RADAR OPERATOR

CENTRAL MARIN POLICE EST. 2013

Service to Our Communities

Radar Operator

Version 1

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Acknowledgements

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Chapter 1 - Introduction

Welcome to Radar Operator Training!

Your instructor(s):

Name	Phone	Email

Before class begins, your instructor(s) will familiarize you with the training facility. He/she will discuss the facility rules, break areas and any other pertinent information, so you will be able to get the most of from this training class.

Overview and Course Information

The California Highway Patrol (CHP) continues to refine its program of radar speed enforcement since its inception in the early 1980s. The first CHP radar program began as a joint project with the California Highway Patrol and the city of Orinda, in Contra Costa County. The Orinda project was successful in reducing the 85th percentile speed on participating roadways and has proven radar to be an effective tool in accident reduction. Due to the relatively small scale of the Orinda project; however, limited attention has been drawn to some of the more technical legal aspects of the use of radar for speed enforcement. As CHP participation in the program expanded, more and more public attention was drawn to the use of radar by CHP officers. This resulted in increased media attention, in addition to “special reports,” focusing on the validity of police traffic radar.

It is imperative that the training presented be consistent with guidelines established by the National Highway Traffic Safety Administration (NHTSA) to avoid any future problems with court acceptance of radar evidence in trials in California. Numerous eastern states have experienced difficulty in the past with poor or little operator training and marginal radar equipment. Case law has established minimum training and equipment specifications.

In this course, we will consider those requirements and will provide you with the knowledge necessary to successfully prosecute a traffic radar speeding offense. You will not become experts in the electronic intricacies of radar, but will be made aware of its history, principles, effects, and application. Training will be provided to sharpen your skills in visual speed and distance estimation. We will discuss adverse effects on the accuracy of the radar readings you may obtain and ways to detect effects which could be brought out in trial at a later date. Case law, as it affects your training and use of radar, will be discussed, along with some tips for court testimony. Finally, you will be you will be required to pass a comprehensive final exam.

This Radar Operator course is California Commission on Peace Officer Standards and Training (POST) certified. This workbook is based on National Highway Traffic Safety Administration's (NHTSA) Basic Radar Operator Course. NHTSA's radar operator training curriculum is an accepted standard throughout the country.

This class is twenty-four (24) hours and will cover the following:

- Speed Enforcement
- Radar Technology and Effects
- Equipment Operation and Tactics
- Legal Aspects
- Case Law
- Courtroom Testimony

All questions regarding this workbook should be directed to:

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Chapter 2 - Speed Enforcement

Drivers and Speeding

History

Traffic laws have been an integral part of our society for generations, from a horse and rider to a 400 horse-power Corvette, rules have been in place to keep vehicle occupants and others safe. Speed has probably been the most controversial subject of these traffic laws.

During America's early years, speed limits as low as 5 or 10 miles per hour were in place. As automobiles became more popular and more powerful, the definition of "speeding" took on a whole new meaning.

The mileage death rate has been steadily decreasing year after year. However, this cannot be directly attributed to the public's conformance to traffic laws. Newer automobiles are faster than ever but at the same time they are safer than ever. Modern safety equipment is protecting occupants better than ever before.

Perception and Reaction

Speed affects many different aspects of driving. Perception and reaction time are two extremely critical elements. Driver's capabilities can be easily overwhelmed at high speeds. The faster a driver operates a vehicle, the less control a driver has.

It is accepted that perception time for the average person is approximately .75 seconds. Additionally, the driver must react to the hazard. It takes an additional .75 seconds to react to the hazard. That is 1.5 seconds before driver is able to take any evasive action.

Collisions

Effective speed enforcement is critical to prevent accidents, save lives and reduce injuries.

There was a steady increase in the number of fatalities until 1974, when a sharp drop is apparent. This reduction was due partially to reduced driving mileage, but more directly a result of the 55 mph maximum speed limit. Enacted in 1974, the number of fatalities slowly increased from 1974 to 1979, but so did the average speed of traffic on our highways. These statistics are meant to point out the importance of a vigorous speed enforcement policy.

In 2001, 29% of injury collisions in California were a result of unsafe speed. In relation to fatal collisions, 13% were attributed to speeding. These numbers show that speed enforcement is still a primary concern to traffic law enforcement.

Stopping Distance

As the speed of a vehicle increases, the reaction time distance also increases in direct proportion. The braking distance also increased, but with much greater difference.

At 20 mph it is 20 feet - but at 80 mph (4 times faster) the distance is over 20 times as great, or 410 feet. The speed at which a collision occurs also has a direct bearing on the relative risk of serious injury or fatality. At 60 mph, a collision is twice as likely to result in a fatality as one occurring at 45 mph. From this, it should be apparent that higher speeds will result in a much higher risk of having a collision, and increases the chances of death or injury if a collision does occur.

Effective speed enforcement is critical to prevent collisions, save lives, and reduce injuries. As speeds increase, the risk of having an collision, the severity of collisions, and the number of fatalities increase.

Radar can be an effective tool in this enforcement, and if properly used, will allow the road patrol officer to make more efficient use of his/her time and efforts. Radar enforcement can also be far safer than conventional speed enforcement.

Speed Laws

Basic Speed Law

22350. No person shall drive a vehicle upon a highway at a speed greater than is reasonable or prudent having due regard for weather , visibility, the traffic on, and the surface and width of , the highway, and in no event at a speed which endangers the safety of persons or property.

This section is used for all speed violations except maximum speed violations. It is used for all posted and unsafe speeds.

Maximum Speed Limit

22349. (a) Except as provided in Section 22356, no person may drive a vehicle upon a highway at a speed greater than 65 miles per hour.

(b) Notwithstanding any other provision of law, no person may drive a vehicle upon a two-lane, undivided highway at a speed greater than 55 miles per hour unless that highway, or portion thereof, has been posted for a higher speed by the Department of Transportation or appropriate local agency upon the basis of an engineering and traffic survey. For purposes of this subdivision, the following apply:

(1) A two-lane, undivided highway is a highway with not more than one through lane of travel in each direction.

(2) Passing lanes may not be considered when determining the number of through lanes.

(c) It is the intent of the Legislature that there be reasonable signing on affected two-lane, undivided highways described in subdivision (b) in continuing the 55 miles-per-hour speed limit, including placing signs at county boundaries to the extent possible, and at other appropriate locations.

When enforcing subdivision (b) be sure to pay close attention to the requirements in (1) and (2).

Increase in Maximum Speed Limits to 70 Miles Per Hour

22356. (a) Whenever the Department of Transportation, after consultation with the Department of the California Highway Patrol, determines upon the basis of an engineering and traffic survey on existing highway segments, or upon the basis of appropriate design standards and projected traffic volumes in the case of newly constructed highway segments, that a speed greater than 65 miles per hour would facilitate the orderly movement of vehicular traffic and would be reasonable and safe upon any state highway, or portion thereof, that is otherwise subject to a maximum speed limit of 65 miles per hour, the Department of Transportation, with the approval of the Department of the California Highway Patrol, may declare a higher maximum speed of 70 miles per hour for vehicles not subject to Section 22406, and shall cause appropriate signs to be erected giving notice thereof. The Department of Transportation shall only make a determination under this section that is fully consistent with, and in full compliance with, federal law.

(b) No person shall drive a vehicle upon that highway at a speed greater than 70 miles per hour, as posted.

(c) This section shall become operative on the date specified in subdivision (c) of Section 22366.

Subdivision (b) is the punitive portion of the is section and in order to utilize this section the highway must be posted at 70 MPH.

Maximum Speed for Designated Vehicles

22406. No person may drive any of the following vehicles on a highway at a speed in excess of 55 miles per hour:

(a) A motortruck or truck tractor having three or more axles or any motortruck or truck tractor drawing any other vehicle.

(b) A passenger vehicle or bus drawing any other vehicle.

(c) A schoolbus transporting any school pupil.

(d) A farm labor vehicle when transporting passengers.

(e) A vehicle transporting explosives.

(f) A trailer bus, as defined in Section 636.

Prima Facie Speed Limits

22352. (a) The prima facie limits are as follows and shall be applicable unless changed as authorized in this code and, if so changed, only when signs have been erected giving notice thereof:

(1) Fifteen miles per hour:

(A) When traversing a railway grade crossing, if during the last 100 feet of the approach to the crossing the driver does not have a clear and unobstructed view of the crossing and of any traffic on the railway for a distance of 400 feet in both directions along the railway. This subdivision does not apply in the case of any railway grade crossing where a human flagman is on duty or a clearly visible electrical or mechanical railway crossing signal device is installed but does not then indicate the immediate approach of a railway train or car.

(B) When traversing any intersection of highways if during the last 100 feet of the driver’s approach to the intersection the driver does not have a clear and unobstructed view of the intersection and of any traffic upon all of the highways entering the intersection for a distance of 100 feet along all those highways, except at an intersection protected by stop signs or yield right-of-way signs or controlled by official traffic control signals.

(C) On any alley.

(2) Twenty-five miles per hour:

(A) On any highway other than a state highway, in any business or residence district unless a different speed is determined by local authority under procedures set forth in this code.

(B) When approaching or passing a school building or the grounds thereof, contiguous to a highway and posted with a standard “SCHOOL” warning sign, while children are going to or leaving the school either during school hours or during the noon recess period. The prima facie limit shall also apply when approaching or passing any school grounds which are not separated from the highway by a fence, gate, or other physical barrier while the grounds are in use by children and the highway is posted with a standard “SCHOOL” warning sign. For purposes of this subparagraph, standard “SCHOOL” warning signs may be placed at any distance up to 500 feet away from school grounds.

(C) When passing a senior center or other facility primarily used by senior citizens, contiguous to a street other than a state highway and posted with a standard “SENIOR” warning sign. A local authority is not required to erect any sign pursuant to this paragraph until donations from private sources covering those costs are received and the local agency makes a determination that the proposed signing should be implemented. A local authority may, however, utilize any other funds available to it to pay for the erection of those signs.

(b) This section shall become operative on March 1, 2001.

This section sets speed limits on certain roadways and areas. This is not a punitive section. You still cite 22350 VC for a violation of one of the above speed prima facie limits. These limits are not always posted. Drivers are required to know them.

Be sure to articulate why a less than maximum speed is unsafe.

Where is radar needed?

