TO	Network Wide
FROM	Acting GM Technical Standards
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SUBJECT	Track and Civil Code of Practice – Section 3 – Switch Tips – Technical Note
TITLE	ETN-03-03 Technical Note - Switch Tips v1.0

References

Track and Civil Code of Practice: Section 3 Version 2.9

Background

Section 3 details measurements of point blades as well as limits and responses to control derailment risk. Some measurements at the switch tip apply to “non-undercut non-tangential switches” only. In practice it has been unclear when to apply them.

Measurement at the switch tip is an important control for preventing flanges from striking the tip as well as split switch derailments.

Additionally, existing intervention limits are very close to the design of some switches. Application of the existing limits would result in excessive and unjustified operational impact. Such switches have performed satisfactorily for a long time.

This technical note:

- clarifies the types of switches that require tip measurement
- provides limits and responses for with a switch tip height design of 13mm
- gives an explanation to how flange strike is avoided at conventional switch tips

There is scope for further improvement in the management of the risks at switch tips. In the interest of expedience this technical note does not address the further improvements.

Switch types requiring tip height and width measurement

Figure 1 shows some of the variations found on ARTC's network and some of the names that have been used to refer to them. There are more types and names for switches. For inspection, the important difference is **the way the closed switch blade is presented to the wheel flange** in a facing movement.

On a **conventional** switch the **stock rail has a full head profile**. The switch blade tip projects beyond the stock rail profile (see 1a and 1b). To prevent a wheel flange of a facing movement from striking the switch tip switch tip width and switch tip height are important.

When the head of the **stock rail is undercut** the closed switch tip is within the unmachined stock rail profile. When the stock is undercut the switch tip is better protected.

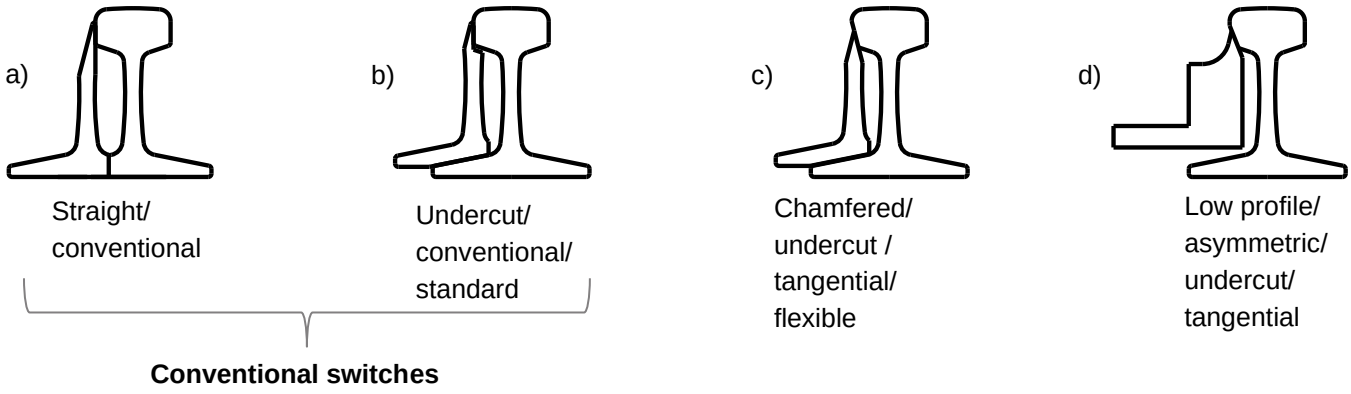

Figure 1

ARTC CoP sections 3.3.5.1.5, 6 & 7 require that non-undercut and non-tangential have switch tip height, width and gauge face angle measured. Switches of the type shown in 1 b) are presented to the wheel flange beyond the profile of the unmachined stock rail, they are conventional and require measurement of the switch height and tip width to control flange strike risk.

Some switches of type 1b) have a 13mm design switch tip height by design. They are found predominately in NSW whereas in other areas 16mm is usual. Interventions in Section 3.3 begin for switch tip heights less than 13mm making them impractical for use with 13mm designed switches.

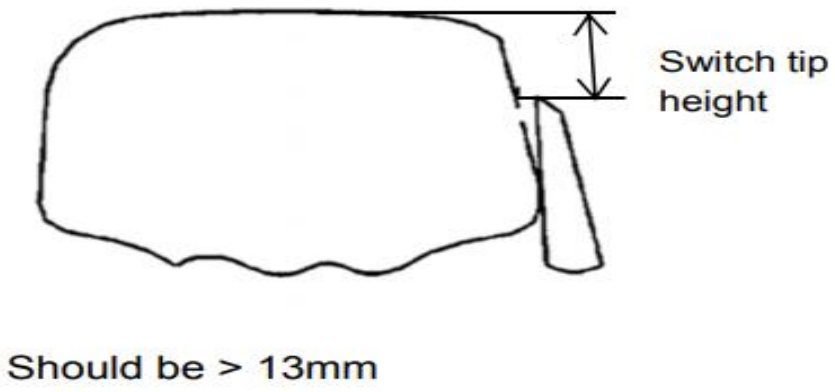

Figure 2

All conventional switches shall be inspected for switch tip height and width. The limits and responses found in ARTC CoP section 3.3.5.1.6 & 7 shall be applied except where switches have a 13mm design switch tip height the table in section 3.3.5.1.6 shall be replaced with the following.

