TEST ROAD SKIDOMETER DATA FOR THE 1964 TEST YEAR

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Annual skid resistance measurements continued in 1964 on more than 50 experimental projects and at 15 intersections throughout Michigan. During 1964, three new experimental projects were added:

1. 3BC sand-asphalt resurfacing north and south of Alba.
2. Bridge deck surface coatings at various locations.
3. Asphalt emulsion hot-mix surface courses on two Lansing intersections.

In accord from instructions in P. J. Serafin's memorandum of April 20, 1964 to E. A. Finney, measurements were discontinued on four projects:

1. Slag bituminous concrete test road in Dearborn (Project M 82-42, C2).
2. Pontiac test road (Project M 63-30, C8R).
3. Wayne County bituminous test road.
4. Sheet asphalt test road south of Ann Arbor (Project M 81071, C1R).

The 1964 tests were conducted with the Research Laboratory's skidometer, using the General test tire. All skidding values given in the 13 tables of this report are 40-mph wet sliding coefficients of friction. A coefficient value of 0.40 is a dividing point between "safe" and "unsafe" pavement surfaces. No such sharp demarcation really exists, however, and surfaces with coefficient values of 0.35 to 0.40 are actually in a "transitional" or "questionable" range. Any project falling below 0.35 under wet conditions could be considered dangerous, depending on prevailing speeds, road alignment, and geometry.

Table 1 gives coefficients of wet sliding friction for 23 projects employing Upper Peninsula mine rock and related crushed igneous gravel. Tests were conducted from July 25 to August 15, 1964. During this period, air temperatures ranged from 60 to 92 F, and pavement temperatures from 80 to 106 F. Projects tested in 1964 varied in age from 2 to 13 years of service. Coefficients ranged from 0.42 to 0.69 and averaged 0.57, thus exhibiting outstanding skid resistance qualities. It was suggested last year (in Research Report R-447) that low traffic volumes may be a contributing factor in the consistently high coefficients

of wet sliding friction over extended time periods on projects containing these aggregate types. Further analysis of effects of traffic could be obtained if test areas having similar aggregate types could be constructed on routes bearing heavier traffic volumes.

Table 2 summarizes results for early bituminous concrete projects with 2NS and conventional 3BC sands. The 1964 tests indicate very little difference between the two sand types. Average wet sliding coefficients obtained during 1964 were 0.36 and 0.38 for 3BC and 2NS sands, respectively. Skid tests on 8 of the 14 areas reported last year have been discontinued and are not being reported this year.

Results of skid tests performed on I 75 - US 27 Interstate bituminous concrete projects from Clare to Indian River are presented in Table 3. Projects tested were constructed between July 1961 and June 1963. Good skid resistance qualities were found on all projects. The average 1964 wet sliding coefficient is 0.61. A noteworthy effect of traffic wear is shown by the consistent variation of friction values between inside and outside lanes. Coefficients in the outside lanes, as shown this year, are almost 26 percent lower than in the inside lane. A significant measure of pavement performance to be considered in connection with skid resistance measurements in the Corrected Wear Factor (CWF), computed for a given project as the product of the years of service and average equivalent daily passenger car traffic, divided by 1000. CWF values for the outer (traffic) lanes of these projects have been computed again this year, for comparison with skid coefficients of the same lanes. The CWF figures are based on 1962-64 ADT and 1962 commercial traffic figures as obtained by Research Laboratory analysis of Traffic Division records.

Table 4 is a summary of four 1960 and 1961 construction projects, for comparison of 31A slag with 31A crushed gravel. The two 1960 projects using slag and the 1960 crushed gravel project have almost identical friction values. The newer 1961 project used two types of slag; the 1964 coefficients for open hearth slag averaged 0.38 as compared to 0.47 for the blast furnace slag lanes. Initial tests on the two slag types in November of 1961 showed little difference in skid resistance qualities; however, in May 1962 a slightly higher average coefficient was obtained on the area containing blast furnace slag. This difference was verified with the September 1964 tests as shown in Table 4.

Table 5 compares a rubberized asphalt surface with a bituminous concrete and a bituminous aggregate project. All were resurfaced in

October 1960. Tests conducted in May 1964 indicated that the rubberized sand asphalt surface had the highest average coefficient of the three resurfacing types.

A summary of skid test data for a sand asphalt resurfacing project located on US 131 from Reed City north is given in Table 6. This project was surfaced in July and August 1961. A later kerosene and sand treatment was applied in November 1961, to correct an area at the north end of the project that was too rich in asphalt content. Tests conducted in May 1964, indicated good skid resistance qualities in all areas.

Skid test results are presented in Table 7 for a special sheet asphalt resurfacing, applied in September 1963 to correct a slippery condition on US 131 from Rockford to Cedar Springs. This resurfacing compares varying asphalt contents in four short test sections (A through D). After one year of service, average coefficients range from 0.41 to 0.47 and maintain the good skid resistance qualities previously reported. The trend that has prevailed on this project still exists, inasmuch as wet sliding friction values again tend to increase as the percent bitumen decreases.

Tables 8 and 9 report tests on Detroit area intersections treated with either 2NS modified sand asphalt or 3BCS slag sand asphalt, respectively. Comparing skid coefficients obtained in tests of July 1963 and September 1964, the 2NS modified intersections improved slightly in skid resistance, while the 3BCS slag intersections retained the same average coefficient.