Some areas to focus would be frequency of traffic accidents, citizen’s complaint areas, and areas know for speed problems.

Just as you would for any type of enforcement keep safety the main concern.

Chapter 3 - Radar Concepts

Radar History

The word radar comes from radio detection and ranging, a device which gained much prominence in World War II as a method of detecting the location, direction, and speed of enemy aircraft and ships.

Due to its history with the military, radar use for traffic law enforcement was well accepted by the traffic courts as virtually unbeatable. However, police radar is no longer accorded the "open and closed" status it once enjoyed. Despite popular belief, most of the allegations made against police radar have been directed toward insufficient training rather than toward the reliability of the instrument. The Doppler Principle, upon which all police radar units operate, is an established physics principle and has received judicial notice from courts nationwide.

The Doppler Principle

In 1842, Christian Johann Doppler, an Austrian physicist, theorized the principle upon which today's police radar is based.

He noted that sound emanating from moving objects seemed to vary in pitch depending on whether the object was moving toward or away from the observer.

The pitch of a locomotive's whistle seemed to be constant if both the locomotive and the listener were standing still. However, he noted that if the locomotive was in motion, the pitch of the whistle was higher as it approached the listener and lower after it passed by the listener.

From this, Doppler theorized that: "When energy is transmitted from a moving object and strikes a stationary receiver, the frequency of the transmitted wave is directly proportional to the closing rate between the signal source and the receiver."

In other words, the speed of the locomotive affected the frequency of the sound waves it generated. This Doppler Shift principle is now well-established as scientific fact and can be applied to other forms of energy, such as light waves and radio waves.

Before the operational aspects of police radar can be understood, a grasp of some fundamental concepts is necessary. There are two basic types of radar in use today - pulse radar and Doppler radar.

The first type, pulse radar, measures direction and distance. This type of radar sends out intermittent radio waves. The time it takes for these radio waves to go out and return determines the distance of an object. Knowing exactly the angle they return, gives direction. Pulse radar is widely used by both military and civilian agencies for locating ships and airplanes.

The second type of radar, Doppler radar, is primarily used by police agencies. Doppler radar sends out a continuous stream of radio waves and measures only speed, not direction or distance. All police radar units in use today incorporate the Doppler Principle in their operation.

The original Doppler Principle has been expanded over the years.

Radio waves transmitted from a stationary patrol car and striking a moving target vehicle will increase in frequency if the target is moving toward the patrol car and will decrease in frequency if the target is moving away from the patrol car. This change upward or downward in frequency is mathematically predictable. If the patrol vehicle as well as the target vehicle are both moving, the difference will reflect the closing rate, or the combined speed, of the two vehicles. As will be explained later, moving radar has the capability of subtracting the patrol car speed from this closing speed of both vehicles to display the speed of the target vehicle.

Radio Waves

Some time must be spent discussing the makeup of radio waves and the interplay of these waves between the patrol car and target vehicle before the principles of radar can really be understood. At this point, however, it should be made clear that the operator is not expected or advised to testify to these scientific principles in court. These explanations are merely meant to increase your knowledge of radar.

Police radar uses high frequency radio waves (including microwaves) that interact between the radar unit and the target vehicle. Radio waves radiate from the antenna, in a continuous series of connected peaks and valleys. The distance from the beginning of a peak to the end of a valley is considered a single wave or one cycle.

Radio waves are present in a variety of frequencies. One cycle per second is referred to as a hertz (Hz). When these cycles become very frequent, they are abbreviated with the following terms:

- KHz (1,000 cps) - AM radio
- MHz (1,000,000 cps) - Extenders, Mobile radios, cordless phones
- GHz (1,000,000,000 cps) - Traffic radar

The number of these individual waves that are transmitted each second constitute the frequency of the radio transmission. All waves have three things in common: wave length, frequency, and speed. The speed of radio waves is constant, and, like light and electricity, travels at 186,000 miles per second. The wave length and frequency of radio waves are inversely proportional to each other in relation to speed. Wave length multiplied by frequency will always be equal to the speed of light. As the wave gets longer, the number of waves each second decreases. As the wave length shortens, the number of waves each second increases. It is this direct mathematical relationship between frequency and wave length that allows police radar to operate.

Radar Waves

Radar waves transmitted from a fixed source and striking a motionless object will reflect back at the same frequency and wave length as those transmitted. There is no motion by the object to produce a Doppler Shift in frequency. If the object is in motion toward or away from the radar source, the Doppler Principle comes into effect. If the object is moving toward the radar source, the reflected waves will be shortened in wave length and, therefore, the frequency will be increased. If the object is moving away, the reflected radar waves will be lengthened and the frequency will decrease. It is this change in frequency, produced by the object's motion or "Doppler Shift," that the radar measures against the original transmitted frequency to arrive at the object's speed.

Traffic Radar

Frequency

Some of today's police radar units operate within the "K" band transmission frequency, which is about 24.150 gigahertz. It is important to note that these frequencies are fixed and do not vary during transmission. Our latest radar unit, the Applied Concepts Stalker Dual, operates on a "Ka" band frequency. Ka-band units may operate at a range of frequencies between 33.4 and 36.0 gigahertz.

Beam Properties

The radar beam transmitted by the antenna is directional in nature and cone shaped in form.

The length of the beam is infinite unless reflected, absorbed, or refracted by some object in its path.

Typical objects from which the beam is reflected include those made of metal, concrete or stone.

The beam is largely absorbed by such substances as grass, dirt, trees, and leaves.

The term refraction refers to the fact that radio waves may pass completely through some substances, but be changed in direction slightly in doing so. Almost all forms of glass and some types of plastic will refract the radar beam.

Side Lobes

If you could look down on a transmitting radar unit from above and could "see" the operational range area of the beam, it would take on the appearance of an elongated cigar. This cigar shape represents that area of beam from which usable reflections back to the antenna can normally be achieved. The range or maximum distance at which a reflected signal can be interpreted by the radar is dependent on the sensitivity of the antenna receiver. Most radar units now in use are capable of receiving reflected signals from targets at a distance in excess of two miles. Located close to the antenna we can see smaller loops. These loops, commonly called "side lobes", are a by-product of the radar antenna and are so reduced in power that they normally do not affect radar operation.

Beam Width

The width of the radar beam is primarily dictated by the type of antenna used. The initial angle of which the radar beam is emitted will determine the beam width. This initial angle may vary from as little as 9 degrees to over 20 degrees, depending upon the manufacturer.

For example, the Stalker Dual transmits a beam at an 12 degree angle. So, at 500 feet from its source is about 105 feet wide. At 1,000 feet, the beam width is almost 210 feet wide. This factor eliminates any possibility that radar is capable of focusing on one particular traffic lane at any significant distance.

It is vital that the operator understand that he/she can not simply point the antenna at a specific target vehicle and be assured of reflecting radio waves from only that vehicle when other vehicles are within the operational range of the radar.

The operator must use other criteria to determine which vehicle the radar is displaying. These criteria will be discussed during the target identification phase of this program. It is also vital to note that the operator is not obligated to know the beam width in feet at any particular distance. It is important for the operator to understand that the beam width at any significant distance is much wider than the roadway he/she is focusing on. In other words, the operator must acknowledge that lane selection capability is virtually nonexistent with current radar units. Reflections and other environmental conditions may cause the unit to display target readings outside the usual indicated angle.

Practice beam width calculations.

Beam Width Calculations

Formula: $X = 2D(\tan \angle 1/2)$

X= Beam Width
D= Distance from the radar device

9º at 110’ = _______

9º at 250’ = _______

9º at 800’ = _______

9º at 1000’ = _______

9º at 1350’ = _______

12º at 50’ = _______

12º at 100’ = _______

12º at 550’ = _______

12º at 1000’ = _______

12º at 3000’ = _______

12º at 5000’ = _______

12º at 750’ = _______

15º at 900’ = _______

15º at 650’ = _______

15º at 775’ = _______

15º at 1500’ = _______

15º at 400’ = _______

15º at 350’ = _______

18º at 75’ = _______

18º at 1750’ = _______

18º at 1050’ = _______

18º at 525’ = _______

18º at 2000’ = _______

18º at 875’ = _______

Beam Energy

By designating a specific beam width, it is not implied that all of the transmitted energy is contained within that beam. Approximately 85 percent of the beam energy is contained within the specifically described cone-shaped beam. The remaining 15 percent is emitted at a much greater angle in the side lobes. This is the reason a vehicle's speed can be displayed from an approach angle far in excess of the prescribed manufacturer's beam width. It should be recognized that the manufacturer sets the beam width angle under ideal, laboratory conditions. However, because of the inferior strength of the signal transmitted outside the main area of the beam, vehicles inside the main portion of the beam will normally be displayed by the radar unit over vehicles outside the main beam.

Operational Range

The operational range of available radar devices on today's market varies from 10 feet to over 6,000 feet. Some of these radar devices are equipped with a range control adjustment which reduces the sensitivity of the receiver portion of the unit, thereby reducing its range. This is accomplished on the Applied Concepts by adjusting the sensitivity (SEn) setting.

Other methods may be employed to reduce the range, such as positioning the unit over the crest of a hill or around a curve. Tilting the antenna unit up or down sharply will have an effect on the range of the signal, but is not a recommended method.

Heavy traffic can be monitored more successfully with the range control in the minimum position.

Waves Per Second

In K-band radar, the Doppler Shift will register 1 mph at 72.023 waves/second; 10 mph - 720 waves/second; and 100 mph - 7200 waves/second. It is obvious that these changes in frequency, produced by a moving vehicle, are very small compared to the original transmitted frequency, which consists of billions of waves per second. Nevertheless, modern radar is sensitive enough to measure these small changes. The process itself is automatic by the radar unit and is updated many times each second. The Department utilizes the Decatur Genesis Handheld radar units. It utilizes K-Band.

Ka-band radar units operate in a frequency ranging from 33.4 to 36.0 gigahertz (GHz). The Doppler Shift for 1 mph will, therefore, also vary. For a Ka-band unit set with a frequency of 33.4 GHz, 1 mph equals a Doppler Shift of 99.61 waves per second. A unit set with a frequency of 36.0 GHz, 1 mph equals 107.36 waves per second. Ka-band Stalker Dual units acquired by the Department have been set at a frequency of 34.7 GHz, so 1 mph equals a Doppler Shift of 103.49 waves per second.

