



## Introduction and Overview to Switches and Derails

Course 102

PARTICIPANT GUIDE



 SIGNALS TRAINING CONSORTIUM

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# Introduction and Overview to Switches and Derails

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## Participant Guide

Signals Maintenance Training Consortium

COURSE 102

*April 2014 Draft*

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## How to Use the Participant Guide

### Purpose of the Course

The purpose of the *Introduction and Overview to Switches and Derails* course is to assist the participant in demonstrating proper safety procedures and gaining an overview the functions of switches, derails, and their associated components.

### Approach of the Book

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

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# Introduction & Overview of Switches & Derails

## Outline

- 1-1 Overview
- 1-2 Basic Terminology
- 1-3 Switch Configurations
- 1-4 Switch Types and Mechanical Operations
- 1-5 Derails
- 1-6 Electrical Workings of Switches and Derails
- 1-7 Summary

## Purpose and Objectives:

The purpose of this module is to provide the participant with an introduction to the basic operation and functioning of switches and the various types that exist on railroads.

Following the completion of this module, the participant should be able to complete the exercises 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 switch symbols recommended by American Railway Engineering and Maintenance-of-way Association (AREMA)
- 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

## Key Terms

- Air Cylinder
- Bellows
- Central Instrument Locations
- Claw
- Closure Rail
- Clutch
- Contacts
- Control Magnets
- Control Pneumatic Valve (CP Valve)
- Control Valve
- Control Wire
- Crossover
- Diamond Crossover
- Directional Control Valve
- Double Crossover
- Double Slip Switch
- Drive Roller
- Electric Switch
- Electro-Hydraulic Switch
- Electro-Pneumatic Switch
- Facing
- Filter
- Fixed Point Frog
- Friction Lock
- Frogs
- Gauge
- Gauge Plates
- Gear Pump
- Gear Reduction
- Gear Train
- Head Blocks
- Head Rod
- Head Sticks
- Heat Kink
- Heel Blocks
- Helper Switch
- Housed Points
- Hydraulic Fluid Tank
- Indication Contacts
- Inlet
- Installation Standards
- Junction Box
- Knife-Blade Point
- Left Hand Normally Closed (LHNC)
- Left Hand Normally Open (LHNO)
- Left Hand Switch
- Linkages
- Lock Box
- Lock Guide
- Locking Dogs
- Locking Rods
- Locking Slide
- Manual Switch
- Motion Plate
- Motor
- Motor Control
- Movable Point Frogs (MPF)
- Mushroom
- Non-Return Valve
- Non-Trailable
- Normal Position
- One-Way Restrictor
- Outlet
- Outside Slip Switch
- Piston
- Point Detector
- Point Detector Rod
- Point Of Switch (PS)
- Points
- Pressure Relief Valve
- Rail Brace
- Rail Dimensions
- Rail Type
- Rail Weight
- Remote Control
- Resistive Lead
- Reverse Position
- Right Hand Normally Closed (RHNC)
- Right Hand Normally Open (RHNO)
- Right Hand Switch
- Rods
- Samson Point
- Setting Unit
- Single Crossover
- Single Slip Switch
- Single-Ended Switch
- Slide Bar
- Slip Switch
- Snub Rectifier
- Solenoid Valve Winding
- Solenoid Valves
- Spring Frog
- Spring Switch.
- Stock Rails
- Swing Nose Point Frog
- Switch Circuit Controller
- Switch Configuration
- Switch Heaters
- Switch Indication
- Switch Layout
- Switch Machine
- Switch Prints
- Switch Stand
- Terminal Board
- Throw Bar
- Track Department
- Track Plan
- Trailable
- Trailing
- Turnout

## 1-1 Overview

### Operation and Purpose of Switches

In railroading, the main purpose of a **switch** also known as a *turnout* is to determine the routing of trains. This is accomplished by using movable parts, the components of the switch, to shift the train from one set of rails to another.

