



Inspection and Maintenance of Switches and Derails

Course 202

PARTICIPANT GUIDE

 **SIGNALS TRAINING CONSORTIUM**

Inspection and Maintenance of Switches and Derails

Participant Guide

Signals Maintenance Training Consortium

COURSE 202

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How to Use the Participant Guide

Purpose of the Course

The purpose of the *Inspection and Maintenance of Switches and Derails* course is to assist the participant in demonstrating safe inspection and maintenance 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.

Module 1

OVERVIEW AND SAFETY

Outline

- 1-1 Overview
- 1-2 Safely Working in an Electrified Territory
- 1-3 Switch and Derail Safety
- 1-4 Tools
- 1-5 Testing
- 1-6 Summary

Purpose and Objectives:

The purpose of this module is to provide the participant with an overview on how to safely inspect and maintain switches and derails.

Following the completion of this module, the participant should be able to complete the exercises 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 in order to stop switch from being thrown
- 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 (monthly, quarterly, etc) as per your authority
- Demonstrate ability to complete proper documentation

Key Terms

- | | | |
|------------------------|---------------------------------------|---------------------------------|
| • 30 amp Current Meter | • Obstruction Gauge | • Switch Crank |
| • Capacitors | • Obstruction Test | • Switch Lock |
| • Cup Gauge | • Operating Wrench | • Switch Restoring Circuit Test |
| • Feeler Gauge | • Personal Protective Equipment (PPE) | • Switch Clamp |
| • Hand Position | • Pinch Points | • Third Rail |
| • Insulation | • Point Detector Test | • Time On The Line |
| • Job Briefing Meeting | • Point Tension Test | • Trip, Slip, And Fall Hazards |
| • Lock Rod Wrench | • Road Worker in Charge | |
| • Lockout-Tagout | • RSA/AAR/Raco Wrench | |
| • Minute-Man Test | • Selector Lever | |
| • Motor Overload Test | • Switch Block And Spike | |
| • Motor Position | | |

Securing the Area

Table 1 Securing the Work Area Before Switch Inspection and Maintenance

	Manual	Electric	Electro-Pneumatic	Electro-Hydraulic
Request Time on Line	X	X	X	X
Disconnect Indication/Motor Power		X	X	X
Secure Points	X	X	X	X
Shut-off Pneumatic Valve			X	

As with most inspection and maintenance of signals, it is important to always make sure that your first step is to request **time on the line**. This means that dispatchers know that you are in the field and will not route any trains in your direction until time is removed or the RWIC gives permission.

If the switch is electric and power is not needed, disconnect power to the motor. This can be done either by using the **hand throw selector lever**, if equipped. Otherwise, power can be removed by inserting the **hand crank**. This will prevent the possibility of the switch being thrown remotely.

For electrical, throw the switch into manual. This will be done differently depending on the specific switch. As illustrated in the video below, for a US&S M23, start by first removing the **switch lock** which is located at the **hand throw lever** (which is located at the **lever lock stand** - see Figure 1.2). Next, step on the **pedal**. Now the **selector lever** is free to be moved. Move the selector lever from the **motor position** to the **hand position**.



Figure 1.2 Hand Throw Lever in Lever Lock Stand

For electrical switches without hand throw ability, insert a hand crank which will open the crank contacts to switch, removing motor and in some instances indication power. If neither application is available remove power in the signal case by turning off breaker or removing the power fuse to the individual switch/s your are working on.



See **Video 1.1 Putting Switch into Hand Throw** for an illustration on how to put an electrical switch into hand throw
(<http://www.youtube.com/watch?v=XqPgoN27GUU>)

For electro-pneumatic switches and derails, use the shut off valve to remove pneumatic pressure (air) - unless it is needed for the inspection/maintenance to be performed.

For in-pavement electro-hydraulic switches and derails, insert the hand throw lever into the lever box. At this point, the hand throw lever energizes the lever box proximity sensor, which de-energizes the motor and detector circuits. The switch can then be manually operated via the hand throw lever with a single stroke.



Figure 1.3 In Pavement Electro-Hydraulic Switch with Red Hand Lever in Place in Lever Box -

If it is not possible to remove power but the point will not need to be moved, the point should be secured using either a **switch clamp** or **switch block and spike** in order to diminish the chance of getting body parts pinched in the switch. Note that permissions may be required from dispatcher/center to block/clamp and spike the switch. Always follow your authority's procedures.



Figure 1.4 Switch Clamp



Figure 1.5 Switch Clamp in Use

For the switch clamp, clamp the point against the rail as close to the end of the point as possible. If the switch will be out of service for a long period of time, a switch clamp with a lock (Figure 1.4 and Figure 1.5) may be used. As always, follow your authorities' procedures.



