Introduction and Overview to Switches and Derails

Course 102

PARTICIPANT GUIDE

SIGNALS TRAINING CONSORTIUM

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Participant Guide

Signals Maintenance Training Consortium

COURSE 102

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NOTE: All images contained within this document were contributed by Signals Training Consortium members unless otherwise noted.

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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.

Introduction & Overview of Switches & Derails

Outline

Purpose and Objectives:

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.

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 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

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
- Hand crank
- Head Blocks
- Head Rod
- Head Ties
- 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
- Magnetic détente
- 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
- 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 resistor
- 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.

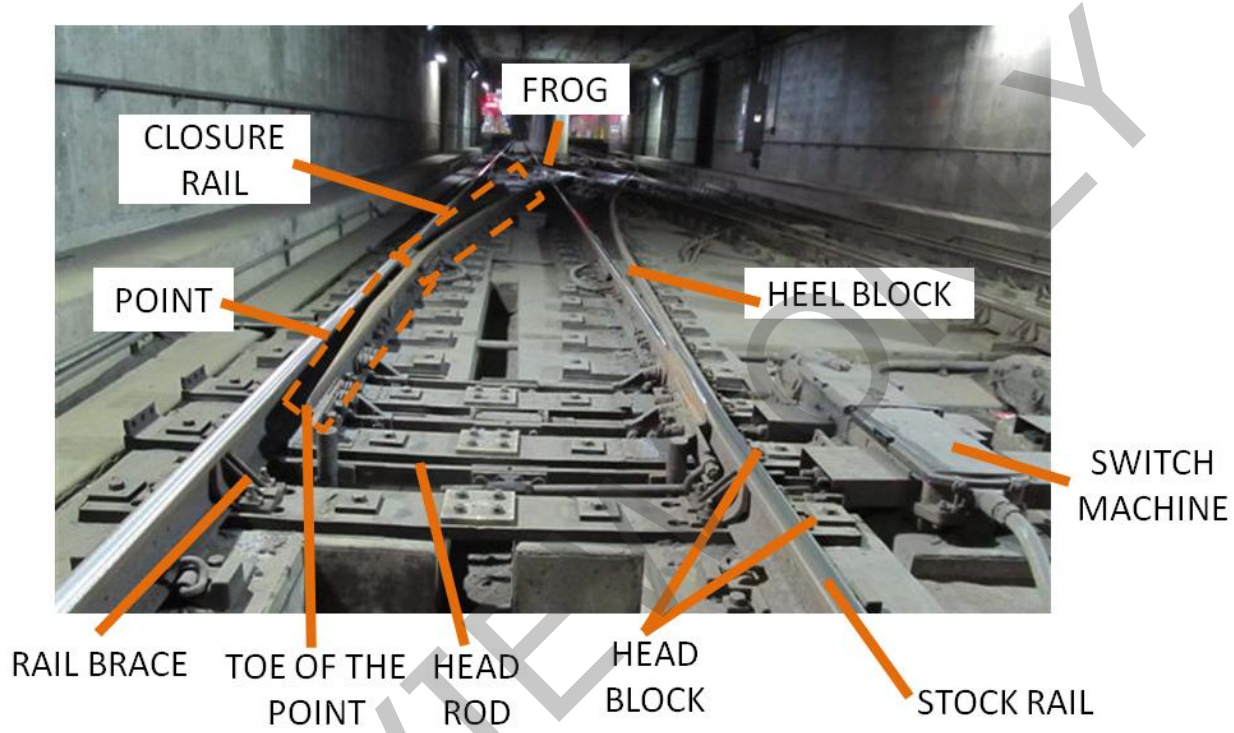


Figure 1 Switch with Main Components Labeled

The main components of the **switch layout** are shown in Figure 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 rods. 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 2) in the determined direction.

Figure 2 Wheel Flange on Rail

See **Video 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 *front rod* which runs between the two points. The movement of the switch points is caused by the mechanisms housed inside the **switch machine.** The switch machine is fixed to the **head blocks** or **head ties** 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.

Rail braces prevent rail spreading (maintain gauge) in the area of the switch points during switch and train movement. They are generally mounted on the outside of the running rails (**Error! Reference source not found.**) but can also be on the inside (see Figure 1). Generally, the signal maintainer will check, but not perform maintenance on rail braces as they are the responsibility of the track department.

