GENERAL SPEED LAW

NO PERSON SHALL DRIVE AT A GREATER SPEED THAN IS REASONABLE AND PRUDENT UNDER THE CONDITIONS AND HAVING REGARD FOR THE ACTUAL AND POTENTIAL HAZARDS THEN EXISTING.

SPEED MUST BE SO CONTROLLED TO AVOID COLLIDING WITH PERSON OR VEHICLE.

- **MAXIMUM SPEED LIMITS:**
  - **70 MPH – INTERSTATES WHERE POSTED**
  - **60 MPH – MULTILANE DIVIDED, PRIMARY HIGHWAYS WHERE POSTED**
  - **55 MPH – IN OTHER LOCATIONS**
  - **40 MPH – ON UNPAVED ROADS**
  - **55 MPH – MAXIMUM FOR MANUFACTURED HOMES (TEN BELOW MAX POSTED SPEED)**
  - **30 MPH – IN URBAN DISTRICTS**

- **A DRIVER MUST REDUCE SPEED WHEN:**
  - **APPROACHING AND CROSSING INTERSECTION**
  - **GOING AROUND A CURVE**
  - **APPROACHING A HILLCREST**
  - **TRAVELING ON A NARROW ROAD OR BRIDGE**
  - **OR BY REASON OF WEATHER OR HIGHWAY CONDITIONS**

South Carolina Speeding Law, excerpt

SECTION 56-5-1520. General rules as to maximum speed limits; lower speeds may be required.

(A) A person shall not drive a vehicle on a highway at a speed greater than is reasonable and prudent under the conditions and having regard to the actual and potential hazards then existing. Speed must be so controlled to avoid colliding with a person, vehicle, or other conveyance on or entering the highway in compliance with legal requirements and the duty of a person to use care.

(B) Except when a special hazard exists that requires lower speed for compliance with subsection (A), the limits specified in this section or established as hereinafter authorized are maximum lawful speeds, and a person shall not drive a vehicle on a highway at a speed in excess of these maximum limits:

(1) seventy miles an hour on the interstate highway system and other freeways where official signs giving notice of this speed are posted;

(2) sixty miles an hour on multilane divided primary highways where official signs giving notice of this speed limit are posted;

(3) fifty-five miles an hour in other locations or on other sections of highways and unpaved roads are limited to the speed of forty miles an hour; and

(4) manufactured, modular, or mobile homes must not be transported at a speed in excess of ten miles below the maximum posted speed limit when the maximum posted speed limit is in excess of forty-five miles an hour, and never in excess of fifty-five miles an hour.

(C) Thirty miles an hour is the maximum speed in an urban district. "Urban district" means the territory contiguous to and including any street which is built up with structures devoted to business, industry, or dwelling houses situated at intervals of less than one hundred feet for a distance of a quarter of a mile or more.

(D) A local authority on the basis of an engineering and traffic investigation may determine that the maximum speed limit permitted under this article is less than thirty miles an hour in an urban district. If this determination is made, the maximum speed limit for the urban district is enforceable by all law enforcement officers authorized to enforce the traffic laws in the urban district. However, this subsection does not apply to highways within the state highway system contained in Section 56-5-1530.

(F) The driver of a vehicle shall drive, consistent with the requirements of subsection (A), at an appropriate reduced speed when approaching and crossing an intersection or railway grade crossing, when approaching and going around a curve, approaching a hillcrest, when traveling upon any narrow bridge, narrow or winding roadway, and when special hazard exists with respect to pedestrians or other traffic or by reason of weather or highway conditions

Accessed 07-11-2019 from https://www.scstatehouse.gov/code/title56.ph

South Carolina Criminal Justice Academy

Radar Log

Officer: ______________________________

Radar Make: __________________________

Serial Number: ________________________

F Antennae SN#:_______________________

R Antennae SN#:_______________________

Tuning Fork SN#:______________________

Tuning Fork SN#:______________________

DATE	TIME	SUMMONS	Internal Circuitry	Internal Light Test	Tuning Fork Tests		Drive Thru Test	
					Front	Rear	Known Speed	Indicated Speed
					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=
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					F=	R=	Ks=	IS=
					F=	R=	Ks=	IS=

South Carolina Criminal Justice Academy

Lidar Log

Officer: ______________________________
Lidar Make: ___________________________
Serial Number: ________________________

DATE	TIME	SUMMONS	Internal Circuitry	Internal Light Test	Known Distance Test _______FT	Drive Thru Test Known Speed	 Indicated Speed
						Ks=	IS=
						Ks=	IS=
						Ks=	IS=
						Ks=	IS=
						Ks=	IS=
						Ks=	IS=
						Ks=	IS=
						Ks=	IS=
						Ks=	IS=
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						Ks=	IS=

STOPPING DISTANCE WORKSHEET

Stopping Distance

S = Speed
DF = Drag Factor

$$\frac{S^2}{30 \times DF} = \text{Distance to Stop Once Brakes are Applied}$$

Perception/Reaction Distance

S = Speed
1.47 = Converts mph - feet per second
1.5 = Average perception/reaction

