Recommended Instructions for Inspection and Test of Wayside Inspection Systems Hot Bearing Detection System, Including Hot Journal, Hot Wheel, Cold Wheel and Dragging Equipment Detectors

Revised 2025 (14 Pages)

A. Purpose

This Manual Part recommends maintenance instructions that apply to the inspection and testing of Wayside Inspection Systems (WIS). This applies to in-service testing and periodic maintenance, and operational inspections. A WIS can include different detection systems that are manufactured by various suppliers. Specific, unique tests of the various data processing systems used should be as prescribed by the individual system manufacturer, railroad instruction, and applicable AREMA recommendations.

B. General

System Overview

1. A WIS is designed to monitor various equipment components of a train as it passes an inspection point and then report any exceptions to normal operational levels. In addition, the WIS may also monitor conditions of the environment and track.

2. The system may utilize many different inspection components to provide a warning for suspect conditions. This could include, but not be limited to, the following:

   a. Infrared Hot Bearing Detector (HBD)

   b. Infrared Hot Wheel Detector (HWD)

   c. Infrared Cold Wheel Detector (CWD)

   d. Dragging Equipment Detector (DED)

3. The system will report any anomalies observed to the train crew and/or the rail traffic controller (RTC) or dispatcher as required. The train may then be stopped safely and under control.

4. Systems are designed to count the passage of wheels using wheel sensors or transducers to determine:

   a. Where in the train to look for an alarmed condition.

   b. Which side of the train the alarm is located.

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c. The direction of travel.

d. The speed of the train.

5. There are many components involved in the detection process that require proper testing and calibration.

a. These calibrations are critical to accurate detection of problems as well as preventing false stops due to component drift or misalignment.

b. Periodic inspections and tests should be made and results recorded in accordance with railroad instructions.

6. The system will be located in a very harsh environment. Many things in this environment adversely affect the proper operation of the system. This would include, but not be limited to, the following:

a. Weather – snow, rain, fog, condensation.

b. Contamination – dust, dirt, chemicals, minerals, scanned surface emissivity (this would be the color and texture of the surface of scanned equipment and affects infrared transmission and sensing characteristics).

c. Freight car loading.

d. Speed of train – must be above minimum specified speed.

e. Time constant of sensors.

f. Temperature - extremes may negatively affect sensor output and linearity.

g. Track conditions.

h. Vibration.

C. Considerations

1. Apply railroad-required lock-out tag-out procedures when working with high voltage.

2. Work that may interfere with the safe operation of trains shall not be started until train movements have been fully protected.

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3. Temporary work, repairs, or adjustments shall be made in such a manner that the safety of train operations shall not be compromised.

4. After repair, adjustment, change, or replacement of any components, tests shall be made to determine that the system functions as designed.

5. When testing, only instruments approved by the railroad shall be used. Care should be taken to ensure that no unsafe conditions are created by the use of test equipment and that the test equipment is used only for its intended use.

6. Enclosures shall be locked or sealed, per the railroad instructions.

7. System enclosures should be kept clean and maintained so that no safety hazard exists.

8. Paint should be applied, as instructed by the manufacturer when required.

D. Periodic Inspection

1. Prior to site inspection

   a. Review historical data from past inspections and alarm reports. This will help identify potential problems.

   b. If the system has a modem or other remote access capability, verify you can access the location. If not, correct the problem when you are at the location

   c. Familiarize yourself with railroad guidelines and instructions for troubleshooting, verifying, testing, and calibrating the system.

2. Site Inspection Process

   a. Check that Plans are available, including manufacturer manuals or electronic storage of manual information.

   b. Documentation should include any unique hardware or software options that must be configured.

   c. Alarm Levels should be recorded for reference.
   d. Verify correct Software Version is in use.

   e. Review the system logs for alarms, warnings, integrity failures, wheel count mismatch, etc.