Included in Table 10 are 1964 skid test results accumulated on four Wyton synthetic binder surface course applications. Experimental mixtures were applied for the following purposes:

a. to repair new concrete pavement which vehicles had rutted before concrete set-up (Project CS 25-71, C1).

b. to repair new concrete pavement damaged by a heavy rain before concrete set-up (Project 39014B, C6RN).

c. to correct a slippery condition (Projects 82112C, C28, and 82121C, C8).

Two of these projects had carried traffic for a year when tested, and maintained an average coefficient of 0.52. The two newer projects have an average coefficient of 0.54. At this early stage, all four projects show good skid resistance qualities.

Table 11 contains a summary of skid tests on a special 3BC sand asphalt non-skid resurfacing on southbound US 131 north and south of Alba. Two penetration grades of asphalt were used in this project. Initial tests and tests conducted three months after surfacing indicate good skid resistance qualities. During skid tests, Laboratory personnel pointed out the existence of unusually soft surfacing material in the section north of Alba, which has the higher penetration asphalt. Future effects of traffic might be expected to cause a significant drop in wet sliding friction values there.

Table 12 presents a summary of skid tests performed on several types of bridge deck coatings. The first five projects were treated with coal tar slurry seal applications on bituminous concrete surfaces. These all exhibit low or dangerous coefficients. Project B03 of 51021 has subsequently been resurfaced with 1/2-in. of sand-asphalt mix. The last three projects were included for comparison and include a Wyton-sand surface and two older epoxy coatings applied to portland cement concrete in 1961. Project B01 of 34032 was coated with too thin an application of epoxy, and consequently the cover aggregate has been scraped off, resulting in fairly low coefficients. Project B01 of 34044 also contains a rubberized coal tar slurry application on concrete, and exhibits somewhat higher coefficients than the five similar coatings on bituminous concrete.

Wet sliding friction values are shown in Table 13 for asphalt emulsion hot-mix surface courses applied to two intersections in Lansing. Skid tests were conducted before and after resurfacing operations. Initial tests show good skid resistance qualities at both intersections.