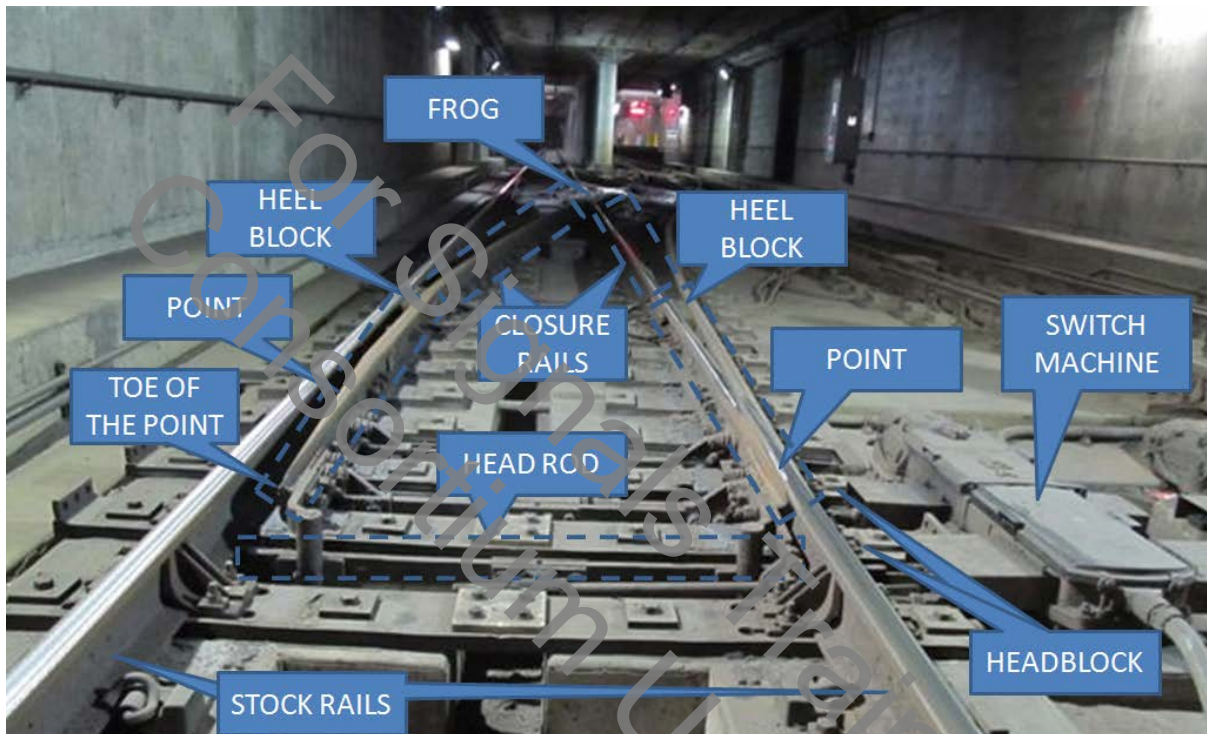


Figure 103.1 Switch with Main Components Labeled - Courtesy NFTA

The main components of the **switch layout** are shown in Figure 103.1. As on any railway, there are two stationary **stock rails**. In territories where required **switch heaters** are installed along the stock rails as well as under the switch operating rod. The switching action is done by the two inner rails which move laterally - these rails are called **points**. Note that the movable points are the length of rail from the movable pointed end, the **toe**, to the stationary **heel blocks**. Between the heel blocks and the frog are the part of the rail known as the **closure rail**. Heel blocks are the pivot or hinge point of the switch point movement. The **point of switch (PS)** is the location of the toe or tip of the point. The final positioning of the switch points guide the wheel flanges of the train, which ride on the inner part of the rail (Figure 103.2) in the determined direction.



Figure 103.2 Wheel Flange on Rail - Courtesy SacRT



See Video 102.1 An Introduction to Switches & Crossings - Network Rail engineering education illustrates the movement of a switch and related components (<https://www.youtube.com/watch?v=ZuR5QTlfOzk>)

It is important to note that the two points are always the same distance apart. Proper point opening allows for clearance of the train wheel between the stock rail and open point. This is insured by proper adjustment of the **head rod** also known as the # 1 *rod* which runs between the two points. The movement of the switch is caused by the mechanisms housed inside the **switch machine**. The switch machine is fixed to the **head blocks** or **head sticks** also known as # 1 and # 2 *ties*. Proper rail gauge is maintained by way of **gauge plates**-metal plates attached to the top of the ties.



Figure 103.3 Rail Braces - Courtesy LIRR





Figure 103.57 Central Instrument Location - Courtesy LIRR

In most switches, there are a series of communications taking place between the switch and different parts of the signaling system. In the field there are switch machines electrically tied to **Central Instrument Locations** via field **junction box(es)** (Figure 103.56). How these are tied together is shown in the print in Figure 103.58.