S X 1.47 X 1.5 = Distance Covered During Perception/Reaction Time

Violator's Speed ________________

1. Reaction Distance______________
2. Stopping Distance______________
3. Total Stopping Distance_________

Violator's Speed ________________

1. Reaction Distance______________
2. Stopping Distance______________
3. Total Stopping Distance_________

Violator's Speed ________________

1. Reaction Distance______________
2. Stopping Distance______________
3. Total Stopping Distance_________

Violator's Speed ________________

1. Reaction Distance______________
2. Stopping Distance______________
3. Total Stopping Distance_________

Violator's Speed ________________

1. Reaction Distance______________
2. Stopping Distance______________
3. Total Stopping Distance_________

Violator's Speed ________________

1. Reaction Distance______________
2. Stopping Distance______________
3. Total Stopping Distance_________

SPEED LIMIT WORKSHEET

Speed Limit______________________

Violator's Speed __________________

1. Reaction Distance______/_______
2. Stopping Distance______/_______
3. Total Stopping Distance________/______
4. % Over Speed Limit__________________
5. % Farther to Stop____________________

Speed Limit________________________

Violator's Speed ____________________

1. Reaction Distance_______/_______
2. Stopping Distance______/________
3. Total Stopping Distance_____/____
4. % Over Speed Limit_____________
5. % Farther to Stop_______________

Speed Limit______________________

Violator's Speed __________________

1. Reaction Distance______/_______
2. Stopping Distance______/_______
3. Total Stopping Distance________/______
4. % Over Speed Limit__________________
5. % Farther to Stop____________________

Speed Limit________________________

Violator's Speed ____________________

1. Reaction Distance_______/_______
2. Stopping Distance______/________
3. Total Stopping Distance_____/____
4. % Over Speed Limit_____________
5. % Farther to Stop_______________

Speed Limit______________________

Violator's Speed __________________

1. Reaction Distance______/_______
2. Stopping Distance______/_______
3. Total Stopping Distance________/______
4. % Over Speed Limit__________________
5. % Farther to Stop____________________

Speed Limit________________________

Violator's Speed ____________________

1. Reaction Distance_______/_______
2. Stopping Distance______/________
3. Total Stopping Distance_____/____
4. % Over Speed Limit_____________
5. % Farther to Stop_______________

SPEED LAWS

ELEMENTS	BASIC SPEED LAW	ABSOLUTE SPEED LAW	PRIMA FACIE SPEED LAW
Driver	Accused must be shown to have been the driver at the time of the infraction.	(Same)	(Same)
Location	Any place to which the public has right of access for vehicle use.	(Same)	(Same)
Speed	Unreasonable or imprudent	In excess of specified limit and thus are in violation of the law.	In excess of specified limit and thus presumed to be driving unlawfully.
Conditions	Having regard to actual and potential hazards.	Not applicable	Having regard to actual and potential hazards.

SPEED AND RANGE ESTIMATION WORKSHEET

Name__________________________________ Location____________________

Date___________________________________ Time_______________________

Speed Est.	Range Est.	Speed Est.	Speed Actual	Range Actual	Difference Speed	Difference Range
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Total	Total	Total	Total	Total	Total	Total

Total of All Speed ÷ 10 = Range of Speed Estimates

"My ability to estimate speeds averaged within___________mph in a structured test."

Total of All Ranges ÷ 10 = Range of Distance Estimates

"My ability to estimate range averaged within___________feet in a structured test."

TRACKING HISTORY

Visual

1.________________________________

2.________________________________

3.________________________________

4.________________________________

Audio

1.________________________________

2.________________________________

Unit Confirmation

1.________________________________

2.________________________________

RADAR FORMULAS

BEAM WIDTH

$$BW = 2D\left(TAN\tfrac{1}{2}\angle\right)$$ or more simply

9° RADAR ∠	=	.16 X Distance in feet
12° RADAR ∠	=	.21 X Distance in feet
16° RADAR ∠	=	.28 X Distance in feet
18° RADAR ∠	=	.31 X Distance in feet

COSINE (Stationary Mode)

Indicated Speed	=	True Target Speed X Cosine ∠
True Target Speed	=	Indicated Speed ÷ Cosine ∠

COSINE (Moving Mode, with Nichols effect and Shadow effect.)

Adjusted Target Speed	=	True Target Speed X Cosine ∠
Closing Rate Speed	=	Patrol Speed + Adjusted Target Speed

*Adjust Patrol Speed if necessary for Low Doppler Cosine or Shadow effect or both.

Low Doppler Cosine Effect

Adjusted Patrol Speed	=	True Patrol Speed X Cosine ∠

Shadow Effect

Adjusted Patrol Speed	=	True Patrol Speed (or adjusted Patrol Speed if Low Doppler Cosine present) – shadow vehicle speed
Indicated True Target Speed	=	Closing Rate Speed – Adjusted Patrol Speed

COSINE	=	Negligible until 10 degrees is exceeded
STATIONARY COSINE	=	Always in favor of the violator
MOVING COSINE		A cosine error on the patrol speed will result in a high target speed reading. YOU MUST VERIFY PATROL SPEED WITH SPEEDOMETER.

