Bilag 1:

**Technical Specifications - Switches and Crossings**

*…for manufacture, delivery, and assembly of*

*new Switches, Crossings, spare parts, and components…*

Version 1: 2023



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|  | **Tekniske Betingelser**- for produktion og levering af sportekniske dele til sporskifter og sporskæringerVersion 1: 2023 | BanedanmarkINF Spor, SystemerGodsbanevejRingstedwww.banedanmark.dk | Udarbejdet: MHSR, ADMTKontrolleret: Godkendt: PJDR |

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1. Introduction

These specifications prescribe the technical requirements for manufacturing, supply and assembling of Switches and Crossings of various dimensions and geometry for use in the conventional Danish network rail, managed by Banedanmark.

These specifications are also valid for purchasing replacements parts or components for maintenance activities.

The Switches and Crossings, Spare Parts and Components shall be in accordance with the approved drawings listed in ref. [2] and [3]. The sleepers, of any type, in principle will not be within the scope of the present requirements. More information can be found in section 4.11.

Unless otherwise specified hereafter, terminology for Switches and Crossings, spare parts and their components must be taken from the latest version of ref. [11]. Each and every Switch and Crossing component or sub-component that is not explicitly referred in these technical specifications shall be manufactured in accordance with the current guidelines of the ISO, EN or UIC standards referred to.

The following table defines the two partial agreements of the tender: Part 1 and Part 2.

|  |  |
| --- | --- |
| **Contract name** | **Content** |
| **Part 1:** Tendering new Switches and Crossings and their subcomponents.Certain spare parts and components, where Supplier own the design (for relevant Switches and Crossings) will also be object of this part 1. | ***Objects*** | ***Scope***  |
| Preassembled & normal Switches and Crossings, see Blad 7960 | Table IV and Table V(**Blad 7960)** |
| Preassembled Switches and Crossings that are **TSI compliant**. Certain spare components (switches and crossing), of supplier’s design will be also object of this part 1. | Switches and Crossings are following EN standard (must meet all the required **conditions** coming from Technical Specifications for Interoperability Infrastructure **TSI INF** according to ref. [1] and section 3.6)Table I & Table II(**Blad 7960)** |
| Cast manganese steel crossing with INOX welded legs of rail profiles, as a spare part (**including necessary assembly/fastening components and extra length**). | Table I, II, IV, V (see “Krydsningstype” marked as ”manganstålkrydsning” in (**Blad 7960**) or symbol **#)**Manganese crossings from the tendering catalogue/list provided in Bilag 2: Tilbudsliste (Appendix 2) |
| Switch blade rollers (**including necessary assembly/fastening components**). | Integrated in the slide baseplates (**TSI compliant**):Table I, II in (Blad 7960)Mounted in between sleepers:Table I, II, IV &V in (Blad 7960) |
| **Contract name** | **Content** |
| **Part 2:** Tendering of spare parts. Components that are a particular supplier design, from part 1, will not be part of this tendering part 2. | ***Objects*** | ***Scope*** |
| Spare parts for switches & crossings.60E2/UIC60 and 45E2/DSB45.* Half set of switch panel
* Complete Set of switch panel
* Build up crossings incl. design by the supplier.
* Check rails.
* Baseplates.
* Slide chair baseplates.
* Check rail chair baseplates.
* Bolts and other parts for assembly and fastenings for Switches and Crossings
 | * Table I, II, IV and V
* (**Blad 7960) (excluding manganese crossing, rolling devices and new developments of Check rail chair baseplates)**
* Table in (**Blad 5730**)
* Components from the tendering catalogue/list provided in Bilag 2: Tilbudsliste, Delaftale 2 (Appendix 2, Partial agreement 2) **(excluding manganese crossing)**
 |

Table 1.1: Definition of Switches and Crossings, spare parts and components covered by these specifications.

The Wording (Part 1 and 2) or only (Part 1) or (Part 2) in paragraphs below is referring to above table, meaning that paragraphs containing (Part 1) will only be applicable for Partial agreement 1 and vice versa for (Part 2). Paragraphs containing (Part 1 and 2) will be applicable for both agreements.

The present technical specifications will be applied for manufacturing, supply, and assembly of the certain Switches and Crossings, their spare parts and components contained in Table 1.

The Switches and Crossings parts are listed as:

* ½ Switch Panel set (with or without slide Baseplates)
* Crossing or Frog
* Check Rail set
* Cast Manganese Crossing

the abovementioned parts will be used as replacement components when carrying out maintenance activities. The following types of Switches and Crossings will be covered by these technical specifications:

* Single Turnouts with fix (non-moveable) parts in the Crossing panel (enkeltsporskifter med fast krydsning),
* Diamond Crossings (sporskæringer)
* Multiple Slip Switches (krydsningssporskifter)
* Three-way Switches and Crossings (forsatte sporskifter)

Mounted both on concrete sleepers and wooden sleepers.

TSI compliant Switches and Crossings must correspond with the performance parameters for passenger traffic P3, as indicated in TSI INF no. 1299/2014 table 2, and performance parameter for freight traffic F1, as indicated TSI INF n0. 1299/2014 table 3, see ref. [48].

Other Switches and Crossings and spare parts will be design and delivered to withstand a maximum speed of 200 km/h and maximum axle load of 22,5 tons.

The rails with Vignole profile will have the following profiles:

* “60E2” also named “UIC60 rail”, reference Blad 7960.
* “45E2” also named “DSB45 rail”, reference Blad 5730.

Any turnout or turnout components supplier must ensure, at Banedanmark request, that any potential sub supplier is also in accordance with these technical specifications.

# References

The following references are a listing of standards, norms, and legislative rules, that Banedanmark complies to.

Tenderer is obliged to follow same, and should Tenderer not be able to do so, a remark must be made in Bilag D: Tilbudsgivers kommentarer til udbudsmaterialet (Tenderers Comments to Tender Material). Further, a comprehensive statement must be given in this regard, when forwarding initial offer, in Bilag E or F: Tilbudsbrev (Offer Letter), Part 1 or 2.

