DT - Výhybkárna a strojírna, a.s.
Kojetínská 4750/6, 796 01 Prostějov, Czech Republic
www.dtvs.cz

EN ISO 9001
EN ISO 3834-2
EN ISO 14001
ISO 45001

258/2013

Manual for the Operation and Maintenance of Turnout Switch Parts

5th Edition

Name:**Manual for the Operation and Maintenance of Turnout Switch Parts**

Release Date: 01. 10. 2024

Number of Pages: 47

Manufacturer of turnout switch parts and publisher of this manual:

DT – Výhybkárna a strojírna, a.s.
(hereinafter referred to as the “manufacturer”)

Drawn up by: Ing. Jakub Navrátil

Checked by: Karel Němec

Approved by: **Ing. Jiří Havlík**
Technical Director

CONTENTS

LIST OF ABBREVIATIONS USED:

SVV-P	Integrated roller stool for a concrete sleeper
SVV-ZP	Integrated roller stool for hollow steel bearer
SVV	Rolling intermediate sleeper stool

1 General

This manual contains technical information on the switch parts of turnouts in track structures (hereinafter referred to as “switches” if not further specified) and the requirements for their installation and operation, including maintenance.
It is binding on all persons who carry out the activities specified below on the aforementioned switches. The manufacturer assumes no responsibility for activities and their consequences performed in a different way, and strongly warns that failure to comply with the provisions of this manual may result in the rejection of any claim, including the possible recovery of related damages.

Before starting any work on a switch, the relevant personnel must be familiar with the instructions in this manual.

1.1 List of the most important symbols

This document includes three categories of safety instructions:

DANGER!

Ignoring these instructions can result in loss of life.

WARNING!

Ignoring these instructions can cause serious injury or substantial damage to property.

NOTICE!

Ignoring these instructions can cause property damage or injury.

1.2 Manufacturer's address

DT – Výhybkárna a strojírna, a.s.
Kojetínská 4750/6
796 01 Prostějov
Czech Republic

Contact details for service personnel are available on the website DT – Výhybkárna a strojírna, a.s.: http://www.dtvs.cz/

1.3 Contact form for sales technical support – Your opinion

The company DT – Výhybkárna a strojírna, a.s. is happy to receive **feedback from its customers**, especially your comments, suggestions, and experience gained from operating the product in question. Please send us a copy of this form to:

DT – Výhybkárna a strojírna, a.s.
Kojetínská 4750/6
796 01 Prostějov
Czech Republic

or you can use the form available on the website of DT – Výhybkárna a strojírna, a.s.:
http://www.dtvs.cz/

Comments, suggestions, and experience using the product:

Name: ……

Organization: ……

Contact details (phone, e-mail):

2 Technical specifications, switch description

2.1 Basic technical data

Basic parameters defining the switch panel:

- Vignole rail profile and steel grade according to EN 13674-1 or other standards
- switch rail profile and steel grade according to EN 13674-2 or other standards
- tangent or secant switch rail design
- switch rail design
- track gauge extension
- widening the gauge
- turning radii
- turning direction
- construction length, length of individual parts
- bedding - concrete, wooden, or steel sleepers, slab track (ST)
- fastener type
- design of retaining supports or pins
- design of switch rail supports
- maximum permissible axle pressure
- maximum permissible speed in the forward direction
- maximum permissible speed in the branching direction
- rail inclination in switch
- rail inclination in open track
- slide chair type
- roller chair type
- type of adjustment equipment (marking of switch rail position, drilling for locking device, opening)
- end drilling (for soldering, welding)

2.2 Description of the switch

The switch is used in the turnout to change the direction of travel in a straight or branching direction (Figure 1). The switch consists of two half sets of switch, right and left, which can be designed for a right or left turnout. The half switch panel is formed by the switch rail and the stock rail. The stock rails are fixed along their entire length. The switch rails are repositioned and decide the direction of travel of the railway vehicle over the switch. In the front part of the switch panel, the switch rails move flexibly on the sliding stools, thus their repositioning is allowed. The switch rails are fixed in an area called the root of the switch panel.
Switch rails and stock rails are usually supplied in EN 13674 R260 and R350HT grades, or others. For R260 rails, the heat treatment of running surfaces to a higher hardness of 350–390 HBW is possible.
The switch panel is designed for the installation of electric heating (EOV).
The replacement can be equipped with trough sleepers (a supporting steel structure designed to incorporate the ending, flange changer, control gear and electric heating rods). Marking of the trough sleepers in the replacement part - see chapter 4.1.4, work procedure for installing the trough sleepers - see chapter 4.4.6.

Figure 1 – Switch of a simple turnout

Description of the parts of a right switch

- A left half switch for a right turnout (Figure 2 above) is made up of a straight stock rail and a curved switch rail.
- A right half switch for a right turnout (Figure 2 below) is made up of a straight switch rail and a curved stock rail.

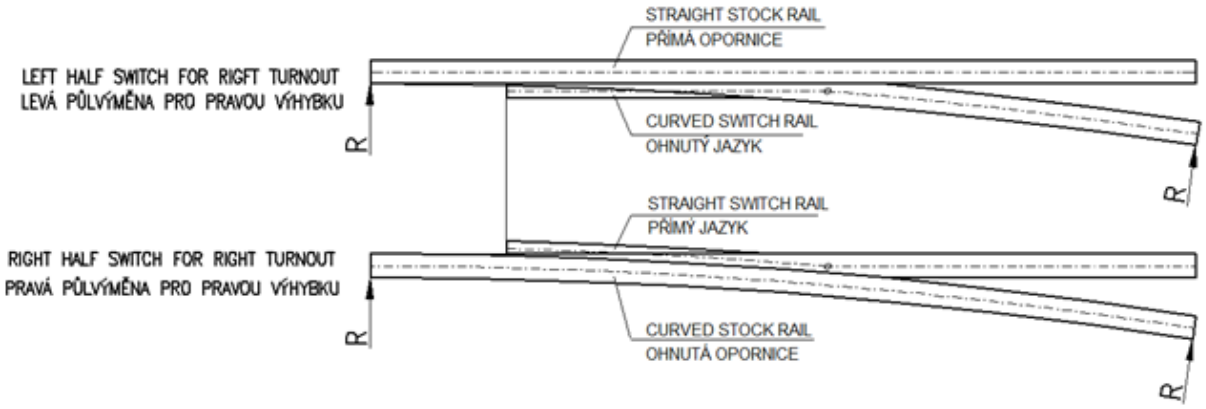


Figure 2 – Description of right switch parts

Description of the parts of a left switch

- A left half switch for a left turnout (Figure 3 above) is made up of a curved stock rail and a straight switch rail.
- A right half switch for a left turnout (Figure 3 below) is made up of a curved switch rail and a straight stock rail.

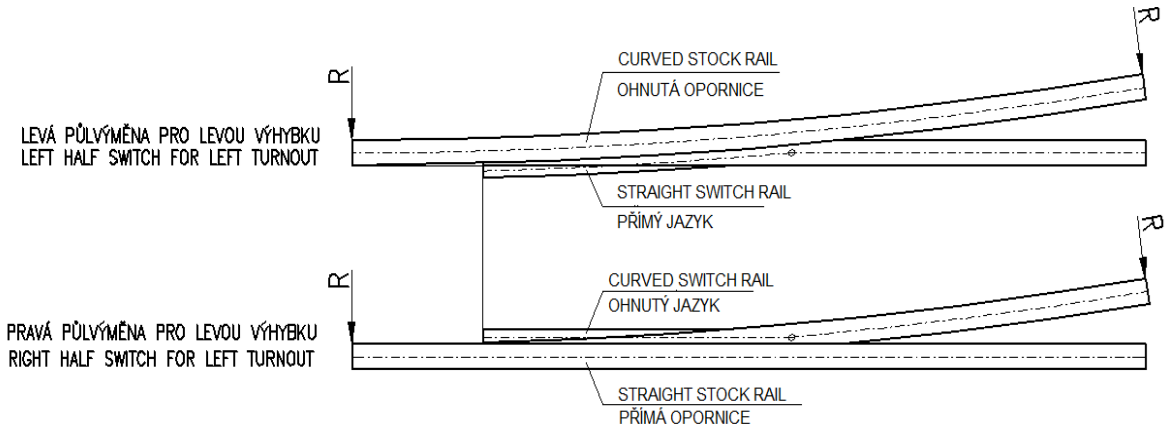


Figure 3 – Description of left switch parts

The switch is laid on sole plates and slide chairs. Slide chairs hold the stock rail firmly and allow the switch rails to move in order to switch to the desired direction. The design of the slide chairs is based on the used profile of the switch rails and stock rails. Most often, they have, for example, a sliding surface with an internal flexible fastening (Figure 4), or are flat with a stock rail support (Figure 5). These are used in cases where the switch rail profile is as high as the stock rail profile and therefore the stock rail cannot be fixed from the inside.

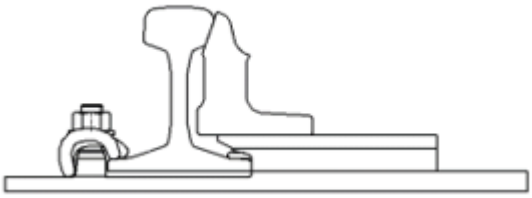


Figure 4 – Slide chair with internal flexible astening of the stock rail

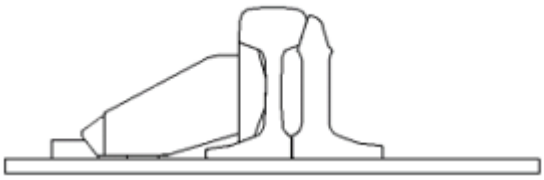


Figure 5 – Slide chair with rigid fastening of the stock rail using stock rail support

To facilitate switch rail repositioning, the switch panels can be equipped with roller stools, either in the integrated sleeper design SVV-P (Figure 6), the intermediate sleeper design SVV (Figure 7) and the integrated sleeper design on the 1st hollow steel bearer (Figure 8). For setup and maintenance, see The Manual 194/15, Manual 195/17 and Manual 348/2022.

Figure 6 - roller integrated stool - type SVV-P

Figure 7 - roller intermediate sleeper stool - type SVV

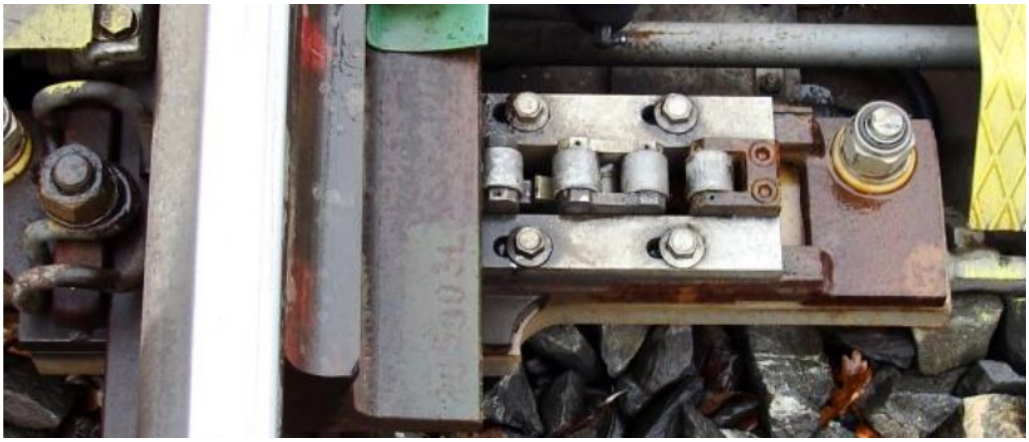


Figure 8 - roller stool for the 1st hollow steel bearer, type SVV-ZP

At the root of the switch panel, where the switch rail no longer moves, the stock rails and switch rails are fixed on sole plates (Figures 9 and 10).

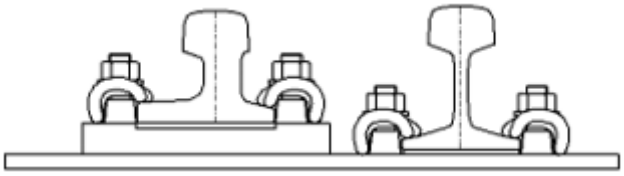


Figure 9 – Sole plate of the switch heel with a levelling plate below the switch rail profile

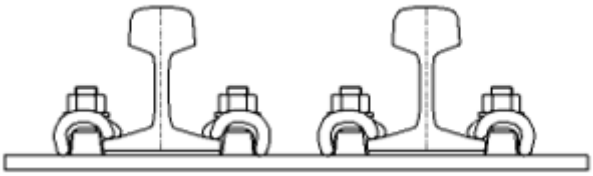


Figure 10 – Sole plate of the switch heel

Retaining pins (Figure 11) are used as means to prevent the switch rails from moving relative to the stock rails; they are made by welded pins on the sole plate at the switch heel and a machined recess in the heel of the switch rail and the stock rail, or retaining support (Figure 12), fastened in the switch rail and stock rail webs which are connected using a lock. These then transfer the longitudinal forces between the switch rail and the stock rail.

