National Signals Training Consortium

Course Catalog
December 2022

SIGNALS TRAINING CONSORTIUM

Table of Contents

Overview

In 2013, public transportation agencies and unions across the country came together to form the National Signals Maintenance Training Consortium (Signals Consortium or Consortium). They were driven to create a full set of standardized national courseware to support training and apprenticeship programs for signal maintainers. Member locations listed multiple reasons for their involvement from addressing retirements and expansions to increasing safety for both the riding public and frontline workers. Some even felt that being involved in such an effort and using the resulting courseware would decrease their liability if an accident were to happen.

Since then, over 70 signals maintenance subject matter experts (SMEs) from 26 member agencies and unions worked with instructional systems designers from the Transportation Learning Center to create over 500 hours of training materials.

Consortium courses cover maintenance training of eight signals subsystems: Track Circuits, Switches and Derails, Train Stops, Grade Crossings, Signals, Interlockings, Power Distribution, and Control Panels. Each course contains participant guides, instructor guides, PowerPoint presentations and assessments. Additionally, the Signals Consortium has developed Orientation to Signal Maintenance; Microprocessors in Signal Systems; Installation and Construction Standards; Signals Train-the-Trainer and a library of checklists and instructional videos to be used for refresher training.

The list of courseware as of December 2022 is listed in this document. The materials themselves are available at https://www.transittraining.net/courseware/rail/category/signals-maintenance as well as at https://learning.transportcenter.org/

View the National Signals Training Consortium Promo video:
https://vimeo.com/253824190

Member Locations of the Signals Consortium (2013-2022)

The following list of agencies and unions contributed to the creation of the materials listed here by offering resources like time with subject matter experts, documentation, videos, photographs and/or time at their location for ITLC instructional designers to capture content.

Contributing Members			
Amtrak	BRS	METRA	BRS
BART	SEIU 1021	Metro North	BRS
CATS		MetroTransit	ATU 1005
Capitol Metro		Maryland MTA	ATU 1300
DART	ATU 1338	NFTA	ATU 1342
Denver RTD	ATU 1001	NJ Transit	BRS
GCRTA	ATU 268	PATCO	IBT 676
IBEW103		Sacramento RT	IBEW 1245
LA Metro	ATU 1277	San Jose VTA	SEIU 521
LIRR	BRS	SEPTA	TWU 234
MBTA	IBEW 103	Sound Transit	ATU 587

Key accomplishments by the Consortium include:

- Development of more than 400 hours **of classroom ready courseware** (29 courses) for the background knowledge, safety procedures, inspection and maintenance, and troubleshooting of signaling sub-systems including the following. See Figure 1 Courseware Map for more information:
  - Track Circuits
  - Switches and Derails
  - Train Stops
  - Highway Grade Crossings
  - Cab and Waysides Signaling Systems
  - Interlockings
  - Power Distribution
  - Control Panels
  - Microprocessor-Based Signaling Systems
  - Networking and Communications
- 11 in-person Consortium meetings where SMEs from member locations engage in concentrated courseware development with the Center's Instructional Designers and shared best practices around training techniques, mentoring practices, assessments, etc.
- Drafted an apprenticeship framework that was accepted by the United States Department of Labor
- Developed Refresher Training resources
- Developed database of technologies at each location
- Created a course catalog
- Developed 8 interactive troubleshooting scenarios
- Developed a Learning Management System
- Approved by FRA as a "Model Program"

For more information on the Signals Training Consortium, contact Julie Deibel-Pundt at jdeibelpundt@transportcenter.org.

Figure 1 Courseware Map

<table>
<tr><th>Topic+B2:KB2:K14</th><th>100
Intro & Overview</th><th>200
Inspection & Maintenance</th><th colspan="2">300
Troubleshooting & Repair</th><th>350</th><th>400</th><th>Refresher Training</th></tr>
<tr><td colspan="8">Pre Requisites: Computer literacy, Electrical theory / Principles of electrical or electronic circuitry (ohm’s law, parallel circuits, etc), First aid and safety practices: are trained on the property, every year, Math – High school GED level math, Reading – High school GED level reading/writing, Ability to read/understand electrical Schematic/Diagrams, Valid Driver’s license (some require CDL), Pass mechanical aptitude test (as per Ramsey, Barrett), Safe work practices around electricity, Series/parallel circuits, Use and care of basic hand tools, Use of multimeters, oscilloscopes, and frequency meters, Agility Test (fear of heights, confined spaces, etc.)</td></tr>
<tr><td>Overview</td><td>100</td><td>N/A</td><td colspan="2">N/A</td><td rowspan="10">C350: Microprocessor Based Signaling Equipment</td><td rowspan="10">C351: Networking and Communications</td><td rowspan="10">400: Advanced Signal Technician Training</td><td>Print Reading</td></tr>
<tr><td>Track Circuits</td><td>101</td><td>201</td><td>301</td><td rowspan="9">Interactive, computer-based scenarios</td><td>Track Circuits</td></tr>
<tr><td>Switches & Derails</td><td>102</td><td>202</td><td>302</td><td>Switches</td></tr>
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<tr><td>Power Distribution</td><td>107</td><td>207</td><td>307</td><td></td></tr>
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<tr><td>Special Topics</td><td>None Yet</td><td>200ST: Install. & Constr.</td><td colspan="2">None Yet</td><td>Microprocessors</td></tr>
</table>

100 Level Courses

Course 100: Orientation

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-100-orientation

Total Instruction	**26 hours, 20 minutes**

Module 1: Introduction to Signaling and Train Control

Outcome: Participants will understand and be able to describe signaling and train control principles as they relate to their work as a signal maintainer including railroad signaling evolution, job safety requirements, governing agencies/authorities and key principles such as fail-safe, vital and non-vital.

🕐 Duration of this Module: 240 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Explain the purpose of a signaling system
- Explain the evolution of railroad signaling
- Specify how signal maintainers are responsible for the safety of the general public
- Identify the importance of Agency and governing location operating rules/policies
- Define “fail-safe”
- Explain why systems have to fail in a safe manner
- Differentiate between vital and non-vital
- Discuss future technologies, such as PTC

Module 2: Roadway Worker Protection and On-Track Safety

Outcome: Participants will understand and be able to describe Right-of-Way (ROW) and on-track safety principles as they relate to their job as a signal maintainer including rail roadway worker protection, on-track safety and communication protocol.

🕐 Duration of this Module: 180 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Identify purpose and various forms of roadway worker protection
- Define rail roadway worker protection
- Recognize the importance of maintaining situational awareness in the field
- Examine vital communications between dispatch/central control, other departments, and roadway workers
- Identify physical characteristics/rules in effect of your rail transportation system to reduce your personal risk and injury

Module 3: Signal System Components

Outcome: Participants will be able to list the subsystems related to railroad signaling and explain the main purpose and components of each.
🕐 Duration of this Module: 240 minutes
🖉 This Module has a Quiz

Learning Objectives

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

- Identify Track Circuits
- Identify Switches and Derails
- Identify Train Stops
- Identify Grade Crossings
- Identify Signaling - wayside, cab
- Identify Interlockings

Module 4: Relays and Relay Logic

Outcome: Participants will have a basic understanding of relays and relay logic including terminology, types of relays, symbols and nomenclature and circuit diagrams.
🕐 Duration of this Module: 200 minutes
🖉 This Module has a Quiz.

Learning Objectives

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

- Define the fundamentals of relays with respect to railroad signaling
- List commonly used relay terminology
- List different types of relays used in railroad signaling
- Illustrate simple relay circuits

Module 5: Introduction to Print Reading

Outcome: The participant will be able to read and interpreting circuit plans related to railroad signaling.
🕑 Duration of this Module: 240 minutes
🖉 This Module has a Quiz

Learning Objectives

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

- Identify components, symbols, and nomenclatures of circuit plans
- Identify indexes, revisions, track layouts, cable layouts, air distribution, power distribution, case equipment / layouts
- Identify FRA or other regulations for up-to-date circuit plans in specified locations including CILs

Module 6: Preparation for Inspection and Maintenance

Outcome: Participants will understand the basics of signal maintenance including tools, equipment and record keeping.
🕑 Duration of this Module: 240 minutes
🖉 This Module has a Quiz

Learning Objectives

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

- Discuss recommended characteristics for devices used in the removal of equipment from service
- Identify recommended procedures for removing equipment from service
- Identify recommended procedures for placing equipment back into service

Module 7: Guidelines and Recommended Practices

Outcome: The participant will understand best practices and recommendations regarding characteristics for jumpers, removing equipment from service, returning equipment to service.

Duration of this Module: 240 minutes

This Module has a Quiz

Learning Objectives

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

- Discuss recommended characteristics for devices used in the removal of equipment from service
- Identify recommended procedures for removing equipment from service
- Identify recommended procedures for placing equipment back into service

Course 101: Introduction and Overview to Track Circuits

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-101-introduction-and-overview-of-track-circuits

Total Instruction	**4 hours, 40 minutes**

Outcome: The participant will understand and be able to describe the basics of train detection within different types of track structures.
Duration of this Course: 280 minutes
This Course has a Quiz

Learning Objectives

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

- Recognize the principles and operations of track circuits
- Name the common of types track circuits
- Record types of track circuits at your location
- List the major components found in track circuits and examine their functions
- List basic components of track structure
- Describe the difference between energized and de-energized track circuits

Course 102: Introduction and Overview to Switches and Derails

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-10-introduction-and-overview-to-switches-and-derails

Total Instruction	**7 hours, 30 minutes**

Outcome: The participant will understand and be able to describe the basic operation and functioning of switches and derails along with the various types that exist on railroads.

Duration of this Course: 450 minutes

This Course has a Quiz

Learning Objectives

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

- Describe theory of operation and purpose of switches
- Identify related components of switches
- Differentiate between facing and trailing
- Identify common switch symbols
- Differentiate between right handed and left handed switch layouts
- Determine normal and reverse position of the switch
- Describe properties of the switch layout as to be able to communicate with the track department
- Given a switch print, be able to identify installation standards
- Describe various types of switch layouts and their main features
- Differentiate between different types of switches
- Identify normal and reverse configuration on the circuit controller
- Identify the different types of motor control voltage
- Describe purpose and components of point detection
- Identify and describe different types of derails
- Describe the operation and purpose of derails

Course 103: Introduction and Overview to Train Stops

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-103-introduction-and-overview-to-train-stops

Total Instruction	**4 hours, 30 minutes**

Outcome: Participants will understand and be able to explain the purpose, principles of operation and various configurations of train stops that are present in transit and commuter rail systems.
Duration of this Course: 270 minutes
This Module has a Quiz

Learning Objectives

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

- Describe principles of operation and purpose of train stops
- Differentiate between pneumatic and electric train stops
- Identify and describe different types of train stops
- Identify and describe the purpose of a dragging equipment detector (DED) trip vane device

Course 104: Introduction and Overview to Highway Grade Crossings

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-104-introduction-and-overview-to-highway-grade-crossings

Total Instruction	**7 hours, 30 minutes**

Outcome: The participant will understand and be able to explain basic terminology, regulations and oversight specific to highway grade crossings, general highway grade crossing components, control circuits and warning systems.

