Advanced Sensors and Applications: Commercial Motor Vehicle Tire Pressure Monitoring and Maintenance

Tire pressure monitoring and automatic tire inflation technologies show significant promise for improving safety and reducing costs in the commercial vehicle industry. Improved tire pressure management directly relates to improved vehicle stability, reduced tire wear and damage, better braking, improved fuel efficiency, and fewer roadside breakdowns. Improved tire pressure maintenance and general tire management can have a direct and substantial impact on carrier productivity as it relates to downtime and road calls.

This study consisted of a field test on two tire pressure monitoring systems (TPMSs) and an automatic tire inflation system (ATIS). The goal was to determine whether these systems could influence maintenance intervals and practices and improve performance and safety.

FIELD TEST PLAN

The outline for the field test included five hypotheses, outlined in Table 1. The authors developed a data collection plan to minimize the impact of the field test on the technicians' daily maintenance responsibilities.

FIELD TEST FINDINGS

Two private fleets participated in the field test. The first fleet, CLI Transport (CLI), monitored 24 married tractor-tanker pairs. The research team installed Wabco's Integrated Vehicle Tire Monitoring (IVTM) System on 12 tractors and Meritor's Tire Inflation System (MTIS) on 12 tankers. The second fleet, Gordon Food Service (GFS), monitored 24 tractors, 30 standard 50-foot trailers, and 20 refrigerated pup trailers (reefer pups). The team installed HCI Corporation's (HCI's) Tire-SafeGuard on 12 tractors and 15 standard 50-foot trailers. GFS ensured the equipment would operate together during the entire field test. In addition, the team installed MTIS on 20 reefer pups.

CLI conducted the field test for 13 months. During the test period, the fleet traveled more than 3.8 million miles and consumed more than 600,000 gallons of diesel fuel. Each tractor-tanker married pair averaged 14,000 miles per month. The technicians conducted 324 inspections to measure tread depth and verify system operation. Between the test fleet and the control fleet, CLI replaced 160 tires for wear and identified 38 tire incidents.

Table 1. Summary of study findings.

Hypothesis	Fleet 1: CLI Transport	Fleet 2: GFS
The use of TPMS and ATIS will increase the life of TPMS/ATIS -equipped tires.	Yes	Inconclusive due to small sample size
The use of TPMS and ATIS will reduce the fuel consumption of equipped tractors.	Yes	Yes
The use of TPMS and ATIS will reduce road calls for damaged/flat tires for equipped tractor-trailers.	Inconclusive, no change in road calls	Yes
TPMS and ATIS will accurately display the tire pressure of equipped tractor-trailers at the driver interface.	Inconclusive due to issues with data gathering practices	Yes
TPMS and ATIS will not introduce unscheduled maintenance that will affect the day-to-day fleet operations.	Yes	Yes

During the 18-month test with GFS, the tractors traveled approximately 3.4 million miles and consumed more than 500,000 gallons of diesel fuel. The tractors averaged 7,900 miles per month. The trailers traveled approximately 5.5 million miles and averaged 4,300 miles per month. The technicians replaced 278 tires for wear and identified 77 tire incidents.

The field test results showed the use of TPMS/ATIS equipment reduced the operational costs of the fleet and improved the driver's awareness of the tractor-trailer tires. The test fleets experienced a 1.4-percent improvement in fuel economy over the control fleet. The test fleet equipped with TPMS/ATIS equipment exhibited an increase in the life of the drive tires by 19 percent compared to the control fleet. Using the analysis results, the team estimated the equipment costs would be recovered in less than 18 months. The return on investment (ROI) dropped to less than 6 months as the cost of fuel and tires increased. The findings from the field test and the ROI calculations confirm that the use of TPMS/ATIS equipment will reduce fleet operating costs.

The field test validated the assumptions outlined in 6 of the 10 hypotheses. No hypotheses were proven invalid. Previous experience and subjective data suggest that an extended field test might have provided sufficient data to validate the inconclusive hypotheses.