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f. Use the System Log Book and verify past calibration records, system failure findings, and test results are being recorded.

g. Wheel Sensors

(1). Check for proper mounting hardware and torque – per manufacturer's specification.

(2). Check for shifted or damaged wheel sensors or damaged cables.

(3). Ensure that the magnetic center spacing matches specifications and they are mounted in the proper location.

(4). Remove metal filings or other metal objects from aroundsensors.

(5). All the above conditions can result in signal gating mistakes or wheel count failures with heat signals possibly partially missed or false readings of heat from other external sources near the actual location to be scanned. AREMA 5.1.50 Recommended Functional/Operating Guidelines for a Rail or Tie Mounted Wheel Detector.

(6). There should be no rail spikes, tie plates, rail anchors, or clips that can come in contact with the wheel sensors.

h. Rail Gauge

(1). Check that the rail gauge meets recommended installation specifications.

(2). This ensures that wheel bearings are scanned at the same time and spot, and therefore are less affected by skewed trucks AREMA 5.1.30 Specification for Hot-Bearing Detection Systems section D.9 states 56-3/4 in (144.15 cm) under load.

i. Gage Plates/Rods

(1). Check the gauge plates or rods when used.

(2). Make sure they match railroad standard instructions and have good insulation.

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j. Environmental Considerations

(1). Check that there's adequate drainage away from the system scanner locations.

(2). Verify there is no ingress of water and/or ice into scanners, scanner mounts, cable connectors, cables, and junction boxes.

(a) If scanner isolation mounts become frozen, they will lose their ability to dampen the shocks transferred from the rail or ballast. This could result in false heat signals and false alarms.

(b) Humidity condensing on mirrors and/or lenses, will diffuse the heat signal, preventing all or part of it from reaching the sensors.

(c) Humidity may cause short circuits in cable junction boxes and connectors, resulting in failure or false heat alarms being generated. Drainage concerns should be brought to the attention of appropriate personnel.

k. Track Stability

(1). Observe that the track vertical pumping under load is limited to manufacturer recommendations. Stability concerns should be brought to the attention of appropriate personnel.

(2). This tolerance, if exceeded, can generate oscillations within the scanner that may build to the point they cause missed axles or false stop noise spikes to be generated, as well as destroy the scanner components over time.

l. Broken Rail Protection

(1). Check the scanner clamps and any conductive protective scanner deflection shields.

(2). Verify insulation is in place and operational. This is to prevent them from bypassing the broken rail detection. (AREMA 5.1.30 - B.5)

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m. Track Mounted Scanner Lightning Protection

(1). Check any ballast or tie-mounted lightning protection.

(2). When used, it is usually mounted between the rails.

(3). Shorted or partially shorted arrestors could load or shunt the track circuit and affect operation of crossing warning systems, and could shorten the warning time if the HBD is located in the approach circuit.

n. Scanner Condition

(1). Check cleanliness of the scanner covers. “This is not for cosmetic reasons.” Dirt or grease changes scanner cover emissivity and effects accuracy of heat signal.

(2). Verify the scanner heaters work.

(3). If insulated outer scanner covers are used ensure that they are secure and parts cannot block the scan area.

(4). Inspect mouse guard, if used, and verify proper location and condition. If black anodized coatings have worn off the wires, the mouse guard should be replaced.

(5). Check the sensor types and verify they are used as a matched pair for channel 1 and channel 2.

o. Scanner Position

(1). Check by triangulation that the scanners are mounted directly opposite each other.

(2). See Addendum for the triangulation procedure.

(3). If scanners are not positioned correctly relative to each other or move due to rail creep, the heat signals may not match (balance) due to their misplaced position in the wheel gate. All manufacturers require this check as part of their system installations.

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p. Scanner Mounting

(1). Check the torque of the scanner clamp mounting system to the rails and/or supports, as well as to the scanner itself is in accordance with the manufacturer's recommendations.

