Abstract: This paper describes how the FRA annual warning time testing method of "by calculation and track shunt simulation of a train movement" (method 2) may be combined with the verification of internal variable values of a motion detector or constant warning time device to accomplish Annual Warning Time testing. As indicated in testing "by use of an electronic device that accurately determines warning time". The process requires the crossing be "Base-lined", using method 2, and recording of manufacturers specified internal variable values when the crossing is installed, modified, or the designated variables are adjusted. Recorded values or “Baseline Values” are used to evaluate and determine that the motion detector or constant warning device remains as previously calibrated and configured.

Introduction:

Within “Technical Bulletin S-08-02”, (July 2008) the Federal Railroad Administration (FRA) provided clarification and definition associated with performing annual warning time testing at highway-rail grade crossing (active) warning systems. As described within S-08-02 this clarification mandates that annual warning time be tested on all routes for both main and standby (where equipped) configurations of all systems.

“Title 49 CFR § 234.259 requires that each highway-rail grade crossing warning system be tested for the prescribed warning time at least once every 12 months and when the warning system is modified because of a change in train speeds. This section applies to all train detection equipment (including standby units, if equipped) used in each highway-rail grade crossing warning system. “
The FRA also defined “prescribed warning time” as “the designed warning time less any associated "buffer time" and "equipment response time."

The FRA states in S-08-02 that "A warning system location is not considered fully tested for the prescribed warning time unless and until the crossing activation is proven for the required distance on all available approaches at the crossing (i.e., all routes and in each direction), including while operating on standby units, if so equipped."

As stated in the FRA’s “Grade Crossing Signal System Safety” manual, testing may be accomplished by one of three methods: 1) observation of a train movement, if practical; 2) by calculation and track shunt simulation of a train movement; or 3) by use of an electronic device that accurately determines warning time.

At the request of Jim LeVere (BNSF) and Mike Lyon (UPRR) the FRA attended a meeting with BNSF, UPRR, Safetran Systems (Invensys Rail) and GE Transportation to evaluate expanding their interpretation so a baseline of internal device parameters may be recorded and used to verify equipment setup and establish a variation of method 3 for the purpose of conducting annual warning time test.

This paper discusses how annual warning time testing would be accomplished by using this “new” method.
Warning System Approach Baseline Testing and Verification:

Baselining the approach as applied to motion sensitive or constant warning time active warning crossing systems requires adherence to the following general process steps.

1. Determine the effective approach length to be baselined.
   a. Convert the maximum authorized approach speed in miles per hour into feet per second by multiplying the maximum authorized timetable speed by 1.467.

   \[ \text{MPH} \times 1.467 = \text{Speed in FPS} \]

   b. Determine the applicable approach distance by multiplying the result in (1a.) by the design warning time. (For a CWT device the design warning time is equal to the requested warning time). (For a motion sensitive device the design warning time is equal to total approach length divided by 1.467 – the equipment response time).

   \[ \text{CWT Design WT} = \text{Programmed Warning time} \]
   \[ \text{MS Design WT} = \left( \frac{\text{Approach Length}}{1.467} \right) - \text{Equipment Response Time} \]

2. Measure the device approach(s) to the greater of either 90% of the total approach length or the approach length calculated in (1b.).

3. Record the full approach settings and apply a hardwire test shunt on each approach (one at time) recording the equipment response (the equipment response should be approximately equal to appropriate percentage of signal level reduction as related to the shunt placement). Active warning systems equipped with standby systems must be tested on both main and standby. See table 1 below.
Once the approach values are recorded they will be retained as test records until the approaches are modified in a manner which requires rebaselining the approach.

**Warning System Equipment Configuration Baseline and Verification:**

Baselining the configuration as applied to motion sensitive or constant warning time active warning crossing systems requires adherence to the following general process steps.

1. Establish and record a baseline of how parameters and settings effecting the vital operation of the equipment is configured.

   a. For old equipment not capable of providing a secure CRC, all vital parameters and settings must be confirmed to match the circuit plans. That confirmation is then recorded as a test record similar to baselining the approach(es) during shunt testing. No additional test records are required.

   b. For modern equipment capable of generating a CRC that may be used to securely represent and record the settings associated with all vital

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parameters, all vital parameters must be confirmed to match the circuit plans. The CRC is then recorded and stored as a test record with no additional test records required.

2. Once the equipment configuration baseline is recorded it is then retained as a test record until the configuration is modified in a manner which requires rebaselining the configuration.

**Internal Equipment Transmitter and Receiver Adjustment Baseline Verification:**

Baselining the internal equipment transmitter and receiver adjustment settings as applied to motion sensitive or constant warning time active warning crossing systems requires adherence to the following general process steps.

1. Establish and record a baseline of how internal transmitter and receiver adjustment variables which are capable of effecting the vital operation of the equipment are set.
   
   a. For old equipment that is not capable of providing a secure CRC, all vital adjustment variables as identified by the equipment manufacture must be measured and recorded as a test record confirming the calibration and adjustment of the equipment at the time of baselining.
   
   b. For modern equipment capable of generating a CRC that may be used to securely represent a record of the measurements associated with all vital adjustment variables. The CRC is recorded and stored as a test record
confirming the calibration and adjustment of the equipment at the time of baselining with no additional test records required.

2. Once the equipment’s internal transmitter and receiver adjustment variables are recorded the baseline will be retained as a test record until the equipment is recalibrated which requires rebaselining the adjustment variables.

**Annual Warning Time Testing and Verification:**

Once the motion sensitive or constant warning time active warning crossing system has been baselined as described above the crossing may be tested (pending FRA guidance) by following the following general process steps for each approach track Main and Standby (where equipped).

1. At the time of the annual warning time testing verify that the full approach values measured are within a range as specified by the manufacture to the previously measured and recorded baseline values.

2. Compare the current equipment configuration values to the baselined configuration values and verify they remain as previously baselined.

   a. For modern equipment capable of providing a secure CRC representing the configuration all that is required is comparison between the current CRC and the previously recorded CRC. For all other equipment the configuration must be verified for each vital parameter capable of effecting warning time performance.
3. Compare the current equipment internal equipment transmitter and receiver calibration settings to the baselined transmitter and receiver calibration settings.

   a. For modern equipment capable of providing a secure CRC representing the internal transmitter and receiver calibration settings all that is required is comparison between the current CRC and the previously recorded CRC. For all other equipment the calibration values must be verified for each calibration capable of effecting warning time performance.

4. Once all three previous steps have been confirmed and the warning system is demonstrated to comply in full with each step. Annual Warning Testing may be completed by placing a .06 ohm shunt at the crossing feed point (on the house side of the crossing) and observing activation of the warning system.

Once the four steps have been completed and the warning system has been activated by applying a test shunt the crossing (pending FRA guidance) will have had its Annual Warning Time testing completed.

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\(^1\) Technical Bulletin S-08-02, (July 2008), the Federal Railroad Administration (FRA)

\(^2\) Grade Crossing Signal System Safety manual, the Federal Railroad Administration (FRA)