314 N.J.Super. 211

714 A.2d 370

In the MATTER OF the ADMISSIBILITY OF MOTOR VEHICLE SPEED

READINGS PRODUCED BY the LTI MARKSMAN 20-20 LASER

SPEED DETECTION SYSTEM.

Superior Court of New Jersey,

Law Division

(Criminal),

Morris County.

Decided June 13, 1996.

[714 A.2d 371]

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Michael M. Rubbinaccio, Butler, for the State.

Alfred V. Gellene, Steven K. Greene, Denville, Joseph T. Maccarone, Lodi and Sohail Mohammed, Clifton, for various defendants.

STANTON, A.J.S.C.

This proceeding involves the reliability of a device known as the LTI Marksman 20-20 Laser Speed Detection System manufactured by Laser Technology, Inc. For ease of expression, I shall hereafter usually refer to this device as the "laser speed detector" or the "detector". The New Jersey State Police have recently purchased 23 of the detectors and have begun to deploy them in their motor vehicle law enforcement operations. More particularly, a number of the detectors have been used along Interstate Route 80 in the Township of Rockaway and in the Township of Parsippany-Troy Hills in Morris County and numerous speeding tickets have been issued based upon readings produced by the detectors.

Because the laser speed detector has only recently been put into use in New Jersey, its reliability in establishing the speed of a motor vehicle has not been adjudicated in any New Jersey court. A number of defendants in speeding violation cases pending in the Municipal Court of Rockaway Township and in the Municipal Court of Parsippany-Troy Hills Township have filed motions challenging the admissibility of speed readings produced by the

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detector. Approximately 30 pending municipal court cases are affected by those motions. In an effort to avoid numerous separate evidentiary hearings in the municipal courts and in an effort to obtain a comprehensive ruling that would bind a large number of municipal courts, various defense attorneys and Michael M. Rubbinaccio, who is the municipal prosecutor for both Rockaway Township and Parsippany-Troy Hills Township, have requested the Law Division of the Superior Court for Morris County to conduct a comprehensive evidentiary hearing including all of the evidentiary motions presently pending in the two municipal courts. I agreed to conduct such an evidentiary hearing in the Superior Court. Because of the potentially widespread implications of any ruling which might be made, the Attorney General of New Jersey was invited to participate in the hearing. The Attorney General decided not to participate formally in the hearing, apparently because she was satisfied that Mr. Rubbinaccio would adequately represent the interest of the State in the proceeding, but her office has given significant informal assistance to Mr. Rubbinaccio, as have the State Police. I conducted an extensive evidentiary hearing on five court days from May 20 to June 4, 1996. On June 5, with the consent of all counsel, I went with State Police Sergeant Robert Ricker to a site on Interstate Route 287 south of Morristown and observed him while he operated the laser speed detector. I also spent some time operating the detector myself.

The laser speed detector is a compact, hand-held device which is covered by United States Patent Number 5,359,404. The patent gives the following summary of the invention embodied in the laser speed detector:

The invention comprises a laser speed detector comprising a laser rangefinder, a sighting scope for a user to visually select a target with an operably-disposed trigger for triggering operation of the detector upon the selected target, and a microprocessor-based microcontroller which is controllingly and communicatively interconnected to the laser rangefinder. In a highly preferred embodiment, the instrument is small enough to be easily hand-held.

The laser rangefinder, under the supervision of the controller, fires a series of laser pulses at a selected remote target at [714 A.2d 372] known time intervals, and detects reflected laser light from each pulse. Preferably, the pulses are fired at equally-spaced intervals. The laser rangefinder further determines count data reflective of the

time-of-flight of each pulse to the target and back, and provides these data to the control means. These count data comprise the respective arrival times of a REF (reference) pulse representing the firing time of the laser pulse, and an RX pulse representing reflected laser pulse light.

The microcontroller is configured to read these count values and to compute from them, the time-of-flight of the laser pulse and in turn, the distance to the target. The controller then computes the velocity of the target relative to the speed detector from the change in distance to the target divided by the known elapsed time between firing of the pulses.

The laser rangefinder has several notable features which provide significant improvement in accuracy and reliability (not necessarily listed in order of importance). First, a crystal clock-based timing analysis circuit including a gating circuit which is a digital logic, edge-sensitive gate for which both the "opening" and the "closing" of the time window can be selectably set by the microcontroller. In a preferred embodiment, the microcontroller is configured to alternately widen and narrow the window to selectively lock on "true" RX pulses and exclude pulses due to noise or other factors.

