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Evaluating Repair Effectiveness via Hunting Detector Data

Sam Chapman, Harry Tournay, and Michael Griffin

This Technology Digest (TD) supplements TD-07-005. It evaluates the effectiveness of various repairs performed by car owners on cars that could have been considered poor performers using hunting detectors (HDs). This TD can be used in conjunction with TD-07-005 *to establish an effective inspection and maintenance program for HD identified cars.*

SUMMARY

HDs identify cars having poor lateral dynamic performance and enable planning of appropriate maintenance actions to reduce inspection and maintenance costs.

In 2005 and 2006, more than 50 single-unit cars were identified as poor performers using HDs and were brought to the Transportation Technology Center (TTC), Pueblo, CO, for inspection, testing, and teardown. Certain cars were also repaired and retested to evaluate the effectiveness of specific repair procedures. Results from these activities were reported in TD-06-025, TD-07-012, and TD-07-005.[1,2,3] It was found that the best means of eliminating hunting was by increasing truck to carbody rotational resistance and truck warp restraint.

Repair experience to date is limited; there are many truck types in service and suspension component replacement and repair options. It is envisioned that individual car owners will use the current recommendations as initial guidelines to be verified or further developed by relating the repairs made to the immediate and long-term improvement obtained in performance at HDs.

To illustrate this process, a preliminary survey of historic performance and repair records of certain cars was conducted. Repairs were not necessarily made to improve HD performance, but in response to the owners' planned maintenance programs. Consequently, some of these initiatives were effective, while others did not improve car performance at HDs; information in this latter regard is still useful as it informs on what initiatives are not effective.

Initial findings from this survey suggest that repair effectiveness can be reasonably evaluated via analyzing HD data. Additionally, one of seven cars more thoroughly repaired at TTC had enough post repair HD data to substantiate the conclusion that the repairs made were effective.

This work was sponsored by the Association of American Railroads as part of its Strategic Research Initiatives Program and conducted jointly with the Advanced Technology Safety Initiative Program, which has been tasked to improve railroad safety and network efficiency by using innovative trackside technologies to provide freight car owners with advanced warning of degraded car performance.

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INTRODUCTION AND BACKGROUND

HDs identify cars having poor lateral dynamic performance (hunting) and enable planning of appropriate maintenance actions to reduce inspection and maintenance costs.

In 2005 and 2006, more than 50 single-unit cars were identified as poor performers at different Salient Systems' hunting index (HI) levels and brought to TTC for inspection, testing, and teardown. Certain cars were also repaired and retested to evaluate the effectiveness of specific repair procedures. Results from these activities were reported in TD-06-025, TD-07-012, and TD-07-005.[1,2,3] It was found that the best means of eliminating hunting was by increasing truck to carbody rotational resistance and truck warp restraint.

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OVERALL CAUSES FOR POOR PERFORMANCE

General causes for hunting, as confirmed through inspection, test, and teardown at TTC, include:

- Low truck to carbody rotational resistance
- Low truck warp restraint
- High wheelset conicity

High wheelset conicity (in excess of 0.3) can be associated with wheels well within current wear limits.[1,2] It has been verified, under test, that well maintained car suspensions adequately control hunting, given wheelsets with these high conicities.[1,3] Consequently no recommendation is made regarding the replacement of wheels that are not condemnable according to existing interchange rules.

DATA ANALYSIS AND RESULTS

Table 1 shows a summary of findings from a performance and repair records survey of eight single-unit cars repaired by their owners. Repairs were not necessarily made in response to poor HD performance, but according to particular maintenance initiatives of the car owners.

Table 1. Influence of Car Repairs

Repairs		Apparent Effect on Performance	Number of Cars Surveyed
Rotational Resistance	Warp Restraint		
Constant contact side bearing or C-Pep shim application	Major truck reconditioning (typically includes AAR Specification M-214); Most of: new or renewed friction wedges, wear plates, gibs, springs, pedestal roofs/liners and adapters	Substantial improvement	4
Nothing done		Moderate to substantial improvement	1
Nothing done	Some or most of: new or renewed friction wedges, wear plates, gibs, springs, pedestal roofs/liners and adapters	Little to no improvement	3

Whenever wheelset repair or replacement is done in conjunction with truck repairs, it becomes difficult to isolate the effectiveness of the latter on performance improvement. Consequently, only cars that received truck repairs but no wheelset repair or replacement were considered.