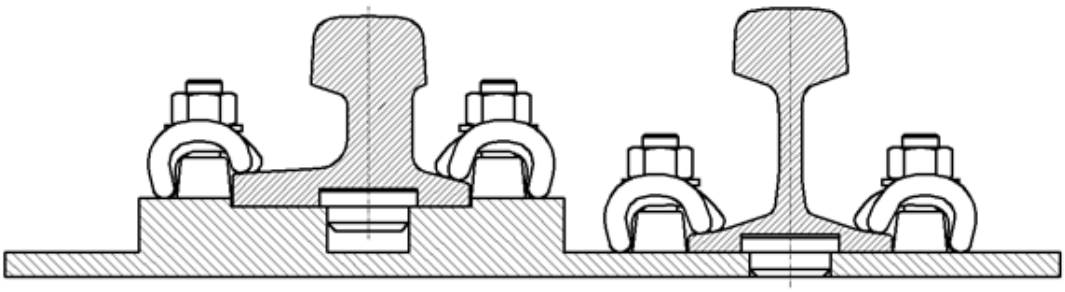


Figure 11 – A cross section of the switch heel sole plate with retaining pins

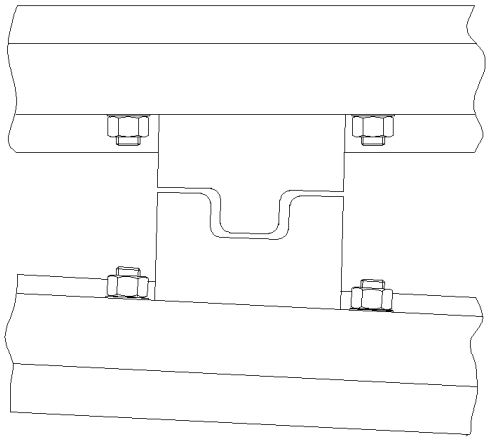


Figure 12 – Retaining support fastened to the switch rail and stock rail webs

The switch rail restraints consist of two parts. The so-called restraint spike is always placed on the switch rail and the so-called restraint fork on the stock rail.

The restraints with a clearance of ± 3 mm are designed for contact switches. The attachment of the restraints to the switch rails and stock rails is made with M24 high-strength bolts of strength class 10.9 and M24-8 nuts (two nuts). The nuts are tightened to the specified torque of 755 Nm during assembly at the factory.

The restraints with a clearance of ± 6 mm are designed for switches welded and welded into a long-welded rail without differentiation of the permanent way for all switch geometries. The attachment of restraints to the switch rails and stock rails is made with M24 high-strength bolts of strength class 10.9 and M24-8 self-locking nuts. Tightening of the nuts to the specified torque of 700 Nm is done at the factory during assembly.

When the switch rail is welded, it is not necessary to dismantle the restraints for welding the switches in accordance with the SŽDC S3/2 Long-welded Rail regulation. However, after the welds between the switch rail and the rail of the middle part of the switch have cooled down, it is necessary to adjust the correct relative position of the restraint parts in relation to the current rail temperature, using the clearances in the mounting holes if necessary. The nuts must then be tightened to the required torque.

If it is absolutely necessary, in the case of restraint supports with a clearance of ± 6 mm, to completely dismantle the restraint supports, which would also lead to the dismantling of the

bolted connections and thus to the plastic nut ring leaving the bolt thread, the original self-locking nuts must be replaced by new ones of the same type.

If necessary, it is possible to replace the self-locking nut with two M24 nuts, but only for the necessary period of time until the self-locking nut is refitted.

If the restraint is supplied as a spare part, it is supplied as a fitted part. When assembling the restraints, after their final alignment (after the mutual alignment of their parts), it is necessary to perform welding and during the final assembly tighten the nuts with the prescribed tightening torque according to the design of the restraint supports with a clearance of ± 3 mm or ± 6 mm.

Tightening of the nuts of the restraints is in accordance with the approved VVD (switches delivered in the Czech Republic for Správa železnic, state organization, also in accordance with the issued model sheet 002.302 Restraints against switch rail movement).

3 Safety instructions

- The assembly, regeneration, and adjustment of the switch may only be carried out by a person authorized to do so, older than 18 years, who has been demonstrably familiarized with the operation, maintenance, and the safety instructions.

- During all adjusting and assembly work on the switch, the rail operator is obliged to ensure the safety of the operator against collision with rail and non-rail vehicles, and to prevent injuries to unauthorized persons by ordering them to leave the assembly area.

- A suitable lifting device with a declared capacity must be used to handle the switch. Use of unsuitable equipment may result in injury to you and to nearby personnel.
- When lifting and assembling the switch, an independent person is required to monitor the suspended load who can, through a means of communication, prevent it from rotating or creating an unstable position resulting in injury. Unauthorized persons must be ordered out of the workplace when laying the switch.

- Manually handling the switch, or welding and the grinding of welds, should be done with caution and using prescribed protective equipment.

- Always use protective equipment when carrying out manual maintenance and cleaning switches, and prevent possible injury to workers caused by sharp edges and laps occurring on the working surface of switches.

4 Preparing the switch for use

4.1 Component identification

In particular, the purpose of the identification is to:

a) demonstrably preserve data on input material properties (e.g. melting = material, manufacturer, steel grade certificate)

b) verifiable maintenance of data on the progress of components (parts) through the manufacturing process, with the recording of basic identification information (e.g. pearlitization number).

Rails for the manufacture of railway turnouts

All rails are identified with the manufacturer's mark (manufacturer's symbol, profile, year of manufacture). This manufacturer's mark is rolled by the manufacturer on the rail web in the centre of the profile at regular distances of 2–6 m (the distance between the rolled marks varies for different profiles).

In addition to the manufacturer's mark, all Vignole and switch rails are also identified with their melt number. The melt number is stamped on the rail web in the centre of the rail by the rail manufacturer and can be repeated several times over the rail length. In addition to the stamped number of the melt, a label is affixed to the rail face on which the melt number is also shown.

In rare cases, the mentioned rail marking may vary depending on the rail supplier.

To identify the switch parts, company labels made of aluminium alloy are used, which are attached to the marked part by gluing. Details of the turnout part are stamped on the name plate.

4.1.1 Switch identification

The right-hand stock rail of switch panels or switches supplied as a unit is labelled on the inside of the stand with the serial number of the switch. The turnout serial number is also stamped on the front of the two stock rails and at the tip of the switch rail foot, and marked in green (Figure 13).

Figure 13 – Example of switch identification: side view and front view

4.1.2 Switch rail identification

The name plate shows the switch geometry, serial number, year of manufacture, and technical inspection markings. Switch rails are marked on the front by stamping the identification number and melt number (Figure 14).

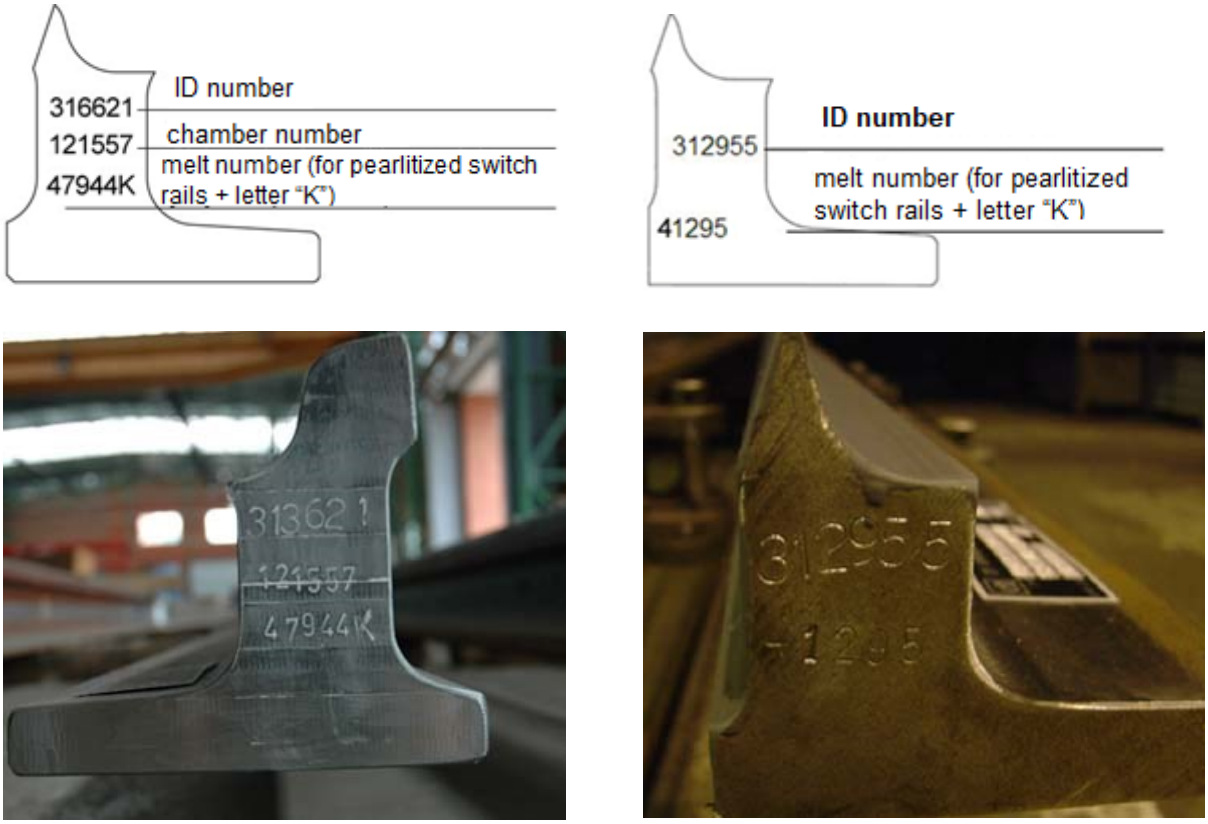


Figure 14 – Example of switch rail identification: front view

In cases where a switch rail is supplied as a separate spare part, a name plate is attached on the switch rail foot at a distance of approx. 50 mm from the front (Figures 15 and 16)

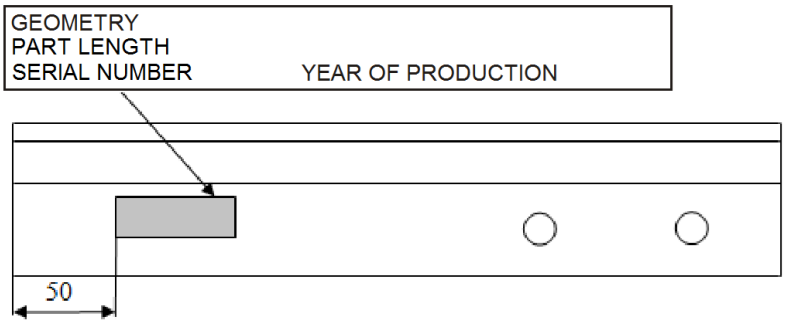


Figure 15 – Label placement

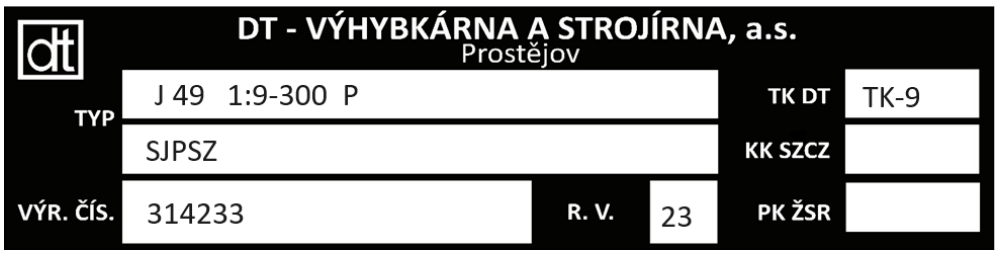
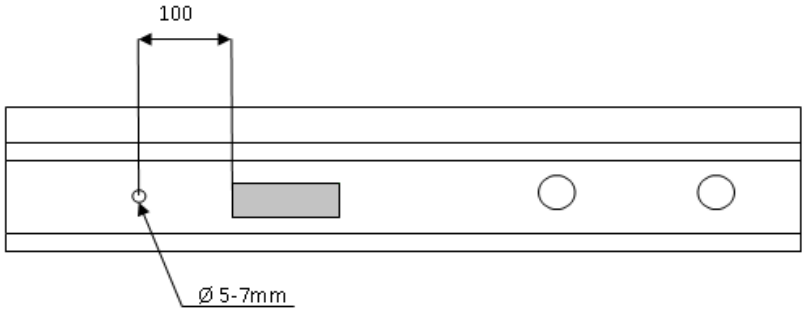


Figure 16 – Example of the identification of a switch rail spare part for simple turnouts J49 1: 9- 300P, switch rail length 13,058 mm, year of manufacture 2013, identification number 314263 – top view of foot, SJPSZ – additional identification according to customer's request

4.1.3 Stock rail identification

The name plate shows the switch geometry, serial number, year of manufacture, and technical inspection markings.



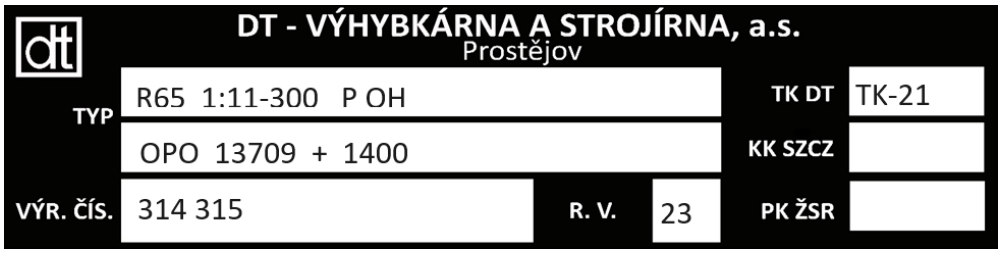


Figure 17 – Example of spare part identification for a simple turnout stock rail R65 1:11-300 P, stock rail length 13,709 mm + extension 1,400 mm, year of manufacture 2013, identification number 314 315 – side view of the web

A switch rail alignment fixture (Figure 18) may be adhered at the switch rail origin to ensure that the adjacent switch rail is correctly positioned relative to the stock rail depending on temperature conditions.

Figure 18 - Switch rail setting jig

4.1.4 Marking of trough sleepers

Trough sleepers are identified by the manufacturer according to Tab. 1, which also indicates its location in the replacement part of the switch.

Trough sleepers with the Pxxxx marking are standard wide trough sleepers (they are additionally identified by stamping the sleeper number on the upper edge of the sidewall of the trough sleeper - Fig. 19).
Trough sleepers marked Vx-xxxxx are in a narrow version (they are also identified by stamping the sleeper number on the upper edge of the sidewall of the trough sleeper - Fig. 20).

