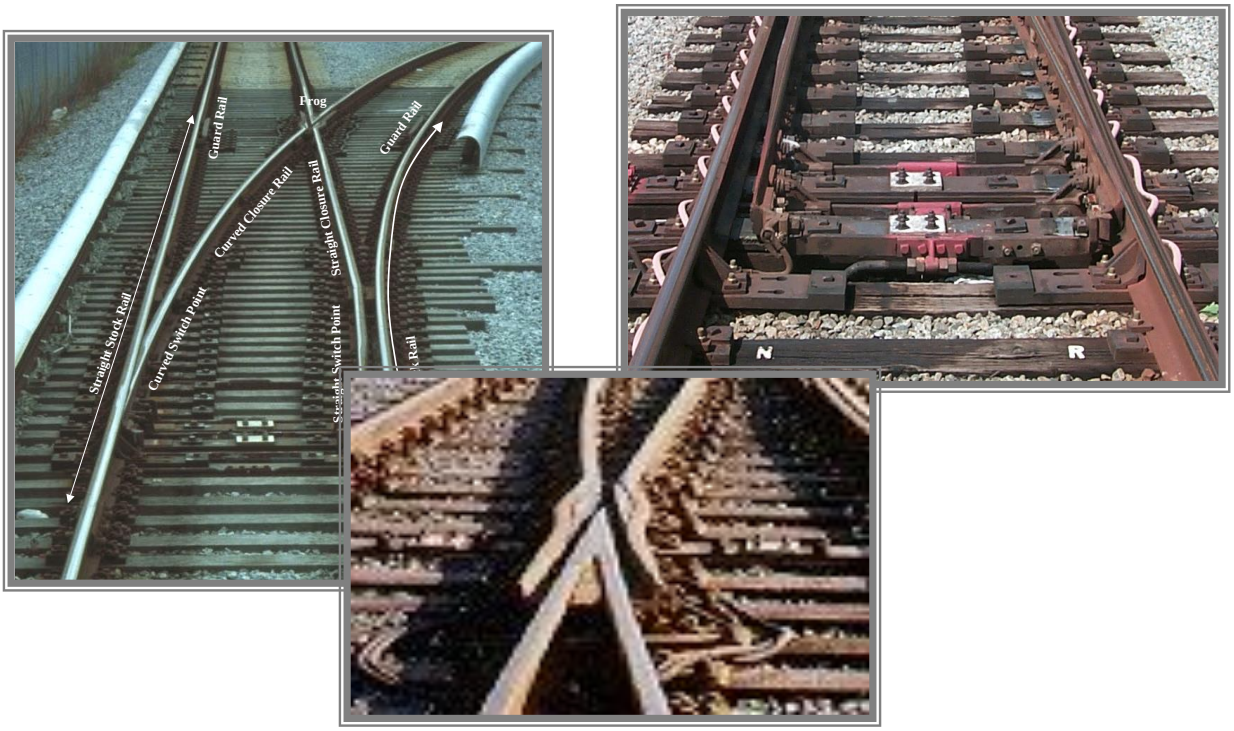
Track & Structure

Track Maintenance Training



Turnouts and Crossovers

Metropolitan Atlanta Rapid Transit Authority

Infrastructure Training

Table of Content

Introduction

Track & Structure training provides a review of MARTA maintenance and railroad standards. At the end of this course, students will be able to describe Switches & Turnouts used at MARTA and demonstrates how to identify the different components.

Requirements

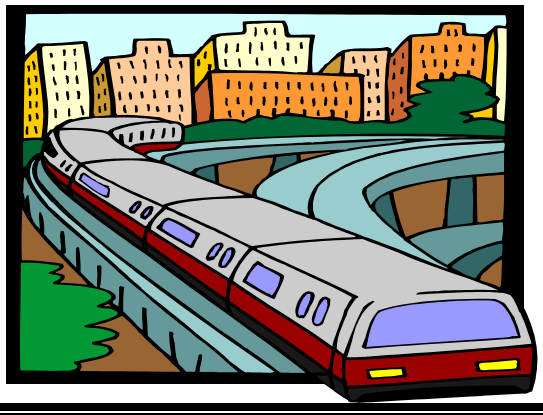
Test scores must be 80% or higher on all written evaluations. Only one retest will be allowed on any written evaluation without additional training. All MARTA Track and Structures personnel must demonstrate knowledge of MARTA Turnouts and Crossovers.

Each student will be asked to complete a class/instructor evaluation at the end of the class.

Learning Objectives

Class Objective

Demonstrate the ability to correctly describe all Track Structure components in accordance with MARTA standards.



Section Objectives

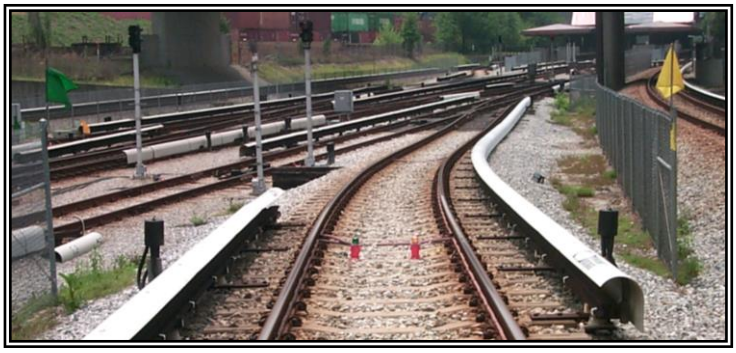
1. Demonstrate ability to identify different turnout sizes.
2. Demonstrate how to determined frog size and angle.
3. Describe flangway depth and width for a frog and switch point.
4. Describe the function of a guard rail.
5. Describe all sections of a turnout and describe their functions.
6. Describe the function of rail braces and their use in a turnout.
7. Identify the stock rails, curved lead, frog, guardrails and closure rails within a turnout.
8. Describe the relationship of the switch point to the stock rail along with the importance of a proper fit.
9. Describe surface problems within a turnout and demonstrate ability to use the MARTA track geometry standards within a turnout including taking the marked measurements.
10. Describe the two types of derails used at MARTA and how they differ from each other.

TURNOUTS AND CROSSOVERS

Transit operations require many types of movements of trains and equipment, other than simply going from one point to another on a single-track.

1. Cars need to be placed on sidetracks or yard tracks for storage or cleaning.
2. Pocket tracks are needed for turning around or storing out of service trains.
3. Trains may have to be diverted from one track to a parallel track for single tracking.
4. One track may cross or connect with another.

In congested areas, it is sometimes necessary to provide special track work that will permit many possible routings for trains in a limited space. (Yards)



Sometimes the nature of the operation requires such movements to be made at considerable speed as with a # 20 switch.

In other cases, relatively slow speeds are quite satisfactory as with a # 10 or # 8 switch.

In this lesson we will study just two of these types of track work:

a) The turnout
b) The crossover

These are the most common types in general use, by far. Other types will be dealt with in another lesson.

In this lesson we will examine the principal parts used in the construction of turnouts and crossovers.

We will consider some of the things in the design of these parts which people responsible for building and maintaining turnouts and crossovers should understand.

It is not the purpose of this lesson to teach you how to construct or to do major maintenance work on turnouts and crossovers.

The foundation, which this lesson provides, is necessary before you are ready to do a good job of building and maintaining such track work.

You will be able to observe any turnouts or crossovers while you are studying this lesson; you will find this to be of considerable help in improving your understanding of this text and the illustrations included with this lesson.

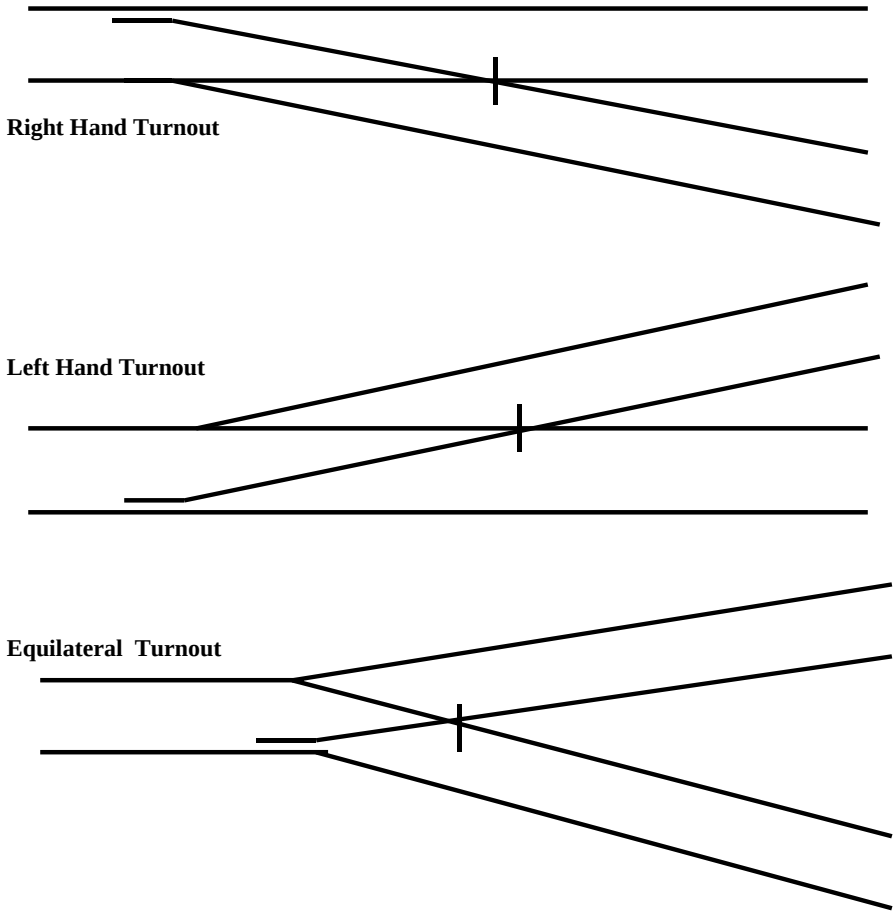
A. TURNOUTS

It is necessary to have a good understanding of what is meant by the words turnout and crossover. The easiest way to do this is by looking at diagrams.

It is entirely possible that you may be in the habit of referring to a turnout as a switch.

This is a fairly common practice but it is not accurate.

A switch is part of a turnout.



The switch consists of two switch points (or switch rails) Plus the fittings needed to hold them in position.

A turnout consists of a:

a) Switch
b) A frog
c) Connecting closure rails.
d) Together with the necessary timber and other parts needed to complete both routes.

B. EXAMINING A SWITCH

The next part of the turnout that will be considered is the switch.

It has already been shown that the switch is made up of a number of parts.

The two largest parts are the switch points.

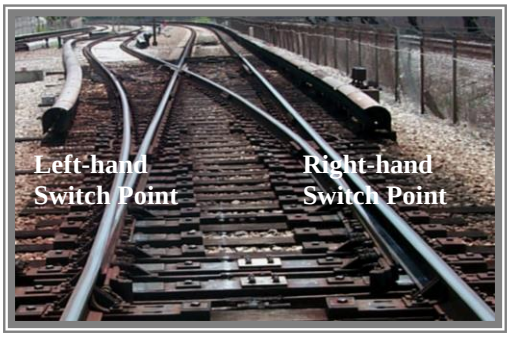
Every switch has a right-hand and a left-hand switch point.

a) To determine the hand of a switch point, stand in the center of the track at a point ahead of the switch.

b) Look toward the switch (this will be in the direction of a facing train movement). The right-hand switch point will be to you. right and the left-hand switch point will be to your left.

c) The thin, tapered end of a switch point is known as the **point of the switch**.

d) The other end of the switch point, with the full tee rail section, is known as the **heel of the switch**.



A switch point is the means by which wheels are diverted from the rail on which they have been running to another route.

To do so, the shape of the point of the switch and the manner in which it fits against the adjacent rail (stock rail) must be designed and maintained within rather close limits.

A switch, which has an exposed point that the flange of a wheel may strike, (during a facing movement) presents a very real danger of derailment, should a wheel flange climb onto the top of the switch point.

- Such an exposed point can be due to improper fit between the switch point and the stock rail.

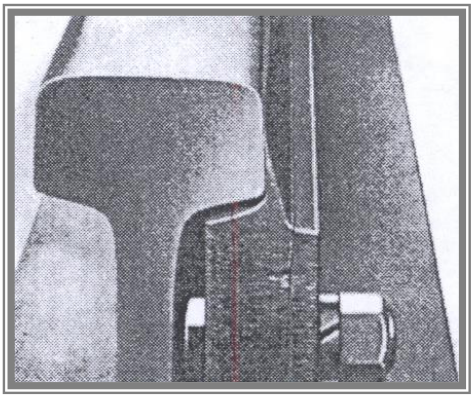
- A gap as little as ¼" can cause the wheels of a train to pick the point and cause a derailment.