Furthermore, in order to reasonably evaluate repair effectiveness using HDs, sufficient post-repair data should exist revealing similar hunting opportunities as pre-repair data. Thus for a car to be included in this preliminary survey, it needed at least five post-repair Salient Systems' Hunting Truck Detector (HTD) passes under similar train speed and truck load conditions as its pre-repair offending passes; i.e., those with absolute valued HI (|HI|) at or above 0.2.[1,2]

For each of the eight cars surveyed, Salient HTD data was obtained from *Inte*RRIS® for the time period beginning at the start of January 2003 and ending near the middle of January 2007. The data was filtered appropriately by train speed and truck load, as discussed, and a graph of recorded |HI| values per truck versus date was developed for each car, with the date of repairs indicated by a labeled, dashed vertical line.

Figure 1 shows an example of performance improvement gained by a car that received the more thorough, combined rotational resistance and warp restraint repairs listed in the first nonheading row of Table 1. The |HI| values for both trucks appear substantially and consistently reduced post repair. Hence, this car's repairs can be judged as effective at curtailing its hunting problem.

These graph characteristics also apply to the other three studied cars that received the more thorough, combined rotational resistance and warp restraint repairs. With only

minor variations, all showed substantially and consistently reduced |HI| values for both trucks post repair.

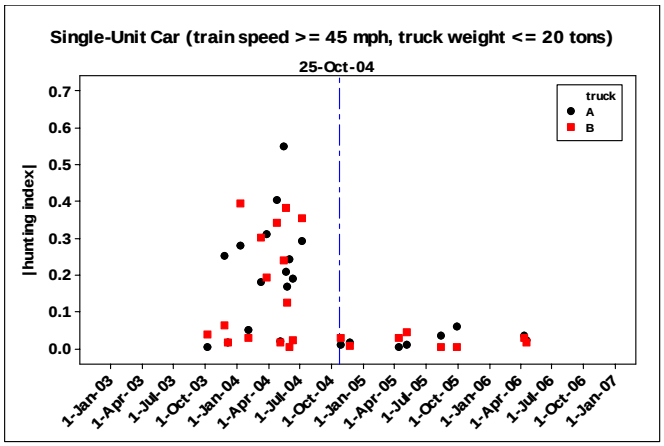

Figure 1. Substantial Improvement from More Thorough Rotational Resistance and Warp Restraint Repairs

Figure 2 shows performance improvement gained by the one studied car that received only the more thorough warp restraint repairs listed in the second nonheading row of Table 1. The |HI| values for the A-truck appear at least moderately and fairly consistently reduced post repair, while the |HI| values for the B-truck appear largely unaffected but remain acceptable. Hence, this car's repairs can be judged as at least partially effective at curtailing its hunting problem.

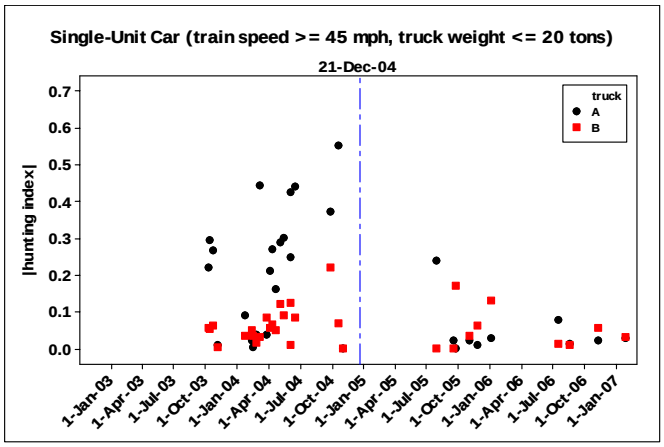

Figure 2. Moderate to Substantial Improvement from More Thorough Warp Restraint Repairs

Figures 3 through 5 show little to no performance improvement gained by the three studied cars that received only the less thorough warp restraint repairs listed in the third nonheading row of Table 1.

The cars displayed in Figures 3 and 4 received most of the listed repairs; whereas, the car shown in Figure 5 only received new friction wedges. Also noteworthy regarding the car displayed in Figure 4 is that its repair records indicate removal of its C-Pep shim assemblies without replacement or installation of constant-contact side bearings to help control rotational resistance. The repair records for the cars shown in Figures 3 and 5 did not reveal anything related to rotational resistance.

