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Authorised and notified according to Article 10 of the Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products

MEMBER OF EOTA

European Technical Approval ETA-10/0189

Trade name:	Knapp Clip Connectors type GIGANT 120, 150 and 180, Type RICON 60/40, 80/40, 100/40, 120/40, 140/40 and 160/40, Type RICON S 60/140, 60/170, 60/200, 60/230 and 80/200, 80/230, 80/260 and 80/290, and Type Walco V60 and V80
Holder of approval:	Knapp GmbH Peter-Mitterhofer-Str. 4 A-3300 Amstetten Tel.: +43 (0) 7472 61282-0 Telefax: +43 (0) 7472 64201 Internet: www.knapp-verbinder.com
Generic type and use of construction product:	Three-dimensional nailing plate (concealed beam hangers)
Valid from: to:	2010-07-05 2015-07-05
Manufacturing plant:	Knapp GmbH Peter-Mitterhofer-Str. 4 A-3300 Amstetten
This European Technical Approval contains:	118 pages including 4 annexes which form an integral part of the document

I LEGAL BASIS AND GENERAL CONDITIONS

1 This European Technical Approval is issued by ETA-Danmark A/S in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1)], as amended by Council Directive 93/68/EEC of 22 July 1993[2)].

- Bekendtgørelse 559 af 27-06-1994 (afløser bekendtgørelse 480 af 25-06-1991) om ikrafttræden af EF direktiv af 21. december 1988 om indbyrdes tilnærmelse af medlemsstaternes love og administrative bestemmelser om byggevarer.

- Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC[3)].

- EOTA Guideline ETAG 015 *Three-dimensional nailing plates*, September 2002 edition.

2 ETA-Danmark A/S is authorized to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3 This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

4 This European Technical Approval may be withdrawn by ETA-Danmark A/S pursuant to Article 5(1) of Council Directive89/106/EEC.

5 Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of ETA-Danmark A/S. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.

6 This European Technical Approval is issued by ETA-Danmark A/S in English.
This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1) Official Journal of the European Communities N° L40, 11 Feb 1989, p 12.
2) Official Journal of the European Communities N° L220, 30 Aug 1993, p 1.
3) Official Journal of the European Communities N° L 17, 20 Jan 1994, p 34.

I SPECIAL CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

Definition of the product

Knapp Clip Connectors GIGANT, RICON, RICON S and WALCO V are two-piece (GIGANT, RICON and RICON S) or one-piece (WALCO V) non-welded, face-fixed connectors to be used in timber to timber connections as well as connections between a timber and a steel member.

The connectors are made from pre-galvanized steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa. Dimensions, hole positions and typical installations are shown in Annex A.

Intended use

The connectors are intended for use in making end-grain to side-grain connections in load bearing timber structures, as a connection between a wood based joist and a solid timber or wood based header, where requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106/EEC shall be fulfilled. They are also intended for use in making an end-grain connection between a timber joist and a steel member.

The connectors can be installed as connections between wood based members such as:

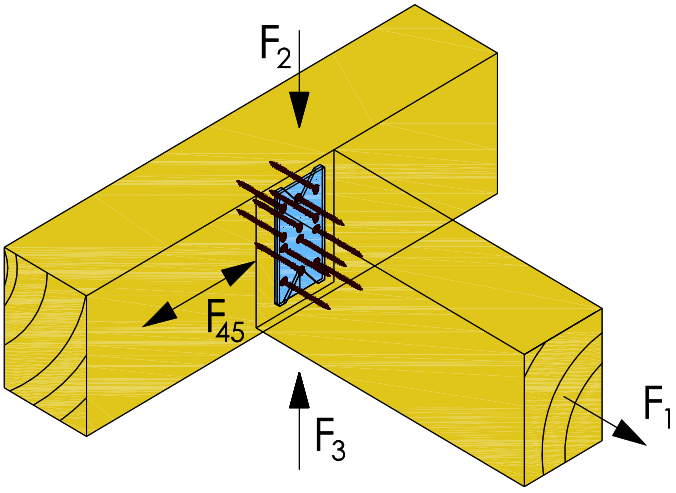
- Structural solid timber classified to C14-C40 according to EN 338 / EN 14081,
- Glulam classified to GL24-GL36 according to EN 1194 / EN 14080,
- LVL according to EN 14374,
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- Cross laminated timber.

However, the calculation methods are only allowed for a characteristic wood density of up to 500 kg/m^3. Even though the wood based material may have a larger density, this must not be used in the formulas for the load-carrying capacities of the fasteners.

Where an interlayer made of wood-based panel is placed between the Knapp Clip Connector and the header, the influence of the interlayer on the load-carrying-capacity of the header fasteners has to be taken into account.

Annex B states the formulas for the characteristic load-carrying capacities of the connections. The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code.

It is assumed that the forces acting on the connection are the following F_1, F_2, F_3 and F_{45}. The force F_1 acts perpendicular to the connector plate, F_2 and F_3 shall act in the middle of the connector in or against the direction of insertion. The force F_{45} is assumed to act with an eccentricity e_{45} with regard to the centre of gravity of the screws in the connector plate. It is assumed that the forces are acting right at the end of the joist.



It is assumed that the header beam is prevented from rotating. Similarly it is assumed that the steel member to which the connector is bolted does not rotate. If the header beam only has installed a connector on one side the eccentricity moment $M_v = F_d \cdot (b_H / 2 + e)$ shall be considered where b_H is the header width. The same applies when the header has connections on both sides, but with vertical forces which differ more than 20%.

It is a condition for a force F_1, F_2, F_3 and F_{45} that the connector plate is connected to a wood-based member with screws in all holes marked.

The connectors are intended for use in connections subject to static or quasi static loading. The zinc-coated connectors are for use in timber structures subject to dry, internal conditions defined by the service classes 1 and 2 of EN 1995-1-1:2004, (Eurocode 5). The fasteners (screws and bolts) to be used shall be made from suitable material.

Assumed working life

The assumed intended working life of concealed beam hangers for the intended use is 50 years, provided that they are subject to appropriate use and maintenance.

The information on the working life should not be regarded as a guarantee provided by the manufacturer or ETA Danmark. An “assumed intended working life” means that it is expected that, when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements.

2 Characteristics of product and assessment

ETAG paragraph	Characteristic		Assessment of characteristic
	2.1	**Mechanical resistance and stability*)**	
6.1.1		Characteristic load-carrying capacity	See Annex B
6.1.2		Stiffness	No performance determined
6.1.3		Ductility in cyclic testing	No performance determined
	2.2	**Safety in case of fire**	
6.2.1		Reaction to fire	The concealed beam hangers are made from steel classified as **Euroclass A1** in accordance with EN 1350-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
	2.3	**Hygiene, health and the environment**	
6.3.1		Influence on air quality	No dangerous materials **)
	2.4	**Safety in use**	Not relevant
	2.5	**Protection against noise**	Not relevant
	2.6	**Energy economy and heat retention**	Not relevant
	2.7	**Related aspects of serviceability**	
6.7.1		Durability	The concealed beam hangers have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2
6.7.2		Serviceability	
6.7.3		Identification	See Annex A

*) See page 5 of this ETA

**) In accordance with http://europa.eu.int-/comm/enterprise/construction/internal/dangsub/dangmain.htm In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

Safety principles and partial factors

2.1 Mechanical resistance and stability

See annex B for characteristic load-carrying capacities of the connectors.

The characteristic capacities of the connectors are determined by calculation assisted by testing as described in the EOTA Guideline 015 clause 5.1.2. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

The design models allow the use of fasteners described in Annex A:

Screws in accordance with EN 14592
In the formulas in Annex B the capacities for self-drilling screws calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral nail load-carrying-capacity.

Further, the connectors can be fastened to a steel member by bolts with a diameter of 5 to 10 mm in holes with a diameter up to 1 mm larger than the bolt.

No performance has been determined in relation to ductility of a joint under cyclic testing. The contribution to the performance of structures in seismic zones, therefore, has not been assessed.

2.7 Related aspects of serviceability

2.7.1 Corrosion protection in service class 1 and 2.
In accordance with ETAG 015 the connectors from 5 mm thick mild steel either have a zinc coating weight of min Z275 or an equivalent coating Fe/Zn 12c. The steel employed is DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa.

3 Attestation of Conformity and CE marking

3.1 Attestation of Conformity system

The system of attestation of conformity is 2+ described in Council Directive 89/106/EEC (Construction Products Directive) Annex III.

a) Tasks for the manufacturer:

(1) Factory production control,
(2) Initial type testing of the product,

b) Tasks for the notified body:

(1) Initial inspection of the factory and the factory production control,
(2) Continuous surveillance

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer has a factory production control system in the plant and exercises permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. This production control system ensures that the product is in conformity with the European Technical Approval.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the control plan[4]. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of materials, such as sheet metal, shall include control of the inspection documents presented by suppliers (comparison with nominal values) by verifying dimension and determining material properties, e.g. chemical composition, mechanical properties and zinc coating thickness.

The manufactured components are checked visually and for dimensions.

The control plan, which is part of the technical documentation of this European Technical Approval, includes details of the extent, nature and frequency of testing and controls to be performed within the factory production control and has been agreed between the approval holder and ETA Danmark.

The results of factory production control are recorded and evaluated. The records include at least the following information:

- Designation of the product, basic material and components;
- Type of control or testing;
- Date of manufacture of the product and date of testing of the product or basic material and components;
- Result of control and testing and, if appropriate, comparison with requirements;
- Signature of person responsible for factory production control.

The records shall be presented to ETA Danmark on request.

3.2.1.1 Initial type testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary initial type testing has to be agreed between ETA Danmark and the notified body.

3.2.2. Tasks of notified bodies

3.2.2.1 Initial inspection of the factory and the factory production control

The approved body should ascertain that, in accordance with the control plan, the factory, in particular the staff and equipment, and the factory production control, are suitable to ensure a continuous and orderly manufacturing of the brackets with the specifications given in part 2.

3.2.2.2 Continuous surveillance

The approved body shall visit the factory at least twice a year for routine inspections. It shall be verified that the system of factory production control and the specified manufacturing processes are maintained, taking account of the control plan.

The results of product certification and continuous surveillance shall be made available on demand by the certification body to ETA Danmark. Where the provisions of the European Technical Approval and the control plan are no longer fulfilled, the certificate

4 The control plan has been deposited at ETA-Danmark and is only made available to the approved bodies involved in the conformity attestation procedure.

of conformity shall be withdrawn by the approved body.

3.3 CE marking

The CE marking shall be affixed on each packaging of brackets. The initials "CE" shall be followed by the identification number of the notified body and shall be accompanied by the following information:

- Name or identifying mark of the manufacturer
- The last two digits of the year in which the marking was affixed
- Number of the European Technical Approval
- Name and size of product
- Number of the ETA Guideline (ETAG no. 015)
- Number of the EC Certificate of Conformity

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

Knapp Clip Connectors GIGANT, RICON, RICON S and WALCO V are manufactured in accordance with the provisions of this European Technical Approval using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

4.2 Installation

Connector joints

A connector joint is deemed fit for its intended use provided:

Header – support conditions

- The header beam shall be restrained against rotation and be free from wane under the connector.

  If the header carries joists only on one side the eccentricity moment from the joists $M_{ec} = R_{joist}$ $(b_H/2+e)$ shall be considered at the strength verification of the header.

R_{joist}	Reaction force from the joists
b_H	Width of header
e	Distance from the end grain surface of the joist to the surface of the header

- For a header with joists from both sides but with different reaction forces a similar consideration applies.

Wood to wood connections

- Connectors are fastened to wood-based members by screws or bolts.
- There shall be screws in all marked holes as prescribed in Annex A.
- The characteristic capacity of the connector joint is calculated according to the manufacturer's technical documentation, dated 2009-12-05.
- The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.
- There is no gap between the end of the joist and the connector plate or between the header surface and the connector plate.
- For Knapp Clip Connectors the width of the joist shall be at least the minimum width as prescribed in Annex A or D.
- The cross section of the joist at the connector joint shall have sharp edges e, i.e. it shall be without wane.
- The cross section of the header shall have a plane surface against the whole connector plate.
- The depth of the joist or header shall be so large that the minimum fastener end and edge distances are observed.
- Screws to be used shall have a diameter, which fits the holes of the connector plates.

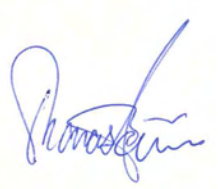
Wood to steel

The above mentioned rules for wood to wood connections are applicable also for the connection between the joist and the connector plate.

- The connector joint is designed in accordance with Eurocodes 3 or 5 or an appropriate national code.
- The connector plate shall be in close contact with the steel over the whole face. There shall be no intermediate layers in between.
- The bolt shall have a diameter not less than the hole diameter minus 1 mm.
- The bolts shall be placed symmetrically about the vertical symmetry line. The number of bolts shall equal the number of the respective screws in the joist.

4.3 Maintenance and repair

Maintenance is not required during the assumed intended working life. Should repair prove necessary, it is normal to replace the connector.

