

ALASKA LEGISLATURE COMMITTEE FILES 1993-1994 8672

8203 HOUSE TRANSPORTATION

408

HB

301

HOUSE COMMITTEE REPORT

(7)
Date Referred: March 15, 1994

FURTHER REFERRALS:

Labor & Commerce
Finance

Date of Committee Action: 3/22/94

The TRANSPORTATION Committee considered:

SSHB 301

SPONSOR SUBSTITUTE FOR HOUSE BILL NO. 301

BAN SALE OF SOME STUDED TIRES AND STUDS

"An Act prohibiting the sale of certain studded tires or the sale of certain studs to be installed in tires; and providing for an effective date."

- RECOMMENDATIONS: the same title
 be replaced with _____ a new title
- have attached amendments(s)
 do pass
 do not pass
 no recommendations
 individual recommendations
 additional referral to the _____ Committee

ADOPTS: _____ letter of Intent

ATTACHES NEW FISCAL NOTE(S): (Dept)

APPROVES PREVIOUS: (Dept/Date)

fiscal impact DOTPF 3/23

fiscal note(s) _____

zero fiscal note _____

zero fiscal note(s) _____

SIGNING DO PASS	DP	OTHER RECOMMENDATIONS	DNP	NR	AM
<i>[Signature]</i>	<input checked="" type="checkbox"/>	<i>[Signature]</i>		<input checked="" type="checkbox"/>	
		<i>[Signature]</i>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		<i>[Signature]</i>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

[Signature]
CHAIRMAN'S SIGNATURE

"An Act prohibiting the sale of certain studded tires or the sale of certain studs to be installed in tires; and providing for an effective date."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* **Section 1.** AS 28.35.155 is amended by adding a new subsection to read:

(c) A person may not sell a studded tire or sell a stud for installation in a tire if the sale is conducted as a part of the person's business and the stud being sold or a stud used in the studded tire has a weight greater than (1) 1.3 grams if the stud is sold for use or is used with a tire that has a tire rim diameter smaller than 17 inches; or (2) 2.0 grams if the stud is sold for use or is used with a tire that has a tire rim diameter equal to or greater than 17 inches, or if any portion of the stud has a hardness greater than 64 on the Rockwell C scale of hardness. In this subsection, "business" has the meaning given in AS 43.70.110.

* **Sec. 2.** This Act takes effect July 1, 1998.

1996 ?

FISCAL NOTE

Revision Date:
Title: Ban Sale of Some Studded Tires and Studs

Department Affected: DOT&PF
BRU:

Sponsor: Hanley
Requestor:

Component:
Component Serial Number:

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY95	FY96	FY97	FY98	FY99	FY00
PERSONAL SERVICES	0	0	0	0	0	0
TRAVEL	0	0	0	0	0	0
CONTRACTUAL	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>
SUPPLIES	0	0	0	0	0	0
EQUIPMENT	0	0	0	0	0	0
LAND & STRUCTURES	0	0	0	0	0	0
GRANTS, CLAIMS	0	0	0	0	0	0
MISCELLANEOUS	0	0	0	0	0	0
TOTAL OPERATING:	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>

CAPITAL	0	0	0	0	0	0
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REVENUE FUND SOURCE	0	0	0	0	0	0
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FUNDING: (Thousands of Dollars)

1002 FEDERAL RECEIPTS	<2,600.0>	<2,600.0>	<2,600.0>	<2,600.0>	<2,600.0>	<2,600.0>
1003 GF MATCH	<360.0>	<360.0>	<360.0>	<360.0>	<360.0>	<360.0>
1004 GF	<1,000.0>	<1,000.0>	<1,000.0>	<1,000.0>	<1,000.0>	<1,000.0>
1005 GF/PROGRAM RECEIPTS	0	0	0	0	0	0
1006 GF/MHTIA	0	0	0	0	0	0
OTHER	0	0	0	0	0	0
TOTAL FUNDING:	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>	<4,000.0>

POSITIONS

FULL-TIME	0	0	0	0	0	0
PART-TIME	0	0	0	0	0	0
TEMPORARY	0	0	0	0	0	0

Estimate of current year (FY94) impact: <\$4,000.0>

ANALYSIS: (Attach a separate page if necessary)

DOT&PF estimates that stud wear of highway pavements creates annual pavement replacement or repair costs of approximately \$4,000,000. While not providing additional funding to DOT&PF, the bill will allow better use of existing Federal Aid Highway funds.

Prepared by: Schuyler J. Stevens, P.E.

Phone: 465-6977

Division: Chief State Engineer

Date: March 18, 1994

Approved by Commissioner: 

Phone: 465-3901

Agency: Department of Transportation and Public Facilities

Date: March 22, 1994

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*Department of Transportation
and Public Facilities*

POSITION PAPER

BILL NO: HB 301

APPROVED:

[Handwritten signature]
[Handwritten initials]

TITLE: Ban Sale of Some Studded
Tires and Studs

DATE: March 22, 1994

This bill provides a restriction on the type of tire studs to be sold in Alaska. The requirements for maximum stud weight follow current research experience and legislation in Northern Europe, which found the stud weight to be a factor in preventing wear.

DOT&PF recommends that the bill be amended by adding an additional requirement for a stud hardness no greater than 64 Rockwell C that will further reduce the damage from studs on paving materials to a tolerable level.

The department is very concerned over the wear to pavements due to rutting. Some rutting is attributable to shoving under excess loading, however, most is due to studded tire wear. Research in Europe, Midwestern U.S., and Alaska has proven studs are the major cause of rutting.

For Further Information contact J.K. Ginger Johnson at 465-3904.



Representative Mark Hanley

Alaska State Legislature

March 11, 1994

TO: Representative Richard Foster
Chairman, House Transportation Committee

FROM: Representative Mark Hanley

RE: Scheduling of SSHB 301: "An act prohibiting the sale of certain studded tires or the sale of certain studs to be installed in tires."

Studded tires have a negative side effect on our roads in the form of increased pavement wear to a point where safety is compromised and the need for road maintenance is increased.

Studs cause between \$133 and \$266 in pavement damage per vehicle, per 40,000 miles of travel. Unfortunately, pavement wear and costs associated with wear are not the only problem. Grooves worn in pavement create the potential for vehicle loss of control, especially during wet or icy conditions.

The direct value of the pavement worn away amounts to \$10 to \$15 per studded tire, however, repairing ruts normally requires that the pavement across the lane from the ruts be extracted. This increases the repair costs to about \$40 to \$50 per studded tire.

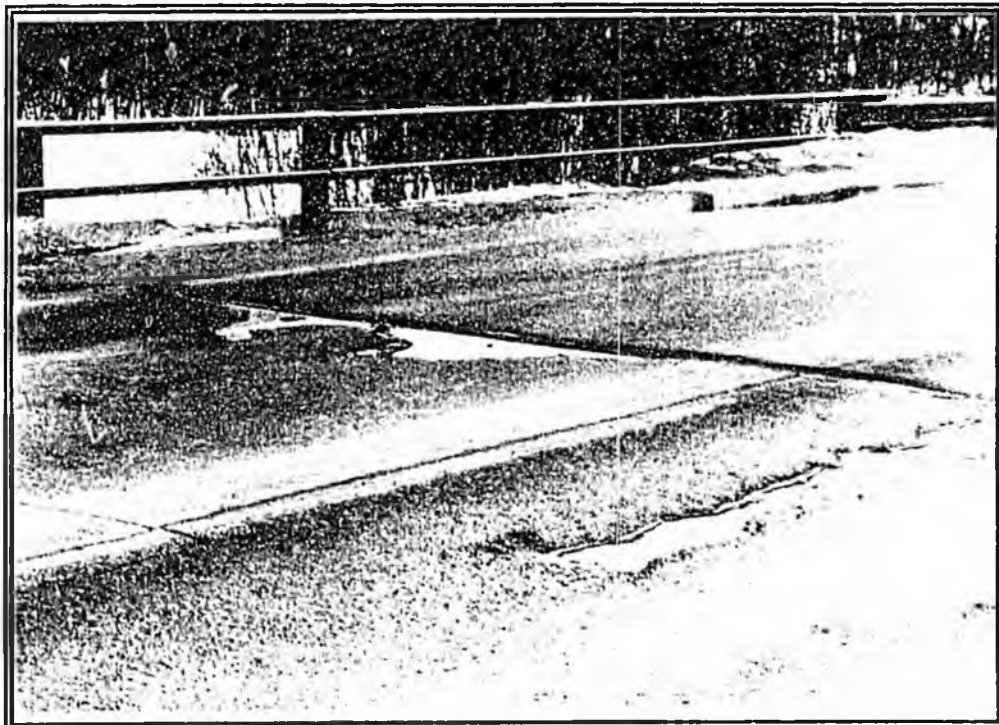
Lightweight studs are now being used in Northern Europe and are expected to cut pavement wear rates in half. The lightweight studs compare favorably in performance tests against standard studs and consist of steel tips seated in aluminum or plastic bodies. I believe Alaska should move in this direction.

HB 301 would require the use of lightweight studs in Alaska starting in 1998. Use of lightweight studs could reduce pavement wear by 50% without compromising the performance benefits of studded tires. This would seem to be a "win-win" situation.

I respectfully request that you schedule SSHB301 at your earliest possible convenience.



Studs have worn through the top pavement layer ($2''\pm$) along lines spaced equally with car wheels.



Pavement ($2''\pm$) on bridge has been stud worn to concrete.



HIGHWAY USERS FEDERATION OF ALASKA

P.O. BOX 90444 ANCHORAGE, ALASKA 99509-0444

October 24, 1991

The Honorable Dave Choquette
House of Representatives
P.O. Box V
Juneau, Alaska 99811

Dear Representative Choquette:

After reviewing the cost and safety impacts of using studded tires, it appears the problem is more severe than previously thought.

A Department of Transportation and Public Facilities (DOT/PF) memorandum indicating tire pavement damage at \$12 per tire, per 30,000 miles, is seriously in error due to oversight of practical pavement repair methods. Previous figures reported by DOT/PF's Commissioner Turpin, in the \$133 to \$266 range per vehicle per 40,000 miles, appears more nearly correct.

Safety aspects of better winter traction from studs may be somewhat offset by warm season vehicle hydroplaning in water-filled, stud-worn grooves (I have personally experienced this). Also, inconvenience and cost of temporary pavement repairs (\$20,000 per lane mile), or resurfacing (\$60,000 per lane mile) is a factor.

Present studs have a MOH's scale hardness of perhaps $8\pm$ and literally grind softer asphalt aggregate, with a hardness of $6\pm$, in an action similar to a grinding wheel on steel. The softer material is removed in direct proportion to the number of passes.

The development of harder studs from once used softer steel studs is apparently the problem. Mild steel has a MOH's hardness of $5\pm$ which more nearly matches pavement aggregate hardness. Steel studs are effective, but also tend to wear more and may not last the life of a tire.

Investigation into replacing studs shows that redrilling and restudding a tire in Anchorage costs \$20 per tire and is effective.

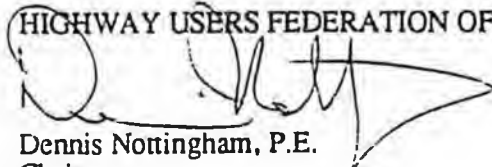
An average of \$200 pavement damage from two studded tires over the tire life does not compare favorably with a \$40 restud charge. For each 100,000 vehicles, an economic pavement loss of \$5 million per year from stud use seems probable.

It appears the only solution to the costly practice of using studs is to limit stud hardness, if elimination of stud use is not possible.

We hope this information will be of use to you.

Sincerely,

HIGHWAY USERS FEDERATION OF ALASKA


Dennis Nottingham, P.E.
Chairman

DN/dj/89072

DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

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ENGINEERING & OPERATIONS STANDARDS

August 3, 1993

Representative Mark Hanley
716 West 4th Avenue
Anchorage, Alaska 99501

Subject: Studded Tires
& Stud Types

Attn: Kip Knutson

File: 2552

AUG 09 1993
Dear Mr. Knutson:

I am responding to your call and our discussion on July 21st regarding the advisability of requiring a tire stud type with a hardness of 6.5 on the Moh hardness scale. You should be aware that the Moh scale is intended only for scratch hardnesses of crystals of minerals and not for metals. As such, it was constructed by determining what mineral would scratch other minerals. I understand that typical steels range from about 5.5 to 6.5. However, tire studs require a carbide center pin which is probably around 7 or 8 on the Moh scale. Studs of only steel would wear quickly and not work as ice gripping studs at all; I doubt that any such are even manufactured. The alternative I suggest for reducing pavement wear is the use of lightweight studs, as are now being required in Northern Europe. Mr. Bo Simonson of Sweden's Road and Traffic Research Institute advised that use of aluminum or plastic bodied studs will be expected to cut pavement wear rates in half. Samples of lightweight European type studs are enclosed, along with typical steel studs from a local tire shop. Legislation requiring such lightweight studs would require that the maximum stud weight be set at 1.3 grams for cars and at about 2.0 grams for large trucks (tire rim sizes of 17" or greater).

As we discussed, our pavement rut measurements from start to end of the winter seasons have shown a pavement wear rate of 0.1 to 0.2 inches per million studded tire passes. The direct value of the pavement worn away amounts to \$10 to \$15 per studded tire during it's useful life. However, repairing the ruts normally requires that we mill or remove and replace the pavement across the entire lane to the bottom of the ruts. This increases the pavement repair costs to about \$40 to \$50 per studded tire. These costs may substantially reduced by lightweight studs.

August 3, 1993

The best wear data we have from pavement rut measurements is from Juneau. It is summarized by my memo of 6/13/91 (copy enclosed). However, in the Anchorage area good data comes from our pavement study site on the Glenn Highway just north of Eagle River. At that location the maximum rut depth is now about 0.9" after 10 years of service. The wear rate has been about 0.10" per million studded tire passes and the pavement loss from wear has been 19 tons per lane per mile per million passes.

As a final comment, the few studded tire use counts we made this past winter indicated large increases in studded tire use over the 1990 levels, which is disturbing from a pavement life standpoint. Juneau studded tire usage levels in March were 35% higher than in 1990, while Anchorage usage was up by 55%.

I hope that these figures will be of help to you. Also, we are just initiating a study of the comparative wear resistance of our different paving mix types. Within the next few months we hope to have some additional information from the wear testing machine being developed under that study. If you need further information on our rutting research work, please call me at 465-6956.

Sincerely,



David Esch
Research Applications Engineer

Enclosures

cc: R. D. Shumway, Chief Engineer
Eric Johnson, Pavement Management Engineer, Stwd. Materials

Washington lawmakers seek a \$25-per-tire fee on studs

By JOSEPH TURNER
McClatchy News Service

TACOMA, Wash. — State lawmakers have tried to outlaw road-damaging studded tires for most of the past 20 years, and they came close a few years ago.

But on the day the ban came up for a vote in the state House, fate intervened. It snowed.

And as supporters of the ban drove down the freeway from Seattle to the state capital in Olympia — slipping and sliding along the way — they started changing their minds.

"The gods were trying to tell us something," said George Walk, who sponsored the bill as chairman of the House Transportation Committee in the late 1980s. "It was going to be a close vote anyway. So when it started snowing outside, we were ready to give up."

Walk let the bill die without a vote.

This year lawmakers are taking a different tack. Instead of trying to ban studded tires, they want to impose a tax of \$25 per tire.

Senate Transportation Committee members approved the special stud tax in Senate Bill 5151 last week; the full Senate is expected to vote on the bill this week.

"We might not have to raise the gas tax so much if we'd do something about studded tires," said Rep. Shirley Winsley, R-Fircrest, this year's bill sponsor. "If people are going to insist on using studded tires, they should be willing to pay a small fee."

Small fee?

"Oh, jeez," said Richard Nordness, director of the Washington State Tire Dealers Association. "People can't afford to put that much money into tires.

NORTHWEST

"A good snow tire costs \$50 to \$60. Most dealers charge \$9 or \$10, plus labor, to put the studs on. With a \$25 tax ... you're talking pretty close to \$100.

"It's insane, really," he said. "Putting such a high tariff on them has the same effect as a ban."

That's the point, said Sen. Larry Vognild, chairman of the Senate Transportation Committee.

Highway officials estimate studded tires cause about \$25 million damage a year to the highway system. The studs gouge into asphalt and concrete roadways. Pavement supposed to last 14 years gets chewed up years earlier.

Historically, the studded tire debate has pitted Western Washington lawmakers against their Eastern Washington counterparts. It's a question of differing climates.

In the slushy snows west of the Cascades, a studded tire is no help. And on wet

or dry pavement, studs can radically reduce traction, said Ron Maulsby, public affairs manager for Good-year Tire and Rubber Co. in Akron, Ohio.

"The only time we recommend a studded tire is where you're in part of the country where ice is covering the road for days or for months at a time," Maulsby said. "Metal studded tires will provide 40 percent better traction on compact snow and ice."

Nordness disputes the amount of damage caused by studded tires, especially since they've been equipped with a softer metal stud.

"It has not been proven that studded tires do that much damage to the road," he said. "Those same kinds of ruts show up in Florida and other states where studs are outlawed.

Heavy trucks get some of the blame for rutted highways.

"If we have to go back to the old days of using chains, we're going to see a lot more damage," Nordness said.

NOTICE



The first clinic of the Alaska Baseball Umpires Association is scheduled for Tuesday, March 16th at 7:00 p.m. at Ptarmigan Elementary School, 888 Edwards Street.

TRAINING BEGINS FOR NEW UMPIRES.

For more information call Allen Smith,
344-0933 or 243-7757.

MEMORANDUM


State of Alaska
Department of Transportation & Public Facilities

TO: Jeffery C. Ottosen
Director, E&O Standards
Headquarters

DATE: June 13, 1991

FILE NO: 64217

TELEPHONE NO: 474-2471

FROM: David C. Esch, P.E. 
Senior Research Engineer
Statewide Research

SUBJECT: Studded Tires

A copy of the attached letter from Commissioner Turpin to Legislator Curt Menard on the subjects of studded tires use and pavement wear has come to my attention, and some new data I have just processed may be of interest.

Studded tire use and roadway rutting in Alaska have been the subject of a research study now nearing completion. I have processed Juneau pavement wear data at the Juneau-Douglas bridge, the Douglas Island "Breeze-In" crosswalk, and the Mendenhall Loop pedestrian over-crossing. Pavement wear rates were calculated based on total studded tire passes estimated from stud usage counts and monthly and annual traffic counts. Results were very consistent between sites, as shown in Table I.

Total Stud Passes by 4/4/91 (Millions)	Location	Wear per Million Passes		
		Wear Rate (inches)	Wear Area (inches) ²	Tons/Lane/Mi.
5.37	On J.D. Bridge	0.148	9.31	23.9
5.37	Before J.D. Bridge	0.134	9.92	25.5
3.87	Douglas Road	0.122	9.08	23.3
5.84	Mendenhall Loop	0.102	7.56	19.3

The 4th column, showing the worn area in square inches is the cross-sectional area worn away in both ruts of one lane at our measurement sites. These results show our wear rates to be much less than quoted in previous literature. These figures convert to pavement losses of 10 to 14 metric tons per kilometer, rather than the 50 to 100 tons quoted in the letter to Representative Menard. This, in turn, converts to a cost for replacement of the worn away pavement of about \$12.00 per studded tire if the tires are used for 30,000 miles. A suitable solution may be to tax studded tires at \$12.00 each at the point of sale.

