CALIFORNIA HIGHWAY PATROL

GENERAL ORDER 40.3

REVISED OCTOBER 2019

SPEED MONITORING

1. POLICY. Speed monitoring for departmental purposes shall be conducted in accordance with direction provided in this General Order.

2. GENERAL. Speed monitoring is a tool to assist departmental personnel in determining which roads, times of day, or days of week merit priority enforcement.

a. Speed monitoring may be useful in problem identification by providing data for determining which roads and what times of day or days of the week merit priority enforcement. Monitoring is also used in the evaluation of enforcement programs and for justification of radar speed enforcement proposals.

b. The California Vehicle Code (CVC) provides the California Department of Transportation (Caltrans) the authority to evaluate and change the prima facie speed limit on state highways when an engineering and traffic survey (E&TS) supports a speed limit change for existing conditions.

3. CALIFORNIA DEPARTMENT OF TRANSPORTATION SPEED MONITORING.

a. Area commanders (with concurrence from their Division) are responsible for replying to requests from Caltrans for information pertaining to the raising or lowering of a prima facie speed limit on any segment of a state highway.

b. The Caltrans E&TS consists of data collection sessions using automatic speed recording equipment instead of radar.

c. Survey site selections are based on statistical requirements of the federal government. Although these selections are generally permanent sites, there could be minor changes from year to year.

d. Departmental personnel can obtain copies of individual Vehicle Speed Survey Sheets from the local Caltrans district office, or the Caltrans Division of Traffic Operations in Sacramento.

e. Area commanders learning of Caltrans speed surveys conducted in their Area should ensure normal deployment procedures are continued. Patrol units should avoid stopping in survey areas except as required in conducting normal activities.

4. DEPARTMENTAL SPEED MONITORING.

a. Field commanders may conduct special speed surveys when speed and/or crash trends warrant such studies. Radar or lidar equipment may typically be used.

b. No enforcement action should be taken solely on the basis of readings obtained during the speed monitoring process.

c. To minimize training costs and ensure reliability of surveys, speed monitoring should be conducted by field personnel trained in the use of radar or lidar.

d. Time devoted to speed monitoring should be limited to the lowest practical level commensurate with effective resource management.

e. Speed monitoring site locations should be representative of typical conditions for a particular roadway segment. The following are situations which should be avoided:

(1) Near a sharp horizontal curve.

(2) Steep grades (i.e., plus or minus 3 percent).

(3) Near significant roadway intersections (less than 1,000 feet) or commercial entrances such as shopping centers.

(4) Where other unusual features exist that might influence motorist speeds (e.g., a narrow bridge).

f. The following environmental conditions promote uniform data collection:

(1) Clear weather.

(2) Road surface free of moisture or snow.

(3) Low wind velocity.

(4) No road construction or repair within one-half mile of the speed monitoring site.

g. The following guidelines are recommended when radar or lidar is used for speed monitoring:

(1) Use an unmarked vehicle.

(2) Conceal the monitoring activity to ensure safety and accurate speed readings (e.g., avoid the median, park well off the road, monitor from an overcrossing, park in a protected area).

(3) Ensure the radar or lidar has been calibrated before monitoring.

(4) Identify the speeds of as many vehicles as possible, not just the lead vehicle in a pack.

h. Speed measurements should be taken during off-peak hours.

i. A statistical calculations guide is provided in Annex A. The Special Projects Section may be contacted for assistance with calculations.

j. A minimum of 100 vehicle speeds is recommended for each survey. For roads with an average daily travel of over 10,000 vehicles, increasing the sample to a minimum of 400 vehicles is recommended. Example Vehicle Speed Survey Sheets are provided in Annex B.

5. AUTHORITY TO CHANGE PRIMA FACIE SPEED LIMITS ON STATE HIGHWAYS.

a. Sections 22354 and 22354.5 CVC provide the authority to Caltrans to raise or lower the prima facie speed limit on state highways when E&TS surveys suggest a change is warranted.

b. If Caltrans proposes raising or lowering the prima facie speed limit on any portion of a state highway, it must consult with, and take into consideration the recommendations of the California Highway Patrol (Section 22354.5 CVC). Upon receiving a Caltrans request for consultation and recommendations, the affected Area commander will provide a proposed response to the respective Division for approval prior to submittal to Caltrans.

