Radar / Lidar Course

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Unit 1

Legal Considerations

Arkansas Statutes

- 12-9-403
  - Establishes the training requirements of an operator.

Arkansas Statutes

- 12-9-404
  - States that any officer not meeting the requirements set forth by statute cannot legally operate a radar unit. If an unqualified operator does take any official action it will be held invalid.

Arkansas Statutes

- Arkansas "Speed Trap Law"
- 12-8-401
- Arkansas State Police are authorized to investigate and determine if a municipality is abusing Police power by:

12-8-401 Cont.

- a. Generating revenue from certain traffic offenses on state highways and that generated revenue exceeds 30% of the municipalities total expenditures (with certain exemptions.)
- More than 50% of the citations issued are for speeds less than 10 MPH over.

CLEST CERTIFICATION

- The Commission established the following radar certification criteria under regulation 1015:
- The operator must have completed an approved course.

CLEST CERTIFICATION

- Full-time, Part-time I, Part-time II and Auxiliary Officers, who have completed the approved training for their level of certification shall be eligible for certification as a Police Traffic Radar Operator.

CLEST CERTIFICATION

- An operator certificate will be issued to the officer after applying for radar certification.
- Radar Operator cards will no longer be issued after 3-1-2016.

CLEST CERTIFICATION

- Any certificates or I.D. cards are the property of the commission and can be recalled.
- The operator certificate, as well as the instructor certificate, is non-expiring unless the officer is separated from law enforcement for more than 3 years.

CLEST CERTIFICATION

- Radar refresher is no longer required.
- The course length for new operators is 8 hours.

Detection Devices

- These devices give advance warning that a Radar is operating in the area.

- Radar detectors are NOT illegal in our state.

Basic Speed Rule 27-51-201

- No person shall operate a vehicle in excess of a speed that is safe and prudent for the conditions that exist at the time.
- The basic speed rule is intended to prohibit unsafe speeds.

Basic Speed Rule

- The basic speed rule is not dependent on posted speed limits.
- Violations of the basic speed rule require proof that the speed was unreasonable and imprudent for the existing conditions.

Basic Speed Rule Conditions

- These existing conditions include:
  - Road conditions.
  - Traffic density and volume.
  - Hazards (road construction etc.)
  - Weather conditions.
  - Visibility
  - Vehicle conditions.

Absolute Speed Laws 27-51-201/216

- Absolute speed is a speed limit that is in force regardless of the environmental conditions.
- Absolute speed rules prohibit driving faster and sometimes slower than predetermined limits.
- Absolute speed rules depend upon posted or mandated speed limits.

Absolute Speed Laws

- The premise of the absolute speed rule is that the predetermined speed limit is the maximum and sometimes the minimum reasonable and prudent speed.

Basic/Absolute Rule Overlap

- The basic and absolute speed rules can overlap. A driver can drive within the absolute speed limit but violate the basic speed rule.

Introduction of Scientific Evidence

- Evidence derived from complex mechanical devices is typically challenged by the defense as to its accuracy and reliability.
- The prosecution must establish this reliability by the use of expert witnesses.

Introduction of Scientific Evidence

- The court can dispense with expert testimony only if the scientific principle underlying the new device has been given judicial notice.
- Judicial notice extends only to the principle, it does not apply to any particular device

Introduction of Scientific Evidence

- The following are landmark court cases that have established judicial notice or established proper operating and testing procedures.

Judicial Notice

- In June 1955, the Supreme Court of New Jersey took judicial notice of the Doppler radar.
- This case was *State v. Dantonio.*
- In this case the court affirmed that the radar concept was generally known and understood by all reasonably informed individuals.

Judicial Notice

- The Arkansas State Supreme Court took judicial notice of Doppler radar in 1959, with the case *Everight v. City of Little Rock.*
- In addition to taking judicial notice, this case established that it is still necessary to prove the accuracy of the particular device employing the Doppler principle.

Judicial Notice (Tests)

- No court can accept every radar device as always being completely accurate.
- What the court may do is take judicial notice of certain methods and techniques for determining accuracy.

Judicial Notice (Tests)

- In *Thomas v. City of Norfolk* The Supreme Court of Virginia ruled that it would be sufficient to test the radar unit at the beginning and end of each duty shift.
- In *State v. Tomanelli* the Supreme Court of Connecticut established the use of the tuning fork as a reliable test of accuracy. It is important that the court noted that the tuning fork's Accuracy may be questioned.

Operator Qualifications

- In *Honeycutt v. Commonwealth* The Kentucky Court of Appeals stated that an operator must be able to:

a. Properly setup a radar Unit

b. Test a radar unit.

c. Read a radar unit.

Honeycutt Vehicle Identification

- Honeycutt also dealt with vehicle identification. The court established a procedure for vehicle identification.

Honeycutt Vehicle Identification

- The officer must establish, through direct visual observation, that a vehicle represents a potential violation.
- The initial estimate is verified by checking the speed displayed by the radar unit.
- If these two pieces of evidence agree, the operator has sufficient cause to believe the target vehicle is the violator.

Honeycutt Vehicle Identification

- The visual estimate must be considered the primary evidence with the radar reading being considered secondary.
- While not mandated by case law, the use of the Doppler tone is strongly recommended as an integral part of tracking history.

Special Requirements Moving RADAR

- In *State v. Hanson* the Wisconsin Supreme Court addressed several issues on the use of moving radar. The issues are:
  - The operator must have proper training and experience in the operation of moving radar.
  - The radar unit must have been in proper working order when the violation took place.

Special Requirements Moving RADAR

- The radar unit was used where road conditions would distort readings as little as possible.
- The patrol car's speed was verified.
- The unit was tested within a reasonable time before and after the arrest.

UNIT 2

Principles of Radar Speed Measurement

Doppler Principle

- In 1842, Christian Doppler discovered that relative motion causes a signal's observed frequency to change by studying sound waves.
- This observation is now referred to as the " Doppler Principle".

Doppler Principle

- This principle was arrived at by Doppler listening to a train whistle as the train approached him.
- As the train approached the whistle sounded high pitched.
- As the train passed the observer the whistle sounded normal.

