

ECONOMIC EVALUATION OF ALTERNATIVE RAIL-DEFECT REPAIR USING A BULLDOG CLAMP

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Summary

The use of a device known as a "bulldog clamp" to make temporary repairs of rail defects has been proven to simultaneously reduce repair costs and train delays.

The Association of American Railroads is studying the use of the bulldog clamps permitted under a Federal Railroad Administration-monitored waiver. Alternative policies may incorporate a grace period for use of bulldog clamps in place of conventional drill-and-bolt practices.

The bulldog clamp is a modified set of angle bars held in place by C-clamps. Since the clamps do not require the use of bolts, crews do not drill holes in the rail, thus expediting repairs and increasing available track time.

Speedy application of temporary repairs to rail defects will increase time available for rail-inspection vehicles, increasing the number of temporary repairs that chase crews can apply each day. This in turn will permit rail-inspection crews to increase mileage.

Furthermore, bulldog clamps in some instances may allow for permanent repairs with only one field weld, rather than the more costly conventional practice of installing a rail plug with two field welds.

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Suggested Distribution:

- Maintenance of Way
- Planning and Analysis
- Track Maintenance
- Safety

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INTRODUCTION AND CONCLUSIONS

Improvements to rail-defect detection and defect-handling methods can increase network operating efficiency. By allowing more efficiency in the temporary repair of detected defects, improved train operations can be obtained. Current practice utilizes bolted joint bars to protect detected defects until these defects are removed. In some cases these joint bars remain in place for extended time periods. With the advent of heavier axle loads and increased tonnage, railroads are striving to remove defects soon after detection, thus the time and expense of drilling holes for a short-term repair becomes an issue. The use of a bulldog clamp, which does not require holes to be drilled in the rail, is being evaluated under a Federal Railroad Administration (FRA)-monitored waiver.

Additional savings could be obtained by expanding the application of bulldog clamps to protect defective thermite welds if an acceptable wide-gap replacement weld becomes available.

APPLICATION AND BNSF EXPERIENCE

Traditionally rail defects discovered by inspection-car crews have been temporarily repaired by chase gangs who drill the rail and install standard joint bars. This process requires that four holes — two on each side of the defect — be drilled, and the joint bars are then bolted onto the rail. When the defect is to be permanently repaired, the angle bars are unbolted, and a rail plug, generally 15 feet to 19 feet or longer, is thermite-welded in place. To eliminate bolt-hole failures, if holes are drilled in the rail, the use of a plug is standard policy by the Burlington Northern Santa Fe (BNSF) in the territory evaluated in this study.

This digest evaluates potential advantages of using bulldog clamps in place of the drill-and-bolt technique. The use of clamps has allowed a significant reduction in the number of bolt holes in high-tonnage track.

The bulldog clamp provides protection equivalent to bolted angle bars, but with the significant advantage of eliminating the need for holes to be drilled into the rail (see Exhibit 1). The advantage is seen not only in reduced installation time of this remedial repair, but when the defect is removed, the potential exists for permanent repair using only one thermite weld rather than a plug and two thermite welds.

The bulldog clamp is being evaluated on a trial

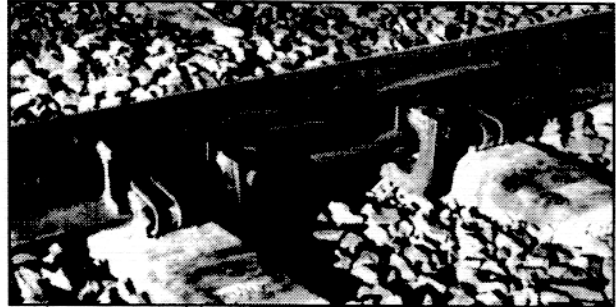


Photo courtesy of Mike Armstrong/BNSF

Exhibit 1. Bulldog-Clamp Repair of Defective Rail

basis by the BNSF Railroad under a limited Federal Railroad Administration (FRA) waiver. The limitations of the waiver include defect removal within 10 days after application. In addition, all uses of bulldog clamps are reported to the FRA.

Since 1993 the BNSF has had the opportunity to apply the bulldog clamp on more than 80 defects on the coal route selected for their FRA waiver. To date, no clamp failures or broken rails under clamp protection have occurred. This includes instances of clamps installed during cold-weather winter months. Since the use of the bulldog clamp has been restricted to one territory, implementation has been conducted gradually, and only after maintenance crews have been thoroughly trained on the waiver restrictions and reporting requirements. As maintenance crews gain experience and confidence in the use of the bulldog clamp, its use is being considered over a wider territory.

BULLDOG CLAMP VS. JOINT BAR INSTALLATION

In order to compare remedial repair methods, researchers adopted assumptions as to labor effort, materials and costs, train delay and number of defects applicable to each method. Much of this data is based on field experience of BNSF railroad personnel participating in this study. Other costs and efforts are based on industry numbers used by the Association of American Railroads (AAR) in other economic models.