TABLE 1
UPPER PENINSULA BITUMINOUS CONCRETE AND BITUMINOUS AGGREGATE USING MINE ROCK AND RELATED AGGREGATE

	Control Section	Project Number	Route	Location	Year Surfaced	Coarse Aggregate	Asphalt Cement	Average Coefficient of Wet Sliding Friction			
								Firestone Tire			General Tire
								1958	1959	1961	1964
MINE ROCK	27021D	C6	US 2	Bessemer - Wakefield	1962	(25A) Caspian Construction Co. - Trap Rock Quarry (Pit #27-62)(1)	Am. Oil Co., Whiting, Ind. (4)	--- ---	--- ---	--- ---	0.57 EBOL 0.65 EBIL 0.57 WBOL 0.65 WBIL
	27021	27-03, C5	US 2	State Line E to Ironwood	1956	(25A) Peterson Mine - Mine Rock(2)	Lion Oil ElDorado, Ark.; Am. Lib. Oil, Mt. Pleasant, Texas(4)	0.52 EB 0.49 WB	0.50 EB 0.50 WB	0.51 EB ---	0.52 EB 0.47 WB
	31011	31-31, C13	M 26	Ontonagon Co. Line NE 3.9 mi	1956	(25A) Winona - Waste Mine Rock (Pit #31-4) (2)	Am. Lib. Oil, Mt. Pleasant, Texas(4)	0.62 NB ---	--- 0.67 SB	--- 0.64 SB	0.66 NB 0.64 SB
	31012 31051	C1, C2 C1, C2	M 26	NE and SW of SW Limits of Houghton	1957	(25A) Hancock - Waste Mine Rock (Pit #31-20) (2)	Am. Lib. Oil, Mt. Pleasant, Texas (5)	--- ---	--- ---	--- ---	0.46 EB 0.43 WB
	66051	66-54, C4	M 26	Mass to Rockland	1956	(25A) Mass Pit - Waste Mine Rock (Pit #66-51)(2)	Lion Oil, ElDorado, Ark.; Am. Lib. Oil, Mt. Pleasant, Texas (4)	--- 0.60 SB	--- 0.69 SB	--- 0.62 SB	0.68 NB 0.69 SB
RELATED AGGREGATE	27024 36021	C1 C1	US 2	From 1.7 mi W of Iron-Gogebic Co. Line E to 5.4 mi E of Co. Line	1957	(25A) Caspian Lumber Co. (Pit #36-34) (2)	Am. Lib. Oil, Mt. Pleasant, Texas; Lion Oil Co., ElDorado, Ark.(4)	--- ---	--- ---	--- ---	0.67 EB 0.67 WB
	27024	27-20, C13	US 2	US 45 East	1956	(25A) Maher (Pit #27-33)(2)	Am. Lib. Oil, Mt. Pleasant, Texas; Lion Oil Co., ElDorado, Ark.(4)	--- ---	0.66 EB ---	--- ---	0.60 EB 0.64 WB
	27051	27-11, C14	US 45	US 2 North 2 mi	1956	(25A) Maher (Pit #27-33)(2)	Am. Lib. Oil, Mt. Pleasant, Texas; Lion Oil Co., ElDorado, Ark.(4)	0.48 NB 0.49 SB	0.53 NB ---	0.49 NB ---	0.42 NB 0.44 SB
	31011	C1	M 26	Painsdale to Lake Roland	1960	(20A) Toivola (Pit #31-53)(2)	Gustafson Oil Co., Escanaba, Mich. (others)(6)	--- ---	--- ---	--- ---	0.61 NB 0.64 SB
	31012	31-20, C9	M 26	Houghton to Painsdale	1953	(25A) Thornton, Hancock(2)	Lion Oil Co., ElDorado, Ark.(4)	0.53 SB	0.60 SB	0.62 SB	Resurfaced
	31013	31-21, C4	M 26	Dollar Bay to Lake Linden	1955	(25A) Thornton, Hancock Race-track (Pit #31-1)(2)	Am. Lib. Oil, Mt. Pleasant, Texas; Lion Oil Co., ElDorado, Ark.(4)	--- ---	0.60 NB ---	--- 0.57 SB	0.58 NB 0.55 SB
	31013	31-25, C4	M 26	Laurium to Lake Linden	1952	(25A) Thornton, Hancock(2)	Lion Oil Co., ElDorado, Ark.(4)	--- 0.50 SB	0.61 NB ---	--- 0.64 SB	0.59 NB 0.58 SB
	31041	C1	M 35	From Ontonagon Co. Line E 12.2 mi in Houghton Co.	1961	(20A) Caspian Construction Co. - Lake Mine #2 (Pit #66-64)(2)	Lion Oil Co., ElDorado, Ark.(6)	--- ---	--- ---	--- ---	0.60 EB 0.60 WB
	31051	31-19, C5	US 41	Houghton to Chassel	1952	(25A) Thornton, Hancock(2)	Lion Oil Co., ElDorado, Ark.(4)	--- 0.54 SB	0.49 NB 0.59 SB	0.58 NB ---	0.50 NB 0.55 SB
	31052	C1	US 41	Hancock to Calumet	1958	(25A) Thornton, Hancock(2)	Am. Petrofina Co., Mt. Pleasant, Texas; Lion Oil Co., ElDorado, Ark.(4)	0.50 NB ---	--- 0.63 SB	0.62 NB ---	0.54 NB 0.57 SB
	31052	31-18, C9	US 41	Calumet to Mohawk	1955	(25A) Thornton, Racetrack - (Pit #31-1)(2)	Am. Lib. Oil, Mt. Pleasant, Texas(4)	0.44 NB ---	0.55 NB ---	0.55 NB ---	0.50 NB 0.54 SB
	36021	C3, C4	US 2	From 4.7 mi W of Iron River E to 0.7 mi E of W Limits of Iron River	1961	(25A) Caspian Construction Co. - Lumber Pit #2 (Pit #36-40)(2)	Gustafson Oil Co., Escanaba, Mich.(4)	--- ---	--- ---	--- ---	0.45 EB 0.52 WB
	42011 42012	42-05, C8 42-14, C4	US 41	Mohawk to Delaware	1955	(20A) Fox Valley Construction Co. C & H Pit #1 (Pit #42-14)(2)	Socony Mobil, Augusta, Kansas(5)	--- ---	--- ---	--- ---	0.65 NB 0.62 SB
	52041	52-13, C5	US 41	Champion West	1956	(25A) Dishneau (Pit #52-1)(2)	Lion Oil Co., ElDorado, Ark.(4)	0.54 EB ---	--- 0.51 WB	--- 0.50 WB	0.44 EB 0.53 WB
	52041	52-19, C4	US 41	Marquette Co. Line East	1956	(25A) Dishneau (Pit #52-1)(2)	Lion Oil Co., ElDorado, Ark.(4)	--- ---	--- 0.56 WB	--- 0.56 WB	0.56 EB 0.56 WB
	52042	52-25, C8	US 41-M 28	From 2.3 mi E of W Limits of Marquette East	1951	(25A) Marquette Co. Rd Comm. (Pit #52-9)(2)	Lion Oil Co., ElDorado, Ark.(4)	--- ---	--- ---	--- ---	0.42 NB 0.42 SB
	66032	C4	US 45	M 26 South, Near Rockland	1960	(20A) Thornton Construction Co. - Arenz (Pit #66-43)(3)	Leonard Refineries, Inc., Alma, Mich.(6)	--- ---	--- ---	--- ---	0.68 NB 0.68 SB
	66041	C2	M 35	Lake Mine E to Houghton Co. Line	1960	(20A) Caspian Construction Co. - Lake Mine Pit #2 (Pit #66-64)(2)	Lion Oil Co., ElDorado, Ark.(6)	--- ---	--- ---	--- ---	0.64 EB 0.64 WB

(1) Filler: Flyash from Wisconsin Flyash, Green Bay, Wisconsin.

(2) Filler: Limestone dust from Hurlbut Chemical Co., Green Bay, Wisconsin.

(3) Filler: Flyash from Detroit Edison Co., St. Clair, Michigan.

