Notes on construction of Great Western old style curved (loose-heeled) leads (turnouts)

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Introduction

It is not widely appreciated that semi-curved switches came into use on the Great Western only in the early 1930’s and were used **only** for new construction. The older curved loose-heeled switches remained in use into BR times. In fact a very large part of the GWR was only using loose-heeled switches throughout the life of the company. Indeed the whole of Brent on the South Devon line were loose-heeled except the turnout from the up refuge siding which was altered in 1937 when a B8 was installed. Mike Longridge’s photographs taken of Brent in May 1947 prove that point admirably.

Two further matters. The Great Western and BR(W) only used loose-heeled switches on compounds, that is single and double slips. Semi-curved B & C switches were never used.

The Great Western regularly ran the turnout curve through the crossing and out on the turnout road, thus not all crossings were straight on straight.

Sadly Great Western layouts in general are not correctly modelled and one can only hope that David J. Smith’s book GWR Switch and Crossing Practice published by the Great Western Study Group, together with these instructions will help put that right.

Loose-heeled switches are a little more difficult to assemble than the typical semi-curved B or C switches provided by the two kit manufacturers and built by most modellers. Unfortunately for the Great Western modellers these semi-curved B & C switches are also wrong as **all** Great Western switches (including the B & C switches) had a ⅜” joggle, usually 6” long, at the toe with a set at the end of the planing to restore the run of the rail. It is this joggle and set that complicates matters somewhat. The joggle offsets the length of stock rail between the joggle and the set by between ⅜” and zero so that this section cannot be used to gauge the opposite rail, which also has a joggle and set, unless both switches are made and properly fettled to fit and in place.

Alternatively the joggle to set section, without switchblades, will have to be fitted by measuring from the running face (RF) of the stock rails at each timber centre line between the joggle and the set. The instruction sheet has drawings of the 10’, 12’, 14’ and 16’ loose-heeled switches (drawings 031, 033, 035 and 037) with the RF to RF dimensions between the stock rails, at the

centres of the timbers. The dimensions are a minimum and must be maintained otherwise the track will be under gauge when the switches are added.

Another important point is the RF to RF clearance at the nominal switch length measured from the toe. This must be 1.5mm (4½"). This means the railhead to railhead dimension at this point must be 0.583 (1¾"), the crossing flangeway clearance. However in P4 this is 0.65mm and so that whilst the edge of the P4 crossing flangeway gauge could be used to check it, I prefer a 0.6mm nickel silver wire. If this dimension is not maintained then there will not be the required clearance between the switch and the stock rail when the switch is opened 4½" (1.5mm). When the switch is opened then this clearance must also be maintained from the toe of the switchblade down to the end of the planing. This dimension effectively sets the clearance at the heel so that the dimension given in the drawings as the heel clearance is effectively the minimum.

In EM the clearance needs to be larger and that makes laying out loose-heeled switches more difficult. My feeling is that many Great Western EM modellers may wish to leave things as they are and accept that the present semi-curved B & C switches without the joggle that are provided by the two manufacturers are the best that they can achieve. Others may have other ideas.

A ⅜" joggle (0.125mm) leaves a very narrow head of the switchblade and is impracticable.

These instructions are based on the use of a 0.2mm joggle and any larger joggle changes the setting out substantially. The principles are the same but the RF to RF dimensions at the switch must be increased by twice the difference. The width of the switchblade at the toe will be 0.2mm, a better proposition. A joggle jig is provided on the etches to make producing this joggle easy.

The term **RF** means running face throughout.

Loose-heeled and semi-curved B & C switch differences

Loose-heeled switches used circular tie bars and stretchers. The tie bars were taken through the web of the rail and the switchblade and this stopped the loose-heeled switchblade from lifting.

When making stock rails and switchblades for loose-heeled switches the railhead and the switchblade are drilled out 0.45mm initially, later broached out to 0.5mm.

Semi-curved B & C switchblades used flat flexible tie bars and stretchers. The flat tie bar ran under the railhead and that prevented the switchblade from lifting. The railhead and the switchblade are **NOT** drilled for B and C switches. The TOU's for semi-curved B & C switches differ, with a different timber spacing than loose-heeled TOU's.

Making the stock rails

Note the comments above that B & C switchblades had flat flexible tie bars that ran under the rail.

*There were **NO** holes in the switchblades or railhead with B & C switches.*

*In the notes in this section **ignore** the drilling of the railhead and the switchblade if you are using B & C switches.*

Cut two stock rails well over length to cover the two groups of extra chairs/timbers outside the turnout proper plus 50mm more. The longer of the two should be chosen for the curved stock rail. You cannot put a smooth curve in a rail if it is short because the ends will remain flat.

Suffice to say at this stage that the two groups of extra chairs and timbers 15mm apart for each rail should be set 50mm outside the turnout proper, at each end. The purpose of these is to carry the rails well outside the turnout proper to give strength and protection to the turnout when it has been removed from the building template and handled prior to laying. In particular these extensions make sure that the curved road carries the radii through the turnout proper and does not end up with a flat to the curve at the ends. These extensions are cut away just before laying.

