"Braking Effectiveness Lessens at Higher Speeds" Is This Still True Today??

By Daniel W. Vomhof III, EIT, ACTAR #484

Over the years, one of the "Urban Legends" within the field of accident reconstruction is that as a vehicles speed increases, the deceleration rate from that speed will decrease ... in other words, a drag factor from 30 mph will be higher than a drag factor from 60 mph given the same vehicle on the same surface.

To test whether this "urban legend" holds true with today's vehicles and today's tires, a review of the automotive magazines published between May 2006 and February 2007 was conducted looking for instances where braking data from two different speeds for the same vehicle was reported. The preliminary findings of this review are as follows:

The two magazines where this testing criteria was met were Motor Trend and Road & Track. Motor Trend will from time to time report braking tests from both 60 mph-0 and from 100 mph-0. Road & Track will report tests from 60 mph-0 and from 80 mph-0. A review of the ten months worth of magazines found a total of 79 tests, 17 were from 100 mph-0, and 62 were from 80 mph-0.

In analyzing these tests, a deceleration factor for each test was calculated. This in turn was used to calculate a theoretical, or "normalized", braking distance from 60 mph-0 for all of the tests. This was done in an attempt to allow the reader to more readily visualize the differences for comparison purposes. Results for the normalized braking distances are displayed to two decimal places for comparative purposes only, not because the author believe that braking distances can be measured to the 100th of a foot outside of instrumented testing situations.

Within the reviewed tests, as shown in Figure 1, the deceleration rates ranged from 0.82-1.16 G. The "average" deceleration from all three speeds was centered around 1.0 G. The sample standard deviation from both 60 and 80 mph was 0.08 G, and the sample standard deviation from 100 mph was 0.07 G. (A list of statistical terminology definitions from the web is attached at the end of this article)

Figure 1

	Distance in feet Braking From Speed			G	G	G	60-0 80-0 100-0 Braking Distance Normalized to:		
	60-0	80-0	100-0	60-0	80-0	100-0	60-0	60-0	60-0
Min	104.00	187.00	288.00	0.83	0.82	0.92	104.00	105.19	103.68
Average	120.51	217.39	318.76	1.00	0.99	1.05	120.51	122.28	114.76
Max	145.00	260.00	361.00	1.15	1.14	1.16	145.00	146.25	129.96
Modal AVG	108.00	212.00	288.00	1.04	0.97	1.16	108.00	119.25	103.68
Mean AVG	120.51	217.39	318.76	1.00	0.99	1.05	120.51	122.28	114.76
Median AVG	119.00	215.00	320.00	1.01	0.99	1.04	119.00	120.94	115.20
Sample Std Dev	10.00	18.19	22.94	0.08	0.08	0.07	10.00	10.23	8.26
Sample Size	79.00	62.00	17.00	79.00	62.00	17.00	79.00	62.00	17.00
Quartile 0	104.00			0.83			104.00		
Quartile 1	112.50			0.94			112.50		
Quartile 2	119.00			1.01			119.00		
Quartile 3	127.00			1.07			127.00		
Quartile 4	145.00			1.15			145.00		

Figure 2 and Figure 3 are the summary comparisons of the 60 mph-0 braking tests with the 80 mph-0 and 100 mph-0 tests respectively.

Figure 2

	Distance in feet Braking From Speed		G	G	60-0 Braking Distance Normalized to:	80-0 Braking Distance Normalized to:
	60-0	80-0	60-0	80-0	60-0	60-0
Min	107.00	187.00	0.83	0.82	107.00	105.19
Average	122.87	217.39	0.98	0.99	122.87	122.28
Max	145.00	260.00	1.12	1.14	145.00	146.25
Modal AVG	115.00	212.00	1.04	0.97	115.00	119.25
Mean AVG	122.87	217.39	0.98	0.99	122.87	122.28
Median AVG	122.00	215.00	0.98	0.99	122.00	120.94
Sample Std Dev	9.57	18.19	0.08	0.08	9.57	10.23
Sample Size	62.00	62.00	62.00	62.00	62.00	62.00
Quartile 0	107.00	187.00	0.83	0.82	107.00	105.19
Quartile 1	115.00	204.25	0.92	0.94	115.00	114.89
Quartile 2	122.00	215.00	0.98	0.99	122.00	120.94
Quartile 3	129.75	226.75	1.04	1.04	129.75	127.55
Quartile 4	145.00	260.00	1.12	1.14	145.00	146.25