Second, the timing analysis circuitry is constructed to generate self-calibration pulses and to process them in the same manner as the REF and RX pulses, thereby producing a set of calibration interpolation counts. The controller uses these calibration interpolation counts along with the REF and RX interpolation counts to compute self-calibrated values of the respective fractional portions of the clock periods at which the REF and RX pulses arrived. The self-calibration pulses comprise a pair of pulses, referred to for simplicity as TMIN and TMAX, which differ by a known integral number of clock periods (with neither TMIN nor TMAX being zero). Together, TMAX and TMAX define an expanded interpolation interval within which the fractional portions of the RX and REF arrival times are interpolated. This self-calibrating interpolation provides greatly enhanced resolution and accuracy of distance measurements based on elapsed time.

Third, the laser rangefinder has a first collimator which directs a major portion of an outgoing laser pulse toward the selected target, and a second collimator which redirects a minor portion of the laser pulse to produce a timing reference signal. In one embodiment, the minor portion of the laser pulse is sent to a second light detector separate from a first light detector (here embodied as a silicon avalanche photodiode detector or "APD") which focusses and receives reflected laser light. Alternatively, the minor portion of the laser pulse is sent to the same detector which detects the returned laser light.

Dr. Daniel Y. Gezari, an astro-physicist who has been employed at the National Aeronautics and Space Administration Space Flight Center for the past 18 years, testified with respect to the general scientific concepts involved in the use of lasers to measure distance and, derivatively, speed. Lasers have been used as a standard tool for the measurement of distances by astro-physicists and other space scientists for a number of years. Mr. Jeremy

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Dunne, a vice president of Laser Technology, Inc. and the designer and inventor of the laser speed detector in question, testified extensively about the scientific concepts involved and about the design and practical operation of the detector. New Jersey State Police Sergeant Robert Ricker, testified about the training of State Police officers in the use of the laser speed detector and about the experience which he and other officers have had with the detector in the field. Mr. Walter Smith, an employee of the Office of the New Jersey State Superintendent of Weights and Measures testified about testing of the laser speed detector which had been done by his agency. Mr. Bryan Traynor, an official of the National Highway Traffic and Safety Administration, an agency of the United States Department of Transportation, testified [714 A.2d 373] about testing of the laser speed detector which had been done under the auspices of his agency.

A laser is an artificially generated and amplified light which is in the infrared light section of the electromagnetic wave spectrum. It is not visible to the naked eye. It is very concentrated. The laser speed detector fires a series of laser pulses at a selected remote target. When the laser light strikes the target, a portion of the light is reflected back to the detector. Since the speed of light is a known constant, by measuring the time which it takes for the laser pulse to travel to the target and back, the detector is able to calculate the distance between the detector and the target. Each laser pulse which is fired and reflected back establishes one distance reading. The laser speed detector fires 43 laser pulses every time the trigger on the detector is squeezed. These 43 pulses are fired in a total period of approximately one-third of a second. If the target at which the laser pulses are fired is a stationary target, each of the 43 pulses will give the same distance reading to the target, and distance will be the only thing that the detector can tell us about the target. However, if the target is moving, each of the 43 pulses will give a slightly different distance reading and the detector can then compute the velocity or speed of the target from the changes in distance divided by the known elapsed time between the firing of each of the laser pulses. In

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simplest terms, this is the basic theory underlying the use of lasers to calculate speed, and there can be no dispute about its fundamental validity.

There are, however, both conceptual and practical problems which have to be overcome in designing and constructing a reliable laser speed detector. The detector works by measuring the time it takes a laser pulse which it transmits to go out to a target and come back. However, there are many other pulses in the environment of the detector which can interact upon it, and the detector must be programmed to distinguish between those "false" pulses and the "true" pulses which it has transmitted.

As mentioned above, the laser is very concentrated and has a characteristically narrow beam. At a point 1,000 feet away from the detector, a laser beam is about three to three and one-half feet wide and has a height of about three feet. This may be contrasted with the beam of radar which is about 320 feet wide at a point 1,000 feet away from the radar transmitter. Although the laser beam is much more concentrated than the radar beam, it is far from being a true pinpoint. As the three by three and one-half foot laser beam strikes the very irregular surface of a moving motor vehicle, it does not hit a single, highly-reflective point on the vehicle. In effect, it splashes over a portion of the vehicle. This is true even though operators are trained to fire at the front license plate area of the vehicle, because the beam is considerably larger than the license plate. Indeed, depending upon the angle at which the beam hits a vehicle, and depending upon the vehicle's location with respect to other vehicles on the highway, particularly a multi-lane highway, it is conceivable that a portion of the beam splashes onto another vehicle. For reasons which will become apparent when I discuss possible sweep error, there is a sense in which it is important for the detector to be programmed so that it can distinguish the point on a vehicle from which the return impulse is coming.