For the purposes of calculating the Doppler Shift, 1 MPH K and Ka band are as follows:

- K band = 72 cps
- Ka band = 104 cps

Practice CPS/Doppler shift calculations.

CPS to MPH Example: 3000 / 72 = 41 MPH

K-Band	Ka-Band
2592 = _______	8112 = _______
6120 = _______	6032 = _______
3960 = _______	11024 = _______
1080 = _______	3224 = _______
3456 = _______	1040 = _______
2016 = _______	2288 = _______

MPH to CPS Example: 100 X 104 = 10400 cps

K-Band	Ka-Band
68 = _______	110 = _______
37 = _______	38 = _______
25 = _______	23 = _______
40 = _______	66 = _______
16 = _______	88 = _______
92 = _______	54 = _______

Stationary Radar

Normally, in order for a radar unit to display a reading, there must be a moving object in the operational target area of the beam. In case of stationary radar, the following examples characterize this process:

Example 1 - A stationary radar beam being transmitted into empty space without an object in its path will continue to infinite without being reflected to the antenna. There will, of course, be no reading.

Example 2 - A stationary radar beam is transmitted down a roadway around which there are a number of large stationary objects, such as parked vehicles, trees, and the roadway itself. As these objects are reflective, a small portion of the original transmission will be bounced back to the antenna. Since none of the objects are moving, the same frequency transmitted will be the frequency returned. Since there is no change in frequency there will be no reading displayed.

Example 3 - When a stationary radar beam is transmitted down the same roadway with a moving vehicle approaching, the following occurs. If the vehicle was approaching at 50 mph, the increase in frequency, due to the Doppler Shift, would be received by the antenna and converted by the counting unit to exhibit the speed of 50 mph.

For example: The transmitted frequency for K-band radar is 24.150 GHz, or 24,150,000,000 cycles per second (CPS). The received signal reflected from a 50 mph vehicle would be 24,150,003,600 CPS. The Doppler Shift frequency would then be 3600 CPS. Thus, 3600 divided by 72 = 50 mph.

The same would apply if the target were moving away from the stationary radar. In that case, however, a decrease in frequency equal to 50 mph would be received by the radar.

The example just described forms the basis on which stationary radar functions.

Moving Radar

The advent of moving radar was dependent upon some means by which the patrol vehicle's speed could be subtracted from the closing speed of both vehicles to display only the target vehicle's speed.

Through new technology, the radar unit was given the capability of receiving and computing two different Doppler Shift signals from the original transmission beam simultaneously (like watching 1 TV show and recording another on your VCR!).

When the patrol car is placed in motion, the radar unit immediately begins receiving a Doppler Shift signal from the stationary terrain in front of the patrol vehicle (approximately 100-150’ in front of patrol car). This strong low frequency shift signal results from the radar unit’s perception of the stationary terrain as moving toward it, rather than it towards the terrain. Normally, this signal is reflected back from the roadway itself. This signal is referred to as the “patrol Doppler”, since it relates to the speed of the patrol vehicle in relation to the ground. The counting unit portion of the radar device is capable of storing and continuously updating the patrol car’s speed several times each second.

The second Doppler Shift signal received by the radar unit results from a moving vehicle entering the radar beam from the opposite direction. This strong, higher frequency shift signal is a product of the closing rate of speeds of the patrol car and the approaching target vehicle.

To determine the speed of the target vehicle, therefore, the radar unit simply subtracts the speed of the patrol car from the closing rate of speed of the two vehicles. The resulting signal is referred to as the “target Doppler”, since it relates to the speed difference between the patrol vehicle and the target vehicle.

The following examples illustrate the mathematics involved (target Doppler - patrol Doppler = computed target speed) when operating in the stationary mode and the moving mode .

Moving radar is simply a further refinement of the principles used in stationary radar. It was once limited, however, in that it could only compute the speed of vehicles approaching from the opposite direction. Modern radar devices such as the Applied Concepts Inc., Stalker Dual, have the capability of determining the speed of vehicles traveling in the same direction as the patrol car.

In same direction method of operation, the radar’s counting unit utilizes the following mathematical computation to determine the speed of the target vehicle: patrol Doppler + target Doppler = computed target speed. Remember that the target Doppler is the speed difference between the patrol car and the target vehicle.

Chapter 4 - Effects

Cosine Effect (Angular Effect)

Doppler radar is designed to measure speed only, not direction. Alignment of the antenna component, other than straight ahead, into the approaching target vehicle's direction of travel, may result in what is referred to as an angular effect. It is also often referred to as the cosine effect, due to its relationship to trigonometry.

The radar unit's perception of a target vehicle's speed may be affected as a result of the relative motion between the target vehicle and the antenna. For complete accuracy, the radar unit requires a "0" degree angle between the approaching target vehicle and the radar antenna. Obviously, this is impractical from a traffic enforcement standpoint, and some slight angle almost always exists. If the target vehicle is not coming directly at the antenna, the radar cannot see all of that vehicle's speed. This angle, created between the target vehicle and antenna, may result in a radar perceived target speed other than the actual. If the angle is small, less than 8-10 degrees, the effect will be negligible. As the angle increases above 10 degrees, the effect of the angle created increases significantly.

Stationary Cosine Effect

In stationary mode this angular or cosine effect will always be in favor of the motorist. The greater the angle, the greater the benefit the motorist will receive in the target reading displayed by the radar. For example, a 50 mph vehicle approaching the radar at a 15 degree angle can result in a displayed speed on the radar of 48 mph.

This stationary angular effect commonly occurs in two different ways. The most common way is also the most recognizable to the operator. The antenna on the patrol car is aligned in a way that it is pointed directly down the adjacent roadway. Well down the road a target vehicle enters the operational area of the radar and a speed reading is displayed. Due to the distance between the radar unit and target vehicle, the angle which exists is very small. The radar perception of the target's speed and its actual speed will be identical. As the target vehicle approaches the radar unit, the angle increases between them. As soon as this angle becomes significant the radar unit will begin to perceive the target's speed as less than actual. The operator may then notice the target vehicle's speed drop several miles per hour on the radar unit before the

The second way in which stationary cosine effect occurs is less recognizable. The radar antenna may be aligned in such a way that an angle is already created between the radar and approaching traffic. The approaching target vehicle will not be displayed by the radar until it is relatively close. By that point, the existing angle of the target in relation to the antenna is already significant and the radar unit may immediately perceive and display a target speed lower than actual. Care must be taken not to align the antenna in a manner which may give away too much speed to approaching vehicles.

Moving Cosine Effect

In moving mode, angular or cosine effect may also bring about a radar displayed speed less than the target's actual speed. The most common example, as in stationary mode, is when an approaching target vehicle gets sufficiently close to the antenna to create a notable angle. The radar may momentarily display a target speed less than actual. This example is more noticeable on expressways where the median is wide enough to create a meaningful angle between the radar antenna and the target vehicle.

A curve in the road is another instance in which moving cosine effect may bring about a reduced radar perception of a target's actual speed. If the target vehicle is approaching the moving patrol unit from around a curve, its relative motion will not be straight at the antenna. In such a case, again, the radar may perceive the target's speed as less than actual.

Both of these examples given in moving mode for the cosine or angular effect can result in radar readings in favor of the motorist only if the radar unit is correctly computing the patrol car's speed.

If the antenna is significantly out of alignment laterally with respect to the direction of travel of the patrol car, then a reverse phenomenon may occur. This situation may not be in the favor of the motorist. The angular effect produced in this case may result in the radar unit perceiving the patrol car's speed as being less than it actually is. The effect of improper antenna alignment is immediate and more significant on the patrol car's speed than on the target's closing speed. When the incorrect low patrol car speed is subtracted from the correct target closing rate, a speed reading in excess of the motorist's true speed can be displayed. It is, therefore, vital that the operator align the radar antenna, as closely as possible, straight ahead into the patrol vehicle's direction of travel. Alignment very close to "0" degrees can be obtained by the operator merely eyeballing the antenna in relation to the patrol vehicle. It should be stressed that, with proper antenna alignment, any angle created by an approaching target vehicle in moving mode will again be in favor of the motorist.

The vertical alignment or "tilt" of the antenna does not normally have the same impact as lateral alignment. However, it is advisable to maintain a straight ahead alignment due to the possibility of increased interference associated with tilting the antenna up or down. It is not recommended to tilt the antenna up or down to control the radar beam's range.

Interference Effects

Allegations have been made that false readings can be displayed by radar. In fact, certain situations can arise which will result in spurious radar readings. A properly trained operator is taught to recognize these readings when present and ignore them. These factors can be characterized in the following manner:

There are a number of situations in which electrical interference and objects in motion, both inside and outside the patrol vehicle, may present a false reading. From inside, the vehicle's two-way radio transmissions, air conditioning unit, and heater fans are the most common causes. Outside the vehicle, high tension power lines and microwave transmission towers are most often alleged to create false readings. Most modern radar equipment will detect radio frequency interference and display a signal or code, such as "RFI."

It is important to stress that the trained operator will ignore these readings when observed because no other supportive evidence for evaluation is present. There is generally no vehicle within the operational area of the radar beam, and therefore, no visual clues on which to base a speed determination. The signal reflected by a bona fide target vehicle in the operational beam will almost always eliminate the much weaker signal produced by interference. Any audio present with an interference will be inconsistent, unlike the clear, coherent tones of a true target signal. Most interferences are momentary and will not exist long enough for a valid tracking history. These interferences are a result of the high degree of sensitivity of today's radar. The interferences are not and cannot be additive to a target vehicle reading. The operator must be cautious to avoid close proximity to areas of known interference. If the radar antenna is operated within the vehicle, proper antenna mounting and alignment will minimize readings caused by fans. Do not aim the antenna at air conditioning or defroster ducts.

Additional Effects.

Batching Effect

The batching effect is a moving radar allegation that the radar is unable to keep up with sudden changes in patrol car speed. The radar perception of the patrol speed may lag behind if the patrol car is suddenly accelerated or decelerated. A sudden acceleration may cause a low patrol speed perception and, therefore, a possible high target reading. A sudden deceleration of the patrol car may cause just the opposite to occur. The radar units presently available are resistant to this effect and will normally blank out with sudden changes in patrol speed. However, the operator must maintain a relatively steady patrol speed while actually in the process of obtaining a target reading to negate any possibility for batching to occur.

