CHANGE IN SPEED

DATA COLLECTION METHOD

Introduction

Spot speed studies are used to evaluate the effectiveness of a project in reducing the prevailing speed of vehicular traffic. Reduced motorist travel speeds give more time for drivers, cyclists, and pedestrians to react to unexpected conditions and reduce the severity of pedestrian and cyclist injuries.

This document provides three methods for collecting speed data and guidance on data analysis. Field conditions may vary, and individual judgement must be applied for personal safety and liability when collecting speed data.

Overview

To collect data for the **change in speed** measure, the data collector can gather information about speed data using one of three tools: radar, stopwatch, or pneumatic tubes. Each of these methods requires different levels of technology and staffing and provides varying levels of accuracy.

- Data collection should occur under typical clear weather conditions (i.e., not during rain or wet surface conditions) and during daylight hours (i.e., not during dawn, dusk, or dark conditions).[1]
- Data collection should occur between the hours of 9:00 am and 3:30 pm to measure free flow traffic conditions, or during school peak hours for a Safe Routes to School project.
- If reducing nighttime speeding is an objective of the project, use methods that record speed 24 hours per day.
- In- person data collection should be approved or assigned by supervisors.
- Collect at least 50 observations. One hundred are preferred.[2]
- Collect pre and post data during the same time of year and at the same place. Post-data should be collected at least 180 days after the completion of the project or plan to ensure a more accurate measure of success.

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[1] This may not apply if the project goal is to address a problem that occurs during darkness.

[2] From ASU POP Center's Spot Speed Methodology.

Staffing Requirements

- The radar and stopwatch methods require at least one coder who has read and understands the methodology to collect data. This coder will be present on site to record driver behavior. The pneumatic tube method should be conducted with a trained and qualified vendor.
- If collecting before and after data to evaluate a countermeasure or design change for change in speed, use the same data collection method and try to maintain the same coder for both time frames.

Data Collection

This section outlines the speed study data collection methods, provides guidance on which materials are needed, preparation reminders, and general instructions for each method. The methods are listed from least expensive to most expensive.

Method 1: Stopwatch

The stopwatch method can be used to complete a spot speed study using a small sample size collected over a short period of time. The method's start-up costs are low, and the collection can be performed by a single staff member. This method is time-based, meaning the data collector will note the time it takes vehicles to pass between two designated points. The distance formula (speed =distance/time) converts this to speed. Consistency in performing the field data collection is the key to success for this spot speed method. A cell phone with a stopwatch function (that measures to tenths of a second or more) may be used.

General Instructions

The stopwatch method has five (5) key steps:

1. **Schedule sufficient time** to complete the data collection.
2. **Select a location** for 50-100 observations with safety, visibility, and comfort in mind.
3. **Determine the study length** and start and end points for data collection.
4. **Record observations** on the data collection form.
5. Once all the data has been recorded, **calculate vehicle speeds** based on the time it took vehicles to travel through your designated study zone.

Schedule Sufficient Time

With the stopwatch method, the margin of error lies in the data collector. Blocking out a window of time without interruption to collect consistent data will make your data more accurate. The length of time required to obtain 100 observations will depend on the traffic volume of the road. Plan for four hours total at the same time of day, over multiple days, if needed.

Select a Location

With the data collector's safety front of mind, choose a location about 100 ft. downstream from the installed project or if assessing a plan, somewhere within the plan's study area. Try to collect data where vehicles are traveling under free-flow conditions, downstream from street elements such as speed humps, traffic signals, stop signs, or pedestrian flashing beacons. Collect data from vehicles traveling in the same direction.