Tab. 1 Trough sleeper marking - replacement part

Switch shape	Replacement part					
	Ending 1	Ending 2	Ending 3	Ending 4	Ending 5	Ending 6
J49-1:7,5-190	P2357					
J49-1:6,6-190	P2357					
J49-1:9-300	P2357					
J49-1:11-300	P2357					
J49-1:12-500	P2357	P2408				
J49-1:14-760	P2357	P2409				
J49-1:18,5-1200	P2357	P2406	P2410			
J49-arbitrary geometry - shortened R	P2402	-	-	-	-	-
J49-arbitrary geometry - shortened L	P2403	-	-	-	-	-
C49-1:9-190-A	P2550	P2551				
C49-1:9-190-B	P2550	P2550				
C49-1:9-190-C	P2551	P2551				
C49-1:11-300-A	P2503	P2504	P2505	P2502		
C49-1:11-300-B	P2502	P2504	P2505	P2502		
C49-1:11-300-C	P2503	P2504	P2504	P2503		
C49-1:11-300-D	P2502	P2504	P2504	P2502		
C49-1:11-300-E	P2503	P2504	P2505	P2503		
C49-1:11-300-F	P2502	P2504	P2505	P2502		
C49-1:11-300-G	P2503	P2504	P2505	P2503		
C49-1:11-300-H	P2502	P2504	P2505	P2503		
J60-1:7,5-190	P2357					
J60-1:6,6-190	P2357					
J60-1:9-300	P2357	P2404				
J60-1:11-300	P2357	P2404				
J60-1:12-500	P2357	P2405				
J60-1:14-760	P2357	P2406	P2407			
J60-1:18,5-1200	P2357	P2406	P2407			
J60-1:26,5-2500-PHS	P2357	P2277	P2278	P2279		
J60-1:33,5-8000-4000-14000-PHS-ČZP	V1-10482/1	V1-10482/2	V1-10482/3	V1-10482/4	V1-10482/5	V1-10482/6
Trough sleepers	V2-15343/1	V2-15343/2	V2-15343/3	V2-15343/4	V2-15343/5	
J60-1:33,5-8000-4000-14000-PHS-ČZP	P2402	-	-	-	-	-
Sleepers for position sensors *	P2403	-	-	-	-	-
*Trough sleepers for the position sensors are symmetrical.						
C60-1:9-190-A	P2550	P2551				
C60-1:9-190-B	P2550	P2550				
C60-1:9-190-C	P2551	P2551				
C60-1:11-300-A	P2503	P2504	P2505	P2502		
C60-1:11-300-B	P2502	P2505	P2505	P2502		
C60-1:11-300-C	P2503	P2504	P2504	P2503		
C60-1:11-300-D	P2502	P2504	P2504	P2502		
C60-1:11-300-E	P2503	P2505	P2505	P2503		
C60-1:11-300-F	P2502	P2504	P2505	P2502		
C60-1:11-300-G	P2503	P2504	P2505	P2503		
C60-1:11-300-H	P2502	P2504	P2505	P2503		

Work procedure for the installation of trough sleepers - see chapter 4.4.6.

Fig. 19 Identification of a wide trough sleeper

Fig. 20 Identification of a narrow trough sleeper

4.2 Method of delivery and packaging of the switch

The most common scope of switch part deliveries:

1) **complete switches** – the delivery includes switch rails, stock rails, mounted slide chairs and sole plates, switch rail supports, retaining supports, fasteners, sleepers. The switch rails are tied to the stock rails with tape. The possible delivery of adjustment equipment is dealt with separately.

Figure 21 - Switch panel on concrete sleepers

2) **complete switch half sets** – the delivery includes the switch rail, stock rail, slide chairs and sole plates, switch rail supports, retaining supports, fasteners, laid on wooden beams; switch rails are tied to the stock rails with tape.

Figure 22 - Complete half-switch panels stacked

3) **half switches** as a spare part without sole plates and slide chairs, only with switch rail supports, are placed for assembly and transport reasons on temporary assembly slide chairs and sole plates, which are spaced about 3–4 m apart.

Figure 23 - Stacked ND of half-switch panels

4) **separately supplied switch parts** as a spare part: switch rail, stock rail, switch rail support, retaining support, slide chair and sole plate, fasteners

4.3 Transport, handling and storage

General principles for handling and storing switches and their parts:
Safety instructions must be observed when handling switches, see point 3

- The method of transferring turnout parts depends on the distance from the assembly to the laying site and the technological equipment used. Depending on the type of transport equipment used, the parts can be transported over a short distance using the laying equipment itself, or it may be necessary to provide transport to the laying site on platform wagons. Transport and laying work must be carried out so as to avoid deformation of the turnout parts and damaging their geometry.
- When handling with a crane, it is necessary to suspend the assembled parts of turnouts by rails fastened to sleepers (if sleepers are fitted). The deviation of the suspension ropes from the vertical direction shall not be greater than ± 20° in the longitudinal direction parallel to the turnout part axis (in order to prevent the movement of sleepers at very high thrust) and a max. 35° in the transverse direction perpendicular to the turnout part axis.
- Half switches must be transported using two harnesses. The lifting capacity of the harness and the lifting device must not be exceeded during handling.

Turnout parts must be stored on a paved levelled surface. Turnout parts must be underlaid with crossers spaced approximately 4 m apart. The overhang of the ends of the stack rails (rails) may be a maximum of 2.5 m, the tip of the switch rail must not overhang the outermost pad by more than 300 mm. The assembled parts of switches can be placed on top of each other in three layers. In doing so, it is necessary to prevent mechanical damage to the insulation of the running rails with LIS (if they are used in the turnouts).

4.4 Installation and assembly instructions

General principles for handling during installation:
Safety instructions must be observed when handling switches

The assembly and laying instructions for railway turnouts shall comply with the applicable legislation in the country where the switches are being delivered.

Switches are manufactured and can be delivered according to the requirements of the buyer (customer) in the following versions:

1) Completely assembled (on concrete or wooden sleepers).
a) Pre-assembled, i.e. a set of pre-assembled sleepers (concrete or wooden) and steel switch parts.
2) Non-pre-assembled, i.e. turnout sleepers (wooden, in specials cases concrete) and steel switch parts.
3) Only steel switch parts, without sleepers.
4) Dissassembled fasteners are supplied in transport cases

4.4.1 Work procedure for assembling partially assembled turnouts on wooden or concrete sleepers

These are turnouts supplied with assembled switches. For the purpose of transport, some sleepers may also be disassembled from the assembled parts of those turnouts that exceed the loading dimensions of the railway wagons.
Assembly is carried out on a grid made of rails on a paved, flat surface.

1. Measure the position of the disassembled sleepers on the assembly grid or on the laying site.

2. Lay out the dismantled sleepers and place the polyethylene pads under the sliding stools. Lay the switch onto the disassembled sleepers; before laying the switch, align the sleepers using heavers.
3. Assemble the disassembled sleepers onto the switch if they have been removed for transport.
4. Place the central part of the turnout onto the disassembled sleepers, adjust the sleepers according to the markings on the foot of the running rails during laying, and mount the sleepers on.
5. Align the middle part with the switch.
6. Check the branch line deflection.
7. With curved turnouts, check the deflection of the stock rails and running rails of the central section of the turnout.
8. Weld turnout parts to lengths that allow them to be transported to the laying site, or weld after laying.
9. Welding the switch rail with the rail of the middle part can only be done after the turnout has been inserted, and its alignment and height have been properly adjusted. The switch rail must not be welded on if the play between the switch rail and the stock rail, and the switch rail and supports, is unsatisfactory.
10. Before welding the switch rail, it must be properly aligned to the support using a fixture glued to the stock rail stand (Figure 18), taking into account the current rail temperature.
11. If the switch panel part is equipped with integrated SVV-ZP or SVV-P roller stools, the roller stools are shipped without roller gates. The roller gates are installed after all construction work has been completed, just before the start of operation. Only a contractor approved by the manufacturer may install the gates of the rolling stools.

The welding on of switch rails is carried out in a position adjacent to the stock rail with the switch rail shifted forward sufficiently from the zero position due to its shrinkage after welding. With regard to the clamping temperature and if the tip of the switch rail is prevented from being adjusted by the switch rail restraint against movement (lock), it can be removed in exceptional situations. Installation of the restraint must be carried out at a more favourable temperature and the self-locking nuts must be replaced with new ones.
After welding the switch panel parts to the long-welded rail, the bolt connection of the restraints must be tightened to the prescribed tightening torque of 700Nm, if it was allowed before welding.

4.4.2 Work procedure for assembling pre-assembled switches of simple turnouts on wooden or concrete sleepers

These are of turnouts supplied as disassembled. The steel part of the turnout, and the set of wooden or concrete sleepers with mounted slide chairs and sole plates are supplied separately.

1. Lay out the sleepers with pre-assembled slide chairs and sole plates according to the layout drawing.
2. Put rubber pads on sole plates (rubber pads under the rail foot).
3. Lay the stock rail on the slide chairs and sole plates.
4. Counter-lay the curved stock rail.
5. Using heavers, align the sleepers using sleeper axis markings on the stock rail feet.
6. Set the switch rails on the sliding stools according to the switch rail setting jig.
7. Fasten stock rails and switch rails to the sole plates and slide chairs using clamps.
8. Adjust the gauge in the switch.
9. Check and fit as necessary the switch rails in the machined part to the stock rails.

10. Check the switch rail seating on sliding surfaces of the slide chairs.
11. Fit the switch rail supports with a maximum play of 0.5 mm.
12. Welding the switch rail with the rail of the middle part can only be done after the turnout has been inserted, and its alignment and height have been properly adjusted. The switch rail must not be welded on if the play between the switch rail and the stock rail, and the switch rail and supports, is unsatisfactory.
13. Before welding the switch rail, it must be properly aligned to the support using a fixture glued to the stock rail stand (Figure 18), taking into account the current rail temperature.
14. If the switch panel part is equipped with integrated SVV-ZP or SVV-P roller stools, the roller stools are shipped without roller gates. The roller gates are installed after all construction work has been completed, just before the start of operation. Only a contractor approved by the manufacturer may install the gates of the rolling stools.

The welding on of switch rails is carried out in a position adjacent to the stock rail with the switch rail shifted forward sufficiently from the zero position due to its shrinkage after welding. With regard to the clamping temperature and if the tip of the switch rail is prevented from being adjusted by the switch rail restraint against movement (lock), it can be removed in exceptional situations. Installation of the restraint must be carried out at a more favourable temperature and the self-locking nuts must be replaced with new ones.

After welding the switch panel parts to the long-welded rail, the bolt connection of the restraints must be tightened to the prescribed tightening torque of 700Nm, if it was allowed before welding.

4.4.3 Work procedure for assembling simple turnout switches on wooden sleepers

These are the steel part of turnouts supplied by DT. The switch is supplied as two half switches, with mounted slide chairs, switch rail supports, and retaining supports against creeping.

1. Before assembly, check the tools, gauges, the binding and protective equipment used, prepare the assembly grid and remove any undesirable objects from the workplace.
2. Select wooden sleepers according to their length – lay out the wooden sleepers and put them on the grid according to the layout drawing of the switch or drawing documentation, and lay out polyethylene pads on sleepers.
3. Set in place the main direction half switch (the half switch with the direct stock rail) with the outer straight running rails of the middle and frog section, including the coupling of these rails with the tightening of joints and fishbolts.
4. Friendly positioning of the second half-switch panel (by means of an angle) and the runner rail of the middle and frog section. Use couplings to connect the running rails (inner belt) behind the stock rail.
5. Use the crowbars to align the sleepers according to the sleeper axis markings on the heels of the stock rails and runner rails.
6. Drill holes in the cross in every third sleeper for the attachment of the sliding stools or switch panel sole plates and the main direction runner rail sole plates. Fitting and turning the sleeper screws into the drilled holes. Check the straightness of the entire outer branch of the main (straight) direction. Impregnate the drilled holes before inserting sleeper bolts – this applies to all holes in the wooden sleepers of the assembled turnout.
7. Checking of gauge and mounting dimensions in the switch panel, including the fit of the switch rails to the stock rails, to the sliding stools and switch rail restraints.
8. Adjust the gauge using modified jacks, for example, within the tolerance specified in the drawing.
9. Save the centre section's runner rails behind the switch rails and frog. Place the centre and frog section of the main direction in the gauge. Drill the holes and turn the sleeper screws on every third sleeper.

10. Place the runner rail of the outer rail of the siding in the correct position and fix it to the sleepers. The alignment of the rail is done by plotting the distances of the running edges in the sleeper axis shown in the assembly drawing. Simultaneously, perform a deflection check in the curve section.
11. Check the gauge, the main branch track straightness, the curved stock rail deflection, and the running rails prior to the turnout's final assembly.
12. For fastening slide chairs and sole plates, drill the remaining holes for sleeper bolts in the switch, in both rail belts, and the frog, constantly checking the gauge, then tighten sleeper bolts using 280 to 350 Nm torque.
13. Assemble the securing bolt, or connecting rods, test the function of the securing bolt.
14. Check the switch rail opening, grooves, switch rail seating to supports, and other specified dimensions and tolerances for the given turnout.
15. Welding the switch rail with the rail of the middle part can only be done after the turnout has been inserted, and its alignment and height have been properly adjusted. The switch rail must not be welded on if the play between the switch rail and the stock rail, and the switch rail and supports, is unsatisfactory.
16. Before welding the switch rail, it is necessary to align it correctly to the stock rail using a jig glued to the stock rail stand (Figure 18), taking into account the current temperature of the rails.
17. If the switch panel part is equipped with integrated SVV-ZP or SVV-P roller stools, the roller stools are shipped without roller gates. The roller gates are installed after all construction work has been completed, just before the start of operation. Only a contractor approved by the manufacturer may install the gates of the rolling stools.

The welding on of the switch rails is carried out in a position adjacent to the stock rail with the switch rail shifted forward sufficiently from the zero position due to its shrinkage after welding. With regard to the clamping temperature and if the tip of the switch rail is prevented from being adjusted by the switch rail restraint against movement (lock), it can be removed in exceptional situations. Installation of the restraint must be carried out at a more favourable temperature and the self-locking nuts must be replaced with new ones.
After welding the switch panel parts to the long-welded rail, the bolt connection of the restraints must be tightened to the prescribed tightening torque of 700Nm, if it was allowed before welding.

