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BSI Standards Publication

Railway applications — Track — Acceptance of works

Part 1: Works on ballasted track — Plain line, switches and crossings

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National foreword

This British Standard is the UK implementation of EN 13231-1:2013. It supersedes BS EN 13231-1:2006 and BS EN 13231-2:2006 which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RAE/2, Railway Applications - Track.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Contents

Page

Foreword **3**

1 Scope **4**

2 Normative references **4**

3 Terms and definitions **4**

4 Acceptance of works on plain line and on switches and crossings and rail expansion devices **6**
4.1 General **6**
4.2 Acceptance deadlines **6**
4.3 Acceptance measurements, checks and related documentation **7**
4.4 Relative track geometry **8**
4.5 Absolute track position **11**
4.6 Other parameters and verifications for plain line and switches and crossings **12**
4.7 Specific measurements for switches and crossings and rail expansion devices **15**
4.8 Specific quality checks for switches and crossings and rail expansion devices **16**

5 Working parameters **17**
5.1 General **17**
5.2 Tamping working parameters **17**
5.3 Dynamic stabilising working parameters **18**
5.4 Ballast compaction working parameters **19**
5.5 Ballast replacement/cleaning working parameters **19**

6 Acceptance responsibilities **20**
6.1 Preliminary procedure to acceptance **20**
6.2 Consequences of the preliminary procedure to the acceptance **21**

7 Warranty **21**

Annex A (informative) **Guidelines for specification of requirements of geodetic measurements** **22**

Annex B (informative) **Switches and crossings measurements and checks** **23**

Bibliography **30**

Foreword

This document (EN 13231-1:2013) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13231-1:2006, EN 13231-2:2006.

This European Standard is one of the series EN 13231 "*Railway applications – Track – Acceptance of works*" as listed below:

— *Part 1: Works on ballasted track — Plain line, switches and crossings* (the present document)

— *Part 3: Acceptance of reprofiling rails in track*

— *Part 4: Acceptance of reprofiling rails in switches and crossings*

— *Part 5: Procedures for rail reprofiling in plain line, switches, crossings and expansion devices*

NOTE Part 2 does not exist in this series.

The following technical modifications have been introduced during the revision:

— merging of EN 13231-1:2006 and EN 13231-2:2006, taking into account the similarities between them;

— definition of the absent tolerances for some existing parameters;

— revision of the tolerances already set up on the former version;

— definition of new parameters and the respective tolerances.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the minimum technical requirements and the tolerances for the acceptance of works on ballasted track situated on plain line and on switches and crossings and rail expansion devices, as part of the track, for 1 435 mm and wider track gauge railways, concerning construction of new track, track renewal and track maintenance. More particularly, this standard gives the requirements for the documentation of work parameters, for the tolerances for relative track geometry and absolute track position and for the acceptance procedures.

This standard does not deal with contractual and legal aspects and it does not cover either works related to reprofiling the railhead nor the associated measurements, except for some measurements related to safety, since these works are covered by other parts of EN 13231 series.

Related works, e.g. platform reconstruction, formation, drainage, level crossings are not covered by this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13450, *Aggregates for railway ballast*

EN 13848-1, *Railway applications — Track — Track geometry quality — Part 1: Characterisation of track geometry*

EN 13848-2, *Railway applications — Track — Track geometry quality — Part 2: Measuring systems — Track recording vehicles*

EN 13848-3, *Railway applications — Track — Track geometry quality — Part 3: Measuring systems — Track construction and maintenance machines*

EN 13848-4, *Railway applications — Track — Track geometry quality — Part 4: Measuring systems — Manual and lightweight devices*

EN 13848-5, *Railway applications — Track — Track geometry quality — Part 5: Geometric quality levels — Plain line*

EN 14587 (series), *Railway applications — Track — Flash butt welding of rails*

EN 14730 (series), *Railway applications — Track — Aluminothermic welding of rails*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
works on ballasted track (including switches and crossings)
works on ballasted track cover:

— construction of new track;

— renewal or partial renewal and maintenance of rails, sleepers, ballast and other components;

— removing and relaying existing track because of works on substructure (e.g. bridges, tunnels, earthworks, etc.);

— renewal or partial renewal and maintenance of switches and crossings (switch rail/stock rail, crossing, etc.), bearers and ballast;

— works to correct track geometry, e.g. track tamping/levelling/lining;

— dynamic stabilising;

— ballast cleaning;

— stressing work;

— welding

3.2
plain line
any section of ballasted track excluding switches and crossings

3.3
acceptance
declaration of the customer to the contractor that the work has been achieved in accordance with the contract

3.4
tolerance
permissible deviation from reference or designed value

3.5
relative track geometry
group of parameters defining the position of the rails, usually comprising the following: track gauge, alignment, longitudinal level, twist and cross level

Note 1 to entry: These parameters are described in EN 13848 series.

3.6
design track position
position of the track defined in the track design process

Note 1 to entry: The design position is defined in the geodetic reference system.

Note 2 to entry: The control of the design studies and layouts for new or upgraded tracks according to EN 13803-1 and EN 13803-2 or other regulations is not part of this standard.

3.7
actual track position
position of the track when measured from external absolute references

EXAMPLE Network of geodetic reference points.

3.8
deviation from design track position
vertical and lateral difference between the design track position and the actual track position

3.9
nominal track gauge
single value which identifies the track gauge but may differ from the design track gauge

3.10
design track gauge
single value which is obtained when all the components of the track conform precisely to their design dimensions, or their median design dimension, when there is range

Note 1 to entry: It may differ from nominal track gauge. The design track gauge is specified by the customer taking into account the materials, the method of measurement and whether the application is on plain line or in switches and crossings.

3.11
new track
new constructed track applying new materials, including formation

3.12
renewal
complete replacement of all the components of the track (rails, sleepers, fastenings, switches and crossings, rail expansion devices and ballast) applying new materials, including the formation if necessary

3.13
partial renewal
replacement of one or more (but not all) track components in a track section

3.14
maintenance
all other works than design track gauge, new track and renewal

3.15
bearer
sleeper for switches and crossings

3.16
stagger
deviation in longitudinal relative position between the rail joints in the left and the right rails

4 Acceptance of works on plain line and on switches and crossings and rail expansion devices

4.1 General

The requirements of this European Standard apply to works as defined in 3.1, to the extent that they are within the scope of the work.

An acceptance form shall be prepared for each item of work outlining the results achieved.

Acceptance is not given until the work is completed in accordance with the requirements of the contract.

4.2 Acceptance deadlines

Acceptance shall not be carried out until the track has been subjected to an appropriate passing tonnage described and defined by the customer. However, acceptance should occur within a period not exceeding six weeks or after the passage of a maximum of 1,500 000 tonnes after the completion of the works, although the customer may extend this timescale to permit any follow-up tamping to be carried out.

4.3 Acceptance measurements, checks and related documentation

Before acceptance, the following measurements or checks shall be carried out when applicable (manually or by automatic means), and shall be documented:

— relative track geometry of plain line, switches and crossings as specified in 4.4;

— absolute track position of plain line, switches and crossings as specified in 4.5;

— sleeper or bearer position, voiding of sleepers or bearers as specified in 4.6.2, 4.6.3, 4.6.4 and 4.6.5;

— correct assembly and integrity of the rail fastenings, pads and insulators as specified in 4.6.6;

— welds as specified in 4.6.7 (running surface and running edge);

— joint gaps, dips and staggers as specified in 4.6.8;

— insulated joints as specified in 4.6.9;

— ballast cross section as specified in 4.6.10;

— stressing work as specified in 4.6.11;

— specific measurements or checks for switches and crossings and rail expansion devices as specified in 4.7 and 4.8;

— tamping work as specified in 5.2;

— dynamic stabilising work as specified in 5.3;

— ballast compaction as specified in 5.4;

— ballast replacement / cleaning work as specified in 5.5;

— damage caused to rails, sleepers, bearers, fastenings, cables and other equipment, or where the work process has displaced the sleepers, the bearers or the rail pads;

— all track materials compliance with the customer's relevant acceptance criteria or specifications, in particular acceptance of associated works as well as approval and acceptance of the material provided by the supplier.

