

Draft Technical Report
The Amount of Vehicle Operation
over 50 MPH

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by

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Notice

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Standards Development and Support Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
U.S. Environmental Protection Agency

I. Introduction

It is a well known fact that vehicle operational characteristics, in particular vehicle driving speeds, are one of the factors that affect a vehicle's fuel economy. It has been found that as a vehicle's speed increases beyond 45 mph, its fuel economy decreases.¹ The purpose of this report is to combine and present all existing public information on the amount of vehicle operation at speeds greater than 50 mph. An extensive data search was conducted to gather information on the amount of miles travelled and time spent in these high speeds. These amounts are then compared to the same parameters calculated from the EPA dynamometer driving schedules.

II. Data Presentation

Three primary sources were used for gathering the vehicle speed information. These sources were: the Federal Highway Administration's Highway Statistics for 1974 and 1975; Scott Research Laboratories' Vehicle Operations Survey; and General Motor's Chase Car Survey. A summary of the data from each source is presented in the following sections.

A. Federal Highway Administration (FHWA)

The FHWA gathers its vehicle miles travelled and speed data from State highway departments. Therefore, the information presented in this section is based on statistics summarized for most states and in some cases for all the states in the nation. Tables 1 and 2 correspond to Table VS-1 from the 1974 and 1975 Highway Statistics². Notice in particular the column that is heavily outlined. This column gives the percent of passenger cars exceeding 50 mph when the traffic is free-flowing, that is, the only obstacle for reducing their speed is the speed limit. If these percentages are weighed by the percent of Vehicle Miles Travelled (VMT) on these roads, we can then obtain a weighted average of the percent of vehicles exceeding 50 mph for the urban and rural roads, and for the U.S. total for free-flowing traffic. The weights were derived using the information in Tables 3 and 4 that correspond to the Highway Statistics' Table VM-2 for 1974 and 1975. These data and the computations performed for estimating the weighted averages can be found in Table 5. The averages are highlighted by a square box. These estimated averages do not include data for all the different FHWA road classifications since not all the road categories in Table VS-1 are the same categories that are found in Table VM-2. However, all the principal heavily travelled roads are included and these roads account for more than half of the total United States road mileage. In addition, the fact that not all the roads were included in the analysis is not likely to affect the calculated averages significantly since some roads left out were high speed roads and some were low speed roads. Therefore their effect on the average should cancel each other out. The road types that are not considered for the calculations are marked with an X on Tables 1 to 4.

Table 1
 AVERAGE SPEEDS AND PERCENTAGES OF FREE-MOVING VEHICLES EXCEEDING VARIOUS SPEEDS,
 BY TYPE OF HIGHWAY — 1974¹

Source: Bureau of Transportation Statistics, Federal Highway Administration, FHWA

TABLE 1.1
 (Continued from page 1)

No. of States	TYPE OF HIGHWAY	AVERAGE SPEED M.P.H.				PERCENT OVER 35 M.P.H.				PERCENT OVER 45 M.P.H.				PERCENT OVER 55 M.P.H.				PERCENT OVER 65 M.P.H.				PERCENT OVER 75 M.P.H.				PERCENT OVER 85 M.P.H.															
		All	P.C.	Tr.	BUS	All	P.C.	Tr.	BUS	All	P.C.	Tr.	BUS	All	P.C.	Tr.	BUS	All	P.C.	Tr.	BUS	All	P.C.	Tr.	BUS	All	P.C.	Tr.	BUS												
43	URBAN INTERSTATE COMPLETED U U	57.0	59.1	56.0	59.0	100	100	99	99	99	99	97	98	93	94	90	92	79	81	74	82	51	54	44	53	21	25	19	24	5	7	4	5	2	2	1	2	0	0	0	0
4	URBAN U.S. TRAVEL-WAY U U U	54.1	54.5	53.4	53.0	100	100	99	100	97	98	96	100	93	94	90	100	75	79	68	75	42	43	39	43	11	11	10	8	3	3	2	0	1	1	1	0	0	0	0	
30	URBAN PRIMARY U U	52.9	54.0	52.1	52.7	99	99	99	99	96	97	96	96	88	90	84	87	69	72	63	70	40	43	33	41	15	16	10	13	5	5	3	3	1	1	1	1	0	0	0	0
21	URBAN INTERSTATE COMPLETED U U	57.1	53.5	51.0	52.0	100	100	99	99	94	90	93	94	91	92	89	81	64	71	60	55	35	37	26	24	18	11	7	10	2	2	1	1	0	0	1	0	0	0	0	0
1	URBAN INTERSTATE COMPLETED...	55.0	51.0	53.0	54.2	100	100	100	100	100	100	99	100	97	99	93	100	65	69	77	84	48	52	37	44	19	16	9	10	1	1	1	1	5	0	1	1	0	0	0	0
	FREEWAYS AND TOLL ROADS																																								
	CONNECTICUT FREEWAYS.....	57.0	57.0	-	-	100	100	-	-	100	100	-	-	100	100	-	-	94	94	-	-	70	70	-	-	14	14	-	-	3	3	-	-	0	0	-	-	0	0	-	-
	CONNECTICUT TURNPIKES.....	57.0	58.0	57.1	55.0	100	100	100	100	100	100	100	100	100	100	100	100	92	92	97	100	59	61	52	74	21	20	18	35	5	6	2	0	1	1	0	0	0	0	0	
	MAINE TURNPIKES.....	54.0	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	MICHIGAN FREEWAYS.....	57.5	60.2	54.0	57.4	100	100	100	100	100	100	100	100	99	99	96	100	94	94	89	93	77	81	61	60	41	46	21	40	14	16	3	7	3	4	0	0	1	1	0	0
	NEVADA FREEWAYS.....	64.0	61.0	54.9	62.0	100	100	100	100	100	100	100	100	99	100	99	100	93	93	96	100	64	69	59	100	58	67	60	59	24	30	18	35	11	11	5	0	4	5	1	0
	NEW JERSEY STATEWIDE FREEWAY	55.0	54.1	64.0	55.0	100	100	100	100	100	100	100	100	99	99	96	100	95	95	96	67	62	63	5	67	21	21	2	44	6	4	0	0	2	2	0	0	0	0	0	0
	NEW YORK FREEWAYS.....	59.0	60.0	58.3	62.1	100	100	100	100	100	100	100	100	99	99	97	100	94	94	97	100	66	68	59	94	54	54	45	35	19	21	11	17	5	6	3	4	2	2	0	0
	OHIO FREEWAYS.....	54.0	55.1	53.7	-	100	100	100	-	100	99	100	-	97	97	96	-	61	62	74	-	43	47	35	-	6	13	2	-	1	2	0	-	1	1	0	-	0	0	0	-
	PENNSYLVANIA FREEWAYS.....	60.0	60.1	60.1	60.4	70	70	96	96	88	91	79	88	84	76	74	61	57	61	77	22	15	10	7	7	3	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0
	RHODE ISLAND FREEWAYS/TURNPIKES...	57.9	58.2	54.0	55.7	100	100	100	100	99	99	99	100	99	99	98	100	60	60	69	57	49	50	49	49	15	12	9	7	2	2	0	0	1	1	0	0	0	0	0	0
	RHODE ISLAND FREEWAYS/TURNPIKES...	47.7	50.1	47.5	54.3	99	100	98	100	95	94	87	100	83	85	72	92	34	39	24	30	19	14	7	10	3	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0
	TEXAS-FT. WORTH-DALLAS FREEWAYS...	55.4	55.0	54.5	52.6	100	100	100	100	99	100	98	100	99	100	98	100	94	94	79	64	55	58	69	46	9	10	6	0	0	2	1	0	0	0	0	0	0	0	0	0
	TEXAS-STEPHENS FREEWAYS.....	54.0	54.2	53.3	51.3	100	100	100	100	100	100	99	100	98	98	97	100	74	78	67	74	40	41	34	22	6	6	4	2	1	1	0	0	0	0	0	0	0	0	0	0
20	URBAN SECONDARY U U	49.0	49.0	48.2	47.2	99	98	93	93	96	97	92	76	71	73	66	51	47	40	41	30	24	25	20	14	8	9	6	9	3	3	2	0	1	1	0	0	0	0	0	
17	URBAN PRIMARY.....	42.3	42.9	41.1	41.0	73	74	67	64	57	58	52	54	40	42	34	23	24	23	20	14	10	11	7	9	2	3	1	0	1	1	0	0	0	0	0	0	0	0	0	
4	URBAN SECONDARY.....	54.5	54.2	53.1	51.9	55	56	50	47	26	26	20	8	11	11	9	3	3	2	9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	URBAN PRIMARY.....	47.0	47.0	45.0	50.2	89	89	88	87	78	82	74	47	63	64	57	44	43	34	37	22	15	15	14	14	7	9	4	9	1	1	1	1	1	1	0	0	0	0	0	0