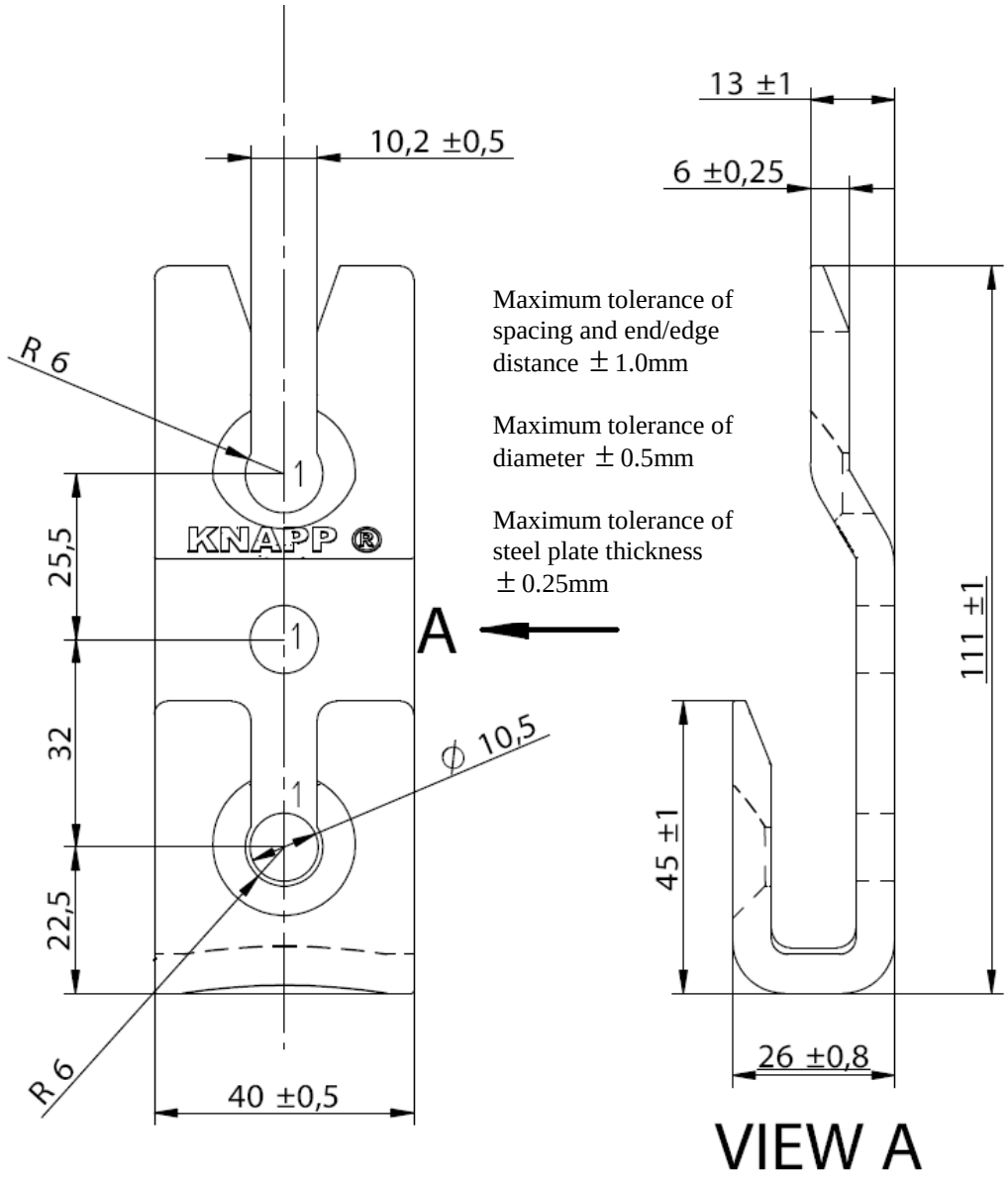


Thomas Bruun
Manager, ETA-Danmark

Annex A
Product details and definitions

Knapp Clip Connector GIGANT 120/40

6.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa.
Pre-galvanized steel plate with coating Zn 5C



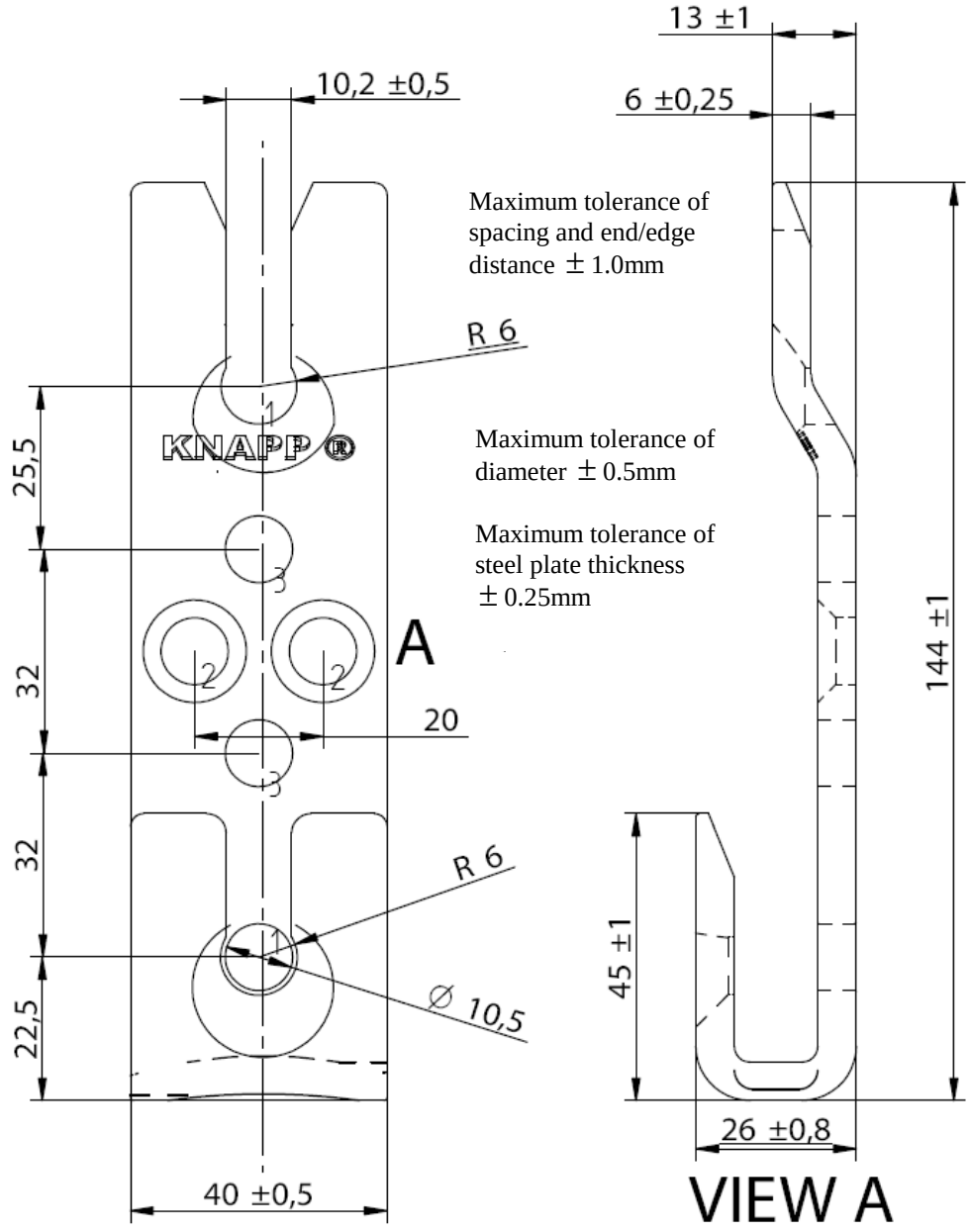
Without clip lock
Screws in header side grain using hole pattern 1, 1, 1, with Knapp SK 10x80 or 10x120
Screws in end grain using hole pattern 1, 1, 1, with Knapp SK 10x120

With clip lock
Screws in header side grain using hole pattern 1, 1, 1, with Knapp SK 10x80 or 10x120
Screws in end grain using hole pattern 1, 1, 1, with Knapp SK 10x120

dimensions in mm

Knapp Clip Connector GIGANT 150/40

6.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa.
Pre-galvanized steel plate with coating Zn 5C



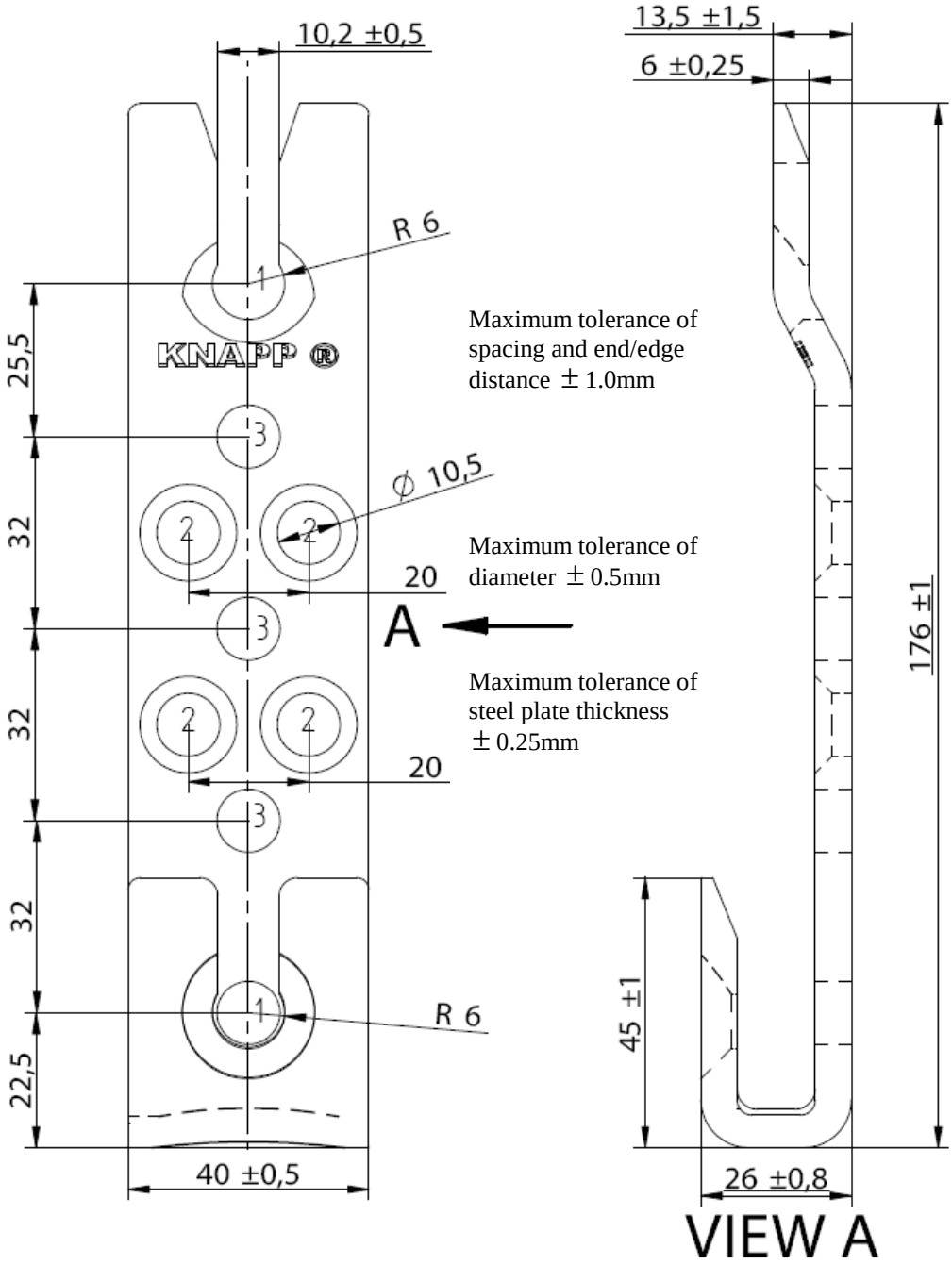
Without clip lock
Screws in header side grain using hole pattern 1, 2, 2, 1, with Knapp SK 10x80 or 10x120
Screws in end grain using hole pattern 1, 2, 2, 1, with Knapp SK 10x120

With clip lock
Screws in header side grain using hole pattern 1, 2, 2, 1, with Knapp SK 10x80 or 10x120
Screws in end grain using hole pattern 1, 3, 3, 1, with Knapp SK 10x120

dimensions in mm

Knapp Clip Connector GIGANT 180/40

6.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa.
Pre-galvanized steel plate with coating Zn 5C



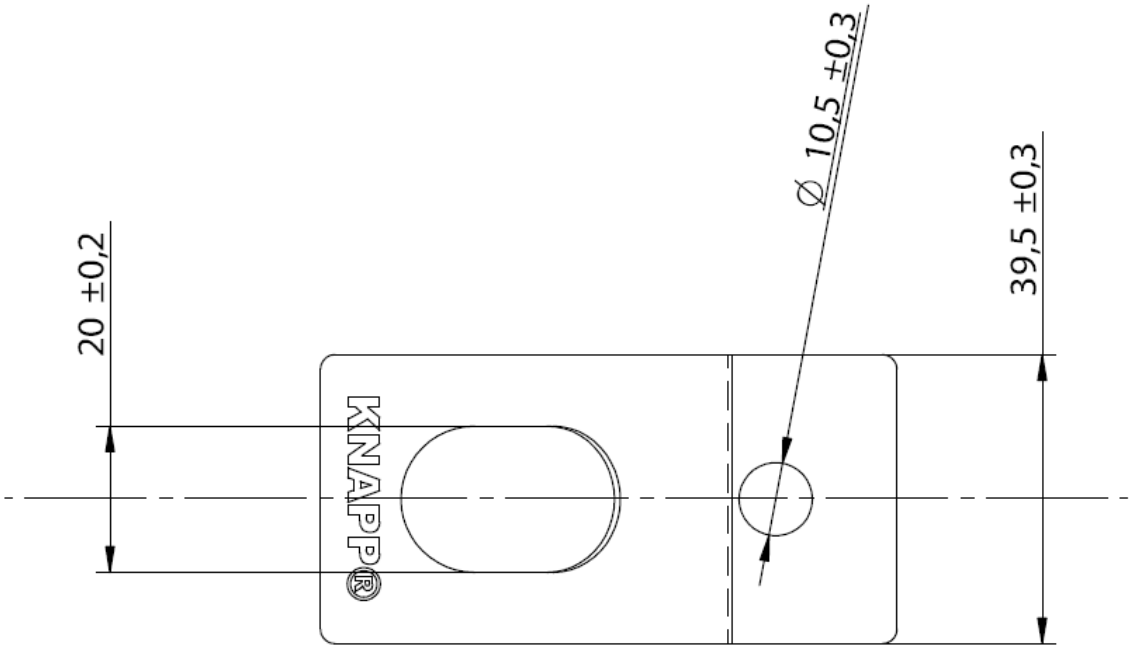
Without clip lock
Screws in header side grain using hole pattern 1, 2, 2, 2, 2, 1, with Knapp SK 10x80 or 10x120
Screws in end grain using hole pattern 1, 2, 2, 2, 2, 1, with Knapp SK 10x120

