

# Understanding trailer tire pressure:

## Considerations for specifying a tire pressure system.

With a continued focus on increased productivity, fleets and owner-operators are constantly looking for ways to reduce costs and increase up-time. Tires are one of the top ten expenses in the trucking industry.<sup>1</sup> Maintaining proper tire pressure can extend tire life substantially, reduce maintenance and save thousands of dollars annually. By gaining a better understanding of under-inflation, over-inflation and mismatched duals, fleets and owner-operators can make informed decisions when it comes to specifying trailer tire pressure maintenance equipment.



1. Retrieved August 2017 from [www.truckinginfo.com/photogallery/photos/781/20fact-book-industry/13998.aspx](http://www.truckinginfo.com/photogallery/photos/781/20fact-book-industry/13998.aspx)

# THE PROBLEM

Tires represent the most important maintenance item on a trailer. They remain the number one reason for trailer breakdowns, weighing in at 48 percent of road calls, according to a published survey by Federal Motor Carrier Safety Administration (FMCSA). It is also estimated that up to 85 percent of blowouts could be prevented if tires were properly inflated.<sup>2</sup> While the number one problem with trailer tires is under-inflation, over-inflation and mismatched duals also account for their share of trouble. Let's look at the specifics associated with each condition.

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under-inflation"**

## Under-Inflation



**In its Confidence Report on Tire Pressure Systems, the North American Council for Freight Efficiency (NACFE) cited reports with some startling statistics:<sup>3</sup>**

- About one in five trailers operate with one or more tires under-inflated by at least 20 pounds per square inch (psi)
- 3 percent of all trailers operate with four or more tires under-inflated by at least 20 psi
- 3 percent of all trailers operate with at least one tire under-inflated by 50 psi or more

**Statistics from research by The Technology & Maintenance Council's Tire & Wheel Study Group on tire pressure were also revealing:<sup>4</sup>**

- Only 44 percent of all tires were inflated to within  $\pm 5$  psi of their recommended inflation pressure
- 22 percent had at least one tire under-inflated by 20 psi or more
- Four percent of all vehicles had at least one flat tire, defined as 50 psi below the recommended pressure
- Approximately 7 percent of all tires in truckload and less than load (LTL) fleets are under-inflated by 20 psi or more

Why is under-inflation such a concern? Under-inflation results in sidewall deflection, generating excess heat and weakening the internal tire structure, called the carcass. If the tire carcass is damaged, retreading the tire is no longer an option, which can add hundreds of dollars to the cost of servicing each tire. Even if the carcass is spared, the heat and deflection of an under-inflated tire leads to increased wear, reduced life and a corresponding drop in fuel economy. Zipper rips and the dreaded "alligators" (black shards of rubber seen along the highway) are other extreme examples of tire disintegration caused by under-inflation.

## Over-Inflation



Over-inflation is also a pertinent problem in the trucking industry. The same FMCSA study noted above found that 16 percent of all trailer tires are over-inflated by more than 5 psi and 5 percent by more than 10 psi. Over-inflated tires are not necessarily the result of drivers or maintenance professionals adding too much air. The most common reason for over-inflation is elevated tire operating temperatures combined with increased ambient air temperature. The TMC Recommended Practice RP 235 states that tire pressure can increase by 10 to 15 percent because of warm-up.<sup>5</sup> Although tires are designed to function with pressure variations from warming during normal use, pressure effects resulting from ambient temperature fluctuations are a different story.

Another potential cause of elevated tire temperatures can be attributed to some tire inflation systems. Tire inflation systems that are only capable of inflating tires will add air pressure to tires anytime the ambient air temperature drops. This includes low temperature extremes to which the vehicle is exposed. When the vehicle returns to a warmer environment, the pressure in the tires increases above the target pressure.