Mark the head of each rail several times along the length to identify the head and prevent it being fixed upside down, using two different colours, say red and blue.

DN.1900 Joggle jig and making joggles

The joggle can be either 6" or 4" long (early 1900's) starting from the toe and going back towards the fishplates of the joint of the previous track panel. The toe is 4" back from the centre line of the toe timber (no.3) towards the joint with the previous panel. See drawings 031 to 038.

Make sure that the joggle about to be put in the straight stock rail is away from the running face (RF) and that to be put in the curved stock rail, when you come to it, is the opposite hand and still away from the RF with the marking you made to identify the rail head is still in front of you. It is very easy to put one of the joggles in the foot instead of the top railhead.

With the marked head of the straight stock rail in front of you, form a 0.2mm joggle in that stock rail. The joggle jig should allow you to make two joggles before it is destroyed.

Measure the distance on the template from the far left extra chairs/timbers to the centre line of the toe timber (no.3), add say 10mm and mark the upper rail face (RF) at this distance. This mark will be where the joggle is to be put.

Place the rail inside the rectangular notch and place in a vice across the corner of the jaws with **aluminium jaw protectors**. Closing up the jaws will put a joggle of something over 0.2mm with steel rail and 0.21mm with nickel silver. Do not do this with the rail parallel to the jaws, as the jaws will put a kink in it at the jaw's extremities. By holding rail and jig across the corner of the jaws the plain rail is in free air and will not be kinked.

When the first joggle has been formed in the straight stock rail put a set in the rail at the end of the planing, restoring the straightness of the rail and put to one side.

The jig should make two joggles and can be used again but you will need to add masking tape to thicken the metal that has been distorted and pressed.

Now turn your attention to the other joggle for the curved stock rail, which is the opposite hand.

Curve the curved stock rail by whatever means you normally use. I have an old set of rolls but you can put in the curve, gripping the rail between finger and thumb, and pulling it across the thigh. It must be well over length if the curve is to run through the crossing, as was common practice on the Great Western. The toe end should be straight outside the joggle. Get a smooth curve throughout the section you are going to use and curve the rail so that it follows the template nicely, marked <u>head</u> uppermost. Don't rely on fixing to hold the curve to the correct radii. Experience shows that such a curve will spring slightly towards the straight when the turnout is removed from the template. Also be careful not to put a twist in the curved rail. If you do then the whole curve will not lie down flat and will spring up when you remove the turnout from the building template.

Put the joggle in this rail after curving. Increase the radius in the joggle to set section to the switch radius. Then put a slight set in the curved stock rail where the planing ends making sure that the set is in the right direction, to restore the continuity of the curve.

For both stock rails, measure 4.33mm from the joggle (crossing side of joggle and on the back face), and on the centre line of the rail, make a centre punch mark, then drill a 0.45mm hole. This hole will take the end of the operating stretcher rod of the operating system and will line up with a similar hole in the switch. This operating stretcher rod prevents the switchblades from lifting.

See later note regarding double compounds where the holes for the second operating stretcher bar are 6.33mm from the outward set of the joggle.

Loose-heeled switches

A loose-heeled switch produces the characteristic "dog leg" of Great Western turnouts and is essentially a fully curved switchblade that is held by a loose fishplate at the heel point, such that the heel end of the switchblade can rotate enough for the toe to be moved 4½" (1.5mm). The other characteristic is that the first stretcher bar is taken through the web of the rail so that the

switchblade cannot lift. Sadly this and the joggle are rarely modelled and yet it are quite easy to achieve.

Making the loose-heel

One or other of these methods should be tried independent of the turnout you are building to establish the best method for you to use.

One simple method of making the loose heel is to use an Exactoscale lost wax brass fishplate, relieving the end into which the switchblade is later inserted or thinning the closure rail end down. Do not rely on the fishplate for electrical conductivity. Apart from soldering to a rail just to try this out, **DO NOT** solder an Exactoscale lostwax fishplate on to a closure rail until told to, much later, **EXCEPT** for this trial. The closure rails have to be cut to length after setting up the wing/splay rails at the "vee" and that comes later.

An alternative way is to use some scrap 0.3mm brass, making up 4 fishplates 6.7 mm long, a pair for each switch. Make them wide enough to be able to put a chamfer along the top and bottom edges so that they nest neatly into the web of the rail head. They must however bottom into the web. See drawing 030.

Put a 2° set into two of them 3.0 mm from the toe end. Carry out a **TRIAL** and solder a pair made up of a plain one and a set one, putting the set one on the inside (toward the middle of the turnout) and solder them to the closure rail with the set one having the set stopping 0.3mm from the end of the closure rail. The reason for this is to allow the first part of the switch blade to be slightly gripped at the set point (allowing about 0.15 clearance between the end of the switch blade and the end of the closure rail). The 2° set will allow that switch blade to move 1.5mm inwards at the toe. Try to avoid getting any solder into the space created by the fishplates and preferable no solder past the end of the closure rail. Make sure that the test switch rail can rotate sideways from the straight, in one direction by about 1.5mm without its end lifting.