Duration of this Course: 450 minutes

This Course has a Quiz

Learning Objectives

At the end of this lesson, the signal maintainer trainee will be able to:

- Identify key highway grade crossing terminology & nomenclature
- Describe regulations pertaining to highway grade crossings
- Describe the principles of highway grade crossing operation
- Identify and describe highway grade crossing warning equipment
- Identify and describe highway grade crossing control circuits
- Describe highway grade crossing warning systems
- Identify three types of warning system malfunctions

Course 105: Introduction and Overview to Cab & Wayside Signaling

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-105-introduction-and-overview-to-cab-wayside-signaling

Total Instruction	**13 hours, 35 minutes**

Module 1: Overview to Cab & Wayside Signaling

Outcome: The participant will understand and be able to list and explain the types of signaling systems that are present in some rail locations.

Duration of this Course: 280 minutes

This Module has a Quiz

Learning Objectives

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

- Describe theory of operation and purpose of signaling
- Identify related elements of signaling
- Describe interface between territories with and without signaling systems
- Describe operation of different types of signaling systems
- Describe equipment for train to wayside communication (TWC)
- Identify signaling symbols recommended by American Railway Engineering and Maintenance-of-way Association (AREMA)
- Given an aspect chart from your location, demonstrate ability to read the chart and explain the aspect that will be given for various moves on the track
- Describe how overlay systems work
- Identify one type of overlay system

Module 2: Automatic Block Signaling and Traffic Control System

Outcome: The participant will understand and be able to explain the function and operation of Automatic Block Signaling.

Duration of this Module: 165 minutes

This Module has a Quiz

Learning Objectives

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

- Describe general operation of Automatic Block Signaling (ABS)
- Describe general operation of Automatic block signaling uni-directionally
- Describe general operation of Automatic block signaling Bi-directionally, Traffic Control System
- Given a schematic, give a sequence of operation for an ABS

Module 3: Automatic Train Control

Outcome: The participant will understand and be able to explain the function and operation of Automatic Train Control.

🕐 Duration of this Module: 210 minutes

✎ This Module has a Quiz

Learning Objectives

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

- List the three Automatic Train Control Subsystems
- Describe operation of Automatic Train Protection (ATP)
- Describe operation of Automatic Train Operation (ATO)
- Describe operation of Automatic Train Supervision (ATS)

Module 4: Communication Based Train Control

Outcome: The participant will understand and be able to explain the function and operation of Communication Based Train Control.

🕐 Duration of this Module: 160 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Describe operation of Radio Frequency Based Signaling
- List and Describe CBTC specific equipment

Course 106: Introduction and Overview to Interlockings

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-106-introduction-and-overview-to-interlockings

Total Instruction	**12 hours, 5 minutes**

Module 1: Overview of Interlockings

Outcome: The participant will understand and be able to describe basic interlocking terminology and regulations, as well as the purpose and function of different types of interlockings and their operation in rail signaling.

Duration of this Module: 245 minutes

This Module has a Quiz

Learning Objectives

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

- Define interlocking
- Define basic interlocking terminology
- Identify the applicable FRA and agency-specific standards related to interlockings
- Describe FRA and agency-specific interlocking-related safety guidelines
- Describe theory of operation and purpose of interlocking
- Describe different types of interlockings
- Describe how signal apparatus interacts in an interlocking system

Module 2: Interlocking Terms & Concepts

Outcome: The participant will understand and be able to explain interlocking specific nomenclature and basic routing and traffic control concepts.

Duration of this Module: 200 minutes

This Module has a Quiz

Learning Objectives

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

- Describe theory of operation and purpose of signaling
- Identify related elements of signaling
- Describe interface between territories with and without signaling systems
- Describe operation of different types of signaling systems
- Describe equipment for train to wayside communication
- Identify signaling symbols recommended by AREMA

- Given an aspect chart from your location, demonstrate ability to read the chart and explain the aspect that will be given for various moves on the track
- Describe how overlay systems work
- Identify one type of overlay system

Module 3: Interlockings and Relay Logic

Outcome: The participant will understand and be able to describe the functions and types of locking, with associated prints and the basics of establishing routes.

Duration of this Module: 280 minutes

This Module has a Quiz

Learning Objectives

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

- Define locking
- Describe different types of locking circuits and their function
- Identify types of locking on a given print design/layout and their main purpose
- Differentiate between single and universal interlockings
- Describe signal control circuits and the basic circuits used in an interlocking when requesting routes

Course 107: Introduction and Overview to Signaling Power Distribution

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-107-introduction-and-overview-to-signaling-power-distribution

Total Instruction	**5 hours**

Outcome: Participants will be able to explain the principles behind power distribution for signal systems including basic terminology, regulations and oversight.
Duration of this Course: 300 minutes
This Module has a Quiz

Learning Objectives

Following the completion of this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Recognize safety hazards when working on current collector systems
- Examine and compare maintenance schedules and checklists
- Inspect and maintain the knife switch assembly

Course 108: Introduction and Overview to Control Panels

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-108-introduction-and-overview-to-control-panels

Total Instruction	**3 hours**

Outcome: Lists and describes the different types of control panels, their purpose and function as well as typical control panel components.
Duration of this Course: 180 minutes
This Module has a Quiz

Learning Objectives

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

- Describe the different functions and components of mechanical interlocking machines as compared to modern control panels
- Describe different types of control panels and their functions
- List and describe control panel components
- Identify each light, button or key on a control panel and describe its function
- Identify areas that have control panels and how their functions may differ Demonstrate ability to read a lock diagram
- Describe different types of communication interfaces as they relate to control panels

200 Level Courses

Course 201: Inspection and Maintenance of Track Circuits

Course Description

Where to access the course:
https://www.transittraining.net/images/uploads/full_documents/C201_Instructor_Guide_7.12.2019.pdf

Total Instruction	**18 hours, 30 minutes**

Module 1: Overview and Safety

Outcome: The participant will be understand and be able to explain the basics of safely inspecting and maintaining track circuits including safety measures to take when working around track circuits, tools to use and the type and frequency of different types of maintenance.

🕐 Duration of this Module: 240 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Use safety measures when working around track circuit
- Identify authority-specific maintenance procedures
- Record maintenance work performed
- Identify tools used in track circuit inspection and maintenance work
- Specify inspection and maintenance timetables for track circuits

Module 2: General Inspection and Maintenance

Outcome: The participant will be able to perform inspection, maintenance and testing that is common to all types of track circuits. More specific details for different types of track circuits are covered in later modules.

🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Define various methods of fouling circuits
- Perform visual inspection of track circuit relay

- Perform inspection and basic preventative maintenance of full circuit, including doing track profiles and shunt tests
- Perform Authority-specific preventative maintenance procedures
- Perform appropriate tests
- Measure circuit values against OEM/authority specifications

Module 3: DC Track Circuit Inspection and Maintenance

Outcome: The participant will be able to inspect and maintain a direct current track circuit in a transit environment.

Duration of this Module: 156 minutes

This Module has a Quiz

Learning Objectives

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

- Recognize the principles of operation of a DC track Circuit
- Identify DC track circuit components
- Inspect and maintain battery and rectifier
- Inspect and maintain DC track circuit relay

Module 4: AC/PF Track Circuit Inspection and Maintenance

Outcome: The participant will be able to inspect and maintain an AC/PF track circuit in a transit environment.

Duration of this Module: 165 minutes

This Module has a Quiz

Learning Objectives

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

- Inspect, adjust, and replace a track feed transformer
- Inspect and replace an isolation transformer
- Inspect and replace a balancing impedance
- Inspect and replace reactors
- Inspect and maintain track leads
- Inspect and replace fuse on the relay end
- Inspect and maintain frequency converters
- Inspect and maintain DC to AC code converters
- Inspect negative return bonds
- Inspect and maintain AC vane relays

Module 5: AF Track Circuit Inspection and Maintenance

Outcome: The participant will be able to inspect and maintain an Audio Frequency track circuit in a transit environment.

🕐 Duration of this Module: 235 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Define the principles of operation of an audio frequency track circuit (AFTC)
- Identify components of an AFTC
- Measure and record receiver input and output
- Measure and record track transmit values including frequency, voltage, and code rate
- Monitor and record power levels
- Identify, record, and report frequency compatibility for harmonics
- Inspect twisted pair
- Inspect and maintain wayside receiving and transmitting bond
- Inspect and maintain AF track circuit module
- Inspect and maintain track relay (vital relay)
- Inspect and maintain audio frequency overlay track circuit
- Inspect high definition loop and receive junction transmitters
- Inspect and maintain common usage areas - for overrun circuits
- Inspect and maintain audio frequency digital track circuit (frequency shift keying)

Module 6: Coded and Electronic Track Circuit

Outcome: The participant will understand how coded and electronic track circuits operate as well as be able to inspect and maintain them.

🕐 Duration of this Module: 135 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Recognize the principles of operation of coded and electronic coded track circuits
- Differentiate between a DC coded track circuit and an AC coded track circuit
- Inspect and maintain an AC coded track circuit
- Inspect and maintain an electronic track circuit
- Inspect and maintain code transmitting and following relays
- Inspect and maintain decoding components
- Inspect and maintain auto-transformer
- Inspect and maintain authority-specific coded track circuits
- Include inspect and maintain batten boards

Course 202: Inspection & Maintenance of Switches and Derails

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-202-inspection-and-maintenance-of-switches-and-derails

Total Instruction	**20 hours, 40 minutes**

Module 1: Overview & Safety

Outcome: The participant will be able to describe how to safely inspect and maintain switches and derails.

🕐 Duration of this Module: 165 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Identify trip, slip and fall hazards related to inspection and maintenance of switches and derails
- Identify pinch points related to inspection and maintenance of switches and derails
- Describe how to manually throw a switch
- Demonstrate ability to utilize secondary protection
- Describe procedures for working in electrified territory
- Identify proper PPE to be used during inspection and maintenance of switches and derails
- Identify and describe tools specific to inspection and maintenance of switches and derails
- List Tests Mandated by the FRA
- List pertinent timing for each test as per your authority
- Demonstrate ability to complete proper documentation

Module 2: Switch and Derail Specific Print Reading

Outcome: The participant will be able to identify and explain specific nomenclature and relays used in railroad switch and derail systems and how they form the operation of railroad switches and derails.