1. **Technical assessment report TSI INF no. 1299/2014** compliant Switches and Crossings in Banedanmark
2. **Banedanmarks specifikkeprojekttegninger** (Banedanmark’s specific project drawings for particular supply).
3. **Banedanmarks standard drawings.** Latest edition.
4. **Banedanmarks Track Norm BN2-15-2.** Dated 01.03.2008.
5. **Bekendtgørelse af lov om arbejdsmiljø (**Promulgation on Working Environment Act)**, LBK** nr. 1072 07/09/2010
6. **Bekendtgørelse om Bygherres forpligtelser** (Declaration on obligations of the developer**)** BEK nr. 117 05/02/2013
7. **Bekendtgørelse om projekterendes og rådgiveres pligter m.v. efter lov om arbejdsmiljø** (Announcement on duties of planners and advisers, etc. according to Working Environment Act) BEK nr. 110 af 05/02/2013
8. **Bekendtgørelse om arbejdets udførelse** (Order of the execution of the work) BEK nr. 559 af 17/06/2004)
9. **Arbejde med stoffer og materialer** (Working with substances and materials) AT-vejledning C.1.3, januar 2003
10. **Løft, træk og skub** (Lift, pull and push) At-vejledning D.3.1, september 2005
11. **CEN norm EN 13232-1**. Railway applications – Track, Switches and Crossings-Part 1: Definitions.
12. **CEN norm EN 13674-1.** Railway applications – Track – Rail – Part 1: Vignole railway rails 46 kg/m and above
13. **CEN norm 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.
14. **CEN norm EN 13674-3.** Railway applications – Track – Rail – Part 3: Check rails.
15. **CEN norm EN 13674-4.** Railway applications – Track – Rail – Part 4: Vignole railway rails from 27 kg/m to, but excluding 46 kg/m.
16. **CEN norm EN 13232-5.** Railway applications – Track – Switches and crossings – Part 5: Switches.
17. **CEN norm EN 13232-6.** Railway applications – Track – Switches and crossings – Part 6: Fixed common and obtuse crossings.
18. **CEN norm EN 13232-9.** Railway applications – Track – Switches and crossings – Part 9: Layouts.
19. **CEN norm EN 13481-1.** Railway applications – Track – Performance requirements for fastening systems – Part 1: Definitions.
20. **CEN norm EN 13481-2.** Railway applications – Track – Performance requirements for fastening systems – Part 2: Fastening systems for concrete sleepers in ballast.
21. **CEN norm EN 13481-3.** Railway applications – Track – Performance requirements for fastening systems – Part 3: Fastening systems for wood and polymeric composite sleepers.
22. **CEN norm EN 13481-5.** Railway applications – Track – Performance requirements for fastening systems – Part 5: Fastening systems for ballastless tracks.
23. **CEN norm EN 13481-7.** Railway applications – Track – Performance requirements for fastening systems – Part 7: Fastening systems for Switches and Crossings, check rails, insulated rail joints and rail expansion devices.
24. **CEN norm EN 13145.** Railway applications – Track – Wood sleepers and bearers.
25. **CEN norm EN 1563:2018** Founding – Spheroidal graphite cast irons
26. **CEN norm EN 10025**. Hot rolled products of structural steels. Dated 22.11.2004.
27. **CEN norm EN 14587-1.** Railway applications – Infrastructure – Flash butt welding of new rails – Part 1: R220, R260, R260Mn, R320Cr, R350HT, R350LHT, R370CrHT and R400HT grade rails in a fixed plant.
28. **CEN norm EN 14587-3.** Railway applications – Track – Flash butt welding of rails – Part 3: Welding in association with crossing construction.
29. **CEN norm EN 287-6.** Qualification test of welders – Fusion welding – Part 6: Cast irons.
30. **CEN norm EN 13146.-7:2019.** Railway applications-Track-Test methods for fastening systems-Part 7: Determination of clamping force.
31. **CEN norm EN 13146.-1:2019.** Railway applications-Track-Test methods for fastening systems-Part 1: Determination of longitudinal restraint.
32. **CEN norm EN** **13146.-9:2009+A1:2011.** Railway applications-Track-Test methods for fastening systems-Part 9: Determination of stiffness.
33. **CEN norm EN** **13146.-4:2012+A1:2014.** Railway applications-Track-Test methods for fastening systems-Part 4: Effect of repeated loading.
34. **CEN norm EN** **15689:2010.** Railway applications – Track – Switches and Crossings – Crossing components made of cast austenitic manganese steel.
35. **Danish working environment and requirements**: **Ensidigt, belastende arbejde og ensidigt, gentaget arbejde (**Monotonous, stressful work and monotonous, repetitive work) At-vejledning D.3.2, august 2002.
36. **UIC 864-6-3ed.** Technical specification for the supply of baseplates or sections for baseplates, made of rolled steel.
37. **UIC 864-7-3ed.** Rolled profiles for baseplates for UIC rails.
38. **DS/ISO 262.** ISO general purpose metric screw threads - Selected sizes for screws, bolts, and nuts.
39. **DIN 980V.** Torque Hex Nuts.
40. **Banedanmarks tekniske betingelser: Svelleskruer SS og SS-4 (**Banedanmark’s Technical specifications for Sleeper Screws, SS and SS-4)
41. **Banedanmarks tekniske betingelser. Firmaskilte til sporskiftedele, skinneudtræk og isolerklæbestød mm. (**Banedanmarks technical specifications. Company stamped identification markings for switch parts, rail, expansion joints and insulating joints)**.**
42. **CEN norm EN 10204. Metallic products – Types of inspection documents**
43. **Banedanmarks sporskiftebyggekort med tilhørende vejledning** (Banedanmarks turnouts construction card with associated guidance).
44. **Requirements for technical documentation in Banedanmark.**
45. **Danish labor inspectorate official site**
46. **Commission Regulation (EU) No 1299/2014 of 18 November 2014 on the technical specifications for interoperability relating to the ‘infrastructure’ subsystem of the rail system in the European Union.**
47. **Particular requirements for documentation in Banedanmark / Spor og ballastboringer**.
48. **Commission regulation (EU) No 1299/2014 of 18 November 2014 on the technical specifications for interoperability relating to the infrastructure subsystem of the rail system in the European Union.**
49. **CEN/ISO-norm EN ISO 9001.**
50. **CEN/ISO-norm EN ISO 14001**
51. **EMAS Forordningen.** Organisationers frivillige deltagelse i en fællesskabsordning for miljøledelse og miljørevision (EMAS). Europa-Parlamentets og Rådets Forordning (EF) Nr. 1221/2009 af 25. november 2009. Se [www.ec.europa.eu/environment/emas/index\_en.htm](http://www.ec.europa.eu/environment/emas/index_en.htm) eller [www.mst.dk/erhverv/groen-virksomhed/groenne-produkter/miljoeledelse/emas/](file:///C%3A/Users/cbgl/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/A7XQ36IS/www.mst.dk/erhverv/groen-virksomhed/groenne-produkter/miljoeledelse/emas/)
52. **Quality Assurance Requirements Manufacturer\_V\_01\_00**
53. **Template Technical Change Request**
54. **Banenorm BN1-61-2**
55. **Banenorm BN2-67-1**
56. **CEN/ISO-norm EN ISO 9606**

Overview of important references for the technical specification of Switches and Crossings, and how to obtain these:

|  |  |
| --- | --- |
| How to get the document | **Reference**  |
| All the European Standards from Chapter 2: References can be obtained at [en-standard.eu](http://www.en-standard.eu/) | 11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,3031,32,33,34,42,49,50 |
| Must be obtained by the supplier through the Danish authority for the working environment at.dk | 5,6,7,8,9,10,35,45 |
| Provided by Banedanmark in a separate appendix, see section 9. | 1,2,3,41,43,44,46,52,53 |
| The reference can be obtained at the official Banedanmark website [bane.dk](http://www.bane.dk/) | 4,40,47,48,54,55 |
| The reference might be available at the official UIC standardization website uic.org | 36,37 |
| The reference is available at the official ISO website www.iso.org | 38,56 |
| The reference might be available at the official DIN website www.din.de | 39 |
| Is available at European standards(European standards, [www.en-standard.eu](file:///C%3A/Users/cbgl/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/WWM8QDNV/www.en-standard.eu)) | 51 |

Table 2.1: Overview, references

Switches and Crossings are part of Banedanmark Infrastructure and must comply to Banedanmark norms and -standards. In general these norms and standards are to be found at Banedanmark website (https://www.bane.dk/da/Leverandoer/Krav/Tekniske-normer-og-regler).

# General Conditions

Manufacturing Switches and Crossings and parts here for must be in accordance with Banedanmark norms, rules and standards, cf. section 4 below.

In addition hereto, Manufacturer (If supplier, tier one is not the producing unit, this applies to producing unit) must possess the following certificates (minimum requirements):

Manufacturer’s quality management system must be certified in accordance with DS/EN ISO 9001 or equivalent (49). Banedanmark shall receive a copy of certificate, at the latest when signing contracts.

Also, Manufacturer’s environmental management system must be certified in accordance with DS/EN ISO 14001 (50) and/or in accordance with EU’s” Eco-Management and Audit Scheme” (EMAS) (51) or equivalent. Banedanmark shall receive a copy of certificate, at the latest when signing contracts.

More information about EMAS can be found here: [www.mst.dk/erhverv/groen-virksomhed/groenne-produkter/miljoeledelse/emas/](file:///C%3A/Users/cbgl/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/A7XQ36IS/www.mst.dk/erhverv/groen-virksomhed/groenne-produkter/miljoeledelse/emas/) or at the European Commission website: [www.mst.dk/erhverv/groen-virksomhed/groenne-produkter/miljoeledelse/emas/](file:///C%3A/Users/cbgl/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/A7XQ36IS/www.mst.dk/erhverv/groen-virksomhed/groenne-produkter/miljoeledelse/emas/)

Questions regarding EMAS may be addressed to local Environmental Authorities.

If the Tenderer is not the manufacturing party - agent or equivalent - both certificates must be presented on behalf of the manufacturer (primary supplier) whom he represents.

## References as a basis (Part 1 and 2)

Production, delivery, and assembly must be carried out in accordance with the documents and drawings mentioned in the reference list (chapter 2; Introduction of these technical conditions) in the latest version, which is valid at the time Banedanmark submits the purchase order to the supplier.

In case of discrepancy between these technical specifications and other documentation/drawings mentioned in the reference list (chapter 2), these technical specifications will apply. The supplier is obliged to immediately inform Banedanmark in case of discrepancies and/or ambiguities in the technical specifications, standard drawings, norms, and other documentation mentioned in these technical specifications to get a clarification from Banedanmark.

## Information regarding drawings (Part 1 and 2)

All delivered Switches and Crossings, their panels, spare parts, and other components shall be in accordance with approved drawings.

Purchase Orders (PO) will be attached drawings and/or other documents, relevant for the order. It will be either Banedanmark´s standard drawings, ref [3], drawings made for the specific purpose, ref [2] or other documentation needed for manufacturing and supplying the related items contained in the purchase order.

Note that any drawing or document listed in the ordering might have sub-drawings or sub-documents, especially the Banedanmark standard drawings, which normally are referred in the main drawing. The sub-drawings and sub-documents are also a part of the main documentation to be used in the manufacturing and supply of the Switches and Crossings and their parts.

The Banedanmark standard drawings is of the type “Blad XXXX”, i.e. “Blad 8857” as a generic drawing. Drawings made for a specific location is called 10-xxxx and will have the same validity as Blad XXXX. Drawings made in the process of a project prior to the 10-XXXX will have another notification, and is valid if so addressed in the purchase order.

The latest edition will always be located at the current Banedanmark´s documentation management system ProArc. The supplier is always expected to have access to the system, or to request the latest edition at Banedanmark’s TekDok (tekdok@bane.dk), on their own request. Please refer to [www.bane.dk/da/Leverandoer](https://www.bane.dk/da/Leverandoer)

The Banedanmark standard drawings may have been produced when Banedanmark was part of DSB, or by Banestyrelsen. These drawings have the same equivalency as Banedanmark´s drawings.

Drawings, relevant for this tender is part of tender material, see Bilag: 1.3 Drawing and Component list for a searchable list and Bilag 1.3i which is listed drawings in a ZIP-file. These drawings are only for the tender process, above applies after the tender.

## Technical changes log (Part 1 and 2)

Supplier is obliged to maintain a log of any changes made and agreed upon with BDK. Any technical change must be approved in advance by Banedanmark. And it must follow the next documents specifications, see ref.[52, 53].

Furthermore, the log register must as a minimum include the following information:

* Date of the change.
* Person and role, that is supplier responsible for the change.
* Short description of the change, including what are the consequences of the change
* Identification of the change, e.g. what is being corrected.
* Why the change was made.
* How the change is implemented, including risk assessment of the change.
* Safety consequences of the change.
* Derivative consequences.
* Relevant documents of the change.
* Documentation describing the change (drawings, etc.)