The customer may request additional documented measurements or checks if contractually agreed.

The customer may also restrict the choice of measuring devices if contractually agreed.

Relative track geometry shall be measured by a track recording vehicle or by a track construction and maintenance machine fitted with measuring equipment, both in accordance with series EN 13848. If the measuring equipment fails, or is not available, corresponding light weight or manual devices measurements shall be taken and documented. Other use of light weight or manual devices measurements shall be in accordance with series EN 13848.

If track works affect track geometry, measurement of relative track geometry according to series EN 13848 shall be performed before allowing commercial trains to run.

For the purpose of acceptance, every section and switch and crossing shall be inspected by the experts as nominated by the customer and the contractor.

The contract shall define who should perform the measurements and how they shall be documented.

4.4 Relative track geometry

4.4.1 Parameters

4.4.1.1 General

Measurements as defined in EN 13848-1.

4.4.1.2 Track gauge and cross level

Measurement:

— by track recording vehicles according to the requirements of EN 13848-2; or

— by track construction and maintenance machines according to the requirements of EN 13848-3; or

— by track measuring trolleys or manually operated devices, according to the requirements of EN 13848-4, with a minimum of 10 measurements on successive sleepers, every 100 m.

4.4.1.3 Longitudinal level and alignment

Measurements for longitudinal level should preferably be undertaken on both rails. Measurement for alignment should be undertaken on both rails on straight track and shall be undertaken on the outer rail in curves:

— by track recording vehicles according to the requirements of EN 13848-2; or

— by track construction and maintenance machines according to the requirements of EN 13848-3; or

— by track measuring trolleys or manually operated devices, according to the requirements of EN 13848-4.

4.4.1.4 Twist

Measurement:

— by track recording vehicles according to the requirements of EN 13848-2; or

— by track construction and maintenance machines according to the requirements of EN 13848-3; or

— by track measuring trolleys or manually operated devices, according to the requirements of EN 13848-4, measurements should be performed at least every 3 m.

4.4.2 Tolerances

Accepted track shall comply with the tolerances shown in Tables 1 and 2.

The tolerances in Tables 1 and 2 are for loaded track measurements, which are recommended. For unloaded track measurements, the customer shall specify the tolerances for the relative track geometry parameters, which should be stricter.

All measurements shall be sampled at constant distance based intervals not larger than 0,5 m.

For track construction and maintenance machines that move non-continuously and measure track geometry whilst working, the sampling interval may be extended up to 1,5 m. For track gauge, values shown in Tables 1 and 2 apply to both isolated defects of track gauge and mean track gauge as defined in EN 13848-1.

The track gauge between any two adjacent sleepers shall not vary by more than 1 mm, unless otherwise specified by the customer (only applicable for hand measurements).

For measurements made by track recording vehicles, track construction and maintenance machines or track measuring trolleys, the track gauge shall not vary by more than 3 mm per 1,5 m, unless otherwise specified by the customer.

Concerning the longitudinal level and alignment for plain line and switches and crossings:

a) the customer shall decide if 10 m chord measurement results or *D*1, *D*2 or *D*3 results according to EN 13848-1 should be used;

b) the analysis method shall be "mean-to-peak";

   Recording vehicles and track construction and maintenance machines delivered prior to the issue of this standard may use the analysis method "peak-to-peak". The values of the tolerances should be set by the customer.

   For special analysis of track geometry during and after tamping and stabilising work as on short sections with difficult track geometry and on switches and crossings, track construction and maintenance machines may use the analysis method "peak-to-peak". The values of the tolerances should be set by the customer.

c) for chord measurements the following applies:

   1) At chord measurement results, the sliding mean for each point shall be taken in a length not longer than 40 m considering a symmetric interval.

   2) For alignment, the corridor as defined by the mean and the tolerances shall include the design value; if not, the defect shall be taken between the design value and the peak.

   3) Chord measurements by recording vehicles or track construction and maintenance machines shall be made by an asymmetrical chord with a ratio of 40 % to 60 %, which should be 10 m long; for measurements by trolleys or manually operated devices a symmetrical chord with 10 m (in curves) and 20 m (in straight tracks) may be allowed.

   4) Recording vehicles and track construction and maintenance machines delivered prior to the issue of this standard may use a symmetrical chord as well.

   5) For measurements made by a chord system with base lengths other than 10 m, the results shall be converted to 10 m asymmetrical chord (40 % to 60 %) results.

The twist base length shall normally be 3 m, and the analysis method shall be "zero-to-peak". In transition curves with design twist, the tolerances shall be considered from the design twist, but not from the zero line, without exceeding the intervention limit values of EN 13848-5.

Where a twist base length other than 3 m is used, the customer shall specify the acceptance tolerances.

For tracks built with used materials, including switches and crossings, the tolerances for the parameters shall be specified by the customer.

In case of partial renewal, the customer shall specify if Table 1 or Table 2 or a combination of both is applicable.

Table 1 — Acceptance tolerances for loaded track – Renewals and new track (including switches and crossings)

Parameters	Type class				
	I	II	III	IV	V
	Speed range (km/h)				
	$V \leq 80$	$80 < V \leq 120$	$120 < V \leq 160$	$160 < V \leq 230$	$230 < V \leq 360$
Track gauge for plain line (mm) (deviation from design value)	+ 4/- 3	+ 4/- 3	+ 4/- 2	+ 4/- 2	+ 3/- 2
Track gauge for switches and crossings (mm) (deviation from design value)	+ 4/- 3	+ 4/- 3	+ 4/- 3	+ 4/- 3	+ 4/- 3
Cross level (mm) (deviation from design value)	± 3	± 3	± 3	± 2	± 2
10 m chord longitudinal level (mm) (mean-to-peak)	± 6	± 4	± 4	± 3	± 3
*D*1 Longitudinal level (mm) (mean-to-peak)	± 4	± 3	± 3	± 2	± 2
*D*2 Longitudinal level (mm) (mean-to-peak)	N/A	N/A	N/A	± 3	± 2
*D*3 Longitudinal level (mm) (mean-to-peak)	N/A	N/A	N/A	N/A	Reserved
10 m chord alignment (mm) (mean-to-peak)	± 5	± 3	± 3	± 3	± 3
*D*1 Alignment (mm) (mean-to-peak)	± 4	± 2	± 2	± 2	± 2
*D*2 Alignment (mm) (mean-to-peak)	N/A	N/A	N/A	± 3	± 2
*D*3 Alignment (mm) (mean-to-peak)	N/A	N/A	N/A	N/A	Reserved
Twist over 3 m (mm) (deviation from design value to peak)	± 4,5	± 3	± 3	± 3	± 3

Table 2 — Acceptance tolerances for loaded track – Maintenance (including switches and crossings)

Parameters	Type class				
	I	II	III	IV	V
	Speed range (km/h)				
	$V \leq 80$	$80 < V \leq 120$	$120 < V \leq 160$	$160 < V \leq 230$	$230 < V \leq 360$
Track gauge for plain line (mm) (deviation from design value)	+ 7/- 3	+ 5/- 3	+ 5/- 2	+ 5/- 2	+ 4/- 2
Track gauge for switches and crossings (mm) (deviation from design value)	+ 7/- 3	+ 5/- 3	+ 5/- 3	+ 5/- 3	+ 5/- 3
Cross level (mm) (deviation from design value)	± 5	± 4	± 4	± 3	± 3
10 m chord longitudinal level (mm) (mean-to-peak)	± 7	± 5	± 5	± 4	± 4
*D*1 Longitudinal level (mm) (mean-to-peak)	± 5	± 4	± 4	± 3	± 3
*D*2 Longitudinal level (mm) (mean-to-peak)	N/A	N/A	N/A	± 4	± 3
*D*3 Longitudinal level (mm) (mean-to-peak)	N/A	N/A	N/A	N/A	Reserved
10 m chord alignment (mm) (mean-to-peak)	± 7	± 5	± 5	± 4	± 4
*D*1 Alignment (mm) (mean-to-peak)	± 5	± 4	± 4	± 3	± 3
*D*2 Alignment (mm) (mean-to-peak)	N/A	N/A	N/A	± 4	± 3
*D*3 Alignment (mm) (mean-to-peak)	N/A	N/A	N/A	N/A	Reserved
Twist over 3 m (mm) (deviation from design value to peak)	± 4,5 [a]	± 4,5	± 4,5	± 3	± 3
In special constructions, e.g. switches and crossings and rail expansion devices, exceedances of the above mentioned values may occur due to the special design of these devices.					
[a] In jointed track: ± 6.					