4.4.4 Work procedure for assembling the steel part of a simple turnout switch on a slab track (Top-down laying system)

1. Lay out both half switches onto the base layer of the concrete slab.
2. Using a sufficient number of jacks, lift the half switches to the required height needed to pour the second concrete layer. Make sure that the height of the half switch is not corrugated due to its own weight and insufficient support, and that the half switches are not rotated from their horizontal position.
3. Adjust the gauge to the required tolerances and fix the half switches to each other using the appropriate means to ensure a constant gauge until the concrete is fully cured.
4. Align the middle part with the switch.
5. Check the branch line deflection.
6. Check whether the switch rail fitting to the stock rails, the switch rail fitting to the switch rail supports, and the switch rail fitting to the slide chairs all meet the specified tolerances.
7. Fit the holes in the slide chairs and sole plates with insulating sleeves (if supplied).
8. Fit the holes with anchor bolts, washers, and nuts. If spring washers under the sole plates are supplied together with the switch, it is necessary to install these washers before

pouring the concrete layer and to fix them perfectly to the bottom surface of the sole plates.

9. Loosely tighten the nuts of the anchor bolts to fix the position of the anchor bolts.
10. Pour the concrete layer to the desired height. If a spring element under the sole plates is to be additionally installed in the form of pouring a special elastic layer, it is necessary to terminate the top surface of the concrete at a sufficient distance from the bottom surface of the sole plates.
11. After the concrete slab has sufficiently cured, the additional spring layer should be poured under the sole plates.
12. After the pour has cured, tighten the anchor bolts to the specified torque.
13. Welding the switch rail with the rail of the middle part can only be done after the turnout has been inserted, its alignment and height have been properly adjusted, and bottom layers cured. The switch rail must not be welded on if the play between the switch rail and the stock rail, the switch rail and supports, and the switch rail and slide chairs, is unsatisfactory.
14. Before welding the switch rail, it is necessary to align it correctly to the stock rail using a jig glued to the stock rail stand (Figure 18), taking into account the current temperature of the rails.
15. If the switch panel part is equipped with integrated SVV-ZP or SVV-P roller stools, the roller stools are shipped without roller gates. The roller gates are installed after all construction work has been completed, just before the start of operation. Only a contractor approved by the manufacturer may install the gates of the rolling stools.

The welding on of switch rails is carried out in a position adjacent to the stock rail with the switch rail shifted forward sufficiently from the zero position due to its shrinkage after welding. With regard to the clamping temperature and if the tip of the switch rail is prevented from being adjusted by the switch rail restraint against movement (lock), it can be removed in exceptional situations. Installation of the restraint must be carried out at a more favourable temperature and the self-locking nuts must be replaced with new ones.
After welding the switch panel parts to the long-welded rail, the bolt connection of the restraints must be tightened to the prescribed tightening torque of 700Nm, if it was allowed before welding.

4.4.5 Work procedure for assembling the steel part of a simple turnout switch on slab track (Bottom-up laying system)

1. Lay out both half switches onto the final layer of the concrete slab. At the same time, insert spring washers under the sole plates.
2. Adjust the gauge to the required tolerances.
3. Align the middle part with the switch.
4. Check the branch line deflection.
5. Check whether the switch rail fitting to the stock rails, the switch rail fitting to the switch rail supports, and the switch rail fitting to the slide chairs all meet the specified tolerances.
6. Drill holes for anchoring elements in the concrete slab through the holes in the sole plates using a core drill.
7. Thoroughly clean the drilled holes with compressed air.
8. Apply the bonding cement to the hole and insert the fully fitted anchor into the hole.
9. After the bonding cement has fully cured, tighten the anchor nut (bolt) to the working position using the specified tightening torque.

10. Welding the switch rail with the rail of the middle part can only be done after the turnout has been inserted, its alignment and height have been properly adjusted, and bottom layers cured. The switch rail must not be welded on if the play between the switch rail and the stock rail, the switch rail and supports, and the switch rail and slide chairs, is unsatisfactory.
11. Before welding the switch rail, it is necessary to align it correctly to the stock rail using a jig glued to the stock rail stand (Figure 18), taking into account the current temperature of the rails.
12. If the switch panel part is equipped with integrated SVV-ZP or SVV-P roller stools, the roller stools are shipped without roller gates. The roller gates are installed after all construction work has been completed, just before the start of operation. Only a contractor approved by the manufacturer may install the gates of the rolling stools.

The welding on of switch rails is carried out in a position adjacent to the stock rail with the switch rail shifted forward sufficiently from the zero position due to its shrinkage after welding. With regard to the clamping temperature and if the tip of the switch rail is prevented from being adjusted by the switch rail restraint against movement (lock), it can be removed in exceptional situations. Installation of the restraint must be carried out at a more favourable temperature and the self-locking nuts must be replaced with new ones.

After welding the switch panel parts to the long-welded rail, the bolt connection of the restraints must be tightened to the prescribed tightening torque of 700Nm, if it was allowed before welding.

4.4.6 Work procedure for the installation of trough sleepers

If trough sleepers are not installed in the replacement part by the manufacturer, they must be inserted into the replacement part according to Fig. 24 and Fig. 25. The trough sleeper serial number at the bottom of the trough sleeper and the trough sleeper serial number at the base of the support shall be placed together as shown in Fig. 25. The marking of the trough sleepers and the corresponding supports (rails) is done by the manufacturer on the side where the embossed mark of the concrete sleeper number is placed - see Fig. 24.

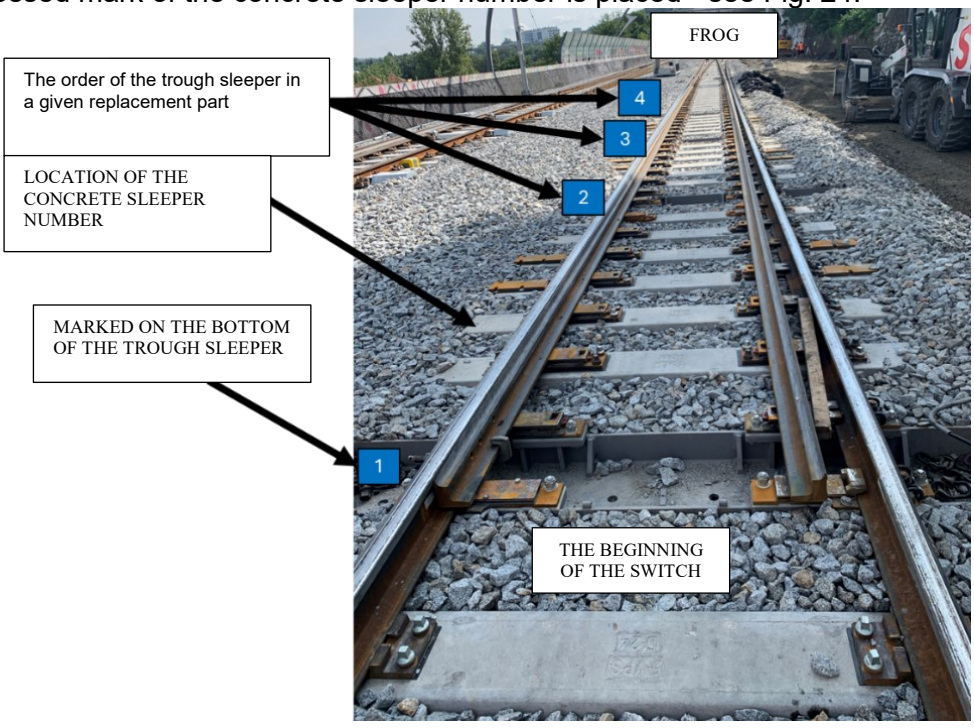


Fig. 24 Marking of trough sleepers to facilitate their installation in the switch replacement part

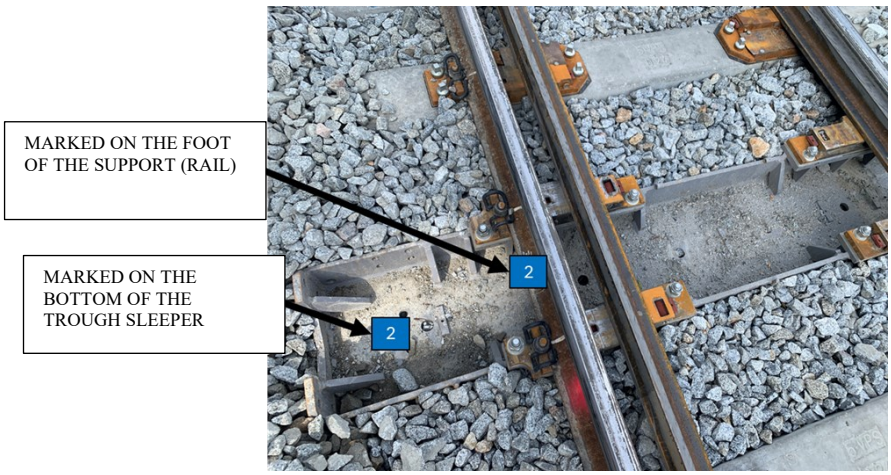


Fig. 25 Matching marking of the trough sleeper at its bottom and at the foot of the support (rail)

For switch type C49 and C60, the manufacturer identifies the trough sleepers according to Fig. 26 and Fig. 27 to the side where the embossed mark of the concrete sleeper number is located. The serial number of the trough sleeper at the bottom of the trough sleeper and the serial number of the trough sleeper at the foot of the support (rail) must be placed together according to Fig. 25.

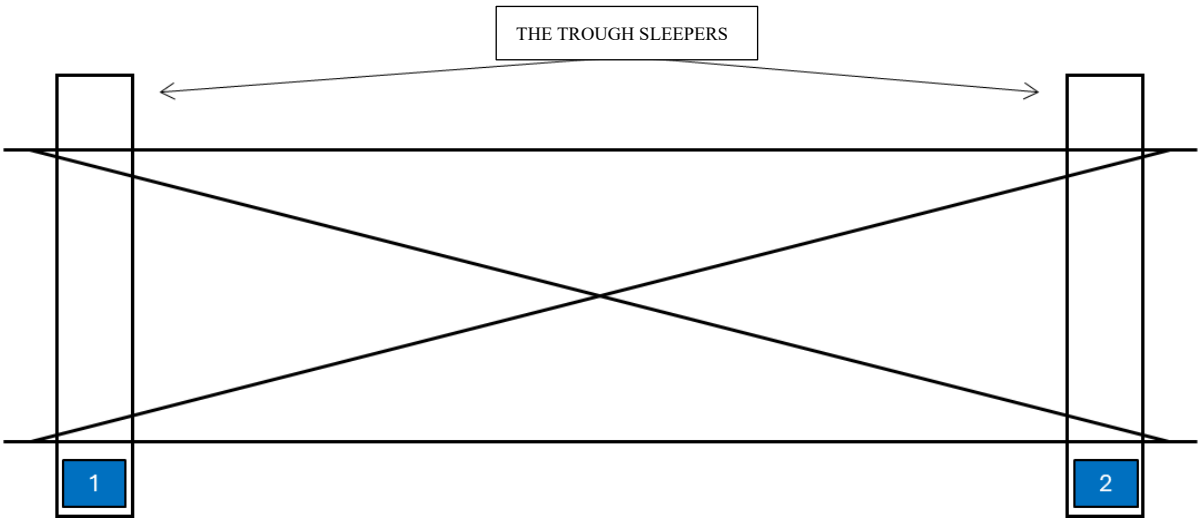


Fig. 26 Designation of trough sleepers for switches of shape C49-1:9-190 and C60-1:9-190

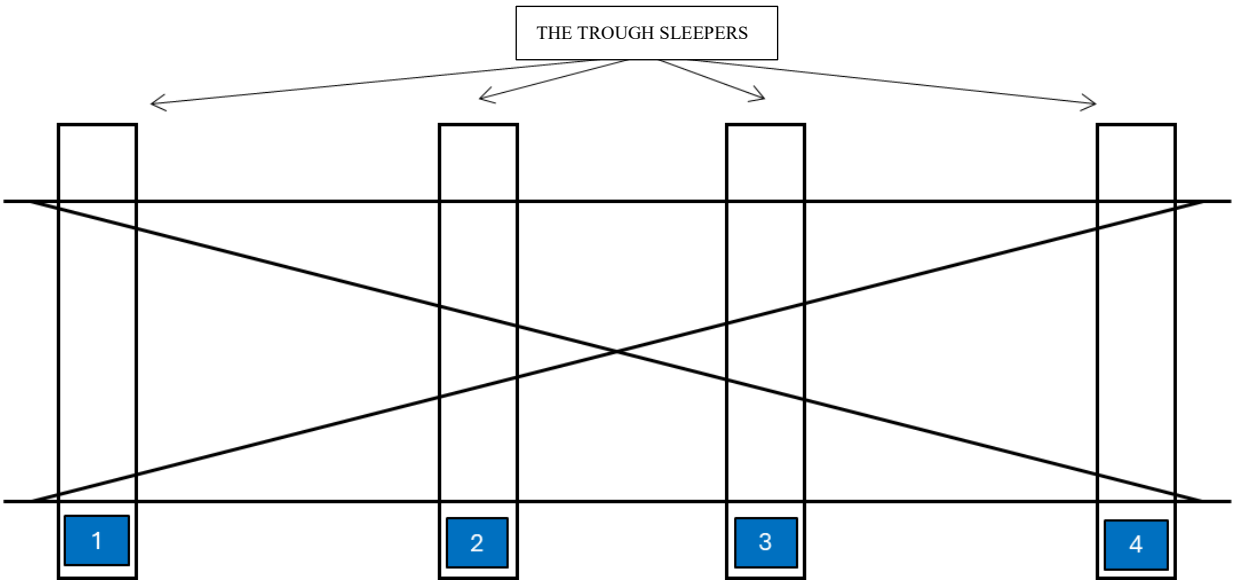


Fig. 27 Designation of trough sleepers for switches of shape C49-1:11-300 and C60-1:11-300

4.5 Limit deviations/tolerances for the assembly of switches in the plant and during acceptance

- If the manufacturing tolerances are not shown in the drawing documentation, then ISO 2768-1 and ISO 2768-2 shall apply with a degree of accuracy of c, L.
- The drawing documentation, TPD 60/02 (only for the Czech Republic), EN 13232-5, and others apply to the production, acceptance and inspection of switches.
- The values of the track gauge and the course of grooves are determined for acceptance at the plant according to the approved production documentation, including permissible tolerances, which are specified in the drawing documentation.

