U.S. Department
of Transportation

**Federal Railroad
Administration**

Office of Research and
Development
Washington, D.C. 20590

PICTON BALLAST MOVEMENT DETECTOR TEST

DOT/FRA/ORD-XXX

May 18, 2000
Draft Letter Report

Executive Summary

Alarm performance tests of a ballast movement detector manufactured by Picton Technologies were performed by Transportation Technology Center, Inc. Tests were carried out at the Federal Railroad Administration's (FRA) Transportation Technology Center (TTC), Pueblo, Colorado, under the Facility for Accelerated Service Testing/Heavy Axle Load Program (FAST/HAL).

The detector tested worked as expected. Separation of the weight at the bottom of the detector; the deployment of the visual alarm plunger; and the arming mechanism appeared free and unobstructed. By sound, the limit switch is activated as expected at about 4-inch extension of the visual alarm plunger.

1.0 BACKGROUND

Alarm performance tests of a ballast movement detector manufactured by Picton Technologies were performed by Transportation Technology Center, Inc. Tests were carried out at the Federal Railroad Administration's (FRA) Transportation Technology Center (TTC), Pueblo, Colorado, under the Facility for Accelerated Service Testing/Heavy Axle Load Program (FAST/HAL).

The detector consists of a cylindrical device, about 5.5 inches in diameter and 16 inches in length, that is embedded in the ballast and is designed to detect ballast movement relative to the track structure or track movement relative to the ballast section. The detector has the capability of providing a visual alarm and a track signal-system alarm.

The visual alarm consists of a plunger that is coated with a reflective material and rises in relation to ballast movement. The detector is able to activate the track signal system with an internal micro-switch. The micro-switch is activated when the plunger reaches a height of 4 inches. Only the visual alarm performance was tested; no track signal-system alarm tests were conducted.

The bottom portion of the detector is a weight. "Arming" the detector consists of turning the visual alarm plunger 180 degrees. Arming the detector releases the lock that holds the weight to the upper portion of the fixture — the portion that contains the micro-switch. As ballast moves away from the bottom of the detector, the weight moves away from the upper portion and pulls on a thin cable. The cable is attached to the internal mechanism that raises the visual alarm plunger and activates the micro-switch. According to the manufacturer, although small movements of ballast are detected by gradual rising of the visual alarm plunger, to avoid false track signal-system alarms, the detector is adjusted such that the plunger must rise at least 4 inches before the micro-switch is activated. The manufacturer also states that the detector can be adjusted for more or less sensitivity.

Picton Technologies representatives Dan Picton and Randy Wills witnessed testing of the Picton Ballast Movement Detector April 27, 2000, at TTC.

2.0 OBJECTIVE

The purpose of the test was to document the performance of the detector in its ability to detect: (a) track movement relative to the ballast section (Part 3.1) and (b) ballast movement on a slope to simulate a slide condition (Part 3.2). The long-term objective is (1) to determine if deployment of the visual alarm plunger occurs due to normal train traffic operations, (2) to determine if manual-movement functionality of the plunger is affected by normal soil and moisture contamination, and (3) to inspect for any other condition that may affect the performance or durability of the detector.

3.0 PROCEDURE

3.1 In-Track Testing

The ballast movement detector was installed in the 5-degree, 4-inch superelevation curve of Section 3 on the High Tonnage Loop (HTL) at FAST.

Mounting brackets were installed about 6 inches in from the end of two concrete ties on the high side of the curve using Chemrex, Inc. PL400 Structural and Sub-Floor Adhesive. Although the PL400 calls for 48 hours of curing, the brackets were well adhered to the concrete ties after about 15 hours. The ballast movement detector was attached to the brackets using two short lengths of chain and machine bolts.

A speed swing was set up to pull the track on the high side of the curve using a chain.

> Track shift 1: As the speed swing made its pull, the chain broke. The pull was enough to shift the track 1 inch to the high side of the curve. At 1-inch lateral track displacement there was no visible deployment of the visual alarm plunger.
>
> Track shift 2: New chain. Track was shifted 3 more inches (4 inches total) causing the visual alarm plunger to rise 7/8-inch.
>
> Continue track shift 2: The track was shifted 4 more inches (8 inches total) causing the plunger to rise 4.5 inches. According to the manufacturer, to avoid false alarms, the plunger must rise at least 4 inches before the micro-switch is activated. Further the manufacturer stated that the detector could be adjusted for more or less sensitivity.