Doppler Principle

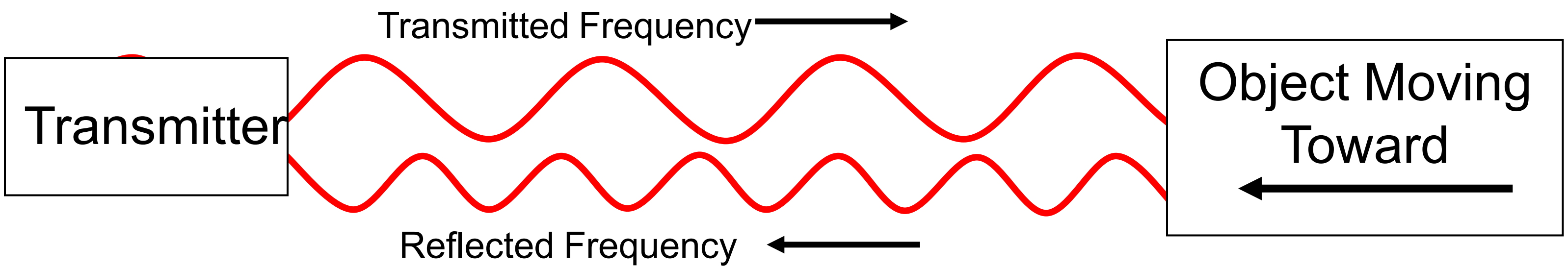
- As the train went away from the observer the whistle sounded low pitched.
- When the principle is applied to traffic radar the following observations apply:

Doppler Principle Observations

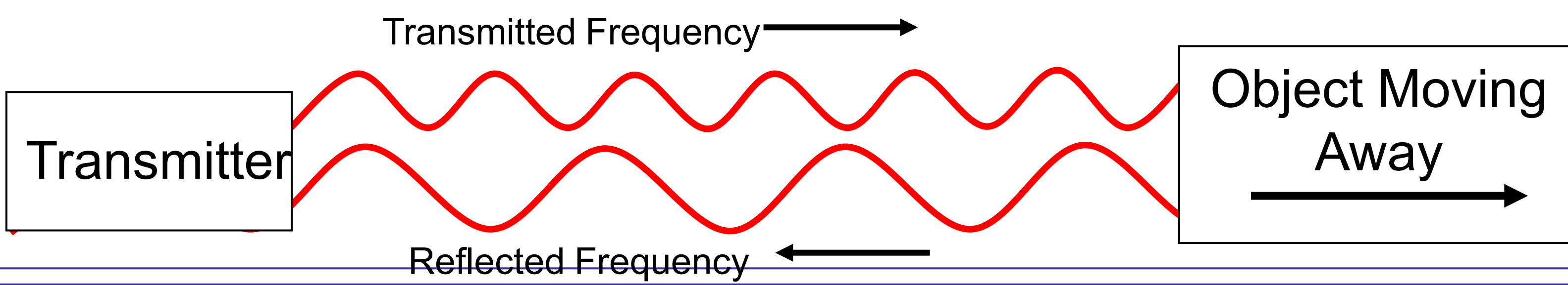
- If relative motion brings the objects closer together, the reflected frequency will be increased.
- If relative motion takes the objects further apart, the reflected frequency will be decreased.
- How much the reflected frequency is changed is determined by the speed of the relative motion between the two objects.

Relative Motion

Objects Moving Towards - Reflect At Higher Frequency



Objects Moving Away - Reflect At Lower Frequency



Relative Motion

- Relative motion occurs when:

  The radar stands still and the object moves.

  The radar moves and the object stands still.

  Both the radar and the object are moving, as long as they both move at different speeds **or** in different directions.

Radar Uses Radio Waves

Basic principle applies to:

- Sound Waves
- Light Waves
- Radio Waves

Radio Waves

- From the transmitter, radio waves spread out in a predictable manner at a known speed, the speed of light (186,282 mps). Given all these known qualities useful information can be gained by calculating the difference between the original transmission and its reflection.

Early Radar

- In the 1930's radar was used to detect aircraft.
- In 1947 law enforcement began to use radar for speed measurement.
- Radar Frequencies: X-Band, K-Band, Ka-Band
- In 1972 Moving RADAR was developed.

RADAR

RAdio

Detection

And

Ranging

Radar Operation

- Radio-frequency is generated by a transmitter.
- An antenna forms the energy into a beam.
- The beam is transmitted into space.

Radar Operation

- When the energy or signal strikes an object, a small amount of energy is reflected back to the antenna.
- From the antenna, the reflected signal is sent to the receiver, where, if the signal is strong enough, it is detected.

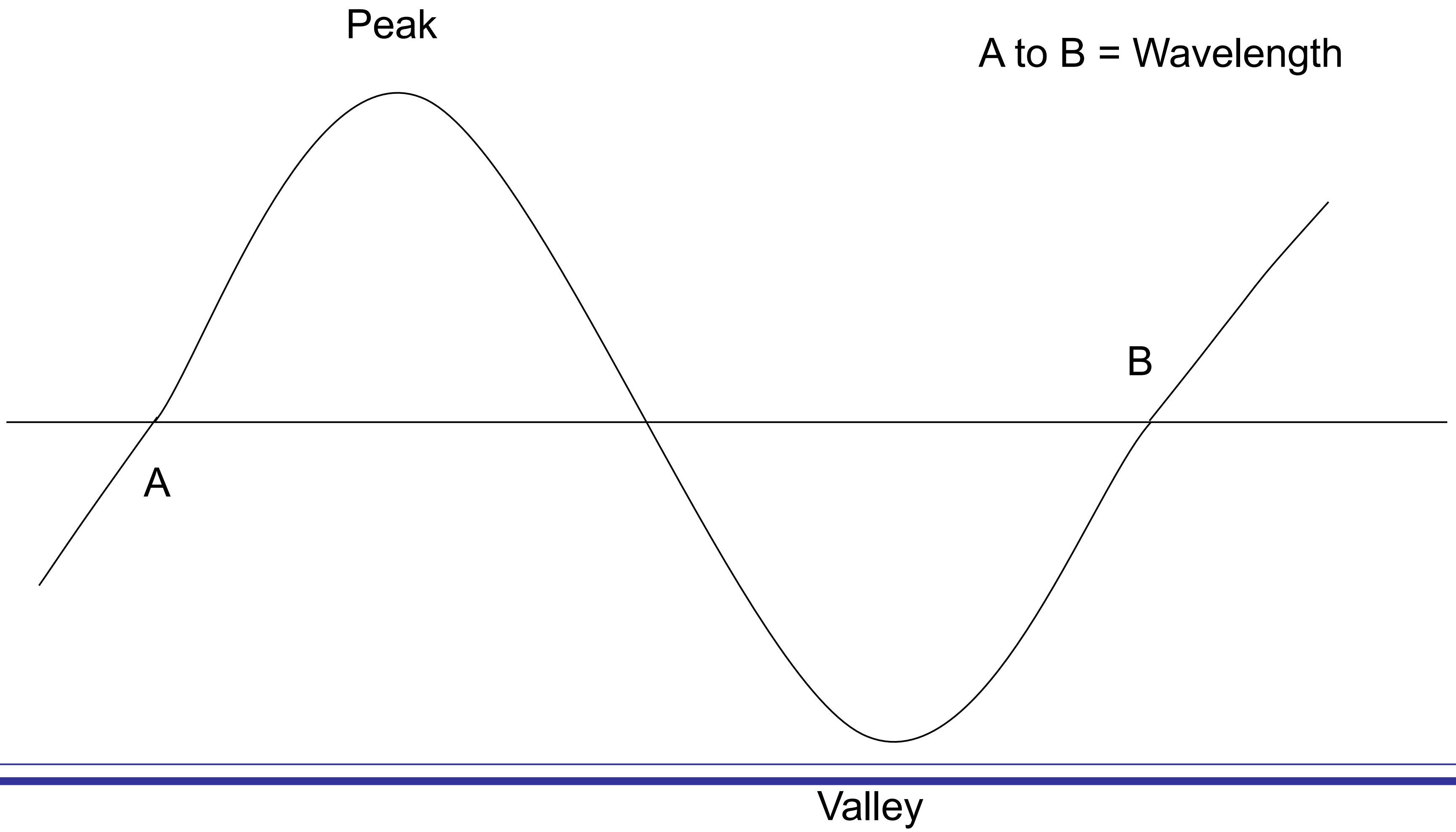
Radar Operation

- To measure speed, a radio signal's frequency is changed when the signal is reflected from a target that is moving at a different speed from that of the radar unit.
- This change or shift is known as "Doppler Shift"