Figure 1.6 Spike Against Closed Point



Figure 1.7 Block Wedged Tightly between Open Point and Stock Rail

When using the switch block and spike technique, a standard wood wedge will be put in the open point, pushed back until it is tight against the stock rail. A spike will be placed through the tie plate tight against the closed point.

Module 2

SWITCH AND DERAIL SPECIFIC PRINT READING

Outline

- 2-1 Overview
- 2-2 Switch and Derail Specific Nomenclature
- 2-3 Switch and Derail Specific Symbols
- 2-4 Switch and Derail Specific Relays
- 2-5 Switch and Derail Sequence of Operation
- 2-6 Summary

Purpose and Objectives:

The purpose of this module is to provide an overview of the specific nomenclature and relays used in railroad switch and derail systems and how they form the operation of railroad switches and derails.

Following the completion of this module, the participant should be able to complete the exercises 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

Key Terms

- Call
- Clutch
- Control Circuit
- Correspondence
- Crank Cut-out Contact
- Field Wires
- Hand Crank
- Heater Circuit
- Indication Circuit
- Indicator
- Lock
- Lock Relay
- Motor Circuit
- Normal
- Normal Configuration
- Overload Coil
- Overload Relays
 - Stick Coil
 - Operation Coil
- Position
- Relay
- Reverse
- Reverse Configuration
- Shunting Strip
- Switch Control Relay (WR)
- Switch Machine Lock (SML)
- Switch Related Component
- Switch Repeater Relay

Table 3 Other Switch and Derail Specific Nomenclature (*Source: AREMA volume 4 page 208)

Item*	Abbreviation		Notes
	AREMA*	Your Location	
Switch operating mechanism or lock valve	W		
Relay, controller or contactor controlling both normal and reverse operations of a switch or an electric switch lock	WR		
Relay, controller or contactor controlling the normal operation of a switch or an electric switch lock	NWR		
Relay, controller or contactor controlling the reverse operation of a switch or an electric switch lock	RWR		
Relay repeating WR	WRPR		
Relay repeating position of switch	WPR		
Relay repeating normal position of switch or normal position of WPR	NWPR		
Relay repeating reverse position of switch or normal position of WPR	RWPR		
Indicator of the positions of a switch	WK		
Switch and derail lock operating mechanism on a switch	WL		
Relay repeating normal position of a switch lock	NWLPR		
Relay repeating normal position of a dual-control lever	NJPR		
Relay repeating reverse position of dual-control lever	RJPR		
Indicator of the normal position of a switch	NWK		
Indicator of the reverse position of a switch	RWK		
Indicator of the block condition in approach to a switch	WAK		
Relay repeating reverse position of a switch lock	RWLPR		
Normal Switch Correspondence Relay	NWCR		
Reverse Switch Correspondence Relay	RWCR		
Spring Switch	SS		
Lock Relay	LR		
Reverse Switch Request Relay	RWZR		
Normal Switch Request Relay	NWZR		
Restore to Normal Request Relay	R-NWZR		