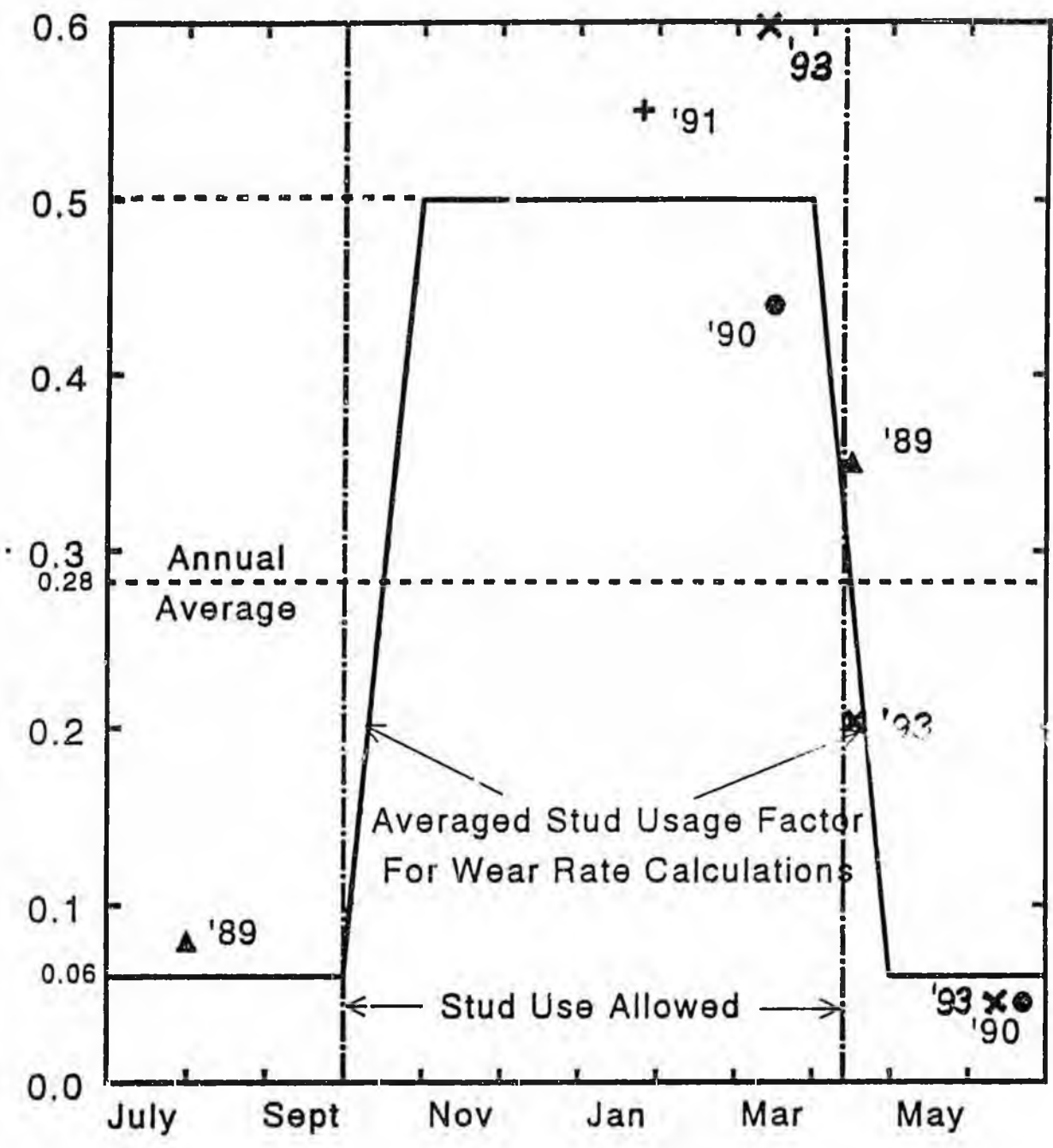
Our Juneau rut data has provided some very interesting conclusions. By measuring rut depths on and off of the Juneau-Douglas Bridge we found essentially the same rut depths developing over the bridge deck concrete as over a crushed gravel subgrade. The approaches and the bridge itself were paved with the same AC mix. This tells us that subgrade deformation is not a cause of the pavement rutting, and that our interpretation of the rutting as wear-related is correct.

Our measurements before and after the 1990-91 winter tell us that rut depths increase much more rapidly in winter than in summer, due to the much higher wintertime usage of studded tires and also to some spinning of the tires when roads are icy. Table II summarizes our measured wear rates over various time periods.

TABLE II: Juneau Area - Seasonal Rut & Wear Measurements				
Site	Period Covered	Dates Covered	Wear Rates inches/million Stud Tire Passes	
S. Douglas	8 Summers + 7 Winters	10/81 to 4/89	.112	
	2 Summers + 1 Winter	4/89 to 10/90	.099	
	1 Winter	11/90 to 4/91	.265	
Mendenhall Loop	7 Summers + 6 Winters	9/82 to 4/89	.105	
	2 Summers + 1 Winter	4/89 to 10/90	.094	
	1 Winter	11/90 to 4/91	.090	
J. Douglas Bridge	8 Summers + 7 Winters 2 Summers + 1 Winter 1 Winter	10/81 to 4/89	<u>On Bridge</u> .145	<u>Off Bridge</u> .133
		4/89 to 10/90	.127	.150
		11/90 to 4/91	.202	.115
Juneau Average Values	8 Summers + 7 Winters 2 Summers + 1 Winter 1 Winter	Up to 4/89	0.124	
		4/89 to 10/90	0.118	
		11/90 to 4/91	0.168	

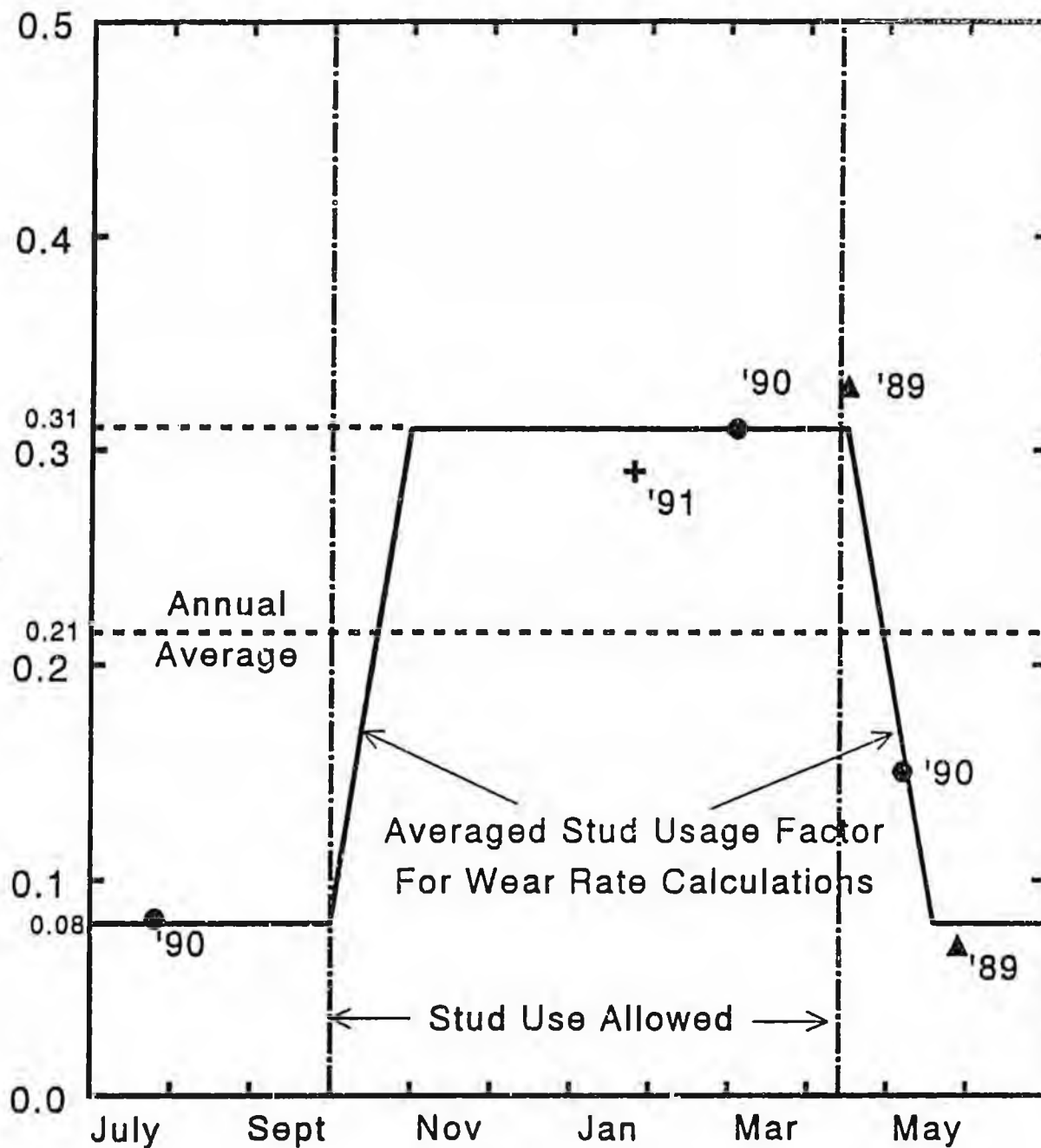
My overall conclusion is that essentially all of the pavement rutting in Juneau is due to studded tire wear, and that about 10% of the total rutting comes from stud use during the "No-studs-allowed" season of the year. The higher winter time wear rates for the first and third sections listed may be because they are in light acceleration or braking areas, while the Mendenhall Loop site has a more constant speed aspect.

Studded Tires per Vehicle Pass
(one wheelpath)



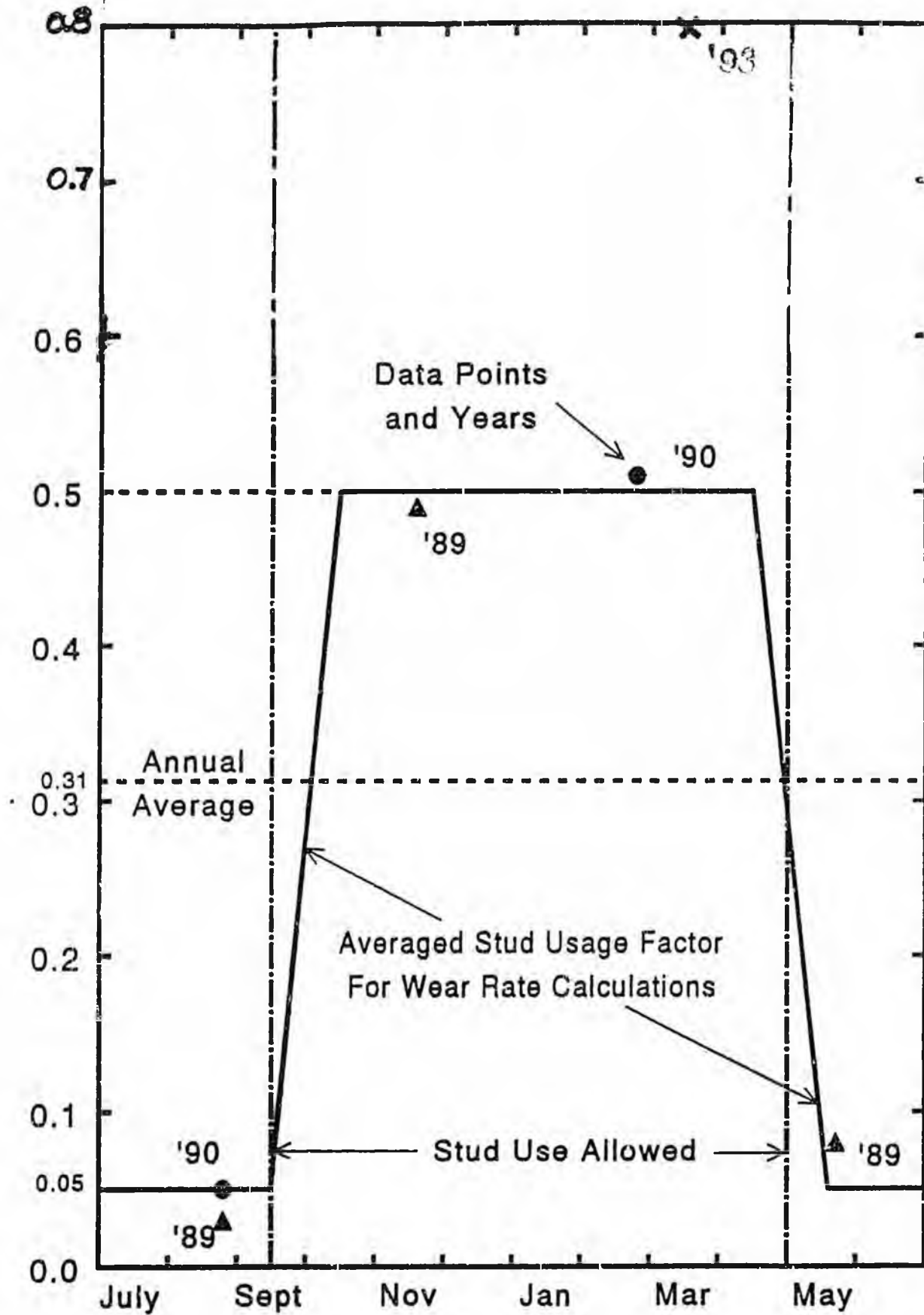
Seasonal Studded Tire Frequency Pattern
Juneau, Alaska

Studded Tires per Vehicle Pass
(one wheelpath)



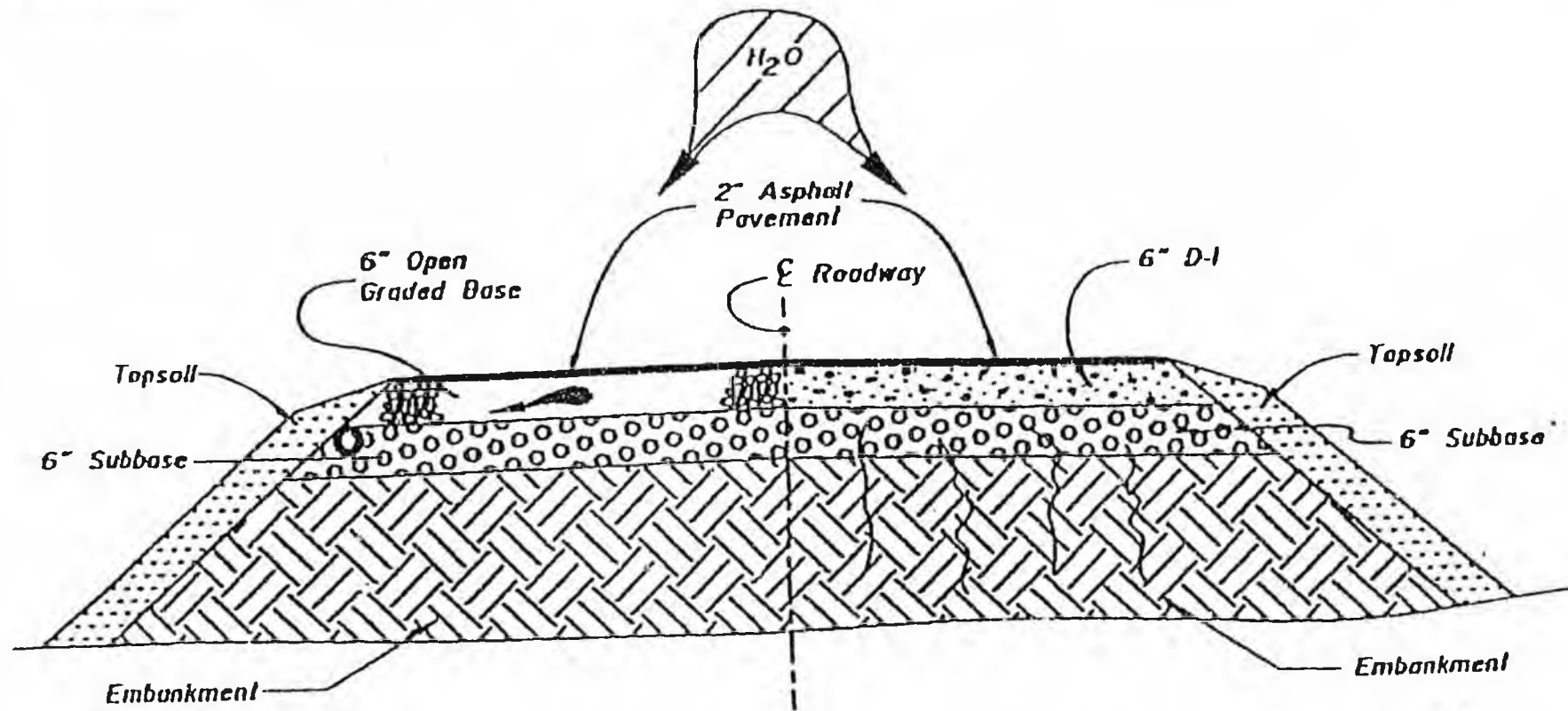
Seasonal Studded Tire Frequency Pattern
Fairbanks, Alaska

Studded Tires per Vehicle Pass
(one wheelpath)



Seasonal Studded Tire Frequency Pattern
Anchorage, Alaska

Alaska Department of Transportation & Public Facilities



OPEN GRADED BASE

Sieve Designation	Percent Passing ^a by Weight
1"	100
3/4"	75-100
1/2"	60-70
3/8"	35-65
No. 4	0-5
No. 8	
No. 40	
No. 200	

^a 2-3% Asphalt

TYPICAL CROSS-SECTION

D-1

Sieve Designation	Percent Passing by Weight
1"	100
3/4"	70-100
3/8"	50-80
No. 4	35-65
No. 8	20-50
No. 40	5-30
No. 200	0-5

Studded Tire

Estimate of the Pavement Damage of A Set of 4 Studded Tires

Weight of Lost Asphalt Concrete* (metric tons)	Distance traveled (kilometers)	US Tons lost per 1,000 Miles	Cost per Ton Asphalt Concrete (US tons)	Allied Costs**: Assume 50% of AC Cost	Cost per 1,000 Miles of Stud Tire Use	Cost for Life of Set of Studded Tires (4)***
50	1,000,000	0.09	\$35.00	\$17.50	\$4.66	\$186
100	1,000,000	0.18	\$35.00	\$17.50	\$9.31	\$373

* From a paper presented at the XIVth World Road Congress, Prague, Czechoslovakia, 1971, based on research in Sweden.

