

### "EFFECTS OF IMPROVED SUSPENSION TRUCKS ON RAIL PERFORMANCE"

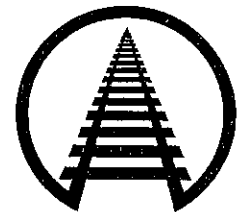
by Joseph LoPresti,  
Greg Garcia and Jon Hannafious

TD 96-029

#### Summary

A series of "quick look" tests conducted at the Facility for Accelerated Service Testing (FAST), Transportation Technology Center (TTC), Pueblo, Colorado, indicate that rail wear, thermite weld batter, and rail end batter at mechanical joints have all decreased with the introduction of improved suspension trucks into the heavy axle load (HAL) train. Specific results include:

- Average rail end batter of mechanical joints was one-third that measured under the conventional trucks.
- Weld repair of battered rail ends was required as early as 31 million gross tons (MGT) under the conventional trucks, while no repairs were needed under the improved trucks through 110 MGT.
- Wear and batter at thermite welds were reduced by an average of 75 percent.
- Reduced straining of the rail surface was evident in the reduction of surface hardening at the welds.
- Gage wear rates on the high rail of a 5-degree curve were reduced by more than 50 percent.
- Vertical rail wear, which was mild under the conventional train, was not measurable under the improved train after 85 MGT.
- Corrugations, which were over 0.1-inch deep on the high rail of the 5-degree curve after 70 MGT under the conventional trucks, have not developed in over 120 MGT with the improved trucks.

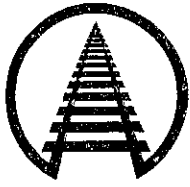


#### Suggested Distribution:

- Bridges & Roadway
- Maintenance Planning
- Locomotive Dept.
- Track Maintenance

Association of American Railroads  
Research and Test Department

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## INTRODUCTION AND CONCLUSIONS

The heavy axle load (HAL) train at the Facility for Accelerated Service Testing (FAST) was retrofitted with improved suspension trucks in 1995. The trucks were designed to improve curving and reduce dynamic forces transmitted into the track structure. Several "quick look" tests were conducted at the Transportation Technology Center, Pueblo, Colorado, to measure the effects improved trucks have had on track component maintenance and degradation. These tests compared the performance of selected track components under 100 MGT of conventional truck operation to the performance of similar components under 100 MGT of improved truck operation.

### Mechanical Rail Joints

Rail end batter at mechanical joints (installed with 1/4-inch gaps in standard rail) under the improved train was about one-third that measured under the conventional train. Exhibit 1 illustrates the batter measured with a longitudinal rail profilometer at a tangent track joint after 31 MGT of conventional and improved truck operations. The relative performance at this location is typical of that noted at all joint locations. Exhibit 2 illustrates the average batter measured in curve and tangent track locations (two joints were installed in curved track and four were installed in tangent track for testing under each truck type).

There was little difference in the performance of joints on the low rail of a 6-degree curve as compared to the high rail, or suspended joints compared to supported joints under either train.

Both tangent track joints required weld repair after 31 MGT under the conventional train, when batter was about 0.10 inch. None of the joints tested under the improved train has required build-up after 110 MGT in track. Joint bar failure was similar under both trains. In each case, one set of bars cracked. And one set broke, in what was classified as a cold weather pull apart (all in tangent track).

