

Improving the Economics of Bulk-Commodity Service: ASF Bulk Truck

by Ken Rownd and Darrell Iler

Summary

An Association of American Railroads' Strategic Research Initiative has demonstrated that an American Steel Foundries (ASF) improved suspension system can provide economic savings in typical eastern and western railroad service. Tests conducted under this program compared the performance of a conventional three-piece truck with an ASF truck as tested in a baseline aluminum coal car loaded to 315,000 pounds.

Compared to the baseline truck, the ASF truck demonstrated the following performance results:

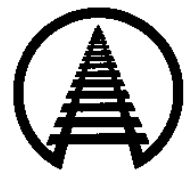
- Lateral curving forces reduced by 50 percent
- Incremental curve resistance reduced by 50-60 percent
- Tangent resistance not changed
- Improved high-speed stability
- Improved vertical dynamics for empty and loaded car

Criteria used to determine savings are described in the Bulk-Commodity Freight Truck Specification developed for this program by Transportation Technology Center, Inc. Performance goals were identified to reduce costs associated with vehicle and track maintenance, energy consumption, worn truck components, and car availability.

The intended applications are double-stack cars used for transporting general merchandise and bulk-commodity cars.

Suggested Distribution:

- Car Department
- Planning & Analysis
- Equipment/Rolling Stock
- Intermodal
- Mechanical



TTCI
Transportation
Technology Center, Inc.

Work performed by
a subsidiary of the Association of American Railroads

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INTRODUCTION AND CONCLUSIONS

Tests indicate that an improved suspension system can provide lower rolling resistance and reduced lateral forces. These tests were conducted by the Transportation Technology Center, Inc. (TTCI) as part of an Association of American Railroads (AAR) Strategic Research Initiative to improve the economics of bulk-commodity service.

The performance of the ASF bulk truck was measured using methods described in a Bulk-Commodity Freight Truck Specification developed specifically for this program. Two identical baseline cars were used for these tests. Both are modern lightweight aluminum coal cars. One was empty and one was loaded to 315,000 pounds.

Exhibit 1 shows the base car used in evaluating suspension types. Compared to a baseline conventional three-piece truck, the ASF bulk truck demonstrated the following performance results:

- Lateral curving forces reduced by 50 percent
- Incremental curve resistance reduced by 50-60 percent
- Tangent resistance not changed
- High-speed stability improved
- Vertical dynamics improved for empty and loaded car

TRUCKS TESTED

Baseline Truck

The baseline truck was a Barber S-2-HD of 125-ton design. Snubbing is by four steel friction wedges, each resting on one B-355 outer and one B-356 inner-coil



Exhibit 1. Base Car Used in Evaluating Suspension Types

spring. Side bearings are Miner TCC 4500 constant-contact side bearings. The truck uses 38-inch wheels and has a secondary coil-spring suspension. Each side has one D5 outer coil and one D6 inner coil in parallel with a dual-rate spring package consisting of the following:

- Six B-291 main coils
- Six B-297 top coils in series with main coils
- Six B-298 intermediate coils in parallel with main coils

In the empty condition, the dual-rate spring group is soft for the first 1 inch of travel because the top coils are in series with the parallel combination of main and intermediate coils.

ASF Bulk Truck

The ASF bulk truck is based on a three-piece variable damped ASF Ridemaster™ truck. Warp restraint is provided by patented ASF high-performance machined features, which produce consistent three-button side frames. Shear pads are used at the side frame pedestal to enhance curving performance. The vertical spring rate is a patented ASF dual rate design. Side bearings were Miner TCC 4500.

TWIST-AND-ROLL TEST RESULTS

The twist-and-roll test measures the ability of a car to negotiate cross-level perturbations. Because the truck center spacing of the high-sided gondola car (40 feet, 6 inches) is very close to the wavelength of the perturbations, the car is excited in pure roll mode. Consequently, twist-and-roll is a difficult test for this car. The ASF bulk truck reduced the vertical load dynamics in this test, as shown in Exhibit 2.