A point which is too thin may not have enough strength to withstand loads placed upon it, nor would it have a reasonable life under traffic conditions which cause wear on the switch point.

On the other hand, a thickly constructed switch point may present a blunt point for the wheel flanges to strike.

In any switch, one switch point will be used by traffic using one route through the turnout, and the other switch point will be used by traffic on the other route.

Switch Points



a) Each stock rail must be securely seated in switch plates, but care must be used to avoid canting the rail by over tightening the rail braces.
b) Each switch point must fit its stock rail properly, with the switch stand or switch machine, in either of its closed positions to allow wheels to pass the switch point.
c) Lateral and vertical movement of a stock rail in the switch plates or pads or of a switch plate or pads on a tie must not adversely affect the fit of the switch point to the stock rail.
d) *Broken or cracked switch point rails will be subject to the requirements of 213.113, except that where remedial actions C, D, or E require the use of joint bars. Joint bars cannot be placed due to the physical configuration of the switch, remedial action B will govern, taking into account any added safety provided by the presence of reinforcing bars on the switch points.*

e) Each switch must be maintained so that the outer edge of the wheel tread cannot contact the gage side of the stock rail.

f) The heel of each switch rail must be secure and the bolts in each heel must be kept tight.

g) Each switch stand (or switch machine) and connecting rod must be securely fastened and operable without excessive lost motion.

h) Each throw lever must be maintained so that it cannot be operated with the lock or keeper in place.

i) Unusually chipped or worn switch points must be repaired or replaced. Metal flow must be removed to insure proper closure.

Switch Point Construction

If there are appreciable differences in the traffic utilizing the two routes, then there will probably be substantial differences in the wear patterns of the two switch points.

A switch point that is in position against its stock rail, so that wheels will move from the stock rail to the switch point during a facing movement, or from the switch point to the stock rail during a trailing movement, is said to be in the closed position.

A switch point that is not in contact with the stock rail, permitting movements of a wheel entirely on the stock rail, is said to be in its reverse or open position.

3. Heelblock

As a switch point is moved between these two positions, it pivots about a joint at the heel of the switch point.

This heel joint acts somewhat like a hinge.

In some cases the heel joint is an ordinary rail joint, connecting the switch point to the closure rail.

The preferable arrangement for heavy-duty use and the one we use here at MARTA, includes a heel block, which is inserted between the heel joint and the stock rail, through which both the heel of the switch point and the closure rail are bolted to the stock rail.

A standard joint bar may be used on the field side of the stock rail in a heel block joint.

A special bent bar is used on the gauge side of the switch point and closure rail to permit the movement of the switch point.

It should be recognized that there is a minimum practical distance between the gauge line of the stock rail and the gauge line of the switch point at the heel of the switch.

This is determined by the width of the head of the switch point.

And the need to keep an adequate flangeway opening between the stock rail and switch point for wheels moving on that route.

When a set of wheels, in which the axle moves through the straight side of a turnout and that turnout is on tangent track.

The switch point which one wheel moves on, and the stock rail, which the other wheel moves on, are both a continuation of the straight line of the tangent.

The wheels undergo no change of direction. Practical speeds are limited only by the quality of the maintenance. The length of the switch point on this route is not particularly critical.

C. FROG

Behind the frog of a turnout, one of three things can happen:

a) The turnout track can curve back to parallel the main track (as shown in Figures 1 and 2).
b) The turnout track can continue to curve away from the parent track.
c) The turnout track may continue at the same angle as the frog.

In a crossover, the track between the two frogs follows the frog angle.

- The timber layout for half of a crossover will be different from that of a turnout.
- Except for these minor limitations, a crossover might be considered as two turnouts.

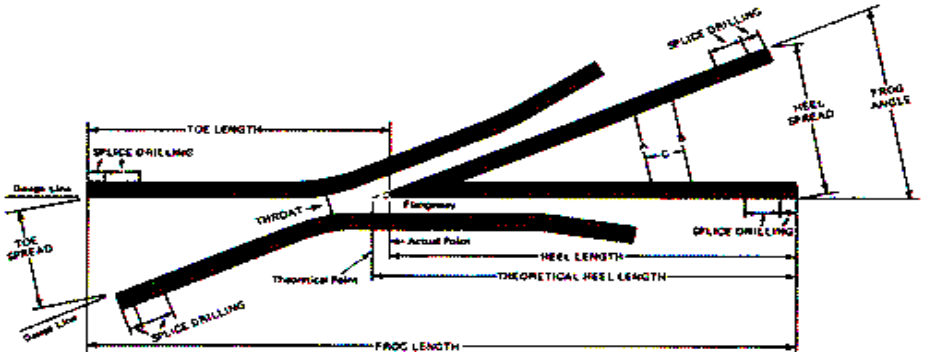
Most of this lesson will deal with turnouts, but the material covered will apply equally to crossovers.

Let's Look at the Frog

The first part of the turnout structure that will be considered is the frog. A **frog** is a device that permits flanged wheels running on a rail to cross another running rail.

Every turnout must have a frog.

In addition, turnouts are classed as to size by the frog.



In determining where a turnout is to be located, it is the position of the frog that is determined first.

All other parts of the turnout are then located relative to the position of the frog.

Some turnouts are designed for operating trains on both routes at substantial speeds.

- Others, such as a spur off a main-line track, are designed for high-speed operation on one route and low-speed on the other route.
- At other locations, such as in yards, they are designed for low-speed-operation only.

Turnouts of various types and sizes are available to meet the requirements of local conditions. The size of a turnout will be considered first.

Turnout Size

The sizes are usually stated as a whole number.

Some of the more frequently used turnouts are the # 6, # 8, # 10 and # 20.

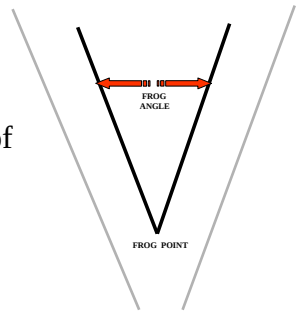
Here at MARTA we use;

- No. 6 turnout (1 only at Canterbury, FR Track into the storage track).
- No. 8 turnouts (Avondale Yard, South Yards & Armour Yard).
- No. 10 turnouts (Mainline Crossovers, turnouts and equilateral).
- No. 20 turnouts (Avondale, Ashby and Canterbury).

Quite a few other sizes are sometimes used, but on most transits and railroads some or all of the above sizes are commonly used.

Frog Angle

Actually, these numbers refer to **the frog angle.**



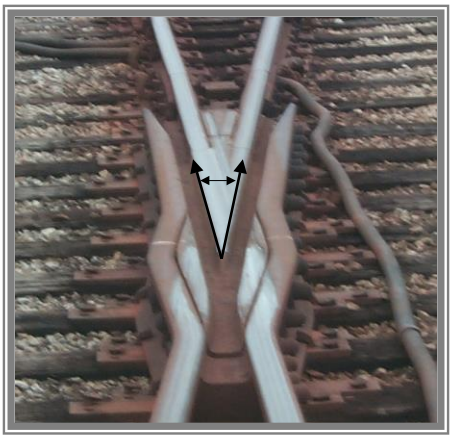
It is because the frog angle is so important in determining the size of the turnout that this designation is used to indicate the size of the turnout.

The frog angle is the angle between the two gauge lines of a frog.

Angles are usually measured in degrees, but an easier method is used to measure frogs.

All track personnel should know how to measure a frog angle.

a) The first thing to find is the intersection of the two gauge lines, brought forward from the point portion of the frog.



b) The actual point of the frog is blunt.
   - If the frog were constructed with the actual point brought forward to the intersection of the gauge lines, the point would come to a knife-edge and would quickly break off under traffic.

c) Determine where the gauge lines come together.
   - This can be done with a straight edge or a piece of string.
   - If there is not much wear it might be done by sighting.
   - It does not have to be highly accurate.

d) Mark the location.
   - If you are within an inch of the right point, that's good enough.

e) Next, you will need something to measure with.
   - Anything of a convenient fixed length will do.
   - You can use a pencil and measure in pencil lengths.

Let's assume you have a pocket ruler.

f) Go back on the point of the frog and find where the distance between the two gauge lines is exactly one foot.
g) Now, mark the point of this line midway between the gauge lines.
h) Next, measure the distance from that point to the point you located at the intersection of the gauge lines.
    - Let us suppose it is 8-feet. This tells you that it is a No. 8 frog.
    - Possibly you have measured 7' 11-1/4", or perhaps 8' 1-3/8". You still have a No. 8 frog, because your method of measuring is not that accurate, and most frogs are built to whole numbers.
    - However, if your distance is about 7' 6-1/2", you had better re-measure more carefully. It might be a No. 7 frog.

Try another example.

Locate the intersection of the gauge lines the same way.

a) This time in determining the spread, you find that you would have to go back a long way to find **a <u>one-foot spread</u>**.
b) Take a more convenient unit.
c) A six-inch spread will do.
d) After locating the point midway between gauge lines on the six-inch spread; measure from there to the intersection point, which you located first.
    - Suppose it comes to about ten feet.
    - Remember that you are no longer using one-foot units.
    - This time you are counting six-inch units.
    - Ten feet is 20, six-inch units.
    - So this is a No. 20 frog.

Maybe you had to use a pencil. You find the location where there is a spread of one pencil length. Then count ahead in pencil lengths to where the gauge lines intersect.

- The number of pencil lengths will tell the frog number.

D. SIZE AND FROG NUMBER

1) The smaller the frog number, the larger the frog angle will be.
2) The larger the frog angle, the sharper the curve will be through the turnout.
3) The sharper the curvature, the lower the maximum permitted speed will be.

For example,

1. A No. 20 turnout is usually found in main tracks where substantial speeds are required on both the straight side and the turnout side.
2. A No. 8 turnout (found in the yards) if well maintained, will permit high speeds on the straight side but only low speeds on the turnout sides.

Point of Frog

It has previously been stated that the point of a frog is somewhat blunted so that it does not break off under traffic.

- The location where the frog point ends is called the **actual point.**
- The intersection of the gauge lines, which has also been described, is also known as the **theoretical point** of the frog.
- The theoretical point, in addition to its importance in determining the number of a frog, is of value to surveyors in determining the proper location of a turnout.

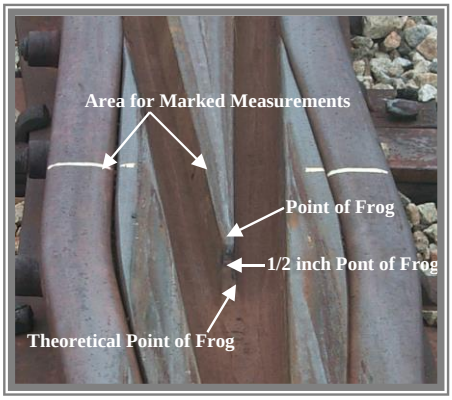
Half Inch Point

There is another frog point, which you need to be familiar with. This is the so-called **half-inch point.**

This is usually located a short distance ahead of the actual point and on most frogs is identified with a chisel mark.

It is so named because it is at the location where the gauge lines on either side of the frog point are one half inch apart.

- It is from the half-inch point that most distances that you will have to work with are taken.



The two legs of the frog closest to the switch are known as **the toe of the frog.**

- The two legs of the frog furthest from the switch are known as **the heel of the frog.**
- The toe length and heel length of a frog, are measured from the half inch point to the end of a toe or the end of a heel.

E. TYPE OF FROGS USED AT MARTA

You should know what the principal types of frogs are. You should be able to identify them, and know where they should be used.

RAIL BOUND MANGANESE STEEL FROG

A cross-sectional drawing would show the central manganese steel casting as well as the surrounding tee rails from which the term **rail bound** is taken.

This type of frog is suitable for high-speed, heavy-tonnage main-line use.

Note that this frog does not include the additional support of the tee rails used in the rail-bound manganese-steel frog.

In addition to providing protection for the frog point against being struck by a wheel flange, all types of frogs, which have been described, are designed with provision for avoiding the placement of the full weight of a heavily loaded wheel on the relatively narrow portion of the point close to the tip.

This is done in one of two ways

a) One is to manufacture the frog with the portion of the wings adjacent to the throat of the frog, and for several inches behind the actual point, slightly raised above the plane of the point. This procedure sometimes results in these wings being referred to as **risers**.
b) The other alternative is to manufacture the frog with the first several inches of the frog point slightly depressed below the plane of the wings.