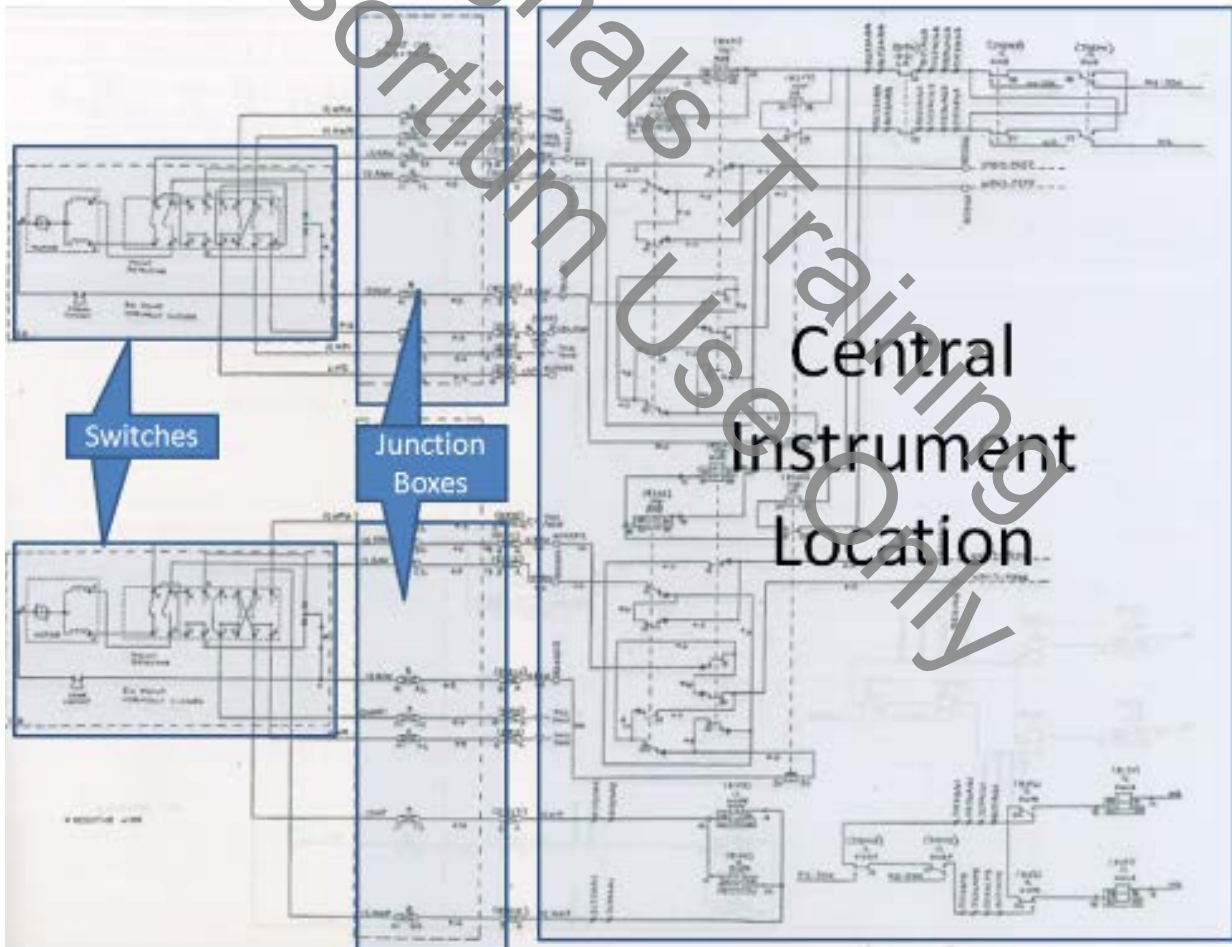


Figure 103.58 Print of Electric Switch Showing Entire System - Courtesy NFTA

The information (aka logic) for the entire signaling system is fed to and from the CIL. Information and power for switch operation and indication is sent/received by the CIL to each individual switch via field junction boxes.

