

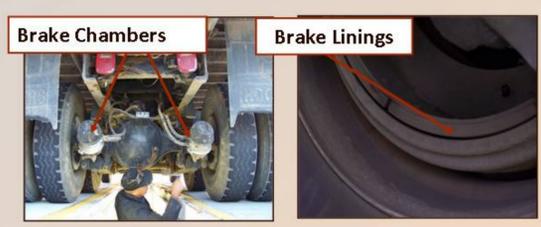
Performance-Based Brake Tester (PBBT) Project: Correlation Study & Mainline Brake Assessment

Background

Commercial Motor Vehicles (CMV)

As of 2005, there were 8,481,999 registered CMV in the nation. These vehicles are often involved in traffic crashes, with 368,000 CMV related accidents in 2006, resulting in 4,995 deaths and 106,000 injuries.
<http://www.fmcsa.dot.gov/facts-research/facts-figures/analysis-statistics/cmvfacts.htm>

CMV Brake Systems



Each wheel end on a CMV must have a brake system made up of multiple components. These components can become damaged, as when a brake lining is cracked, reducing brake effectiveness.

North American Standard (NAS) Inspection Program

- Commercial Vehicle Safety Alliance (CVSA) establishes and maintains a set of inspection criteria for CMV
- Inspections at various levels (where Level-1 is most rigorous) performed by enforcement officers.
- If a vehicle does not meet any of the inspection criteria, it is placed Out-Of-Service (OOS)
- In the fall of 2007, a new criterion was established, setting a minimum overall vehicle brake efficiency

Criterion: 49 CFR part 393.393.52 "(a) Upon application of its service brakes, a motor vehicle or combination of motor vehicles must under any condition of loading in which it is found on a public highway, be capable of — (a)(1) Developing a braking force at least equal to the percentage of its gross weight specified [in a separate table]"
For "property-carrying vehicles or combinations" over a given weight
Minimum Percentage = 43.5%

Performance-Based Brake Testers (PBBT)

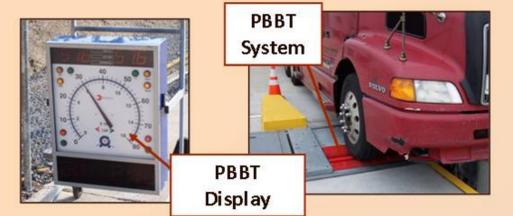


Measures Brake Efficiency (B.E.)
B.E. = BF/Weight
Brake Force (BF) measures the resistive force applied by the brakes.
Brake Efficiency can be measured either for the overall vehicle or for each individual wheel end.

Procedure

1. Randomized Vehicle Selection (Mainline Brake Assessment)
 - a. Set vehicle pre-clearance selection to 100%
 - b. Select 10th Vehicle for testing
1. Vehicle Selection (Correlation Study)
 - a. Vehicle is selected for testing from CMV traffic

2. Collect PBBT Results
 - a. Run PBBT Test
 - b. PBBT Machine generates files with weight, brake force and brake efficiency data.



From PBBT

Carrier ID

Set Adjuster Length Limits

Pass if < Limit

Determines whether Level-1 Is Pass/Fail

Any Violations NOT Related To Brake System

3. Collect Level-1 Inspection results
 - a. Gather hard copies of inspection reports generated by TN state troopers.
 - b. Transcribe hard copy into Microsoft Access database. (shown to the left)
4. Run Correlation program
 - a. Correlation program run using Matlab® software.
 - b. Test Number and Vehicle ID data from Level-1 database connect to PBBT machine output.
 - c. Correlation results generated in text format.

Correlation Study

Data Collection Period: February 14th, 2008 – November 21st, 2008
Number of Vehicles Examined: 647
Number of Wheel Ends Examined: 5642

Correlation Results If We Neglect Violations Not Related to Brake System on Level-1 Inspection

Level-1 Inspection \ PBBT	Pass	Fail
Pass	57.34%	10.36%
Fail	20.87%	11.44%

Overall Vehicle Correlation Results

Level-1 Inspection \ PBBT	Pass	Fail
Pass	51.47%	9.12%
Fail	26.74%	12.67%

Brake Push Rod Stroke

The Brake Push Rod originates in the brake chamber and "Strokes" out of the chamber when the brakes are applied. Limits are set for this stroke length and vary by brake chamber type.
If Length > Limit:

- Individual brake effectiveness decreases
- Level-1 inspection violation recorded
- Vehicle Out-Of-Service (OOS) if 20% or more individual brakes found in violation