Use the above instructions to make up a trial heel joint to establish which method you are going to use.

Now leave the heel joint fishplate until you are laying up the turnout. Under NO circumstances solder any heel fishplate to the end of any closure rail at this time, apart from the trial mentioned above. That will come later when the heel point has been established and you are able to cut the closure rails to length.

Making the switchblades for loose-heeled turnouts

David J.Smith's book *GWR Switch and Crossing Practice* on page 11 describes the Swindon practice of planing switchblades. I have drawn both blades for a 10' switch from the drawings of poor quality that I photographed at the Wiltshire and Swindon Record Office.
The drawing is for a right hand turnout.

In the pack of drawings that accompany these instructions is drawing 044 with the switch radii drawn. Use them to assist in making the switchblades.

Note: The loose-heeled switchblade is always 2' longer than the declared nominal length. Thus a 10' blade is actually 12' long. Add 10mm outside of toe and 25mm outside the other end so that a 10' switch, being 12' overall (having added the extra 2') plus 100mm, gives an overall length of 158mm. You need this sort of length to be able to hold the switch blade to file it.

You should have already put a pair of holes through the joggled stock rails so now use the stock rails as a jig to drill out the switchblades, so they match.

Now clamp the raw switchblade and the joggled stock rail together, rail head to rail head, so that the toe of the switchblade is just lying on the rail head, the rail panel joint side of the joggle, with the other end clamped close to the other end of the switch blade and a third to keep the rail heads level.

Drill 0.45mm through the switchblade using the hole in the joggled stock rail as a jig.

Do likewise with the other pair of rails and **mark each pair of switch and stock rail with the same colour marker**.

The holes in the stock rails and switchblades are now opened up to 0.5mm using a broach, checking that a 0.5mm nickel silver wire can just be run through.

Replenish the colour marking and put these to one side and do not allow them to become mixed.

There are many experts' views on the onerous task of making switchblades. I find it quite simple. Starting with the straight stock rail side, pickup the matching switchblade and prepare to work on that. Leave it with the toe end cut about 9mm from the 0.5mm hole and do not shorten the switchblade until it is completed.

There are four drawings show how the Great Western produced their switchblades and we are, in general, going to follow that practice.

Toe to end of planing			**Hole to end of planing including compounds**	**Hole to end of planing for double compounds****
9' switch	5' 10"	(23.33mm)	(19mm)	not used
10' switch	6' 4½"	(25.5mm)	(21.17mm)	(19.17mm)
12' switch	7' 8½"	(30.83mm)	(26.5mm)	(24.5mm)
14' switch	8' 11"	(35.66mm)	(31.33mm)	(29.33mm)

****Note regarding double compounds (double slips).** Fig 30 on page 61 (David Smith's Switch & Crossing Practice), shows the second pair of switchblades with the operating stretcher bar 1' 7" away from the toe, against the standard dimension of 1' 1", the difference being 2.0mm (6")

Notes regarding the filing surface for making switchblades.

Two filing surfaces are required, one a solid flat edge to a table and the other a flexible surface produced by clamping a square of hardboard or formica over the edge of the corner of a table so that it can flex.

When using the solid flat surface for filing, place the switchblades so that the toe is on the edge of the flat surface so you are filing away from the end of the planing to towards the toe.

When using the flexible surface for filing, place the start of the planing on the edge or slightly over it and file towards the toe. Don't be too strong at the start of the planing as you are trying to reduce the blade into a taper whilst putting a curve into it between the planing and the toe.

Stage 1. Drawing shows how the switchblades lie as regards the running face, at the toe. You can identify the back face that you are going to file first. Mark where the planing ends taking the dimensions from the table below, or table 1, page 139 (David Smith's book). Use the hole to end of planing dimension rather than from the toe (as the toe metal is over length by 9mm).

Stage 2. Drawing shows the filing of the back of the blade facing to stock rail running faces. You are filing from the end of the planing back towards the toe thinning down the blade evenly until at the toe end the railhead thickness between the filed face and the outside of the web is 0.2 mm. The filed taper at the toe end should have just broken into web.

Stage 3. Drawing shows what has to be achieved. Some of the work is on a flexible board, maybe hardboard or formica clamped with an 4" overhang over the edge of a table. Some is on the solid flat surface of the table.

Filing tapers

Start with the curved turnout blade (straight stock rail side of turnout). File the blade over the solid table surface filing a smooth taper in from the end of the planing down to the toe, leaving the toe width between the filed face and the far side of the web at 0.2mm.

Turn this blade over and working on the flexible board file the rail head only, filing a taper from the end of the planing down to the toe, the rail foot being left untouched. The flexible board

should cause you to take more metal away from the middle part and toe end of the blade leaving the section at the start of the planing more or less untouched. The toe end should be reduced to 0.2mm thickness.

