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TECHNICAL SPECIFICATIONS FOR 54E1 AND 60E1 RAILWAY TURNOUTS

These technical specifications are valid on the Finnish railway network administrated by Finnish Transport Infrastructure Agency.

These technical specifications in conjunction with comission regulation (EU) no 1299/2014 –TSI Infrastructure and approved turnout drawings as well as the standards and the UIC leaflets referred to in these technical specifications specify the requirements for new 54E1 and 60E1 turnouts to be delivered to the Finnish railway network.

In behalf of Director, Engineering and Environment	Kari Lehtonen
Director, Railway	Markku Nummelin
Specialist, Track Superstructure	Tuija Myllymäki

Ohje hyväksytään sähköisellä allekirjoituksella.

Lisätietoja
Tuija myllymäki
Finnish Transport Infrastructure Agency
etunimi.sukunimi@vayla.fi

Sisällysluettelo

1 INTRODUCTION

These technical specifications specify requirements and instructions for manufacture and assembly of turnout steel parts of new 54E1 and 60E1 turnouts as well as assembly of turnouts or turnout panels.

These technical specifications can also be applied for purchasing replacements parts for maintenance of turnouts. The purchaser of replacement parts shall specify the content of the purchasing order, if it differs from these technical specifications. For instance, switches may be purchased as half-sets of switches with or without specified turnout baseplates instead of complete sets of switches or double sets of switches.

The delivered turnout steel parts and turnouts shall be in accordance with the approved turnout drawings listed in Appendix 2.

The previously approved turnout designs and constructions are not required to be changed, if not otherwise specified in these technical specifications.

Terminology used in these technical specifications is specified in Appendix 1. Definitions of the standard EN 13232-1 are used, when possible.

1.1 Procurement of turnouts

These technical specifications divide the procurement of turnouts into the following contracts:

delivery of major turnout steel parts
assembly of turnouts/ turnouts panel

The delivery of turnout steel parts includes delivery of switches, crossings, check rail units, associating fastening systems and small fittings specified in these technical specifications.

The assembly of turnouts/ turnout panels includes the delivery of all the parts which are not included in the major steel parts referred above. These other parts include all the baseplates, rail and baseplate pads, all rails on closure panel, bearers, hollow sleepers, fastenings and fittings required to complete the

turnout. Assembly of turnouts also includes the installation of actuating, detection and locking devices with rods specified by the customer.

1.2 New turnout designs and components

Only approved turnout designs and constructions as well as turnout devices and components shall be used on the Finnish railway network.

The use of new turnout devices and components is only permitted after approved by the customer. Details of the approval procedure shall be discussed with the customer.

2 TURNOUT TYPES

Standard turnout types to be purchased for the Finnish railway network according to these technical specifications are as follows:

YV60-300-1:9	(Single turnout)
YV60-500-1:11,1	(Single turnout)
YV60-500-1:14	(Single turnout)
YV60-900-1:15,5	(Single turnout)
YV60-900-1:18	(Single turnout)
YV60-5000/2500-1:26	(Single turnout)
YV60-5000/3000-1:28	(Single turnout)
SRR60-2x1:9-4,8	(Scissors crossover)
YV54-200N-1:9	(Single turnout)
KRV54-200-1:9	(Double slip)
KV54-200N-1:9	(Non-symmetrical tandem turnout)
TYV54-200-1:4,44	(Equal split turnout)
TYV54-225-1:6,46	(Equal split turnout)
RR54-1:9	(Diamond crossing)
RR54-2x1:9	(Diamond crossing)
SRR54-2x1:9-4,8	(Scissors crossover)
SRR54-2x1:9-6,8	(Scissors crossover)

The geometry, lengths of elements, bearer spacing and location of actuation, detection and locking (ADL) devices of each turnout type are specified on the turnout layout drawing.

Prior to purchasing, geometrical and other details of non-standard turnout types shall be discussed with the customer and the supplier.

3 GENERAL DESIGN REQUIREMENTS

3.1 Axle loadings, speeds and designed service lives

Turnouts and their components shall be designed for the following static axle loads and the corresponding train speeds (V):

60E1 turnouts	300 (+10 %) kN, when V ≤ 100 km/h 250 (+10 %) kN, when 100 km/h < V ≤ 120 km/h 220 (+10 %) kN, when V > 120 km/h
54E1 turnouts	250 (+10 %) kN, when V ≤ 120 km/h 220 (+10 %) kN, when V > 120 km/h

Turnouts and their components shall be designed for the following maximum train speeds:

Straight track of short 60E1 turnouts	220 km/h (+10 %)
Straight track of long 60E1 turnouts	220 km/h (+10 %, fixed crossing) 300 km/h (+10 %, moveable point crossing)
Straight track of short 54E1 turnouts	160 km/h (+10 %)
Diverging track of short turnouts	40 km/h (+10 %)
Diverging track of long turnouts	60 km/h (+10 %, 1:11,1**,** 1:14 turnouts) 80 km/h (+10 %, 1:15.5, 1:18 turnouts) 140 km/h (+10 %, 1:26 turnouts) 160 km/h (+ 10 %, 1:28 turnouts)
Diamond crossings	100 km/h (+10 %)

60E1 turnouts shall be designed and manufactured for the minimum service life of 450 Mbrt and 54E1 turnouts for the minimum service life of 300 Mbrt.

3.2 Track gauge

The nominal track gauge is 1524 mm.

In all other turnout types except in TYV (equal split) and KRV (double split) turnouts the track gauge of both on the straight and diverging track shall be 1524 mm. TYV and KRV turnouts shall have a widened track gauge of 1534 mm in accordance with the turnout layout drawings.

The tolerance of track gauge is ± 1 mm.

The track gauge shall not vary more than 1 mm/m in 60E1 turnouts and not more than 2 mm/m in 54E1 turnouts, if not otherwise specified on the turnout layout drawing.

3.3 Rail inclination

The rail inclination of 60E1 turnouts shall be 1:40 throughout the turnout.

In 54E1 turnouts rails shall be placed vertically.

The upper surface of all bearers is planar and non-inclined. The rails of 60E1 turnouts shall be inclined using baseplates having inclined rail seats. Inclined baseplates are also used in the front and end of 54E1 turnouts to transform the inclination of rails from the vertical position to the rail inclination of 1:40.

3.4 Geometric data

The geometric data of standard turnouts and turnout steel parts is specified on the turnout drawings.

All horizontal dimensions of the turnout are specified on the gauge reference plane, if not otherwise specified. The gauge reference plane is 14 ± 1 mm below the running plane, if not otherwise specified on the turnout drawings.

The Finnish railway network is operated by both Finnish and Russian wagons. Geometries of standard turnout types are optimised to ensure applicability for

both Finnish and Russian wheelsets and bogies and, thus, the specified turnout geometries shall not be changed without the permission of the customer.

The bearer spacing of each turnout types is specified on the relevant layout drawing. The bearer spacing at the location of actuation, detection and locking devices is 670 mm.

Turnout steel parts, baseplates and check rail supports shall be compatible with the existing coordinates of cast-in dowels of concrete bearers.

If not otherwise specified in these technical specifications and on the turnout drawings, the turnout shall fulfil the requirements for geometric design and wheel/rail interaction in accordance with the standards SFS-EN 13232-2 and SFS-EN 13232-3.

3.5 Tolerances

Dimensions of turnouts and turnout steel parts shall fulfil the tolerances specified in these technical specifications and on the turnout drawings, and if not otherwise specified the tolerances of critical dimensions specified in the relevant part of the standard SFS-EN 13232.

3.6 Other requirements

The supplier shall specify constructions and assembly methods of turnout steel parts and turnouts or turnout panels. Constructions of turnout steel parts must be approved by the customer before starting production.

Turnouts and their components must be designed and manufactured to perform without limitations in the temperature range of -40...+50 ° C. The neutral temperature is 17 ± 5°C.

To prevent accumulation of snow and ice, corners, hollows and other similar shapes shall be avoided in the turnout, when possible. The turnout shall be constructed to enable installation of snow protection shields, electrical heating systems and similar equipments.

The flangeway depth must be minimum 50 mm throughout the turnout.

Only concrete bearers shall only be used in 60E1 turnouts. Both wood and concrete bearers can be used in 54E1 turnouts. Turnout steel parts of 54E1 turnouts shall be applicable with both wood and concrete bearers.

REMARK: The previous version of these technical specifications (RHK 2446/731/06, 9th October 2006) is still valid for manufacturing wood bearers.

The turnout (especially the crossing) shall be designed and constructed by means to minimise noise resulting from the wheel/rail interaction.

4 MATERIALS

Only the following materials shall be used in the turnouts, if not otherwise agreed with the customer.

4.1 Rails

All rails shall be in accordance with the relevant part of the standard SFS-EN 13674. Rail profiles and steel grades shall be in accordance with these technical specifications even, if otherwise specified on the turnout drawings.

The manufacturer of rails shall be approved by the customer.

4.2 Rail profiles

Only the following rail profiles shall be used for constructing turnouts:

Rail profile	Applications	Standard
54E1	54E1 turnouts	SFS-EN 13674-1
60E1	60E1 turnouts	SFS-EN 13674-1
54E1A1	54E1 switch rails	SFS-EN 13674-2
60E1A1	60E1 switch rails	SFS-EN 13674-2
60E1A5	60E1 switch rails	SFS-EN 13674-2
54E1F1	54E1 crossings	SFS-EN 13674-2
60E1F1	60E1 crossings	SFS-EN 13674-2
33C1	Check rails	SFS-EN 13674-3
48C1	Checks (obtuse crossings)	SFS-EN 13674-3

4.2.1 Steel grades

Check rails shall be of the steel grade R320Cr. All other rails including check rails of obtuse crossings shall be of the steel grade R260.

The hardness of rails shall be tested in accordance with the standard SFS-EN ISO 6506-1

4.2.2 Special requirements for 54E1 and 60E1 rails

The tolerances of 54E1 and 60E1 rails shall be in accordance with the straightness class A and the profile class X.

The rail head cross-section of 60E1 rails shall not vary more than ± 0.5 mm from the nominal dimensions of the rail head.

4.3 Austenitic manganese steel castings

Austenitic manganese steel (AMS) castings shall be in accordance with the standard SFS-EN 15689.

The foundry of AMS castings shall be approved by the customer.

