

SINTEF Building and InfrastructureNorwegian member of European Organisation for Technical Approvals, EOTA,
and European Union of Agrément, UEAtc**RVK and TSS staircase connections**

are approved by SINTEF Building and Infrastructure with properties, fields of application and conditions as stated in this document

1. Holder of the approvalSB Produksjon AS
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www.sbproduksjon.no**2. Manufacturer**

SB Produksjon AS, Åndalsnes, Norway

3. Product description

RVK and TSS staircase connections consist of double, extendable, hollow rectangular steel tubes to be cast into prefabricated concrete staircase and landing elements. The smaller tube is sliding inside the other and form load carrying connections to stairwell walls, see fig. 1.

The position of the inner tube of the RVK unit is adjusted through a slot in the surface of the staircase element. A threaded insert at the end of the adjustment slot can be used as a temporary lifting device for the element.

The TSS unit is identical to the RVK unit except for the TSS unit has no opening to the upper part. The position of the inner tube is instead adjusted by two strings with different colours.

The TSS unit has a safety stop at the back of the inner tube in order to avoid overloading. The unit has a hole for a locking pin, and a control line marks the correct position of the sliding tube.

Drawings and dimensions for the RVK and TSS connections are shown in fig. 2 and 3 and table 1, 2 and 4.

The following types of the RVK unit are produced, where the numbers indicate vertical load carrying capacity in kN and the letter G indicate hot dip galvanized version:

RVK 40, RVK 40 G, RVK 100, RVK 100 G, RVK 140 and RVK 140 G.

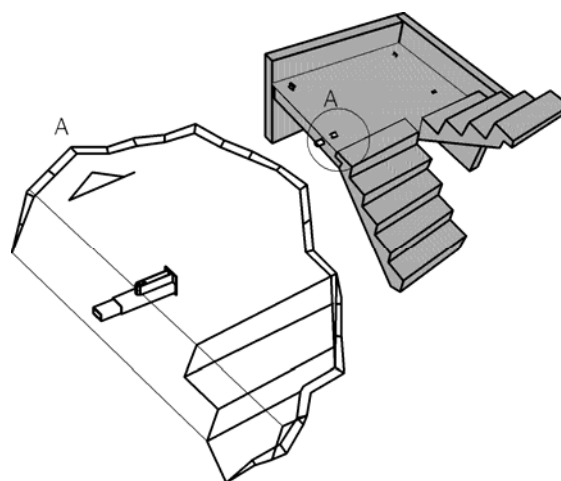


Fig. 1
Principle for RVK and TSS staircase connections. Type RVK has a slot at the upper surface the concrete element which is to be filled after installation, see fig. 2. Type TSS has no slot, but a string for adjustment, see fig. 3.

Correspondingly the following types of the TSS unit are produced: TSS 40, TSS 40 G, TSS 100 and TSS 100 G.

The additional product “Masticord bearing pads” is delivered for providing equal support load distribution and elastic support in order to reduce impact sound transmission. The pads are made of a homogeneous blend of ozone resistant rubber elastomers with a high strength random synthetic fibre cord. The bearing pads are 75 mm wide, 125 mm long and 6,5 mm thick. The hardness is 75shore.

As additional products the manufacturer also provides “Rubberbox with form work wings for RVK/TSS 40 and 100” and “Blockout box for RVK/TSS 40 og 100”. The first simplifies the filling of the recess in the stairwell walls without reducing the impact sound reduction. The second product is used to make recesses in the walls. The blockout boxes are made of rubber elastomers with a hardness of 60 shore. They are delivered with or without magnets.

