

WINTER TIRE TRACTION EVALUATIONS

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16. Abstract In Alaska, studded tires have been used during the winter season to increase vehicle traction force for safety reasons. Past experience and factual data have shown that the problems of accelerated pavement wear and airborne dust have been caused by the use of studded tires. Use of studded tires has been prohibited in many countries. Recently, the Bridgestone Tire Company designed and examined a new type of studless winter tire under the "Blizzak" brand name to improve winter vehicle traction and minimize pavement wear. In order to evaluate this new type of tire, the Alaska Department of Transportation and Public Facilities conducted a preliminary field study in January of 1994 to compare the new tires with studded tires in stopping distance tests on packed snow and icy surfaces in Fairbanks and Anchorage. To verify and extend these results, more comparative tests of the Blizzaks, studded tires, and all-season tires were conducted in March and April of 1994 by the University of Alaska at locations in Fairbanks and Anchorage. The vehicles used in these tests were mid-sized front wheel drive cars, large rear wheel drive cars, and half-ton full size rear wheel drive pickup trucks. The purpose of these tests was to evaluate the differences between these tire types. Field tests included 25 mph, maximum cornering speeds on short radius curves typical of intersections, and hill climbing ability. From field tests results, the new studless tires were proven superior to all-season tires under all conditions. On icy surfaces, the Blizzaks and studded tires showed almost the same performance on cornering speed in different curves, and in hill climbing ability. However, on ice surfaces, the Blizzaks had 25 mph stopping distances, which were greater by about 8-10% (than those of studded tires) as well as longer times to reach 25 mph by about 12-15%. In summary, the Blizzaks may be used during the winter season as the best alternative to replacing the studded tires commonly used in Alaska.			
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ABSTRACT

In Alaska, studded tires have been used during the winter season to increase vehicle traction force for safety reasons. Past experience and factual data have shown that the problems of accelerated pavement wear and of airborne dust have been caused by the use of studded tires. Use of studded tires has been prohibited in many countries. Recently, the Bridgestone Tire Company designed and examined a new type of studless winter tire under the "Blizzak" brand name to improve the winter vehicle traction and minimize pavement wear. In order to evaluate this new type of tire, the Alaska Department of Transportation and Public Facilities conducted a preliminary field study in January of 1994 to compare the new tires with studded tires in stopping distance tests on packed snow and icy surfaces in Fairbanks and Anchorage. To verify and extend these results, more comparative tests of the Blizzaks, studded tires, and all-season tires were conducted in March and April of 1994 by the University of Alaska at locations in Fairbanks and Anchorage. The vehicles used in these tests were mid-size front wheel drive cars, large rear wheel drive cars, and half-ton full size rear wheel drive pickup trucks. The purpose of these tests was to evaluate the differences between these tire types. Field tests included 25 mph stopping distances, starting traction and times to reach 25 mph, maximum cornering speeds on short radius curves typical of intersections, and hill climbing ability. From field test results, the new studless tires were proven superior to all-season tires under all conditions. On packed snow surfaces, the new tires were equal to studded tires in terms of stopping distances, times to reach 25 mph, maximum cornering speeds, and hill climbing ability. On icy surfaces, the Blizzaks and studded tires showed almost the same performance on cornering speed on different curves, and in hill climbing ability. However, on ice surfaces, the Blizzaks had 25 mph stopping distances which were greater by about 8 - 10% as well as longer times to reach 25 mph by about 12 - 15%. In summary, the Blizzaks may be used during the winter season as the best alternative for to replacing the studded tires commonly used in Alaska.

SUMMARY

Stopping, starting traction, cornering, and hill climbing ability tests of studded and non-studded tires were recently completed in Fairbanks and Anchorage. A new type of non-studded ice traction tire, called the "Blizzak", and made by Bridgestone, was included in the tests. It proved superior to normal all-season tread designs under all conditions. This new tire was equal to studded tires in hill climbing, starting traction (time to reach 25 mph), and stopping distances under all conditions except on polished lake ice. On that surface, stopping distances were about 10 to 15% greater for the new tire type while all-season tire stopping distances were about 20% greater than with studs. Finally, no significant differences were found in maximum cornering speeds between any of the tire types tested. In fact, studded tires gave slightly slower cornering speeds, by 1 mph, as compared to all non-studded tire types tested.

