

ANTI-SKID BRAKING DEVICES

Presentation to

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It is misleading to confuse the application of anti-skid devices on aircraft or railroad locomotives or railroad cars with the application on automobiles. The principal objective originally in the development of anti-skid devices in both aircraft and rail applications was to avoid wearing flat spots or destroying tires, because these require expensive and premature replacement. Moreover, in the use of these brakes under landing conditions where aileron and rudder control are also required as part of the steering of the aircraft, considerable investment in hardware to eliminate or reduce these repairs and complicated control problems is justified.

There have been a number of anti-skid devices proposed for automotive use, and one discussed by the British Road Research Laboratory is claimed to reduce the stopping distance somewhat from that of uncontrolled slide under some conditions and still preserve the capability of steering. This device operates on the four wheels of the vehicle and provides independent front and rear braking, and it requires four separate and complete sensing and actuating units.

Other devices recently proposed in England for automotive application are simplified somewhat in an attempt to reduce the cost, and a still simpler device has been publicized recently in the United States.

Unquestionably, safety would be enhanced if a reliable device could be developed which would preserve steering control during a panic brake stop and maintain or reduce the stopping distance.

In our continuing observation of devices of this type, a series of tests was recently conducted at the General Motors Proving Ground to evaluate one of these devices. The results are shown on the following charts.

Figure 1 is a tabulation of the stopping distances required for several speeds on a car in standard condition and with this anti-skid device operating on snow-covered, wet, and dry roads.

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On the upper part of the chart, covering the condition of snow-covered roads, it will be noted that the stopping distance with the anti-skid device operative ranged from 16 to 22 feet greater than on the panic stop on the standard car.

At 40 mph, the stopping distance with the anti-skid device being used was from 27 to 47 feet greater than that of the standard car. These increases in stopping distances range from 12 to 21 percent.

In the central part of the chart, data from tests from 30 to 50 mph on wet roads are reported. At 30 mph the car required 7 and 12 feet farther to stop when the anti-skid device was operating than the standard car did, and at 50 mph the increase was 5 and 9 feet. These increases in stopping distance required when the anti-skid device was in use ranged from 4 to 27 percent.

In the lower part of the chart, stopping distance tests at 30 and 50 mph on a dry road are shown. At 30 mph the car required approximately 9 feet more to stop when the anti-skid device was operating than when it was not, and at 50 mph the car required from 11 to 30 feet more to stop. These increases in stopping distance when the anti-skid device was operating ranged from 12 to 26 percent.

Figure 2 is a comparison of the minimum stopping distances obtained when steering control was maintained, in one case by careful braking control by the driver, and in the other by steering control preserved by the operation of the anti-skid device. At 30 mph the stopping distance when the anti-skid control device was operating ranged from 7 to 12 feet less than the distance required under driver control. At 50 mph the stopping distance required when the anti-skid device was operating ranged from 14 to 32 feet less than that required under driver control. The reduction in stopping distance when the anti-skid control was used ranged from 9 to 18 percent.

Figure 3 shows the comparison of the stopping distances under panic and driver-controlled conditions on a dry road surface at 30 and 50 mph. At 30 mph the full panic stop is from 16 to 21 feet less than the controlled stop, and at 50 mph the panic stop is from 25 to 54 feet shorter than the controlled stop. At these speeds, the panic stopping distance is from 20 to 48 percent less than that of the controlled stop. Data are summarized in bar chart form in Figure 4. On the snow-covered roads, stopping distances were approximately twice those on wet and dry pavement; there is very little difference between the stopping distances on wet and dry pavements. In each case, the panic stopping distance is significantly less than the stopping distance obtained when the anti-skid control device is used. On dry pavement, at both speeds, the stopping distance required when the anti-skid device is used is intermediately between the panic stopping distance and the controlled stopping distance.

It is clear that on this group of tests the minimum stopping distance is obtained on snow-covered, wet, and dry roads during a full four-wheel slide and that the anti-skid device

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produces shorter stopping distances than the driver can while regulating brake application to the point that steering control is maintained.

It is our opinion that it would be unjustifiable to offer a device which provides anything more than the minimum stopping distance, and that the advantages of steering control during emergency stop are less than the disadvantages of a significant increase in stopping distance.

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EFFECT OF AN ANTI-SKID DEVICE PANIC BRAKE STOPPING DISTANCES				
SPEED—MPH	STOPPING DISTANCE—FEET		DIFFERENCE FT. %	
	Without Anti-Skid Device	With Anti-Skid Device		
Road—Dry—Concrete				
20	137	133	4	3
30	194	184	10	5
40	270	247	23	8
50	353	308	45	13
Road—Wet				
20	40	36	4	10
30	64	54	10	16
40	123	106	17	14
50	194	143	51	26
Road—Dry				
20	44	51	7	16
30	64	53	11	17
40	64	54	10	16
50	117	147	30	26
50	136	129	7	5
50	134	141	7	5

Figure 1

COMPARISON OF STOPPING DISTANCES
WITH STEERING CONTROL
MAINTAINED

SPEED—MPH	DRIVER CONTROL	ANTI-SKID CONTROL	DIFFERENCE	
			FT.	%
20	64	51	-13	-20
30	64	53	-11	-17
40	61	54	-7	-11
50	171	147	-24	-14
50	133	129	-4	-3
50	173	141	-32	-19

Figure 2

COMPARISON OF PANIC AND
DRIVER-CONTROLLED STOPPING DISTANCES

SPEED—MPH	ROAD—DRY		DIFFERENCE FEET PER CENT	
	PANIC	DRIVER CONTROL		
20	44	51	7	16
30	64	53	11	17
40	64	54	10	16
50	117	171	54	46
50	136	129	7	5
50	134	173	39	29

Figure 3

COMPARISON OF AVERAGE STOPPING DISTANCES
WITH AND WITHOUT AN ANTI-SKID DEVICE

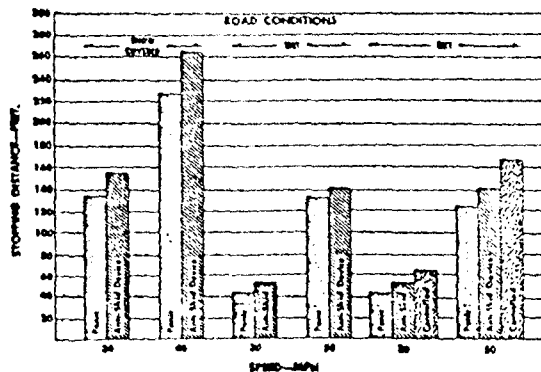


Figure 4

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