANOVA showed no significant difference in lateral G-force between the three tires when all are considered simultaneously.

Dry Static Circle—Ford Crown Victoria

ANOVA showed a significant difference in lateral G-force between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—Firestone has significantly higher results.

2. Firestone to Goodyear—No significant difference.

3. General to Goodyear—Goodyear has significantly higher results.

(Firestone and Goodyear were essentially tied for highest; General was lowest.)

Wet Static Circle—Chevrolet Caprice

ANOVA showed a significant difference in lateral G-force between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—General has significantly higher results.

2. Firestone to Goodyear—No significant difference.

3. General to Goodyear—General has significantly higher results.

(General was highest; Firestone and Goodyear were essentially tied.)

Wet Static Circle—Ford Crown Victoria

ANOVA showed a significant difference in lateral G-force between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between the pairs showed the following:

1. Firestone to General—General has marginally but statistically higher results.

2. Firestone to Goodyear—No significant difference.

3. General to Goodyear—No significant difference.

(General was marginally, but significantly, higher than Firestone; however, Firestone and Goodyear were essentially tied, as were General and Goodyear.)

Summary of Serpentine Results

The serpentine tests were conducted under both wet and dry pavement surface conditions. For each pavement surface condition, a number of combinations were tested using a single driver, two cars, and tires from three manufacturers. Each tire and car combination generated 15 data points, each of which represents a run through the serpentine course.

The base measurement for each data point is the elapsed time required to navigate one trip through the serpentine course. Based on the length of the course and the elapsed time, a determination of "miles-per-hour (mph)" is made. Mph is probably more recognizable to the readers of this report, and as such, this analysis includes basic statistics on this derived measure. However, the statistical analysis used to determine if there are significant differences in the data set was done on the base measurement, elapsed time.

For each combination of car and surface condition an ANOVA was conducted. This determines if there is a significant difference between populations (tire brands), but not necessarily where it is. T-tests were subsequently run between pairs to determine specific differences. All analyses were done using a 95-percent level of significance.

Dry Serpentine—Chevrolet Caprice

ANOVA showed a significant difference in serpentine speed between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—Firestone was significantly faster.

2. Firestone to Goodyear—Firestone was significantly faster.

3. General to Goodyear—No significant difference.

(Firestone was fastest; General and Goodyear essentially tied.)

Dry Serpentine—Ford Crown Victoria

ANOVA showed a significant difference in serpentine speed between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—No significant difference.

2. Firestone to Goodyear—Firestone was significantly faster.

3. General to Goodyear—General was significantly faster.

(Firestone and General were essentially tied for fastest; Goodyear was slowest.)

Wet Serpentine—Chevrolet Caprice

ANOVA showed a significant difference in serpentine speed between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between the pairs showed the following:

1. Firestone to General—Firestone was significantly faster.

2. Firestone to Goodyear—Firestone was significantly faster.

3. General to Goodyear—No significant difference.

(Firestone was fastest; General and Goodyear essentially tied.)

Wet Serpentine—Ford Crown Victoria

ANOVA showed a significant difference in serpentine speed between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between the pairs showed the following:

1. Firestone to General—Firestone was significantly faster.

2. Firestone to Goodyear—No significant difference.

3. General to Goodyear—Goodyear was significantly faster.

(Firestone and Goodyear were essentially tied for fastest; General was slowest.)

Summary of Stopping Distance Results

The stopping distance tests were conducted under both wet and dry pavement surface conditions. For each pavement surface condition, a number of combinations were tested using a single driver, two cars, and tires from three manufacturers. Each tire and car combination generated six data points each of which represents maximum braking from target speeds of 60 mph (dry) and 45 mph (wet).

The base measurement for each data point is the average rate of deceleration during the stop. The stopping distance is also recorded, however, this measure is affected not only by braking performance but also by the actual speed at the start of the test. This additional variability makes braking distance a poor measure for analysis. As such, only deceleration rate was considered in this analysis.

For each combination of car and surface condition an ANOVA was conducted. This determines if there is a significant difference between populations (tire brands), but not necessarily where it is. T-tests were subsequently run between pairs to determine specific differences. All analyses were done using a 95-percent level of significance.

Dry Stopping Distance—Chevrolet Caprice

ANOVA showed a significant difference in average deceleration rate between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between the pairs showed the following:

1. Firestone to General—Firestone had a significantly higher average deceleration rate.

2. Firestone to Goodyear—Firestone had a significantly higher average deceleration rate.

3. General to Goodyear—No significant difference.

(Firestone was highest; General and Goodyear tied for lowest.)

Dry Stopping Distance—Ford Crown Victoria

ANOVA showed a significant difference in average deceleration rate between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—Firestone had a significantly higher average deceleration rate.

2. Firestone to Goodyear—Firestone had a significantly higher average deceleration rate.

3. General to Goodyear—No significant difference.

(Firestone was highest; General and Goodyear tied for lowest.)

Wet Stopping Distance—Chevrolet Caprice

ANOVA showed a significant difference in average deceleration rate between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—General had significantly higher average deceleration rate.

2. Firestone to Goodyear—Goodyear had significantly higher average deceleration rate.

3. General to Goodyear—General had significantly higher average deceleration rate.

(General was highest; Goodyear was next; Firestone was lowest.)

