

SUMMARY OF HIGHWAY DEPARTMENT CONCERN
IN CONNECTION WITH THE USE OF TIRE STUDS



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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

SUMMARY OF HIGHWAY DEPARTMENT CONCERN
IN CONNECTION WITH THE USE OF TIRE STUDS

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State of Michigan
Department of State Highways
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OFFICE MEMORANDUM



MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

November 19, 1969

To: R. L. Greenman
Engineer of Testing & Research

From: L. T. Oehler

Subject: Summary of Highway Department Concern In Connection with Continued and Expanding Use of Tire Studs.

Studded tires became generally available in the United States in 1964. However, in many states immediate active promotion of these tires was not made because of the questionability of their legality under existing statutes. However, activity was instigated to legalize them and many states passed legislation to permit their use. By October 1965, 25 northern states and the District of Columbia had modified their laws to remove the ban against studded tires. At that time, Indiana, Iowa, Oregon, and Michigan were studying the matter of modifying the ban. Legislation to legalize their use was primarily based on the improvement in stopping distance on ice. At that time, no valid research was available concerning the effect of studded tires on pavement wear, and the somewhat poorer stopping distance of studded tires on clear pavements was not generally known.

In February 1965, the Department submitted a "Research Problem" statement under the National Cooperative Highway Research Program for a study of "The Effects of Safety Studded Tires on Pavement Surfaces." Specific objectives of this proposed study were: 1) to determine the wearing and abrasive effects of studded and non-studded tires on concrete and bituminous pavement surfaces, 2) to determine the maximum abrasive effects of studded tires that might occur at signalized intersections under repeated turning, braking, and acceleration conditions, and 3) to determine the effect on skid coefficients of concrete and bituminous surfaces subjected to studded and conventional tires. This study was eventually implemented under the NCHRP program and conducted by Cornell Aeronautical Laboratory; but because of limited financing, the study was primarily a literature review and did not directly answer the previously stated objectives. The Department's position on April 1, 1965 to Senate Bill No. 218 "...to permit the use of tires studded with steel or other wear-resisting material constructed to prevent any appreciable damage to the road surface" was briefly as follows: "The Highway Department is opposed to this bill at this time because of insufficient research to determine the extent of damage to various types of road surfaces and to determine if these studs would create safety hazards while reducing the hazard of driving on ice." Also, the Department statement continued, these tires do cause damage, the question is how much damage; and that the "appreciable damage" in the bill is not defined, nor who is

to make such a determination. The Department was also concerned from the safety standpoint, in that the studs would actually have a polishing effect on pavements containing certain types of aggregate, thus reducing the coefficient of friction and increasing the hazard to motorists using conventional tires.

However, in June 1967, Senate Bill No. 65 took effect which legalized the use between November 1 and May 1 of tire studs, "...constructed to prevent any appreciable damage to the road surface."

Although some limited information was available by 1967 concerning the damaging effect of tire studs on the pavement, it was not sufficient to deter legislative approval. In the past few years, however, more and more information has become available describing the damaging effects of tire studs and some of the limitations of their safety aspects. Tire studs were used in Europe before they were in the States. By 1966, German road authorities expressed deep concern over the destruction of roads by salt and studded tires. "...it is estimated that the damage is so severe that the surfaces will have to be replaced at approximately 4 year intervals. Studded tires are now limited to vehicles under 7,700 lb. It has been suggested that these weight limits be lowered and that cars with studded tires should have a lower speed limit."⁽¹⁾ There is no weight limit for vehicles with studded tires in Michigan.

In order to study the problem more extensively an Ad Hoc Committee on Studded Tires was organized by the Highway Research Board, Department of Design. Some excerpts from the minutes of their January 18, 1968 meeting are as follows:

The use of studded tires has vastly increased in Finland during the last year and today 55 percent of the cars and 7 percent of the trucks are using studded tires in wintertime. Because most of the main roads are not covered by snow in winter, the studs are now wearing the pavement. Laboratory investigations along with field observations have led to the conclusion that studded tires strongly wear asphalt pavements. From Sweden the experience was related of a new pavement after one winter of traffic with slides illustrating the very extensive erosion of the sand-binder matrix with the coarse aggregate being all exposed and subject to continuing wear and heavy loss. Mr. Ulstad, Chief of the Oslo Road Department related that 55-60 percent of the cars use studded tires but only 7 percent of the trucks and busses. He reported that the wear on their pavements is very serious.

⁽¹⁾ "Salt and Studded Tires Ruin German Roads," World Road News, January, 1966.

Since widespread use of studded tires occurred later in the United States, it has only been recently that evidence of extensive wear has been found by State Highway Departments. It should be noted that in January 1968, Minnesota, with 10 percent of the cars equipped with studded tires, had no evidence of severe wear except on entrance ramps. On August 1, 1969 the Minnesota State Highway Department invited representatives of Iowa, Wisconsin, and Michigan to a meeting to formulate a research program for quantitative data on pavement wear due to studded tires to present to the Minnesota Legislature by December 15, 1970. Their present concern on continued use of tire studs was summarized by Mr. Ekern, Deputy Commissioner. The first winter (1965-66) that studded tires were legal resulted in about 4 percent of the cars using them. The second winter, 9.3 percent, the third winter 23.4 percent, and last winter (1968-69) between 30-33 percent of the cars were using studded tires. By the third winter the Department could see that pavement wear was becoming a serious situation. At present the best method of repairing this wear is unknown, but it may require thin epoxy surfacings or a bituminous overlay, both of which are quite expensive. At the present rate of wear it appears that overlays may be required on new pavement in four years. The most serious wear has taken place on high speed expressways around the St. Paul - Minneapolis metropolitan area. Some concrete pavements of recent construction have shown appreciable wear and coarse aggregate exposure, five months after opening to traffic. Some Minnesota pavements have been grooved for safety reasons with grooves 1/8- by 1/8- at 3/4-in. centers. In less than two winters the grooves in the wheel paths have disappeared due to wear from tire studs. A maximum of about 1/4-in. loss of pavement surface has been observed to date. The wear is not confined to stopping and starting areas but to the open highway where traffic is travelling at high speeds. A 1968 summer survey in the twin cities metropolitan area showed 210 lane miles of concrete pavement had sustained abrasive damage resulting in wheel path rutting. Two conclusions of an interim Minnesota report⁽²⁾ are of interest: 1) studded tires significantly accelerate the rate of abrasion of highway surfaces and 2) since most motorists in Minnesota use studded tires on the rear only, the benefits provided are primarily increased traction. Safety benefits, such as decreased stopping distance and increased control in cornering, are minimal, particularly after a few thousand miles of use. (With respect to safety, tire chains are much more effective than studded tires and are much more likely to be used only when needed.)

