



# Memorandum

U.S. Department  
of Transportation

Federal Railroad  
Administration

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**Subject:** Technical Bulletin S-12-01, Guidance Regarding the Appropriate Process for the Inspection of Highway-Rail Grade Crossing Warning System Pre-emption Interconnections with Highway Traffic Signals

**From:** Ron Hynes  
Director, Office of Safety Assurance and Compliance

**To:** Regional Administrators, Deputy Regional Administrators, Staff Directors, Signal and Train Control (S&TC) Specialists, Chief Inspectors, Railroad System Oversight Managers, State Program Managers, and all Federal and State S&TC and Highway-Rail Grade Crossing Inspector Personnel

This technical bulletin is intended to provide specific guidance to all Federal and State inspectors related to the performance of inspections of highway traffic signal pre-emption interconnections at highway-rail grade crossings. Pre-emption interconnections are intended to prevent entrapment of highway traffic on a crossing by changing the sequence of the highway traffic signal to allow highway vehicles to exit the crossing prior to the arrival of an approaching train. Pre-emption interconnections can also prevent conflicting visual traffic control messages from being provided to highway users by highway traffic signals and nearby grade crossing warning systems. The proper functioning of these interconnections is essential to the overall warning provided at a highway-rail grade crossing. Federal Railroad Administration (FRA) accident data indicates that inappropriately designed or wholly nonfunctioning pre-emption interconnections have contributed to a number of severe highway-rail grade crossing collisions.

## Background

Highway traffic signal pre-emption interconnections play a critical role in the overall proper functioning of a highway-rail grade crossing active warning system where such interconnections exist. There are two basic types of pre-emption: simultaneous and advanced. Simultaneous pre-emption is that which results in the initiation of the traffic signal cycle at the same time the highway-rail grade crossing warning system is activated. Advanced pre-emption results in initiation of the traffic signal cycle prior to the grade crossing warning system being activated. The type of pre-emption installed, and any additional time required for pre-emption operation,

will be determined and specified by the public agency responsible for the highway traffic signal in accordance with Section 8C.09 of the Manual on Uniform Traffic Control Devices.

Following the October 25, 1995, train-school bus incident in Fox River Grove, IL, the National Transportation Safety Board issued 18 recommendations to various Federal, State, and local agencies, and railroad and industry associations, addressing the need to exchange information regarding grade crossings and to modify various design elements regarding pre-emption operation. These recommendations resulted in significant study and research within the industry to better understand the various elements required to properly implement pre-emption and to ensure the ongoing testing and verification of pre-emption systems.

The studies and research conducted helped develop methodologies to analyze and calculate the time required for pre-emption operation, which—in many cases—was significantly longer than what was in operation at numerous highway-rail grade crossings. More recent analysis of traffic signal control equipment uncovered a lack of standardization of pre-emption operation as well as the failure to respond to pre-emption requests, especially under multiple train conditions. Highway-rail grade crossing active warning systems were also studied to determine the effects of train operations, including acceleration, deceleration, and stops within the approach to a pre-empted highway-rail grade crossing. As a result of this work, a number of standards and recommended practices have been developed to define pre-emption-related parameters and the terminology used to ensure that a “common language” is spoken between the railroad and highway signal engineers. Numerous public agencies have also developed standardized methodologies to determine the period of time required for pre-emption operation in order to permit a design vehicle to clear the tracks prior to the arrival of a train.

With all of the progress that has been made, FRA accident data analyzed in recent years continues to show a significant increase in collisions at highway-rail grade crossings where pre-emption is in place. This is of particular concern to FRA because the design and operation of pre-emption interconnections, from a traffic signal perspective, are outside the scope of the railroad’s direct responsibility. Yet, the safety of the railroad, its employees, and the public are directly impacted by these systems and their failure to provide sufficient time to permit a vehicle to clear the path of an approaching train.

Despite the fact that FRA regulations governing the operation of pre-emption interconnections are limited in scope to the railroad’s portion of the circuitry, it is vital to have a clear understanding of our safety inspection role—related to pre-emption operation—in order to facilitate the overall proper functioning of the system for the benefit of the traveling public.