4.4 Turnout baseplates

Baseplates can be cast, forged or rolled. Baseplates shall be made of the following materials:

	Grade	**Standard**
Cast baseplates	EN-GJS-400-18-LT	SFS-EN 1563
Forged baseplates	S355J2G3	SFS-EN 10025-1 and SFS-EN 10025-2
Rolled baseplates	S275J0	SFS-EN 10025-1 and SFS-EN 10025-2

The ultimate tensile strength of baseplate material shall be minimum 400 MPa.

Baseplates shall have the following cast or stamped identification markings:
- manufacturer's mark
- baseplate type
- year of manufacture with two last digits

The manufacturer of baseplates and check rail supports shall be approved by the customer.

4.5 Distance and crossing blocks

Distance and heel blocks of switches and crossing blocks (vee, throat, wing front, flangeway and similar crossing blocks) shall be of minimum the steel grade R200 or a material possessing similar properties.

4.6 Fastening components

Only metric ISO bolts and nuts shall be used. Bolts, nuts and washers shall be in accordance with a relevant EN ISO standard.

4.6.1 Bolts

All bolts shall have a forged hexagonal head and rolled threads.

The following bolts shall be used for assembling turnout steel parts and components:

	Thread	**Strength grade**	**Flat size (mm)**
Assembly of crossings (block bolts)	M27	10.9	36
Assembly of switches (distance and heel blocks, anti-creep devices)	M24	min. 8.8	36
Assembly of check rail units	M24	10.9	36
Fastening tension clips and clamps	M22	min 5.6	See drawing 1-450 (Erikoiskantaruuvi Hs32x65 SKL-kiskonkiinnitystä varten)

All other bolts shall be of minimum the strength grade 5.6, if not otherwise specified.

The length of each bolt shall be dimensioned to reach 3...15 mm beyond the respective nut when tightened, if not otherwise specified on the turnout drawings.

Bolt heads shall have the following marks:
- manufacturer's mark
- strength grade
- year of manufacture

The use of any other bolts shall be approved by the customer.

4.6.2 Nuts

Only hexagonal nuts shall be used.

Turnout steel parts shall be assembled using the nuts specified as follows:

	Thread	**Special properties**	**Strength grade**	**Flat size (mm)**
Block bolts nuts (crossings)	M27	Self-locking[1)]	10	36
Assembly of switches (distance and heel block, anti-creep devices)	M24	Self-locking[1)]	min. 8	36
Assembly of check rail units	M24	Self-locking[1)]	10	36
Fastening tension clips and clamps	M22	Self-locking[2)]	min. 6	39

[1)] Self-locking nuts shall be reusable (Vargal or similar nuts).
[2)] Nuts shall be phosphatised. The nut shall be replaced, if re-opened.

All other nuts shall be of minimum the strength grade as the respective bolts.

Nuts shall have followings marks:
- manufacturer's mark
- strength grade
- year of manufacture

The use of any other nuts shall be approved by the customer.

4.6.3 Coach screws

Coach screws shall be of the type R 170-p (drawing 4022-1-501B). Coach screws shall be manufactured in accordance with the UIC leaflet 864-1.

Coach screws shall have a forged head and rolled threads.

Coach screws heads shall have the following marks:
- strength grade
- year of manufacture
- type of coach screw

4.6.4 Washers

If not otherwise specified, the plane and conical washers used shall be in accordance with the relevant EN ISO standard.

Depending on the diameter of the bolt, the internal diameter of the plane or conical washer shall be maximum 1...2 mm greater than the thread size of the bolt. The external diameter of the washer shall be minimum the external size of the respective bolt head or nut, if not otherwise specified on the turnout drawings.

Helical springs washers used for securing coach screws shall be in accordance with the drawing 4022-1-087B. Helical spring washers shall be made of steel 38Si7 (P_{max} 0.035 %) in accordance with the UIC leaflet 864-3.

Web washers shall be of minimum the steel grade R200 or made of a material possessing similar properties. Web washers shall be formed to ensure flat counter surface for the respective bolt head or nut.

4.6.5 Tension clips, tension clamps and spring clips

Tension clips and clamps as well as spring clips shall have the following stamped markings:

- manufacturer's mark
- year of manufacture with two last digits
- type of clip or clamp

The manufacturer of tension clips, tension clamps and spring clips shall be approved by the customer.

The spring clips (SKL) should be approved in accordance with the Standard SFS-EN 13481 and SFS-EN 13146.

4.7 Pads

4.7.1 General requirements

Elastic pads shall be used in the case of rail pads, baseplate pads and to prevent direct contact with turnout devices and concrete bearers. The size of the pad shall be at least the effective area of respective surfaces.

All pads shall be manufactured in accordance with the UIC leaflet 864-5, category 1.

Rail and baseplate pads shall be tested in accordance with the standard SFS-EN 13481-7.

4.7.2 Rail pads

Rail pads shall be placed on each rail seat expect not on rail seat of switch baseplates equipped with stopper bolts. Rail pads or other pads shall be used neither on slide surfaces of switch baseplates nor crossing baseplates (crossings with moveable point).

Rail pads shall be made of ethylene vinyl acetate (EVA).

The thickness of rail pads in 60E1 turnouts shall be 6 mm and in 54E1 turnouts 4 mm. The thickness of rail pads in common crossings with moveable point shall be 9 mm on the section specified on the relevant turnout drawing.

Rail pad shall have shoulders to prevent longitudinal movement of the rail pad.

4.7.3 Baseplate pads

Baseplate pads shall always be used between the baseplate and the concrete bearer.

Baseplate pads shall be made of corkrubber or EVA, but they must be the same material in one turnout.

The thickness of baseplate pads shall be 4 mm.

4.7.4 Other pads

Cork rubber pads shall be placed between concrete bearers and turnout components and devices to prevent direct contact with metallic surfaces and concrete bearers.

4.8 Stainless steel ferrules

Mounting holes required for installation of actuation, detection and locking devices to switches and common crossings with moveable point shall be equipped with stainless steel ferrules made of the steel grade Ss2346 in

accordance the standard EN 10088 (part 3), or alternative AISI 304. Ferrules shall be Ø34u7/Ø26D9.

5 MANUFACTURING OF TURNOUT PIECES AND COMPONENTS

Turnout pieces and components shall be cut, drilled, machined and bent to confirm tolerances specified on the relevant turnout drawing.

Manufacturing of turnout pieces and components shall be carried out preventing any detrimental phase transformations of machined, drilled or cutting surfaces.

5.1 Drilling

Only drilled holes are accepted in the turnout steel parts and components.

The distance between two holes, edge to edge, shall not be less than 2 x diameter of the minimal hole.

The distance between the edge of a hole and the edge of the switch rail, shall not be less than the diameter of the hole.

All drilled holes must be bevelled at an angle of 45°. If the rail is to be bent, holes must always be drilled after bending.

Plugging of holes with help of welding or other means is not permitted.

Fishbolt holes shall always be drilled to switch rails, stock rails, crossing legs, outside rails of check rail units and closure rails in accordance with the turnout drawings. The innermost fishbolt holes shall be drilled as follows:

	Distance from rail end (mm)	**Distance from rail foot bottom (mm)**	**Diameter (mm)**
54E1 turnouts	265 ± 0.5	70 ± 0.5	30 ± 0.5
60E1 turnouts	230 ± 0.5	76 ± 0.5	30 ± 0.5

Mounting holes of ADL devices shall always be drilled in accordance with the turnout drawings, even if the ADL devices are not included to the delivery of turnout steel parts. The diameter of mounting holes shall be 34H8 mm, if not otherwise specified on the turnout drawings.

All drilled holes shall be chamfered minimum to the depth of 1 mm.

5.2 Machining and cutting

Machining and cutting shall be done in accordance with the turnout drawings.

The roughness of machined wheel contact surfaces of switch rails and crossings shall be maximum Ra 6.3 µm. The roughness of machined non-critical surfaces shall be maximum Ra 12.5 µm, if not otherwise specified on the turnout drawings.

Rails shall be cut by cold sawing or similar method using appropriate cutting jigs and/or templates. Flame cutting is strictly forbidden.

The tolerance of cutting angle in the vertical and horizontal direction is ± 2 °, if not otherwise specified on the turnout drawings.

Sharp edges shall be rounded and de-burred after machining and/or cutting.

5.3 Bending

Prior to bending, rails shall be straightened, if necessary.

Curved rails shall have the form of a uniform arc of a circle in accordance with the relevant turnout drawing.

The middle ordinate of a curved rail shall not vary more than 10 % from the nominal value measured with a chord of 3 metres at any point of the rail.

Bending shall not cause any injuries to the rail. The bent rail shall have no twist when it rests on a planar surface.

5.4 Welding

Welds shall be specified on manufacturing drawings. Turnout 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 slag and finish ground after welding. The wheel contact areas shall be finished to the maximum roughness of Ra 6.3 µm.

5.5 Heat treatments

The hardness shall be tested in accordance with the standard SFS-EN ISO 6506-1 after heat treatment.

Preferred heart treatment is fine-perlitization.

5.5.1 Heat treatment of rails

Switch rails, stock rails and closure rails of YV60-300-1:9 turnouts shall be head hardened to the hardness of 340...430 HB.

Other rails shall not be heat treated, if not otherwise agreed with the customer.

5.5.2 Heat treatment of crossings

The wheel transfer area of crossings, except AMS crossings, shall be heat treated to the hardness of 360...425 HB. The wheel transfer area is specified on the relevant turnout drawing.

5.6 Corrosion protection

Machined surfaces shall be protected with corrosion protection agent.

Slide surfaces of slide baseplates which are not equipped with rollers shall be lubricated with environmentally friendly lubricant.

Bolts and coach screws except coach screws to be installed to cast-in dowels of concrete bearers shall be dipped in oil.

Inspection of the component shall be done before corrosion protection.

6 SWITCHES

Switches shall be in accordance with the standard SFS-EN 13232-5.

6.1 Constructions

Switches shall be flexible switches.

6.1.1 Half-set of switches

A half-set of switches consists of one stock rail and one switch rail, distance and heel blocks completed with fittings.

6.1.2 Set of switches

A set of switches consists of two half-set of switches, switch baseplates, distance and heel blocks, anti-creep devices and fittings required to complete the set of switches.

A single turnout has one set of switches. A double turnout has two sets of switches.

6.1.3 Double set of switches

The inside double slip turnout has two double sets of switches. A double set of switches consists of four switch rails, four stock rails, switch baseplates, heel and distance blocks, and fittings required to complete the double set of switches.