Frog Flangway Depth

a) The flangeway depth measured from a plan across the wheel-bearing area of a frog on Class 1 track may not be less than 1 3/8", or less than 1 ½" on Classes 2 through 5 track.
b) If a frog point is chipped, broken, or worn more than 5/8" down and 6"back, operating speed over the frog may not be more than 10 mph.
c) If the tread portion of a frog casting is worn down more than 3/8" below the original contour, operating speed over that frog may not be more than 10 mph.
d) *Where frogs are designed as flange bearing, flangeway depth may be less than that shown for Class 2 if operated at Class 1 speeds.*

F. PURPOSE OF GUARD RAILS

It has already been shown that a wheel moving through the open flangeway of a frog must be guided along the proper route.

On all frogs other than self-guarded frogs, this is done by means of guardrails.

- Guardrails must be provided on both the straight and turnout sides.
- Guardrails guide wheels moving through a frog throat by applying pressure to the back of the flange of the wheel on the other end of the axle.
- The restraint is therefore transmitted through the entire assembly of both wheels and the axle.

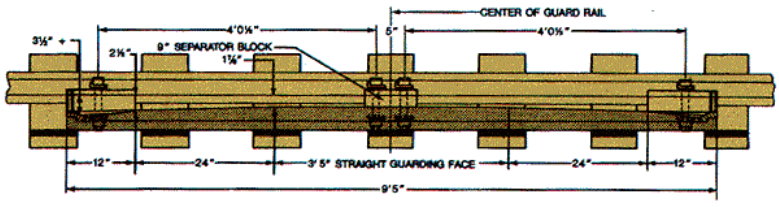
Types of Guard Rails

There are several kinds of frog guardrails in general use. Most of them can be grouped in one of two general types.

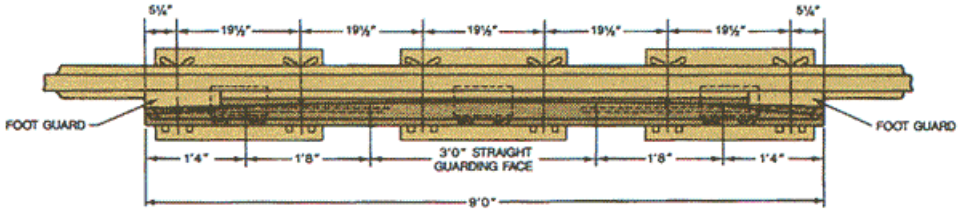
a) One is the type fastened directly to the running rail, using either bolts or clamps with spacer blocks. These are usually made of tee rail with the ends flared and tapered. (this is the type that we use here on MARTA mainline tracks)

b) The other type includes base plates permanently attached to the guardrail. These base plates, generally, extend under the running rail serving as tie plates for the running rail.(this is the type we use here at MARTA on the yard tracks)

- An advantage of this construction is that when the guard rail is called upon to provide lateral restraint to a wheel, the weight of that wheel load is being transmitted through the running rail to the guard rail base, helping to keep the guard rail from moving.



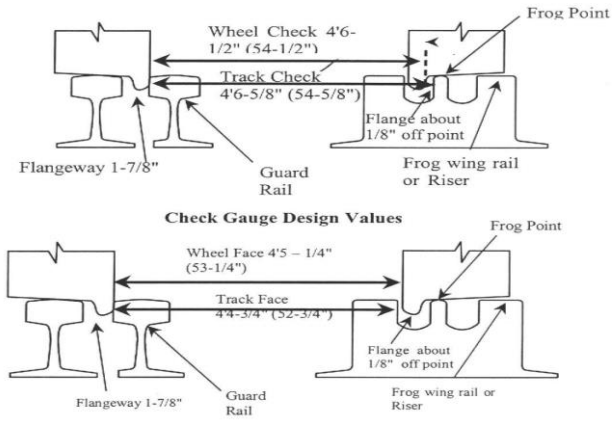
Also, there may be more than one length of frog guardrail provided to meet certain conditions. These you must determine so that you will be prepared to install and maintain guard rails in accordance with your company's requirements.



Guard Rail Measurements

New guardrails are securely fastened to 1 7/8" flangeway opening. The guard-check and guard face gauges in frogs must be within the limits prescribed in the following table.

Check location of guardrail in relation to frog point to insure that the open area ahead of the point is protected by the straight portion of the guardrail.



The minimum length of straight guarding face should be, in inches; two times the frog number for rail bound frogs and 40 inches for spring frogs.

A minimum of 6 inches straight guarding face is required following the frog point.

G. CHANGING WHEEL DIRECTION

When a wheel set moves through the other side of a switch, leading to or from the turnout side, the wheels do undergo a change of direction.

- A change of direction does impose restrictions on speeds that can be permitted.

- The extent to which speeds must be restricted depends on how abrupt the change of direction is.

Two things, which determine the abruptness of the change of direction, are:

a) The spread between gauge lines at the heel of the switch.
b) The distance between the point of the switch, and the heel of the switch.

Length of Switch Point

The distance between these points is the length of the switch point.

A deflection from a straight line of 6-1/4", which is the standard heel spread for switches built to the designs recommended by the American Railway Engineering Association. And occurring within the length of an 11-foot switch point will be more abrupt than a similar deflection occurring in the length of a 39-foot switch point.

- Thus, it can be seen that relatively long switch points are needed in order to permit substantial speeds on the turnout side.
- The length of the point on the straight side is not important from the standpoint of speed.

However, if both switch points in a turnout were not of the same length, it would not be possible to maintain uniform gauge through the turnout side of the switch.

- Therefore, both points within a turnout are normally of the same length.
- There is one other thing that can help determine the abruptness in the change of direction at a switch point.

Consider a switch point on the turnout side, which has a straight gauge line throughout its length.

- The change in direction occurs suddenly, at the point of the switch.
- On the other hand, if this switch point is provided with a curved gauge line, the change in direction is more gradual.
- The change of direction is continual throughout the entire length of the switch point and less severe at any one point.

Because of this, **ALL** switches at MARTA are designed with a curved gauge line on the straight side.

Turnout No.	**#8**	**#10**	**#15**	**#20**
Length of Switch Point	**16'-6"**	**19'-6"**	**26'-0'**	**39'-0"**

Different Kinds of Switch Points

By now, it should be apparent that you will not have to deal with a considerable number of different kinds of switch points in your work.

There will be a range of points for each weight and section of rail used on your railroad for turnouts.

There will be various lengths of points

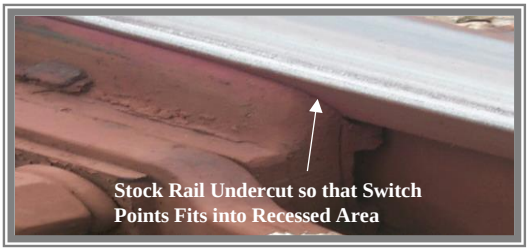
- The longer lengths being designed for use in turnouts with higher frog numbers.
- The shorter lengths with lower frog numbers.

There will always be straight points to deal with and curved points as well.

There will also be right-hand and left-hand points in each category.

There may be even more variety if heavy-duty designs are used for certain locations, rather than a standard switches point design.

a) One way in which to obtain increased life of switch points that are in locations subject to heavy wear is to provide a heat treated version of such a switch point. (The type used at MARTA.)
b) Another approach might be to use a Samson type point (The type used at MARTA.) or manganese tipped point.
c) At MARTA, the Samson Undercut Switch Point is used.
    - This type of switch point protects the point from being chipped or broken.


Stock Rail Undercut so that Switch Points Fits into Recessed Area

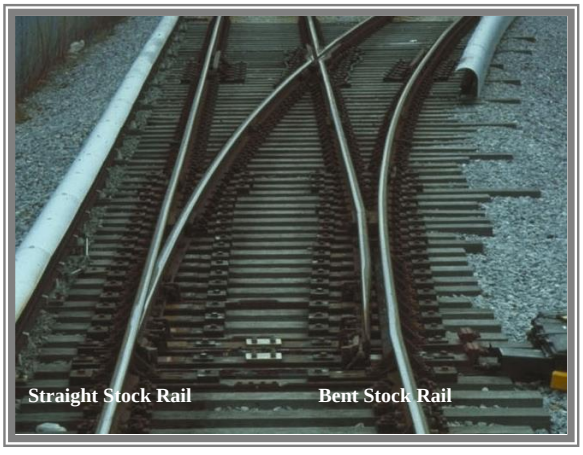
You will probably never see all possible combinations of switch point types in your entire career.

You should become familiar with the types used by your transit and learn how to identify them. And become knowledgeable about locations where each type is to be used.

Some of the classifications you will learn to recognize by a general inspection of the switch point.

H. THE STOCK RAIL

The next part of the turnout structure that will be examined is the stock rail.


Straight Stock Rail Bent Stock Rail

The stock rail is the conventionally shaped tee rail against which the switch point fits, when the point is in the closed position.

When the switch point is in the open

position, the stock rail is part of the route on which the wheels travel instead of the switch point route.

Each switch point must have a stock rail; therefore, each turnout must have two stock rails.

Stock rails are designated as right-hand or left-hand in the same manner as switch points.

- A straight stock rail is used on the straight side of a turnout.
- A curved stock rail on the curved or turnout side.
- Stock rails need to be able to do certain things in relation to the switch point with which they are matched.

a) To provide a good fit at the point of the switch, so that an exposed point will not be available for wheel flanges to strike on facing movements.
   - To do this properly, a full contour on the head of the stock rail is needed.
   - A worn railhead will not adequately protect the switch point.
   - In most cases when a switch point needs replacement**, <u>the stock rail should also be replaced.</u>**
   - It is not good practice to place a new switch point against even a moderately worn stock rail.
   - It should be remembered that a switch point is usually a much more costly piece of track work than a stock rail and that the emphasis should be on attaining maximum useful life from the switch point.

b) Provide a recess in the gauge side of the stock rail.
   - This is limited to the portion of the stock rail with which the switch point makes contact. It is sometimes done in a shop, usually by planning.
   - In other cases, it is accomplished on the ground, usually immediately after installing a stock rail in track.
   - In such instances, it is usually done with a grinder.
   - A switch point which fits into such a recess or pocket will be less exposed to an oncoming wheel flange at the tip of the point.

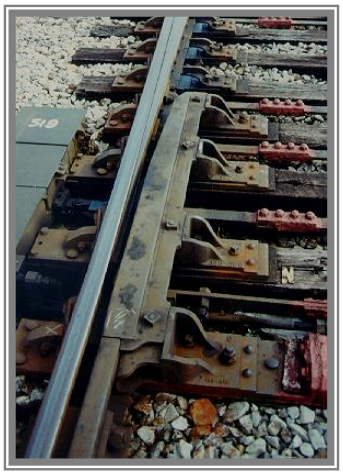
c) Another way in which the point of a switch is protected from wheel flanges, is by bending the stock rail a short distance ahead of the point of the switch.

- This is commonly done to the stock rail on the turnout side, which, is matched with the switch point on the straight route.
- It is not done with the stock rail on the straight side.

I. RAIL BRACES

Another important function of the stock rail, in relation to the switch point, is one of support.

Since a switch point can only be used when in the closed position, the lateral support provided by the gauge side of the stock rail bearing against the back side of the switch point is an important part of the total support of the switch point.



Certainly, the stock rail must be able to provide substantial support for the switch point, one complicating factor in this, is that the base of the gauge side of the stock rail cannot be spiked or clipped within the limits of the switch point.

- This is because of lack of clearance between the switch point and the stock rail, in the closed position.

To overcome this problem, additional support is provided to the field side of the stock rail by means of braces

- Such braces are fastened to switch pads or switch plates and bear against the web of the stock rail.
- In some cases they also bear against the underside of the railhead.

In this manner, considerable resistance is developed against any tendency for the stock rail or the switch point to be rolled over.

While it may not be so in some older designs, most modern types of stock rail brace are adjustable. This aids in setting the stock rail so that a good bearing can be had with the switch point throughout the entire intended contact area.

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J. SWITCH POINT PROFILE

We have seen how switch point, stock rail installations must provide protection against potential hazards that could exist for equipment moving in the facing direction.

Movements in the trailing direction are not, without the potential for a hazardous condition either.

- Consider a switch point and a stock rail which fit well, but in which the head of the switch point throughout its length is slightly lower than the head of the stock rail.

Gap at both switch points will de-rail a train

As a wheel moves along the switch point in the trailing direction, from the heel toward the point, as the outer edge of the wheel rim first makes contact with the stock rail, the wheel probably will not climb up onto the head of the stock rail.

Instead, the wheel might very well stay inside the gauge side of the stock rail, forcing the stock rail to be spread away from the switch point.

This would almost certainly result in a derailment.

If both the stock rail and the switch point were at the same level, this probably would not happen.