(4) Penetration: 85/100

(5) Penetration: 60/70

(6) Penetration: 150/175

TABLE 2
BITUMINOUS CONCRETE PROJECTS WITH 2NS AND 3BC SANDS

	Project Number		Route	Location and Length	Experimental Section	Coarse Aggregate	Average Coefficient of Wet Sliding Friction*						
							Firestone Tire						General Tire
	Control Section	Contract Number					1958	1959	1960	1961	1962	1963	1964
SURFACED 1958	SS 79061	C1R	M 81	Watrousville, E&W (4.9 mi)	Sec. #1 (2NS) Sec. #3 (3BC)	Inland L.S., Pt. Inland	.52(11) .48	.53(10) .49	.49(9) .44	.45(5) .42	.43(5) .40	.40(7) .38	.40(5) .40
		79-23, C4	M 81	Between Sections #1 and #3 (1.45 mi) (comparison section, passed 1952)	Sec. #2 (3BC)	Drummond Dolomite	.38	.44	.41	.41	.41	.34	.32
SURFACED 1959	M 30071 46011	C1R C1R	US 127	From M 34 to US 12 (13.9 mi)	3BC, 3.5% MF 2NS, 4.5% MF 2NS, 2.0% MF 2NS, 0.0% MF	France Stone, Waterville, Ohio		.48(12) .50 .55 .55	.39(9) .49 .44 .39	--- --- --- ---	--- --- --- ---	--- --- --- ---	.28(11) .40 .33 .35
	M 39042	C6U	M 96	Kalamazoo to Galesburg (6.6 mi)	3BC Coarse sand 2NS	Materials Service, Chicago		.39(12) .42 .46	.40(9) .46 .44	.44(5) .48 .38	--- --- ---	--- --- ---	.30(11) .40 .36
	F 41051	C1R	US 131 BP	Knapp Rd., North (3.95 mi) (Grand Rapids)	3BC 2NS	Grand Rapids Gravel Co.		.52(12) .48	.58(10) .54	--- ---	--- ---	--- ---	.42(11) .46
	F 81032	C2U, C3R	US 12	In Ypsilanti (1.5 mi)	2NS	Am. Agg., Green Oak		.46(12)	.44(9)	---	---	---	.35(11)
	F 81102	C1R	M 14	Ann Arbor, East (11.6 mi)	3BC 2NS	Am. Agg., Green Oak		.59(12) .58	.52(9) .48	--- ---	--- ---	--- ---	.44(11) .40

* Month of test is shown in parentheses.

TABLE 3
INTERSTATE BITUMINOUS CONCRETE PROJECTS
I 75 - US 27 from Clare to Indian River (Projects listed from South to North)

Project Number	Length in Miles	Date Paved (wearing course)	Location	Paving Contractor	Source of Coarse Aggregate	Average Coefficient of Wet Sliding Friction										CWF***
						Firestone Tire								General Tire		
						1961		1962		Apr. 1963		Aug. 1963		1964		
						IL*	OL*	IL	OL	IL	OL	IL	OL	IL	OL	
18033, C5	4.150	June 1962	N. of Hatton Rd. to M 61	Pierson Const. Co.	Wallace Stone, Bay Port	---	---	---	---	---	---	---	---	.50	.49	9.3
18034, C3	6.758	May-June 1962	M 61 to Arnold Rd.	Rieth-Riley	Wallace Stone, Bay Port	** .52	** .51	---	---	---	---	---	---	.58	.47	7.5
18034, C1	5.902	July-Aug.-Oct.	Arnold Rd. N. to Roscommon Co. L.	Mid-America Eng.	Wallace Stone	.60	.60	.60	.52	---	---	---	---	.61	.49	10.7
72013, C2	3.007	July-Aug.-Oct. 1961	Roscommon Co. L. N. 3 Mi.			---	---	---	---	---	---	.58	.47	.69	.56	10.6
72013, C1	9.643	July-Aug.-Sept. 1961	3 Mi. N. of Clare Co. L to 0.5 Mi. N. of M 55	Ann Arbor Const. and Lake-Howell	Afton Quarry (20-35)	---	---	.60	.50	---	---	.57	.44	.63	.44	10.4
72014, C1	6.981	Sept.-Oct. 1961	0.5 Mi. N. of M 55 to 0.5 Mi. N. of Higgins Lake Rd.	Thornton Const.	Pickitt, Schreur, Merritt Pit	.52	.48	.60	.53	---	---	.58	.51	.70	.62	8.3
72014, C3 & 4	4.229	May 1962	0.5 Mi. N. of Higgins Lake Rd. to N. Co. L.	Thornton Const.	Pickitt, Schreur, Merritt Pit	---	---	.54	.48	---	---	.58	.51	.67	.57	6.3
20016, C1 & 3	5.804	May-June 1962	Crawford-Roscommon Co. L. to M 18-M 76	Thornton Const.	Pickitt, Schreur, Merritt Pit	---	---	.51	.48	---	---	.58	.53	.68	.59	8.1
20014, C3	4.874	Aug.-Sept. 1961	M 18-M 76 to 0.5 Mi. S. of M 72	Lake and Howell	Afton Quarry	.43	.43	.56	.43	---	---	.53	.40	.65	.43	10.8
20015, C4	4.534	Sept.-Oct. 1961	0.5 Mi. S. of M 72 to 0.5 Mi. N. of M 93	Saginaw Asphalt	Afton Quarry	.53	.50	.60	.50	.58	.49	.53	.46	.74	.54	5.7
20015, C2	4.864	May-June 1962	0.5 Mi. N. of M 93 to Co. Rd. #612	Thornton Const.	McCready Pit (60-16)			.56	.51	.57	.55	.57	.51	.70	.64	5.8
20015, C3	4.847	Sept. 1961	Co. Rd. #612 to N. Crawford Co. L.	Thornton Const.	McCready Pit	.60	.56	.60	.52	.61	.56	.59	.51	.73	.63	7.1
69013, C1	7.665	Oct. 1961 (1.5 mi) June 1962 (6.1 mi)	Otsego Co. L. North Marlette Rd. to Charles Brink Rd.	Saginaw Asphalt	Afton Quarry			---	---	.57 .56	.49 .47	.59 .59	.54 .47	.70 .68	.54 .48	5.2
69013, C3	5.385	June 1962	Brink Rd. N. to M 32 (Gaylord)	Spartan Asphalt	Lewiston Pit			---	---	.59	.54	.63	.57	.71	.62	5.9
69014, C3	8.718	June-July 1962	M 32 N. to Vanderbilt	Spartan Asphalt	Lewiston Pit (and Drummond Dolomite)			.54	.52	.60	.58	.58	.57	.70	.60	5.1
69014, C5	3.894	Sept.-Oct. 1962, also	Vanderbilt to 3/4 Mi. N. of Wolverine Rd.	Rieth-Riley	Afton Quarry			---	---	.60	.55	.58	.48	.75	.53	5.0
16093, C1	6.657	June 1963 (2.5 mi)	NB from Alexander Rd. to NYCRR - SB from Co. Line to NYCRR									.51	.47	.69	.51	4.2
16093, C3 & 5	7.942	Aug.-Sept. 1962	3/4 Mi. N. of Wolverine Rd. to 0.5 Mi. S. of M 68	Saginaw Asphalt	Afton Quarry			.56	.52	.62	.55	.60	.50	65	.50	4.3
16091, C9	2.629	Aug.-Sept. 1962	0.5 Mi. S. of M 68 N. to MCRR	East Shore Asphalt	Big Cut Pit			.62	.58	---	---	.63	.56	.75	.58	3.5