When lifted from the flexible board you should have produced a blade with the back face planed straight and the running head's face (RF) with a concave curve, the switch radius. The middle drawing of David Smith's book Fig 1, page 10 shows what this blade should look like. This section should be filed to the switch radius. The remainder of the switchblade outside of the planed end also needs to be curved to the switch radius so that the filing on this side's railhead marries into a single curve.

Now make the straight blade that fits the turnout side of the turnout. The above process is reversed.

Working on the solid surface, file a smooth taper on the running face (RF) of the rail head only, from the end of the planing to the toe web, the taper just breaking through the web, leaving the foot of the blade untouched. Turn the rail over and put in a slight set to restore the RF to a straight. Now working on the flexible board file the full back face of the blade from the end of the planing to the toe reducing the width at the toe end, back face to web, to 0.2mm. The flexible board should cause you to take more metal away from the middle part and toe end of the blade leaving the section at the start of the planing more or less untouched. The toe end should be reduced to 0.2mm thickness.

By working over the flexible board should have put a concave curve in this blade which should be close to the switch radius. Check against drawing 050.

You will likely need to bend the (RF) of the blade straight again and to increase the back face curve to the switch radius (do that on a solid surface filing where needed).

Stage 4. The new blades now must now be cut to the correct length from the hole back towards the toe. In the case of standard turnouts the hole for the loose-heeled switch will be 4.33mm from the toe and whereas with the double slip compound one pair will be at 4.33mm and the other pair at 6.33mm from the toe.

For standard turnouts (4.33mm) cut back the blade at the toe end to just **5mm** from the centre of the 0.5mm hole and reduce the tapered faces again so that the actual toe width is close to or at 0.2mm. For the other compound pair cut back to just **7mm**.

(In my experience it was quite difficult to get the toe width down to 0.2mm. I found it was more often 0.22mm or thereabouts. I overcame that by filing back the railhead on the RF side to 0.2mm over the last 20mm or so, the longer the taper the better as you want a smooth transition on the RF and not a dogleg).

Once done, cut the overall length to the switchblade's nominal length PLUS 8mm (2 feet) PLUS 1mm. (Cut too much away now and it cannot be put back on again). Thus a 10' switch will now measure toe to heel at 49.67mm at this point. A final reduction of 0.67mm at the toe end and 1.00mm at the heel end will be made when fitting the blade later.

Finally put in the toe radius of 0.66mm at the top of the toe, shown in David Smith's book Fig 1, page 10. Put in a slight chamfer along the bottom edge of the foot back filing, from the toe to the end of the planing. This is to make sure the switchblade seats down when in place and doesn't catch when moved. It might be also necessary to put in a slight vertical rake starting at the railhead, on the back face to get the blade to nest and seat.

When you have completed the blades keep them with the associated stock rail in pairs. Open the 0.45mm holes to 0.5mm with a broach and check that a 0.5mm n/s wire will just pass through.

To set up the closure rails you simply pass a 0.5mm wire through the stock rails and the blades and the far end of the switchblade is the heel point, but do not cut to length at this time. Of course the other end of the closure rails have to be set correctly at the "vee", and this is when the final reduction of the switchblade length takes place – see later under closure rails.

B & C switches.

The heel of these switches is an integral part of the flexible switchblade. Do not drill a 0.5mm hole through the rail head or through the toe of the switch, they are not needed. Make up the switch closure rails and form the switch blade as above but using the planing length, toe to end of planing, as below. NOTE: The stock rails also have the joggle at the toe.

	Toe to end of planing
B switch	8' 4½" (25.5mm)
C switch	10' 5½" (41.83mm)
D switch	12' 4½" (49.5mm)

Laying up a turnout with a joggle

Usual laying convention

The convention for laying up a turnout is, crossing vee and wing rails first, then the stock rails, switchblades and finally the closure rails (might be part of switchblades), with the check rails last.

However the Iain Rice method differs. Iain suggests that the two stock rails are laid first, then the crossing vee with wing rails. Next the switches and then the closure rails, the straight one first..

Convention to be used for joggled turnouts

The above conventions should not be used.

Fit the joggled straight stock rail first, followed by the crossing vee, then the curved closure rail and with wing and splay rails, at the vee. Then fettle the switchblade into the joggle to set section of the straight stock rail. If and when it meets the checks detailed below, then it can be used to gauge the curved stock rail.

Fit the straight closure rail. Then fit the curved stock rail whilst fettling the switchblade to fit into the joggle to set section. Next the wing and splay rails and lastly the check rails in both roads.

Difficulties that joggled stock rails present

Joggled loose-heeled switches present the modeller with one difficulty. The joggle and set in both stock rails prevents that section of the turnout from being gauged during building unless one has fettled the switchblades satisfactorily and fitted them. Then and only then can gauge off them in a convention manner.

There is an alternative to the above convention and that is to build the turnout without the switchblades and to dimension the RF's using the accompanying drawings that give the RF to RF dimensions on the centre line of the timbers in this zone, for 10', 12', 14' and 16' switches (drgs 031, 033, 035 and 037).

Those dimensions are a minimum and need a little clearance else the track gauge when later checked will be tight.