4.5 Absolute track position

4.5.1 General

Requirements and tolerances in 4.5 shall be applied for new track and track renewal (including switches and crossings).

It is voluntary for the customer to apply requirements and tolerances in 4.5 for acceptance after maintenance of the track.

When defined by the customer, distance between tracks shall comply with tolerances in Table 3 for the lateral position of the track.

4.5.2 Tolerances

Accepted track shall comply with selected classes (AP1 to AP 4) in Table 3. Classes shall be specified by the customer.

Table 3 — Tolerances for the deviation from design track position – Renewals and new track

Class	Vertical position (mm)	Lateral position (mm)	Longitudinal position of the switches and crossings (mm)
AP 1	± 10	± 10	± 10
AP 2	± 15	± 15	± 15
AP 3	± 20	± 20	± 20
AP 4	± 25	± 25	± 25
Combination of classes in Table 3 is permitted, for instance due to requirements for thermal forces, structure gauge, tracks in interaction with platforms and other fixed installations. Class AP 1 tolerances may be reduced in order to allow for restricted structure gauges.			

4.5.3 Compliance measurements

When requirements and tolerances for the deviation from design track position are applied, following items shall be specified by the customer:

a) Compliance measurements shall refer to defined survey point in the track. The survey point defines the absolute track position. The survey point and spacing of control measurements shall be defined by the customer.

b) The external reference system, normally a network of geodetic reference points, and geodetic measurements for verification of the absolute track position shall be specified by the customer. Guidelines for specification of requirements for geodetic measurements are given in Annex A.

The absolute track position shall be measured from geodetic reference points, e.g:

c) total station measurements;

d) levelling:

   1) satellite measurements;

   2) measurement tape or equivalent.

4.6 Other parameters and verifications for plain line and switches and crossings

4.6.1 General

Requirements and tolerances in 4.6 apply to new track, renewal and maintenance work.

4.6.2 Sleeper spacing

Permissible deviation from the designed sleeper spacing shall be ± 20 mm (except at welds or other justifiable cases) and shall be checked by sampling. Checking shall be made at least every 200 m.

The number of sleepers within 1 000 m shall be within 0,5 % of the designed number.

4.6.3 Bearer spacing

Permissible deviation from the designed bearer spacing in individual cases shall be ± 10 mm.

4.6.4 Out of squareness of the sleepers

This sub-clause is only applicable on request from the customer.

Permissible deviation from squareness of the sleepers shall be ± 10 mm.

4.6.5 Voiding of the sleepers and bearers

This sub-clause is only applicable on request from the customer.

The quality of the tamping shall be checked by sampling 10 % of the sleepers and bearers.

All sleepers and bearers shall be fully supported under the rails (not voided).

When tamping machines are not used, 5 % voided sleepers are permitted, but the following shall apply:

— no more than two adjacent voided sleepers shall be permitted;

— voided sleepers shall not be permitted at joints or other sensitive locations;

— the voided sleepers shall be marked;

— voided bearers shall not be permitted.

NOTE Experienced personal will identify voided sleepers and bearers by the sound when striking them with a rubber coated iron ball.

4.6.6 Rail fastenings

All fastening systems shall be complete and correctly fitted.

4.6.7 Welds

The acceptance of welding work in conjunction with track works is covered by EN 14730 series and EN 14587 series.

Further non-destructive testing shall be required to verify the integrity of the welds if specified by the customer.

4.6.8 Fishplated joints

The acceptance tolerance for the nominal value, set by the customer, of the total sum of gaps for the number of joints corresponding to a section of 100 m of track, is ± 5 mm.

Maximum permissible values of dips shall be 0,5 mm on railhead and 0,5 mm on running edge, both measured over 1 m.

Maximum permissible staggers, in squared joints, shall be 10 mm.

4.6.9 Insulated joints

The customer shall specify the acceptance criteria for installation of insulated joints.

Maximum permissible values of dips shall be 0,5 mm, on railhead and 0,5 mm, on running edge, both over 1 m.

4.6.10 Ballast cross section

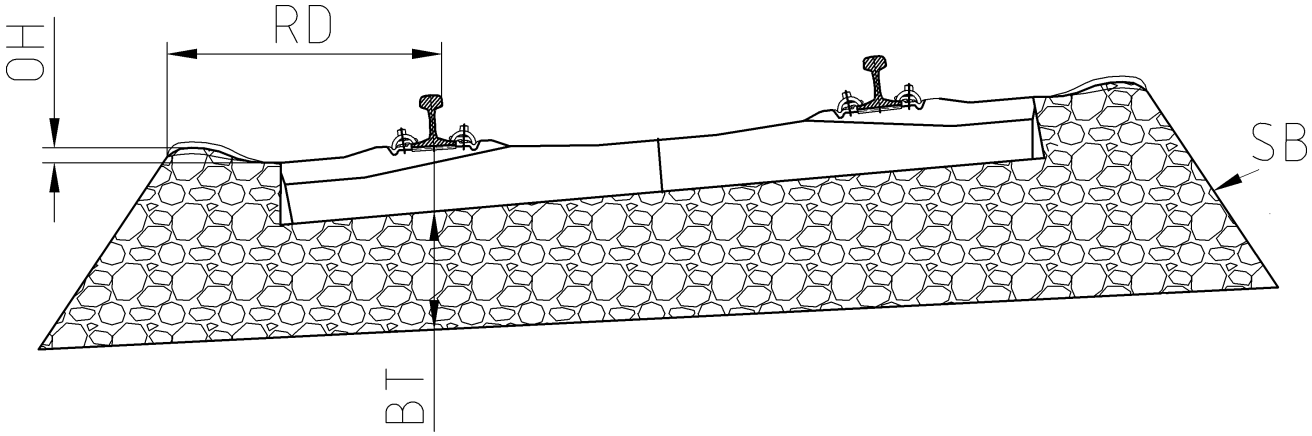
Accepted track ballast cross section shall comply with the tolerances in Table 4.

If not specified otherwise by the customer, the upper surface of the ballast shall be at the same level as the upper sleeper surface.

No ballast is allowed on top of sleepers.

Table 4 — Tolerances for ballast cross section – New track, renewal and maintenance work

Parameter	Deviation from design value
Ballast thickness (BT) [a]	+ 15 % / 0 %
Distance between the running edge of the rail and the ballast shoulder (RD)	+ 10 cm / 0 cm
Ballast slope inclination (SB)	± 10 %
Ballast shoulder over height (OH)	+ 2 cm / 0 cm
[a] Minimum distance between the formation surface and the lower base of the sleeper, measured under the inner rail in curves.	



Key

BT ballast thickness

RD distance between the running edge of the rail and the ballast shoulder

SB ballast slope inclination

OH ballast shoulder over height

Figure 1 — Ballast cross section

4.6.11 Stressing work

Stressing work shall be documented as specified by the customer.