* IL and OL denote passing and traffic lanes.
** Tested on leveling course mix.
*** CWF is wear factor for traffic lane only.

TABLE 4

BITUMINOUS CONCRETE SURFACES WITH 31A AGGREGATE

Project Number	Location	Year Paved	Type of Material	Lane and Direction	Average Coefficient of Wet Sliding Friction			
					Firestone Tire			General Tire
					Nov. 1960	May 1961	June 1962	Sept. 1964
Mb 82062, C4U	US 12 (Michigan Ave.) from Washington St. to Brady St. in Dearborn	1960	31A Slag coarse	EBOL	.51	.41	.31	.36
			3BCS Slag sand	EBIL	.51	.42	.32	.34
			60-70 pen. AC	WBOL	.48	.43	.32	.34
				WBIL	.50	.41	.31	.35
Mb 82121, C1U	Gd. River (old US 16) 6 Mile Rd. to Berg Rd.	1960	31A Slag coarse	EBOL	.44	.40	.38	.34
			3BCS Slag sand	EBCL	.46	.45	.38	.36
			60-70 pen. AC	EBIL	.47	.43	.40	.39
				WBOL	.49	.44	.39	.36
				WBCL	.46	.44	.39	.39
				WBIL	.52	.45	.40	.35
Mb 82131, C5U	US 10 (Woodward Ave.) Clairmont St. to city limits of Highland Park	1960	31A Crushed gravel	NBOL	.52	.45	---	.35
			3BC Sand	NBIL	.52	.43	---	.37
			3MF Fly ash	SBOL	.52	.42	---	.36
			60-70 pen. AC	SBIL	.54	.43	---	.35
						Nov. 1961	May 1962	
Mb 82091C, C5U	Schaefer Rd., Gate 4 to Mellon Rd., Dearborn	1961	31A Open hearth slag	NBOL	---	.59	.41	.30
			3BCS Open hearth slag	NBCL	---	.65	.45	.38
			Open hearth slag	NBIL	---	.64	.49	.48
			31A Blast furnace slag	SBOL	---	.62	.51	.45
			3BCS Blast furnace slag	SBCL	---	.66	.49	.46
			Blast furnace slag	SBIL	---	.64	.53	.51

TABLE 5
RUBBERIZED SAND ASPHALT SURFACES
US 31 in Charlevoix (Project Mb 15012, C2U)
Surfaced October 1960

Test Area	Average Coefficient of Wet Sliding Friction					
	Firestone Tire					General Tire
	Nov.* 1958	Aug.** 1959	Oct. 1960	Sept. 1961	July 1963	May 1964
US 31 Bascule bridge N. to Dixon St. (rubberized sand asphalt)	.19	.48	.52	.40	.38	.46
US 31 Bascule bridge South to Party St. (31A mix)	.19	.44	---	---	.29	.32
M 66 Stover St. to Garfield St. (Mb 15031, C1U) (Bit. Agg. mix)	---	---	.54	---	.36	.38

* Initial tests on polished portland cement concrete surface.
** Tests run on temporary seal coat applied in summer of 1959.