It is important for the laser detection device to measure distances between it and a motor vehicle at the same point on the

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motor vehicle. In traffic law enforcement, the ultimate use of the detector is to fix the speed of a vehicle. However, the primary measurement made by the detector is distance. (In this respect, the detector contrasts with the Doppler radar units employed in police work. The Doppler radar units compute speed from differences in frequency between microwaves. For them, distance is not significant.) This distinction is important, because, although the entire vehicle travels at the same speed, not every point on the vehicle is the same distance away from the detector. A vehicle traveling along a highway at 60 miles per hour travels 88 feet in a second. In the one-third second which elapses while the laser speed detector is firing 43 pulses at the vehicle, the vehicle will travel 29.33 feet. If the laser pulses being fired by the detector were allowed to sweep [714 A.2d 374] from the front grille of the vehicle to the windshield of the vehicle during the one-third of the second the pulses were being fired, the pulses reflecting back from the windshield would be four feet farther away than the pulses reflecting back from the front grille. Unless the detector has an appropriate error trapping program built into it, the detector would conclude that the vehicle traveled 33.33 feet instead of the 29.33 feet which it actually traveled, and the detector would show the speed of the vehicle as being 68 miles per hour instead of the correct 60 miles per hour. This would be what is known as "sweep" error. If the detector were allowed to sweep for ten feet along a vehicle, that would lead to about 20 miles per hour being erroneously added to the calculation of the vehicle's speed. If the detector were allowed somehow to pan from one vehicle to another vehicle in a way which would lead to a distance differential of 30 feet, that would convert to a speed reading 60 miles per hour too high.

The inventor of the laser speed detector is clearly aware of many of the conceptual and practical problems involved and has designed computer programs and hardware mechanisms designed to trap a variety of errors. The State's expert, Dr. Gezari, submitted a report which had this to say on the subject of error trapping:

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One of the basic operating features of the LTI 20-20 is an error trapping algorithm which tests the integrity of the received data. Thirty to forty data pulses received must have the correct pulse shape, rise time, duration, color and basic time sequence to be considered valid data fit for analysis. If at least thirty received impulses do not fit the criteria the data is rejected and no velocity is calculated. Other criteria are also used by the manufacturer to identify valid pulses having to do with actual vehicle characteristics--acceleration/deceleration parameters, change in target direction, etc. The LTI 20-20 speed gun will display error messages if no velocity is calculated informing the operator as to the reason no answer was given or no velocity was calculated. These error messages do not indicate errors were made; they simply identify the reason that no calculation was made. The error trapping approach used in data analysis further insures that factors such as steadiness of the gun during the measurement, weather conditions, motion of other objects nearby, etc. do not affect the accuracy of the speed reading calculated.

The electrocomputer circuitry of the LTI 20-20 speed gun uses sophisticated techniques including pulse stretching algorithm, statistical data analysis techniques, etc. to provide fully adequate timing accuracy in the generation and detection of laser pulses resulting in typical velocity measurement accuracies of ± 1 mile per hour or better for typical highway speed measurements.

The inventor and designer of the detector, also testified fairly extensively with respect to his efforts to eliminate inconsistent data and to trap error. One of the mathematical techniques to screen out inconsistent and erroneous readings is a procedure called the "average of least squares". That procedure was discussed at some length by Mr. Dunne and by three of the defense experts, and an exhibit setting forth a partial test program for least square speed error was admitted in evidence. The average of least squares is a common procedure which can eliminate inconsistency and error in a variety of applications, but it is only a limited part of the error trapping techniques which are purportedly built into the laser speed detector.

At this point, it is important to note a very significant difficulty. That difficulty lies in the fact that Laser Technology, Inc., the manufacturer of the laser speed detector, is unwilling to disclose the details of the error trapping programs and devices built into the detector on the ground that such information is proprietary information which gives it an important competitive advantage which it should not be required to disclose. The result is that no one outside of the employ of the manufacturer knows the details of

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the error trapping techniques which are being employed in the detector. This means that there is no way for any independent expert to test the adequacy of the procedures or the internal logic of any of the programs being employed.