Shadow Effect

A shadow effect in moving mode may occur when the radar stops tracking the stationary terrain in front of it to determine the patrol car's speed, and instead, locks onto a large moving vehicle in front of the patrol car. This large vehicle, usually a truck, must be close enough to the radar unit to effectively block off most of the normal radar beam. This strong reflected signal results in the difference in speed between the patrol car and the truck being displayed as the patrol speed. If a target vehicle is approaching at this time, the remainder of the patrol car's speed could be added to the target's speed by the radar. It should be noted that there must be a significant difference in speed between the truck and the patrol car to produce this effect. Current radar units can be made to shadow, but are generally resistant to this effect. To the experienced operator, two inconsistencies are noticeable. First, the target speed displayed will be in excess of the visual estimation of the target as perceived by the operator. Second, when the operator checks the patrol car's speed after the false target reading is obtained, he/she will note that it in no way corresponds to the patrol car's calibrated speedometer. The reading obtained would, of course, be ignored.

Scanning

The scanning effect is generally attributed to hand-held stationary radar units. Allegedly, the rapid sweeping motion of the antenna to another direction will cause the unit to display a spurious reading due to its movement in respect to the stationary terrain about it. Technically, the potential for this effect is doubtful and is difficult to demonstrate. In any event, the rapid swinging of an antenna constitutes improper operation of the unit and shall be avoided.

Feedback (Panning) Effect

The feedback effect, also called the panning effect, is an allegation made against both moving and stationary radar that the operator may pan the antenna unit across the face of the separate readout module. This can cause spurious readings due to an electronic feedback effect. This also constitutes improper operation of the unit and is to be avoided.

Billboard Effect

The billboard effect is a moving radar allegation that a transmitted radar beam can reflect off a large stationary object, return to the patrol vehicle, reflect off the front of the patrol vehicle, reflect again off the stationary object, and return to radar antenna. This will result in a display of approximately the patrol vehicle's own speed. The potential for this effect does exist, but the radar signal at the conclusion of all of these reflections is extremely weak. It should be stressed that any bona fide target vehicle within the operational range of the radar would override this weak signal. In any event, the presence of such a displayed reading would lack the necessary supportive evidence and would be ignored.

Harmonics

Related to the billboard effect is the concept of 'harmonics.' This effect will occur when strong reflections from roadside objects, such as large signs, parked cars, or buildings, cause double bounce reflections which are the same or multiples of the patrol car's speed. These "harmonics" are detected by modern radar units and usually no speed reading will be displayed. Instead, the unit will display a smalll dot on the readout. A strong target signal, or adjusting the patrol car's speed, will eliminate this effect.

The Nichols Effect

The Nichols effect is a moving radar allegation relating to the possibility that the radar's patrol speed signal may be received from roadside stationary objects, such as, guardrails, metal signs, large buildings, and bridge abutments, rather than from the roadway directly in front of the patrol car. Due to the cosine effect, this could result in the radar's perceived patrol speed being displayed as less than actual. A target vehicle approaching could then possibly be displayed at a speed higher than actual. However, if a proper tracking history is followed, including verification of the displayed patrol speed against the calibrated speedometer, possible situations where this effect may arise will be recognized and the target reading ignored.

Beam Reflection

Beam reflection may occur if the antenna is positioned behind a reflective source, such as a mirror. A portion of the radar beam will bounce back, while a portion of the beam continues ahead. Both vehicles in front and behind the antenna may affect the speed reading indicated by the radar unit. This practice constitutes improper operation of the unit and should be avoided.

Weather

Weather conditions, such as rain, snow, fog, etc., could affect the range of the radar unit. It may be necessary to curtail radar operations under such adverse weather conditions.

Recognizing Effects

All of the aforementioned effects will lack the necessary supportive evidence for a valid target reading, e.g., the officer's visual estimation of the target vehicle's speed will not match the radar's displayed reading.

The proper operation of radar requires supportive evidence, obviously not present in these examples. A valid reading will be obtained when: 1) the particular target vehicle is in the operational range of the radar, 2) a significant period of visual and audio tracking of the target vehicle occurs, 3) the patrol car's speed reading on the radar unit is verified against the calibrated patrol car's speedometer, if moving, and 4) the radar reading is consistent with the visual and audio estimation. All of these are necessary elements supporting a valid radar citation. If a complete and proper tracking history exists, it is improbable that any of these factors affecting radar can be present.

Looking at all of the factors which are alleged to affect radar operation, several conclusions can be reached:

1. Many of these factors constitute blatant improper operation of the radar instrument.

2. Some of the factors have no basis in fact.

3. The potential for many of these factors even occurring is minimal when the radar is operated according to proper procedure.

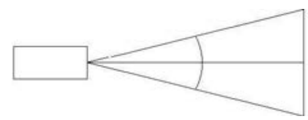
4. Most of the factors have only a momentary effect on the radar unit.

5. All of the factors lack the necessary supportive evidence for a valid target reading.

6. Modern equipment is designed to eliminate some of these effects (e.g., batching).

Mathematical Formulas for Traffic Radar Effects

Beam Width Fonnula



X2D (tan L Yz)

TS -Target Speed

PS -Patrol Speed

CRS -Closing Rate Speed

Cosine Effect (Stationary Mode)

1. true TS (cos L) indicated TS

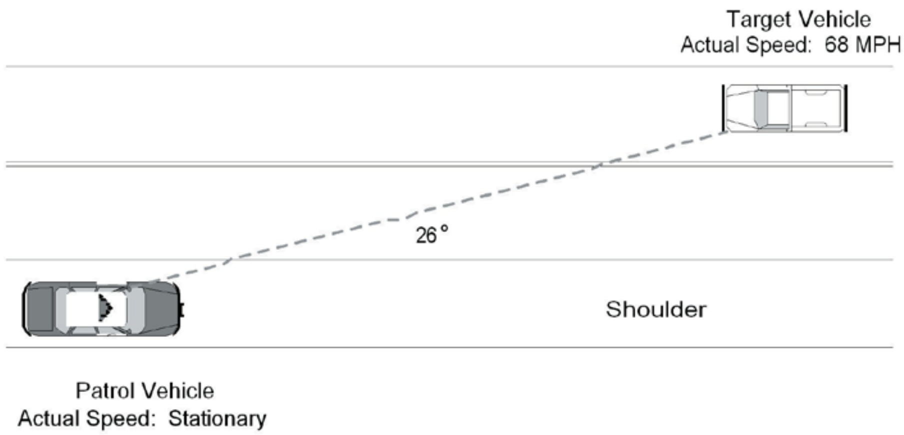
Cosine Effect (Moving Mode), with Shadow and Nichols options

1. true TS (cos L) adjusted TS
2. PS + adjusted TSCRS
3. adjust PS if necessary (Use steps 3a, 3b or both)

3a. Nichols Effect	true PS (cos L) adjusted PS.
3b. Shadow Effect	true PS or adjusted PS (if Nichols was present)-shadow vehicle speedadjusted PS

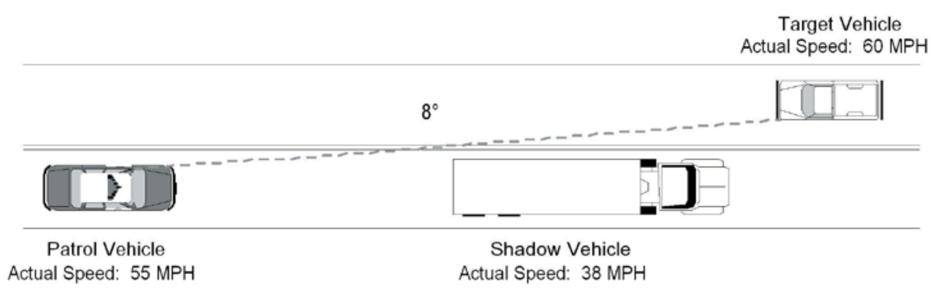
4. CRS -adjusted PSindicated TS

1.



Indicated Target Speed:

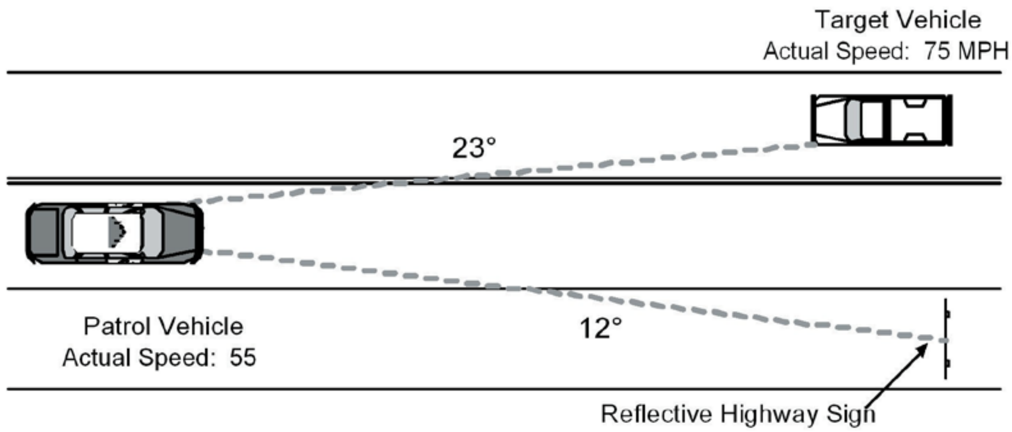
2.



Indicated Target Speed:

Indicated Patrol Speed:

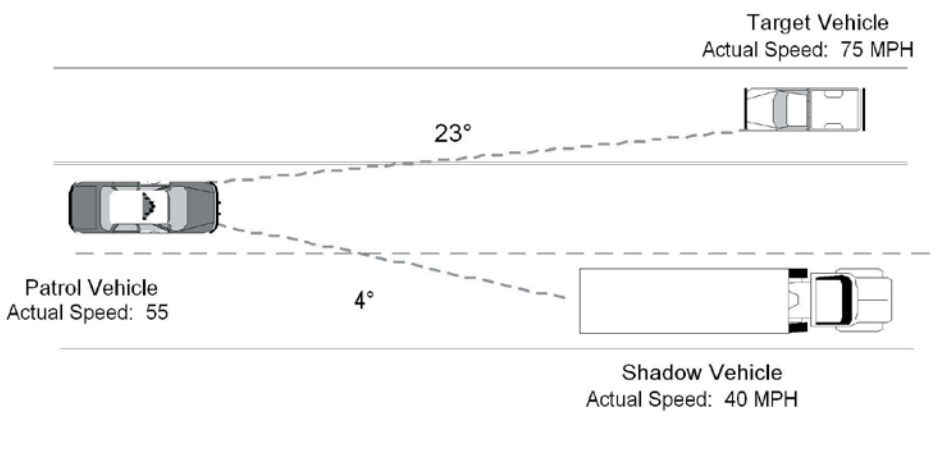
3.



