

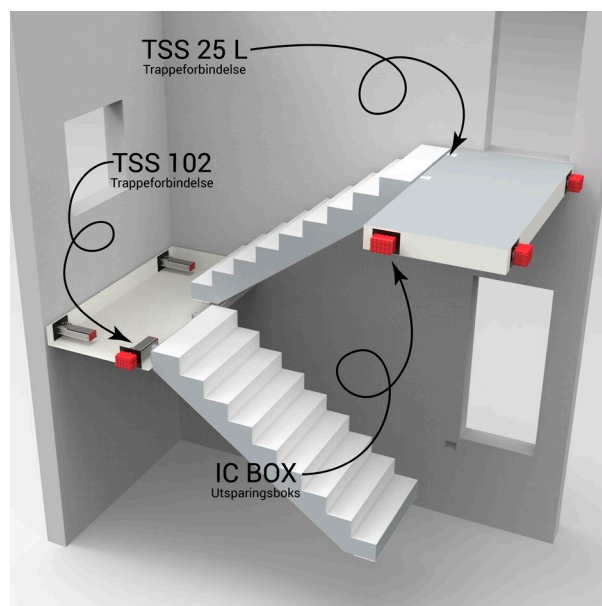
MEMO 31  
GUIDANCE RVK AND TSS

Dato: 04.02.2022  
Siste rev.: 06.10.2023  
Dok. nr.: K3-10/9

Sign.: ELS  
Sign.: ELS  
Kontr.: SB

## GUIDANCE TO IC STAIR CONNECTORS

The easiest way for fixing stair and landings.

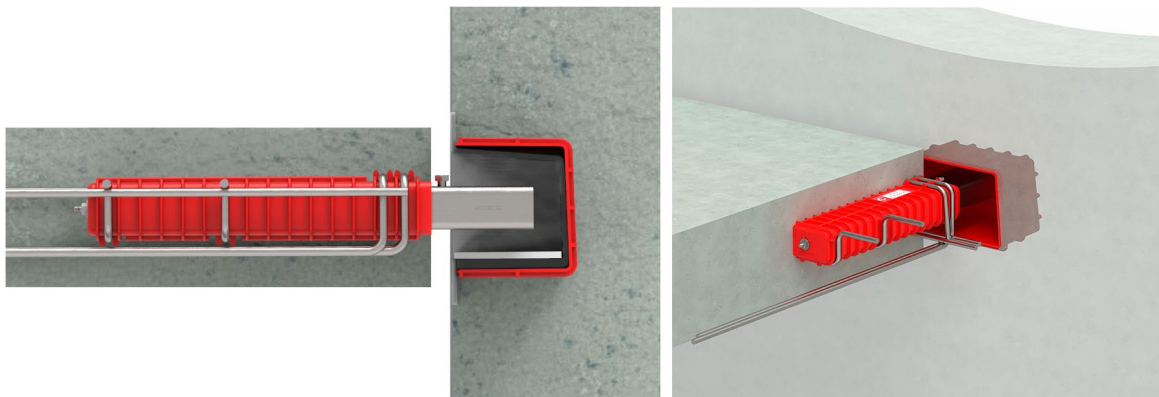


- Thinner slabs (20-25% reduce concert consumption)
- ETA tested and approved solution
- Fast installation
  - no shimming
- Good tolerances
- Fire protection
- Safe to install
- Rapid provision of access stairs

**Demands for the stairs?**

- Surface, terasso see below
- Sound transmission see memo 34
- Fire protection, see page 9 and memo 45

**TSS or RVK**



**TSS**


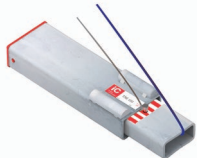
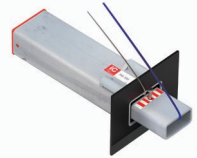
Inner sleeve pulled out with a wire (no visual marks in the surface of the slab).





**RVK**

Inner sleeve adjusted through a slot in the surface of the staircase (the slot has to be grouted).


