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Inspection and Maintenance of Poorly Performing Cars Identified by Hunting Detectors

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This Technology Digest (TD) describes inspection and maintenance procedures for cars identified as poor performers by hunting detectors (HDs). It catalogs the inspection and maintenance process for cars identified by HDs. It complements a second TD, TD-07-006, which describes inspection and maintenance processes for cars identified by truck performance detectors (TPDs).

When maintaining cars identified by HDs, it is important to refer to the experience gained from inspection of cars identified by TPDs. This experience suggests that care be taken not to introduce excessively high truck to carbody rotational resistance that will cause the car to alarm at the latter detector.

Summary

HDs identify cars having poor lateral dynamic performance. Data collected is used for planning appropriate maintenance actions that reduce inspection and maintenance costs.

In order to prove HD effectiveness and to develop appropriate inspection and maintenance processes for car owners, poorly performing cars were identified using HDs and subsequently sent to Transportation Technology Center, Pueblo, CO, where they were inspected, tested, and torn down.

Experience gained from this process enabled the development of procedures to guide inspectors in the identification of car subsystems and components requiring maintenance. Appropriate maintenance procedures have also been identified. Component suppliers' and Association of American Railroads' (AAR) performance limits are used where applicable. Where published limits do not exist, but are desirable, suggestions are made.

Inspection and maintenance experience in response to HD identification is, to date, limited. In addition, poor performance has been observed to result from a combination of subsystem and component condition and functionality as well as car type. Consequently, recommended condition limits and maintenance actions are often qualitative. It is envisioned that individual car owners will use these recommendations as guidelines for developing inspection and maintenance processes most appropriate for their fleets and operating conditions.

This work was sponsored by the AAR as part of its Strategic Research Initiatives Program and was conducted jointly with the Advanced Technology Safety Initiative Program 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

North American railroads are increasingly moving to wayside detection to improve operating efficiency and to reduce the cost of inspection and maintenance of equipment. Wayside detectors can:

- Identify poorly performing cars for immediate maintenance attention
- Provide data for fleet maintenance planning
- Focus maintenance actions on those components and systems requiring attention
- Provide post maintenance data to confirm the effectiveness of these maintenance actions

Algorithms have been developed to identify poorly performing cars using wayside detector data. The relationships between the detector data, the developed algorithms, performance limits, and the physical condition of the equipment need to be established for effective car identification and maintenance.

Transportation Technology Center, Inc. was tasked by the AAR, as part of its Strategic Research Initiative Program, to develop inspection and maintenance procedures for cars identified as poor performers by HDs.

This work has been conducted jointly with the Advanced Technology Safety Initiative (ATSI) 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.

As part of these initiatives, cars were identified as poor performers at different Salient Systems' hunting index (HI) levels and brought to the Transportation Technology Center (TTC) for inspection, testing, and teardown. Certain cars were also repaired and retested to evaluate the effectiveness of specific repair procedures.[1,2] Historic performance records of cars repaired by certain car owners are being studied to ascertain the effectiveness of their maintenance actions.

The ATSI Program has suggested, and the AAR has promulgated, an interchange rule to include identification of poorly performing cars at various Salient Systems' HI levels and to guide the maintenance of these cars (Rule 46[3]).

This TD serves to document a recommended inspection and maintenance process developed from experience gained to date to assist car owners with more precise:

- Identification of components and subsystems requiring maintenance
- Maintenance procedures

Inspection and maintenance experience is limited, however. In addition, poor performance has been observed to result from a combination of subsystem and component condition and functionality as well as car type. Consequently, recommended condition limits and maintenance actions are often qualitative. It is envisioned that individual car owners will use these recommendations as guidelines for developing inspection and maintenance processes most appropriate for their fleets and operating conditions.

OVERALL CAUSES FOR POOR PERFORMANCE

General causes for poor lateral dynamic performance, as confirmed through inspection, test, and teardown at TTC, include:

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

Low truck warp restraint and truck to carbody rotational resistance are considered prime and maintainable causes for poor performance.

High wheelset conicity is generally associated with wheels well within current wear limits.[1,2] Replacement of worn wheels within wear limits is not considered an appropriate repair because subsequent accelerated wheel wear may soon degrade performance. Well maintained car suspensions should be adequate to control hunting at speeds greater than or equal to 50 mph, given wheelsets at the measured high conicities. This has been verified under test.