1. PERCENTAGES FOR 70 M.P.H. ARE BASED ON 31 STATES FOR MAIN RURAL FREEWAYS, FOR RURAL FREEWAYS, AND FOR RURAL INTERSTATE COMPLETED 2 STATES FOR RURAL INTERSTATE TRAVEL-WAY 20 STATES FOR URBAN INTERSTATE COMPLETED 12 STATES FOR RURAL SECONDARY.
 2. PERCENTAGES FOR 55 M.P.H. ARE BASED ON 31 STATES FOR MAIN RURAL FREEWAYS, FOR RURAL FREEWAYS, AND FOR RURAL INTERSTATE COMPLETED 2 STATES FOR RURAL INTERSTATE TRAVEL-WAY 20 STATES FOR URBAN INTERSTATE COMPLETED 12 STATES FOR RURAL SECONDARY.
 3. RURAL INTERSTATE TRAVEL-WAY INCLUDES ROADS, AND URBAN INTERSTATE TRAVEL-WAY INCLUDES STREETS THAT ARE ADEQUATE FOR FREEWAY TRAFFIC BUT HAVE NOT BEEN UPGRADED TO FULL INTERSTATE DESIGN STANDARDS, AND THOSE OTHER SECTIONS OF EXISTING ROADS AND STREETS THAT ARE PRESENTLY SERVING THE INTERSTATE TRAFFIC IN INTERSTATE CORRIDORS.
 - INDICATED DATA NOT AVAILABLE.