MATERIALS NEEDED

- Stopwatch
- Printed data collection form and clip board
- 50 – 300 ft. of measuring tape
- Safety vest
- Two cones

PREPARATION REMINDERS

- Contact local law enforcement to notify them of the study
- Select a time and day to perform the study that is outside of rush hour traffic and has temperate weather

Determine Study Length

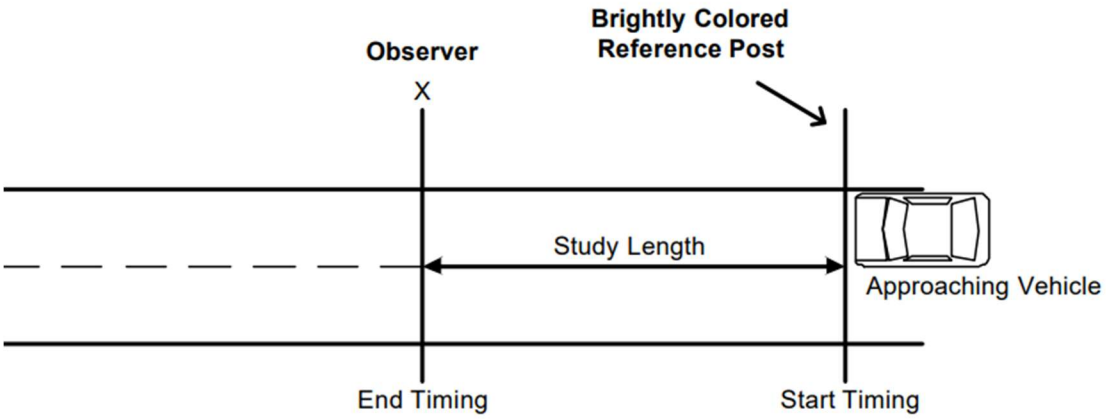
The stopwatch method relies on timing vehicles passing between two points. The data collector starts the watch when a vehicle's front wheels cross over point 1 and stops the stopwatch once the front wheels cross over point 2. Both points and passing vehicles need to be in the sightline of the data collector. The table below recommends the distance between point 1 and point 2 based on the road's current speed.

Figure 1 Recommended Spot Speed Study Lengths

Traffic Stream Posted Speed	Recommended Study Length
Below 25 miles per hour (MPH)	88 ft.
25 – 40 MPH	176 ft.
Above 40 MPH	264 ft.

With the measuring tape, mark out the appropriate study zone distance. Drop one cone at Point 1 and the second cone at Point 2, the end of the study zone.

Figure 2 Example Data Collection Setup for Stopwatch Method



Source: Arizona State University Center for Problem-Oriented Policing

Record Observations

Record information about the location on the top of the **Data Collection (Stopwatch)** sheet, including the date, your name, location, start and end time, weather, posted speed limit, vehicle travel direction, and study length.

Again, the start time is when the vehicle's front wheels cross over point 1 and the end time is when the vehicle's front wheels cross over point 2. The data collection form allows the coder to enter time data in tenths of seconds.

Target Passenger Vehicles

Except for studies conducted under low-volume conditions, it is impossible to obtain a stopwatch measurement for every vehicle. Focus only on recording speed for **passenger cars** as these are usually the fastest vehicles and most prevalent. Passenger cars generally include sedans, sports utility vehicles (SUVs), station wagons, pickup and panel trucks, and motorcycles. (Passenger cars do **not** include city buses, school buses, farm equipment, semi-trailer trucks, dump trucks, or box trucks.)

Choose the Sampling Frame

To reduce bias for the recorder to only collect data on vehicles that stand out, obtain a time recording for every **third** vehicle.

Calculate Vehicle Speeds

The table in the **data collection form** uses the calculation below to determine miles per hour based on recorded entries. Multiplying the time elapsed in seconds by 1.47 converts unit of feet per second to miles per hour.

*Spot speed (MPH) = study length (ft) / (1.47) * time elapsed (seconds)*

The **Overview** sheet calculates the number of data points, median speed, 85th percentile speed, 95th percentile speed, top speed, percent of observed vehicles exceeding the speed limit, and the percent of vehicles traveling at excessive speed (i.e., more than 10 miles over the speed limit).

Method 2: Radar Meter

This method may require a one-time investment in a radar meter if there is not one available from your police or public works department. This method can collect exact speeds of vehicles without any follow-up calculations and can be performed by a single staff member. Location of the hand-held speed radar is key to the success of this spot speed method.

General Instructions

A spot speed study includes four (4) key steps:

1. **Schedule sufficient time** to complete the data collection.
2. **Select a location** for 50-100 observations with safety, visibility, and comfort in mind.
3. **Record observations** on the data collection form to ensure the most accurate study results.
4. Once all the data has been recorded, **observe the results** in the Overview sheet.

