

Railway applications — Track — Switches and crossings —

Part 4: Actuation, locking and detection

ICS 45.080

National foreword

This British Standard is the UK implementation of EN 13232-4:2005+A1:2011. It supersedes BS EN 13232-4:2005, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

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

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

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Bahnanwendungen - Oberbau - Weichen und Kreuzungen -
Teil 4: Umstellung, Verriegelung und Lageprüfung

This European Standard was approved by CEN on 1 August 2005 and includes Amendment 1 approved by CEN on 13 September 2011.

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Contents

Page

Foreword.....	3
1 Scope	5
2 Normative references	5
3 Terms and definitions	5
3.1 General.....	5
3.2 Actuation forces.....	7
3.3 Geometrical parameters.....	7
4 Design criteria	10
4.1 Parameters required	10
4.2 Calculations and verifications	11
4.2.1 Object detection between stock rail and switch rail	11
4.2.2 Calculation of minimum flangeway.....	11
4.2.3 Correct closing.....	12
4.2.4 Neutral position.....	13
4.2.5 Negative force	13
4.2.6 Mechanical integrity	13
5 Test methods.....	13
5.1 Obstacle detection.....	13
5.2 Minimum flangeway / free passage of wheel	13
5.3 Correct closing.....	14
5.4 Actuation force, F_a	14
5.5 Neutral position.....	14
5.6 Negative force	14
5.7 Trailability	15
5.7.1 General.....	15
5.7.2 Factory testing	15
5.7.3 Track testing.....	15
6 Acceptance.....	15
6.1 General.....	15
6.2 Standard testing (no prototypes)	15
6.3 Prototype testing	16
6.4 Testing requirements for change in flexibility	16
Annex A (informative) Commonly used values for obstacle detection	17
Annex B (informative) Commonly used values for flangeway	18
Annex ZA (informative)  Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC 	19

Foreword

This document (EN 13232-4:2005+A1:2011) 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 April 2012, and conflicting national standards shall be withdrawn at the latest by April 2012.

A1 This document has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document. **A1**

This document includes Amendment 1, approved by CEN on 2011-09-13.

This document supersedes EN 13232-4:2005.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**.

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 series of standards “Railway applications – Track – Switches and crossings” covers the design and quality of switches and crossings in flat bottom rails. The list of parts is as follows:

- Part 1: Definitions
- Part 2: Requirements for geometric design
- Part 3: Requirements for wheel/rail interaction
- Part 4: Actuation, locking and detection
- Part 5: Switches
- Part 6: Fixed common and obtuse crossings
- Part 7: Crossings with moveable parts
- Part 8: Expansion devices
- Part 9: Layouts

Part 1 contains terminology used throughout all parts of the European Standard.

Parts 2 to 4 contain basic design guides and are applicable to all switch and crossing assemblies.

Parts 5 to 8 deal with particular types of equipment, including their tolerances. These use parts 1 to 4 as a basis.

Part 9 defines the functional and geometrical dimensions and tolerances for layout assembly.

The following terms are used within to define the parties involved in using the EN as the technical basis for a transaction:

CUSTOMER The operator or user of the equipment, or the purchaser of the equipment on the user's behalf.

SUPPLIER The body responsible for the use of the EN in response to the customer's requirements.

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

1 Scope

This European Standard determines the interface between moveable parts and the actuation, locking and detection equipment, and defines the basic criteria of switches and crossing with moveable parts in respect of the interface.

It concerns:

- rules parameters and tolerances for alternative positions of the moveable parts;
- criteria and limits for the forces which move and restrain the moveable parts.

2 Normative references

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

EN 13232-1:2003, *Railway applications – Track – Switches and crossings – Part 1: Definitions*

prEN 13232-9, *Railway applications – Track – Switches and crossings – Part 9: Layouts*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13232-1:2003 and the following apply.

3.1 General

3.1.1

actuation system

system that ensures the correct movement of the moveable parts of the switch and crossing. The actuation system includes the rods, links and actuators needed to ensure the operation. The actuation system may be either electric, hydraulic, manual etc.