With clip lock
Screws in header side grain using hole pattern 1, 2, 2, 2, 2, 1, with Knapp SK 10x80 or 10x120
Screws in end grain using hole pattern 1, 3, 3, 3, 1, with Knapp SK 10x120

dimensions in mm

Knapp GIGANT clip lock

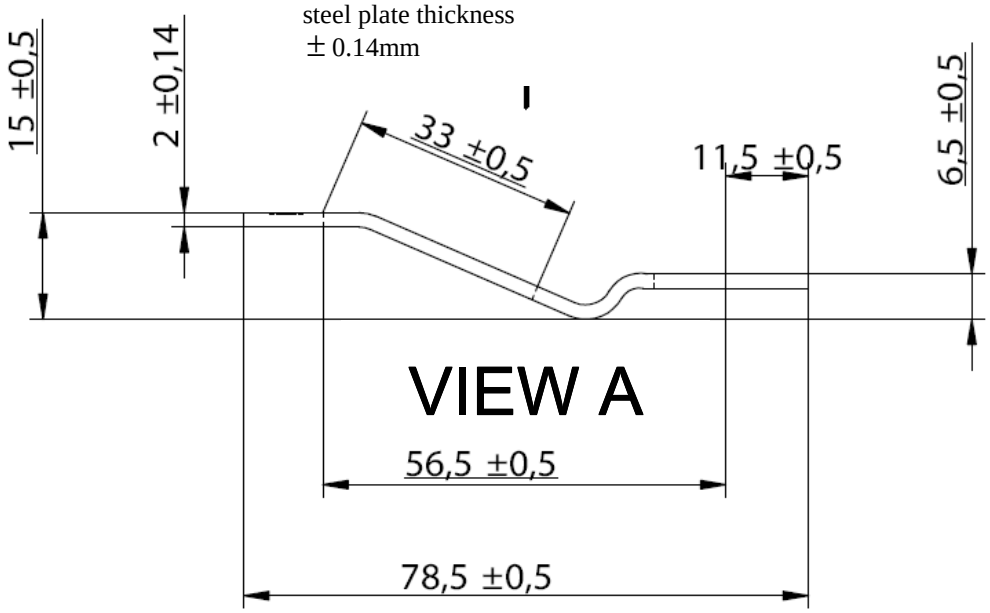
2.0 mm thick steel grade S500MC according to EN 10149-2:1995-11 with minimum yield strength R_e of 500 MPa, minimum tensile strength R_m of 580 MPa, maximum tensile strength R_m of 700 and minimum ultimate strain A_{80} of 6%
Corrosion protection by pre-galvanizing, chromate conversion coating, and sealing according to specifications on file at ETA Danmark



Maximum tolerance of spacing and end/edge distance ± 0.5mm

Maximum tolerance of diameter ± 0.5mm

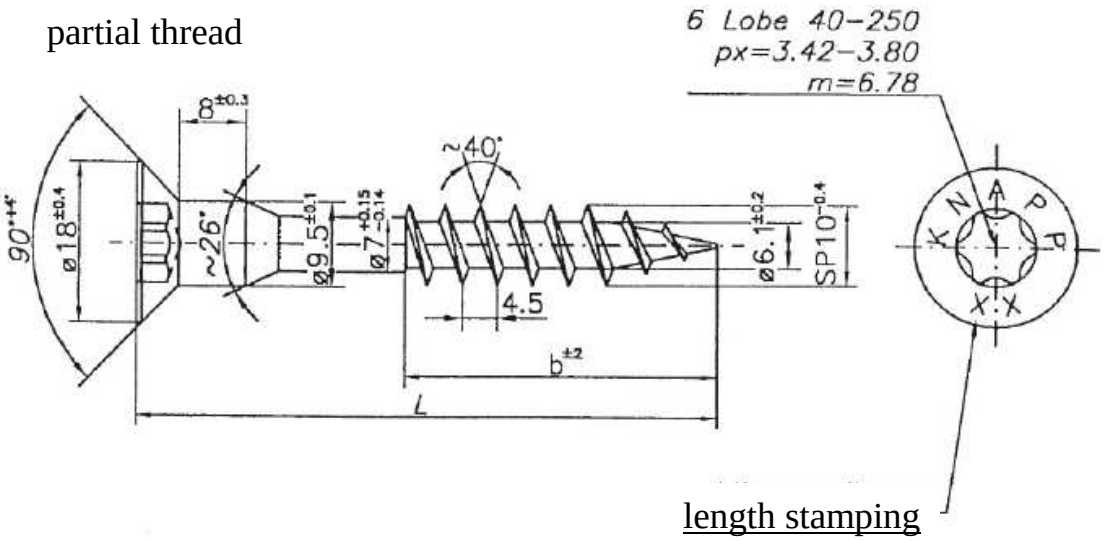
Maximum tolerance of steel plate thickness ± 0.14mm



dimensions in mm

Knapp GIGANT Screw SK 10x80, SK 10x120

Screws according to EN 14592 manufactured of carbon steel according to SSH specifications K17, K20 or K22 on file at ETA Danmark, minimum torque $M_{t,u,k}$ of 30Nm and corrosion protection according to Eurocode 5

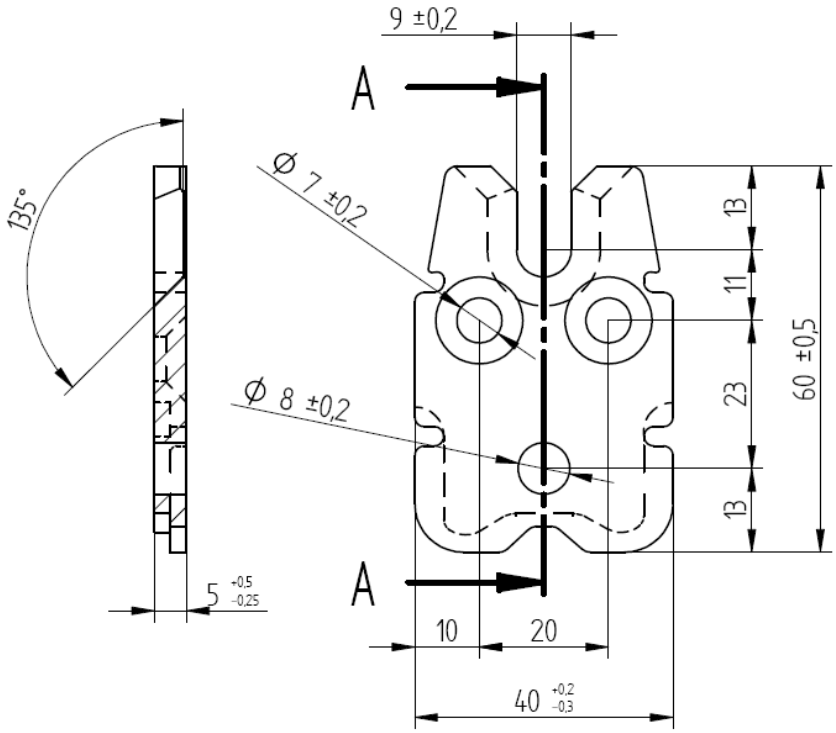


Pos	L	b ±2
1	80 -1.5	54
2	120 -1.75	84

dimensions in mm

Knapp Clip Connector RICON 60/40

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5



VIEW A-A

Maximum tolerance of spacing and end/edge distance ± 0.3mm

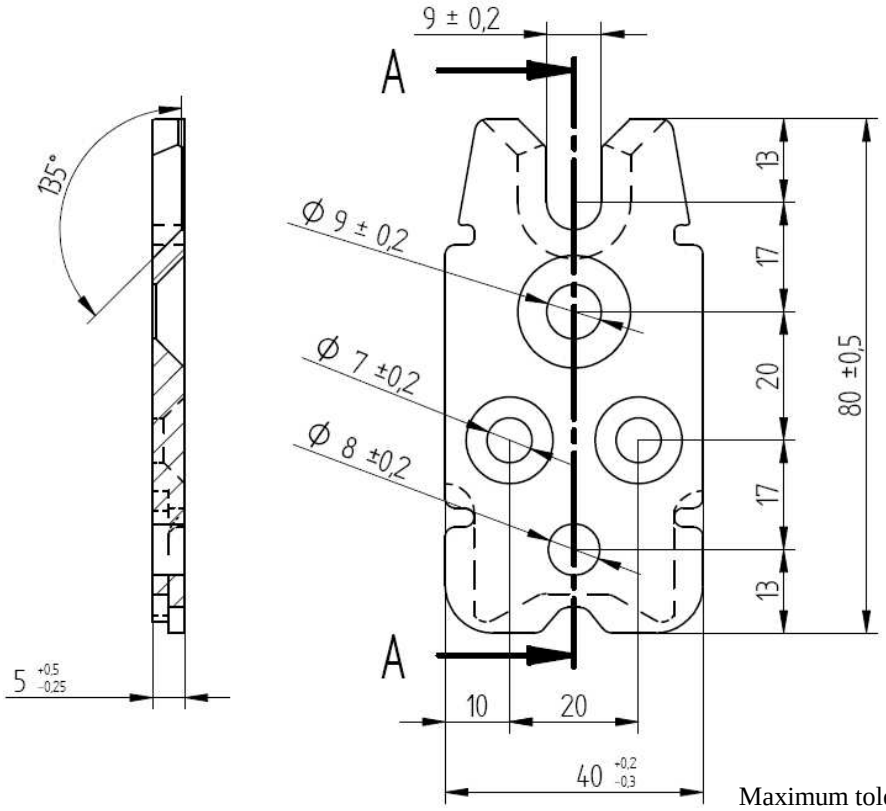
Maximum tolerance of steel plate thickness ± 0.25mm

1:1

dimensions in mm

Knapp Clip Connector RICON 80/40

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5



VIEW A-A

Maximum tolerance of spacing and end/edge distance ± 0.3mm

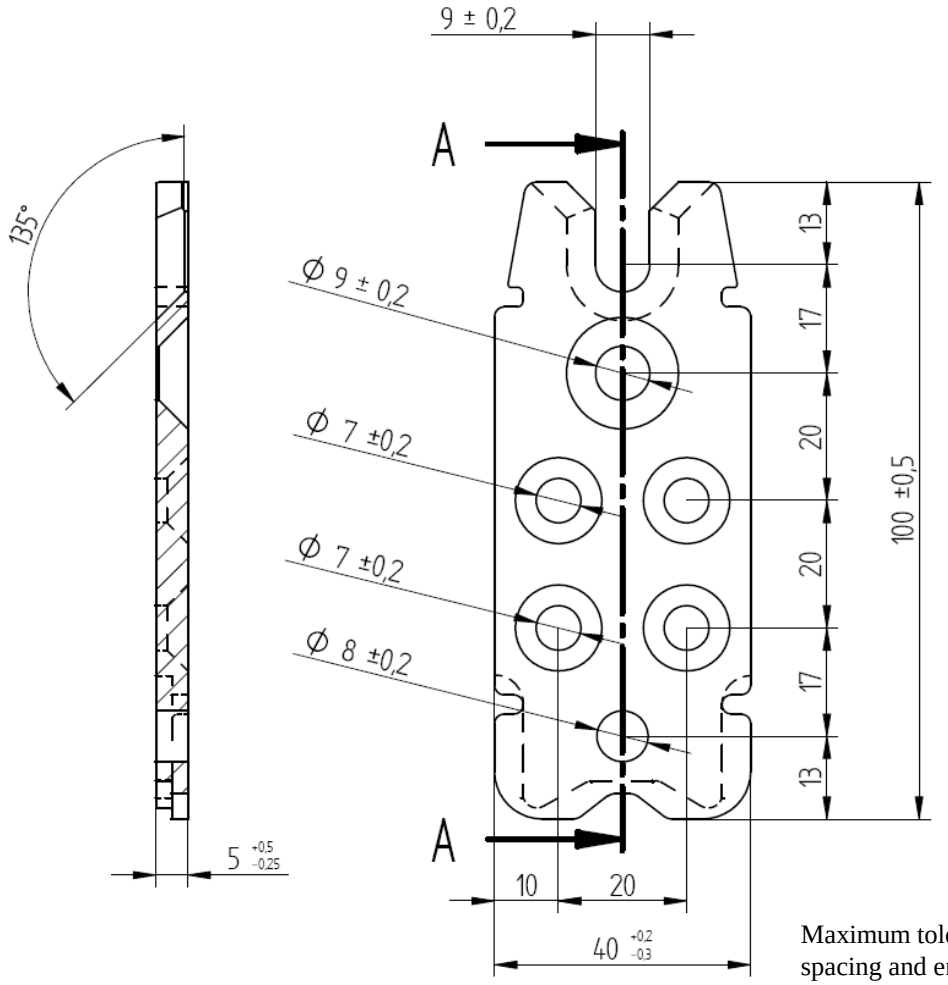
Maximum tolerance of steel plate thickness ± 0.25mm