MOVING RADAR

Target Speed = Closing Speed – Patrol Speed

Target Speed = Separation Speed – Patrol Speed

TIME DISTANCE EQUATIONS

Reaction Time Distance	=	Speed X (Perception + Reaction) Time X 1.5 X 1.47
Speed	=	(Reaction Time) Distance ÷ 1.47 ÷ (Perception + Reaction) Time
(Perception + Reaction) Time	=	(Reaction Time) Distance ÷ 1.47 ÷ Speed
Velocity	=	Speed X 1.47

TOTAL STOPPING DISTANCE

$S^2 \div 30$ X Drag Factor + Reaction Time Distance

$(S^2 \div 22.5) + (S \times 1.47 \times 1.5)$

Drag Factor: Use .75

Reaction Time Distance: Speed X 1.47 X 1.5

RADAR: RAdio Detection And Ranging

TRACKING HISTORY

Visual	ID Target Est. Speed Est. Range Check Environment
Audio	Pitch Clarity
Speed Verification	Constant Readout Consistent with Visual Estimate Verify Patrol Speed with Speedometer

Scanning: Pointing antenna at counting unit Panning:
Swinging stationary unit toward target Simulation Test:
(Moving)

Patrol	35
Target	30

FREQUENCY FORMULA

Frequency x Wave Length = The Speed of Light

The speed of light as measured by National Institute of Standards and Technology, (NIST), is 186,282.396 miles per second.

There are 63,360 inches in a mile.

Most wavelengths can more easily be visualized in fractions of an inch than in fractions of a mile. Therefore, you must convert miles per second to inches per second. This is done by multiplying by 63,360 or dividing by 63,360 depending on which conversion you are attempting to make.

Examples:

K-band:

$$frequency * \frac{wavelength}{\#\ of\ inches\ in\ a\ mile} = speed\ of\ light$$

$$\mathbf{24,150,000,000 * \frac{.488729918\ in}{63,360\ in} = 186,281.999\ miles\ per\ sec}$$

$$\frac{speed\ of\ light * 63{,}360}{frequency} = wavelength$$

$$\frac{186{,}282 * 63{,}360}{24{,}150{,}000{,}000} = .488729918\ in$$

BEAM WIDTH COMPUTATIONS

$$BW = 2D(TAN\frac{1}{2}\angle)$$

	(∠) TRANSMISSION ANGLE	(*D*) DISTANCE	(*BW*) BEAM WIDTH
1.	12°	105	FT.
2.	12°	286	FT.
3.	16°	116	FT.
4.	16°	306	FT.
5.	18°	96	FT.
6.	18°	319	FT.
7.	24°	84	FT.
8.	24°	510	FT.
9.	9°	686	FT.
10.	9°	544	FT.
11.	12°	1467	FT.
12.	24°	1270	FT.
13.	9°	1619	FT.
14.	18°	1598	FT.
15.	16°	1321	FT.

DOPPLER SHIFT COMPUTATIONS

Compute the correct speeds in miles per hour given the following Doppler shift.

K- Band Transmitted Signal: 24,150,000,000 CPS

$Difference = Transmitted - Returned$

To calculate Doppler shift to speed: $72CPS = 1mph$

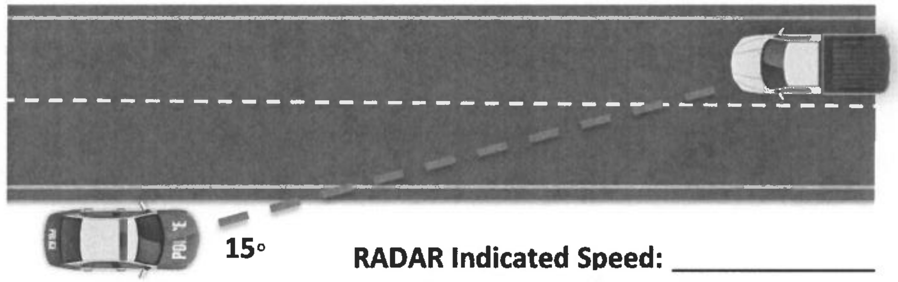
Example: $3000 \div 72 = 41mph$

	Returned Signal	Difference	Miles Per Hour	Toward or Away
1.	24,150,002,880	2880 CPS		
2.	24,149,998,488	1512 CPS		
3.	24,150,005,616	5616 CPS		
4.	24,150,003,960	3960 CPS		
5.	24,149,994,816	5184 CPS		
6.	24,149,992,362			
7.	24,150,008,280			
8.	24,149,996,760			
9.	24,149,990,280			
10.	24,150,010,800			

Look at the returned signal for each problem and determine whether the target is moving toward the source or away from the source.