Stress-free temperature shall be in the specified range for the neutral temperature area, which shall not exceed 12 ºC.

The destressing records and the records about the installation temperature of the switches and crossings shall be provided for the acceptance inspection.

The position and condition of the anti-creep device shall be checked during acceptance inspection.

If the customer requires the achieved stress-free temperature to be measured as part of the acceptance process, he shall specify the method of doing so.

4.7 Specific measurements for switches and crossings and rail expansion devices

4.7.1 General

The tolerances given in 4.7 apply to new, as well as used switches and crossings, and related maintenance works.

4.7.2 Free wheel passage in switch area

The tolerance for the designed value of free wheel passage in switch area (F_{wps} in Figure B.1) shall be maximum + 3 mm, not exceeding the maximum value as specified by the customer.

4.7.3 Fixed common crossing and obtuse crossing nose protection

The permissible tolerance for the designed value of fixed common crossing (N_{pcf} in Figure B.2) and of fixed obtuse crossing nose protection (N_{pof} in Figure B.3) shall be ± 2 mm.

4.7.4 Free wheel passage in fixed obtuse crossing

The tolerance for the designed value of the free wheel passage in fixed obtuse crossing (F_{wpof} in Figure B.3) shall be maximum + 1 mm.

4.7.5 Free wheel passage at check rail entry and at wing rail entry

The tolerance for the designed value of the free wheel passage at check rail entry and at wing rail entry (F_{wpcre} in Figure B.4) shall be maximum + 4 mm.

4.7.6 Flangeway width

The tolerance for the designed value of the flangeway width (f_{cr} in Figure B.2) shall be $\pm$ 1 mm.

4.7.7 Flangeway depth

The tolerance for the designed value of the flangeway depth (d_{cr} in Figure B.2) shall be maximum - 3 mm.

4.7.8 Vertical gap of switch rail base or movable frog base at sliding chairs

The tolerance for the vertical gap of switch rail base or movable frog base at sliding chairs (F_{vgs} in Figures B.5 and B.6) shall be maximum + 1 mm.

4.7.9 Horizontal gap of switch rail to stock rail or of movable frog to wing rail

The tolerance for horizontal gap of switch rail to stock rail or of movable frog to wing rail (F_{hgs} in Figure B.5) shall be maximum + 1 mm.

4.7.10 Horizontal gap between switch rail and distance block (switch stud)

The tolerance for horizontal gap between switch rail and distance block (F_{hbs} in Figure B.6) shall be maximum + 1 mm.

4.7.11 Vertical displacement of switch rail to stock rail

The tolerance for the vertical displacement of switch rail to stock rail shall be maximum 1 mm (F_{vd} in Figure B.6). It shall be measured near the first distance block looking from the switch tip.

4.7.12 Check for possible wheel face overlapping with the switch tip of switches and crossings and rail expansion devices

To prevent dangerous contact between a worn wheel and the switch tip, the free wheel passage at the switch tip shall be proved with a gauging tool defined by the customer (Figure B.7).

The measurement method for the overlap check shall be defined by the customer.

4.7.13 Variation of track gauge on a base distance equivalent to 3 bearers

The tolerance for deviation of track gauge on a base distance equivalent to three bearers shall be maximum 3 mm (4 mm for maintenance work) ($G_n – G_{n+1}$ in Figure B.8).

In special constructions, exceedances of the above mentioned tolerance may occur to the special design of these devices.

4.8 Specific quality checks for switches and crossings and rail expansion devices

4.8.1 Longitudinal displacement of stock rails in switches and crossings

The longitudinal displacement of stock rails to each other shall be checked with a double angle bracket at the punch marks, if available (D_{st-st} in Figure B.9). The tolerance for longitudinal deviation between the straight and the branch stock rail shall be maximum 2 mm.

4.8.2 Longitudinal displacement of stock rail to switch rail in switches and crossings

The longitudinal displacement of stock rail to switch rail shall be checked with a double angle bracket at the punch marks (D_{st-sw} in Figure B.9). The tolerance for punch mark displacement at switch heel from the rectangular connecting line to punch mark on stock rail shall be maximum 2 mm.

4.8.3 Longitudinal displacement of fixed rails in rail expansion devices

The longitudinal displacement of fixed rails shall be checked with an angle bracket (D_{fr} in Figure B.10). The tolerance for displacement between the fixed rails shall be maximum 2 mm.

4.8.4 Adjustment dimension for moveable rails in expansion devices

The position of the moveable rails depends on the ongoing temperature of the bridge or rails. With respect to the measured temperature at the time of inspection the tolerance of installed position of the moveable rails compared with the designed position (D_{mr} in Figure B.10) shall be ± 3 mm.

5 Working parameters

5.1 General

Because working parameters cannot be checked after completion of works, and because they have influence on the quality and the durability of track works, the items listed below should be measured when carrying out track works.

5.2 Tamping working parameters

5.2.1 General

Tamping machines should be equipped with systems able to measure tamping working parameters.

The customer shall define in the contract if he accepts the work performed by tamping machines not or partly equipped with such systems.

The quality of the work of tamping machines shall be evaluated and documented by measuring the relative track geometry.

Information about uncertainty and resolution of the working parameters shall be documented in the machine manufacturer's manual. Calibration and validity checks shall be carried out according to the manufacturer's manual.

5.2.2 Lift of track

The maximum lift of track per tamping pass is dependent on the construction of the track (type of rails and sleepers), the geometrical dimensions of the tamping machine (bending line of the rail) and the required compaction level.

The maximum lift of track per tamping pass shall be set by the customer.

The lift value shall be recorded for each rail at each tamping cycle.

NOTE The lift of track in this clause describes the lifting by means of the tamping tools during operation, not the real lifting achieved.

5.2.3 Shift of track

The maximum shift of track per tamping pass is dependent on the construction of the track (type of rails and sleepers), the geometrical dimensions of the tamping machine (tensile stress in the rail) and the required compaction level.

The maximum shift of track per tamping pass shall be set by the customer.

The maximum shift value shall be documented.

NOTE The shift of track in this clause describes the shifting by means of the tamping tools during operation, not the real shifting achieved.

5.2.4 Work depth of tamping tools

The work depth of the tamping tools is dependent on the construction height of the track (height of rails, sleepers and rail fastening systems).

The distance of the upper line of the tamping tool plate to the lower face of the sleeper (including under sleeper pads) shall be in the range of 15 mm to 30 mm. Change of the track structure height requires adjustment of the tamping depth. This adjustment shall be documented.

The values for the work depth shall be set by the customer.

5.2.5 Squeezing time of tamping tools

The squeezing time of the tamping tools is dependent on the type of ballast and the lift of the track.

One measurement per squeezing shall be carried out. The squeezing time shall not be less than 0,8 s. The recommended value range is from 1,0 s to 1,2 s.

The values for the squeezing time shall be set by the customer.

5.2.6 Documentation of functioning of the controlling system / device

Prior to and after every tamping work a functional check of the controlling system/device should be carried out according to the manufacturer's manual.

The results of this functional check shall be documented.

5.3 Dynamic stabilising working parameters

5.3.1 General

Dynamic stabilising machines should be equipped with systems measuring working speed, vertical load and frequency.

The customer shall define in the contract if he accepts the work performed by dynamic stabilising machines partially equipped with such systems.

The quality of the work of dynamic stabilising machines shall be evaluated and documented by measuring the relative track geometry and the lowering of the track.

Information about uncertainty and resolution of the parameters mentioned above shall be documented in the machine manufacturer's manual. Calibration and validity checks shall be carried out according to the manufacturer's manual.

Values of dynamic stabilising machines working parameters (working speed, vertical load and stabilising tools frequency) should be set all together and adapted to the actual condition of the track before stabilisation, e.g. height of tamping lift, type of sleepers, ballast depth, maintenance or renewal works, etc. If they are not, either the quality of track geometry may not be acceptable with respect to this standard or the stabilisation of the track may not be completed properly.

