



# Holland

**Automated  
Inspection of  
Concrete Ties:  
Identifying Indications of  
Rail Seat Deterioration**

RMSS White Paper Series



A TrackSTAR® unit equipped with Gauge Restraint Measurement System.

Track gauge strength measurement systems have been used to identify a range of geometry-related issues that occur under “dynamic,” i.e., loaded, as well as under “static,” i.e., unloaded, conditions. Visual inspections and those performed with light hi-rail vehicles without a load axle that applies a consistent lateral load are able to obtain static or near-static measurements. Railbound geometry cars, like those used by Class 1 railways, are able to obtain dynamic vertical measurements and unspecified lateral loads in curves. But only geometry cars equipped with Gauge Restraint Measurement Systems, such as the Holland TrackSTAR fleet, are able to apply a constant, controlled lateral load in all segments of track — curves and tangents — to identify weak track, especially as it applies to poor tie conditions on timber- and concrete-tie track.

## Rail Seat Deterioration

Individual or combined measurements, such as cant, loaded gauge, delta gauge (the difference between loaded and unloaded gauge), and gauge widening projection (GWP), a calculation developed by the FRA to identify reserve track gauge strength, can provide a quantifiable measure of overall tie conditions on timber tie track. On concrete-tie track, one set of measurements in particular — unloaded / loaded / delta cant — provides a quantifiable assessment of — rail seat deterioration (RSD), a critical measure of concrete tie track that often cannot be identified under static conditions.

RSD is essentially damage to the top surface of the tie beneath the base of the rail and rail pad. Left unattended, RSD can lead to a multitude of problems, such as broken fasteners, loss of longitudinal rail restraint (fastener loading), accelerated pad wear, loss of cant, gauge-widening, and other track geometry deviations that can lead to the types of concrete tie/fastener system failures that have caused major derailments.

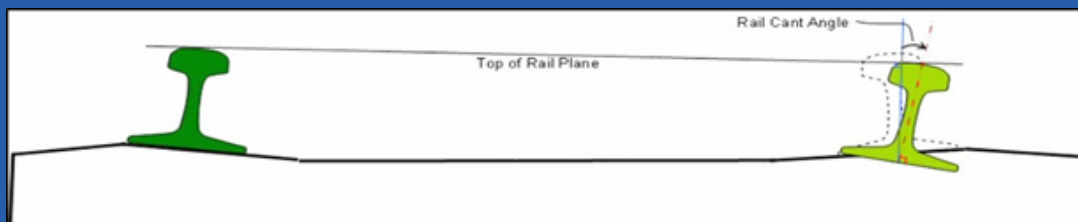


Figure 2. Rail cant is reported in degrees as an angular variance from perpendicular to a line through the apex of both rails.

Because of the difficulty of visually identifying RSD, the FRA established performance standards for Automated Inspection Measurement Systems that are capable of recognizing the indications of RSD. The rules relating to the inspection and condition of concrete crossties (found in 49 CFR 213.109 Track Safety Standards, Concrete Crossties), which were updated in 2012, require railways with concrete crossties in main track in segments of 600 feet or more on Class 3, 4 or 5 track to perform one or more automated inspections, annually.

## Automated Inspection of Concrete Ties

Section 213.109 Crossties of the FRA Track Safety Standards states that the automated inspection measurement system must:

- be capable of indicating and processing rail seat deterioration
- have a measurement accuracy to within 1/8 inch
- have a distance-based sampling interval of five feet or less
- be capable of producing a systematic list of all exceptions so that inspectors can field verify each exception

Of the six areas defining concrete tie condition in Section 213.109, the two that pertain to RSD can be identified by GRMS-equipped TrackSTAR® vehicles. These identify areas in which concrete ties are:

- Deteriorated such that the base of either rail can move laterally more than 3/8 inch relative to the crosstie on curves of 2 degrees or greater; or can move laterally more than 1/2 inch relative to the crosstie on tangent track or curves of less than 2 degrees. These conditions can be found through GRMS-based exception reporting of delta gauge.
- Deteriorated or abraded at any point under the rail seat to a depth of 1/2 inch or more. Differential RSD can be indicated with automated inspection using rail cant measurement thresholds to identify inward or outward rotation of the rail under GRMS or geometry car loading.

## Testing for RSD with TrackSTAR®

Holland TrackSTAR® systems measure track geometry, rail wear, track gauge strength, rail cant, and other parameters that can provide indications of RSD. Holland's patented split-load-axle technology (Figure 3) provides quantifiable assessment of (loaded, unloaded and delta) cant and gauge, the primary indicators of RSD in GRMS-type measurement. Delta cant (the difference between loaded and unloaded) is determined from two measurements — an unloaded measurement taken at the front of the vehicle, and a loaded measurement taken at the split loading axle, which delivers a constant, nondestructive, vertical and lateral load that effectively identifies the weakest track locations. Cant and gauge are measured in one-foot increments, providing real-time exception reporting to identify locations where gauge or cant (rail rotation), exceed thresholds, an indicator of RSD in concrete ties.



TrackSTAR® Gauge Restraint Measurement System is capable of detecting Rail Seat Deterioration through loaded cant measurement.

GRMS-based TrackSTAR® testing meets the FRA requirements (as shown in Section 213.109 of the Track Safety Standards) for Automated Inspection on concrete crossties, providing:

- Accuracy within 1/8 inch (established by rail cant variation from design).
- Distance-based sampling (one-foot sampling, with exceptions reported after three feet of exceedance).
- Calibration procedures, configuration, and data output and reports that identify the track segments requiring follow-up field inspection.
- Exception reporting for required field verification/inspection. Rail cant exceptions are reported in degrees.
- Reports that meet record-keeping requirements.