The documents must be made as a digital file (.dgn, .dwg, .pdf, .tiff). Banedanmark has full rights to use the material/documentation made due to the change.

## Working environment (Part 1 and 2)

#Note: Requirements below (related only to documentation) will be applied only to components that are not Banedanmark´s design.

The supplier must ensure that the installation and maintenance of the delivered Switches and Crossings, their spare parts and components can take place with the best possible consideration for the working environment.

All parts and components included in the Switches and Crossings must follow the Danish working environment legislation, related to installation, operation and maintenance. These rules are described in "Promulgation of the Working Environment Act”, ref. [5], including all changes. This also applies to the three references below:

* "Declaration about the obligations of the developer", ref. [6].
* "Declaration about the duties of planners and advisers, etc. according to the Working Environment Act", ref. [7].
* "Order of the execution of the work", ref. [8].

Regarding installation, service and maintenance of the Switches and Crossings, spare parts and components, consideration must also be given to compliance with the following three guidelines on the working environment:

* "Working with substances and materials", ref. [9]
* "Lift, pull and push", ref. [10]
* "Monotonous, stressful work and monotonous, repetitive work", ref. [35]

For more information on the Danish working environment legislation and executive orders, please visit the website http://arbejdstilsynet.dk. ref. [45] (website also offers some of the information in English).

Further requirements need to be fulfilled by the supplier:

1. The supplier must prepare all documentation relating to the working environment in Danish, to comply with the Danish working environment legislation.
2. The supplier must consider the Danish working environment legislation in relation to the preparation of installation and maintenance instructions.
3. The supplier must prepare a separate document on the working environment. The document must describe how considerations for the working environment and the Danish working environment legislation are incorporated into the installation and maintenance instructions, with appropriate references to the Danish working environment legislation.

## Delivery Conditions (Part 1 and 2)

Delivery conditions must be DDP, Incoterms 2020 cf. Frame Agreements, part 1 and 2, section 8.

Delivery time is stated in Bilag 2: Tilbudsliste and cannot exceed these. Specifically on Full Switches and Manganese Crossings (part 1), delivery times are pre-defined (see Bilag 2: Tilbudsliste, Delaftale 1, column G) and the acceptance of these are minimum requirements.

Delivery of Switches and Crossings (Part 1) is excluding delivery of Sleepers - which is supplied by Banedanmark – but it does entail transporting Sleepers in accordance with Bilag 1. - Requirements, Sleeper transport related to production of Switches and Crossings.

Applicable for Part 1, at the delivery of full Switches and Crossings, Supplier must produce Inspection Documents in accordance with EN13232, and save these for no less than five (5) years, to be handed at any time, out upon request from Banedanmark.

## Technical Specifications for Interoperability - TSI INF requirements (Part 1)

From table 1 it can be distinguished two types of Switches and Crossings, the ones that are TSI approved and the others which do not necessarily meet TSI requirements.

The TSI approved Switches and Crossings will be designated as TSI200 according to Sheet 7960 and they comply with the following design requirements for Switches and Crossings in ref. [46] and implementing Regulation (EU) 2019/776:

* 4.2.4.1 Nominal track gauge.
* 4.2.4.7.2 Requirements for Switches and Crossings.
* 4.2.5.1 Design geometry of Switches and Crossings.
* 4.2.6.1 Track resistance to vertical loads.
* 4.2.6.2 Longitudinal track resistance.
* 4.2.6.3 Lateral track resistance.
* 4.2.8.6 The immediate action limits for Switches and Crossings.

The supplier must meet the previous requirements when delivering and assembling Switches and Crossings according to Partial agreement 1 (Part 1).

Any fastening system from partial agreement 1 (Part 1) must comply with the TSI requirements given in ref. [ 23]:

* Determination of clamping force before repeated load test (procedure is defined in ref. [30]).
* Determination of longitudinal rail restraint before repeated load test (procedure is defined ref. [31]).
* Static vertical stiffness of the assembly and low frequency dynamic vertical stiffness of the assembly before repeated load test (procedure is defined ref. [32]).
* Repeated load test under 3 million load cycles (procedure is defined ref. [33]).
* Static vertical stiffness of the assembly and low frequency dynamic vertical stiffness of the assembly after repeated load test (procedure is defined ref. [32]).
* Determination of longitudinal rail restraint after repeated load test (procedure
* is defined ref. [31]).
* Determination of clamping force after repeated load test (procedure
* is defined ref. [30]).

The abovementioned requirements must be properly documented in separate report(s), to be saved for no less than five (5) years, and handed out, at any time, upon request from Banedanmark.

## Technical approval of supplier´s (or manufacturer) components (Check rail chairs, Slide chairs with integrated rollers, Cast Manganese Crossings, and other minor components)

### General

This section gives the supplier insight into the process that the manufacturer/supplier must expect, related to the technical approval of the supplier's particular components. This applies regardless of reasons to the change, cf. Frame Agreement § 6.5 and § 6.6

The manufacturer must contribute with expertise in the approval of the Switches and Crossings components.

Banedanmark's technical and safety approval of the Switches and Crossings does not relieve supplier/manufacturer of their overall responsibility for the design of the Switches and Crossings components, cf. current legislation, or the quality of any component, included in this Tender.

Specifically on below components, R&D process is recommended to start as soon as Partial Agreement 1 contract is awarded, and not later than October 1st, 2023.

As part of Supplier Solution, Logistics and R&D, cf. Tender Conditions, section 7.2.2 a timeline of R&D process on these specific components must be shown, explained, and deemed plausible by Banedanmark:

* Check Rail Chairs (applicable for Part 1) TSI relevant
* Cast Manganese Crossings (applicable for Part 1) Not TSI relevant

The technical approval consists of different phases described below:

* Design phase: This phase has as goal a preliminary approval of the design phase.
* Production phase: This phase consists of the technical approval of the design. It is applied to:

At least one prototype of each of the items (per turnout type) above must be produced in the factory to be finally approved before or in (whatever applicable) the next phase.

The approval of this phase requires an in-situ visit (1-3 days) of a Banedanmarks committee of experts to the factory, to check and approve all the supplier’s particular component(s) (FAT).

* Final approval: This is the last phase and will give “green light” for the utilization of the supplier´s components at Banedanmark´s net.

It consists of:

* + Laboratory test & Site acceptance test for
		- Check rail chairs in compliance with TSI requirements. The laboratory test must be done by a third independent party prior agreement with Banedanmark.
		- Other check rail chairs must be also tested according to the TSI requirements, but it is sufficient if they are tested and validated directly by the supplier/manufacturer.
		- Cast manganese crossing and other minor components: Only site acceptance test is required.

Site acceptance test (SAT) will consist of the installation (supervised by Banedanmark) of at least one of each of the supplier´s components coming from the production phase. Nevertheless, the amount of the components and the duration of the site test must be agreed upon between Banedanmark and the supplier.

The accepted timeline for above R&D process, Check Rail Chairs and Cast Manganese Crossings, in the Tender evaluation, must be no more than 16 months in total, including any preparation for production and/or similar.

R&D process is presumed to be run simultaneously but Tenderer may choose to conduct activities following each other. In any case, the total timeline cannot exceed 16 months, and it will be valued positively in the evaluation if total timeline is shorter.

Please note that Check Rail Chairs and Cast Manganese Crossings exist on the market, that has already been approved, or that may be approved after minor adjustments.

Other Components, applicable for R&D process of different prioritizations and different time spans, but to be initiated after commencing contracts, following same phases as above:

* Slide Chairs with/without Integrated Rollers TSI relevant
* Assembled Crossing (Assembled Monobloc Crossing)
* Other minor components

*(Applicable for Part 1 and 2).*

Note: All documentation and approval process documents must be in English.

### Management tools for the technical approval of switches and crossing components.

To facilitate and manage the technical approval of the supplier´s components, the supplier must expect to use the following forms, which will be provided by Banedanmark:

* "List-of-Open-Points (LoOP)": Sheet, where all general comments and agreements between Banedanmark and the supplier are entered, so that agreements and deficiencies are kept under control and followed up on.
* Documentation comment log: Sheet where Banedanmark will collect and incorporate all comments and remarks to the suppliers’ design documentation. The manufacturer must also incorporate their response to Banedanmark's comments. There must be full traceability between the log and the suppliers’ documentation.
* Banedanmark will elaborate a list (Excel document) of the supplier components in question (Part 1 and 2).
* In this list, the status of the approval process for each component (Design phase, Production phase and Final approval), that must be supported by the due documentation exchange between Banedanmark and the supplier, will be included.

# Component’s requirements

## Climate requirements

All components related to Switches and Crossings and Spare parts must be fully functional with rail - and air temperature between -25 °C and +55 °C.

## Rail profiles

### Rail profiles (Part 1).

This section contains the general requirements for all the rails used in the supplied Switches and Crossings. General requirements must follow ref. [12-15] and for the particular components of Switches and Crossings, ref. [16-18] must be followed.

1. Switches and Crossings rails must be manufactured with rail profiles "60E2" or "60E1".
2. All types of rails are supplied in steel grade 260 or "350HT".

The tolerances for rail profiles must comply with the ones specified in table 7 ref. [12] for profile class "X".

The straightness must comply with the class A requirements (as shown in table 8 in ref. [12]). As stated in EN 13674, there is no requirement for stamping on the ends of the rails (the cut surfaces of the rails).

A proper quality certificate , according to EN standard, for all types of rails including switch Blades and stock rails, must be included in the quality documentation.