[714 A.2d 375] I can understand why the manufacturer would be reluctant to disclose its proprietary information to experts retained by defendants, even under a strong and tightly drawn protective order. But, surely, techniques could be developed for disclosure to governmental agencies or to non-governmental independent testing institutions which would protect the manufacturer from any misappropriation of its intellectual property by a competitor. I note that I myself do not have the ability to analyze and evaluate the error trapping techniques involved in the detector, and I myself would not be able to do anything useful with the details of the techniques if they were disclosed to me. However, there are many experts available to government agencies and to non-governmental testing organizations who could effectively evaluate those techniques and tell us whether they appear to be adequate and have good internal logic. Under the total circumstances of this case, I have not thought it appropriate to order disclosure of the proprietary data involved. This leaves the data securely intact in terms of the proprietary interests of the manufacturer, but it also places the manufacturer in the position of losing the probative advantage of having its methodology validated by reliable experts not in the employ of the manufacturer.

Three expert witnesses testified for the defendants. They were Mr. Henry Roberts, a retired electrical engineer, Mr. Jim Coleman, an engineer who works for a defense contractor and has considerable experience with the design of electronic appliances used to measure velocity, and Mr. Paul S. Greenberg, an employee of the National Aeronautics and Space Administration who has considerable experience working with lasers to measure velocity in space applications. Each of these experts testified at considerable length with respect to a variety of conceptual and practical problems which they found with the application of laser technology

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to the measurement of speed in motor vehicles. Unfortunately, none of the defense experts had the advantage of having worked with the laser speed detector involved in our case and none had conducted any testing of this detector.

The State presented documentary evidence and testimony to the effect that the laser speed detector has been approved for use by law enforcement agencies in the United Kingdom, Sweden, Germany and Austria. It has also been approved for use by the Royal Canadian Mounted Police. The detector is being used by state and local law enforcement agencies in a fairly large number of states. In Goldstein v. State of Maryland, 339 Md. 563, 664 A.2d 375 (1995), Maryland's highest court has approved the general concept of admitting laser speed measurements into evidence in judicial proceedings in a case in which the LTI 20-20 Laser Speed Detection System was involved. The Court of Appeals did not reach the issue of the reliability of the particular device.

The State produced a certificate issued by the Office of the New Jersey State Superintendent of Weights and Measures which reads: "This certifies that Laser Speed Detection Instrument Serial Number 008999 has been compared with standards of the State of New Jersey in possession of the State Superintendent of Weights and Measures. The error found in the time base component will result in an error of less than 0.030 MPH at any speed. Agency certified for New Jersey State Police."

The State has also presented a final report issued by the National Highway Traffic Safety Administration of the United States Department of Transportation, issued in February, 1995, establishing "Model Minimum Performance specifications for Lidar Speed Measurement Devices". (The laser speed detector is a lidar speed measurement device.) The Model Minimum Performance Specifications were developed in response to a request for standards made by the International Association of Chiefs of Police. Purportedly, the laser speed detector meets the standards embodied in the Model Minimum Performance Specifications and

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it appears to have been recommended for inclusion on a list of products suitable for purchase by law enforcement agencies.

At first glance, the list of foreign governments which have in some way approved the laser speed detector for use by their law enforcement agencies, the list of states of the [714 A.2d 376] United States which have allowed the detector to be used by law enforcement agencies, the certification issued by the New Jersey Superintendent of Weights and Measures, the issuance of Model Minimum Performance Specifications by the National Highway Traffic Safety Administration and the approval of the general validity of using laser speed measurements in judicial proceedings by the Court of Appeals of Maryland appear to constitute a rather strong endorsement of the validity of the laser speed detector. However, on closer examination, the endorsements appear to be somewhat hollow in terms of using them to make a realistic assessment of the reliability of the detector. A number of American and foreign governmental agencies (or testing organizations working with them) have subjected mechanical components of the laser speed detector to limited testing and there has been some limited testing under conditions not reflective of actual highway circumstances of the detector's ability to measure the speed of a motor vehicle which was actually being driven towards the detector. There was also very limited testing in Colorado by two state police sergeants of the laser speed detector and a similar device made by a competitor under actual highway conditions. The officers tracked the same vehicles with competing laser speed measurement devices and compared the results. Less than 100 vehicles were tracked by the officers. The competing laser speed measurement devices produced results which were roughly consistent with each other, although a few readings were widely inconsistent. The Colorado study is not particularly useful because the actual speeds of the vehicles were not known and they were not measured by any device other than the two competing laser speed measurement devices.