** Allied costs include engineering, mobilization and demobilization, and preparation.

*** A set of tires is assumed to have a 40,000 mile life.

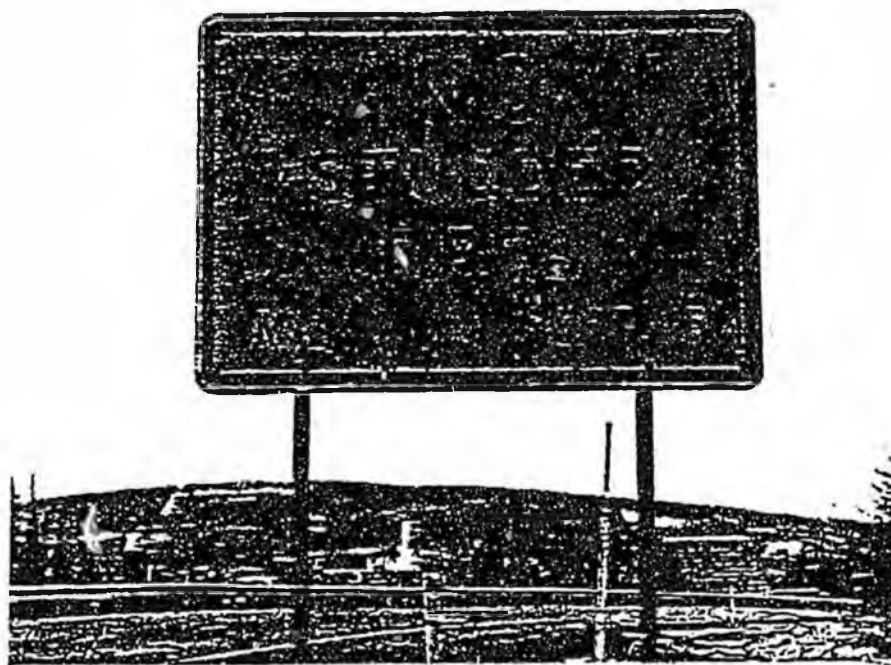
Prepared by Engineering and Operations Standards Division, Alaska DOT&PF, April, 1991

WHEEL TRACK RUTTING DUE TO STUDDED TIRES

R.G. Hicks

Todd V. Scholz

David C. Esch



STATEWIDE **DOT** & PF RESEARCH

Wheel Track Rutting Due to Studded Tires

by

R.G. Hicks
Professor of Civil Engineering

and

Todd V. Scholz
Research Assistant

Oregon State University
Corvallis, OR 97331

and

David C. Esch
Research Engineer

Alaska DOT&PF
Fairbanks, AK 99709

prepared for

Alaska DOT&PF
Fairbanks, AK 99709

December 1990

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4. Title and Subtitle Wheel Track Rutting Due to Studded Tires				5. Report Date December 1990	
				6. Performing Organization Code	
7. Author(s) Hicks, R.G., T.V. Scholz and D.C. Esch				8. Performing Organization Report No. AK-RD-90-14	
				10. Work Unit No. (TRAIS)	
9. Performing Organization Name and Address Oregon State University Department of Civil Engineering Corvallis, OR 97331				11. Contract or Grant No.	
				13. Type of Report and Period Covered Interim Oct. 1, 1989 - Dec. 31, 1990	
12. Sponsoring Agency Name and Address Alaska DOT&PF Research Section 2301 Peger Rd. Fairbanks, AK 99709				14. Sponsoring Agency Code	
				15. Supplementary Notes	
16. Abstract This is the second of a series of reports which deals with wheel track rutting in asphalt pavements. Specifically, this report is concerned with the extent of rutting due to studded tires. Significant findings include: 1) Very little research has been done since 1980 in this area, with the exception of work in the Scandinavian countries. 2) Many agencies continue to prohibit or restrict the use of studded tires. 3) Very little new information on percent of vehicles using studded tires or on tire wear studies was available. 4) Factors affecting wear rates were defined. 5) The consequences and benefits of using studded tires were identified.					
17. Key Words Studded tires, flexible pavements, wheel track rutting			18. Distribution Statement Unrestricted		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 64	22. Price

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
1.1 Background	1
1.2 Objectives	1
1.3 Scope of Work	2
2.0 STUDED TIRES PRACTICES	3
2.1 Use of Studded Tires	3
2.2 Percent of Vehicles With Studs	4
2.3 Characteristics of Studs	4
2.4 Permitted Use Periods	10
2.5 Enforcement	10
3.0 ROAD WEAR STUDIES	16
3.1 Causes of Pavement Wear	16
3.2 Factors Affecting Wear Rate	16
3.3 Pavement Wear Studies	23
4.0 IMPACTS OF STUDED TIRE USE	26
4.1 Economic Impacts	26
4.2 Benefits of Studded Tires	26
5.0 SUMMARY	35
6.0 REFERENCES	36

APPENDICES

- A Survey Form
- B Summary of Survey Responses
- C Controlled Protrusion Stud Information
- D Telephone Interviews with Tire Manufacturers

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
2.1	G78x14 studded (R) and unstudded passenger tires	7
2.2	Four basic stud types	8
2.3	Typical dimensions for a controlled protrusion stud	11
2.4	Spring-action stud (Fagersta Steels Limited)	12
2.5	Legal restrictions on use of studded tires	13
3.1	Relationship between acceleration and deceleration on portland cement concrete	19
3.2	Relationship of studded tire induced wear vs. pavement type; Minnesota research	21
3.3	Effect of stud type on wear for asphalt concrete pavements	22
4.1	Stopping distance versus speed for cars traveling on asphalt pavement	32
4.2	Stopping distance versus speed for cars traveling on concrete pavement	32
4.3	Stopping distance versus ice temperature for four cars traveling at 20, 35, and 50 mph	33
4.4	Changes in skid resistance of some pavements in Ontario with increasing use of studded tires	34

LIST OF TABLES

<u>Table</u>		<u>Page</u>
2.1	Historical data on the use of studded tires	5
2.2	Recent counts of studded tire usage in Alaska	6
2.3	Typical cross-sectional area specifications	8
2.4	Characteristics of studs	9
2.5	Restrictions on use of studded tires in the U.S./Canada	14
2.6	Restrictions on use of studded tires in Scandinavia	15
3.1	Cause of pavement wear under studded tires	17
3.2	Factors affecting pavement wear	18
3.3	Effect of factors on resistance of asphalt pavement to wear by studded tires	20
3.4	Summary of road wear studies	24
3.5	Factors affecting studded tire wear	25
4.1	Cost effects of studded tires on pavement wear and safety (for a ban on studded tires) . . .	27
4.2	Estimate of additional costs due to the continued use of studded tires	28
4.3	Consequences of studded tire usage	29
4.4	Stopping distances from report for the Canadian Safety Council	31

1.0 INTRODUCTION

1.1 Background

The use of studded tires has long been recognized as improving traction in highways during the winter months when the roads are often icy. However, they also have been shown to increase road wear on both asphalt and portland cement concrete pavements. This report has been prepared to document the use and effects of studded tires, particularly in terms of producing wheel track ruts.

1.2 Objectives

Specific objectives of this report are to:

- 1) Quantify the use of studded tires in countries throughout the world. This includes data on

- Percent of vehicles using studded tires
- Characteristics of the studs (size and number)
- Time periods that studded tires are permitted

This information is summarized in Chapter 2.

- 2) Summarize the results of road wear studies (field and test track) in each of the following areas

- Mechanism of pavement wear
- Rate of pavement wear
- Factors affecting the wear rate

These results are presented in Chapter 3.

- 3) Identify the consequences/benefits of using studded tires such as

- Increased pavement maintenance to repair ruts, etc.
- Increased safety problems due to splash and spray

These results are presented in Chapter 4.

1.3 Scope of Work

In order to accomplish the stated objectives, two major work activities were undertaken. These included:

- 1) A computer literature search (TRIS). Many of these publications were reviewed and evaluated in the preparation of this report.
- 2) A survey of agency practices. A survey form (see Appendix A) was developed and mailed to 30 highway agencies, 11 Canadian provinces and territories, and 4 foreign countries (Norway, Sweden, Finland, and West Germany). The responses to the survey are given in Appendix B.
- 3) A telephone survey of selected tire manufacturers to identify the types and number of studs currently being used. These results are summarized in Appendix D.

2.0 STUDDED TIRES PRACTICES

The data presented in this chapter is the result of an extensive literature review, the survey of selected transportation agencies, and selected calls to studded tire manufacturers. Information was obtained from various agencies in the United States, Canada, and Europe.

2.1 Use of Studded Tires

The results of the survey were used to provide an indication of use of studded tires throughout the United States, Canada and abroad. The results indicate the following agencies permit their use:

United States	Canada	Europe
Alaska	New Brunswick	Sweden
California	Nova Scotia	Norway
Colorado	Quebec	Finland
Connecticut	Saskatchewan	
Delaware		
Idaho		
Indiana		
Iowa		
Kansas		
Maine		
Montana		
Nebraska		
New Jersey		
Nevada		
New York		
North Dakota		
Oregon		
Pennsylvania		
Rhode Island		
South Dakota		
Utah		
Vermont		
Washington		
Wyoming		

It should also be noted that in all cases where studs are permitted, so are chains.

2.2 Percent of Vehicles With Studs

The results of the survey did not provide much useful recent information on use of studded tires. In fact, only a few agencies provided an estimate for current usage. Therefore, heavy reliance was placed on results from the literature (pre-1980) since the actual usage rates are virtually unknown in the USA and Canada.

Historical data on the percent usage by vehicle type (cars and trucks) of studded tires in the United States and abroad is given in Table 2.1. As noted, many states do not allow studded tire use, while usages as high as 60% or more have been reported by the states of Alaska, Montana, and Vermont (TRB, 1975).

Sweden reports that 60% of all vehicles use studs, while 90-95% of cars and 30-60% of trucks use studded tires in Finland (Huhtala, 1978). Provinces in Canada reported usage rates on cars as low as 20-25% and as high as over 50% (Smith & Schonfeld, 1971).

The percentages of use on two versus all four wheels are generally unknown except for Scandinavia and Alaska. In certain countries, the use is mandated on all four wheels if studs are used on any wheel. This is to increase safety as well as acceleration.

A recent survey of studded tire usage in Alaska is given in Table 2.2. As indicated, studded tire usage varies seasonally as well as between years and locations. However, it can be seen that wintertime usage (through March) by light vehicles is between 20 and 35% with roughly one-third of these vehicles being four-wheel drive.

2.3 Characteristics of Studded Tires

As indicated in Figure 2.1, a typical studded tire is essentially a normal winter or all-season tire with studs embedded in the tread. Typical specifications for passenger car studded tires are given in Table 2.3.

Although there were many types of studs found in the literature, all have similar components. These consist of a pin (typically tungsten carbide) surrounded by the stud housing or body (typically steel), which has a flange at its base to hold the stud in the tire tread. Figure 2.2 illustrates the four basic stud types that have been used in the past, while Table 2.4 summarizes the characteristics of each type. Conversations with tire manufacturer/distributor personnel revealed that only the Controlled Protrusion (Type I) stud is currently used in the U.S. The principal reason is that as the stud housing or body wears, coinciding with the tread

Table 2.1. Historical data on the use of studded tires.

Agency		% of Vehicles with Studs	Reference
Canada	Ontario	32	Smith, 1971
	Manitoba	20-25	Smith, 1970
	Quebec	50	Smith, 1970
	Maritime Provinces	50+	Smith, 1970
	Ottawa	48	Smith, 1971
United States	Alabama	1	NCHRP Syn. 32
	Alaska	61	
	Arizona	1	
	Arkansas	1	
	California	NA	
	Colorado	30	
	Connecticut	25	
	Delaware	18	
	Florida	NA	
	Georgia	NA	
	Idaho	27	
	Illinois	12	
	Indiana	10	
	Iowa	25	
	Kansas	7	
	Kentucky	12	
	Maine	NA	
	Maryland	NA	
	Massachusetts	32	
	Michigan	12	
	Missouri	14	
	Montana	50	
	Nebraska	38	
	Nevada	6	
	New Hampshire	30	
	New Jersey	20	
	New Mexico	NA	
	New York	30	
	North Carolina	2	
	North Dakota	32	
	Ohio	20	
	Oklahoma	1	
	Oregon	10	
	Pennsylvania	28	
Rhode Island	NA		
South Carolina	3		
South Dakota	40		
Tennessee	NA		
Texas	0		
Vermont	60		
Virginia	10		
Washington	35		
West Virginia	10		
Wisconsin	20		
Wyoming	35		
Finland	Cars:	90-95	Lampinen, 1988
	Trucks:	40	Huhtala, 1978
Sweden		60	Keyser, 1970

Table 2.2. Recant counts of studded tire usage in Alaska

Survey Date	Total Vehicles	Studded Tires (one side)	Studs per Vehicle Pass	% Vehicles w/Studs		% 4WD Vehicles
				On Some Tires	On All Tires	
a) Fairbanks						
4/18/89	250	81	0.324	28.0	12.4	24.8
5/22/89	319	23	0.072	6.6	0.63	24.0
3/2/90	583	182	0.312	20.4	10.8	34.1
5/7/90	820	121	0.148	11.0	4.10	33.2
7/16/90	1226	101	0.082	5.45	2.77	35.4
1/23/91	1385	402	0.290	19.3	9.75	43.4
b) Anchorage						
5/17/89	1766	143	0.081	6.4	1.7	—
8/21/89	1892	63	0.033	2.9	0.4	—
11/16/89	2361	1142	0.484	36.8	11.5	—
2/14/90	2076	1043	0.502	33.0	14.4	—
8/20/90	2339	112	0.048	3.8	0.9	24.3
c) Juneau						
4/17/89	993	348	0.350	24.8	9.3	32.5
5/1/89	352	28	0.080	6.2	1.7	30.0
6/15/90	1187	512	0.431	30.8	12.1	32.7
6/25/90	1119	40	0.036	2.9	0.45	35.3
1/25/91	650	345	0.531	40.6	16.9	40.6

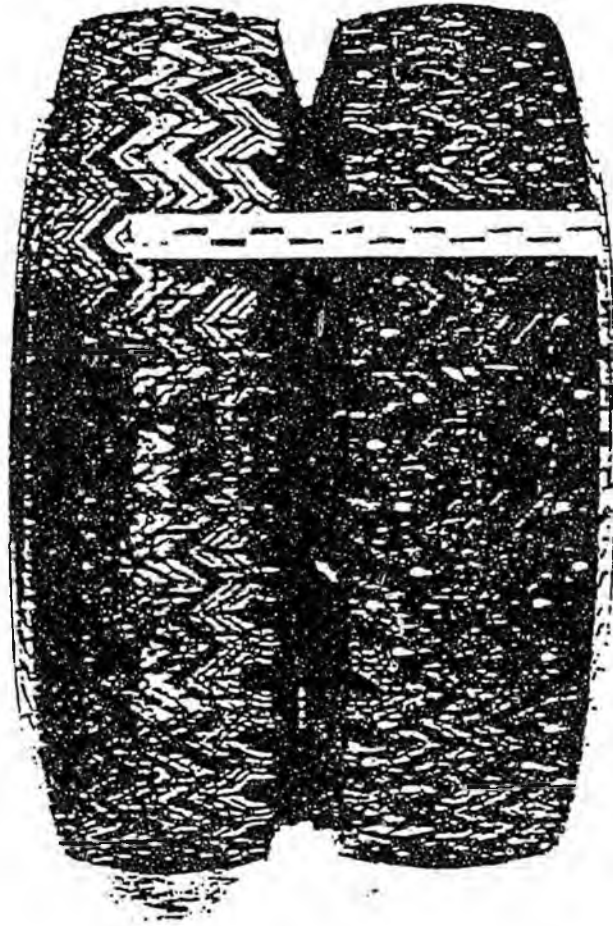


Figure 2.1. G78x14 studded (R) and unstudded passenger tires (Krukar & Cook, 1972).

Table 2.3. Typical cross-sectional area specifications (NCHRP Syn. 32).

Nominal Car Size	Tire Data		Tire Stud Data		
	Nominal Size	Typical Tread Surface Area (sq. in.)	Typical Maximum Number of Studs	Typical Cross-Sectional Area (sq. in.)	Percent of Tread Surface Area
Compact	B78x13	250	96	.0314	1.25
Intermediate	F78x14	270	96	.0314	1.10
Full Size	H78x15	312	96	.0314	1.00

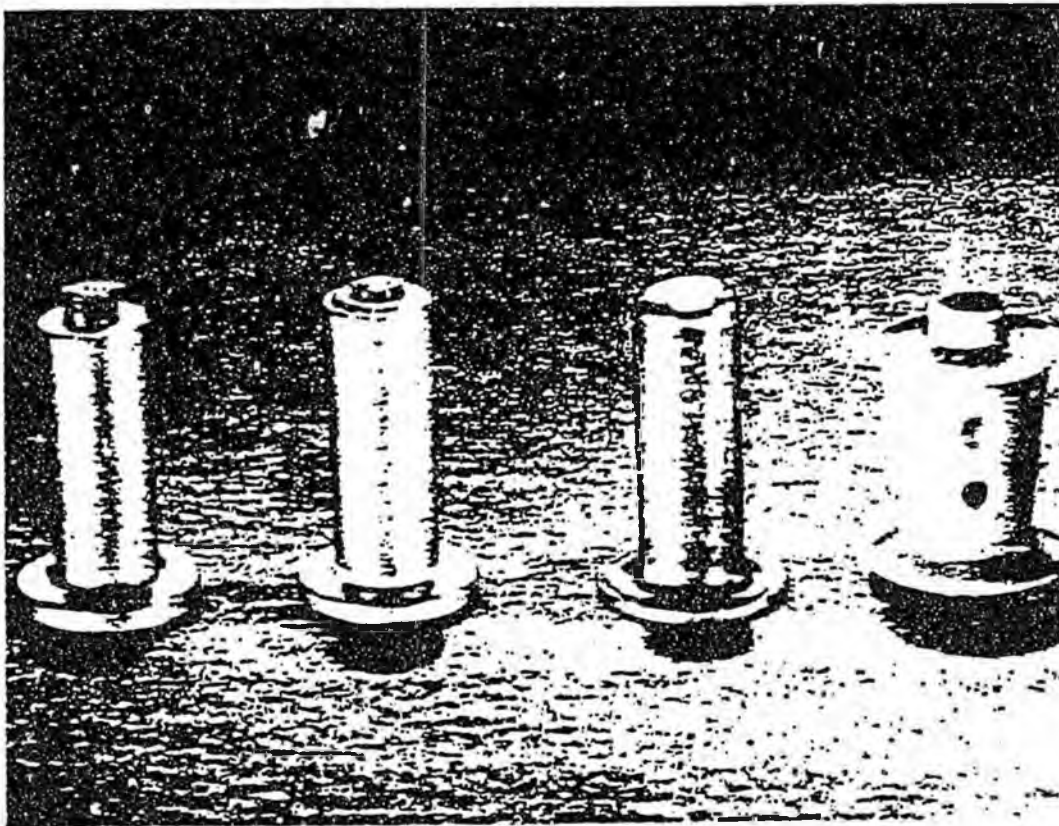


Figure 2.2 Four basic stud types. Left to right: Type III or CV Stud; Type I or CP Stud; Type II or PT Stud; and Type IV or FS Stud (Krukar & Cook, 1973).

Table 2.4. Characteristics of studs (Krukar & Cook, 1972).

Stud Type	Characteristics
Type I - "Controlled Protrusion Stud"	<ul style="list-style-type: none"> ● Carbide pin will move further into stud body if protrusion limit is exceeded ● 18% lighter in weight than conventional stud ● 5% smaller flange than conventional stud
Type II - "Perma-T-Gripper Stud"	<ul style="list-style-type: none"> ● Pin found in other studs has been replaced with relatively small tungsten carbide chips in a soft bonding matrix enclosed in a steel jacket ● Designed to wear within 10% of tire wear, thus maintaining a protrusion of approximately 0.020 in. or less
Type III - "Conventional Stud"	<ul style="list-style-type: none"> ● Tungsten carbide pin ● Stud protrusion will increase with tire wear
Type IV - "Finnstop Stud"	<ul style="list-style-type: none"> ● Complete stud of light plastic casing with a tungsten carbide pin ● Stud can be adjusted close to the tread rubber eliminating oscillation of the stud ● Pin angle contact with road varies little with speed ● Plastic housing tends to reduce effect of centrifugal force and heat build-up between rubber and stud ● Air cushion can be left under stud to reduce stiffness (floating stud)

wear, the tungsten carbide pin is pushed deeper into the stud housing providing a uniform protrusion length throughout the life of the stud. This benefit is not fully realized with the other stud types since the protrusion length of the stud can vary over time. Figure 2.3 gives the dimensions for the Controlled Protrusion Stud (see Appendix C for further details), while Figure 2.4 illustrates a fifth type of stud which was listed in the literature as being considered for manufacture. The number of studs/tire range from 64 to 120 (see Table D1).

In Sweden, it has been long recognized that the conventional studs cause excessive tire wear. They have therefore developed a new low-noise, reduced road wear ice-stud. It weighs only 0.7 gram, yet reportedly retains ice grip and durability. The reduction in weight is possible due to the use of a new polymer in the stud body (Simonsson, 1990).

2.4 Permitted Use Periods

Based on the results of the literature review the periods of the year to which studded tire use is restricted in the United State and Canadian Provinces is shown in Figure 2.5 (TRB, 1975). Note that in the 1970's 14 states and two provinces had no restrictions and that nine states and one province prohibited the use of studded tires. The remaining states and provinces allow use of studded tires only during the fall, winter, and spring months. The results of the 1990 survey (Table 2.5) showed, for North America, that only three agencies had no restrictions, 25 states/provinces restrict stud use to a given time period, and eight agencies prohibit their use. For those agencies restricting the use of studs to a specific time period, most restrict their use to the period from October through April. Similar results for the European countries surveyed are given in Table 2.6.

2.5 Enforcement

The results of the survey (see Appendix B, Question 7) also investigated the role of enforcement during prohibited periods. Generally, the risk of getting caught is considered low to moderate. Only South Dakota, Washington, Illinois, Minnesota, Nevada, Ontario, and Quebec indicated a high risk. The cost of being cited also varies considerably, with ranges in fines from <\$25 to \$500 plus vehicle impoundment.