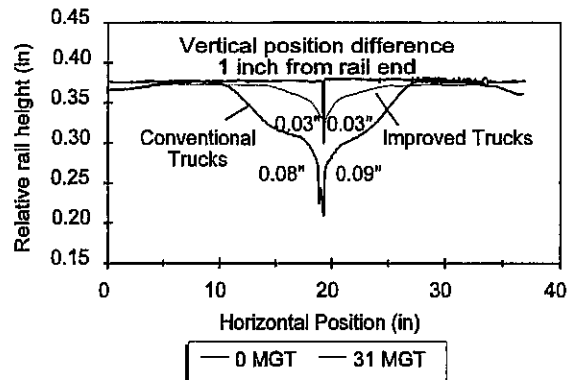


Exhibit 1. Joint Batter, Conventional vs. Improved Trucks, Tangent Track

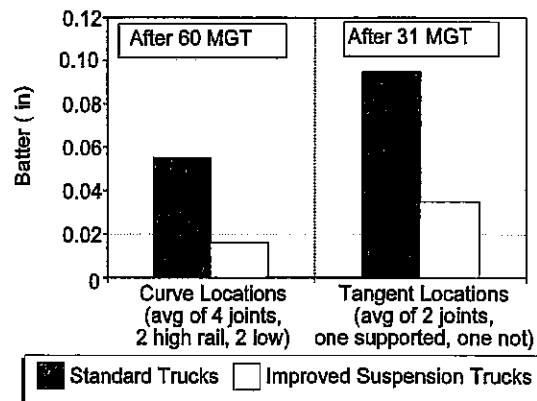


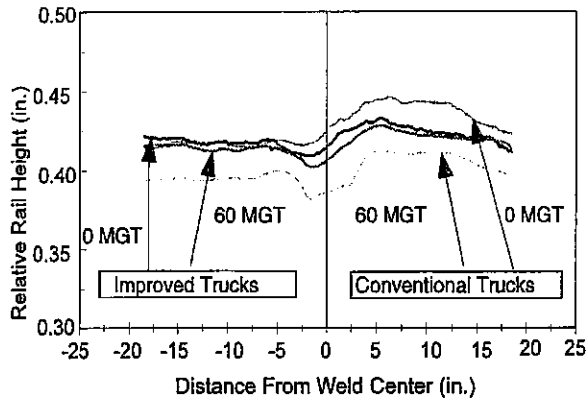
Exhibit 2. Rail End Batter at Mechanical Joints

### Thermite Welds

Exhibit 3 illustrates typical longitudinal rail profiles measured on thermite welds at 0 and 60 MGT of HAL traffic under the conventional and improved trucks. Six test welds were installed in head hardened rail in a 5-degree curve for test under conventional trucks. Six of the same types of welds were later installed for test under the

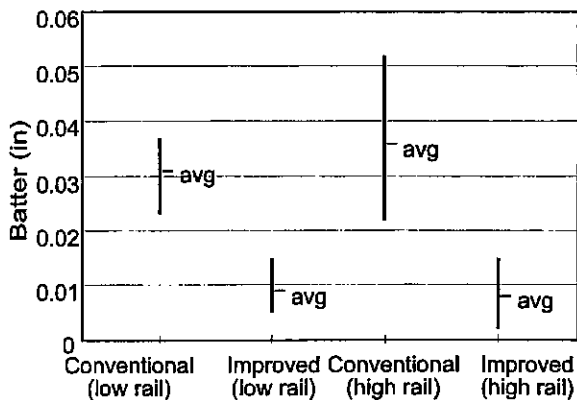


improved trucks. Three welds were installed on the high rail and three on the low rail for each truck configuration.



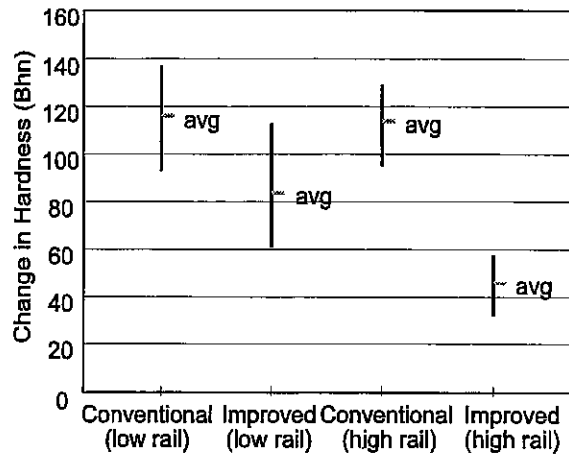
**Exhibit 3. Thermite Weld Profile Comparison between Conventional and Improved suspension Trucks after 60 MGT of HAL Traffic**

There was a 75-percent reduction in average wear and batter with the improved trucks. The ranges and averages are shown in Exhibit 4. The average wear and batter was 0.034 inch under conventional trucks after 60 MGT; under the improved trucks the average was 0.008 inch. There were no consistent differences in high- versus low-rail weld batter depths.



**Exhibit 4. Comparison of Accumulated Wear and Batter (min, max, avg) of Test Welds after 60 MGT of Conventional and Improved Truck Operation**

Weld hardness was measured to determine the amount of work hardening occurring on the surface of each weld. Exhibit 5 illustrates the range and average of increase in hardness of the test welds. The average increase was 115 Bhn under the conventional trucks and 65 Bhn under the improved trucks. The increase in hardness gives an indication of the amount of material strain taking place at the surface of the rail/weld.