🕐 Duration of this Module: 185 minutes

✎ This Module has a Quiz

Learning Objectives

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

- List switch and derail specific nomenclature
- List switch and derail specific relays and describe their functions
- Using a print, describe the sequence of operation for an M3 single ended switch
- Demonstrate ability to outline the sequence of operation of a single-ended switch

Module 3: General Inspection and Maintenance

Outcome: The participant will be able to describe and demonstrate the inspection, maintenance and testing that is performed on all types of switches. More specific details for different types of switches will be covered in later modules.
Duration of this Module: 235 minutes
This Module has a Quiz

Learning Objectives

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

- Identify hardware which needs to be tightened
- Demonstrate ability to tighten appropriate hardware
- Ensure all locks are in place and secure
- Identify areas/components which need to be lubricated on a regular PM schedule
- Inspect and maintain switch layout (where applicable)
- Describe purpose and components of mechanical locking
- Inspect and maintain lock rod
- Inspect and maintain throw rod
- Inspect and maintain point detector rod
- Inspect and maintain switch circuit controller
- Inspect and maintain switch point heaters/snow melters(where applicable)
- Inspect and maintain moveable point frogs
- Demonstrate ability to perform point detector test
- Demonstrate ability to perform switch obstruction test
- Demonstrate ability to adjust point tension
- Inspect and maintain circuit control heaters (where applicable)
- Demonstrate ability to test electrical indication

Module 4: Manual Switches and Derails

Outcome: The participant will be able to describe and demonstrate the inspection, maintenance and testing that is performed on manual switches and derails.
Duration of this Module: 145 minutes
This Module has a Quiz

Learning Objectives

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

- Inspect and maintain manual switches
- Inspect and maintain electric locks
- Inspect and maintain circuit controller

Module 5: Electrically Operated Switches & Derails

Outcome: The participant will be able to describe and demonstrate inspection, maintenance and testing that is performed on all types of electrically operated switches and derails.

🕐 Duration of this Module: 165 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Inspect and maintain electrically operated switches and derails
- Inspect and maintain Components in Motor Compartment
- Demonstrate ability to perform friction clutch test
- Demonstrate ability to perform switch restoring circuit test

Module 6: Pneumatic Switches and Derails

Outcome: The participant will be able to describe and perform the inspection, maintenance and testing that is performed on pneumatic switches and derails.

🕐 Duration of this Module: 190 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Inspect and maintain electro-pneumatic switches and derails
- Inspect and maintain air source/valves
- Inspect and maintain pneumatic switch (and valve magnets)
- Demonstrate Ability to perform a test on the switch restoring circuit, on an electro-pneumatic switch
- Demonstrate Ability to perform minute man test

Module 7: Electro-Hydraulic Switch and Derail Inspection & Maintenance

Outcome: The participant will be able to describe and demonstrate inspection and preventive maintenance to be performed on electro-hydraulic switches.

🕑 Duration of this Module: 155 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Inspect and maintain hydraulic switches

Course 203: Inspection & Maintenance of Train Stops

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-203-inspection-and-maintenance-of-train-stops

Total Instruction	**23 hours, 30 minutes**

Module 1: Overview and Safety

Outcome: The participant will understand and be able to describe the safety procedures to be performed during the inspection and maintenance of train stops.

Duration of this Module: 240 minutes

This Module has a Quiz

Learning Objectives

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

- Identify proper PPE to be used during the inspection and maintenance of train stop
- Describe Operation Control Center notification process
- Describe adverse working conditions
- Describe procedures for working in electrified territory
- Identify pinch points related to inspection and maintenance of train stops
- Identify trip, slip and fall hazards related to inspection and maintenance of train stops
- Identify and describe the standard safety tools and devices specific to the inspection and maintenance of train stops
- List tests and frequency for each test (monthly, quarterly, etc.) as per your authority
- For each test, identify documentation that needs to be done as per location and regulating authority
- Demonstrate ability to complete proper documentation as per location and regulating authority

Module 2: Print Reading

Outcome: The participant will be able to interpret typical design circuits associated with train stops and dragging equipment detectors.

Duration of this Module: 330 minutes

This Module has a Quiz

Learning Objectives

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

- List typical train stop nomenclature
- List train stops specific relays and describe their functions
- Given a print for a specific electric train stop, describe the sequence of operation
- Given a print for a specific electro-pneumatic train stop, describe the sequence of operation
- Given a print for a specific dragging equipment detector (DED) circuit, describe the sequence of operation
- Demonstrate ability to outline the sequence of operation of an electric train stop
- Demonstrate ability to outline the sequence of operation of an electro-pneumatic train stop
- Demonstrate ability to outline the sequence of operation of a DED

Module 3: Electric Train Stops

Outcome: The participant will be able to inspect and maintain electric train stops to ensure they are operating safely and appropriately and thereby increase their reliability and reduce the risk of hazards and failures.

Duration of this Module: 300 minutes

This Module has a Quiz

Learning Objectives

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

- Inspect/test and maintain contacts
- Inspect/test and maintain push button
- Inspect/test and maintain holding circuits
- Inspect/test and maintain capacitors
- Inspect/test and maintain resistors
- Inspect/test and maintain motor
- Inspect/test and maintain cribs
- Inspect/test and maintain wire connections
- Inspect/test and maintain exterior stop box housing
- Inspect/test and maintain exterior heaters
- Check for appropriate clearances when gauging trip arm in accordance with authority guidelines
- Perform a trip arm cycle test

Module 4: Electro-Pneumatic Train Stops

Outcome: The participant will be able to inspect and maintain electro-pneumatic train stops to ensure they are operating safely and appropriately and thereby increase their reliability and reduce the risk of hazards and failures.
🕐 Duration of this Module: 270 minutes
🖉 This Module has a Quiz

Learning Objectives

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

- Inspect/test and maintain the following mechanical parts:
    - Contacts
    - Push button / Key release
    - Holding circuits
    - Cribs
    - Wire connections
    - Exterior stop box housing
    - Exterior heaters
    - Air line
    - Solenoid / Magnet
- Check for appropriate clearances when gauging trip arm in accordance with RTS guidelines
- Perform a trip arm cycle test

Module 5: Dragging Equipment Detectors

Outcome: The participant will be able to inspect and perform preventive maintenance on dragging equipment detectors.
🕐 Duration of this Module: 270 minutes
🖉 This Module has a Quiz

Learning Objectives

- Inspect/test dragging equipment detector (DED)
- Inspect/test and maintain DED components
- Check for appropriate trip vane clearances
- Tighten mounting/hold down hardware
- Perform cycle check

Course 204: Inspection and Maintenance of Highway Grade Crossings

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-204-inspection-and-maintenance-of-highway-grade-crossings

Total Instruction	28 hours

Module 1: Overview and Safety

Outcome: The participant will understand and be able to demonstrate safety and pre/post inspection and maintenance procedures such as securing the right tools and record keeping.

Duration of this Module: 240 minutes

This Module has a Quiz

Learning Objectives

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

- Describe safety practices as related to grade crossing inspection & maintenance
- Identify tools and describe their required care necessary for highway grade crossing inspection and maintenance
- Identify agency specific schedules for grade crossing inspection and maintenance
- Describe inspection, maintenance & testing documentation for reporting as per agency regulations

Module 2: Theory of Operation and Circuits

Outcome: The participant will be able to explain how circuits and their subcomponents relate to the operation of track circuits and how these are represented in nomenclature and symbols.

Duration of this Module: 300 minutes

This Module has a Quiz

Learning Objectives

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

- Identify nomenclature, symbols and relays specific for highway grade crossings
- Describe highway grade crossing circuits for flashers, bells, crossing gates, detection circuits, island circuits and approach circuits
- Identify and explain a grade crossing sequence of operation and related systems

Module 3: Warning Devices

Outcome: The participant will be able to inspect, maintain and replace highway grade crossing warning devices in accordance with regulatory and location requirements.
🕐 Duration of this Module: 240 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Identify nomenclature, symbols and relays specific for highway grade crossings
- Describe highway grade crossing circuits for flashers, bells, crossing gates, detection circuits, island circuits and approach circuits
- Identify and explain a grade crossing sequence of operation and related systems
- Identify the location of prints for highway grade crossing maintenance and inspection purposes

Module 4: Crossing Gates and Mechanisms

Outcome:
🕐 Duration of this Module: 300 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe highway grade crossing gates and gate mechanisms
- Identify regulatory requirements for highway grade crossing gates and gate mechanisms
- Describe and demonstrate inspection, maintenance, replacement & routine testing for highway grade crossing gates and gate mechanisms
- Identify agency specific schedules for gates and gate mechanism inspection, maintenance & routine testing

Module 5: Warning Systems

Outcome: The participant will be able to inspect and maintain highway grade crossing warning systems and circuits.
🕐 Duration of this Module: 420 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe highway grade crossing warning systems

- Identify highway grade crossing regulatory requirements
- Describe and demonstrate inspection, maintenance & routine testing practices for highway grade crossings and related subsystems
- Identify agency specific schedules for inspection, maintenance & testing of highway grade crossing warning systems

Module 6: General Inspection & Maintenance Procedures

Outcome: The participant will be able to inspect and maintain highway grade crossings.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe general highway grade crossing instructions for inspection and maintenance practices
- Identify monthly highway grade crossing testing and inspection practices
- Identify quarterly highway grade crossing testing and inspection practices
- Identify annual highway grade crossing testing and inspection practices
- Describe agency specific procedures
- Describe cautions to take when inspecting and maintaining highway grade crossings

Course 205: Inspection & Maintenance of Cab and Wayside Signaling Systems

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-205-inspection-and-maintenance-of-signaling-systems

Total Instruction	**8 hours, 25 minutes**

Module 1: Overview & Safety

Outcome: The participant will understand and be able to demonstrate safe practices for inspecting and maintaining cab and wayside signaling systems.
Duration of this Module: 180 minutes
This Module has a Quiz

Learning Objectives

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

- Identify trip, slip and fall hazards related to inspection and maintenance of signaling systems Identify pinch points related to inspection and maintenance of signaling system
- Describe procedures for working in electrified territory
- Identify proper PPE to be used during inspection and maintenance of signaling systems
- Identify and describe tools specific to inspection and maintenance of signaling systems
- List Tests Mandated by the FRA
- List pertinent timing for each test (monthly, quarterly, etc.) as per your authority
- Demonstrate ability to complete proper documentation