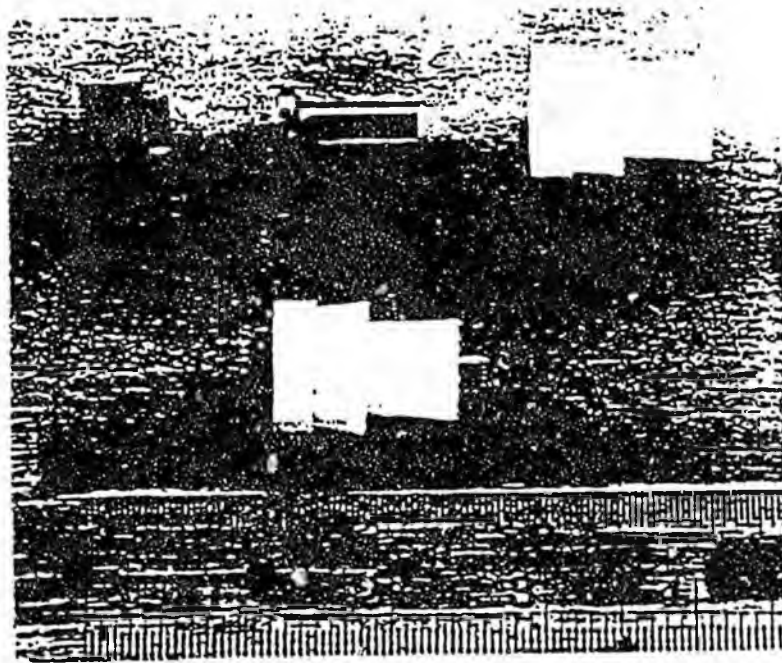
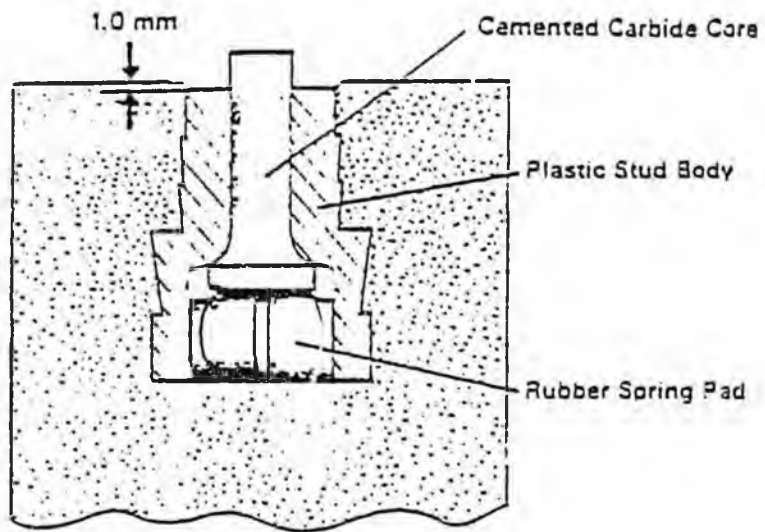
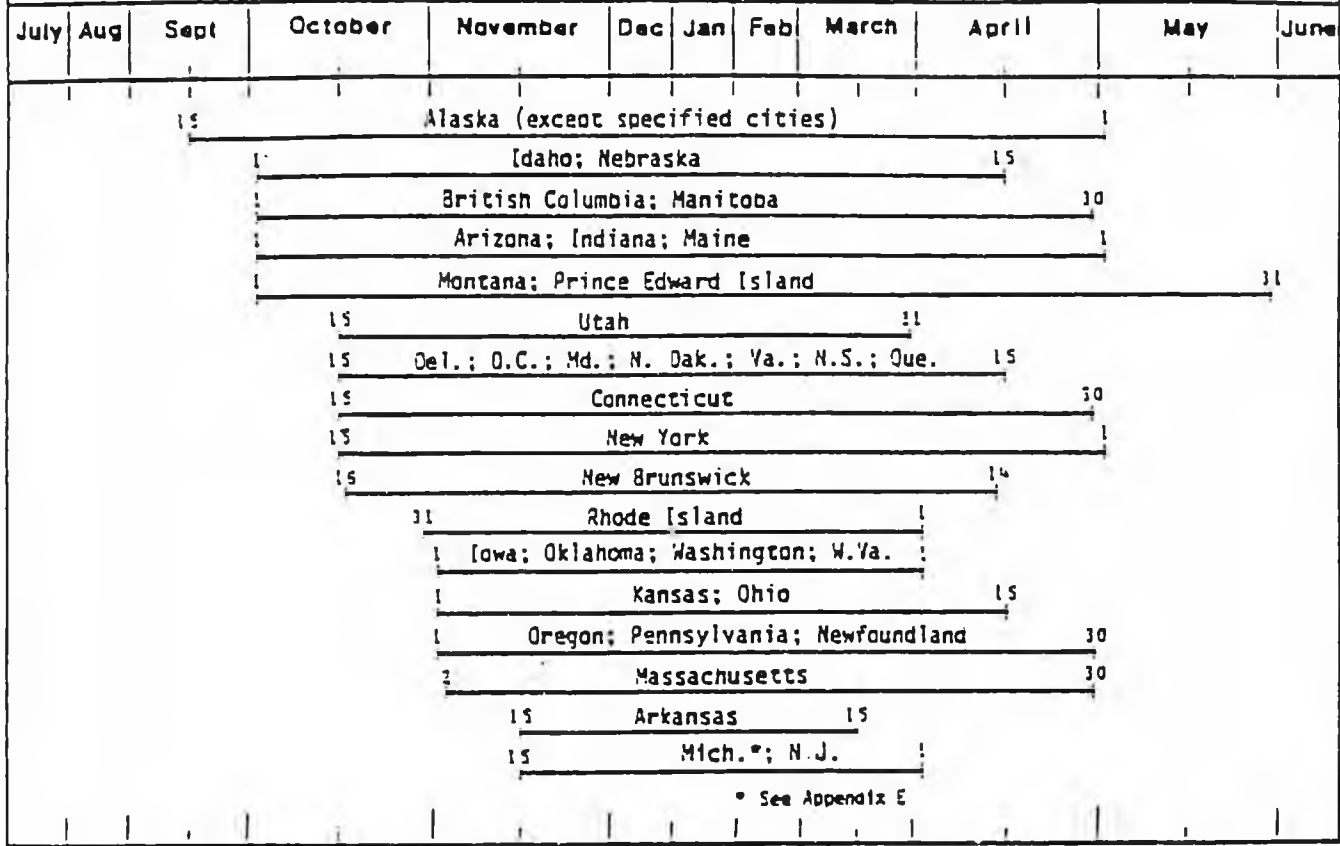


Figure 2.4. Spring-action stud (Fagersta Steels Limited) (NCHRP Syn. 32).

a) No restrictions:	Alabama	Missouri	North Carolina	Vermont
	Colorado	Nevada	South Carolina	Wyoming
	Georgia	New Hampshire	South Dakota	Alberta
	Kentucky	New Mexico	Tennessee	Saskatchewan

b) Restricted to period shown:



c) Prohibited:	California	Louisiana	Texas
	Florida	Minnesota**	Wisconsin**
	Hawaii	Mississippi	Ontario
	Illinois		

** Limited use by out-of-state motorists permitted

Sources: American Automobile Association 12-1-74
Federal Highway Administration June 1975

Figure 2.5. Legal restrictions on use of studded tires (NCHRP Syn. 32).

Table 2.5. Restrictions on use of studded tires in the U.S./Canada (August 1990).

a) No restrictions	Colorado Vermont Saskatchewan																				
b) Restricted to time period shown	<table> <tr> <td>Alaska</td> <td>Sept. 15 - April 30 (north of latitude 60°N) October 1 - April 14 (south of latitude 60°N)</td> </tr> <tr> <td>Connecticut</td> <td>November 15 - April 30</td> </tr> <tr> <td>Iowa</td> <td>November 1 - April 1</td> </tr> <tr> <td>Kansas</td> <td>November 1 - April 5</td> </tr> <tr> <td>Maine</td> <td>October 1 - May 1</td> </tr> <tr> <td>Nevada</td> <td>October 1 - April 30th</td> </tr> <tr> <td>New Jersey</td> <td>November 1 - April 1</td> </tr> <tr> <td>New York</td> <td>October 15 - May 1</td> </tr> <tr> <td>Rhode Island</td> <td>November 15 - April 1</td> </tr> <tr> <td>Utah</td> <td>October 15 - March 15</td> </tr> </table>	Alaska	Sept. 15 - April 30 (north of latitude 60°N) October 1 - April 14 (south of latitude 60°N)	Connecticut	November 15 - April 30	Iowa	November 1 - April 1	Kansas	November 1 - April 5	Maine	October 1 - May 1	Nevada	October 1 - April 30th	New Jersey	November 1 - April 1	New York	October 15 - May 1	Rhode Island	November 15 - April 1	Utah	October 15 - March 15
Alaska	Sept. 15 - April 30 (north of latitude 60°N) October 1 - April 14 (south of latitude 60°N)																				
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Kansas	November 1 - April 5																				
Maine	October 1 - May 1																				
Nevada	October 1 - April 30th																				
New Jersey	November 1 - April 1																				
New York	October 15 - May 1																				
Rhode Island	November 15 - April 1																				
Utah	October 15 - March 15																				
c) Restricted (period unreported)	California Delaware Idaho Indiana Montana Nebraska North Dakota Oregon Pennsylvania South Dakota Washington Wyoming New Brunswick Nova Scotia Quebec																				
d) Prohibited	Arizona Illinois Maryland Michigan Minnesota Alberta Northwest Territories Ontario																				

Table 2.6. Restrictions on use of studded tires in Scandinavia (August 1990).

a) No restrictions	
b) Restricted	Sweden - 31 October to Easter Finland - 1 November to 31 March
c) Prohibited	Germany

3.0 ROAD WEAR STUDIES

This chapter summarizes, based on the literature, the results of studies from throughout the world to identify the cause (mechanism) of pavement wear owing to studded tires, the rate of pavement wear, and factors which affect the rate.

3.1 Cause of Pavement Wear

The results of the literature review indicated that the mechanism of wear is primarily by abrasive action. Nieme (1978) has summarized the mechanism best, as shown in Table 3.1. Which of the four possible cases is most important is still open to debate. In Alaska, it is generally felt that the primary mechanism of studded tire wear is by scraping off the mastic and abrasion of the aggregate.

3.2 Factors Affecting Wear Rate

Several factors have been identified as affecting the pavement wear rate. Keyser (1970) has prepared (in Table 3.2) an excellent summary of these factors. In addition, Keyser (1972) stated the most important factors to be wheel load, stud protrusion, temperature, and humidity.

Figure 3.1 shows the effect of pavement type on wear rate. The "regular" bituminous pavements consisted of fine-graded mixtures for thin overlays with 85-100 penetration asphalts while the "high type" bituminous pavements contained either rubber or asbestos admixtures and 85-100 asphalts. The "regular" pavements contained a filler while no filler was present in the "high type" pavements. For both tests (on a test track and typical highway pavements), the wear rate was considerably greater for asphalt concrete compared with portland cement concrete pavements. Aggregate type also had an effect for the portland cement concrete pavements. Other factors, as shown in Table 3.3, can also affect the wear rate. In addition, as shown in Figure 3.2, the wear rate in acceleration can be 2 1/2 times the wear rate in deceleration.

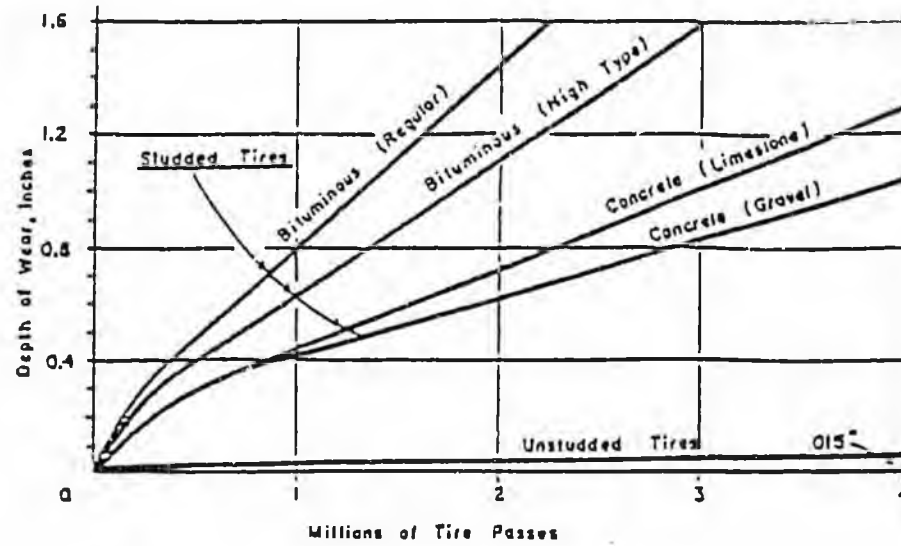
Figure 3.3 shows the effect of stud type on the average rate of wear on a test track under 542,000 wheel passes. In all cases, the wear rate was greatest during the initial 160,000 wheel passes. Wear rates then decreased to only 11 to 31% of the initial rates during the final 220,000 wheel passes. Type I and III studs caused much greater wear than type II studs.

Table 3.1. Cause of pavement wear under studded tires (after Niemi, 1978).

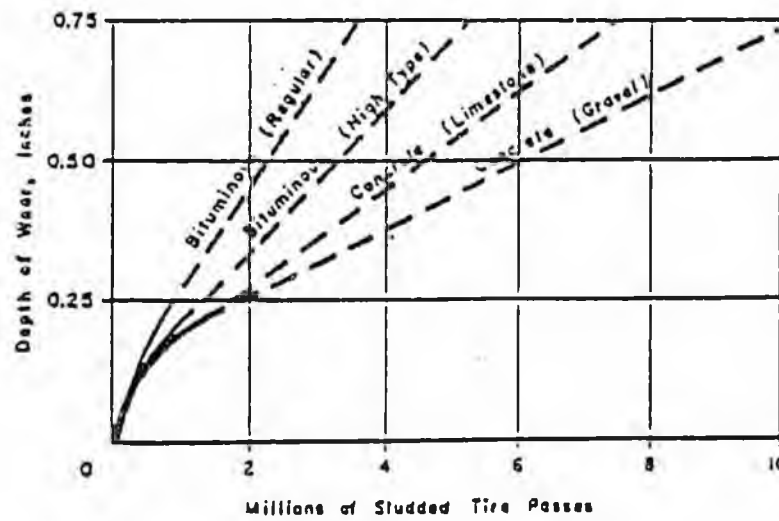
Cause	Description
1	The scraping action of the stud produces marks of wear on the mastic formed by the binder and the fine-grained aggregate.
2	The aggregate works loose from the pavement surface as a result of scraping by studs.
3	Scraping by the stud produces marks of wear on stones. Only in very soft aggregate does a rock fragment wear away completely by this action.
4	A stone is smashed by the impact of a stud and the pieces are loosened by the scraping action of the stud.

Table 3.2. Factors affecting pavement wear (Keyser, HRR 331, 1970).

Factor	Component	Characteristic
Vehicle, tire, and stud	Vehicle	Type and Weight Axle load Number of studded tires (front, rear)
	Tire	Type (snow or regular with or without stud receiving holes) Pneumatic pressure Age Configuration of studs Number of studs
	Stud	Type (material, shape) Protrusion length Orientation of studs with respect to tire wear
	Stud wear vs. tire wear	
Pavement	Geometry	Cornering (curve, sharp turn) Straight section Intersection Slope (up and down)
	Surfacing Material	Type and characteristics (bituminous mixtures, surface treatment, precoated chipping, portland cement, hardness) Age
	Surface Condition	Surface texture and profile Icy Compacted snow (compactness) Sanded or salted icy surface Slush
Environment	Humidity, temperature	Wet, dry, humid
Traffic	Volume	Number of passes and composition
	Speed	
	Wheel track	Width Distribution of wheel load
	Contact mode	Start (normal, abrupt) Stop (normal, abrupt) Acceleration (rate) Deceleration (rate) Spin Skid
Measure	Method and precision	



a) Wear rates of pavement specimens at test track



b) Wear rates of pavements of typical Minnesota highways

Figure 3.1. Relationship of studded tire induced wear vs. pavement type; Minnesota research (Keyser, HRR 352, 1971).

Table 3.3. Effect of Factors on Resistance of Asphalt Pavement to Wear by Studded Tires (Keyser, HRR 352, 1971).

Factors	Influence on Wear	Wear Ratio
Penetration of bitumen ^a 60 vs 300	Significant	1:1.3
Bitumen content ^a 5 vs 7 percent (opt. at 7 percent)	Very significant	1:1.8
Type of aggregate ^b Lamprophyre vs limestone	Very significant	1:1.6
Mix type ^b Special mix vs sheet	Very significant	1:1.8
Voids in mix ^a 3 vs 7 percent	Significant	1:1.4
Uniformity ^a Asphalt concrete variation	Variation	X ± 42 percent
Vehicle Speed ^a 60 to 80 km/hr	Not significant	—
Vehicle Weight ^a Car vs truck	Very significant	1:1.9
Tire pressure ^a	Not significant	—
Temperature ^c 37 ± vs 50 F	Very significant	1:1.5