Radar Operation

- By measuring the amount of the frequency shift, the radar is able to calculate and display the target speed in miles per hour and generate a corresponding Doppler tone.
- The higher the speed, the higher the pitch.
- The lower the speed, the lower the pitch.

WAVE, WAVELENGTH



Wave Concept

- Every radio signal has two related characteristics that distinguish it from every other signal.
  - Wave length - the distance from the beginning of the peak to the end of the valley. A wave usually consists of many cycles not just one.

Wave Concept

Frequency – the number of the recurrences of a signal during one second of time.

Wave Concept

- Every radio signal has its own particular frequency and wave length.
- The speed of a radio signal is constant. The signal travels   at the speed of light, 186,282 miles per second.

Wave Concept

Whenever a signal is changed, the signal speed remains the same. As frequency increases, the wave length will shorten. As the frequency decreases, the wave length will lengthen.

Assigned Frequencies

- Police radar units operate in the Microwave frequency band. This means that the signal contains billions of waves per second, otherwise expressed as gigahertz.

X- band Radar Frequency

- 10,525,000,000 Waves per second
- 10.525 Gigahertz

K- band Radar Frequency

- 24,150,000,000 waves per second
- 24.15 Gigahertz

KA- band Radar Frequency

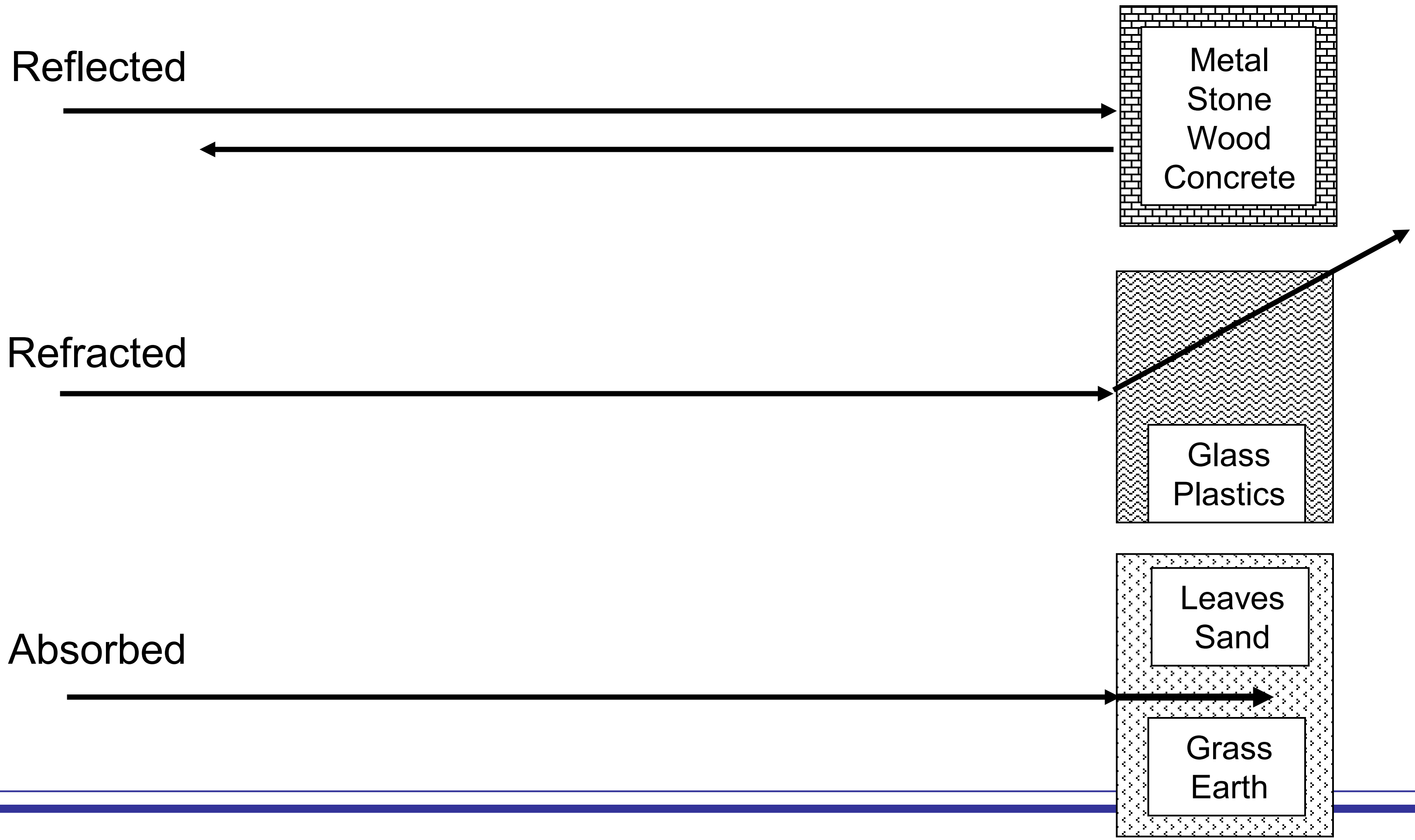
- 33.4 to 36 Gigahertz

Wavelength

• AM Radio	950 feet long
• Police Radio	6 feet long
• X-Band Radar	1.1 inch
• K-Band Radar	0.49 inch
• Ka-Band Radar	0.34 inch