Module 2: Generic Inspection

Outcome: The participant will understand and be able to demonstrate generic inspection and maintenance of signaling systems.
Duration of this Module: 185 minutes
This Module has a Quiz

Learning Objectives

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

- Identify cab and wayside signaling components that need to be inspected and maintained on a regular schedule

- Demonstrate ability to inspect and maintain cab and wayside signaling components
- Demonstrate ability to document inspection and maintenance

Module 3: Communication Based Train Control

Outcome: The participant will understand and be able to inspect and maintain Communication Based Train Control specific components.
🕐 Duration of this Module: 140 minutes
🖉 This Module has a Quiz

Learning Objectives

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

- Demonstrate ability to perform and document Radio Frequency Based Signaling Systems specific tests

Course 206: Inspection & Maintenance of Interlockings

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-206-inspection-and-maintenance-of-interlockings

Total Instruction	**7 hours, 20 minutes**

Module 1: Overview and Safety

Outcome: The participant will understand and be able to describe safety procedures to be performed during the inspection, testing and maintenance of interlockings.
Duration of this Module: 220 minutes
This Module has a Quiz

Learning Objectives

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

- Describe safety procedures and requirements as per location and regulating authority
- List tools and testing equipment used in the inspection, testing and maintenance of interlockings
- Identify agency specific schedules for interlockings inspection and maintenance
- List tests, frequency and purpose of each test per your authority
- Describe inspection, maintenance and testing documentation for reporting as per agency regulations

Module 2: Testing and Maintenance

Outcome: The participant will understand and be able to describe the locking and interlocking tests to be performed during the inspection and maintenance of interlockings.
Duration of this Module: 220 minutes
This Module has a Quiz

Learning Objectives

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

- Perform route locking test
- Perform approach locking test
- Perform time locking test
- Perform indication locking test
- Give a basic description of locking tests per FRA standards
- Describe the inspection and tests for interlockings and associated apparatus
- Identify general maintenance procedure

Course 207: Signal Power Distribution Inspection and Maintenance

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-207-signal-power-distribution-inspection-and-maintenance

Total Instruction	**9 hours, 15 minutes**

Module 1: Signal Power Distribution Inspection & Maintenance Overview

Outcome: The participant will be able to explain and demonstrate how to safely prepare for and clean up after maintenance and inspection of signal power distribution systems.
Duration of this Module: 215 minutes
This Module has a Quiz

Learning Objectives

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

- Describe safety practices as related to performing inspection & maintenance for signal power distribution.
- Identify and explain the use of tools used for signal power distribution inspection and maintenance.
- Identify agency specific schedules for signal power distribution inspection and maintenance.
- Describe inspection and maintenance documentation for reporting as per agency regulations.

Module 2: Power Distribution Components

Outcome: The participant will be able to explain and demonstrate how to inspect and maintain power distribution components.
Duration of this Module: 340 minutes
This Module has a Quiz

Learning Objectives

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

- List steps for inspecting and maintaining primary power supply to signal systems•
- Explain and demonstrate how to perform inspection and maintenance on general power distribution components
- Explain how to perform a grounds test

- Explain how to perform an insulation resistance test
- Explain how to perform inspection and maintenance on electrical circuit and equipment protection devices.
- List steps for inspecting and maintaining secondary power sources

Course 208: Inspection & Maintenance of Control Panels

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-208-inspection-and-maintenance-of-control-panels

Total Instruction	**2 hours, 40 minutes**

Outcome: The participant will understand and be able to explain how to inspect, test and maintain control panels to verify they are operating as designed.
Duration of this Course: 160 minutes
This Module has a Quiz

Learning Objectives

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

- List tools and materials used in the inspection, testing and maintenance of control panels
- Describe inspection and maintenance procedures as per location and regulating authority of non-vital components of the control panel
- Describe basic inspection and maintenance procedures as per industry standards
- Describe control panel functions when testing specific type of interlockings
- Identify agency specific schedules, if applicable, for control panel inspection and maintenance
- Describe inspection, maintenance and testing documentation for reporting as per agency regulations

Course 200ST: Introduction to Installation and Construction Standards

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-250-introduction-to-installation-and-construction-standards

Total Instruction	**8 hours, 15 minutes**

Module 1: Overview of Installation and Construction Standards

Outcome: Introduces standard setting agencies, practical application and general safety considerations.

🕐 Duration of this Module: 103.5 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Identify national and local standard setting agencies
- Given the appropriate documents, demonstrate the ability to locate standards related to railway signaling equipment
- Explain the importance of installation and construction standards for railway signaling equipment to the job of the signal maintainer
- Describe generic safety considerations for troubleshooting and re-installing railway signaling equipment
- Demonstrate understanding of confined space compliance

Module 2: Cabling Characteristics

Outcome: Introduces cabling characteristics including types of conduits, which agencies have standards for cabling, splicing, reading schematics and testing cables.

🕐 Duration of this Module: 71 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Describe types of cable used and their purpose
- Describe characteristics of cabling
- Describe how to install and/or replace cabling
- Demonstrate ability to use the appropriate guide to locate needed information

- Explain which test(s) should be performed prior to equipment being place into service
- Demonstrate ability to read schematic prints and properly identify, terminate and test cables
- Demonstrate ability to splice wires

Module 3: Insulated Joints

Outcome: Introduces insulated joint characteristics including which agencies have applicable standards specific safety considerations, re-installation and testing.
🕐 Duration of this Module: 62 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Follow proper safety guidelines when working with insulated joints
- Describe how to install and/or replace insulated joints
- Demonstrate ability to use the appropriate guide to locate needed information
- Explain which test(s) should be performed prior to equipment being place into service
- Identify types, parts and placement of insulated joints
- Describe proper communication protocols to use w/ traction power and OCC to coordinate installation

Module 4: Impedance Bonds

Outcome: Introduces impedance bond characteristics including which agencies have applicable standards specific safety considerations, re-installation and testing.
🕐 Duration of this Module: 45 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe how to install and/or replace impedance bonds
- Demonstrate ability to use the appropriate guide to locate needed information
- Explain which test(s) should be performed prior to equipment being place into service
- Explain safety procedures when working with of impedance bonds

Module 5: Wayside Signals

Outcome: Introduces wayside signal characteristics including which agencies have applicable standards specific safety considerations, re-installation and testing.
🕐 Duration of this Module: 62 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe how to install and/or replace wayside signals
- Demonstrate ability to use the appropriate guide to locate needed information
- Explain which test(s) should be performed prior to equipment being placed into service
- Given blue prints, identify height requirements, type of signal head and lamp requirements
- Identify signal line of sight

Module 6: Switch Layouts

Outcome: Introduces switch layout characteristics including which agencies have applicable standards specific safety considerations, re-installation and testing.
🕐 Duration of this Module: 68 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe how to install or replace switch layouts – point opening (site specific), over throw (site specific), tie spacing, dap points, rail gauge, prints, mounting methods, type of switch, switch stand
- Demonstrate ability to use the appropriate guide to locate needed information
- Explain which test(s) should be performed prior to equipment being placed into service
- Demonstrate application of agency or manufacturer switch standards to ensure proper switch layout and function for new installations

Module 7: Grade Crossings

Outcome: Introduces grade crossing characteristics including which agencies have applicable standards specific safety considerations, re-installation and testing.
🕐 Duration of this Module: 83 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Identify relevant regulatory agency standards
- Demonstrate ability to use the appropriate documentation to locate needed information
- Describe how to install and/or replace highway grade crossings
- Explain which test(s) should be performed prior to equipment being place into service
- Identify location and orientation for grade crossing prints
- Describe grade crossing layouts
- Demonstrate understanding of electric and mechanical safety
- Describe how to maintain public safety

300 Level Courses

Course 301: Troubleshooting Track Circuits

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-301-troubleshooting-track-circuits

Total Instruction	9 hours, 5 minutes

Module 1: Principles of Troubleshooting

Outcome: The participant will understand and be able to explain the principles and steps of troubleshooting signaling systems.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes.

Module 2: Overview to Troubleshooting & Repair of Track Circuits

Outcome: The participant will understand and be able to explain how to troubleshoot track circuits in a safe way and following guidelines from the FRA and their agency.
🕐 Duration of this Module: 170 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Identify safety practices when troubleshooting and repairing track circuits
- Organize process for troubleshooting when track circuit is down
- Describe FRA guidelines and agency-specific documentation procedures
- Describe specialized test equipment used for troubleshooting highway grade crossings

- Identify procedures for removing equipment from service
- Identify procedures for placing equipment back into service

Module 3: Resolving Problems with Track Circuits

Outcome: The participant be able to resolve problems with track circuits.
🕐 Duration of this Module: 195 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Identify symptoms of track circuit failure and possible causes
- Given a track circuit problem and cause, describe possible solution and necessary repairs
- Given a real world track circuit problem, apply troubleshooting principles to figure out the root cause

Course 302: Troubleshooting and Repair of Switches and Derails

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-302-troubleshooting-switches-and-derails

Total Instruction	20 hours, 5 minutes

Module 1: Principles of Troubleshooting

Outcome: The participant will understand and be able to explain the principles and steps of troubleshooting signaling systems.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes

Module 2: Overview to Troubleshooting and Repair of Switches & Derails

Outcome: The participant will understand and be able to explain how to troubleshoot switches and derails in a safe way.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe safety practices and processes as related to troubleshooting and repair of switches and derails
- Describe agency specific documentation procedures
- Describe types of malfunctions for switches and derails
- Explain process for when a switch or derail cannot be repaired promptly
- Describe specialized test equipment used for troubleshooting switches and derails

Module 3: Generic Troubleshooting & Repair of Switches/ Derails

Outcome: The participant will be able to resolve problems generic to all types of switches and derails.
🕐 Duration of this Module: 125 minutes
✎ This Module has a Quiz

Learning Objectives

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

- List common failures in all types of switches/derails
- Describe generic malfunctions common for switches/derails
- Identify generic symptoms for switch/derail malfunctions and possible causes
- Given a generic switch/derail problem and cause, describe possible solutions and/or necessary repair
- Test, troubleshoot, adjust or repair generic switch/derail components

Module 4: Troubleshooting & Repair of Manual Switches/Derails

Outcome: The participant will be able to resolve problems specific to manual switches and derails.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Identify possible causes of manual switch/derail malfunctions
- Given a manual switch/derail problem and cause, describe possible solutions and/or necessary repair
- Demonstrate ability to troubleshoot and repair manual switches/derails using authority specifications and OEM manuals
- Use a flowchart to troubleshoot and repair manual switches/derails
- Demonstrate ability to adjust/replace contacts
- Demonstrate ability to adjust/replace a clutch

Module 5: Troubleshooting & Repair of Electric Switches/Derails

Outcome: The participant will be able to resolve problems specific to electric switches and derails.