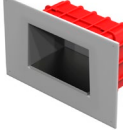
**TSS for landing/wall.**

Article no	Description	Capacity	
TSS 60 p	Slim design allows thinner slabs all the way down to $\geq 120$ mm (full capacity 170 mm). Outer sleeve made of recycled HDPE.	57 kN	
TSS 101	Connector capacity up to 80 kN in a minimum 200 mm thick landing increasing to 100 kN for 265 mm thick landing.	100 kN	
TSS 102	Incorporates sound reducing rubber composite. Connector capacity up to 80 kN in a minimum 200 mm thick landing increasing to 100 kN for 265 mm thick landing	100 kN	




**RVK for landing/wall.**

Article no	Description	Capacity	
RVK 60 p	Slim design enables thinner landings and stair thicknesses $\geq 120$ mm (full capacity 170mm). Capacity up to 57kN. Recycled HDPE outer.	57 kN	
RVK 101	Standard connector capacity up to 80 kN in a minimum 200 mm thick landing, increasing to 100 kN for 265 mm thick landing.	100 kN	

**IC Box .**

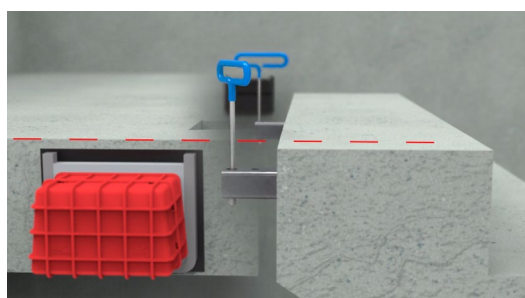
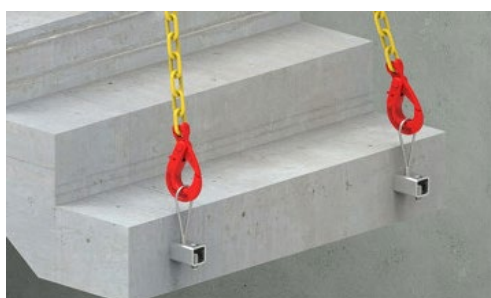
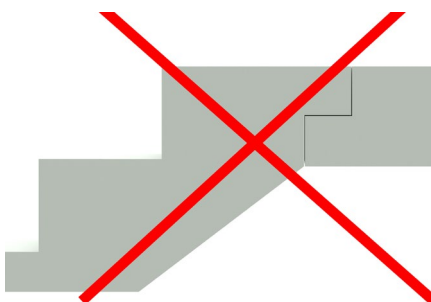
Article no	Description	Capacity	Bilde
IC Box	Recess box, out-block. Made of 100% recycled HDPE		
IC Box SRU	Recess box with sound reduction, Recycled HDPE.		

**Connections for stair flight to landing.**

Article no	Description	Capacity	
TSS 20 FA	Stairflight to landing connector with adjustment	20 kN	
TSS 25 L	Stair flight to landing connector with adjustment and lifting device.	25 kN	
TSS 60 p	Slim design allows thinner slabs all the way down to $\geq 120$ mm (full capacity 170 mm). Outer sleeve made of recycled HDPE	57 kN	

**TSS 25 L**

- Lift of element under production.
- Treads for wire loop lift during installation at site
- Stepless height adjustment during installation
- Saves stair shelves
- Efficient installation on construction site, avoids shimming
- No need for local reinforcement