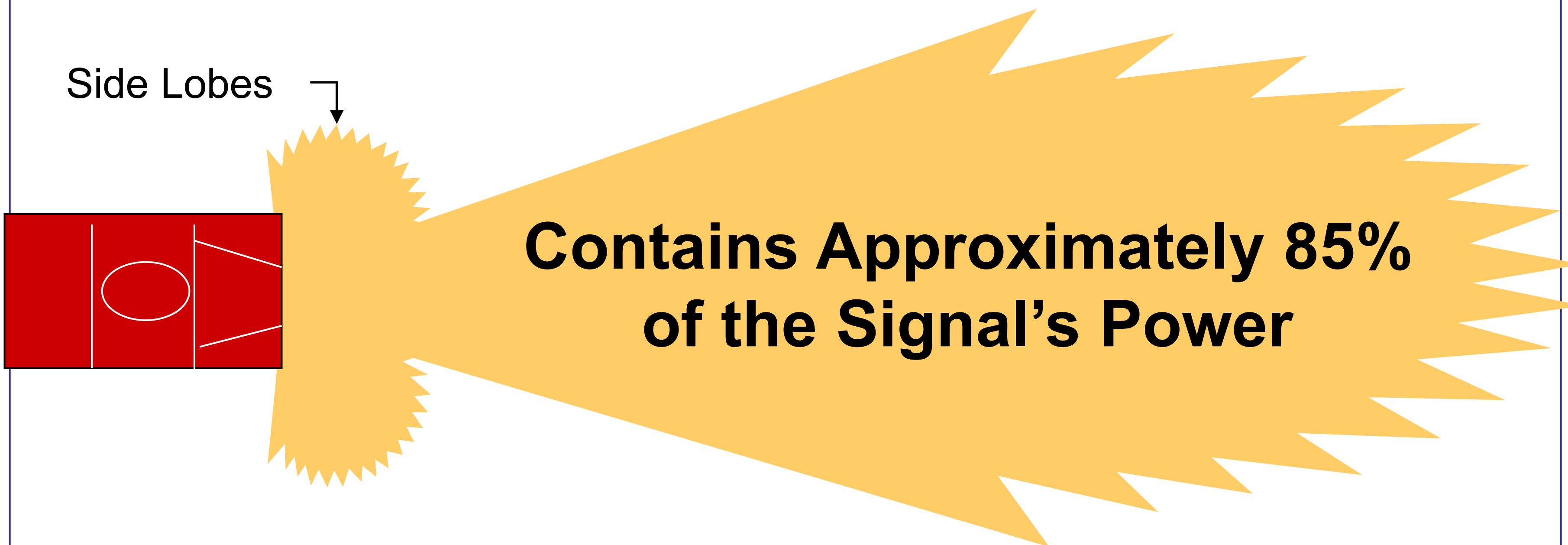
Radar Beam

- The radar wave energy transmitted by police radar is concentrated into a cone shaped beam.
- The energy level decreases as the distance from the unit increases.
- The energy level also decreases with distance from the beam’s centerline.


Reflected
Metal
Stone
Wood
Concrete
Refracted
Glass
Plastics
Absorbed
Leaves
Sand
Grass
Earth

Radar Range

- The range or distance at which a reflected signal will be read by the radar device, depends on the sensitivity of the antenna receiver.
- The effective range of most radar devices easily exceeds a half a mile.


Side Lobes
Contains Approximately 85%
of the Signal's Power

Beam Width

- Beam width will vary from manufacturer to manufacturer and from model to model.
- The initial angle of the emitted RADAR beam will determine the relative beam width.
- The initial angle may vary from 9 to 18 degrees depending on the manufacturer.

Beam Width

- A beam emitted at an 18 degree angle will be:

  80 feet wide at 250 feet from its source.

  160 feet wide at 500 feet from its source.

  320 feet wide at 1000 feet from its source

Beam Width

- A beam emitted at an angle of 11.5 degrees will be:

 50 feet at 250 feet from its source.

100 feet wide at 500 feet from its source.

200 feet wide at 1,000 feet from its source.

Beam Width

- This makes it impossible for radar to select or focus on any one particular target vehicle at any significant distance.
- The radar device will display the strongest signal that it receives.
- The beam width at any significant distance is much wider than the roadway itself, therefore radar devices are not lane selective.

Unit Three

Radar Operations

Radar Operations

- Radar measures the change in the return frequency to determine target vehicle speed.
- This target speed is reached by using what is called Doppler shift.
- With an X-band radar an increase or decrease of 31.4 waves per second is equal to 1 mph in speed for a target vehicle.

Stationary Radar

- With a K-band radar an increase or decrease of 72 waves per second is equal to a 1 mph change in speed for a target vehicle
- With a KA-band radar an increase or decrease of 103 waves per second is equal to a 1 mph change in speed for a target vehicle.
- These changes in frequency are very small when compared to the original frequency.

Angular or Cosine Effect. Stationary Operation

- We will always be at an angle to the target.
- A significant angle will result In the stationary radar unit giving a lower than true speed.

Angular or Cosine Effect. Stationary Operation

- The Angular effect is manifested in several ways:
  - As a target vehicle approaches very close to the radar, the speed displayed can begin to fall. This is caused by the increase in the angle.
  - When the angle is great, the target is not picked up until it is close.

Angular or Cosine Effect. Stationary Operation

- An extreme manifestation would be when a vehicle passes through the radar beam at a 90 degree angle to the unit.
- In this case no speed reading is generated, but you may notice a quick, faint, unclear Doppler tone.

Angular or Cosine Effect. Stationary Operation.

- Minimizing angular effect
  - Set up as close to the roadway as you safely can.
  - Align the antenna as straight down the road as possible.
  - With stationary radar the angular effect is always in favor of the violator and will produce a lower than true speed reading.

Radar
Moving Operation

- In moving mode, the radar device determines and displays the speed of the patrol vehicle by sending out a signal beam that strikes the roadway just ahead of the patrol vehicle and returns. This is known as the low Doppler beam.

Moving Operation

- The device also sends out a signal beam that strikes the target vehicle and returns. This is known as the high Doppler beam.

Moving Operation

- The moving radar compares the difference between the low and high Doppler beam returns. It then calculates and displays a target vehicle speed.

Moving Operation

- Formula:

- Closing Speed – Patrol Speed = Target Speed.

- This procedure and calculation is done automatically and instantaneously by the radar unit.

Moving Operation

- Any mistake in the patrol vehicle speed computation could result in the violator's displayed speed reading being higher than true speed.

Moving Operation

- This is why it is so important that you compare the patrol vehicle's displayed speed on the radar to the calibrated speedometer of the patrol vehicle at the instant of the violation.

Moving Operation

- If the patrol vehicles displayed speed and the calibrated speedometer reading differ by more than +/- 1 MPH, disregard the violators displayed speed and take no enforcement action.

Angular or Cosine Effect Moving Operation

- Same basic cause as with stationary operation.
- This can happen when there is a wide median between lanes and the operator has turned the antenna slightly toward the oncoming vehicles.

Moving Radar

- True speed readings can only be obtained if the radar unit is correctly computing the patrol vehicle speed.
- If less than true patrol vehicle speed is computed by the radar, it will produce an incorrectly high target speed reading.

Moving Operation

- Conditions that can create a low patrol speed reading:
  - The antenna being pointed at an angle to the direction of travel.
  - Antenna receiving a low Doppler reflected from some object at an angle or from a moving object.

Moving Operation

- To avoid or recognize these potential problems
  - Align the antenna as straight as possible
  - Continually monitor your displayed patrol speed in comparison to your calibrated speedometer reading.

Unit 4: The Radar Decision Process

- When multiple vehicles are present in the radar beam, additional factors must be considered.

