AMERICAN TRUCKING ASSOCIATIONS
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Engineering Department

Tire Pressure Monitoring and Inflation

The number one maintenance issue that fleets face today is tire inflation pressure. A Federal Motor Carrier Safety Administration (FMCSA) research has shown that:

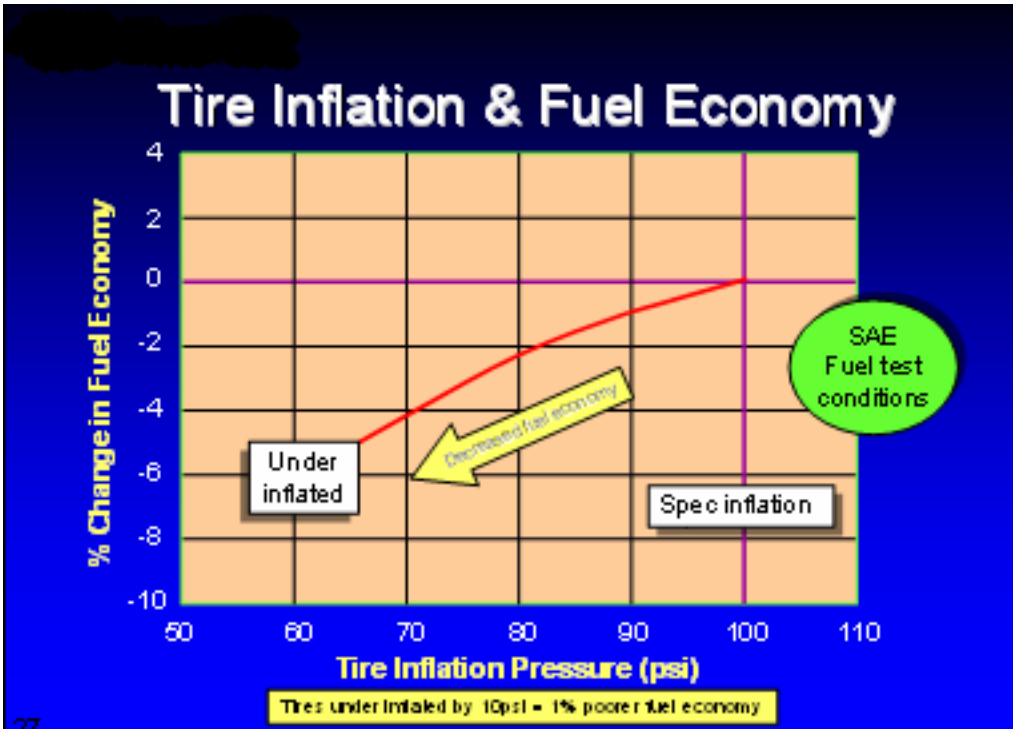
- Approximately 7 percent of all tires are under-inflated by 20 psi or more. Only 44 percent (approximately) of all tires are within 5 psi of their target pressure.
- Tire-related costs are the single largest maintenance cost item for commercial vehicle fleet operators. National average tire-related costs per tractor-trailer are about 2 cents per mile, or about $2,500 for an annual 125,000-mile operation.
- For the average fleet operator in the United States, improper tire inflation increases the annual procurement costs for both new and retreaded tires by about 10 to 13 percent.
- Improper tire inflation, as little as 10 psi low, reduces fuel economy by about one percent.
- Improper tire inflation is likely responsible for about one road call per year per tractor-trailer combination due to weakened and worn tires.
- Improper inflation increases total tire-related costs by approximately $600 to $800 annually per tractor-trailer combination.

This and ongoing studies at the Department of Transportation (DOT) calls attention to the fact that tire monitoring may well become regulated in the near future for commercial vehicles. All passenger cars were required to have some type of tire monitoring system and warning function by 1 September, 2007. The National Highway Traffic Safety Administration (NHTSA) reports that truck systems are 3-5 years away.

Drivers do not check the tire pressure due to many reasons: It takes too long to check, it gets them dirty and the inside dual tire is difficult to reach. Other problems include inaccurate gauges, the loss of the valve caps, the fact valves can stick in cold weather and slowly leak air. All tires can be neglected but it has been shown that the further away form the driver the tire is, the more likely it is to be under inflated. Trailer tires typically have the worst air pressure. Even new tires lose air up to 2 pounds per square inch (PSI) naturally through the tire itself. The popularity of nitrogen filled tires reduces the osmosis, or bleed through, of the tire casing as nitrogen has larger molecules than oxygen (although air is already 78% nitrogen).

