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Evaluation of Winter Tires

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Some Forest Service employees can avoid traveling icy roads during inclement weather while others may face severe driving conditions in performing their duties (figure 1). For example, law enforcement duties can include high-speed pursuits. When your vehicle is skidding sideways down an icy road, it's too late to wish for tire chains, studded tires, or a set of the latest high-tech studless winter tires. These traction aids provide a margin of safety over summer or all-season tires but can be expensive. Paul Kain, a law enforcement officer for the Seward Ranger District at the Chugach National Forest, asked the Missoula Technology and Development Center (MTDC) to look at options to enhance the safety of Forest Service vehicle operators during severe winter road conditions.

Highlights...

- The proper vehicle with the right traction aid for driving during severe weather conditions is critical for your safety.
- The choice to buy studded or studless winter tires is a decision that needs to be based on safety, not equipment and installation cost.



Figure 1—Some Forest Service vehicles need high-performance winter tires to handle extreme weather conditions.

This tech tip evaluates two alternatives to tire chains: studded tires and high-tech studless winter tires that can be used at higher speeds. Tire chains and temporary traction aids are not within the scope of this project because they are not effective at higher speeds on winter road surfaces.

Not all Forest Service vehicles driven during winter months require traction aids. Working capital fund (WCF) dollars typically are not used to purchase studded or studless winter tires. Fleet managers advise local units to purchase winter tires with project dollars.

This tech tip contains field information, links to ratings from neutral parties, and cost comparison data from a tire company. No actual tests were performed by MTDC.



Forest Service Policy on Winter Tires

Each region of the Forest Service is empowered by the Washington Office (WO) to determine its own policy regarding studded and high-tech studless winter tires.

While tire chains typically are made available for WCF vehicles, chains may not provide an adequate traction solution for all emergency response vehicles. In most cases, a second set of tires for winter driving will not be paid for with WCF dollars. Keep in mind that no regional tire policy was identified that prohibits purchasing winter tires with project dollars.

Comparing Studded and Studless Winter Tires

Studded tires were introduced in the United States in the early 1960s; studless tires entered the U.S. market in 1993.

Studded Tires

Studded tires come from the factory to tire distributors with holes predrilled to insert studs that will provide better traction during inclement driving conditions. Tire stud design has evolved dramatically. Modern studs are shorter, lighter, and made of different materials. “A Synthesis on Studded Tires” (Angerinos, Mahoney, Moore, and O’Brien 1999) discusses the development of studs from the 1960s through the 1990s and the roadbed damage they cause.

Some States have limited the use of studded tires or banned them altogether. Studs create ruts that fill with water, creating spray and the potential for hydroplaning during the wet season. Studs cause fine cement dust that may affect human health. The Washington State Department of Transportation (WSDOT) maintains that studded tires (figure 2) may polish some road aggregates, reducing skid resistance and creating a slippery driving surface. Studded tires may remove pavement markings quicker than other tires.

Studless Winter Tires

Numerous studless winter tires are available from tire manufacturers. They utilize advanced rubber compounds or additives to increase traction in winter driving conditions.



Figure 2—Studded tires may damage the road surface.

In general, studless tires designed for passenger vehicles are constructed with soft rubber compounds. Trucks and heavier vehicles use studless tires made with hard rubber compounds that last longer under the extra weight. Brief descriptions of studless winter tire technology:

- Bridgestone Americas Tire Operations, LLC, uses a multi-cell rubber compound with microscopic pores to provide traction on ice (figure 3) <<http://www.bridgestone-firestone.com>>.
- Yokohama Tire Corporation uses absorptive carbon flakes and resin-coated shelled microbubbles to cut through water and icy surfaces <<http://www.yokohamatire.com>>.
- Michelin North America, Inc., uses vertical tunnel-like tubes in tread blocks to allow water to escape (Mahler 2008).
- Toyo Tire & Rubber Co., LTD, uses ground walnut shells embedded in tire tread to dig in to the ice and snow <<http://www.toyotires.com>>.
- Green Diamond tires are remolded with thousands of silicon carbide granules embedded evenly throughout the tread for better traction <www.greendiamondtire.com>.

The research report “An Overview of Studded and Studless Tire Traction and Safety” (Scheibe 2002) compiles performance-based data from a number of sources and provides 17 conclusions about winter driving traction aids.



Figure 3—Studless tires employ various techniques to improve traction, such as this Bridgestone Blizzak tire that uses a special rubber compound with microscopic pores.



Figure 4—This tire has factory sipes and microsipes.

Comparing All-Season and Studless Winter Tires

In general, there are three main differences between typical all-season tires and studless winter tires: tire composition, tire use designation, and tire design.

All-Season Tires

Composition—According to the Automobile Protection Association (APA) in Canada, the rubber in all-season tires can begin to lose its elasticity at about 45 °F (7 °C).