But suppose the head of the switch point acquired *more wear than the stock rail*, or *suppose a badly worn wheel* were to make such a movement.

- The wheel might have more tread wear close to the flange than at the outer edge of the tread.

In either case the results could be the same. The stock rail could be forced to the field side, resulting in a derailment immediately ahead of the switch point.

The way to protect against this hazard is to provide for the head of the switch point to be *raised higher* than the head of the stock rail, in the area where wheels make this transition from the switch point to the stock rail, on trailing movements.

- To do this, switch points are bent vertically in manufacture.

Remember that it is equally important for the point of the switch not to be higher than the stock rail because of the dangers of point breakage and wheel climbing in facing movements.

K. SPECIAL PADS AND PLATES UNDER POINTS

This vertical shaping would be of no value if matching support were not provided for the base of the switch point.

If the switch pads or plates provided the same level of support for the switch point that they did for the stock rail, the weight of traffic would soon remove the vertical contour of the switch point.

Examine a set of switch pads or plates carefully. If possible look at both a set of pads or plates which are in track and a set which are stock piled.

You will be able to see that there is a variety of pads or plates with different relative elevations provided for the switch point and stock rail. The usual difference in elevation at the maximum point is 1/4-inch.

At this point it should be noted that there are two basic types of switch point riser design in use. Some railroads use only one type; others use both types.

The two designs are generally similar between the point of the switch and the point of maximum riser height.

- It is behind this point that the difference in design occurs.

If the difference in elevation is run out within the limits of the switch point (which means that the stock rail and switch point are at the same elevation within the heel block), the switch is said to have graduated risers.

However, if a less sudden change in elevation is desired for a smooth ride at high speed, then this difference in elevation can be run out behind the heel block on the closure rails.

This design requires special switch plates under the portion of the closure rails within the limits of the run-off. A switch so designed is said to have **uniform risers.**

MARTA uses only the UNIFORM RISERS system.

The turnout pads or plates shown behind the left-hand heel block are typical of those used with a switch having uniform risers.

The pads shown behind the right hand heel block are typical of those used with a switch having uniform risers.

L. SWITCH ROD ARRANGEMENT

At this point, we should direct our attention to some of the other fittings within a switch.

In the operation of a switch, it is highly desirable to have both points move in unison, that is, as one point is being closed, the other is being opened.

- Without such an arrangement, there would be opportunity for error in aligning a switch.

A derailment can occur with both points in the open position or with both points in the closed position.

Switch rods are used to connect the right and left-hand switch points so that one switch point cannot be operated independently of the other.

Switch Rods

The switch rod, which is located closest to the point of the switch, is called **the No. 1 rod**.

Each rod in order, moving towards the heel of the switch is numbered according to its position. A short switch may only have two rods; longer switches will have additional rods.

The designations such as;

- No. 3 rod
- No. 2 rod
- No. 1 rod

A No. 4 rod, for example, should not be used in the No. 2 position because the drilling would be wrong.

 # 1 Switch Rod

The No. 1 rod is usually distinctively different from the other switch rods.

- The reason for this is that there is another rod, which is connected on one end to the No. 1 switch rod.
- The other rod is not called a switch rod; it is an **operating rod.**
- The end of the operating rod, which is not connected to the switch rod, is connected to whatever type of mechanism is provided for moving the switch from one position to the other.
- The necessary thrust for throwing the switch is transmitted through the operating rod to the No. 1 switch rod, and through the No. 1 rod to the switch points themselves.

Other Throw Rods

On some of the longest switch points, there will be a switch rod, which looks similar to the No. 1 rod, located somewhere about midway between the point and the heel of the switch.

- This switch rod will have a rod or arrangement of rods connected to it and to a power source, which provides assistance in throwing such long switch points.

It is not practicable to connect switch rods directly to the switch points. This is accomplished through an intermediate fitting known as a **switch clip.**

In a typical switch clip, the bolts, which fasten a switch clip to a switch point, are known as **switch clip bolts**.

The bolts, which connect a switch rod to the switch clips, are known as **switch rod bolts.**

Sometimes an alternative arrangement is used to connect the switch points to the switch stand or switch machine.

Instead of providing an operating rod, which is connected to the switch stand or switch machine on one end. And to the middle of the No. 1 switch rod on the other end, a shorter rod is used which makes a connection between the switch stand and the switch clip that is closest to the switch stand.

Such a rod is known as a **connecting rod,** rather than an operating rod.

These installations are generally limited to slow speed territory on railroads, which use this arrangement.

You may find cases in which there is another difference in types of switch rods. If the width of a switch rod is greater than its height, it is known as a **horizontal switch rod.**

In such rods, the switch rod bolts are installed in a vertical position. If its height is greater than its width, it is a vertical switch rod.

Such rods require a different type of switch clip and the switch rod bolts are installed horizontally.

Switch Calls

A switch call positions a switch in either the normal or the reverse position. Switch calls can be made by the route logic, Rail Control, or the local control panel.

Switch calls are executed only if the switch in the unlocked condition. If locked, the switch will remain in the locked position.

Dangerous Practices to be Avoided in Signaled Track

1. Placing any metal object across both rails can act as the train wheels and stop the current flow to the track relay.
    - This action of the wheels or the metal object is called shunting the track circuit.

- When the track is shunted, the signals will display their most restrictive aspect. This situation can cause trains to stop in either direction.

2. The track wires, rail bond wires, or underground signal cables, if damaged, will also open the closed circuit and cause the same situation as with the wheels or metal object.
    - Any damage done to signal components must be immediately reported to A.T.C..
3. During electric welding operations, precautions must be taken to isolate the frog that is being welded from the signal circuit. Contact the A.T.C. Maintainer prior to welding and he/she will protect his circuit.
4. Report any danger or disturbance of any signal installation components to the A.T.C. Maintainer.

These components include:

1. Cables
2. Relay cases
3. Bungalows
4. Switch machines

When working around track switches with any tool that conducts electricity such as:

- Track wrench
- Shovel
- Ballast fork
- Tie tongs
- Metal handled broom

Use extreme care not to cause a short across an insulated gauge rod, insulated gauge plate or insulated joint.

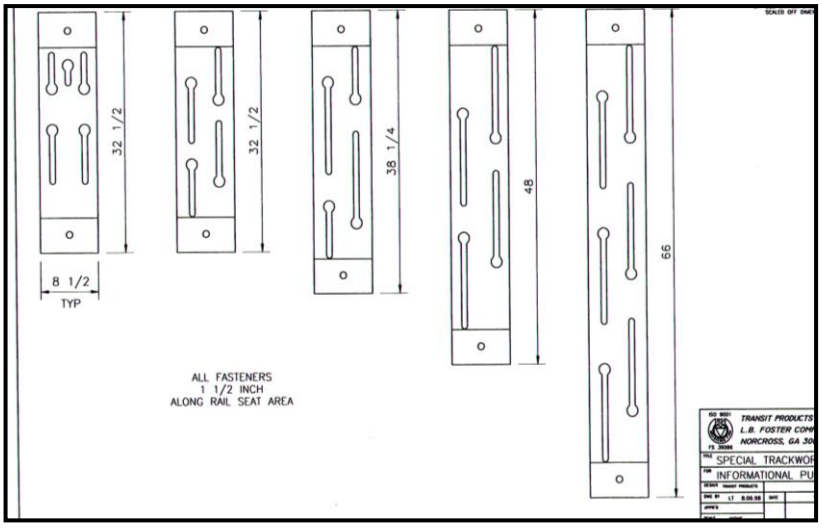
Track fasteners must not be installed at insulated joints in a manner that may short-circuit the track circuit.

Track units must not be left with a wheel spanning the rail gap at an insulated joint. Wheels must be stopped clear of the joint.

The Signal System is necessary for the safe and efficient operation of trains. Help protect the Signal System by working with the A.T.C. Maintainer.

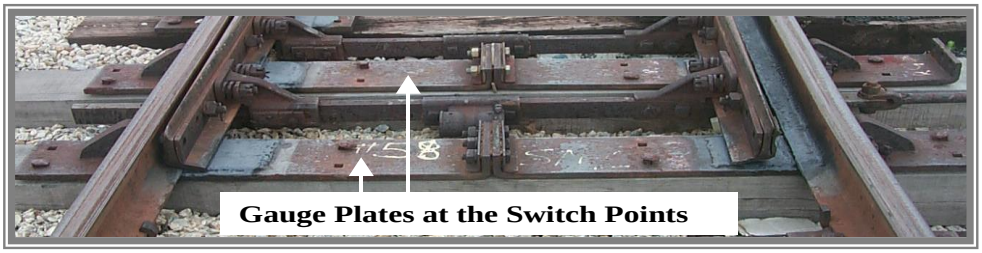
M. SPECIAL PLATES

A number of different types of pads or tie plates are required under various parts of a turnout.



Special pads or plates are required under the frog guardrails and adjacent running rails, if the guardrails don't have integral plates.

We have seen how special switch pads or plates are required under switch points and the adjacent portions of the stock rails.



Some types of frogs may have integral tie pads or plates, but many frogs do not.

N. RAIL AND RAIL JOINTS

This lesson has been concerned mostly with special track work parts used in turnouts and crossovers.

Conventional track materials, such as

- Standard tie plates or pads
- Joint bars
- Spikes
- Bolts
- Rail anchors
- Ballast

Some attention should be given to the use of rail within turnouts and crossovers.

The balance of the rails used within turnouts and crossovers do not need special preparation, but the location of joints connecting these rails requires careful attention.

A list of several facts and desirable goals regarding the location of joints within turnouts and crossovers would include the following:

1. It is necessary to install insulated joints in turnouts and crossovers located within the A.T.C. circuits.
2. Insulated joints must be located with a minimum stagger distance because of electrical requirements.
3. It is preferable to maximize the stagger of all joints from the standpoint of track stability.
4. It is not practical to locate joints within the limits of frog guard rails or switch points.
5. It is not good practice to have a stock rail terminate in a heel block joint.

It is sometimes desirable to build or replace turnouts with pre-assembled panel sections.

- This type of construction lends itself to minimum stagger of joints.
- It can be seen that some of the above conditions are not compatible with each other.

This leads to a situation where the stagger of joints within turnouts and crossovers is less than desirable.

Many railroads have standard plans for turnouts and crossovers, which among other things show the recommended locations for joints in such track work.

- At MARTA we have a criteria for joint locations.

In some cases, pre-cut lead rails of special lengths are available to reduce cutting and drilling of rails on the job site.

You should become familiar with such plans, not necessarily to the extent of learning the various rail lengths and locations, but to the extent of being able to find the needed information when you need to put it to use.

O. TURNOUT CLOSURE RAILS

The rails, which connect the heels of the switch with the toes of the frog, are the closure rails.

- In a right-hand or left-hand turnout, the length of the curved closure will be slightly longer than the length of the straight closure.
- In the case of an equilateral turnout, the two closures will be of equal length.
- In most cases more than one rail will be required to complete each closure.

In A.T.C. circuited territory, an insulated joint will be required at an intermediate point within the curved closure if the normal route of traffic is to the straight side.

In present-day practice, there is a trend toward the reduction in the number of joints in turnouts and crossovers through the use of welded rail.

There can be a good deal of variation in the extent to which this practice is carried out.

In other cases, the effort to eliminate joints may receive equal attention on both routes.

In some instances, joints at the toe and heel of the frog are eliminated through welding.

- Many times they are not welded, and either conventional or adhesive type joints are installed.
- Here at MARTA, we typically use conventional joints or adhesive joints.
- Stock rails may be prepared in a shop, and after installation the ends may be either field welded or connected with joints.
- In other cases, continuous welded rail may be laid through the stock-rail locations.
- The drilling, bending and grinding operations can then be performed in track.

While insulated joints must still be provided at appropriate locations within turnouts and crossovers, the use of the glued type insulated joints greatly reduces the amount of maintenance required.

P. SWITCH TIES

With very few exceptions, switch ties are made of timber. MARTA uses not only standard oak ties or Azobe ties.

Although a good deal of interest is being shown in reinforced concrete as a substitute for cross ties, this interest does not yet extend to switch ties.

One important reason for this is, that reinforced concrete requires a pre-set arrangement for fastenings, as the tie is constructed.

In constructing turnouts, no two switch ties will have an identical arrangement of fasteners.

The ability of the timber switch tie to be lagged or spiked in whatever locations are required, is a very important factor in favor of this material for use in turnouts and crossovers.

Some railroads purchase switch ties in increments of 6 inches in length.

- Others use increments of 1-foot.

Usually the minimum length is 9-feet, with the increments increasing to about 16-feet.

Ties several feet longer than this are also provided for crossovers, the actual length being dependent upon prevailing track centers.