The attached photographic documentation shows ballast movement detector installed, embedded in the ballast, and with deployed visual alarm plunger after the 8-inch track shift.

3.2 Ballast Stockpile Testing

The ballast movement detector was embedded in the sloped side of a ballast stockpile using two lengths of square steel channel. The channels were driven horizontally into the ballast, and the detector was attached using tie wraps.

The slow ballast-removal portion of the test, using a shovel, caused the detector to provide the 4-inch plunger extension required to activate the micro-switch after two shovels full of ballast were removed.

The more intrusive ballast-removal portion of the test, using the speed swing bucket, provided the alarm response required as the machine backed away from the stockpile.

The attached photographic documentation shows the ballast movement detector installed, embedded in the ballast, and with deployed visual alarm plunger after slow and more rapid removal of ballast.

4.0 OBSERVATIONS

The detector tested worked as expected. Separation of the weight at the bottom of the detector; the deployment of the visual alarm plunger; and the arming mechanism appeared free and unobstructed. By sound, the limit switch is activated as expected at about 4-inch extension of the visual alarm plunger.

5.0 LONG-TERM TESTING (ONE YEAR)

The detector will be inspected on a monthly basis for free movement of the visual alarm plunger and for general appearance. The visual inspections will also serve to determine if the visual alarm plunger is deployed due to normal train operations. Due to the normally arid conditions at TTC, it may not be possible to determine the effect that more severe moisture and contaminated ballast, typically found at many revenue service locations, may have on the internal mechanical components or the micro-switch. The detector will not be connected to the track signal-system; therefor at this time it will not be tested in that capacity.

ATTACHMENT 1
In-Track Testing

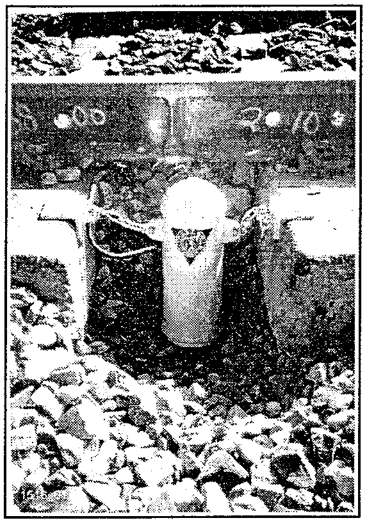

Figure 1. Ballast Movement Detector Attached by Chain to Glue-Mounted Brackets on Concrete ties

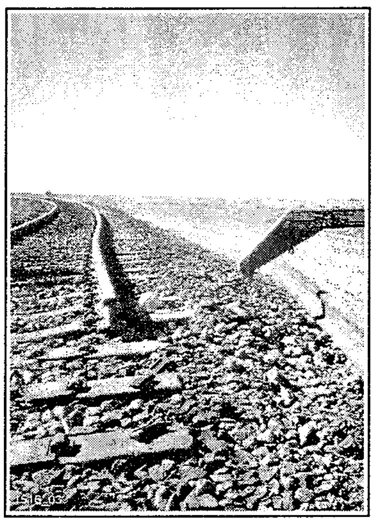

Figure 3. Detector in the Alarm Mode

An 8-inch lateral track shift raised the visual alarm plunger 4.5 inches.

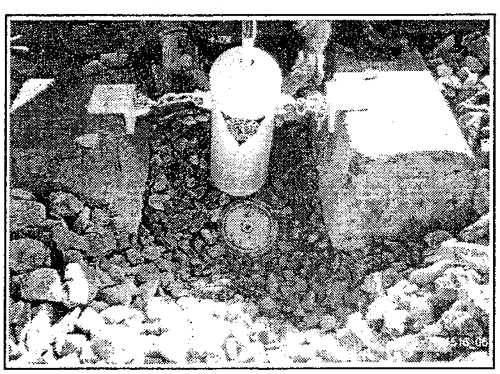

Figure 5. Separation of the Two-part Detector Body.