Motor Vehicles

AVERAGE SPEEDS AND PERCENTAGES OF FREE-MOVING VEHICLES EXCEEDING VARIOUS SPEEDS,
BY TYPE OF HIGHWAY - 1975

Table 2

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TABLE NO. 1
APRIL 1976

NO. OF STATES	TYPE OF HIGHWAY	AVERAGE SPEED (M.P.H.)				PERCENT OVER 55 M.P.H.				PERCENT OVER 60 M.P.H.				PERCENT OVER 65 M.P.H.				PERCENT OVER 70 M.P.H.				PERCENT OVER 75 M.P.H.				PERCENT OVER 80 M.P.H.				
		ALL	P.C.	TR.	HWY.	ALL	P.C.	TR.	HWY.	ALL	P.C.	TR.	HWY.	ALL	P.C.	TR.	HWY.	ALL	P.C.	TR.	HWY.	ALL	P.C.	TR.	HWY.	ALL	P.C.	TR.	HWY.	
X	RURAL INTERSTATE COMPLETELY	57.0	56.7	56.8	56.8	100	100	100	99	99	99	97	99	99	97	97	97	99	99	99	97	99	99	97	99	99	97	99	99	97
26	RURAL INTERSTATE COMPLETELY	57.6	56.9	56.6	57.5	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3	RURAL UNIMPROVED	57.8	56.5	56.7	57.2	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
26	RURAL UNIMPROVED	55.6	55.1	55.6	56.2	100	100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
X	URBAN INTERSTATE COMPLETELY	56.7	55.7	55.8	56.1	100	100	100	100	99	99	99	100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	
X	URBAN INTERSTATE COMPLETELY	55.9	56.8	56.9	56.1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	FRONTIERS AND TOLL ROADS																													
	CONNECTICUT FRONTIERS	56.9	56.9	-	-	100	100	-	-	100	100	-	-	100	100	-	-	100	100	-	-	100	100	-	-	100	100	-	-	
	CONNECTICUT TOLL ROADS	56.6	56.7	57.5	57.7	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	DELAWARE FRONTIERS	56.8	56.8	56.7	61.0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	DELAWARE TOLL ROADS	57.3	57.3	57.6	-	100	100	100	-	99	99	99	-	99	99	99	-	99	99	99	-	99	99	99	-	99	99	99	99	99
X	NEW HAMPSHIRE TOLL ROADS	59.2	59.2	62.0	62.7	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	NEW HAMPSHIRE TOLL ROADS	59.1	59.3	59.3	-	100	100	100	-	100	100	100	-	99	99	99	-	99	99	99	-	99	99	99	-	99	99	99	99	99
	NEW HAMPSHIRE TOLL ROADS	57.9	57.9	55.2	55.3	100	100	99	100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
	NEW HAMPSHIRE TOLL ROADS	56.9	55.1	55.6	55.2	100	100	100	100	99	99	100	100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
	NEW HAMPSHIRE TOLL ROADS	58.5	58.7	55.7	55.7	100	100	100	100	99	99	99	100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
	NEW HAMPSHIRE TOLL ROADS	56.9	57.7	58.6	57.5	100	100	99	100	100	100	100	100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
	NEW HAMPSHIRE TOLL ROADS	57.7	56.9	56.7	56.5	100	100	100	100	100	100	100	100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
15	RURAL STATE	51.7	52.0	58.1	52.7	97	98	99	100	91	92	99	99	81	82	75	78	79	81	82	83	84	85	86	87	88	89	90	91	92
11	URBAN STATE	57.6	56.7	62.0	61.2	75	76	76	76	55	56	55	55	28	29	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
X	URBAN STATE	59.6	59.5	59.8	59.7	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
X	URBAN STATE	55.9	59.0	58.6	56.7	95	95	95	95	79	83	78	87	85	87	88	88	87	88	88	87	87	87	87	87	87	87	87	87	87

Source: U.S. Federal Highway Administration, Highway Statistics, 1975.

VEHICLE MILES, BY STATE AND HIGHWAY SYSTEM-1974

Table 3

Source: Program Reevaluation Division
Office of Highway Planning, FHWA

(In millions of miles)

TABLE B-1
BYROAD 1974

FEDERAL FUNDS TRAFFY DIVISION	STATE	PERSONAL-AID SYSTEMS																	BY ALL PERSONAL-AID SYSTEMS																			
		INTERSTATE RURAL						STATE RURAL						TOTAL RURAL					TOTAL FEDERAL AID					TOTAL FEDERAL AID		TOTAL FEDERAL AID		TOTAL	TOTAL									
		FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION	FED. TRAFFY DIVISION													
CONNECTICUT																																						
DELAWARE																																						
ILLINOIS																																						
INDIANA																																						
IOWA																																						
KANSAS																																						
KENTUCKY																																						
LOUISIANA																																						
MAINE																																						
MARYLAND																																						
MASSACHUSETTS																																						
MICHIGAN																																						
MINNESOTA																																						
MISSISSIPPI																																						
MISSOURI																																						
MONTANA																																						
NEBRASKA																																						
NEVADA																																						
NEW HAMPSHIRE																																						
NEW JERSEY																																						
NEW MEXICO																																						
NEW YORK																																						
NORTH CAROLINA																																						
NORTH DAKOTA																																						
OHIO																																						
OKLAHOMA																																						
OREGON																																						
PENNSYLVANIA																																						
RHODE ISLAND																																						
SOUTH CAROLINA																																						
SOUTH DAKOTA																																						
TENNESSEE																																						
TEXAS																																						
UTAH																																						
VIRGINIA																																						
WASHINGTON																																						
WEST VIRGINIA																																						
WISCONSIN																																						
WYOMING																																						
TOTAL																																						

68

Highway Statistics, 1974

1. Includes travel on highways in the Interstate System status of completion group 2. This group consists of all highways that are in the Interstate System but will need further construction or improvement to bring it to full Interstate status. It does not include travel on all other highways with full control of access and 16 where they are not, shown, as Four-Lane undivided highways with no access control.

2. Based on Delaware's Interstate transportation system B and C. It is included in the figures for Interstate System.

3. In millions of total travel provided by the state highway department. Distribution by highway system made by the Federal Highway Administration based on data for 1974.

VEHICLE MILES, BY STATE AND HIGHWAY SYSTEM - 1975

1134

Table 4

TABLE NO. 1
APRIL 1977

FEDERAL FUNDS UNIT OF STATE	STATE	VEHICLE MILES, BY STATE AND HIGHWAY SYSTEM - 1975																															
		DOMESTIC TRIP MILES														OVERSEAS TRIP MILES											TOTAL	TOTAL PERCENT OF TRIP MILES					
		TOTAL	FREEWAY		OTHER		LOCAL		TOTAL	LOCAL			OTHER			TOTAL		TOTAL	TOTAL PERCENT OF TRIP MILES														
TRIP MILES	PERCENT		TRIP MILES	PERCENT	TRIP MILES	PERCENT	TRIP MILES	PERCENT		TRIP MILES	PERCENT	TRIP MILES	PERCENT	TRIP MILES	PERCENT	TRIP MILES	PERCENT			TRIP MILES	PERCENT												
REGION 1	Connecticut	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100	527	100
	U.S. Total - Domestic Trip Miles	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100	112,572	100
	U.S. Total - Overseas Trip Miles	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100	100,000	100
	U.S. Total - All Trip Miles	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100	212,572	100

-5-

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1. Based on Bureau of Transportation Statistics, Highway Statistics for the United States, 1975. This publication is available from the Bureau of Transportation Statistics, Department of Commerce, Washington, D.C. 20540. (205) 616-1620.