Turnout and crossover plans usually indicate the number of switch ties required of each length and their location for commonly used track layouts.

The usual practice is to maintain a uniform alignment of switch tie ends on the straight side at a fixed distance from the near rail.

The tie ends on the turnout side will then follow a stepped pattern for each increment in length.

Usually, the greatest care in maintaining spacing between switch ties, as shown on the plan, has to be in the vicinity of the switch and the frog.

- This is due to the need for clearance for the switch rods and clips, and for proper placement of frog guardrails.

A good understanding of the principles of the design of turnouts and crossovers, which this lesson has covered, will benefit you when you undertake the study of these other subjects.

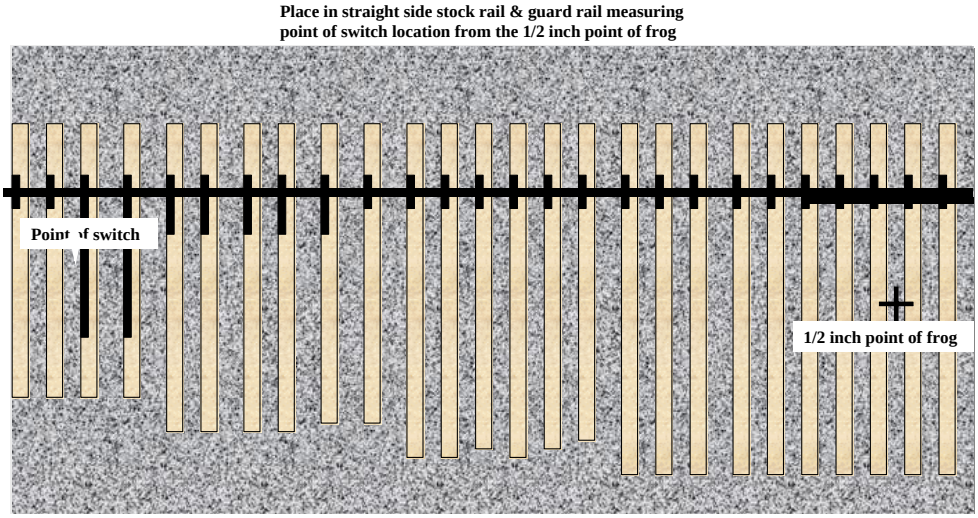
In the meantime, when opportunities are available, look closely at turnouts and crossovers in track.

- Acquire knowledge of the types of each part with which you are likely to come in contact.

Q. SWITCH COMPONENTS

The best line rail to install first is the one on the straight side of the turnout that does not contain the **frog**. **(Line Rail)**

- This is referred to as the **straight stock rail**.

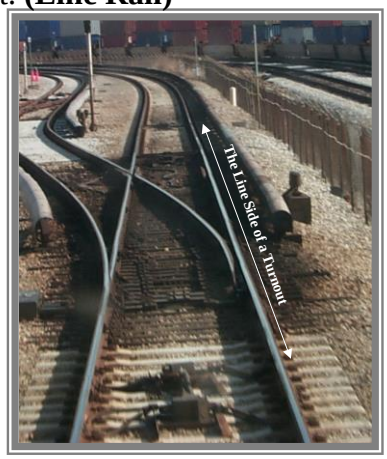


Straight Stock Rail

There are certain advantages to this. The straight stock rail can be installed on the switch plates or pads without having to place its **switch point** at this time.

It may be desirable to place the **frog's guardrail** during this operation if plates or pads are common to the guardrail and running rail.

- In most installations, this will be on a straight alignment. **(Line Rail)**
- It will be the easiest part to place with a minimum of line irregularities.
- Also, the switch tie ends adjacent to this line rail are the ones to be located at a uniform distance from the rail.



Installation of this line rail first will simplify the proper alignment of the switch ties.

The other straight line rail and fittings which contains the straight route switch point and the frog can be installed, using, a standard track gauge to properly locate it in reference to the first line rail.

Bent Stock Rail

A portion of the **bent stock** is on this route and it should be installed at this time. Again, care must be taken in locating the stock rail so that the point of the switch is accurately established.

Great care must to be taken in locating the rail joints relative to the reference points.

The critical need is to have the **lead** or **closure rails** located so that when the switch point is connected to it, the point will be exactly in the right position.

Actual Lead

Accurately maintaining the **actual lead** distance between the 1/2 inch point of frog and the point of' switch is essential if the rest of the turnout is to be constructed properly.

Once this line rail is installed and spiked, lagged and clipped to its proper place on the switch ties and lined to the reference stakes, the remainder of the turnout can be built in relation to its location.

The other straight line rail and fittings which contains the straight route switch point and the frog can be installed, using a standard track gauge to properly locate it in reference to the first line rail.

A position of the bent stock is on this route and it should be installed at this time.

- Again, care must be taken in locating the stock rail so that the point of the switch is accurately established.

It will be necessary to assemble the **heel block** for this side of the switch during this phase of work. In order to more adequately fasten the switch point, it may be decided to install the switch rods at this time.

- In turn, this will necessitate installing the other switch point (the one on the curved route).

Once this is done, adjustment of the switch can progress. This involves;

- Getting all **switch plates**, **pads** and **braces** placed so they provide the support intended by their design.
- The adjustment must also provide the proper fit for the switch points against their stock rails, which maintain gauge, surface and alignment.

No gap between point & stock rail

At this point, the turnout will not be on final grade. Nevertheless, adequate support must be provided for the switch ties at the points to get the switch adjusted.

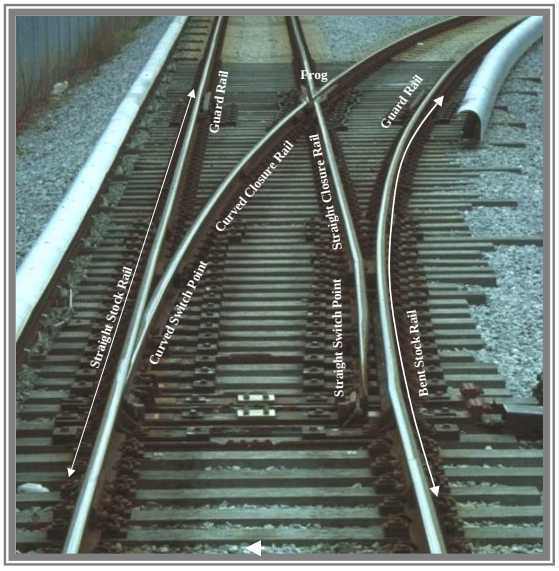
In new construction, the assembled switch does not have to be connected to the **operating rod, switch machine** or **switch stand** at this time.

Proper adjustment of this portion and securing smooth operation can frequently be best done after the final surface is attained.

Installing the Curved Lead

If the frog point and switch points have been properly located, and if the lead rails, also referred to as closure rails, are of the specified length, there should be no problem in fitting the lead rails and other components together.

Should it be necessary to force the lead rails into place because there is excessive gap between rails or a recheck shows an error in the actual lead distance, the reason for the problem should be determined and corrected.



- Measured distance from ½" point of frog to switch point may be to long.
- Measured distance from ½" point of frog to switch point may be to short.

The next phase of work will be to install the rails on the **curved lead**. Once these are set on the plates or pads and the joint bars are applied, it will be necessary to spike-line or use turnbuckles to line these rails to the proper curve.

- The proper alignment is established at the heel of the switch at the heel block.

Likewise, the proper alignment is established at the toe of the frog by the rigidity of the properly placed frog.

- Between these points it will be necessary to have some intermediate reference points.
- Near the top of that plan and several ties behind the heel blocks there is a dimension indicating 29 feet 11 3/4 inches from point of switch (PT). (These charts are located in a separate book of switch and component diagrams)

Below and slightly to the right of that dimension is shown 12-11/32 inches.

Note: That is the distance between the gauge side of the straight rail and the gauge side of the curved lead, at a point on the straight rail 29 feet 11 3/4, inches from the point of switch.

- At this point, the curved lead should be spiked or clipped so as to have the proper offset.

Moving further away from the switch, you will find a distance of 43 feet 5 -1/2 inches from switch point.

Below this you will see that there is to be 21-7/16 inches between gauge lines.

Further back, at a distance of 56 feet 11 ¼ inches from the point of switch, the offset between gauge line is to be2 feet 9 17/32 - inches.

Note: By spiking or lagging to these dimensions, adequate reference points will be established to permit lining by eye between each of these points before spiking or lagging.

After the curved lead is spiked or lagged in place, the other line rail can be installed.

- This will start at the stock rail and be carried past the frog.

Alignment should be determined by referencing to the Curved lead and frog with a standard track gauge.

Standard gauge of 4 feet 8'-½ inches (56 ½") is used throughout turnouts and other special track work.

R. RENEWAL of STEEL COMPONENTS

The steel components of a turnout include the rail, switch point, frog, guardrails and fittings, normally have a relatively long life.

Limits on their life are governed by speed, frequency of rail traffic and tonnage of the traffic which operates over the turnout as well as the quality of maintenance the turnout receives.

- Eventually, the condition of the material will require that it be replaced.
- This may be done along with a general rail renewal through the territory, or the turnout components may be renewed as a separate job or done piece by piece as needed.

There are some things to consider that differ from new installations prior to doing such a job,

1) With the switch ties already in place, make certain that their overall condition is good enough to adequately spike or lag the new material.
2) It could be necessary to replace some switch ties before renewing the steel, but when practical, it is better to replace defective switch ties after the steel has been replaced.
3) Check the alignment particularly on the straight trackside that is opposite to the side replaced first. *This is the alignment that will be reproduced, through the gauging process.*
4) If attempts to correct line irregularities are unsuccessful, it may be necessary to spike or lag the first line rail laid to good alignment. This will produce some temporary variations in gauge.
5) If trains operate before the second side is replaced, make sure the gauge is within the acceptable limits.
6) The job will have to organized to provide for removal of the old material and preparation for the installation of the new material.

The latter includes such operations as:

- Plugging of spike or lag holes
- Adzing of tie plate or pad seats as necessary
- Removal of any excess ballast.

7) If there is a difference in the height of the rails, vertical runoffs on switch ties must be made by shims under the tie plates.

Aside from these considerations, the renewal of steel in a turnout can be carried out in a manner similar to constructing a new turnout.

At times, the surface condition within the turnout may be relatively poor, prior to replacement of the steel.

A general raise may be planned following the steel renewal, possibly with replacement of switch ties.

- Make certain the conditions that exist after the steel is replaced and before the other work is undertaken does not permit damage to occur to the new steel from excessive wheel impact.

S. Replacing Defective Switch Ties

When switch ties need to be replaced, the most common situation is that only a portion of the switch ties within a turnout are defective.

This situation is similar to the usual one that exists in track supported by cross ties.

- Unfortunately, mechanization of the renewal of switch ties has proved to be considerably more difficult than with crossties.

The ballast removed from adjacent crib using picks and ballast forks or track shovels.

- Spikes and lags are pulled with claw bars, a bolt machine or the spike pulling machine.
- Old switch ties are removed from track using tie tones, tie extractors or tie loader.
- Tie beds are scarified manually (ballast removed and tie bed dug down)
- New switch ties are installed the same way the old ones were removed.
- Spiking or lagging, tamping and restoration of the ballast are all manual operations.

Present day practice does offer the opportunity for at least partially mechanizing the renewal of switch ties.

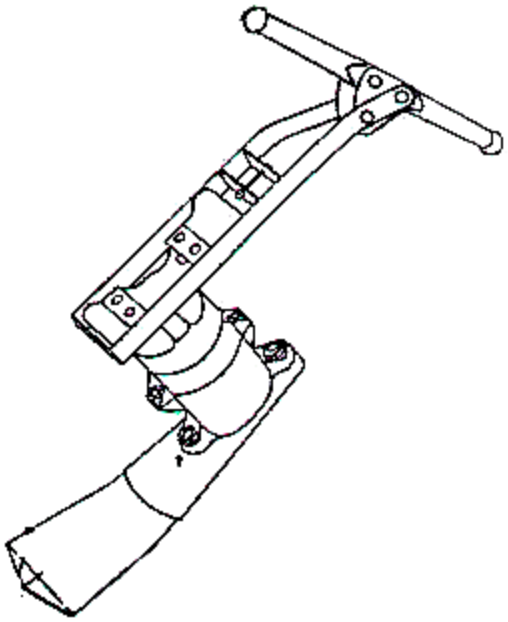
Spike pullers of the type commonly used in tie crews can be used to mechanize that operation

- In order to reach all of the spikes or lags to be pulled, it is necessary to either use two machines or to make two passes, one on the straight side and one on the turnout side.