2. Retrieved August 2017 from [www.slideshare.net/TiroGage/report-commercial-vehicle-tire-condition-sensors](http://www.slideshare.net/TiroGage/report-commercial-vehicle-tire-condition-sensors)

3. Retrieved August 2017 from [nacfe.org/wp-content/uploads/2014/01/TPS-Detailed-Confidence-Report1.pdf](http://nacfe.org/wp-content/uploads/2014/01/TPS-Detailed-Confidence-Report1.pdf)

4. Retrieved August 2017 from

[www.trucking.org/ATA%20Docs/About/Organization/TMC/Documents/Position%20Papers/Study%20Group%20Information%20Reports/Tire%20Pressure%20Monitoring%20and%20Inflation%20Maintenance%E2%80%94TMC%20I.R.%202010-2.pdf](http://www.trucking.org/ATA%20Docs/About/Organization/TMC/Documents/Position%20Papers/Study%20Group%20Information%20Reports/Tire%20Pressure%20Monitoring%20and%20Inflation%20Maintenance%E2%80%94TMC%20I.R.%202010-2.pdf)

5. Retrieved August 2017 from [studylib.net/doc/8328185/tmc-rp-manual---american-trucking-associations](http://studylib.net/doc/8328185/tmc-rp-manual---american-trucking-associations)

## Over-Inflation *(Cont'd)*

The increase in pressure caused by both use and ambient temperature typically cannot bleed off at the same rate that it increases. Natural air loss due to diffusion through the tire casing is only estimated to be 1 to 2 psi per month at normal operating pressures, thus resulting in over-inflation.

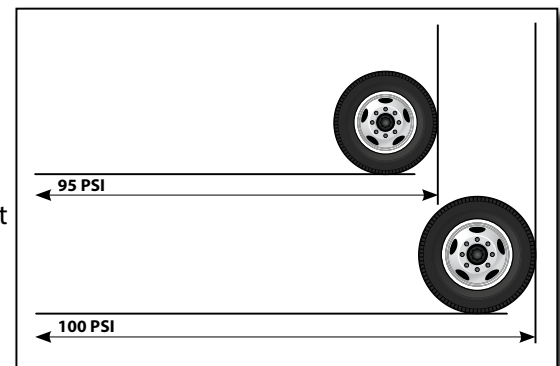
Over-inflated tires are harder than properly inflated tires, making them more susceptible to tread surface cutting, punctures and impact breaks. Over-inflation also changes a tire's footprint, which can affect tire traction and lead to irregular wear patterns. TMC Recommended Practice RP 219B, Radial Tire Wear Conditions and Causes, indicates that the probable cause of excessive wear found on both shoulder ribs of trailer tires in the study was likely over-inflation.<sup>6</sup> The edges of an over-inflated tire pull away from the ground and only make contact when they skip across road imperfections, or when the tire bounces with enough force to press the edges into brief contact with the road. That scuffing of the rubber causes rapid and irregular edge wear. This accelerated tread wear can cost 7 to 15 percent of the tire life.

## Mismatched Duals



Trailer tires that work in a dual configuration are intended to share the load equally. They should be the same size and diameter and have the same tread pattern. Equal inflation pressure is optimal but tire manufacturers recommend that they are at least within 5 psi of each other. However, research indicates that reality is quite different. The TMC Tire & Wheel Group Study found that 22 percent of all dual tires inspected had mismatched air pressure with a difference of more than 5 psi. Similar findings were stated in the FMCSA Report, with one out of four trailer dual assemblies (25 percent) having tires that differed in pressure by 5 psi or more. So, the issue of mismatched dual pressures is real and often goes both unnoticed and unaddressed. Within a matter of weeks, mismatched pressures can cause permanent irregular wear patterns, which can lead to early tire removal.

Testing has shown that a 5 psi difference between duals creates a 5/16-inch difference in tire circumference. In general, a tire makes about 500 revolutions per mile. In 100,000 miles, that is 50 million rotations, which equates to a difference of 246 miles between the two dual tires. So it's as though the smaller tire drags against the pavement at highway speeds for 246 miles, resulting in rapid and irregular wear. The tire with the larger circumference also likely suffers from internal damage from the braking force of the smaller tire which can also result in premature wear. Tires that are not matched properly will also have a difference in overall height. This causes the taller trailer tire to carry slightly more load than the smaller one. Ultimately, failure to properly equalize dual tire pressures can lead to unequal tread wear for both tires.