Table 5

Estimate of the Percent of Passenger Cars Exceeding 50 mph for Free-Flowing
Traffic by Area and Road Classification for 1974 and 1975

Road Type	VMT*	Weight	Urban		VMT*	Weight	1975	
			1974				% P.C.	
			% P.C. Over 50 mph*	Weight x Percent			Over 50 mph	Weight x Percent
Urban Interstate Completed	109,647	.316	71	22.4	118,225	.361	80	28.9
Urban Primary	173,028	.500	25	12.5	160,126	.490	23	11.3
Urban Secondary	63,684	.184	3	.6	48,744	.149	11	1.6
Total	346,359	1.000		35.5	327,095	1.000		41.8
			Rural					
Rural Interstate Completed	104,408	.218	92	20.1	111,972	.225	94	21.2
Rural Interstate Travelled-Way	14,655	.031	78	2.4	13,168	.027	94	2.5
Rural Primary	205,734	.430	72	31.0	213,436	.429	79	33.9
Rural Secondary	153,824	.321	48	15.4	158,370	.319	61	19.5
Total	478,621	1.000		68.9	496,946	1.000		77.1

* Source: U.S. Federal Highway Administration, Highway Statistics, 1974 and 1975.

Table 5 (cont)

		<u>U.S. Total</u>							
		1974				1975			
<u>Road Type</u>	<u>VMT</u>	<u>Weight</u>	<u>% P.C. Over 50 mph</u>	<u>Weight x Percent</u>	<u>VMT</u>	<u>Weight</u>	<u>% P.C. Over 50 mph</u>	<u>Weight x Percent</u>	
Urban Interstate Completed	109,647	.133	71	9.4	118,225	.144	80	11.5	
Urban Primary	173,028	.210	23	5.3	160,126	.194	23	4.5	
Urban Secondary	63,684	.077	3	.2	48,744	.059	11	.6	
Rural Interstate Completed	104,408	.127	92	11.7	111,972	.136	94	12.8	
Rural Interstate Travelled-Way	14,655	.018	78	1.4	13,168	.016	94	1.5	
Rural Primary	205,734	.249	72	17.9	213,436	.259	79	20.5	
Rural Secondary	153,824	.186	58	8.9	158,370	.192	61	11.7	
Total	324,980	1.000		54.8	824,041			63.1	

The calculated averages for the U.S. total found in Table 5 (54.8% in 1974 and 63.1% in 1975) therefore indicate that for free-flowing traffic in the United States, a significant number of the passenger cars travelled at a speed greater than 50 mph during both 1974 and 1975. The large amount of travel at these high speeds therefore is increasingly important because of its significant impact on the nation's overall vehicle speed pattern and primarily on its fuel economy.

Another useful piece of information that can be estimated from Tables 1 thru 4 is the percent of urban, rural, and total U.S. VMT at speeds greater than 50 mph. These percentages provide a more accurate picture of the amount of travel done in excess of that speed. In order to estimate these average percentages, applied probability statistics computations were needed. The assumptions and modeling required to derive the following equation can be found in Reference 3.

$$\% \text{ VMT}/>50\text{mph} = \frac{\text{VMT}_1 \times p_1(>50) + \text{VMT}_2 \times p_2(>50) + \dots + \text{VMT}_n \times p_n(>50)}{\text{VMT}_1 + \text{VMT}_2 + \dots + \text{VMT}_n} \times 100$$

where

VMT_i = Vehicle Miles travelled on road type i

$p_i (>50)$ = Percent of passenger cars travelling at speeds greater than 50 mph on road type i

For calculation of the % Urban VMT/>50 mph and % Rural VMT/>50 mph, the VMT_i 's and p_i 's would be those corresponding to the urban or rural areas only. The road classifications used were the same ones used for the previous analysis. The resulting percentages are presented in Table 6. The % VMT at other speeds were also calculated and are presented in histogram form on Figures 1 to 3.

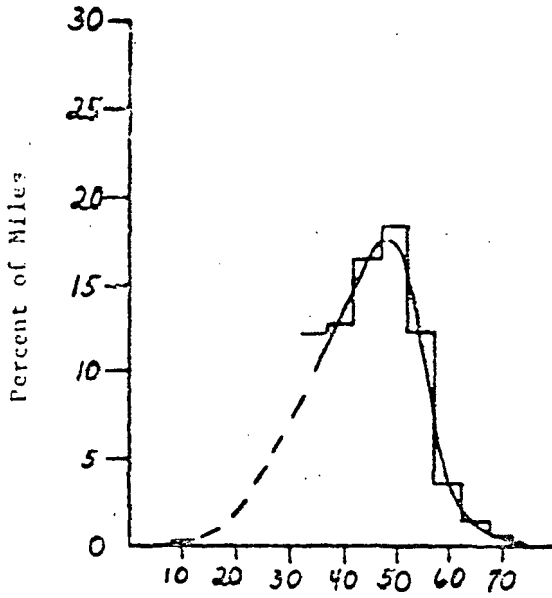
Table 6

Percent of Vehicle Miles Travelled in Excess of 50 mph

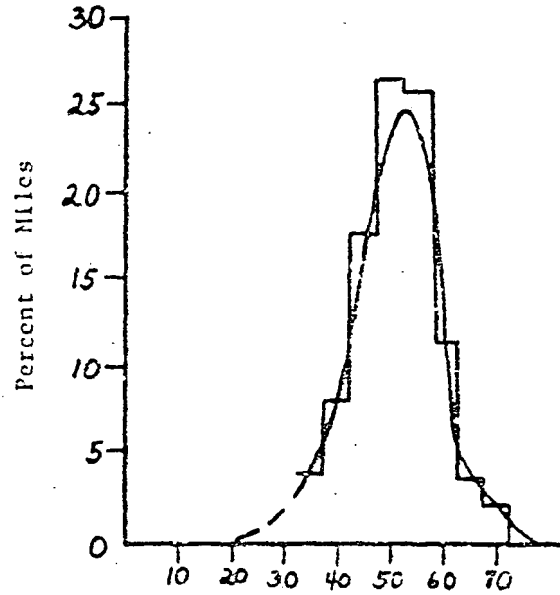
Area	1974	1975
Urban	35.5%	41.8%
Rural	68.8	77.0
U.S. Total	54.8	63.1

The percentages probably increased consistently for the urban and rural area in 1975 because 1974 was the first year when the maximum speed limit was reduced to 55 mph. Drivers were most probably more aware of their speed in 1974 because of the new adjustment. Data for 1976 is