Wet Stopping Distance—Ford Crown Victoria

ANOVA showed a significant difference in average deceleration rate between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—General had significantly higher average deceleration rate.

2. Firestone to Goodyear—Goodyear had significantly higher average deceleration rate.

3. General to Goodyear—General had significantly higher average deceleration rate.

(General was highest; Goodyear was next; Firestone was lowest.)

Summary of High-Speed Handling Tests

The high-speed handling test was conducted only under dry pavement conditions. Unfortunately, only the Chevrolet was able to complete this test due to a disabling accident with the Ford. The measure used for this test was elapsed time per lap of the course. Three drivers participated in this testing. Each drove the course for 4 timed laps with each of the three tires. The analysis is based on the three best runs for each driver and each tire. As such, a total of 27 runs were analyzed.

There is considerable variation introduced in the raw data set as a result of differences between the drivers. This was mathematically eliminated by subtracting the per-run elapsed time for the slower drivers from the equivalent per-run time for the fastest driver (VanDenBerg). The deviations were averaged across all runs, and those averages were subtracted from the slower drivers' times. This weighting effectively removed the "driver effect."

An ANOVA was conducted on the data set. This determines if there is a significant difference between populations (tire brands), but not necessarily where it is. T-tests were subsequently run between pairs to determine specific differences. All analyses were done using a 95-percent level of significance.

High-Speed Handling—Chevrolet Caprice

ANOVA showed a significant difference in average lap time between the tires at the 90-percent confidence level when all three are considered simultaneously.

T-tests between pairs showed the following:

1. Firestone to General—Firestone was significantly faster.

2. Firestone to Goodyear—No significant difference.

3. General to Goodyear—Goodyear was significantly faster.

(Firestone and Goodyear were essentially tied for fastest; General was slowest.)

High-Speed Handling—Ford Crown Victoria

As previously indicated, due to damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete this portion of the evaluation.

Summary of the Tire Wear Measurement Results

Tire wear was assessed by measuring groove depth in the tread. The right front tire of the test set from each tire manufacturer and for each of the two vehicles was measured in 16 locations; 4 positions radially, and 4 positions across the tire, (4 tread grooves). The measurements were in .001 inch and were taken as follows:

1. Before any testing, but after a specific break-in routine.
2. After all testing except the high-speed handling portion.
3. After the high-speed handling test.

Because the initial groove depths across the tire vary as a result of tire design, it was decided to "normalize" the wear by transforming the data set to "percent wear" at each measurement point. In this way, the distorting variation related to initial groove depth is eliminated and only the effect of wear remains.

The actual data analyzed were the percent wear after all testing except high-speed handling, and total percent wear after all testing was complete. (Because the Ford Crown Victoria was unable to complete the high-speed handling test, only the pre-high-speed handling wear was analyzed for the Ford in this portion.)

An ANOVA was conducted on the data set. This determines if there is a significant difference between populations (tire brands), but not necessarily where it is. T-tests were subsequently run between pairs to determine specific differences. Because the groove positions were related, the T-test was done as a conservative "related pairs" test which tends to reduce sensitivity. All analyses were done using a 95-percent level of significance.

Before High-Speed Handling Analysis—Chevrolet Caprice

ANOVA showed significant differences in treadwear between the tires at the 95-percent confidence level when all three tires are considered simultaneously.

T-tests between the pairs showed the following:

1. Firestone to General—General showed less wear than Firestone.

2. Firestone to Goodyear—Goodyear showed less wear than Firestone.

3. General to Goodyear—No significant difference.

(General and Goodyear were essentially tied and showed the least wear; Firestone had the most wear.)

Before High-Speed Handling Analysis—Ford Crown Victoria

ANOVA showed significant differences in treadwear between the tires at the 95-percent confidence level when all three tires are considered simultaneously.

T-tests between the pairs showed the following:

1. Firestone to General—General showed less wear than Firestone.

2. Firestone to Goodyear—Goodyear showed less wear than Firestone.

3. General to Goodyear—No significant difference.

(General and Goodyear were essentially tied and showed the least wear; Firestone had the most wear.)

After High-Speed Handling (Road Course)

In general, the high-speed handling (road course) test generated more uniform wear across the tire than was experienced before the high-speed handling portion of the test. This outcome was to be expected since the high-speed handling test is more balanced and less tire-wear biased than the other tests. This also gave a good general understanding of the durability of all of the test tires in high-speed pursuit type driving.

After High-Speed Handling—Chevrolet Caprice

ANOVA showed significant differences in the percentage of tread wear between the tires at the 95-percent confidence level when all three are considered simultaneously.

T-tests between the pairs showed the following:

1. Firestone to General—General showed less overall wear than Firestone.

2. Firestone to Goodyear—Goodyear showed less overall wear than Firestone.

3. General to Goodyear—Goodyear showed less overall wear than General.

(Goodyear showed the least wear; General was next; Firestone had the most wear.)

After High-Speed Handling—Ford Crown Victoria

As previously indicated, due to damage sustained in a vehicle accident, the Ford Crown Victoria was unable to complete the high-speed handling portion of the evaluation, and consequently, no treadwear data are available for the Ford on this portion of the test.

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