1:1

dimensions in mm

Knapp Clip Connector RICON 100/40

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5



VIEW A-A

Maximum tolerance of spacing and end/edge distance ± 0.3mm

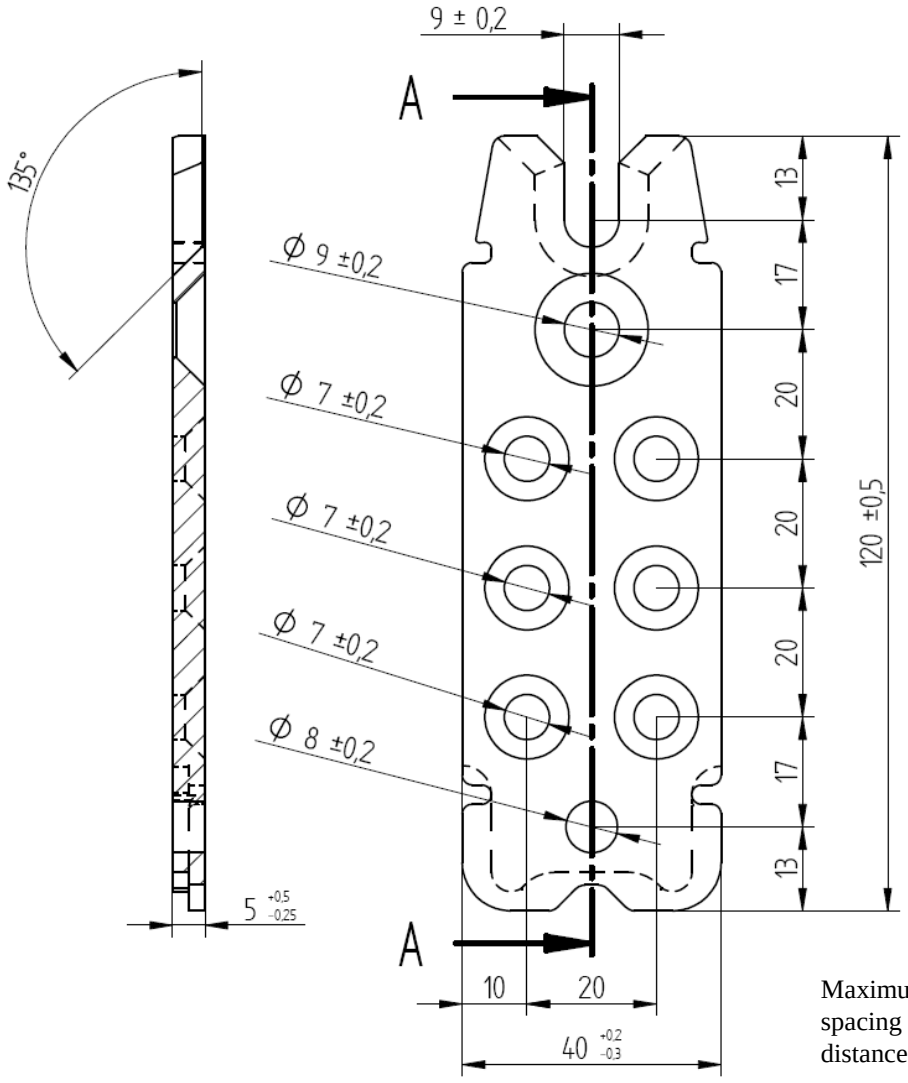
Maximum tolerance of steel plate thickness ± 0.25mm

1:1

dimensions in mm

Knapp Clip Connector RICON 120/40

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5



VIEW A-A

Maximum tolerance of spacing and end/edge distance ± 0.3mm

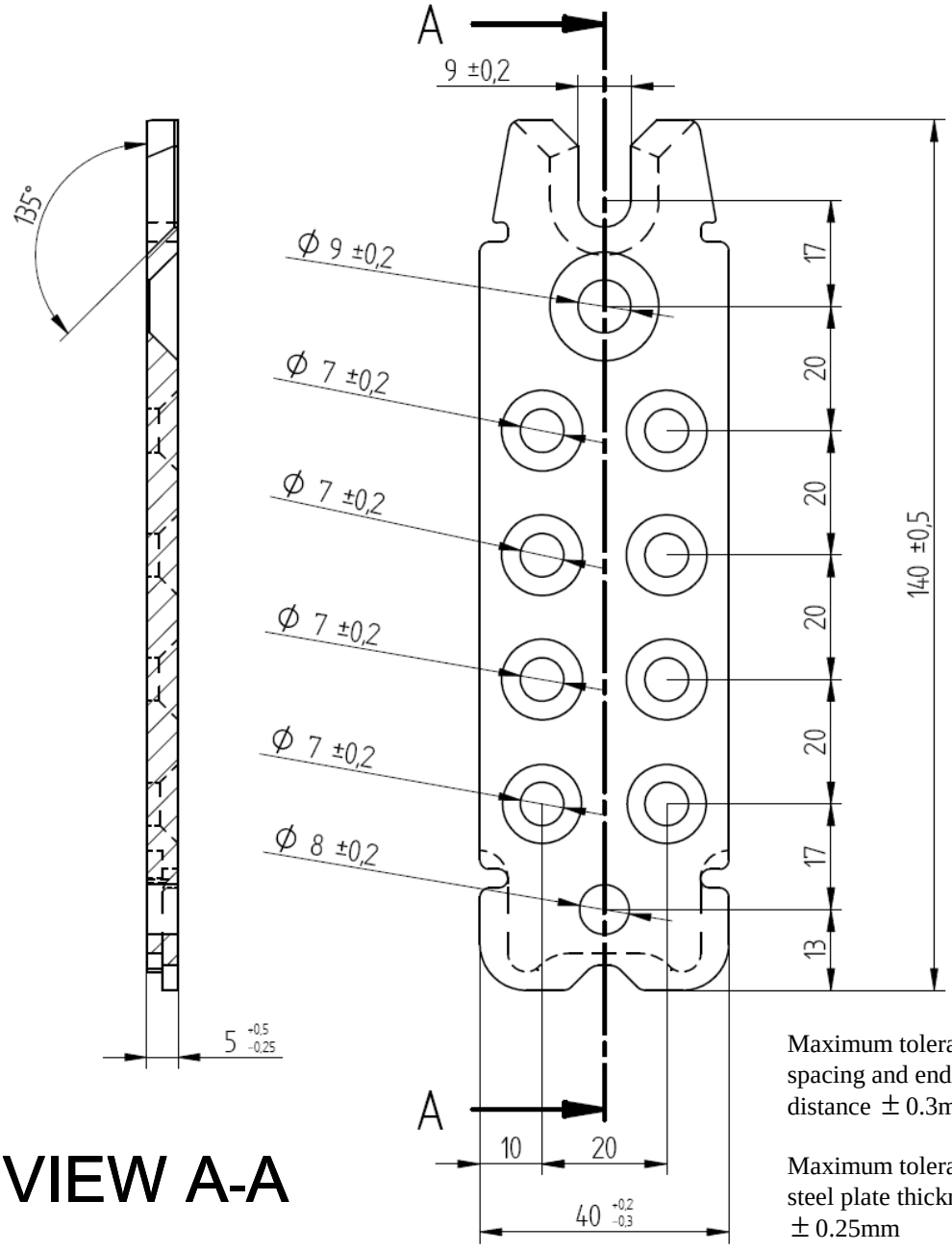
Maximum tolerance of steel plate thickness ± 0.25mm

1:1

dimensions in mm

Knapp Clip Connector RICON 140/40

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5



VIEW A-A

Maximum tolerance of spacing and end/edge distance ± 0.3mm

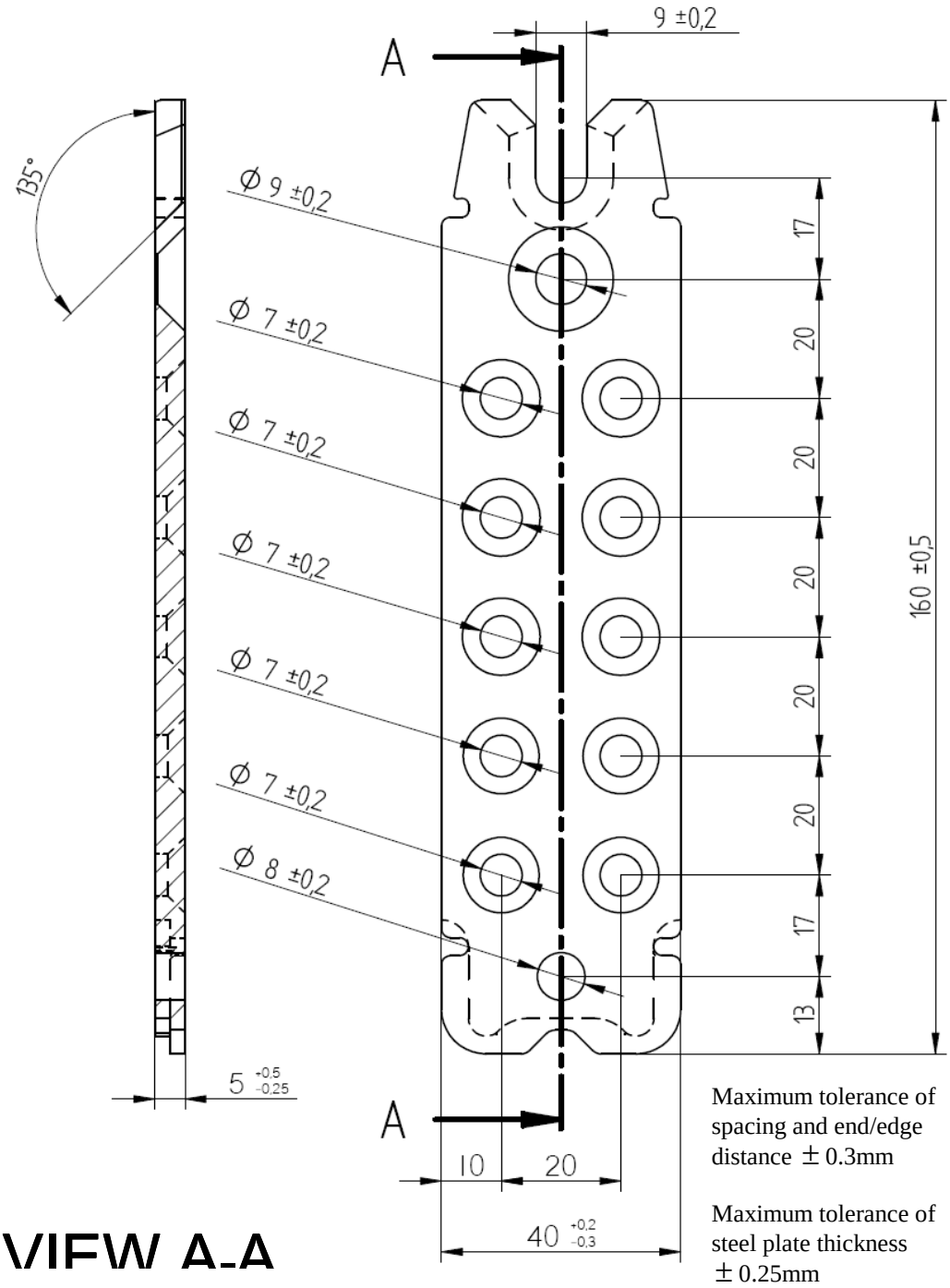
Maximum tolerance of steel plate thickness ± 0.25mm

1:1

dimensions in mm

Knapp Clip Connector RICON 160/40

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa; Corrosion protection according to Eurocode 5

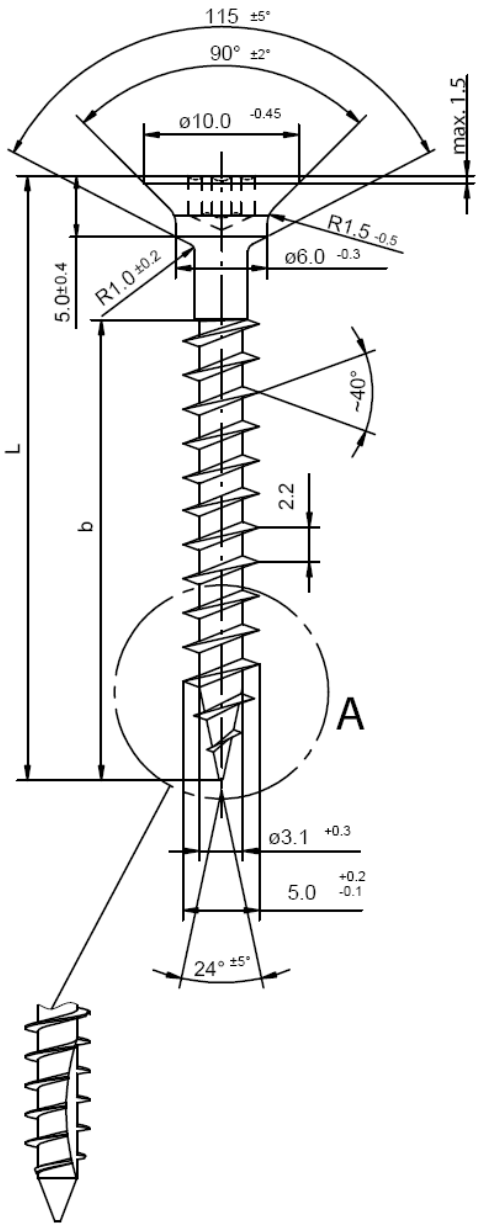


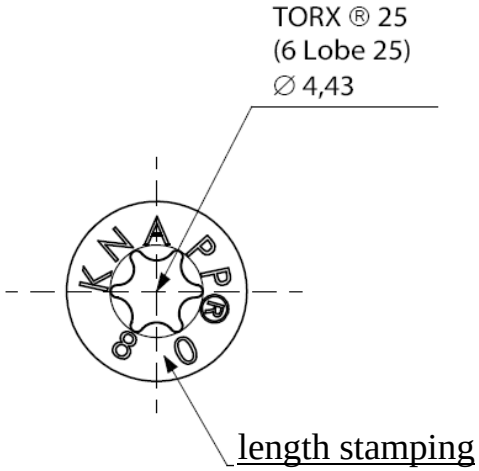
1:1

dimensions in mm

Knapp RICON Screw SK 5x50, SK 5x80

Screws according to EN 14592 manufactured of carbon steel according to SSH specifications K17, K20 or K22 on file at ETA Danmark, minimum torque $M_{t,u,k}$ of 6 Nm and corrosion protection according to Eurocode 5



