BRIDGESTONE Firestone

TECHNICAL BULLETIN

March 2021 Ref. No. P-21-01

Heat Effects of Truck Tractor Aerodynamics and Emissions Equipment on Tires

OVERVIEW

The temperature at which a tire operates is important to achieving optimal tire performance and durability. Tire temperature is affected by both external and internal factors. External heat sources include, but are not limited to, ambient air temperature, road surface temperature, and heat generated by the vehicle's engine, exhaust system, and emissions control equipment.

Recent evolutions in vehicle aerodynamic designs and emissions equipment have created conditions that may further contribute to heat build-up in tires. The purpose of this Technical Bulletin is to help Bridgestone and Firestone authorized dealers and fleet customers understand various tire heat contributing factors and the cumulative impact they can have on tire performance, and ultimately safe vehicle operation.

Heat damage to tires is cumulative and irreversible. It is critically important to closely monitor and manage tire heat-contributing factors that are within an operator's control. See Page 4 for recommendations on how to prevent excessive heat build-up in tires.

BACKGROUND

Historically, the external temperature in the fender well surrounding the tires has closely paralleled ambient air temperature. Heat generated by the vehicle's engine and exhaust was dissipated by air-flow through the fender well. This air flow also acted to dynamically cool the tires while in-service.

To improve fuel economy, manufacturers recently have introduced aerodynamic body features on their vehicles – including low ground-clearance air dams and side fairings. These aerodynamic features may have the unintended consequence of reducing air flow in the fender wells, thereby preventing the dissipation of heat and increasing tire operating temperatures.

TESTING

Daimler Truck North America's recall of certain vehicles equipped with Bridgestone steer tires demonstrates how tires can be damaged by heat[1]. Bridgestone has been evaluating tire performance on late model vehicles equipped with standard, intermediate, and lowest ground-

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[1] See NHTSA Recall 21V-007

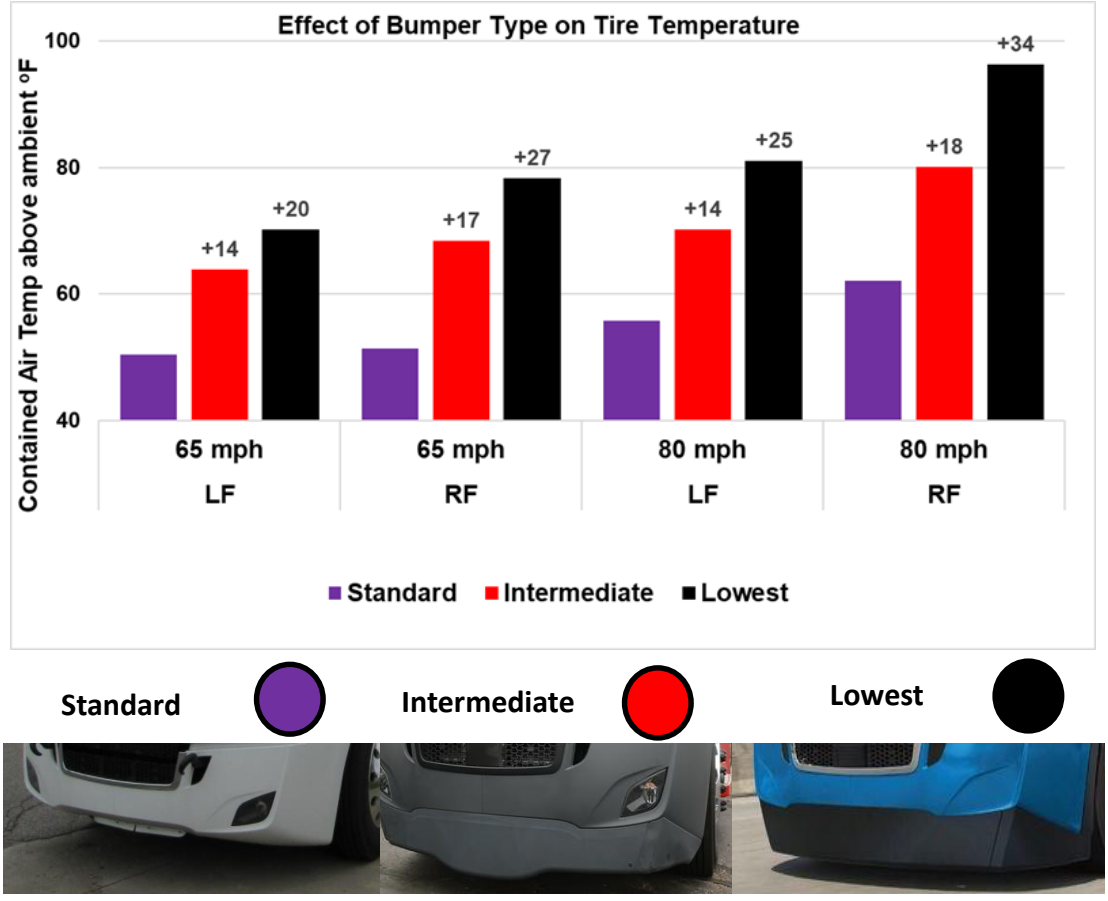
clearance bumper configurations. In controlled track testing, Bridgestone measured fender well temperatures during vehicle operation.