^aData taken from Norwegian studies

^bData taken from Keyser's work

^cData taken from Finnish studies

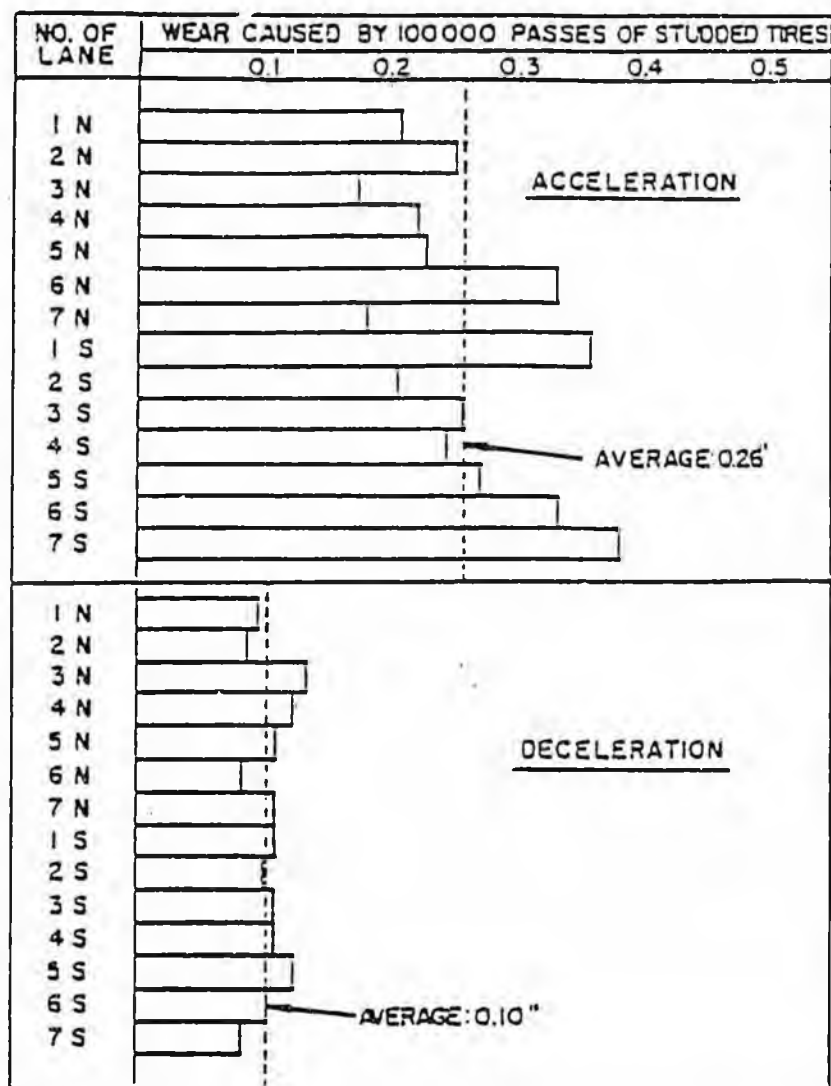
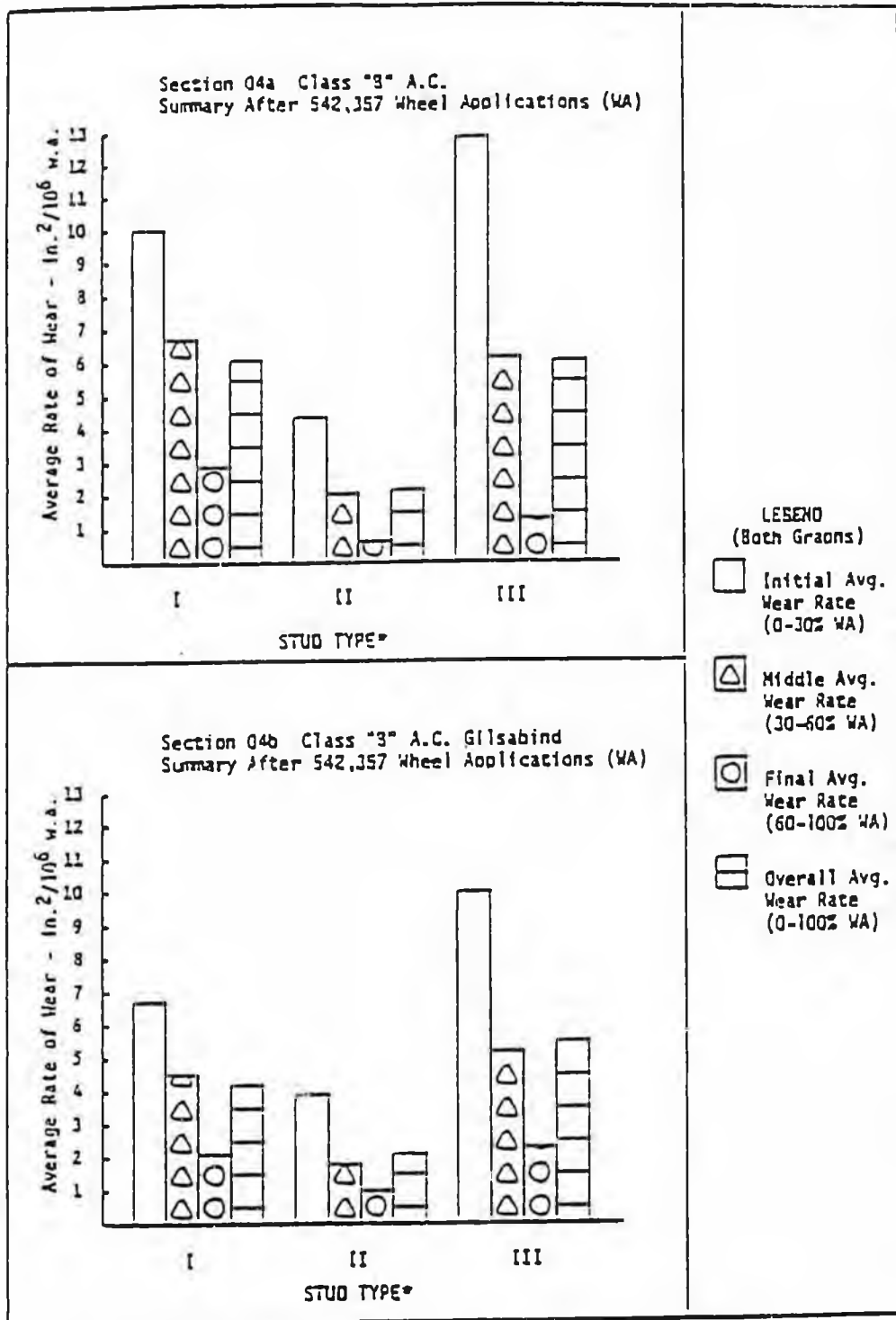


Figure 3.2. Relationship between acceleration and deceleration on portland cement concrete (Keyser, HRR 352, 1971).



* Wear Rate Due to Unstudded Tires Insignificant or Inmeasurable.

Figure 3.3. Effect of Stud Type on Wear for Asphalt Concrete Pavements (Krukar and Cook, 1972).

Finally, temperature affects wear rates for asphalt concrete. The work by Krukar and Cook (1973) shows the lowest wear rate at or near 0°C. Increases in pavement wear as pavement temperatures go below 0°C are reportedly associated with increased tire hardness and pavement stiffness. As temperature decreases, pavement stiffness increases, as does the force required to push the stud into the tire so that it is flush with the pavement surface. Thus, at low temperatures, the combination of high stud force and increased pavement brittleness may result in increased wear rate. However, in Alaska it has been observed that wintertime frost and ice formation on roadways in colder cities such as Fairbanks can provide a protective surface coating and greatly reduce the low temperature wear rates.

The rate of wear reportedly increases when the pavement is wet (Keyser, 1970).

3.3 Pavement Wear Studies

The number of pavement wear studies is quite limited. However, both the literature review and survey did yield some basic information as shown in Table 3.4. In general, these results indicate:

- 1) Reported wear rates vary considerably between agencies. This likely is due to differences in percentages of vehicles with studded tires, and to materials differences.
- 2) Pavement type has a great effect on pavement wear. Asphalt surfaces wear at a faster rate than portland cement concrete.
- 3) In areas of acceleration and deceleration, pavement wear increases substantially.
- 4) Mixes with larger, more durable aggregates wear less.

In addition, other factors were shown to influence the wear rate. These are given in Table 3.5.

a) Literature

Reference	Rate of Wear (in./passes)	Avg. Rate/ 100,000 passes	
Quebec (1967)	0.25/100,000	0.25	
Quebec (1970)	Acceleration	0.35-0.44/100,000	0.40
	Deceleration	0.18-0.20/100,000	0.19
	Normal	0.11/100,000	0.11
Germany (19XX)	0.11/120,000	0.09	
Finland (1988)	.15-2/10,000 AADT		
Sweden (Keyser, 1970)	0.5/40,000 AADT		
Maryland	0.28-1.07/100,000	0.7	
Minnesota	1.5/4,000,000	0.04	
Oregon (ODOT, 1974)	Concrete	0.026/100,000	0.03
	Asphalt	0.066/100,000	0.07

b) Survey

Reference	Rate of Wear (in./passes)	Avg. Rate/ 100,000 passes
California	0.0005-0.0018/1000	0.12
Connecticut	0.08/1,000,000	0.01
Maryland	0.028-0.107/10,000	0.68
New Jersey	0.05 per year for 5400 AADT per lane	
New York	0.009-0.016/year PCC pavements 0.022-0.025/year ACC pavements	
Oregon	0.032/100,000 PCC pavements	.03
	0.073/100,000 ACC pavements	.07
Norway	SPS*: AC = 25, Topoka = 15, Mastic stone = 10-15, PCC = 10	
Sweden	35 g/vehicle (4 studded tires)/km driven	

*SPS = g/cm (specific wear in grams worn out of the surfacing when a car with 4 studded wheels drives a 1 km distance)

Table 3.5. Factors affecting studded tire wear.

Factor	Variable	Comments
Traffic (ADOT)	Normal	Standard wear
	Acceleration	Increases wear rate by 300%
	Deceleration	Increases wear rate by 200%
Surface Type (ADOT)	Bare pavement	Increases wear rate*
	Snow pack	No wear

*Amount not reported.

4.0 IMPACTS OF STUDED TIRE USE

The impacts of studded tire usage are twofold: 1) Increased costs to the agencies through accelerated pavement wear as well as through safety problems created by the wheel track ruts and 2) benefits derived through increased traction during icy conditions which either improve safety or allow increased speeds. The use of studded tires is somewhat dependent on the agency's ice control practices. For example, heavy salt use for a "bare pavement" policy reduces icy road concerns in exchange for increased vehicle and bridge corrosion effects. This section of the report discusses each of these impacts, and is based on the results of the literature review and of the survey of agencies.

4.1 Economic Impacts

The survey of agencies clearly indicated that increased pavement wear was the major concern of most agencies. Safety problems due to increased wear of pavement markings were another concern. However, in most cases the improved stopping distance and/or maneuverability associated with studded tire use generally offset any negative impacts.

Though costs were not requested in the survey, the literature has some data which is useful in defining the economic impacts (Table 4.1). Though most of this information is from Scandinavia, it clearly indicates substantial costs associated with pavement wear, but a potential benefit due to improved (not reduced) safety and reduced winter maintenance (e.g., sanding) costs.

Table 4.2 also provides information on the additional costs associated with the continued use of studded tires on municipal roads and streets in Ontario. As indicated, not only does the cost for pavement maintenance increase, but significant costs can be realized in replacing traffic markings.

Table 4.3 summarizes the impacts of studded tire usage. Clearly the primary reason people use studded tires is for improved maneuverability and control under icy conditions.

4.2 Benefits of Studded Tires

Clearly the primary benefit of studded tires is improved traction (apparent) and hence improved safety. This is noted in the survey of agencies; however, little documentation was provided to substantiate the benefits.

Table 4.1. Annual cost effects of studded tires on pavement wear and safety (for a ban on studded tires).

Agency	Pavement Wear Costs	Winter Maintenance Costs	Accident Costs
Oregon DOT (1974)	+1.1 million	NA	NA
Finland (Pelkonen, 1978)	+175 to 250 million mks	-44 million mks	-0 to 190 million mks
Sweden (VTI - 1988/89)	+160 to 250 million SEK (national roads)	NA	-560 to 1160 million SEK (switch to snow tires)
	+95 to 150 million SEK (municipal roads)	NA	-1230 to 2590 million SEK (switch to summer tires)

Notes:

6 SEK = 1 U.S. dollar
4 mks = 1 U.S. dollar

+ Increase in costs
- Decrease in costs

NA = Not available

Table 4.2. Estimate of additional agency costs in Ontario due to the continued use of studded tires (Smith and Schonfeld, HRR 331, 1970).

Financial Year	Department of Highways				Municipalities				Grand Total
	New Pavement Construction ^a	Resurfacing and Patching ^b	Traffic Marking ^c	Total	New Pavement Construction ^d	Resurfacing and Patching ^e	Traffic Marking ^f	Total	
1970-71	608,000	589,000	1,078,000	2,275,000	458,000	470,000	1,078,000	2,006,000	4,281,000
1971-72	625,000	1,533,000	902,000	3,060,000	469,000	1,226,000	902,000	2,597,000	5,657,000
1972-73	855,000	4,298,000	778,000	5,931,000	641,000	3,438,000	778,000	4,857,000	10,788,000
1973-74	683,000	6,769,000	302,000	6,754,000	512,000	4,815,000	302,000	5,429,000	12,183,000
1974-75	625,000 ^g	6,960,000 ^g	325,000 ^g	6,910,000	469,000	4,768,000	325,000	5,562,000	12,472,000
1975-76	625,000 ^g	2,250,000 ^g	1,325,000 ^g	4,200,000	469,000	1,800,000	1,325,000	3,594,000	7,794,000
1976-77	625,000 ^g	8,669,000 ^g	1,325,000 ^g	10,619,000	469,000	6,855,000	1,325,000	8,649,000	19,168,000
1977-78	625,000 ^g	18,607,000 ^g	1,325,000 ^g	20,557,000	469,000	14,886,000	1,325,000	16,680,000	37,237,000
1978-79	625,000 ^g	8,578,000 ^g	325,000 ^g	9,528,000	469,000	6,860,000	325,000	7,654,000	17,182,000
Total	5,896,000	58,153,000	7,685,000	69,734,000	4,425,000	44,918,000	7,685,000	57,028,000	126,762,000

28

^aCosts include both concrete and bituminous pavements.

^bCosts include additional costs of providing more wear-resistant surfaces for the normal resurfacing program.

^cAdditional cost of providing more permanent traffic markings for both new pavements and existing ones.

^dTaken as 75 percent of corresponding King's Highway figures.

^eTaken as 80 percent of corresponding King's Highway figures.

^fTaken as 100 percent of corresponding King's Highway figures.

^gEstimated figure based on continuance of department's construction and resurfacing program at about the level of preceding years.

Table 4.3. Impacts of studded tire usage.

a) Consequences

Factor	Consequences
Effect on Safety	<ul style="list-style-type: none"> ● Increased rutting, ponding and hydroplaning ● Increased splash and spray
Effect on Pavement	<ul style="list-style-type: none"> ● Destruction of pavement markings ● Increased rutting ● Build up of snow and ice in ruts

b) Benefits

Factor	Benefit
Effect on safety	<ul style="list-style-type: none"> ● Improved stopping distance on ice ● Improved maneuverability on ice
Effect on pavement	<ul style="list-style-type: none"> ● None identified

The literature review shows mixed results. Smith et al. (1971) shows a minor benefit in terms of stopping distance on asphalt pavements and mixed benefits on concrete pavements (Table 4.4). This is also shown in Figures 4.1 and 4.2 for wet and dry pavements. However, Figure 4.3 clearly indicates the benefits of studded tires on ice (i.e., significantly improved stopping distances). Finally, it is clear from Figure 4.4 this decrease in stopping distance is not due to increased pavement skid resistance. Work by Smith et al. (published in HRR 352) shows that in most cases the skid resistance decreases with increasing use of studded tires.

Results of a recent skid survey done in Alaska in the summer of 1987 indicated that higher traffic areas were more polished and had lower skid numbers by late summer. However, pavement age was not a factor, so total number of stud passes were not a factor. The conclusion was that studs roughen the pavement and that normal tires polish the pavement (Ryer, 1988).

Table 4.A. Stopping distances from report for the Canadian Safety Council (Smith et al., HRR 352, 1971).

Stopping Distances from 50 miles per hour (In feet) Under Various Road Conditions	Dry Asphalt	Wet Asphalt	Dry Concrete	Wet Concrete	Glass Ice 0° C
Highway tread on 4 wheels	121	151	105	154	640'
Snow tire tread on rear wheels	118	148	106	165	620'
Studded snow tire on rear wheels	117	142	115	177	580'
Studded snow tire on 4 wheels	116	149	122	195	500'

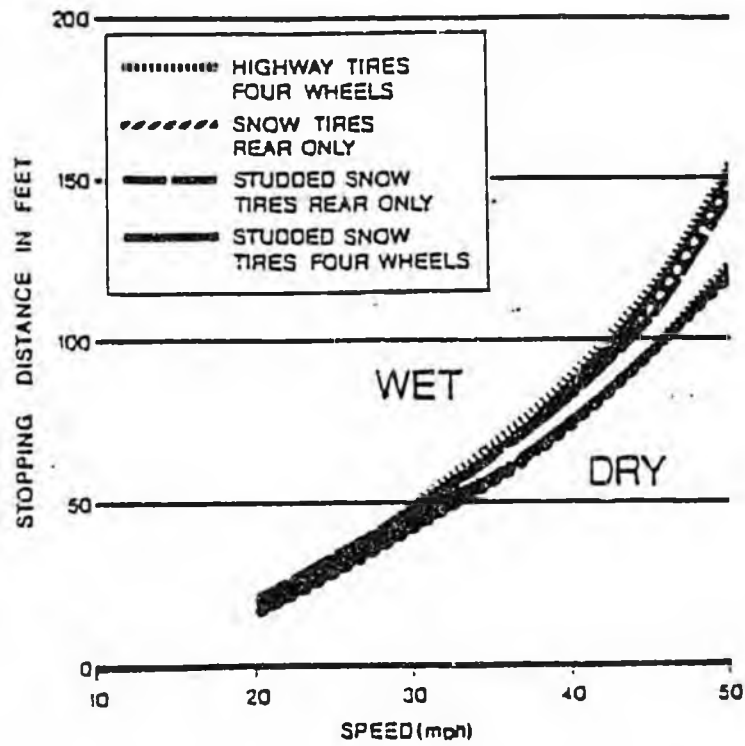


Figure 4.1. Stopping distance versus speed for cars travelling on asphalt pavement (Smith, et al., HRR 352, 1971).

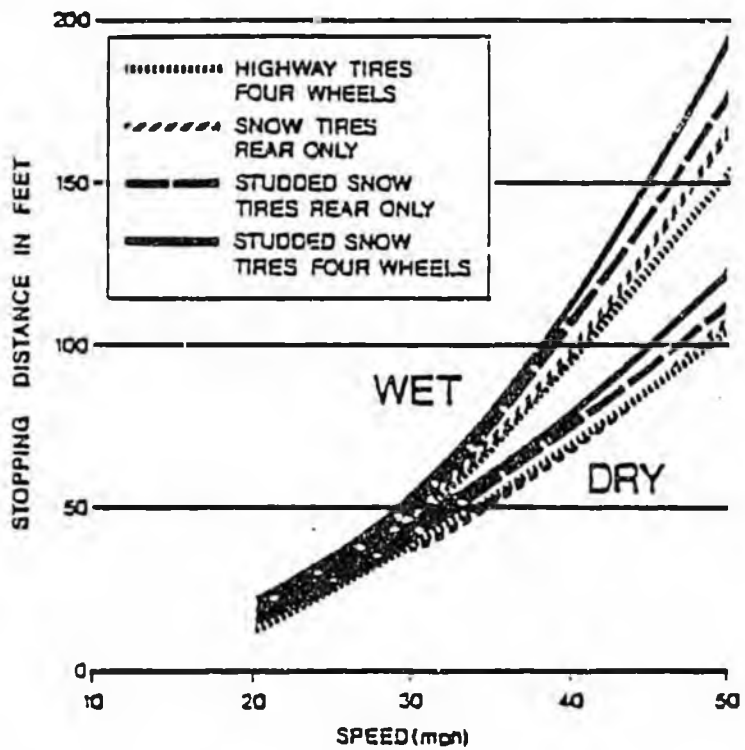


Figure 4.2. Stopping distance versus speed for cars traveling on concrete pavement (Smith, et al., HRR 352, 1971).

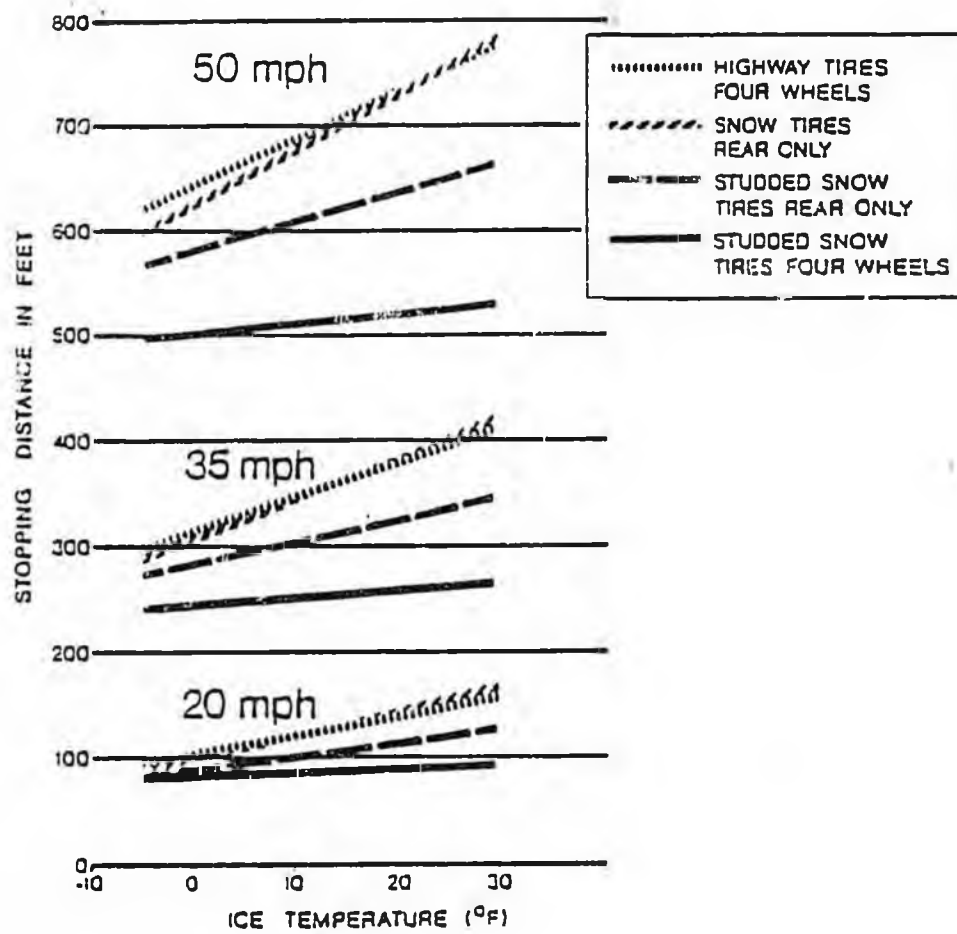


Figure 4.3. Stopping distance versus ice temperature for four cars traveling at 20, 35, and 50 mph (Smith et al., HRR 352, 1971).