6.2 General requirements

Slide surfaces of switch baseplates shall be non-inclined.

Switch rails of 54E1 turnouts shall be made of the switch rail profile 54E1A1.

Switch rails of 60E1 turnouts can be of the switch rail profile 60E1A5 or alternatively the switch rail profile 60E1A1 machined to the rail inclination of 1:40. Switch rails of 60E1 turnouts shall be non-welded.

Switch and stock rails shall be drilled and machined in accordance with the relevant turnout drawing.

Switch rails shall have a machined groove (height 18 mm, depth 6 mm, rounding R3) for heating elements of the electrical heating system. The groove shall be machined around the tip of the switch rail with a radius of 10 mm. The length of grooves shall be in accordance with the turnout drawings.

6.3 Design requirements

6.3.1 Opening at switch toe and flangeway width

The opening at the switch toe of short turnouts (YV, KV and KRV turnouts) equipped with clamp locking devices shall be 170 ± 2 mm. The opening at the

switch toe of TYV turnouts shall be 140 ± 2 mm. The opening at the switch toe in other short turnouts shall be within 160...172 mm.

The opening at the switch toe of long turnouts shall be 143 ± 2 mm.

The minimum flangeway width shall be shall be 65 ± 2 mm.

The flangeway width between the open switch rail and the stock rail shall decrease linearly from the switch toe to the minimum flangeway width.

6.3.2 Other requirements

To enable installation of heating elements of the electrical heating system, there shall be an open space of 8 x 18 mm on the inner side of the stock rail foot throughout the movable length of the switch rail.

Switch rails shall be machined and bent so that the horizontal force caused by the switch rail in the open or closed position is maximum 300 N.

6.4 Assembly of switches

Prior to assembly, counter surfaces of rails and distance blocks as well as anti-creep devices shall be cleaned from scale, rust and other contaminations.

Bolted joints shall be tightened using a torque wrench or a similar tool to ensure the correct tightening torque.

Anti-creep devices shall be centred to comply with the neutral temperature of 17 ± 5 °C. The male part of the anti-creep device shall be installed to the switch rail and the female part to the stock rail. Alternatively, special baseplates equipped stopper bolts (Ø 34 + 0.5 mm / Ø 36H11 mm) can be used as anti-creep devices in 54E1 turnouts. In the case of stopper bolt ferrules, the switch and stock rail shall have machined grooves in the bottom of the rail foot.

Switch and stock rails as well as distance and heel block and anti-creep devices shall have drilled assembly holes. The diameter of assembly holes shall be maximum 2 mm greater than the external diameter of the respective bolt, if not otherwise specified on the relevant turnout drawing.

Switch rails shall have mounting holes (Ø 34H8) for installation of ADL devices. The mounting holes shall be precisely drilled in accordance with the relevant

turnout drawing and equipped with stainless steel ferrules specified in Chapter 4.8.

Switch baseplates shall be installed in accordance with Chapter 11.4. Rollers of roller baseplates shall be adjusted to elevate the switch rail 2...3 mm above the slide surface of the roller baseplate. The switch rail shall rest completely on the slide surface of the roller baseplate in the closed position.

6.5 Inspection and tolerances

Switches shall be inspected in accordance with the standard SFS-EN 13232-5.

Dimensions of the switch shall fulfil the tolerances specified in these technical specifications or on the relevant turnout drawings or national regulations by FTIA, if not otherwise specified, tolerances of critical dimensions specified in the standard SFS-EN 13232-5.

6.6 Delivery of switches

Set of switches and double set of switches shall be delivered as assembled in accordance with Chapter 6.4 and completed with small fittings. The delivery shall include switch baseplates pre-installed to the correct positions in the switch.

The delivery shall not include the following components, if not otherwise agreed with the customer:
- actuation, detection and locking (ADL) devices
- electrical heating systems
- soleplates
- coach screws

Prior to transportation, switch rails shall be secured to respective stock rails with steel wires to prevent any movement of switch rails during transportation.

7 CROSSINGS

Crossing types used in standard turnouts are fixed common and obtuse crossings, and common crossings with moveable point.

Fixed common and obtuse crossings shall be manufactured in accordance with the standard EN 13232-6 and common crossings with moveable point in accordance with the standard EN 13232-7.

7.1 General requirements

Repair welding of crossings shall be allowed. If the supplier has special requirements for repair welding which may affect the terms of guarantee of crossings, the supplier shall delivery welding procedure specifications (WPS) ((for welding process 111 and FTIA approved welding consumable)) for repair welding to the customer.

7.2 Constructions

Crossing pieces made of cast or forged blocks as well as full-profile rails, as the case may be, shall have formed or machined wing fronts and/or heel ends to fit with the rail profile of adjacent legs.

Crossing construction shall be agreed with the customer.

7.2.1 Fixed common crossings

Fixed common crossings of 60E1 turnouts shall be monobloc crossings with welded wing front and heel end legs.

Fixed common crossings of 54E1 turnouts can be monobloc with welded wing front and heel end legs or assembled/semi-assembled crossings with welded heel end legs.

Crossings of short turnouts shall have raised wing rails in accordance with the relevant turnout drawing.
Assembled/semi-assembled fixed common crossings consist of the vee and two wing rails. The vee can be made of a forged nose block or full-profile rails. Wing rails are assembled to the vee mechanically with crossing blocks, appropriate web washers and bolted joints. Crossing blocks can also be welded to the vee.

7.2.2 Fixed obtuse crossings

Fixed obtuse crossings can be monobloc or assembled crossings.

Fixed obtuse crossings shall have raised checks elevated 40 (+9/-1) mm above the running table.

Assembled obtuse crossings consist of two points or point rails, one wing rail and one check rail. Points can be made of forged point blocks with welded heel end legs or, alternatively, point rails can be made of full-profile rails by machining. The point or the point rail shall have welded heel end legs. The wing and check

rail are assembled to the points mechanically with neck and crossing blocks, appropriate web washers and bolted joints.

There is a possibility to replace 48C1 rail profile with 33C1 profile, but in that case it shall be discussed with the customer.

7.2.3 Common crossings with moveable point

Common crossings with moveable point consist of a flexible vee and two wing rails or alternative a cast saddle with welded wing front legs. Alternatively, the vee can be formed of a point and splice rail coupled mechanically by distance blocks, appropriate web washers and bolted joints. Castings shall be made of austenitic manganese steel.

The vee and the saddle or wing rails are assembled together mechanically by spacer and flangeway blocks and bolted joints.

ADL devices are not included to the delivery of a common crossing with moveable point, if not otherwise agreed with the customer. However, machining and drilling required for installation of ADL devices shall be precisely in accordance with the relevant turnout drawing. Mounting holes (Ø 34H8) of ADL devices shall be equipped with stainless steel ferrules (see Chapter 4.8).

7.3 Austenitic manganese steel castings

Centre blocks of monobloc crossings must be made of cast austenitic manganese steel (AMS). AMS castings can also be used as swing nose blocks and saddles in common crossing with moveable point.

Castings shall have welded legs. The ends of castings shall be formed in accordance with the standard SFS-EN 15689 to fit with the rail profile of adjacent legs.

AMS castings shall be designed by means to avoid shapes which may encourage formation of casting defects, when possible.

7.3.1 Inspection

AMS castings shall be inspected and tested in accordance with the standard SFS-EN 15689.

Repair welding of casting defects is allowed. Repair welding shall be done in accordance with the standard SFS-EN 15689.

In addition to minimum inspection requirements, the underside of the casting shall be inspected visually especially near ribbed sections considered as potential locations of casting defects, such as shrinkage cavities and gas pores. To ensure the size of a casting defect, dye penetrant shall be used, if necessary. If the size of a casting defect is approximately 2 cm^3 it shall be opened, if necessary, and filled by using appropriate welding method and filler material.

7.3.2 Pre-hardening of wheel contact surfaces

Pre - hardening EDH (Explosive Depth Hardening) of wheel-running surfaces of AMS crossing block to hardness of 320 to 350 HB can be offered and applied as an option.
The casting shall be straightened and PT – tested after EDH process, if necessary

Pre-hardened AMS castings shall be inspected in accordance with the standard SFS-EN 15689.

7.4 Assembly of crossings

The supplier shall specify in the tender assembly methods used for assembling crossings.

Prior to assembly, counter surfaces of rails and crossing blocks shall be cleaned from scale, rust and other contaminations.

Assembled and semi-assembled crossings shall be assembled with block bolts, block bolt nuts and appropriate web washers to ensure a flat surface with the bolt head or the nut.

Assembled- and semi-assembled crossings shall have drilled assembly holes for fastening block bolts. The diameter of assembly holes shall be 29 (+0.5/-0.5) mm.

Bolted joints shall be tightened using a torque wrench or a similar tool to ensure the correct tightening torque.

Bolt heads shall be installed to the same side of the crossing, if possible. The tightening torque of bolted joints shall be 850 (+40/0) Nm.

Crossing baseplates shall be assembled in accordance with Chapter 11 of these technical specifications.

7.5 Inspection and tolerances

Fixed common and obtuse crossings shall be inspected in accordance with the standard SFS-EN 13232-6

Common crossings with moveable point shall be inspected in accordance with the standard SFS-EN 13232-7.

Dimensions of the crossing shall fulfil the tolerances specified in these technical specifications or on the relevant turnout drawings or national regulations by FTIA, if not otherwise specified, tolerances of critical dimensions specified in the standard SFS-EN 13232-6 or SFS-EN 13232-7.

7.6 Limits and extent of delivery

Crossings shall be delivered as assembled and completed with small fittings.

Crossing baseplates of obtuse crossings of double split turnouts shall be included to the delivery of double set of switches. The delivery of all other crossings shall include all crossing baseplates pre-installed to their correct positions.

Common crossings with moveable point shall not include actuation, detection and locking devices, if not otherwise agreed with the customer. The delivery of common crossings with moveable point shall include also running rails associating the crossing panel as well as associating baseplates and fastenings.

8 CHECK RAIL UNITS

8.1 Constructions

A check rail unit consists of one check rail, one outside rail (the running rail of the check rail unit), check rail supports, and adjacent fastenings. Check rail units shall be delivered as pairs, if not otherwise agreed with the customer.

8.2 General requirements

The check rail shall be machined and drilled in accordance with the relevant turnout drawing.

The check rail shall be elevated 20 (+1/-0) mm above the running plane of the outside rail.