Limits and responses for 13mm conventional switches

The following table shall be used when inspecting switches that had a 13mm design height.

Component parameter	Switch tip height	Switch Tip Width		
		2mm or less	2mm to 4mm	4mm or more
(13mm conventional switches only)	13 mm and greater	A7	A7	^
	less than 13 to 12mm	A6	A6	^
	less than 12 to 10mm	A6*	A1	A1
	less than 10 to 8mm	A4*	A1	A1
	less than 8mm	A1	A1	A1

Table 1

*This response for switch tip height may be applied irrespective of tip width when all the following conditions are met:

1. the applicable stock rail has been joggled (as found on heavy duty or housed switches see figure 3)
2. the whole of the switch tip sits within a virtual extension of the stock (see figure 3)
3. there is no evidence of recent wheel contact on the tip (i.e. first contact is behind and or below the tip)

^Refer to switch width at the tip table for response.

Identifying 13mm design switches

1. 12.7mm switch tip height designs shall be regarded at 13mm.
2. 13mm switch tips designs are only known to exist in NSW.
3. Switch tip height can normally be found on switch manufacturing drawings.
4. 10600 conventional switches in NSW had a 13mm switch tip height design. The length can be checked by measuring the length of the straight switch blade.

Repair of high switch tips.

High switch tips are often the result of wear on the stock rail however, they can also occur as the result of a blade sitting high caused by crippled switch blade or track geometry fault. Blades sitting high cannot be corrected by profiling, high tips due to stock wear can be. Refer to Switch Blade and Stock Rail Profiling Work Instruction ETW-03-02.