COST-BENEFIT ANALYSIS

Commercial truck fleets use TPMS or ATIS equipment due to their potential to reduce commercial motor vehicle (CMV) operating costs. Researchers conducted a cost-benefit analysis to estimate the fleets' expected return on investment (ROI) for the TPMS and ATIS equipment. The cost of fuel, the cost of tires, and the average mileage traveled influenced were factored into the ROI calculations. For example, CLI operates a high-mileage fleet with wide-based single tires (a high-cost consumable supply). As shown in Figure 1, CLI would recover the costs of the TPMS and ATIS equipment in less than a year. Although fuel savings offer the highest incentive for TPMS and ATIS use, the high cost of wide-based tires further shortens CLI's expected ROI. In comparison, GFS operates a lower-mileage fleet with standard tires. In addition, the size of GFS's fleet reduces the need to dispatch the entire trailer fleet daily. The annual savings for GFS are less than half of the savings for CLI. At the mid-2011 cost of $3.98 per gallon of diesel fuel, CLI would save $3,160 per year for each tractor-trailer, compared to $1,327 per year at GFS.

While CLI would recover the cost of the TPMS and ATIS equipment in less than 6 months (with the cost of fuel at $3.98 per gallon), GFS's cost recovery period would be twice as long. At the same fuel prices, GFS would recover the TPMS and ATIS purchase costs within 14 months.

The findings from the field test and ROI calculations confirm that the use of TPMS/ATIS equipment is very likely to reduce the operating costs of a fleet. The time required for the ROI decreases as the cost of diesel fuel increases. Fleets that use TPMS and/or ATIS equipment will not only reduce their operating costs, but will improve their tire pressure maintenance programs. The use of such equipment encourages mechanics and drivers to monitor tire pressures and report abnormal tire conditions. Interviews with drivers confirmed their acceptance of the equipment and a desire to expand its use to the entire fleet.

For more information, please visit: http://www.fmcsa.dot.gov/safety/research-and-analysis/publications?keywords=&title=&author=&year=&to=&page=0.

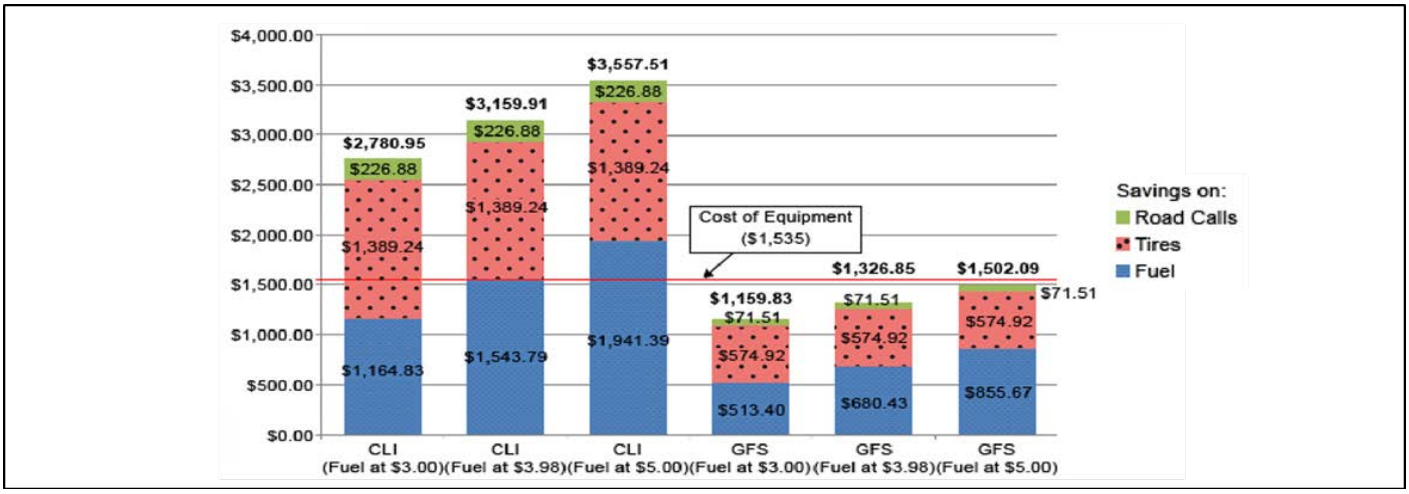

Figure 1. Bar graph. Annual savings on road calls, tires, and fuel per TPMS/ATIS-equipped tractor-trailer by different fuel costs.