FRA inspectors should encourage railroads to take a proactive role in the analysis, design, and operation of pre-emption systems by partnering with the applicable public agencies to help ensure that both existing and new systems provide the necessary time and traffic signal operation to permit vehicles to clear the grade crossing prior to the arrival of a train. FRA inspectors should also encourage railroads to obtain information from public agencies, regarding pre-emption operation, to facilitate the proper testing of pre-emption during grade crossing warning system inspections.

## **Routine Inspection Process**

During all “routine” highway-rail grade crossing warning system inspections, an inspector must determine whether the location is equipped, or intended to be equipped, with an operational highway traffic signal pre-emption interconnection. The inspector must review the circuit plan in order to obtain the designed connection and operation of the interconnection. (The designed operation of the interconnection must be contained in the site-specific circuit plan, as the proper operation of the pre-emption interconnection is considered critical to public safety. In addition, the circuit plan should show the actual interconnection and the designed pre-emption time.) The inspector must also observe the physical location to verify that the interconnection is in place and the train detection device (or equivalent) is programmed or equipped to provide the appropriate designed pre-emption function.

It may be necessary to obtain information regarding the traffic signal operation from the public agency responsible for the operation of the traffic signal prior to performing any testing. The inspector should specifically request the maximum right-of-way transfer time (RWTT), the minimum track clearance green (TCG) interval, and the worst-case traffic signal condition.

The RWTT is the designed maximum allowable period of time that elapses from when the interconnection circuit is activated until the traffic signal displays the track clearance interval (most likely GREEN indications beyond the track). The minimum TCG interval is the least amount of time the track clearance interval is displayed by design. The worst-case traffic signal condition is the point in the traffic signal sequence when the RWTT is at the maximum value. The traffic signal system may require that a pedestrian pushbutton be activated, or other action be taken, to reach the worst-case condition.

While performing operational testing of the highway-rail grade crossing warning system, the inspector should closely observe the operation of the highway traffic signal. The inspector should not rely solely on the operation of a relay or the opening of a control circuit to the traffic control housing in determining whether the interconnection is operating properly. During this observation, the inspector should determine that the pre-emption interconnection actually initiates the traffic signal cycle versus a coincident normal cycle activation that could be mistaken for pre-emption.

The preferred method of testing the pre-emption circuitry consists of observation of a train movement and of the actual pre-emption function. This should include observation that the pre-emption control was received when sent by the railroad equipment, the track clearance interval was displayed within the RWTT, the TCG interval was displayed for at least the minimum design time, and the pre-emption function was cancelled when the crossing gates started to rise or, in the case of flashing light only warning devices, when those devices were deactivated. In the event that a train movement is not available, alternative methods of testing may be used while observing the pre-emption function. Where a railroad has installed pre-emption operation recording and monitoring equipment, as addressed in FRA Safety Advisory 2010-02, the inspector may be able to rely on this equipment in order to verify that the pre-emption operation and interconnection functions properly.

In some cases, a gate-down circuit may be included as a part of the interconnection. If a gate-down circuit is present, it should prevent the traffic control signal from leaving the TCG interval until the gate controlling vehicular access over the crossing is fully lowered to a preset position. This function can be tested by simulating that the specified gate is not fully lowered. In this scenario, the highway traffic signal should remain in TCG until the gate-down input is received or the train occupies the crossing. The presence of a traffic signal representative will greatly assist in validating this test.

Where multiple tracks are present, and a second train may appear shortly after the first train, the inspector should have the railroad conduct a test where the pre-emption circuit is restored to its normal state following a test for the first train and then reactivated within 1 to 2 seconds to simulate the approach of the second train. The traffic signal should either remain in the track clearance interval or, if the sequence has left the track clearance interval, return to the track clearance interval. The RWTT and TCG values should again apply to the traffic signal sequence.

In some cases, other interconnect circuits may be present based on site-specific needs. Where present, the inspector should consult the circuit plan in order to determine how these additional interconnect circuits are used and how their proper operation can best be verified.