Figure 3

	Distance in feet Braking From Speed		G	G	60-0 Braking Distance Normalized to:	100-0 Braking Distance Normalized to:
	60-0	100-0	60-0	100-0	60-0	60-0
Min	104.00	288.00	0.95	0.92	104.00	103.68
Average	111.88	318.76	1.08	1.05	111.88	114.76
Max	126.00	361.00	1.15	1.16	126.00	129.96
Modal AVG	108.00	288.00	1.11	1.16	108.00	103.68
Mean AVG	111.88	318.76	1.08	1.05	111.88	114.76
Median AVG	111.00	320.00	1.08	1.04	111.00	115.20
Sample Std Dev	6.15	22.94	0.06	0.07	6.15	8.26
Sample Size	17.00	17.00	17.00	17.00	17.00	17.00
Quartile 0	104.00	288.00	0.95	0.92	104.00	103.68
Quartile 1	108.00	301.00	1.05	1.01	108.00	108.36
Quartile 2	111.00	320.00	1.08	1.04	111.00	115.20
Quartile 3	114.00	329.00	1.11	1.11	114.00	118.44
Quartile 4	126.00	361.00	1.15	1.16	126.00	129.96

Practical Implications

The practical implications of this data for the accident investigator as perceived by this author are:

- Given modern tires and modern braking systems in vehicles which are properly maintained, one should no longer expect a decrease in deceleration rate as the initial speed at which braking is initiated increases.
- Premium/Luxury vehicles have a braking system which provides significantly better performance than the “generic” rates of 0.7-0.75 G that have been historically used for braking vehicles on good pavement
- Even the “normal” vehicles today have better deceleration rates than the “generic” rates of 0.7-0.75 G that have been historically used when braking on good pavement.

Caveats

The testing of these vehicles were all done on "test tracks", but not all on the same track, even within one publication. It is unknown what the coefficient of friction of the test track surfaces are/were, nor how they compare to a "normal" roadway surface.

The magazines report the "best" numbers they can obtain .... its good PR. Further, the magazines tune the vehicles before testing to assist in obtaining the best numbers possible. While the summary test numbers do not specify the "type" of braking (locked wheel, incipient skid or threshold braking, ABS, etc.), it is assumed by this author, based on reviewing hundreds of magazine braking test reports, that these tests are all ABS braking tests. Regardless of whether this assumption is true or not, the first sentence of this paragraph still applies.

No testing is commonly done by the automotive magazines at the lower speeds of ~30 mph-0. Therefore, based on the published data which has been reviewed, it is still possible, though this author believes it unlikely, to see a "significant" increase in the deceleration rate when the starting speed for braking is at 30 mph or below. (Note, this statement is a "hypothesis", the first step in the scientific process. The author welcomes and requests any data the readers may have, be it published or testing, to support or refute this hypothesis.)

Finally, most, if not all, of the testing is conducted by "professional" drivers. Therefore, they may be able to coax a bit more performance out of a vehicle than the Joe (or Josephine) Schmoe who drives back and forth to work every day.

Data

The individual test details, including publication and publication date, are attached at the end of this article. In addition, this article and the spreadsheet in Excel format is available for download from the Papers, Publications page of our website - www.4n6xprt.com - so that others can study the data further.

