

Government / Industry Brake Research, Rulemaking and Technologies – CV102

Analysis of the Maintenance and Repair Expenses for the Anti-Lock Brake System for Tractors and Trailers

NHTSA Final Report by: Kirk Allen

Presented by: Alrik L. Svenson

**National Highway Traffic Safety Administration
Washington, D.C.**

**SAE Commercial Vehicle Engineering Congress &
Exhibition**

Rosemont, IL

October 6, 2009



Scope of Safety Problem

- Brake failure is a contributing factor in 29% of fatal & injury crashes (FMCSA, 2006)
- Large trucks were involved in 11% of fatal crashes but comprised only 3.4% of registered vehicles (FMCSA, 2005)

NHTSA Regulations

- **FMVSS No. 121** mandates anti-lock braking (ABS) systems on all new air-braked tractors manufactured on or after March 1, 1997 and semi-trailers and single-unit trucks manufactured on or after March 1, 1998.
- **FMVSS No. 105** mandates ABS systems on all new hydraulic-braked vehicles with a gross vehicle weight rating (GVWR) of 10,000 pounds or greater manufactured on or after March 1, 1999.

Current Study

- Database supplied to NHTSA through a contract with NAMDX
- Based on a census of repair receipts from 13 trucking fleets who perform in-house maintenance – over 2,000 each tractors & trailers
 - Size, vocation, & scope of fleets vary
- Repairs were catalogued using Vehicle Maintenance Reporting Standards (VMRS)
 - Identifies vehicle system, assembly, & component
 - Individual repair lines are classified as Labor, Parts, or Service

Example of Data

TYPE	CODE	DESCRIPTION	TOTAL			BRAKE			ABS		
			HRS	PT	SVC	HRS	PT	SVC	HRS	PT	SVC
P	13-011-068	ABS RELAY VALVE	-	\$40			\$40		\$40	-	
P	13-001-015	FRONT BRAKE PADS	-	\$38			\$38				
P	XX	DOOR GUARD	-	\$154	-	-	-	-	-	-	
P	53-000	SEAL	-	\$15	-	-	-	-	-	-	
L	13	BRAKES	3			3					
P	44-002	FUEL FILTER	-	\$4	-	-	-	-	-	-	
L	00-021	IGNITION TUNE-UP	1	-	-	-	-	-	-	-	
P	00-105	OIL FILTER	-	\$3	-	-	-	-	-	-	
P	53-999-016	10/30 OIL	-	\$12	-	-	-	-	-	-	
L	00-001	PM LEVEL A	0.5	-	-	-	-	-	-	-	
S	13-011-002	SENSOR REPAIR	-	-	\$64		\$64		\$64		
C	00-018	CHECKOVER	-	-	-	-	-	-	-	-	
S	53	ADDED OIL TO TRUCK	-	-	\$17	-	-	-	-	-	

Identifying ABS repairs

- ABS repairs were already identified in data provided
- All repairs noting ABS charges were manually reviewed to ensure accuracy
- Repairs were noted as to certain parts of the ABS – sensor, ECU, warning light
- Labor was generally considered to be one hour, unless otherwise specified

Result #1 – ABS Expenses per month of vehicle service

		No. of Vehicles	Total	Brakes	ABS
Tractors	Pre-Mandate	675	\$525	\$35.52	\$0.10
	Post-Mandate	1344	\$499	\$26.78	\$0.85
Trailers	Pre-Mandate	1610	\$151	\$21.93	\$0.08
	Post-Mandate	982	\$143	\$13.66	\$0.25

- Months of vehicle use during the survey period was estimated using the first & last repairs for each vehicle since mileage data was not usable.
- For both Tractors & Trailers, the pre-mandate (i.e., prior to 1998/9) units had slightly higher expenses for Total and for Brakes.
 - The repairs to Brakes as a percentage of Total was higher for Pre-Mandate units.
 - There is no evidence that ABS led to increased brake repair & maintenance

Result #2 – Frequency of components repaired

– Average number of ABS repairs per 100 vehicles during the study –

		Wheel Sensor	ECU	Warning Light	Others	Total
Tractors	Pre-Mandate	1.2	0.6	0.3	1.3	3.4
	Post-Mandate	7.4	4.2	5.3	4.1	21.0
Trailers	Pre-Mandate	0.9	0.1	1.6	2.2	4.8
	Post-Mandate	3.5	0.3	8.8	6.8	19.3

- Pre-mandate units rarely needed repairs, but this provides evidence that some fleets purchased equipment with voluntary ABS installations before the requirement
- Tractors most often required repairs to the Wheel Sensor, but the repairs are distributed somewhat equally across all components
- Trailers most often required repairs to the Warning Light, much more frequently than the other components

Result #3a – Comparison to previous NHTSA reports

- Prior NHTSA studies (1992 & 1993) can be placed on a per-month basis & expenses inflated to a common baseline of 2007 dollars
Tractors \$1.25 per month, Trailers \$2.11 per month (prior study).... compared to
Tractors \$0.85 per month, Trailers \$0.25 per month (current study)
- Current study more closely resembles today's on-road vehicle fleet
- 1992/3 studies included ABS components and charges for inspections & adjustments that are not part of a typical maintenance scheme

Result #3b – Comparison to previous NHTSA reports

- Lifetime ABS expenses from current study were calculated based on a supplementary analysis of vehicle mileage and survival
- ABS expenses compared to the a range of capital equipment costs from the teardown study (depending on the interest rate used)
 - **Tractors:** maintenance & repair expenses are 9% to 16% of the capital cost,
 - **Trailers:** maintenance & repair expenses are 3% to 6% of the capital cost
 - **Combined Tractor + Trailer:** maintenance & repair expenses are 6% to 9% (including the capital expense of the connections)

Study Limitations

- Study included 13 fleets so results may not be representative of all fleets or owner-operators
- Time in use for vehicles was estimated, since vehicle mileage data was not useable
- Post-mandate vehicles were newer vehicles
 - Data does not capture if ABS begins to wear or break down more frequently as vehicles age
- Lacks specifics about brands of ABS and brake equipment
 - Does not provide fleet managers with guidance on setups that may be particularly troublesome or steps that can be taken to reduce maintenance & repair expenses

Conclusions

- ABS is relatively inexpensive to maintain & repair in terms of:
 - Frequency of repair
 - Expense relative to brakes and all other vehicle systems
 - The cost of equipping a vehicle with ABS
- Final report also includes details about repairs to the underride guard and replacement of trailer conspicuity tape.

For More Information

- Contact Kirk Allen: Email Kirk.Allen@dot.gov
- Final Report (DOT HS 811 109) is available at following link:

<http://www-nrd.nhtsa.dot.gov/Pubs/811109.PDF>

Thank you!