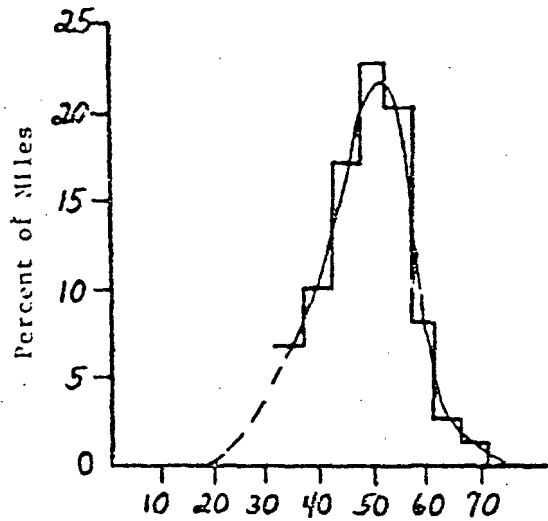
Percent of Miles Spent in Speed Bands
For Free-Flowing Traffic



Speed - MPH
Figure 1
Urban Driving



Speed - MPH
Figure 2
Rural Driving



Speed - MPH
Figure 3
U.S. Driving

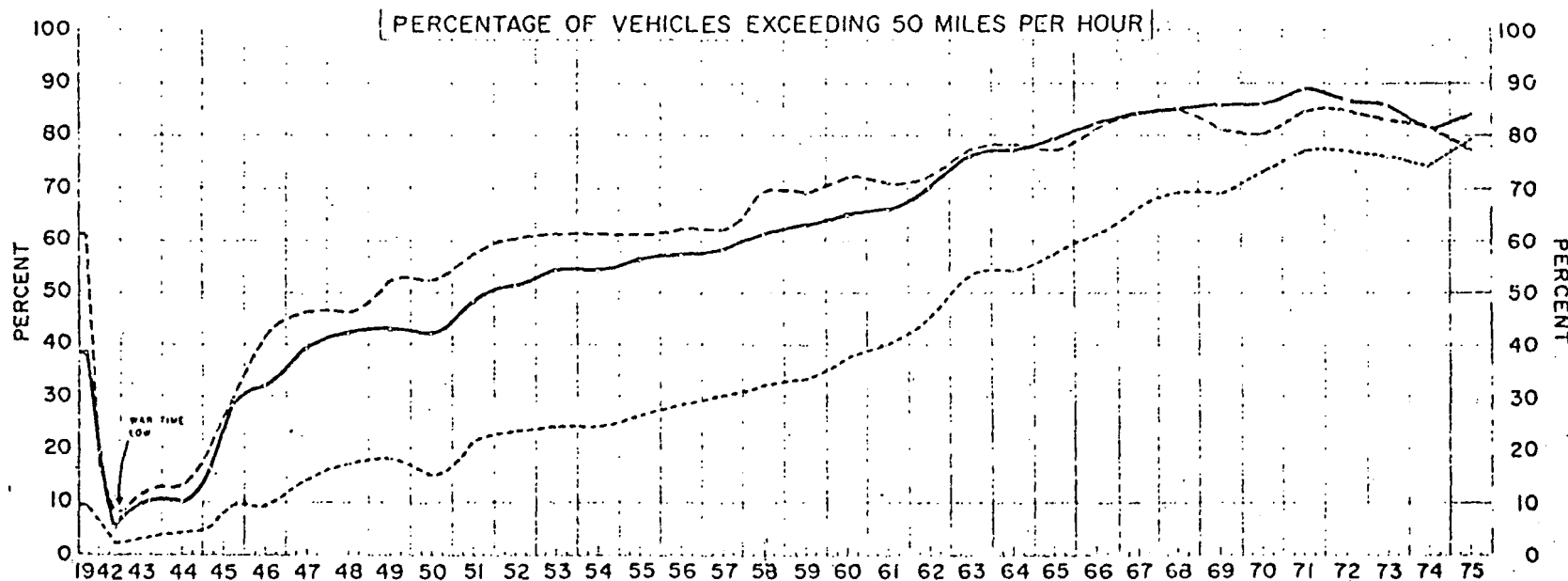
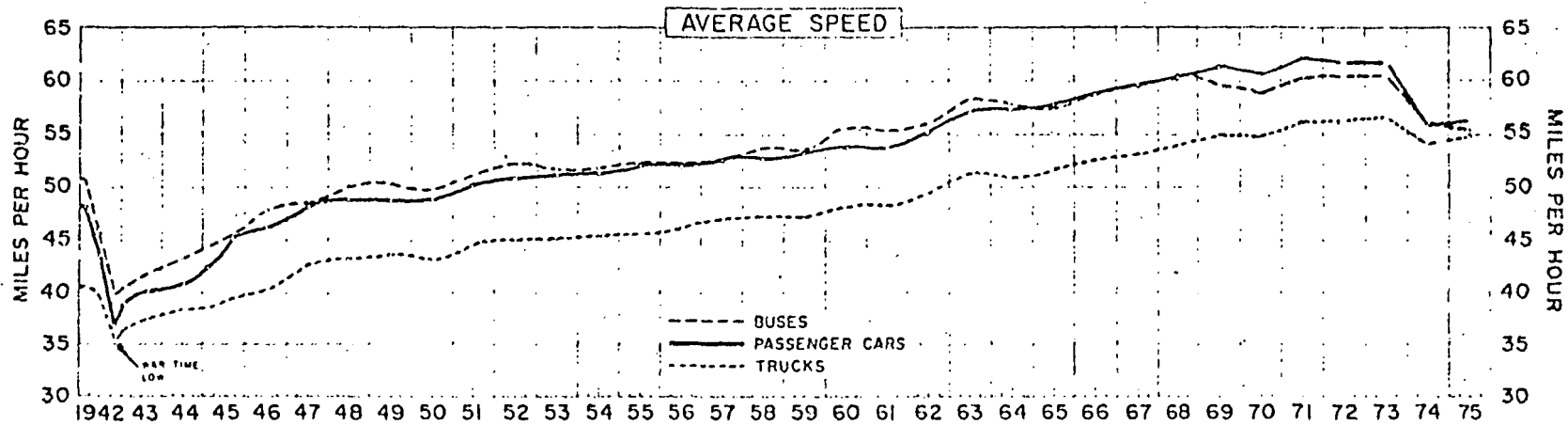
Source: U.S. Federal Highway Administration, Highway Statistics, 1974 and 1975.