In HD identified cars, it is suggested that wheelsets exhibiting asymmetric wear patterns be replaced and the associated trucks and truck to carbody interfaces be inspected for causes of asymmetric wear.

Other causes for poor performance may be:

- Wheelset misalignment within a truck
- Truck to carbody rotational misalignment

Although not evidenced in any of the cars brought to TTC for inspection, test, and teardown, general railroad experience suggests that these factors should be considered when inspecting and evaluating poorly performing cars.

Appropriate repairs should be made with particular reference to the companion TD-07-006, which catalogs inspection and maintenance procedures for cars identified as poor performers by TPDs.[4]

Excessive wear of particular car and truck components is considered evidence of hunting, not necessarily a prime cause. This evidence is documented in the following inspection procedures. Maintenance of these components is not considered within the scope of this digest.

INSPECTION PROCEDURE

An HD identified car should be inspected before teardown.

Evidence of hunting may be confirmed in worn truck and body components, such as worn:

- Door gear (e.g., on box cars)
- Coupler carrier plates (Figure 1)
- Uncoupling rods (Figure 1)
- Adapter crowns or wear plates
- Adapter shoulders, bearing cups or pedestal surfaces
- Melted constant-contact side bearing (CCSB) polymer elements

Lack of this evidence is, however, not an absolute indication that hunting has not occurred.

The following measurements should be made and recorded before the carbody is lifted:

- Wheel flange and hollow wear (Rule 41[3])
- Friction wedge rise (Rule 88[3])
- Side bearing clearances or setup heights (Rule 62[3])

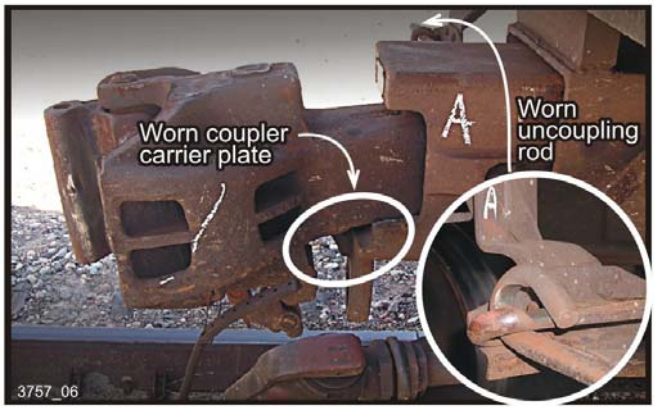

Figure 1. Evidence of Hunting

Tests have shown that the presence of noncontacting side bearings generally indicates inadequate truck to carbody rotational resistance, resulting in poor hunting performance.[1,2] The carbody should then be lifted.

If fitted, the condition of CCSBs should be noted. Loss of preload (and hence low truck to carbody rotational resistance) may be indicated by:

- CCSB free height being equal to the height measured under the carbody. CCSB suppliers do not specify free height limits.
- Excessive wear of CCSB elastomeric elements, top caps, or cage (Rule 46[3]). Some manufacturers provide wear indicators on top caps.
- Localized wear of body side bearings. Since this wear is localized (Figure 2) current measurements suggested by CCSB suppliers may not indicate the need for replacement. CCSBs with very stiff elements, typical for short-travel CCSBs, may lose substantial preload with only minor wear to the body side bearings.
- Melted CCSB polymer elements.
- Excessively deformed CCSB polymer elements. This is qualitative. Polymer elements are expected to develop a permanent set after a short time in service. No quantitative limits for this set are currently available.

Experience has shown that loss of preload is most reliably measured by commercially available CCSB preload measurement equipment. Such equipment or equivalent is highly recommended because:

- Observations of CCSB and associated component condition, as discussed previously, have proven unreliable
- CCSB manufacturers' set-up procedures and measurements may be reliable for new and associated components; however, they are not proven reliable for worn or deformed components.