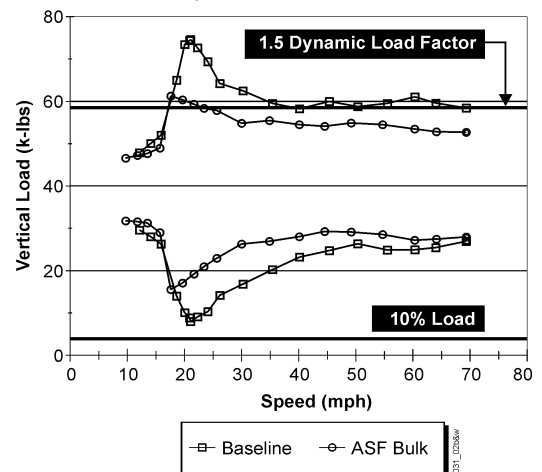


Exhibit 2. Maximum and Minimum Vertical Wheel Loads in Twist-and-Roll Tests — Loaded Car

PITCH-AND-BOUNCE TEST RESULTS

The pitch-and-bounce test regime measures the ability of the loaded car to negotiate vertical profile deviations. Poor performance results in suspension bottoming and high vertical track loads. The car's truck-center spacing is very close to the wavelength of the track perturbations; therefore, it is excited in an almost pure bounce mode of vibration.

Exhibit 3 compares the performance of the baseline and ASF bulk truck. Vertical loads were smaller for the ASF truck up to 60 mph. Above 65 mph, 1.5 dynamic load factor goal was exceeded for both trucks.

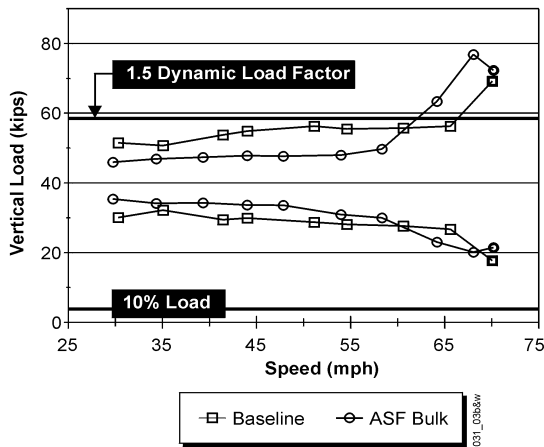


Exhibit 3. Vertical Wheel Load Performance in Pitch and Bounce Tests

CONSTANT CURVING TEST RESULTS

The constant-curving test measures a car's ability to negotiate well-maintained track curves. Poor performance increases costs associated with derailment and track maintenance. Exhibit 4 compares lead wheel and truck-side lateral forces in several curves. The ASF truck reduced average lateral curving forces by more than 50 percent.

DYNAMIC-CURVING TEST RESULTS

The dynamic-curving test combines cross-level and gage deviations in a 10-degree curve. The cross-level deviations are similar to those installed in the twist-and-roll test section. Minimum vertical-load was 11 percent of static for the base truck. The ASF truck improved this value to 29 percent of static.

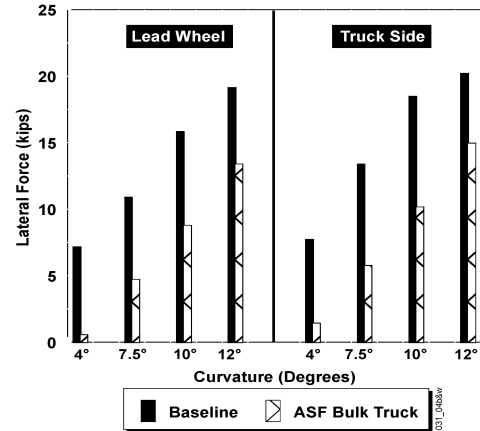


Exhibit 4. Lateral Wheel Load Performance in Constant-Curve Tests

HIGH-SPEED STABILITY TEST RESULTS

The high-speed-stability test is conducted to ensure that the empty car does not become laterally unstable at speeds up to and including 70 miles per hour. The base truck became unstable at 60 miles per hour. A worn baseline truck would be unstable at a lower speed. Exhibit 5 compares ASF and base truck performance.