## TSS 25 L

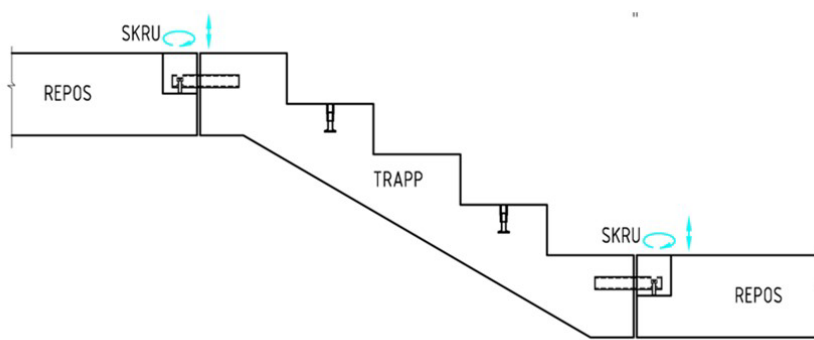
For more Information see: **Memo 65A**



## TSS 20 FA

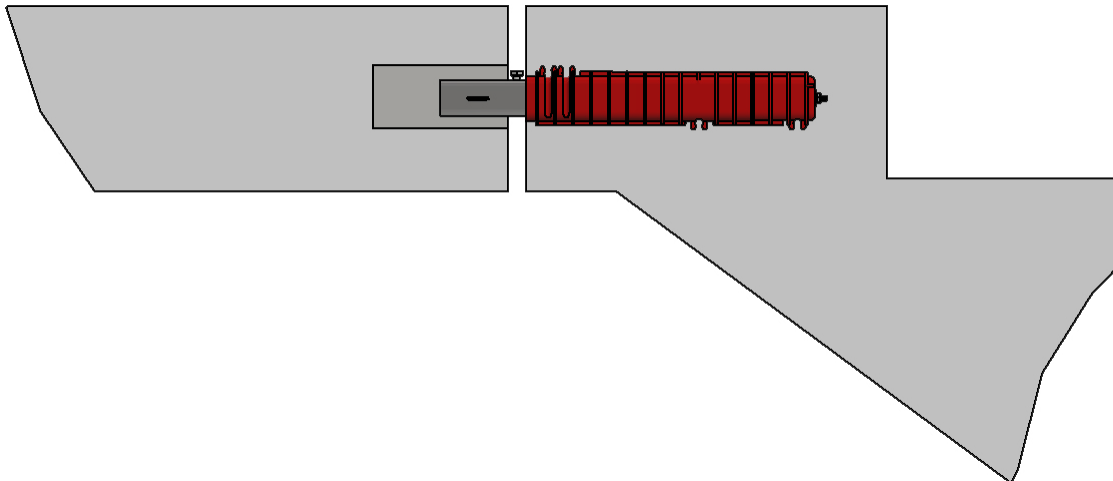
- Stepless height adjustment
- Saves stair shelves
- Efficient installation on construction site, avoids shimming

For more information about TSS 20 FA see: **Memo 65A**



**TSS 60 P**


Can be used as connection between stair flight to landing.



## Which model and capacity to choose?

Our bespoke calculation tool helps you to find correct model.  
<https://www.invisibleconnections.no/wp-content/plugins/download-attachments/includes/download.php?id=7626>

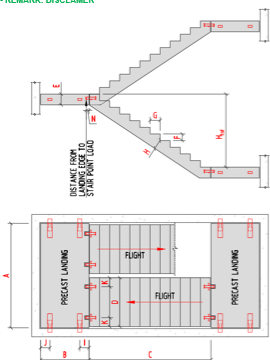
**Tip!** TSS/RVK should be located as close to the front edge as possible to avoid uplift/negative forces in the rear end of the element.

Client			
Project			
Location			
Sign	Date:	-	

Version 1.4 - Release date: 04.02.2022  
Page 1 of 1

**INPUT:**

**-REMARK: DISCLAIMER**



PLEASE NOTE: ALWAYS USE TO STAIR POINT LOAD

PRECAST LANDING

FLIGHT

PRECAST LANDING

**GEOMETRY OF LANDING AND FLIGHT**

Landing length (A)	3,50	[m]
Landing width (B)	1,40	[m]
Flight length (C)	3,00	[m]
Flight width (D)	1,20	[m]
Landing thickness (E)	265	[mm]
Rise (F)	163	[mm]
Gearing (G)	250	[mm]
Wriston (H)	200	[mm]
Tread (I) (shall equal C/G)	12	[-]
Height stair, H <sub>stair</sub> (calculated)	1,36	[m]

**LANDING CONNECTIONS (TYPE TO BE SELECTED)**

Dist. to front insert (I)	180	[mm]
Dist. to rear insert (J)	180	[mm]

**FLIGHT CONNECTIONS (TYPE TO BE SELECTED)**

Edge distance (K)	220	[mm]
Dist. from landing edge to stair point load (N)	70	[mm]

TSS 20 FA: H=55mm (nominal value)  
TSS 25 L : H=70mm (nominal value)

**MATERIAL**

Concrete density: 25,00 [kN/m<sup>3</sup>]  
**NOTE: Minimum concrete grade: C35/45**