*Example of Distance Traveled of Mismatched Duals*

## THE CONSEQUENCES

There are many consequences associated with trailer tires operated at improper tire pressure. Let's take a closer look at the significant impact it can have on fleets and owner operators.

### Decreased Tire Life

TMC's Recommended Practice 235A states that "a constant 20 percent under-inflation will increase tread wear by 25 percent, and a constant 10 percent over-inflation will increase tread wear by 5 percent."<sup>7</sup> The increase in tread wear directly correlates to a decrease in tire life.

6. Retrieved August 2017 from [studylib.net/doc/8328185/tmc-rp-manual---american-trucking-associations](http://studylib.net/doc/8328185/tmc-rp-manual---american-trucking-associations)

7. Retrieved August 2017 from [studylib.net/doc/8328185/tmc-rp-manual---american-trucking-associations](http://studylib.net/doc/8328185/tmc-rp-manual---american-trucking-associations)

## Downtime Expense

With nearly half of all road calls being for tire-related issues, it's no wonder proper tire inflation is gaining more and more attention in the trucking industry. In fact, according to TMC, improper inflation causes about one road call each year per tractor-trailer. The average out-of-pocket cost of a tire-related road call could easily reach \$900, and that is only the cost of one new dual trailer tire and the associated service call. The total expense could be much greater when factoring in things such as: distance from service provider, late freight penalties, reduced shipper confidence and a reduction in available driver hours-of-service.<sup>8</sup>

**"...nearly half of all road calls are for tire-related issues"**

## Reduced Fuel Economy

According to TMC, 30 percent to 40 percent of the fuel required to move a vehicle down the highway is spent overcoming tire rolling resistance. When tires are under-inflated, the amount of drag created by the tires increases. This additional drag causes an increase in friction and heat and therefore an increase in fuel consumption. Conventional wisdom says vehicles running with tires under-inflated by 10 psi can see a 1.5 percent decrease in fuel economy. That is equivalent of \$415 per tractor per year in excess fuel costs, using today's diesel prices.

## CSA Violations and Fines

Under-inflated tires can result in a citation during a roadside inspection, as tire inflation is covered in the CSA Maintenance BASIC. In fact, tires are among the top three components most often responsible for violations in the Maintenance BASIC, with a flat tire being an eight-point deduction and an under-inflated tire being a three-point deduction. In addition, under-inflation is often responsible for much of the tire damage inspectors see.

## ADDITIONAL FACTORS

### Greenhouse Gas Phase 2 (GHG2) Regulations

The recent release of phase two of the Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (GHG2), places an increased focus on technology that improves fuel efficiency and reduces greenhouse gas (GHG) emissions for trailers used in combination with tractors. A recent report published by the International Council on Clean Transportation (ICCT) estimates "fuel savings will be over half a million barrels of oil per day in 2035, and by 2050, when the rule is fully phased in, these savings increase to over 800,000 barrels per day."<sup>9</sup>

The GHG2 ruling can be overwhelming when trying to decipher. However, the requirements specific to trailers can be summed up fairly easily. All full and partial-aero box vans (dry and refrigerated) are held to a performance-based compliance standard. This means original equipment manufacturers (OEMs) of these trailer types can use a combination of low-rolling resistance tires, aerodynamics, weight savings and/or tire pressure system to meet the required carbon dioxide (CO<sub>2</sub>) emission spec. Non-aero box vans, liquid and gas tanks, straight flatbeds, and container chassis are held to a design-based compliance standard. Trailer OEMs of these styles are required to use low-rolling resistance tires and a tire pressure system; no calculation or equation is used.