🕑 Duration of this Module: 180 minutes

🖉 This Module has a Quiz

Learning Objectives

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

- Identify possible causes of electric switch/derail malfunctions
- Given an electric switch/derail problem and cause, describe possible solutions and/or necessary repair
- Demonstrate ability to troubleshoot and repair electric switches/derails using authority specifications and OEM electrics.
- Use a flowchart to troubleshoot and repair electric switches/derails
- Demonstrate ability to replace the motor in an electric switch

Module 6: Troubleshooting & Repair of Electro-Hydraulic Switches/Derails

Instructor

Outcome: The participant will be able to resolve problems specific to electro-hydraulic switches and derails.

🕑 Duration of this Module: 180 minutes

🖉 This Module has a Quiz

Learning Objectives

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

- Identify possible causes of electro-pneumatic switch/derail malfunctions
- Given an electro-pneumatic switch/derail problem and cause, describe possible solutions and/or necessary repair
- Demonstrate ability to troubleshoot and repair electro-pneumatic switches/derails using authority specifications and OEM electrics.
- Use a flowchart to troubleshoot and repair electro-pneumatic switches/derails
- Demonstrate ability to replace the switch air cylinder and CP valve assembly

Module 7: Troubleshooting & Repair of Electro-Pneumatic Switches/Derails

Outcome: The participant will be able to resolve problems specific to electro-pneumatic switches and derails.

🕑 Duration of this Module: 180 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Identify possible causes of electro-hydraulic switch/derail malfunctions
- Given an electro-hydraulic switch/derail problem and cause, describe possible solutions and/or necessary repair
- Demonstrate ability to troubleshoot and repair electrohydraulic switches/derails using authority specifications and OEM electrics
- Use a flowchart to troubleshoot and repair electrohydraulic switches/derails
- Demonstrate ability to replace a proximity sensor on an electro-hydraulic switch/derail

Course 303: Troubleshooting and Repair of Train Stops Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-303-troubleshooting-train-stops

Total Instruction	15 hours, 55 minutes

Module 1: Principles of Troubleshooting

Outcome: The participant will understand and be able to explain the principles and steps of troubleshooting signaling systems.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes.

Module 2: Overview to Troubleshooting and Repair of Train Stops

Outcome: The participant will understand and be able to explain how to safely troubleshoot train stops.
🕐 Duration of this Module: 185 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe safety practices and processes as related to troubleshooting and repair of train stops
- Describe agency specific documentation procedures
- Describe types of malfunctions for train stops
- Explain process for when a train stop cannot be repaired promptly
- Describe specialized test equipment used for troubleshooting train stops

Module 3: Electric Train Stops

Outcome: The participant will be able to troubleshoot and repair problems with electric train stops.
🕑 Duration of this Module: 300 minutes
✎ This Module has a Quiz

Learning Objectives

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

- List common failures in electric train stops
- Describe types of train stop malfunctions
- Identify symptoms of train stop malfunctions and possible causes
- Given a train stop problem and cause, describe possible solutions and/or necessary repair
- Demonstrate ability to troubleshoot and repair train stops using authority specifications and OEM manuals
- Describe how to use flowcharts to troubleshoot and repair a train stop problem
- Test, troubleshoot, adjust or repair specific train stop components, including heaters/snow melters, if applicable

Module 4: Electro-Pneumatic Train Stops

Outcome: The participant will be able to troubleshoot and repair problems with electro-pneumatic train stops.
🕑 Duration of this Module: 290 minutes
✎ This Module has a Quiz

Learning Objectives

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

- List common failures in electro-pneumatic train stops
- Describe types of train stop malfunctions
- Identify symptoms of train stop malfunctions and possible causes
- Given a train stop problem and cause, describe possible solutions and/or necessary repair
- Demonstrate ability to troubleshoot and repair train stops using authority specifications and OEM manuals.
- Test, troubleshoot, adjust or repair specific train stop components, including heaters/snow melters, if applicable

Course 304: Troubleshooting and Repair of Highway Grade Crossings

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-304-troubleshooting-highway-grade-crossings

Total Instruction	**10 hours**

Module 1: Principles of Troubleshooting

Outcome: The participant will understand and be able to explain the principles and steps of troubleshooting signaling systems.

Duration of this Module: 180 minutes

This Module has a Quiz

Learning Objectives

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

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes

Module 2: Overview to Troubleshooting & Repair of Grade Crossings

Outcome: The participant will understand and be able to explain how to troubleshoot highway grade crossings in a safe way.

Duration of this Module: 210 minutes

This Module has a Quiz

Learning Objectives

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

- Describe safety practices and processes as related to grade crossing troubleshooting & repair
- Describe FRA guidelines and agency specific documentation procedures
- Describe types of highway grade crossing malfunctions
- Describe specialized test equipment used for troubleshooting highway grade crossings

Module 3: Resolving Problems with Grade Crossings

Outcome: The participant will be able to resolve problems with highway grade crossing warning systems.

🕐 Duration of this Module: 210 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Describe how to use prints, schematics and flowcharts to troubleshoot and repair a highway grade crossing problem
- Identify symptoms of improper highway grade crossing operation and possible causes
- Given a highway grade crossing problem and cause, describe possible solution and necessary repairs

Course 305: Troubleshooting and Repair of Highway Grade Crossings

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-305-cab-and-wayside-signaling-troubleshooting-and-repair

Total Instruction	**7 hours, 55 minutes**

Module 1: Principles of Troubleshooting

Outcome: The participant will understand and be able to explain the principles and steps of troubleshooting signaling systems.

🕐 Duration of this Module: 180 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes

Module 2: Overview to Troubleshooting & Repair Of Cab & Wayside Signals

Outcome: The participant will understand and be able to explain how to troubleshoot cab and wayside signaling systems in a safe way.

🕐 Duration of this Module: 130 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Identify safety practices when troubleshooting and repairing signaling systems
- Organize process for troubleshooting when signaling systems are faulty
- Describe FRA guidelines and agency-specific documentation procedures
- Describe specialized test equipment used for troubleshooting signaling systems
- Identify procedures for removing equipment from service
- Identify procedures for placing equipment back into service

Module 3: Resolving Problems with Cab & Wayside Signals

Outcome: The participant will be able to resolve problems with cab and wayside signaling systems.

🕐 Duration of this Module: 165 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Identify symptoms of signaling failures and possible causes
- Given a signaling problem and cause, describe possible solution and necessary repairs
- Given a real world signaling problem, apply troubleshooting principles to figure out the root cause

Course 306: Troubleshooting and Repair of Interlockings

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-306-troubleshooting-and-repair-of-interlockings

Total Instruction	4 hours, 10 minutes

Module 1: Overview

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

Duration of this Module: 140 minutes

This Module has a Quiz

Learning Objectives

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

- Demonstrate knowledge of the basic theories of heat
- Describe the basic concepts of refrigeration and air conditioning
- Describe the basic components and basic concepts of a typical heating system
- Demonstrate basic knowledge of HVAC piping and tubing

Module 2: Troubleshooting and Repair

Outcome: The participant will understand and be able to describe general processes for troubleshooting and repairing typical interlocking problems and apply these principles to real world examples.

Duration of this Module: 110 minutes

This Module has a Quiz

Learning Objectives

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

- Describe and demonstrate how to use prints, schematics and flowcharts to troubleshoot, adjust and/or repair an interlocking problem
- Identify symptoms of improper interlocking operation
- Describe corrective actions to resolve typical interlocking failures:
- Use diagnostic software, where applicable
- Given a specific interlocking problem, provide possible solutions and necessary repairs

Course 307: Troubleshooting and Repair of Signal Power Distribution

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-307-signal-power-distribution-troubleshooting-and-repair

Total Instruction	**17 hours, 30 minutes**

Module 1: Principles of Troubleshooting

Outcome: The participant will understand and be able to explain the principles and steps of troubleshooting signaling systems.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes

Module 2: Overview to Troubleshooting and Repair of Signal Power Distribution

Outcome: The participant will understand and be able to explain how to troubleshoot power distribution systems in a safe way.
🕐 Duration of this Module: 210 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe FRA and other regulatory or agency specific guidelines for documentation procedures
- Describe safety practices and processes as related to power distribution troubleshooting & repair
- Describe specialized test equipment used for troubleshooting power distribution
- Describe how to verify operation of power supply

- Describe how to identify and recognize when power is not functioning as normal
- Explain processes for delayed repairs

Module 3: Troubleshooting and Repair of Signal Power Distribution Using Electrical Prints

Outcome: The participant will be able to use prints for troubleshooting signal power distribution systems.
🕐 Duration of this Module: 180 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Identify basic nomenclature and symbols for power distribution equipment
- Identify the layout of power distribution and circuits using prints
- Measure input and output of power using prints
- Identify various prints representing various power distribution systems
- Explain how to use prints for troubleshooting signal power distribution systems
- Explain how to sectionalize power sources for testing and troubleshooting

Module 4: Overview and Safety

Outcome: The participant will understand and be able to explain how to troubleshoot signal power distribution components in a safe way.
🕐 Duration of this Module: 240 minutes
✎ This Module has a Quiz

Learning Objectives

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

- List steps in testing, troubleshooting, and repairing/replacing primary power source and its components
- List steps in testing, troubleshooting, and repairing/replacing secondary power source and its components
- Troubleshoot and replace batteries
- Troubleshoot and replace frequency converters
- Troubleshoot and replace inverters
- Troubleshoot, adjust or repair rectifiers
- Troubleshoot, adjust or repair transfer switches
- Troubleshoot, adjust or repair transformers, circuit breakers, and cables

Module 5: Resolving Problems with Signal Power Distribution

Outcome: The participant will be able to resolve problems with power distribution systems.

🕐 Duration of this Module: 240 minutes

✎ This Module has a Quiz

Learning Objectives

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

- Identify common problems and possible solutions for signal system power distribution
- Apply knowledge of troubleshooting and repair to signal power distribution problems
- Use a flowchart to troubleshoot and repair signal power distribution

Course 308: Troubleshooting and Repair of Control Panels

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-308-troubleshooting-and-repair-of-control-panels

Total Instruction	**5 hours, 50 minutes**

Module 1: Principles of Troubleshooting

Outcome: The participant will understand and be able to explain the principles and steps of troubleshooting signaling systems.