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Daniel W. Vomhof III is one of the principals at 4N6XPRT Systems, which publishes software for accident investigators and reconstructionists. He has obtained his EIT and is and accredited accident reconstructionist by ACTAR. He can be reached via e-mail at *dv3@4n6xprt.com*.
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Selected Statistics Terms Defined

normalize - To make normal, especially to cause to conform to a standard or norm

minimum - *Mathematics.* The smallest number in a finite set of numbers.

average - number used to represent or characterize a group of numbers. The most common type of average is the arithmetic mean. See median; mode.

maximum - *Mathematics.* The largest number in a set.

mode - In statistics, the most frequently appearing value in a set of numbers or data points. In the numbers 1, 2, 4, 6, 8, 4, 9, 6, 8, and 6, the mode is 6, because it appears more often than any of the other figures. (See average; compare mean and median.)

mean - in statistics, a type of average. The arithmetic mean of a group of numbers is found by dividing their sum by the number of members in the group; e.g., the sum of the seven numbers 4, 5, 6, 9, 13, 14, and 19 is 70 so their mean is 70 divided by 7, or 10. Less often used is the geometric mean (for two quantities, the square root of their product; for n quantities, the nth root of their product).

median - 1) In statistics, a type of average. In a group of numbers as many numbers of the group are larger than the median as are smaller. In the group 4, 5, 6, 9, 13, 14, 19, the median is 9, three numbers being larger and three smaller. When there is an even number of numerals in the group, the median is usually defined as the number halfway between the middle pair.

std deviation - In statistics, a measure of how much the data in a certain collection are scattered around the mean. A low standard deviation means that the data are tightly clustered; a high standard deviation means that they are widely scattered.

About sixty-eight percent of the data are within one standard deviation of the mean.

sample size - (statistics) The number of objects in the sample.

Quartile - A statistical term describing a division of observations into four defined intervals based upon the values of the data and how they compare to the entire set of observations.

Investopedia Says: Each quartile contains 25% of the total observations. Generally, the data is ordered from smallest to largest with those observations falling below 25% of all the data analyzed allocated within the 1st quartile, observations falling between 25.1% and 50% and allocated in the 2nd quartile, then the observations falling between 51% and 75% allocated in the 3rd quartile, and finally the remaining observations allocated in the 4th quartile.

For some basic explanations of the statistical terms, with pictures, the reader is directed to the following web site: http://www.robertniles.com/stats/