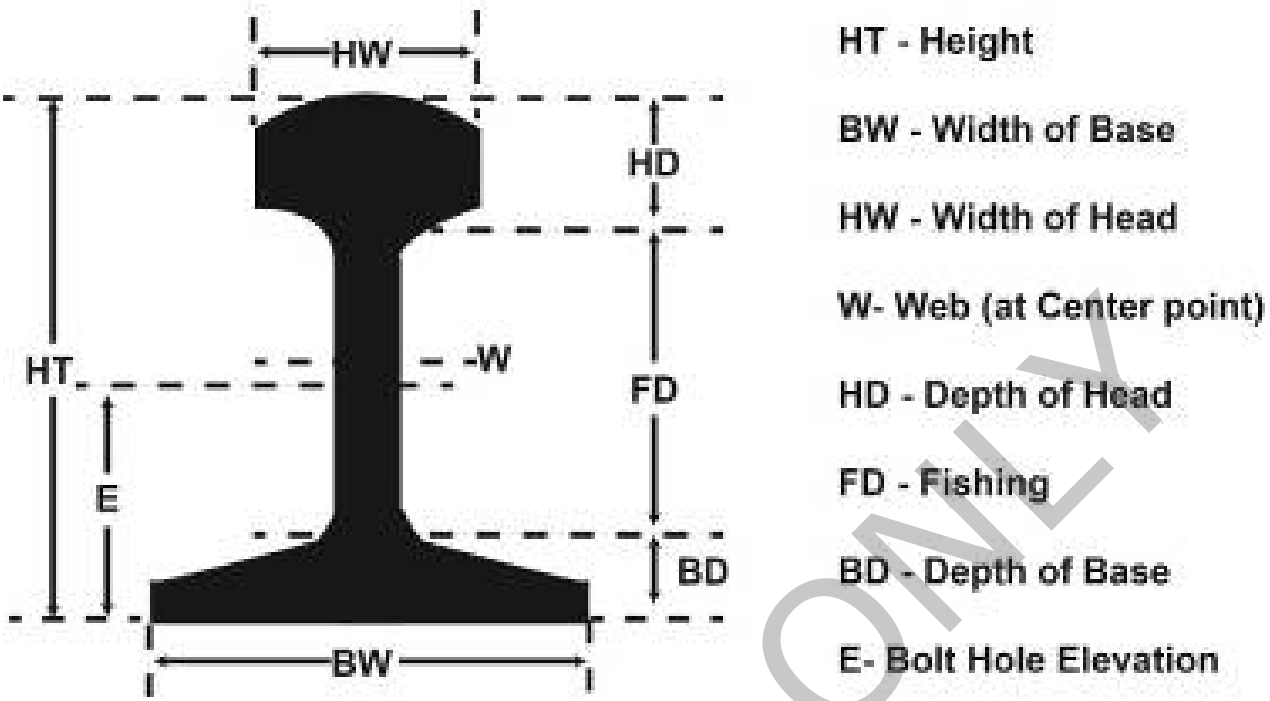


Figure 14 Diagram Showing Where to Take Track Dimension Measurements

Gauge

Additionally, there may be times when the distance between the two running rails, the **gauge**, is not what it should be. This can be caused by things like inadequate track maintenance, derailment or excessive heat - this instance is called a **heat kink**. The gauge of a rail should be at least 4' 8" (56"). These measurements are taken by track department personnel during routine inspections. In the case of visual difference or an issue such as the point of a switch not making contact with the running rail.signal maintainers will take measurements and report any issue to the track department.

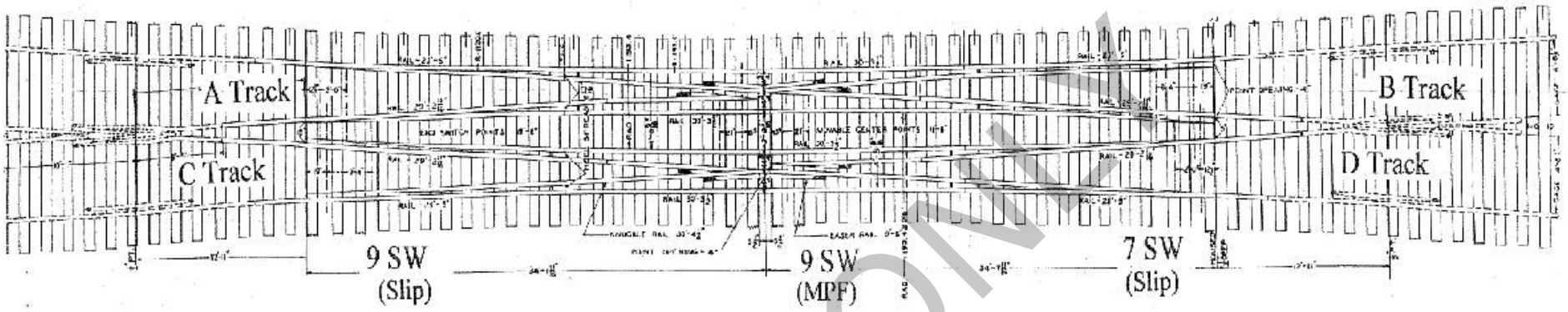
Points

There are two main types of points: knife-blade point and housed point. The standard type of point is known as a **knife-blade point**. It is best used in straight switch points. Because of the high exposure of the point and low amount of protection from the stock rail, the knife-blade point requires more maintenance than the housed point and should only be used for low speed train movements. See damaged knife-blade point in Figure 14.

Extra protection provided by the housed point include:

- Train wheel flange impact absorption
- Decreasing chance of a wheel flange picking a point

Double Slip Switch



Switch Position	Movement
7 Normal – 9 Normal	A Track to D Track
7 Reverse – 9 Reverse	B Track to C Track
7 Normal – 9 Reverse	A Track to B Track
7 Reverse – 9 Normal	C Track to D Track

MPF Has two of each – Lock rods, Operating rods, & Point detector rods. The MPF is Basically two switches facing each other.

Switch point openings are 4" for the Slip & MPF.

Figure 24 Double Slip Switch Diagram – Courtesy of LIRR

A **double slip switch** also known as a *double slip* or *slip, frog, slip* is a narrow-angled diagonal flat crossing of two lines combined with four pairs of points in such a way as to allow vehicles to change from one straight track to the other, as well as going straight across. A train approaching the arrangement may leave by either of the two tracks on the opposite side of the crossing. To reach the third possible exit, the train must change tracks on the slip and then reverse.

The arrangement gives the possibility of setting four routes, but because only one route can be traversed at a time, the four points at each end of the crossing are often connected to move in unison, so the crossing can be worked by just two levers or switch machines. This gives the same functionality of two points placed end to end. These compact (albeit complex) switches usually are found only at locations where space is limited, such as station throats (i.e., approaches) where a few main lines spread out to reach any of numerous platform tracks.