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The certificate issued by the New Jersey State Superintendent of Weights and Measures quoted above on its face seems impressive. On analysis, the certification does not actually say much about the reliability of the detector. The testimony of Mr. Smith during our hearings established that what actually occurred was that the frequency of the time base component of the detector was measured and was found to be as stated. This means that the time base component of the detector is functioning as specified, and, if every other component and program of the detector is functioning as it is supposed to, then there will be no error greater than 0.030 MPH at any speed. The time base component is an important element in the detector. If it were not functioning properly, the results produced by the detector would be unreliable. However, the fact that it is found to be functioning properly does not mean that the results produced by the detector are reliable, unless everything else works as it is supposed to, and no effort was made to test whether everything else did work as it was supposed to. In short, the certification turns out to be a very limited one.

The Model Minimum Performance Specifications issued by the National Highway Safety Administration also end up not being as impressive as they appear to be at first blush. One obvious deficiency is that the speed accuracy test called for by the Specifications does not approach the conditions which exist on real highways. The testing of the speed of actual vehicles contemplated by the Specifications is really testing under closed circuit test track conditions. A tripod is used to hold the device steady and retroreflective areas may be temporarily affixed to the vehicle to increase the amplitude of the laser pulse echoes. The testing procedures involved might be a useful first step in a more comprehensive testing program, but the reality is that vehicles do not travel along our highways one at a time, tripods are not used and retroreflective areas are not attached to vehicles being driven along the highways. The reality is that the shape of motor vehicles is highly irregular and their surfaces reflect pulses off at many angles, with the result that most of the incoming pulse is not

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sent back towards the detector. The challenge is to devise a program for the detector which can capture reliable pulses off the irregular shape of an actual motor vehicle. If the motor vehicle is equipped with a retroreflective area which is affixed to the vehicle for the explicit purpose of making it more likely that a larger part of the incoming pulse will be reflected straight back at the detector, that renders the test largely meaningless in terms of the ability to [714 A.2d 377] recapture and identify pulses reliably from motor vehicles as they are actually driven along our highways. The Model Minimum Performance Specifications also suffer from the serious deficiency that they do not require the manufacturer of the device to disclose the actual error trapping programs and mechanisms contained in its device.

Some of the objections posed by the defense experts, particularly by Mr. Roberts, seem to me to have been somewhat overstated. The defense experts appropriately pointed to many possible errors in the application of laser to the measurement of motor vehicle speed, but they suggested at times that it was almost conceptually impossible for those errors to be overcome. I think it is fairly clear that at least the most egregious errors have probably been eliminated from the laser speed detector. In this regard, it is important to take note of the experience which members of the New Jersey State Police have had with the use of the laser speed detector on our highways.

Sergeant Ricker testified about the classroom training and field training which State Police officers receive before they are certified as being qualified to use the laser speed detector. He also testified about the field practice which they must have with the detector before they are able to issue summonses. He detailed the operational checks which are made on each individual laser speed detector every day by an officer before the unit is used. He also spoke of the experience which he and other members of the State Police have had in the months during which they have been using the detector. I note that Sergeant Ricker's testimony about the training of members of the State Police who use the detector

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satisfies me that the members of the State Police are adequately trained in the use of the detector and that it is not likely that errors will be made in its use because of lack of training or skill in the operator of the individual laser speed detector.

By this time, officers of the State Police operating under normal traffic enforcement conditions have obtained speed readings with the laser speed detector on thousands of motor vehicles. They do not keep comprehensive data with respect to the conditions under which they are obtaining the readings, and they are not simultaneously taking readings on targeted vehicles with other kinds of devices which have previously been found to be reliable. Accordingly, the experience of the State Police does not establish the degree of accuracy of the laser speed detector. However, it seems clear to me that the State Police are getting readings from the detector which are at least broadly sensible. State Police officers who take readings on a target vehicle on an interstate highway where their experience leads them to believe that the flow of traffic is probably moving in the 65 to 75 mile an hour range and where their visual observation leads them to believe that a particular vehicle is probably going around 70 miles an hour are not getting bizarre readings. They are not firing the laser speed detector device at a vehicle which they think is going around 70 miles an hour and getting readings in the range of 40 miles an hour or readings in the range of 95 miles an hour. They are getting readings which are fairly close to where the expect them to be. They are also not encountering many motorists who claim that the speeds being attributed to them are way out of line. This leads me to conclude that the error trapping mechanisms and programs contained in the laser speed detector are eliminating the most serious potential errors.