*The intent of this preferred testing method is to verify that the highway traffic signal pre-emption is actually working as intended in connection with the activation of the highway-rail grade crossing warning system, as opposed to mere observation of the railroad's portion of the pre-emption interconnection.*

The U.S. Department of Transportation (DOT) task force that was assembled following the Fox River Grove incident recommended the installation of a warning label in both the railroad equipment enclosure and the traffic control signal enclosure. The purpose of the warning label was to identify the presence of the interconnection and the need for the parties to contact one another in the event of pre-emption failure, or prior to initiating any changes or modification to either system. While not federally required, it is recommended that a check for the warning labels be performed and, if one or both are missing, to remind the appropriate party or parties of the DOT task force recommendation.

### **Post-Accident/Incident Inspection Process**

When performing “post-accident/incident” operational testing of a highway-rail grade crossing warning system having a pre-emption interconnection, it is strongly recommended that the inspector arrange to have a representative from the party responsible for the maintenance and operation of the highway traffic control signal (traffic signal representative) on hand to verify proper pre-emption operation. This should include confirmation by the traffic signal representative that the pre-emption control was properly received and the highway traffic signal function was as designed and intended. The traffic signal representative should verify that the RWTT and TCG values are set to the design values. The pre-emption interconnection may be

tested as outlined above. However, the expert assistance of the appropriate traffic signal representative will help verify and substantiate proper functioning of the entire pre-emption interconnection.

### **Recording Inspection Findings**

In the event that a highway traffic signal pre-emption interconnection is found to be inoperative, malfunctioning, defective, or not operating as designed due to a fault within the railroad's responsibility, the inspector must note the defective condition on the inspection report (see Title 49 Code of Federal Regulations (CFR) Section 234.207) and inform the railroad of the necessity to correct the defective condition and return the highway traffic signal pre-emption interconnection to proper operation without undue delay. Note that the inspector may wish to remind the railroad of the importance of involving the appropriate highway traffic signal representative to ensure that the pre-emption is working properly from both perspectives.

Anytime a highway traffic signal pre-emption interconnection is found to be inoperative, malfunctioning, defective, or not operating as designed due to a non-railroad-related failure (i.e., something on the highway traffic control side), the inspector must immediately contact the Federal Highway Administration (FHWA)- and/or State Department of Transportation (SDOT)-designated person. An up-to-date listing of FHWA and SDOT contacts should be prepared by each respective region and provided to the appropriate personnel of the region for this reporting purpose. (Regional grade crossing managers may assist with formulating and updating this listing.)

Anytime an FHWA/SDOT person is contacted to report a faulty highway traffic signal pre-emption interconnection, the inspector should record on the associated inspection report, as a comment, the FHWA/SDOT contact's name, call date and time, the DOT crossing number, and a short description of the defective condition reported. In the rare case that an inspection report is not completed but a defective condition is observed, an email notice (or some other documentation containing the prescribed information) must be prepared on the day the defective condition is observed. In addition, necessary followup should occur such that assurance is gained that action will be taken to restore the interconnection to proper functioning.

### **FRA Pre-emption Testing Requirements**

Title 49 CFR § 234.261 requires that a railroad test each highway traffic signal pre-emption interconnection, for which the railroad has maintenance responsibility, at least once each month. Accordingly, the railroad is only responsible for the maintenance and testing of its portion of the interconnection. However, FRA inspectors should determine the method by which the railroad representatives perform this test, and verify their understanding of appropriate steps to be taken if the railroad portion is found to be functioning properly but the highway traffic signal does not appear to be properly responsive.

Please feel free to contact Mr. Thomas McFarlin, Staff Director, S&TC Division, at (202) 493-6203 or [Thomas.McFarlin@dot.gov](mailto:Thomas.McFarlin@dot.gov); or Mr. George Hartman, S&TC Specialist, at (202) 493-6225 or [George.Hartman@dot.gov](mailto:George.Hartman@dot.gov), if you have any questions.