Use designation—Many all-season tires come with the mud and snow sidewall designation (MS, M/S, M&S, etc.) that indicates a Rubber Manufacturers Association (RMA) defined geometric tread pattern, which has no performance requirement.

Design—All-season tires with the mud and snow sidewall designation use multiple pockets or slots in a geometric pattern to increase contact with the road surface and, thus, provide better starting, stopping, and driving performance in snow conditions.

Siping is used to improve traction. Factory sipes are straight or wiggly slits or small grooves molded into the tires. Microsiping may also improve traction. Lateral slits are cut into the tire tread, no rubber is removed (figure 4). According to Consumer Reports (2009), adding more siping can hurt dry road performance and longevity. Microsiping also may void the tire warranty.

Studless Winter Tires

Composition—According to the APA, the softer rubber compounds used in studless winter tires maintain their pliability, and consequently their grip, to about -22 °F (-30 °C).

Use designation—Some studless winter tires come with the mud and snow designation and the RMA severe snow use pictograph of a mountain with a snowflake (figure 5), which has a performance requirement.

Design—Winter tires have numerous factory sipes and don't need microsiping.



Figure 5—Tires designed for use in severe snow conditions are marked on at least one sidewall with the mud and snow designation and the pictograph.

Logistical Issues and Tire Pressure Monitoring Systems

One issue raised by Forest Service regional fleet managers is the storage and accountability of winter tires, whether mounted on a second set of rims or not. Security and physical space is needed to store the tires. Tires should be clean and wrapped to protect them from damage. Lay them flat or stack safely but do not place them tread-down as this can cause flat spots to develop (figure 6).



Figure 6—Multiple stacks of stored tires that are wrapped should be labeled for easy identification.

Another issue is the annual cost of changing out the winter tires that are not “run” year round. Some users of winter tires prefer to purchase a second set of rims for their vehicles, but costs go up when proper tire inflation sensors (mandatory since 2008) are installed on the second set of rims.

Do not use a second set of wheels without the tire pressure monitoring system; doing so may be seen as purposely disabling factory installed safety equipment if a tire-related accident occurs. Section 12.2—Required Vehicle Equipment of FSH 6709.11 states “Factory installed safety devices and equipment shall not be nullified, altered, or removed.”

According to Consumer Reports, sensor prices range from \$150 to \$350. Some aftermarket sensors can be found for \$40 to \$100 each, with the recalibration cost depending on the model. Check your tire pressure at least once a month with a reliable tire gauge.

A Les Schwab tire store in Missoula, MT, provided information (January 2011) on the break-even point between purchasing a second set of steel wheels with sensors versus mounting and dismounting winter tires on the original equipment manufacturer (OEM) wheels each year. Table 1 shows a general cost comparison.

Table 1—Cost comparison—2011 Ford F-150 4x4 pickup.

Purchasing dedicated studded tires mounted on separate rims					
<ul style="list-style-type: none"> • 245x70-17, 10-ply tire—\$208.23 (General Service Administration pricing) x four tires = \$832.92. • Studding—\$14.85 x four tires = \$59.40. • Valve stem—\$4.50 x four tires = \$18. • Aftermarket steel rim—\$83 x four tires = \$332. • Tire pressure monitoring system (banded) sensors—\$64.48 x four tires = \$257.92. • Mount and balance—\$14.50 x four tires = \$58. (No cost for new tires from Les Schwab.) • Reprogram tire pressure monitoring system—\$20. (No cost for new tires from Les Schwab.) • Initial investment—\$1,558.24. • Swap tires twice each year after initial year. (No cost for new tires from Les Schwab.) • Reprogram tire pressure monitoring system twice each year after initial year. (No cost for new tires from Les Schwab.) 					
Running total	Year 1	Year 2	Year 3	Year 4	Year 5
	\$1,558	\$1,558	\$1,558	\$1,558	\$1,558
<p>According to Les Schwab, one advantage of dedicated winter tire rims is that it is easier on the tires because the tire bead is not being stretched as often.</p>					
Mounting and dismounting studded winter tires on OEM wheels					
<ul style="list-style-type: none"> • 245x70-17, 10-ply tire—\$208.23 (GSA pricing) x four tires = \$832.92. • Studding—\$14.85 x four tires = \$59.40. • Valve Stem—\$4.50 x four tires = \$18. • Mount and balance—\$14.50 x four tires = \$58. (No cost for new tires from Les Schwab.) • Reprogram tire pressure monitoring system—\$20. (No cost for new tires from Les Schwab.) • Initial Investment—\$968.32. • Each subsequent year—Mount and balance four tires at \$65 twice a year—\$130. • Each subsequent year—Reprogram tire pressure monitoring system at \$20 twice a year—\$40. 					
Running total	Year 1	Year 2	Year 3	Year 4	Year 5
	\$968	\$1,138	\$1,308	\$1,478	\$1,648
<p>Based on these criteria, the break-even point for a 4x4 pickup is about 4.5 years. The break-even point may be sooner for a passenger vehicle because the tires are less expensive. If the wheels are rotated, the tire pressure monitoring system may have to be reprogrammed because of the position change on the vehicle.</p>					

Are Two Winter Tires Enough?