TABLE 6
SAND ASPHALT RESURFACING
US 131: Reed City North (Project Mb 67014, C3R)

Area Tested	Treatment(a)	Average Coefficient of Wet Sliding Friction				
		Firestone Tire				General Tire
		Sept. 1961*	Jan. 1962	Nov. 1962	July 1963	May 1964
Section 1 2.3-2.9 mi N of Ashton Rd	.035 gal kerosene per sq yd plus sand	.45	.49	.52	.48	.56
Section 2 1.4-2.3 mi N of Ashton Rd	.050 gal kerosene per sq yd plus sand	.37	.46	.52	.47	.55
Section 3 0.9-1.4 mi N of Ashton Rd	.040 gal kerosene per sq yd plus sand	.34	.47	.52	.47	.53
Remainder of Project US 10 to 0.9 mi N of Ashton Rd	None	.44	.41	.49	---	.56

(a) Areas 0.9 to 2.9 mi N of Ashton Rd treated as indicated on November 20, 1961. Original sand asphalt surfacing was placed July 5 through August 9, 1961.

* Initial skid tests run in northbound lanes only. All subsequent skid tests represent an average of northbound and southbound lanes.

TABLE 7

SHEET ASPHALT RESURFACING

US 131: Rockford to Cedar Springs (Project Mb 41013C, C12)

Location			Materials		Average Coefficient of Wet Sliding Friction						
					Firestone Tire			Avg. of Both Tires	Firestone Tire	General Tire	
Section Designation(1)	Stationing	Lane	Percent Bitumen	Dust	Sept. 20 1963	Sept. 25 1963	Oct. 24 1963	Dec. 5 1963	May 12 1964	May 12 1964	Sept. 4 1964
A	323+90 to 299+25	SB	7.5	3.5	.35	.33	.31	.38	.45	.43	.40
	323+79 to 314+94	NB	7.5	3.5	.35	.32	.36	.38	.45	.46	.42
	Average				.35	.33	.33	.38	.45	.44	.41
B	314+94 to 297+20	NB	6.5	3.5	.38	.37	.38	.42	.47	.46	.46
C	299+25 to 281+80	SB	6.5	4.5	.41	.40	.36	.42	.45	.45	.45
	297+20 to 281+94	NB	6.5	4.5	.38	.38	.36	.45	.45	.45	.46
	Average				.40	.38	.36	.44	.45	.45	.46
D	281+80 to 264+97	SB	5.5	4.5	.44	.44	.42	.49	.49	.47	.47
	281+94 to 268+93	NB	5.5	4.5	.44	.45	.44	.46	.51	.49	.49
	Average				.44	.44	.43	.48	.50	.46	.46
Kent County Resurfacing (1962)	138+88 to 156+92	SB	31A, Grand Rapids Gravel Co. No. 8 (Pit 41-16)		.35	.34	.35	.44	.37	.36	.36
	138+88 to 156+92	NB			.38	.35	.35	.44	.40	.39	.39
	Average				.36	.34	.35	.44	.38	.38	.38
Balance of Project	90+00 South	SB	6.5	4.5	.46	.40	.39	.47	.50	.47	.47
	90+00 South	NB	6.5	4.5	.47	.40	.43	.46	.49	.47	.47
	Average				.46	.40	.41	.46	.50	.47	.47

(1) Test areas designated in P. J. Serafin's letter to E. A. Finney, September 16, 1963. Sheet asphalt surfacing placed September 9-13, 1963.

TABLE 8
2NS MODIFIED SAND ASPHALT SURFACES
District 10 Intersections

Control Section No.	Intersection Location	Route	Lane and Direction	Average Coefficient of Wet Sliding Friction			
				Firestone Tire			General Tire
				Nov. 1961	July 1962	July 1963	Sept. 1964
58053	US 24 at US 25 (So. Jct.)	US 25	NBOL	.45	.57	.35	.42
		US 25	NBIL	.51	.53	.34	.52
		US 24 & US 25	SBIL	.50	.50	.33	.37
		US 24	NBOL	.52	.54	.34	.40
		US 24	NBIL	.48	.54	.35	.42
82052	US 24 (SB) at M 17 (N. Jct. - Ames Rd.)	US 24	SBOL	.45	.49	.31	.40
		US 24	SBIL	.46	.49	.32	.39
82052	US 24 at Cypress St.	US 24	NBOL	.45	.49	.28	.39
		US 24	NBIL	.49	.51	.32	.39
		US 24	SBOL	.42	.52	.30	.39
		US 24	SBIL	.46	.53	.30	.39
82052	US 24 at Wick Rd.	US 24	NBOL	.43	.49	.32	.36
		US 24	NBIL	.44	.48	.31	.38
		US 24	SBOL	.44	.47	.32	.36
		US 24	SBIL	.49	.51	.31	.39
82052	US 24 at Goddard Rd.	US 24	NBOL	.45	.45	.30	.35
		US 24	NBIL	.40	.47	.30	.36
		US 24	SBOL	.40	.43	.29	.37
		US 24	SBIL	.41	.47	.30	.37
82052	US 24 at Northline Rd.	US 24	NBOL	.45	.43	.28	.36
		US 24	NBIL	.47	.46	.29	.38
		US 24	SBOL	.47	.47	.30	.38
		US 24	SBIL	.48	.45	.30	.37
82041	M 17 at Pelham Rd.	M 17	EBOL	.42	.47	.29	.41
		M 17	EBIL	.46	.49	.29	.39
		Pelham	NBIL	.46	.45	.29	.40
		Pelham	SBOL	.44	.44	.28	.42
		Pelham	SBIL	.46	.48	.28	.39
	Average of All 2NS Modified Sand Lanes			.46	.49	.31	.39