Multiple Signals

- The radar may receive reflected signals from many vehicles.
- The radar unit will display a reading based on the strongest signal received.
- How do we know which vehicle?

Reflective Capability

- Reflective Capability

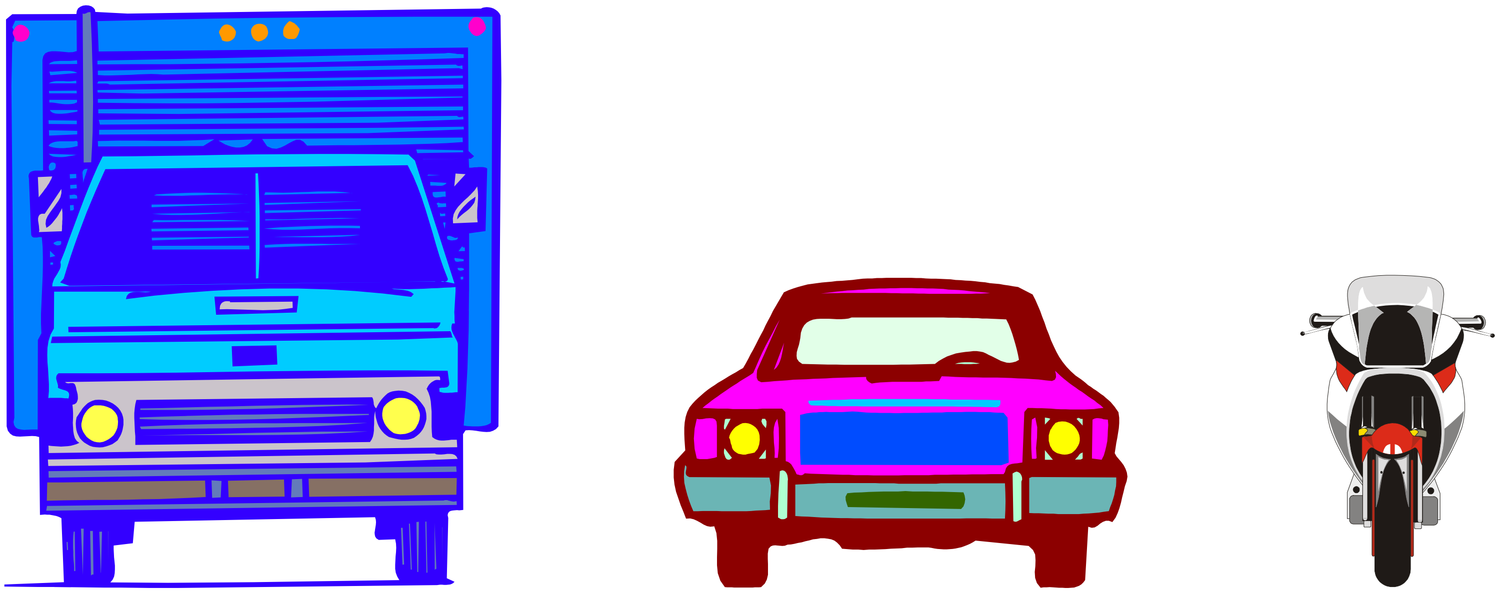
A large truck will obviously have a larger reflective area than a small passenger car. Thus a truck can create a stronger signal than a passenger vehicle, and a passenger vehicle can create a stronger signal than a motorcycle.

The shape and physical make up of a target vehicle will also affect its reflective capability. A Jeep is likely to be more reflective than a Corvette.

Reflective Capability

- Streamlined vehicles, or those made of fiberglass will reflect a radar signal. However, the distance at which the radar displays a reading for such vehicles will be reduced.

Reflective Capability



Position

- Normally the closer a vehicle is to the antenna, the stronger the reflected signal.
- If vehicles of comparable size are in question, the target vehicle closest to the antenna will be the one most often displayed.

Position

- The position of a target vehicle relative to other vehicles and the radar antenna is important in regard to which vehicles speed the radar unit will display.

Tracking History

- Visual estimation of target speed.

a. This is the most critical element.

b. Testimony must substantiate that the vehicle in question was observed to be speeding.

c. This observation is arrived at separate from the radar evidence.

Tracking History

- Audio Tracking

a. The audio feature allows you to hear the incoming Doppler signal.
b. A stable target will result in a single, pure clear audio tone.
c. The higher the pitch of the tone, the faster the speed of the target producing the Doppler signal.
d. Interference that could affect the radar unit is heard as static and is not consistent with the pure, clear Doppler tone from a valid target.

Tracking History

- The target speed displayed by the radar must correspond reasonably with the visual speed estimation and the correct audio tone.
- Each of the three must reinforce the others.
- If any of them is incompatible, the reading must be disregarded.

Tracking History

- **Patrol speed verification**

(moving radar only)

a. **The patrol speed indicated on the radar must correspond with the speed reading on the patrol vehicle's speedometer +/- 1 MPH.**

b. **The patrol vehicle's speedometer must be certified Calibrated.**

c. **This verification insures that that the radar computation of the target speed is based on a valid patrol speed.**

Tracking History

- A tracking history must be obtained for each radar based enforcement action. Whenever radar speed measurements are conducted, two points must be kept in mind:

a. The radar-displayed speed measurement is only one part of the evidence and cannot be the sole basis for any enforcement action.

b. In order to be valid and admissible, the radar speed measurement must be obtained in strict compliance with all applicable case law and department policy.

Tracking History

- Never base a decision on an instant radar measurement.
- Watch the speed measurement and listen to the audio output for at least a few seconds.
- Be sure that the signal that you are receiving is from the target vehicle.

Locking Feature

- The idea behind a locking feature is to preserve evidence for the short term. It captures the target speed reading at the instant it is activated.
- It does not lock-onto and track the target vehicle like a missile guidance system.

Locking Feature

- Once a good tracking history has been obtained, the target vehicles speed can then be manually locked in.
- The automatic locking feature and/or auto alert should never be used for enforcement purposes.

Tracking History

- Radar operations should be conducted only at the appropriate times and places. If traffic flow builds up to a point that it becomes a problem to make a good target identification you should stop using radar.
- **If any doubt exists take no enforcement action.**

Unit 5

Radar Effects

Radar Effects

- The terrain can have an effect on radar.
- The best area to operate radar is on straight and level roadways.

Radar Effects

- Police radar is designed to operate on a line of sight basis.
- Hilly terrain can create a problem with target identification in that the beam may reflect more strongly from a target higher on the hill than from the vehicle closest to the radar.

Operational Range Control

- Some radar instruments have a control device that allows the operator to adjust the unit's "operational range".

Operational Range Control

- This control only affects the radar’s ability to process a received signal and that is at or above a desired strength.
- This can incorrectly be perceived by the operator as limiting the beams range.

Operational Range Control

- A low sensitivity setting means that the radar will only perceive fairly strong signals and won't begin to register a signal until the vehicle is fairly close.
- A high sensitivity setting means that the radar will perceive fairly weak signals from a vehicle that is quite far away.