For all of these cars, at least some of their |HI| values for both trucks still appear inordinately high post repair. Hence, their repairs can be judged as ineffective at curtailing their hunting problems.

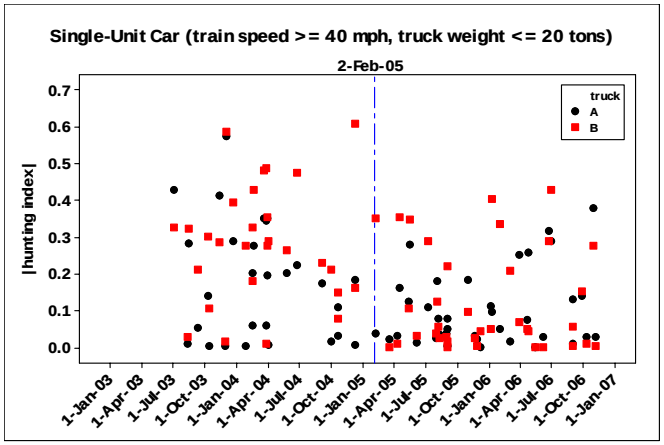

Figure 3. Little to No Improvement from Less Thorough Warp Restraint Repairs

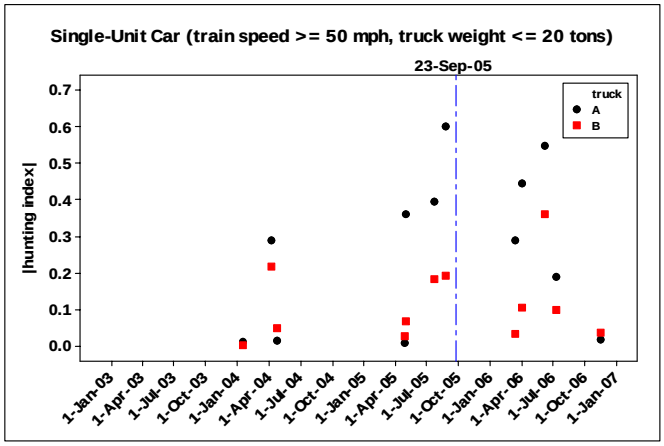

Figure 4. Little to No Improvement from Less Thorough Warp Restraint Repairs

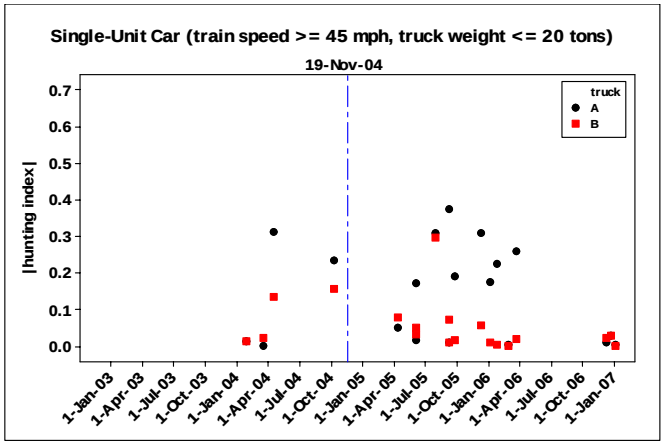

Figure 5. Little to No Improvement from Less Thorough Warp Restraint Repairs

ADDITIONAL OBSERVATIONS

While conducting the aforementioned survey, unanticipated yet relevant information was also discovered regarding other cars repaired by their owners.

Specifically, some cars that received only new bolsters to replace existing cracked ones were identified and analyzed. Figure 6 shows an example of what was found. The performance of these cars across Salient HTDs certainly did not improve after their bolsters were replaced. Thus, as expected, bolster replacement by itself does not appear to prevent or correct hunting.