8.3 Design requirements

The minimum flangeway width in all turnouts shall be 42 (+1/-0) mm, except in YV60-300-1:10, YV54-165-1:7, TYV54-200-1:4,44 turnouts.

In YV60-300-1:10 turnout the minimum flangeway shall be 44 ± 1 mm.

In YV24-165-1:7 and TYV54-200-1:4,44 the minimum flangeway width shall be 50 ± 1 mm.

In short turnouts the openings of the flangeway flares shall be 90 ± 2 mm. In long turnouts the openings of the flangeway flares shall be 85 ± 2 mm.

Other flangeway widths are defined in the relevant turnout drawings.

8.4 Assembly of check rail units

Check rails and check rail supports shall have drilled assembly holes. The diameter of assembly holes shall be maximum 2 mm greater than the nominal diameter of respective bolts, if not otherwise specified on the relevant turnout drawing.

Bolted joints shall be tightened using a torque wrench or a similar tool to ensure the correct tightening torque.

The outside rail shall be fastened with check rail supports in accordance with Chapter 11.4.

8.5 Inspection and tolerances

Dimensions of the check rail unit shall fulfil the tolerances specified in these technical specifications and on the relevant turnout drawing.

8.6 Extent and limits of delivery

The delivery shall include both/all check rail units associating with an individual crossing/turnout, if not otherwise specified in the purchase order.

Check rail units shall be delivered as assembled. The delivery shall include all check rail supports. Other baseplates adjacent to the check rail unit shall not be included to the delivery, if not otherwise agreed with the customer.

9 CLOSURE RAILS

Closure rails shall be delivered as closure panels and are not included to the delivery of turnout steel parts, if not otherwise agreed with the customer.

Curved rails shall be bent in accordance with Chapter 5.3.

Baseplates of closure rails shall be installed to closure rails in accordance with Chapter 11.4.

The delivery shall include the whole closure panel as a complete unit.

10 CLAMP LOCKING DEVICES

Clamp locking devices shall fulfil the requirements of the standard SFS-EN 13232-4.

10.1 General requirements

The bearer spacing at the clamp locking device shall be 670 mm. The clamp locking device shall fit to the free space of 380 mm between the adjacent bearers.

Any part of the clamp locking device shall not be more than 100 mm below the bottom of the rail foot.

The clamp locking device shall lock both the open and closed switch rail simultaneously. The actuator movement is 220...240 mm.

The contact allowance between the switch and stock rail shall be adjustable within the range of 0...5 mm without an effect on the correct closing.
The roughness of sliding surfaces of the clamp locking device shall be maximum Ra 12.5 µm or Rz 42 µm.

The clamp locking device shall permit occasional trailing of a vehicle at the speed of up to 40 km/h.

The clamp locking device shall be lubricated with oil having minimum the pour point at
- 45 °C.

The clamp locking device shall be protected from snow, dust and other substances, which may have a detrimental effect on performance of the clamp locking device.

The clamp locking device shall not affect track circuits.

10.2 Inspections

Minimum 10 % of each dispatch of clamp locking devices shall be inspected by dye penetrant. In addition, ultrasonic inspection with 45° probe shall be carried out minimum 1 % of clamp locking devices from each dispatch (not less one of each dispatch).

11 FASTENING SYSTEMS

11.1 General requirements

Fastening system of rail shall be designed so that the deflection of the rail is maximum 2.5 mm, when loaded with vertical load of 125 kN and lateral load of 100 kN in accordance with the load test specified in the standard SFS-EN 13481-7.

11.2 Baseplates

Baseplates shall be inspected in accordance with the relevant parts of the standards SFS-EN 13146 and SFS-EN 13481.

11.2.1 General requirements

The baseplates and check rail supports used are specified on the relevant turnout drawings. Other types of baseplates and check rail supports shall be used only with the permission of the customer.

Baseplates shall have notched ribs for fastening stock rails, outside rails of check rail units and closure rails and fixed crossings as well as non-moveable sections

of switch rails or crossings with moveable point. The notch of ribs shall be compatible with the heel of special heel bolts.

Slide and roller baseplates, soleplates as well as check rail supports shall be fitted with an single inner bracing clip for fastening the inner side of the stock rail or outside rails of check rail units.

The nominal toe load of the inner bracing clip should be 12±1 kN. The deflection range of -1 mm to +0.7 mm at nominal toe load should be approved.

The underside of all baseplates shall be planar.

Convexity of rail seat and slide surfaces shall be 0...+1.4 mm. Concavity is not permitted.

Slide surfaces of baseplates of switches and crossings with moveable point shall be parallel with the underside of the baseplate.

Baseplates shall have drilled coach screw holes. The diameter of the holes shall be 26 (+1/0) mm. Holes shall fit with cast-in dowels of concrete bearers.

11.2.2 Special requirements for switch baseplates

Rollers of roller baseplates shall be non-lubricated.

Slide baseplates specified on the relevant turnout drawings of long turnouts shall have machined X-formed lubrication grooves on the slide surfaces. The grooves shall reach diagonally through the slide surface. The depth and width of the grooves shall be 2 (+1/0) mm and 10 ± 1 mm, respectively. These baseplates shall be equipped with grease nipples and associating borings for adding lubricant.

Non-lubricated slide baseplates can be used only with the approval of the customer.

Electrical insulation of the soleplate shall be minimum 10 kΩ / 500 V DC. The insulation distance shall be minimum 2.5 mm.

11.3 Tension clips, tension clamps and spring clips

Skl 12 tension clips shall be used, when possible. At locations having inadequate space for the Skl 12 tension clip, Skl 3w tension clips or special tension clamps can be used instead of the Skl 12 tension clip.

Spring clips shall be of the type Ssb 2 or Ssb 4.

11.4 Installation of fastening systems

Fastening systems shall be pre-installed precisely to their correct positions in turnout steel parts.

Nuts and coach screws shall be tightened using a torque wrench or a similar tool to ensure the correct tightening torque.
Rail pads and baseplate pads shall be installed in accordance with Chapters 4.7.2 and 4.7.3 of these technical specifications.

Tension clips and clamps shall be installed to ribbed baseplates with special heel bolts specified in Chapter 4.6.1, self-locking nuts specified in Chapter 4.6.2 of these technical specifications and ULS 6 plane washers. Nuts shall be tightened in accordance with instructions of the supplier of tension clips and clamps to ensure the clamping force of 12...14 kN. If the nut is re-opened, it shall be replaced with an unused nut.

Spring clips shall be installed in accordance with instructions of the supplier of baseplates/check rail supports equipped with a single inner bracing clip to ensure the clamping force of 12 ± 1 kN.

Coach screws shall be secured with helical spring clips of the FE 6. Coach screws shall be tightened to the tightening torque of 250 ± 10 Nm.

12 IDENTIFICATION MARKINGS OF TURNOUT STEEL PARTS

Each turnout steel part shall be marked with a fixed identification marking. Switches, assembled crossings and check rail units shall be marked using a manufacturing plate with embossed or stamped markings. Centre blocks of monobloc crossings and similar cast pieces shall have a cast identification marking. In addition, the customer's purchase order number shall be marked to each turnout steel part and the handedness of switches, crossings and check rail units with a painted marking. Details of markings are specified as follows.

The fixed identification marking shall include the following marks:
- customer's mark
- manufacturer's mark
- month and year of manufacture
- type of turnout including handedness
- unique identification number

The customer's mark of turnout steel parts purchased by Finnish Transport Infrastructure Agency shall be "FTIA". However, in existing casting moulds the former customer's mark "FTA" is not required to be changed.

Cast pieces shall be marked with both the manufacturer's and foundry's mark.

The month of manufacture shall be marked with numbers (January = 01, February = 02 etc.) and the year of manufacture with two digits. For instance, the month and year of manufacture of turnout steel parts manufactured in September 2010 shall be marked as "09 10".
The turnout type shall be marked using turnout type markings specified in Chapter 2 of these technical specifications.

The handedness of turnouts and turnout steel parts (crossings and switches of non-symmetrical turnouts, half-set of switches check rail units of symmetrical turnouts), shall be marked as follows:
- "O" (Oikea = Right)
- "V" (Vasen = Left)

The handedness of check rail units and half-sets of switches of non-symmetrical turnouts shall be marked as follows:
- "OO" (right-hand turnout, right-hand turnout steel part)
- "OV" (right-hand turnout, left-hand turnout steel part)
- "VO" (left-hand turnout, right-hand turnout steel part)
- "VV" (left-hand turnout, left-hand turnout steel part)

For instance, the crossing or set of switches of a 54E1 1:9 right-hand single turnout shall be marked as "YV54-200N-1:9-O", and the left-hand half-set of switches or check rail unit as "YV54-200N-1:9-OV". Respectively, the crossing of a 54E1 1:4,44 equal split turnout shall be marked as "TYV-200-1:4,44" and the right-hand check rail unit or half-set of switches as "TYV54-200-4,44-O".

Each turnout steel part shall have a unique identification number. Right-hand turnouts shall have an even identification number and the left-hand turnouts an odd identification number, respectively. Symmetrical turnouts can have either an even or odd identification number.

The manufacturing plate shall be glued to the turnout steel part (SikaBond AT-Metal or similar glue).

The stamped identification marking shall include the following markings:
- manufacturer's mark
- year of manufacture with two last digits
- unique identification number

The manufacturing plate and the stamped marking shall be placed as follows:

Turnout steel part	**Manufacturing plate**	**Stamped marking**
Switches	Web of each switch rail and foremost soleplate	Each switch rail[1)]
Monobloc crossings	Flank of central block (cast marking)	Not required
Assembled common crossings	Web of either wing rail	Heel of wing rail (head crown)
Assembled obtuse crossings	Web of wing rail	Heel of wing rail (head crown)
Crossings with moveable points	Inner side of point rail and both wing rails or flank of saddle[2)]	Not required
Check rail units	Backside of check rail	Upper surface of check rail

[1)] The marking shall be stamped 0.5...1 m from the switch heel to the opposite side of the gauge corner of the switch rail.
[2)] Saddles of common crossings with moveable point shall have a cast marking.

The purchase order number of Finnish Transport Infrastructure Agency shall be marked clearly and legible to each switch, crossing and check rail unit with chalk or crayon. The purchase order number shall be marked to the web of the stock rail.

The handedness of switches, crossings and check rail units shall be marked as painted marking. The diameter of the marking shall be minimum 50 mm. Right-hand switches and crossings shall be marked with blue colour and left-hand

switches and crossings with red colour. The marking shall be painted to the ends of stock rails and crossing legs.