Speed = MPH
Distance = feet

Mag	Month/Yr	Model year	Make	Model	Distance in feet Braking From Speed 60-0	80-0	100-0	NOTES	G 60-0	G 80-0	G 100-0	60-0 Braking Distance Normalized to: 60-0	80-0	100-0
RT	2/07	2007	Acura	TL Type S	117	214			1.03	1.00		117.00	120.38	
MT	5/06	2007	Audi	Q7 4.2 ASI Quattro	121		361		0.99		0.92	121.00		129.96
RT	8/06	2007	Audi	RS4	121	212			0.99	1.01		121.00	119.25	
MT	2/07	2007	Audi	S6	110		322		1.09		1.04	110.00		115.92
RT	8/06	2007	Audi	S8	112	215			1.07	0.99		112.00	120.94	
MT	11/06	2007	Audi	S8	108		301		1.11		1.11	108.00		108.36
RT	1/07	2008	Audi	TT 3.2 Quattro	115	196			1.04	1.09		115.00	110.25	
MT	10/06	2005	Bentley	Arnage R	115		331		1.04		1.01	115.00		119.16
RT	7/06	2006	BMW	550i	117	212			1.03	1.01		117.00	119.25	
RT	5/06	2006	BMW	750i	114	202			1.05	1.06		114.00	113.63	
RT	6/06	2006	BMW	M Roadster	115	208			1.04	1.03		115.00	117.00	
MT	2/07	2006	BMW	M5	114		325		1.05		1.03	114.00		117.00
RT	11/06		BMW	X5 4.8iS	134	227			0.90	0.94		134.00	127.69	
RT	9/06	2006	BMW	Z4 M Coupe	119	215			1.01	0.99		119.00	120.94	
RT	2/07	2006	Bugatti	Veyron 16.4	111	199			1.08	1.07		111.00	111.94	
MT	2/06	2006	Bugatti	Veyron 16.4	104		293		1.15		1.14	104.00		105.48
RT	6/06	2006	Cadillac	XLR-V	123	220			0.98	0.97		123.00	123.75	
RT	11/06		Chevrolet	Blazer SS	125	222			0.96	0.96		125.00	124.88	
RT	9/06		Chevrolet	Corvette Z06	118	203			1.02	1.05		118.00	114.19	
MT	1/07	2006	Chevrolet	Corvette Z06	113	206			1.06	1.04		113.00	115.88	
MT	12/06	2006	Chevrolet	Corvette Z06	108		320		1.11		1.04	108.00		115.20
MT	1/07	2007	Chevrolet	Corvette Z51	118	209			1.02	1.02		118.00	117.56	
MT	8/06	2005	Chrysler	300 C	126		360		0.95		0.93	126.00		129.60
RT	8/06		Dodge	Ram SRT10 Pickup	129	224		RT said 100-0	0.93	0.95		129.00	126.00	
RT	9/06		Dodge	Viper SRT10	115	197			1.04	1.08		115.00	110.81	
RT	8/06		Dodge	Viper SRT10 Coupe	112	195		RT said 100-0	1.07	1.09		112.00	109.69	
MT	12/06	2006	Dodge	Viper SRT10 Coupe	104		288		1.15		1.16	104.00		103.68
MT	1/07	2007	Ferrari	599 GTB Fiorano	105		288		1.14		1.16	105.00		103.68
MT	6/06	2006	Ferrari	F430	112		300		1.07		1.11	112.00		108.00
RT	9/06		Ferrari	F430 F1	122	196			0.98	1.09		122.00	110.25	
RT	5/06	2006	Ford	Escape Hybrid FWD	141	250			0.85	0.85		141.00	140.63	
RT	5/06	2006	Ford	Escape XLT FWD	145	260			0.83	0.82		145.00	146.25	
RT	9/06		Ford	GT	116	199			1.03	1.07		116.00	111.94	
MT	1/07	2007	Ford	Mustang GT/CS	133	233			0.90	0.92		133.00	131.06	
MT	1/07	2007	Ford	Shelby GT500	124	212			0.97	1.01		124.00	119.25	
RT	7/06	2007	Ford	Shelby GT500	122	216			0.98	0.99		122.00	121.50	
MT	12/06	2007	Ford	Shelby GT500	112		321		1.07		1.04	112.00		115.56
MT	7/06	2007	Ford	Shelby GT500	110		310		1.09		1.08	110.00		111.60
RT	5/06	2006	Honda	Civic EX NAVI	133	240			0.90	0.89		133.00	135.00	
RT	5/06	2006	Honda	Civic Hybrid NAVI	140	248			0.86	0.86		140.00	139.50	
RT	11/06		Infiniti	FX45	120	213			1.00	1.00		120.00	119.81	
RT	2/07	2007	Infiniti	G35 Sport	120	208			1.00	1.03		120.00	117.00	
RT	8/06	2007	Jaguar	XK Coupe	114	204			1.05	1.05		114.00	114.75	
RT	2/07	2007	Jaguar	XKR	115	205			1.04	1.04		115.00	115.31	
RT	11/06		Jeep	Grand Cherokee SRT8	132	230			0.91	0.93		132.00	129.38	
MT	6/06	2006	Lamborghini	Gallardo	111		302		1.08		1.10	111.00		108.72
RT	9/06		Lamborghini	Gallardo	108	189			1.11	1.13		108.00	106.31	
RT	8/06	2006	Lamborghini	Gallardo Spyder	108	188			1.11	1.13		108.00	105.75	
MT	1/07	2007	Lamborghini	Murcielago LP640 Coupe	108		317		1.11		1.05	108.00		114.12
RT	11/06		Land Rover	Range Rover Sport Supercharged	126	223			0.95	0.96		126.00	125.44	
RT	11/06	2007	Lexus	ES350	129	238			0.93	0.90		129.00	133.88	
RT	7/06	2007	Lexus	GS450h	125	220			0.96	0.97		125.00	123.75	
RT	2/07	2007	Lexus	IS350	126	219			0.95	0.97		126.00	123.19	