REVERSE CONFIGURATION - CONTROL CIRCUIT

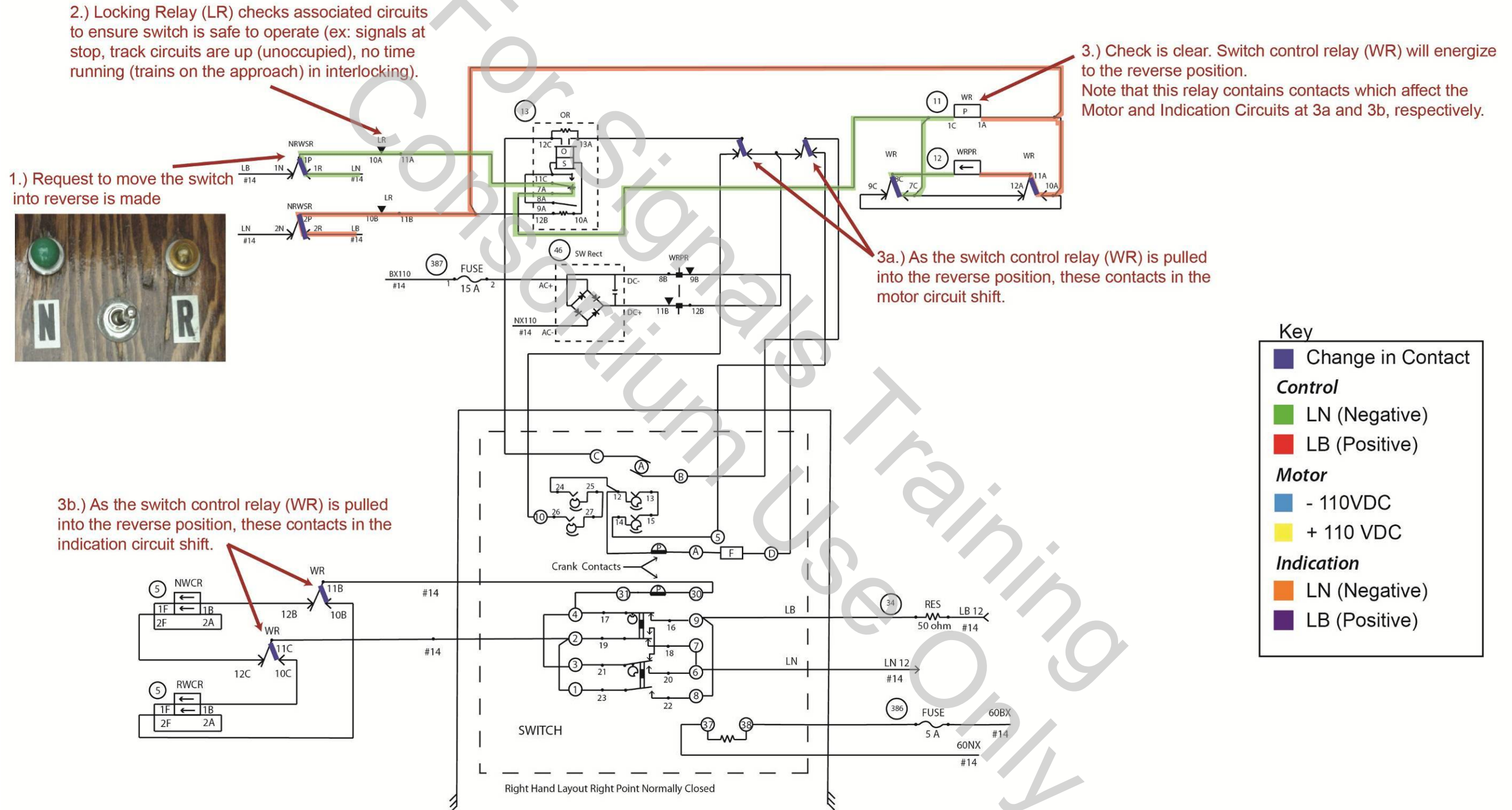


Figure 2.9 Example Reverse Configuration Control Circuit of an Electric Switch

Module 3

GENERAL INSPECTION & MAINTENANCE OF SWITCHES AND DERAILS

Outline

- 3-1 Overview
- 3-2 General Inspection and Maintenance
- 3-3 Lubrication
- 3-4 Inspecting and Maintaining Rods
- 3-5 Inspecting and Maintaining Circuit Controllers
- 3-6 Inspecting and Maintaining Ancillary Parts
- 3-7 Seasonal Inspection and Maintenance
- 3-8 Testing
- 3-9 Inspection and Maintenance Cleanup
- 3-10 Summary

Purpose and Objectives:

The purpose of this module is to provide an overview of 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 the following modules.

Following the completion of this module, the participant should be able to complete the exercises 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 obstruction test
- Demonstrate ability to adjust point tension
- Inspect and maintain circuit control heaters (where applicable)
- Demonstrate ability to test electrical indication

3-2 GENERAL INSPECTION AND MAINTENANCE

The first step in doing any inspection and maintenance is to perform a sensory inspection. For switches and derails this includes walking the length of the layout, both inside and outside, to make sure that all **hardware** is in place, clean and secure. Hardware that should be checked include nuts, bolts, ties, points, derails, etc. One visual sign that may indicate that hardware is not secure is the presence of **rust** around that hardware. Pay special attention looking for items that would inhibit smooth movement of the switch point and/or hang the switch up.

The majority of hardware to check are nuts and bolts. These are found on operating rod, track rods, lock rods, point detector rods, yoke and on switch mounting bolts (on all four corners).