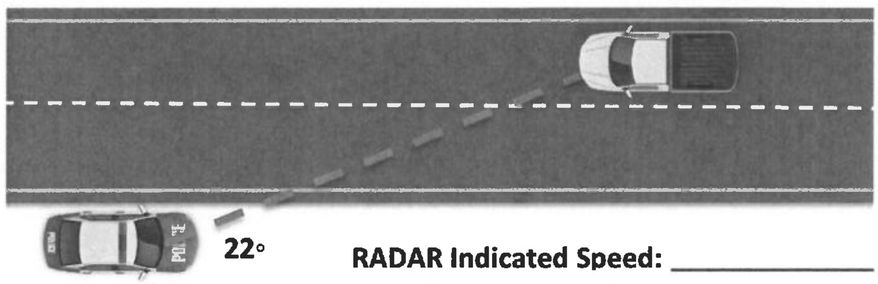
STATIONARY COSINE EFFECT WORKSHEET

True Speed 60 mph



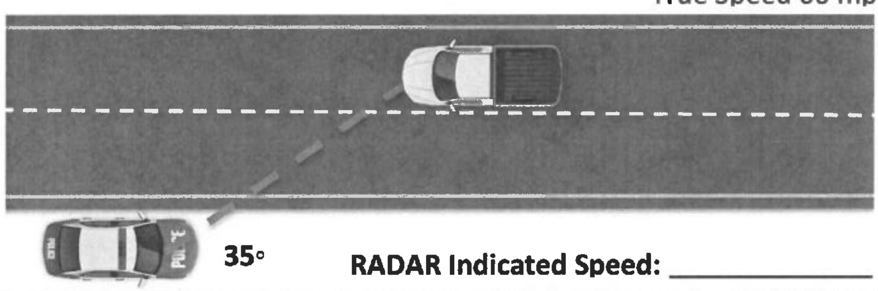
RADAR Indicated Speed: _______________

True Speed 60 mph



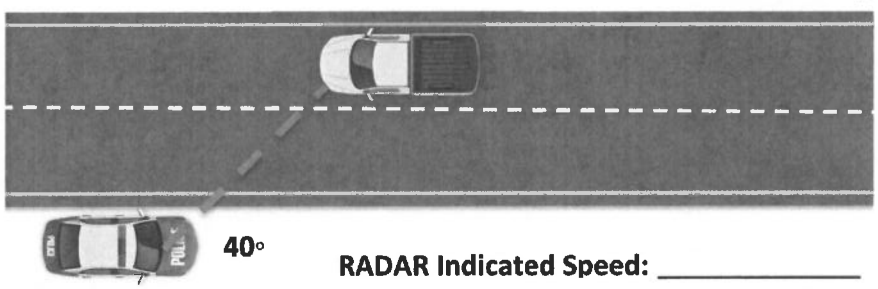
RADAR Indicated Speed: _______________

True Speed 60 mph



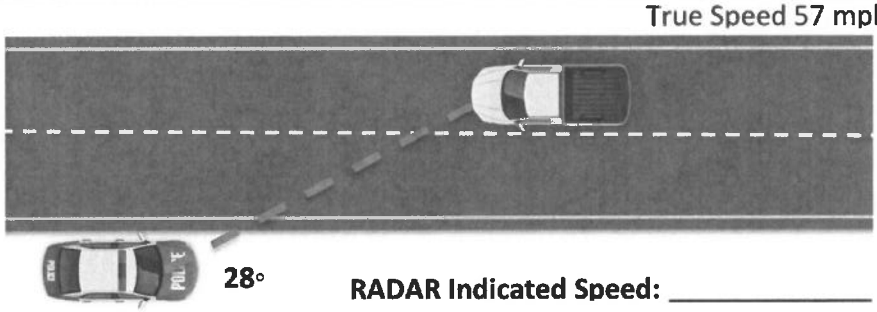
RADAR Indicated Speed: _______________

True Speed 45 mph



RADAR Indicated Speed: _______________

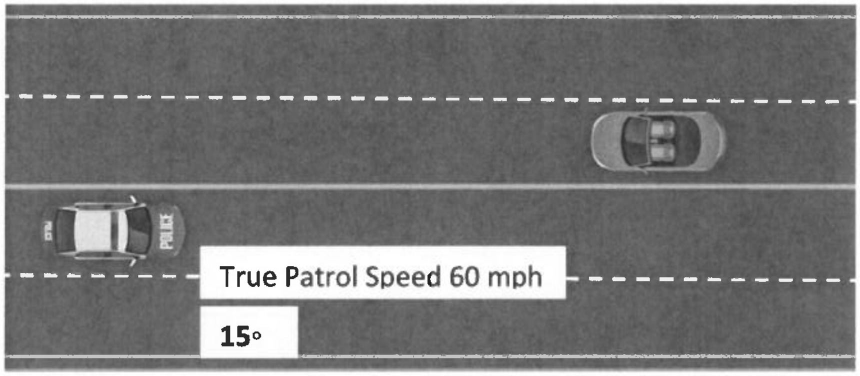
True Speed 57 mph



RADAR Indicated Speed: _______________

MOVING COSINE EFFECT WORKSHEET

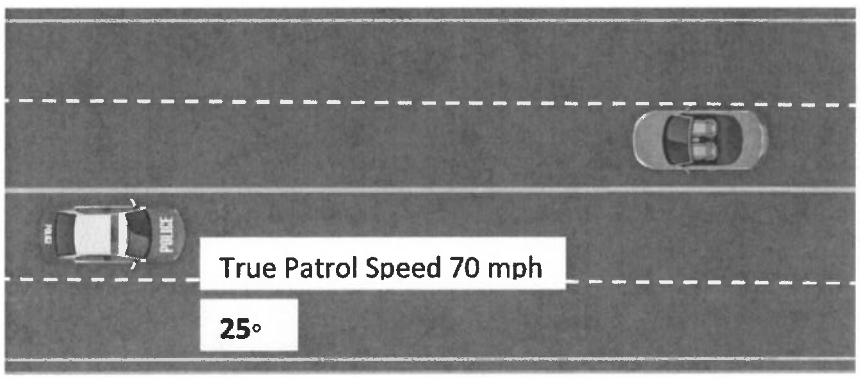
True Speed 60 mph



Closing Rate: __________ **Patrol Indicated Speed:** __________

Target Indicated Speed: __________

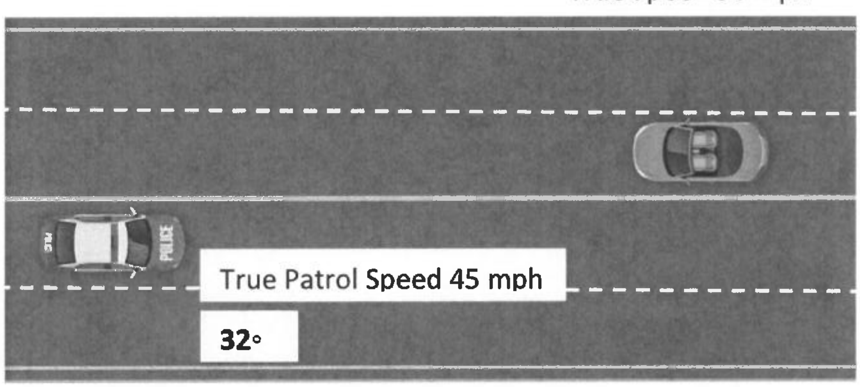
True Speed 65 mph



Closing Rate: __________ **Patrol Indicated Speed:** __________

Target Indicated Speed: __________

True Speed 50 mph

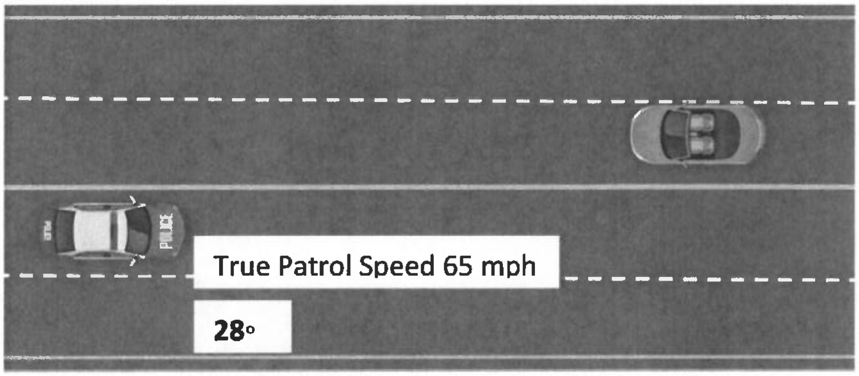


Closing Rate: __________ **Patrol Indicated Speed:** __________

Target Indicated Speed: __________

MOVING COSINE EFFECT WORKSHEET

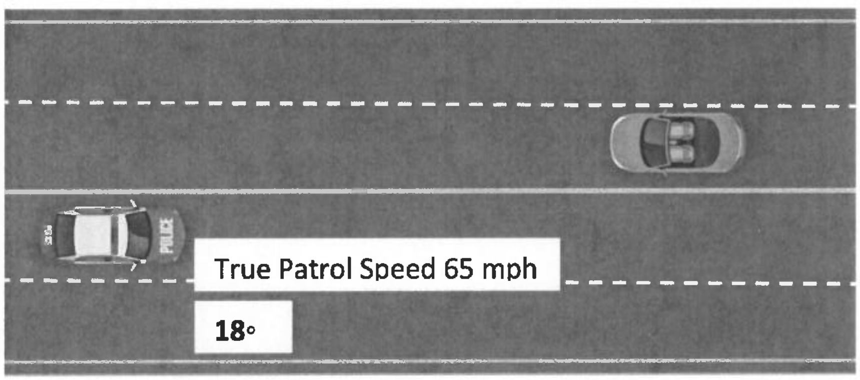
True Speed 70 mph



Closing Rate: __________ **Patrol Indicated Speed:** __________

Target Indicated Speed: __________

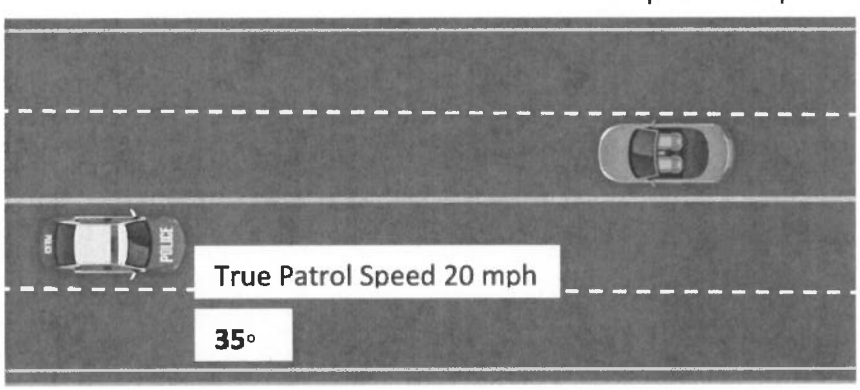
True Speed 65 mph



Closing Rate: __________ **Patrol Indicated Speed:** __________