**VERTICAL LOADS ON FLIGHT AND LANDING**

*Dead loads:*

Finish on landing	0,00	[kN/m <sup>2</sup> ]
Finish on flight	0,00	[kN/m <sup>2</sup> ]

*Live loads:*

Landing	4,00	[kN/m <sup>2</sup> ]
Flight	4,00	[kN/m <sup>2</sup> ]

**ULS - LOAD FACTORS**

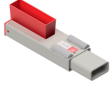
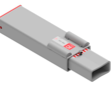
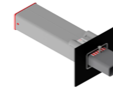
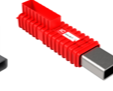



Dead load factor ULS	1,20	[-]
Live load factor ULS	1,50	[-]

**SUMMARY OF RESULTS:**


MAXIMUM ULS LOAD ON INSERTS IN LANDING	MAXIMUM ULS LOAD ON INSERTS IN FLIGHT
Vertical load on each of the two rear inserts: 17,03 kN	Vertical load on each of the four inserts: 14,05 kN
Vertical load on each of the two front inserts: 49,14 kN	(Assuming 55% of total flight load on each support)
Temporary: Not vertical load on each of the two rear inserts when the load only on flight: 5,14 kN (OK - up lift cannot occur)	

Performance of TSS/RVK units, and recommended reinforcement pattern, see Memo 54 and 55

Performance of TSS 20 FA/TSS 25 L units, and recommended reinforcement pattern, see Memo 65/65A

**CALCULATIONS: STATIC LOAD ON FLIGHT AND LANDING**



5,14 kN (OK - up lift cannot occur)

RVK 60 P

TSS 60 P

TSS 25 L

TSS 20 FA

Performance of TSS 20 FA/TSS 25 L units, and recommended reinforcement pattern, see Memo 65/65A

**Flight [mm]**

Calculated length	3581 mm
Chord length	3581 mm
Total weight of water + load weight of stairs	24,63 kN
Total weight of stairs	24,63 kN
Total weight of flight	24,63 kN
Weight on flight	12,31 kN
Weight on landing	12,31 kN
Center of gravity of flight	12,31 kN

Vertical load on each of the four inserts: 14,05 kN

Vertical load on each of the two rear inserts: 17,03 kN

Vertical load on each of the two front inserts: 49,14 kN

Temporary: Not vertical load on each of the two rear inserts when the load only on flight: 5,14 kN

LOAD ON LANDING CONNECTIONS FROM LANDING ALONG BY MOMENT ABOUT REAR

Front insert	65,300 kN
Rear insert	65,300 kN

LOAD ON FLIGHT CONNECTIONS FROM FLIGHT ALONG BY MOMENT ABOUT REAR

Front insert	14,05 kN
Rear insert	14,05 kN

Vertical load on each of the four inserts: 14,05 kN

Vertical load on each of the two rear inserts: 17,03 kN

Vertical load on each of the two front inserts: 49,14 kN

Temporary: Not vertical load on each of the two rear inserts when the load only on flight: 5,14 kN

## Reinforcement of stair connectors TSS/RVK landing-wall

Standardized local reinforcement for TSS/RVK, see **Memo 55**

See also film «Stairs engineer» at [IC akademi](http://IC.akademi).

**MEMO 55**

**ANBEFALT MAKSIMAL BRUDDGRENSELAST ( $F_{v,ed}$ )**

PRODUKT	RVK 60 P	TSS 60 P	TSS 101 RVK 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
KAPASITET STÅLENHET $F_{v,ed}$ [kN]					
Lastkategori a)	60	60	100	100	100
Lastkategori b)	60	60	94	94	90