My own limited experience in observing Sergeant Ricker use the laser speed detector and my own limited experience in using it myself reinforced the view that the error trapping is in fact getting rid of at least the worst errors.

The field view of the operation of the operation of the laser detector which I conducted on June 5 took place on Interstate Route 287 at a location a little south of Morristown. We were located in the center median of the highway and were taking readings on motor vehicles traveling in the three northbound lanes. Sergeant Ricker and I used the same unit in succession. He was able to get a much higher percentage of speed readings from vehicles which he targeted than I was able to get from vehicles which I targeted. I frequently got an error [714 A.2d 378] message from the detector when I targeted a vehicle. As noted in the report of Dr. Gezari quoted above, an error message does not mean that the detector has made an erroneous calculation of speed. It means that the detector does not make a calculation of speed because something has occurred (usually a mistake by the operator) which makes it impossible for the detector to compute the speed correctly. My getting frequent error messages was, of course, highly consistent with the fact that I had had no formal training in the operation of the device and no experience in using it. Also, the particular error messages which I got were consistent with my sense of what was occurring around me. For example, I found it much easier to get a speed reading on vehicles traveling in the left lane of the highway than on vehicles traveling in the center lane or the right lane. The relative ease of getting readings on vehicles in the left lane was what I expected based on the testimony in this case, because I was able to get a much clearer and unobstructed shot on those vehicles, given the fact that I was standing in the center median of the highway. When I did get an error reading on a targeted vehicle in the left lane, it was usually "E03" which indicated poor aiming or panning, and when I got such a message I was frequently conscious of having been unsteady when I depressed the trigger. Although I was successful in getting some speed readings on vehicles in the right lane, I very frequently got error messages when I attempted to target them, and the message was usually "E02" which indicated that another vehicle intruded between me and the targeted vehicle. When I got such an error message, I was usually conscious of

the fact that I had mistimed my depression of the trigger in the sense that I was aware that an intervening vehicle in the center lane or left lane was closely crowding my line of sight to the targeted vehicle. I also notice that the speed readings which I did obtain were consistent with what I expected them to be based on my experience as a motorist and based on what I was observing with respect to the traffic moving in front of me.

In urging me to find that the laser speed detector is a reliable device for measuring the speed of motor vehicles and in urging me to rule that the defendants may be convicted of motor vehicle violations based upon readings produced by the detector, the State points to the various approvals which have been granted to the detector by the agencies and organizations mentioned earlier in this opinion. The State has also pointed to the moderately widespread use of the detector in a number of state and local police departments in this country and in a number of law enforcement agencies in foreign countries. The State also urges me to take notice of the fact that the principle of using lasers to measure speed is broadly accepted as being scientifically sound.

The State has called my attention to cases such as State v. Wojtkowiak, 170 N.J.Super. 44, 405 A.2d 477 (Law Div.1979), reversed, 174 N.J.Super. 460, 416 A.2d 975 (App.Div.1980) (approving use of K-55 Doppler Radar device), and Romano v. Kimmelman, 96 N.J. 66, 474 A.2d 1 (1984). It is argued that there has been wide acceptance of the scientific techniques involved in the laser speed detector and there has been wide approval of the detector itself and that the Court should accept the detector as being a reliable device for measuring speed when used by a properly trained police officer. State v. Wojtkowiak and Romano v. Kimmelman can be read in a way which is broadly supportive of the State's position in the present case, but my view of those cases and others cited in the State's brief is that they do not require me to accept the laser speed detector as being reliable, given the proofs and analysis which have been presented in our present case.

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After considering all of the proofs and the analysis and the argument presented, I am satisfied that the general concept of using lasers to measure speed is widely accepted in the relevant scientific communities and is valid. I am, however, not satisfied that the laser speed detector device is accurate and reliable enough to be used for law enforcement purposes. Accordingly, I will not permit speed readings obtained by the use of the laser speed detector to be used in any of the motor vehicle law violation cases pending in the municipal courts of the Township of Rockaway and the Township of Parsippany-Troy Hills, and I will also order that evidence [714 A.2d 379] based on such speed readings may not be presented in any municipal court in the County of Morris or the County of Sussex at the present time.