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1. INTRODUCTION

a. Background

Studded tires are commonly used in Alaska during the winter season to increase vehicle traction forces. However, studded tires cause accelerated pavement and traffic marking wear and airborne dust. These factors have been reported by researchers from Canada, Japan, Sweden, and other countries. In Alaska, the majority of the pavement rutting on Alaska's roadways has been caused by studded tires, according to winter versus summer season wear measurements. However, vehicle owners continue to buy studded tires with expectations that the gains in traction and braking and the reductions in travel time will justify the added costs for tires and for semi-annual changeovers.

Because of the problems of accelerated pavement wear and of airborne dust caused by studded tire abrasion of paved roadway surfaces, a number of States, Canadian Provinces and countries have totally banned studded tires. In Japan the use of studded tires was recently banned primarily to reduce the amount of airborne dust. New tire tread types were then developed in an attempt to improve the wintertime traction benefits of non-studded tires. One such new tire type is the "Blizzak" (brand) tire developed by Bridgestone Tire Company. To compare the traction benefits of this new tire type with currently available studded and non-studded all-season tire types, the Alaska Department of Transportation and Public Facilities (AKDOT&PF) made some stopping distance test comparisons on hard packed snow surfaces at Fairbanks and Anchorage International Airports in January of 1994. Results of these initial test runs indicated excellent performance of the new tire type in comparison to studded tires. These results provided information for State Equipment Fleet purchases of winter tires, as well as information useful to the general public in making decisions on their need for studded tires.

In March, 1994, the University of Alaska Fairbanks (UAF) and the University of Alaska Anchorage (UAA) were requested by AKDOT&PF to perform a comparative testing program of the different winter tire types, including the newly developed Blizzak tires from Bridgestone Tire Company, and studded and all-season tires purchased from Firestone, Michelin, and Goodyear. Field tests were conducted to consider tire type, vehicle type, and surface condition effects. This report summarizes the research activities and the results obtained through this study.

b. Objectives

The main objective of this study was to compare the traction performance of different types of tires. The tires tested included the newly developed Blizzak (brand) tire from Bridgestone, and two brands each of studded and non-studded all-season tires as purchased from Firestone, Michelin, and/or Goodyear. Surfaces tested included old snowpack, freshly packed snow, old surface ice deposits and newly prepared glare ice surfaces. Test vehicles included full size rear-wheel-drive sedans, full size 1/2 ton pickups, and compact front wheel drive cars. The research was conducted in March and April of 1994 by the Transportation Research Center of the University of Alaska Fairbanks (UAF) and the School of Engineering of the University of Alaska Anchorage (UAA). All tires were purchased and tested in near new condition.

2. DATA COLLECTION

During the University of Alaska's field experiments, various tests were conducted at Anchorage and Fairbanks, including stopping distance, starting traction, and cornering speed, with different surface conditions, different vehicle types, and different drivers.

a. Test Sites

Anchorage tests were done on the taxiway at the Birchwood Airport, located 20 miles northeast of Anchorage, and on Jewel Lake, a small lake on the south side of Anchorage. These airport and lake sites were selected to avoid traffic interference and traffic effects on the surfaces being tested.

Fairbanks tests were done on the taxiway end at Fairbanks International Airport. To add data on actual road surfaces additional stopping and starting traction tests were done on snowpack covered low volume sections of the Chena Lake access road and the Old Nenana Highway.

b. Tests Included

Stopping Distance Tests

The measured stopping distances of the vehicles were obtained after applying and attempting to lock the brakes from an initial speed of 25 mph. Because of the anti-lock braking systems used, full locked wheel skids did not occur but braking continued until the vehicle was stopped. The maximum braking forces were also recorded during each test with a G-Analyst force meter.