In test vehicles equipped with air dams, Bridgestone observed front fender well temperatures significantly higher than ambient air temperatures – leading to increased operating temperatures of the tires. Bridgestone also observed the right-side fender well was hotter than the left side. The engine's turbo and emissions control unit are located near the right fender well. (Fig. 1)

Bridgestone also conducted indoor drum testing on four leading brands of steer tires from competitive manufacturers. Bridgestone tested tire durability using an industry standard testing method[2] that was modified to test at laboratory room air temperatures between 95°F and 140°F.

This testing shows that the average durability of all tires tested decreased significantly as external heat increased. (Fig. 2.)

Figure 1: Change in tire cavity air temperatures by speed, bumper type, and vehicle side.



[2] FMVSS 119 NPRM Docket #2010-0132 Endurance Procedure

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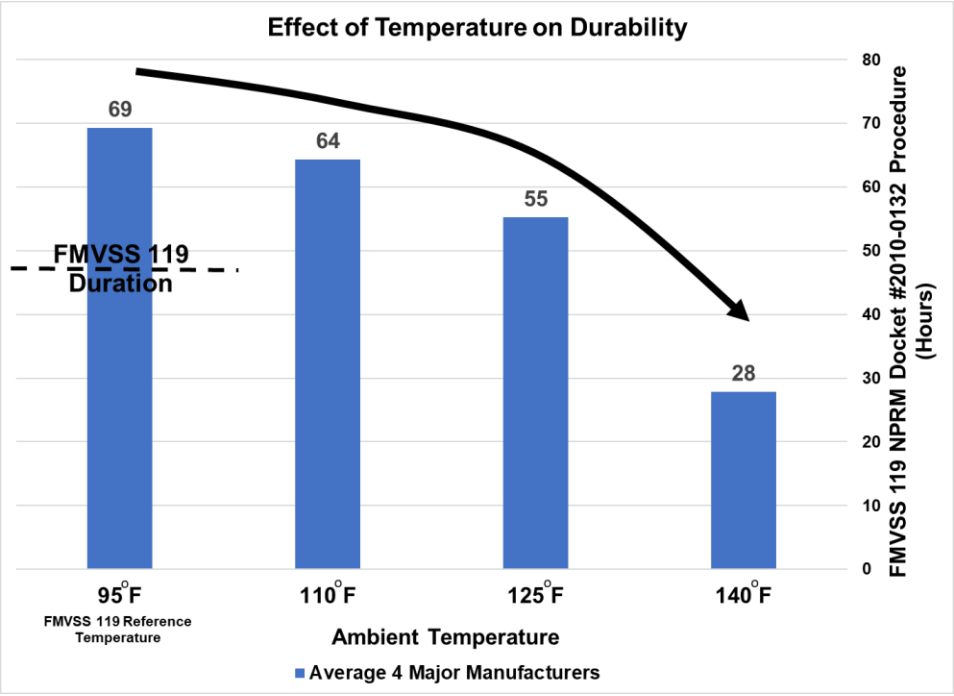
Figure 2: Internal drum testing comparing steer tire performance of four leading tire brands from competitive manufacturers.