13 BEARERS

Concrete bearers are used both in 54E1 and 60E1 turnouts.

Wood bearers are used only in 54E1 turnouts. The turnout shall contain only either wood or concrete bearers. The bearer type shall be specified in the purchase order of complete turnout or turnout panel.

13.1 Concrete bearers

Only pre-stressed monobloc concrete bearers may be used.

Currently, the only approved concrete bearer type for conventional turnouts is BP92. New concrete bearer types shall be designed in accordance with the BP92-drawing (4022-161-062C) and also with the UIC leaflet 713-R. In addition to this, new concrete bearer types shall fulfil the requirements of these technical specifications and the standard SFS-EN 13230-1 and SFS-EN 13230-2.

Normally concrete bearers are ordered in lengths matching the track diagram. The supplier calculates the locations of screw holes. If the turnout requires special geometry, the supplier shall also calculate the lengths of bearers. The location tolerance of screw holes is ±1 mm. The holes shall be equipped with a plastic bushing for fastening rail screws R170-p.

13.1.1 Reinforcement and tension

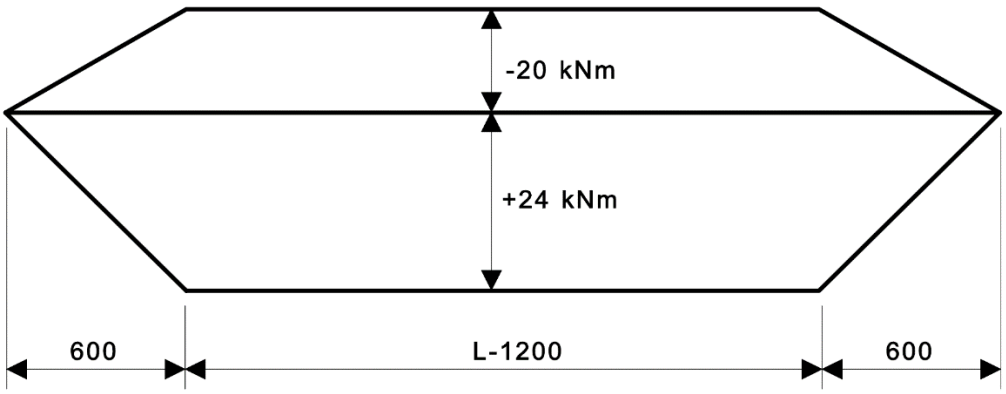
A bearer shall be reinforced at upper and lower surfaces, and tensioning shall be carried out by using a method proposed by the supplier and approved by the purchaser. The properties of prestressing steel (for example chemical consistency, strength values, manufacturing method and possible surface finish) shall be provided in the product declaration certified by the Finnish Concrete Association.

The supplier shall deliver the instructions to the purchaser before the steel is taken into use. Prestressing steel is tested in accordance with currently valid norms. Before the steel is used the supplier shall provide the purchaser or an inspector authorized by the purchaser, for each steel lot of maximum 25 tonnes, with research reports issued by an approved research institute, on dimension, bending and tensile stress tests, as well as the factory certificates given by the

steel manufacturer and describing, among others, the consistency and strength values of the steel. Prestressing method shall have a certified product declaration. There shall be a steel around reinforced steels (closed ≥ 5 mm profile cramps) against bearer split in both
ends of a bearer. While the spacing between rail screw bushings is less than 150 mm, cramps ≥ 5 mm shall be installed horizontally to bind the bushings pairwise in direction y.

13.1.2 Acceptable tensions

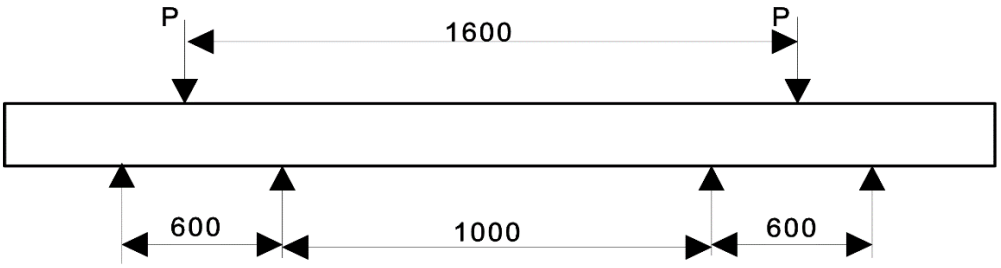
Concrete bearers shall be designed so that torques along the torque plane of the external forces described below, do not cause neither tensile stress exceeding 3 MN/m^2, nor compressing tension exceeding 20 MN/m^2 in the concrete. At least a double security against breaking must be proven.



Bearers must be designed to stand dynamic bending tests, including:

Test of static load on sleeper ends and dynamic fatigue test

The bearer is loaded at the rail fastening point and supported symmetrically with respect to the point of load. Both ends are loaded simultaneously (figure below).



At the actual points of load, above the supporting bearings, of which the other is fixed and the other one is moving freely along the length, there are 25 x 100 mm steel plates and at the supporting points below the loading cylinders, there are 50 x 100 mm steel plates, which are taking the load and stretching across the bearer in a plane perpendicular to the length of the bearer. Before tests the surfaces which go against the steel plates of a bearer, are smoothed with a layer of 2-5 mm gypsum, and the bearer is stored submersed completely in water for 48 hours. A microscope magnifying 50 times shall be used when measuring cracks and when searching for cracks a magnifying glass with 6-fold resolution.

The load test of a concrete bearer is started by increasing the static force first at a rate of 10 kN/min up to 150 kN, after which the force is increased in steps of 5 kN up to the upper limit 260 kN of the dynamic test. At each step one shall check and measure the width and side-wise lengths of cracks while the force stays constant for at least 10 minutes. After the dynamic test one shall continue the static loading up to the breaking point with a rate of 10 kN/min. The breaking load value and type of breaking are registered and the test sleeper photographed on both sides. The requirement for a static test is that the first crack may occur only when the force is higher than 210 kN. Permanent cracks (width ≥ 0.05 mm) are not allowed.

During the dynamic load the number of load changes corresponding to the first crack is registered, and after the test, the number of cracks, greatest widths and side lengths at the upper load, and the width of a permanent crack. The load exchange rate of the dynamic test is 8 1/3 (10) Hz, the number of load exchanges 2,000,000, the upper limit of loading 260 kN and the lower one 50 kN. In the dynamic test permanent cracks (width ≥ 0.05 mm) are not allowed.

13.1.3 Structural requirements

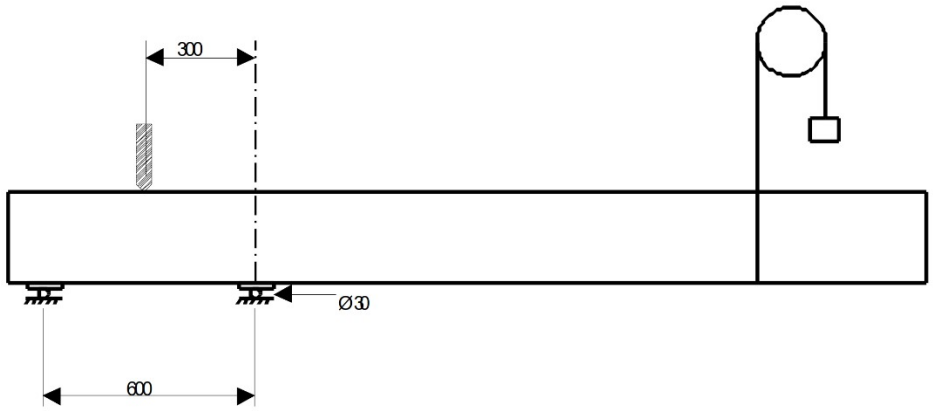
Concrete bearers shall be designed and manufactured in accordance with Finnish norms, structural class K60-1 and environmental class Y1 (water resistance and frost resistance required). However, the minimum accepted value of the concrete cover is 30 mm.

Compression and bending tests of concrete

Compression and bending tests of concrete are carried out in accordance with the currently valid norms. A test meeting the norms can however by a separate

approval be replaced with a test, in which the test pieces will be manufactured and stored in the same way as a concrete sleeper. In that case 2 concrete cubes for each layout as well as 3 concrete cubes and 3 concrete sleepers are manufactured for each casting day. 2 of the concrete cubes shall be stored under the same conditions as the bearers. Before transferring the tension force only the first of these cubes is compressed and if this one does not meet the requirements, the second cube is also compressed later. The last 3 cubes are compressed when they are 7 days old. If the mean value of these does not meet the requirements 3 cubes are compressed when they are 28 days old. Concrete bearers shall be tested when they are 7 days old.

The bending test is carried out with the shortest concrete bearer once a week with a load of 225 kN so that the bearer is placed as in the following figure:



The end to be tested is placed on two ball bearings having a distance of 600 mm and placed symmetrically on both sides of the resting surface of the rail foot. The bearings shall be equipped with cylinders with a diameter of 30 mm and bearing plates of 100 mm wide against the concrete. An approximately 5 mm thick rubber sheet shall be placed between the bearing plate and the concrete. A force corresponding to half of the bearers weight is directed upwards at the other end of the bearer. On the resting surface of the rail foot to be tested, shall be placed an approximately 5 mm thick rubber pad on which a 30 mm wide and 15 mm thick steel plate is placed exactly in the centre with respect to both bearings. The point load is directed towards the middle of the steel plate, using a controlled pin punch or a steel roll having a rounding of 15 mm. The load is increased gradually to 225 kN, and no cracks reaching the lowest steel row on the pulling side may appear.

The tension test of plastic bushings is done separately for each bushing by pulling straight upwards with a force of 50 kN. The plastic bushing may not rise at all during pulling, and no cracks may appear in the concrete.

Documents concerning calculations, description of the manufacturing method and its approval, concrete consistency and proportioning, and certified product declarations on the use of additives confirmed by the Finnish Concrete Association, as well as complete drawings, shall be appended to the offer. The proportions and materials must not be altered before the purchaser has approved the changes.

Finnish concrete norms valid at the time of the contract shall be applied in the procurement, if not otherwise stated in these technical specifications or the purchase contract.

The bending strength of concrete used in bearers shall at the age of 7 days, be at least 5 MN/m^2 and the compression strength 55 MN/m^2, or at the age of 28 days at least 60 MN/m^2. At the moment of transferring the tension force the compression strength shall be at least 30 MN/m^2.