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ANNEX A

STATISTICAL CALCULATIONS

The following statistics may be calculated from speed monitoring data gathered using radar or lidar. All examples of calculations are based on information from the Vehicle Speed Survey Sheets in Annex B.

1. AVERAGE SPEED.

a. The average speed provides an overall indication of how fast motorists generally travel on a particular segment of road. With surveys of less than 100 vehicles, the average speed may be misleading if a group of particularly fast or slow vehicles was monitored.

b. The average speed is usually calculated by multiplying the speed (in miles per hour [MPH]) by the number of times a vehicle was observed at that speed; then adding that product to the result of the same calculation for all other speed categories; and finally, dividing that sum by the total number of vehicles observed. Table 1 uses the data from the first example of the Vehicle Speed Survey Sheets in Annex B, and illustrates the average speed calculation:

Table 1

Speed (MPH)	**x**	**Number of Vehicles Observed**	**=**	**Speed x Vehicles**
52	x	4	=	208
51	x	8	=	408
50	x	12	=	600
49	x	10	=	490
48	x	9	=	432
47	x	6	=	282
46	x	5	=	230
45	x	2	=	90
44	x	2	=	88
		Sum = 58		Sum = 2,828
Average Speed: 2,828 = 48.8 MPH				
58				

ANNEX A

STATISTICAL CALCULATIONS (*continued*)

2. EIGHTY-FIFTH PERCENTILE SPEED.

a. The eighty-fifth (85th) percentile speed is the speed at or below which 85 percent of all drivers operate vehicles on a particular stretch of roadway. In other words, only 15 percent of the motorists are traveling faster than the 85^{th} percentile speed.

b. Most drivers believe the 85th percentile speed is the speed at which they can safely operate their vehicles, and is often used as a basis for determining speed limits. Table 2 calculates the 85th percentile speed using the data from the second example of the Vehicle Speed Survey Sheets in Annex B:

Table 2

Speed (MPH)	Number of Vehicles Observed	Cumulative Number of Vehicles
50	2	109
49	7	107
48	11	**100**
47	11	**89**
46	13	78
45	13	65
44	11	52
43	10	41
42	10	31
41	8	21
40	8	13
39	5	5
	Sum = 109	

c. Calculation Process.

(1) Arrange the vehicle speeds from highest to lowest.

(2) To determine the cumulative number of vehicles for a speed category, add the number of vehicles observed both at and lower than that speed. Start with the lowest speed category.

(3) Multiply the total number of vehicles observed by 85 percent. In Table 2, the 85th percentile speed of the Cumulative Number of Vehicles is at point "92.65" (109 x .85 = 92.65). Therefore, the 85th percentile speed is between 47 and 48 MPH; and between 89 and 100 Cumulative Number of Vehicles.

(4) In the Cumulative Number of Vehicles column, locate point 92.65 (between bolded 89 and 100). The 85th percentile speed is between 47 and 48 MPH (bolded); it is greater than 47, but less than 48 MPH. The 85^{th} percentile (92.65) is closer to 89 than to 100 indicating the 85th percentile speed will be closer to 47 than 48 MPH.

(5) To calculate the statistic precisely, subtract the lower boundary (89) from the 85th percentile point (92.65): 92.65 – 89 = 3.65.

(6) Determine how many vehicles were traveling between the upper and lower speeds (47 and 48 MPH): 100 – 89 = 11.

(7) Divide 3.65 by 11: 3.65/11 = .332.

(8) Multiply .332 by the increment size in MPH of the Speed MPH column (between 47 and 48 MPH is 1 MPH): .332 x 1 = .332.

(9) Add .332 to the lower speed (47 MPH) to obtain the precise 85th percentile speed: .332 + 47 = 47.332.

(10) The 85th percentile speed is 47.3 MPH rounded.

3. PERCENTAGE OF MOTORISTS EXCEEDING THE SPEED LIMIT.

a. This is a measure of the precise proportion of motorists violating the law. The statistic is generally less affected by groups of very fast or slow drivers. Table 3 calculates the percentage of motorists exceeding the speed limit (50 MPH) using the data from the first example of the Vehicle Speed Survey Sheets in Annex B.

ANNEX A

STATISTICAL CALCULATIONS (*continued*)

Table 3

Speed (MPH)	**Number of Vehicles Observed**
52	**4**
51	**8**
50	12
49	10
48	9
47	6
46	5
45	2
44	2
	Sum = 58

b. Calculation Process.