In general, EN 13674 descriptions must be followed regarding requirements for documentation for rails.

No used rails may be delivered.

### Rail profiles (Part 2)

PO´s and the attached drawings will specify whether components with rail profile "45E2" or rail profile "60E2" are to be delivered.

Relationship between rail and a particular Switch and Crossing component can be found in ref. [3], ref. [1] of these technical specifications.

1. For Switches and Crossings with rail profile "45E2", the Vignole rails must have a rail profile "45E2".
2. For Switches and Crossings with rail profile "60E2", the Vignole rails must have a rail profile "60E2".

As an alternative to rail profile "60E2", it is permitted to use rail profile "60E1". This must be stated on the nameplate/identification, see ref.[41], plate for each switch and crossing component.

All types of rails are supplied in steel grade "R260", unless otherwise specified. The tolerances for rail profiles "60E2" or "60E1" must comply with the ones for profile class "X", as shown in table 7 in ref. [12].

Rail lengths are specified in ref. [3] or ref. [1]. All rail components with lengths below 30 m must be delivered in one continuous piece without welds.

For rails with profiles "60E2" or "60E1", the straightness must comply with the class A requirements, as shown in table 8 in ref. [12].

There is no requirement for stamping on the ends of the rails (the cut surfaces of the rails) as per ref. [12], [13] and [15].

A proper quality certificate, according to EN standard, for all types of rails including switch Blades and stock rails, must be included in the quality documentation.

In general, EN 13674 descriptions must be followed regarding requirements for documentation for rails.

No used rails or other components may be delivered.

## Switch panel

### Switch Blade profiles (Part 1 and 2)

1. Switch rails for "60E2" Switches and Crossings must be made of the Switch rail profile "60E1A1".
2. Switch rails for "45E2" Switches and Crossings must be made of the Switch rail profile "49E1A1".

### Stud Blocks and Connection parts (Part 1 and 2)

Stud blocks are made as a welded construction as specified in relevant drawing, Blad nr. XXXX (e.g. Blad 8136). Steel quality of this components must be the same as for the rails.

The stud block bolt must be made and supplied as a prestressed bolt assembly. See chapters 4.5.1, 4.5.2 and 5.5.1.

If the supplier wishes to use a different type of stud block or other connecting parts than indicated in these specifications, the supplier must apply for this in accordance with the procedure described in Tender Conditions § 6.6 as well as ref [52] and section 3.7 of this document.

### Slide Baseplate (Part 1 and 2)

#### **General conditions**

The Switch panel for new Switches and Crossings must have two types of slide baseplates:

* One with integrated switch rollers (Roller slide baseplate).
* One without rollers.

Both types must be detailed and designed by the supplier according to the following requirements:

* The slide baseplate must fit the sleeper holes pattern (to set dowels and screws) given at Blad 8128 for single turnouts.
For double slip diamond crossings, half and full set, according to the switch panel drawings in the attached documentation.
* The design must include a baseplate pad of 4mm and a railpad of 6mm. Material to be EVA for the baseplate pad and MLP180 for the railpad.
* The stock rail must be attached with a fastening system as per indicated in Blad 8128.
* It is allowed to have sliding surface which is either:
	+ cast together with the baseplate
	+ welded to the baseplate, or
	+ assembled to the baseplate.
* The height to the bottom of the stock rail above the sleeper surface to be:
Pad 4 mm + steel baseplate 15 mm + railpad 6mm = 25 mm.
* The switch Blade height above the sleeper surface to be:
pad 4 mm + sliding surface 44 mm = 48 mm.
* The surface roughness to be maximum Ra 6,3 µm.
* Slide baseplate with integrated rollers must comply with the TSI requirements given in section 3.5 and must be properly documented according to ref.[52] (Only part 1)

#### **Slide Baseplate without integrated rollers:**

The slide baseplate without integrated rollers must apply to the following conditions additional to the general conditions in section 4.3.3.1.

* The width of the sliding surface to be minimum 150mm.
* The length to support the switch Blade at a maximum opening of the Blade of 160 mm at the tip of the Blade measured 12 mm below top of stock rail.
* One design only for all baseplates in the switch panel. Right side and left side must use the same slide baseplate.

The following type(s) is already TSI INF approved and used in Banedanmark’s net:

* Blad 8128:

*Fig. 4.2. Slide Chair, standard Banedanmark. Blad 8128.*

* For “60E1"/"60E2" profiles with railpad, height 44mm.

#### **Slide Baseplate with Integrated Rollers (Roller slide baseplate) in compliance with TSI.**

The slide baseplate with integrated switch rollers must be detailed and designed by the supplier according to following requirements.

The use of rolling devices in the Switch panel must work lubrication free at both the rollers and the slide baseplates.

Note#1:
The rolling system makes it possible to reduce the friction efforts between the tip of the Switch rail and the Slide Chair during their relative movements, since the Switch rails moves on rollers that do not need greasing, instead of doing so on the surface of the Slide Chair, which needed to be greased to facilitate its movement.

Note#2:

Integrated rolling/Slide Chairs solution offer an improvement in the movements performance by reducing the contact between the Switch rail and the Slide Chairs.

It is important to note that all type of rolling devices need a periodic adjustment/maintenance that is much reduce than greasing activities that take place when no rolling devices are used. From the above, it has been widely proved that Switches and Crossings with rolling devices (specially integrated in the Slide Chair) suffer much less degradation and consequently the useful lifetime of the Switches and Crossings increases.

In the following, the main characteristics of the integrated rollers/Slide Chairs are defined:

* The width of the sliding surface to be minimum 100 mm.
* The length to support the switch Blade at a maximum opening of the Blade of 160 mm at the tip of the Blade measured 12 mm below top of stock rail.
* One design only for all baseplates in the switch panel. Right side and left side must use the same slide baseplate. The roller-units are allowed to be different for one roller or two rollers.
* The slide baseplate and the rollers constitute a single device that is located on the sleeper. The roller mechanism must be located on one of the sides of the slide plate (not in the central part of the device) and will consist of 1 or 2 elements (rollers).
* If possible, the (sub-)supplier of roller systems should be able to demonstrate references for the proposed system demonstrating operation, preferably for a period of minimum 5 years’ service, in Europe.
* If possible, the design should have a proven performance from the (sub-)supplier in similar climatic conditions witnessed on site, preferably for a period of minimum of 5 years.
* The integrated system replaces the standard slide baseplate, and it is compatible with the rest that remain in the Switch panel. The fastenings of the integrated system must correspond to those usually used in the remaining Slide Chair components.
* Roller systems shall be lubrication- and maintenance free
* Outside diameter of the rollers to be 45mm – 50mm.
* The contact surface of the roller barrel shall have a stress, not exceeding 900N/mm2. The axle and bush assembly shall be lubrication free and have sealed end caps.
* Independent initial adjustment for each row of rollers. No additional active regulation.
* Roller assembly. Each roller shall be infinitely adjustable in the range of 0.0 mm – 6.0 mm in the vertical plane by means of an eccentric axle, independent of the adjacent roller in the same frame.
* Roller assemblies shall be independently adjustable vertically and laterally without the requirement for shims.
* The rollers shall not have contact with the closed switch rail.
* In the event of a breakdown/failure, the possibility of acting on the roller mechanism, so that the switch and crossing is kept in service without the need for immediate replacement of the failing rollers (This might make it necessary to temporary go back to traditional lubrication of the Slide Chairs until the failing device is substituted.
* Possibility of assembly, with due simplicity and efficiency.
* Once mounted on the device, the system will not interfere with ballast tamping tasks, both with heavy machines and light (manual) machinery.
* The supplier must indicate if it is necessary to protect the system, and the planned solution, to avoid damage to any of its elements.
* It will be the supplier task to state the best possible location (sleeper number) and the minimum and recommended quantity of rolling devices, used in the Switch panel depending on the type of Switches and Crossings.
* The Integrated Roller/Slide Baseplate device must have been already used in other networks, as described above. In this regard, the supplier must deliver a report with specific information regarding use, installation, and maintenance of the rolling device (written in Danish).
* The Integrated Roller system to avoid greasing must be supplied with all the necessary material for its assembly. In case that special tools are necessary for assembly of the system, the supplier must supply the required special tool(s) together with the set Integrated Rollers at no further cost to Banedanmark.

### Other Slide Baseplates (Part 1 and 2)

The main dimensions and tolerances of the slide chair on the baseplate are shown in Banedanmark's standard drawings, ref. [3], depending on the Switches and Crossing type.

The following types (- already approved and used in Banedanmark´s net) must be produced and delivered by the supplier:

* For "45E2" profile.
Type 656 F, Blad 6750.
Various types 656, 657, 658. See drawing (Blad) at Bilag 2: Tilbudsliste, Glidestole.
* For "60E1"/"60E2" profile without railpad, height 38 mm.
Type 756 F, Blad 7888.
Type 758, Blad 7821.
* For "60E1"/"60E2" profile with railpad height 44 mm.
Type 756 FM, Blad 7948.
Type 756 FM-T, Blad 7956.

In case of alternate needs from Banedanmark, Banedanmark will supply Offeror with relevant type and specification.