Some of the machines currently in use for the removal and installation of crossties can be used effectively to perform this function with switch ties.

- Currently, equipment does not exist that will effectively scarify the tie beds within a turnout other than undercutter equipment.
- The need for tie bed scarifying may be reduced or eliminated if a general track raise is to be preformed concurrently with the switch tie renewals.

Spiking or lagging of new switch ties is probably best performed with manual setting for a hydraulic or air drivers because of the diversity of spike and lag configurations within a turnout.



Switch tampers are highly effective at performing that function within a turnout, having been designed primarily for such work. But hand surfacing with the Jitterbugs will also work well. See **Surfacing Track module** for details on the proper way to use the Jitterbugs.

T. MAINTAINING SWITCH POINTS

The proper maintenance of switch points is one of the most critical jobs associated with the care of turnouts and crossovers.

If a switch point fails to guide every wheel of every train to the proper route, a derailment is practically inevitable.

There are numerous conditions that can develop which may result in a wheel not being directed to the proper route.

There are more potential hazards connected with equipment movements made in the facing direction than in the trailing direction.

Whenever any equipment makes a facing, movement through a turnout, both wheels of each axle are first moving on the stock rails.

- One switch point is in the closed position, and the other switch point is in the open position.
- The flange of each wheel on the side with the closed point must be guided to the proper route by that point.
- It is essential that each wheel flange must contact with the gauge side of the switch point. For this guiding action to take place.

Should a wheel flange make contact with the end of the switch point, rather than the gauge side, trouble will result.

1. One thing that can happen when a wheel flange strikes the tip of a switch point is that it can be deflected so that it goes behind the switch point.
    - It this occurs. The tread of the wheel will continue to ride on the stock rail.

2. When the distance between this stock rail and the other stock rail on which the opposite wheel is riding becomes too great, one or both of the wheels will fall inside a stock rail.
    - Another possibility when a wheel flange strikes the tip of a switch point is that of the flange climbing onto the top of the switch point.
    - There is a strong chance of derailment occurring, in this situation.

3. A wheel flange that strikes the end of the switch point may still be deflected to the proper route, along the gauge side of the switch point.
    - When this happens, the movement will continue without derailment.
    - However, the impact of the wheel flanges striking the tip of the switch point can cause rapid deterioration of the point.
    - The end of the point can be battered down. Becoming successively more blunt with each impact until the wheel flange does become deflected to the wrong route.
    - A piece of the switch point could break out suddenly; leaving a blunt exposed surface, which a following wheel flange can climb.
4. A wheel flange might strike a switch point because it does not fit tightly against its stock rail.
    - In other words, the switch point is said to be, **gapped**. There are several conditions that can cause this to occur.

        a) Improper adjustment of the operating rod
        b) Switch stand or switch machine not securely spiked or lagged to the head block ties
        c) Stock rail braces loose or worn
        d) There may be ballast or debris between the switch point and stock rail.
        e) Loose, worn or undersized connecting rod and switch rod holts
        f) Worn bolt holes in switch rod fittings

The portion of the plate or pad, are designed for the switch point to provide for raising the head of the switch point above the head of the stock rail.

A lip of metal flow may have developed on the gauge side of the stock rail or back of the switch point that should to be removed by grinding.

Switch points can become worn thin because of being located in a curve or because of heavy diverging traffic.

- The top surface of the point can be worn down to a point where the wheel flanges can pass over it.
- Cracks can develop near the tip of the point.
- Chips can break off, either at the end of the point or a short distance behind the point of the switch.

These conditions can result in a wheel flange climbing onto the top of the switch point, just as with a gapping condition.

Switch points must be inspected regularly to see if any of these defects are developing.

- These inspections should include operating the switch so that the fit of each switch point against the stock rail can be observed.

If any of these defects are approaching a dangerous condition, and if the condition cannot be corrected by methods which have been described, it will probably be necessary to replace the switch point.

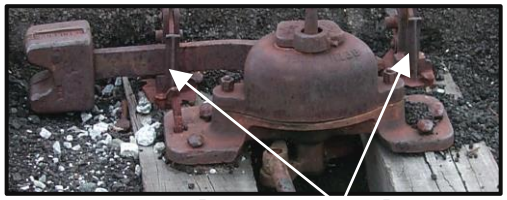
- With sufficient damage to the switch point, it may become necessary you slow order the switch.(Check with the Track Foreman before any slow order is implemented.)

Switch Latches and Locks

Power operated switches have a built-in mechanism that locks the operating rod so the closed switch point will not beadle to open under moving wheels.

For manually operated switches a means is provided to restrain the lever of the switch stand in its extreme position, there've enabling the operating rod to hold the closed point tightly against the stock rail. `

- This is done for both positions of the switch.

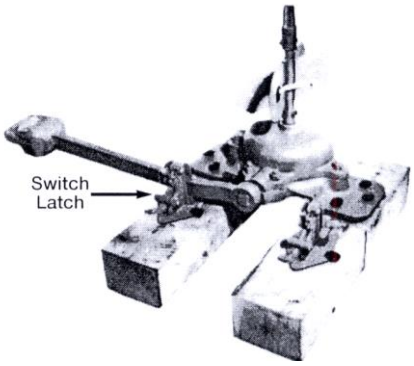


Switch Lever Latches

The devices that restrain the lever so the switch point will remains closed are called **switch latches**. One thing that a switch latch must do is to prevent the lever from becoming free unless the latch is opened. Also, latches must work freely and not jam and should be inspected periodically.

Whenever a switch is located where train movements can be anticipated at a speed where the train may not be able to stop short of the switch if not properly lined, provision must be made for keeping the switch locked.

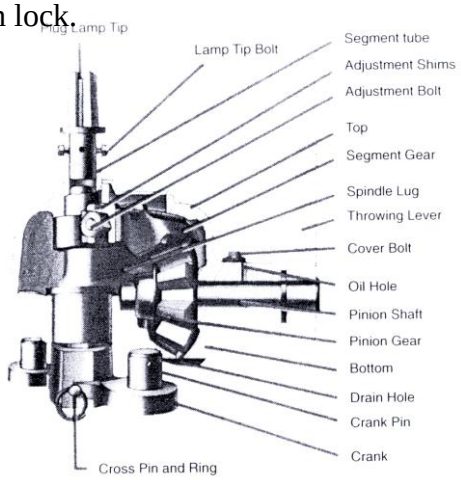
Here is a picture of a switch stand with latches. Each latch provides for attaching a switch lock, which will prevent tripping of the latch.



Switch can be left in the improper position either erroneously by an employee who used it previously or deliberately by someone intent on malicious mischief.

Latches used in this situation provide for attaching a switch lock. So the switch cannot be operated by anyone without the proper switch key.

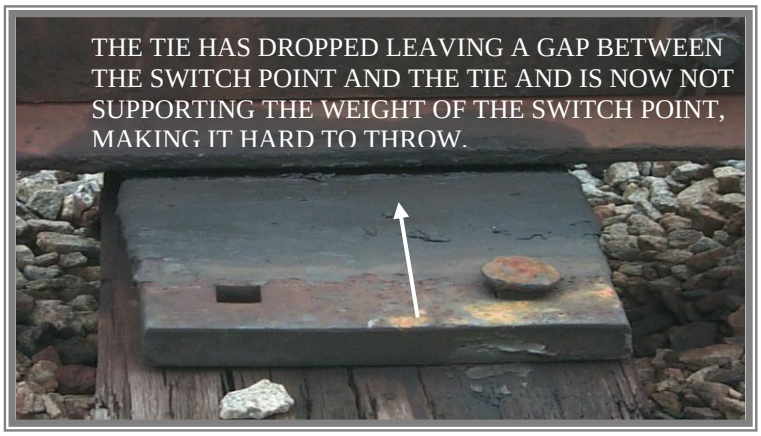
Here shows the internal components included in the switch stand. There are many different designs of switch stands in use. You will probably only have to work with a few. Become familiar with their parts, so you will be able to make adjustments or repairs when necessary



U. SWITCH SURFACE

Much difficulty in throwing a switch can develop because of poor surface of the turnout.

- Under some conditions, most of the load may be carried on a few switch plates
- This can result in one or both of the switch points binding, and being difficult to throw.



Particular attention needs to be given to the switch heel block joints.

- These are hinged joints, and the support they provide is somewhat less effective than with conventional joints

Heel joints need to be watched for a tendency to become low spots in the surface of the track. Loose ties in this area can cause excessive friction on switch plates closer to the point of switch.

There is another hazard caused by loose ties at the heel block joints.

- When a wheel passes over the heel joint and causes further depression, the tip of the switch point can rise up in relation to the stock rail
- Depending on wheel spacing in relation to the length of the switch point, a following wheel can come into contact with an improperly exposed switch point.

V. ADJUSTING A SWITCH EQUIPPED WITH A RIGID STAND

Preparation

a) Spike the switch points aginst the bent stock rail in the normal position.
b) Remove cotter pins from adjusting bolts on the switch rods and from rod bolts on the connecting rod.
c) Loosen the jam nut on the connecting rod.
    - If difficult to do at this point, do after step 5.
d) Remove the connecting rod bolt (on the rigid end of the connecting rod) and disconnect the connecting rod.
    - Lift the switch handle to release pressure on the rod bolt.
e) Remove the switch stand.
f) Disconnect the clevis end of the connecting rod from the crank eye bolt on the switch stand.
g) Plug the spike holes if the headblock ties are to be reu-used and adze as required.

Adjust Switch Rods

a) Loosen bolts used to adjust switch rods so that the point won't bind while adjusting.
b) Adjust front rod to provide a standard throw as indicated on the standard plan.
c) Adjust the back rod, using 2 track jacks placed back-to-back.
    - The planed portion of the points must fit evenly along the stock rails in both the normal and reverse positions.
d) Adjust any intermediate rods, if so equipped.
    - Take clearance, or throw, between the point and the stock rail is normally 5 in, measured at the first rod of a turnout.
    - 4 ¾" throw for spring and power operated turnouts.

Initial Settings

a) Turn the clevis on the adjustable rod until the threaded end of the rod protrudes through the clevis 1 ½".
   - This permits adjustment of up to 1 ¼ in. in either direction.

b) Screw the crank eye bolt into the spindle so that the eyebolt is under the operating lever.

c) Adjust the crank eyebolt until the distance between the center of the hole to the near face of the spindle is 2 ½ in.

d) Connect the clevis end of the connecting rod to the crank eyebolt.
   - **Do not** reverse the orientation of the connecting rod!

e) Place the stand in an upright position on the head block ties.

f) Attach the rigid end of the connecting rod to the front switch rod.
   - While adjusting, drop the bolt in from the top.

g) Open the points and install wedges to hold them open one half the standard throw distance.

h) Square the switch stand on the head block ties with the throw lever in the center of its stroke.

i) Spike or bolt the stand to the head block ties.

Final Settings

a) Remove wedges and throw the switch to the reverse and normal positions.

b) Hand tightens the jam out.

c) Shorten or lengthen the connecting rod by turning the rod in the clevis until and equal throw is obtained on both sides.
   - I.e., points are equally too loose or too tight.

d) **To set the correct tension** turn the crank eyebolt clockwise or counter clockwise:
   - If points are too tight, tighten or screw in the eyebolt.
   - If points are too loose, loosen or unscrew the eyebolt.

e) **To check the tension adjustment** on a rigid switch stand:
   - Place a 1/8" shim between the point and stock rail at the first switch rod.
   - If the throw lever cannot be placed in the lock position with **normal pressure**, then the switch is in proper adjustment.

f) If necessary, make fine adjustments on the connecting rod or eyebolt to provide equal throw and required tension.

Final Connections:

a) Ensure that the bolt on the clevis end of the connecting rod is installed from the top.
b) Install a spring washer and nut on bottom and secure with a cotter pin.
c) Set the rod bolt on the rigid end in from the bottom.
d) Install spring washer and nut on top and secure with a cotter pin
e) Tighten the jam nut on the connecting rod against the clevis face
f) Install all other cotter pins as required.

Final check

a) Turn the switch from the normal to reverse position
   - Switch should move freely, if not, lubricate switch plates.
b) Secure the switch in the normal position
   - Lock or hook must be in good condition
c) Verify that the switch target, if so equipped, and tip assembly are properly oriented.
d) Clean up work site.

X. DERAILS

Their purpose is to prevent the uncontrolled movement of equipment from a sidetrack onto a mainline track. The hazards of a possible collision of such equipment with a train on a mainline track is so great, that it is preferred to deliberately derail uncontrolled equipment before it blocks the mainline track.

Rail Head, Derail

There are two basic types of derail in general use.

The most common type is placed on the head of one of the rails of the sidetrack.