5.3.2 Working speed

Working speed is dependent on the construction of the track (type of rails and sleepers and ballast conditions) and the required compaction level.

The range of the working speed is to be set by the customer.

5.3.3 Vertical load

The maximum load on the track by the stabilisation tools is dependent on the construction of the track (type of rails and sleepers and ballast conditions), the required compaction level and the type of substructure and infrastructure along the track.

The measurement shall be effected on both rails.

The values of the vertical load shall be defined by the customer.

5.3.4 Stabilising tools frequency

Stabilising tools frequency is dependent on the construction of the track (type of rails and sleepers and ballast conditions) and the required compaction level.

The range of the stabilising tools frequency shall be set by the customer.

5.3.5 Lowering of track

The lowering range of the track is dependent on the construction of the track (type of rails and sleepers) and the required compaction level.

The lowering range of the track shall be set by the customer.

The final position of the track shall be verified against external references, using the tolerances shown in Table 3 concerning vertical position.

5.4 Ballast compaction working parameters

5.4.1 General

Machines equipped with ballast compaction (ballast shoulder and ballast between sleepers) devices should also be equipped with systems able to measure ballast compaction working parameters. Information about uncertainty and resolution of the working parameters shall be documented in the machine manufacturer's manual. Calibration and validity checks shall be carried out according to the manufacturer's manual.

The customer shall define in the contract if he accepts the work performed by ballast compaction machines unequipped or partially equipped with such systems.

NOTE Work done by tamping machines with compaction tools close to the tamping tools is not covered by this requirement.

5.4.2 Duration of compaction work

The duration of the compaction shall be set by the customer (e.g. 4 s).

5.4.3 Compaction tools frequency

The frequency of the compaction shall be set by the customer (e.g. between 45 Hz and 50 Hz).

5.4.4 Compaction dynamic pressure

The dynamic pressure of the compaction shall be set by the customer (e.g. 12 N/cm^2).

5.5 Ballast replacement/cleaning working parameters

5.5.1 General

Ballast replacement/cleaning machines should be equipped with systems able to measure ballast replacement/cleaning working parameters. The requirements in this clause do not apply if other type of equipment is used. In this case, the customer shall specify the requirements.

The customer shall define in the contract if he accepts the work performed by ballast replacement/cleaning machines unequipped or partially equipped with such systems.

Information about uncertainty and resolution of the working parameters shall be documented in the machine manufacturer's manual. Calibration and validity checks shall be carried out according to the manufacturer's manual.

5.5.2 Depth and inclination of ballast cutting bar

During work, depth and inclination of the ballast cutting bar shall be measured and documented. For the machines not equipped with measuring systems, manual measurement, as specified by the customer, shall be carried out and documented.

The desired values of the depth and inclination shall be specified by the customer.

5.5.3 Lowering of the track

During work, lowering of the track in relation to the track surface before cleaning work shall be measured. At least one measurement per metre shall be carried out and documented.

The desired value of the lowering shall be specified by the customer.

5.5.4 Ballast-size distribution curve and degree of purity

The ballast size distribution of the cleaned ballast and the degree of purity shall be controlled at least every 500 m, according to the relevant regulations specified by the customer and the requirements of EN 13450.

In switches and crossings, specific control distances should be defined by the customer.

6 Acceptance responsibilities

6.1 Preliminary procedure to acceptance

After the completion of work, the contractor shall inform the customer in writing that the preliminary procedure to the acceptance may be carried out.

The customer shall carry out the preliminary procedure to the acceptance of the works.

The preliminary procedure to the acceptance consists of the following operations:

— checking the list and quantification of the works carried out;

— checking the records of the measurements and tests according to the contract;

— checking of documents according to the contract (e.g. drawings, notes of calculations, certificates, quality control, etc.);

— listing of works not performed although agreed in the contract;

— listing of non-conformities.

The personnel and the equipment requested by the customer to allow the carrying out of the preliminary procedure to the acceptance shall be made available by the contractor according to the contract.

6.2 Consequences of the preliminary procedure to the acceptance

The consequences of the preliminary procedure to the acceptance shall be as follows:

— acceptance is granted; or

— acceptance is granted with reservations; or

— acceptance is granted with allowance.

If the acceptance is granted, the decision shall be notified to the contractor.

If the acceptance is granted with reservations, the decision shall be notified to the contractor, who shall then take the necessary actions to correct the defects within the period of time as agreed in the contract. After taking these actions, the preliminary procedure to the acceptance shall be applied again to the corrected defects.

If the customer decides that the defects, if any, shall not be corrected, the acceptance shall be granted with allowance according to the contract or shall be subject to a negotiation between both parts. The decision shall be notified to the contractor.

7 Warranty

The warranty periods and conditions shall be specified in the contract.

Annex A
(informative)

Guidelines for specification of requirements of geodetic measurements

This annex provides an example of requirements of geodetic measurements.

The Technical Specification for a network of geodetic reference points should include requirements for:

— placing, interval and permanent marking of the geodetic reference point;

— uncertainty and calibrations of measuring and ancillary equipment;

— uncertainty in measurements;

— analysis and final calculation between geodetic reference points;

— documentation.

The Technical Specification for compliance geodetic measurements should include requirements for:

— uncertainty and calibrations of measuring and ancillary equipment;

— establishment of total station over a geodetic reference point or free stationing;

— uncertainty in measurements;

— interval in geodetic measurements in the track;

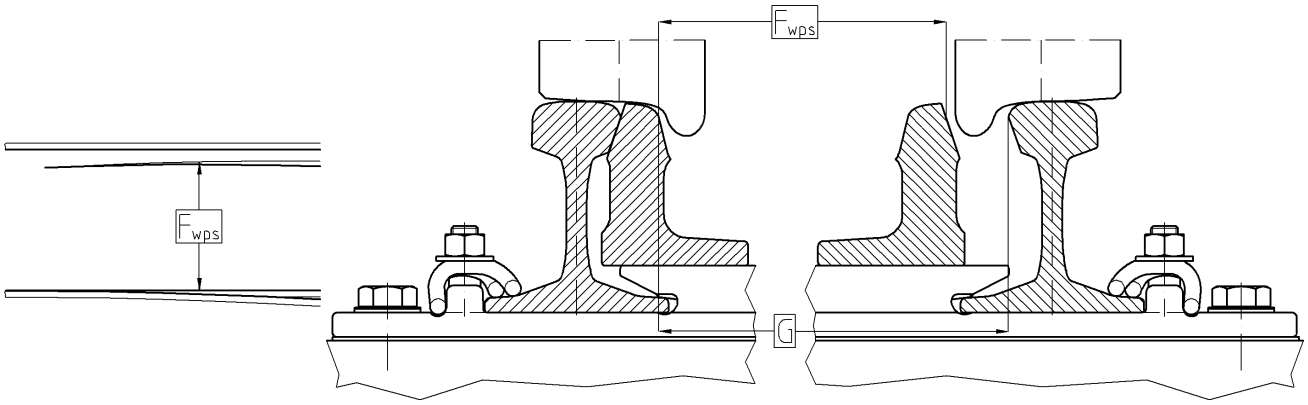
— method for quality assurance regarding continuous geometry, e.g. overlapping measurements when changing the reference station;

— limitation for length in observations;

— documentation.