Fuel efficiency can be affected greatly by low tire pressure. A set of tires at 60 PSI versus the specification inflation of 100 PSI can reduce fuel economy by up to 6%, as well as destroy the tire. A tire 20% under inflated equates to 25% less tread wear life and maybe even more importantly, a tire that is 10% under inflated equates to a 0.5% increase in fuel use.

At 30% under inflation, fuel economy drops almost 4%. A tenth here or there in miles/gallon may not appear to be a very large number, until you consider that a line haul truck spends $65,000 per year on fuel (100,000 miles/yr divide by 6.5 miles/gallon times $4.25/gal) Multiply 4% of $65,000 = $2600 per year in added fuel for just one (1) truck.



The number one cause of road breakdowns are tire related. The statistics compiled by Heavy Duty Trucking Magazine are as follows. For trucks and tractors, tires are the number one cause of breakdowns at 53.5%. Tires are also the number one contributor to the hours and costs of road breakdowns. Trailer road breakdowns are attributed to tires 48% of the time. Tires are responsible for 36% of the hours of breakdowns.

According to the FMCSA study, commercial vehicle tire inflation and condition directly link to stopping distance and handling, and thus overall safety. Properly maintained and performing tires aid drivers in preventing and mitigating crash situations.

Automatic tire pressure and/or monitoring increases tire life, maximizes the casing value, reduces downtime and expense. Fuel efficiency is improved as well as safety and time spent checking pressures by the driver.

There are essentially three types of systems from simple tire pressure monitoring to complete monitoring and automated inflation. Commonly used names and acronyms are as follows:

Tire Pressure Monitoring System (TPMS) are systems that only monitor inflation pressure and warn driver's through a warning light. These can work in several ways. There are wheel mounted, tire mounted and valve stem mounted systems. Wheel mounted systems use a direct signal through anti-

lock brake sensors that compare the rotational speed of the tires relative to each other. If a tire is low it will be rotating faster that the others because with low air pressure the tire diameter is smaller. The tire and valve stem mounted systems use a radio frequency (RF) indirect signal to transmit pressure information to a driver display. These can often also be read with a hand held device during walk around. There is also a simple valve stem mounted system that has a mechanical gauge visible.

With these systems, if a tire is low, then it is the responsibility of the driver to stop and get air. These can cost up to $50.00 or roughly $1,000.00 to retrofit a truck and trailer. Costs can go up to $200 each depending on the sensor design and complexity.

Tire Mounted RF

Valve Stem Mounted RF

Valve Stem Mounted Mechanical

Central Tire Inflation System (CTIS) are used by the military to automatically adjust tire pressure. Allows accurate selection of tire pressure for different terrain and load conditions. These systems can automatically add air if the vehicle speed increases to a level where a lower inflation setting for off road use would be hazardous. Multi-channel pressure control available by axle groups and integrated diagnostics alert the driver of potential tire problems and system status. These are very costly systems and would not likely be the choice of commercial vehicle owners in the near future.

Automatic Tire Inflation System (ATIS) systems automatically add air when the tire is below the specified air pressure. Driver can keep on driving without stopping to fill up with air. Payback is typically under 12 months.

At the regulatory level TPMS for trucks is already active. As stated previously, NHTSA estimates that they will be forthcoming in the three to five year time period.

There will be problems with truck TPMS as with cars as a multitude of manufacturers and designs are available. Multiple repair tools required for these various products adds even more complexity. Many aftermarket products are also available further increasing the potential for servicing problems.

The servicing of these systems, especially outside of a fleets' service facility, creates liability issues. Imagine a tire failing and the accident being caused because the truck stop repair shop, garage or tire dealer did not correctly repair, inspect or recalibrate a TPMS. The driver may never be warned of an under inflated tire and the vehicle's computer could show a fault code that indicated the TPMS was not in operation at the time of the accident. Another potential issue is that the TPMS will need to work after tires and/or wheels are replaced. There should be a warning of some type indicating that the TPMS sensor is not working if a tire/wheel combination has been placed on the vehicle that renders the system inoperable. Liability issues could be boundless.

In addition to the equipment issue, it is likely that this will become a safety inspection item via CVSA and other enforcement agencies. Drivers waiting for their next scheduled stop to "top off" their low tire could

be fined for not making that unscheduled stop for just air pressure correction. This also could open the possibility of a driver ignoring the warning light for many hours if they have just begun their driving day.

The regulatory effort will have to be monitored to ensure that the requirement of tire pressure monitoring being applied to commercial vehicles does not adversely effect the operation of the fleets. More information can also be found at the Tire Industry Association (www.tireindustry.org) that outlines in detail the potential concerns of these systems and the history of the rulemaking for passenger cars.