If the switchblades have been fitted well and conform with the various checks then it should not be necessary to use these dimensions but they are useful so that any RF to RF width over the joggle to set section can be checked, if needs be.

Placing timbers on the template

The usual method of laying up timbers on the template will be followed; the template having been stuck down to a smooth surface like melamine faced chipboard. Details of assembling the operating systems in one of two ways are elsewhere.

Note, All timbers are at right angles to the straight stock rail for loose-heeled switches.

David Smith says on page 35 and fig 14 page 36 that running the crossing timbers at right angles to a line intersection the crossing was gradually adopted in the mid- 1930's as the new B & C switches were used for new work. Fig 14 is of no consequence with loose-heeled switches.

Suffice to say at this stage that additional pairs of chairs/timbers 15mm apart for each rail should be set 50mm outside the turnout proper, at each end. The purpose of these is to carry the rails well outside the turnout proper to give strength and protection to the turnout when it has been removed from the building template and handled prior to laying. In particular these extensions make sure that the curved road carries the radii through the turnout proper and does not end up with a flat to the curve at the ends. These extensions are cut away just before laying.

Laying the straight stock rail

The straight stock rail is first laid in the normal way. Note the slight offset due to the joggle and set. If you formed the joggle and set correctly, then it will be away from what would have been the RF of this rail. Use a straight edge along the full length of the RF, including the extra timbers at each end, so as to lay this stock rail absolutely straight. Also make sure that the joggled section, from joggle to set, is also straight and check that with a short rule.

The crossing side of the joggle is positioned 1.33mm (4") to the left of the centre line of the no.3 (toe) timber. This point also coincides with the start of the toe of the switch.

Run a length of 0.5mm brass wire through the hole in the railhead and set this parallel to and 3.00mm to the right from the centre line of the no.3 timber (toe timber). Tape the brass wire down on both sides to prevent the stock rail from moving while it is being fixed.

Start by fixing the straight stock rail at the chair on the no.3 (toe) timber. With the straight edge placed against this chair and lined up with the template at both ends, and with the joggle section still straight, fix the no.3 chair. With the straight edge still in place and the joggle to set section straight, fix the chair at the end of the planing (adjacent to the set). Still with the straight edge in place fix the chairs on the extra timbers outside of the turnout proper both sides.

Had you fixed every chair at this stage then any error that had crept in, perhaps due to the straight edge moving slightly, will have been magnified. Check again that the stock rail from left to right is straight and also the joggled section. If not, then you will have to adjust some chairs by re-soldering or moving the timbers slightly.

Leaving the straight edge hard against these four points, then fix every 4th or 5th chair only, move outwards towards each end until the extra chairs/timbers well outside the turnout proper are reached. Finally, if all is well, then keeping the straight edge in place the whole of the time, fix the remaining chairs, to complete the laying of this stock rail. This rail gives a straight datum from which the rest of the turnout is gauged.

Making the "vee"

The next task is to make up the "vee" to the crossing angle and cut it to the correct length. It is normal practice to have the point rail on the main route with the splice rail spliced into the back of the point rail on the secondary road. See David Smith's photograph on page 30. I usually file the two rail ends into a taper until the two together give the correct crossing angle. Not correct but when soldered it will not differ from the "vee" formed by splicing one rail into the point rail. It is a question of what is easier for you. It would help if you made up a card template fig 12, page 30.

The Great Western regularly ran the turnout curve through the crossing so that one side of this vee may be curved. If it is, then what I usually do is to make the curved closure rail over length to the correct radius which I check on the building template and then cut a length off that to make up the splice rail of the "vee". That ensures continuity of the turnout curve through the crossing. Give the point rail and the splice rails sufficient length to reach the two external holding timbers well to the right outside of the building area. File back the intersection of the point/splice rails to a blunt nose. The blunt nose is 0.2mm wide.

I use a high temperature solder (388°) for the "vee" so that it does not later unsolder because I use an etched brass BC plate at the nose with etched BC chairs. (These are attached by a tag

from the underside of the nose timber, which means that a recess has to be cut in the building template to take up the 0.3mm thickness of this tag).

This “vee” with point/splice rail extensions are gauged from the straight stock rail and is carefully placed over the intersection, to line up over the template correctly. Check that the “vee” is parallel with the straight stock rail by running a straight edge along it towards the toe and checking the gauge at each end. Do not fix the “vee” until you are sure that it **is parallel** with the stock rail and the “vee” and the point rail extension is in line and gauged from the stock rail. It is critical for the appearance of the turnout to get this right. If you are using a BC plate chair then make sure the blunt nose is positioned correctly, see David Smith fig 48, page 98. The blunt nose is N x 11/16” from the intersection on this 12” timber, N being the crossing ratio.

Making up and laying the curved closure rail

Note: Using aluminium hair clips is a well- established track laying practice. Cut back the legs squarely on a number and make them quite short so as to increase the spring pressure for gripping.

Prepare a pair of loose-heeled fishplate parts or use an Exactoscale brass lost-wax fishplate, as the heel joint, as earlier described and have handy.