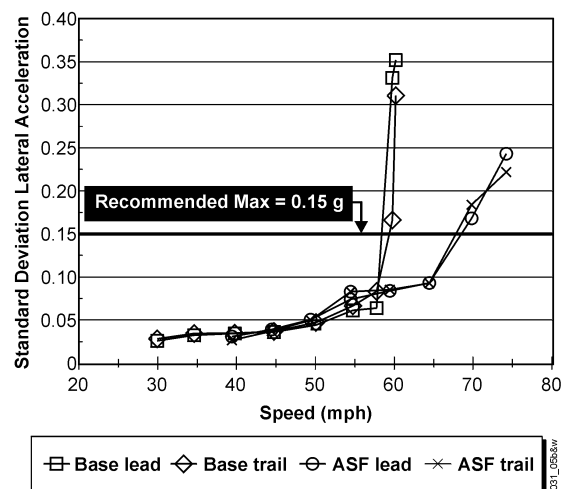


Exhibit 5. High-Speed Stability Performance — Both Ends of Empty Car



ROLLING-RESISTANCE TEST RESULTS

The ASF truck reduced incremental curve resistance by more than 50 percent, as Exhibit 6 shows. This will reduce wheel wear, rail wear, and fuel consumption. Tangent track resistance was not reduced.

ECONOMIC SAVINGS CALCULATION

Exhibit 7 shows the calculated economic benefit for the ASF truck on an eastern and a western route. Savings were determined from comparison of test results by the following method. Test results were modified by NUCARS model to reflect the difference between TTCI test tracks and well-lubricated railroad property.

At TTCI the rail friction is 0.5 while the railroad service friction is 0.31. The modification reduces the expected savings. The modified results were used in AAR models to calculate wheel wear, rail wear, track wear, and fuel consumption on typical routes at 100,000 miles service per year. The same method can be used to calculate savings on any specific route.

SUMMARY

The ASF bulk truck performance demonstrates potential to reduce operating costs for bulk-commodity cars through improved suspensions. The Advanced Truck Program offers assistance to designers of new suspensions through modeling support, testing of promising prototypes, and evaluation using cost models.

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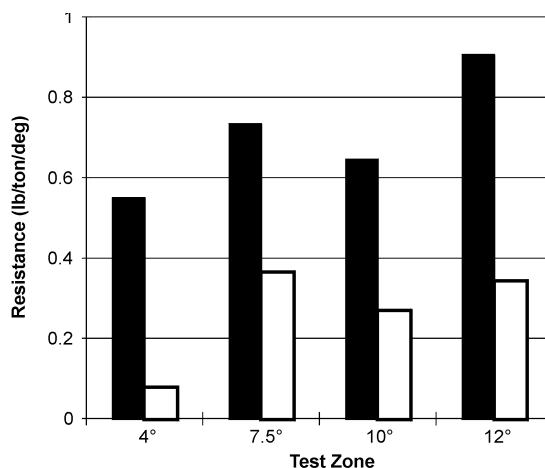


Exhibit 6. Incremental Curve Resistance in Pounds per Ton per Degree of Curve

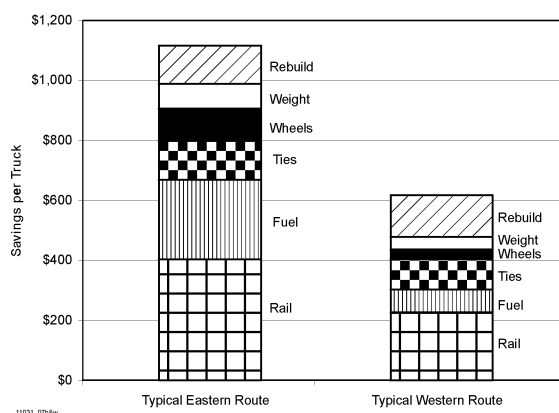


Exhibit 7. Savings for One ASF Truck in 100,000 Miles Service

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