Annex B
(informative)

Switches and crossings measurements and checks

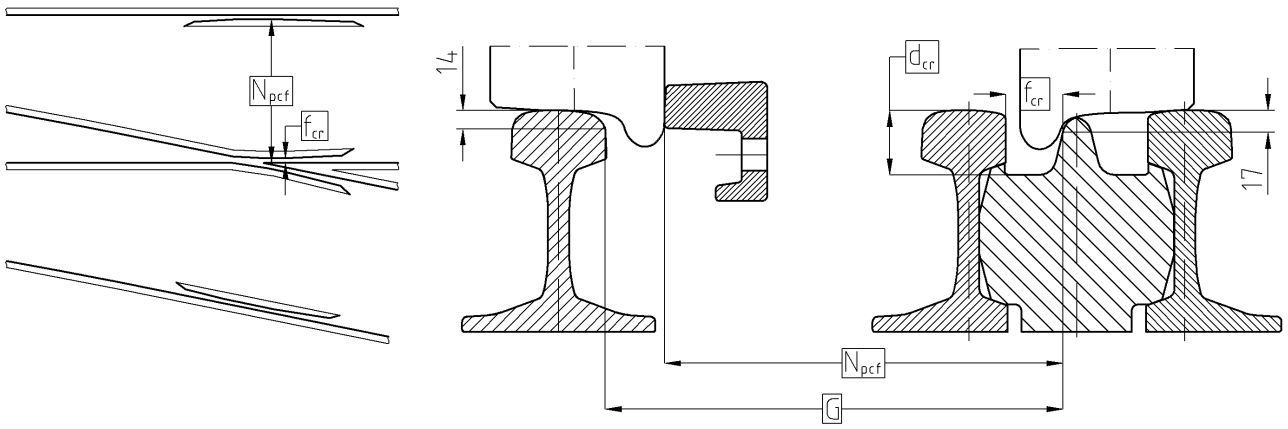


Key

F_{wps} free wheel passage
G track gauge

Figure B.1 — Measurement of free wheel passage in switches

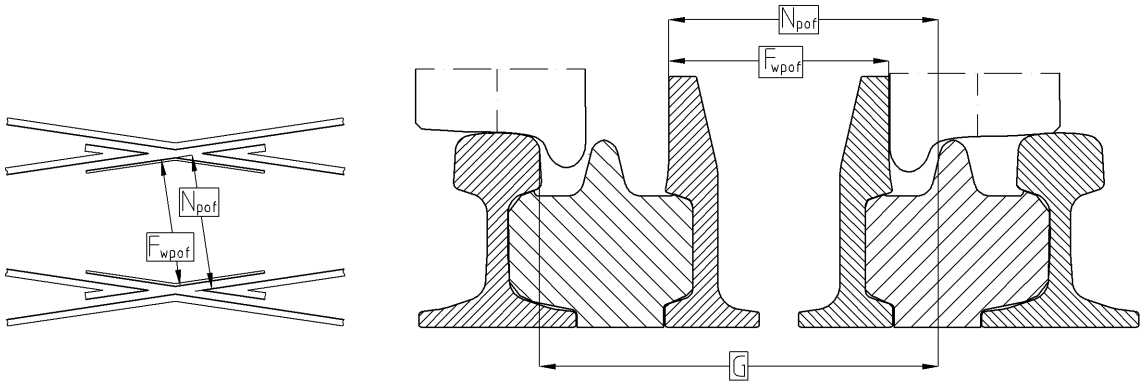
Dimensions in millimetres



Key

N_{pcf} nose protection at fixed common crossings
f_{cr} flangeway width
d_{cr} flangeway depth

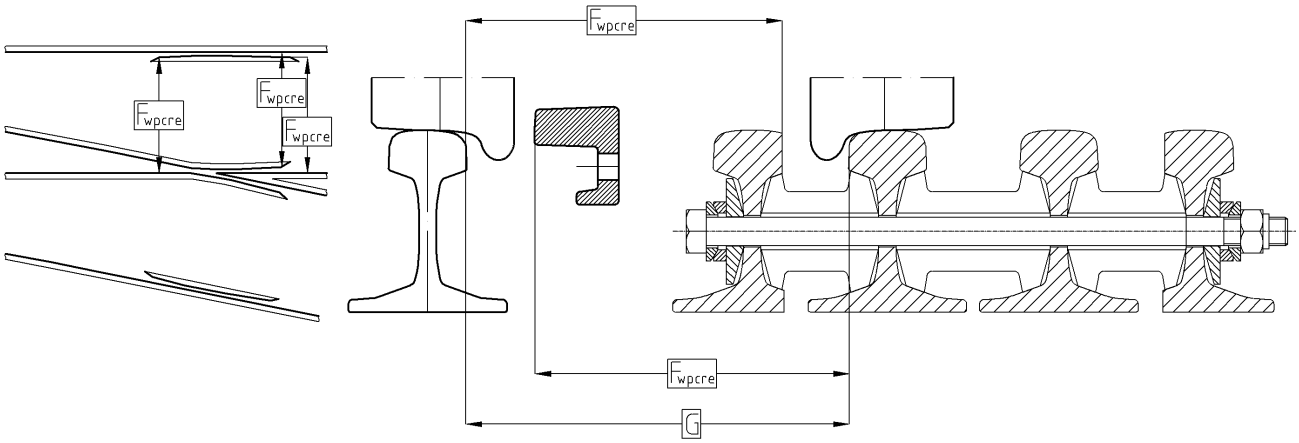
Figure B.2 — Fixed common crossing nose protection



Key

N_{pof} nose protection at fixed obtuse crossings
F_{wpof} free wheel passage in obtuse crossings

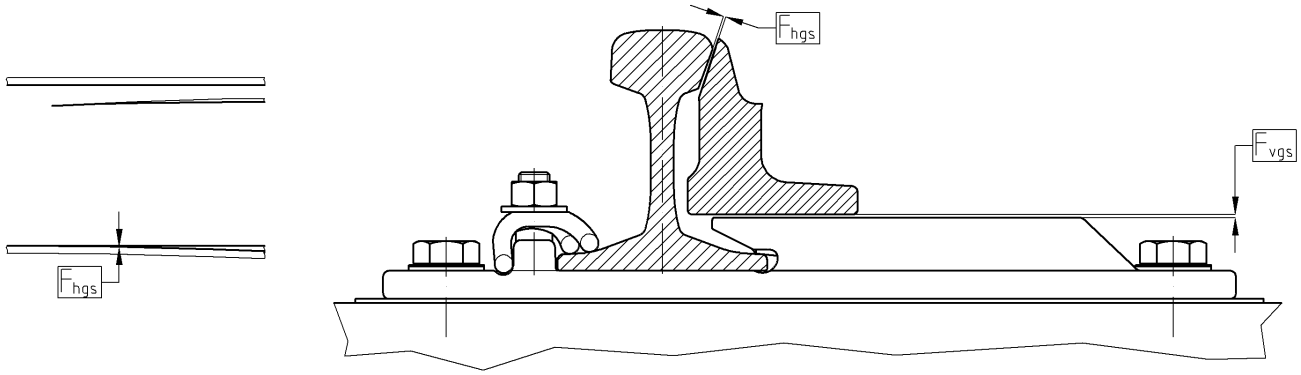
Figure B.3 — Free wheel passage in fixed obtuse crossing



Key

F_{wpcre} free wheel passage at check and wing rail entry

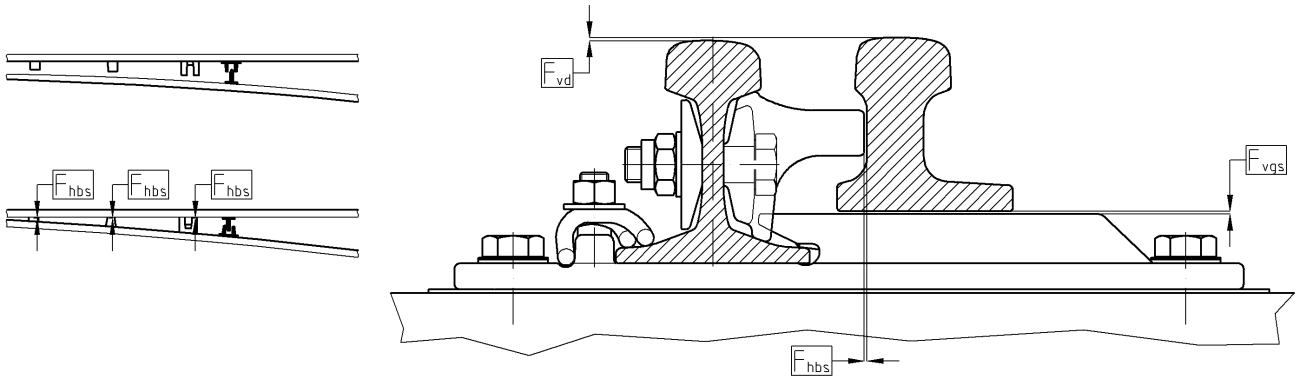
Figure B.4 — Free wheel passage at check rail entry and wing rail entry



