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of Transportation

**Federal Railroad  
Administration**

## **Fiberglass Wrapped Tie Performance Evaluation Report**

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Office of Research and  
Development  
Washington, D.C. 20590

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<b>13. ABSTRACT</b> <p>Forty-two fiberglass fabric wrapped, solid-sawn wood ties during 300 million gross tons (MGT) of heavy axle load (HAL) traffic and eight fiberglass fabric wrapped ties with metal cover plates were recently evaluated during 125 MGT of HAL traffic at the Transportation Technology Center in Pueblo, Colorado.</p> <p>This observational test was a followup to West Virginia University's test of 200 fiberglass wrapped ties test that concluded in 2002 after 145 MGT of HAL traffic. The original test showed that the fiberglass wraps were not as durable as intended, thus prompting this evaluation of improved fiberglass and metal covered fiberglass wraps. The second test showed that the changes made to the fiberglass wraps improved their durability.</p>				
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## 1.0 INTRODUCTION

Transportation Technology Center (TTC), located in Pueblo, Colorado, recently completed an evaluation of the performance of 42 fiberglass fabric wrapped, used solid-sawn wood ties under 300 million gross tons (MGT) of heavy axle load (HAL) traffic, and 8 fiberglass fabric wrapped ties with metal cover plates under 125 MGT of HAL traffic. West Virginia University (WVU) at Morgantown, West Virginia, supplied the ties. The fiberglass wraps are intended to extend tie life by refurbishing used ties.

This evaluation was a followup to a test of WVU's 200 fiberglass wrapped ties that was concluded in 2002 after 145 MGT of HAL traffic at TTC. Those fiberglass wraps showed significant degradation, and WVU requested a new test on ties with wraps that were intended to better withstand the effects of tonnage. After 175 MGT of traffic on the ties with the new wraps, WVU asked for an evaluation of 8 additional ties with metal cover plates. The cover plates were intended to protect the wraps from damage caused by tie plates or rail anchors. Two of the ties had solid, light-weight cover plates; two had solid, heavier plates; and four had perforated plates.

The test was observational, with the objective of monitoring durability of the fiberglass fabric wrap.

## 2.0 OBJECTIVES

The objectives of the evaluation were to determine the following:

- The durability of the fiberglass fabric wraps
- The spike retaining and gage holding ability of the ties based on need for maintenance to Federal Railroad Administration Class 4 track standards
- The durability of the metal cover plates

## 3.0 PROCEDURES

The ties were installed during August 2002 in Section 3 of the High Tonnage Loop (HTL) at the Facility for Accelerated Service Testing (FAST) at TTC. The ties were handled in the same way railway cross-ties are normally handled during unloading and installation. Table 1 lists test conditions.

**Table 1. Test Conditions at the Original Installation Site**

Location	Section 3 on the HTL at FAST
Test Zone	68 track-feet, 42 ties at 19.5-inch spacing
Track Geometry	5-degree, 4-inch superelevation curve
Ballast Section	Existing ballast; nominal 18-inch depth with 15-inch shoulders
Fastening System	14-inch AREMA tie plates; cut pike hold-down and rail spikes; rail anchors on every tie
Rail Section	136 pound-per-yard RE welded rail
Train	70 to 80 315,000 pound (39-ton axle load) cars
Operating Speed	40 mph
Suspension	Standard suspension trucks

After the ties had accumulated 175 MGT, the 42 ties were moved during the fall of 2003 to accommodate installation of two test bridges at FAST. The ties were moved to a spiral, near the point of curvature of the five-degree curve in which they were originally installed. The rail spike holes were plugged with wood plugs when the ties were reinstalled. The eight ties with cover plates were installed at that time.

The ties were visually inspected at the start of the test and at 25 MGT intervals. Figure 1 shows the ties before installation. During the test, the portion of fiberglass wrap that was visible under typical track conditions was inspected. At the conclusion of the test, ballast was moved away from two ties to document the condition of the sides of the ties. At the same time, two ties were removed by pulling them through the ballast section to expose the bottoms of the ties and to determine if removal in this manner caused damage to the wrap. Tie plates were removed from the ties that had been removed from the track to allow observation of the condition of the wrap that had been under the plates.



**Figure 1. Wrapped Ties before Installation**



## 4.0 RESULTS

The following summarizes the condition of the 42 original ties after 300 MGT:

- The test zone held gage, surface, and alignment without maintenance.
- Rail anchors had damaged 77 of the 84 wraps (Figure 2).
- Tie plates had damaged 36 of the 84 wraps (Figure 3), but it did not appear that the wrap had been cut completely through on most of those ties. Removal of the tie plates would be necessary to further determine the condition of the wraps.
- Nine of the 420 spikes were up more than 0.5 inch. No maintenance was required. This is comparable to other used ties in the same area that had been plugged with wood plugs and re-spiked when installed.
- Two of the wraps showed clear indications of loosening from the tie.
- Seven of the wraps had wear and abrasion extending through the wraps to the tie corners.
- On the two ties that had ballast moved away so the sides were exposed:
  - The sides on the low rail side of one tie were in poor condition (Figure 4). The sides of the other three wraps were in good condition (Figure 5).
- On the two ties that were removed by pulling them through the ballast and that had their plates removed:
  - None of the four wraps had plate cutting damage that penetrated the entire wrap (though two of the four wraps had minor damage, as noted, during the final in-track inspection).
  - There was no indication that pulling the ties through the ballast had damaged the wraps.
  - The sides of all four wraps were in good condition.
  - The bottoms of both wraps on one tie were in good condition (Figure 6).
  - The bottoms of both wraps on the other tie were in poor condition (Figure 7).
  - The wraps of both ties were in better condition than wraps on the original 200 ties were after 356 MGT (Figure 8).