The microcracking index must not exceed 1.5 (the number 0 corresponds to concrete having little or no microcracking, and the number 3 to concrete with numerous microcracks). The cracking shall be investigated by an approved research laboratory using a microscope and thin slices. The upper surface and sides of bearers shall be as free from cracks as possible. Porosities functioning as water bags may not occur and porous cells are not accepted. The greatest diameter of a pore on the rail resting surface is 5 mm, and elsewhere 10 mm. The number of pores having a diameter greater than 5 mm must not exceed 20 per sleeper. The maximum acceptable depth of a pore is 5 mm.

Recrystallized ettring is not permitted at all. Investigations of ettrings shall be carried out by an approved laboratory, using analysis of thin slices and x-ray diffraction. The samples are taken from a ready-made bearer.

The surfaces of the bottom sides of the bearers must be rough planes, local deviations greater than ± 3 mm from the base level in the drawings, may not occur. On the lower edges of bearers no greater jaggs or spalls may occur. Corners and lower edges may contain maximum 10 mm deep and 30 mm long cracks.

The surface for the rail foot shall have well-formed side edges and an even carrying surface. Post-grinding is allowed only to remove minor irregularities from the rail carrying surface.

Reinforcement steels shall be cut near the bearer surface, the greatest acceptable protrusion being 3 mm.

13.1.4 Markings

Factory badge, two last digits of the manufacturing year, manufacturing month and the number of the mould shall be marked at the top surface of all bearers. The marking place has to be defined in the drawings. Also, the use of USP shall be marked in the same place "USP". The date of manufacturing shall be stamped or printed at the ends of the bearers. The date marking must be readable for at least two months.

13.1.5 Manufacturing of bearers

The bearers shall be delivered exactly as specified by the approved drawings and the working method.

In heat treatments, the temperature of the concrete is adapted to the concrete consistency and to the heat treatment method. The temperature of the concrete during casting shall be maximum + 30°C. Pre-storing after casting and before possible extra heating must take at least 3 hours. The highest acceptable temperature of the concrete is + 55°C, but it should be kept at maximum +50°C. The highest rate of change shall be 15°C per hour. Bearers shall be protected against drying during pre-storing.

The bearers shall be stored in a mould tightly closed by plastic or in a humid space (relative humidity at least 90%), starting at the earliest ½ hour after casting and continuing until the tension force is being transferred. Immediately after the first cutting bearers are protected by spraying 0.125 l/m2 Curing 101 agent or similar on bearer surfaces, except for the bottom side, or alternatively right after the final cutting so that watering is used between the cuttings. The temperature difference between the different parts of the bearer may not exceed 20°C during the first three days after casting. While the outdoor temperature is below + 5°C bearers must be stored indoors for at least two days after casting and warm bearers shall be protected against sudden changes of temperature when taking them outside for storing.

Before installation in the mould and after casting plastic bushings to be inserted in the rail screw holes shall be cleaned from concrete and other materials that could hamper their function or from holding fast. They shall be well fastened during casting.

13.1.6 Measurements of finished bearers

In connection with the assembly of a turnout control measurements are taken of the coordinates of each bearer that have been manufactured by using a new matrix. Other dimensions are measured of at least one 7-day old bearer taken from each cast series.

In each shift all steel reinforcement tensions and locations are tested in at least four different rows of bearers.

The internal temperature of a bearer should be measured at least once a week, and the temperature is registered at least once an hour during the first 24 hours after casting. The humidity of the bearer storage shall be measured at least once a week. Reports shall be written on tests and inspections and signed by the supplier and the purchaser or the inspector authorized by him.

The purchaser or the receiver authorized by him will decide whether a defect is significantly negative with respect to the use of the bearer.

All the tests and measurements mentioned in these specifications as well as the additional measurements the purchaser may require, if those mentioned here do not give desired results, are paid by the supplier.

13.1.7 Frost resistance

The frost resistance of concrete shall be tested in accordance with the standard SFS 5449

The frost resistance factor P shall be at least 25.

P is calculated using the formula $P = 100/\Delta V/(50)*100\%$,

where $\Delta V/(50)$ is the change in volume in a frost salt test after 50 freezing cycles (%). The frost salt test shall be repeated at three months intervals by an

approved test laboratory. Test pieces are taken from a finished bearer which is at least 21 days old. The test is run on three pieces.

13.2 Wood bearers

Wood bearers are allowed to be used only in 54E1 turnouts. The approved wood species for wood bearers are Nordic pine (Pinus sylvestris) and European oak. The turnout may contain only wood bearers produced from the same wood species.

13.2.1 Timber sleepers made of Nordic pine

Instead of concrete bearers impregnated timber sleepers made of Nordic pine can be used in 54E1 turnouts. The must be manufactured according to European standard SFS-EN 13145.

13.2.2 Purchasing time and properties

Logs intended for sleepers shall be from living and straight pines. They shall be felled during the period 1 October - 15 April. The entire length of a sleeper, except for 300 mm at both ends, is considered the rail fastening area.

13.2.2.1 Wood properties and faults

The form of sleepers shall be regular, opposite sides parallel and joining sides at right angles to each other. The volume weight of sleepers shall be > 450 kg/m3, when they have a humidity of < 25 %. The standard SFS 4891 (RT 21-10188) is used for defining wood properties and faults.

No bark, damage by pests, rot or watercore, nor bluing which could prevent impregnation shall occur on sleepers. Cross-graining may not occur in the rail fastening area. On the upper side of sleepers maximum 50 mm large elevations or bark residues are allowed. Faults such as ring or through-going cracks that weaken strength, are not allowed. The maximum accepted inclination is 1:10. Neither saw dust nor soil shall occur on sleepers, and they shall not be treated with agents that prohibit the impregnation from penetrating the wood.

Horizontal crookedness not exceeding 60 mm is allowed in 7.5 meter long sleepers, but only on a half of the length of the sleeper. A maximum of 2 mm concavity or convexity may be present in the rail fastening area. The maximum crookedness in a length of 1 meter is 4 mm.
The number of healthy and solid branches is unlimited, but such branches that owing to size, form or grouping may weaken the strength of the sleeper, are not

allowed. Single dry branches can have a maximum size of 50 mm. The size of single rotten branches or bark branches or of single branch cracks, may not exceed 10 mm in the rail fastening area, and elsewhere not 30 mm. Sleepers shall be sawn from the material asymmetrically, so that the core of the tree comes closer to the bottom side of a sleeper.

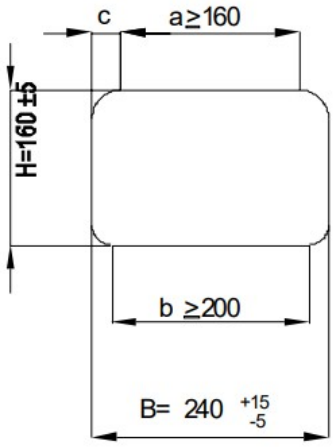
13.2.2.2 Classification, measurement and form of sleepers

Sleepers have the following lengths 2.70; 3.00; 3.25; 3.50; 3.75; 4.00; 4.25; 4.50; 4.75; 5.00; 6.00 and 7.50 m.

The longitudinal tolerance of sleepers is " 20 mm. The cross section dimensions of sleepers are presented as follows.

All dimensions concern sleepers having dry weight humidity less than 25 %. Sleeper ends may not diverge more than 20 mm from the vertical plane. As to other dimensions please note the following:

Dimension a (160 mm) on the upper surface is the minimum length in the rail fastening area. Dimension c is maximum 40 mm in the rail fastening area and elsewhere maximum 60 mm. The cut side surface stretching from end to end shall be more than 50 %. The dimension b (200 mm) of the bottom surface is the minimum length along the entire length of a sleeper.



13.2.2.3 Drying and storing of sleepers

Sleepers are dried in staples by air. Different lengths shall be stapled in different stacks. The height of stored staples must not exceed 20 sleepers, and the width not 12 sleepers. Staples must be spaced at least 1 m from each other. After three staples one should leave a space of at least 2 m. The staples should be supported below by at least 300 mm high supports.

Sleepers shall be stored laying on their sides upper surface upwards with a gap of at least 100 mm between them so that the ends are even. Between each layer of sleepers one shall use even, at least 50 mm thick battens. Sleeper storage shall be covered. The staples shall be marked with the month and year of sawing (for example 1/2021).

In the rail fastening area the longest allowed crack caused by drying is 400 mm and the width 5 mm. Large cracks that weaken the strength of a sleeper are not allowed elsewhere.

13.2.2.4 Acceptance and marking of sleepers

The quality inspection and classification of sleepers is carried out at the supplier's storing places before the sleepers are impregnated, and when the dry weight humidity is less than 25 %.

The length in centimeters is marked on sleepers by the supplier. A measurement certificate is written based on the quantity inspection carried out at the impregnation plant. The supplier provides the stickers needed in the transportation of sleepers free of charge.

13.2.2.5 Impregnation

The dry weight humidity of sleepers shall be at least 25 % during impregnation. The sleepers are impregnated according to class A as defined by the standard SFS 3974/EN 351 (RT 21-10414), in which the protective compound penetrates through the whole sapwood down to the core.

As creosote distillate is used oil, which shall meet the requirements in the decision 1405/95 by the Council of State, on regulations concerning the use of creosote and wood treated with it, as well as on restricting its release to marketing. The decision is based on the European Parliament´s and Council´s directive (94/60/EC). The content of Benzo(a) pyrene can be at most 0,005 percentage by weight.

A diary shall be kept on the impregnation process, where the number of the impregnated lot, impregnation date as well as the number and volume of the sleepers are registered. Also the temperature and consumption of the creosote distillate is registered, as also the initial and impregnating pressures and the duration of the final vacuum. The consumption of creosote shall be at least 135 kg/m3 in the sapwood. The duration of the final vacuum shall meet the purchaser=s requirements, 2–18 hours depending on the intended use.

During each shift at least ten drilling samples of the impregnated sleepers shall be taken in order to control the absorption of the impregnation agent. The drilling samples are taken in the rail fastening area, at the upper edge of sleepers. The drilled holes shall be plugged with impregnated wooden plugs.

13.2.3 Other wooden sleepers

Oak is also approved to be used in sleepers. Impregnated sleepers made of oak have to fulfill the requirements in point 13.2.1 in applicable parts.