Schedule Sufficient Time

Blocking out a window of time without interruption to collect consistent data will make your data more accurate. The length of study time will depend on the traffic volume of the road. Plan for four hours.

MATERIALS NEEDED

- Radar meter
- Radar tripod (if using)
- Safety vest

PREPARATION REMINDERS

- Contact local law enforcement to notify them of the study
- Select a time and day to perform the study that is outside of rush hour traffic and has temperate weather

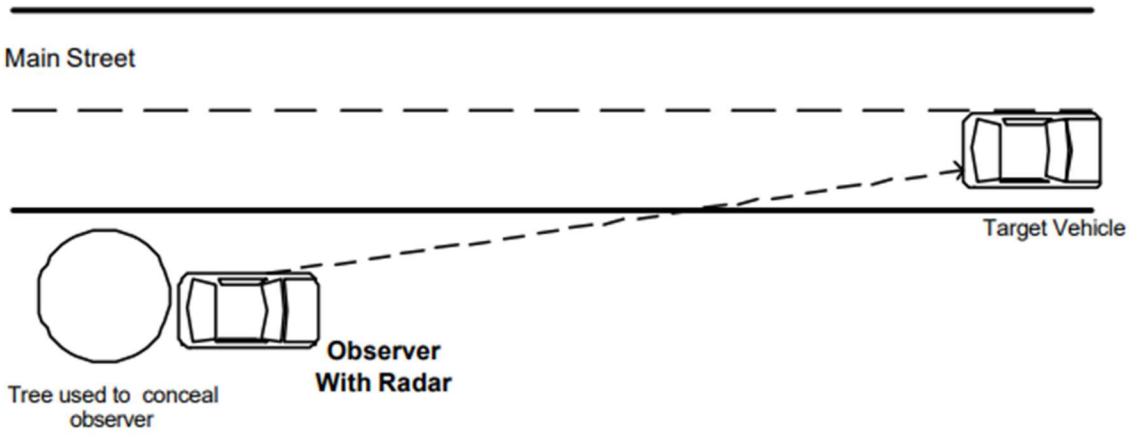
Select a Location

With the radar meter method, choose a location about 100 ft. downstream from the installed project or if assessing a plan, within the plan's study area. Try to collect data where vehicles are traveling under free-flow conditions, downstream from street elements such as speed humps, traffic signals, stop signs, or pedestrian flashing beacons. Collect data from vehicles traveling in the same direction.

Radar meters work by measuring a vehicle's speed passing by, meaning the staff member must point the radar meter at the car. A radar meter can read speeds from up to two miles away, but its accuracy decreases with distance. A radar meter is most accurate when aimed at the front or rear of a vehicle.

To reduce the possibility that a driver will notice the radar meter and slow down, stand with the radar meter or mount the radar meter on a tripod where it can be **aimed at the back of a vehicle** driving away. The data collector may also stand or mount the radar meter on the tripod somewhere concealed from the roadway.

Figure 3. Example Data Collection Setup for Radar Method



Source: Arizona State University Center for Problem-Oriented Policing

Record Observations

Record information about the location on the top of the **Data Collection (Radar)** sheet, including the date, your name, location, start and end time, weather, posted speed limit, vehicle travel direction, and study length. Record speed observations for vehicles.

Target Passenger Vehicles

Except for studies conducted under low-volume conditions, it may be impossible to obtain a radar measurement for every vehicle. Focus only on recording speed for **passenger cars** as these are usually the fastest vehicles and most prevalent. Passenger cars generally include sedans, sports utility vehicles (SUVs), station wagons, pickup and panel trucks, and motorcycles. (Passenger cars do **not** include city buses, school buses, farm equipment, semi-trailer trucks, dump trucks, or box trucks.)

Choose the Sampling Frame

To reduce bias for the recorder to only collect data on vehicles that stand out, obtain a time recording for every **third** vehicle.

Observe the Results

The **Overview** sheet calculates the number of data points, median speed, 85th percentile speed, 95th percentile speed, top speed, percent of observed vehicles exceeding the speed limit, and the percent of vehicles traveling at excessive speed (i.e., more than 10 miles over the speed limit).