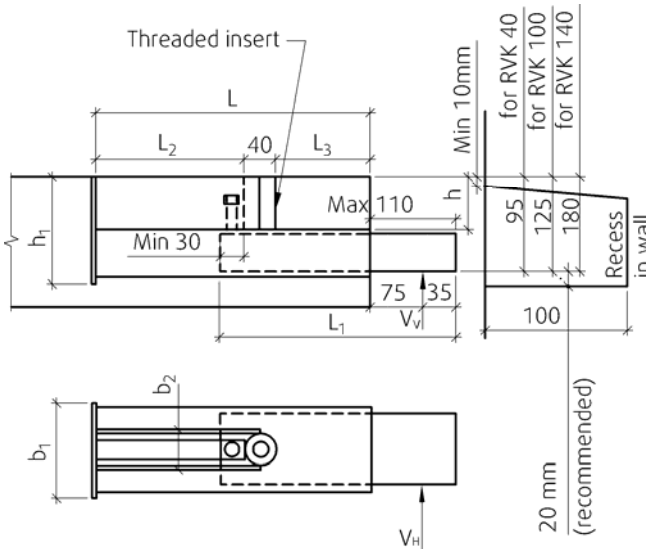


Fig. 2
Type RV. Design and main dimensions. See also table 1 and 2.

Table 1
Main dimensions for RVK in mm

RVK	L	L ₁	L ₂	L ₃	h	h ₁	b ₁	b ₂
40	303	280	160	100	50	110	90	41
100	353	300	190	120	70	140	130	51
140	403	380	160	200	70	200	130	51

Table 2
Additional dimensions for RVK

RVK	Rectangular steel tube dimensions w/h/t (mm)		Free space between tubes (mm)		Threaded insert dimension (mm)
	Outer tube	Inner tube	Vertically	Horizontally	
40	80/50/4	70/40/4	2	2	M16
100	120/60/4	100/50/6	2	12	M20
140	120/120/8	100/100/6,3	4	4	M24

Table 3
Load carrying capacity and minimum thickness of concrete landing elements for RVK. Full utilization of the capacity requires standard reinforcement design for the RVK unit.

RVK	Max. vertical capacity V _v in kN	Max. capacity across V _H in kN	Minimum landing thickness in mm		Lifting capacity in kN
			For max. capacity	To make sufficient space	
40	40	50	150	150	30
100	100	-	265	200	40
140	140	140	300	265	60

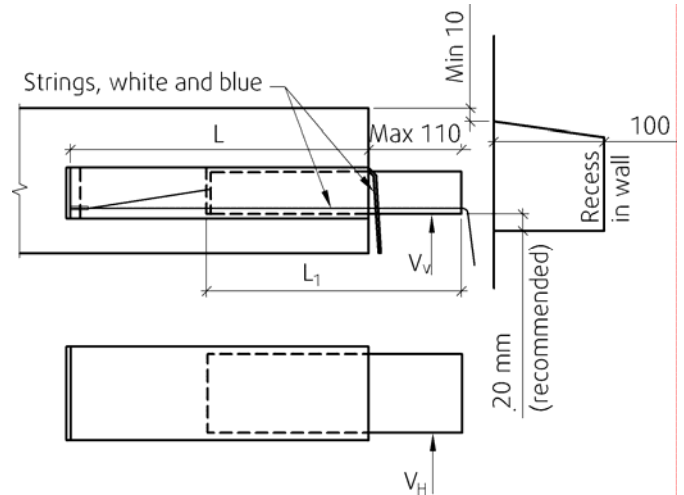


Fig. 3
Type TSS. Design and main dimensions. See also table 4.

Table 4
Dimensions for TSS in mm

TSS	L	L ₁	Rectangular steel tube dimensions w/h/t (mm)		Free space between tubes (mm)	
			Outer tube	Inner tube	Outer tube	Inner tube
40	303	280	80/50/4	70/40/4	2	2
100	353	300	120/60/4	100/50/6	2	12

Table 5
Load carrying capacity and minimum thickness of concrete landing elements for TSS. Full utilization of the capacity requires standard reinforcement design for the TSS unit.

TSS	Max. vertical capacity V _v in kN	Max. capacity across V _H in kN	Minimum landing thickness in mm	
			For max. capacity	To make sufficient space
40	40	50	150	150
100	100	-	265	200

4. Field of application

The RVK- and TSS staircase connections are used to connect precast concrete stairway and landing elements to the stairwell walls. The connections may also be used to support balcony and floor slab elements. The TSS unit is specially designed to connect precast stair- and landing elements where the final surface finish of the elements are made in the factory, for example terrazzo.