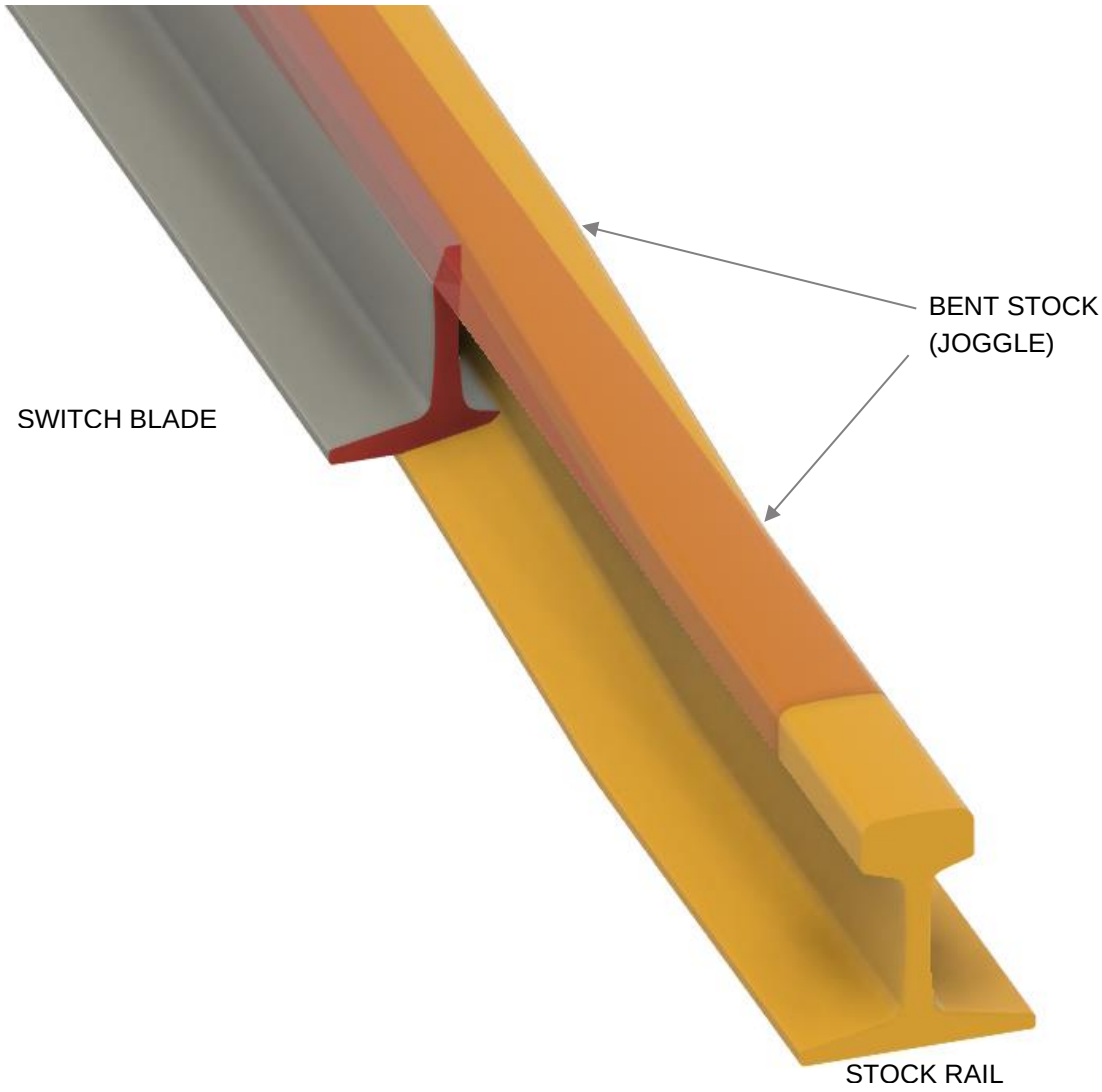

Figure 3

Figure 3 shows a joggled stock rail in yellow. It is identified by the offset created by two adjacent bends. The end of the switch rail is shown in red. The virtual extension of the straight portion of the stock rail head is shown as transparent in red. In this example the switch tip sits within the virtual extension of the stock. In practice the switch tip can be checked with a straight edge aligned to the straight portion of the stock.

Wheel negotiation of conventional switches

It is not obvious how a wheel avoids contacting a switch tip or how switch tip height and width prevent it. The following figures give an explanation.

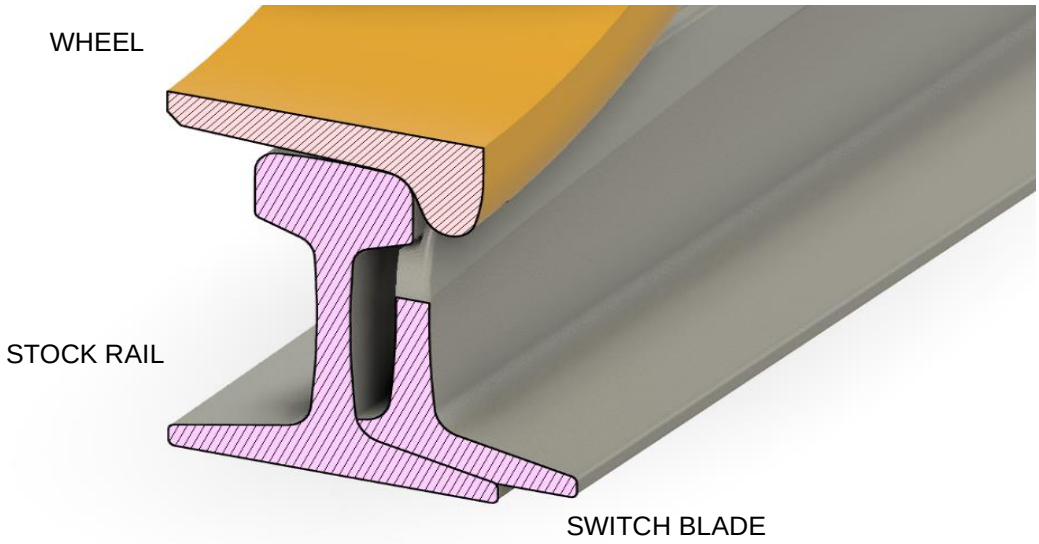

Figure 4

Figure 4 shows a section of wheel aligned on the gauge corner alongside the switch tip. Ideally the wheels would be centred on gauge and the flange would be away from the switch. However, we do need to protect for scenarios where the wheels have been pushed to one side.