3.1.2

locking device

device that ensures the moveable part of the switches and crossings stays in the desired position. It guarantees the correct position of the moveable part during the passage of the vehicle

3.1.3

detection device

device that enables the verification of the correct positioning of the moveable part of the switch and crossing. It enables the signalling to decide whether safe train passage can be guaranteed

3.1.4

trailability

ability of actuator and locking systems to permit the trailing of the switches and crossings by a vehicle. There are two different trailing devices – trailable devices and non-trailable devices

3.1.4.1

trailable devices

- devices which permit trailing as non-standard operation

In this case, parts of the switch may be slightly damaged. The switches and crossings will only be released for further operation after full inspection of switch and actuator.

- devices which permit trailing as standard operation.

In this case the actuator and locking system permits the trailing of the switches and crossings by a vehicle, without damaging any part of it.

In both cases the maximum trailing speed is defined

3.1.4.2

non-trailable devices

devices which do not permit the trailing of the switches and crossings by a vehicle

3.1.5

single or multiple drives

3.1.5.1

single drive

drive operated at one position, i.e. the switch toe

3.1.5.2

multiple drives

drives operated at more than one position. In this case there may be either single or multiple locking

3.1.6

lubrication free switch operation

3.1.6.1

non-lubricated slide baseplates

no lubrication on the slide baseplates is required to ensure the correct actuation of the switch and crossing. This can be assured by special baseplates, roller systems or other devices

3.1.6.2

lubrication free actuator and locking system

no lubrication is required to ensure the correct actuation and locking of the switch and crossing

NOTE Track lubrication may still be required, for other reasons.

3.1.7

open and closed position

3.1.7.1

switches and switch diamond crossings – closed position

switch rail is applied to its corresponding stock rail

3.1.7.2

switches and switch diamond crossings – open position

switch rail stands away from its corresponding stock rail by a defined distance (switch toe opening)

3.1.7.3

common crossings with moveable parts – closed position

running edge (of main line or branch line) is not interrupted

NOTE An open position does not exist.

3.2 Actuation forces

3.2.1

actuation force, F_a

maximum value of the force, applied by the actuator in order to operate the moveable parts of the switches and crossings (see Figure 1).

This force is measured at the interface between actuator and the throwing or locking device

3.2.2

actuator capacity, F_{cap}

maximum force the actuator can provide (see Figure 1)

3.2.3

negative force, F_{neg}

force needed to keep the moveable part at its closed position

3.2.4

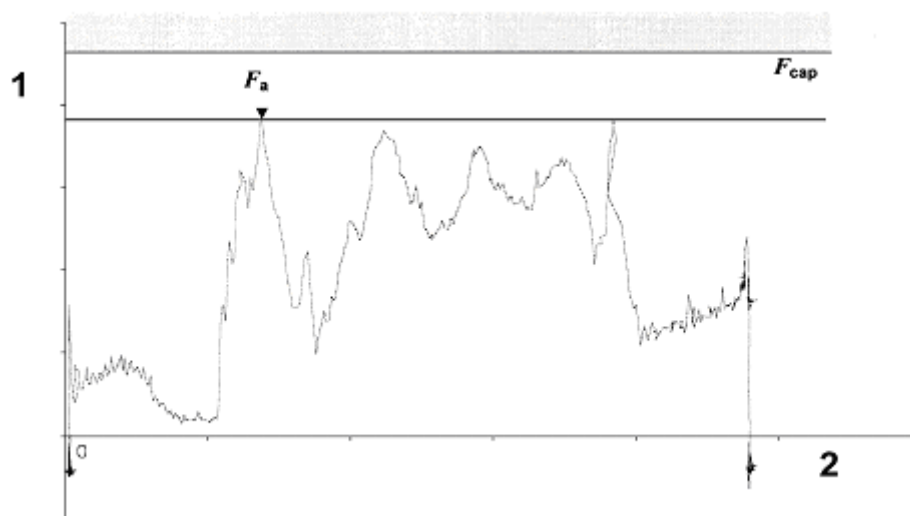
retaining force, F_R

force, provided by the actuator to keep the moveable parts in their positions, during vehicle passage

3.2.5

locking force, F_L

force the locking device guarantees and applies to the moveable parts in order to keep them at their locked position



Key

- 1 Actuation force
- 2 Displacement

Figure 1 — Actuation forces

3.3 Geometrical parameters

3.3.1

stud gap, d_{stud}

gap between the stud supporting surface and the corresponding surface of the moveable part (i.e. switch rail, point rail, wing rail)