Set up a 0.5mm brass wire through the straight stock rail hole near the joggle, parallel to and 3mm from the centre line of the no.3 timber (1.0mm from its edge) and taping this wire down so that it cannot move.

Measure radially the heel point from the 0.5mm brass wire at the stock rail, using the nominal switch length plus 8mm (2’) less 4.33mm. For a 10’ switch, measure 43.67mm from that wire.

Heel distances from the toe and from toe 0.5mm hole

Nominal switch	Actual switch length	Heel from toe	Heel from 0.5mm toe hole
10’ (40mm)	12’ (48mm)	48mm	48 – 4.33 = 43.67mm
12’ (48mm)	14’ (56mm)	56mm	56 – 4.33 = 51.67mm
14’ (56mm)	16’ (64mm)	64mm	64 – 4.33 = 59.67mm
16’ (64mm)	18’ (72mm)	72mm	72 – 4.33 = 67.67mm

Note: If you are building a compound then a pair of switchblades will have the holes 6.33mm from the toe so the heel to toe hole dimension in that case will be 2mm shorter.

Make up the curved closure rail 25mm over length having included the combined wing/splay length and mark the railhead and RF so you put in the turnout curve correctly. At the far right make the first bend of the wing and splay rail combined, using the table below, marking the knuckle on the rail head. Now prepare a slip of brass partially bent to the turnout radius if the turnout runs straight from the “vee” or fully curved to the turnout curve if is runs curved right through the “Vee” and clamp this brass slip in place.

Test the angle of the combined bend against the straight RF of the “vee” with the closure rail hard against the above brass slip. When you have the angle of the combined wing/splay rail right and the knuckle is hard against the brass slip, the closure rail should run close to the heel point as measured above.

Test the combined wing rail against the RF of the “vee” again, this time inserting a flangeway slip gauge in between it and the “vee” to offset the combined wing rail towards the straight stock rail. Clamp the closure rail to the brass slip. At this point the back face of the closure rail should be about 1.0mm from the RF of the straight stock rail. You may need to slightly correct the bend of the angle of the combined wing/splay rail until you are satisfied that the closure rail runs over the heel point, the bend for the combined wing/splay rail sits where the knuckle should be and is hard against the brass slip and with the combined wing/splay rail hard against the “vee” with the flangeway slip gauge in place. Again check that the clearance between the back of the closure rail and the RF of the stock rail is still about 1mm. (The actual dimension is on the drawings and is very close to 1mm).

When all conditions are met mark the heelpoint with a marker pen on the rail head. This is the approximate position of the heel point but it will change slightly shortly.

Lift the curved closure rail and make a second bend for the splay rail. Cut the end of the splay rail 14mm from this bend and holding the wing rail part hard against a flat metal surface adjust the bend until the end of the splay rail (face that will be closest to the "vee") is 0.5833mm clear.
I use a 0.6mm n/s wire to check this.

Replace the closure rail as above and check that the clearance of the splay is 1.17mm from the "vee". I use a 1.2mm drill as a gauge.

Now mark the position of the rail joint in the closure rail from the table below. Cut the closure rail at right angles to form the wing and splay rails and clean up both sides of the cut, putting the remainder to one side.

Now replace the wing/splay rail exactly as above using the flangeway slip gauge and with the knuckle hard against the brass slip, and fix in place (solder hopefully). Abut the closure rail to that joint, clamp in place with just a little clearance, say 0.2mm or whatever you allow for rail joints for expansion, re-align the closure rail over the heel point, mark accurately, remove and cut squarely. Clean up and solder on the chosen heel fishplate, keeping solder out of the space between both sides and at the end of the closure rail.

Recheck that the 0.5mm wire junction at the stock rail and the heel point is still 43.67mm or thereabout.

Put the closure rail back in place and fix but first again check the clearance between the RF of the stock rail and the back of the closure rail at the heel point. It should still be 1.0mm. The drawing also gives the RF to RF at this point, and alternative means of checking. This side of the turn out is ready to have the switchblade fitted in place.

The wing rail dimensions from the knuckle are -

Crossing angle 1 in -	Wing rail	Splay rail	Two combined for first bend from knuckle	** Length of wing rails from knuckle
6	10.375mm	14mm	24.375mm	27.6mm
6.5	10.79mm	14mm	24.79mm	27.2mm
7	11.20mm	14mm	25.20mm	26.8mm
7.5	11.61mm	14mm	25.61mm	26.4mm
8	12.00mm	14mm	26.00mm	26.0mm
8.5	12.42mm	14mm	26.42mm	25.6mm
9	12.83mm	14mm	26.83mm	25.2mm
10	14.29mm	13.33mm	27.62mm	24.4mm

**** Note:** Length of wing rail from knuckle is towards the switch, from the knuckle. This is the dimension to the rail joint in the closure rail.