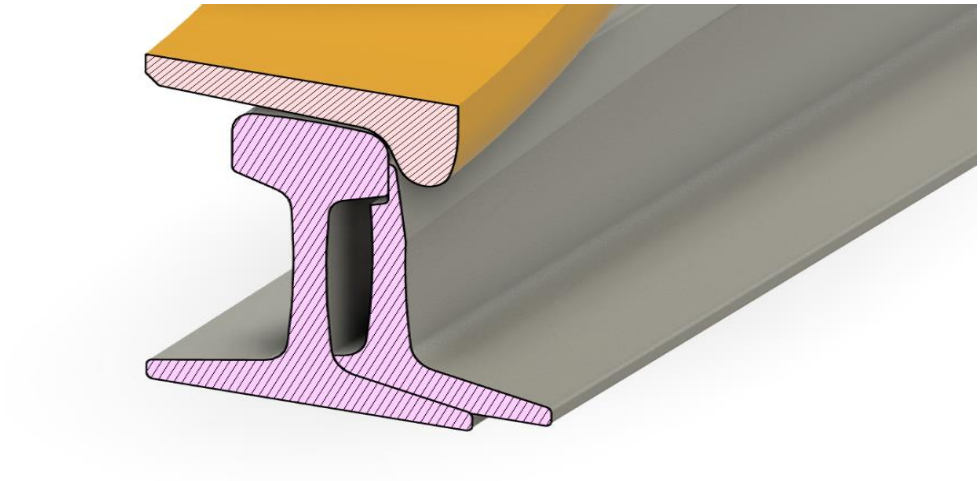

Figure 5

The wheel has not moved but the section has been moved along 30mm. The wheel is still in contact with gauge corner as we saw in figure 4. Here we can see the switch blade tip is higher than wheel flange but not touching it.

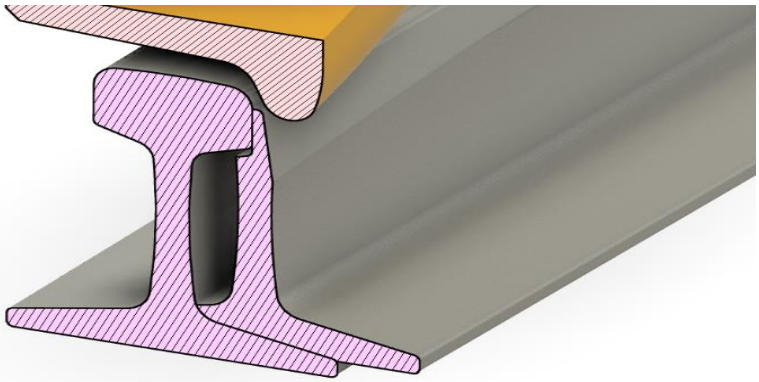

Figure 6

With the section now 90mm past the switch tip the flange is now higher than the switch tip.

Through figures 4-6 we can see in this scenario that the flange tip has not contact the switch tip. As the wheel travels further along it will contact the blade. Importantly The flange tip got past the switch tip without contacting it.

For longevity of the switch ideally first contact of the flange to the blade occurs well behind the tip where the blade is thicker. For safety the flange tip should not touch the switch tip.

In figure 5 we can see that a thicker or higher switch tip could be contacted by the flange. In figure 7 we can see a combination of tip height, width and wheel condition can cause the flange tip to strike the switch tip.

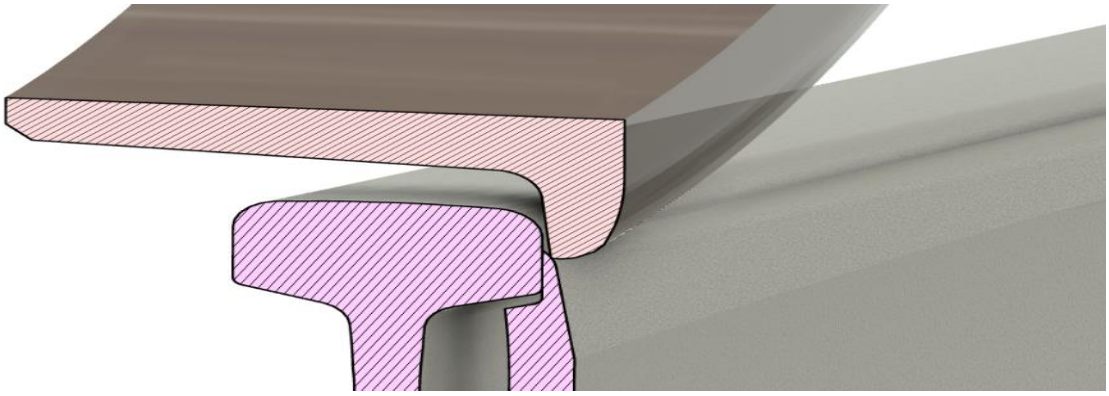

Figure 7

Wheel profile and angle of attack vary. Figure 7 shows a section of steep flange about 300m ahead of the alignment to the gauge corner. This is an unsafe condition that could derail. Controlling tip height and thickness help avoid this unsafe contact condition.

Future work

Difficulty of repeatable measurement of gauge face angle and lack of specific controls to prevent derailment near the tip for switches with undercut stock rails requires further investigation. It is also anticipated the controls in this document could be superseded by simpler ones, but investigation is required.

Outcome:

As interim controls:

- all conventional switches shall have switch tip height, switch tip width and gauge face angle measured in accordance with sections ARTC CoP sections 3.3.5.1.5, 6 & 7.
- conventional switches with 13mm switch tip height design shall use table 1 and accompanying conditions when assessing switch tip height.