### Retrofitted roller system (mounted between two sleepers) (Part 1 and 2)

Retrofitted rollers mounted between two consecutive sleepers will have the following characteristics:

* The roller system is located between two consecutive sleepers, and it must be fixed to the stock rail.
* If possible, the (sub-)supplier of roller systems should be able to demonstrate references for the proposed system demonstrating operation, preferably for a period of minimum 5 years’ service, in Europe.
* If possible, the design should have a proven performance from the (sub-)supplier in similar climatic conditions witnessed on site, preferably for a period of minimum of 5 years.
* Roller systems shall be lubrication- and maintenance free
* Outside diameter of the rollers to be 45 mm – 50 mm.
* Independent initial adjustment for each row of rollers. No additional active regulation.
* Roller assembly. Each roller shall be infinitely adjustable in the range of 0.0 mm – 6.0 mm in the vertical plane by means of an eccentric axle, independent of the adjacent roller in the same frame.
* Roller assemblies shall be independently adjustable vertically and laterally without the requirement for shims.
* The rollers shall not have contact with the closed switch rail.
* In the event of a breakdown/failure, the possibility of acting on the roller mechanism, so that Switch and Crossing is kept in service without the need for immediate replacement of the failing rollers. This might make it necessary to temporary go back to traditional lubrication of the Slide Chairs until the failing device is substituted.
* Possibility of assembly, with due simplicity and efficiency.
* It will be the supplier task to indicate the best possible location (sleeper numbers) and the minimum and recommended quantity of rolling devices (only applicable in case they are needed for the Switches and Crossings in Table I and Table II from Blad 7960) used in the Switch panel depending on the type of Switches and Crossings.
* The roller device must have been already used in other railway infrastructure. In the regard, the supplier must deliver a report with specific information in regard to use, installation, and maintenance of the rolling device, giving at least the following information:
* The roller system to avoid greasing must be supplied with all the necessary material for its assembly. In case that special tools are necessary for assembly of the system, the supplier must supply the required special tool(s) together with the set Integrated Rollers at no further cost to Banedanmark.

## Crossings (Part 1 and 2)

### Overview (Part 1 and 2)

Crossings include Crossings for Switches; Crossings including double slip Crossings and diamonds; and double Crossings for double slips Crossings and diamonds.

These technical specifications include 3 types of Crossings:

* Assembled Crossing/built-up crossing with rail profile vee e.g. Blad 6537
* Assembled Crossing/built-up crossing with forged or milled crossing vee e.g. Blad 8140
* Cast manganese Crossing e.g. Blad 8252

From Banedanmark's standard drawing or project-specific drawing, it can be seen, for a specific Switch and Crossing, which Crossing type must be delivered.

### Assembled & Assembled Crossing with forged or block crossing vees (Part 1 and 2)

####  **Geometry (Part 1 and 2)**

The geometry for Assembled Crossing with forged or block crossing vees must follow the measurements and dimensions of the holes of the Baseplates for the sleeper screws according to the Banedanmark drawings even at a new design of the crossings.

An Assembled Crossing with forged crossing vee or block crossing vee must be used, which is a crossing where the nose is made of special steel and hardened to the requirements given below.

In the types of Crossings listed in the table below, a former type of assembled Crossing is used, but must be replaced by above-mentioned new type of crossing. This must be designed and detailed documented by the supplier.

|  |  |  |  |
| --- | --- | --- | --- |
| **Switch and Crossing type** | **Part 1 or 2** | **Related drawing****Blad****Wood sleepers** | **Related drawing****Blad****Concrete sleepers** |
| 60E2-R190-1:7,5 | 2 | 8110 | 8314 |
| 60E2-R190-1:9 | 2 | 8100 | 8290 |
| 60E2-R300-1:9 | 2 | 8060 | 8160 |
| 60E2-R500-1:12 | 2 | 8090 | 8150 |
| 60E2-R500-1:14 | 2 | 8080 | 8130 |
| 60E2-R1200-1:19 | 2 | 8000 | 8180 |
| 60E2-R2500-1:26,5 | 2 | 8050 | Not applicable |
| 60E2-R190-1:9 Diamond double slipSingle crossings | 1 and 2 | 8210 | 83408810 |
| 60E2-R190-1:9 Diamond single slipSingle crossings | 1 and 2 | 8235 | 8400 |
| 60E2-R190-1:9/1:7,5 Diamond single slipSingle crossings | 1 and 2 | 8355 | Not applicable |

*Table 1: Assembled Crossings, replaced by Assembled Crossings with forged or block crossing vees*

The geometry and design of the Crossings are shown in ref. [3].

#### **Requirements for assembly**

The assembled crossing with forged crossing vee must be assembled with cross bolts corresponding to the principle at Blad 8470 “Snit 4” for single Crossings.



*Figure 4.1: Snit 4 from Blad 8470*

* The cross-section bolt assembling with distance blocks must be of a principle to both support the crossing vee and wing rails in both vertical and lateral directions as well as longitudinal direction for both wheel loads, breaking and temperature forces.
* The distance blocks must be welded to the vee or be an integrated part of the vee.
* At any load direction the bolt must not be influenced by shear force, only by a bolt longitudinal pulling force as a prestressed assembly. Dimensions, quality and torque of the bolts and nuts are in section 4.7 and 5.5.



*Figure 4.2: Snit 4 from Blad 8470, cont.*

* A ball-disc system with a form piece for the rail body must be used to compensate for the rail body and misalignment between bolt and contact surface and to align the angle of the crossing vee or wing rails. See Blad 8470 cross bolt connection UIC60.
* One form piece for UIC60 with a ball-disc for M27 as well as M24 bolts using a washer for downsizing from M27 to M24, is allowed.
A form piece for DSB45 with a M24 and ball-disc is required for. Must fit M24 bolts.

It might be necessary to have several form pieces for large and narrow angels of the crossing angles. To be designed by the supplier.

Regarding the assembling set for assembled crossings, i.e. items 64200003, 64200005 and 64200006 (KPL SAMLESÆT TIL SK. X-NING BL8470), as illustrated in "Blad 8470" and above. Blad 8470 shows UIC60 only, but same principle has to be applied to DSB45, item 62400003. See figure 4.1, red squares for illustration of the desired solution.

Different alternatives to the assembly solution, shown in Blad 8470 and in figure 4.1, that work with the same mounting principle, are acceptable.

#### **Hardness and hardening zones (Part 1 and 2)**

All rail crossings and double Crossings must be hardened.

The hardness and hardening zones must be in accordance with Blad 7116. If the hardness and hardening zones does not appear from Blad 7116 (for a specific Crossing), the supplier must obtain information from Banedanmarks Technical System Responsible (TSA) about hardness and hardening zones.

The tip of the Assembled Crossing with forged crossing vee shall have a surface hardness of 350 to 400 HB, to a minimum depth of 25mm and shall conform to Blad7116.

#### **Documentation and material certificate (Part 1 and 2)**

The tip of the Assembled Crossing with forged crossing vee and the assembly drawing of the Crossing with the Monoblock tip must be documented with drawings for each type of Crossing.

The hardness of both the Assembled Crossing with forged crossing vee, the Monoblock rails and the wing rails must be documented by an accredited body, as described in chapter 7.

The Assembled Crossing with forged crossing vee must be delivered including a proper material certificate according to ref. [42].

#### **Double Crossings (Part 1 and 2)**

In double Crossings for diamond Crossings, the check rail profile must be of the "33C1" type. Please, notice that the rail profile "33C1" is sometimes referred to as "UIC33".

Double Crossings for double slip Crossings must be manufactured and delivered according to Banedanmark's standard drawings.

### Cast manganese Crossing (Part 1)

The cast manganese crossings are to be constructed for the following types of Switches and Crossings, see table 4.3.3-1 below, in close cooperation with Banedanmark. The supplier must provide a report showing the wheel/rail contact (impact forces) in the crossing area. The idea of this cooperation is to minimize the value of the contact forces between the wheels and the rails in the frog area.

Banedanmark will provide the main/general geometry (it is supplier´s role to optimize the geometry) for each crossing, that is to be mounted on baseplates with Skl-12 clips fastenings.

The supplier must produce and deliver all necessary detailed drawings to manufacture the pattern for each type of Crossing.

Before any production, the detailed drawings must be approved by Banedanmark.

The cast manganese Crossings will be produced according to following references:

* European Standard EN15689, ref. [34].
* Geometrical aspects according to European Standards EN 13232-6, ref. [17].

A production description; description of test procedure; and documentation of the welding of UIC60 rails to the Crossing ends must be delivered and approved by Banedanmark before acceptance of the cast manganese Crossing.

The manganese steel crossing must be compatible for use on the Switches and Crossings listed in Table 4.3.3-1. Total lengths and lengths from theoretical nose tip must be according to the Banedanmark´s drawings, attached to these technical specifications.

The crossing must be delivered together with all the required baseplates and fastening parts according to Banedanmark's drawings specified in table 4.3.3-1. The baseplates must match existing sleeper locations and sleeper spacing. Holes in baseplates for manganese steel Crossings on concrete sleepers must match center to center with the location of the dowels in the existing concrete sleepers where manganese steel Crossings are already used according to table 4.3.3-1.

The foundry of the cast manganese crossings shall be prior approved by Banedanmark.