## GHG Phase 2 FACTS

Effective January 1, 2018

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### AFFECTED TRAILER CATEGORIES



#### BOX TRAILERS

- Dry Vans
- Refrigerated Vans



#### NON-BOX TRAILERS

- Liquid and Gas Tanks
- Straight Flatbeds

(Single continuous load-bearing surface)

- Container Chassis

2

### COMPLIANCE STANDARDS

#### PERFORMANCE-BASED

##### Full- and Partial-Aero Box Trailers

Combination of low-rolling resistance tires, aerodynamics, tire pressure system and/or weight savings that meet the required CO<sub>2</sub> emission spec. Calculate using the compliance equation.

#### DESIGN-BASED

##### Non-Aero Box Trailers and Non-Box Trailers

Requires the use of low-rolling resistance tires and a tire pressure system.

3

### EXCLUSIONS

- All other vocational trailers not listed
- All trailers with 4 or more axles
- Trailers less than 35 feet long with 3 axles
- Trailers with fixed axle spread  $\geq$  120 inches

### AERO Defined

**FULL-AERO:** Underside and rear of trailer are **FREE** of any work-performing equipment

**PARTIAL-AERO:** Work-performing equipment is installed on underside **OR** rear of trailer

**NON-AERO:** Work-performing equipment is installed on underside **AND** rear of trailer

8. Retrieved August 2017 from [www.ttnews.com/articles/tire-maintenance-effective-preventing-blowouts](http://www.ttnews.com/articles/tire-maintenance-effective-preventing-blowouts)

9. Retrieved August 2017 from [theicct.org/US-phase2-HDV-efficiency-GHG-regulations-FRM](http://theicct.org/US-phase2-HDV-efficiency-GHG-regulations-FRM)

# AVAILABLE METHODOLOGY

The importance of proper trailer tire inflation is clear. Fleet managers and owner operators continue to struggle with finding ways to maintain proper tire inflation. However, by simply putting a little air in the right place at the right time can save both effort and expense on trailer operations. There are a variety of ways to address the tire pressure issue. Below is a summary of the most commonly available in today's market.

## **The Driver**

Drivers are the first line of defense for proper tire inflation. As part of their pre- and post-trip inspections, they should complete a visual inspection of all tires. Depending on the company's maintenance policy, most drivers are expected to check actual tire pressures weekly. Drivers have indicated that pressure checks can be time consuming and that the inside tire on a dual assembly is difficult to check. The FMCSA study indicates that it takes approximately 30 minutes to check tire pressures on an eighteen wheeler, which equates to 13 minutes per trailer, assuming tandem duals. This in turn, leads many to wonder how often drivers truly are checking tire pressures.<sup>10</sup>

## **Tire Pressure Monitoring Systems**

Tire pressure monitoring systems provide a direct measurement of pressure, and sometimes temperature, for each individual tire. The measured pressure is compared to a preset target pressure for a given vehicle wheel position. If the pressure differs from the target, an alert is issued. The alert can be in the form of a visual display at the wheel-end, or via the transmission of data to an in-cab display or a computer system that can be accessed by the fleet.

Continuous tire pressure monitoring is the primary function of TPMS. If the system contains non-transmitting wheel-end sensors, then the operator must be diligent about performing walk-arounds and checking for a visual indication. Systems that have transmitting wheel-end sensors provide the added benefit of automatically transmitting tire pressure conditions at each wheel position to the operator and/or fleet maintenance personnel.

Tire pressure monitoring systems can be used on both tractors and trailers, which differentiates them from the other forms of pressure systems. However, they do not have the ability to provide air to or relieve air from the tires when incorrect pressures are detected. This activity still requires human intervention. Also, if the sensors are removed in the field for any reason, it is critical they are reinstalled on the original tire location in order for them work properly and not send false alerts.