- This device raises the wheels above the rail so the wheel flanges can be directed diagonally across the railhead.
- As each wheel flange passes beyond the field side of the railhead, it derails.
- This in turn causes the other wheel on the same axle to full off the other rail to the gauge side.

This type of derail is normally attached to the rail of the sidetrack, furthermost from the mainline track.

- It must be located so the equipment will not interfere with mainline track clearance, either before or after derailing.

  a) The purpose of a derail is to safely derail rolling equipment to stay clear of and away from the track it is intended to protect.
  b) Derails must be installed:
    - Where there is any possibility of equipment that has been left standing on tracks other than main tracks or sidings being moved by gravity so as to obstruct a main track or siding.

- On tracks on which an industry will move cars or equipment.
- On mine and other bulk loading facility tracks where cars are dropped by gravity toward the main or other track that is to be protected.
- At tracks used to tie up locomotives on a regular basis. Through tracks so used must be equipped with derails at both ends. Locations used to tie up power will be specified by the Transportation Department.
- At entrances and exits of Main and Running Repair Shops. Derail must be applied to each track not less than 40 feet from doors.

Here at MARTA we use derails behind the MOW shop to keep track equipment from infringing on Yard tracks and where the CSX track connects to the Yard track to keep their trains from entering the Yard.

c) Only approved types of derails are to be installed (examples include):
   - Hinge and sliding type derails may be used where the speed of the equipment to be derailed will not exceed 15 mph. A derail wheel crowder must also be installed where any of the following conditions apply:
   - Derailing speed could exceed 9 mph;
   - The derail is installed on the inside of a curve.

Switch Point Derail

a) Switch point derails are to be used when speed of the equipment to be derailed could exceed 15 mph. Where switch point derails are used, adequate rail anchorage must be provided to prevent rail creep.
   - To eliminate the possibility of cars running over hinge and sliding derails without derailing, they must be the proper model, size and hand to fit the running rail.

- In the derailing position the derail block must cover the ball of the rail and lie flat on the top of the rail throughout the underside of the derailing block surface.
- The direction of movement of a car to be derailed determines whether a right or left-hand derail is required.
- A right-hand derail is installed on the right-hand rail and derails toward the right; a left-hand derail is installed on the left-hand and derail toward the left.
- The correct size of derail to be used on various rail sections is as follows:

  Size 5: up to 85 LB

  Size 6: 100 LB & *115 LB

  *Size 7: *115 LB and larger*

On worn 115 LB rail a Size 6 derail should be used.

- A plywood or steel shim of the correct thickness with holes punched or drilled for all fasteners may be necessary under the derail to ensure the block lies flat on the top of the rail.
- If the rail at the derail location is relayed, the derail should be replaced with one of the correct size for the rail.

b) Operating stands of a rigid type (31B, 36D or 112E) must be used with switch point derails. Rigid stands or Hayes operating stands must be used with sliding type derails.

- Throw of switch point type derails is 5”
- Throw of sliding type derails is 6 ¼”
- The switch stand for a switch derail will be painted black similar to any other switch stand.

c) ***Hinge and sliding*** derails must be painted yellow.

- All derails not equipped with high operating stands shall have a derail sign mounted on a separate post.
- All derails equipped with high operating stands shall have a derail sign mounted on the mast of the operating stand.

- When derail signs are mounted on the mast of high operating stands, they shall be attached to the mast so that they are parallel to the track when the derail is in the non-derailing position, and at right angles to the track when the derail is in the derailing position.
- Targets and target tips, whether reflective or not, shall not be used in connection with derails.
- Tracks equipped with a derail shall have the switch stand lever painted yellow.

d) Derails must be installed in such a way that equipment will derail away from the track being protected.

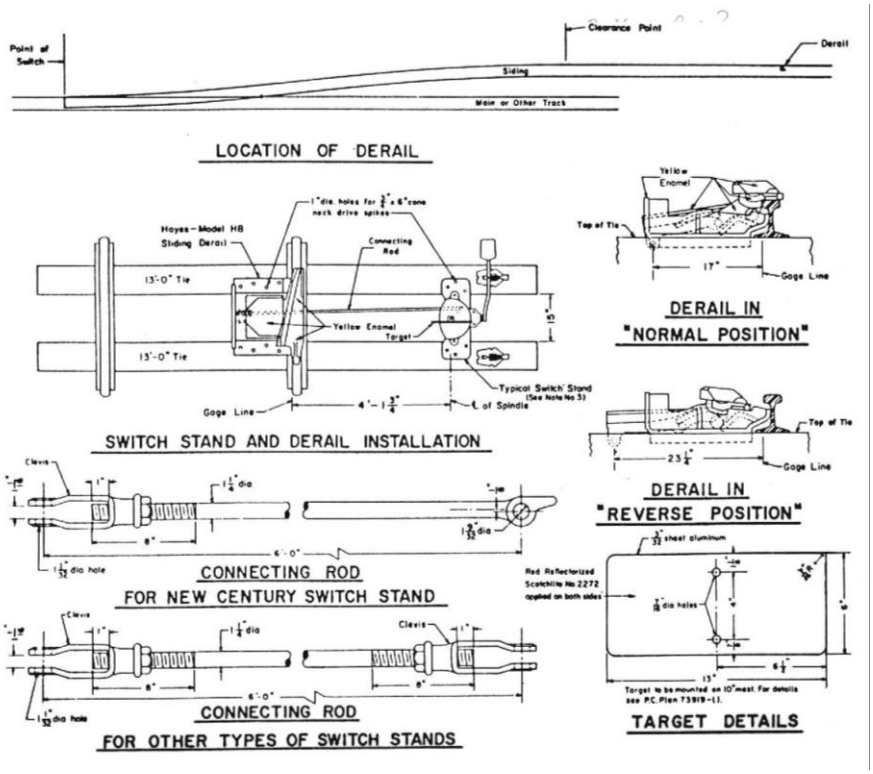
- Location for a derail is governed by local conditions such as grade and length of track, but shall never be located less than 20 feet behind the fouling point and installed so as to derail cars away from the track being protected. Sufficient distance should be allowed so that the derailed car cannot continue to move and foul the track being protected.
- When the derail must be located close to the clearance point, a **bent type guard rail** must be installed between the rails, to provide additional assurance that the derailed equipment will not foul the track being protected.
- Derails should not be installed on the inside of curves if it can be avoided. If necessary to install a hinge type or sliding type derail on the inside of a curve, a derail wheel crowder must be installed on the outside rail on the same ties.
- Where there are insulated joints, derails must be placed far enough behind the insulated joints so that equipment derails before fouling the track circuit.

e) Straight guard rails will be required where the derailing point is;

- On a high embankment
- Near structures that could be struck by derailed equipment
- On a sharp curve

- Derails and locks must be kept lubricated and adjusted to maintain ease of movement.

De-rail and Crowder



Occasionally there are instances where this type of derail, is not completely effective. Reasons for this include improper adjustment on the railhead and deteriorated ties which permit the derail to be torn loose. Even without these conditions, a heavy car that has picked up considerable speed prior to contacting the derail will occasionally tear a derail loose.

Typical layout of split switch point derail

Sometimes when thin possibility is anticipated such as with a substantial descending grade toward the mainline track connection, a switch point derail is installed. Usually this is a single switch point and snick rail, located in a similar position to the rail head type of derail. This is located behind the M.O.W. shop where CSX connects to MARTA.

It may be necessary to locate a derail near the clearance point.

- If there is a possibility of derailed equipment fouling the mainline track a deflecting rail may be used.

This is a length of scrap rail spiked to the ties in a diagonal position between the running rails.

- This is intended to guide the wheels that have derailed on the gauge side of the rail away from the main track.

Derails are normally kept set in the derailing position. It is necessary to operate a derail so it will be in a non-derailing position when movements are to be made into or out of the sidetrack.

There are various ways in which derails may be operated. The rail head type is sometimes grasped directly and moved to or from the railhead. This type may be guided by a hinge or sliding mechanism.

Either type of derail may be attached to a switch stand located adjacent to the de-rail. These de-rails are operated by throwing a switch lever, just as switches are operated. Sometimes, the derail is connected by a system of pipes, cranks and rollers so when the switch is operated, the derail is operated also.

- Where switches are power operated, the derails are also power operated.

Where derails are operated separately from the switch conditions at many locations require the derail be kept locked in the derailing position with a switch lock except when equipment is moving to or from the sidetrack.

- It is essential that such a lock will eliminate the possibility of moving the derail to a non-derailing position.

It is also essential that derails be readily visible to train crews or track personnel working in the vicinity. A lamp, target or a signal sometimes accomplishes this, similar to those used for switches, but displaying the colors prescribed for derails.

Sometimes, the procedure with the rail head type is to paint the derail itself, using a highly visible color prescribed by the individual railroad. It is also necessary to control vegetation and debris so as not obscure the derail.

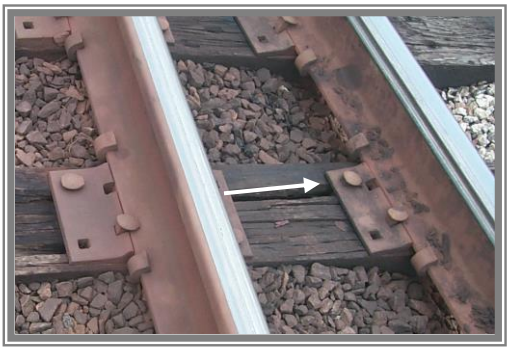
Y. MISCELLANEOUS MAINTENANCE

Most turnouts and crossovers have substantial curvature on the diverging route. The nature of these track layouts makes it impractical to provide superelevation on the curved route.

These conditions severely limit the speeds at which equipment can safely be operated over such a route.

- In most installations, only a relatively small amount of excess speed can place considerable stress on the track.

At locations where such tendencies exist, one part of the turnout that must be watched carefully, is the curved lead.



- Under severe usage, a curved lead can develop severe flange wear on the gauge side of the railhead.
- The outward thrust of the wheels can also tend to cause an outward movement of the rail, particularly if the switch ties are nearing the end of their useful life.

Where there are indications of these conditions, the lead area needs to be watched closely for the development of wide gauge.

Most leads have a rail joint somewhere between the heel of the switch and the toe of the frog. This is frequently the most critical location if wide gauge is a problem.

Turnouts and other special track work have a variety of sizes and types of bolts. In addition to regular track bolts, they usually are:

1. Connecting rod bolts
2. Stock rail Brace bolts
3. Frog bolts
4. Switch Clip bolts
5. Guard rail bolts
6. Switch Rod bolts
7. Heel block bolts

Each must be properly maintained to perform its function. Periodic tightening and lubrication should be performed.

- If any bolt breakage is taking place, replacements should be installed promptly and efforts made to determine and correct the cause of breakage.

The types of track work that has been investigated in this lesson usually cost several times as much to install or replace as an equivalent footage of conventional track.

Sound practice dictates that such facilities should receive preferential treatment, if necessary, to secure a proper return on such investment.

- Also, these installations can potentially present many more ways that train operations can be interrupted than conventional track.

This Lesson has dealt with a wide variety of maintenance and construction functions. You most certainly will not have to make use of all the information that this Lesson contains at once.

However, it is recommended that you do not set this Lesson aside and wait for the day you will have to perform a specific job. Study the types of' facilities in your- areas. Look for signs of defects that this Lesson has discussed. Check resources that are available. Consider how to carry out the various maintenance and construction operations when needed.

Z. DIAMOND CROSSOVERS

1. Crossings must be installed and maintained to the plans supplied for each crossing.

2. Sub-grade under crossings must be well drained. Clean crushed rock or slag ballast must be maintained.

3. (a) Track gauge and flangeways in the crossing must be maintained in accordance with the plan of the crossing.
   (b) Guard check gauge and guard face gauge shall be maintained as prescribed.
   (c) If the tread portion of a casting is worn down more than 3/8" below the original contour (below level corners where diamond crossing corner pads have been off), operating speed over that crossing may not be more than 10 mph.

4. Crossing must be fully bolted. All bolts must be provided with spring washers or hardened steel flat washers as indicated on the manufacturer's plan, and must be kept tightened to the torque prescribed.

5. Crossings must be spiked or otherwise fastened as prescribed by the railroad.

6. Metal flow on frogs shall be kept ground off to maintain proper gauge and to prevent chipping.
   (a) When necessary, repairs by welding shall be made in accordance with approved methods.
   (b) Reversible crossing inserts must be transferred between corners to equalize wear.

7. Movable point crossings must be adequately lubricated with an approved lubricant.

8. Crossings must be kept free of snow, ice and other obstructions.

9. All ties under crossings must be sound and firmly tamped for 16 inches on either side of both rails on both routes of the crossing.