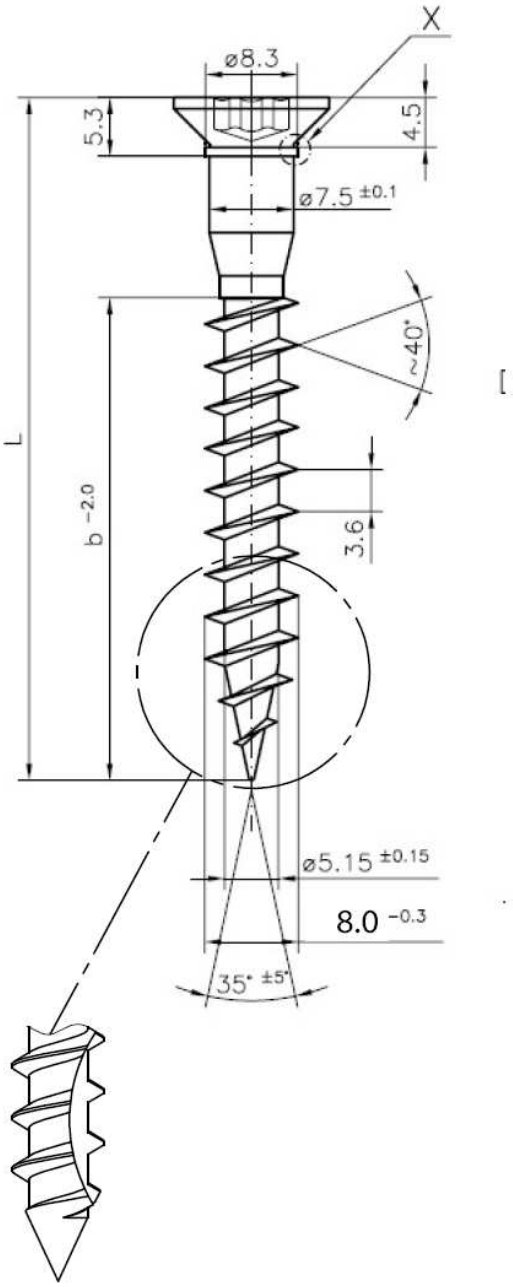


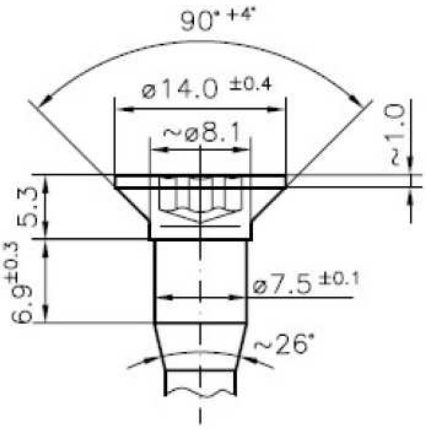
Pos	L	b
1	50 -1,25	40 +1,0
2	80 -1,50	70 + 1,0
3	120 -1,75	110 + 1,0

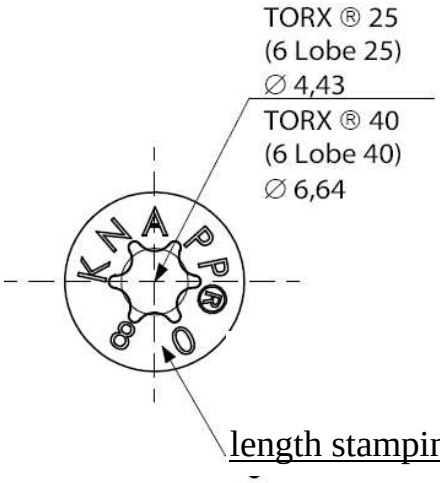
dimensions in mm

Knapp RICON Screw SK 8x50, SK 8x80

Screws according to EN 14592 manufactured of carbon steel according to SSH specifications K17, K20 or K22 on file at ETA Danmark, minimum torque $M_{t,u,k}$ of 20 Nm and corrosion protection according to Eurocode 5







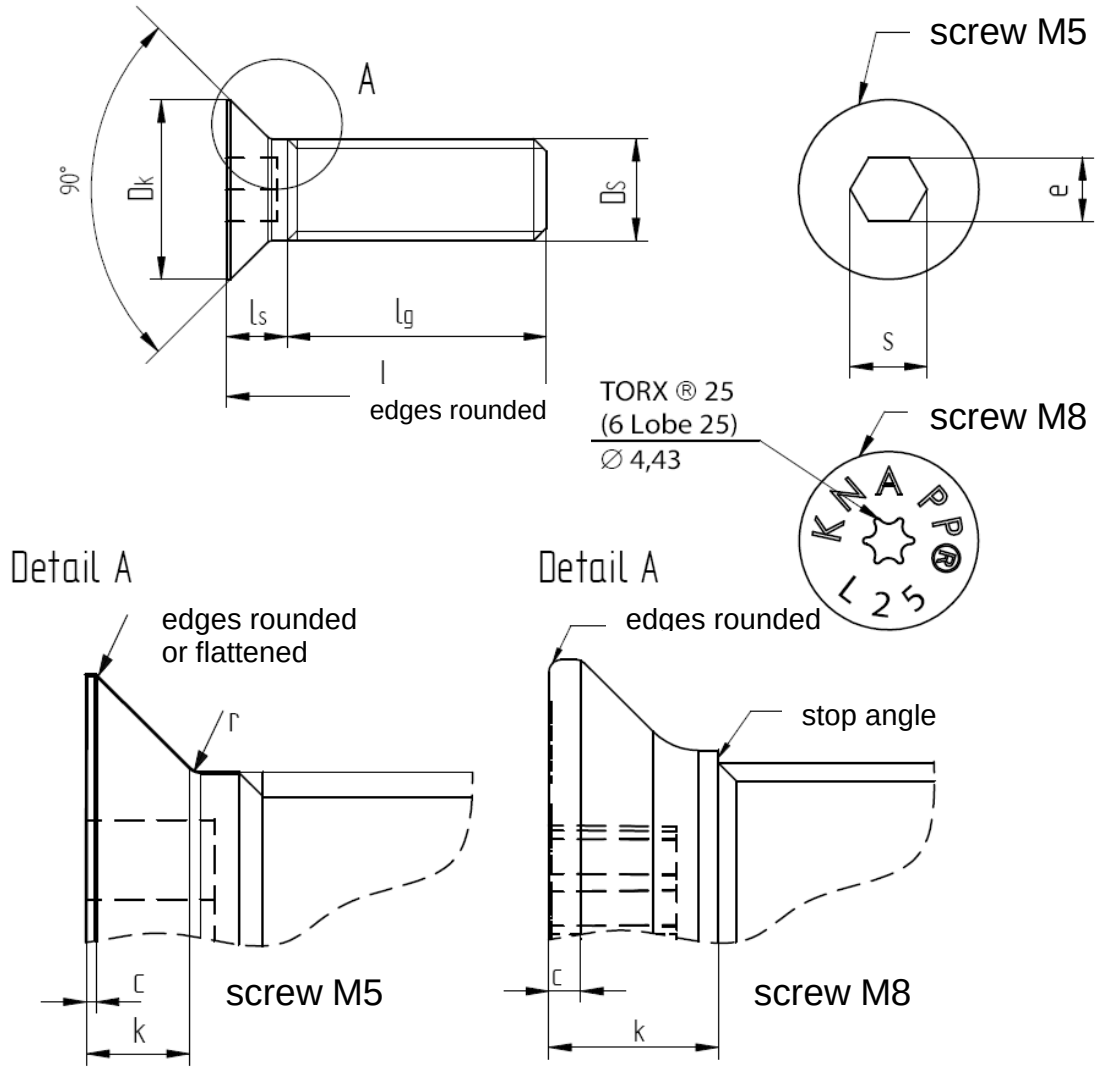
length stamping

Pos	L	b -2,0
1	50 - 1,25	35
2	80 - 1,50	65
3	120 -1,75	95

dimensions in mm

Knapp RICON Screw M5, M8 for DA and EAR

Screws according to EN 14592 manufactured of steel grade 8.8 according to EN ISO 898-1

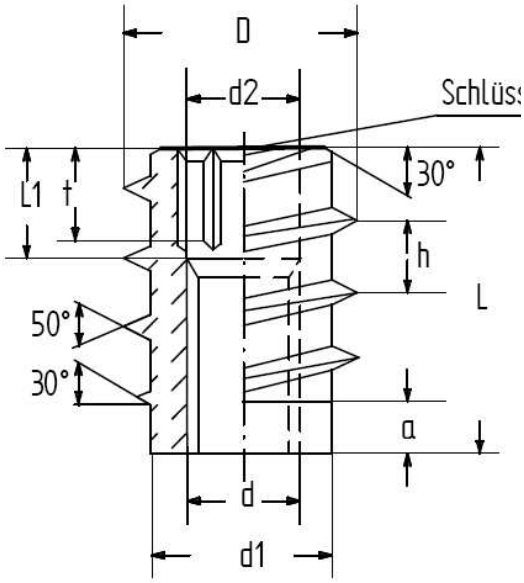


Typ	l	lg min.	ls max.	Dk	Ds	r	c	k	e	s
M 5x20	20 ± 0,5	14,8	5,2	10 ± 0,4	5 6g	0,2	0,3	2,8	3,5	3
M 5x25	25 ± 0,5	19,8	5,2	10 ± 0,4	5 6g	0,2	0,3	2,8	3,5	3
M 8x25	25 ± 0,5	18,0	5,7	14 ± 0,4	8 6g	0,5	1,5	5,3	TORX® 25, ∅ 4,43	

dimensions in mm

Knapp RICON insert

steel grade 11SMnPb30 according to EN 10087 or EN 10277-3 with minimum yield strength R_{eH} of 440 MPa, minimum tensile strength R_m of 560 MPa, maximum tensile strength R_m of 810 and minimum ultimate strain A_{80} of 6% for inside/outside thread nut M5 or with minimum yield strength R_{eH} of 410 MPa, minimum tensile strength R_m of 510 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7% for inside/outside thread nut M8

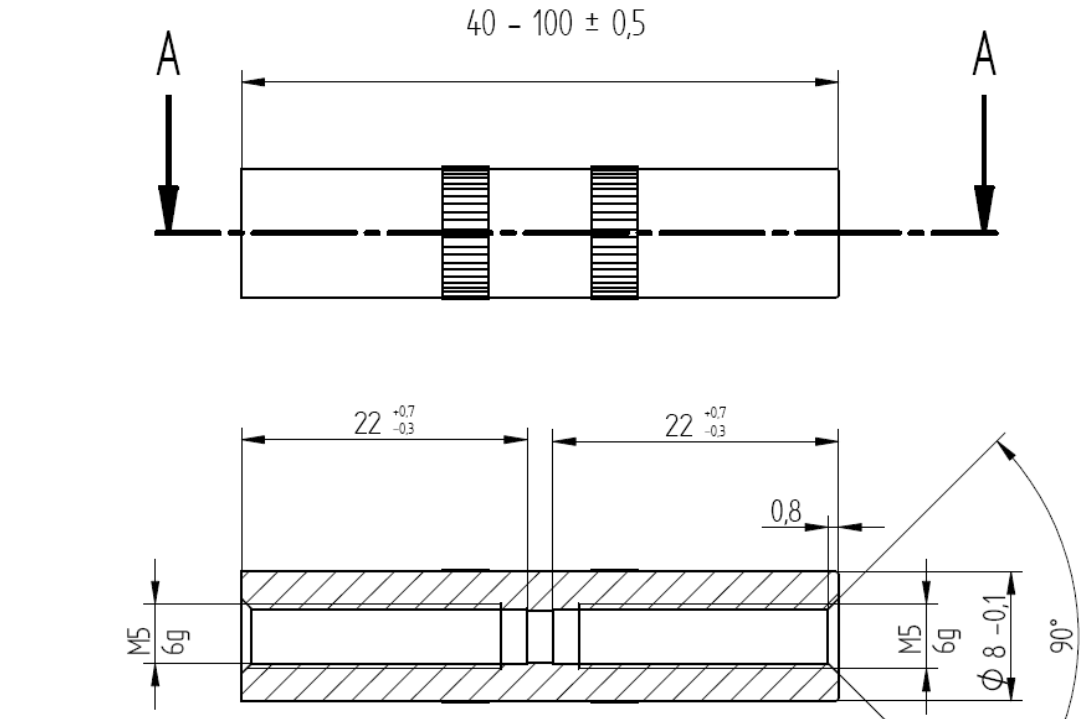


D	L	d	d1	d2	L1	SW	t	h	a
10 ± 0,3	14 ± 0,3	M5 6g	7,5 ± 0,3	5,25 ± 0,2	5 ± 0,5	5	4 ± 0,5	3 ± 0,2	2 ± 0,3
14 ± 0,3	18 ± 0,3	M8 6g	11,5 ± 0,3	8,4 ± 0,2	6 ± 0,5	8	5 ± 0,5	3,5 ± 0,2	3 ± 0,3

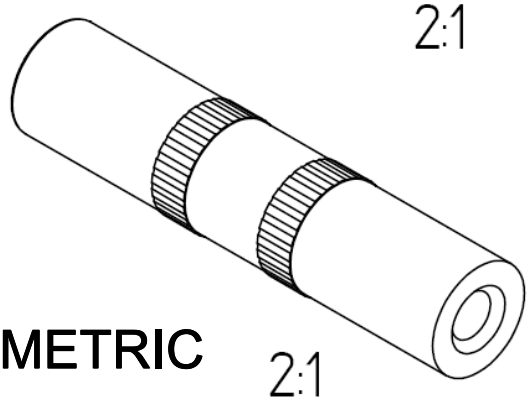
dimensions in mm

Knapp RICON connection nut M5 for RICON 60/40 DA

steel grade 11SMnPb30 + C according to EN 10087 or EN 10277-3 with minimum yield strength R_{eH} of 440 MPa, minimum tensile strength R_m of 560 MPa, maximum tensile strength R_m of 810 and minimum ultimate strain A_{80} of 6%