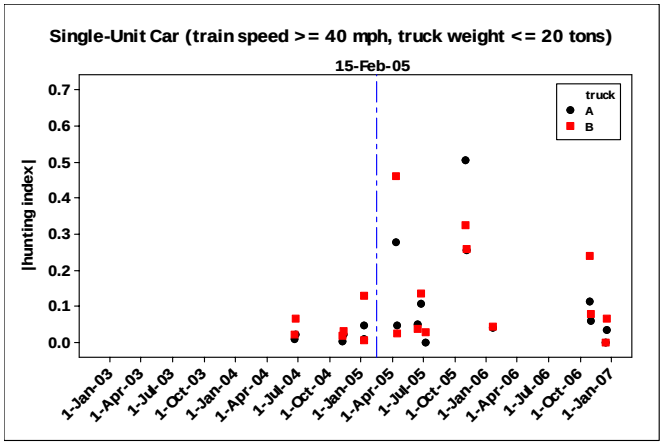

Figure 6. No Improvement from New Bolsters

Of the more than 50 single-unit cars identified as poor performers and brought to TTC in 2005 and 2006, 7 were ultimately repaired, in a manner consistent with the more thorough, combined rotational resistance and warp restraint repairs listed in the first non-heading row of Table 1, before being returned to revenue service.[1]

Retesting at TTC validated the effectiveness of their repairs.[1] Analyzing their pre- and post-repair HD performance can help to reinforce these validations. Through the middle of January 2007, however, only one of the seven cars had sufficient post repair Salient HTD passes, under similar train speed and truck load conditions as its pre-repair offending passes, to reveal substantial insight into potential performance improvement.

Figure 7 displays the performance of this car. The time it spent at TTC is contained within the labeled, dashed vertical lines, and accordingly it has no Salient HTD data during this period. Like the other four studied cars that received the more thorough, combined rotational resistance and warp restraint repairs from their owners, its |HI| values for both trucks appear substantially and consistently reduced post repair. Hence, it provides further evidence to substantiate the conclusion that such repairs are effective at curtailing hunting.

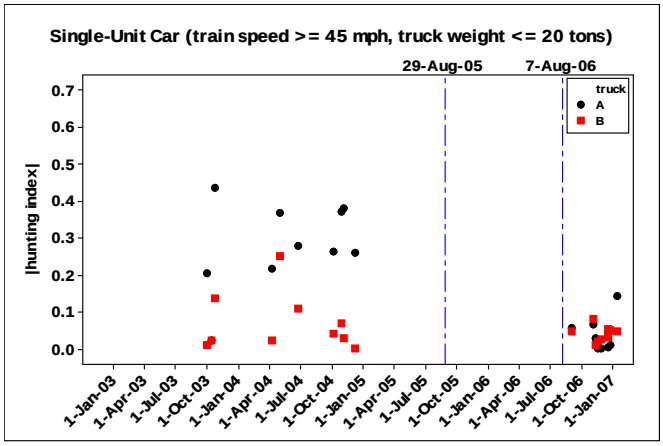

Figure 7. Substantial Improvement from More Thorough Rotational Resistance and Warp Restraint Repairs

CONCLUSIONS

Initial findings from a preliminary survey of historic performance and maintenance records of certain cars repaired by their owners suggest that:

- Repair effectiveness can be reasonably evaluated via analyzing HD data
- More thorough repairs are effective and less thorough repairs are ineffective

Additionally, one of seven cars more thoroughly repaired at TTC had enough post-repair HD data to substantiate the conclusion that such repairs are effective.

This TD can be used in conjunction with TD-07-005 to help establish an effective inspection and maintenance program for HD identified cars.

FUTURE WORK

It is recommended that additional repaired cars be analyzed similarly to harden initial conclusions drawn regarding repair effectiveness or ineffectiveness as well as to extend consideration to more types or combinations of repairs.

REFERENCES

1. Tournay, Harry, et al. October 2006. “Evaluation of Cars Registering Salient Hunting Indices at or above 0.25.” *Technology Digest* TD-06-025, Association of American Railroads, Transportation Technology Center, Inc., Pueblo, CO.

2. Tournay, Harry, et al. April 2007. “Evaluation of Cars Registering Salient Hunting Indices at or above 0.1.” *Technology Digest* TD-07-012, Association of American Railroads, Transportation Technology Center, Inc., Pueblo, CO.

3. Tournay, Harry, et al. April 2007. “Inspection and Maintenance of Poorly Performing Cars Identified by Hunting Detectors.” *Technology Digest* TD-07-005, Association of American Railroads, Transportation Technology Center, Inc., Pueblo, CO.