Operational Range Control

- Stationary Procedure
  - Turn the range control to its lowest setting.
  - Slowly increase the radar sensitivity.
  - Observe when and where approaching vehicle begins being displayed on the radar. This will allow you to determine the operational range for your unit.
  - Beware that different sized vehicles may begin to display at different points.

Operational Range Control

- For moving radar the sensitivity may need to be set significantly higher, because both vehicles are moving and the distance between the patrol vehicle and the target vehicle could be great and is changing rapidly.

Operational Range Control

- A radar unit's range setting is approximate, not precise.
- Don't try to adjust your sensitivity by adjusting the antenna up or down. If your unit doesn't have a range control, keep the antenna pointed straight ahead.
- Adjusting the sensitivity of your range control will have no impact on radar detectors. The beam strength remains the same.

Interference - Harmonics

- Harmonics interference can occur in the absence of a strong valid target.
- In these circumstances the radar may process weak frequencies at or near its assigned frequency.
- These signals are usually weak, lack the proper tone, and disappear when a valid target moves into the radar beam.

Interference - Harmonics

- Although not common, harmonics could include energy released by:
  - Airport radar
  - Mercury vapor and Neon lights.
  - High-tension power lines.
  - High-output microwave transmission towers
  - Transmissions from CB and police radios.
  - **If you experience this in a particular area, err on the side of caution and disregard any readings**.

Interference - Moving Objects

- Because Doppler radar is designed to measure relative motion it can possibly pick up any moving object, not just a vehicle.
- The most common moving objects that may interfere with radar are:
  - Vibrating or moving signs near the roadway.
  - Fan blades moving either inside or outside of the patrol vehicle.

Interference

- Interference can come from within the patrol vehicle.
- Using the Doppler audio feature on the radar will help in recognizing interference - instead of a clear, pure tone of a valid target, the audio can emit rhythmic, static or buzzing sounds.

Interference Induced Readings

- The trained operator will ignore interference-induced readings, since:
  - There is generally no vehicle within the operational range of the radar and therefore, no visual clue.
  - Interference is usually weak. When a valid target enters the operational range it will almost always override the interference.

Interference Induced Readings

- The Doppler audio effect caused by interference will not usually be the clear, pure tone of a valid target.
- Usually interference is momentary and is not consistent with a valid target tracking history.

Inclement Weather

- Rain, snow etc. doesn't affect radar's accuracy as much as it does its range.
- Inclement weather decreases the unit's operational range. Moisture laden air tends to scatter the radar beam slightly, thus reducing its effective range.

- In moving radar, the low Doppler beam may strike standing water immediately ahead of the patrol vehicle and cause a brief loss of patrol vehicle speed readout and/or produce an extremely high momentary target vehicle speed that does not match the visual estimation of the target vehicle.

- The patrol vehicles wiper blades passing across the beam may produce a Doppler tone indicating interference.
- Many agencies prohibit the use of radar while it is raining.

Multi - Path Beam Cancellation

- The high Doppler beam may reflect off of multiple targets/objects and not return to the radar unit. This results in the speed readings blanking out momentarily.
- In the event that the beam does return to the radar unit, it may produce a brief, extremely high target speed reading.
- Patrol speed verification and tracking history will not correlate with that of a valid target.

Scanning Effect

- A hand-held radar that is rapidly moved in a sweeping motion or a Stationary unit mounted in the vehicle while making a fast U-turn, may produce a brief speed measurement as the beam sweeps across objects in the environment.

Not moving the handheld unit while taking a measurement and always following proper tracking history procedures can prevent this.

Panning Effect

- This only occurs in two piece radar units.
- Can occur when the antenna is pointed at the counting unit. This is a type of electronic interference.
- Mount the antenna so that it does not point at the counting unit.

Electronic Interference

- Can be created by other devices that produce radio waves when those devices are operating in very close proximity to the antenna or counting unit.

Turn On Power Surge Effect

- Suddenly turning on the radar unit can result in a speed reading because of a sudden surge of voltage to the unit.
- This is not an appropriate method of defeating radar detectors.
- The antenna hold switch is more effective in defeating detectors. This switch prevents the release of the generated radar beam until the switch is activated.

Patrol Speed Shadow Effect

- A shadow effect may be experienced when the low beam that is supposed to determine the patrol vehicle speed by striking the ground just ahead of the patrol vehicle, instead locks onto a very close, large moving vehicle that is traveling in the same direction as the patrol vehicle. The radar may read the difference in speed between these two vehicles as the patrol vehicle speed, causing a low patrol vehicle speed display.

Patrol Speed Shadow Effect

- This effect then causes the remainder of the patrol vehicle speed to be combined with and read as target speed.
- This results in an extremely high speed reading and Doppler tone that does not match your observation of the target vehicle.
- At the same time, it results in an extremely low patrol vehicle reading that does not match your speedometer reading.

Batching Effect

- The batching effect may occur if the patrol vehicle is rapidly changing its speed while the radar speed measurements are being made.
- Most radar units are fast enough to keep up with significant speed changes, thus avoiding the batching effect, and / or blank out when such changes occur.

Conclusions on Effects

- Many of these effects arise only through blatant improper operation of the radar unit.
- Most can be avoided or easily identified by following the proper operating procedures.
- If one does occur, it will be brief and only affect the radar momentarily.
- **ALL OF THEM WILL LACK THE NECESSARY SUPPORTIVE EVIDENCE FOR A VALID TARGET READING.**

Unit 6

Case Preparation and Documentation

Case Preparation and Presentation

- While there is no specific Arkansas case that requires the keeping of a radar log, officers should be prepared to back up their testimony with documentation, just as they would do in any criminal case.

Case Preparation and Presentation

- The officer must be prepared to:
  - Establish the time, and place of the radar measurement.
  - Establish the location of the offending vehicle.
  - Establish that the defendant was driving the vehicle.
  - Must state/present your qualifications and training.

Case Preparation and Presentation

- Present the most recent annual certification/calibration for the unit and its tuning forks.
- Establish that the radar unit was properly operating.
- Establish that the unit was properly tested for accuracy both before and after its use, using a certified tuning fork or other accepted method.

Case Preparation and Presentation

- Accurately identify the target vehicle.
- Observed that the vehicle appeared to be speeding and estimated how fast.
- Observed a radar reading that agreed with the visual estimate of the vehicle’s speed.
- Establish that the audio Doppler pitch emitted correlated with both the visual estimate and the radar reading.

Case Preparation and Presentation

- If moving radar is used, testify that the patrol vehicle's speed was verified at the time that the speed measurement was taken.
- Be prepared to present the patrol vehicle manufacturers speedometer calibration certification.
- Do not allow yourself to be drawn into a technical discussion of the Doppler principle or a radar unit's internal workings.(Honeycutt v Commonwealth)

Unit 7

Radar Component Assembly and Mounting

Instrument Licensing

- A radar unit is composed of a radio transmitter and receiver; as such it must be licensed by the FCC.
- Only a station license is required.