Starting Traction and Hill Climbing Ability Tests

Test vehicles were started from zero and accelerated to 25 mph as quickly as possible without excessive wheelspin. The time to reach 25 mph was recorded with a stopwatch and the maximum G-Forces were also recorded. The G-forces were then converted to maximum grades which the vehicle would be able to climb with the various surface conditions, vehicles, and tires. In fact, the value of G-force is the acceleration or deceleration of the vehicle. The mathematical relationship between the maximum G-forces and hill climbing ability will be described later in this report.

Maximum Cornering Speeds

Two curves, with radii of 25 and 50 feet, were marked with traffic cones. The curves were approached at various speeds to determine the maximum speed around the corner without skidding. Cornering speeds were observed and the maximum cornering G-forces (centrifugal accelerations) were also recorded at or near the maximum cornering speed. Because cornering speeds were difficult to observe while keeping the vehicle on course, cornering speeds were also calculated for the turn radius and recorded G-forces. This approach eliminates the errors from wheelspin and observer errors.

c. Test Vehicles:

Three different types of vehicles were used and all were selected from the State Equipment Fleet to represent 1993 or 1994 models:

Front Wheel Drive Intermediate Size Car

Chevrolet Lumina models with anti-lock brakes (ABS on all 4 wheels) were used in UAF and UAA tests.

Two-Wheel Drive 1/2 Ton Full Size Pickup Trucks

Chevrolet trucks were used and had anti lock braking on the rear axle only. This feature is typical of late model trucks and acts to prevent the rear axle brakes from locking up before the front and causing a skid. This system is inactive below 20 mph according to Chevrolet.

Rear Wheel Drive Full-Size Four-Door Cars

A Ford Crown Victoria was tested in Anchorage and a Chevrolet Caprice was used in the Fairbanks tests. Both vehicles had 4-wheel ABS systems.

d. Tires Tested

Three types of tires were included in the test program. To obtain accurate comparisons between tire types, all tires were pre-mounted on rims and tire sets were exchanged in sets of four at the test site. Different tire types were compared on the same vehicles.

Blizzak (brand) Tires by Bridgestone

This tire is a winter tire with a special soft rubber compound which incorporates micro bubbles to provide tiny gripping edges on ice.

Studded Winter Tires

Firestone studded "Town and Country" brand and Goodyear brand studded tires were tested.

All-Season Type Tires

This tire type is marketed for year round use and generally has many small gripping edges to provide good traction on snow and ice. Michelin XGT-4 and Firestone Supreme brands were tested.

e. Surface Conditions:

Packed Snow

The surface at the Birchwood airport taxiway test site was hard snowpack at the start of the tests. Snowfalls during the testing period resulted in the need for daily snow removal, resulting in a surface best described as newly packed snow over old snowpack. At Fairbanks the taxiway was covered with old and very hard snowpack, as were the local roads tested. Fairbanks had events of freezing rain earlier in the winter, which further hardened the surface snowpack.

Ice

Tests on ice at Anchorage were done on Jewel Lake. After removing the snowcover, the ice surface was found to be very rough. To prepare it for the skid tests the surface was conditioned with a "Zamboni" type machine which melts and levels the surface as for an ice-skating rink. This surface was probably smoother than any road surface the motorist will encounter. At Fairbanks the taxiway was prepared for the icy surface tests by spraying it with water and allowing overnight refreezing.

Bare Pavement

Tests on bare pavement surfaces were conducted at Birchwood Airport in Anchorage and Old

Nenana Highway in Fairbanks to compare the stopping distances and starting traction for all tires.

f. Temperatures

Most tests were conducted under near freezing temperatures. Air temperatures varied between 24° and 36°F, while surface temperatures varied from 25° to 32°F. The time required to test each vehicle with each tire type and then to change tires for the next test run resulted in some temperature effects on the comparative results. Attempts were made to randomize the tests to avoid a temperature bias.