Indicated Target Speed:

Indicated Patrol Speed:

4.



Indicated Target Speed:

Indicated Patrol Speed:

Chapter 5 - Tracking History

Target Tracking History

Now that the theory of radar and possible effects have been covered, it is possible to discuss the actual operational sequences. It is vitally important to stress that the radar reading is only one piece of supportive evidence and not the sole basis for issuing a citation. The radar operator must rely heavily on the visual estimation of a target's excessive speed as a primary element. In addition to the visual element, many radar units are equipped with an audio tone which is an audible representation of the Doppler Shift. With experience, the trained operator becomes adept at estimating the speed of a target vehicle from the audio tone emanating from the radar unit. In addition to the visual estimate made by the officer, this audio tone is important corroborative evidence.

There are a number of supportive elements involved in the valid radar identification of a target vehicle. Together these elements comprise what is referred to as a "Tracking History." The elements are:

a. A target vehicle in the operational area of the radar beam.

b. A visual estimation of the target's excess speed.

c. A Doppler audio estimation of the target's excess speed.

d. A target speed reading on the radar.

Audio Doppler

Audio Doppler pitch plays a vital role in the tracking history of selected targets. CHP specifications for traffic radar devices require that they operate with unfiltered Doppler audio. Unfiltered Doppler tones will allow the operator to detect the relative strength of interferences against the true Doppler reflection of a target vehicle.

It is important to understand that the audio Doppler is not, as widely believed, directly related to the speed of the target, although target speed is a factor. The audio Doppler pitch is, however, always related to the speed difference between the radar antenna and the target vehicle.

These four elements are necessary for both stationary and moving radar. An additional element is present in a moving radar tracking history. This is the verification of the radar displayed patrol speed against the patrol car's calibrated speedometer. The actual sequence in which the elements of the tracking history occur is unimportant. It is vital, however, that all of the necessary elements be present.

If desired, you may lock in a target speed reading, if possible. While no case law exists at this time which states the motorist must be allowed to see a violation reading, it is permitted to allow the motorist to view the radar reading if he/she requests to do so. This would not stop the operator from issuing a citation when the observed target reading was not locked in for some reason.

The necessity for a tracking history that takes place over a significant period of time is to be repeatedly stressed. The usual time has tentatively been identified as a minimum of three to five seconds. This allows the operator the capability of audibly and visually tracking the target vehicle on the radar unit over several seconds.

The following examples represent typical sequences of the elements necessary to establish a valid tracking history for moving radar:

> The radar operator is on patrol on a two-lane roadway. From training and experience he/she is able to discern that an approaching vehicle is entering the operational portion of the 'radar beam.' He/she then hears an audio tone which, through past experience, can be correlated with excessive speed. The vehicle is by then in a position such that he/she can make a visual estimate of its speed. A target reading appears on the display screen of 67 mph. This agrees with the audio and visual estimate of the vehicle's speed by the officer. The radar unit is locked in manually by the operator. The operator then quickly verifies the patrol car speedometer reading with the patrol car speed shown in the radar patrol window. The speedometer and radar patrol readings should correlate closely. At this time, the sequence is complete and the officer can take enforcement action.
>
> In an additional example, the officer observes a vehicle approaching around a curve. While the vehicle is not yet in the radar beam, the officer obtains a visual estimate of the vehicle's apparent excessive speed. The vehicle enters the operational area of the beam and an audio tone consistent with his/her visual estimate of speed is heard. A reading of 63 mph is displayed on

the radar. The officer verifies the speedometer reading against the patrol vehicle speed displayed by the radar unit and then locks in the reading of 63 mph, if desired. Enforcement action may be properly taken with the violator.

The two examples possess the same elements but in different sequences. Additional examples could be cited showing yet different combinations of the elements utilized in a valid tracking history. By necessity, the locking of the radar must occur at the end of the sequence, or just before the speedometer verification element, in order for a proper tracking history to be obtained. Again, it should be noted that the patrol speed verification element is not present in a stationary radar tracking history. Current court decisions indicate that the combination of these elements by a trained radar operator into a valid tracking history is sufficient supportive evidence for prosecution of a radar speeding case.

Lane Selection.

Target identification on a roadway where multiple targets are present is a matter of radar decision and operator interpretation.

Radar is not lane selective. In respect to target selection, the decision making process by the radar unit is affected by three factors; reflective capability, position, and speed. The radar beam may be only a few inches wide at its origin, but several hundred feed wide at its maximum operational range. The antenna receives reflections from any moving objects that are within the beam up to the operational limit. This means that vehicles in different lanes will reflect radio waves as well as vehicles closer to, and farther away from, the radar unit. The radar unit is designed to display the strongest signal from the choice of multiple signals available.

Reflective Capability.

Not all vehicles operating on a roadway are, of course, the same size. The reflective area present on a large truck is greater than that of a smaller passenger vehicle. Consequently, in the case of a large truck in proximity with a passenger car, the truck will probably create the stronger signal even though the passenger vehicle may be positioned in front of the truck. The same reasoning would also hold true in the case of a motorcycle in front of a passenger car.

The shape and physical makeup of a target vehicle will also affect its reflective capability. Low profile streamlined vehicles have less surface area to reflect a radar signal from than vehicles of the same relative size, but not as streamlined.

Vehicles constructed with a large amount of plastic materials or vehicles made of fiber glass will be generally less reflective than those of metal.

Streamlined vehicles, or vehicles made of fiberglass, will reflect a radar signal. However, the distance at which the radar may display a reading for such vehicles will be reduced over other more reflective targets.

The position of the target vehicle in respect to the antenna also plays an important part in the radar decision-making process. The nearer a vehicle is to the antenna, the stronger the signal reflected from it. In other words, the closer a vehicle is, the larger the portion of the conical beam it occupies.

In respect to vehicles of comparable size, the target vehicle closest to the antenna is normally the one displayed by the radar unit.

The speed of a target vehicle is the third possible determining factor which the radar unit will use in selecting a target.

Most radar units used today are signal selective rather than speed selective, and the radar will display the one vehicle among many reflecting the strongest signal. This signal is usually a result of the reflective capability or position of the target vehicle. As will be explained shortly, the speed of a target vehicle may be the determining factor by the radar only in some very specific circumstances.

When multiple targets of unequal size are present, then either reflective capability or position will most often be the determining factor by the radar. It is vital for the operator to understand that position and reflective capability are two completely different factors. With this understanding, the operator will be better able to interpret which is coming into play in multiple target situations.

To illustrate this, an explanation of what actually happens to the radio wave energy after it leaves the antenna is in order.

If a slice of the cone-shaped radar beam could be observed at 250 feet from the antenna, you would find that almost all of the energy originally transmitted is still contained there. However, instead of being contained in a circle of a few inches in diameter as originally transmitted, the energy is now dispersed over a circle approximately 70 feet in diameter. If this distance is now doubled, the original energy would be spread over an area four times as large as at 250 feet. If the distance is again doubled, the energy would be spread over an area four times as large as at 500 feet, but 16 times as large as at 250 feet. It is readily apparent that the farther away from the radar unit a target vehicle is, the lesser the amount of energy available to be reflected back to the antenna. This relationship between available energy and distance is called the inverse square rule and is an established mathematics principle.

To relate this principle to radar target identification of vehicles of unequal size, let's take a look at this example: A full sized passenger vehicle is approaching the radar unit at a distance of 500 feet. The passenger vehicle has a reflective surface of approximately 20 square feet. At 1,000 feet from the antenna a truck is also approaching. The total of its reflection surface amounts to approximately 100 square feet.

At 1,000 feet from the antenna, the truck has four times less energy per square foot to reflect back than the car at 500 feet. However, because the truck has five times as much reflective surface, its reflected signal will probably be stronger. In this example, reflective capability would probably be the determining factor in which vehicle's speed is displayed by the radar.

Now let's advance the position of the vehicle to a point where the car is 250 feet away and the truck is now 750 feet away from the antenna. The car now has four times more radar energy concentrated in each square foot of reflective surface as it did at 500 feet. The truck also has more reflective radar energy at 750 feet than it did at 1,000 feet, but, proportionately has not picked up nearly as much as the car. In this case, the greater surface area of the truck will probably not reflect a stronger signal than the lesser surface area of the passenger car. Therefore, the position of the car in occupying a larger portion of the radar beam would probably be the determining factor by the radar.

Under some specific circumstances, radar units can be speed selective. The most common example would involve multiple target vehicles of comparable size on an expressway. If a passenger vehicle traveling at 50 mph is being overtaken by a similar size vehicle from the rear at a much greater speed, for example, 70 mph, then the faster vehicle's speed may be displayed. This will not occur normally until the faster vehicle is in close proximity to the lead vehicle. This results from the radar's tendency to scan the various signals received from the highest to the lowest. This speed selective factor is much less likely to occur on two-lane roadways. The front vehicle is more likely to block the radar waves from striking the vehicle approaching from the rear.

Operators should be aware that with the radar units currently in use, the individual speed of an approaching target vehicle is not normally the determining factor by the radar in deciding which vehicle to display. Modern radar equipment through the use of Digital Signal Processing (DSP) and intricate computer programs, have the capability of determining the fastest target's reflective signal, even if it is not the strongest signal. In other words, they can determine the speed of a motorcycle passing a large truck. This feature is available in the stationary and the moving, opposite direction modes. The remotes have a "FASTEST" button, which should be depressed when this feature is desired. It should be noted that the Doppler audio tone will continue to be that of the strongest signal.