The following summarizes the condition of the eight ties with metal cover plates after 125 MGT:

- The two ties with light-weight solid cover plates:
  - Were not able to withstand normal tie handling and train traffic. One of the plates was damaged during transit to TTC, and one was damaged during tie installation.
  - The two that were in good condition at 0 MGT were sufficiently damaged after 25 MGT, in that they no longer provided protection to the fiberglass wraps (Figure 9).
- The two ties with heavier solid cover plates:
  - One cover was damaged during installation.
  - Rail anchors had damaged four of the four cover plates (Figure 10).
  - Tie plates had damaged two of the four cover plates.
- The four ties with perforated cover plates:
  - Rail anchors had damaged five of the eight cover plates.
  - Tie plates had damaged three of the eight cover plates (Figure 11).

## 5.0 CONCLUSIONS/OBSERVATIONS

- The changes made to the fiberglass wraps improved their durability compared to the original 200 test ties.
- The reconditioning/filling of the spike holes before the application of the fiberglass wraps resulted in ties that required no spike maintenance in 175 MGT (the tonnage at which the ties were relocated). No spike maintenance was required in the additional 125 MGT after the ties were moved (wood tie plugs were used when spikes were reapplied).
- Rail anchors damaged nearly all of the wraps. The only wraps that were not damaged were those that were protected from contact with the anchors by the shape of the ties.
- Forty-three percent of the wraps showed some damage caused by tie plates. It did not appear that the wrap had been cut through on most of those ties.
- The heavier metal plates and perforated metal plates provided the fiberglass wraps some protection from plate and anchor damage. The perforated plates were more durable.
- The track crew reported that it was difficult to drive spikes through the heavier solid and the perforated metal plates with a spike maul.
- One potential benefit of the wraps, protecting ties from moisture, was not evaluated in the dry climate at TTC. The wraps might perform differently in wet conditions.
- The test was observational. There were no quantitative comparisons with earlier wrapped ties tested or non-wrapped ties tested.
- Based on their performance and current condition, the ties should provide several more years of acceptable service at FAST. Tie life cannot yet be estimated.
- Evaluating the economics of attempting to extend tie with fiberglass wrap is beyond the scope of this project.



**Figure 2. Damage to Wrap Caused by Rail Anchor**



**Figure 3. Tie Plate Cutting into Wrap**





**Figure 4. Side of Tie with Ballast Moved to Expose Wrap (poor condition)**



**Figure 5. Side of Tie with Ballast Moved to Expose Wrap (good condition)**





**Figure 6. Bottom of Tie Removed from Track Showing Wrap in Good Condition**

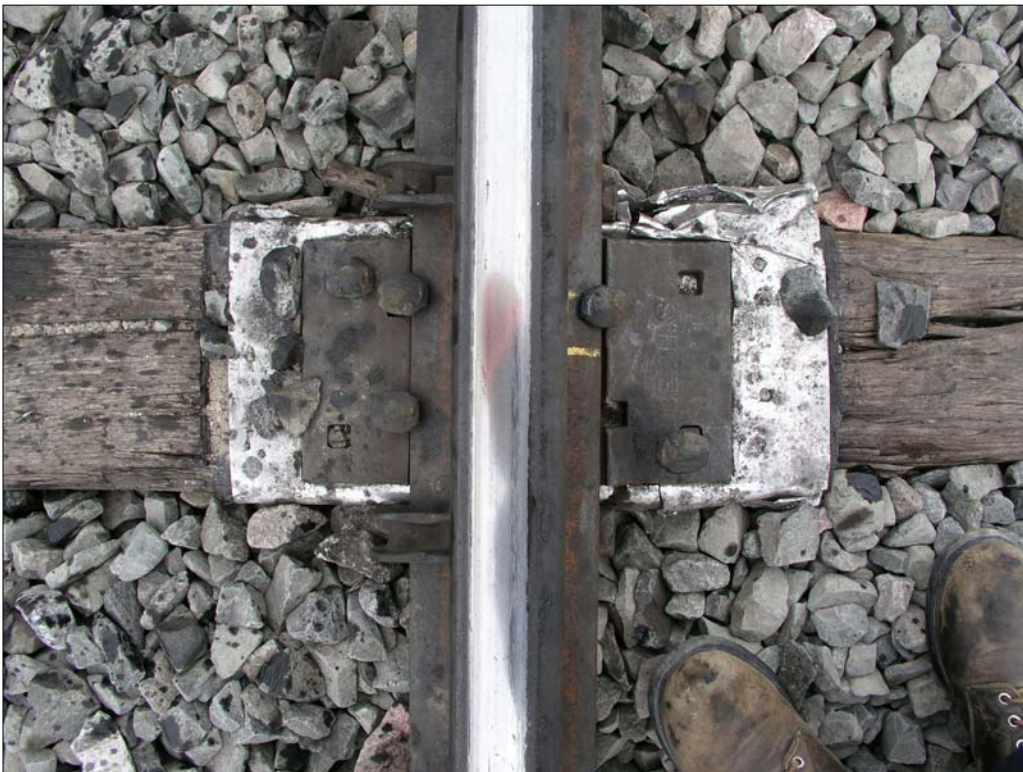


**Figure 7. Bottom of Tie Removed From Track Showing Wrap in Poor Condition**





**Figure 8. Bottom of Tie with First Generation Wrap after 356 MGT**



**Figure 9. Light-Weight Cover Plate after 25 MGT**





**Figure 10. Heavier Cover Plate Damaged by Rail Anchor**



**Figure 11. Perforated Cover Plate Damaged by Tie Plate**