**ANBEFALT MAKSIMAL BRUDDGRENSELAST  $F_{v,ed}$  FOR LASTKATEGORI a) OG b) FORUTSETTER:**

- Forankringsarmring iht. Figur 1 og Tabell 1 (eller Tabell 2).
- Minimum hjørneavstand iht. Figur 1 og Tabell 1.
- Overdekning (sa) mot underkant dekke for bøyene P1 og P2 er ikke større enn angitt. Ved større endring i overdekning, minimum reduseres kapasiteten tilsvarende et tynnere dekke som korrelerer med armering i dekket er tilstrekkelig til å kvote lastene som påføres.
- Betongkvalitet: Minimum C35/45.
- Armering i dekket er basert på FEM analyser. FEM analysene er utført for lastkategori a), med RVK/TSS 60 P og RVK/TSS 101 enheter i dekket av varierende tykkelse. For lastkategori b) er bruddgrenselasten bestemt ved å kvote at reaksjonskraft  $R_{1,2}$  skal være mindre, eller bli beregnet reaksjonskraft  $R_{1,2}$ .  $R_{1,2}$  er reaksjonskraft i dekket for hhv. lastkategori a) og b), beregnet iht. formlene gitt i Memo 54.

**ANBEFALT MAKSIMAL BRUDDGRENSELAST  $F_{v,ed}$  ER BASERT PÅ FEM ANALYSER. FEM ANALYSENE ER UTFØRT FOR LASTKATEGORI a), MED RVK/TSS 60 P OG RVK/TSS 101 ENHETER I DEKKET AV VARERENDE TYKKELSE. FOR LASTKATEGORI b) ER BRUDDGRENSELASTEN BESTEMT VED Å KVOTE AT REAKSJONSKRAFT  $R_{1,2}$  SKAL VÆRE MINNRE, ELLER BLI BEREKNET REAKSJONSKRAFT  $R_{1,2}$ .  $R_{1,2}$  ER REAKSJONSKRAFT I DEKKET FOR HJV. LASTKATEGORI a) OG b), BEREKNET IHT. FORMLENE GITT I MEMO 54.**

PRODUKT	RVK 60 P	TSS 60 P	TSS 101 RVK 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
Lastkategori a) - uten samtidig virkende horisontalkraft jgga. Sikker, $H_{u,0.2F_{v,ed}}$					
Anbefalt maksimal bruddgrenselast $F_{v,ed}$ [kN]					
Dekke tykkelse [mm]					
120	34	34	-	96	96 <sup>1)</sup>
150	46	46	-	100	100
170	-	57	-	100	100
200	-	57	-	100	100
265	-	-	-	100	100
Lastkategori b) - med samtidig virkende horisontalkraft jgga. Sikker, $H_{u,0.2F_{v,ed}}$					
Anbefalt maksimal bruddgrenselast $F_{v,ed}$ [kN]					
Dekke tykkelse [mm]					
120	33	33	-	90	90 <sup>1)</sup>
150	44	44	-	94	94
170	-	55	-	94	94
200	-	55	-	94	94
265	-	-	-	94	90

1) TSS102 kan i enkelte tilfeller monteres i dekket med tykkelse  $H_{u,0.2F_{v,ed}}$  dersom man har ressurser for å betongoverdekket slik at stifter har enheten plassert i dekket. Dette vil redusere høyden  $H_{u,0.2F_{v,ed}}$  til noe under minimumsverdi gitt i Tabell 1.

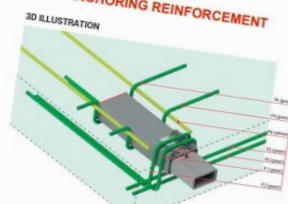
**Tabell 3: Anbefalt maksimal bruddgrenselast  $F_{v,ed}$  i lastkategori a) og b)**

Side 5 av 6 [www.invisibleconnections.no](http://www.invisibleconnections.no)