(2). Loose or over-tightened scanners or clamps may result in distorted bearing scans and inaccurate information resulting from shock/vibration/oscillation-induced noise.

(3). There should be no rail spikes, tie plates, rail anchors, or clips that can come in contact with the scanner body.

(4). There should be a minimum of three (3) inches of clearance under the scanner between the bottom of the scanner and the ballast.

q. Lens Condition

(1). Clean lenses periodically using only manufacturer-approved cleaning methods.

(2). Ensure the lens types are identical when changes are needed as more than one type may be available.

(3). Focus of lenses, when necessary, must be done in accordance with railroad and manufacturer's instructions. In some systems, this may be a factory adjustment only.

(a) Note: "HBD/HWD systems are optical first, electrical/electronic second, then become digital processor-based systems."

(b) A system calibrated with a lens out of focus will give different heat readings at the focal point than at the shorter normal calibration distance. This may result in a site that appears to test perfectly with the test fixture, and then shows a side-to-side imbalance when the train scan results are examined.

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(4). Dirty lenses attenuate the available heat signal as they accumulate a coating on the lens resulting in a gradual reduction in heat levels obtained.

(a) Dirt can also abrade the lens coatings that contribute to their infrared transmission ability. It is imperative that the analog infrared light energy and electrical signals be accurate prior to digitizing and processing by the data processors for analysis and information transmission to users.

(b) Care should be used in cleaning to avoid removal of optical coatings on the lens or mirror. Damaged coatings significantly reduce system response to infrared energy.

r. Scanner Mirror (if used)

(1). Check for cleanliness, absence of moisture, and that there is no visible abrasion damage on the front surface mirrors.

(2). Front surface mirrors are prone to damage of their coatings, resulting in a gradual loss of their ability to reflect heat signals.

(3). Moisture will cause distortion or loss of the heat signal reducing the energy that gets focused on the sensor.

(4). Dirt contamination will attenuate the heat signal resulting in missed or false alarms.

(5). Use only manufacturer-approved cleaning methods.

s. Scanner Shutter

(1). Check that the shutter drive functions and is not out of manufacturer specification.

(2). When integrity heaters are utilized, verify their operation according to manufacturer instructions.

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t. Scanner Alignment

(1). Check the scanners periodically for alignment to ensure they have not moved and correctly compensate for rail cant.

(2). Verify scanners are located correctly in relationship to gating transducers.

(a) Misaligned scanners can result in missed or false alarms.

u. HWD Filter Shields

(1). Check, clean, or replace damaged or dirty HWD lens protectors, if used.

(2). There are several different types of manufacturer-approved infrared transmitting filter or shield materials.

(a) One type is an optical membrane.

(i) It should be noted that most materials will not pass infrared.

(ii) Replace only with approved products.

(b) A different type shield is a restrictor plate.

(c) In both cases, if the filter or shield is not in place, the calibration of the HWD is affected.

v. Dragging Equipment Detector

(1). Check if the paddle type dragging equipment detector needs to be greased or torqued and all paddles are in proper position.

(2). Electronic DED's must be recalibrated and tested to the manufacturer's specifications to ensure proper operation.

(3). Ensure DED is well anchored and is not damaged.

(a) A loose moveable component could generate false DED alarms, whereas an overly tight component that is less responsive may result in a missed alarm.

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w. Inspection and Testing of Field located Central Processor Unit Equipment and Functions

(1). Lightning Protection

(a) Check lightning and surge protection devices for visible signs of damage and that protected circuits operate as intended.

(b) Replace components as required.

(2). Reference or Calibrated Heat Source

(a) Check the accuracy of the calibration tool or heat source.

(b) Verify that the site thermometer and associated equipment are available.

(3). Stored Heat Level Data

(a) Check that the stored train axle data heat levels are closely matched on both sides of the trains.

(i) The side to side difference, for the average heat of the train, should be within 5 degrees F (~2 °C) providing the system is calibrated properly.