14 HANDLING, STORAGE AND TRANSPORTATION

Turnout steel parts and their components shall be handled, lifted, stored and transported with care to avoid any detrimental distortions or injury. Handling or lifting shall not damage corrosion protection coatings.

Turnout steel parts, turnout pieces and turnouts/turnout panels shall be lifted using appropriate lifting devices. Rails shall be lifted the rail head upwards. Lifting shall not effect on straightness of surface quality of rails. Lifting points (minimum four points) shall be marked to each turnout panel. Markings shall be made to the upper surface of bearers with crayon, paint or water-resistant chalk. Lifting points shall be specified to ensure no detrimental distortion, longitudinal movement of bearers or similar faults to the turnout panel when lifted properly. Special care shall be paid on avoiding any damages to actuation, detection and locking devices.

Turnout steel parts as well as turnouts or turnout panels shall be stored on a plane and solid surface or ground. If stored outside, the ground shall be well drained. Turnout steel parts as well as turnouts/turnout panels shall be adequately supported. Turnout steel parts and pieces shall not lie directly on the ground.

Prior to transportation, the switch rail shall be securely fastened to the stock rail with steel wires. Set/double set of switches shall be loaded on wooden transportation beams or pallets, which shall ensure adequate support for the switch, when lifted.

All loose parts shall be packed at the manufacturing plant in separate transportation boxes. Each transportation box shall have clear and legible markings as well as the purchase order number of the customer to characterize the respective turnout steel part. Separate baseplates can be loaded on pallets, if properly secured.

Turnout steel parts, pieces and components shall be prevented from dust and other contaminants during transportation.

Turnout steel parts, pieces and components shall be delivered to the delivery address of the receiver specified by the customer. Prior to delivery, the supplier shall be sent a prior notice to the receiver, which shall include the following information:

- customer's purchase order number
- details of turnout steel parts to be delivered including types and identification numbers of turnout steel parts
- net and total weight of delivery
- supplier's and receiver's contact information

15 QUALITY CONTROL AND QUALITY DOCUMENTS

The supplier shall have a quality management system certified in accordance with the standard ISO 9001 or otherwise specified quality management system. The customer shall have the right to inspect the quality management system of the supplier at any time during the contract period.

The supplier shall store all quality documents (inspection records, material quality certifications etc.) including the quality documents of sub-suppliers minimum ten (10) years from the date of delivery. On request, the supplier shall be responsible to deliver to the customer the quality documents minimum within the period of ten (10) years from the date of delivery.

Each dispatch of turnout steel parts as well as turnouts or turnout panels shall include quality inspection reports concerning to the delivered turnout steel parts or turnout/turnout panels. The form of quality inspection reports shall be

approved by the customer before starting production. The customer shall have the right to specify the quality certifications, which shall be delivered to the customer as attachments of each dispatch.

If the supplier intends to cease to manufacture, the supplier shall deliver to the customer all quality documents of such deliveries purchased by the customer which are from the date of delivery not older than ten (10) years.

The supplier shall be responsible of quality certifications of sub-suppliers. All quality certifications shall be stored minimum ten (10) years since the date of delivery. On request, the supplier shall deliver the quality reports to the customer without a delay.

16 DOCUMENTATION

All delivered turnout steel parts as well as turnouts or turnout panels shall be in accordance with the approved turnout drawings listed in Appendix 2.

All drawings shall include the supplier and an FTIA title block. Necessary information for FTIA title block presented in https://julkaisut.vayla.fi/pdf3/lo_2012-14_ratatekniset_piirustusohjeet_web.pdf will be given by FTIA prior to delivery.

All text on the drawings shall be in Finnish.

16.1 BIM model

- The supplier must prepare a BIM model for every turnout type prior to delivery.
- The BIM model shall be based on FTIAs requirements
- The BIM model shall be based on open standard, IFC version 4.3 as described in ISO 16739
- The model shall include all details in the S&C, including main parts, baseplates, fastening components and bolts.
- The BIM object of the turnout shall be delivered to FTIA's object library.
- Structured information shall be connected to the BIM model
- FTIA must be assigned all rights to the models.

16.2 Turnout drawings

16.2.1 Layout drawings

The layout drawing specifies the overall turnout geometry, bearer spacing, and location of actuation, detection, and locking devices. Necessary information for FTIA requirements presented in https://julkaisut.vayla.fi/pdf3/lo_2012-14_ratatekniset_piirustusohjeet_web.pdf will be given by FTIA prior to delivery.

The layout drawing of a new turnout type must be approved by the customer before starting production.

The supplier shall prepare the following drawings in plane view prior to manufacture of any switch type:

- Main layout drawing of full turnouts – scale 1:50 /1:200 or 1:1500
- General drawing of switch section – scale 1:20
- General drawing of crossing section – scale 1:20
- Detail drawing of crossing, with all necessary cross-sections – scale 1:5
- Detail drawing of switch blade and stock rail, with necessary cross-sections – scale 1:5
- Detail drawing of check rail and running rail, with necessary cross-sections – scale 1:5
- Drawing of all types of baseplate

After approval the supplier shall deliver all drawings in dwg (autocad) and pdf. The supplier has an obligation to supply files that are compatible with the version of Autocad currently used by FTIA.

FTIA must be assigned all rights to the drawings.

16.2.2 Assembly/installation drawings

Assembly drawings specify critical dimensions and part list of turnout steel parts. Necessary information for FTIA requirements presented in https://julkaisut.vayla.fi/pdf3/lo_2012-14_ratatekniset_piirustusohjeet_web.pdf will be given by FTIA prior to delivery.

Turnout steel parts shall be in accordance with the approved turnout drawings.

Every turnout assembly supplied shall be accompanied by the following drawings in plane view:

- Main layout drawing of full turnouts – scale 1:50 /1:100
- General drawing of switch section – scale 1:20
- General drawing of crossing section – scale 1:20

The drawings shall include:

- all measurements necessary for assembly of the switch.
- part list of turnout steel parts.
- The drawings shall show the turnout "as installed", i.e. any curvature must be shown.

After approval the supplier shall deliver all drawings in dwg (autocad) and pdf. The supplier has an obligation to supply files that are compatible with the version of Autocad currently used by FTIA.

FTIA must be assigned all rights to the drawings.

16.3 Parts lists

- The supplier shall prepare a parts list for each switch type.
- For each S&C type, the supplier shall deliver a detailed description with material properties of all elastic layers in the fastenings and under sleeper pads.

16.4 Manufacturing drawings

Details of each individual turnout piece and component except conventional bolts, nuts, washers and similar standard components shall be illustrated on a manufacturing drawing. The manufacturing drawing shall include machining profiles, drillings, heat treated sections, welds and dimensions with pertinent tolerances.

The customer shall have the right to inspect manufacturing drawings. The supplier shall deliver manufacturing drawings specified by the customer as pdf – drawings for inspection.

17 GUARANTEE

Rail materials shall be guaranteed for five years ending in the end of the fifth calendar year following the year of manufacture in accordance with the UIC leaflet 860-R.

Switches, crossings, check rail units and concrete bearers shall be guaranteed for five years ending in the end of the fifth calendar following the year of manufacture.

Other turnout components as well as assembly work shall be guaranteed for three years ending in the end of the third calendar year following the year of manufacture.

The guarantee shall cover any failure resulting from manufacturing or material defect or improper assembly work.

The supplier shall replace the failed turnout steel part or component without a charge and delay.

18 OTHER REQUIREMENTS

The supplier shall specify in the tender sub-suppliers of rails, AMS castings, baseplates and fastenings (tensions clips and clamps, spring clips). If the supplier uses sub-suppliers also for manufacturing or assembling turnout steel parts, they shall also be specified in the tender. Any other sub-suppliers shall not be used without the permission of the customer.

The customer or an authorized representative of the customer shall have the right to carry out acceptance inspection of turnouts, turnout panels or turnout parts on the manufacturing site of the supplier or his sub-supplier. The supplier shall provide personnel, tools and instruments requested by the customer or his authorized representative for the acceptance inspection without charge.

REFERENCES

SFS-EN 10025-1, Hot rolled products of structural steels, Part 1: General technical delivery conditions, 21st December 2004.

SFS-EN 10025-2, Hot rolled products of structural steels, Part 2: Technical delivery conditions for non-alloy structural steels, 21st December 2004.

SFS-EN 10088-3, Stainless Steels, Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes, 28th November 2005.

SFS-EN 13146-1, Track. Test methods for fastening systems. Part 1: Determination of longitudinal rail restraint, 3rd September 2012.

SFS-EN 13146-2, Track. Test methods for fastening systems. Part 2: Determination of torsional resistance, 3rd September 2012.

SFS-EN 13146-3, Track. Test methods for fastening systems. Part 3: Determination of attenuation of impact loads, 3rd September 2012.

EN 13146-4, Track. Test methods for fastening systems. Part 4: Effect of repeated loading, 3rd September 2012.

SFS-EN 13146-5, Track. Test methods for fastening systems. Part 5: Determination of electrical resistance, 3rd September 2012.

SFS-EN 13146-6, Track. Test methods for fastening systems. Part 6: Effect of severe environmental conditions, 3rd September 2012.

SFS-EN 13146-7, Track. Test methods for fastening systems. Part 7: Determination of clamping force, 3rd September 2012.

EN 13146-8, Track. Test methods for fastening systems. Part 8: In service testing, 3rd September 2012.

SFS-EN 13146-9 + A1, Track. Test methods for fastening systems. Part 9: Determination of stiffness, 21st November 2011.

SFS-EN 13230-1, Concrete sleepers and bearers, Part 1: General requirements, 12th October 2012.

SFS-EN 13230-2, Concrete sleepers and bearers, Part 2: Prestressed monobloc sleepers, 12th October 2009.

SFS-EN 13232-1, Switches and crossings, Part 1: Definitions, 21st November 2011.

SFS-EN 13232-2, Switches and crossings, Part 2: Requirements for geometric design, 21st November 2011.

SFS-EN 13232-3, Switches and crossings, Part 3: Requirements for wheel/rail interaction, 21st November 2011.

SFS-EN 13232-4, Switches and crossings, Part 4: Actuation, locking and detection, 21st November 2011.

SFS-EN 13232-5, Switches and crossings, Part 5: Switches, 21st November 2011.

EN 13232-6, Switches and crossings, Part 6: Fixed common and obtuse crossings, 21st November 2011.

SFS-EN 13232-7, Switches and crossings, Part 7: Crossings with movable parts, 21st November 2011.