Switches and Crossings with cast manganese Crossing:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sheet** | **Rail profile** | **Geometry/Type** | **Right-hand / Left-hand turnout** | **Sleeper material** |
| 8429 | 60E2 (UIC60) | UIC60 1:7,5 H R190  | R/L | Concrete |
| 8415 | 60E2 (UIC60) | UIC60 1:9 R190  | R = L | Concrete |
| 8421 | 60E2 (UIC60) | UIC60 1:9 R300 | R/L | Concrete |
| 8425 | 60E2 (UIC60) | UIC60 1:12 R500  | R/L | Concrete |
|  | 60E2 (UIC60) | UIC60 1:19 R1200 | R/L | Concrete |
| 8253 | 60E2 (UIC60) | UIC60 1:14 R500 | R = L | Concrete |
| 8381 | 60E2 (UIC60) | UIC60 1:26,5  | R/L | Concrete |
| 8391 | 60E2 (UIC60) | UIC60 1:27,5  | R/L | Concrete |
|  |  |  |  |  |
| 8110 | 60E2 (UIC60) | UIC60 1:7,5 R190 | R/L | Wood |
| 8100 | 60E2 (UIC60) | UIC60 1:9 R190 | R = L | Wood |
| 8060 | 60E2 (UIC60) | UIC60 1:9 R300 | R/L | Wood |
| 8090 | 60E2 (UIC60) | UIC60 1:12 R500  | R/L | Wood |
| 8443 | 60E2 (UIC60) | UIC60 1:14 R500 | R = L | Wood |
| 8040 | 60E2 (UIC60) | UIC60 1:19 R1200 | R/L | Wood |
| 8050 | 60E2 (UIC60) | UIC60 1:26,5 R2500 | R/L | Wood |
|  |  |  |  |  |
| 6578 | 45E2 (DSB45) | DSB45 1:7,5 R190 | R/L | Wood |
| 6766 | 45E2 (DSB45) | DSB45-1:9 R190 | R = L | Wood |
| 6577 | 45E2 (DSB45) | DSB45 1:11 R330 | R/L | Wood |

*Table 4.3.3-1: Switches and Crossings with cast manganese Crossing.*

## Check rail chair baseplate

### Check Rail Chair Baseplate in compliance with TSI (Part 1)

The check rail chair must be **detailed and designed** by the supplier according to following requirements:

* The Check Rail Chair Baseplates must fit the sleeper holes pattern (to set dowels and screws) given at Blad 8368 for single crossings at both single S&Cs and diamond double slip and single slip Switches and Crossings.
* The design must include a baseplate pad of 4mm and a railpad of 6mm. Material to be EVA for the baseplate pad and MLP180 for the railpad.
* The stock rail must be fastened using nuts, bolts and, at least, one of the spring clamps according to Blad 8368.
* It is allowed to have the check rail chair which is either:
	+ - cast together with the baseplate, or
		- welded to the baseplate
* The height to the bottom of the stock rail above the sleeper surface to be:
Pad 4 mm + steel baseplate 15 mm + railpad 6mm = 25 mm.
* The check rail profile height above the stock rail top of rail to be 20 mm +1/-1 mm.
* The gap between stock rail and check rail to be 41 mm +0/-1 mm at the running edge 14 mm below top of rail.
* Check rail chair must be TSI approved by a third party, meeting the next requirements:
	+ - Determination of clamping force before repeated load test (procedure is defined in ref. [30]).
		- Determination of longitudinal rail restraint before repeated load test (procedure is defined ref. [31]).
		- Static vertical stiffness of the assembly and low frequency dynamic vertical stiffness of the assembly before repeated load test (procedure is defined ref. [32]).
		- Repeated load test under 3 million load cycles (procedure is defined ref. [33]).
		- Static vertical stiffness of the assembly and low frequency dynamic vertical stiffness of the assembly after repeated load test (procedure is defined ref. [32]).
		- Determination of longitudinal rail restraint after repeated load test (procedure is defined ref. [31]).
		- Determination of clamping force after repeated load test (procedure is defined ref. [30]).
		- The above-mentioned TSI requirements must be properly documented in a separate report before delivery of the check rail chair.

Any type of check rail chair to be supplied must be approved by Banedanmark and follow requirements from ref [52] and section 3.7 of this document.

### Check Rail Chair (Part 2) Woodden Sleppers

* Check rail chair baseplates and theirs fastening systems, mounted on wooden sleepers, must be manufactured according to the relative drawings listed in Table V (Blad 7960) all the Switches and Crossings from Blad 5730 and the corresponding Blad nr from the tendering list give in Bilag 2: Tilbudsliste, Part 2.

### Check Rail Chair (Part 1)

The check rail chair must be **detailed and designed** by the supplier according to following requirements:

* Check rail chair baseplates must fit the sleeper holes pattern (to set screws) given for rail profile DSB45 and UIC60 and even special editions in some Switches and Crossings.

The check rail chair baseplate must be designed, manufactured, and delivered to be compatible with the geometry and tolerances specified in the detailed drawings (derived from Blad 7960 and Blad 5730) for check rail chairs also enclosed in these technical specifications.

* If the design includes a baseplate pad of 4mm and a railpad of 6mm, the material is to be EVA for baseplate pads MLP 180 for the railpad.
* The stock rail must be attached with the same fastening system indicated in the respective drawings depending on the type of turnout. For instance Blad 8368.
* It is allowed to have the check rail chair which is either:
* cast together with the baseplate, or
* welded to the baseplate
* The height of various components if they are a part of the specific type:
* EVA baseplate pad 4 mm
* Steel baseplate 15 mm
* EVA railpad 6mm.
* The check rail profile height above the side rail top of rail to be 20 mm +1/-1 mm.
* The gap between stock rail and check rail to be 41 mm +0/-1 mm at the running edge 14 mm below top of rail.
* Check rail chairs must be TSI approved only internally by the supplier, meeting the same requirements as for check rail chair (Part 1). This must be properly documented in a separate report before delivery of the check rail chairs.

For the sake of clarification the supply of check rail chairs (CRC) and complete check rail sets will follow the scheme, given in the table below:

|  |  |  |
| --- | --- | --- |
| **Contract type** | **CRC & complete set UIC 60** | **CRC complete set DSB 45** |
| **Concrete sleeper** | **Wooden sleeper** | **Wooden sleeper** |
| Partial agreement 1 | YES (Supplier design - new developed). More info in Tender List 1 | YES (Supplier design - new developed). More info in Tender List 1 | NO |
| Partial agreement 2 | NO | NO | Yes, according to existing Banedanmark’s drawings from Blad 5730 and Tender List 2 |

### Check Rail Bolts (Part 1 and 2)

All Check Rail Bolts must have an excess length of at least 10 mm (for use when later adjusting the distance between Check Rail and stock rail). Check rail bolts according to section 5.5.

## Other baseplates

Baseplates for all the supplied Switches and Crossings must be made of steel. These components can be cast, forged, rolled, and partially welded. Baseplates shall be manufactured according to the following standards:

|  |  |  |
| --- | --- | --- |
| **Type** | **Material grade** | **Reference** |
| Cast plate | EN-GJS-400-18-LT | EN 1563, see ref. [25]  |
| Forged plate | S355J2G3 | EN 10025 see ref. [26]  |
| Rolled plate | S275J0 | EN 10025, see ref. [26] |

*Table 4.6-1*

Ribbed Baseplates used in all the Switches and Crossings must be manufactured with a steel grade S275J2G3 or equivalent quality according to ref. [26].

The ultimate tensile strength of Baseplate material shall be minimum 400 MPa. They must be manufactured with the following cast or stamped identification markings:

* Baseplate type e.g.: "656-49"

All the relevant baseplate types can be found in the drawings attached to these technical specifications and in the tendering of spare parts list, also enclosed to this document.

In case of Baseplates being ordered as spare part, please note that the Baseplates are classified depending on their length and type (given by the number of ribs and holes).

## Baseplate pads

Baseplate pads shall always be used between the baseplate and the concrete sleeper. Baseplate pads shall be made of ethylene vinyl acetate (EVA) material, despite in drawings and other documentation might be otherwise specified.

The thickness of baseplate pads shall be 4 mm.

## Bolts and sleeper screws (Part 1 and 2)

### Bolts

Prestressed bolted joints must be delivered for all bolted joints. This requirement applies regardless if Banedanmark's standard drawings show otherwise.

* The quality of bolts and nuts must meet requirements of steel grade 8.8.
* Bolts and nuts must be with metric thread according to ref. [38].
* If nothing else is stated, bolts and nuts with a rough surface are used, i.e. untreated.
* Nuts must be all-metal locking nuts M27 according to ref. [39], electro-galvanized quality 8.
* Cross/block bolts in assembled Crossings must be of dimension M27.
* Stud blocks bolts must be of dimension M24 or M27.
* Check rail bolts must be in dimension M24, and with a bolt head adapted to the groove in the forced rail profile.
* Bolts for ribbed baseplates will be of type R55, R75, R90 and R100 according to relevant drawings and PO.
* Bolt heads shall have the following marks:
	+ - manufacturer’s mark
		- strength grade
		- year of manufacture

### Washers at bolted joints

Unless otherwise specified the plane and conical washers delivered shall follow the relevant EN ISO standard (CSN EN ISO 898-3).

### Sleeper Screws

#### **Sleeper screws for concrete sleepers and wooden sleepers**

Must be manufactured and delivered in accordance with Banedanmark's standard drawings (e.g. Blad 5012, Blad 7942…), ref. [3] and in accordance with next conditions:

* The Sleeper screws material quality manufacturing and acceptance conditions shall be in accordance with UIC 864-1.
* The Sleeper screws shall be manufactured from single piece, without welding. Their head shall be formed by hot-working from the bar-stock.
* The Sleepers screws steel category shall be in accordance with EN 10139 or EN 10025.
* The Sleeper screws tensile strength shall be greater than 500 N/mm2 (min steel grade 5.6)
* The Sleeper screws elongation shall be greater than 20%.
* The Sleeper screws limit of elasticity shall be greater than 300 N/mm2.
* The Sleeper screws shall be galvanized. The Sleeper screws must be free from any trace of grease, paint, etc. before the galvanization.
* The complete surface of the Sleeper screws shall be suitably trimmed. Care shall be taken to ensure that trimming does not give rise to any tearing of the metal or leave any roughness on the contact surfaces.
* The threads must be clean, uniform, and complete. If the threads of the Sleepers screws are stripped or if there is a lack of material in their shank, they shall not be accepted.
* The supplier must be in possession of a works certificate, in accordance with DS/ISO 10204 – 2.2, which must be submitted to Banedanmark upon request.
* Mechanical testing (to test any of the abovementioned mechanical characteristics) of finished screws is carried out on random samples of lots, according to a test method of the supplier's choice, documentation of the results must be submitted to Banedanmark on request.
* Dimensional control of finished screws is carried out on random samples of lots, according to a test method of the supplier's choice, documentation of results must be submitted to Banedanmark on request.