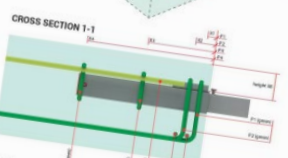
**MEMO 55**

**LAYOUT OF ANCHORING REINFORCEMENT**

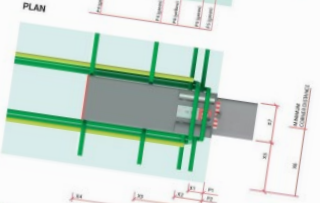
**3D ILLUSTRATION**



**CROSS SECTION 1-1**

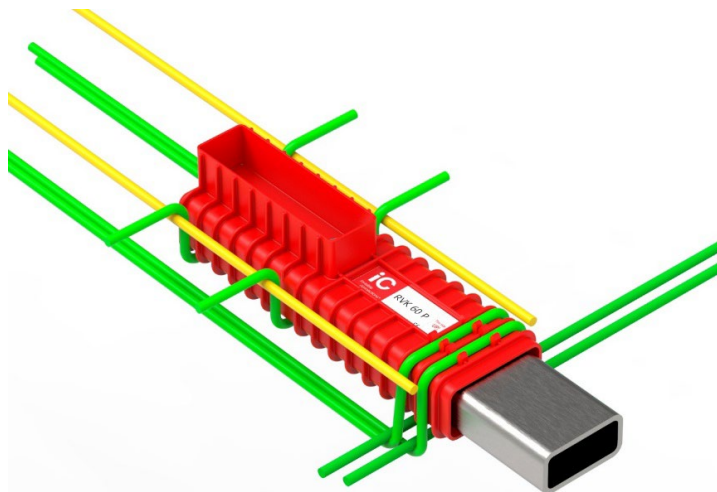


**PLAN**



**Figure 1: Layout of anchoring reinforcement.**

Page 2 of 5 [www.invisibleconnections.no](http://www.invisibleconnections.no)



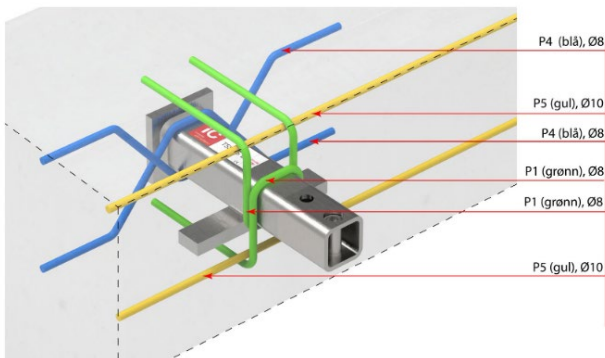


**Reinforcement of connector star flight-landing**

TSS 25 L, see Memo 65A

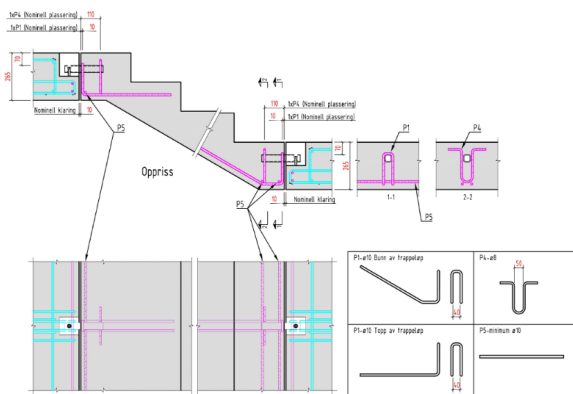


TSS25L no need for additional local reinforcement, the backplate and flat steel is enough  
 Vertical load 25 kN,  
 Lifting capacity 8 kN