3.3.2 longitudinal displacement

NOTE longitudinal displacements may occur in the switch and crossing area due to thermal, acceleration and braking forces. These forces can create differential displacement between the various components of the switch or crossing

3.3.2.1 switches

differential displacement between switch and stock rail is the most important with regard to the switch actuation, locking and detection system. These displacements will be defined in two main places:

a) differential toe tip displacement (y)

This is the differential longitudinal displacement between the switch rail and the corresponding stock rail. In order to be able to measure the switch toe displacement, a reference point will be placed on the stock rail.

b) differential displacement at the heel block (z)

This is the differential longitudinal displacement between the switch rail and the corresponding stock rail, at the switch heel

3.3.2.2 crossings with moveable parts

differential displacement between point or switch rail and the corresponding housing (wing rail) is the most important with regard to the actuation, locking and detection system. This displacement is defined at the nose point. In order to be able to measure the swing nose or switch toe displacement, a reference point will be placed on the wing rail

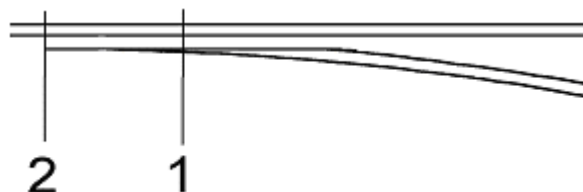
3.3.3 maximum gap of closed switch rail, d_{gap}

maximum permissible parallel distance between the two machined contact faces of the switch and stock rail to give detection. A different value applies in front of the first detection position (d_{gap1}) than in the rest of the machined area (d_{gap2}). See Figures 2 and 3.

The same definition applies in principle to crossings with moveable parts

3.3.4 maximum gap at switch toe, d_{toe}

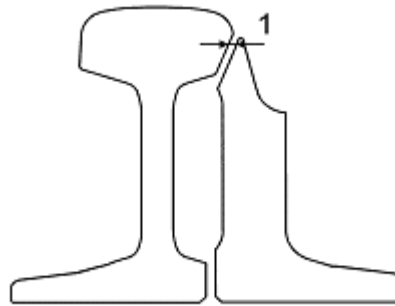
maximum permissible horizontal distance between the two machined contact faces of the switch and stock rail to give safe operation. The dimension is defined at the switch toe. This basic dimension is taken into account during switch point design to avoid derailment



Key

- 1 d_{gap} (either d_{gap1} or d_{gap2})
- 2 d_{toe}

Figure 2 — Gap of closed switch rail



Key

1 d_{gap} or d_{toe}

Figure 3 — Maximum gap of closed switch rail

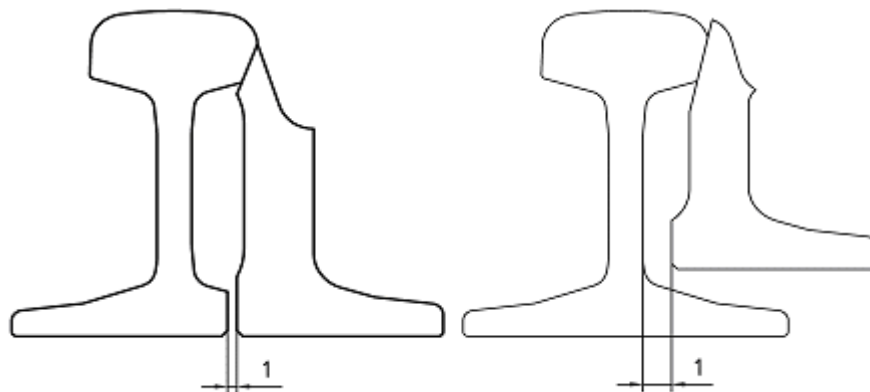
3.3.5

foot clearance, d_{foot}

distance between the foot of the switch rail and the nearest part of the stock rail or any other component (bolt, heaters etc.) fixed to it, ensuring clearance between both is maintained (see Figure 4)

For additional equipment (e.g. heaters, cable connections) this clearance has to be maintained.

Longitudinal displacements are taken into account.