still not available and even if it were available the same comparisons could not be made since the FHWA road classifications were changed for that year. However, the speed trends for main rural highways in Figure 4 show a slight increase almost each year in the average speed driven by passenger cars. This same trend can also be seen for the percentage of vehicles exceeding 50 mph except for the three years before 1974. Some of this trend can partly be explained by vehicles having an increasing power/weight ratio up until 1970. In addition, road improvements continue to be made thereby increasing the speed limits in some roads. Therefore, it would seem likely that the amount of driving in excess of 50 mph would not decrease for 1976.

A comparison can be made of these percentages to the percent of miles travelled over 50 mph by the Highway Dynamometer Driving Schedule (HDDS).⁴ For this schedule, 46.5% of all the speed points are over 50 mph. In terms of distance travelled, these speed points account for 54.0% of the total length of the schedule. Recall that the percentages calculated from the FHWA statistics are for free-flowing traffic, where stops signs and stop lights or other factors that can cause a reduction in speed are not accounted for. The highway cycle has these same characteristics of free-flowing movement, however, its amount of speed over 50 mph is significantly less than the U.S. percent of VMT exceeding that speed for 1975 (63.1%). The difference is even larger than the numerical difference between 54.0% and 63.1% for 1975 since this last percentage includes free-flowing traffic within the city where the speed travelled at is much slower than on highways outside the city.

It would be more accurate to compare the HDDS percentage to the results for the FHWA Rural Highways. The HDDS was actually constructed by driving an instrumented test vehicle over a variety of non-urban roads and highways reflecting the correct proportion of vehicle operation over four main rural road types as classified by the FHWA. It was designed in this manner in order to complement the UDDS that characterizes urban driving only. Therefore, the difference between the HDDS and FHWA data is even larger since 68.8% of the VMT in rural roads were travelled in excess of 50 mph in 1974 and 77.0% in 1975.

Therefore, it appears that the EPA highway driving schedule does not include sufficient current real-world high speeds. This is in most part due to the fact that the data used for developing the HDDS was collected in 1974 by driving the instrumented test vehicle on rural roads in the southeast part of Michigan and a freeway segment in northern Ohio. The vehicle was driven by a trained EPA employee who simulated as much as possible the general traffic speed. In Ohio, however, the driver purposely maintained a maximum speed of 55 mph since the freeway travelled on was already subject to that speed limit. The intent was to develop a rural driving schedule that reflected the anticipated nationwide 55 mph speed limit.



SPEED TRENDS ON MAIN RURAL HIGHWAYS BY VEHICLE TYPE

Figure 4

Source: U.S. Federal Highway Administration, Highway Statistics, 1974 and 1975.

B. Scott Research Laboratories, Inc.

The study conducted by SRL consisted of a five-city survey of automobile driving patterns using the chase car method. These cities were Los Angeles, Houston, Cincinnati, Chicago, and New York City. Therefore, their results will reflect metropolitan driving characteristics only, including both freeway and non-freeway travel in the city.

One of SRL's approaches to reduce their large data base was to prepare mode-matrices for each city and for the five-city composite. One of these matrices, the Normalized Time in Mode Matrix, provides the percent of vehicle operating time for 196 modes. These 196 modes result from the matrix having that amount of cells where each cell represents a particular mode. Table 7 is a copy of that matrix for the five-city composite. One of the pieces of information that can be extracted from the table is the percent of total vehicle operation time above 50 mph in the city.

The matrix is a little confusing on its own and thus requires some explanation in order to understand how the percent is derived. All cruises can be found along the diagonal of the matrix that runs from upper left to lower right. If we were interested in the percent of time spent cruising at 55 mph, that percent would be found at the intersection of an initial speed of 55 mph and final speed of 55 mph, 1.806%. The percent of time spent cruising at speeds greater than or equal to 55 mph would be the sum of the last three percentages on the diagonal, 6.166%. The percent of time spent in accelerations can be found above the cruise diagonal. An acceleration from 30 mph to 55 mph would occur .038% of the time. The percent of time spent in accelerating to speeds greater than or equal to 55 mph is the sum of the percentages under the final speeds of 55, 60, and 65 mph up until the figures before the diagonal cruises. This percent adds up to 1.972%. For decelerations, the procedure is the same, except that the figures are found below the cruise diagonal. The percent of time spent decelerating from speeds greater than or equal to 55 mph would then be calculated by adding the figures on the rows next to 55, 60, and 65 mph up until the figures before the diagonal. This percentage is 1.820%

Except for the lowest speed, zero, and the highest speed, 65 mph, each speed includes all data from 2.5 mph below that speed to 2.5 mph above that speed. Therefore, the calculations for 55 mph include data from 52.5 mph to 57.5 mph. If we add the calculations made in the previous paragraph, we then have a good estimate of the percent of total time in operation above 52.5 mph. This percent adds up to be 9.958%, that is, approximately 10% of city operation time. Therefore, 10% would be a low estimate of the city operation time in speeds greater than 50 mph.