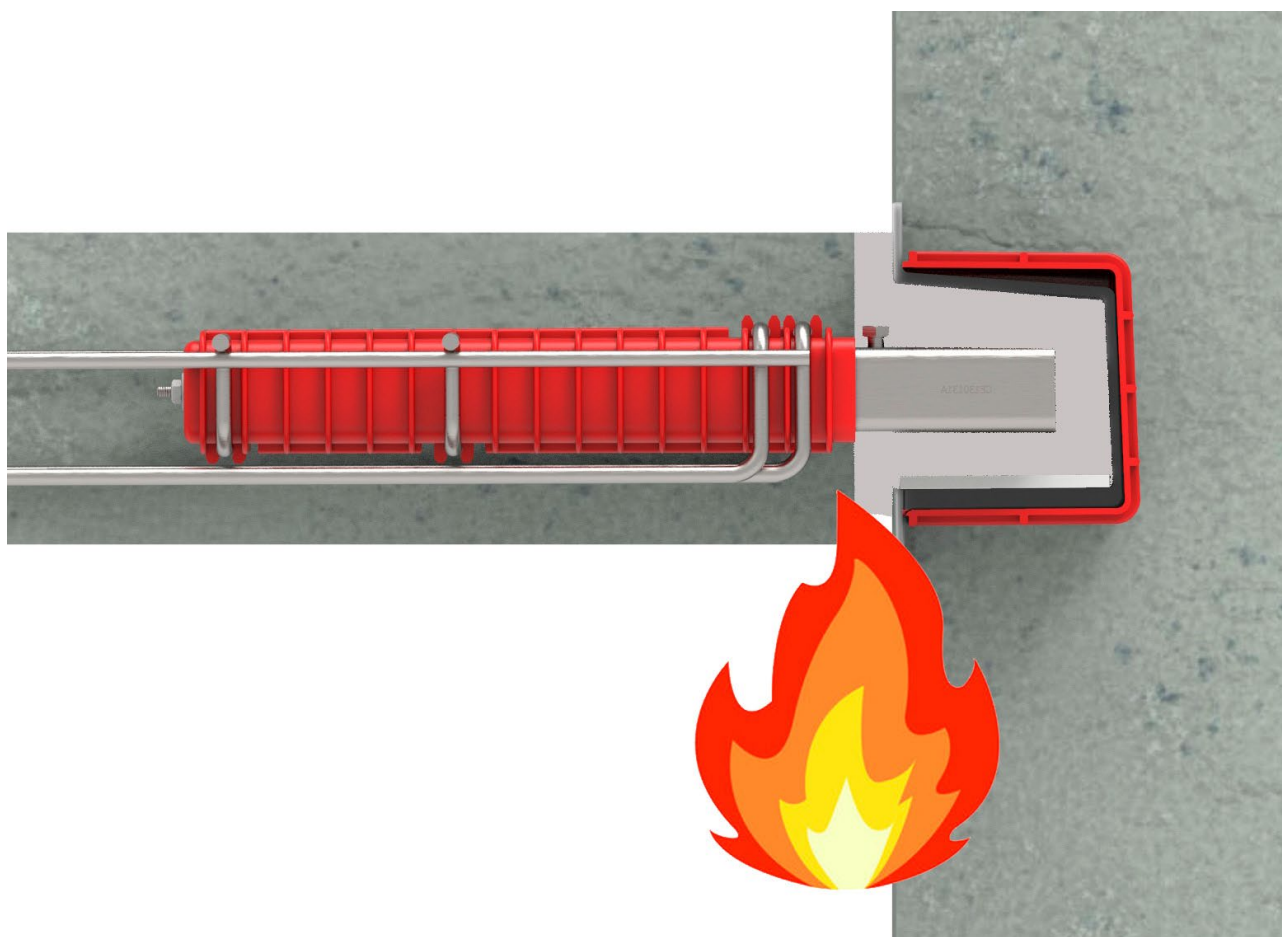
Picture illustrate additional reinforcement for **12 kN** lifting capacity.

TSS 20 FA, see **Memo 65**



## Fire protection

See **Memo 45** and IC Academy for correct installation.



Fire protection is taken care of in a good way when using IC star connectors. After installation the TSS/RVK will be completely covered with concrete.

Fire rating in accordance with Eurocode

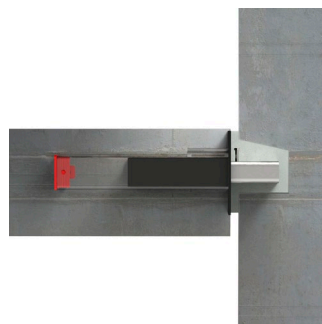
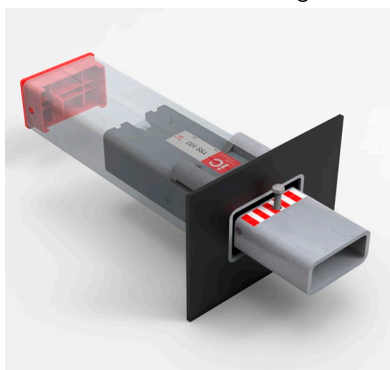
Required fire resistance	R30	R60
Minimum cover «C» mm	25	40