These examples involving reflective capability, position, and speed are not meant to imply that the operator must attempt to compute the relative size and distance of an approaching vehicle mathematically. However, from these examples, several guidelines on target identification can be drawn.

a. If the approaching target vehicles are all about the same size, the vehicle closest in the radar beam will normally be the one displayed by the radar.

b. If the vehicles are not of the same size and a truck is positioned in front of a car, the truck will normally be the vehicle displayed.

c. If a car is followed by a truck and the truck is as close to the car as the car is to the antenna, then it is probable that the truck will be the one displayed,

d. If a car is followed by a truck and the car is significantly closer to the antenna than to the truck behind it, then the car would normally be displayed by the radar unit.

These guidelines are not absolutes and may not always hold true due to other factors such as vehicle shape and road terrain. These rules do underline the importance of the operator tracking a suspected violator as long as possible before locking the radar in. The closer the target is tracked to the radar unit, the greater the potential for positive target identification by the operator.

The number of possible combinations of these factors of reflective capability, position, and speed are infinite. However, this interpretive process is generally an easy matter for the trained operator. It must be remembered that the radar reading is only one piece of the supportive evidence the operator uses in establishing a speed violation. The operator relies heavily on visual and audio clues which indicate that there is a speeder approaching. The operator's attention focused on a specific vehicle makes it much easier for him/her to determine when that vehicle is being registered on the readout module. Situations will arise where either the radar cannot make a decision, or the operator will be unable to confirm a reading displayed by the radar. This will occur most often in areas with heavy traffic volume. The multiple targets present will limit the operator to interpreting only those vehicles which are easily identifiable, visually and audibly. In heavy traffic, the range of the radar unit should be decreased to concentrate only on closer vehicles. The operator should consider suspending radar operations when there is heavy traffic.

Light or medium traffic obviously is the easiest for the operator to interpret. In any case, whenever the operator is in doubt as to the validity of his/her reading, he/she should not issue a citation.

A 'Tracking History Checklist' has been developed to ensure that all elements of target identification are considered before enforcement action is initiated:

- Visual Observation
- Identify Target
- Estimate Speed
- Confirm Target Range
- Check Environment

- Audio Confirmation
- Pitch
- Clarity

- Radar Verification
- Verify Patrol Speed (Moving mode)
- Stable Reading
- Manually Lock Reading (if desired)

Chapter 6 - Equipment

As a radar operator, it is critical you have a complete understanding of all the equipment you use.

Be prepared to answer questions regarding the equipment. Case law has established you should be able to setup, ***operate*** and test the radar units you use.

Become familiar with the included operator manuals.

Operation

Components

Most modern police radar units are composed of two parts, the antenna and the readout module.

The antenna transmits and receives radio waves. The readout module's primary purpose is to validate and compute the signal received by the antenna. The signal, converted to mph, is then displayed by the readout module to the operator. Hand-held radar units often contain both components within a single device.

The actual assembling of the radar unit for use is a matter of following the manufacturer's guidelines. There is a designated sequence to follow in assembling a radar unit for operation. The most critical factor in assembly is that the antenna be attached to the readout module prior to turning on of the instrument. Failure to attach the antenna first could cause serious damage to the radar unit.

The actual installation of the radar in the patrol car is dictated by the physical configuration of the unit and the patrol car. All but a few of the radar units are provided with brackets which allow both the antenna and readout modules to be securely mounted inside the vehicle.

The primary advantage of inside mounting the antenna is that inclement weather is not a factor in its use. Vandalism and accidental damage are also minimized. The potential for interference which may affect the antenna when mounted inside can be significantly reduced by dash-mounting the antenna as close to the windshield as possible and maintaining proper antenna alignment. Patrol vehicles equipped with passenger side airbags may preclude dash-mounting as an option.

Whichever type of mounting is used, it is recommended that the operator not align the antenna such that it is pointing directly at him/her. The radiation levels for all police radar units have been declared completely safe by the National Institute of Safety and Technology. However, there is no need for an operator to be exposed to even low level radiation when it is unnecessary.

We have already discussed the alignment of the antenna in a straight ahead and level mode. This ensures the greatest level of accuracy.

Verification and Calibration Tests

Modern police radar has a number of verification capabilities available to the operator for checking the accuracy of the unit. Before moving radar can be used for traffic enforcement purposes, four separate system checks must be made.

1. A light segment check.

2. An internal calibration check.

3. A verification by tuning forks.

4. A verification by calibrated speedometer. For radar units operated in the stationary mode, only the first three checks normally apply.

The light segment check of the verification procedure allows the officer to check and ensure that all of the individual segments of each lighted number are working. The failure of any of the segments to light may result in a mistaken reading by the operator and the unit should not be used. Most radar units use a fixed frequency crystal inside the unit for the internal calibration test. This crystal should simulate a predetermined speed in the display windows. This check ensures that the circuitry in the readout module is working properly. The failure of the unit to respond with the correct speed in the display window is grounds for immediate removal of the unit from service. All police radar units employ tuning forks in the verification sequence. Case law over the years has mandated that the use of tuning forks is a reliable means of checking the accuracy of the radar unit. A tuning fork used for verification purposes in police radar is a small, two-pronged metallic instrument. Most forks have serial numbers stamped on them. When struck, the tuning fork oscillates at a fixed rate. The tuning fork is then positioned in front of the radar antenna and the radar unit processes this oscillation as it would a target vehicle. Each tuning fork is stamped with the speed it is meant to simulate.

The tuning fork should be positioned within two inches of the face of the antenna. It is suggested that holding the fork parallel to the face of the antenna with one prong or “tine” exposed is the most efficient method. It is also suggested that the antenna be pointed up to reduce the possibility of spurious readings. When struck, the speed stamped on the tuning fork should appear on the radar display screen.

The accuracy of the tuning fork will vary only slightly with changes in temperature. Here, 1.3 mph over a 160 degree range. For moving radar, two forks are used in the verification process. One of the forks simulates a low speed between 30 and 50 mph. The second fork is a high-speed fork simulating a speed between 60 and 90 mph. Moving radar requires five different steps using two forks. The first two checks are made in stationary mode. The operator verifies the radar unit first with the low-speed fork and then with the high-speed fork.

The correct readings will be displayed in the target vehicle window. The third and fourth checks are made by switching to moving mode and again testing the radar with the forks separately.

The readings will now be displayed in the patrol speed window. The fifth and final check is made in moving mode by first striking the low speed tuning fork and holding it in front of the antenna. This simulates a patrol car speed or “patrol Doppler” in the patrol window.

The second high speed fork is then immediately struck and also held in front of the antenna. This second fork, when presented in conjunction with the first fork, will simulate a target closing speed or “target Doppler”. The speed displayed in the target window at that time should reflect the difference between the high and low-speed forks. This difference represents a simulated moving mode target speed.

Together, these five tuning fork checks constitute a reliable means of checking both the antenna and readout module component. Case law indicates that it is acceptable to obtain a displayed speed within plus or minus one mile per hour of the speed stamped on the tuning fork. However, the tests should be repeated if deviations occur, until the actual designated speeds appear on the readouts. If the operator is unable to obtain the proper readings, the radar unit must not be used. A determination must be then made on whether the radar unit or the tuning forks are defective.

The final verification procedure, verification of the patrol speed readout against the patrol car's calibrated speedometer, is mandated only for moving radar units. This check, referred to as the Doppler reflection test, is superior to the tuning fork test in the identification of off-frequency antennas, or other antenna related problems. Unlike the Doppler reflection test, the tuning fork test only checks the proper operation of the counting unit. Thus, only one antenna on a dual-antenna unit need be tested. Since Ka-band radar units operate among a range of frequencies (33.4 to 36.0 GHz) the antennas and tuning forks must be matched to the specific frequency that the logic control unit is designed to process. Both antennas on a dual-antenna unit must be checked against the patrol car's calibrated speedometer.

The purpose of this check is to establish that the radar unit is properly tracking and displaying the actual patrol car speed. To perform this, the operator places the radar unit in moving mode, accelerates the patrol car to a steady speed, and notes the relationship between the patrol speed readout and the calibrated speedometer. The speeds must correlate closely. If a noticeable deviation exists, the radar unit must not be used. A determination must then be made whether the radar unit or the speedometer is in error.

It should be stressed that failure of the radar unit to properly respond to any one of the required verification tests is grounds for its immediate removal from service. A number of appellate court decisions nationwide have indicated that together these four verification tests are sufficient proof that the moving radar unit was in proper working order prior to the issuance of a citation. The courts also indicate that the successful completion of these tests by the operator at the beginning of his/her shift and again at the end of shift is sufficient, and policy reflects this. It is recommended, however, that the calibration be checked after each citation to eliminate having to void a large quantity of citations if the final check indicates a malfunction.

Chapter 7 - Patrol Techniques and Tactics

Departmental policy guides us through many of our procedures relating to patrol vehicle operations. The following guidelines are not policy and should be discontinued if deemed unsafe or otherwise inappropriate.

Remember-SAFETYisthenumberonepriority.

Patrol Vehicle Positioning

Stationary Operation

When operating radar in stationary mode, most operators position their patrol vehicle on the right shoulder in the same direction as traffic, usually obtain readings on vehicles approaching from the rear. After obtaining a radar reading, they pull out into the lane after the violator passes and conduct the enforcement stop.

When working on a undivided highway, the officer has the option to obtain readings on vehicle travelling in either direction. When attempting to conduct an enforcement stop on a vehicle travelling in the opposite direction, a U-turn will become necessary.

WARNING - Be sure to clear all traffic lanes prior to conducting U-turns across the roadway.

Be aware of the “blind-spots” in your patrol vehicle and adjust your movements accordingly.

Moving Operation

Personnel utilizing radar in the moving mode, operate similarly to stationary mode but with some added benefits and risks.

If you are targeting traffic travelling in the opposite direction, you have two options if other traffic is travelling near your patrol vehicle.

Option 1 - Stay in front of the pack of traffic. The advantage is you have a clear view of nearly all traffic ahead. The disadvantage is when you need to slow suddenly, turn, and proceed in the opposite direction. This can be a hazard to the vehicles travelling behind you. They will need to brake suddenly to avoid your movements.

Option 2 - Stay behind the pack of traffic. The advantage is you have vehicles in front of you to provide “cover.” Additionally, you will no longer have vehicles behind you to worry about. This will allow for safer turns. The disadvantage is you have limited visibility due to traffic in front of you and it may prevent a more thorough visual estimation.