The Rubber Association of Canada (RAC) recommends installing four winter tires instead of just two. Installing two winter tires on the front drive axle only will increase grip in the front, leading to a false sense of confidence and decrease grip in the rear, causing oversteer. Conversely, installing two winter tires on the rear drive axle only will increase grip in the rear, but may reduce grip in the front, causing understeer.

Conclusions

Research indicates that studded tires offer a traction advantage over all-season tires on icy roads. But, studded tires increase stopping distances on wet and dry road surfaces because less rubber is in contact with the road surface. Lateral control of the vehicle on dry pavement also is compromised. Studded tires are known to accelerate the wear of road surfaces. Studs become less effective as they wear down, and their advantage may be lost in as little as 5,000 miles, requiring replacement of all four tires.

Whether studded or studless winter tires are installed on a dedicated set of steel wheels, installation of tire pressure monitoring system sensors is required to comply with Forest Service policy.

The selection of studded versus studless winter tires should reflect the typical operating road conditions. Studded tires may

be more appropriate in primarily icy road conditions while studless winter tires may perform better in primarily snowy road conditions with intermittent patches of ice. Tires with the severe snow tire symbol have been performance tested for snow conditions. Employees in parts of the country with mild winter conditions may not need anything beyond all-season tires. The decision of which winter tires to purchase ultimately is up to local managers who are responsible for their employees' safety.

Both studded and studless winter tires offer better performance on ice and snow than all-season tires (table 2).

With most winter tires (studded or studless), annual tire changes or the purchase of a second set of wheels to mount them on is necessary. MTDC makes the following recommendations:

- Emergency response vehicles (such as law enforcement) should be given special consideration for studded or studless winter tires if the winter road conditions warrant it.
- Install a matched set of four winter tires instead of just two.
- Maintain the tire pressure monitoring system even if it means purchasing additional sensing units and reprogramming the vehicle each time tires are changed.
- If budgets are tight, select other non-emergency vehicles that use traction aids, such as chains, or, if possible, just delay the trip until road conditions improve.

Table 2—Comparison of studded tires, studless winter tires, and all-season tires.

Tires	Pros	Cons
Studded	<ul style="list-style-type: none">• Provide best traction on ice if studs are NOT worn out	<ul style="list-style-type: none">• Increase stopping distances on wet and dry roads; less rubber contacts the road surface• Cause damage to road surfaces• Contribute to air pollution and noise• Cannot be driven “year round”• Require storage when not in use• Prohibited in some States
Studless Winter	<ul style="list-style-type: none">• Provide better traction on ice than all-season tires• Do not damage road surfaces	<ul style="list-style-type: none">• Should not be driven year round• Require storage when not in use• May wear out faster than all-season tires if made of soft rubber compounds
All-Season	<ul style="list-style-type: none">• Can be driven year round in areas with mild winters	<ul style="list-style-type: none">• Perform poorly on ice and packed snow

Ratings and Resources

Here is some information to help Forest Service employees select winter tires.

Summary of Independent Ratings

Marketing information from tire companies must be viewed critically. MTDC sought unbiased ratings by going to sources that do independent testing or rely on data from independent test organizations. Four sources included:

- Consumer Reports only tests a subset of winter tires each year <<http://www.ConsumerReports.com>>.
- Automobile Protection Association (APA) in Canada operates with limited funding. Input from other organizations, like Consumer Reports, is used to help guide their recommendations <<http://www.apa.ca>>.
- Consumer Search presents categorical recommendations based on the research of others. Extensive winter tire testing conducted in Scandinavia is included <<http://www.ConsumerSearch.com>>.
- Tirerack shares information on in-house testing of selected tires they sell. Their Web site also has an interactive database that displays survey results from customers' input <<http://www.tirerack.com>>.

Tire ratings from these four sources are a mixture of objective and subjective tests. Since there are no established industry performance testing procedures for tires on ice, it is difficult to determine if their conclusions and recommendations are appropriate for the winter conditions in your area. Tire designs are constantly changing in this competitive industry; each year a product at the top of the list may not even make the list the following year.

Web Documents

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Library Card

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Traction is important when driving during severe weather conditions. Some Forest Service vehicles are driven in locations that require more traction aids than others. This tech tip evaluates two alternatives to tire chains: studded tires and studless winter tires.

Keywords: fleet management, NHTSA, National Highway Traffic Safety Administration, safety at work, siping, working capital funds



For additional information about evaluating winter tires, contact MTDC:

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