





Troubleshooting and Repair of Interlockings





Course 306

PARTICIPANT GUIDE



SIGNALS TRAINING CONSORTIUM

Troubleshooting and Repair of Interlockings

Participant Guide

Signals Maintenance Training Consortium

COURSE 306

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Course 306: Troubleshooting Interlockings

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How to Use the Participant Guide

Purpose of the Course

The purpose of the *Troubleshooting and Repair of Interlockings* course is to assist the participant in demonstrating proper procedures and gaining an overview of the functions of interlockings and their associated apparatus.

Approach of the Book

Each course module begins with an outline, a statement of purpose and objectives, and a list of key terms. The *outline* will discuss the main topics to be addressed in the module. *Learning objectives* define the basic skills, knowledge, and abilities course participants should be able to demonstrate to show that they have learned the material presented in the module. A list of *key terms* identifies important terminology that will be introduced in each course module. *Review exercises* conclude each module to assist the participants in reviewing key information

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Module 1

TROUBLESHOOTING AND REPAIR OF INTERLOCKINGS

Outline

- 1-1 Overview
- 1-2 Interlocking Troubleshooting Safety and Procedures
- 1-3 Documentation Procedures
- 1-4 Types of Malfunctions
- 1-5 Test Equipment
- 1-6 Summary

Outcome and Objectives:

The participant will understand and be able to demonstrate how to troubleshoot and repair interlockings.

Following the completion of this module, the participant should be able to complete the exercises with an accuracy of 70% or greater:

• Describe safety practices and processes as related to interlockings troubleshooting and repair

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- Describe FRA guidelines and agency specific documentation procedures
- Describe types of malfunctions for interlockings
- Describe specialized test equipment used for troubleshooting interlockings
- Access and read event reports

Key Terms

- Code line / Communication line
- Job hazard analysis
- Job site analysis
- Situational awareness
- Track occupied light (TOL)
- Vital microprocessor interlocking system (VMIS)

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1-1 OVERVIEW

The previous course, *Course 206 Inspection and Maintenance of Interlockings*, provided an overview of locking tests, safety practices, and general inspection and maintenance procedures. The approach to this next level of training, Course 306, is to help the participant hone the necessary skills for troubleshooting interlockings (Figure 1.1). Specifically, this course will address common interlocking malfunctions and possible corrective actions to resolve typical interlocking failures.



Figure 1.1 Typical Interlockings Layout Sample 1

While general troubleshooting is covered in earlier courses, troubleshooting interlockings can prove to be challenging and unique. Since interlockings are a product of numerous track and signal components, the approach to a troubleshooting module may deviate from past procedures. Understanding the infrastructure of an interlocking, which can include track circuits, signals, switch machines, and other wayside devices, is the first step in troubleshooting these complex circuits. Relay logic plays a major role in the troubleshooting process, regardless of whether physical relays or microprocessor-based circuits, part of the **Vital Microprocessor Interlocking System (VMIS)**, are involved.

Since interlocking is a process which includes several sub-systems and various types of rail equipment, throughout this course the participant will be provided with references to specific areas previously covered in earlier courses.

Troubleshooting interlocking problems uses testing procedures the participant studied in previous courses. When a fault is discovered, the signal maintainer must always begin troubleshooting in a safe and sequential manner. In addition, proper equipment must be used and testing procedures must follow a fail-safe protocol. Given the uniqueness of interlockings, Module 1 will provide the basis and foundation for troubleshooting interlocking by exploring the

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general processes of troubleshooting and overall interlocking safety considerations. Module 2 of this course covers the general processes of troubleshooting and overall interlocking safety considerations. Module 2 of this course will introduce a troubleshooting process that includes a VMIS (MicrolokTM) and field apparatus to present a detailed example of an interlocking troubleshooting format. We will also look at a universal interlocking and work through some interlocking issues that would enhance our troubleshooting techniques.

As always, each agency has specific procedures that must be followed. This is especially true when working with interlockings.



CAUTION

Regulations and procedures differ among rail authorities. Always refer to your authority for specific guidelines and regulations.

1-2 TROUBLESHOOTING SAFETY AND PROCEDURES

As in earlier modules, troubleshooting is defined as a systematic approach to find the source of a problem in an effort to restore an operation or process. In situations where multifaceted systems need to be maintained, symptoms and problems may have causes difficult to diagnose or even have multiple causes. However, troubleshooting at interlockings not only presents the challenges of general troubleshooting for a signal maintainer, but also presents situations that can prove to be stressful and dangerous for the troubleshooter and the entire rail traffic system. While signal maintainers should always follow their own agency's policies and procedures for troubleshooting interlockings, knowledge of a general system of procedures and skills for troubleshooting the signal system at interlockings will help the signal maintainer to face a challenging situation.

Analysis and Effective Response

From the first notice of an interlocking problem, a signal maintainer should begin analysis. This should continue until the problem is corrected, and the interlocking tested and returned to service. Analysis can be defined as a "careful study of something to learn about its parts, what they do, and how they are related to each other." With this in mind, this section will look at the various facets of analysis for troubleshooting interlockings.

Initial Notice of Problem

Often, a signal maintainer first learns of an interlocking problem before they are on site. Consequently and to prepare for the work ahead based on the initial notice of problem, a signal maintainer must determine as much as possible about the nature of the problem and begin the critical process of communication prior to their arrival at the interlocking location. This communication consists of alerting and asking questions to the appropriate personnel and departments. When there is a malfunction at an interlocking, it is critical that the larger rail system be alerted and signal maintainer safety established by means of proper communication as determined by your agency. This important first step, and when done correctly, will help to begin restoration of the interlocking in the safest and fastest way possible.

Upon first learning of an interlocking problem, a signal maintainer should complete the following:

- 1. Determine the nature of the problem
- 2. Predict hazards related to the problem
- 3. Decide how to respond

Determine the nature of problem

In determining the nature of a problem, a signal maintainer should identify the location of the interlocking, what associated system of the interlocking may not be in proper operation, as well as what effects the problem will have on traffic and to the overall signal system. Properly determining the nature of the problem can make the troubleshooting process safer and more efficient.

Predict Hazards of Problem

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From the initial set of information, a signal maintainer must predict what potential hazards may exist. This initial set of problem data collection also begins a **job hazard analysis**. Specifically, a job hazard analysis is a technique to identify the dangers of specific tasks in order to reduce the risk of injury to workers.

Decide How to Respond

After determining as much information about the problem as possible and considering what potential hazards may exist, the signal maintainer must decide how to respond. In deciding how to respond, the signal maintainer must consider the following:

- **Proper communication** and actions taken will depend on the nature of the problem, potential hazards and your agency policy. Proper communication may include informing a dispatcher or OCC and obtaining some sort of interlocking or train protection in accordance with the problem as known at this point and in accordance with your agency policy.
- Items and/or people to gather After determining as much information about the problem as possible, a signal maintainer must consider what to gather and take to the location. Part of the planning and items to gather should include consideration and anticipation for what other problems may be encountered. Items to take may include any additional tools required, possible parts that will be needed, essential PPE, and any other items that may be necessary for restoration of the interlockings.
- Quickest Route to Location A signal maintainer must know the rail system in conjunction with road systems and must consider possible traffic difficulties that may result from times such as rush hour or the interlocking problem itself. From this knowledge, the signal maintainer can determine the quickest route to location of the interlocking problem. Sometimes, signal maintainers may even listen to radio communication while en route to continue to learn about the problem and monitor the situation for better and faster response once on site.

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Classroom Activity
Discuss your agency-specific guidelines for Initial Problem Response Procedures and Directions for Interlockings.