Some important tolerances if not specified otherwise:

- The tolerance of the distance between the running edges at the end of the switch joint is ± 2 [mm].
- The head of the adjacent switch rail must fit against the stock rail with a max. play of 1 mm after the insertion of the new turnout into the track.
- The adjoining switch rail web must fit against the switch rail supports, a max. clearance of 0.5 mm is allowed after assembly.
- The play between the foot of the switch rail in its movable part and the sliding surface of the slide chair during assembly is max. 1 mm.
- The length of parts up to 15 m ± 3 mm, over 15 m ± 4 mm (1 mm to every 5 m of length)
- Coupler holes to the more distant hole ± 2 mm from the front
- The relative position of the switch rail/stock rail is usually indicated by an opening with Ø 5–7 mm at a temperature of 15°C
- Tolerance of the position of sleepers (if used) at the locking device is ±5 mm from the beginning of the switch, others ±10 mm

4.6 Safe operation/limit operating deviations and tolerances

- The permissible limit deviations and tolerances are governed by the standards and regulations of the local railways (railway operators).

- To ensure the operability of the switch and its proper function, it is necessary to monitor its parameters.
- In a given territory, operators may have standards with their own requirements and conditions that differ from our proposal.
- The parameters below are therefore only recommended by the manufacturer, and are not binding on the user.

Switch rails are made so that the switch rail in the adjacent position (without tension and without the force of the outlying switch rail), does not move away from the stock rail after the locking device is released, with the exception of turnouts at the cant of the track. This must be maintained even when the switch rail is welded to the central rails.
The following conditions shall apply to assembled and operated turnouts after the switch rails have been switched to their end position:

The head of the adjacent switch rail must fit against the stock rail with the play:
a) max. 2 mm at a travelling speed V > 120 km.h-1,
b) max. 3 mm at a travelling speed 60 < V ≤ 120 km.h-1,
c) max. 6 mm at a travelling speed V ≤ 60 km.h-1.

The adjacent switch rail web must fit against the switch rail supports; the following plays are permissible:
a) max. 1 mm after assembly,
b) max. 2 mm at a travelling speed V > 160 km.h-1,
c) max. 3 mm at a travelling speed 90 < V ≤ 160 km.h-1,
d) max. 5 mm at a travelling speed V ≤ 90 km.h-1.

The play gap between two adjacent supports shall not exceed 2 mm;

The width of the groove between the head of the outlying switch rail and the head of the stock rail shall be:
a) min. 60 mm at the point of the greatest approach of the switch rail to the stock rail (the value may be reduced – up to 55 mm – depending on the geometry of the switch, the wheel shape, and the travel of switching box)
b) the value of this groove should not exceed 75 mm for single-lock and 70 mm for multi-lock turnouts. It is recommended that the groove is adjusted at the lower limit (to reduce the reverse effect of the switch rail to the switching device).

The prescribed relative position of the switch rail and the stock rail in the longitudinal direction is indicated by a mark stamped with a punch or hole in the neutral axis of the stock rail opposite the beginning of the tip of the switch rail or by a glued jig for setting the switch rail. The position of the beginning of the tip of the switch rail against the punch mark, the axis of the hole or the fixture is valid at a stock rail temperature of + 15 °C.

The play between the switch rail foot and the sliding surface of the slide chair
In their moving part, switch rails are placed on slide chairs and have to rest against them (with max. 1 mm play during assembly). If the switch rail does not rest against the chairs, the play between the switch rail foot and the sliding surface of the slide chair during operation may be:
a) max. 2 mm at a travelling speed V > 120 km.h-1,
b) max. 3 mm at a travelling speed 90 < V ≤ 120 km.h-1
c) max. 4 mm at a travelling speed V ≤ 90 km.h-1

5 Maintenance and repair of switches recommended by the manufacturer

To ensure that turnouts are operational, regular inspections and measurements must be carried out at the defined time intervals specified in the relevant railway documents.
For foreign customers, these activities are governed by local railway standards and regulations, or by the railway operator's standards and regulations.

When performing maintenance and repair work on switches, the relevant safety regulations must be observed, as well as the safety instructions in point 3.

Stress and wear depend mainly on the geometry and the speed at which the turnout is travelled.
Maintaining rails and turnouts generally involves repairing defects that endanger the safety and smoothness of railway traffic, or defects whose continued development would threaten railway traffic if they were not eliminated in time.
Defects and deformations occur on the running and stressed parts of the turnout. Their timely removal will prolong the life of these components.
The elimination of defects is divided according to their scope into:

- minor maintenance of the permanent way
- planned repair work of a higher grade (based on findings from regular inspections)

5.1 Rail defects and wear in the switch area

5.1.1 Exceptional vertical wear

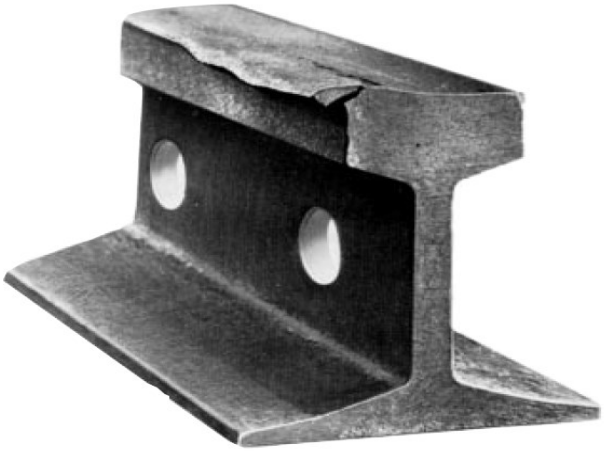


Figure 28 – Exceptional vertical wear

The excessive pressure of wheels on the inner belt pushes against the material of the rail head and creates laps. The base material is pushed out sideways and often over the end of the rail. In extreme cases, a lap which tends to separate off from the rail can be formed. The formation of chips (burrs) can then be observed, which can extend to the entire length of the rail, split into narrower chips, and gradually come apart from the rail head. The counter-measure consists in monitoring and repairing by grinding or replacing parts.

5.1.2 Angled cracks of the running edge (head checking)

Figure 29 – Head checking

This defect results from high contact pressure on the wheel/rail connection.
The defect is initiated from the top of the running surface (edge). It manifests as a large number of parallel cracks, usually at a distance of 1–5 mm from each other on the running edge, inclined at a certain angle, and reaching a depth of approx. 2 mm. If a transverse crack is detected, replace or repair the part promptly.

5.1.3 Sloping cracks of the running edge (squats)

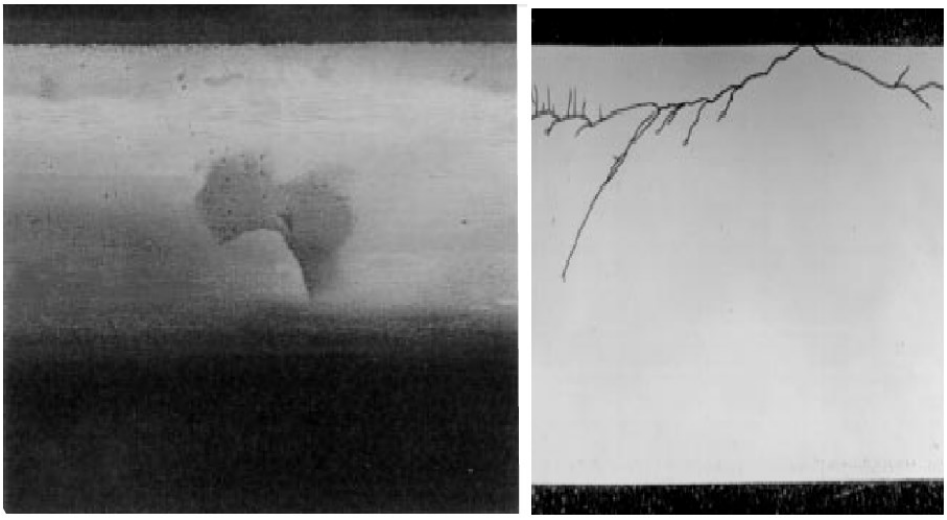


Figure 30 – Inclined cracks to the running surface (squats)

The defect occurs both in straight line and in curve sections, especially on tracks running at 160 km/h or more, but also on tracks with lower speeds on a climb. It is a contact fatigue defect initiated from the surface. At an early stage it is displayed by randomly distributed cracks (also in clusters) between the centre of the rail head and the running edge, 12–15 mm long, which in the cracks' direction of travel point at an angle of about 45° to the running edge. From the head surface, cracks go at an angle of about 10–15° from the longitudinal axis of the rail to the rail head in forward and backward longitudinal directions. When the cracks reach a depth of about 1.6 mm, a dark spot appears on the surface, indicating the splitting of the material. This is accompanied by a local expansion of the running surface around the dark spot. The cracks develop further and, after reaching a depth of about 4 mm, branch down in the direction of the train travel. At the critical crack size, a brittle fracture of the rail occurs. If a defect develops, replace or repair the part promptly.

5.1.4 Peeling and scoring of metal on the running surface of the rail

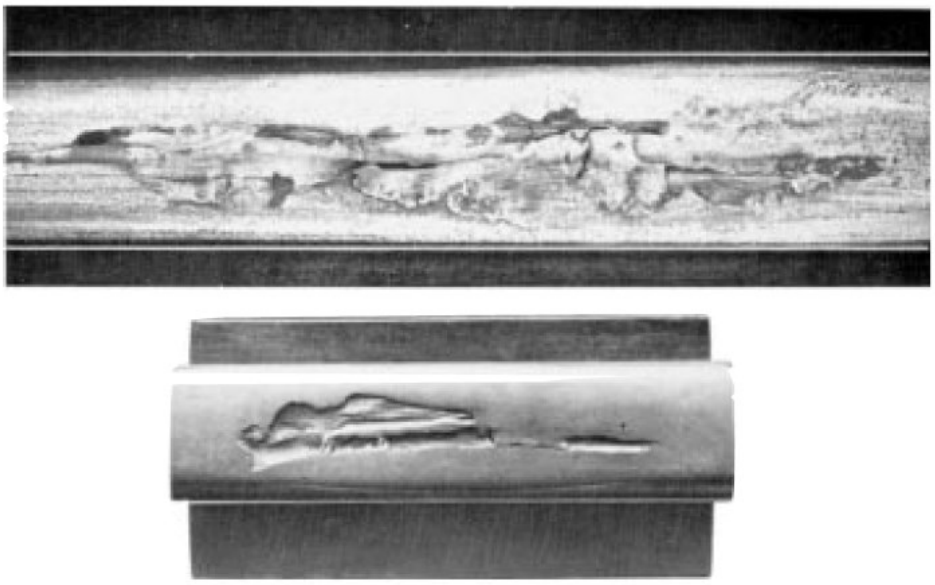


Figure 31 – Flaking and crumbling metal on the running surface of the rail

Incorrect production technology already produces hair cracks, laps and slivers during rail manufacture. The dynamic effects of vehicles widen these defects, with thin layers of metal crumbling or shelling away from the running surface of the rail. Repair by welding and grinding.

5.1.5 Places on the running surface damaged by a single slipping

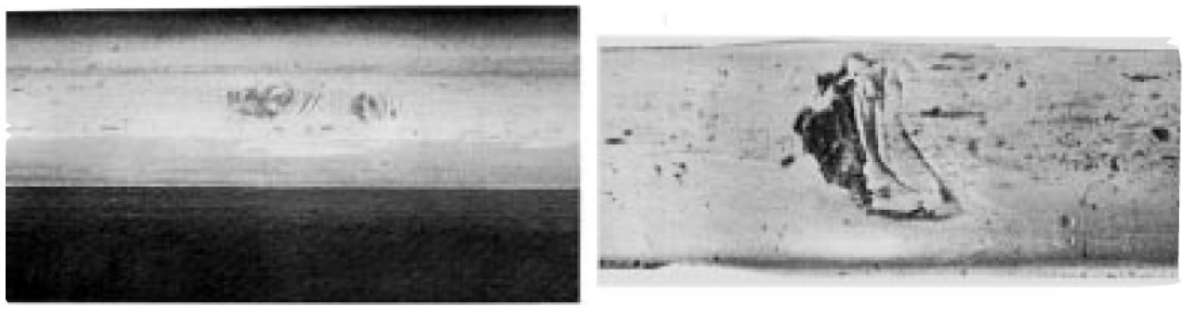


Figure 32 – Spots on the running surface ground by a single slip of the driving axle (“frogs”)

Drive axle slippage causes spontaneous cloudy spots with oval circumferences. This stain may either disappear or develop further. Repair by welding and grinding.

5.1.6 Places on the running surface damaged by repeated slipping

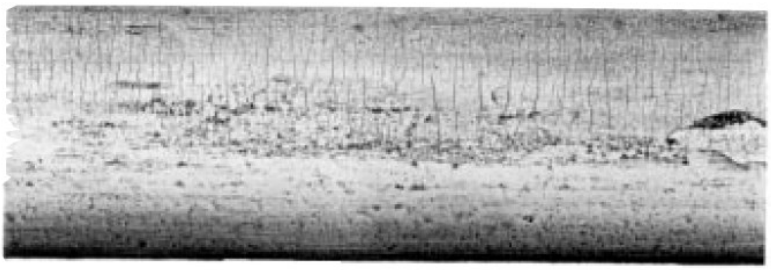


Figure 33 – Spots on the running surface ground by repeated slips

It occurs in sections of repeated starting-up and braking, or in areas where tractive vehicles often slip. On the running surface can form a network of hair cracks which are oriented downwards and are known as net cracks. In cold periods, these cracks increase rail susceptibility to fractures. If a transverse crack is found, the counter-measure consists in prompt exchange or repair.