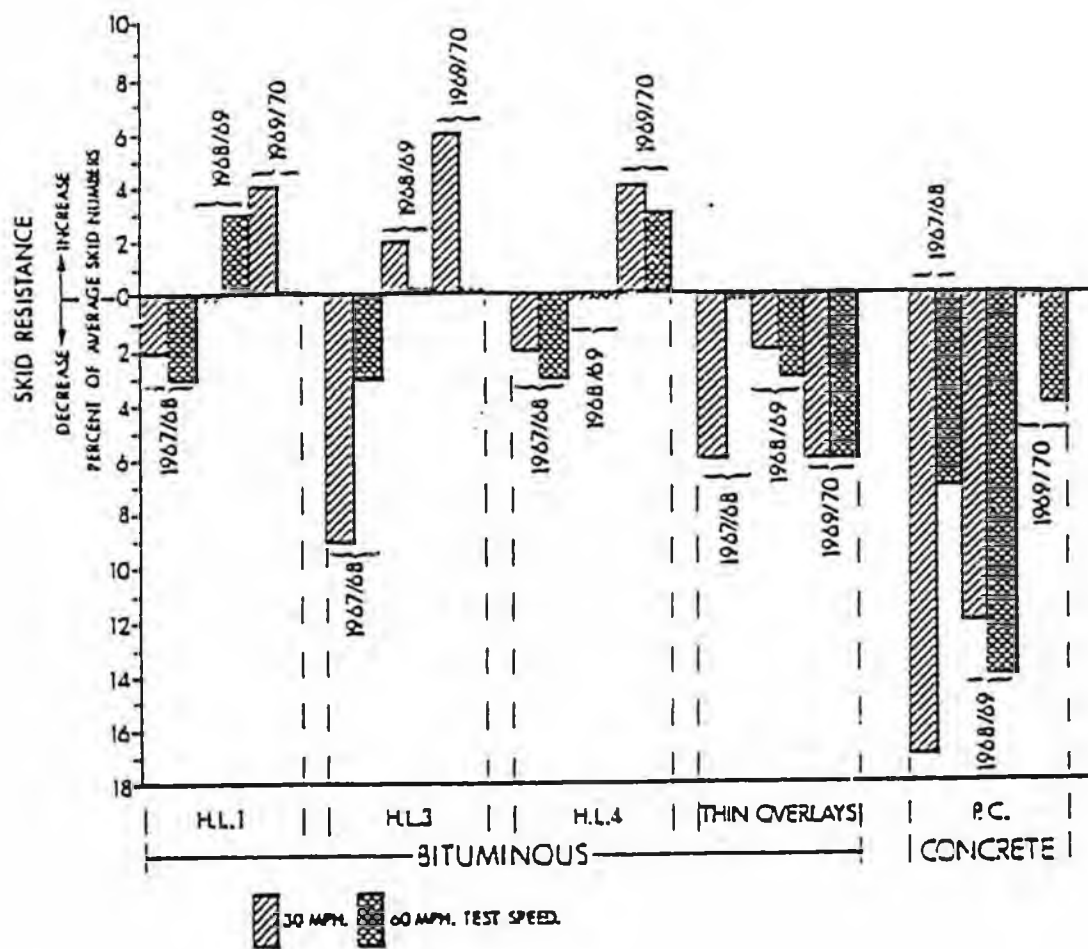


Figure 4.4. Changes in skid resistance of some pavements in Ontario with increasing use of studded tires (Smith and Schonfeld, HRR 352, 1971).

5.0 SUMMARY

This report presented a summary of the results of a literature review and survey of agencies on the use and effects of studded tires. Significant findings include the following facts:

- 1) Very little research has been done since 1975 in this area, with the exception of the Scandinavian countries.
- 2) Many agencies continue to prohibit or restrict the use of studded tires.
- 3) Very little new information on percent of vehicles using studded tires or on tire wear studies was available. Agencies basically do not know the rates of stud use.
- 4) Factors affecting wear rates were defined (e.g., pavement type, temperature, acceleration and deceleration areas).
- 5) The consequences and benefits of using studded tires were identified, but remain largely unquantified.
- 6) Telephone conversations with the manufacturers/distributors revealed that only the controlled protrusion type stud is currently used in the U.S.

Car owners continue to spend millions each year on studded tires for perceived or real benefits. Benefits associated with new tire types, radials instead of bias-ply tires, all-season treads vs. the older summer and winter treads, have not been evaluated in the USA. The shift from rear axle to front axle drive would also increase the effectiveness of studs on the drive axles, since the front axles perform much of the braking work. Therefore the above conclusions may no longer be valid.

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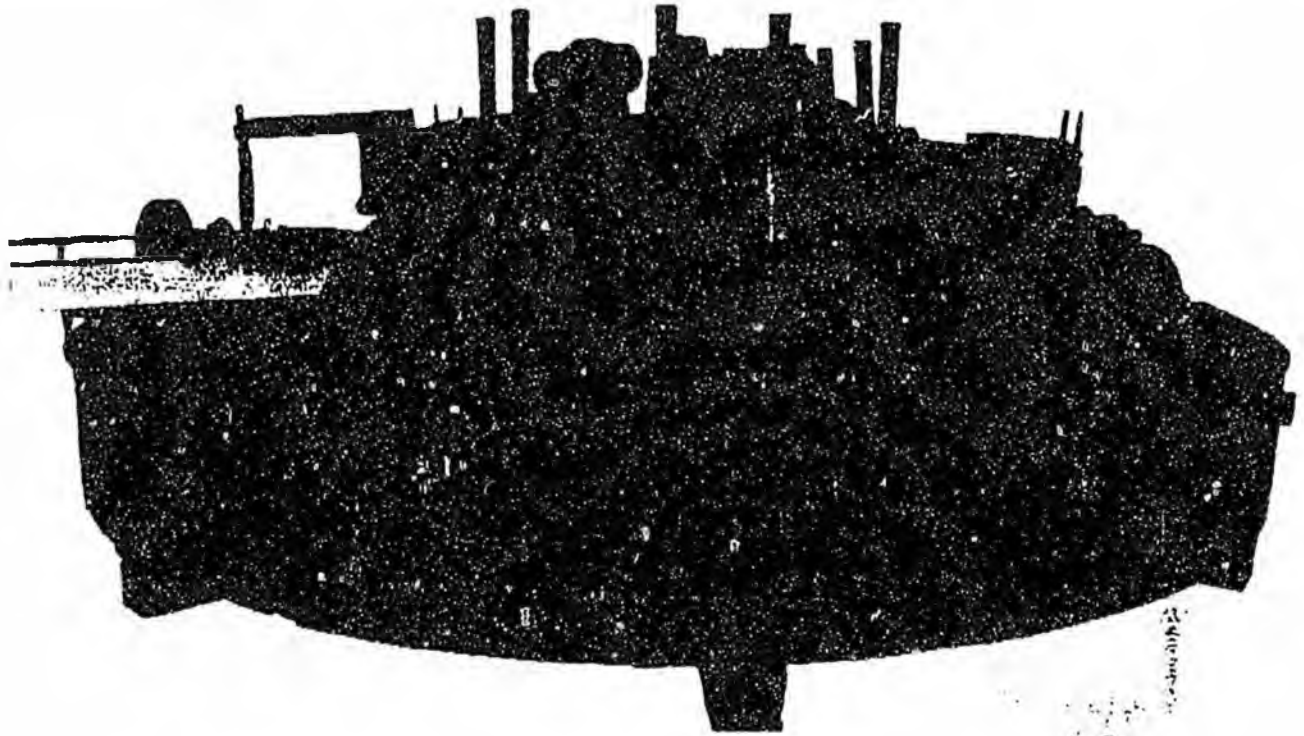
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VTI ROAD SIMULATOR

The VTI Road Simulator is a machine for accelerated testing of tyre influence on pavements under controlled conditions.

The machine has six wheels rotating on a circular track covered with the pavement material. A separate motor drives each wheel. The diameter of the track is 5.25 m, giving a mean lap length of 16.5 m. The maximum width of the track is 0.85 m.

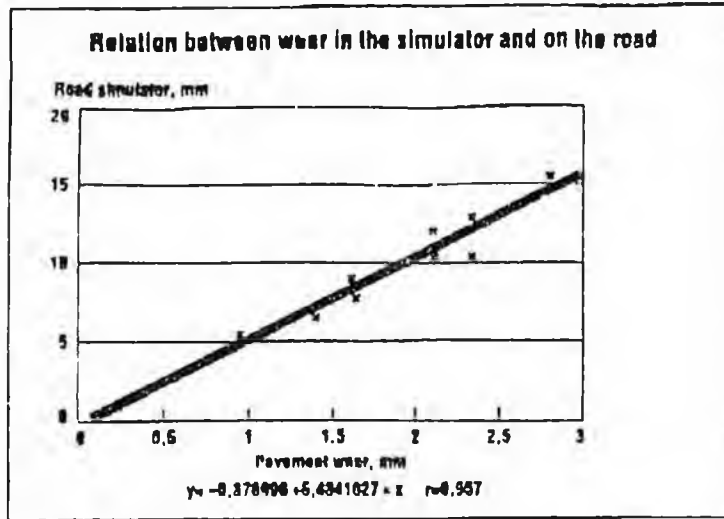
The wheels can be fitted at various radial distances from the centre of the machine and the machine's axis can be slowly moved laterally while running by means of an eccentric device. This enables all wheels to be moved

in and out a total of 60 mm. The lateral movement is especially important when using studded tyres, which would otherwise produce narrow ruts after each line of studs.

The pavement of the machine can be sprayed with water and the hall in which the machine stands can be cooled to -20°C . The speed of the machine can be varied, but the maximum speed is limited according to the wheel load. With the present design, the maximum speed is 85 km/h for a wheel load of 5 kN. Truck or car tyres with conical or conventional treads can be used. Normally, the machine is run with conventionally studded car tyres, size 185/70 R14.

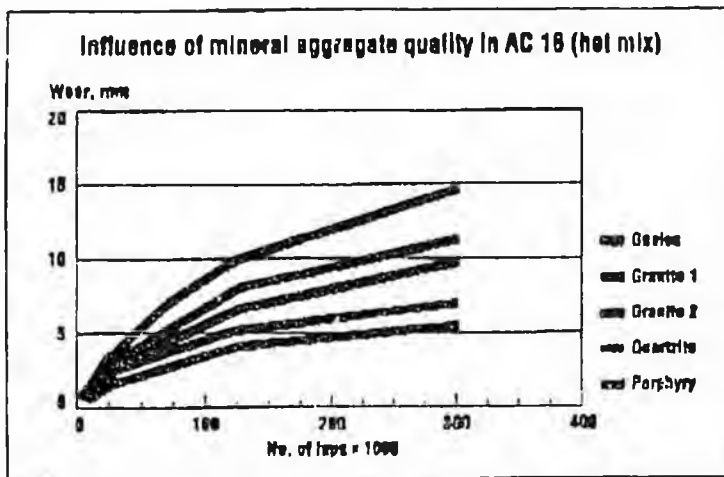
Determination of wear is performed from cross-sections recorded perpendicularly to the direction of travel. Measurement is done on





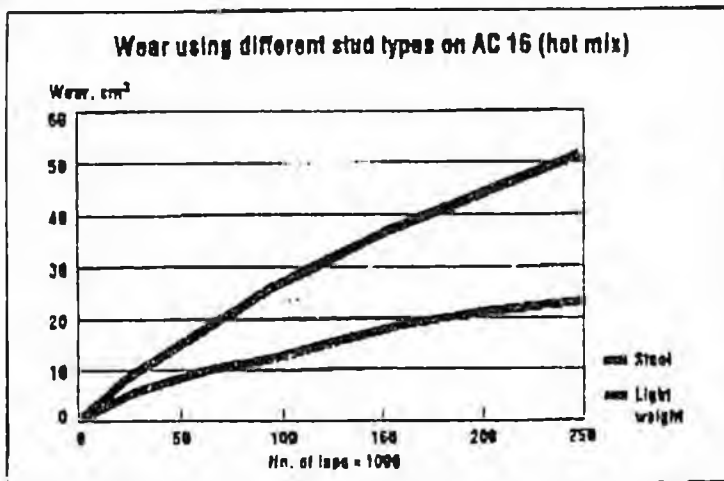
RELATION BETWEEN SIMULATOR AND FIELD TESTS

The simulator has shown excellent correlation with pavement wear in the field. The diagram indicates the relation between the wear on test slabs laid on the road and in the simulator. Pavement type AC 12 and 16 (hot mix).



STUDIES OF PAVEMENT MATERIAL

In studies of resistance of pavements to studded tyres, laboratory rolled slabs with known compaction and composition were tested. The parameters that can be studied include the effect of pavement type, binder, mineral aggregate quality, particle size etc.




STUDED TYRE TESTS

The development of studs for car tyres has resulted in a steady reduction of stud mass. Among new studs on the market are types with plastic or alloy mantle surrounding a hard metal pin. Tests with these lightweight studs have been performed in the road simulator. The results show that the lightweight studs produce considerably less wear on the pavement than the heavier conventional steel studs.

Examples of other applications

- testing traffic count cables
- testing wear on surface condition sensors



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<p><i>Author:</i></p> <p>Kent Gustafson</p>	<table border="1"> <tr> <td data-bbox="939 224 1195 291"><i>Published:</i> 1992</td> <td data-bbox="1195 224 1485 291"><i>Project code:</i> 43361-5</td> </tr> </table>	<i>Published:</i> 1992	<i>Project code:</i> 43361-5
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	<p><i>Project:</i> Tests with lightweight tyre studs in the VTI's pavement testing machine</p>		
	<p><i>Sponsor:</i> Swedish National Road Administration</p>		
<p><i>Title:</i> Tests with lightweight tyre studs in the VTI's pavement testing machine</p>			
<p><i>Abstract (background, aims, methods, results) max 200 words:</i></p>			
<p>The use of studded tyres, while having a direct effect on traffic safety, gives rise to a number of problems and increased costs, especially on roads with high traffic volumes. The wear from studs contributes to rutting and shorter pavement life. In the latest investigation of studded tyres, carried out in 1989, the cost of pavement wear from studded tyres was estimated at SEK 250–300 million per year for the Swedish road network. In recent years, new types of lightweight studs have appeared on the market, which may reduce pavement wear and consequent expense.</p>			
<p>At the VTI, a special machine for accelerated testing of pavement wear is being used to perform investigations under controlled conditions. Using the machine, a study has now been completed on two types of lightweight studs, one with a plastic body and the other of light metal.</p>			
<p>Tests using plastic studs have been performed at two speeds, 60 and 85 km/h, while the light metal stud has been tested only at the higher speed. With the exception of one case, the test runs have been made on an dense asphalt concrete (AC) pavement with normal wear resistance. In one run, plastic studs were also tested on Stone Mastic Asphalt (SMA) pavements with high wear resistance.</p>			
<p>On both the highly wear-resistant and normally wear-resistant pavements, abrasion from the lightweight plastic studs was generally about half that from corresponding steel studs. However, the absolute wear level naturally differed according to the wear resistance of the particular pavement. For example, the most wear-resistant pavements in the tests, SMA pavements with very high quality aggregate demonstrated 3-5 times less abrasion than the "normal pavement" with locally obtained aggregate. Also abrasion from the light metal studs was considerably lower than from the conventional steel studs and even lower than from the somewhat lighter plastic studs. Light metal studs produced only about one third, 35 %, as much wear as steel studs. The corresponding ratio between plastic and steel was 44 %.</p>			
<p>The tests showed that speed is of great significance for pavement wear. Abrasion increased significantly at higher speed. Steel studs gave almost the double amount of wear at 85 km/h compared to 60 km/h.</p>			
<p>To obtain an idea of the wear-resistance of the studs, stud protrusion has also been measured. The decrease in protrusion was of the same order of size for plastic studs as for light metal and steel studs. Thus, the results do not indicate any significant difference in wear resistance between the various types of stud.</p>			
<p>The conclusion from the investigation is that the lightweight studs that have been tested reduce pavement wear by about half. The calculated cost of this wear could thereby be halved within a few years when these studs have replaced the conventional steel stud.</p>			
<p><i>Keywords:</i></p>			

Tests with lightweight tyre studs in the VTI's pavement testing machine

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Summary

The use of studded tyres, while having a direct effect on traffic safety, has also had certain negative effects. Perhaps the most tangible of these pavement wear, contributing to rutting and shortened life of the wearing course, especially on roads with heavy traffic volumes. In the latest Swedish investigation of studded tyres, conducted in 1989, the cost of pavement wear as a direct result of studded tyres was estimated at SEK 250–300 million per year for the Swedish road network as a whole.

The extent of the wear caused by studded tyres depends on a number of factors, as stated in the report. One critical factor is the design and weight of studs. For many years, the basic principle of the tyre stud for passenger cars has been a hard metal pin enclosed in a mantle of steel, the whole stud having a weight of about 2 g. In recent years, however, several tyre and stud manufacturers have carried out intensive development to find a stud that is less aggressive to pavements. This work has resulted in studs of new design and/or weight, which are expected to reduce pavement wear.

At the VTI, a special machine for accelerated testing of pavement wear is being used to perform investigations under controlled conditions. Within a relatively short time, the machine produces a rut depth which is comparable to many years pavement wear on a road with large traffic volumes. In this study, the machine has been used to investigate pavement wear from tyres fitted with lightweight studs.

Tests have been conducted with the two types of lightweight studs which have so far captured a certain share of the Swedish market, in addition to conventional steel studs. One of the lightweight studs, "BETEK", has a body of plastic and weighs 0.7 g. These studs were fitted to Gislaved "Nord Frost" tyres. The other type of lightweight stud, "Eurometec", is made of light metal and weighs 0.95 g. These were fitted to Goodyear "Ultra Grip" tyres.

All test runs except one took place on a pavement of normal wear resistance, asphalt concrete (AC). In addition, one run was made on pavements with very good wear resistance, having asphalt wearing courses of high aggregate content and the best abrasion resistance, so called Stone Mastic Asphalt (SMA). The aim of the runs on wear-resistant pavements was to study whether the results obtained on a normal pavement also applied to these types of asphalt concrete.

The tests comprised a total of four types:

- Wear from plastic studs and steel studs at 60 km/h
- Wear from plastic studs and steel studs at 85 km/h
- Wear from plastic studs and steel studs at 85 km/h on highly wear-resistant pavements
- Wear from light metal studs and steel studs at 85 km/h

In the first two runs, with both plastic studs and steel studs, the speed was 60 km/h and the AC pavement with locally produced aggregate. The test comprised a total of 150,000 rotations in each case and the rut depth was about 10-15 mm at the end of the run. The result showed that pavement wear from the lightweight plastic stud was considerably less than that from the conventional steel stud. After the run, pavement wear from the lightweight stud was found to be 65 % of that from the steel stud at this speed, 65 km/h.

Three runs were performed at 85 km/h, two with steel studs and one with a lightweight plastic stud. Two somewhat different steel studs were tested, a single-shouldered stud weighing 1.6 g and a double-shouldered stud weighing 2.1 g. Despite some variation in design and

weight, the difference in pavement wear between these two types of stud was very marginal. The small difference between the two runs also shows that the reproducibility of the tests is fairly good.

As in the runs at lower speed, the difference in abrasion between the lightweight plastic stud and the conventional steel stud in runs was relatively great also in this case. After 150,000 rotations, the lightweight stud had caused abrasion equal to only 44 % and 47 % of that from the single-shouldered and double-shouldered types respectively, compared to the steel stud. At 250,000 rotations, the plastic stud had caused wear equal to only 44 % of that from the double-shouldered steel stud at this speed, 85 km/h. The large difference in wear also appeared in the maximum rut depth measured in the pavements. After 250,000 rotations, rut depth was about 15 mm for plastic studs and about double, 30 mm, for steel studs.