10. Line, surface and gauge of track approaching crossings must be accurately maintained.

11. Sufficient rail anchors must be applied on all approach tracks to the crossing to prevent rail creep and skewing of the crossing.

12. Inspections of all crossings shall be conducted as follows:
    (a) Every time the crossing is passed it shall be visually inspected for defects.
    (b) Crossings shall be inspected at least monthly on foot measuring gauge and observing overall condition.
    (c) Crossings shall be inspected annually (unless otherwise directed by the Head of Engineering), looking closely at the condition of all components.
    (d) Items to check and minimum acceptable maintenance conditions are listed in the following Table.

13. (a) All unacceptable conditions must be either corrected or reported to the Track Supervisor.
    (b) All unsafe conditions which cannot be corrected immediately must also be reported to the Rail Traffic Controller and proper action taken to protect traffic on all routes.

14. Crossings must be adequately protected at all times with spare components to ensure continued operation.

ITEMS TO CHECK	MINIMUM ACCEPTABLE MAINTENANCE CONDITIONS
1. Ballast and Drainage	(a) Cribs not less than three-quarters full. (b) Ballast shoulder not less than 10 inches. (c) No standing water or indications of it.
2. Line, gauge, surface, and cross-level	See FRA 213.
3. Ties, fasteners.	(a) Sound and holding (b) Properly spaced and aligned.
4. Plates	(a) None broken (b) None missing (c) All stops and shoulder firmly welded on. (d) Not worn in excess of 1/8 inch
5. Rails (including wing rails, closure rails, guard rails and frog rails)	(a) No visible defects such as rust streaks, ordinary breaks, vertical or horizontal split heads, engine burns, broken. (b) End batter or mismatch not exceeding 0.040 in.
6. Castings	(a) Manganese Inserts not cracked or broken (b) Metal flow ground off (c) No broken castings (blocks and rail braces, etc.) (d) If the tread portion of a casting is worn down more than 3/8"below the original contour, operating speed over that crossing may not be more than 10 mph.
7. Rail Fasteners	(a) Fully spiked. (b) Spikes fully driven (c) Tie screws tight, double spring washers compressed. Pandrol clips in place, shoulders not broken
8. Rail Anchors	Sufficient anchors properly adjusted to prevent movement of crossing.
9. Bolts	(a) None missing (b) All tight. (c) Proper length and diameter.
10. Insulation	In place and not visibly damaged.
11. Flangeways	(a) Not more than 2” wide (b) Not less than 1 ¾” wide (c) Not less than 1 ½” deep (d) Clear of foreign objects

APPENDIX I

Glossary of Terms

Actual lead - The distance between tile actual switch point and half-inch frog point along the centerline of the tangent track in a lateral turnout. In a curved turnout, the lead is measured along` the centerline of the curve with the longer radius. Also known as Lead Straight.

Basket rod - A switch rod with sleeve-like appliance for connection to all operating rod.

Center frog - Two diamond frogs at opposite end, ref the short diagonal of a track crossing. See, End frog.

Connecting rod - A switch rod that connects a switch stand or auxiliary device such as target stand to a switch. The connecting rod usually attaches to the end of the head rod as compared to an operating rod, which usually connects to the basket rod.

Curve, lead - The curve comprising the turnout track between the switch heel and frog toe.

Derail - A safety apparatus strategically located that intentionally guides run-a-way rolling stock off a side track to protect against collisions on the mail) trick.

End frog - The two frogs in a track crossing opposite to the long diagonal.

Flangeway - The space between a running rail and a guardrail or between a running rail and a guard timber which provides a passageway for flanges.

Frog plate - A tie plate specifically designated to be placed under a frog of a turnout.

Frog point (point of frog) - Where the two rails converging into the frog intersect.

Guardrail - A track work component. frequently made from tee rail and placed next to a running rail. A working Guardrail guides rolling stock by maintaining contact with the backside of the wheels. A **passive** or **non-working** guardrail does not normally contact wheels.

Guard Rail, frog - A guardrail placed adjacent to the running rail across from a frog to wide wheels through the frog.

Half-inch frog point - The projected frog point where the Gauge lines are half-inch apart. The half-inch frog point is obtained by taking one-half the frog number in inches and measuring back toward the frog heel from the theoretical frog point. Frog points made of manganese steel have the half-inch frog point indicated by a mark on the casting.

Heel block - steel or iron filler placed between the stock rail and switch rail at the switch heel and held in position with through bolts. The heel block maintains the space between the stock rail and switch rail, holds track gauge, and provides a hinge-like apparatus, which allows the switch to change position.

Lead (or closure) rail - file rail that connects the frog rind heel block. The lead rail on the straight side is referred to as the straight lead or straight closure rail. The lead rail on the turnout side is referred to as the curved lead or curved closure rail.

Operating rod - A switch rod connecting the switch to the switch stand or switch machine. Usually the operating rod is connected to a basket rod as opposed to a connecting rod, which is connected to the end of the head rod. The switch stand or switch machine throw action is transmitted to the switch rails through the operating rod.

Parent track - A track which a turnout is constructed.

Running rail -The rails which rolling stock and on-track equipment runs directly on as opposed to guardrail or third rail.

Running surface (of' rail) - The top portion of the rail head where rail/wheel tread contact occurs. Also called rail tread.

Stock rail - The rail against which a closed switch point contacts in a switch. The stock rail on the straight side of the turnout is often referred to as the straight stock rail. The stock rail on the turnout side is often referred to as the turnout stock rail.

Superelevation - The banking of track by raising or superimposing
the high rail above the low rail at a curve. File desired speeds and curve degree or curve radius determine the amount of superelevation.

Switch heel - The end of a switch rail closest to the frog.

Switch heel joint - The end of a switch rail closest to the frog. Usually the joint between the switch rail and the closure rail.

Switch latch - A device, which secures the switch lever in place. Often provides a means for applying a switch lock.

Switch point - The end of a switch rail formed into a sharp point for diverting rolling stock and on-track equipment wheels from one track to another. The entire switch rail is commonly called the switch point.

Switch rod - General term describing the various steel rods that connect the components of a switch.

Tee rail - The typical rail shape used in track construction. The tee rail consists of a railhead; rail web and rail base, and is so called because of the inverted **T** shape it assumes.

Tie plate - A metal plate placed between the rail base and tie to distribute the weight of trains over a larger surface, thereby reducing tie damage. Tie plates also give lateral stability to the rail by restraining movement.

Tie plates, standard - The tie plate normally found in track not involving a turnout, track crossing, or other special track layout.

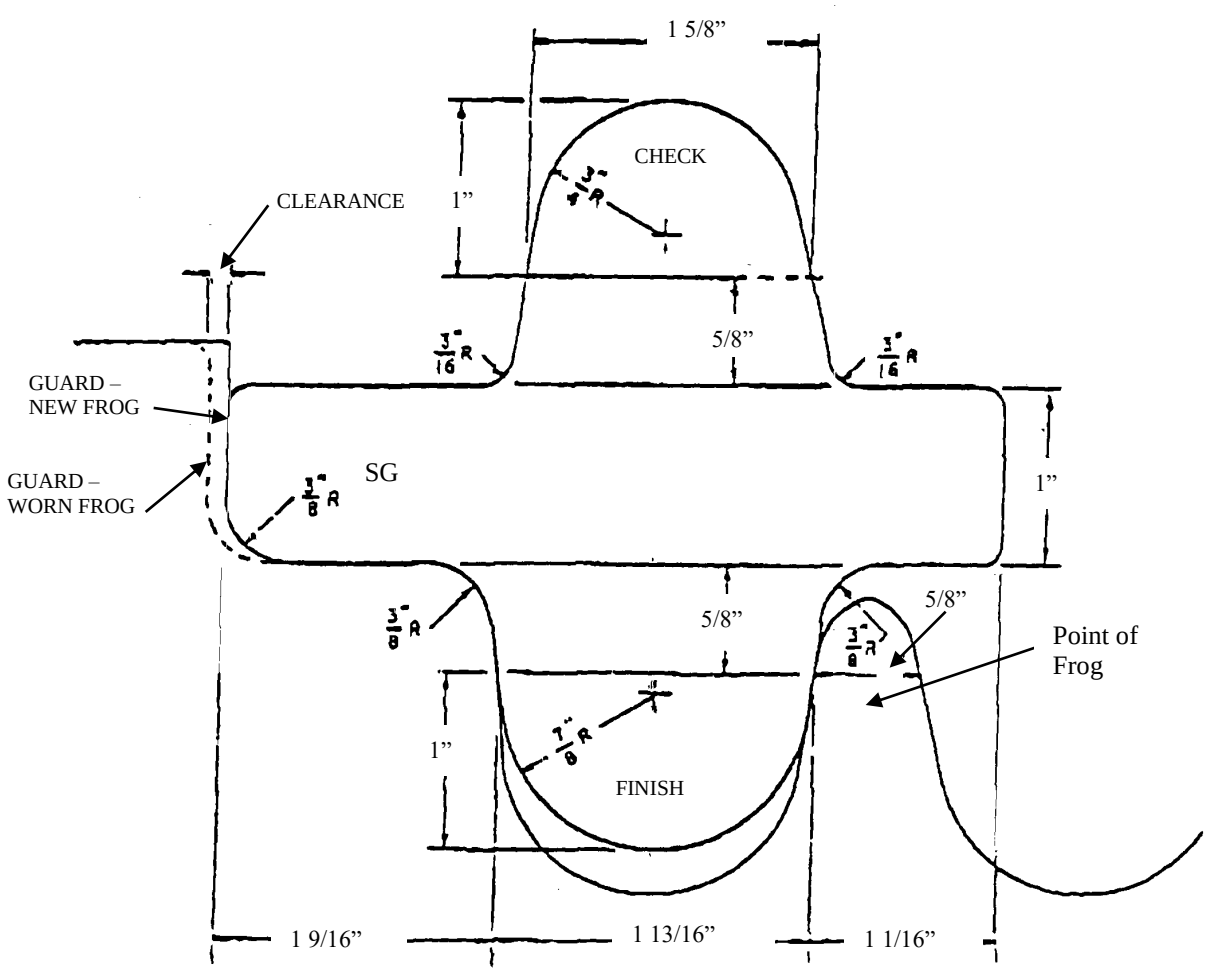
Turnout - A particular grouping of two tracks joined together with a frog and switch, so arranged as to allow for the transfer of rolling stock and on-track equipment froth one track to another.

Turnout steel - A general referral to the components within a switch or turnout excluding the switch cross ties. This would include stock rails, lead rails, switch rails, frogs, guardrails, and sometimes rods and fastenln`0S.

Turnout, straight side - The side of the turnout which is not the diverging- or the turned outward side.

Wing rail - The toe rails of a frog so called because of the wing shape it assumes as it passes around the center portion of a frog. It opens up to a flare to accept wheel flanges as they pass through the frog.

FROG AND CROSSING FLANGE WAY CHECK GAGE



CHECK GAGE: To inspect, apply in flangeway of frog or crossing and

1. Grind top corners and flangeway walls if necessary to permit entry and
2. Restore top surface if bottom of gage contacts flangeway floor.

FINISH GAGE: Apply after grinding flangeway of frog or crossing

For checking maximum wear of guard on self guarded frogs, apply at actual 5/8" point, SG as illustrated above and restore surface of guard when clearance is greater than ¼".

Review Questions

1. When building a turnout, which rail do you start with?

2. In building a turnout, what is the first component placed in the track?

3. How many stock rails are there to a single turnout?

4. Name the stock rails.

5. The area between the ½" point of frog and the point of switch is called the _____ _____.

6. What is the rail joint that connects the switch point to the other rails?

7. Name the two closure rails.

8. How many guardrails are there to a frog?

9. What is standard track gauge in a turnout?

10. What is the name of the ties that support the switch machine?

11. Where within a turnout is it necessary to have the ballast in the cribs low?

12. What is the average gap for an open switch point measured at the #1 switch rod?

13. When surfacing a turnout, it is necessary to hand tamp what area of the turnout?

14. If a switch point fails to guide every wheel of every train to the proper route, what will happen?

15. Do each of the switch points move together or do they move independently?

16. When it becomes necessary to replace a switch point, is it also advisable to replace the stock rail? And why

17. Can poor track surface make it difficult for a switch point to throw?

18. What should be the crosslevel readings be within a turnout?

19. Name the three rails connected by the heelblock.

20. Can a switch point from a # 8 turnout be used on a # 10 turnout?

21. Can a # 10 frog be used to replace a # 20 frog and why?

22. Do the length of guardrails very according to the size of the frogs?

23. What is the purpose of a derail?

24. True or False. Derails are always kept in the derailing position.

25. What is the best lubricant for the switch point riser plates?