5.1.7 Short waviness

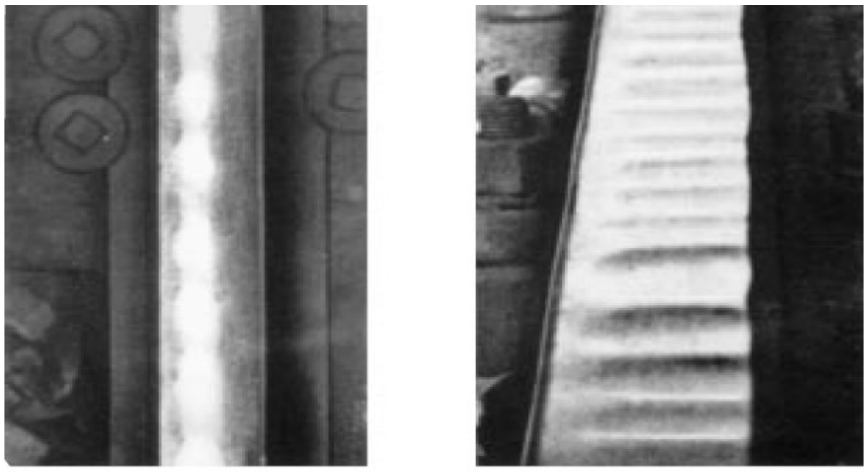


Figure 34 – Corrugation

A whole complex of causes (coarse surface of the rail from production, construction of the ballast foundation, character of operation, etc.) contribute to the formation of corrugation. If the depth of corrugation has reached a level that is harmful (high noise level, vehicle travel vibration), the counter-measure is to grind rails.

5.1.8 Long waviness

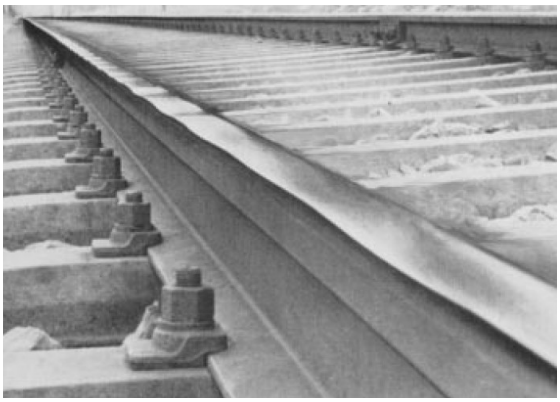


Figure 35 – Wavy deformation of the head, long waves

Regular vertical waves 1.5 to 3 m long and more than 2 mm deep. The origin of the defect is in the manufacturing process, especially in the straightening of the rails. If the corrugation – with respect to the depth of the wave and track speed – causes a rapid decay of the track's geometrical position, it is necessary to repair it by grinding or replacing the part.

5.1.9 Metal peeling from the running surface (shelling)

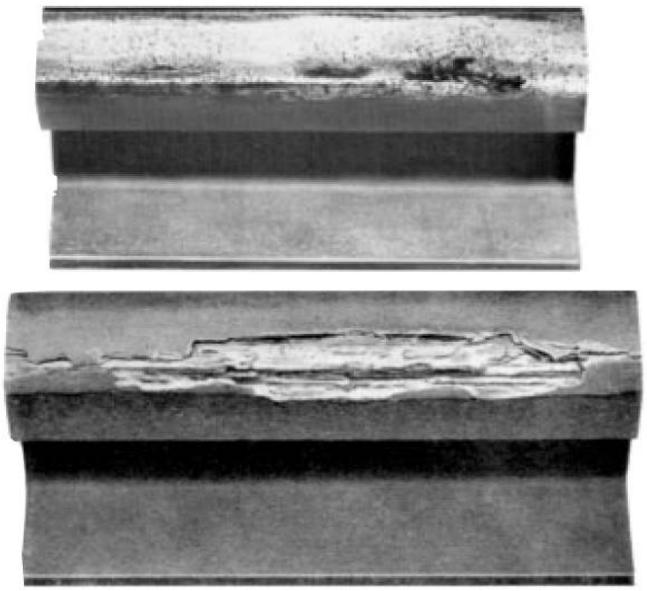


Figure 36 – Material flaking from the running edge (shelling)

This is caused by a longitudinal crack below the surface of the running edge of the rail, resulting from contact and slip forces, especially when travelling through curves. If this defect is found, it is necessary to replace the entire rail.

5.1.10 Peeling of the running edge

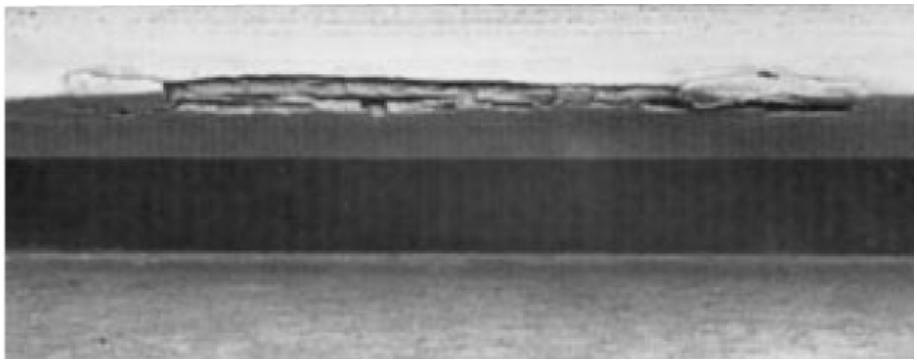


Figure 37 – Shelling of the running edge of the rail

Shelling is caused by insufficient strength of the rail steel, high tensile stress, and non-metallic inclusions. Most often, the inner edge of the outer track stretch is damaged in small radius curves and turnout switch rails. Turnout switch rails with shelling (crumbling) deeper than 5 mm must be repaired or replaced.

5.1.11 Lateral wear of the rail head

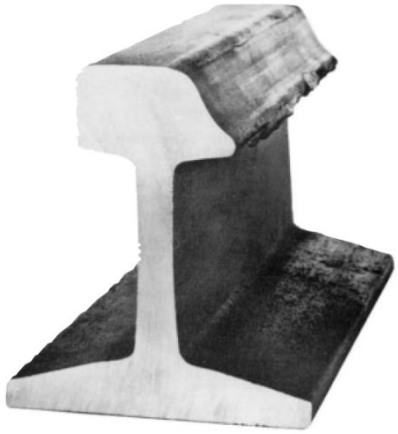


Figure 38 – Lateral wear of the rail head

Lateral wear occurs in outer track stretches in curves due to vehicle loading. Repair or replacement of the part is required.

Switch rail wear

During service switch rails may exhibit crown wear, lateral wear, or damage. Defects that cannot be attributed to production are caused by differences between the actual position of the wheel and rail contact and the theoretically optimal contact point. There are different points of contact between new and heavily worn vehicle wheels. The size and shape of the wear depend on the size of the forces, the site of action, and their frequency.

Defects include laps, degradation, slips, and shape deformation through to material damage (e.g. head checks, corrugation). Checking the wear of the switch rail and the stock rail must be carried out using templates in both the straight and branch lines. In principle, it is necessary to prevent the flange hitting against the tip of switch rail, as there is a risk that the flange may be raised to the crown of the switch rail and stock rail. When repairing an unsatisfactory

inclination of the side running surface of the switch rail (angle less than 55° as measured by the wear gauge), at least a 60° angle should be achieved by grinding.
Another cause of defects can be the laps on the switch rail and stock rail chambers.

5.1.12 Lateral wear of the tip of the switch rail by the driving contour

Figure 39 – Lateral degradation of the switch rail tip with the wheel's running profile

This switch rail degradation is due to transverse forces produced by the flange, and occurs mainly in curved switch rails. Repair is done by grinding.

5.1.13 Switch rail peeling

Figure 40 – Switch rail crumbling

The crumbling of the switch rail is a consequence of wear from the passing wheel profile, most often with a curved switch rail at the beginning, where the switch rail tip is not thick enough; the most critical section prone to crumbling is the area where the tip is 2–5 mm thick. It is solved by grinding or replacing with a new switch rail. In order to increase switch rail resistance to this type of damage, special optimized switch rails are constructed. The principle of this optimization lies in the reinforcement of the switch rail tip on the adjacent side and its embedding in the stock rail, which is machined to the value of the reinforcement.

5.1.14 Laps on the running edge of the switch rail

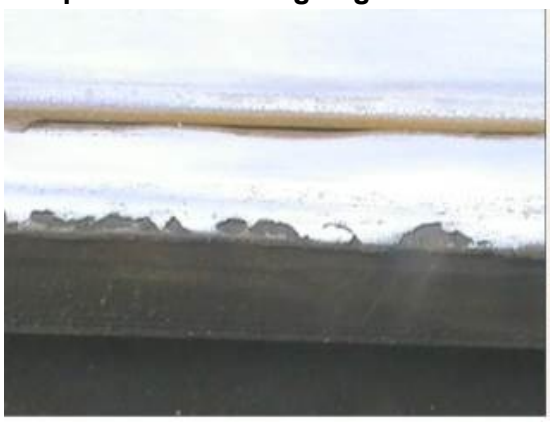


Figure 41
– A lap on the running edge of the switch rail

Figure 42
– Detached lap due to neglected maintenance

Laps in the switch area are created due to traffic on the side of the running edge in both switch rails and stock rails. They are continuously removed as part of minor maintenance. Failure to perform maintenance may result in the breakage of the lap.

5.2 Assessing and monitoring the switch condition

5.2.1 Checking the safety of the wheelset guide

Consists in assessing whether the inclination of the lateral running surface of the rail section is maintained at a depth of 14 mm to 18 mm below the contact points linking the wheel contact circles with the upper rail running surface. The angle of inclination of the lateral running surface at the point of contact must be greater than or equal to 55° (Figure 43).
The measurement is carried out with a template (Figures 44, 45, 46), in which a line is marked at the level 18 mm, below the level of the stock rail crown. The surface that touches the lateral running surface of the switch rail has inclination of 55°. If there is a point of contact in the area above the line or exactly on the line, it is in a satisfactory condition (Figure 44); if the point of contact is located below the line (Figures 45, 46), it is in an unsatisfactory condition.
The stated values of 14 mm and 18 mm below the stock rail crown are set for the central position of the wheelsets in a track with a gauge of 1,435 mm and with rails without lateral or height degradation.
When measuring the operating condition, the assessment may also be performed at depths of less than 14 mm and 18 mm due to a change in the point of contact of the wheel profile, depending on the shape of the running surface profile being assessed and on the degree of wheel travel abutment to the running edge.

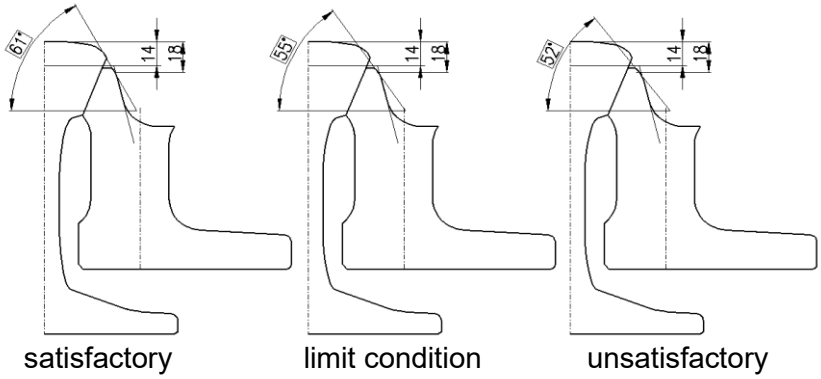


Figure 43 – Assessment of the inclination of the lateral running surface

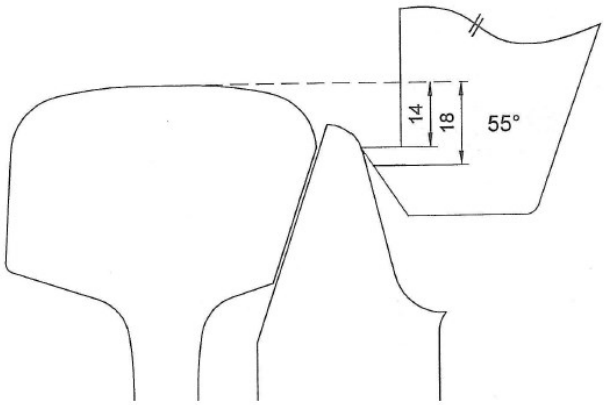


Figure 44 – Inspection of the lateral running surface with the PŠR-3 template

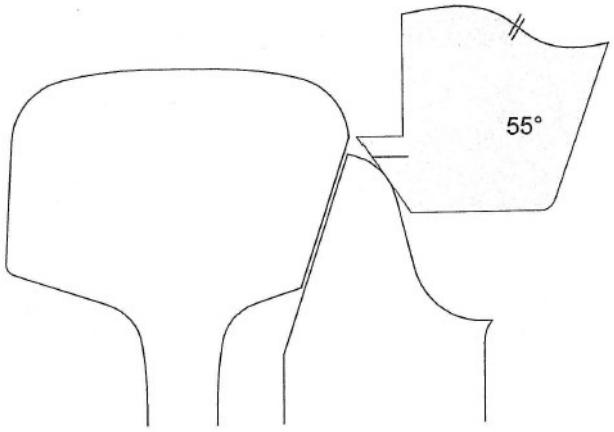


Figure 45 – Inspection of the lateral running surface with the PŠR-3 template, unsatisfactory condition

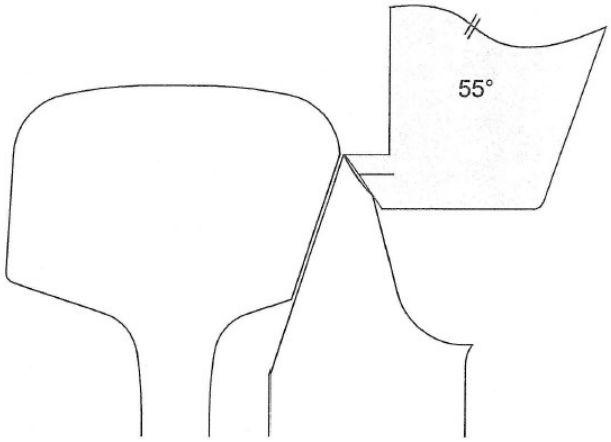


Figure 46 – Inspection of the lateral running surface with the PŠR-3 template, unsatisfactory condition

Measurement of safe wheelset guide:

For measuring the safety of the wheelset guide we use a suitable gauge, e.g. a PŠR-3 template for the driving profile UIC ORE, S 1002 (Figure 47). This device consists of a base which is placed on the rail crowns. The base supports on the rails form the driving profile of a **medium worn wheel**, thereby ensuring the most reliable location of the base with respect to the actual wheelset position in the switch. The assessment is carried out using the driving profiles of the

wheels serving as a support, and further by means of another set of templates which can be used to assess the shapes of the running surfaces of the switch rails and stock rails. These templates are mounted on the base in a guide groove, which allows them to move in a mounted position that is parallel to the axis of the base.