Key

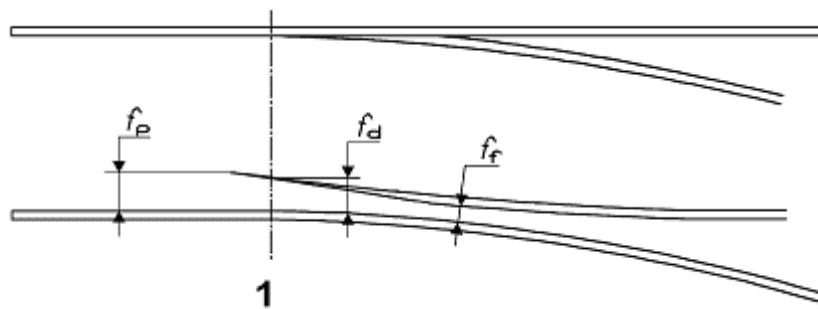
1 d_{foot}

Figure 4 — Foot clearance

3.3.6

toe movement, f_p

movement of the toe, when moved by the actuator. It is the distance between open and closed position at the toe (see Figure 5)



Key

1 Actuation position

Figure 5 — Opening and flangeway

3.3.7

opening at the drive position, f_d

movement of the switch rail at the drive position. This movement is less than the toe movement (see also Figure 5)

3.3.8

neutral switch rail position, f_N

position of the switch rail, if no external effort is applied to it.

The neutral position is verified at the first drive position.

The same principle applies to crossings with moveable parts

3.3.9

actuator movement, f_a

movement of the actuator rod

3.3.10

minimum flangeway, f_f

see EN 13232-1:2003, 7.4.6 and Figure 59. (See also Figure 5.)

This dimension is measured at the gauge reference plane

3.3.11

track gauge, G

see EN 13232-1:2003, 2.11 and Figure 5. (See also Figure 6.)

This dimension is measured at the gauge reference plane

4 Design criteria

4.1 Parameters required

The designer of the switches and crossings shall take into account all parameters that may influence the design. The following minimum information is required for the design of the switch panel or moveable crossing.

- Minimum flangeway (f_f);
- trailability;

- maximum cant, that can be applied to the switches and crossings in track;
- main line speed;
- the conceptual dimensions of actuator and locking system, including the drive, locking and detection positions;
- actuator capacity F_{cap} ;
- maximum actuation force applied F_a ;
- the mechanical interfaces of all actuating, locking and detection devices;
- toe movement (f_p) or switch opening at drive position (f_d);
- maximum gap at switch toe (d_{toe});
- actuator displacement.

The customer or the designer of the operating system will provide the designer with a set of actuator, locking and detection systems, in order to permit the designer to verify his design.

4.2 Calculations and verifications

4.2.1 Object detection between stock rail and switch rail

The system should only lock and detect when the whole switch rail is closed with a maximum gap of d_{gap} . This depends on switch flexibility, actuation forces, number of actuation points, stretcher bar positions, detection positions and detection settings.

The value for d_{gap} is different in front of the first detection point (d_{gap1}) than in the rest of the machined area (d_{gap2}) (see Figure 2).

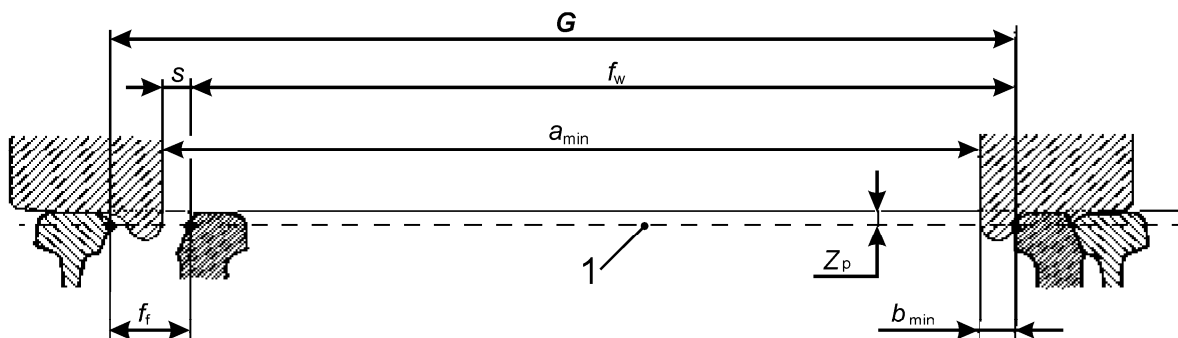
Commonly used values are given in informative Annex A.