Speed = MPH
Distance = feet

Mag	Month/Yr	Model year	Make	Model	Distance in feet Braking From Speed 60-0	80-0	100-0	NOTES	G 60-0	G 80-0	G 100-0	60-0 Braking Distance Normalized to: 60-0	80-0 60-0	100-0 60-0
RT	12/06	2007	Lexus	LS460	143	251			0.84	0.85		143.00	141.19	
RT	12/06	2007	Mazda	Mazdaspeed3	119	215			1.01	0.99		119.00	120.94	
RT	6/06	2006	Mercedes Benz	C350 Sport	124	218			0.97	0.98		124.00	122.63	
RT	11/06	2007	Mercedes Benz	E350 Sport	129	226			0.93	0.94		129.00	127.13	
RT	2/07	2007	Mercedes Benz	E550	126	224			0.95	0.95		126.00	126.00	
MT	2/07	2007	Mercedes Benz	E63 AMG	113		329		1.06		1.01	113.00		118.44
RT	6/06	2007	Mercedes Benz	S550	130	229			0.92	0.93		130.00	128.81	
RT	6/06	2007	Mitsubishi	Eclipse Spyder GT	137	247			0.88	0.86		137.00	138.94	
RT	8/06		Mitsubishi	Lancer Evolution MR	114	207			1.05	1.03		114.00	116.44	
RT	8/06	2006	Porsche	911 Carrera 4S	109	192			1.10	1.11		109.00	108.00	
RT	11/06	2007	Porsche	911 Turbo	116	207			1.03	1.03		116.00	116.44	
RT	9/06		Porsche	911 Turbo	107	187			1.12	1.14		107.00	105.19	
RT	11/06		Porsche	Cayenne Turbo	127	219			0.94	0.97		127.00	123.19	
RT	1/07	2007	Porsche	Cayman	110	194			1.09	1.10		110.00	109.13	
RT	9/06	2006	Porsche	Cayman S	116	203			1.03	1.05		116.00	114.19	
RT	8/06		Porsche	Cayman S	112	195			1.07	1.09		112.00	109.69	
RT	8/06	2006	Rolls Royce	Phantom	123	219			0.98	0.97		123.00	123.19	
MT	10/06	2006	Rolls Royce	Phantom	121		351		0.99		0.95	121.00		126.36
RT	6/06	2006	SAAB	9-3 Convertible	132	226			0.91	0.94		132.00	127.13	
RT	9/06	2006	Saleen	S7 Twin Turbo	119	210			1.01	1.02		119.00	118.13	
RT	6/06	2007	Saturn	Sky	132	239			0.91	0.89		132.00	134.44	
RT	11/06	2007	Saturn	Sky Red Line	130	231			0.92	0.92		130.00	129.94	
RT	5/06	2007	Toyota	Camry Hybrid	136	241			0.88	0.89		136.00	135.56	
RT	5/06	2007	Toyota	Camry SE V6	127	223			0.94	0.96		127.00	125.44	
RT	5/06	2006	Toyota	Prius	135	256			0.89	0.83		135.00	144.00	
RT	5/06	2006	Volkswagen	Passat 3.6	138	252			0.87	0.85		138.00	141.75	

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Average	120.51	217.39	318.76	1.00	0.99	1.05	120.51	122.28	114.76
Max	145.00	260.00	361.00	1.15	1.14	1.16	145.00	146.25	129.96
Modal AVG	108.00	212.00	288.00	1.04	0.97	1.16	108.00	119.25	103.68
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Median AVG	119.00	215.00	320.00	1.01	0.99	1.04	119.00	120.94	115.20
Sample Std Dev	10.00	18.19	22.94	0.08	0.08	0.07	10.00	10.23	8.26
Sample Size	79.00	62.00	17.00	79.00	62.00	17.00	79.00	62.00	17.00
Quartile 0	104.00			0.83			104.00		
Quartile 1	112.50			0.94			112.50		
Quartile 2	119.00			1.01			119.00		
Quartile 3	127.00			1.07			127.00		
Quartile 4	145.00			1.15			145.00		