Hardware to check include:

- Nuts and bolts
- Switch Heater Terminations
- Bonding
- Ground Wires
- Switch keeper* also known as *Lock Stand*
- Track braces*
- Plates*
- Stock Rail Spikes/Screw Spikes*



Electro-Hydraulic Difference: do not inspect/maintain the following:

- Switch Keeper
- Track Braces
- Plates
- Stock Rail Spikes/Screw Spikes

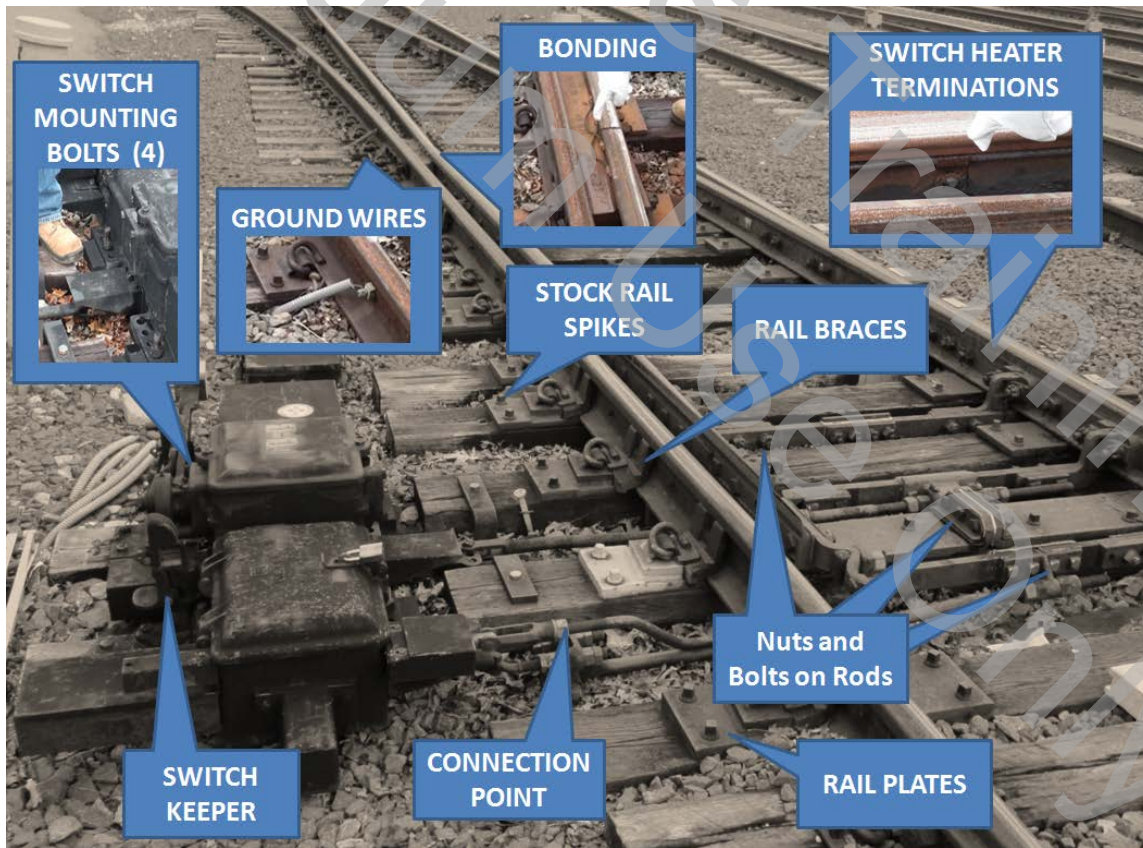






Figure 3.1 Switch Layout Highlighting Hardware to Inspect - Courtesy LIRR

An operating rod wrench or pry bar is used to make sure that the point or derail is tight against the stock rail. Next, the switch should be thrown. Notice any excessive movement of the tie plates, ties, stock rail or the switch machine itself. Additionally, make sure all appropriate locks are in place and secure. Generally, the locks that should be in place include the **keeper lock** also known as the *throw lock*, **circuit controller lock**, **gear compartment locks**, two **motor locks** and a **junction box lock**, if equipped. Make sure to tighten any loose hardware and replace any pieces that are missing.

Table 7 Generic Sensory Inspection of Switches and Derails

Sense	Example Problems
 Sight	Debris, dirt, clutter, untamped ballast, rotting, instabilities, rust, worn insulation, lubricant outside the gearbox, proper drainage, hairline damage or distortion to case, cover and/or other structural components, breaks/weak points or any other signs of physical damage.
 Smell	Burning
 Touch	loose points, hardware, etc
 Hear	Grinding, clanging sound, loose or broken parts

During this walkthrough, perform a visual inspection of switch rod and gauge plate **insulation**. Worn/deteriorated insulation will not only disrupt the track circuit but can also affect the integrity/alignment of the switch layout. This may be a problem the day of inspection or in the future if further deterioration occurs. If insulation is worn and/or deteriorating, notify the correct personnel in charge so that it will be replaced as soon as possible.



Figure 3.2 Insulation - Courtesy LIRR