*PBBT wheel end result is evaluated as a Pass if the wheel end brake efficiency value is greater than 43.5%

Mainline Brake Assessment

Data Collection Period: October 6th, 2008 - November 21st, 2008
Number of Vehicles Tested: 24

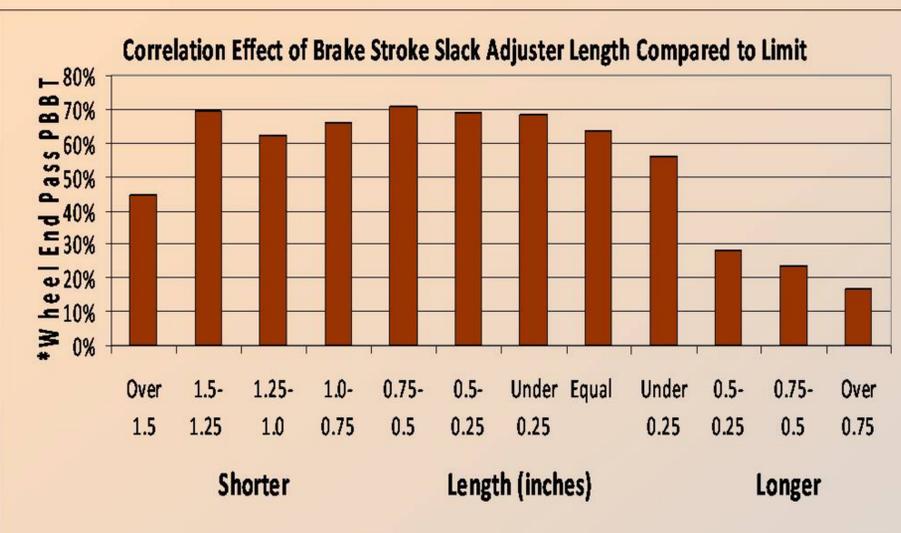
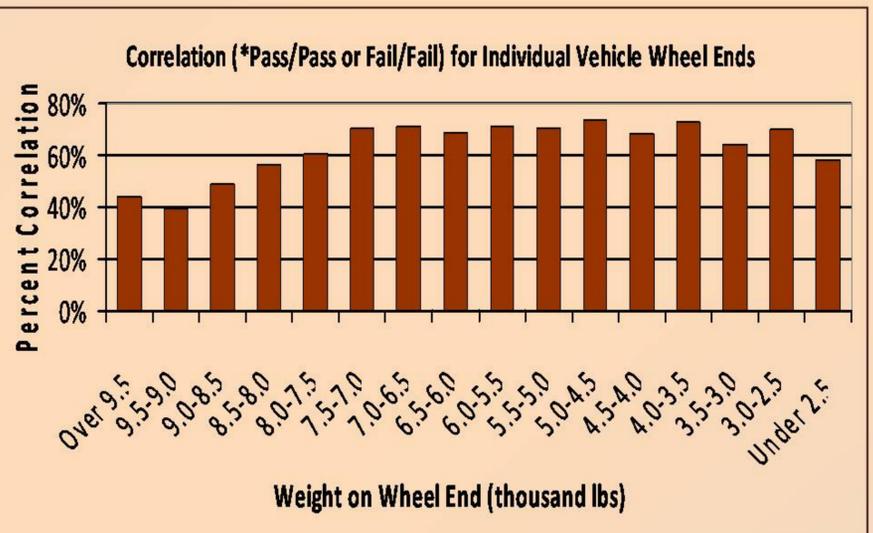
Overall Vehicle Correlation Results (Mainline Brake Assessment)

Level-1 Inspection \ PBBT	Pass	Fail
Pass	50.0%	4.17%
Fail	37.5%	8.33%

Note that the percentage of vehicles that were not put Out-Of-Service due to either the PBBT or the Level-1 Inspection is only 1.47% smaller than the value for the Correlations study data, indicating that there is little to no bias present in the correlation study data.

Vehicle Weight by Wheel End

Correlation is affected by the weight of the vehicle and its distribution over the various wheel ends on the vehicle. The chart above shows this effect for different ranges of weights on individual wheel ends.



Future Work:
Correlation work will continue to allow for increased understanding of how the additional correlation variables examined affect the results. In addition, the results will be evaluated by CMV enforcement personnel to help guide future use of the PBBT in examining vehicles.
Because the number of vehicles tested for the Mainline Brake Assessment at this point is roughly half of the initial desired sample size due to weather and scheduling challenges, further data collection will be performed to confirm the results with a larger vehicle sample size.