When the track was shifted, the weight remained in place as the upper portion of the detector moved with the track causing the visual alarm plunger to deploy.

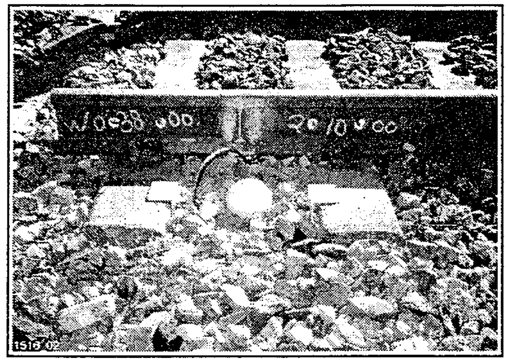

Figure 2. Detector Embedded in Ballast and Armed

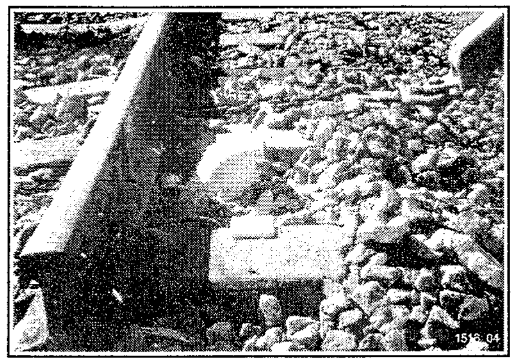

Figure 4. Close-up of the Detector in the Alarm Mode

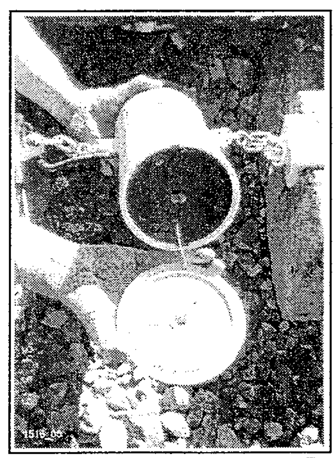

Figure 6. Close-up of the Two-Part Detector Body Lengthening of the Cable.

Increasing the distance between the weight and the upper portion of the detector deploys the visual alarm plunger and activates the internal microswitch

ATTACHMENT 1
In-Slope Testing

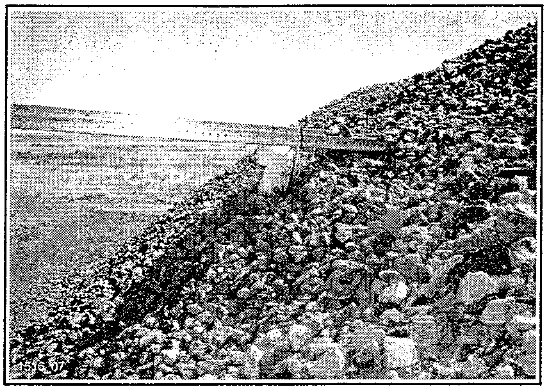

Figure 7. Ballast Movement Detector Attached to Square Steel Channels and Embedded in a Ballast Slope

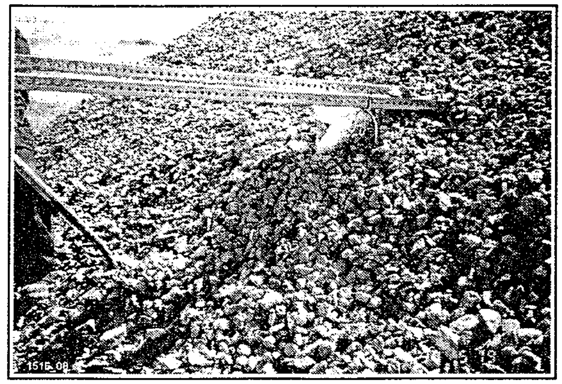

Figure 8. Material was Removed by Shovel to Simulate Slow Ballast Loss Below the Detector

Figure 9. Material was removed by Speed Swing Bucket to Simulate Rapid Loss of Ballast Below the detector.