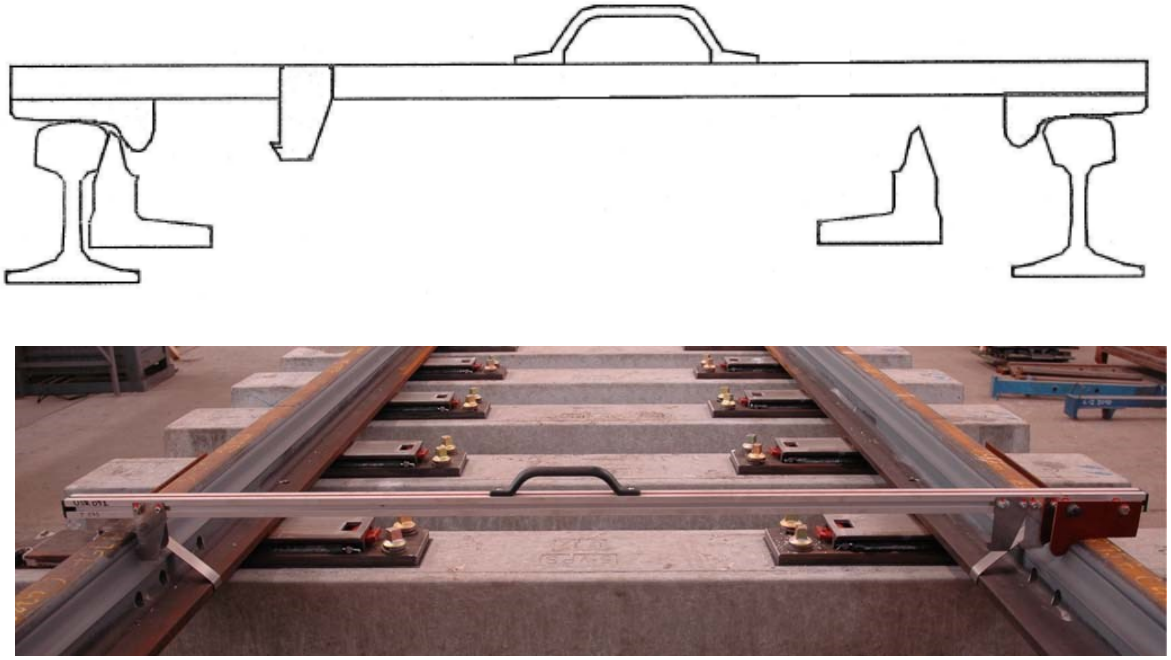


Figure 47 – PŠR-3 template

When conducting an assessment it is necessary to evaluate in particular the ability to safely guide the wheels of railway vehicles, and to further diagnose the occurrence of possible defects and deficiencies affecting the driving comfort of vehicles.

The switch rail and stock rail cannot be assessed separately, they must always be assessed as a system.

The safety assessment of the wheelset guide is performed in the wheel drive position adjacent to the running edge of the stretch of rails.

The assessment for defects and driving comfort is performed both for the adjacent position and for the outlying position of the wheel.

5.2.2 Safety assessment of the wheelset guide

The possibility of ramping onto the tip of the switch rail is assessed when contact of the wheel's running profile occurs in the flange area with the tip of switch rail. The most common cause of such a condition is lateral wear of the stock rail, when the beginning of the switch rail originally embedded under the stock rail becomes less protected (Figure 49).
If the wheel template does not contact the front of the tip of switch rail, this is a satisfactory condition (Figure 48).
Another cause may be laps on the switch rail and stock rail contact surfaces.
The assessment is carried out using the wheel profile template in the adjacent switch rail position. If the template contacts the front of the tip of switch, the condition is unsatisfactory (Figure 49).
In the event that wheel contact traces are found in the area of the front of the tip of switch during such a satisfactory assessment, then the locking device must be checked to ensure it

is functioning correctly, or the laps on the switch rail and stock rail contact surfaces must be removed. Comparing the shape of the worn-out driving profile of a wheel with a new one – their shapes are shown in Figure 50.

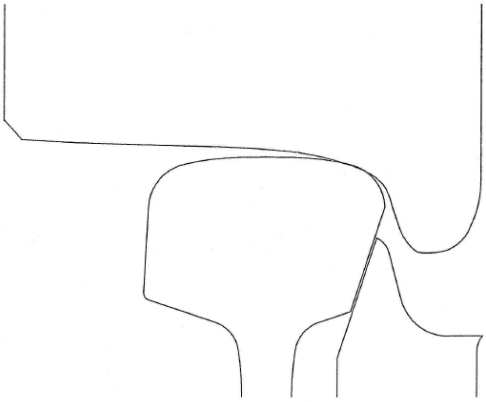


Figure 48 – Assessment of possible flange ramping on the tip – satisfactory condition

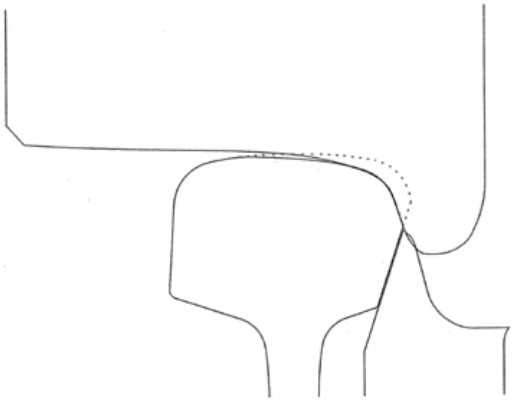


Figure 49 – Assessment of possible flange ramping on the tip – unsatisfactory condition

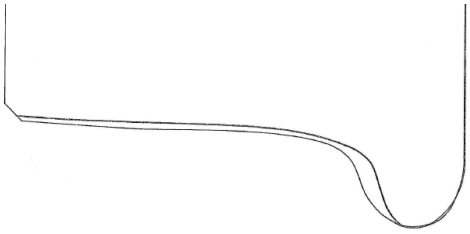


Figure 50 – Comparing the shape of the worn-out driving profile of a wheel with a new one

5.2.3 Defect and driving comfort assessment

Vertical load transition on the switch rail should not occur where the switch rail does not have sufficient width to prevent it from crumbling – unsatisfactory condition (Figure 51). The width of the switch rail at the point where the vertical load transition occurs should be between **25 mm and 35 mm** (Figure 52). If transition occurs at a point wider than 35 mm, there will be increased wear from the longitudinal slippage of the wheels and a sudden change of direction of the wheelset at this point.

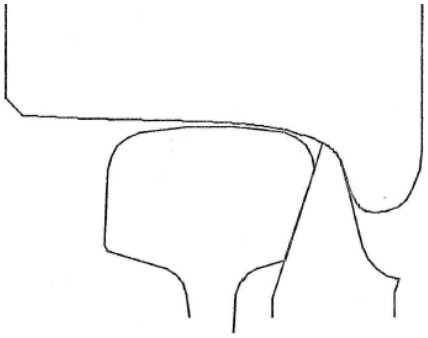


Figure 51 – Unsatisfactory area of wheel load transition

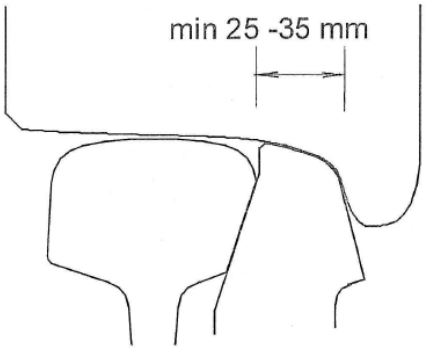


Figure 52 – Satisfactory area of wheel load transition

5.3 Maintenance and repairs of switches

5.3.1 Switch repair equipment

Figure 53 – Grinding machine

Figure 54 – Manual grinding with an abrasive disc

5.3.2 Minor maintenance of switches

Minor maintenance of switches includes:

Lap grinding

The basic grinding (first) is used to remove the decarburised layer from the rail and to remove defects on the rail heads caused by manufacturing and laying. Basic grinding should be done within 3 months of TBZ and within a maximum of 6 months. Lap grinding should be subject to cyclic grinding and, in the case of more frequent occurrences, to extraordinary grinding.

Principles for removing laps:

When grinding laps, it is necessary that the running surfaces of the turnout components achieve a smoothness.
The profile of the ground part must not undergo excessive changes – check the radius of the running edge with a template. Grinding is performed first with a portable grinding machine able to travel and be guided on the rails of the ground turnout, and with the ability to set and fix the position of the grinding tool (example in Figure 53); edges formed by the grinding (Figure 56) are further rounded with a manual grinder with abrasive disc (Figure 54).

Grinding eliminates defects to the surface and head shape of the rails. Grinding prevents the development of defects. Depending on the purpose, grinding is divided into basic, corrective, and regular. These terms are specified in the applicable regulations.

Figure 55 – Switch rail lap

Figure 56 – Partially ground lap

The pressure on grinding tools and the travel speed of the grinding tool must be selected so that the individual chamfered edges of the finishing grinding have a maximum width Z calculated according to:

Z=25*R/(R+50)
where R [mm] is the radius of the curvature of the rail profile.

At the end of the grinding, it is possible to round off these chamfered edges to the shape closest to the desired profile.
When grinding in the area of the slide chairs, and if the grinding technology allows it, the slide chairs must be covered. After the grinding is completed, it is cleaned of steel filings and abrasive and lubricated.

5.3.3 Correction of switch panel geometry

Repairing or replacing individual parts of turnouts which, due to wear, show deviations exceeding the permitted values.

Tightening the fasteners. Inspection and repair activities include other actions specified in the relevant rail regulations (checks on the fitting of switch rails into switch rail supports, on the correct position of the spring clips in the slide chairs, on the position of rollers in the integrated roller chairs, on sleeper packing, on the tightening of fasteners, on geometry, on the turnout's geometric parameters, etc.).

On the basis of the regular inspections of turnouts and their assessment, it is necessary to carry out the following corrective actions, if needed:

Correction of gauge deviations

The recommended construction and operating limit deviations of the track gauge in the turnout from the gauge specified in the drawing documentation during acceptance of the work are governed by the prescribed regulations and standards set by the user or the railway operator.
Methods used for correcting the gauge in turnouts:
In general, the track gauge for turnouts on concrete sleepers, wooden sleepers or a concrete bed is corrected to meet the specified tolerances in a similar way as it is corrected in the track, i.e. by loosening the fasteners, adjusting the gauge and tightening the fasteners.

When repairing gauge deviations, it is necessary to maintain the gauge values specified in the drawing documentation and to respect the so-called structural gauge widening. Structural gauge widening has several causes:

- The switch rail usually starts at a certain distance from the beginning of the radius, thereby increasing the measured gauge between straight and curved stock rail between the beginning of the switch and the beginning of the switch rail.
- At the beginning of the switch rail there is a widening of the gauge by an “x” value due to height processing (Figure 57).

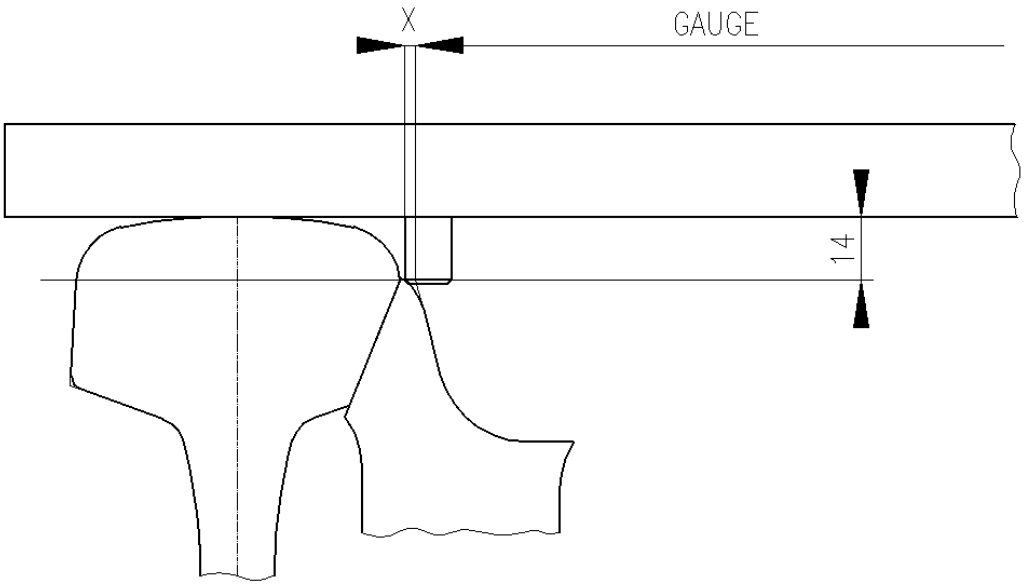


Figure 57 – Gauge widening at the beginning of the switch rail tip

- For switches where the curved switch rail tip is optimized by its reinforcement on the adjacent side, the straight stock rail on the side of the running edge is machined by the reinforcement value. This creates the structural gauge widening by an “x” value (Figure 58).