5. Properties

5.1 Load carrying capacity

Table 3 and 5 show the load carrying capacity and minimum thickness of the landings for full utilization of the capacity for type RVK and TSS respectively. Full utilization of the capacity also requires standard concrete reinforcement design for the RVK- and TSS units.

The given load carrying capacities across are also valid for vertical load when the installed units are turned 90 degrees.

The maximum load on “Masticord bearing pads” is depending of possible non perpendicular load, and varies between 225 kN (0,6 degrees) og 13 kN (4,5 degrees).

5.2 Properties related to fire

Fire resistance of 30 minutes may be achieved for RVK and TSS staircase connections by filling the joint between the stairway components and the wall with mortar. However, filling with mortar reduces strongly the possibility to achieve low impact sound transmission and thermal movement. An alternative is to fill the joint between the stairway components and the wall with mineral wool around the RVK/TSS unit. The filling shall be sealed off with an elastic sealant to prevent the mineral wool filling from falling out. The filling shall cover the full element thickness and with equivalent width.

Fire insulation made of rockwool may be provided as standard elements with 25 mm or 40 mm thickness for RVK and TSS units 40 and 100.

5.3 Sound insulation

The impact sound insulation achieved by elastic support is direct proportional to the stiffness of the underlay. The more elastic underlay, the better sound reduction. An impact sound reduction of approx. 25 dB is obtained by using a recommended design criteria equivalent to 1 mm compression from the dead load of the staircase.

5.4 Environmental declaration and effect on indoor environment

No special environmental declaration has been worked out for RVK and TSS connections. The products do not contain any chemical substances listed on the Norwegian environmental authorities' observation list of compounds hazardous to human health or the environment, and are not regarded as emitting any particles, gases or radiation that have a perceptible impact on the indoor climate or tha have any significant impact on health.

5.5 Durability

Hot dip galvanized products shall have a minimum zink thickness of 0,08 mm according to ISO 2081 / NS 1978. Black steel products are normally acceptable in dry stairways. Galvanized versions are recommended for staircases stored outdoor for some time, for staircases that may be exposed to salt water and chlorides (for example parking decks), and for outdoor staircases and staircases exposed to corrosion.

5.6 Waste treatment/recycling

Steel parts and concrete elements may be recycled under given circumstances. Alternatively they may be delivered to a public waste deposit site at the end of the working life.

6. Special conditions for use and installation

6.1 Design of load carrying capacity

Type and number of RVK or TSS-units shall be designed in accordance with structural calculations for sufficient load carrying capacity in each case. The position of the units in stairs- and landings elements and in the recess in the stairwell walls shall be accurately designed and specified in construction drawings.

The concrete structures shall be reinforced especially for the single loads from the staircase connections, e.g. transverse reinforcement in the upper edge for moment along the edge or in the lower part when the unit is placed near a corner. Structural design for upwards forces at the supports may be required in particular cases, and in such cases the support must also be designed to handle such load.

To ensure a good load distribution and supporting forces when using four RVK- or TSS units per element the staircase elements should be supported on a relatively thick and soft rubber pad. This provides also a good impact sound insulation.

Horizontal forces are normally taken care of by friction. In special cases the horizontal load distribution may be attended to by casted, adjustable bolts with rubber dampers at the end, which are pressed against the stairwell walls.

Since a connection does not normally transfer tensile forces between the RVK unit and the wall, the concrete element must be kept in position with connections in at least three sides. Alternatively a steel plate may be embedded in the bottom of the recess in the wall, and a welded connection can be established. This is normally not recommended because of the poor sound insulation performance.

6.2 Joint width

Staircase and landings must be sufficiently separated from the walls. The joint width shall be 20 mm ± 10 mm for the RVK unit, and 30 mm ± 10 mm for the TSS unit. The joint width must not exceed these values if the load carrying capacities indicated in section 5 are used.