The Urban Dynamometer Driving Schedule (UDDS) is representative of metropolitan Los Angeles driving in 1969 and contains a freeway segment travelled in the city. Of all the speed points in the schedule, 3.87%

Table 7

COMPACTED NORMALIZED TOTAL TIME MATRIX FOR 5-CITY COMPOSITE



SCOTT RESEARCH LABORATORIES, INC

INITIAL SPEED, MPH	FINAL SPEED, MPH													
	0	5	10	15	20	25	30	35	40	45	50	55	60	65
0	13.060	0.582	0.559	0.668	1.025	1.891	2.631	2.314	1.321	0.501	0.140	0.052	0.018	0.010
5	0.577	0.746	0.283	0.253	0.299	0.442	0.506	0.427	0.236	0.092	0.028	0.012	0.006	0.002
10	0.419	0.287	0.760	0.345	0.422	0.546	0.519	0.381	0.141	0.051	0.021	0.013	0.007	0.005
15	0.505	0.207	0.303	0.941	0.509	0.589	0.542	0.425	0.244	0.091	0.031	0.023	0.018	0.027
20	0.943	0.286	0.298	0.401	1.633	0.878	0.641	0.357	0.167	0.059	0.030	0.023	0.015	0.008
25	1.829	0.454	0.395	0.465	0.725	3.518	1.246	0.541	0.224	0.083	0.037	0.031	0.024	0.020
30	2.419	0.488	0.441	0.471	0.560	1.136	5.463	1.228	0.354	0.119	0.048	0.038	0.022	0.024
35	2.142	0.394	0.349	0.380	0.311	0.493	1.103	5.255	0.857	0.228	0.066	0.030	0.014	0.017
40	1.267	0.204	0.158	0.182	0.152	0.193	0.318	0.775	3.450	0.483	0.145	0.063	0.028	0.019
45	0.477	0.087	0.064	0.074	0.065	0.072	0.114	0.214	0.443	2.027	0.340	0.134	0.054	0.015
50	0.160	0.026	0.031	0.022	0.027	0.034	0.035	0.059	0.128	0.319	1.535	0.330	0.107	0.040
55	0.085	0.012	0.013	0.011	0.013	0.018	0.023	0.032	0.061	0.109	0.317	1.806	0.324	0.107
60	0.043	0.013	0.006	0.005	0.006	0.007	0.010	0.020	0.020	0.053	0.109	0.323	2.069	0.292
65	0.037	0.014	0.005	0.001	0.002	0.001	0.002	0.008	0.010	0.016	0.031	0.098	0.284	2.291

NORMALIZED MODE MATRIX SUMMARY

PERCENT IDLE = 13.060
 PERCENT CRUISE = 31.502
 PERCENT ACCELERATION = 29.158
 PERCENT DECELERATION = 26.303

SRL 2922 13 1271

are over 52.5 mph. This is less than half of the estimate from the SRL five-city composite. The big difference in the percentages could be due in part to the fact that 26% of the total 7.486 miles of the UDDS are freeway miles while 32% of the total survey miles in all five cities were freeway travelled miles. This large difference in the freeway percentages results from a difference in SRL's and EPA's definition of urban area. SRL included in their urban definition the entire metropolitan area that comprised both the central city and the suburban areas. EPA defined urban as a six mile radius area from the Central Business District. An increase in the amount of driving outside the central city would result in an increase in the percentage of freeway and thus high speed travel.

C. GM Chase Car Survey

The GM Chase Car survey was conducted in 1974 in twelve major metropolitan areas in the United States. Chase cars were instrumented to monitor several driving parameters while following a vehicle and duplicating its operation. The data was primarily grouped according to the different road types travelled on, some of which were rural, urban, highway, and non-highway type of roads. In this section, the amount of driving over 50 mph monitored by the GM chase cars on each of these four road types will be presented and discussed. The data will also be compared to the same statistics computed from both the UDDS and the HDDS wherever this comparison can be made. However, final conclusions must not be drawn from these comparison since an extensive EPA study revealed that for several reasons the GM Chase Car survey results were not representative of the national driving pattern.

The percentage of miles and time spent in various speed bands for the HDDS and GM chase car data are presented in Tables 8 and 9. Tables 10 and 11 compare the GM urban data with the EPA UDDS data for the same speed bands. The percentages for speeds over 52.5 mph derived from these tables for the EPA schedules will not correspond exactly to the amounts reported in the previous sections. The reason for this difference is because GM developed a computer program to evaluate the chase car data and this same program was employed to analyze the EPA schedules. The percentages provided in the previous sections were derived by a simple count of the speed points over 52.5 mph divided by the total number of points. A more comprehensive description of the GM chase car and EPA comparison techniques can be found in Reference 9.

Tables 8 and 9 indicate that GM monitored a larger amount of vehicle operation over 52.5 mph than is reflected by the HDDS. The same observation can be made from Tables 10 and 11. The percent of miles and time spent in speeds greater than 52.5 mph for both EPA and GM are found directly below each table.

From Figures 5 through 7 we can extract the percent of miles travelled at speeds greater than 52.5 mph for highways, non-highways and all road

Table 8

Percentage of Miles Spent in Speed Bands

mph \pm 2.5 mph	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
EPA HDDS	.05	.08	.10	.22	.24	.68	1.47	3.54	8.11	26.41	17.72	38.02	3.37	0	0	0
GM Rural RT	.01	.10	.21	.39	.85	1.26	2.22	3.34	5.71	8.59	16.08	24.68	20.08	9.14	5.37	1.24

Percent Miles >52.5 mph

EPA HDDS
41.39

GM Rural RT
60.51

-15-

Table 9

Percentage of Time Spent in Speed Bands

mph \pm 2.5 mph	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
EPA HDDS	4.07	.51	.38	.64	.51	1.14	2.16	4.57	9.02	26.43	16.26	31.64	2.67	0	0	0
GM Rural RT	1.25	.96	1.01	1.27	2.07	2.46	3.62	4.65	6.97	9.33	15.68	22.06	17.13	6.92	3.79	.83

Percent Time >52.5 mph

EPA HDDS
34.3

GM Rural RT
50.73

Source: Elwood Vogt, "Analysis of GM Chase Car Data," EPA Report.

Table 10

Percentage of Miles Spent in Speed Bands

mph \pm 2.5 mph	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
EPA UDDS	.84	2.38	3.78	8.68	18.53	27.90	9.77	6.68	1.27	4.46	8.61	7.10				
GM Urban RT	.62	1.84	3.75	5.84	8.52	13.88	16.47	14.91	10.80	7.57	7.02	6.07	2.31	.35	.06	.01
Percent Miles >52.5 mph						<u>EPA UDDS</u> 7.10										<u>GM Urban RT</u> 8.80

Table 11

Percentage of Time Spent in Speed Bands

mph \pm 2.5 mph	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
EPA UDDS	24.56	6.03	5.81	9.59	16.06	20.28	5.96	3.63	.58	1.82	3.20	2.47				
GM Urban RT	16.79	6.01	7.34	8.18	9.38	12.51	12.59	9.91	6.32	3.95	3.31	2.62	.92	.13	.02	
Percent Time >52.5 mph						<u>EPA UDDS</u> 2.47										<u>GM Urban RT</u> 3.69

Source: Elwood Vogt, "Analysis of GM Chase Car Data," EPA Report.