I reach the conclusion just stated with considerable reluctance. If the laser speed detector were known to be accurate and reliable, it would, in my judgment, be markedly superior to radar in many situations that exist on the highways, roads and streets of New Jersey. New Jersey is a very densely populated state and its highways, roads and streets are crowded with traffic. Traffic flow along our interstate routes tends to be dense with traffic flow tending to be heavy in all lanes at almost all times. Wide beam radar under those circumstances requires the exercise of considerable skill and judgment by the operator in order to identify a speeding vehicle. The laser speed detector (assuming its accuracy and reliability) can much more readily target an individual vehicle in a heavy traffic flow than can radar. I am also aware of the fact that radar detectors are in very wide use among motorists, particularly among truckers, and they make it possible for chronic and persistent speeders to frustrate detection by radar. I see the laser speed detector as being potentially an extremely useful tool in enforcing speed laws in New Jersey.

My frustration is deepened by the fact that I suspect that the laser speed detector may be accurate and reliable. The problem is that I cannot be reasonably sure that it is accurate and reliable under the proofs and analysis which have been presented in this

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case. As I see it, there are two major obstacles to the acceptance of the laser speed detector as being accurate and reliable at the present time. The first obstacle is that no one other than the manufacturer knows the details of how the error trapping in the detector works. As noted above, the manufacturer has declined to release the details on the ground that this would compromise the confidentiality of proprietary information which is essential to its maintaining its business advantage over competitors. The lack of access to detailed information about error trapping is important because there are many factors which could interfere with an accurate calculation of speed by the laser speed detector. Error trapping programs must comprehensively deal with the wide range of potential sources of error and they must deal with those potential errors pursuant to programs whose inner logic is sound. If no one other than the manufacturer knows the details of the error trapping mechanics and programs, there is no way of evaluating their conceptual validity through intellectual evaluation.

The absence of detailed knowledge about the workings of the error trapping procedures in the laser speed detector is not necessarily an insurmountable obstacle to accepting the detector as being accurate and reliable. Even if we did know all the details of the error trapping procedures and could subject them to thorough intellectual analysis, and even if that analysis showed that they were conceptually sound, we would still need to have adequate performance testing of the laser speed detector under conditions which exist on our highways before we could accept it as reliable. Indeed, if we had adequate operational testing of the laser speed detector under actual highway conditions, we might be able to accept the detector as being reliable even though we did not have complete details about the way in which the error trapping procedures are designed and programmed. Good performance testing might conceivably put us in a position of being sure that the detector in fact worked reliably, although we were not sure precisely how it managed to achieve its results. This leads us to the lack of acceptable performance testing in this case.

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We know that there are many factors which could affect the accuracy of the laser speed reading. There is no way of knowing whether the laser speed detector successfully copes with those problems in the absence of detailed performance tests which deal rather comprehensively with potential error producing factors and which record results in a way which makes it possible for other persons to evaluate the tests and to replicate them.

In principle, it should be relatively easy to design performance tests which would let independent observers know how accurate the laser detector device truly is. The tests [714 A.2d 380] would have to include vehicles of varying sizes and shapes. They would have to be conducted under various conditions of traffic flow along actual highways and roads. They would have to be conducted at different times of the day under varying climatic conditions. They would have to involve target vehicles whose speed was reliably established either by controlling the driver of the vehicle or through simultaneous measurement of its speed by a reliable device other than the laser speed detector. The test data would have to be accurately recorded and reproduced for examination, analysis and replication by other persons and agencies. The factors that I have mentioned are illustrative, not exhaustive. Absent this kind of testing, I do not see how we can have any real confidence that the detector is sufficiently accurate.

I note that the Model Minimum Performance Specifications for Lidar Speed Measurement Devices issued by the National Highway Traffic Safety Administration in February 1995 state that the standard for speed measurement accuracy should be that the device would be within a tolerance of no more than one mile per hour in excess of the true speed and no more than two miles an hour below the true speed. The manufacturer in our case, Laser Technology, Inc., claims that the laser speed detector meets that standard. But there is no way in which we can be sure of that, in my judgment, under the present proofs. I do not think we can even be sure that the device is accurate over a wide range of conditions and with respect to a wide range of vehicles within a

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tolerance of plus or minus five miles per hour. I suspect that the device is probably measuring speed within a tolerance of plus or minus ten miles per hour, or we would be getting much more negative feedback from police officers and from motorists than has thus far been obtained.