The tests on pavements of varying wear-resistance showed that abrasion in absolute levels differs greatly between pavement types. Particularly large was the difference between, on the one hand, the conventional pavement with normally wear-resistant aggregate and, on the other hand, the highly wear-resistant pavements with good quality aggregate and generally a high content of coarse material. The highly wear-resistant pavements showed abrasion usually only one fifth to one third of that on the conventional AC pavement with local aggregate.

However, the difference between the wear from lightweight plastic studs and conventional steel studs changed very little among the pavement types. The smallest difference was found for an AC (with maximum 20 mm aggregate) pavement, where the abrasion from plastic studs was 57 % of that from steel studs, and the largest difference was found on an SMA (with maximum 16 mm aggregate) pavement, where the corresponding figure was 37 %.

Summing up, the difference in wear between the new lightweight studs with a body of plastic and conventional steel studs is relatively constant for different pavement types. On both highly wear-resistant and normally wear-resistant pavements, abrasion from the lightweight studs is generally about half the corresponding abrasion from steel studs.

However, the absolute wear level naturally depends on the wear resistance of the particular pavement. For example, the most wear-resistant pavements in the tests, SMA pavements with very good quality aggregate (porphyry) showed 3-5 times less abrasion than the "normal pavement", AC with local aggregate.

Tests similar to those above have also been conducted with light metal studs. The speed was 85 km/h and the pavement was of the same type as previously: AC with local aggregate. The run with light metal studs was continued until 300,000 rotations had been completed. The same number of rotations had earlier been made with plastic studs and somewhat fewer, 250,000 rotations, with steel studs on a similar pavement, thereby allowing a comparison to be made.

The abrasion from the light metal studs was considerably less than that from the conventional steel studs and even lower than that from the somewhat lighter plastic studs. After 250,000 rotations, the ratio between light metal and steel was only 35 %, i.e. light metal studs produced wear that was only about one third of that from the steel studs. The corresponding ratio between plastic and steel was 44 %. The reason for this difference between the two types of stud can only be surmised, but may be due to differences in stud design, pressure or wear during the run. Otherwise, it would be natural for the lightweight plastic stud to produce less wear than the light metal stud.

The tests on the effects of steel studs and plastic studs on asphalt pavements have been performed at two speeds, 60 and 85 km/h, and it is therefore possible to study the effect of speed on abrasion and whether the various types of stud are similar in this respect.

This study, like many others, has shown that speed is of great significance in regard to pavement wear. Abrasion increases considerably when speed increases. For steel studs, abrasion after 150,000 rotations at 85 km/h was 86 % greater than at 60 km/h. After a smaller number of rotations, the increase was even greater, so that the increase from 60 to 85 km/h led to an overall increase of appr. 100 % in pavement wear for conventional steel studs.

In the case of plastic studs, speed does not have fully the same influence on abrasion. A speed increase from 60 to 85 km/h increased wear by 44 % after 150,000 rotations. The fact that speed has a lesser influence in the case of the lightweight plastic stud compare to the conventional steel stud is probably because the former is in itself less aggressive to the pavement owing to its lower weight. The influence on pavement wear from both speed and stud weight is probably exponential, i.e. the increase in wear becomes higher at higher speed and higher stud weight respectively.

The pavement testing machine is primarily designed for investigations of the effects of tyres on road surfaces, in particular pavement wear. However, wear on tyres and studs is somewhat different to that in normal traffic, where there is a combination of acceleration, braking, cornering, etc. Since the tyres in the pavement testing machine rotate constantly in a very tight circle, the wear on the studs is much heavier. To obtain a certain idea of the wear resistance of the studs being tested, the stud protrusion has been recorded. However, it must be emphasised that the protrusion observed cannot be compared in absolute terms with protrusion in normal conditions, but only against other measurements made in the same context.

Stud protrusion was recorded in most cases after 500 kilometres ("zero" measurement) and after each 50,000 rotations. However, there were deviations from this routine. The results of the stud protrusion measurements when running at 60 km/h showed that protrusion was almost constant for the steel studs, while the plastic studs showed reduced protrusion. A comparison between the two types of stud shows that the plastic studs had somewhat greater wear in this case.

The results for the three runs, one with plastic studs and two with steel studs, at 85 km/h showed that the difference in protrusion was relatively great, even for new tyres. The plastic studs had the smallest protrusion, an average of 1.13 mm, while the steel studs had a protrusion of 1.32 mm (single shoulder) and 1.59 mm (double shoulder). A comparison of the wear resistance of the studs thus refers to the decrease in protrusion and not the absolute protrusion. A comparison between plastic studs and single shoulder steel studs after 150,000

rotations showed that the decrease in protrusion was very similar. For both types, the decrease was 0.4 mm. In this case, the plastic studs had a wear resistance comparable to steel studs. The same applies even in a comparison with the other steel stud, the double shoulder type. For this steel stud, protrusion decreased from 1.59 mm to 0.60 mm, i.e. about 1 mm, after 250,000 rotations, while the decrease in protrusion of the plastic stud was about 0.6 mm, from 1.13 mm to 0.50 mm, after 300,000 rotations.

A third comparison of stud protrusion for lightweight plastic studs and conventional steel studs was performed in the run on wear-resistant pavements. Neither in this case did the results reveal any difference in wear resistance between the two types of stud compared, the decrease in protrusion being of the same order of size. In general, the lightweight type of stud had similar wear resistance compared to the conventional steel stud in the reported tests.

The change in stud protrusion in tests with light metal studs has been investigated in the same way as above. The protrusion of the light metal stud was recorded both on new tyres and after 150,000 and 300,000 rotations. From the beginning, the light metal studs had the smallest average protrusion of the types tested, about 1 mm. By the end of the run, the protrusion had decreased to 0.60 mm. This decrease is smaller than that of the other two types of stud after the same number of rotations. As with the plastic studs, the result therefore indicates no reason to fear that the wear resistance of these studs is poorer than that of conventional studs.

The conclusion from the reported investigations is that, given full market coverage, the lightweight types of stud of plastic and light metal will reduce pavement wear from tyre studs by about half within a few years. This means a cost saving of SEK 125-150 million according to the calculations in the latest investigation on studded tyres. Reduced pavement wear naturally also means other positive effects for the environment.

A number of other factors concerning the extent of pavement wear have also changed since the latest investigation on studded tyres. The use of highly wear-resistant SMA pavements has increased in recent

years and has spread to other roads and streets besides those with the heaviest traffic. SPS (Specific wear = pavement wear in gram per km of road and vehicle with studded tyres) ratios under 10 are not uncommon for this type of pavement and the average SPS ratio for the Swedish road network in 1989 (calculated at 30 in the investigation) should therefore have fallen somewhat. A further decrease is expected since this type of pavement is being laid to a greater extent than before.

Another factor that may be assumed to have a positive influence in reducing pavement wear is the change in painted lane markings now being introduced on a wider scale. Today, 13 metre roads are in some cases being painted with lanes 5.5 metres wide. The traffic is thereby distributed more evenly across the road and pavement wear is thereby less concentrated. Moving the markings laterally on motorways is another alternative that also leads to less concentrated rutting, according to initial experiments.

In general, the use of lightweight studs, together with the other factors mentioned above, may contribute to a decrease in pavement wear from studded tyres to about half the present level within a few years. This means that the cost of pavement wear from studded tyres could be reduced to a figure in the region of SEK 100 million per year, a relatively modest level in relation to the positive effect on road safety resulting from the use of studded tyres. Results so far also show that these new lightweight studs have the same road grip and wear resistance as the conventional steel studs. The positive effect on traffic safety with these new studs would therefore be of the same order of size as earlier.

In defense of studs

Experts suggest limits, light version of winter tires

By STEVE RINEHART

Daily News reporter

With road ruts deepening in Anchorage and Juneau, the state's chief highway research engineer called Tuesday for limits on the use of popular studded winter tires.

The state estimates every studded tire sold adds \$50 to road maintenance costs, engineer David Esch told a discussion panel at the Winter Cities conference in Anchorage. Fixing stud ruts costs about \$5 million a year, he said.

The highway department is not looking to ban studs, Esch said, but it is backing legislation to require the use of newer, lightweight studs. The department also wants a shorter studded-tire season and more enforcement of the summer stud ban, he said.

On one high-traffic Juneau road, Esch said, studded tires chiseled through nearly an inch of pavement in four years. In Anchorage, tire ruts on Muldoon Road got so

dangerously deep that the state put down temporary pavement last summer, just to hold the road over until this year's scheduled pavement reconstruction project. Project manager Bill Goodell said the ruts averaged nearly 2 inches, and in places were 4 inches deep. The one-year patch-up job cost about \$250,000, he said.



A leading North American tire stud distributor took issue with Esch's findings Tuesday. Bruno Wessel, of Sarasota, Fla., claimed the state's road-wear studies are based on faulty research. He said studs cause some wear, but he blamed heavy trucks and other factors for grooving the pavement.

But Esch said it's obvious to him that

Please see Page C-3, TIRES

TIRES: Experts suggest limits

Continued from Page C-1

studs cause the ruts. The tracks are the width of a car, he said; the ruts are the width of a car tire. He estimated that half the cars in Alaska have studs.

"The public wants to blame these ruts on the trucks, and does not want to admit it is studs," he said.

The conference is intended to bring together experts from northern countries to figure out smarter ways to live in wintry places.

Scandinavians, considered the world's experts on winter driving, told Tuesday's panel they think studded tires are great, even if they do tear up the roads.

Finnish transportation researchers have devised an elaborate equation to compare the costs to the benefits of studded tires. For example, studded tires cost consumers more,

and require the state to do more road maintenance, and they make the road rough, which slows down traffic in the summer. But they speed traffic up in the winter and save 300 million Finnish marks a year — about \$60 million — by preventing accidents.

In a country where 95 percent of the cars have studded winter tires, the pluses outweigh the drawbacks, said Asko Saarela, a professor at the Technical Research Center of Finland.

The Swedes, too, have concluded studs save more than they cost. Without studs, "there would be a dramatic increase in accidents," according to Kent Gustafson of the Swedish National Road Administration.

But the road damage from studs cannot be ignored, he said, so Sweden is switching to lightweight studs and is reducing the allowable number of studs in each tire.

HB

330

Alaska State Legislature

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COMMITTEE
ECONOMIC TASK FORCE

Representative Joe Green

Sponsor Statement

HB 330

Use of Natural Gas as a motor fuel in state vehicles

Natural gas is being used as a vehicle fuel in several states and provinces across the continent. Yet, while supplies of natural gas are abundant, we in Alaska appear to be waiting for an answer to the question "who goes first, the public sector or the private sector"?

Private sector fleet managers have expressed interest in utilizing natural gas, which offers a number of advantages. The state already uses natural gas in a few of its "around-town" cars. The barrier to more widespread use is refueling. Presently, the range of natural gas vehicles (NGV's) is limited, and there are few refueling stations.

HB 330 answers the question "who goes first" by allowing the public and private sectors to go forward together. HB 330 dedicates a minimum number of state vehicles to compressed natural gas (CNG) use. By establishing this critical mass in the NGV fleet, investors will have the confidence to build refueling stations. With the development of a refueling infrastructure, private sector fleet managers could utilize CNG.

HB 330 is a first step in the effort to utilize natural gas as a motor vehicle fuel in Alaska.

FISCAL NOTE

Revision Date:
Title: Fuel State Auto Fleet with Natural Gas

Department Affected: DOT&PF
BRU: STW Administrative Services

Sponsor: Green, Sanders
Requestor:

Component: State Equipment Fleet
Component Serial Number: #539

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY95	FY96	FY97	FY98	FY99	FY00
PERSONAL SERVICES	0	0	0	0	0	0
TRAVEL	0	0	0	0	0	0
CONTRACTUAL	0	0	0	0	0	0
SUPPLIES	0	0	0	0	0	0
EQUIPMENT	0	0	0	0	0	0
LAND & STRUCTURES	0	0	0	0	0	0
GRANTS, CLAIMS	0	0	0	0	0	0
MISCELLANEOUS	0	0	0	0	0	0
TOTAL OPERATING:	0	0	0	0	0	0

CAPITAL — INFRASTRUCTURE	1,200.0	0	800.0	0	0	800.0
CAPITAL — CONVERSION	350.0	0	321.0	0	0	735.0

REVENUE FUND SOURCE	0	0	0	0	0	0
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FUNDING: (Thousands of Dollars)

1002 FEDERAL RECEIPTS	0	0	0	0	0	0
1003 GF MATCH	0	0	0	0	0	0
1004 GF	1,550.0	0	1,121.0	0	0	1,535.0
1005 GF/PROGRAM RECEIPTS	0	0	0	0	0	0
1006 GF/MHTIA	0	0	0	0	0	0
OTHER	0	0	0	0	0	0
TOTAL FUNDING:	1,550.0	0	1,121.0	0	0	1,535.0

POSITIONS

FULL-TIME	0	0	0	0	0	0
PART-TIME	0	0	0	0	0	0
TEMPORARY	0	0	0	0	0	0

Estimate of current year (FY94) impact: \$0

ANALYSIS: (Attach a separate page if necessary)

See Attached.

Prepared by: Ken Langel, Manager

Phone: 243-7671

Division: State Equipment Fleet, Administrative Services

Date: January 14, 1993

Approved by Commissioner: *B.A. Campbell*

Phone: 465-3901

B.A. Campbell

Agency: Department of Transportation and Public Facilities

Date: January 14, 1994

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HB 330 FISCAL NOTE ANALYSIS

The estimated capital requirements to comply with the proposed legislation include two elements: vehicle conversion costs and cost for developing refueling infrastructure. Additional operating costs are anticipated for mechanic training, specialized shop equipment, and facility changes to accommodate repair work on CNG vehicles. It is anticipated that these costs will be offset by operational savings in vehicle fuel and maintenance expenses.

Vehicle Conversion Costs

The incremental cost of purchasing or converting vehicles to run on Compressed Natural Gas (CNG) over the cost of purchasing conventional fuel vehicles is estimated as an average cost per vehicle of \$3,500.00 through FY95. As manufacturers market a greater volume of these units in outlying years, this average cost is expected to decrease. Accordingly, an estimated cost of \$3,000.00 per unit was used for FY97, and \$2,500.00 per unit for FY2000.

There are 2,007 light vehicles maintained by DOT&PF statewide. Complying with the conversion percentages mandated by this legislation would require capital expenditures in accordance with the following schedule:

FY95	5% of the fleet	=	100 units @ \$3.5	=	\$350.0
FY97	10% of the fleet	=	107 additional units @ \$3.0	=	\$321.0
FY00	25% of the fleet	=	294 additional units @ \$2.5	=	\$735.0
	TOTALS	=	501 units	=	\$1,406.0

Refueling Infrastructure Costs

Because private sector CNG stations (except one in Anchorage) are not available, capital expenditures will be necessary to provide minimal refueling infrastructure to support vehicles which operate on CNG.

Currently, a natural gas supply is only available in the Anchorage and Matanuska Valley (Mat-Su) areas. In order to provide minimal refueling facilities to support a CNG fleet, it is estimated that a total of seven stations will be needed by FY2000. An average cost of \$400.0 per station is estimated, with capital requirements in accordance with the following schedule:

FY95	2 Stations in Anchorage @ \$400.0				
	1 Station in Mat-Su @ \$400.0	=		=	\$1,200.0
FY97	1 Additional Station in Anchorage @ \$400.0				
	1 Station in Kenai @ \$400.0	=		=	\$800.0
FY00	2 Additional Stations in Anchorage @ \$400.0	=		=	\$800.0
	TOTALS	=		=	\$2,800.0



*Department of Transportation
and Public Facilities*

POSITION PAPER

BILL NO: HB 330

APPROVED: 

TITLE: An Act relating to the use of natural gas as a motor vehicle fuel in state-owned vehicles.

DATE: January 11, 1994

The Department of Transportation and Public Facilities (DOT&PF) has statutory responsibility for management of the Statewide Equipment Fleet (SEF). SEF is responsible for procurement of new replacement equipment, including alternate fuel vehicles, in order to provide safe, reliable, and cost-effective vehicles to state agencies.

Although SEF supports the use of compressed natural gas (CNG) as a motor vehicle fuel in state-owned vehicles, the lack of CNG refueling infrastructure within the state at this time would severely limit the realistic use of CNG vehicles.

Provisions of the proposed legislation that would require a specified percentage of state vehicles to be fueled by natural gas prior to certain timelines cannot be met for the following reasons.

1. There is currently only one CNG refueling station in the state, which is located in Anchorage.
2. A large number of vehicles maintained by DOT&PF are in remote areas where there is no CNG, or even a supply of gas available.
3. Because CNG vehicles have a restricted range, and because CNG storage cylinders take up considerable cargo room, they may not be suitable for some work situations encountered by state agencies.

For these reasons, the department does not support the proposed legislation in its current form.

For Further Information contact J.K. Ginger Johnson at 465-3904.



*Department of Environmental
Conservation*

POSITION PAPER

BILL NO: HB330

APPROVED: *John A. Sandoz*

TITLE: An Act relating to the use of
natural gas as a motor vehicle
fuel in state owned vehicles.

DATE: February 2, 1994

The Department of Environmental Conservation (DEC) has statutory responsibility for the management of the Statewide Air Quality Program. As part of that responsibility the Department is tasked with the reduction of carbon monoxide (CO) in Anchorage and Fairbanks. Both of these cities are in nonattainment with ambient standards for CO.

To bring these cities into attainment the State has been working with the local governments for the past 15 years. Cooperative efforts have led to a State Implementation Plan (SIP) being developed that provides for a plan to reach attainment. The Anchorage Air Quality Plan for attainment speaks to using Compressed natural gas (CNG) as a CO reduction strategy. The Clean Air Act of 1990 (CAA90) requires nonattainment areas that have not reached their air pollution goals by 1995 to implement a CNG PROGRAM for "fleets."

HB330 has the potential for supporting the Anchorage Air Quality Plan. There are no provisions for CNG in Fairbanks at this time unless expensive mobile refueling stations are provided for. The statewide infrastructure for CNG to accommodate this bill is not in place. To accommodate the mandates of HB330, significant capital would have to be established for the provisions to be implemented.

Due to the high cost to establish this infrastructure statewide, the Department cannot support the bill in its present form, but would support a bill that was tailored to resolve the Anchorage and Fairbanks Ambient Air Quality Standard violations. The Department would be willing to work with the authors of the bill to help resolve the infrastructure and timing issues housed within the current bill as proposed.

For further information contact Ron King at 465-5100.

NEWS CLIPPINGS IN
Anchorage Daily News

Date: 2/7 1994

State tries to set example by driving with natural gas

By HUGH CURRAN
Daily News reporter

Ken Langel knew he had to floor it and make the big van zoom.

"See? Notice any difference?" Langel asked as the cavernous white Dodge and its natural gas-sipping engine roared to life and raced down Aircraft Drive on the banks of Lake Hood.

Langel knows that before Alaskans will accept compressed natural gas-powered cars and trucks as another option to consider on the showroom floor, they'll have to first be convinced how familiar and routine the cleaner-burning fuel can be.

"You don't need to know one thing different to drive one of these," he said.

As manager of the 2,800-vehicle fleet for the state Department of Transportation and Public Facilities, Langel and department commissioner Bruce Campbell see compressed natural gas-fueled vehicles as a way to cut down on the fleet's contribution to Anchorage's carbon monoxide problems, introduce the idea to the public and blaze the trail for widespread, everyday use by residents.

The department took delivery of five vehicles last month to test the practicality and driver reactions to the alternative fuel. A Ford Taurus sedan, Chevy Blazer and Chevy van were converted locally to use either natural gas or regular gas at the flip of a switch. The Dodge Van and Dodge mini-van that the agency plans to buy next month use only compressed natural gas and come that way from the factory.

Langel said it's the recent availability of such factory-made natural gas vehicles — along with growing air-quality concerns in Anchorage after years of federal clean-air standard violations — that made the time right to try natural gas.

"Compressed natural gas vehicles have been around for 80 or 90 years; it's not like a new rocket science," Langel said.

An Anchorage hotel has been using a natural gas van for the 10 years.

"But previously, there were performance problems with carbureted engines that fuel injection has solved. The tanks and the available pressure weren't as

Please see Page C-2, CARS

CARS: State goes natural gas

Continued from Page C-1

good before, either. We also finally have a wide selection of factory-made vehicles and a new environmental awareness that just wasn't there 10 years ago."