TABLE 9
3 BCS SLAG SAND-ASPHALT SURFACES
District 10 Intersections

Control Section No.	Intersection Location	Route	Lane and Direction	Average Coefficient of Wet Sliding Friction			
				Firestone Tire			General Tire
				Nov. 1961	July 1962	July 1963	Sept. 1964
82053	US 24 (NB) at 5 Mile Rd.	US 24	NBOL	.55	.46	.32	.33
		US 24	NBCL	.50	.47	.35	.29
		US 24	NBIL	.52	.41	.34	.31
82053	US 24 (NB) at W. Chicago Blvd.	US 24	NBOL	.43	.46	.30	.28
		US 24	NB #3	.48	.46	.32	.25
		US 24	NB #2	.52	.43	.31	.26
		US 24	NBIL	.51	.44	.32	.34
82053	US 24 (NB) at Joy Rd.	US 24	NBOL	.53	.47	.31	.32
		US 24	NB #3	.55	.45	.33	.28
		US 24	NB #2	.54	.45	.35	.33
		US 24	NBIL	.55	.46	.33	.32
82053	US 24 (NB) at Richardson St.	US 24	NBOL	.51	.52	.33	.35
		US 24	NB #3	.54	.58	.34	.36
		US 24	NB #2	.58	.57	.33	.40
		US 24	NBIL	.61	.57	.36	.43
82121	US 16 at Inkster Rd.	US 16	WBOL	.53	.42	.33	.25
		US 16	WBCL	.55	.41	.31	.29
		US 16	WBIL	.55	.42	.31	.30
		US 16	WBPL	---	---	---	.31
		US 16	EBOL	.51	.41	.29	.35
		US 16	EB #3	.49	.42	.31	.29
		US 16	EB #2	.54	.44	.31	.31
		US 16	EBIL	.54	.40	.33	.35
82121	US 16 at Poinciana St.	US 16	WBOL	.53	.41	.34	.27
		US 16	WBCL	.51	.42	.33	.26
		US 16	WBIL	.53	.41	.33	.34
		US 16	PL	---	---	---	.33
		US 16	EBOL	.52	.43	.33	.31
		US 16	EBCL	.53	.44	.34	.30
		US 16	EBIL	.55	.43	.32	.35
		US 16	PL	---	---	---	.33
82121	US 16 at Beech-Daly Rd.	US 16	WBOL	---	---	---	.28
		US 16	WB #3	.49	.39	.29	.24
		US 16	WB #2	.53	.44	.26	.30
		US 16	WBIL	.51	.41	.30	.32
		US 16	EBOL	---	---	---	.26
		US 16	EB #3	.49	.42	.30	.27
		US 16	EB #2	.48	.40	.29	.29
		US 16	EBIL	.46	.40	.32	.29
82141	M 102 at Inkster Rd.	Inkster	NB	.47	.42	.28	.25
		Inkster	SB	.45	.39	.28	.34
82141	M 102 at Beech-Daly Rd.	M 102	EBOL	.48	.40	.28	.20
		M 102	EBCL	.51	.41	.28	.32
		M 102	EBIL	.66	.45	.34	.39
	Average of All Slag Sand Lanes			.52	.44	.31	.31