The fundamental point is that there is no way of being sure under the present state of the proofs and analysis how accurate the detector is. I point out that a belief that the device is broadly accurate is not sufficient. If I were presented with a reading in a particular case indicating that a motorist was traveling 72 miles an hour in a 55 mile an hour zone, I would feel quite confident that the motorist was exceeding the 55 mile an hour speed limit. I would not feel confident that he was going 72 miles an hour. I would not feel confident that he was going 70 miles an hour. I could probably satisfy myself that he was going at least 65 miles an hour, but I might have some slight reservation about that. Under the laws of our state (and under the laws of many states) the degree to which somebody is exceeding the speed limit is important. The penalties both in terms of fines and points against one's license increase with the increase of speed in excess of the limit. If police officers and municipal court judges do not have a good handle on the range of accuracy of the detector, it becomes difficult to enforce the speeding laws in a way which is predictable, uniform and fair. I do not think it would be necessary to have a range as tight as the plus one mile minus two mile range of the Model Minimum Performance Specifications. Perhaps a range as wide as plus or minus five miles per hour would be sufficient. We do need to know what the range is.

I recognize that courts should not routinely require thorough performance testing of every conceivable device that might be used in the course of law enforcement, or of every conceivable device whose efficacy comes into question in civil litigation. Frequently, common knowledge or the rather conclusory testimony of informed experts might be sufficient. But we are dealing here with a major innovation in law enforcement techniques. We are

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dealing here with something that could readily be tested in ways which would satisfy most reasonable observers that the device was reliable or not. Although I think there should be a number of comprehensive performance testing programs carried out with respect to a device like the laser speed detector, I do not suggest that performance tests need be conducted by every state, much less by every local police department that might want to use the laser speed detector. If adequate tests were conducted by an agency or agencies outside of New Jersey, and if the detailed data with respect to those tests were published and were available for analysis and replication, there is no reason why [714 A.2d 381] New Jersey or any other state or entity would have to conduct repetitious and expensive tests once there had been sufficient testing to establish the reliability of the detector. I note that it probably is fair to expect the manufacturer itself to conduct performance testing and to have detailed data with respect to it. Laser Technology, Inc. has no recorded data.

I realize that courts should be hesitant about rulings which impose costs and burdens on litigants. However, it is important to note that highway safety and the fair and efficient enforcement of motor vehicle laws which are designed to promote highway safety are matters of very great concern and they are matters which involve enormous expenditures every year in this country. In 1994, 40,676 lives were lost on the highways, roads and streets of the United States. I do not know what the exact figures are, but I am sure that in any given year various governmental entities in the United States spend billions of dollars on the enforcement of motor vehicle laws, health insurance companies pay billions of dollars to pay for the injuries received by people in motor vehicle accidents and casualty insurance companies pay billions of dollars for such injuries and for property loss. Surely, a society such as ours can figure out some way to come up with the very modest amount of money which would be involved in subjecting an important device such as the laser speed detector to adequate performance testing.

I think it slightly ironic that at one point during the trial of the present case the State suggested that the defendants were somehow remiss for not having conducted adequate tests on the laser speed detector. That suggestion was made when I asked the prosecutor about the absence of meaningful performance testing by the manufacturer or by some governmental entity or some public interest testing group. The defendants in this case are people who are charged with relatively minor traffic violations which would, if they were found guilty, result in modest fines, points against their licenses, insurance surcharges and, perhaps, in some cases, loss of a motor vehicle driver's license. The defendants, of course, have an interest in this case, but they do not begin to have an economic stake which would justify the kind of expenditures which would be involved, and they do not have the resources of time, talent and personnel to conduct the testing. There should be adequate performance testing, but it would not be reasonable to expect it to come from the defendants or from people broadly situated as they are.

ORDER

For the reasons expressed in the foregoing Opinion, speed readings produced by the LTI Marksman 20-20 Laser Speed Detection System shall not be used in the prosecution of any case arising under the motor vehicle laws now pending in the Municipal Court of the Township of Rockaway or in the Municipal Court of the Township of Parsippany-Troy Hills.

IT IS FURTHER ORDERED that, until further Order of the Superior Court, no municipal court in Morris County and no municipal court in Sussex County shall receive in evidence a speed reading generated by the LTI Marksman 20-20 Laser Speed Detection System in connection with any prosecution arising under the motor vehicle laws.