(1) Add the total number of vehicles traveling over the speed limit (50 MPH).

(2) Divide the number of vehicles traveling over the speed limit (12) by the total vehicles observed (58): 12/58 = .2069.

(3) Multiply .2069 by 100 to get the percentage of vehicles traveling over the speed limit: .2069 x 100 = 20.69 percent.

4. TEN MILES PER HOUR PACE.

a. There are several ways to measure how variable the speeds are at which motorists travel. A common measurement of variability is the “pace” which is the 10 MPH range of speeds that contains the most vehicles. This statistic is useful in estimating crash frequency because crashes are more common when motorists are traveling at many different speeds.

ANNEX A

STATISTICAL CALCULATIONS (*continued*)

Table 4

Speed (MPH)	**Number of Vehicles Observed**
50	2
49	**7**
48	**11**
47	**11**
46	**13**
45	**13**
44	**11**
43	**10**
42	**10**
41	**8**
40	**8**
39	5
	Sum = 109
*102 vehicles (94 percent) are contained within the 10 MPH pace.	

b. Calculation Process.

(1) Add together the number of vehicles observed in the selected 10 MPH range (pace) which contains the greatest number of vehicles. Using the data in the second example of the Vehicle Speed Survey Sheets in Annex B, the 40 to 49 MPH range contains 102 vehicles.

(2) Divide 102 by total number of vehicles observed (109): 102/109 = .9357.

(3) Multiply .9357 x 100 to get percentage of vehicles traveling in the 10 MPH pace (94 percent rounded).

(4) The higher the proportion of vehicles in the pace, the more uniform the speeds are, and the less likely crashes will be caused by variance in speeds.

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ANNEX B

VEHICLE SPEED SURVEY SHEET

Example of Vehicle Speed Survey with a Vehicle Count Less Than 100

City: _____ Date: _____ Post Mile: _____
Location: _____ Weather: _____ Posted Speed: ____
Recorder Name: _____ Begin Time: _____ End time: _____

MPH					5					10					15					20	Total	MPH x Total
55																						
54																						
53																						
52	X	X	X	X																	4	208
51	X	X	X	X	X	X	X	X													8	408
50	X	X	X	X	X	X	X	X	X	X	X	X									12	600
49	X	X	X	X	X	X	X	X	X	X											10	490
48	X	X	X	X	X	X	X	X	X												9	432
47	X	X	X	X	X	X															6	282
46	X	X	X	X	X																5	230
45	X	X																			2	90
44	X	X																			2	88
43																						
42																						
41																						
40																						
39																						
38																						
37																						
36																						
Cumulative Vehicles Counted																					**58**	
Cumulative MPH Vehicles Counted																						**2,828**

Average Speed: 2,828/58 = **48.8 MPH**

Signed: _____ Date: _____ Title: _____

ANNEX B

VEHICLE SPEED SURVEY SHEET (*continued*)

Example of Vehicle Speed Survey with a Vehicle Count Greater Than 100

City: _____ Date: _____ Post Mile: _____
Location: _____ Weather: _____ Posted Speed: ____
Recorder Name: _____ Begin Time: _____ End time: _____

	Number of Vehicles																				
MPH					5					10					15					20	Total	Cumulative Total
55																						
54																						
53																						
52																						
51																						
50	X	X																			2	109
49	X	X	X	X	X	X	X														7	107
48	X	X	X	X	X	X	X	X	X	X	X										11	100
47	X	X	X	X	X	X	X	X	X	X	X										11	89
46	X	X	X	X	X	X	X	X	X	X	X	X	X								13	78
45	X	X	X	X	X	X	X	X	X	X	X	X	X								13	65
44	X	X	X	X	X	X	X	X	X	X	X										11	52
43	X	X	X	X	X	X	X	X	X	X											10	41
42	X	X	X	X	X	X	X	X	X	X											10	31
41	X	X	X	X	X	X	X	X													8	21
40	X	X	X	X	X	X	X	X													**8**	13
39	X	X	X	X	X																**5**	5
38																						
37																						
36																						

Number of Free Flow Vehicles Counted: 109 # to count up: 93
85th percentile calculation: total (109) times 0.85 = 92.65

This vehicle's speed was: 48 MPH
Number of all vehicles at this speed: 11

Signed: _____ Date: _____ Title: _____