VIEW A-A
2:1

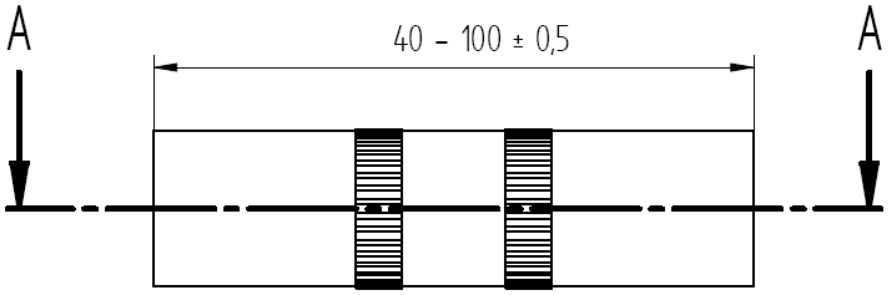


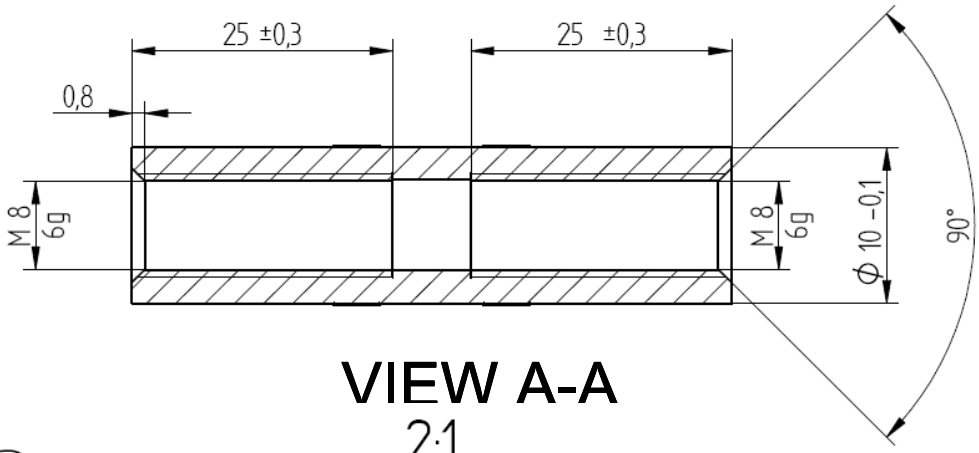
ISOMETRIC VIEW
2:1

dimensions in mm

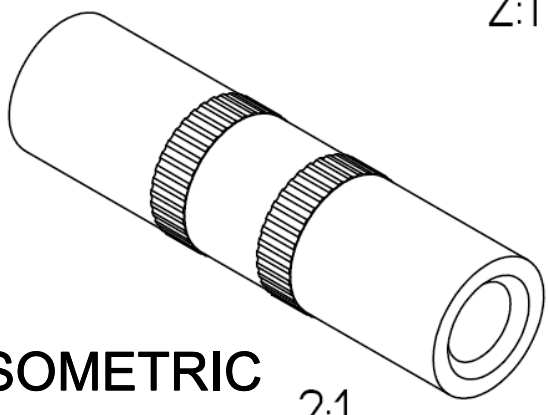
Knapp RICON connection nut M8 for RICON DA

steel grade 11SMnPb30 + C according to EN 10087 or EN 10277-3 with minimum yield strength R_{eH} of 440 MPa, minimum tensile strength R_m of 560 MPa, maximum tensile strength R_m of 810 and minimum ultimate strain A_{80} of 6%





VIEW A-A
2:1

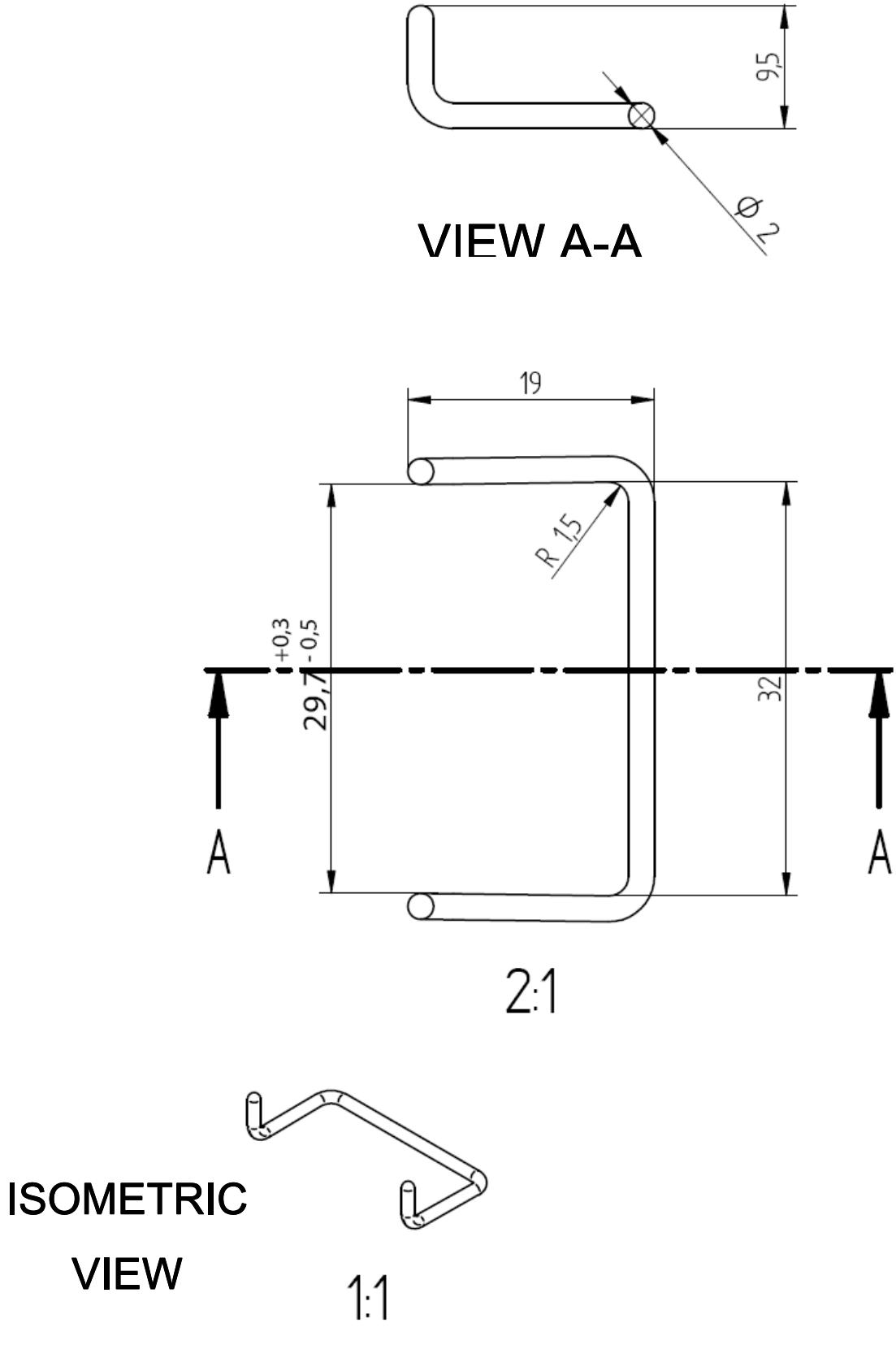


ISOMETRIC VIEW
2:1

dimensions in mm

Knapp RICON stirrup

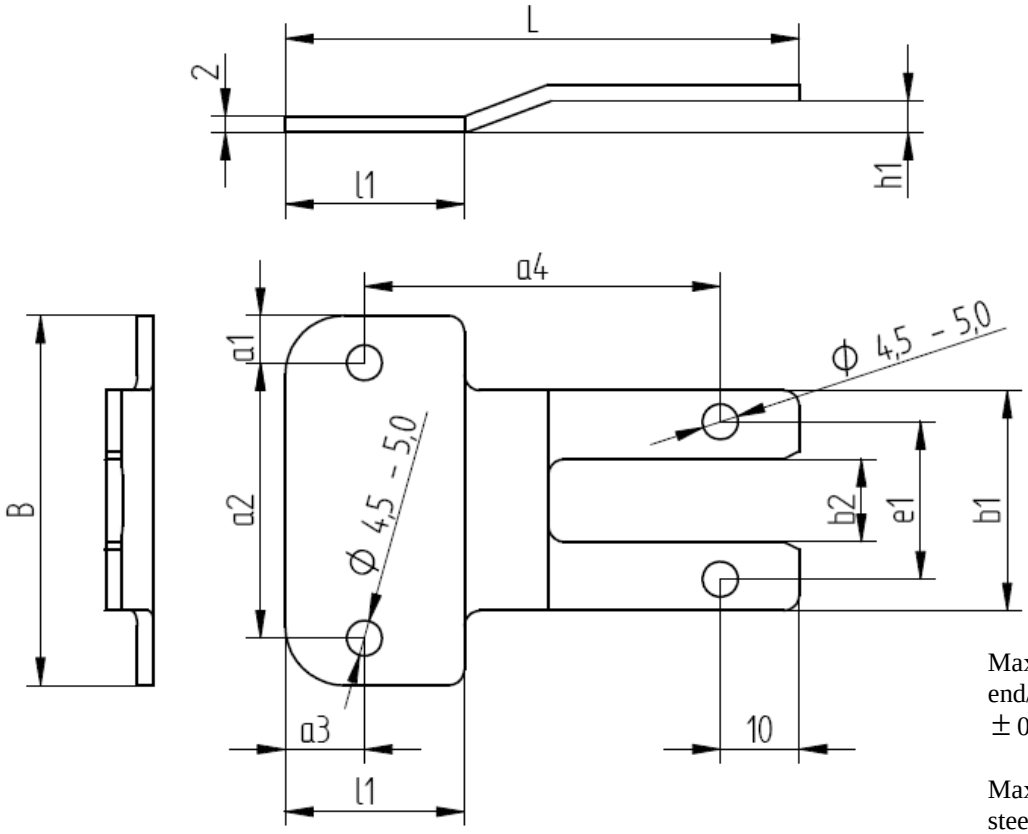
2.0 mm thick stainless steel wire grade X 12CrNi17-7 according to EN 17224 with minimum tensile strength R_m of 1700 MPa and maximum tensile strength R_m of 1950 MPa



dimensions in mm

Knapp RICON reinforcing plate

2.0 mm thick stainless steel grade X 12CrNi17-7 according to EN 17224



Maximum tolerance of end/edge distance ± 0.2mm

Maximum tolerance of steel plate thickness ± 0.14mm

Dimension of Reinforcement plates	basic profiles by producer						
	esco Metallbausysteme GmbH				Hermann Gutmann Werke AG		
	FWT50	FWT50	FWT55	FWT55	P GF 50	P GF 60	P GF 80
Approval	Z-14.4-480				Z-14.4-501, Z-14.4-502		
Post/Header-Size H [mm]	50	60	55 - 60	80	50	60	80
B [mm]	47 ± 0,1	47 ± 0,1	47 ± 0,1	47 ± 0,1	47 ± 0,1	47 ± 0,1	65 ± 0,1
L [mm]	65 ± 0,1	70 ± 0,1	70 ± 0,1	80 ± 0,1	65 ± 0,1	70 ± 0,1	80 ± 0,1
b1 [mm]	28 ± 0,1	28 ± 0,1	28 ± 0,1	28,5 ± 0,1	28 ± 0,1	34 ± 0,1	50 ± 0,1
b2 [mm]	10,5 ± 0,1	10,5 ± 0,1	10,5 ± 0,1	10,5 ± 0,1	10,5 ± 0,1	10 ± 0,1	11 ± 0,1
l1 [mm]	22,6 ± 0,1	29,6 ± 0,1	29,6 ± 0,1	39,6 ± 0,1	22,6 ± 0,1	29,6 ± 0,1	37,6 ± 0,1
a1 [mm]	6	6	6	6	6	6	6
a2 [mm]	35	35	35	35	35	35	53
a3 [mm]	10	10	10	10	10,25	12,5	17,5
a4 [mm]	45	45	50	60	44,75	47,5	52,5
e1 [mm]	20,5	20,5	20,5	20,5	21	25	35
h1 [mm]	4	4	4	4	4,5	4,5	4,5