Instrument Component Assembly

- Radar units fall into two categories:

  a. One-piece

  b. Two-piece

- One-piece units only require being plugged in to a power source, being sure the unit is turned off when doing so.

Instrument Component Assembly

- Two-piece units require some component assembly.

  a. The antennas are connected to the counting box.

  b. The remote is connected to the counting box

  c. The counting box is connected to a power source.

  c. The unit is turned on.

  Always remember to have the unit off when it is attached to a power source or it can cause damage to the unit or blow a fuse.

Radar Unit Components

Antennae

Power Supply

Counting Unit

Remote

Mounting the Counting Unit

- Three considerations
  - The safety of the mount.
  - The visibility of the radar speed display.
  - If the unit obstructs the operators view.

Antenna Mounting

- Avoid mounting the antenna where it unnecessarily exposes the operator or passengers to microwave radiation.
- Do not mount the antenna so that the counting unit is in the radar beam.
- Mount the antenna so as to avoid interference from inside the vehicle.

- Mounting the antenna as close to the windshield as possible and maintaining the proper straight ahead antenna alignment will significantly reduce the likelihood of interference.
- Follow the manufacturers recommendations for antenna mounting.

Antenna Direction

- The radar's antenna/s can be directed toward vehicles either approaching or going away from the patrol car.
- Adjust the antenna/s for ideal beam/target contact, considering both range and angle.

Antenna Direction

- Depending upon the features of your particular radar unit, and the number of antennas (1or 2) you may be able to detect target vehicles while you are:
- Stationary or moving, target traveling toward or away from you.
- Moving same direction ahead of you.
- Moving same direction from behind you.

Unit 8

Accuracy Tests

Tests for Accuracy

- Internal circuit test
  - This is usually the first test conducted on your unit.
  - This tests the counting unit for proper function. Some units may also test the antenna connection.
  - If any numbers are displayed other than those set by the manufacturer the unit should not be used.

Tests for Accuracy

- Light Segment Test
  - Most radar units have a feature that allows the operator to verify that all light segments are working.
  - If a light segment is burned out the unit should be taken out of service.

Tests for Accuracy

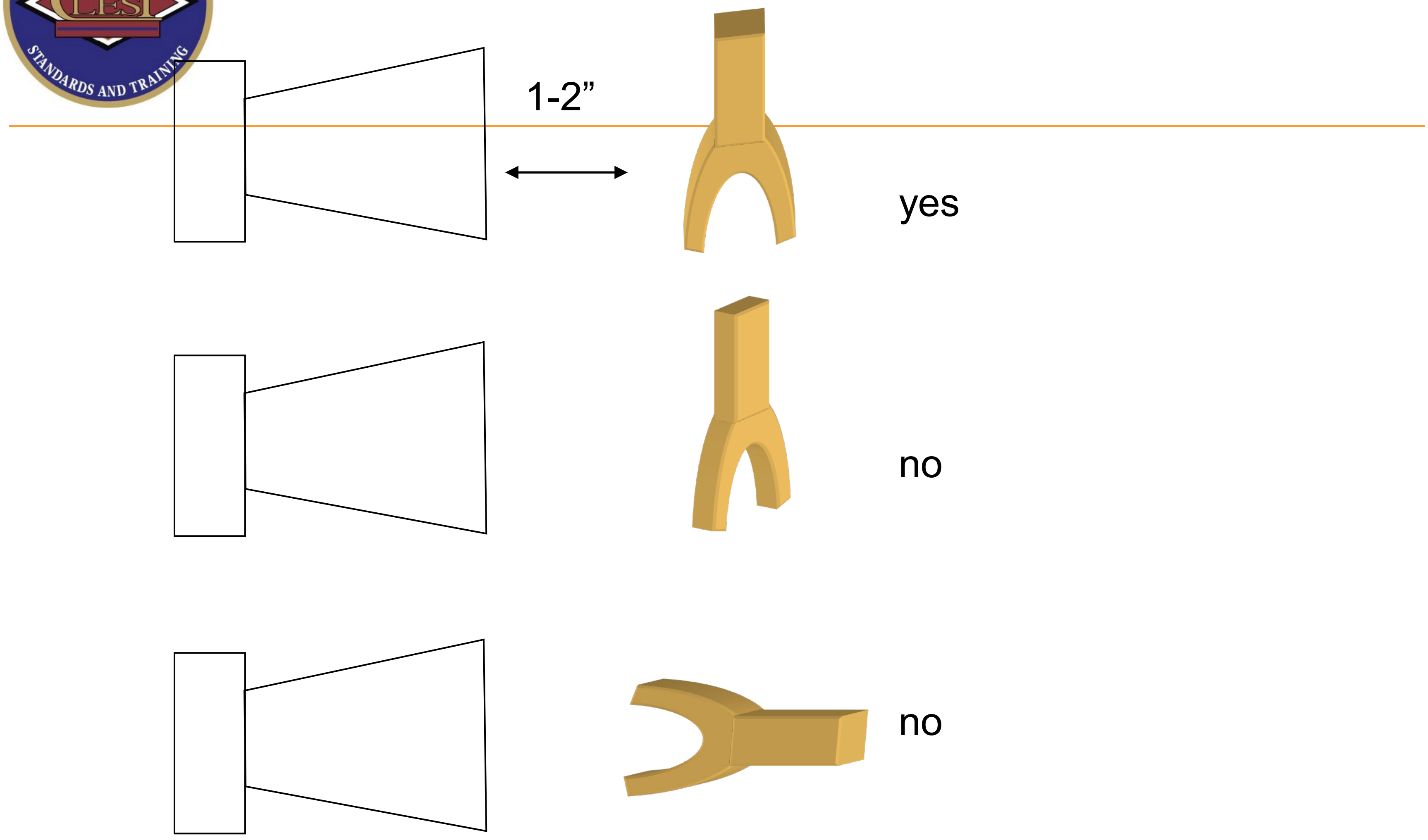
- External Tuning Fork Test
  - The external tuning fork test tests both the antenna and the counting unit.
  - Use the calibrated forks assigned to the particular unit to conduct the following steps:

Tuning Fork Use

- Grasp its handle and strike one of the tines against a surface that is not as hard as the fork itself. This causes the fork to vibrate.
- Avoid striking the fork when the fork is very hot or very cold. This could cause a false reading.
- Place the radar unit in stationary mode.
- Be sure there is no target in the beam or interference when conducting this test.

In Stationary Mode

- Hold the fork 1 to 2 inches ahead of the antenna so that the fork vibrates toward and away from the antenna.
- A speed measurement will appear in the target window of the counting unit. If this speed is more than 1 m.p.h. above or below the speed of the fork, do not use your unit.