## Fastening system (Part 1)

Fastening elements include Sleeper screws, clips, internal bracings etc. for attaching rails, Baseplates, and elastic pads to the sleepers.

The fastening elements appear in ref. [3] or ref. [3].

The Switches and Crossings shall be equipped with Fastening Systems manufactured in accordance with the relevant CEN ref. [20-23].

## Fastening system (Part 2)

Fastening elements include screws, clips, internal bracings etc. for attaching rails, Baseplates and Elastic pads to the sleepers.

The fastening elements appear in ref. [3] or ref. [2].

## Sleepers (Part 1)

Concrete sleepers for Switches and Crossing are supplied by Banedanmark. More relevant information about concrete sleepers may be found in ref. [2] and [3].

Wooden sleepers can be supplied by either the supplier or Banedanmark. This will be specified specifically in the purchased order.

Requirements for wooden sleepers according to ref. [24].

1. Preparation and assembly (Part 1 and 2)

## General

In cases where tolerances are not specified in these technical specifications, the tolerances must be taken from the respective documents and drawings mentioned in the reference list and attached documentation.

## Welding

Welding must be done at the factory. Welds of rails must be of a flash butt welding type, and they shall be specified on manufacturing drawings. The manufacturer must have a welding certificate according to ISO 9606, ref. [56]

Butt welding of rail steel must be made following ref. [27] and [28]. Switches and Crossings steel parts, pieces and components shall not have any other welds than specified on the relevant manufacturing drawing, excluding possible repair welds of austenitic manganese steel castings.

Mechanical properties of welds and heat affected zones shall not differ more 10 % from that of mechanical properties of the base material. Welding shall not cause any detrimental phase transformations.

Welds shall be cleaned of slack and finish ground after welding. The wheel contact areas shall be finished to the maximum roughness of Ra 6.3 μm.

Welders must be properly certified according to the guidelines in ref [29].

## Crossing (Part 1 and 2)

### Double assembled Crossing

For "60E2" Crossings - if where full rails are used for the building the nose - the ends of the rails must be milled to a "60E2" profile for aluminothermic welding, at least in length according to the standard drawings.

### Assembled Crossing with forged or block crossing vee

All assembled Crossings with forged or block crossing vee must be processed and installed in accordance with section 2.

### Cast manganese Crossing (Part 1)

All manganese steel crossing must be processed and installed in accordance with section 4.3.3.

## Drilling

Tolerances for drilled holes are given in ref. [16], [17], [18], [54], and [55] . If holes are to be drilled where tolerances are not specified in the previous references, these holes must be placed with a tolerance of -1/+1 mm, and they must be drilled with a hole diameter tolerance of -0.1/+0.1 mm.

All drilled holes must have 1 mm x 45° chamfered hole edge.

## Bolts

### Tightening of prestressed bolts

Tightening torques for prestressed bolts are given, assuming clean and new threads.

Tightening of preloaded bolts:

| **Bolt type** | **Thread and quality** | **Torque** | **Flat size** |
| --- | --- | --- | --- |
| Bolts for assembled crossings UIC60 | M27 hexagonal head bolt Strength grade 8.8 | 900 Nm ± 50 Nm | 41mm |
| Stud block bolt | M27 hexagonal head bolt Strength grade 8.8 | 900 Nm ± 50 Nm | 41mm |
| Bolts for assembled crossings DSB45 | M24 hexagonal head bolt Strength grade 8.8 | 700 Nm ± 50 Nm | 36 mm |
| Check rail bolt | M24 special head Strength grade 8.8 | 700 Nm ± 50 Nm | 36 mm |

Table 2: 5.5.1: Tightening of preloaded bolts.

### Tightening of bolts with spring elements

Bolted connections or screws using double clamping rings (helical washer) must be tightened to a gap of approx. 1-2 mm between the windings of the clamping ring.

Spring clamps/clip Fk2 Blad7126, must be tightened so that there is contact between the rail foot and the outer winding, and 0-2 mm contact with the inner winding. A maximum torque of M = 300 Nm shall be used.

## Baseplates; Check Rail Chairs; Slide Baseplates; and related components

Manufacturing of special ribbed baseplates must be done either by welding on the ribs, by riveted ribs or by welding together the rolled plates no. 756 and no. 656. See ref. [36] and [37].

Tolerances for the respective location of the Check Rail Chairs, the sliding plates and the Baseplates are in most cases specified in ref. [3] or ref. [1]. In cases these tolerances are not specified in ref. [3] or ref. [1], the particular tolerance must be:

* +/- 2 mm between two Check Rail chairs/Sliding Chairs/Baseplates.
* +/- 3 mm between an arbitrary number (greater than 2, but measured over a maximum of 15 meters) of Check Rail chairs/Sliding Chairs/Baseplates

## Curving of Switches and Crossings

It will be specified in Purchase Order (PO) if a curved turnout (inside or outside curved) is to be made.

If the turnout is to be curved, the supplier must prepare the necessary detailed drawings for the curvature of the Switch panel, Crossing, rails in the Crossing panel and Check Rail according to the main geometry presented in the PO.

If there is to be curvature of the Switch and Crossing, curvature must be carried out in accordance with ref. [4].

Intermediate rails (closure panel) must be curved in all Switches and Crossings with radius R<300 meters, and the curvature must be done at the factory.

When the curvature of the turnout has been achieved, the switch rails must still rest simultaneously against the stock rails and all stud blocks along their entire length.

If a turnout is curved, the Check Rail must be shaped and installed so that they follow the curvature of the stock rails, so the gap or distance between the stock rails and the Check Rail is maintained.

When the supplier has completed curving the turnout, the supplier must indicate the radius of curvature for inside curved turnout or the outside curved turnout on the company stamped identification, see ref. [41].

## Switch rails

### General

All switch rails must be designed so that, when repositioned, they rest both against the stock rail and all stud blocks over the entire length of the switch panel.

### Switch Blade Gap

The minimum dimensions of the groove appear from ref. [16], can be seen from the table below.

The switch Blade gap is measured at the 3rd hole in the base of the Switch rail seen from the tip of the Blade.

Switch blade opening for different configurations of point machines, seen at the third hole (at switch Blade foot) from the tip of the switch Blade1:

| **Switch blade opening for:** | **turnout** **with 1 point machine** | **turnout** **with 2-point machines** | **turnout** **with 3-point machines** | **Double slip Diamond with 1 point machine** |
| --- | --- | --- | --- | --- |
| 1st point machine | 160 mm | 143 mm | 143 mm | 160 mm |
| 2nd point machine | Not relevant | 90 mm | 143 mm  | Not relevant |
| 3rd point machine | Not relevant | Not relevant | 90 mm | Not relevant |

Table 3: Switch blade opening for different configurations of point machines, seen at the third hole (at switch Blade foot) from the tip of the switch Blade1

1. Note that the exact switch blade opening of the different point machine depends on the point machine type. As Banedanmark has many different types of point machines, different switch blade opening will thus occur depending on which point machine is used in the specific case. Since it is often unknown at the time of measurement which type of point machine is to be used, the table shows the smallest value (of switch blade opening) that can occur.

### Switch blade tension

During the measurement, the Switch blade must be adjusted manually without any point machine and must be fixed to the Stock Rail using a screw clamp at each point machine.

The Switch blade must be tension-free in the middle position. With full Switch blade extension according to table 3 (see above), the "Switch blade tension" must not exceed 600 N per Switch blade. Switch blade tension is measured as the force it takes to move the rail from mid-position to open and closed positions.

### Holes bracket for pulling and control rods

Nylon bushings must be placed in holes for bracket for the pulling and control rods.

## Check Rail (Part 1 and 2)

### Check rails (part 1 and 2)

When the present technical specifications refer to a Check Rail, the following is applicable: The combined component of a Check Rail profile and a Stock Rail assembled on Check Rail Chairs.

The check rail profile is produced by planing and drilling profile "33C1" according to the standard drawings.

## Prefabricated Switches and Crossings (Part 1)

Prefabricated Switches and Crossings is a term, normally used when the whole Switch and Crossing is assembled and delivered on sleepers by the supplier. This is always the case when delivering to Banedanmark.

A prefabricated Switch and Crossing must be built according to ref. [2], unless it otherwise stated in purchase order, i.e. the Switch and Crossing must be built according to alternate drawings, which will be the case with project-specific adaptations or special constructions.

A prefabricated Switch and Crossing is assembled in batches according to the main components:

* Switch panel
* Closure panel
* Crossing panel

For inspection and delivery of a prefabricated Switch and Crossing: See chapter 7.

## Company and commercial stamp (Part 1 and 2)

All the relevant information to install these identifications can be found in ref. [41].