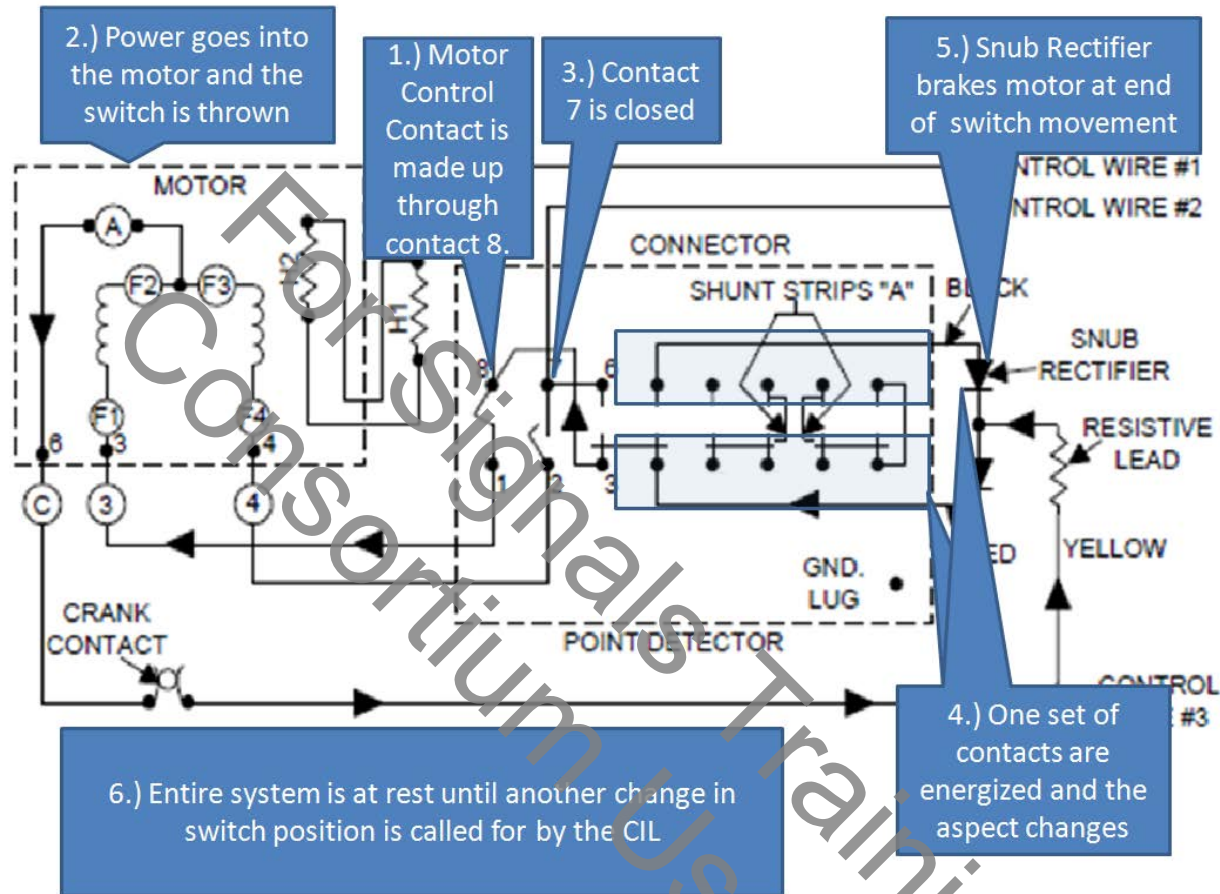


Figure 103.59 Print for an Electric Switch Motor with Notes on Sequence of Operation - Courtesy NFTA

Figure 103.59 is a close up version of the print for the electric switch machine showing what happens inside the electric switch machine itself after these signals are sent from the junction box. Before we talk about the changes that are made when the switch is thrown, remember that prints are always drawn in normal position. This means that in normal position contacts 1/8 are closed and 7/2 and 6/3 are open. The opposite will be true in reverse position 1/8 will be open and 7/2 and 6/3 will be closed.

The dotted lines are field equipment and the solid lines represent electrical connections. Information and power comes in from the **control wire** from the junction box (which originated at the CIL). Contact pairs 1/8 and 2/7 are motor contacts. The motor control contact is made up through contact 8. After this, power goes into motor and switch is thrown over. After the switch is completely thrown, contact 7 is closed.