Duration of this Module: 180 minutes

This Module has a Quiz

Learning Objectives

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

- Examine the importance of troubleshooting
- Restate the troubleshooting process
- Identify troubleshooting steps
- Identify troubleshooting best practices
- Apply troubleshooting principles to some common signal systems problems and causes

Module 2: Overview to Troubleshooting and Repair of Control Panels

Outcome: The participant will able to safely troubleshoot and repair control panels.

Duration of this Module: 170 minutes

This Module has a Quiz

Learning Objectives

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

- Replace and/or program a control panel
- Troubleshoot and diagnosis control panel to the component level
- Replace local control panel components
- Read schematics associated with local control panels
- Replace base lamps, push buttons, and control panel tiles
- Reboot HMI display panel
- Check connection and integrity of interfacing cables

Interactive, Online Troubleshooting Scenarios

These scenarios can be used before or in preparation for hands-on practice in the field. Advantages include:

- Cost savings for locations that would otherwise use simulators
- Safer environment to try out troubleshooting skills
- Interactive computer-based scenarios are not dependent on weather, etc.
- Hands-on practice can be closely paired with other instruction, which leads to higher retention – instead of waiting for the problem to arise in the field

These scenarios can take 5 – 25 minutes to complete. In this catalog, we are only listing the problem, not the root cause. That is available to the instructor when logging into learning.transportcenter.org. Example Screenshots from a Troubleshooting Scenario from one of these scenarios found at the end of the list.

Interlocking Issue Scenario
Problem: A crossover in the interlocking is flashing out of correspondence in the intended direction.

Dark Signal Scenario
Problem: The operator was expecting a clear but instead the signal is dark - showing no aspect.

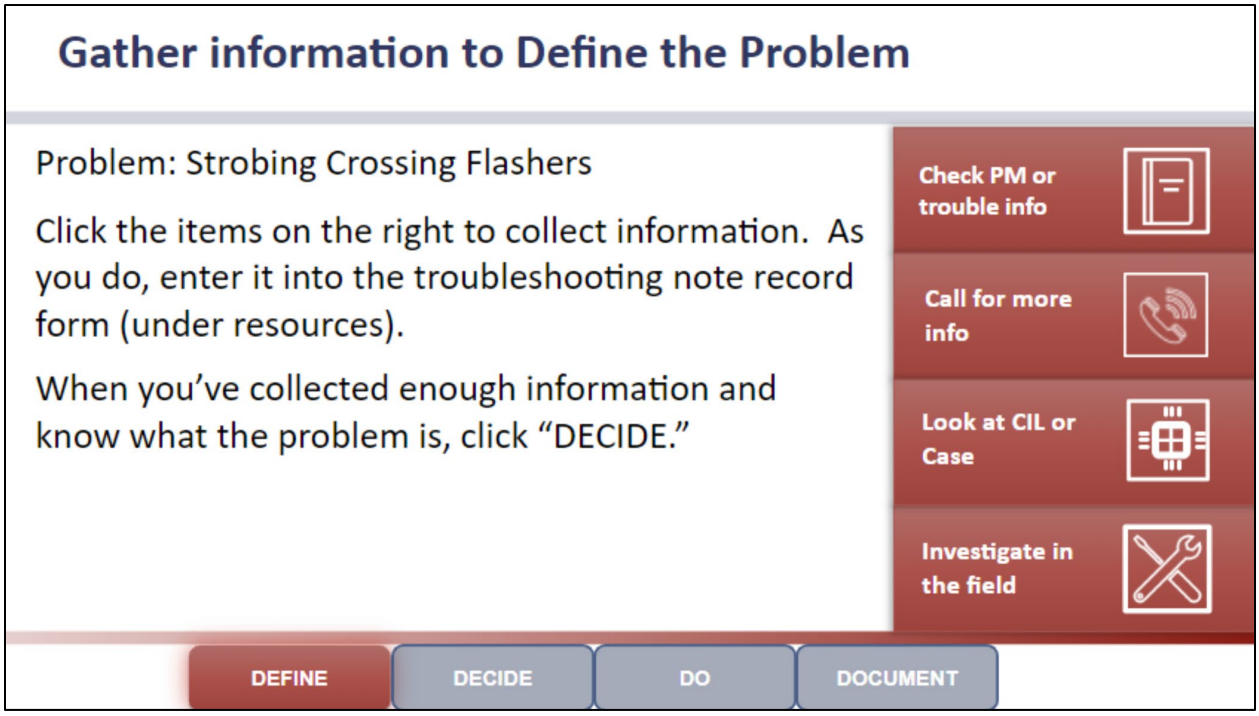
False Proceed Scenario
Problem: Train 2 just went past signal S834 which was yellow. They found that the next signal (S836) was green and the following signal (S838) is yellow again. The area in question is an AC track circuit, double rail design.

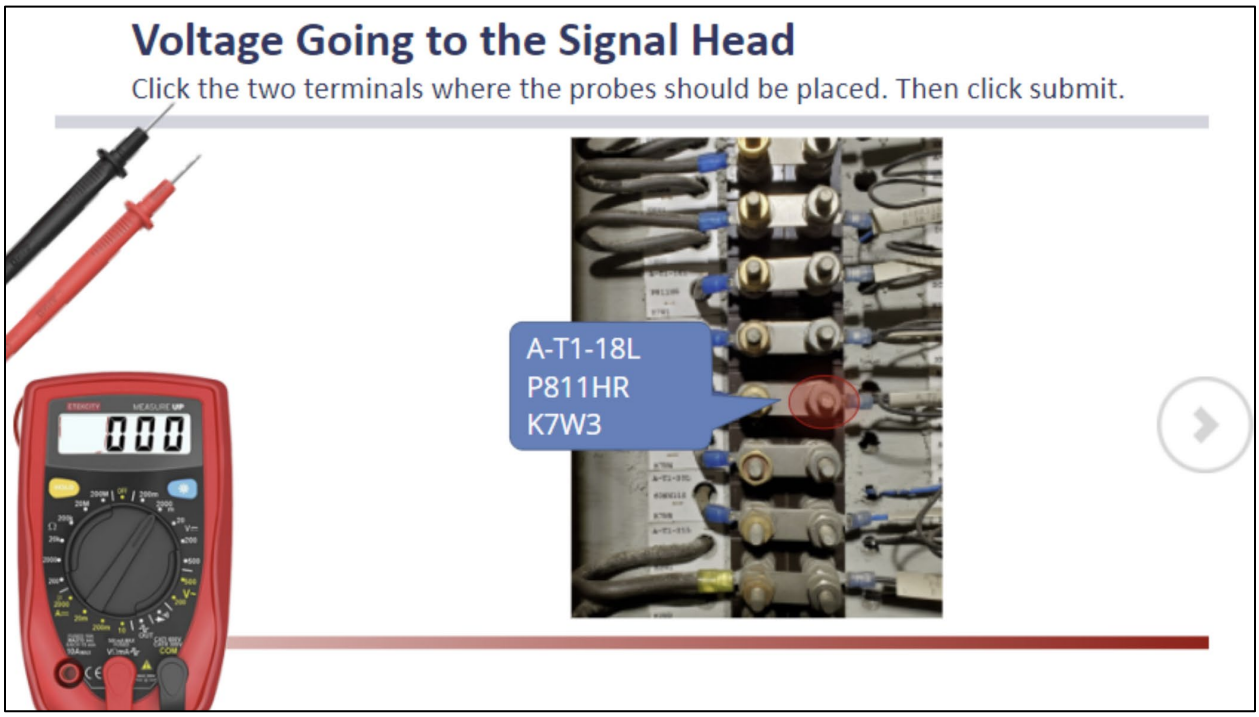
Requested Route Not Received
Problem: Train #1 has TWC code 10 but is not getting its route at interlocking B for a straight move. This area uses ABS and AF Track Circuits.Traffic is not moving.

False Occupancy Scenario
Problem: Signal 12 is restrictive, and the grade crossing ahead of it is down. There is no train ahead of this train, therefore signal 12 should be non-restrictive and the grade crossing should be up.

Strobing Crossing Flashers Scenario
Problem: A crossover in the interlocking is flashing out of correspondence in the intended direction.

Example Screenshots from a Troubleshooting Scenario





Course 350: Microprocessors in Signal Systems

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-350-microprocessors-in-signal-systems

Total Instruction	**10 hours, 30 minutes**

Module 1: Introduction and Overview to Microprocessors in Signal Systems

Outcome: The participant will understand and be able to explain the history of microprocessors, the main types of microprocessors in signal system, basic computer concepts and basic Boolean logic.
Duration of this Module: 70 minutes
This Module has a Quiz

Learning Objectives

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

- Define microprocessor
- Describe the history of microprocessors
- Explain basic computer concepts
- Differentiate between relay logic and Boolean logic

Module 2: Microprocessors in Signal Systems

Outcome: The participant will be able to identify and describe common microprocessor components, and specific microprocessors and their components.
Duration of this Module: 90 minutes
This Module has a Quiz

Learning Objectives

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

- Describe the general components of a microprocessor
- Describe the specific parts of four microprocessors used in signal systems
- Explain redundancy of system

Module 3: Microprocessor Architecture and User Interaction

Outcome: The participant will understand and be able to describe microprocessor architecture and user interaction.
🕐 Duration of this Module: 110 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe microprocessor architecture
- Define vital and non-vital communication
- Explain microprocessor user interaction

Module 4: Inspection, Maintenance and Testing of Microprocessors in Signal Systems

Outcome: The participant will be able to identify and explain the principles and terminologies associated with maintenance of microprocessors in signal systems.
🕐 Duration of this Module: 110 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Identify and explain microprocessor safety and security concerns
- Identify microprocessor housekeeping tasks
- Explain how to monitor the microprocessor and signal system by viewing the CPU and other boards
- Explain how to use a computer to download event logs
- Explain and describe the importance of documentation procedures

Module 5: Troubleshooting and Repair of Microprocessors in Signal Systems

Outcome:
🕐 Duration of this Module: 250 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe microprocessor troubleshooting and repair practices
- Explain how to use Boolean logic circuits for troubleshooting purposes
- Describe printed circuit board replacement practices

- Explain how to troubleshoot serial communication problems
- Describe how to restore the system to normal operation
- Explain operational checks
- Solve microprocessor troubleshooting scenario problems

Course 351: Networking and Communication in Signal Systems

Course Description

Where to access the course: https://www.transittraining.net/courseware/details/course-351-networking-and-communication-in-signal-systems