## **Inflate-Only Automatic Tire Inflation Systems**

Automatic tire inflation systems (ATIS) monitor trailer tire pressure in comparison to a preset target pressure and automatically inflate trailer tires whenever the detected pressure is below the target. Typically, an ATIS uses a status light to alert the driver that the system is delivering air to the tires. These systems do not report out actual tire pressures, nor can the driver adjust the system target pressure from inside the cab. Most ATIS draw air from vehicle-mounted, compressed-air tanks and these systems cannot manage tractor tires. However, some draw air directly from the environment via a self-contained pump; these systems can be installed on truck drive axles. Either way, both styles are only capable of inflating tires found to be below the target pressure. They are unable to relieve air from over-inflated tires.

## **Central Tire Inflation Systems**

The operation of a central tire inflation system (CTIS) is similar to ATIS, except that the driver has the ability to adjust the target pressure from an in-cab display depending on the operating conditions of the vehicle. CTIS are typically found in off-road and military applications.

## **Advanced Automatic Tire Pressure Control Systems**

An advanced automatic tire pressure control system is the next generation of ATIS for trailer tires. These systems not only address under-inflated tires but also over-inflated tires. They automatically provide air to a tire found to be below the preset target pressure, and they can respond to changes in ambient temperature by relieving air from a trailer tire found to be above a preset upper threshold. One specific advanced automatic tire pressure control system also can equalize tire pressures across all wheel positions. The primary advantage is that all of this is done automatically, with no driver intervention required.

10. Retrieved August 2017 from [www.slideshare.net/TiroGage/report-commercial-vehicle-tire-condition-sensors](http://www.slideshare.net/TiroGage/report-commercial-vehicle-tire-condition-sensors)

# THE SOLUTION - TIREMAAX® PRO

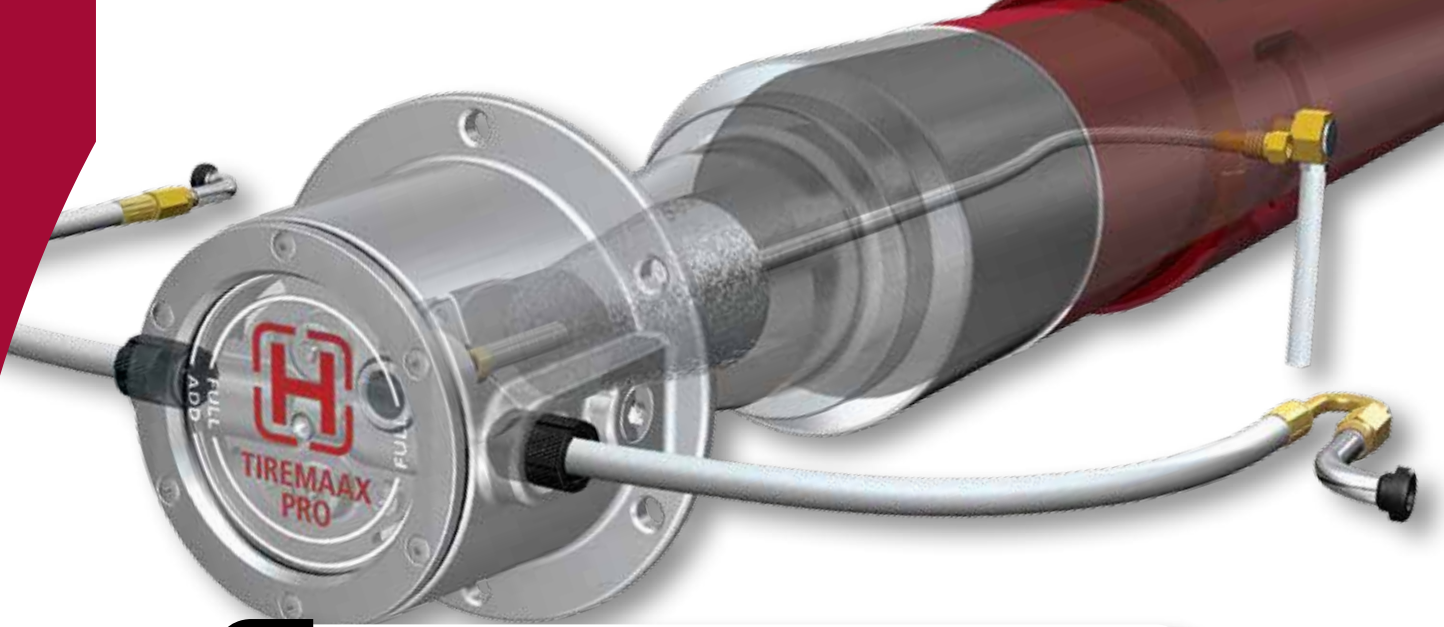
There are more options for trailer tire pressure management than ever before. When selecting a tire pressure system, owner-operators and fleet managers must determine which technology best meets their operational requirements and provides the best return on investment. Hendrickson delivers a revolutionary solution with TIREMAAX® PRO. It is an advanced automatic tire pressure control system for the trailer industry capable of active inflation, relieving and equalizing, minimizing costly tire wear, improving productivity and increasing fuel mileage.