Key

F_{vgs} vertical gap at sliding chairs
F_{hgs} horizontal gap of switch rail to stock rail or of movable frog to wing rail

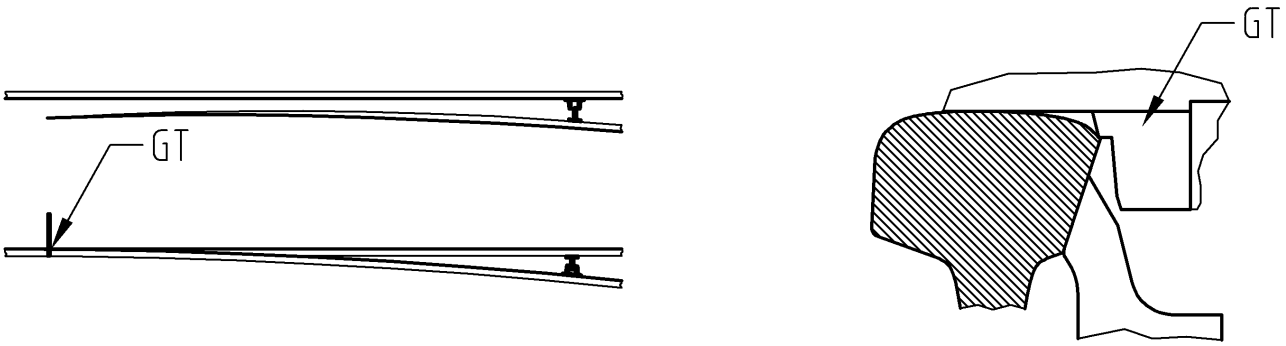
Figure B.5 — Vertical and horizontal gap of switch rail or movable frog base



Key

F_{vgs} vertical gap at sliding chairs
F_{hbs} horizontal gap between switch rail and distance block
F_{vd} vertical displacement of switch rail to stock rail

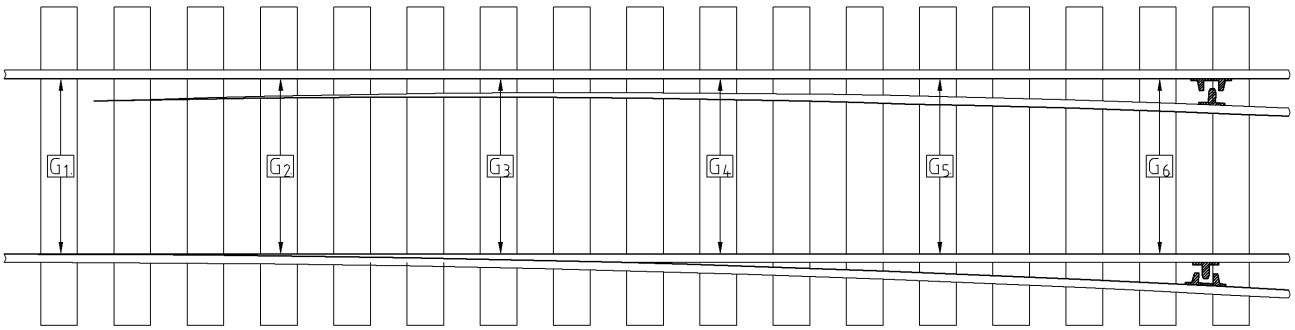
Figure B.6 — Vertical and horizontal gaps of switch rail and vertical displacement of switch rail to stock rail



Key

GT gauging tool

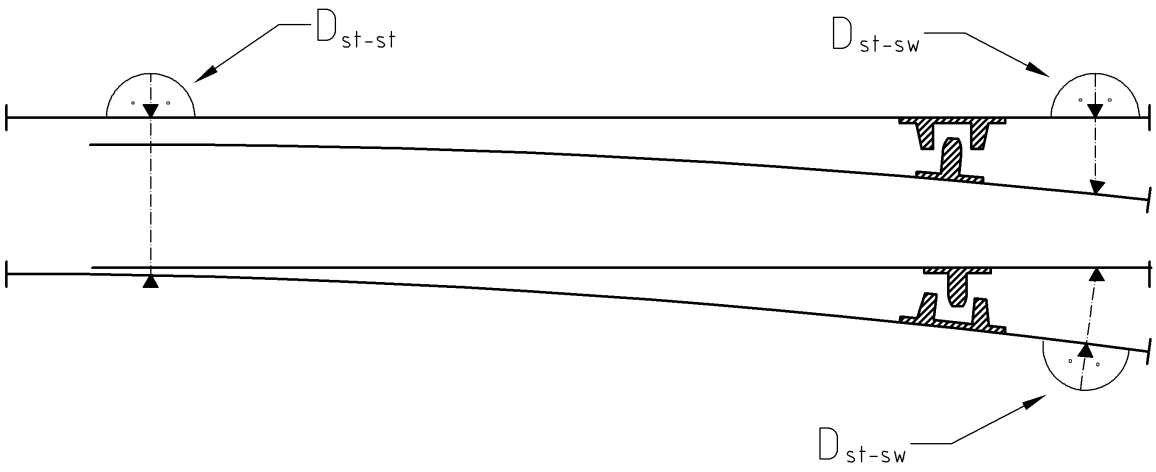
Figure B.7 — Check for possible wheel face overlapping



Key

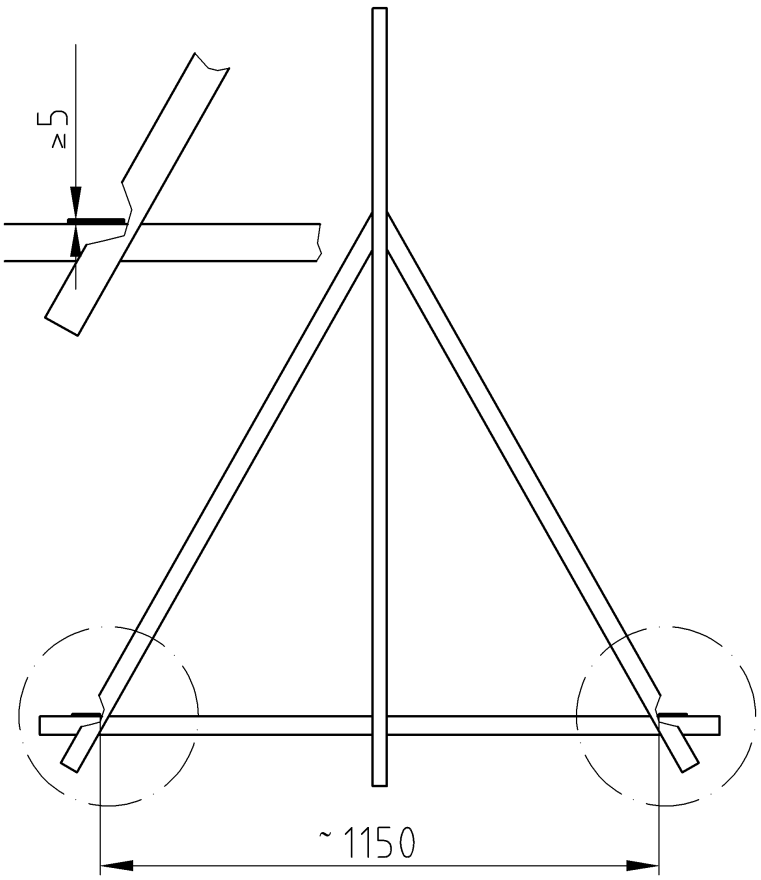
$G_n – G_{n+1}$ variation of designed track gauge between 3 sleepers

