

“INTERIM REPORT: FAST RAIL SEAT ABRASION TEST”

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TD 95-019

SUMMARY

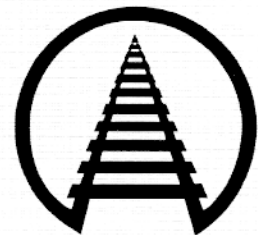
During the past four years and 300 MGT of train operations, the Facility for Accelerated Service Testing (FAST)/Heavy Axle Load Program (HAL) at the Transportation Technology Center, Pueblo, Colorado, has evaluated a number of materials and components designed to resist or prevent abrasion. Results suggest that there are some combinations of pads which can reduce or prevent abrasion. Repair techniques which appear to survive HAL traffic are also available.

The following pad materials seem to offer promise in preventing abrasion:

- ▶Dual durometer materials (hard and soft materials bonded to a single pad)
- ▶Sandwich materials (multiple products such as a sealant, steel plate and resilient material on one pad)
- ▶Convex rail seats

Many abrasion resistant pads may not provide a permanent solution. During the life of the tie, they may require replacement on a periodic basis. Repairing rail seats and replacing tie pads between programmed rail replacement cycles can be a significant cost item. For this reason, the target life cycle between tie pad replacement should be the same as the rail at a given location.

Currently, a continuation of this test is being planned. With fewer test variations and a larger population of each product, determination of the full life cycle of each promising technique will be possible.



Suggested Distribution:

Operating/Engineering Dept.

- Maintenance of Way
- Maintenance Planning
- Track Maintenance

Research and Development/Test Dept.

Association of American Railroads
Research and Test Department

August 1995



INTRODUCTION AND CONCLUSIONS

During the past four years, a matrix of materials intended to eliminate or control concrete tie rail seat abrasion has been monitored as part of the Facility for Accelerated Testing (FAST)/Heavy Axle Load (HAL) program at the Transportation Technology Center, Pueblo, Colorado. Results after 300 MGT of HAL traffic point to several promising solutions for preventing rail seat abrasion, as well as repair techniques designed to address areas where abrasion has already occurred. It is uncertain if those materials showing promising performance have sufficient tonnage to be considered a permanent solution, or whether they must be periodically inspected and replaced.

WHAT IS RAIL SEAT ABRASION?

Concrete tie rail seat abrasion results when tie material under the pad is lost to abrasion, hydraulic action, and motion transmitted from the rail. Abrasion takes the form of localized breakdown of cement paste under the rail seat. The appearance of moderate abrasion is shown in Exhibit 1.



Exhibit 1. Appearance of Rail Seat Abrasion in the Field

In revenue service, many of the following characteristics present at abrasion sites are also present in the FAST/HAL program:

- ▶ High annual tonnage
- ▶ High moisture (rain, snow, etc.)*

- ▶ Severe curvature and high L/V conditions
- ▶ Heavy axle loads
- ▶ Rail grinding
- ▶ Use of locomotive sanding

*High annual moisture has been addressed in the test conduct by adding water to simulate higher annual rainfall conditions. Spraying this additional water adds approximately 21 inches of effective moisture to the natural 11 inches per year.

EVALUATION OF MATERIALS AT FAST

A number of new concrete ties and ties from revenue service with various amounts of abrasion were obtained and installed in FAST during the December 1990 track rebuild. A range of tie pads and repair techniques was introduced to this mix of concrete ties. At the time and during subsequent phases of the abrasion test, tie and pad selection was accomplished under the direction of the ad-hoc Concrete Tie Rail Seat Abrasion Committee. The abrasion test zones at FAST surround existing concrete ties in Section 3, a 5-degree curve. Refer to Exhibit 2.

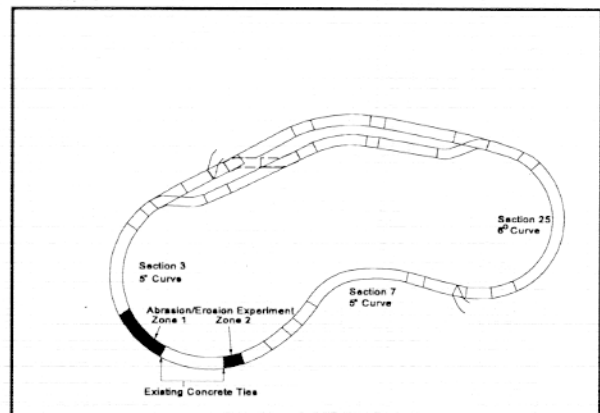


Exhibit 2. Rail Seat Abrasion Test Zones at FAST

Major combinations of pads, ties, and repair techniques included variations in the following categories:

- ▶ Dual Durometer Rubber pads
- ▶ Rubber reinforced pads
- ▶ EVA pads



- ▶ Various pad materials with various shape factors
- ▶ Polyurethane
- ▶ Tie pads bonded or glued to the tie surface
- ▶ Pads with a sealing ring built into the surface
- ▶ Three part sandwich pads (foam/steel plate/pad material)
- ▶ Steel plate cast into new tie
- ▶ Steel plate/epoxy repair
- ▶ Epoxy repair
- ▶ Variety of filler materials for repair
- ▶ Alternative insulator materials
- ▶ Tie surface coatings
- ▶ Alternative concrete mixes
- ▶ Rail seat surface shape factors

Each system has been proposed according to its unique approach to solving the abrasion problem. For example, glued pads sealed to the tie surface were evaluated based on their ability to eliminate contamination by water, sand and other particles, thus eliminating the cause of abrasion. This solution did not reduce abrasion at FAST as the pads did not remain "glued" to the tie surface. The scope of this test summary cannot begin to describe each of the 65 pad and material combinations and the theory behind each technique.

DATA

Fewer data collection cycles were available to measure the abrasion depth, primarily because rail had to be removed, pads had to be individually picked up and the rail seat had to be cleaned. Initially, data was obtained on a 50 MGT cycle, then on a 100 MGT cycle. Because each railseat had to be disturbed, the inspection and measurement process may have occasionally had an adverse effect on how some pad combinations resisted abrasion. A modified version of the CXT abrasion gage, which compares the perimeter areas of a tie pad footprint of the rail seat relative to the non-wearing tie surface, was fabricated. Exhibit 3 shows a three dimensional plot of typical abrasion data utilizing this gage. As can be seen, the deepest abrasion generally occurs on the field side of the high rail, with the depth of abrasion reducing towards the gage side. This is due to lateral loads.

RESULTS/OBSERVATIONS TO DATE

Based on the solutions under evaluation at FAST, it appears that abrasion can be

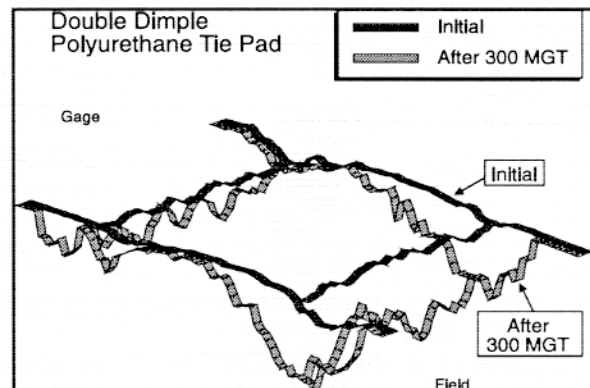


Exhibit 3. Typical Rail Seat Abrasion Data Resulting from Use of Modified CXT Abrasion Gage

controlled by certain combinations of pads and materials. However, the life cycle of these techniques is not yet known. Several solutions, including very soft pads, dual-durometer pads, and sandwich pads appear to either prevent or minimize the formation of abrasion. At this time though, they do not appear to be permanent solutions; they must be replaced during the life of the tie or rail installation.

Exhibit 4. Performance Data for Various Abrasion Resistant Pads and Materials

Pad Type	MGT	Avg. Abrasion Depth.	Abrasion Rate mm\100 MGT
Flat EVA	300	4.4 mm	1.47
Soft Rubber	142	1 mm	.7 *
Double Dimple Polyurethane	300	5.4 mm	1.8
3-Piece Sandwich	200	<1 mm	<.5
Convex Rail Seat	100	<1 mm	<.5

* Limited life, < 150 MGT



Many of the softest rubber pads at FAST have shown no abrasion, but after 100 to 150 MGT of service, the pad has worn through or must otherwise be replaced. Exhibit 4 summarizes data for a number of materials selected to show a sampling of good and bad performers.

Ideally, the life of abrasion eliminating materials should, at least match, if not exceed the rail replacement cycle. This would allow materials to be replaced at little incremental cost during routine, planned rail change-outs. If they must be replaced between rail replacement cycles, then a significant increase in cost will be incurred in track time, train delays, and labor effort to de-clip rail, raise and replace the pad, and replace the rail. Based on data collected to-date, the rail seat abrasion problem, although not "solved", can be managed if a proper combination of material and replacement protocol is selected.

NEXT PHASE

To determine which of the promising solutions have an adequate life cycle, selected pad materials will continue to be evaluated at FAST. The abrasion program at FAST is currently being reviewed for reconfiguration to improve long-term evaluation of a limited number of materials. The test conduct will be revised to allow a smaller number of material variables that have shown abrasion resistance to be evaluated, but in larger sections. This will permit a few samples from each matrix to be measured on a periodic basis and allow long-term evaluation of the most promising materials.

A more detailed summary of results from the FAST rail seat abrasion test will be presented at the November 6-8 Engineering Conference to be held in Pueblo, Colorado.

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