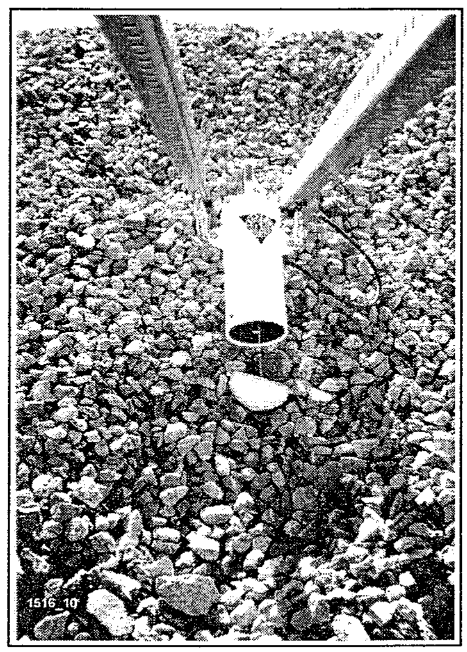

Figure 10. Ballast Movement detector in the Alarm Mode after Slow and Rapid Removal of Material

Ballast Movement Detector Test

A Proposal to:
Picton Technologies

Presented By:
Transportation Technology Center, Inc.
A Subsidiary of the **Association of American Railroads**
55500 D.O.T. Road
P.O. Box 11130
Pueblo, Colorado, USA 81001

Background

TTCI is proposing to conduct a test of the Picton Technologies Ballast Movement Detector. The Detector is designed to provide a warning of ballast movement that could affect track geometry or stability. The detector is buried in the ballast shoulder, and senses and provides an indication of either rapid or gradual ballast movement. The indication is a mechanical red flag indicator or the activation of a block signal. The warning is intended to give approaching trains time to stop before they reach the area of ballast movement.

The test will be performed on the High Tonnage Loop (HTL) of the Heavy Axle Load (HAL) Facility for Accelerated Service Testing (FAST), and at the ballast loading facility at the Transportation Technology Center in Pueblo, Colorado.

This project for Picton Technologies will be managed by:

Transportation Technology Center, Inc.
55500 D.O.T. Road
P.O. Box 11130
Pueblo, Colorado 81001 USA.

Procedure for testing the Picton Technologies Ballast Movement Detector

The test will consist of two distinct parts. Part 1 is an in-track installation that will monitor the long term performance and durability of the Detector. Part 2 is a set of simple tests of the effectiveness of the detector in sensing and indicating ballast and/or track movement.

Part 1

Section	Section 3 of the High Tonnage Loop (HTL)
Track Geometry	5-degree, 4-inch superelevation curve
Ties and Fasteners	Concrete Ties with Elastic fasteners
Test location	High-rail side, ballast shoulder
Train	70 to 80 cars, 315,000 lb. GWR (39-Ton Axle Load)
Operating Speed - balance	40 MPH – 1.6 inches over balance speed
Consist	Coal hoppers and tank cars
Accumulation of Tonnage	About 110 Million Gross Tons (MGT) per year

The Detector will be installed in the ballast shoulder of Section 3, and left in place for one year. Part 1 will test the resistance of the Detector to mechanical damage under normal operation of the FAST train, and its resistance to damage from dirt, oil, and other contaminants typical in-and-near railroad track.

The Detector will be inspected once a month for general condition and functionality. This will be a simple visual inspection and test of the flag mechanism. The condition of the Detector will be documented at each inspection. The Detector will not be connected to a block system, or tested for its ability to transmit to such a system.

Part 2

Part 2 will be conducted at two locations. Part 2a will be at the ballast unloading facility. The Detector will be buried in the side slope of a ballast pile. Ballast below the Detector will be slowly removed (by shovel) to simulate gradual ballast movement. The Detector will then be removed, reset, and reinstalled. The ballast below the Detector will then be rapidly removed with a front-end loader to simulate a slide. The response of the Detector will be monitored and recorded.

Part 2b will take place in Section 3 during scheduled track work. Rail in part of Section 3 will be replaced during the last two weeks of April 2000. A Detector will be installed in this area. When the rail is disconnected from the adjoining rail, but before it is removed from the ties, the track will pushed six inches laterally with a front-end loader or speed-swing. The Detector will be observed for its ability to detect track movement. The response will be recorded.