4.2.2 Calculation of minimum flangeway

The value of minimum flangeway can be reduced if the customer can demonstrate that the actuation and locking system of the switch is able to resist the lateral impact forces of the wheelset.

The minimum free wheel passage f_w is calculated as follows (see Figure 6).

$$f_w = a_{min} + b_{min} - s$$



Key

- 1 Gauge reference plane
- f_w Width of the free wheel passage area
- f_f Minimum flangeway
- G Track gauge
- a_{min} Minimum back to back
- b_{min} Minimum flange width (worn wheel)
- s Margin
- z_p Distance between gauge reference plane and running surface

Figure 6 — Wheel flangeway calculation

NOTE The passage of the wheel always has to be guaranteed

The distance G between the gauge faces of adjacent running rails is measured at a defined distance $z_p \leq 15$ mm below the running surface.

s is a margin, depending on:

- special design aspects (for example, switch head profile);
- maximum permissible gauge widening;
- a safety value (for example, deformations in track, tolerances in the actuation system).

The minimum flangeway can be derived from the equation:

$$f_f = G - f_w$$

The values of a_{min} and b_{min} are to be provided by the customer.

If the customer does not provide f_f or f_w , the supplier will propose a value, based on calculations made according to the consideration made above.

Commonly used values for f_f are given in informative Annex B.

NOTE f_w can be calculated using the equation in the second paragraph of this subclause.

4.2.3 Correct closing

The design shall ensure the actuator correctly brings the moveable part into its closed position(s). In order to check the correct closing following parameters are to be verified:

- stud gap $d_{\text{stud}} \leq 1 \text{ mm}$;
- the gap between contact surfaces of stock and switch rail $\leq 1 \text{ mm}$;
- the gap between contact surfaces of stock and switch rail at the switch toe $\leq 0,5 \text{ mm}$.

4.2.4 Neutral position

The design will guarantee the neutral position f_N . The nominal value and the corresponding limits are chosen or agreed by the customer.

4.2.5 Negative force

The negative force will only be taken into account when no locking device will be used. Its value will have to be checked at the actuator position.

The test result will be compared with the maximum value defined by the customer.

4.2.6 Mechanical integrity

The supplier will guarantee that no permanent deformations of the switch and crossing constituents will be induced by operating the moveable parts during normal operating conditions at any time in the product life cycle, and taking into account the maximum actuation forces.

In case of a trailable switch (as standard operation) no part of the switch and crossing will be permanently deformed by train passing in the trailing direction.

5 Test methods

5.1 Obstacle detection

This test applies to both switch panels and crossings with moveable parts.

This test is to be performed in factory conditions and on the switch or crossing panel as a whole. The switch or crossing panel will be mounted with the complete actuation, locking and detection system. This will be arranged so that it delivers its maximum permissible actuating force.

The switch or crossing panel is put in a flat surface. An un-deformable obstacle with cylindrical dimensions of d_{gap} mm is placed between the two machined faces of the stock and switch rail at the least favourable position.

When the maximum actuating force is applied, the detection system shall show that the switch rail is not properly closed.

5.2 Minimum flangeway / free passage of wheel

This test only applies to switch panels.

This test is to be performed in factory conditions on the switch or crossing panel as a whole. The switch or crossing will be completely mounted with the actuating system.

The test will be carried out on the switch panel in both flat position and put in the maximum design cant.

The switch is put in its closed position and will be operated by the actuator. The flangeway or the free wheel passage will be measured and compared with the given value.

This test is to be performed 3 times for both directions. Between every measurement the switch or crossing is operated 2 times.

5.3 Correct closing

This test applies to both switch panels and crossings with moveable parts.

This test is to be performed in factory conditions on the switch or crossing panel as a whole. The switch or crossing will be completely mounted with the actuating and locking system.

The moveable part is applied to its corresponding fixed part by the actuating system. The requirements of 4.2.3 are verified.

