

<i>Time-Distance Operator Training</i>
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TDI-B04.01

Course Title: TIME-DISTANCE OPERATOR TRAINING

Lesson Title: Basic Principles of Time-Distance Speed Measurement

Lesson Purpose: To acquaint the participant with basic principles on which Time-Distance speed measuring instruments operate.

Performance Objective: At the end of this unit of instruction, the participant will be able to achieve the following objective:

Describe the basic principles on which Time-Distance instruments operate.

Hours: Two (2) hours

Instructional Methods: Lecture, Conference

Materials Required: Time-Distance Operator Training Course Manual
Pen/Pencil
Note Paper

References: See Bibliography

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Date Prepared: Spring 1981

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Date Revised: March 1999

Revised By: North Carolina SMI Advisory Committee

Date Revised: January 2004

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Reviewed By: North Carolina SMI Advisory Committee

Date Reviewed: August 2008

Revised By: North Carolina SMI Advisory Committee

Date Revised: August 2011
August 2013

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TDI-B04.02

Course Title: TIME-DISTANCE OPERATOR TRAINING

Lesson Title: Basic Principles of Time-Distance Speed Measurement

I. Introduction

A. Opening Statement

Ever since the automobile first appeared on the American scene, the problem of speed and its regulation has been present. In order to deal with the problem of speed regulation law enforcement personnel have continually sought to develop newer and more efficient methods to corroborate the officer's opinion of vehicle speed.

This section will deal with Time-Distance speed measuring methods available to the officer. These methods are referred to as Time-Distance because they employ measurements of time and distance to calculate average speed. This unit will be devoted mainly to Time-Distance speed computers which basically incorporate a stopwatch principle and can be operated from stationary or moving patrols.

Note: Show Slide, "Performance Objectives"

B. Performance Objective

At the end of this block of instruction, the trainee will be able to achieve the following objective in accordance with the information provided during the instructional period:

Describe the basic principles on which Time-Distance instruments operate.

C. Reason

Understanding the basic operations of Time-Distance instruments is important to your role as a Time-Distance operator.

II. Body

A. Time-Distance Speed Measuring Methods

1. The Stopwatch Method

Note: Show Slide, “Stopwatch Method-Speed”

Perhaps the earliest mechanical method for measuring speed was the stopwatch. The basic principle behind the stopwatch method is simple. A stopwatch is used as a timer showing the elapsed time for a vehicle traveling a predetermined distance between two points. The elapsed time and the known distance is then converted to average speed in miles per hour using the Speed Formula:

$$D / T = S$$

“or”

$$S \times T = D$$

“or”

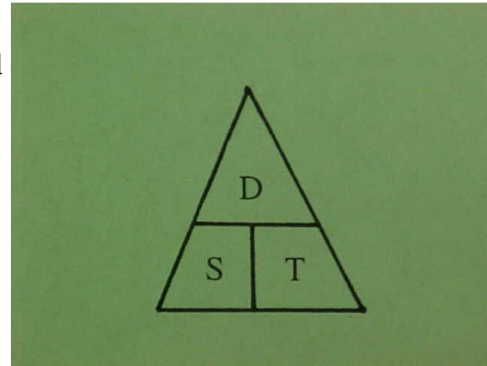
$$D / S = T$$

Where:

D = Distance in miles

T = Time in hours

S = Speed in miles per hour (mph)



When using this Time-Distance method, an officer selects two points of reference with a pre-measured distance between them. As a car passes the first point the officer starts the stopwatch. When the car passes the second point, the officer stops the watch and notes the elapsed time. He now simply calculates the speed by dividing the known Distance by the elapsed Time.

It would be quite difficult to employ this method using markers, or points of reference, when large distances are used between the markers. The officer might not see the target vehicle pass the first marker if it is set up a mile or so down the road. Therefore, the markers are typically selected with a matter of feet separating them. Since Distance is now measured in feet, it is necessary to measure Time in seconds. A car traveling at a fast rate will pass through the markers in seconds or tenths of seconds, not minutes or hours.