Target Indicated Speed: __________

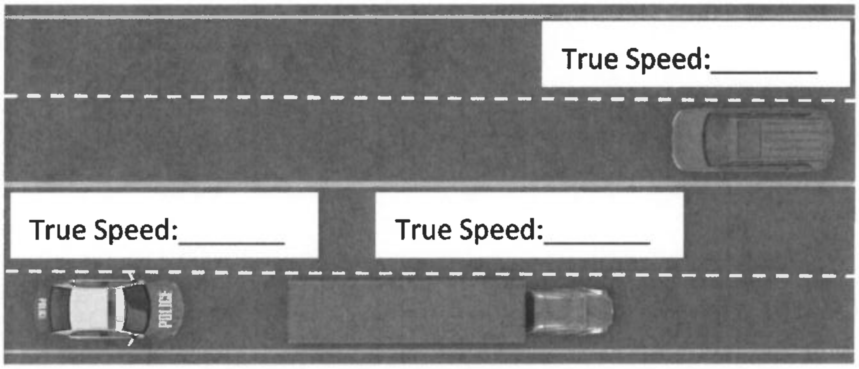
True Speed 23 mph



Closing Rate: __________ **Patrol Indicated Speed:** __________

Target Indicated Speed: __________

SHADOWING EFFECT WORKSHEET



Closing rate of speed computed by RADAR: ________________

Patrol vehicle speed displayed by RADAR: ________________

Target vehicle speed displayed by RADAR: ________________

RADAR PRACTICUM

Practical exercises should follow the instructions for each RADAR device.

Tuning Fork

Hold an oscillating (struck) tuning fork approximately 3 feet from the face of the traffic radar antenna. Is there an appropriate display on the readout?

Yes_____No ______

Slowly move the oscillating the tuning fork towards the face of the radar antenna. Approximately how close to the face of the antenna does the tuning fork have to come before an appropriate reading appears on the readout display?

_____Inches

Are the two above measurements approximately the same (within 1 or 2 inches of each other)?

Yes_____ No _____

If the answer is "no", then explain why there would be a difference.

Hold the oscillating tuning fork directly in front of the of the antenna at a distance of approximately 1 foot. Slowly move the fork out of the main lobe of the antenna beam. Approximately how many degrees can the tuning fork be moved to the side of the beam before the display on the readout disappears?

____Degrees

RADAR PRACTICUM

A. Antenna Alignment

1. Vertical Alignment

Aim the radar antenna beam so that it is parallel with the surface of the roadway. Approximately how far down the roadway can the unit first detect a full-sized passenger vehicle?

_____Feet

Aim the antenna beam up approximately 20 degrees from the surface of the roadway. In this position, how far down the roadway can the unit now first detect a full-sized passenger vehicle?

_____Feet

Aim the antenna beam up approximately 40 degrees from the surface of the roadway. In this position, how far down the roadway can the unit now first detect a full-sized passenger vehicle?

_____Feet

Aim the antenna beam down approximately 20 degrees to the surface of the roadway. In this position, how far down the roadway can the unit now first detect a full-sized passenger vehicle?

_____Feet

Horizontal Alignment-Stationary radar

This experiment requires the use of both the radar device and a motor vehicle. The radar device is to be operated as stationary radar. The antenna is to be aimed straight down the road. The target vehicle is to be accelerated to 50 mph (according to that vehicles speedometer). At this point, record the reading on your display.

_____mph

Now repeat this experiment with the radar antenna misaligned approximately 10 degrees out-of-true. What is the reading displayed?