SFS-EN 13481-1 Performance requirements for fastening systems, Part 1: Definitions, 3rd September 2012.

SFS-EN 13481-2/AC Performance requirements for fastening systems, Part 2: Fastening systems for concrete sleepers, 22nd April 2014.

SFS-EN 13481-3 Performance requirements for fastening systems, Part 3: Fastening systems for wood sleepers, 3rd September 2012.

SFS-EN 13481-7 Performance requirements for fastening systems, Part 7: Special fastening systems for switches and crossings and check rails, 3rd September 2012.

SFS-EN 13674-1, Rail, Part 1: Vignole railway rails 46 kg/m and above, 28th March 2011.

SFS-EN 13674-2, Rail, Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above, 6th September 2010.

SFS-EN 13674-3, Rail, Part 3: Check rails, 6th September 2010.

SFS-EN 1563 Founding, Spheroidal graphite cast irons, 13rd February 2012.

SFS-EN 15689, Crossing components made of cast austenitic manganese steel, 20th April, 2010.

SFS-EN 16431, Track. Hollow steel sleepers and bearers, 1st September 2014.

SFS-EN ISO 6506-1, Metallic materials. Brinell hardness test, Part 1: Test method, 18th April, 2006.

SFS-EN ISO 9001/AC, Quality management system (ISO 9001:2008/Cor 1:2009), 12th October, 2009.

RHK 2446/731/2006, Technical specifications for 54E1 and 60E1 turnouts.

SFS 5449, Concrete, Preservation, Frost salt resistance, 21st March 1988 (only in Finnish).

UIC 713-R, Design of monobloc concrete sleepers, 1st edition, November 2004.

UIC 860-R, Technical specification for the supply of rails, 9th edition, January 2008.

UIC 864-O, Part 1: Technical specification for the supply of sleeper screws, 3rd edition, 1st January 1982.

UIC 864-O, Part 3: Technical specification for the supply of spring steel washers, 2nd edition, 1st January 1982.

UIC 864-O, Part 5: Technical specification for the supply of rail seat pads, 4th edition, 1st January 1986.

APPENDIX 1: DEFINITIONS

The definitions defined in the standard EN 13232 (all parts) are used when possible. The particular terms used throughout these technical specifications are listed as follows:

54E1 turnout is a turnout, which is compatible with the 54E1 rail track.

60E1 turnout is a turnout, which is compatible with the 60E1 rail track.

ADL devices refer to actuation, detection and locking devices.

AMS is the shortening of austenitic manganese steel.

Assembled crossing (also called as built-up or fabricated crossing) is made of pieces assembled together mechanically.

Assembly hole refers to drillings of turnout steel parts or pieces required for assembling the turnout steel part.

Check rail unit is an entity consisting of one check rail, one outside rail, check rail supports, and their mutual fastenings.

Customer is the purchaser of turnouts, turnout panels or turnout parts. Primarily, the customer is Finnish Transport Infrastructure Agency.

Gauge reference plane is 14 ± 1 mm below the running plane, if not otherwise specified.

Manufacturing drawing is a detailed drawing used for manufacture of an individual component or item. The manufacturing drawing shall include dimensions with pertinent tolerances as well as machining and bending details, drillings, welds, heat treated sections and similar details of the component.

Mounting hole refers to drillings of the turnout steel part required for installation of ADL devices.

Outside rail is the running rail of the check rail unit.

Semi-assembled crossing (also called semi-fabricated crossing) is made of pieces assembled together mechanically and by welding.

Short turnouts are turnouts having a turnout angle of 1:9 or steeper. Other turnouts are called **long turnouts**.

Supplier is the manufacturer of turnouts or parts of turnouts, or the assembler of turnouts or turnout panels.

Switch refers to the set of switches and the double set of switches.

Turnout is a complete track unit consisting of switches, crossings, closure rails, baseplates, bearers, supports, fastenings, fishplates, insulated joints, turnout devices and all associating fittings.

Turnout drawings refer to the approved turnout layout and assembly drawings as well as manufacturing drawings of particular turnout components. The turnout drawings are listed in Appendix 2 of these technical specifications.

Turnout panels are switch panels, crossing panels and closure panels. A turnout panel is a complete unit of a turnout including baseplates, bearers, supports, fastenings and all fittings associated with the turnout panel.

Turnout piece (or piece) refers to particular turnout components such as switch rails, crossing vees, check rails, stock rails and similar parts of the turnout.

Turnout steel part is a particular entity of a turnout such as a half-set of switches/set of switches/double set of switches, a crossing or a check rail unit completed with small fittings.

APPENDIX 2: APPROVED TURNOUT DRAWINGS

Turnout layout drawings		
Turnout layout	YV60-300-1:9	4022-165-001H
Turnout layout	YV60-500-1:11,1	4022-165-103
Turnout layout	YV60-500-1:14	4022-165-104
Turnout layout	YV60-900-1:15,5	4022-165-089E
Turnout layout	YV60-900-1:18	4022-165-079E
Turnout layout	YV60-5000/2500-1:26	4022-165-072E
Turnout layout	YV60-5000/3000-1:28	4022-165-100
Turnout layout	SRR60-2x1:9-4,8	4022-165-010
Turnout layout	YV54-200N-1:9	4022-20-100 (concrete bearers
Turnout layout	YV54-200N-1:9	4022-20-105F (wood bearers, steel parts as above)
Turnout layout	KRV54-200-1:9	4022-20-116J (concrete bearers)
Turnout layout	KV54-200N-1:9	4022-20-099 (wood bearers, steel parts as above)
Turnout layout	KV54-200N-1:9	4022-20-122 (concrete bearers)
Turnout layout	KV54-200N-1:9	4022-20-099H (wood bearers)
Turnout layout	TYV54-200-1:4,44	4022-20-052D
Turnout layout	TYV54-200-1:4,44	4022-20-031C (“Tampere design”)
Turnout layout	TYV54-225-1:6,46	4022-20-051F
Turnout layout	TYV54-225-1:6,46	402-20-059G (“Tampere design”)
Turnout layout	RR54-1:9	4022-20-024A
Turnout layout	RR54-2x1:9	4022-20-028B
Turnout layout	SRR54-2x1:9-4,8	4022-20-011E
Rail profiles		
60E1 rail, replaces UIC60 rail		EN 13674-1
54E1 rail, replaces UIC 54 rail		EN 13674-1
Switch rail profiles		
60E1A1 switch rail		EN 13674-2
60E1A5 switch rail		EN 13674-2
54E1A1 switch rail		EN 13674-2
Check rail profiles		
33C1 check rail		EN 13674-3
48C1 check rail		EN 13674-3
Crossings		
60E1 1:9 crossing		4022-165-006A
60E1 1:11,1 crossing		4022-165-106
60E1 1:14 crossing		4022-165-109

60E1 1:15,5 crossing	4022-165-007A
60E1 1:18 crossing	4022-165-008A
60E1 1:26 crossing	*under preparation*
60E1 1:28 crossing	*under preparation*
60E1 2x1:9 crossing	4022-165-058
60E1 2x1:9 obtuse crossing	4022-165-059B
60E1 1:9 crossing, long wing rails	4022-165-057
54E1 1:9 crossing	4022-40-049C
54E1 2x1:9 obtuse crossing	4022-70-080B (alternative with 4022-40-125C)
54E1 2x1:9 obtuse crossing	4022-70-125C (alternative with 4022-70-080B)
54E1 9 ° 26´30,6´´ crossing	4022-41-001G
54E1 1:9 crossing, short wing rails	4022-41-013G
54E1 1:4,44 crossing	4022-90-051B
54E1 1:4,44 crossing	4022-90-104E (“Tampere design”)
54E1 1:6,46 crossing	4022-91-009C
54E1 1:6,46 crossing	4022-91-035B (“Tampere design”)
54E1 2x1:9 crossing	4022-42-002I
54E1 2x1:9 obtuse crossing	4022-42-001G
54E1 1:9 crossing, long wing rails, right	4022-42-004C
54E1 1:9 crossing, long wing rails, left	4022-42-003D
Switches	
60E1 1:9 set of switches	4022-165-004A
60E1 1:14 set of switches	4022-165-108
60E1 1:18 set of switches	4022-165-084A
60E1 1:26 set of switches	*under preparation*
60E1 1:28 set of switches	*under preparation*
54E1 1:9 set of switches	4022-31-082
54E1 1:9, machining of heating grooves	4022-30-140D (straight switch rail)
54E1 1:9, machining of heating grooves	4022-30-141F (bent switch rail)
54E1 set of switches, KV, 2nd turnout	4022-31-084D
54E1 KRV double set of switches	4022-70-124F
54E1 KRV, machining of switch rails	4022-70-141A
54E1 TYV 1:4,44 set of switches	4022-90-134C
54E1 TYV 1:4,44 set of switches	4022-90-133D (“Tampere design”)
54E1 TYV 1:6,46 set of switches	4022-91-052C
54E1 TYV 1:6,46 set of switches	4022-91-050F (“Tampere design”)
Check rails	
60E1 check rails 1:9 RL	4022-165-034
60E1 check rails 1:9 RR	4022-165-035

60E1 SRR 2x1:9 check rails	4022-165-009A
60E1 check rails 1:11,1 RL	4022-165-107
60E1 check rails 1:11,1 RR	4022-165-107
60E1 check rails 1:14 RL	4022-165-110
60E1 check rails 1:14 RR	4022-165-110
60E1 check rails 1:15,5 RL	4022-165-011
60E1 check rails 1:15,5 RR	4022-165-012
60E1 check rails 1:18 RL	4022-165-013
60E1 check rails 1:18 RR	4022-165-014
54E1 check rails, YV	4022-~~51-027D~~ 50-038 I
54E1 check rails, KV	4022-51-027D
54E1 double check rails, KV	4022-51-014F
54E1 TYV 1:4,44 check rails	4022-90-135D
54E1 TYV 1:4,44 check rails	4022-90-105F (“Tampere design”)
54E1 TYV 1:6,46 check rails	4022-91-029G
54E1 TYV 1:6,46 check rails	4022-91-034G (“Tampere design”)
Special turnout drawings	
Installation of corner brackets	4022-1-623A
Concrete bearer	4022-161-062C
Coach screw R 170-p	4022-1-501B
Cast-in dowel	4022-1-429B
Helical spring washer FE 6	4022-1-087B
Signal plate	4022-422C-4064A

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Jakelu Kirjoita tähän

Tiedoksi Kirjoita tähän

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