At the August 1 meeting, the Wisconsin representative stated that they had a similar record of pavement wear to that experienced by Minnesota.

(2) "Studded Tires, Their Effect on Pavement Wear and Performance Characteristics," Interim Report, 1968, Minnesota Special Study No. 290.

Maryland⁽³⁾ reported after 10,000 passenger car vehicle circuits with studded tires front and rear a maximum wear of 0.107 in. for bituminous pavements and 0.052 in. for concrete pavements. After 10,000 truck (23,000 lb gross) circuits with studded tires front and rear, the maximum bituminous pavement wear was 0.174 in. and for concrete pavements 0.170 in. With as low as 20 percent of the cars and trucks equipped with studded tires, there are many traffic locations where 10,000 vehicle applications would take place in less than two weeks under normal traffic.

Illinois⁽⁴⁾ reported abrasion depths up to 1/16 in. under 25 emergency stops followed by 25 quick starts (to simulate intersection wear) on a concrete pavement. All pavements tested showed evidence of abrasion, with bituminous surface treatments showing the most wear. Also, Illinois showed that studded tires may be less safe on dry pavements than regular tires. Tests on dry pavements showed up to 23 percent more stopping distance for a vehicle with studded tires on all four wheels than a vehicle with regular tires. Nine percent more stopping distance was needed when only rear-mounted studded tires were used. In tests reported later, conducted in Tennessee, it was reported that tires equipped with 72 studs had no longer stopping distances than regular tires, but for tires equipped with 144 studs there was a limited tendency toward longer stopping distances and lower coefficients of friction on wet or dry pavements.⁽⁵⁾

Conclusions from a New Jersey Department of Transportation study are partially quoted as follows: "A plausible extension of the data on hand and the analysis presented indicates that the more immediate benefits of studded tire use in New Jersey are very limited and could likely be outweighed ultimately by the principal disadvantages attached to the potential presence of a less skid resistant and/or more costly system of highway pavement, as well as other important deficiencies."⁽⁶⁾

The recent National Cooperative Highway Research Program was primarily a compilation of published research from other studies. However, it does have one very significant statement in reporting a pilot study where wear depths of 0.25 in. were obtained in a cross-over point in a parking lot after 21,000 passes with a 3/4-ton truck with studded tires. "The point is that under conditions that were more or less representative of actual road

(3) "Effects of Carbide Studded Tires on Roadway Surfaces," by Allan Lee, Thomas A. Page and Rafael DeCarrera. Highway Research Board Record No. 136.

(4) "Some Tests of Studded Tires in Illinois," John E. Burke and Lloyd J. McKenzie, Highway Research Board Record No. 136.

(5) "An Evaluation of Studded Tires Performance," E. A. Whitehurst and A. H. Eastman, Highway Research Board Record No. 171.

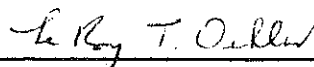
(6) "Studded Tire Evaluation in New Jersey," W. R. Bellis and J. T. Dempster, Jr., Highway Research Board Record No. 171.

conditions, wear depths of tenths of an inch were obtained with numbers of passes that could occur in days at busy highways. "(7)

The Michigan Department of State Highways is currently involved in two research studies in an attempt to obtain more factual data which will make it possible to determine the annual maintenance costs involved in continued use of tire studs in Michigan. As a result of the August 1 meeting, Michigan has joined Minnesota in financial support for a \$208,000 study to be conducted by the American Oil Company at their circular track facilities at Whiting, Indiana. In this study the wear resulting from studded and unstudded tires will be measured on 12 different sections of pavement, both bituminous and concrete. Separate test series will be run on pavements subjected to (a) sand and salt, (b) salt, and (c) without any foreign material added. Evaluation of the damage done by studded tires will be based on a comparison of the wear measured where studded tires are used and that measured where unstudded tires are used. This study is currently underway and a final report containing quantitative data on wear must be made by December 15, 1970 in order to meet the deadlines imposed by the Minnesota legislature. In the meantime, the Minnesota legislature has permitted the use of tire studs for two more years on a trial basis.

Second, the Department's Research Laboratory is conducting a survey of the frequency of use of studded tires throughout Michigan during this winter. This survey, which will be conducted annually in each of the ten highway districts, will locate areas of the state to watch for pavement wear and will make it possible to extrapolate pavement wear, knowing frequency of use and results of laboratory wear studies such as the one being conducted jointly with Minnesota. To date, the only observed pavement wear in Michigan which can be ascribed to studded tires has occurred in the Houghton-Hancock area where the use of tire studs is apparently more frequent than in other parts of the state.

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(7) "Evaluation of Studded Tires-Performance Data and Pavement Wear Measurement," Highway Research Board, National Cooperative Highway Research Program, Report No. 61.