_____mph

Keep repeating the experiment, successively misaligning the radar antenna 10 degrees further out-of-true until the antenna is aimed 90 degrees (at a right angle) to the oncoming target vehicle. The target vehicle, meanwhile, should make each pass at 50 mph. What are the readings (if any) for each successive misalignment?

DEGREES	DEGREES
20_____mph	60_____mph
30_____mph	70_____mph
40_____mph	80_____mph
50_____mph	90_____mph

Panning

Holding the antenna of a two-piece unit or holding a one-piece unit, pan the horizon in a fast, sweeping motion and record the effects this has on the readout in your display window.

_____mph

Scanning

With the radar turned on, scan or point the antenna beam at the readout module. (Note: This can only be accomplished with a two-piece unit, unless you pan a hand-held unit at another hand-held unit.) Record the reading that was obtained.

_____mph

Power Surge

With the radar device turned off, apply power to the unit (turn it on). Note any display that occurs as the power is applied.

_____mph

RADAR PRACTICUM

Audio Use

Describe the audio (if you unit has this feature) as a target vehicle approaches your radar operating position and suddenly decelerates. Does the sound frequency increase or decrease, and how does it sound?

Does a truck have a radar audio sound different from a motorcycle when both are going 50 mph?

_____Yes _____No

Describe the sound, if any.

Interference Readings

With the radar antenna held in your hands, check around the interior of the patrol vehicle and attempt to find areas that will produce interference of "ghost" readings. Vary the speed of your heater of defroster fans, the air conditioning fan, the vehicle's engine speed, etc. Watch the readout and record the readings displayed together with what caused them.

REVVED ENGINE:

HEATER AT LOW:

HEATER AT HIGH:

DEFROSTER:

OTHERS:

Citizen's Band Radio Effect

With someone else helping you, have a CB radio "keyed up" while its antenna is in your radar's beam. Have the CB set move through the beam while keyed and observed the effects, if any, on your readout.

RESULTS:

RADAR PRACTICUM

Public Band Radio Effect

While using the radar to track a target vehicle, key the police radio in your patrol vehicle. Record the effect, if any.

RESULTS:

Whistling on Citizen's Band Radio

Have an assistant whistle into the microphone of a CB set that has its antenna in your radar's beam.

RESULTS:

Experiments Specific to Radar

The following three experiments require the use of a moving radar device, a patrol vehicle, and a target vehicle.

Horizontal Antenna Alignment - Moving Radar

With the antenna pointed straight down the road, establish a patrol vehicle speed of 30 mph and an approaching target-vehicle speed of 40 mph. Record the reading on your radar displays.

0 degrees Patrol speed:___mph. Target speed:___mph.

Repeat this experiment with the antenna misaligned approximately 10. What are the readings displayed?

10 degrees Patrol speed:___mph. Target speed:___mph

Keep repeating the experiment, successively misaligning the radar antenna 10 degrees or more until the antenna is aimed 90 degrees (at a right angle) to the approaching target vehicle. The target vehicle should make each pass at 40 mph. What are the readings, if any, for each successive misalignment?

20 degrees Patrol speed:	mph.	Target speed:	mph.	30
degrees Patrol speed:	mph.	Target speed:	mph.	40
degrees Patrol speed:	mph.	Target speed:	mph.	50
degrees Patrol speed:	mph.	Target speed:	mph.	60
degrees Patrol speed:	mph.	Target speed:	mph.	70
degrees Patrol speed:	mph.	Target speed:	mph.	80
degrees Patrol speed:	mph.	Target speed:	mph.	90
degrees Patrol speed:	mph.	Target speed:	mph.	

Batching Effect

Because of the stress placed on the motor vehicle and the fuel required to produce the batching effect, it is recommended that this experiment be conducted only once. It would also be helpful in this experiment to have a partner to assist you. Rapidly accelerate the patrol vehicle and continuously monitor the speedometer reading.
Note the difference in speeds between the vehicle speedometer and the patrol ("VERIFY") display on a moving radar device as you "floor it".

Note: This exercise can be duplicated using a stationary radar device, but the batching effect concerns only moving radars. As you "floor it", record the readouts on the radar display as your calibrated speedometer shows 25 mph and 40 mph.

25 mph______ 40 mph _____

While batching can occur under heavy deceleration, you will not be experimenting with this effect. However, if batching did occur while you were slamming on the brakes, what would be the effect on the target speed display by the radar?

Check one: _____Higher-than-true-speed:
_____ Lower-than-true-speed:

Explain your reasoning:

____

____

RADAR PRACTICUM

Shadowing

Individual radar devices will vary in their susceptibility to this effect. Attempt to create the shadowing effect with your department's radar. A shadowing effect can sometimes be achieved by accelerating up to or past a large vehicle, such as a truck, that is moving in the same direction you are. Describe the circumstances that create a shadowing effect and the effect that was produced:

LIDAR PRACTICUM

Practical exercises should follow the instructions for each LIDAR device.