TIREMAAX PRO features a mechanical design that constantly monitors tire pressure to respond to under-inflated tires and changes in outside temperature that can cause over-inflated tires. The patented system draws from the trailer air supply to help keep all the trailer tires properly inflated and rolling smoothly. PRO detects pressure dips below a preset level in one or more tires and directs air to the affected tire(s). The system responds to changes in outside temperature and prevents over-inflation by relieving air from the tires. This excess pressure flows back through the supply lines and exhausts at the controller. Finally, TIREMAAX PRO equalizes the pressure at all wheel positions by using special valves in the hubcaps that allow air to flow both to and from the tires. This ability to equalize pressures reduces scrubbing between duals and improves tire life.



Pressure-checking system	Status Indicator	Automatically Inflates Under-inflated	Automatically Relieves Over-inflated	Automatically Equalizes Mismatched
Driver	✗	✗	✗	✗
TPMS	✓	✗	✗	✗
Inflate-only ATIS	✓	✓	✗	✗
TIREMAAX® PRO	✓	✓	✓	✓

Hendrickson is a recognized leader in the supply of suspension systems and components for the global commercial vehicle industry. That legacy continues with TIREMAAX PRO.



### **TIREMAAX® literature, website and microsite:**

- **L1199** TIREMAAX® PRO brochure
- **L1017** TIREMAAX Tire Inflation System flyer
- **L878** TIREMAAX Parts List
- **L868** TIREMAAX Ordering Guide
- **T51002** TIREMAAX CP & PRO Technical Procedure

**TIREMAAX Online:** [www.tiremaax.com](http://www.tiremaax.com)

**TIREMAAX PRO ROI Calculator:** [www.hendrickson-intl.com/tiremaaxroi](http://www.hendrickson-intl.com/tiremaaxroi)



#### **ABOUT HENDRICKSON**

Hendrickson is a leading global manufacturer and supplier of medium- and heavy-duty mechanical, elastomeric and air suspensions; integrated and non-integrated axle and brake systems; tire pressure control systems; parabolic and multi-leaf springs; stabilizers; and bumper and trim components to the global commercial transportation industry. Everyday around the world, millions of Hendrickson suspensions carry countless loads of freight and raw materials both on- and off-highway. We supply durable, lightweight, high-performing suspension systems and components to the major North and South American, European, Asian and Australian medium- and heavy-duty truck and trailer OEMs and fleets. Hendrickson's growing global position in the commercial transportation industry and the on-going drive to provide products and services benefits truck and trailer manufacturers, fleets and owner operators around the world. Our tagline, **The World Rides On Us®**, not only reflects the spirit of the brand but also Hendrickson's 100 plus years of innovation, engineering advancements and manufacturing excellence.



**Trailer Commercial Vehicle Systems**  
2070 Industrial Place SE  
Canton, Ohio 44707-2641

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