Total Instruction	10 hours, 10 minutes

Module 1: Introduction to Networking and Communication in Signal Systems

Outcome: The participant will understand and be able to explain the history of communication in signaling, current communication and networking practices, and basic networking and communication concepts.
🕐 Duration of this Module: 30 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Define network and communication
- Explain types of communication in rail and transit systems
- Explain types of networks in rail and transit systems
- Explain control center communication with rail operation.
- Describe network and communication safety and security

Module 2: Networking and Communication Basics

Outcome: The participant will understand and be able to explain the essentials for communication including data transmission and networking concepts.
🕐 Duration of this Module: 60 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe essentials for communication
- Explain data transmission
- Explain key network concepts

Module 3: Introduction to Networking and Communication in Signal Systems

Outcome: The participant will understand and be able to explain and compare the two fundamental and widely used networking models.
🕐 Duration of this Module: 50 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Explain OSI Model
- Explain the TCP/IP Model
- Compare the OSI and TCP/IP Models

Module 4: Hardware and Software for Networking and Communication

Outcome: The participant will understand and be able to explain the hardware and software used for networking and communication in signal systems and most frequently encountered by signal maintainers.
🕐 Duration of this Module: 100 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe common hardware components for rail and transit signal networking systems.
- Explain the importance of network maps.
- Describe common software for networking in rail and transit signal systems

Module 5: Inspection, Maintenance and Testing of Networks in Signal Systems

Outcome: The participant will understand and be able to explain procedures, safety requirements and tools needed for the inspection, maintenance and testing of transit and rail signal network and communication systems.
🕐 Duration of this Module: 250 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Explain safety and security concerns for maintenance of networking systems
- Identify and describe tools used for the maintenance of networking systems
- Identify and explain proprietary concerns
- Identify network and communication-related housekeeping tasks
- Explain how to verify the communication system is operating as designed
- Explain hardware maintenance
- Explain software maintenance
- Explain agency procedures for addressing problems
- Explain the importance of documentation procedures

Module 6: Troubleshooting and Repair of Networks in Signal Systems

Outcome: The participant will understand and be able to explain the tools and procedures used for troubleshooting and repairing networking and communication systems.

🕐 Duration of this Module: 120 minutes
✎ This Module has a Quiz

Learning Objectives

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

- Describe tools for network troubleshooting and repair
- Describe troubleshooting and repair practices for network problems
- Explain the process of pinging
- Explain the purpose of troubleshooting and diagnostic software
- Examine possible network and communication problems a signal maintainer may encounter

Refresher Training Resources

The Signals Training Consortium has developed refresher training resources in multiple formats. This training is meant to be used two to five years after initial instruction, when skills are lacking and/or whenever necessary as per location protocol and/or appropriate regulatory organizations

eLearning Modules

The following interactive, online training modules are meant to:

- Engage new technicians who are drawn to technology
- Minimize classroom time
- Let learners focus on the exact skill areas in which they need assistance

Because the participant decides which content areas to explore more, knowing that there is an assessment at the end, it can take them anywhere from 10 – 35 minutes to complete. Online Learning Refresher Training Example Screen Shots from one of these modules found at the end of the list.

Ground Faults

- List hazards related to ground faults
- List requirements from regulatory agencies
- Identify that there is a ground fault
- Find ground faults

Microprocessor (Re)Orientation

- Describe the purpose of microprocessors
- List common components & their functions
- Differentiate between application and executive software
- Perform functions: identify indication lights, verify software, login, create data logs, analyze data logs, replace board.

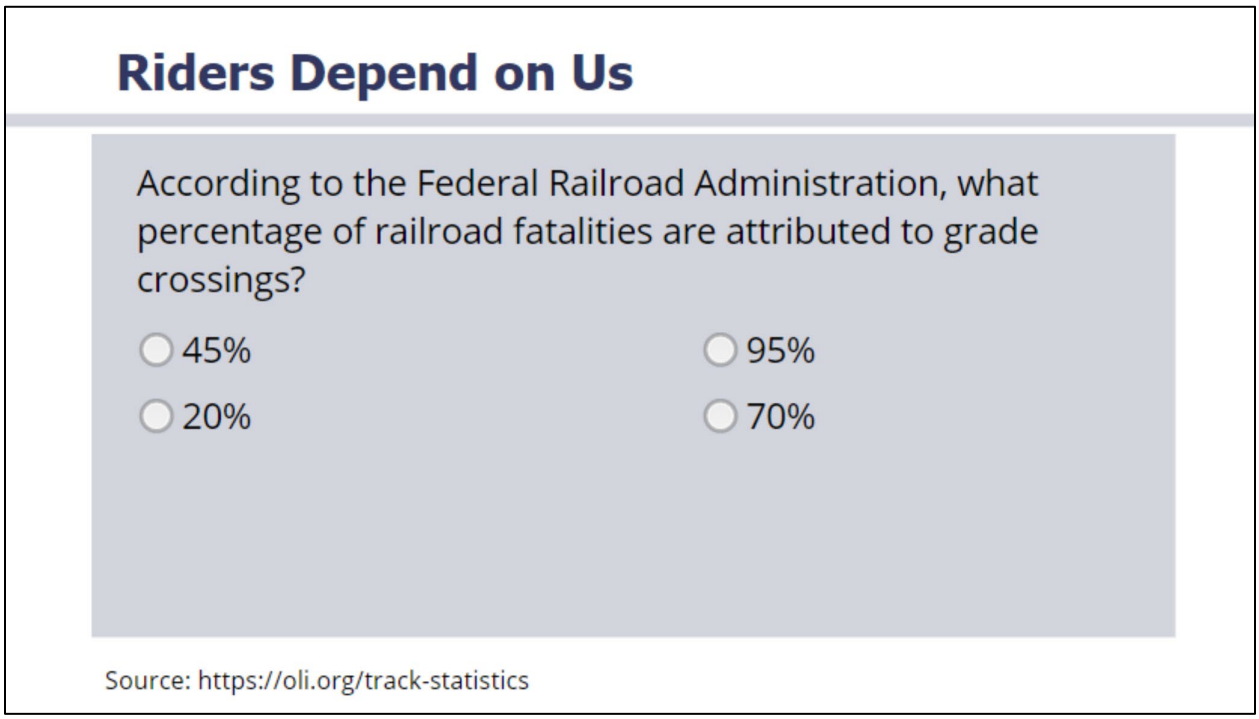
Grade Crossings Operation, Components and Configurations

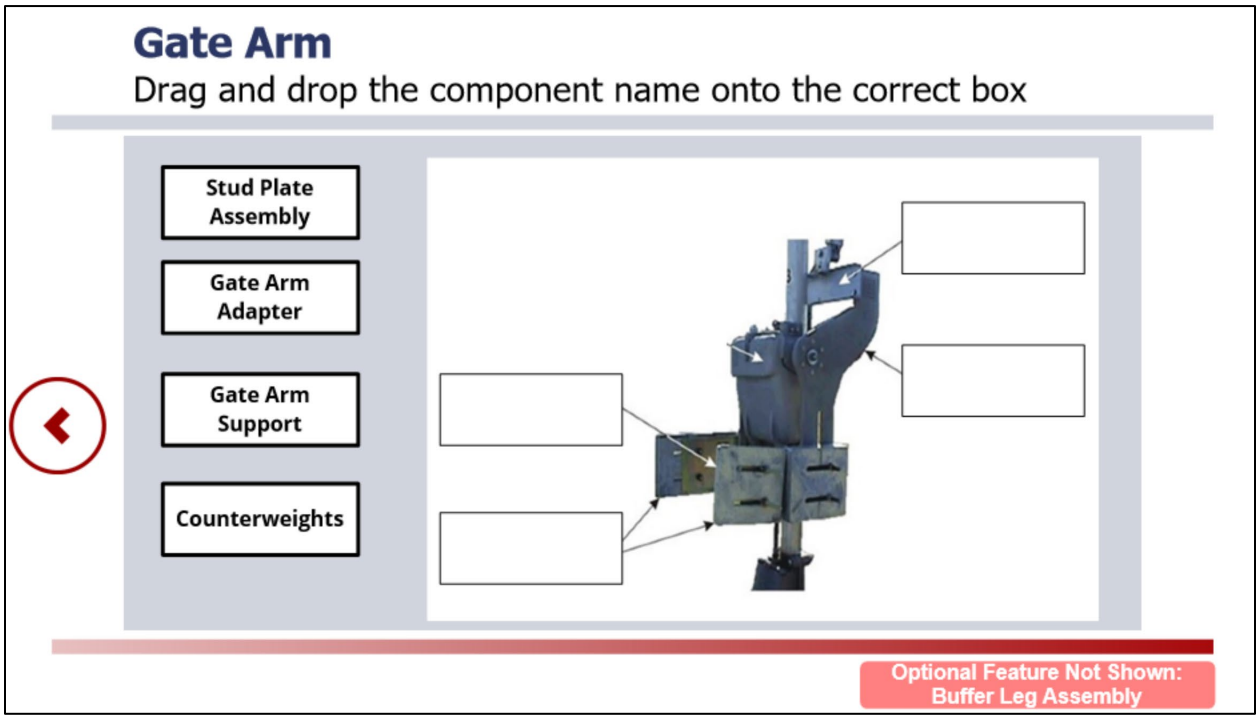
- Describe the purpose of grade crossings
- Identify common components & their functions
- Describe crossing theory of operation
- Identify when a crossing is not following installation and construction standards