**Exhibit 5. Comparison of Hardness Change at Weld Running Surface (min, max, avg) after 60 MGT of Conventional and Improved Truck Operation**

### Rail Wear

Gage wear rates in a lightly lubricated 5-degree curve at FAST were reduced by over 50 percent with operation of the improved trucks. Vertical wear, which was a minor concern during operation of the conventional train, was nearly eliminated with the introduction of the improved trucks. Exhibit 6 illustrates the average amount and type of wear on all rails in the test curve both under the conventional trucks and under the improved trucks.

Further evidence of the reduction in wear attributable to the improved trucks is given in Exhibit 7. New standard 300 Bhn rail profiles have been overlaid with profiles worn with 85 MGT of HAL traffic under both truck types.

On the low rail, wear is only slightly discernable under the improved trucks and is obvious with the conventional trucks.



Corrugations developed on the high rail of standard 300 Bhn rail under the conventional trucks and grew to a depth of over 0.1 inch in 70 MGT. Corrugations did not develop under the improved trucks in over 125 MGT.

Much of the gage wear under each truck type developed within the first 20 MGT. Exhibit 8 illustrates gage wear rates as a function of tonnage

for all rails in the test curve. The wear rates declined with tonnage up to around 70 MGT and then stabilized (for the improved trucks). The wear rates declined as the wheels and rails wore to a stable conformal shape, as the rail running surface work hardened.

Note: Contact Joseph LoPresti at (719) 584-0589 with questions or comments about this document.  
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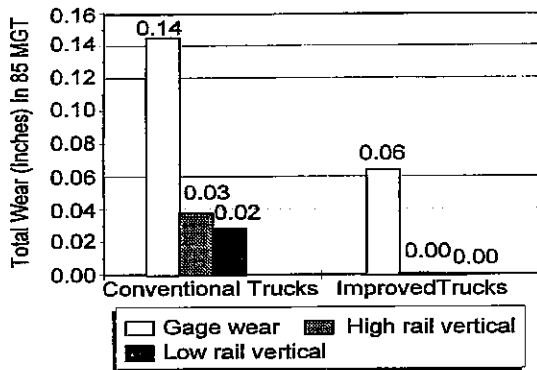


Exhibit 6. Average Total Wear after 85 MGT  
All Rails in 5-degree Curve

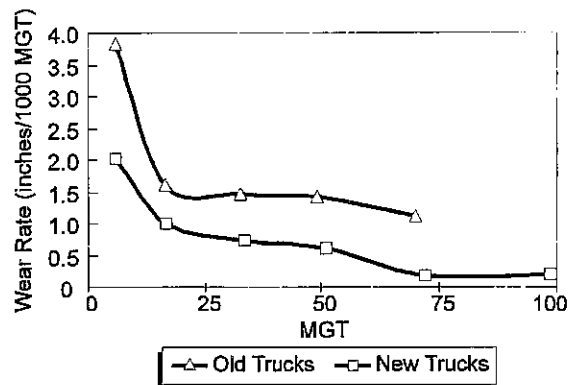


Exhibit 8. Wear Rate vs. Tonnage, Conventional and Improved Trucks, 5-Degree Curve

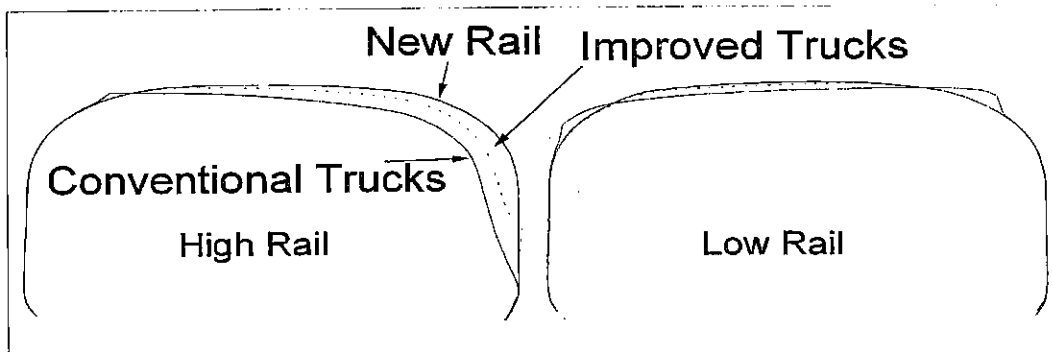


Exhibit 7. 85 MGT Profiles on Standard 300 Bhn Rail under Conventional and Improved Trucks

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