If the patrol car is positioned correctly, the second option may be a safer alternative.

Chapter 8 - Speed Traps, Surveys and Case Law

Departmental Policy- No Current Department Policy

BUT… remember….

Deployment of radar is consistent with the problem.

Use on unauthorized roads is prohibited.

Normal service is also provided.

Conduct the radar unit's light segment check.

Perform the internal circuitry check.

Calibration (tuning fork) check performed at the beginning and end of shift, at a minimum.

Suggested calibration test after each cite.

Complete the Doppler reflection test, that is, ensure that the patrol car's speed reading as indicated on the radar unit matches the speed indicated by the calibrated speedometer. Both antennas of a dual-antenna unit must be checked in this manner.

Used to verify visual estimate of speed.

Paced speed and estimates okay.

Officers should have list of ETS limits

Radar units in need of repair should be immediately removed from service and reported to a supervisor.

All radar units shall be certified by an independent testing laboratory, such as San Diego State University, every 30 months.

Speed Traps

Vehicle and Uniform Used by Officers

40800. Every traffic officer on duty for the exclusive or main purpose of enforcing the provisions of Division 10 or 11 of this code shall wear a full distinctive uniform, and if the officer while so on duty uses a motor vehicle, it must be painted a distinctive color specified by the commissioner. This section does not apply to an officer assigned exclusively to the duty of investigating and securing evidence in reference to anytheft of a vehicle or failure of a person to stop in the event of an accident or violation of Section 23109 or in reference to any felony charge, or to any officer engaged in serving any warrant when the officer is not engaged in patrolling the highways for the purpose of enforcing the traffic laws.

Speed Trap Prohibition

40801. No peace officer or other person shall use a speed trap in arresting, or participating or assisting in the arrest of, any person for any alleged violation of this code nor shall any speed trap be used in securing evidence as to the speed of any vehicle for the purpose of an arrest or prosecution under this code.

Speed Traps

40802. (a) A "speed trap" is either of the following:

(1) A particular section of a highway measured as to distance and with boundaries marked, designated, or otherwise determined in order that the speed of a vehicle may be calculated by securing the time it takes the vehicle to travel the known distance.

(2) A particular section of a highway with a prima facie speed limit that is provided by this code or by local ordinance under

subparagraph (A) of paragraph (2) of subdivision (a) of Section 22352, or established under Section 22354, 22357, 22358, or 22358.3, if that prima facie speed limit is not justified by an engineering and traffic survey conducted within five years prior to the date of the alleged violation, and enforcement of the speed limit involves the use of radar or any other electronic device that measures the speed of moving objects. This paragraph does not apply to a local street, road, or school zone.

(b) (1) For purposes of this section, a local street or road is defined by the latest functional usage and federal-aid system maps submitted to the federal Highway Administration, except that when these maps have not been submitted, or when the street or road is not shown on the maps, a "local street or road" means a street or road that primarily provides access to abutting residential property and meets the following three conditions:

(A) Roadway width of not more than 40 feet.

(B) Not more than one-half of a mile of uninterrupted length. Interruptions shall include official traffic control signals as defined in Section 445.

(C) Not more than one traffic lane in each direction.

(2) For purposes of this section "school zone" means that area approaching or passing a school building or the grounds thereof that is contiguous to a highway and on which is posted a standard "SCHOOL" warning sign, while children are going to or leaving the school either during school hours or during the noon recess period. "School zone" also includes the area approaching or passing any school grounds that are not separated from the highway by a fence, gate, or other physical barrier while the grounds are in use by children if that highway is posted with a standard "SCHOOL" warning sign.

(c) (1) When all of the following criteria are met, paragraph (2) of this subdivision shall be applicable and subdivision (a) shall not be applicable:

(A) When radar is used, the arresting officer has successfully completed a radar operator course of not less than 24 hours on the use of police traffic radar, and the course was approved and certified by the Commission on Peace Officer Standards and Training.

(B) When laser or any other electronic device is used to measure the speed of moving objects, the arresting officer has successfully completed the training required in subparagraph (A) and an additional training course of not less than two hours approved and certified by the Commission on Peace Officer Standards and Training.

(C) (i) The prosecution proved that the arresting officer complied with subparagraphs (A) and (B) and that an engineering and traffic survey has been conducted in accordance with subparagraph (B) of paragraph (2). The prosecution proved that, prior to the officer issuing the notice to appear, the arresting officer established that the radar, laser, or other electronic device conformed to the requirements of subparagraph (D).

(ii) The prosecution proved the speed of the accused was unsafe for the conditions present at the time of alleged violation unless the citation was for a violation of Section 22349, 22356, or 22406.

(D) The radar, laser, or other electronic device used to measure the speed of the accused meets or exceeds the minimal operational standards of the National Traffic Highway Safety Administration, and has been calibrated within the three years prior to the date of the alleged violation by an independent certified laser or radar repair and testing or calibration facility.

(2) A "speed trap" is either of the following:

(A) A particular section of a highway measured as to distance and with boundaries marked, designated, or otherwise determined in order that the speed of a vehicle may be calculated by securing the time it takes the vehicle to travel the known distance.

(B) (i) A particular section of a highway or state highway with a prima facie speed limit that is provided by this code or by local ordinance under subparagraph (A) of paragraph (2) of subdivision (a) of Section 22352, or established under Section 22354, 22357, 22358, or 22358.3, if that prima facie speed limit is not justified by an engineering and traffic survey conducted within one of the following time periods, prior to the date of the alleged violation, and enforcement of the speed limit involves the use of radar or any other electronic device that measures the speed of moving objects:

(I) Except as specified in subclause (II), seven years.

(II) If an engineering and traffic survey was conducted more than seven years prior to the date of the alleged violation, and a registered engineer evaluates the section of the highway and determines that no significant changes in roadway or traffic conditions have occurred, including, but not limited to, changes in adjoining property or land use, roadway width, or traffic volume, 10 years.

(ii) This subparagraph does not apply to a local street, road, or school zone.

The following sections are not included under speed trap laws.

- Local streets and roads - 40802(b) VC
- School zones - 22352(b)(2) VC
- Railroad crossing - 22352(a)(1) VC
- Uncontrolled blind intersections - 22352(a)(2) VC

- ✸ Alley - 22352(a)(3) VC
- ✸ Construction zone - 22362 VC
- ✸ Tunnel or bridge - 22405 VC
- ✸ Trucks on down grades - 22407 VC
- ✸ All absolute/maximum speed limits

Speed Surveys

Speed surveys are required by Section 627 VC. The guidelines are set forth in the Caltrans Manual for Uniform Traffic Control Devices. (2003 Supplement). Some of the guidlines are as follows:

- ✸ Conducted by an independent party
- ✸ Conducted under normal conditions
- ✸ 85th percentile/critical speed defined: That speed at or below which 85 percent of the traffic is moving
- ✸ Usually set prima facie speed at or within five mph below this speed unless factors dictate a lower speed

Case Law

Traffic radar is used primarily by traffic law enforcement officers to acquire evidence. This evidence must be ruled admissible if it is to be useful in court. The basic question concerning the acceptability of traffic radar evidence is as follows:

Are traffic radar results an accurate representation of the actual or true speed of the accused? To answer this question, four specific questions must be asked and answered.

How do we know the Doppler Principle is valid?

How do we know this particular traffic radar instrument was working properly at the time of the alleged violation?

How do we know this particular operator has the necessary qualifications and that proper procedures for this traffic radar speed measurement were followed?

How do we know that this particular speed was that of the accused vehicle?

State vs. Dantonio (New Jersey).

The question of validity of the Doppler Principle has been resolved through judicial notice.

Judicial notice of the Doppler Principle was first accepted in June 1955. (State of New Jersey vs. Dantonio.)

Thus, a traffic radar operator is not required to present evidence to show the validity of the Doppler Principle.

Judicial notice means the court will accept or recognize the existence and truth of certain facts without the production of evidence.

State vs. Tomanelli (Connecticut).

The accuracy of a particular radar instrument is not and should not be resolved through judicial notice.

Courts require evidence.

Courts require an operator to provide evidence that the instrument was working properly at the time of the speed enforcement.

Courts may accept judicial notice of certain methods or procedures for determining whether a particular traffic radar instrument was working properly.

Calibrated Speedometer Check. Courts have accepted the method of driving a test vehicle with a calibrated speedometer through a radar beam at a set speed. If the radar measurement agrees with the test vehicle speed, the instrument will be accepted as working properly.

This method is cumbersome and time consuming. Requires a second person and vehicle.

Requires two persons to attest to the speedometer reading and radar results.
Requires evidence that the test vehicle's speedometer is properly calibrated.

Tuning Fork. Judicial notice of the tuning fork as a reliable method to determine the accuracy of a particular radar instrument was first taken by the Connecticut Supreme Court in State vs. Tomanelli. The court said:

While the tuning fork method is acceptable, the results of the test are only as good as the particular tuning fork used. In short, the court was asking for proof that the tuning fork actually was producing the frequency it was supposed to produced.

To verify this, manufacturers usually certify their tuning forks; by stamping the speed and a serial number on the surface.

Commonwealth of Kentucky vs. Honeycutt

Kentucky Court of Appeals in a landmark case, Honeycutt vs. Commonwealth, 1966, has ruled that a traffic radar operator:

Should be able to properly set up the instrument.

Should be able to properly verify proper calibration and functioning of the instrument.

Should be able to properly read the instrument to obtain the actual speed.

Need not understand the scientific principles on which the unit is based.

Need not be able to explain the internal workings of the radar instrument.

Case of Honeycutt vs. Commonwealth, a traffic radar operator:

Must establish necessary qualifications and training as a traffic radar operator.

Must establish that the instrument was properly setup and working normally.

Must establish that the instrument was accurately verified using a proper method of testing. (External verification, using a tuning fork.)

Should not be required to explain scientific principles in court.

An operator’s knowledge of the Doppler Principle is irrelevant to his/her qualifications as a traffic radar operator.

Proper target identification was also addressed in Honeycutt vs. Commonwealth. The Kentucky Court of Appeals cited conditions under which it can be reasonably assumed that a radar speed measurement applies to a particular vehicle. These conditions are:

The target vehicle must be the closest vehicle to the radar unit.

