TECHNOLOGY DIGEST

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# PRELIMINARY ANALYSIS OF CAR AND WHEEL LOADS IN REVENUE HEAVY HAUL SERVICE,

by John D. Mazza, Duane E. Otter and M. Carmen Trevizo

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**Summary**

The Association of American Railroads (AAR) Heavy Axle Load (HAL) Revenue Service Monitoring program is evaluating the effects of HAL traffic on revenue service lines. Wheel load data sampled on the Chicago & North Western (C&NW) Powder River Subdivision from April to October 1994 showed that 60 percent of the loaded unit trains had an average car weight per train above 263 kips. Traffic from this line also travels over the Union Pacific, the Santa Fe, and other C&NW lines.

Results from a sample of about 1,000 loaded coal trains showed that 60 percent of the trains had an average car weight per train above 263 kips and 4 percent had an average car weight per train above 286 kips. Ten percent of the HAL train wheel loads exceeded 40 kips and the average wheel loads was 35.5 kips. The highest measured wheel loads, most likely generated by wheel impacts, were 85 kips for a HAL train and 73 kips for a conventional train.

The AAR will continue to monitor the HAL traffic patterns over this coal line and will also attempt to capture impact loads with recent modifications made to the load station.

**Suggested Distribution:**
Operating/Engineering Dept.
- ❑ Bridges and Roadway
- ❑ Maintenance Planning
- ❑ Planning & Analysis
- ❑ Track Maintenance

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Research and Test Department
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## INTRODUCTION AND CONCLUSIONS

The Association of American Railroads (AAR) Heavy Axle Load (HAL) Revenue Service Monitoring program is evaluating the introduction of HAL traffic (286 kip cars) on revenue service lines. To quantify the loads over the line as HAL traffic is introduced, load monitoring stations have been installed on two different revenue service lines.

The data presented here is from the Chicago & North Western (C&NW) Powder River Subdivision. The locomotive wheel load data has been removed from the wheel load data base in order to focus on car loadings and corresponding wheel loads.

### Average Car Weight Per Train

Exhibit 1 shows a histogram of the distribution of average car weight per train for approximately 1,000 coal trains sampled between April and October 1994 under normal operating conditions. Note that the number of trains loaded to about 286 kips per car is significant.

The distinction between trains with average car weights of 263 kips and 286 kips is not as well defined as one might expect. It is likely that some trains of 286 kip cars are not being fully loaded, and/or that some trains of 263 kip cars are being overloaded. Either of these practices could contribute to the significant number of trains loaded at intermediate levels.

The histogram in Exhibit 1 has a valley centered about 278 kips. This car weight was therefore selected as a break point between conventional trains and HAL trains.

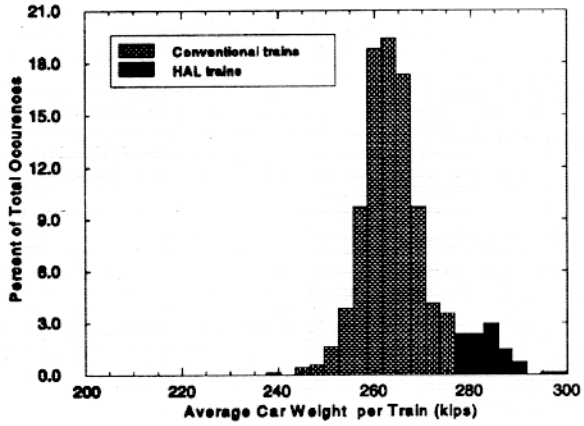


**Exhibit 1. Histogram of Average Car Weight Per Train**

A cumulative distribution of average car weights per train for the same trains is shown in Exhibit 2. Sixty percent of the trains have an average car weight per train above 263 kips; 4 percent have an average car weight above 286 kips. The highest observed average car weight for one train was nearly 300 kips.

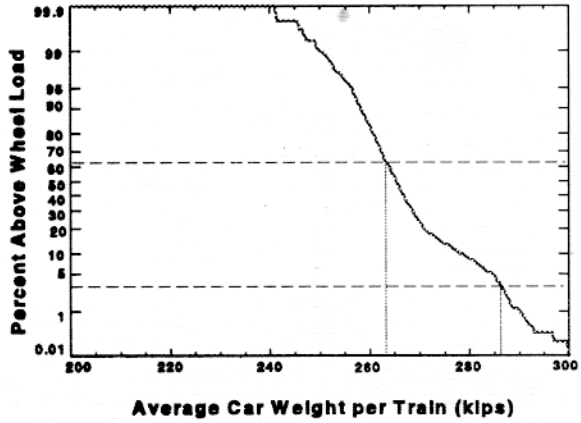


**Exhibit 2. Distribution of Average Car Weight Per Train**

Exhibit 3 shows the percentage of HAL trains with gross rail loadings above 278 kips. The fluctuations in monthly percentages may be due to a variety of factors, such as train cycle times, policy changes, operating conditions, and mine loading practices.

