Part II: Wheel/Rail Profile Management

As part of the AAR's Strategic Research Initiatives Program, TTCI developed improved software, new wheel/rail profiles, friction control measures, and measurement tools to manage the wheel/rail interface to reduce the stress state between wheel and rail.

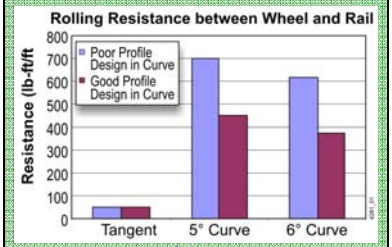


Figure 1.
Fuel consumption improvements in curves due to improved wheel and rail profile design

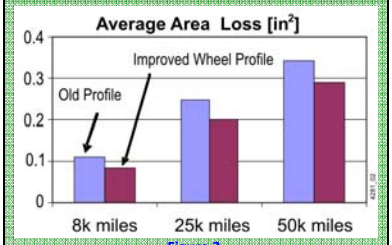


Figure 2.
Compatible wheel/rail contact reduces wheel wear, rail wear and fuel consumption

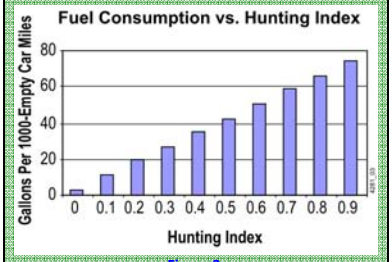
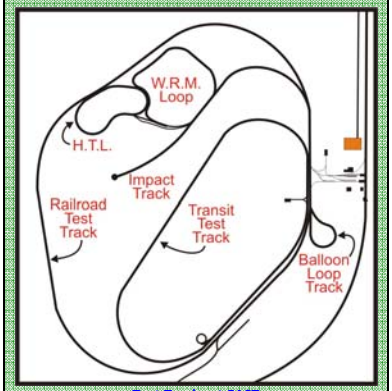


Figure 3.
Gallons of fuel consumed per 1000 empty car miles



Test Tracks at FAST

Poor wheel/rail contact, particularly in curves, reduces the effective steering capacity of the cars negotiating these curves. This appreciably increases the rolling resistance of trains on curved track, significantly impacting fuel consumption, track forces, and wheel and rail wear.

Figure 1 illustrates the reduction in drag resistance that can be achieved through improved rail profiles in curves. The graph shows the results of a simulation of the rolling resistance of a car as it negotiates sections of track at the Facility for Accelerated Service Testing at the Transportation Technology Center, Pueblo, Colorado. Use of the correct wheel and rail profiles on the car results in a 40 to 50% reduction in rolling resistance in the 5- and 6-degree curves as indicated. Both profile combinations were correct for tangent track; consequently there was little difference in performance on the tangent.

Anecdotal evidence suggests that poor wheel rail mismatch on railcars on a loaded coal train resulted in the locomotive engineers requiring to negotiate particular curves in notch 6 where they normally used notch 2 on trains with wheels with improved contact conditions.

Figure 2 illustrates the reduction in wheel wear attributable to these improved profiles, referred to as the SRI 1A, during the first 50,000 miles of a new wheel profile. The tests were conducted on Norfolk Southern railroads.

The profile analysis software, developed by TTCI engineers and named WRIM™, has identified wheel and track profile conditions that can lead to both empty and loaded car truck hunting, a type of vehicle instability that leads to track damage and ultimately leads to derailment. Truck and car hunting cause the wheels of the car to be excited laterally and the carbody to roll on the suspension. The energy to excite the car comes from the locomotive; increased car hunting thus increases the rolling resistance of the train. Improved wheel and rail management will reduce the propensity for hunting and save fuel.

Figure 3 shows the relationship between a so-called hunting index and fuel consumption; a typical, well maintained car on good track should exhibit a hunting index at least below 0.2 and, at best, less than 0.05 with a commensurate fuel consumption less than 20 gallons per 1000 miles (50 mpg) and possibly lower than 500 mpg. Figure 3 shows that poorly hunting cars may consume as much as 8 to 10 times these figures.

It may thus be seen that wheel and rail profile management is vital to ensuring the energy efficient operation of railroads.