KEY TAKEAWAYS

The results of Bridgestone's testing strongly suggest that heat is building in the fender wells of certain air dam-equipped vehicles due to the lack of cooling air-flow.

High ambient air temperatures, as well as heat contribution from vehicle sources, may allow temperatures in the fender wells to reach levels not previously observed in commercial vehicle applications. This external heating may be worsened by abusive operating conditions that further increase internal tire temperatures. Bridgestone believes this unprecedented high heat environment substantially contributes to reducing the life span of tires on certain vehicles.

Excessive heat degrades all pneumatic tires. This may lead to premature removal from service and possible tire failure. For years, the tire industry has warned that operating tires over-loaded, under-inflated, or at high speeds could cause excessive heat to build-up in tires. Factors contributing to tire heat are additive and the list of factors is expanding.

ACTIONS TO TAKE

Operators may not be able to control certain vehicle design features that contribute to tire heat build-up, making it critically important to closely monitor heat-contributing factors that are more easily controlled.

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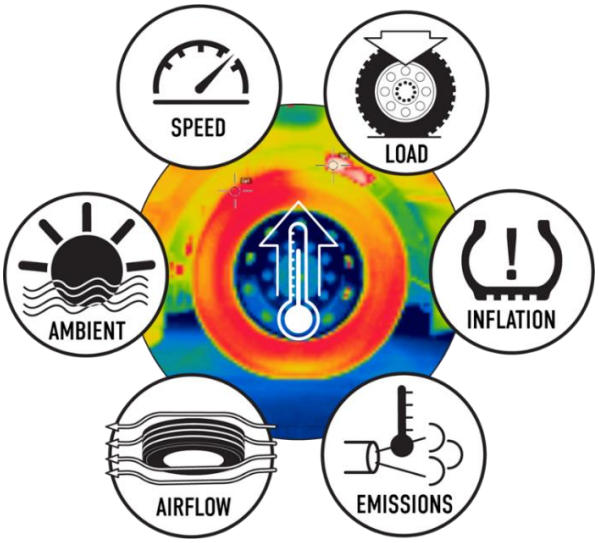
Bridgestone recommends the following practices to prevent excessive heat build-up in tires:

- **Do not exceed the tire's maximum rated speed, which may be lower than posted speed limits**
- **Do not exceed the tire's maximum load carrying capacity;**
- **Set and maintain proper cold inflation pressures as shown on the vehicle's placard;**
- **Use a tire pressure gauge to check tire inflation pressures at preventative maintenance intervals and during pre-trip vehicle inspections;**
- **Inspect tires regularly for damage such as cuts, cracks, bulges, irregular wear, and penetrations; and**
- **Monitor tire inflation pressures and temperatures with your vehicle's TPMS system (if equipped). If alerted by the TPMS of high operating temperatures, the operator should confirm the tires' pressure, the vehicle's load, and reduce operating speed.**



Proper Tire Load: Overloading causes excessive heat build-up that will degrade all pneumatic tires. This may lead to premature removal from service or possible tire failure.

Proper Tire Inflation: Under-inflation causes excessive heat build-up that will degrade all pneumatic tires. This may lead to premature removal from service or possible tire failure.

High Speed Driving: Internally, the tire generates heat based on the speed of tire rotation. No tire, regardless of its design or speed rating, has unlimited capacity for speed. Operating beyond the rated speed may lead to premature removal from service or possible tire failure.

External Heat Factors: Wheel well temperatures can be increased by restricted airflow due to aerodynamic features, vehicle's engine and emissions control equipment, and ambient temperatures. In certain instances, this can be a greater influence than the other sources of increased heat.

The recommendations provided in this technical bulletin are meant to address operating conditions that are within the fleet or vehicle operator's control. The heating effects from vehicle design features, such as aerodynamic packages and emissions equipment, may vary greatly from manufacturer to manufacturer due to ground clearance, air ducting/venting, and the position of other heat-generating vehicle components. Your vehicles may perform differently than the vehicles tested by Bridgestone. These recommendations are intended to supplement the recommendations provided by your vehicle's manufacturer.