# Anti-corrosion treatment (Part 1 and 2)

## Movable surfaces and parts

Surfaces that, during rotating or sliding movements meet or touch each other, as well as threads on bolts and nuts, must be thoroughly cleaned and lubricated. The lubricant must be approved by Banedanmark prior to use.

## Weld seams, reprofiled areas

Welding seams; as well as planed and milled areas, must be lubricated with a rust protection agent immediately after processing.

Baseplates; Sliding Baseplates; Check Rail Chairs; and other fastening parts are not to be protected from rust.

# Control and Documentation (Part 1 and 2)

## General

At any time, Banedanmark must be allowed to inspect processes and methods, used to manufacture Switches and Crossings, or parts hereof.

The supplier must ensure that Banedanmark has access, at all times, to review any quality documentation that is not processed by the supplier.

At any time, Banedanmark must be allowed access to review working processes in all details, and be allowed to analyze what Banedanmark deems necessary, to ensure that technical requirements are met, and meets chosen technical agreements.

## Control

### Control forms of main parts

The supplier must complete a quality control form for every Turnout/Switch Crossing and for parts, i.e. Switch Panels or ½ Switch Panels; Cross Sections and/or Check Rail Chairs.

Quality control forms must be made by the supplier in accordance with ref. [16], [17] and [18]. This also applies to control forms for special constructions, for instance cross sections. Every type of control form must be approved by Banedanmark before work is started.

Casted Manganese Crossings must be controlled according to ref. [17].

In addition to controlling, what is mentioned at the norms, the following must be checked:

* Checking the vertical and horizontal straightness of the flash butt welding between the manganese part and the rails. The control must be in accordance with EN 14587 ref [28]. The max tolerance +0,5/-0,3 in horizontal direction, or according to EN 14587 ref. [28] if the tolerance is tighter.
* Same plane of underside of rail ends of welded rails. Tolerance ≤ 2 mm.

### Control, hardening

The hardening process must be documented at every delivery, to be handed out on request.

### Control of Switches and Crossings and Diamonds, mounted on Sleepers (prefabricated)

Control and documentation of Switches and crossings, mounted on sleepers, must be done on “Turnout construction scheme” in accordance with ref. [4] and ref. [43].

Supplier must conduct this control and documentation upon delivery.

### Construction site

Banedanmark has the following requirements for the construction bedding/construction site to the supplier's control measurements (carried out by the supplier):

* The surface must be level and firm.
* The turnout must be sufficiently supported to be able to carry out a check.
* Must be covered, if possible.
* Must have lifting gear to be able to safely lift and move turnout parts

Upon transfer in the delivery process in the project, this takes place on a construction site at the supplier with the participation of a representative from the supplier and Banedanmark, respectively, in accordance with the instructions for turnout construction card ref. [43].

## Templates

It is the supplier's responsibility to make, among other things, the following templates and measuring tools (properly calibrated) available during an inspection.

### Switch Panel

* Danish Rail distance measurement instrument, according to TM04
* 1 set of drawings.
* 1 m steel ruler.
* Vernier calipers. Curve template.
* Molding templates for switch rods.
* Test mandrel for holes for switch rods.
* Feeler gauge Blade.
* Cord.
* Chalk or ink.
* Ruler and measuring tape.

### Crossings

* Rail distance measurement instrument.
* 1 set of drawings.
* 1 m steel ruler.
* Curve templates.
* Templates for flange groove widths.
* Templates for splice rail and rail rooves.
* Length template for tip.
* Feeler gauge Blade.
* Chalk or ink.
* Ruler and measuring tape.
* Vernier callipers.

### Check Rails

* Rail distance measurement instrument.
* 1 set of drawings.
* 1 m steel ruler.
* Curve templates.
* Feeler gauge Blade.
* Wrench.
* Chordor felt
* tip pen.
* Chalk.
* Vernier callipers.
* Ruler and measuring tape

### Double slip Crossings and Diamonds

At double crossings in double slip crossings and diamond crossings, a template is required for transverse (gauge) measurements in the middle of the double crossing, in addition to the templates and measuring tools mentioned in chapters 7.3.1, 7.3.2 and 7.3.3.

## Drawing documentation

### Definition

**Standard drawings**

Standard drawings (in Danish: “normaltegninger/Bladtegninger”) is drawings of rail components and track parts, standard/generic for Banedanmark’s track facility design. The drawings are named “Bladtegninger” (Blad XXXX).

Examples of these drawings: Switches and Crossings, Crossings, Sleepers etc.

#### **“10-talstegninger” or ”10-drawings”**

“10-talstegninger” are not standard drawings, and differs from “the standard drawings, mentioned above.

“10-talstegninger” are project-specific and provides chosen solutions for specific location, where the normal design will not apply. Hence, they entail technical differences, compared with “Bladtegninger”.

Examples of these drawings: Curved Switches and Crossings, Crossings, special project designed Switches and Crossings etc.

Both types of drawings are made to be used at given construction, for:

* Manufacturing
* Building
* Maintenance and renewal

Further, both types of drawings are seen as documentation for installed track constructions and is regarded as type documentation.

### Acceptance

According to ref. [3], every single drawing of a type component (standard drawing/nonstandard drawing) is to be followed by a written certification from a technical supervisor within Banedanmark before the component may be used.

Following this, all drawings of both types must follow ref. [47] and must be certified by Banedanmark’s Technical System Responsible (TSA).

### Design of normal and 10-drawings

#### **General**

For general requirements, refer to [44].

If there are any special requirements for standards drawings and non-standard drawings these are stated below. Otherwise the supplier must follow [44] and [47].

The drawings must be made according to “Banedanmark’s normaltegninger” (refer to [3]), so that they can be understood along these, or to project-specific drawings (refer to [2]).

Standard drawings (Bladtegninger) and nonstandard drawings (10-talstegning) can be obtained by contacting Banedanmark’s Technical Archive department.

#### **Size of drawings**

The height of the drawing = 296 mm (A4 height).

#### **Scale**

The normally used scale ratios:

* Overview drawing 1:100 or 1:75
* Details 1:20
* Assembly drawings 1:10
* Section drawings of single components 1:2,5

#### **Text**

Text on the title block must be according to [44] and [47].

All outline drawings must be provided with a list of materials. This must be stated; item number, designation, Kg / pc, pc and kg, refers to [44] and [47] in total, see example below.

|  |
| --- |
| Konstruktionsdel (Construction part) |
| Vare nr. (Material No.) | Benævnelse (Material name) | Kg/stk. | Stk. | Kg |
| xx xx xx xxx | Dobbelt spændering | x | y | z |

For further information, in regard to documentation, please also refer to Bilag 1.7: Særlige krav til Spor-Dokumentation.

## CSM/Safety in the Rail system

Banedanmark uses the pan-European safety method, which aims to evaluate and assess the acceptable level of safety for a railway system. In this context, the component's contribution to an overall safe railway system is at the same level or better than the existing one.

More information can be found in Bilag 1.11: Quality Assurance Requirements or on ERA's website, <https://www.era.europa.eu/activities/common-safety-methods_en> where, in addition to the CSM-RA regulation itself, it is also possible to find instructions etc.

Banedanmark applies the latest regulation CSM-RA 402/2013 with later amendment 1136/2015.

If appropriate, this will mean that a hazard identification must be carried out in order to identify the hazards and safety risks associated with its design, installation, operation, and maintenance.

In this regard, Banedanmark will, if necessary, request the Supplier's assistance, as there may be requirements for documentation as well as the Supplier's possible cooperation in hazard identification.

If relevant, Banedanmark will inform the Supplier of Banedanmarks expectations for meetings and activities - and will facilitate the process.

# Technical changes (Part 1 and 2)

Banedanmark has the right to any technical change request either on basis of an order from an authority, new requirements from Banedanmark's norms/rules or similar, as well as stricter requirements from authorities.

Banedanmark shall not be charged any costs for the technical change request.

In connection with any technical change request, Banedanmark must justify and document this in accordance with Bilag 1.9 - Technical change request form.

# Appendix (Part 1 and 2)

Below, please find a list of Bilag (= Appendices) for these technical requirements, also to be found in tender material:

|  |  |
| --- | --- |
| Bilag 1.1  | Technical Assessment report TSI INF no. 1299/2014 compliant Switches and Crossings in Banedanmark (Engelsk) |
| Bilag 1.2 | Krav til teknisk dokumentation (Dansk) |
|  |  |
|  |  |
|  |  |
| Bilag 1.5 | Banedanmarks tekniske betingelser. Firmaskilte til Sporskiftedele, Skinneudtræk, Indpasser og Isolerklæbestød mm. (*Banedanmarks Technical Specifications. Company Stamped Identification Markings for Switch Parts, Rail, Expansion Joints, and Insulating Joints*) (Dansk) |
| Bilag 1.6 | Banedanmarks sporskiftebyggekort med tilhørende vejledning (*Banedanmarks Turnouts Construction Card with Guide*) (Dansk) |
| Bilag 1.7 | Særlige krav til Spor-Dokumentation (Dansk) |
| Bilag 1.8 | Commission Regulation (EU) No 1299/2014 of 18 November 2014 on the Technical Specifications for Interoperability relating to the ‘Infrastructure’ (Engelsk) |
|  |  |
|  |  |
| Bilag 1.11 | Quality Assurance Requirements Manufacturer (Engelsk) |
|  |  |

Specifically related to Bilag 1.3: Drawing and Component list: Drawings may only be used for tendering. For production and manufacturing, please refer to Banedanmark’s drawings database, ProArc. See also section 3.2 in this document.