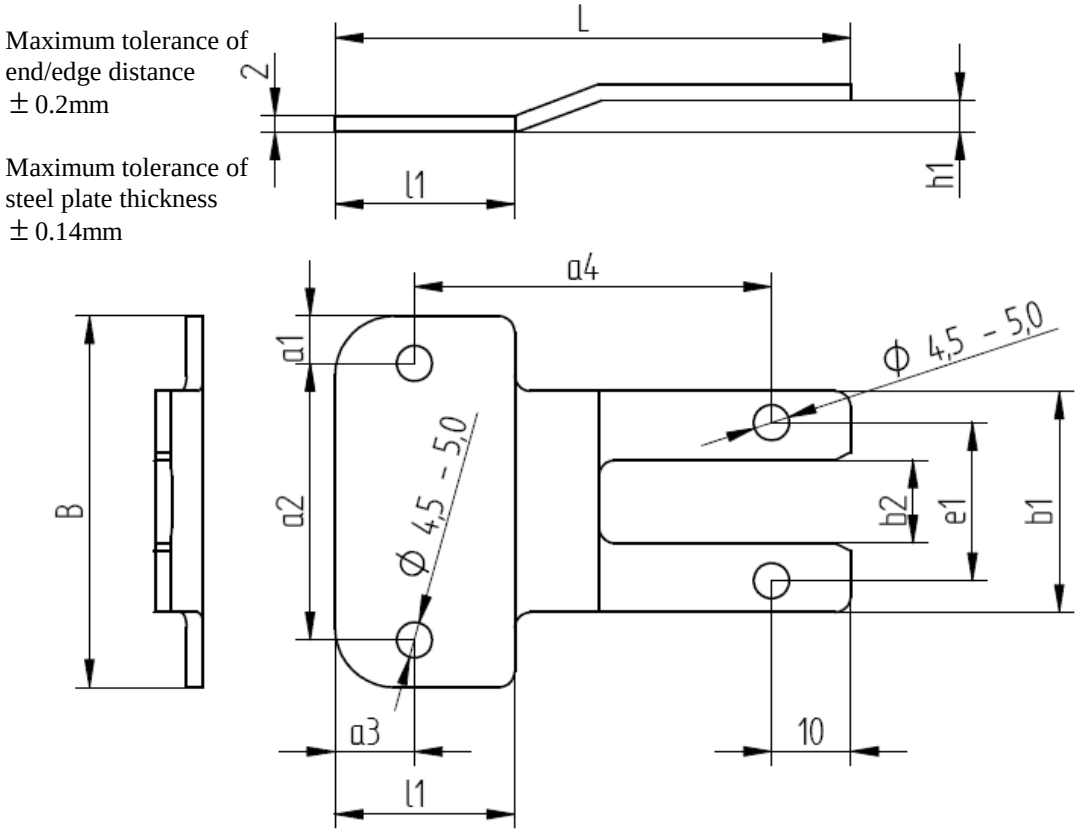
dimensions in mm

Knapp RICON reinforcing plate

2.0 mm thick stainless steel grade X 12CrNi17-7 according to EN 17224

Maximum tolerance of end/edge distance ± 0.2mm

Maximum tolerance of steel plate thickness ± 0.14mm

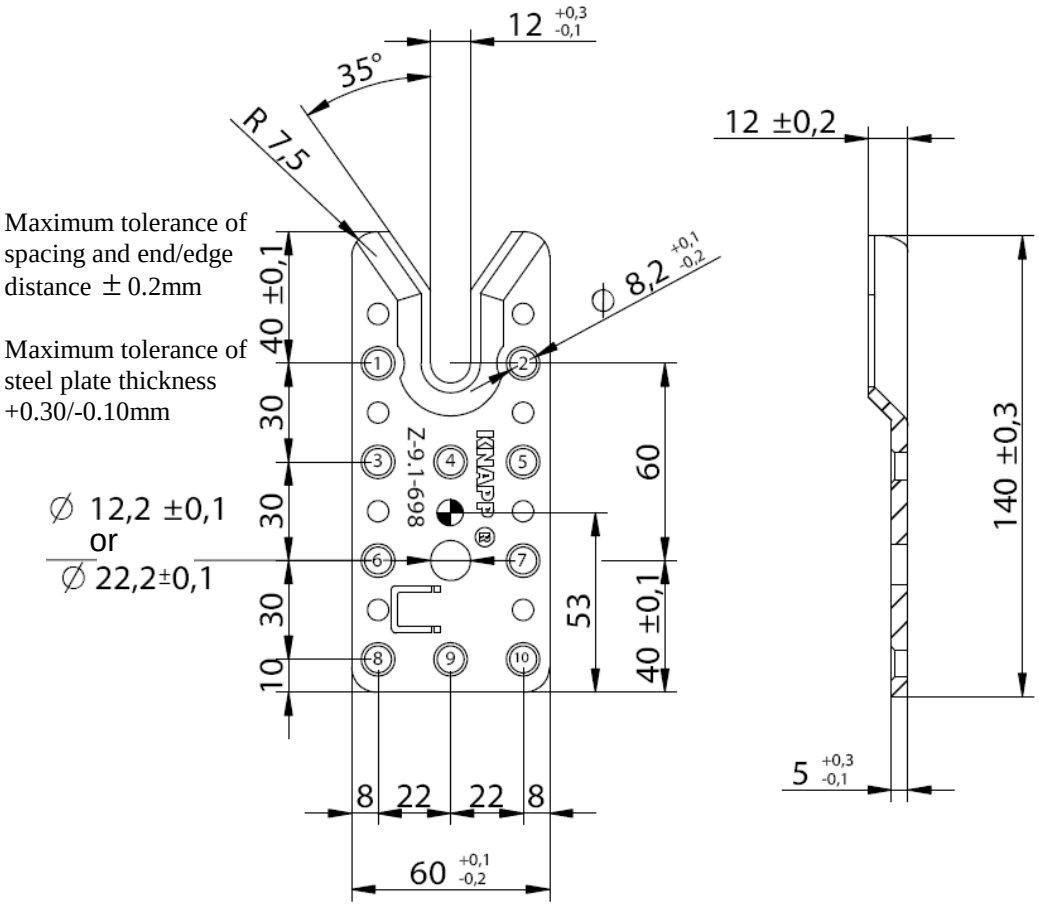


Dimension of Reinforcement plates	basic profiles by producer			
	RAICO Bautechnik GmbH			
	41/40	41/40	47/40	67/60
Approval	Z-14.4-516			
Post/Header-Size H [mm]	50	60	60	80
B [mm]	47 ± 0,1	47 ± 0,1	47 ± 0,1	65 ± 0,1
L [mm]	65 ± 0,1	70 ± 0,1	70 ± 0,1	80 ± 0,1
b1 [mm]	28 ± 0,1	28 ± 0,1	28 ± 0,1	50 ± 0,1
b2 [mm]	11,5 ± 0,1	11,5 ± 0,1	11,5 ± 0,1	11,5 ± 0,1
l1 [mm]	24,6 ± 0,1	29,6 ± 0,1	29,6 ± 0,1	37,6 ± 0,1
a1 [mm]	6	6	6	6
a2 [mm]	35	35	35	53
a3 [mm]	10	10	10	10
a4 [mm]	45	50	50	60
e1 [mm]	20	20	20	20
h1 [mm]	4,5	4,5	4,5	4,5