The target vehicle must be out in front of any other vehicles, and well separated from them.

The officer must have made an initial visual estimation on the vehicle's speed.

The radar speed measurement must reasonably correlate with the initial visual estimation of speed.

People vs. Hanson

The introduction of moving radar brought with it several new legal questions to be answered. People vs. Hanson, a 1978 Wisconsin case, addressed the question of what an officer must be able to testify to so as to establish that the target speed calculated was not based on a too low radar tracking patrol car speed. This Wisconsin case held that an officer must testify that:

He/she has had adequate training and experience in the operation of moving traffic radar.

The moving traffic radar instrument was properly functioning at the time in question and that suggested methods of testing its working condition had been followed.

That the traffic radar instrument was used in an area where road conditions were such that there was a minimum possibility of distortion.

The patrol vehicle's speedometer must be verified to be the same as the radar readout's patrol vehicle speed. This is a critical element which must be established.

The traffic radar instrument was expertly tested within a reasonable proximity following the citation and that such testing was done by means that do not rely on the instrument's own internal calibrations.

The use of tuning forks for external verification of proper calibration is required by policy. The policy calls for the verification at the beginning and end of each shift, at a minimum.

Florida vs. Aguilera (1979).

Judge Nesbitt viewed a television expose on the reliability of radar as an accurate method of speed enforcement. He then placed all radar traffic citations (approximately eighty) in abeyance. The judge found that traffic radar, as it was being used in Dade County, had not been established as reliable. The court did not necessarily say that the instruments themselves were not sufficiently reliable. The court did say that a combination of the complexity of the instruments, coupled with lack of adequate training of the operators, results in unreliability so as to preclude the radar evidence from being received in court.

Florida vs. Aguilera was decided by a district court.

Major criticism was directed at inadequate training.

New Jersey vs. Wojtkowiak (1979).

The Wojtkowiak case supported the contention that the Dade County case was not based upon the unreliability of the radar instruments themselves, but rather on the lack of training of radar operators. However, the New Jersey court concluded that traffic radar evidence is reliable and admissible.

The New Jersey operator had received 80 hours of training.

Court ruled this amount of training is, beyond doubt, sufficient.

People (California) vs. Halopoff (1976).

The court ruled that in prosecuting cases of speeding, it is the duty of the prosecution to inform the defendant, without his/her request, that radar was involved.

The prosecution must also demonstrate the existence of the engineering and traffic survey required by Section 40802(b) CVC.

People (California) vs. Miller (1979).

The court held that radar enforcement may be used for violations of maximum speed limits irrespective of the existence of a traffic and engineering survey.

People (California) vs. Krueger, Pantos, Payne, et al. (1986).

In ruling on a motion to exclude evidence of Doppler radar readings, the court took judicial notice of the scientific reliability of Doppler radar devices the accuracy of Doppler radar when operated in moving mode. The court found the admissibility of radar readings to be dependent on evidence that the radar operator was certified to use the equipment and was cognitive of error (false) readings through an extensive training program.

In a 22-page decision, Sacramento Municipal Court Judge Michael Ullman stated that the courts and the public could be assured that an officer certified under the CHP training program, who utilizes radar in conformity with NHTSA standards, will operate radar error-free and with scientific reliability. In contrast, the lack of an adequate training program for officers of another (local) law enforcement agency caused the court to conclude that there should be a presumption against admissibility of radar readings obtained by these officers, unless the evidence establishes significant experience and knowledge to overcome the lack of training. (Their trainingconsisted of three hours of classroom instruction and six hours of field orientation).

The court also stated that an “automatic lock” feature on radar units should not be used. This feature allowed the operator to set a certain speed into theradar unit. The unit would sound an alarm or buzzer when a vehicle obtained or exceeded the set speed reading. It was determined that thisfeature detracted from the normal visual and audio confirmations required for a valid target tracking history.

The decision also urged State government to adopt Statewide standards for radar equipment and the training of radar operators.

People (California) vs. DiFiore (1987).

The defendant in this case was issued a citation (22350 CVC) for traveling 64 mph in a 40 mph zone. No traffic and engineering survey was introduced. The court found the defendant guilty.

The guilty finding was reversed on appeal. The appellate court ruled that prosecutions under absolute (maximum) speed law do not require a speed survey so long as no evidence of the posted speed limit (less than 55 mph) is introduced. Only evidence regarding the speed over the maximum limit may be presented. In this case the defendant was traveling 64 mph in a 40 mph zone, so only nine mph is an issue, not the full 24 mph.

The court also ruled that the prosecution may amend a citation from 22350 CVC to a maximum speed limit charge when desirable.

People (California) vs. Goulet (1992).

The defendant was found guilty of speeding (52 mph in a 35 mph zone) based on radar enforcement. A current traffic and engineering survey was on file for the roadway in question. The cased was reviewed by the appellate court, which overturned the conviction.

The appellate court found that speed trap laws require the prosecution to establish that the posted limit was justified by a speed survey, except under certain conditions outlined in the Vehicle Code. None of the exceptions applied in this case. Although a current (less than five years old) speed survey was on file, the court found that the survey did not justify the posted 35 mph limit. Their decision was based on:

The 85th percentile critical speed indicated on the traffic and engineering survey was 48 mph.

The posted speed must be established at the first five mile per hour increment below the 85th percentile speed.

An additional five mile per hour reduction may be made if warranted by accident records, prevailing speeds, or conditions not readily apparent to the driver. If this additional speed limit reduction is made, the reason(s) must be documented on the speed zone survey or the accompanying engineering report.

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Chapter 9 - Radar Evidence and Additional Information

Evidence Kits

The following items should be available to an officer called to testify in a radar speeding case. The items mentioned should be contained in an evidence kit for each radar unit in operation. Documentation pertaining to the patrol vehicle will be found in the Motor Transport file at the Area office and may be obtained prior to the court appearance. (Handout)

- Operator certification
- Operator's manual for radar
- Tuning fork certification
- Radar service log

Officer's Notes on Citation

Notes should contain the following;

- Make and model of radar
- Serial number
- Tuning fork number
- Audio. Yes - No. (Should always be on for a valid target tracking history)
- Visual speed estimate and distance observed
- Radar speed
- Other traffic
- When was the unit's calibration tested last? Result?

Courtroom Testimony

Required elements:

The preponderance of the evidence must establish that:

The traffic radar instrument was operating properly.

The instrument's accuracy was verified using an appropriate method - tuning forks.

Checked against a calibrated speedometer.

The operator was properly trained and qualified.

There was a visual observation of the violation and that a speed estimate made based on that observation which was confirmed by the radar unit.

The traffic radar measurement was taken when the area between the radar antenna and the violator's vehicle was not obstructed.

There was an absence of outside interference which could have caused a spurious reading, such as outside electromagnetic sources, vehicle blower fans, or other vehicles within range which could have influenced thereading.

See sample testimony on next page.

Sample Testimony

On (date/time) , I was in full uniform in a marked CMPA patrol vehicle. I was working radar enforcement at (location).

I was using a (radarmodel)(unit#). The unit is affixed to CMPA unit number (platenumber).

I was operating the unit in (stationary/moving) mode at (location) when I observed a (vehicle)(infront/behind) my location an excessive speed. I visually estimated the vehicle's speed to be (speed) at approximately (distance). I then activated the (front/rear) antenna towards the vehicle by pushing the transmit/hold button. I detected a consistent audio Doppler tone which indicated that the target vehicle was within the radar beam and confirmed my visual estimation with a digital display of a speed of (speed). *Addtionally, I confirmed the radar unit's patrol speed readout with the patrol vehicle's calibrated speedometer. The speeds were consistent. *(If moving mode)

Discuss speed limit and/or survey including 85th percentile if necessary.

Stop and Cite

Discuss calibration tests (if applicable):

Beginning and end of shift
Internal test
Tuning fork test
End result: Everything was working properly

Discuss training:

24 POST certified radar course
Recertification process

Detectors and Jammers

Radar detectors are not illegal in California. Most radar detectors are merely receivers of the specific radio frequencies used by police radar equipment. Some states have made the use of radar detectors illegal by statute.

FCC licensing is required for any device which transmits a signal. Since radar "jammers" transmit a strong signal which causes the radar device to malfunction, they are not legal unless a license has been issued by the FCC. It is the opinion of the FCC that radar jammers serve no lawful purpose, so they will not issue a license for their operation. Effective January 1, 1999, Section 28150 V.C. was enacted, prohibiting any person from using, buying, possessing, manufacturing, selling or distributing, and prohibiting any vehicle from being equipped with any device that is designed for or is capable of jamming, scrambling, neutralizing, disabling, or otherwise interfering with radar, laser (LIDAR), or any other electronic device used by a law enforcement agency to measure speed of moving objects. Some radar units have the capability of detecting the signal transmitted by a radar jammer. They will alert the operator to the existence of the device by a signal or code, such as "JAM."

Jamming: Electronic Speed-Measuring Devices

28150. (a) No vehicle shall be equipped with any device that is designed for, or is capable of, jamming, scrambling, neutralizing, disabling, or otherwise interfering with radar, laser, or any other electronic device used by a law enforcement agency to measure the speed of moving objects.

(b) No person shall use, buy, possess, manufacture, sell, or otherwise distribute any device that is designed for jamming, scrambling, neutralizing, disabling, or otherwise interfering with radar, laser, or any other electronic device used by a law enforcement agency to measure the speed of moving objects.

(c) Except as provided in subdivision (d), a violation of subdivision (a) or (b) is an infraction.

(d) When a person possesses four or more devices in violation of subdivision (b), the person is guilty of a misdemeanor.

(e) Notwithstanding any other provision of law, a person who has a valid federal license for operating the devices described in this section may transport one or more of those devices if the license is carried in the vehicle transporting the device at all times when the device is being transported.

Licensing Requirement

In order to legally use traffic radar, an instrument must be properly licensed by the Federal Communications Commission. The Department's license to operate police traffic radar falls within its general FCC license, KA-4993.

FCC licensing is required for any device which transmits a signal.

SPEED AND RANGE DETERMINATION EXERCISE

Name: ____________________________

	Stationary				Moving			
Vehicle #	Speed Estimate	Range Estimate	Actual Speed	Actual Range	Speed Estimate	Range Estimate	Actual Speed	Actual Range
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								