Set-up

- ☐ Inspect device condition. Is there any visible damage?
    - ☐ Yes
    - ☐ No
- ☐ Check optics for cleanliness
- ☐ Inspect power cord (if applicable). Is there any visible damage?
    - ☐ Yes
    - ☐ No

Tests

- ☐ Perform light segment and indicator test. Are all individual light segments and indicators functioning properly?
    - ☐ Yes
    - ☐ No

Internal Test

- ☐ Perform internal circuit check

External Tests

- ☐ Perform sight alignment (horizontal and vertical). Is the LASER beam aligned with the reticule or cross-hairs?
    - ☐ Yes
    - ☐ No
- ☐ Perform range test
- ☐ Perform Delta Distance test

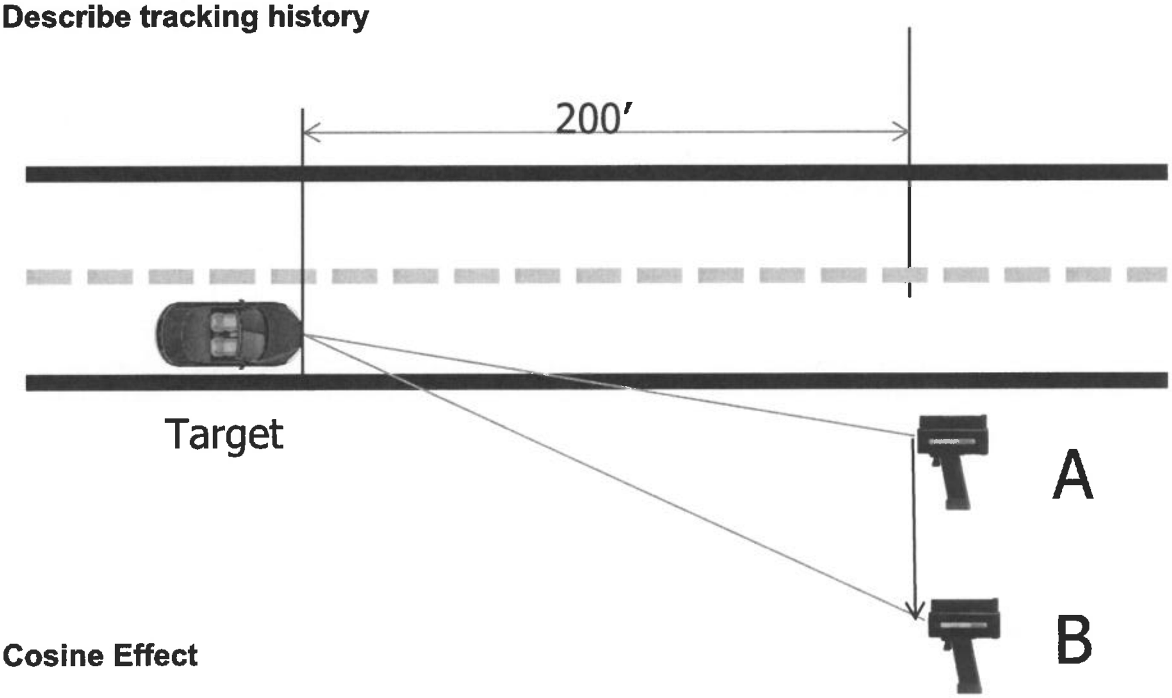
Site selection

- ☐ Line of sight
- ☐ Safe location

Target identification

- ☐ Device aiming
- ☐ Aiming point on target

Speed estimation
Target acquisition
Speed display corresponds with visual estimate
Describe tracking history



Cosine Effect

Using a control vehicle traveling at a set speed, pick a targeting point approximately 200 feet down the roadway.

Operate the LIDAR from a close yet safe distance from the roadway and note the speed readings obtained (point A).

Move from point A to a location creating a significant angle from the path of the target (point B).

Using the same target speed, what is the difference in speed readings?

________mph

Sweep Effect

During the course of monitoring traffic, if and when you observe a suitable vehicle capable of creating a sweep effect, an attempt should be made to create the effect. What was the change in speed?

_________mph

Beam Obstruction

Attempt to experience what happens when the LIDAR beam is interrupted. This can occur when the beam is passed across some object that momentarily obstructs the beam's path to the target. You should note how narrow the obstruction is and its affect on the LIDAR device. A variety of obstructions should be used, including obstructions on patrol vehicle glass.

Size of obstruction____________

Affect on device:

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Radio Frequency Interference (RFI)

Determine from the manufacturer's operation manual if the LIDAR has an RFI indicator or how the device reacts to RFI. Attempt to create a situation where RFI affects the device and note the results. (Refer to Chapter 4: LIDAR Effects for sources of RFI.)

Results from RFI on device:

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Adverse Weather Conditions

Adverse weather conditions may result in the LIDAR's ability to acquire a target. Although difficult to create, the simulation of fog, dust, and rain can be demonstrated and their affects noted.