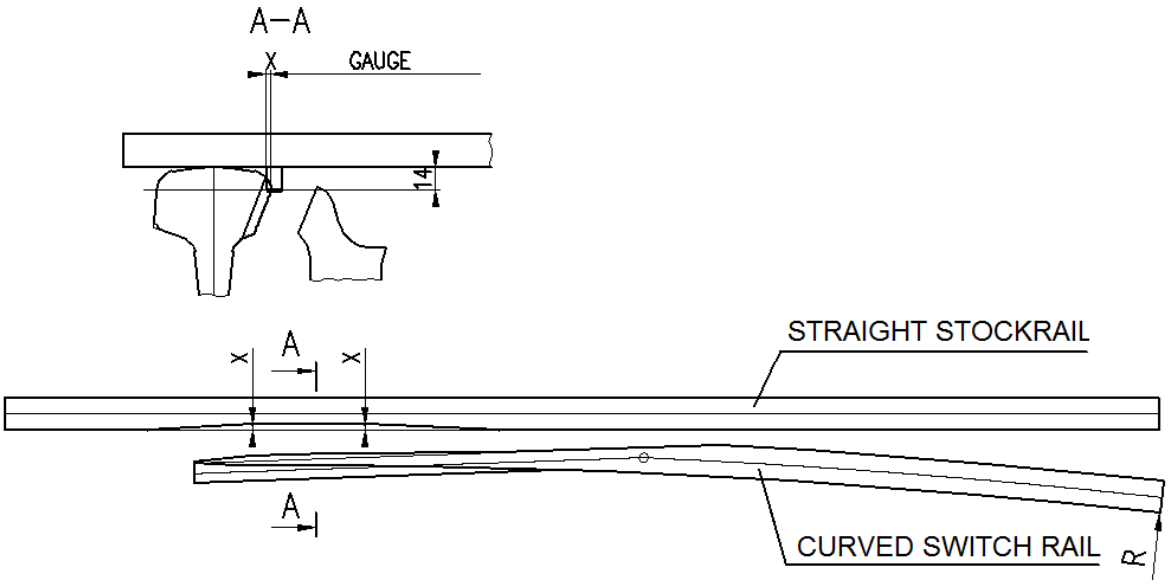


Figure 58 – Widening of the track gauge due to the machining of the stock rail for the optimised switch rail

Switch rail and stock rail position:

The switch rails in their moving part are placed on slide chairs and should sit right down against them.

If the switch rail does not sit down against the chairs, in operation the play between the switch rail foot and the slide surface of the chair may be in accordance with the values given in Section 4.6.

If this is not the case, possible causes of switch rail misalignment are switch rail height deformation or the height position of the sleepers.

In operation, the switch rail in the adjacent position, after the locking device is released, abuts against the stock rail with the play:

a) max. 2 mm at a running speed of V > 120 kmph
b) max. 3 mm at a running speed of 90 < V ≤ 120 kmph
c) max. 4 mm at a running speed of V ≤ 90 kmph

The switch rail supports are adjusted with play (see the values in Section 4.6).

The clearance groove at the point of greatest approach between the outlying switch rail head and the stock rail head must be in accordance with the values given in Section 4.6.

If this is not the case, it is necessary to adjust or modify the operation of the switcher.

The prescribed relative position of the switch rail and the stock rail in the longitudinal direction is usually marked by a hole or dimple in the neutral axis of the stock rail opposite the beginning of the tip of the switch rail or by a glued jig for setting the switch rail.

5.3.4 Repairing a switch rail breakage in the tip area

The crumbling of the running edge, from the point of view of safe guidance of the wheelset, is assessed with a template with a lower edge depth of 17 mm. If the template can be slid over the crumbled part (Figure 59) in a section where x = 150 mm or longer (Figure 61), this is an unsatisfactory condition. If the template cannot be slid over the crumbled part, or the crumbled section is shorter than 150 mm, this is a satisfactory condition (Figure 60).

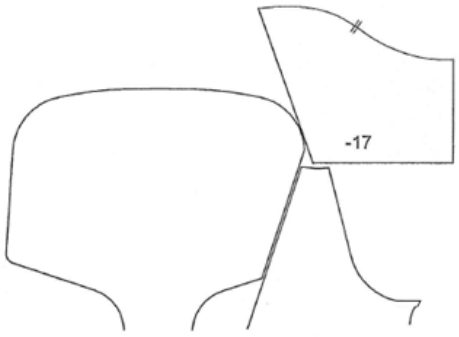


Figure 59 – Crumbled switch rail

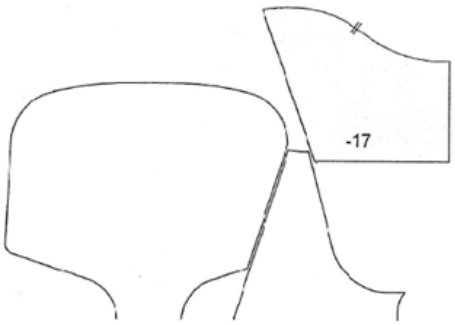


Figure 60 – Non-crumbled switch rail

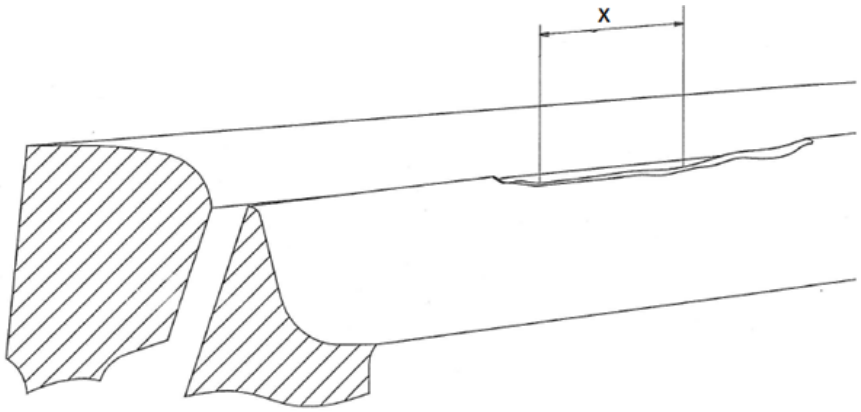


Figure 61 – Crumbled section length – x

An example of repairing a broken switch rail

Figure 62 – Crumbled switch rail

Figure 63 – Crumbled switch rail before grinding

5.3.5 Repairing a head-check defect

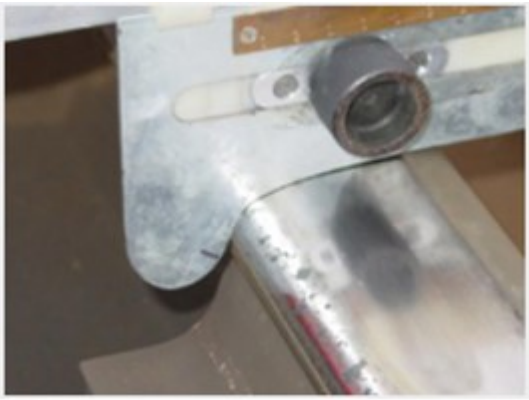


Figure 64 – Head-check before grinding

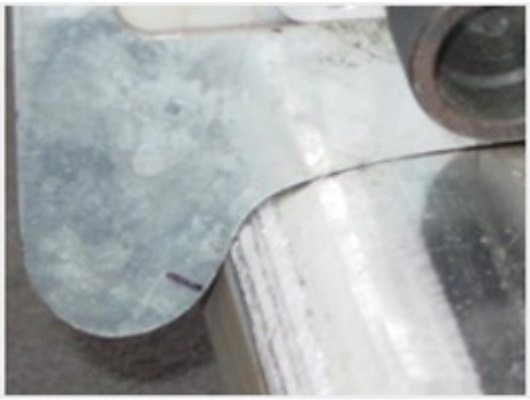


Figure 65 – Head-check after grinding

5.4 Recommended check and inspection intervals for turnouts embedded in the track

Inspection intervals are determined by local railway regulations or by the railway operator, and these must be observed during regular rounds.
The manufacturer recommends observing the following intervals:

Track gauge and track height measurement	once every 3 months
Inspection of turnouts	once every 3 months
Non-destructive check of the turnouts, switch rails	once every 6 months

The results of inspections and the causes of faults must be thoroughly analysed and corrected in a timely manner, and subsequently used in maintenance planning.

6 Occupational safety and health, environmental protection

6.1 Risk assessment related to occupational safety and health

The manufacturer declares that in connection with the handling, assembly, operation, maintenance, and disassembly of turnout switch parts in accordance with this manual, there are no specific safety hazards associated with the aforementioned activities that need to be addressed in this manual. These are common activities carried out during the construction, assembly, and maintenance work on the permanent way. In the course of carrying out activities, the implementing companies and their employees must comply with the occupational health and safety regulations associated with this type of activity in accordance with the applicable legislation (e.g. use of personal protective equipment, storage, working with lifting equipment).

6.2 Assessing risks associated with impacts on the working and living environment

If properly operated, turnout switch parts according to this manual do not have any negative effect on the environment. The best available technologies have been used in their design and development, and environmental requirements have been fully respected. No waste is generated during their operation.
The manufacturer is certified in compliance with EN ISO 14001.
Packing materials (wooden boxes, wooden pallets, wooden interlinings, binding wire, binding straps, and other suitable fixing materials) are used in the transport and handling of turnouts according to this manual pursuant to the applicable legislation of the Czech Republic on the placement of packaging on the market. The manufacturer participates in the Ekokom system, and charges for and keeps records of its packaging. All of this packaging and equipment is disposable; it is marked according to ČSN 77 0052–2 specifications, and after use, the waste must be properly sorted and handed over to authorized persons for disposal in accordance with the applicable legislation. The materials used for packaging are fully recyclable. The soundness of the delivered material for packaging has been demonstrated by the manufacturer.
Other and hazardous waste pursuant to the applicable legislation may be generated during the assembly and maintenance of turnouts in accordance with this manual, in particular:

120101	Ferrous metal filings and turnings
150103	Wooden packaging
150110*	Packaging containing residues of hazardous substances
150202*	Absorbents
170101	Concrete
170204*	Glass, plastic, and wood containing hazardous substances
170405	Iron and steel

Note: (*) hazardous waste marking

This waste must be sorted and handed over to authorized persons for disposal pursuant to the applicable legislation.
Other waste and hazardous waste arise when disposing of end-of-life turnouts according to this manual, in particular:

120101	Ferrous metal filings and turnings
150202*	Absorbents
170101	Concrete
170106*	Mixtures or separate fractions of concrete containing dangerous substances
170204*	Glass, plastic, and wood containing hazardous substances
170405	Iron and steel
200138	Wood not specified under 200137*

Note: (*) hazardous waste marking

This waste must be sorted and handed over to authorized persons for disposal in accordance with the applicable legislation. The above obligations must be met by the respective companies in accordance with the concluded contract.

7 List of used and related standards, as amended

EN 13232-1	Railway applications - Track - Switches and crossings - Part 1: Definitions (Railway applications - Track - Switches and crossings - Part 1: Definitions)
EN 13232-2	Railway applications - Track - Switches and crossings - Part 2: Requirements for geometric design (Railway applications - Track - Switches and crossings - Part 2: Requirements for geometric design)
EN 13232-3	Railway applications - Track - Switches and crossings - Part 3: Requirements for wheel/rail interaction (Railway applications - Track - Switches and crossings - Part 3: Requirements for wheel/rail interaction)
EN 13232-4	Railway applications - Track - Switches and crossings - Part 4: Actuation, locking and detection (Railway applications - Track - Switches and crossings - Part 4: Actuation, locking and detection)
EN 13232-5	Railway applications - Track - Switches and crossings - Part 5: Switches (Railway applications - Track - Switches and crossings - Part 5: Switches)
EN 13232-9	Railway applications - Track - Switches and crossings - Part 9: Layouts (Railway applications - Track - Switches and crossings - Part 9: Layouts)
EN 13481	Railway applications - Track - Performance requirements for fastening systems

	(Railway applications - Track - Performance requirements for fastening systems)
EN 13674-1	Railway applications - Track - Rail - Part 1: Vignole railway rails 46 kg/m and above (Railway applications - Track - Rail - Part 1: Vignole railway rails 46 kg/m and above)
EN 13674-2	Railway applications - Track - Rail - Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above (Railway applications - Track - Rail - Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above)
EN 13715	Railway applications - Wheelsets and bogies - Wheels - Tread profile (Railway applications - Wheelsets and bogies - Wheels - Tread profile)
UIC 510-2	Trailing Stock: Wheels and Wheelsets. Conditions concerning the use of wheels of various diameters.
UIC 864-2	Technical specification for the supply of steel bolts for the permanent way.
UIC 864-3	Technical specification for the supply of spring steel washers for use in permanent way.
UIC 864-6	Technical specification for the supply of base-plates or sections for base-plates made of rolled steel.
M 195/17	Operation and maintenance manual for SVV-P integrated roller stools for single switches
M 194/15	User manual for SVV roller stools for interchange sleeper parts of switches
M 348/2022	Operation and maintenance manual for SVV-P + SVV-ZP integrated roller stools on the hollow steel bearer for single switch switch panel parts

National standards and regulations:

ČSN 73 6360-1	Geometrical characteristics of railway tracks - Part 1: Layout
ČSN 73 6360-2	Geometrical characteristics of railway tracks - Part 2: Construction and acceptance, service and maintenance.
Regulation SŽDC S3	Permanent Way