A 1990 test by the American Gas Association showed vehicles using compressed natural gas release less than a quarter of the carbon monoxide emitted by gasoline engines.

Based on talks with Lower 48 fleet managers who have used compressed gas for several years, Langel hopes to see miles per gallon equal to or greater than gasoline vehicles and the rough equivalent of 80 to 90 cents per gallon for the fuel.

Langel said another hoped-for advantage is reduced maintenance costs and longer engine life because the fuel is less likely to leave damaging deposits in the engine and on spark plugs.

The agency spent \$2,500 to \$4,500 to convert its three vehicles from gasoline to natural gas, Langel said. The factory models cost \$3,500 to \$5,000 more than gasoline vehicles. He said greater production should translate into lower costs.

The vehicles look, sound and feel no different from their gasoline cousins. The

only telling sign in the Taurus was something that looked like an oxygen tank under the hood and a small metal plug for refueling that sticks out of the grill.

Refueling is currently handled at the Lake Hood office through a compact pump that compresses the natural gas used in the department's building. Langel said the pump refuels an empty vehicle in six to 10 hours. The only commercial compressed natural gas station in Anchorage refills at almost the same speed as regular gasoline.

Langel said the availability of refueling stations will determine whether natural gas vehicles will ever see wide use.

"To really make a dent in air pollution you're going to have to get the public involved, and that can only happen if the refueling infrastructure is there," Langel said. "You'd need at least four stations in Anchorage, one in the Valley and one in Kenai."

Langel said to promote the building of such an infrastructure, local, state and federal agencies — as well as private companies such as Alaska Cab, Enstar, the Alaska Railroad and some tour companies — are putting the final touches on a group tentatively called the Alaska Compressed Natural Gas User's Coalition.

Office of th

Anchorage, Alaska



**Washington
Gas**

Energy Policy Act of 1992: Alternative Fuel Vehicles (AFVs)

NGV Hotline: 202-624-NGVS

Introduction

On October 24, 1992, Former President Bush signed the Energy Policy Act of 1992. This new law is designed, in part, to reduce the nation's dependence on foreign oil imports by encouraging the use of domestically produced fuels. As such, the Energy Policy Act contains both mandates and incentives for the use of alternate fuels in vehicles.

Alternative Fuels

Under the Energy Policy Act of 1992, "alternative" fuels include the following:

- Methanol*
- Ethanol*
- Natural Gas*
- Propane*
- Hydrogen*
- Coal-derived Liquids*
- Biological Materials*
- Electricity*

The Act also includes any other fuel that the Secretary of Energy finds to be substantially not petroleum and which would yield substantial energy security benefits and substantial environmental benefits.

Fleet Requirements

The Energy Policy Act requires federal fleets to begin purchasing alternative fuel vehicles (AFVs) in fiscal year 1993. The Act requires state fleets and alternate fuel providers to begin purchasing AFVs in model year 1996. And the new law may require private and municipal fleets to acquire AFVs, starting as early as model year 1999. The following table summarizes the annual purchase requirements for federal and state fleets, alternate fuel providers, and private and municipal fleets.

Table 1.

ALTERNATIVE FUEL VEHICLES NEW FLEET LIGHT DUTY VEHICLE PURCHASES

Year	Fuel			
	Federal	State	Providers	Private*
1993	5,000	-	-	-
1994	7,500	-	-	-
1995	10,000	-	-	-
1996	25%	10%	30%	-
1997	33%	15%	50%	-
1998	50%	25%	70%	-
1999	75%	50%	90%	20%
2000	75%	75%	90%	20%
2001	75%	75%	90%	20%
2002	75%	75%	90%	30%
2003	75%	75%	90%	40%
2004	75%	75%	90%	50%
2005	75%	75%	90%	60%
2006 on	75%	75%	90%	70%

* Under the early rulemaking scenario

These percentages generally apply to small vehicles in large fleets operating in large cities. Covered vehicles are those up to 8,500 pounds gross vehicle weight, which include passenger cars, pickup trucks and vans. Fleets have to have at least 20 vehicles which are centrally fueled, and the fleet owner must have at least 50 vehicles nation-wide. And the affected areas are those with a 1980 population of at least 250,000.

For non-governmental fleets, the penalties for violation start at \$5,000 and increase to \$50,000 for repeat violations.

Alternative Fuel Providers

Table 1 shows the requirements for alternate fuel providers, which include natural gas and electric utilities. Starting with model year 1996, 30% of new light duty vehicles must be AFVs, increasing to 90% in 1999. These vehicles must be operated exclusively on alternative fuels unless the appropriate fuel is not available. If these fuel providers have more than one affiliate, division or business unit, only those which are engaged in the alternative fuels business are included.

The Secretary of Energy has discretion to extend the schedule and to reduce the purchase requirements to as low as 20%. Electric utilities have the option of waiting until 1998 if they plan to use electric vehicles. And a fleet may be exempted from this requirement if it can demonstrate that the alternate fuels and/or vehicles are not available.

Private and Municipal Fleets

Under the Act, the Secretary has two opportunities to justify a mandate for private fleets, as shown in Table 2. If a rulemaking is issued by December 15, 1996, then the percentages in the right hand column apply. And if no rulemaking is issued until January 1, 2000, then the percentages in the right hand column apply. And if no rulemaking is issued by the latter date, there will be no private fleet mandate.

Table 2.

PRIVATE AND MUNICIPAL FLEETS NEW LIGHT DUTY VEHICLES

Model Year	By 12/15/96	By 1/1/00
1999	20%	-
2000	20%	-
2001	20%	-
2002	30%	20%
2003	40%	40%
2004	50%	60%
2005	60%	70%
2006 on	70%	70%

In order to issue one of these rulemakings, the Secretary must find that the program is necessary, practicable and achievable; and that adequate alternative fuels, infrastructure and vehicles will be available. The Secretary also has discretion to delay the deadlines and/or reduce the percentage requirements.

Tax Incentives

The following table shows the amount of tax deductions for AFVs. They include \$2,000 to \$50,000 for the vehicle (depending on size) and up to \$100,000 for the fueling station. These tax deductions apply to property placed in service after June 30, 1993. The vehicle deductions apply to the incremental cost of an AFV over its gasoline counterpart, including either factory-made vehicles or after-market conversions. The facility deduction applies to each fueling station installed by a taxpayer at a single location.

Table 3.









ALTERNATIVE FUEL VEHICLES MAXIMUM TAX DEDUCTIONS

Vehicle (up to 10,000 lbs. gvw)	\$ 2,000
Vehicle (10,001 to 26,000 lbs. gvw)	\$ 5,000
Truck or Van (over 26,000 lbs. gvw)	\$ 50,000
Bus (Seating capacity of 20 or more adults)	\$ 50,000
Alternative Fuel Refueling Facility	\$ 100,000

In addition, electric vehicles qualify for a 10% tax credit, up to \$4,000 per vehicle.

Other Provisions

Other provisions of the Act which will encourage the use of alternative fuels include:

-  Up to \$30 million/year to assist in the purchase of alternate fuel transit buses and school buses.
-  \$25 million/year for low-interest loans for the purchase of AFVs.
-  State and local incentive programs, including \$10 million/year to assist states in acquiring AFVs.
-  Exemption for Vehicular Natural Gas, or "VNG," from certain federal and state regulations, allowing non-utilities to participate without becoming regulated.
-  Pipeline recovery of Gas Research Institute costs associated with natural gas vehicle research and development.
-  Certification of training programs for alternate fuel vehicle technicians.
-  Public information program.
-  Electric vehicle research and development.

Clean Air Act Amendments of 1990

How do the fleet requirements of the Energy Policy Act compare with those of the Clean Air Act Amendments of 1990? First, the Clean Air Act affected fleets in 22 urban areas, while the Energy Policy Act will affect fleets in 125 metropolitan areas.

Second, the Clean Air Act included reformulated gasoline and "clean" diesel as alternative fuels. But the Energy Policy Act requires alternative fuels to be "substantially not petroleum," so in the additional cities, reformulated gasoline and clean diesel won't qualify. (Under the new law, DOE is authorized to allow private fleets in the 22 Clean Air Act cities to use reformulated gasoline.)

Third, both laws provide "credits" for those who buy more AFVs than required or who purchase them earlier than required.

Under both laws, the following vehicles are exempt: rental cars, vehicles held by dealers for sale or demonstration, manufacturer test vehicles, law enforcement and emergency vehicles, military vehicles which are exempted for national security reasons, non-road vehicles, and those which are garaged at personal residences.

Under both laws, a study will be made of non-road vehicles, such as airport ground support equipment and marine vessels. In the case of the Clean Air Act, the study is to determine whether the use of alternative fuels in these non-road engines would reduce pollution, while the Energy Policy Act study will determine whether the use of alternative fuels in non-road vehicles would reduce our dependence on foreign energy sources.

Conclusion

Natural gas vehicles (NGVs) fulfill the objectives of both laws. NGVs have lower emissions, as required by the Clean Air Act, and natural gas is domestically produced, as required by the Energy Policy Act.

Metropolitan Areas with 1980 Population of 250,000 or More

Washington, DC-MD-VA

Albany-Schenectady-Troy, NY	Greensboro-Winston Salem-High Point, NC	Pensacola, FL
Albuquerque, NM	Greenville-Spartanburg, SC	Peoria, IL
Allentown-Bethlehem-Eastern, PA-NJ	Harrisburg-Lebanon-Carlisle, PA	Philadelphia-Wilmington-Trenton, PA-NJ-DE-MD
Appleton-Oshkosh-Neenah, WI	Hartford New Britain-Middletown, CT	Phoenix, AZ
Atlanta, GA	Honolulu, HI	Pittsburgh-Beaver Valley, PA
Atlantic City, NJ	Houston-Galveston-Brazoria, TX	Portland-Vancouver, OR-WA
Augusta, GA-SC	Huntington-Ashland, WV-KY-OH	Providence-Pawtucket-Fall River, RI-MA
Austin, TX	Indianapolis, IN	Raleigh-Durham, NC
Bakersfield, CA	Jackson, MS	Reading, PA
Baltimore, MD	Jacksonville, FL	Richmond-Petersburg, VA
Baton Rouge, LA	Johnson City-Kingsport-Bristol, TN-VA	Rochester, NY
Beaumont-Port Arthur, TX	Johnstown, PA	Rockford, IL
Binghamton, NY	Kansas City, MO-KS	Sacramento, CA
Birmingham, AL	Lakeland-Winter Haven, FL	Saginaw-Bay City-Midland, MI
Boston-Lawrence-Salem, MA-NH	Lancaster, PA	Saint Louis, MO-IL
Buffalo-Niagara Falls, NY	Lansing-East Lansing, MI	Salinas-Seaside-Monterey, CA
Canton, OH	Las Vegas, NV	Salt Lake City-Ogden, UT
Charleston, SC	Lexington-Fayette, KY	San Antonio, TX
Charleston, WV	Little Rock-North Little Rock, AR	San Diego, CA
Charlotte-Gastonia-Rock Hill, NC-SC	Los Angeles-Anaheim-Riverside, CA	San Francisco-Oakland-San Jose, CA
Chattanooga, TN-GA	Louisville, KY-IN	Santa Barbara-Santa Maria-Lompoc, CA
Chicago-Gary-Lake Country, IL-IN-WI	Macon-Warner Robins, GA	Scranton-Wilkes-Barre, PA
Cincinnati-Hamilton, OH-KY-IN	Madison, WI	Seattle-Tacoma, WA
Cleveland-Akron-Lorain, OH	McAllen-Edinburg-Mission, TX	Shreveport, LA
Colorado Spring, CO	Melbourne-Titusville-Palm Bay, FL	Spokane, WA
Columbia, SC	Memphis, TN-AR-MS	Springfield, MA
Columbus, OH	Miami-Fort Lauderdale, FL	Stockton, CA
Corpus Christi, TX	Milwaukee-Racine, WI	Syracuse, NY
Dallas-Fort Worth, TX	Minneapolis-St. Paul, MN-WI	Tampa-St. Petersburg-Clearwater, FL
Davenport-Rock Island-Moline, IA-IL	Mobile, AL	Toledo, OH
Dayton-Springfield, OH	Modesto, CA	Tucson, AZ
Daytona Beach, FL	Montgomery, AL	Tulsa, OK
Denver-Boulder, CO	Nashville, TN	Utica-Rome, NY
Des Moines, IA	New Haven-Meriden, CT	West Palm Beach-Boca Raton-Delray Beach, FL
Detroit-Ann Arbor, MI	New London-Norwich, CT-RI	Wichita, KS
Duluth, MN-WI	New Orleans, LA	Worcester, MA
El Paso, TX	New York-N. New Jersey-Long Island, NY-NJ-CT	York, PA
Erie, PA	Norfolk-Virginia Beach-Newport News, VA	Youngstown-Warren, OH
Eugene-Springfield, OR	Oklahoma City, OK	
Evansville, IN-KY	Omaha, NE-IA	
Flint, MI	Orlando, FL	
Fort Wayne, IN		
Fresno, CA		
Grand Rapids, MI		

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CNG CONSOLIDATED NATURAL GAS COMPANY

Federal AFV Fleet Program Expands

The number and type of alternative fuel vehicles (AFVs) purchased under the Alternative Motor Fuels Act of 1988 (AMFA) have substantially increased since the AFV purchasing program began, and the number will double in the coming year.

The U.S. General Services Administration (GSA), which purchases and leases vehicles to the federal fleet, is working with the U.S. Department of Energy (DOE) to place AFVs in fleets around the nation to meet environmental and energy regulations. Currently, the fleet consists of 6,237 AFVs. With money provided by DOE for the incremental costs of AFVs, GSA plans to purchase 6,000 to 7,000 more for 1994.

GSA's first fleet consisted of only 67 AFVs, most of which were M85 flexible-fuel vehicles (85% methanol, 15% gasoline). Today's fleet, however, includes a significant number of compressed natural gas (CNG) and E85 (85% ethanol, 15% gasoline) vehicles. And while most of the fleet is flexible-fuel (uses a combination of the alternative fuel with gasoline), the number of vehicles dedicated to a single alternative fuel is rising.

The National Energy Policy Act of 1992 and the Clean Air Act Amendments of 1990 have played a significant role in strengthening AMFA by further requiring the use of alternative fuels to displace foreign oil imports. Additionally, President Bill Clinton's recent Executive Order 12844 increased by 50% the number of AFVs that must be purchased by the federal fleet.

Historical AFV Purchases by the U.S. General Services Administration

Model Year	M85	E85	CNG	Annual Totals
1991*	25 Variable-Fuel Chevrolet Luminas; 40 Flexible-Fuel Ford Tauruses		2 Flexible-Fuel Chrysler vans	67
1992	20 Flexible-Fuel Ford Econoline vans; 2,500 Flexible-Fuel Dodge Spirits	25 Variable-Fuel Chevrolet Luminas	600 3/4-Ton dedicated Chevrolet pickup trucks; 75 dedicated eight-passenger Chrysler vans	3,220
1993	300 Flexible-Fuel Ford Tauruses; 50 Variable-Fuel Chevrolet Luminas; 2,500 Flexible-Fuel Dodge Spirits	50 Variable-Fuel Chevrolet Luminas	50 Chrysler vans	2,950
Total	5,435	75	727	6,237

*Because federal fleet vehicles are replaced every three years on average, GSA expects to sell 1991 model year Luminas next year to the general public.

Table 1

Under these mandates, the federal fleet is required to add 11,250 AFVs in 1994. GSA's Inter-agency Fleet Management System will acquire more than two-thirds of this total for leasing to other agencies. The rest of the AFV requirements will be met by conversion of existing vehicles or direct acquisition by other federal agencies such as the U.S. Postal Service.

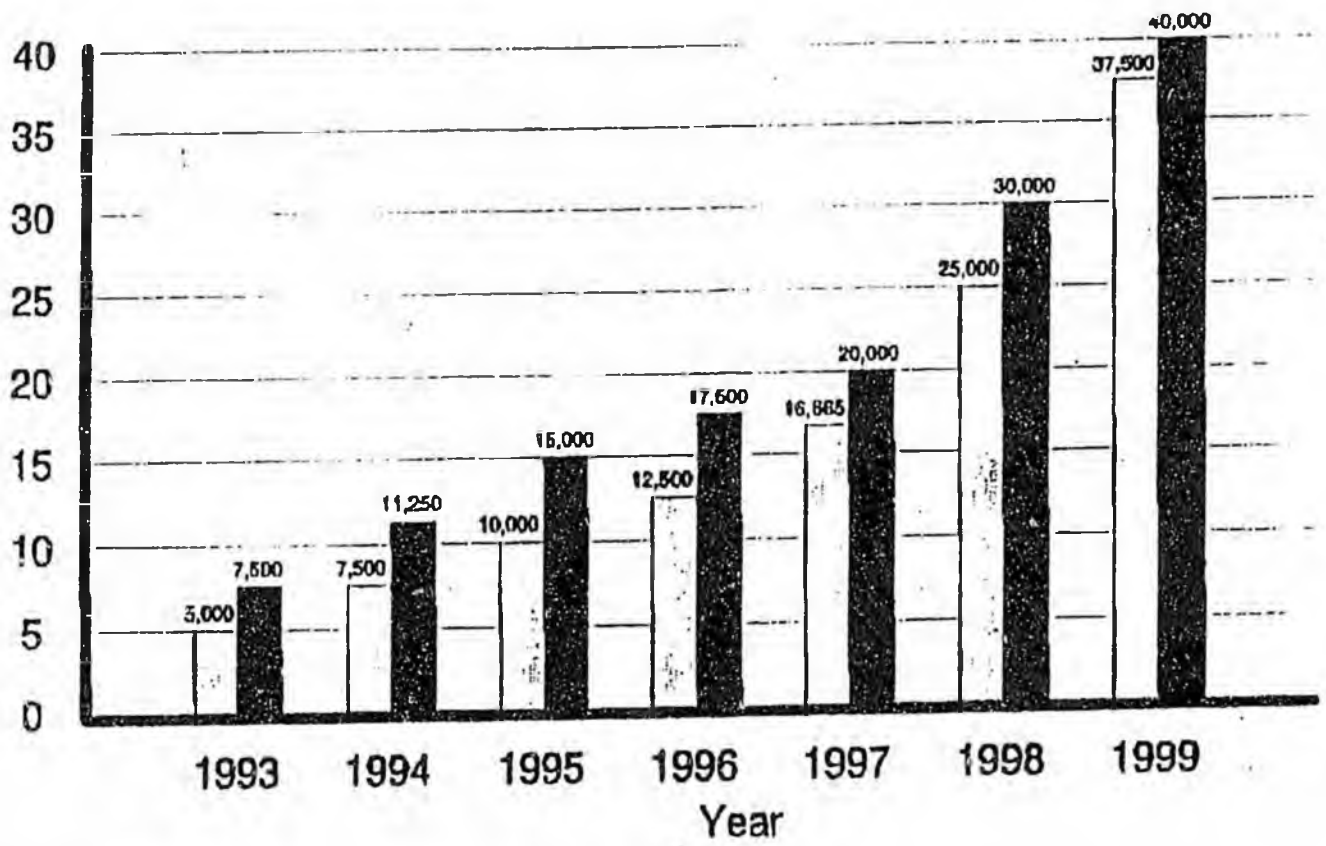
GSA officials commented that they would like to see a greater variety and number of vehicles produced by original equipment manufacturers (OEM), especially compact sedans because of their

fuel efficiency. In addition to the limited availability of OEM vehicles, an obstacle to placing AFVs is the availability and location of fueling sites. "It's really difficult to place vehicles where the fueling infrastructure hasn't been established or the drivers have to go out of their way—up to 30 miles in some cases—to refuel," according to a GSA spokesperson.

To better understand the benefits of alternative fuels, the Alternative Fuels Data Center is collecting emissions and performance information on more than 600 of these AFVs, also an AMFA requirement. □

Requirements for Federal Fleet Alternative Fuel Vehicle Acquisition

Number of Acquisitions (in thousands)



□ Energy Policy Act of 1992
■ Executive Order 12844

Based on 50,000 vehicle acquisitions per year

p. 10 of 11