5.4 Actuation force, F_a

The actuation force is measured at the interface between actuator and throwing or locking device. When measuring the actuation force, ensure that the measurement is not affected by any other point machine or force in the switch rail etc.

This test is to be performed in factory conditions on the switch or crossing as a whole. All actuation and locking devices will be mounted.

The switch or crossing will be put in a flat surface or in the maximal permissible cant.

The switch or crossing will be operated by the actuator. During operation the actuation force is measured and recorded. The maximum value has to be compared to the given requirements.

This test is to be performed 3 times for both directions. Between every measurement the switch or crossing is operated 2 times.

5.5 Neutral position

This test applies to both switch panels and crossings with moveable parts.

This test is to be performed in factory conditions and on a half set of switches or on the switch or crossing as a whole. All actuation, locking or detection devices will be dismantled.

The switch or crossing will be put in a flat surface. Friction between slide baseplates and switch rail should be reduced. This could be done by greasing the slide baseplates or by putting the switch rail on free rollers.

The moveable part will be manually put at the theoretical neutral position. After releasing the moveable parts, it should stay within the limits of the given neutral position.

5.6 Negative force

The negative force is measured at the drive position nearest the switch toes. This is the friction-less force. Friction between slide baseplates and switch rail shall be reduced. This could be done by greasing the slide baseplates or by putting the switch rail on free rollers. The measurement shall be performed by an agreed method between customer and supplier.

The test is to be performed under factory conditions on the switch or crossing. The switch or crossing will be put in a horizontal plane.

The test shall be performed three times and the highest reading used as the negative force.

5.7 Trailability

5.7.1 General

Trailable switches and crossings shall be checked by two methods: factory testing and track testing.

Track testing shall always be performed with the actuation and locking system completely mounted.

5.7.2 Factory testing

Tests performed under factory conditions, shall be agreed between customer and supplier.

5.7.3 Track testing

The minimum axle load $Q_{\min}$ will be defined by the customer, as well as the maximum trailing speed V_{tr} .

In this case the switches and crossings will have to be mounted in a track section, and assembled according the prescriptions of prEN 13232-9. A train with specified wheel profile and minimum axle load will negotiate the switch in trailing direction with increasing speeds.

The first trailing will take place at 5 km/h. All movements of the actuator will be inspected. Then the speed will be increased in steps of 5 km/h until a speed of V_{tr} 10 km/h.

After every test the complete switch and crossing, together with its actuator and locking devices will be inspected for any defects, deformations or wear. The switch or crossing will be operated to check the correct performance of all constituents.

In the case of a trailable switch where trailing as standard operation, no deformation, or any other defects should appear on the switch or crossing or actuator and locking system. The complete actuator and locking system should be dismantled and disassembled after the tests for a full visual inspection for internal defects. No defects or abnormal wear may appear on any of the components.

In case of a trailable switch for non-standard operation no deformations of the parts of the switch or crossing may appear. Deformations, breakage or wear on the actuator or locking system should be reported in the test report.

6 Acceptance

6.1 General

The acceptance tests depend on the type of contract. In case of prototypes the supplier shall validate his design with special acceptance tests. In the case of deliveries of existing designs, only standard acceptance tests are to be performed.

6.2 Standard testing (no prototypes)

For deliveries of switches and crossings with proven design, the following tests are to be performed if requested by the customer:

- neutral position;
- negative force.

If the delivery includes the actuator and locking system, the following additional parameters are to be checked:

- actuating force;
- proper closing.

6.3 Prototype testing

The following tests are to be performed on prototypes:

- minimum flangeway;
- obstacle detection test;
- foot clearance;
- proper closing;
- negative force (if requested);
- neutral position (if requested);
- trailability (if required).

If the delivery includes the actuator and locking system, the following parameters are to be measured:

- actuating force;
- correct closing (with actuator).

6.4 Testing requirements for change in flexibility

A new switch or crossing is considered to be a prototype if no comparable switch or crossing with a proven design can be given. Modifications to an existing design might involve new prototype testing whenever the flexibility of the moveable parts is changed or if the actuator and locking system changes.

Following prototype testing, tests are to be repeated in the case of:

a) increased flexibility of the moveable part:

- minimum flangeway;
- proper closing;
- obstacle detection test;
- trailability (if required);

b) decreased flexibility of the moveable part:

- minimum flangeway;
- proper closing;
- negative force;
- trailability (if required).