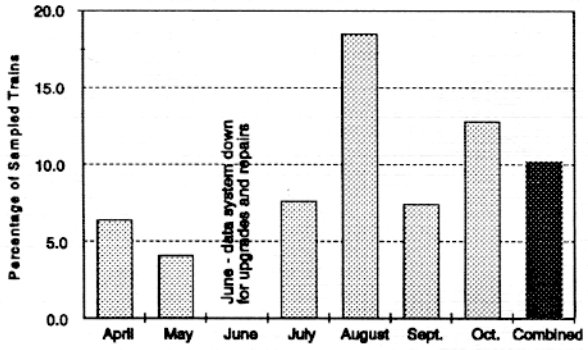


**Exhibit 3. Percentage of Sampled Trains with Average Car Weight above 278 kips**

## Wheel Loads

Exhibit 4 shows the cumulative distributions of wheel loads measured for conventional and HAL trains sampled between April and October 1994. The mean wheel load for the measured HAL trains was 35.5 kips and about 10 percent of the wheel loads exceeded 40 kips. The mean wheel load for the measured conventional train was 33 kips and about 10 percent of the wheel loads exceeded 37 kips.

The highest measured wheel load on the HAL trains was 85 kips, while the highest measured wheel load on the conventional train was 73 kips. These high values were probably generated by wheel impacts.

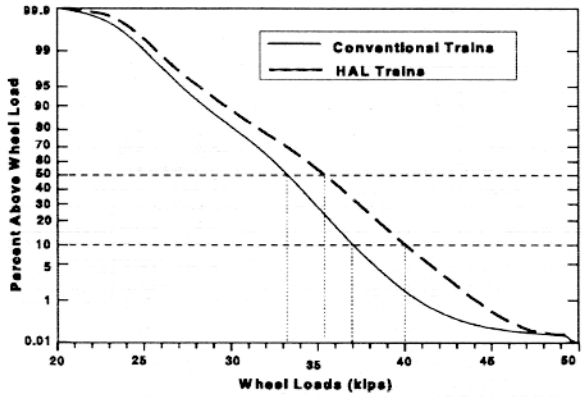


**Exhibit 4. Cumulative Distributions of Wheel Loads for Conventional and HAL Trains (loaded trains only)**

Exhibit 5 shows the variations in wheel loads for conventional and HAL trains. The conventional 263 kip car has a static wheel load of 32.9 kips, while the HAL 286 kip car has a static wheel load of 35.7 kips. Note that there is a considerable variations in wheel loads. These variations are most likely due to uneven loading, as well as car dynamics through the measurement zone.

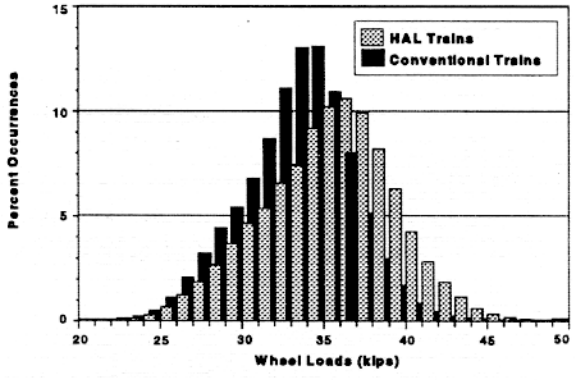


**Exhibit 5. Wheel Load Histograms for Conventional and HAL Trains**

Exhibit 6 provides a summary of vertical and lateral wheel load statistics. Note the load station is located on a typical curve for this line, 1.5-degree curve, therefore, the lateral wheel loads are very low.

Exhibit 6. Vertical and Lateral Wheel Load Statistics for Conventional and HAL Cars

| **Vertical Wheel Loads** | Mean (kips) | Std. Deviation (kips) |
|---|---|---|
| 100-ton cars | 33.0 | 2.9 |
| HAL cars | 35.5 | 3.3 |
| **Lateral Wheel Loads** | (kips) | (kips) |
| 100-ton cars | 1.3 | 3.6 |
| HAL cars | 1.0 | 3.6 |

The load station on this line was recently modified to capture impact loads. Results will be reported in a future report as data becomes available.

## BACKGROUND

Traffic on the C&NW Powder River Subdivision is almost exclusively unit coal trains. The loads make up about 80 percent of the tonnage, all moving eastward, while the empties make up the remaining 20 percent of the tonnage moving westward. Track speed is 45 mph for loaded trains and typical train length is about 110 cars. Annual tonnage for 1994 is expected to exceed 130 million gross tons on this line.

In order to quantify both vertical and lateral wheel loads in this line, the load measuring station was located in a representative curve. The site is located on a portion of single track that sees both loaded and empty coal trains. The load station is located on a 1.5-degree curve with 1.5 inches of superelevation.

Standard strain gage rail force circuits were installed on the rails to measure vertical and lateral wheel loads. The circuits are calibrated on a yearly basis and after any maintenance in the test area. Trigger circuits on both ends of the test zone activate the data collection system. Monitoring of the vertical wheel loads will continue in 1995.

## ACKNOWLEDGEMENT

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**Contact John D. Mazza (719) 584-0731, Duane E. Otter (719) 584-0594 or M. Carmen Trevizo (719) 584-0560 with questions or comments about this document.**



*A MORE DETAILED REPORT, WHICH MAY CONTAIN REVISED INFORMATION, WILL BE AVAILABLE AT A LATER DATE THROUGH THE DOCUMENT DISTRIBUTION CENTER, CHICAGO TECHNICAL CENTER, 3140 SOUTH FEDERAL STREET, CHICAGO, ILLINOIS 60616. PHONE: BETTY J. VAUGHAN (312) 808-5421. A REPORT LIST IS AVAILABLE UPON* REQUEST.