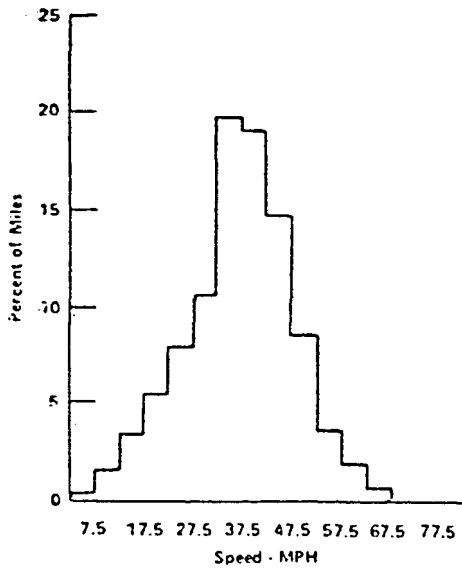


Figure 5
Percent of Miles Spent in
Speed Bands-Non-Highway Driving

% miles > 52.5 mph = 6.5%

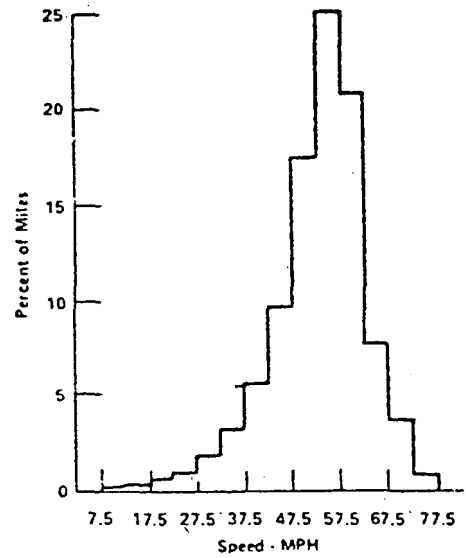


Figure 6
Percent of Miles Spent in
Speed Bands-Highway Driving

% miles > 52.5 mph = 59%

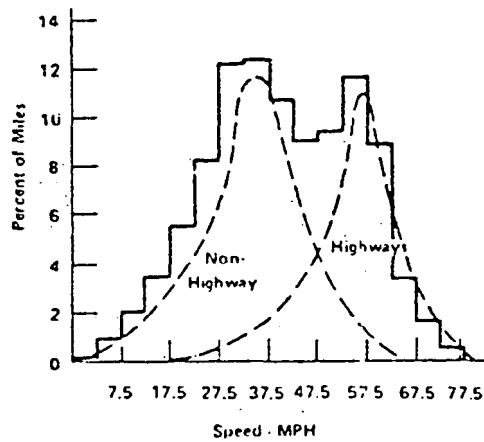


Figure 7
Percent of Miles Spent in Speed Bands

% miles > 52.5 mph = 26%

Source: Johnson, Formenti, Gray, and Peterson, "Measurement of Motor Vehicle Operation Pertinent to Fuel Economy," SAE, 750003.

types combined. These percentages can be found directly under each figure. It should be noted that these distributions and percentages are not weighted by the fraction of national driving mileage accumulated annually on each road type. This was one of the reasons given for concluding that the survey's results were not representative of the national driving pattern. The road types that fall into GM's classification of highway and non-highway are listed below:

<u>Highway</u>	<u>Non-Highway</u>
Expressway	Suburban Artery
Expressway-Business Route	Rural Unpaved
Rural Highway	Urban Artery
	Strip Commercialism
	Suburban - No Curb
	Suburban - Curb
	Suburban - Unpaved
	Central Business District Parking
	No Parking
	Urban
	Shopping Center/Parking Lot

The highway road types appear to be comparable to the HDDS's road representation. The percent of miles travelled over 52.5 mph, 59%, estimated from Figure 6 for highway driving is actually very close to the 60.5% estimated from Table 8 for rural driving. Therefore, a comparison of GM highway data to the HDDS also indicates that GM monitored more high speeds than the EPA schedule accounts for.

Conclusions

The main conclusions of this report for vehicle operation over 50 mph are:

1. Data reported by the Federal Highway Administration (FHWA) indicate that for free-flowing traffic in the United States, over half of the passenger cars travelled at a speed greater than 50 mph in both 1974 and 1975.
2. Approximately 54.8% in 1974 and 63.1% in 1975 of the total U.S. Vehicle Miles Travelled (VMT) were conducted at speeds greater than 50 mph when the traffic was free-flowing.
3. The percent of VMT at speeds exceeding 50 mph for rural roads (with free-flowing traffic) is approximately 68.8% for 1974 and 77.0% for 1975. These percentages are significantly larger than the 54.0% for the EPA Highway Dynamometer Driving Schedule (HDDS). Since the HDDS is basically a free-flowing traffic cycle it appears, that the HDDS does not include sufficient real-world high speeds. This is due largely to the fact that the HDDS represents rural driving in the southeastern part

of Michigan and a freeway segment in northern Ohio soon after the enforcement of the 55 mph speed limit in Ohio. The driver flowed with the traffic when possible, and when he was not in traffic he purposely maintained a maximum speed of 55 mph in order to reflect the anticipated nationwide 55 mph speed limit.

4. The data from a study conducted by Scott Research Laboratories reveals that 10% of the average urban operation time is spent in speeds greater than 52.5 mph. The EPA Urban Dynamometer Driving Schedule (UDDS), representative of Los Angeles city driving in 1969, has 3.87% of its speed points over 52.5 mph, less than half of SRL's estimate.

5. A comparison of the GM chase car data to the UDDS and HDDS indicates that GM monitored more high speeds than the EPA schedules account for.

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