For more information se memo 45 **Fire protection**

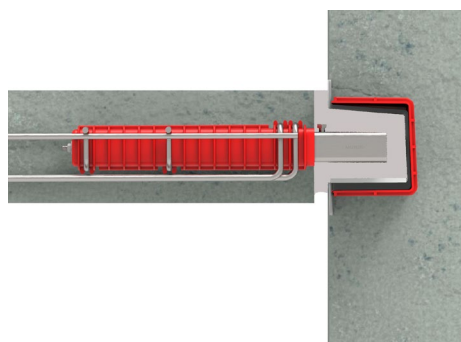
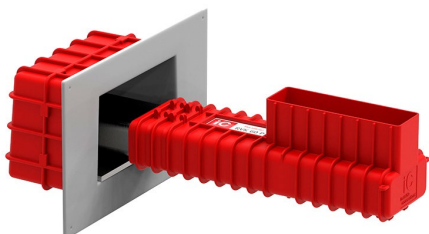
**Impact sound insulation**

IC deliver several solutions for impact sound insulation, see **Memo 34** and IC Academy film stair engineer.

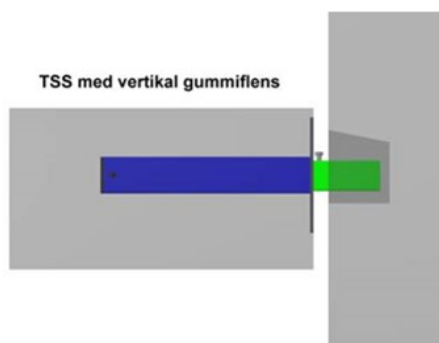
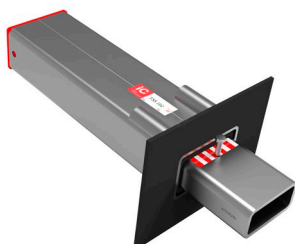
**TSS102** with vertical rubber flange, reduce sound impact by 22-28 dB



**TSS/RVK** with IC-Box SRU  
Reduce impact sound by 8-23 dB



**TSS/RVK** with vertical rubber flange,  
Reduce sound impact by 10-12 dB



## Slab thickness and edge distances

See **Memo 55**

PRODUCT SERIES	RVK 60 P	TSS 60 P	TSS 101 TSS 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G	
<i>Load category a) - without simultaneously acting horizontal design support reaction. <math>H_{Ed}</math></i>						
<b>Recommended maximum ULS load <math>F_{v,Ed}</math> [kN]</b>						
Slab thickness [mm]	120	34	34	-	-	
	150	46	46	-	-	
	170	57	57	96	96	
	200			100	100	96 <sup>1)</sup>
	265			100	100	100
<b>Minimum edge distance:</b>						
$x_5$ [mm]:	120	120	130	130	130	
$x_6$ [mm]:	160	160	180	180	180	
$x_7$ [mm]:	80	80	100	100	100	

## Drawings

At our webpage click *resources* and you will find drawings for each model in the most used formats  
<https://www.invisibleconnections.no/category/tegninger/#tss-og-rvk>

## Production

See Memo 20 and 32 for production procedure.

IC Academy fil stair production

<https://www.invisibleconnections.no/category/ic-akademiet/>

## Installation

See IC Academy stair installation.

<https://www.invisibleconnections.no/category/ic-akademiet/>

## Approvals



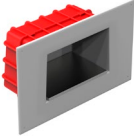
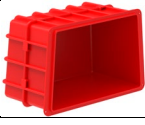

ETA

EN 1090

<https://www.invisibleconnections.no/category/godkjenning/>

## Additional products

For more info see **Memo 41**

	Article no	Description
	GF 60	Vertical rubber flange 240x190x5
	GF 100	Vertical rubber flange 240x190x5
	GF 102	Vertical rubber flange 240x190x5
	Lokk 101	Cap for sealing storage and transport RVK101/TSS101
	Lokk TSS 102	Cap for sealing storage and transport TSS 102
	IC Box 100 SRU	IC Box 100 SRU recycled HDPE with sound insulation 170x115x100
	IC Box 100	IC Box 100 SRU recycled HDPE 170x115x100
	USK 100	Out block RVK/TSS
	USK 100 M	Out block with magnet RVK/TSS

<b>REVISJON</b>	
<b>Date:</b>	<b>Description:</b>
04.02.2022	Preliminary
18.02.2022	Updated
31.03.2023	Updated pictures of IC box 100 SRU
06.10.2023	Updated fireprotection