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Note: Show Slide, “Stopwatch Method-Velocity”

Therefore, the Speed Formula becomes:

$$D / T = V$$

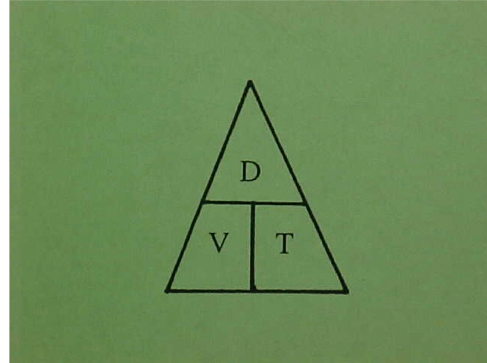
“or”

$$V \times T = D$$

“or”

$$D / V = T$$

Where: D = Distance in feet
 T = Time in seconds
 V = Velocity in feet per seconds (*fps*)



Note: Show Slide, “Converting Velocity to Speed”

It is obvious that we need this information converted to miles per hour. Let's look at some examples:

Example A:

A vehicle travels 1320 feet in 10 seconds. What is the speed of the vehicle?

$$D / T = V \quad 1320/10 = 132 \text{ fps}$$

To convert velocity to speed we divide by 1.466:

$$V / 1.466 = S \quad 132/1.466 = 90 \text{ mph}$$

So the speed of the vehicle is 90 mph.

Example B:

A vehicle travels 88 feet in 1 second. What is the speed of the vehicle?

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$$D / T = V \quad 88/1 = 88 \text{ fps}$$

To convert velocity to speed we divide by 1.466:

$$V / 1.466 = S \quad 88/1.466 = 60 \text{ mph}$$

So the speed of the vehicle is 60 mph.

Example C:

A vehicle travels 6 tenths of a mile in 25 seconds. What is the speed of the vehicle?

There is 5280 feet in a mile and 528 feet in 1/10th of a mile, so 6 tenths of a mile would be 3168 feet. 528 x 6 = 3168

$$D / T = V \quad 3168/25 = 126.72 \text{ fps}$$

To convert velocity to speed we divide by 1.466:

$$V / 1.466 = S \quad 126.72/1.466 = 86 \text{ mph}$$

So the speed of the vehicle is 86 mph.

Example D:

A vehicle travels .22050 miles in 21 seconds. What is the speed of the vehicle?

There is 5280 feet in a mile, so in order to determine how many feet are in .22050 miles we multiply .22050 by 5280 and get 1164.24 feet. .22050 x 5280 = 1164.24

$$D / T = V \quad 1164.24/21 = 55.44 \text{ fps}$$

To convert velocity to speed we divide by 1.466:

$$V / 1.466 = S \quad 55.44/1.466 = 37 \text{ mph}$$

So the speed of the vehicle is 37 mph.

2. The Time-Distance Speed Computer Method

Time-Distance speed computers are versatile instruments that enable traffic law enforcement personnel to measure vehicle speeds while on moving or stationary patrols. These instruments enable an officer to measure the speeds of vehicles in front of, behind, approaching from the opposite direction, or crossing the path of the officer's patrol vehicle. In other words, any time an officer can clearly see the target vehicle and establish reference points he can measure the speed. These instruments are totally immune from violator warning devices, such as "Fuzzbusters" or radar detectors.

Time-Distance speed computers are designed to record the distance traveled by a vehicle and the elapsed time required to travel that distance. They employ the same speed formula as discussed in the previous section on stopwatches, the only difference is the methods of acquiring the time and distance measurements and the computation of the average speed.

Note: Show Slide, "The time-distance computer"

The Time-Distance computer, like all other speed measuring methods, is used to corroborate the officer's opinion of vehicle speeds.

The basic Time-Distance computer may consist of from one to two modules:

Note: Show Slide, "Modules"

- a) A Computer Module consisting of electronic circuitry to accept time and distance information and that automatically calculates average speed;
- b) An Odometer / Distance Data Module simply translates and sends distance information to the computer. Depending upon the particular patrol vehicle manufacturer or model year, the module may be either an "odometer module" or what is referred to as a "distance data module." The odometer module is mechanical and is commonly attached directly to the patrol vehicle's transmission or odometer cable. The "distance data module" may be mechanically attached to the drive shaft of the patrol car which

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utilizes magnets and a receiver, or it may electronically interfaced with the vehicle's onboard diagnostics (OBD-2) port, or may be electronically interfaced with the vehicle speed sensor data line from the patrol vehicle's onboard computer system. Regardless as to which module is used, its purpose is to simply translate the distance traveled by the patrol vehicle which is used as part of the distance-over-time computation.

Time-Distance Instruments may be used to "time" events or measure distances such as skid marks at the scene of an accident or distances to the nearest landmarks for pinpointing an accident scene. With some Time-Distance Instruments, the operator may pre-program into the computer a known distance between two reference points or markers; he then only times vehicles between these same two points to obtain an average speed measurement.