Fettling the switchblade the straight stock rail side

Take up the correct switchblade and retain it by a 0.5mm brass wire run through its toe hole and the hole in the straight stock rail. Note how it marries up with the end of the curved closure rail. It should be just a little over length. Now see how that switchblade nests into the joggle to set section. You need to remove the 0.5mm wire to do this.

To fit correctly the blade should nest along the whole of its filed back face with the joggle to set section. Some new filing might be required to achieve this. Maybe a slight rake on the back face will be required or the chamfer along its foot needs more work.

Start to reduce the switchblade's length slightly until it can just be fitted with the 0.5m wire in place through the stock rail lying parallel with the no.3 timber, and the end of the curved closure rail now encased with the heel fishplate.

Is the switchblade still nested correctly?

Finally the switchblade can be re-inserted into the fishplate and maybe slightly shortened to get a small clearance at the heel whilst still having the 0.5mm wire in place and parallel to the no.3 timber. The use hair clips to hold the switchblade in place.

This fettling process seems to be complicated but in actual practise takes very little time. Just approach it with care and caution.

You are now in a position to gauge the curved stock rail from the straight stock rail side.

Making up and laying the straight closure rail

Prepare a pair of loose-heeled fishplate parts or use an Exactoscale brass lost-wax fishplate, as the heel joint, as earlier described and have handy.

Extend the 0.5mm brass wire through the straight stock rail hole and its switchblade, keeping it parallel to and 3mm from the centre line of the no.3 timber (1.0mm from its edge) and then taping it down so that it cannot move.

Measure the heel point from the 0.5mm brass wire at the stock rail, using the nominal switch length plus 8mm (2') less 4.33mm. Thus for a 10' switch measure 43.67mm from that wire.

Make up the straight closure rail 25mm over length plus the combined wing/splay rail and mark the railhead and RF so you put in the wing/splay rail bend correctly. At the far right make the first bend of the wing and splay rail combined, using the table above, marking the knuckle on the rail head.

Test the angle of the combined bend against the turnout RF of the "vee" with the straight closure rail hard gauged from the stock rail in two places. If the turnout curve runs through the "Vee" then bend the wing rail to follow that curve. Use flangeway slip gauges to set the wing rail part of the combined wing/splay rail off the "vee" whilst maintaining the track gauges from the stock rail.

When you have the angle of the combined wing/splay rail right, bend the splay rail such that the distance from the end of the splay rail to "vee" is 1.17mm as before. I use a shank of a 1.2mm drill.

Replace the straight closure rail and with the flangeway slip gauges in place at the"vee" and the track gauges from the straight stock rail locating the rail, then mark up the heel point from the 0.5mm wire using the calculated dimension as above for the particular nominal switch you are using. The example above gave 43.67mm for a 10' switch.

Now mark the position of the rail joint in the closure rail from the table above. Cut the closure rail at right angles and clean up both sides of the cut.

Now replace the wing/splay rail exactly as above using the flangeway slip gauge and gauged from the straight stock rail, using a flangeway slip gauge to check the clearance at the knuckle and fix the wing/splay rail in place.

Abut the remainder of the straight closure rail to that joint, clamped and gauged in place with just a little clearance, say 0.2mm or whatever you allow for rail joints for expansion, re-align the closure rail over the heel point, mark accurately, remove and cut squarely. Clean up and solder on the chosen heel fishplate, keeping solder out of the space between both sides and at the end of the closure rail.

Fix the straight closure rail in place, rechecking the heel point dimension from the 0.5mm wire, see earlier table.

Fettling the switchblade the curved stock rail side

Take up the turnout switchblade and retain it by a 0.5mm brass wire that was run through the straight stock rail/switchblade. It should be just a little over length. Now mark the end from the heel point of the straight closure rail.

Start to reduce the switchblade's length slightly until it can just be fitted in the straight closure rail heel fishplate and the 0.5m wire parallel with and 3mm from the centre line of the no.3 timber.

Reduce the length just a fraction more to get a small clearance at the heel fishplate joint. The switchblade's straight RF should have its gauge checked and be in a straight line with the straight closure rail. The curved back face should be curved to the switch radius.

You are now in a position to set up and gauge the curved stock rail from the straight stock rail side.

Laying the curved stock rail

Take the curved stock rail and put the turnout curve in with the marked railhead uppermost and increase the curve to the switch radius in the joggle to set section.

Leave the section left of the joggle straight and put a slight set in the curve at the distance of the planing from the joggle. The set is to restore the continuity of the curve. Check that the joggle and set are offsetting away from the RF. There must be sufficient straight to reach the extra chairs/timbers to the left of the turnout and sufficient curve to reach to other extra chairs/timbers to the right.

Re-run the 0.5mm wire run though the switchblade and straight stock rail on the far side and through the switchblade on the curved stock rail side, having first inserted the switchblade into the fishplate of the straight closure rail.

When the 0.5mm wire is parallel to the no.3 timber and 3.00mm away from the centre line, tape that wire down so that it cannot move. Insert the curved stock rail on to it and set up a track gauge from the heel end of the curved closure rail. Set up another track gauge from the curved closure rail near the vee, and another adjacent to the next rail panel joint side of the joggle. That should hold the curved stock rail roughly in place.