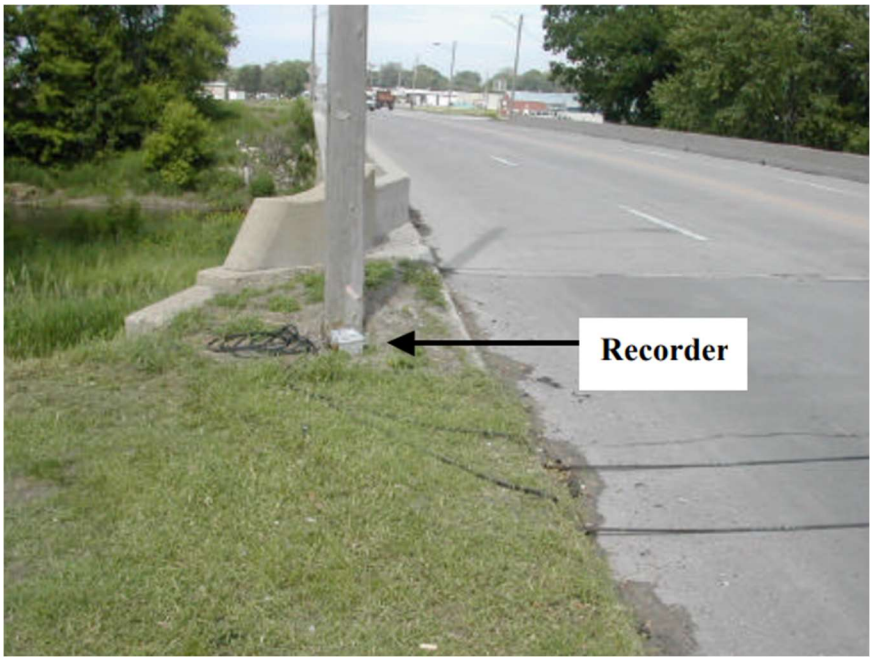
Method 3: Pneumatic Tubes

The pneumatic road tube method collects speed and vehicle classification data over a period of one or more days. Pneumatic tubes are placed in the travel lanes and are connected to recorders located at the side of the road. The recorders save the time lapsed as the front wheels roll over a set of two tubes.

The pneumatic road tube method requires specialized equipment and knowledge of how to maintain the equipment. Use a trained and qualified vendor to deploy this method and request that the vendor provide the following data:

- Number of data points collected
- Median, or 50th percentile, speed in MPH
- 85th percentile speed in MPH
- 95th percentile speed in MPH
- Top speed
- Percent of vehicles exceeding the posted speed limit
- Percent of vehicles traveling at excessive speed (More than 10 MPH over the posted speed limit)

Figure 4. Example Data Collection Setup for Pneumatic Tubes Method



About Speed Data

This methodology uses speed as a proxy measure for road safety. Change in the percent of vehicles speeding or overall operating speeds provides information about the impact of a specific intervention. This section explains the significance of data outputs.

Median Speed

Median speed, or 50th percentile speed, represents the speed at which half of the observed vehicles are below and half of the observed vehicles are above. The 50th percentile speed represents the typical speed of the traffic stream. Assuming the traffic is distributed normally, the majority of vehicles will cluster around the median.

85th and 95th Percentile Speed

The 85th percentile speed is the speed at which 85% of observed vehicles are traveling at or below. This percentile has been historically used in recommending and establishing speed limits based on the assumption that 85% of drivers are traveling at a speed perceived to be safe.

The 95th percentile speed can be used as an estimate for the fastest speed a typical user will encounter on a street. It also provides context to the 85th percentile speed by offering a better picture of dangerous speeds on the street.

Top Speed, Percent Exceeding the Speed Limit, and Percent Excessive Speed

Top speed, the percent of vehicles exceeding the speed limit, or traveling at excessive speed can represent high-end speeding on a roadway. A decrease within these indicators from before and after data counts can show effective speed management. While the top recorded speed can sometimes be a data anomaly, it can be useful to verify whether there are times of day when the road design allows dangerous speeds.