B. Speed Estimates

Note: Show Slide, "Estimating Speed"

Perhaps the most basic way to minimize target selectivity problems is to rely on your own ability to estimate vehicle speeds. Most traffic violations require an officer to make some type of observation or measurement. One of the most common types of observation is the speed of vehicles. In North Carolina an officer must first have an opinion, independent of any speed-measuring equipment used, as to the speed of a specific vehicle. In essence, determining speed by the use of speed-measuring equipment alone is not sufficient to establish vehicle speed. However, the determination of speed by use of speed-measuring equipment can be used to corroborate the opinion of an officer as to the speed of a specific vehicle.

From a legal standpoint, one of the most commonly recognized elementary rules of evidence is that an opinion as to the speed of a moving vehicle may be given by an ordinary witness whose actual observation has qualified him to form such an opinion. Quoting from Brandis & Brown on North Carolina Evidence, Section 183 (5th ed. 1998) "A lay witness with sufficient knowledge and opportunity to observe may testify to the speed of a vehicle or the distance within which it could have been stopped on a given occasion." Accordingly, "any person of ordinary intelligence, who has had an opportunity for observation, is competent to testify as to the rate of speed" of a motor vehicle. Id. The rules of evidence in North Carolina require that facts necessary to prove the essential elements of a case be

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established by testimony or evidence. Therefore, an officer must have the ability to form an opinion as to speed in order to substantiate a speeding charge.

Ability to estimate the speed of a vehicle is not something we are born with but is a learned ability. Human limitation coupled with other environmental conditions such as night or day; the size of vehicles; the limitation of time to observe; the angle of observation; and other variables make the formation of opinion of speed an inexact science. Yet your ability to form opinions based upon observation is something you either consciously or unconsciously use every day of your life. For example, when crossing a street you observe approaching traffic and make a determination that you may or may not cross the street safely. This is determining speed. Your ability to make this determination was developed through individual mental judgments. Therefore, as a professional traffic officer, it is incumbent that you learn to estimate speed using objective criteria.

The fundamentals of speed-measurement involve forming a basis for measuring the rate of movement of a vehicle from one point to another. Mathematically speaking, a vehicle traveling 60 miles per hour is traveling at a rate of one mile per one minute. The formula for this computation is the distance it moves divided by a given unit of time. Therefore, a vehicle traveling 60 miles per hour is moving at a rate of 88 feet per second. For a person to estimate vehicle speed, he must have a conception of distance and its relationship to the rate of movement.

It is indeed important for an officer to know the difference between guessing and estimating speed. Guessing the speed of a vehicle would involve influence by superficial conditions such as sound or distortion of vehicles in relationship to distances involved. Because estimating speed is more scientific than guessing speed, an officer can confirm his observation based only upon established procedures. In this respect, the more practice the officer has in determining the speed of vehicles over a given distance will add credibility to the officer's opinion.

The development of an officer's ability to estimate speed will grow as he practices with known speeds. A calibrated stopwatch used in conjunction with a measured distance will provide him experience in visual comprehension. While practicing, the officer should add to his experiences by positioning himself at different angles in relation to the vehicles which are traveling the measured distance. The vehicle used to assist in this experiment should be one with a calibrated speedometer. The vehicle should travel at varying speeds. A cross check of time that would be necessary to travel a known distance coupled with a known speed by the vehicle operator, serves to corroborate the officer's opinion and build upon his ability to visually and mentally conceptualize distance-time relationships. In 2012, a couple of important decisions by the United States

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Fourth Circuit Court of Appeals (*U.S. v. Sowards*; and *U.S. v. Mubdi*) brought attention to the technique of independent visual estimations of speed. These two cases are of paramount importance for the Operator to understand, and will be discussed later within the Legal and Operational Considerations section of this manual.

Practicing the estimation of speed, from a stationary position will enhance the officer's confidence, especially when he is able to make reasonably close estimates. The next stage of practice involves the officer driving a vehicle and making estimates of speed when meeting or following another vehicle. Here again, the test vehicle should be equipped with a calibrated speedometer and variable speeds should be observed. During this practice, the officer must also become familiar with different size vehicles, design features, and any other characteristics that may influence his perception of the vehicle's speed. Visual and mental perception must be learned during this practice. As you become more proficient in stationary and moving estimates, you should then build your ability to make judgments during inclement weather, night hours, and other environmental conditions that may exist. The key to successful development of your ability to accurately estimate speed is through hours of practice. You will continue to develop this ability through experience. The experiences will provide you with factual information so that you will have a broader baseline to support your ability to estimate speed. In the final analysis, the test of your ability to accurately estimate speed will depend upon your honesty as an estimator. If doubt ever exists as to the speed of a certain vehicle, always give the benefit of that doubt to the violator.

III. Conclusion

- A. Summary
- B. Questions

Note: Show Slide, “Questions”

- C. Closing Statement