TABLE 10
WYTON SYNTHETIC BINDER SURFACE COURSE MIXTURES

Project No.	Location	Aggregate	Percent Wyton	Mineral Filler	Direction and Lane	Average Coefficient of Wet Sliding Friction — General Tire					
						Oct. 1963	Dec. 1963	June 1964	July 1964	Aug. 1964	Oct. 1964
CS 25-75, C1 (Applied Sept. 1963)	On Bristol Rd from M 15 West	(2NS) Local Pit (31A) Wallace	6.0	Fly Ash	EB	---	0.47	0.49	---	0.47	---
					WB	---	0.46	0.48	---	0.46	---
39014 B, C6 RN* (Applied Sept. 1963)	US 131 at M 43	(2NS) American Agg. -Kalamazoo (Pit #39-1)	6.3	Limestone Dust - Material Service, Thornton, Illinois	NBOL	0.41	---	---	0.60	0.56	---
					NBIL	0.46	---	---	0.63	0.61	---
82112 C, C28 (Applied Oct. 1964)	John Lodge Expressway (I 696 BS) at Wyoming Avenue	(2NS) Manning-Lockin (Pit #82-4) (31A) American Agg. -Green Oak (Pit #47-3)	6.6	Limestone Dust - Ohio Lime Co., Woodville, Ohio	NBOL	---	---	---	---	---	0.52
					NBCL	---	---	---	---	---	0.51
					NBIL	---	---	---	---	---	0.54
					SBOL	---	---	---	---	---	0.50
					SBCL	---	---	---	---	---	0.50
					SBIL	---	---	---	---	---	0.53
82121 C, C8 (Applied Oct. 1964)	Grand River Ave. (I 96 BS) at Telegraph Rd (US 24)	(2NS) Manning-Lockin (Pit #82-4)	6.6	Limestone Dust - Ohio Lime Co., Woodville, Ohio	EBOL	---	---	---	---	---	0.47
					EB #3	---	---	---	---	---	0.54
					EB #2	---	---	---	---	---	0.52
					EBIL	---	---	---	---	---	0.66
					WBOL	---	---	---	---	---	0.57
					WB #3	---	---	---	---	---	0.55
					WB #2	---	---	---	---	---	0.57
					WBIL	---	---	---	---	---	0.54
					NBOL	---	---	---	---	---	0.60
					NB #3	---	---	---	---	---	0.51
					NB #2	---	---	---	---	---	0.55
					NBIL	---	---	---	---	---	0.60
					SBOL	---	---	---	---	---	0.62
					SB #3	---	---	---	---	---	0.59
					SB #2	---	---	---	---	---	0.54
					SBIL	---	---	---	---	---	0.66

* See Authorization No. R 2006 and S 2007.

TABLE 11
3BC SAND ASPHALT NON-SKID RESURFACING
Project Mm 4 BC-3A (Control Section 05072)

Area Tested	Asphalt Cement	Mineral Filler	Aggregate	Penetration	Lane and Direction	Average Coefficient of Wet Sliding Friction	
						General Tire	
						July 1964	Oct 1964
Southbound US 131 from Mancelona to South of Alba	Trumbull Asphalt Co. Muskegon, Michigan*	Fly Ash - Detroit Edison Co.	1:1 mixture from Polous and Gerstenberger Pits	85-100	SBOL SBIL	0.51 0.68	0.54 0.66
Southbound US 131 from North of Mancelona to M 32	Trumbull Asphalt Co. Muskegon, Michigan**	Fly Ash - Detroit Edison Co.	1:1 mixture from Polous and Gerstenberger Pits	150-175	SBOL SBIL	0.50 0.63	0.60 0.68

* 6.9 percent Bitumen
** 6.4 percent Bitumen

TABLE 12
SUMMARY OF 1964 SKID TESTS
ON BRIDGE SURFACE COATINGS
Tests Conducted in September and October 1964

Bridge No.	Location	Year Coated	Type of Coating	Direction and Lane	Average Coefficient of Friction
B01 of 10042*	M 115 over Betsie River	1963	Coal tar slurry and fine sand applied to old bit. concrete	NWB SEB	0.19 0.20
B01 of 34032	M 66 over Grand River	1961	Polysulfide epoxy coating applied 80 sq ft/gal and 8-30 mesh quartz applied to scaled and cracked concrete	NBOL NBIL SBOL SBIL	0.28 0.30 0.26 0.25
B01 of 34044	I 96 over Grand River	1961	East Half of Deck Only Coal tar slurry (rubberized) and 8-30 mesh quartz applied to cracked concrete	WBOL WBIL	0.31 0.41
			West Half of Deck Only Coal tar epoxy (Guard Kote 140) 0.3 gal/sq yd and 8-30 mesh quartz applied to cracked concrete	WBOL WBIL	0.52 0.67
B03 of 51021	M 55 over Pine River	1964	Coal tar slurry and fine sand applied to new bit. concrete	EB WB	0.18 0.17
B01 of 51041*	M 115 over Betsie River	1963	Coal tar slurry and fine sand applied to old bit. concrete	NWB SEB	0.25 0.25
X01 of 51041*	M 115 over C & O RR	1963	Coal tar slurry and fine sand applied to old bit. concrete	NWB SEB	0.24 0.24
B01 of 59022	M 57 over Flat River	1962	Coal tar slurry (rubberized) and 8-30 mesh quartz applied to new bit. concrete	EB WB	0.26 0.27
B01 of 79051	M 24 over Cass River	1964	Wyton with 2NS sand mix applied at 50 lb/sq yd	NB SB	0.51 0.51

* County Maintenance Projects.

TABLE 13
ASPHALT EMULSION HOT MIX SURFACE COURSES

Intersection	Surface Type	Direction and Lane	40 mph Wet Sliding Coefficients	
			6-22-64*	11-1-64**
Cedar Street (US 127) at Holmes Road	Sand Emulsified asphalt hot mix surface course	SBOL	0.23	0.45
		SBIL	0.22	0.47
		NBIL	0.20	0.47
		NBOL	0.19	0.49
		Avg.	0.21	0.47
Cedar Street (US 127) at Baker Street	Bituminous Concrete Emulsified hot mix wear course	SBOL	0.33	0.47
		SBIL	0.32	0.55
		NBIL	0.31	0.56
		NBOL	0.24	0.48
		Avg.	0.30	0.52

* Tests run prior to resurfacing.
** Tests run after resurfacing.