Next see how the switchblade and the curved stock rail nest. The switch blade should be in a straight line, checked with a straight edge from both ends of the turnout with the back face of the switchblade nesting into the joggle to set section of the curved stock rail. The crossing side of the joggle and the toe should coincide.

Place another track gauge between the straight stock rail side right up against the toe of that switchblade and see whether the switchblade on the curved stock rail side gauges correctly at its toe. Make whatever adjustments are needed to this switchblade until it seats and nests correctly.

Now gauge the straight extension part of the curved stock rail out to the left, starting at the toe and moving left until it reaches the extra chairs/timbers well to the left. When this is all in order and the 0.5mm wire hasn't moved then fix a couple of chairs to the left of the toe, checking with a straight edge run through the crossing that the straight closure rail, the "vee", the point rail and this straight extension of the curved stock rail are all in line. If they are, as they should be, then fix the remaining chairs on this straight extension including the extra ones.

The curved remainder of the curved stock rail is unfixed and floating for the time being.

If the switchblade on the curved stock rail side nests correctly and is not distorting the curved stock rail, which is being held by the track gauge at the heel point then you may proceed further. My guess is that there will need to be a fair amount of re-filing and fiddling around until the switchblade and the joggle to set section nest properly. Much will depend on the radius of the switchblades back face. It should be the switch radius, the RF remaining straight. It must nest properly with the curve of the stock rail between the toe and the set. You may have to chamfer the bottom edge of the switchblade or even put a slight angular rake to the back filing to get it to nest and seat properly. If all is OK then clamp the switchblade and the joggle to set section with hair clamps.

When all is well, starting at the no.3 timber (toe timber) check the gauging moving toward the heel and fix a few chairs in the joggle to set section to secure the curved stock rail.

Now check three sets of dimensions. At the nominal length of the switchblade when closed, the clearance between the curved stock rail RF and the back of the switchblade must be the crossing flangeway 0.5833. When the switch is opened 1.5mm at the toe then the clearance must be the crossing flangeway 0.5833 throughout. The second dimension is at the heel. This must be as the drawing at the heel, which is approximately 1.0mm. Either check the RF to RF at the heel or check the clearance of the curved stock rail RF and the outside edge of the heel of the straight closure rail. It is crucial to get these clearances right. For crossing flangeway gauge use a 0.6mm drill shank and not the P4 crossing flangeway slip gauge.

Then proceed carefully toward the crossing and beyond, gauging and fixing a few chairs until the rail is held by the two extreme timbers well outside of the turnout. Do not let the curved stock rail form into a series of short straights, it must remain a sweet curve throughout. Check the 1.0mm clarancw at the heel and curved stock rail, see drawing dimensions for that switch.

If all is satisfactory then fix the remaining chairs without distorting the curved stock rail.

Run another check with the track gauges from left to right. The roller gauge should run quite freely from left to right.

Laying the check (guard) rails

Fit the check rails in the usual way, gauging with the check gauge. For plain track at 18.83 you could also use the crossing flangeway gauge (0.5833mm – use 0.6mm drill shank) but if you have introduced gauge widening to the curved stock rail then you will have to maintain the check gauge and increase the flangeway by the gauge widening you have applied.

Nominal switch	Length of guard	Length of splay
10’	11’6 ’ (46mm)	3’ 6” (14mm)
12’	14’ (46mm)	3’ 6” (14mm
14’	14’ (46mm)	3’ 6” (14mm)
16’	14’ (46mm)	3’ 6” (14mm)

Final check

Finally re-check again that at the nominal switchblade length (10’ for a 10’ switchblade) from the toe there is a 4½” (1.5mm) clearance, between the RF of the switchblade and the RF of the stock rail, when the switch is closed. This is the same as using the crossing flangeway (0.5833mm – 0.6mm drill shank). What is important is the clearance between the stock rail RF and the back of the switchblade when the toe is opened 4½” (1.5mm). It should be the crossing flangeway (0.5833mm – 0.6mm drill shank) throughout but as the effective wheel flange is 0.40mm a wheel set should easily pass.

Then a final check can be made by removing the tape that held the switchblades and stock rails, removing the 0.5mm wire and seeing if you can move the switchblades the requisite 1.5mm (4½”) opening. Some of my Paddington drawings give this as 4¼” but personally I am happy with 4½” as a maximum. If OK then replace 0.5mm wire for the time being.

Checking the switch gauge.

With both switchblades in place, check the gauge from them, from the toe down to the end of the planing. Of course the joggle to set section gives some relief particularly in the middle and it is either end of the switchblade that may need further work. This is more likely at the toe end but you can remove more from the head along the gradual taper section that you put in.

The alternative is to re-file the back face of the straight stock rail switchblade. Try not to alter the curved switchblade’s back unless of course the RF is not straight and not in line from the crossing through to the far left.

It may take a little time to fettle these blades but with patience you will get them into gauge. Making switchblades is laborious but it doesn’t take that long. Fitting them is time consuming.