6.3 Sound insulation design

Elastic supports with rubber underlay are normally designed on the basis of the compression from the dead load of the staircase and landings. If the compression exceeds 2 mm the supports are so soft that small movements may be noticed when walking. With a compression less than 0,2 mm there is a risk that the sound reduction only becomes a few dB. The recommended compression level is in the range 1,0 mm – 2,0 mm.

To achieve the best sound reduction it is important that there the stairway is not connected to walls at any places. An open joint that can be inspected is the best.

6.4 Recesses in stairwell walls

The recess elevation in the walls must be measured accurately to minimize the need for vertical adjustments. Smaller adjustment may be done by using shims.

Using the additional products “Rubberbox with form work wings” and “Blockout box” for RVK/TSS 40 og 100 simplifies the filling of joints and the recesses in the walls, and secure support for upwards / sideways forces without reducing the impact sound reduction.

6.5 Installation

Staircase and landing elements are lifted into the shaft either by strapping (TSS) or by a lifting bolt attached to a threaded insert in the unit (RVK).

During erection the inner tube is retracted into the unit. When the precast element is in correct position the inner tube of the RVK is pushed out through the open slot at the upper part of the element.

The inner tube of the TSS unit is pushed out by pulling the extension string. A red and white control line will mark the correct position. If needed, e.g. at mistakes during erection, the inner tube can be retracted by the returning string. A safety stop at the back of the inner tube ensures overextension.. A safety pin will prevent the inner tube from getting out of position.

Both the installation slot in the RVK units and the recess in the shaft wall are normally filled with mortar after erection. It is recommended to put some mineral wool around the steel unit in the joint before filling the grout into the recess.

The joint between the stairway components and the wall shall normally not be filled, because this causes higher impact sound transmission. Filling the joint may be done when the staircase elements are an active part of the stabilisation of the building, in order to prevent dirt to gather in the joint. An alternative to prevent dirt in the joints is to use an elastic sealant with a backing gasket at the top.

The installation of the staircase connections, including concrete reinforcement and positioning, shall in general be carried out in accordance with the manufacturer’s installation guide. All installation is done inside the stairwell, without perforating holes in the walls.

7. Factory production control

The production of RVK and TSS staircase connections is subject to supervisory factory production control according to contract between SINTEF Building and Infrastructure and SB Produksjon AS as part of the Technical Approval.

8. Basis for the approval

The approval is based on verification of properties that are documented in the following reports:

- Spenncon AS. Report on load tests on RVK 40 – units. Hønefoss, Juni 1998.
- Spenncon AS. Report on load tests on RVK 100 – units. Hønefoss, April 1998.
- FSD Fire Safety Design. Preliminär brandteknisk bedömning avseende TSS-trappförbindelser. Malmö. 24.02.2005
- FSD Fire Safety Design. Preliminär brandteknisk bedömning avseende TSS-trappförbindelser. Malmö. 08.04.2005
- FSD Fire Safety Design. Dokument 4S: Preliminär brandteknisk bedömning avseende TSS-trappförbindelser. Malmö. Revidering A. 24.10.2005
- FSD Fire Safety Design. Dokument 5S: Preliminär brandteknisk bedömning avseende TSS-trappförbindelser. Malmö. 18.11.2005
- FSD Fire Safety Design. Dokument 6S: Brandteknisk bedömning avseende TSS-trappförbindelser. Malmö. 23.11.2005

9. Marking

RVK and TSS units shall be packed in boxes marked with the name of the manufacturer, product type and a production code or similar to identify the time of production. The approval mark for SINTEF Technical Approval TG 2501 may also be used.



Approval mark

10. Liability

The holder/manufacturer has sole product responsibility according to existing law. Claims resulting from the use of the product cannot be brought against SINTEF beyond the provisions of Norwegian Standard NS 8402.

11. Technical management

Project manager for this approval is Sigurd Hveem, SINTEF Building and Infrastructure, dep. Materials and Structures, Oslo.

for SINTEF Building and Infrastructure

Trond Ø. Ramstad
Approval manager