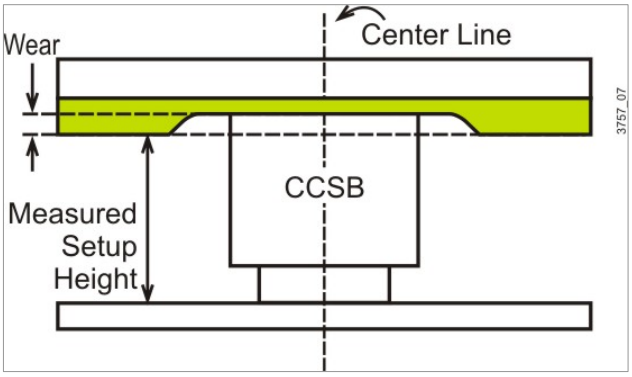

Figure 2. Body Side Bearing Wear Possible with CCSBs

The condition of center plate (Rule 60[3]) and center bowl (Rule 47[3]) should be checked. The majority of cars torn down at TTC, to date, had truck centers fitted with dry, steel liners; however, experience has shown that excessively low center plate friction, associated with lubrication, may cause poor performance.

The truck bolsters should then be lifted from the spring nests. Friction wedges should be removed and the condition of the following components observed:

- Friction wedge surfaces for excessive wear. Manufacturers' wear indicators should be examined.
- Bolster friction wedge pockets and wear plates for excessive localized wear (Figure 3).
- Truck side frame column guide wear liners for excessive localized wear, especially with wedges under empty car conditions (Figure 3).
- Missing, loose, cracked, or damaged truck side frame column guide wear liners or securing bolts (Figure 4).
- Missing, deformed, or broken springs

Trucks may then be lifted from the wheelsets and the roller bearing adapters and pedestals examined. Excessive wear of any component is cause for removal.

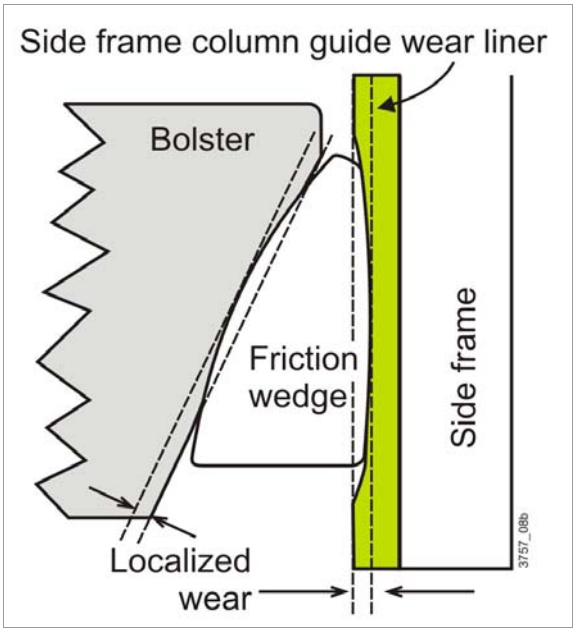

Figure 3. Localized Wear of Bolster/Side Frame Interface

Figure 4. Damaged Truck Side Frame Column Guide Wear Liner

REPAIR AND MAINTENANCE

Observations reveal that poor hunting performance may result from a combination of components' conditions, although all may not be condemnable according to the AAR *Field Manual*.[1,2,3] Generally, the following maintenance procedures should be followed:

- Verify that trucks and their components meet AAR *Field Manual* requirements or repair accordingly (Rule 46[3]).
- Replace condemnable friction wedges (Rule 46[3]). It is also considered advisable to replace truck side frame column guide wear liners and friction wedge pocket wear plates to enable bedding-in of parallel surfaces for adequate warp restraint.
- Replace noncontacting side bearings with long-travel CCSBs or replace elements of short-travel CCSBs (Rule 46[3]), heeding body side bearing wear constraints discussed previously.
- Replace worn roller bearing adapters (Rule 37[3]).
- Replace broken, deformed or missing truck springs (Rule 50[3]).
- Replace pedestal roof liners or deformed resilient roller bearing adapter pads.

CONCLUSIONS

Inspection and repair procedures are proposed for cars that exhibited poor lateral stability.

These procedures suggest that some components and assemblies should be replaced or repaired even though, individually, they may not be condemnable according to present standards and rules.

It is anticipated that these procedures will be further developed through car owners' experiences in repairing cars to differing levels and monitoring subsequent performance across HDs in the short and long term. Experience and future cost/benefit evaluations will thus define more refined inspection and maintenance procedures.

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