(ii) Car loading, sun loading, and dirty lenses or mirrors may also skew the data.

(4). Backup Power

(a) Check the standby power (when used) and that it is maintained and ventilated properly.

(i) Gas, a byproduct of charging batteries or generator fuel, may be explosive and dangerous to the personnel and the system.

(b) Follow the manufacturer's instructions for charging and maintaining the batteries/generators.

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(5). Alarm Level Checks

(a) Check each system to verify that alarms operate at their appropriate settings and are reported for the correct side of the train.

(b) Follow manufacturer or railroad procedures for verifying alarms.

(i) Many microprocessor-based systems have a software function that will automatically test the alarm functions.

(6). Radio Messages

(a) Check that the radio broadcasts all alarms and speaks all messages clearly and correctly, and axle count is correct.

(b) If the broadcasts are recorded, ensure the recording device is functional.

(c) If data radio is used, verify data is received as sent.

(7). Radio Interference

(a) Check radio power and deviation levels periodically to ensure they are as specified for the specific location.

(i) Many systems have a software function to output a “test tone.”

(ii) This function may be used to adjust deviation to railroad specifications.

(8). Test Talker message

(a) Check the talker messages and output.

(b) Verify alarms are reported on the correct side of the train.

(c) Verify that the re-broadcast function is operational if the talker is able to repeat messages sent to trains from stored train data in memory.

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x. Wire and Cable Components

(1). Wire Identification Check that wires are tagged or marked so they are identifiable at each termination point.

(2). Wire Securing and Protection Check that insulated wire is free from damage, exposure to moisture, and protected and secured to prevent tampering or vandalism.

(3). Test Equipment Cables Check that cables used are clean, dry, and not damaged.

(4). Wire Underground Check that underground wire/cable locations are identified on the installation plans and protected from damage by track machines or contractors and that they are secured, preventing rodent/insect entry.

(5). Wire Pole Line & Aerial Cables Check that pole line and aerial cable is secured preventing rodent/insect entry and meets clearance requirements.

(6). AC Power and Components Check the AC power installation for compliance with railroad standards.

(7). Wire and Cable Clearance Check that wires and cables that run near the rail are protected from the elements, rail movement, and damage, including freezing and the possibility of vandals placing them on the rail. Eliminate any hazards associated with high voltage that could prove dangerous to rail employees or trespassers on the railroad right of way.

(8) Wire and Cable Junction Boxes If junction boxes are used, verify they are secured. All external connectors, where provided, should be checked to make sure they are tight and secured as designed.

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Triangulation

A. Use a triangle with 2 equal sides to ensure that the centerlines of both scanners are perpendicular to tracks. Refer to **Figure 5311-1** for an illustration of this step.

1. Select a tie ('Z') which is 10 to 15 feet from the scanners.

2. For *wood ties*, drive a small nail partway into tie at the **center point between the rails**. For *concrete ties*, drive a thin rod down the side of the tie at the center point between the rails.

3. Attach the end of the tape measure to the nail in tie 'Z'.

4. Measure the distance from tie 'Z' to the centerline of the right scanner. Call this distance '*x*.'

5. Move the measuring tape to the other rail.

6. Measure '*x*' from tie 'Z' to the other rail and mark the rail. This mark is the centerline of the left scanner.

7. Adjust the position of the left scanner so that its centerline lines up with this mark, and then secure the left scanner to the rail.

B. Verify parallelism between both scanners:

1. Attach the end of the tape measure to the nail in the reference tie.

2. Measure the distance to a point on the right scanner.

3. Using the dimension in step (b), measure the distance to the same point on the left scanner. If measurements do not match, adjust the position of the *left* scanner to match the measured distance of the *right* scanner.