Annex A (informative)

Commonly used values for obstacle detection

Commonly used values of d_{gap1} and d_{gap2} for obstacle detection between switch and stock rail at the first detection position and the rest of the machined area respectively are given in Table A.1.

Table A.1 - Common values for obstacle detection

Country	d_{gap1}	d_{gap2}
Austria		12 mm
Belgium		12 mm
Czech Republic		12 mm
Denmark	3 mm	No demands
France	< 6 mm	≤ 10 mm
Portugal	3 mm	4 mm
Spain	< 1 mm ¹⁾	< 8 mm ³⁾
	< 2 mm ²⁾	< 10 mm ⁴⁾
Switzerland	10 mm	10 mm
United Kingdom		12 mm
¹⁾ recommended for new assembling ²⁾ limit to apply in maintenance operations ³⁾ for switches with 1 electric point motor + 1 check point machine ⁴⁾ for switches with several electric point motors		

Annex B (informative)

Commonly used values for flangeway

Commonly used values of minimum flangeway f_f are given in Table B.1.

Table B.1 - Common values for flangeway

Country	f_f
Austria	58 mm
Belgium	50 mm
Czech Republic	60 mm
Denmark	60 mm
France	55 mm ¹⁾
Germany	58 mm
Portugal	40 mm
Spain	58 mm
Switzerland	60 mm
United Kingdom	50 mm ²⁾ 60 mm ³⁾
¹⁾ for gauge = 1435 mm ²⁾ BS113A FB ³⁾ UIC60	

Annex ZA (informative)

A1 Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2008/57/EC¹.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 for HS Infrastructure and in Table ZA.2 for CR Infrastructure confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

¹ This Directive 2008/57/EC adopted on 17th June 2008 is a recast of the previous Directives 96/48/EC 'Interoperability of the trans-European high-speed rail system' and 2001/16/EC 'Interoperability of the trans-European conventional rail system' and revisions thereof by 2004/50/EC 'Corrigendum to Directive 2004/50/EC of the European Parliament and of the Council of 29th April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system'.

Table ZA.1 — Correspondence between this European Standard, the HS TSI INF, published in OJEU dated 19th March 2008, and Directive 2008/57/EC

Clause(s)/ sub-clause(s) of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
4 Design criteria 5 Test methods 6 Acceptance	4. Description of the infrastructure domain 4.2.2 Nominal track gauge 4.2.8 Cant deficiency 4.2.11 b). Rail inclination – Switches and crossings 4.2.12. Switches and crossings 4.2.13 Track resistance 5. Interoperability constituents 5.3 Constituents performances and specifications 5.3.4 Switches and crossings Annex A – Table A1	Annex III Essential requirements 1. General requirements 1.1 Safety Clauses 1.1.1 – 1.1.2 and 1.1.3 1.5 Technical compatibility	

Table ZA.2 — Correspondence between this European Standard, the CR TSI INF published in OJEU dated 14th May 2011, and Directive 2008/57/EC

Clause(s)/ sub-clause(s) of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
4 Design criteria 5 Test methods 6 Acceptance	4. Description of the infrastructure subsystem 4.2.5 Track parameters 4.2.5.4 Cant deficiency 4.2.5.7.2 Rail inclination – Requirements for switches and crossings 4.2.6 Switches and crossings 4.2.6.1 Means of locking 4.2.6.2 In-service geometry of switches and crossings 4.2.7 Track resistance to applied loads 6. Assessment of conformity of interoperability constituents and EC verification of the subsystems 6.2.4.7 Assessment of geometry of switches and crossings 6.2.5.2 Assessment of track resistance for switches and crossings Annex B – Table 21	Annex III Essential requirements 1. General requirements 1.1 Safety Clauses 1.1.1 – 1.1.2 and 1.1.3 1.5 Technical compatibility	The TSI makes only reference to means of locking, not to means of detection Rails, fastenings and sleepers used for short length of track for specific purposes, for example in switches and crossings, at expansion devices, transition slabs and special structures, are not considered to be interoperability constituents according to § 5.2 (3) of the CR TSI INF

WARNING — Other requirements and other EC Directives may be applicable to the product(s) falling within the scope of this standard. 

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