Figure 4 shows a sample report identifying a “yellow” exception, indicating a Right rail cant deviation of approximately 3.5 degrees (to the field side) and Combined rail cant deviation of approximately 5.5 degrees (to field) from design on concrete ties, as reported by a GRMS-equipped TrackSTAR® vehicle. The approximate -3.5-degree (to field) reading represents about 7/16-inch of rail rotation, about 1/16-inch below the FRA threshold of 4-degrees (or 1/2 inch of rail rotation). As such, it is classified as “yellow,” since it does not yet meet the FRA 1/2-inch, “red” exception condition.

Exception Report For Automated Inspection of Track Constructed with Concrete Ties

Vehicle: TTS478 Direction: E Units: Miles Test Date: 4/8/2018 2:00:43am  
 State: Substation: RR Personnel: JOEY  
 Station: Track: MDN

Offset	Miles Loc. (MP)	Track Info	R/T	Defect Name	Max	Len (FT)	Track Class	Unit	Gauge (In)	Start Milepost	Start Station	End Milepost	End Station	Chr
20	251.95 (5040)	MDN (MDN)	V	LOCANTC	72.88 deg	14	2		0.44	21.884800	117.184800	21.884800	117.184800	S
21	251.95 (5040)	MDN (MDN)	V	LOCANTC	71.56 deg	14	2		0.44	21.884800	117.184800	21.884800	117.184800	S

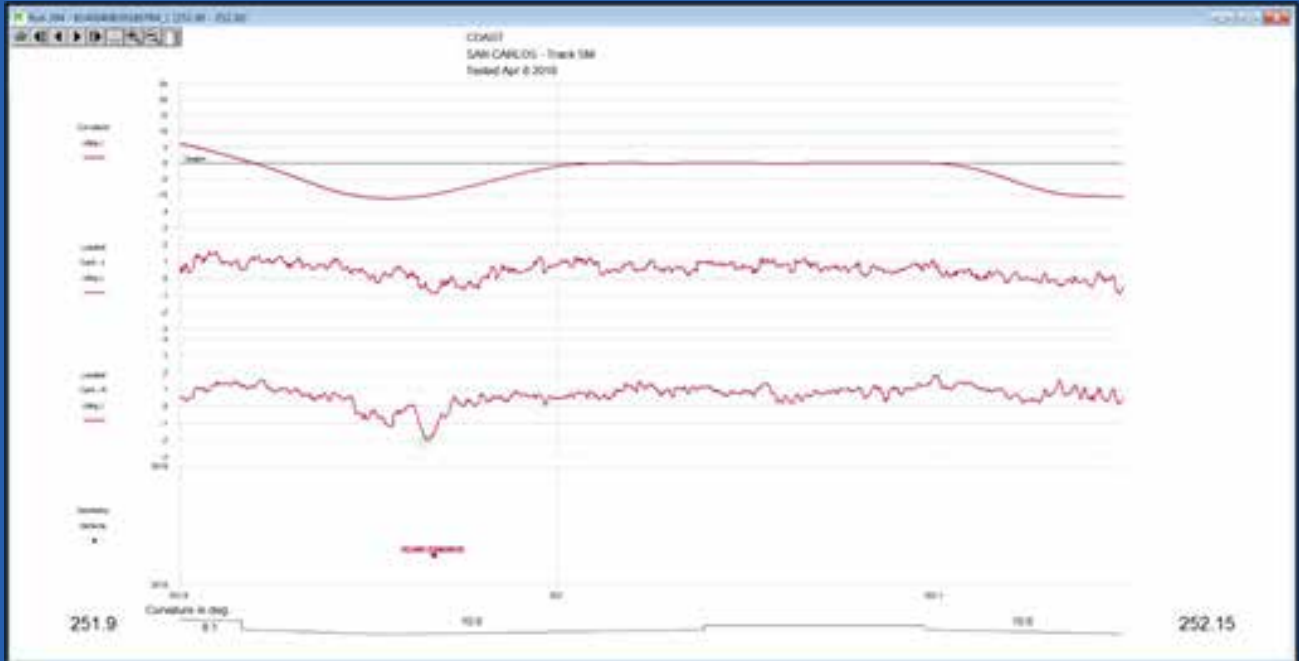
Post 251.000 to 252.000 End of Territory Defect Parameter Summary For All Tracks

	Total
Total	2
Cant	2

This test complies with and meets all of the requirements of 49 CFR 213.214 for the "Automated Inspection of Track Constructed with Concrete Ties". The rail cant defects listed above on this report are reported "Rail Seat Deterioration" in the tie. The defects listed should be evaluated to determine if any "Rail Seat Deterioration" is evident in the full seat area of the tie.  
 This report shall serve as evidence that a "Automated Inspection of Track Constructed with Concrete Ties" was performed on the date indicated above.

TrackSTAR® report identifying loaded cant exceptions — indications of RSD.

The same information is shown on a strip chart in Rangecam® below. Holland's Track Analyst software, provides context, with the ability to view the data over a variable scale (¼ mile, in this example).



Rangecam® track condition reports can be scaled to provide context to RSD (and other) data.

Beyond testing and identifying exceptions, railways are required to maintain a record of the inspection data and exception reports, including the date, location and remedial action. Testing with the use of GRMS-equipped TrackSTAR® unit, reporting, verification and record keeping will ensure compliance with FRA requirements for automated testing to detect rail seat deterioration on concrete ties.



800-series TrackSTAR® vehicle

Holland's fleet of track testing vehicles are designed to satisfy the track geometry and rail profile measurement requirements of Class 1, Regional, Short Line, and Transit properties in North America.

Email [sales@hollandco.com](mailto:sales@hollandco.com) and let us help you learn more about how Holland helps you make the most of your testing and data requirements.

# Holland

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