The baseline standard method of joint-bar emergency repairs was compared to utilizing a bulldog clamp in selected locations. The following figures were used in this economic analysis:

ROUTE AND TONNAGE

- Route length — 1540 mile coal route
- Tangent track — 76 percent, or 1,170 miles
- Under 2 degrees — 13 percent or 200 miles



- Over 2 degrees — 11 percent or 163 miles
- Traffic of 150 MGT per year
- 20 loaded and 20 empty trains per day
- 90 percent probability of train delay
- Train delay cost at \$295 per hour
- 5-mph speed reduction on empty trains only

REMEDIAL ACTION OPTIONS

Itemized costs for installation of standard joint bars:

- Crew size of two
- 0.5 hour installation time
- 0.5 hour travel/preparation time
- \$28.50 hourly wage, fully loaded
- \$5 per installation incidental materials
- \$35 per pair angle bar cost
- 80 pairs in inventory for test case
- 2 pairs replaced annually

BULLDOG CLAMP

Itemized costs for installation:

- Crew size of two
- 0.25 hour installation time
- 0.5 hour travel and preparation time
- \$28.50 hourly wage, fully loaded
- No incidental materials cost
- \$390 per clamp purchase price
- 80 sets in inventory for test case
- 2 sets replaced annually

The above items are required for crews to take immediate remedial action on defects found by detector cars. The policy for subsequent removal of these defects is determined by their size and location. If the

defect is located between ties, within limits of the crib, and no holes have been drilled, a replacement using the bulldog clamp and a single field weld is feasible, provided the defect size and orientation allows complete removal within the opening required for a thermite-weld gap. If the defect falls over a tie, is within an existing thermite weld or is too large for a standard weld site, then a plug is required.

PERMANENT REPAIR OPTIONS

It is assumed that all plug repairs will require the installation of two thermite welds and a plug of repair rail 19 feet long. The following comparative costs are included in the evaluation of the two repair techniques.

RAIL PLUG INSTALLATION ITEMIZED COSTS

- Crew size of two
- 1.5 hour installation time
- 6.5 hours preparation and travel
- \$28.50 hourly wage, fully loaded
- 2 thermite weld kits, \$100 each
- 19-foot length of 136# rail, \$650/ton

ITEMIZED COSTS FOR INSTALLATION OF A THERMITE-WELDED REPAIR FOLLOWING BULLDOG CLAMP INSTALLATION

- Crew size of two
- 1 hour installation time
- 3 hours travel and preparation time
- \$28.50 hourly wage, fully loaded
- 1 thermite weld kit, \$100
- Estimated \$150 per kit for wide gap

Exhibit 2. Annual Rail Flaw Repairs and Unit Costs

Repair Policy Case	Defects per Year	Rail Defects		Defective Thermite Welds		
		Joint Bar with Plug Repair	Bulldog Clamp with Plug Repair	Joint Bar with Plug Repair	Bulldog Clamp with Thermite Weld Repair	Bulldog Clamp with Wide-Gap Thermite Weld Repair
Base Case	1,400	1,400	N/A	N/A	N/A	N/A
Test Case 1	1,400	700	280	N/A	420	N/A
Test Case 2	1,400	700	N/A	N/A	420	280
Cost per Repair*		\$1,685	\$1,670	\$1,685	\$828	\$878

* Based on itemized costs shown in this report.

Note: Test Case 1 — Current FRA waiver practice using bulldog clamps.

Test Case 2 — Additional savings if wide-gap weld becomes available.



RESULTS OF ECONOMIC SIMULATIONS

A number of alternative rail-replacement policies were evaluated using a model developed by the AAR that includes labor and material costs, train delay and the other parameters listed above. These parameters can be varied to suit different scenarios as needed. The cost to replace each defect includes remedial action and final removal. Exhibit 2 summarizes unit costs for various defects.

UNIT COSTS

The Base Case assumes only drilled joint-bar remedial action. Test Case 1 shows costs to repair defects when a bulldog clamp is an option. Test Case 2 shows costs if a wide-gap repair weld is offered as an option for repairing defective thermite welds. In Cases 1 and 2, the number of rail defects where a bulldog clamp can be used is 420. In Case 2, the number of defective thermite welds where a bulldog clamp with a wide-gap weld can be used is 280. The remaining 700 rail defects are located where the use of a bulldog is restricted, and repair would require moving a tie in order to allow a single thermite weld to be made. For

Case 2, it is assumed that any defective thermite weld in place is located between ties, thus it can be repaired using a single wide-gap weld.

Exhibit 3 summarizes the total annual cost for rail-defect repairs on the coal loop evaluated in this study. Annual costs for repairing all 1,400 defects (1,120 rail defects and 280 defective thermite welds) have been estimated. Using the estimated parameters and costs, annual savings of \$253,000 can be obtained by using bulldog clamps, with an additional \$221,000 annual savings potential if wide-gap repair welds were available. (Total benefit of \$474,000.)

Given the large net-present benefits of the bulldog clamp, its use on a wider territory should be investigated. Experience to date has shown that no rail breaks, pull-aparts or premature rail-defect failures have occurred while the bulldog has been in place.

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Exhibit 3. Rail Flaw Repair Policy Cost Breakdown and Benefits Comparison

Policy Cost Breakdown and Total for Study Route	Base Case Drilled Joint Bar	Case 1 Bulldog Clamp	Case 2 Bulldog Clamp with Wide-Gap Weld
Installation Cost (Remedial Repairs Made)	\$84,000	\$74,000	\$74,000
Repair Cost (Permanent Repairs Made)	\$1,321,000	\$1,062,000	\$904,000
Remedial Repair Installation Time Delay	\$0	\$0	\$0
Repair Time Train Delay (Permanent Repairs)	\$995,000	\$859,000	\$796,000
Remedial Repair Slow-Order Train Delays	\$0	\$113,000	\$113,000
Annual Equipment Cost	\$7,000	\$6,000	\$6,000
Total Annual Policy Cost	\$2,367,000	\$2,114,000	\$1,893,000
Estimated Before-Tax Annual Savings	N/A	\$253,000	\$474,000
First Year Equipment Expense	\$6,000	\$34,000	\$34,000
After-Tax PV of Benefits Relative to Base Case 10-Year Time Horizon	N/A	\$924,000	\$1,748,000

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