1-2”
yes
no
no

Tuning Fork Use

- Place the radar unit in moving mode.
  - Two forks are used.
  - The low speed fork is struck and used first. This will produce a patrol speed.
  - The high speed fork is then struck and used at the same time as the low speed fork.
  - Then target speed displayed should be difference between the high speed and low speed forks.
  - The same test speed deviation will be allowed.

Patrol Speed Verification

- This test is required only for moving radar.
- This check is to establish that the moving radar unit is properly displaying the actual patrol car speed.
- Be sure the antenna is pointing straight ahead.

Patrol Speed Verification

- Conduct this test by accelerating to a steady speed and compare the calibrated speedometer reading with the patrol speed displayed.
- Remember you need to test the accuracy of your unit as often as possible.

Unit 9

Site Selection

Site Selection

- Avoid areas where interference might be encountered or alleged.
- Avoid areas that do not allow adequate observation for a tracking history of the target.
- Avoid areas that are not conducive to conducting a safe traffic stop.

Site Selection

- A need for radar operation could be based on:
  - A lot of accidents involving speed.
  - Many speed violations have previously occurred.
  - Citizens have made complaints about violations.
  - Special speed regulations or other characteristics require selective or special speed enforcement.

Site Selection Considerations

- Safety - this is a primary consideration. The site selected should not pose a threat to officers or a motorist.
- Traffic and roadway conditions - the site should give you an unobstructed view of a target vehicle. The traffic flow should not be so heavy that it does not allow you to get a good target verification.

Unit 10

Operation of Specific Devices

- Each model of radar will have its own unique features and characteristics. As the operator, it is your responsibility to learn how to properly operate each of those features.

Same Direction Radar

- Same direction moving mode is designed to measure the speed of a target vehicle going the same direction as the patrol vehicle.
- Formula for computing the target speed.
  - Target speed = Separation speed - Patrol speed.

Same Direction Radar

- The operator must select the proper operating function on the unit to match the situation that is presented.
- Example: Violator moving same direction ahead of you vs. same direction behind you.

Same Direction Radar

- Target Identification Considerations.
  - All previously established guidelines for target verification will still apply to same direction radar.

Same Direction Radar

- Tracking history elements are:
  - Visual estimation of speed.
  - Doppler audio
  - Correlation between visual speed estimate and speed displayed.
  - Patrol speed verification if using moving radar.

Unit 11
Lidar

- Lidar is a device that measures speed and distance using a laser (focused light) based technology.
- Lidar differs from radar in its ability to measure distance as well as speed.

Laser

- Laser is an acronym that stands for; Light Amplification by Stimulated Emission of Radiation.

LIDAR

- What does LIDAR stand for?
  - Light Detection and Ranging.

Lidar

- When the trigger is pulled the unit sends out hundreds of invisible infrared light pulses per second.(100 to 600 depending upon the model)
- As each pulse is transmitted, a timer is started, and when the energy of a laser pulse is reflected from a target and received by the unit, the timer is stopped.
- This appears to happen instantly to the operator.

Lidar

- From the elapsed time taken for the laser pulse to strike and return from the target, the distance to the object is calculated with the known speed of light. (186,282 miles per second)
- By comparing two such readings, the unit can then calculate the target vehicles speed based on the distance traveled by the vehicle between pulses.

Lidar

- If the results are within the preprogrammed parameters of the unit, it will display the speed and distance. If an error has occurred and the results are outside of the preprogrammed parameters, the unit will display an error reading.

Lidar

- The most common error is caused by the operator moving the unit while attempting to obtain a reading.

Lidar

- The laser beam is much smaller than a radar beam. At 2000 feet the laser beam is 8 feet wide. A radar beam at 2000 feet could be between 400-500 feet wide depending upon the band used.
- Because the lidar beam is so narrow, the operator must aim the lidar, and as a result the operator is able to pick a single target vehicle from within a heavy traffic pattern.

Lidar

- The maximum effective range of a lidar is 2000 feet.
- The lidar operates at a light frequency of 330 terahertz. (trillion waves/cycles per second)
- Unlike radar, the frequency of the lidar beam is **not** used to calculate speed.

Lidar Operation Set-up

- When setting up to use a lidar you should consider the following things:
  - Cosine angle (angle to the target)
  - Clear line of sight
  - Visibility Conditions
  - Windshields
  - Absolute stability of the unit upon activation of the trigger.

Speed Measurement

- The lidar must be aimed. Since the beam is narrow you have to be steady and precise.
- On a vehicle moving toward you aim at the front license plate, the headlights, or the turn signal reflectors.
- On a vehicle moving away from you aim at the license plate or the tail light reflectors.

Speed Measurement

- The unit must be held still while a measurement is being taken. If you move the unit you will receive an error message.
- Once you have a sighted target, the trigger is squeezed. The unit instantly records the target speed and distance.

Automatic Internal Test

- Once the unit is powered up it will automatically conduct internal tests.
- Display test
- Memory test
- Accuracy test
- Software version
- Unit of Measure
- HUD display mode

Manual External Test

- Set up targets at known distances, such as 250 and 500 feet.
- The measurement should be accurate to +/- 1 foot.

Testing HUD Alignment

- Select an object about 200 feet away, such as a stop sign or a utility pole.
- Sweep the unit across the target and observe that the proper range is displayed only when the target is in the reticule. This test will establish lateral alignment.
- Repeat the sweep going up and down to establish the vertical alignment.

Lidar Maintenance

- Maintenance of the unit consists of periodic cleaning of the external optical surfaces.
- This should only be done when needed.
- Use a lint free cloth dampened with low-residue isopropyl alcohol. Clean the lenses using a circular motion.

Lidar Maintenance

- The external optical surfaces are coated glass. Extreme care must be taken when cleaning these surfaces to prevent scratching. Scratching will lead to performance degradation.

Care of the Lidar

- Protect the optical surfaces from contacting objects.
- Do not point the unit at the sun or other intense light.
- Whenever the unit is not in use, put on the protective lenses cap.

Care of the Lidar

- Whenever the unit is not in use, place it in its carrying case.
- Follow manufacturers recommendation concerning any potential safety hazards.

Eye Safety Concerns

- The lidar unit emits a very brief pulse of infrared light. (invisible to the human eye) Because the pulse of infrared light is so brief, it is not possible for the eye to focus on it like it could with the continuous beam of visible light from a laser pointer.

Eye Safety Concerns

- Always follow the unit manufacturer’s recommendations, if any, concerning any potential safety hazards.

Unit 12

Practical Exercises

Practical Exercises

The students will be required to complete a ride along practical to observe the proper operation of a radar unit.

The students will be required to conduct a stationary and moving speed and range estimation exercise.

The exercise will be completed with a plus or minus 20% degree of accuracy.

Conclusion

- We have covered radar and lidar operation from a basic approach. You will be expected to learn how to operate your agency's radar and lidar devices and to follow your departmental policies for proper operation.

Conclusion

- If you follow the guidelines that you have been given, you should have no problems operating in a professional, ethical and legally defensible manner.

Remember

- If any doubt exists about the validity of a target vehicle speed reading, take no enforcement action.