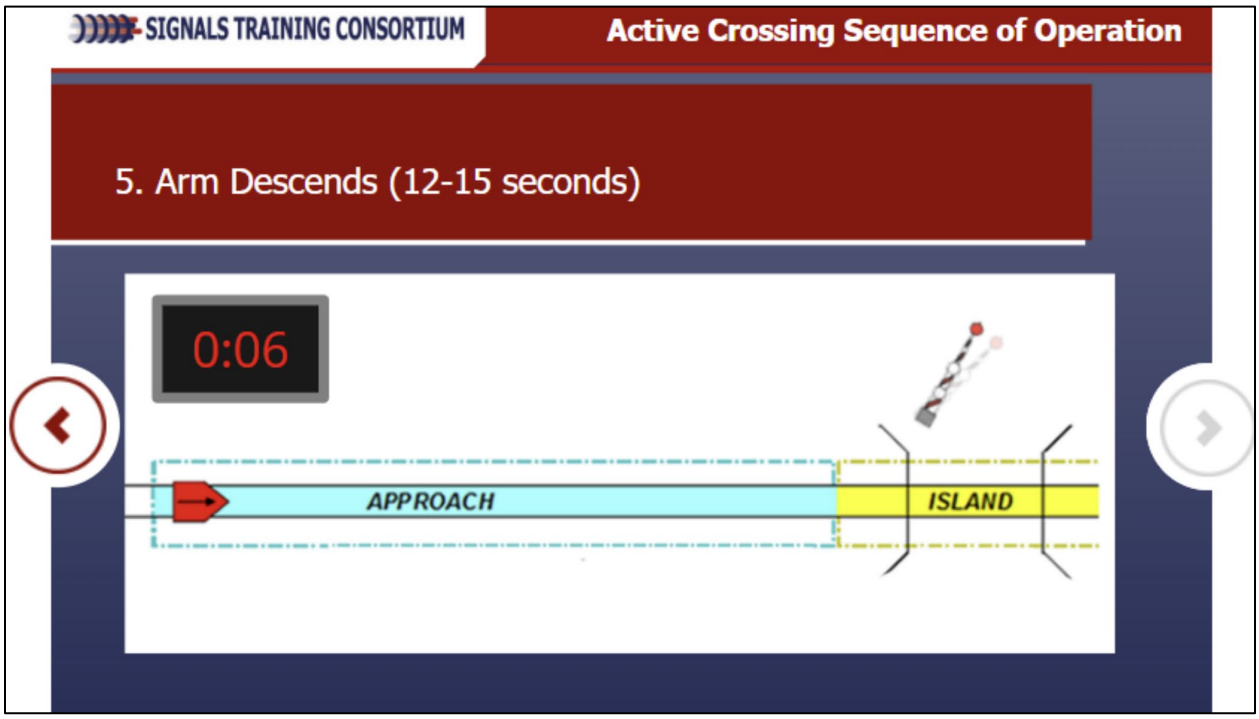
Interactive Troubleshooting Flowchart

- Demonstrate ability to interpret a troubleshooting flow chart
- Demonstrate ability to navigate a troubleshooting flow chart

Online Learning Refresher Training Example Screen Shots







Hands-on Instruction Checklists

The following checklists were developed to be used for hands-on refresher training. They can be easily modified to (1) meet your location's specific protocols and/or (2) be used as hands-on assessments. A Hands-on Instruction Checklist Example is found at the end of the list.

Orientation

- Removing Equipment from Service
- Returning Equipment to Service

Track Circuits (Troubleshooting)

- All
  - Low Voltage
  - Track Circuit De-Energizes
- AC/Power Frequency only
  - Two Adjacent PF Track Vane Relays Are Down
  - One AC_PF Vane Relay is Down
  - Vane Relay End Voltage_Current Incorrect
- DC only
  - Incorrect feed voltage on one track circuit
  - Neutral Relay End Voltage Current Incorrect
  - One Neutral Relay is Down
  - Two Adjacent Neutral Relays Are Down

Switches

- Describe purpose and components of electrical locking
- Friction Clutch Test
- Inspection and Maintenance of switch rods
- Minute Man Test / CP Valve Test
- Obstruction Test (electro-hydraulic)
- Obstruction Test (manual, electrical, EP)
- Perform point detector test with 5 Series
- Switch restoring test for EP
- Test Electrical Indication

Grade Crossings

- Troubleshooting template for customization
- Troubleshooting Safety
- Basic Train Detection
- Audible Devices
- Lights
- Motion Sensitive Systems

- Inspection & Maintenance Safety
- Inspection & Maintenance Warning System Operation
- Overview Motion Sensitive Systems
- Overview Warning System
- Routine Monthly Quarterly Annual Inspection, Maintenance and Test
- SOP and Directional Stick Circuits
- SOP Flasher, Bell and Gate Circuits

Signals

- Signaling Systems Overview ABS
- Signaling Systems Overview Signals
- Inspection, Maintenance and Testing (where applicable)
  - AC Vane Relay
  - All Purpose Relay
  - CBTC
  - Loops
  - Signals
  - Speed Commands
  - Timer Relay
  - Communication Interface
  - Track Transformers-Transmitters
  - Transmitter Module
  - Tuned Impedance Bonds
  - TWC Controller Interrogator

Interlockings

- Access and read event reports
- Approach Locking Test
- Detector Locking Test
- Indication Locking Test
- Prepare for Interlocking Testing, I&M, Troubleshooting and Repair
- Route Locking Test
- Time Locking Test
- Traffic Locking Test

Troubleshooting

- Battery voltage low
- Cab signal failures
- Code line failure
- Interlocking continues to run time after a train movement
- Interlocking TOL_TOK clear on arrival - intermittent TC issues
- Signal Dumps or Drops out

- Signal lamp failure
- Switch indication failure
- Track circuit de-energized
- Track Occupied Light is lit when it shouldn't be
- Unable to clear a signal
- Unable to throw a switch

Print Reading

- Fundamentals
  - Print Characteristics
  - Nomenclature and Symbols
    - Orientation
    - Grade Crossings
    - Interlockings
    - Power Distribution
    - Signals
    - Switches
    - Track Circuits
    - Train Stops
- Two Year Test
  - Inspection & Maintenance of Signaling ABS
  - Testing
    - Approach stick relay
    - Lock stick circuit
    - Route check circuit
    - Signal indication locking circuit
    - Switch correspondence circuit
    - Switch indication lcoking circuit
    - Time locking circuit
    - Traffic Block Repeaters Circuit
    - Traffic line circuit
    - Traffic locking circuit
    - Traffic plan schematic
    - Traffic sequence schematic
    - Traffic stick circuit
    - Universal crossover and aspect chart
- AC and Back up Enabled
  - Aspect Chart
  - Electric Train Stop Print
  - Installation Construction
  - Track Identification

Hands-on Instruction Checklist Example

Topic:	Switches and Derails
Learning Objective:	Inspect and maintain switch rods
Courseware Reference:	For purpose of mechanical locking: Signals Course 102: Introduction and Overview of Switches and Derails, 1-4 Switch Types and Mechanical Operations For I&M of Switches: Signals Course 202: Inspection and Maintenance of Switches and Derails, Unit 3.4: Inspecting and Maintaining Rods
Instructional Video	Describe purpose and components of mechanical locking: https://vimeo.com/329348370 (password: for members only)
Preparation: Get time on the switch and place it into the hand throw position. Remove equipment from service as appropriate by following location specifications.	
Tools, Equipment and Materials Required: solvent, lint free cloth, lubricant, point detector gauge tool with feeler gauge	

Who is the manufacturer of this switch?

Courseware reference:

Switch Type	Manufacturer
M23, M3, etc.	US&S, then Ansaldo, Now Hitachi
5 Series	GRS, then Alstom

Which rods must be inspected under preventive inspection and maintenance?

- Throw Road/Operating Rod
- Point Detector Rod
- Lock Rod

What is the purpose or mechanical locking? What components are involved?
The function of a lock rod is to insure that the switch points are mechanically held in place. If a switch point is not locked in position, the switch machine and or points could be damaged, or in a worst case scenario, a train could de-rail. The connection of the lock rods to the switch points is a discrete point of attachment and provides additional safety in the event of the failure of the operating rod or hardware. In order to change a switch position, the points must first be unlocked, the switch moves and the points will be locked in place after the switch completes its movement. This is accomplished through the lock mechanisms including the slide bar (motion plate, locking dogs, drive roller) and the locking rods.

To be filled in by Mentor

What is the authority/OEM recommended solvent for cleaning switch rods?

What is the authority/OEM recommended clearance between lock rods and slide bar?

Assessment Form

Print one for each participant being evaluated. Rate each task:

S – Satisfactory: Performed task correctly without assistance

M - Marginal: Performed task correctly with assistance from Mentor and/or peers

U – Unsatisfactory: Did not perform task correctly

Always Follow Location and OEM Specifications

Task: Inspect and maintain switch rods		**S**	**M**	**U**	**N/A**
1	Identify manufacturer of this switch				
2	State purpose/importance of inspecting and maintaining rods and state which rods to inspect and maintain.				
3	State frequency of rod inspection				
For steps 4-10, have mentee state the next step before performing it. Correct or demonstrate where needed. Provide positive feedback and tips on how to improve.					
4	Perform a visual inspection – remove debris/ballast surrounding rods, look for cracks or bends in the rods, check that hardware is in place, secure and in good condition (threads on rods, nuts, pins, cotter pins)				
5	Clean rods with authority/OEM recommended solvent and lint free rag				
6	Lubricate as needed				
7	Describe purpose and components of mechanical locking				
8	Inspect lock rod to ensure notches are still sharp (if not, replace)				
9	Ensure proper clearance between the lock rods and slide bar (if not, adjust lock rod – see next sheet)				
10	Inform personnel to put switch back into service, following location specifications.				
11	Complete and submit proper documentation				

Did the employee successfully inspect and maintain switch rods? ___ Yes ___ No

Comments (use back if needed):

_____	_____	_____	_____
Employee Name	Employee Number	Signature	Date
_____	_____	_____	_____
Mentor Name	Employee Number	Signature	Date

Topic:	Switches
Learning Objective:	Adjust lock rod
Courseware Reference:	Signals Course 302: Troubleshooting and Repair of Switches and Derails, Unit 3.3: Component Specific Corrective Maintenance
Instructional Video	https://vimeo.com/329444292 (Password: TLC Signals)
Preparation: Get time on the switch and place it into the hand throw position, remove locks and covers from switch mechanism, secure switch. Remove equipment from service as appropriate by following location specifications.	
Tools, Equipment and Materials Required: Wrench, mechanism to secure switch such as block or spike.	

Assessment Form

Print one for each participant being evaluated. Rate each task:

S – Satisfactory: Performed task correctly without assistance

M - Marginal: Performed task correctly with assistance from Mentor and/or peers

U – Unsatisfactory: Did not perform task correctly

Always Follow Location and OEM Specifications

Task: Adjust Lock Rod		**S**	**M**	**U**	**N/A**
For steps 1 - 9, have mentee state the next step before performing it. Correct or demonstrate where needed. Provide positive feedback and tips on how to improve.					
1	Take all possible safety measures such as securing the point and disconnecting the power.				
2	Loosen the tail bolt which holds the two lock rods together.				
3	Loosen the associated hardware.				
4	If necessary, use a wrench to lightly tap the lock rod into the correct position.				
5	Tighten/loosen the adjusting nuts as needed.				
6	Perform all required tests (such as a point obstruction test) before putting the switch/derail back into service.				
7	Tighten all associated hardware, including tail bolt.				
8	Inform personnel to put switch back into service, following location specifications.				
9	Complete and submit proper documentation				

Did the employee successfully adjust the lock rod? _____ Yes _____ No

Note any comments on back.

_____	_____	_____	_____
Employee Name	Employee Number	Signature	Date
_____	_____	_____	_____
Mentor Name	Employee Number	Signature	Date