Figure B.8 — Variation of track gauge

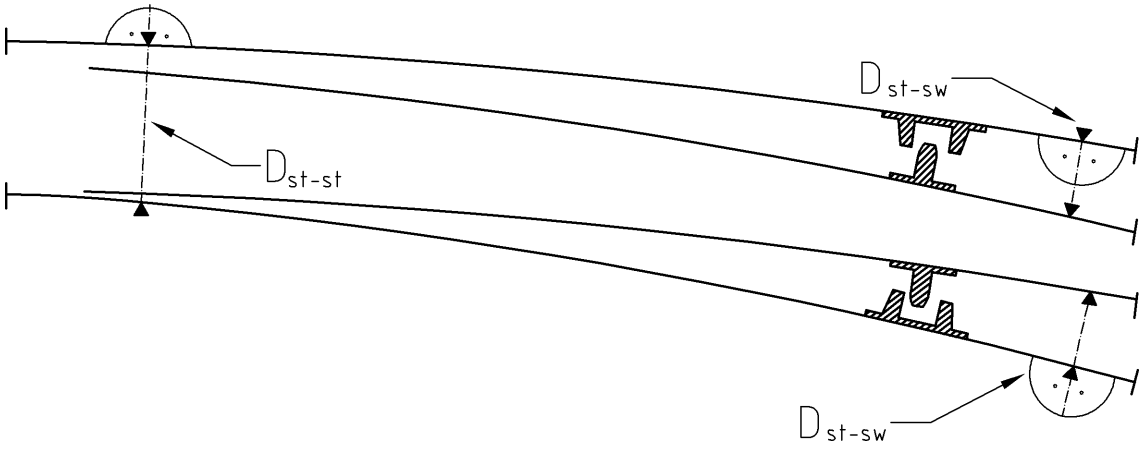


a) Common turnout

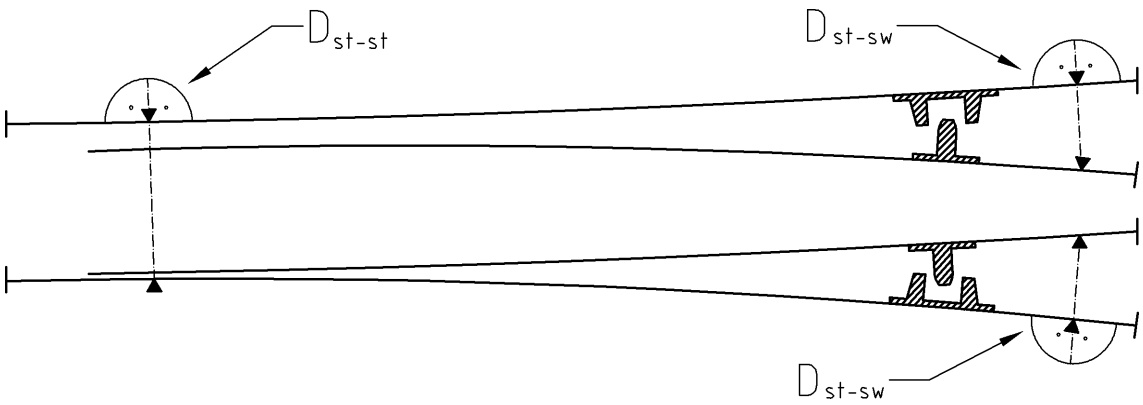
Dimensions in millimetres



b) Double angle bracket



c) Inside curved turnout

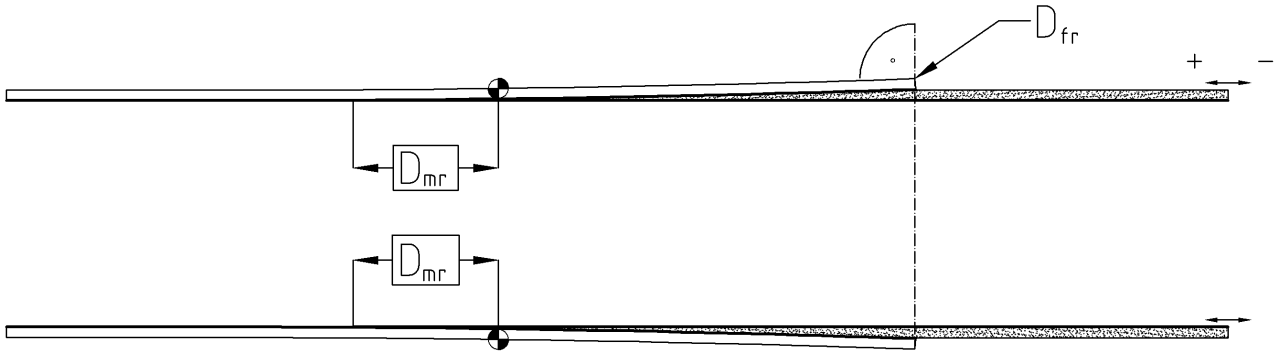


d) Contraflexure turnouts

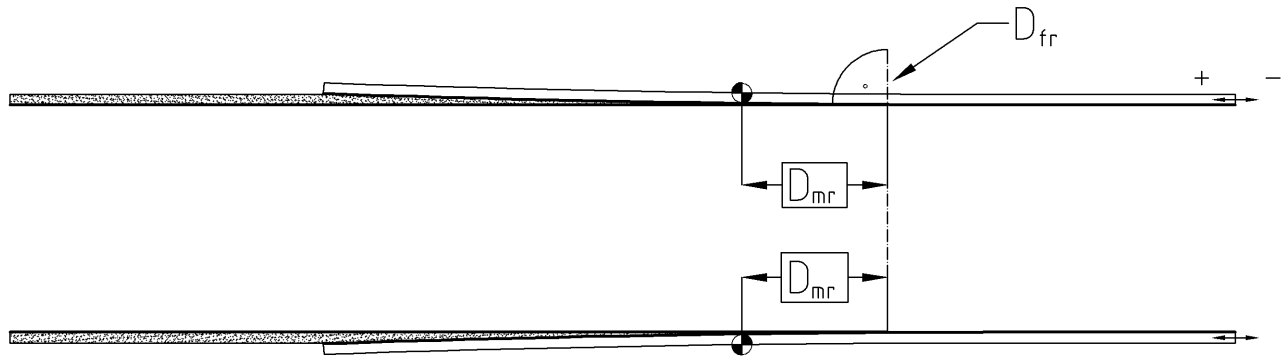
Key

D_{st-st} longitudinal displacement between the straight and the branch stock rail
D_{st-sw} longitudinal displacement between stock rail and switch rail
▲ punch mark

Figure B.9 — Longitudinal displacement of rails in turnouts



a) Moveable switch rails



b) Moveable stock rails

Key

D_{fr} longitudinal displacement of fixed rails

D_{mr} installed position of the moveable rails related to the reference point

reference point

Figure B.10 — Longitudinal relationship of fixed rails to each other and adjustment dimension for moveable rails in expansion devices

Bibliography

[1] EN 13803-1, *Railway applications — Track — Track alignment design parameters — Track gauges 1 435 mm and wider — Part 1: Plain line*

[2] EN 13803-2, *Railway applications — Track — Track alignment design parameters — Track gauges 1 435 mm and wider — Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature*

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