4. Torque to manufacturer's specifications.

5. Tighten all self-locking nuts.

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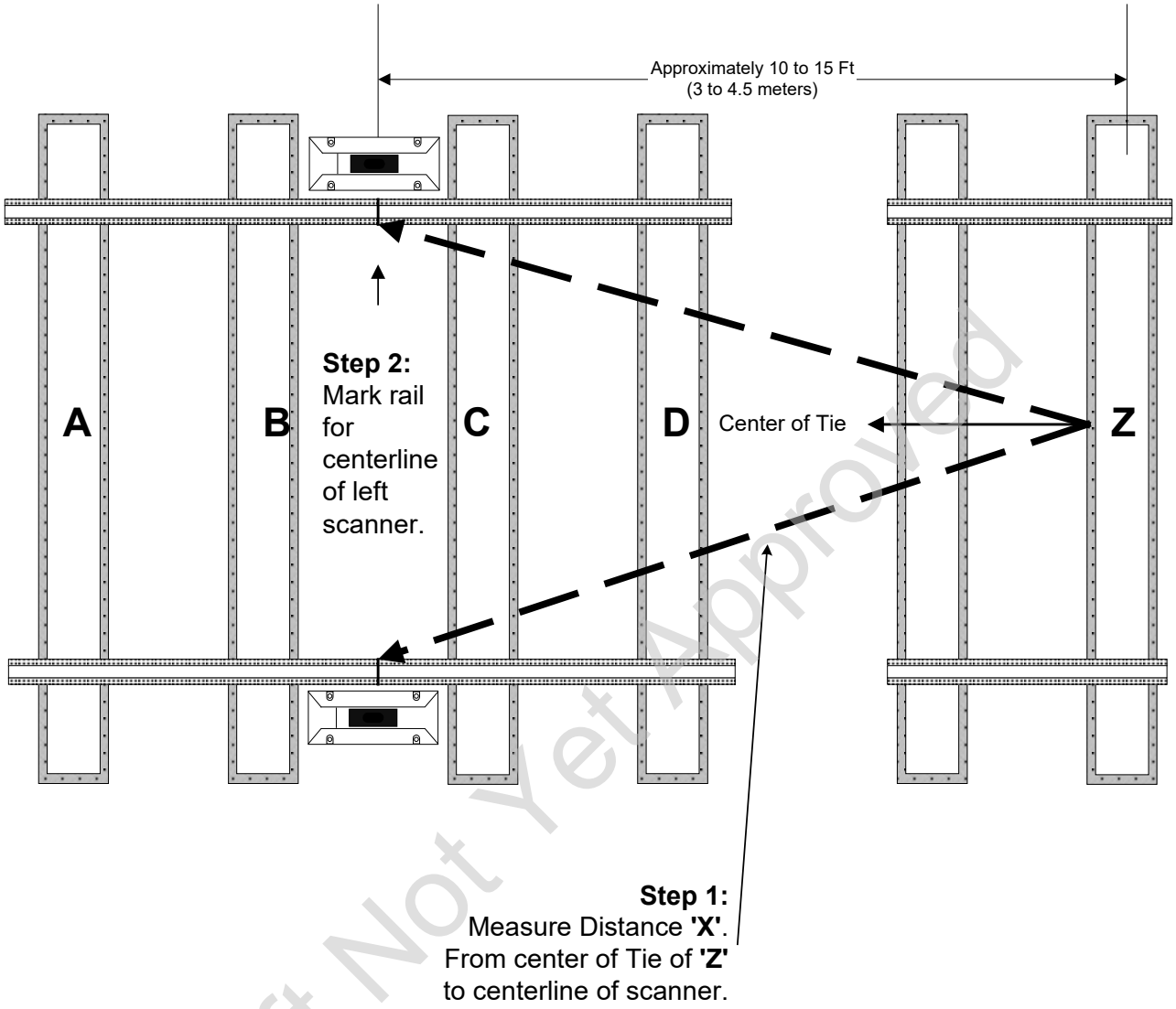

Figure 5311-1

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