dimensions in mm

Knapp Clip Connector RICON S 140/60

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

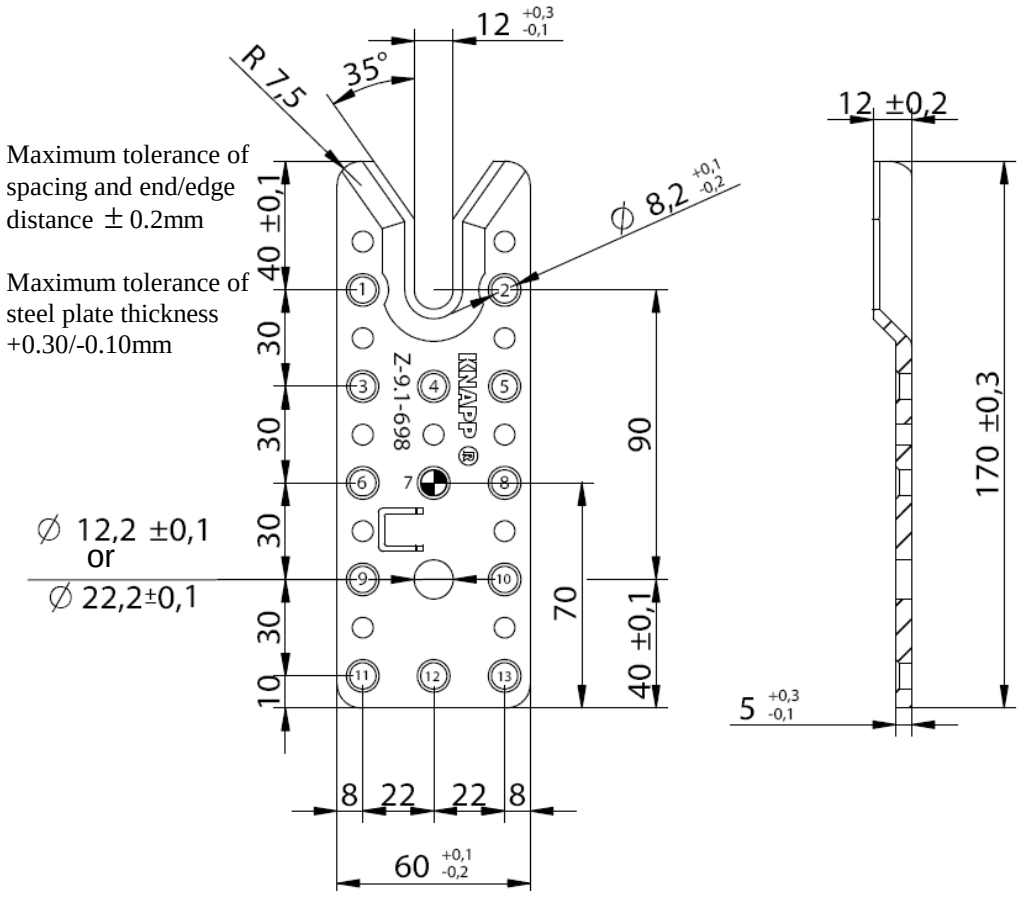
1:2

Screws
Header 1, 2, 4, 6, 7, 8, 10
Joist 1, 2, 4, 6, 7, 8, 10

dimensions in mm

Knapp Clip Connector RICON S 170/60

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

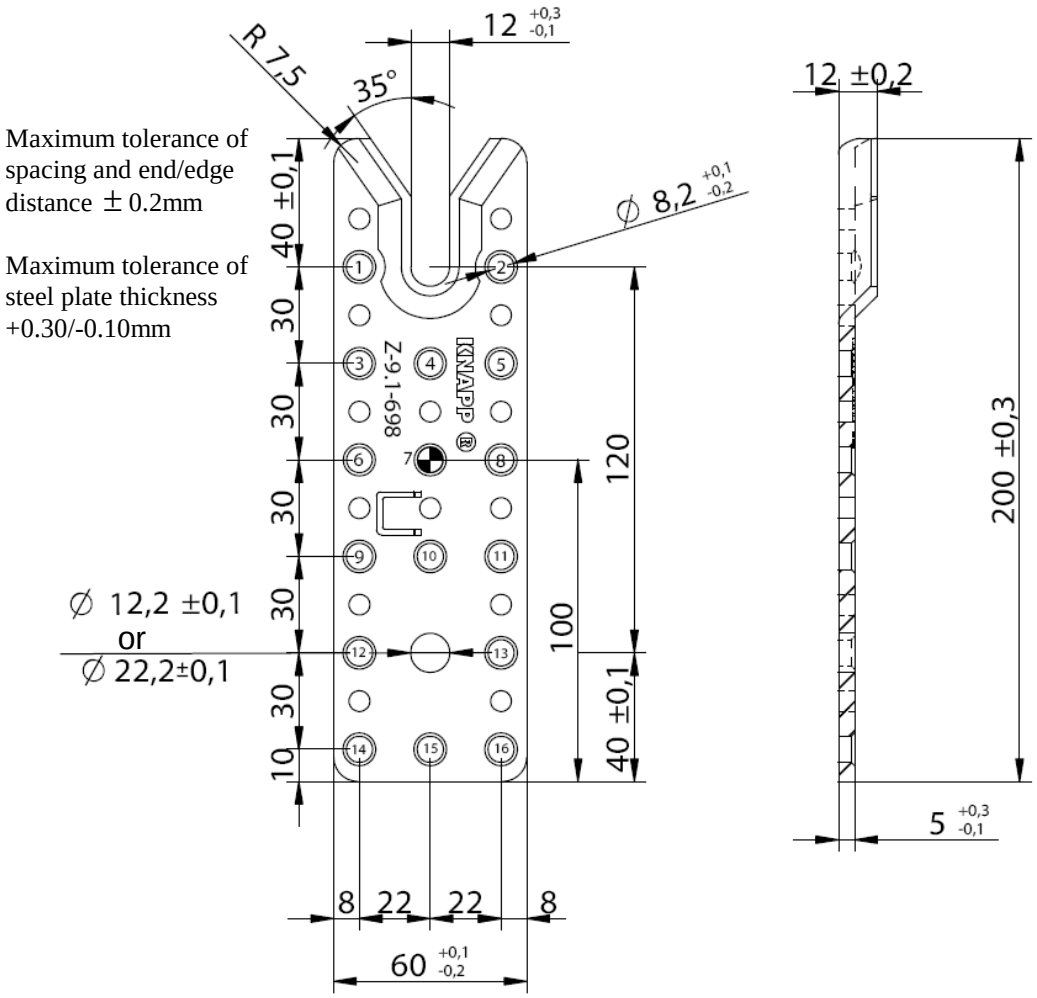
1:2

Screws
Header 1, 2, 4, 7, 9, 10, 11, 13
Joist 1, 2, 3, 5, 9, 10, 11, 13

dimensions in mm

Knapp Clip Connector RICON S 200/60

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

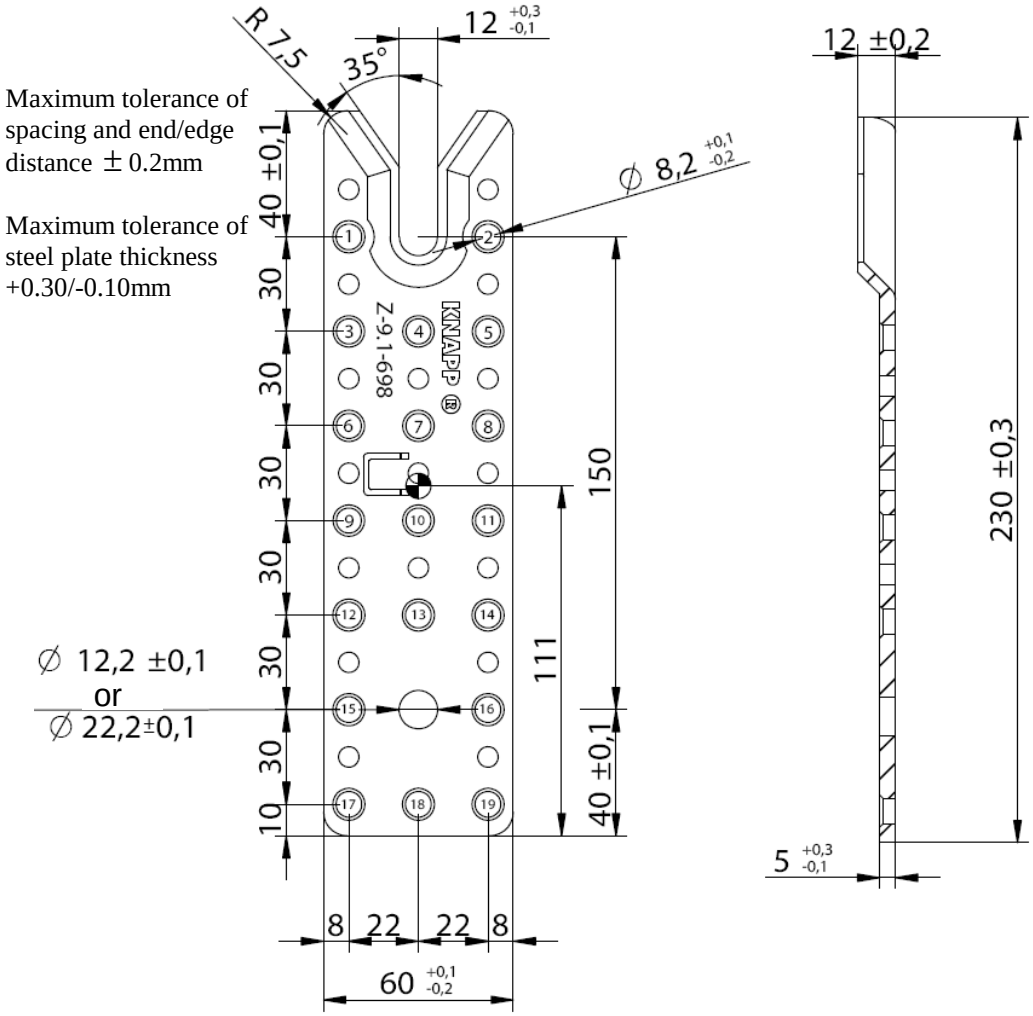
1:2

Screws
Header 1, 2, 4, 6, 8, 10, 12, 13
Joist 1, 2, 4, 6, 8, 10, 12, 13

dimensions in mm

Knapp Clip Connector RICON S 230/60

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

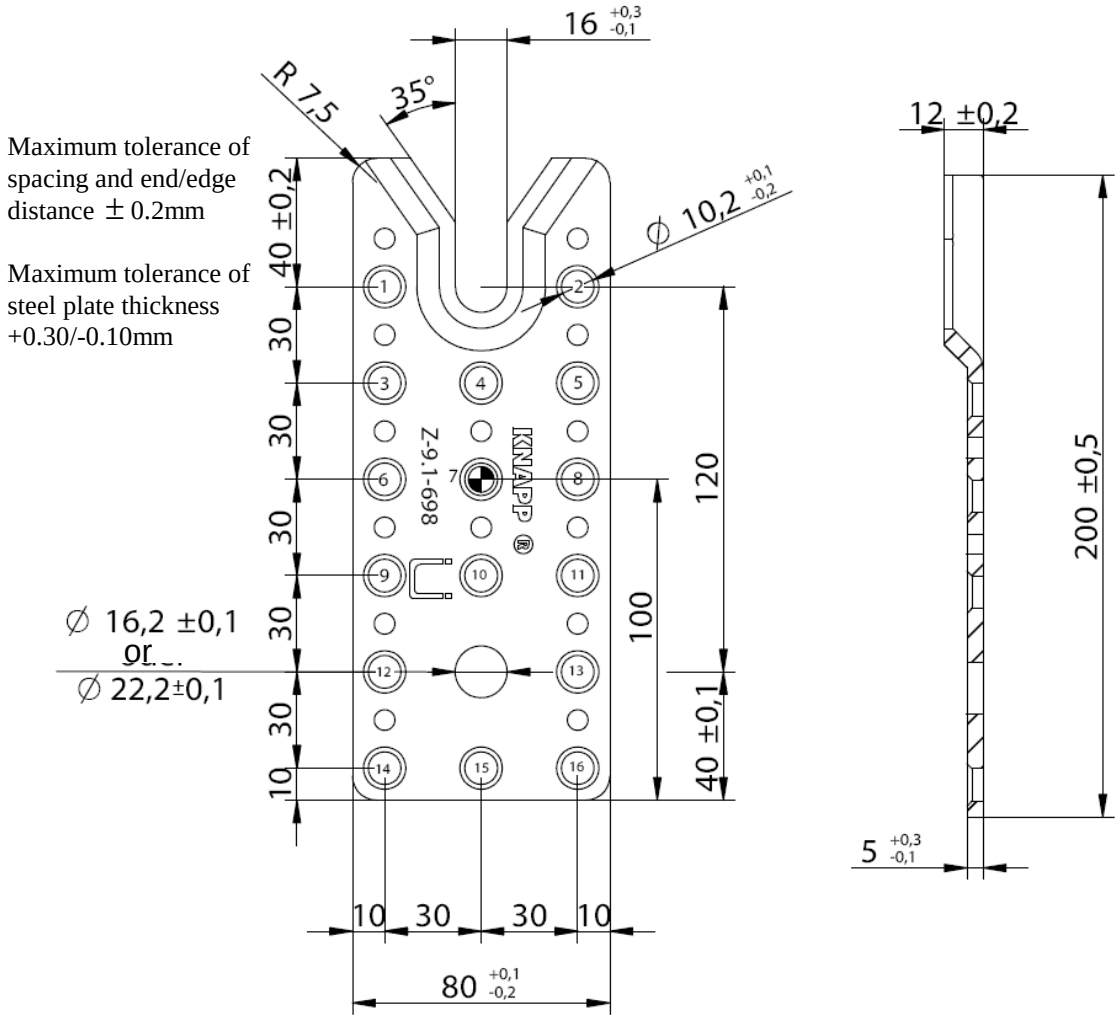
1:2

Screws
Header 1, 2, 4, 9, 11, 13, 15, 16
Joist 1, 2, 4, 9, 11, 13, 15, 16

dimensions in mm

Knapp Clip Connector RICON S 200/80

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

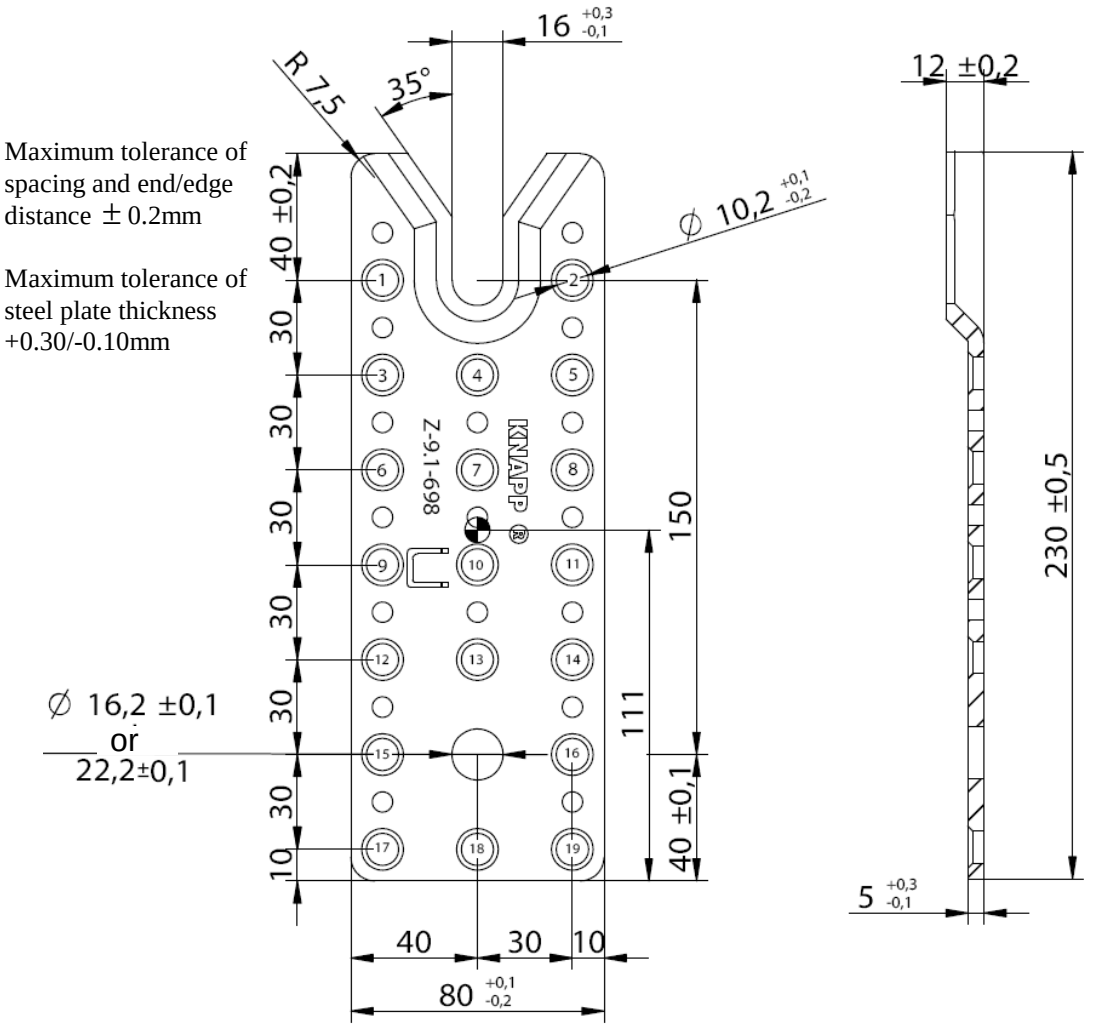
1:2

Screws
Header 1, 2, 4, 6, 8, 10, 12, 13
Joist 1, 2, 4, 6, 8, 10, 12, 13

dimensions in mm

Knapp Clip Connector RICON S 230/80

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

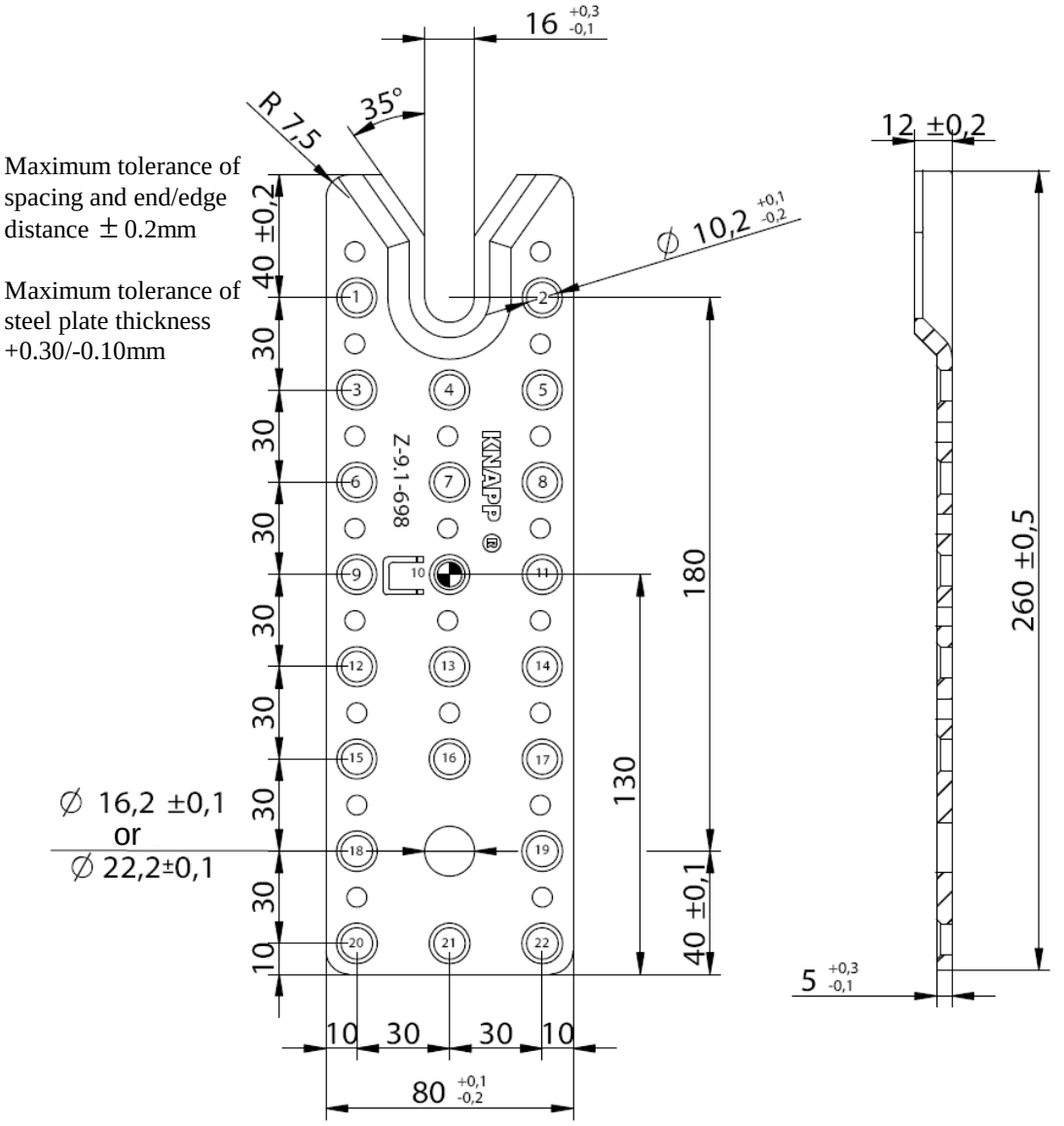
1:2

Screws
Header 1, 2, 4, 9, 11, 13, 15, 16
Joist 1, 2, 4, 9, 11, 13, 15, 16

dimensions in mm

Knapp Clip Connector RICON S 260/80

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

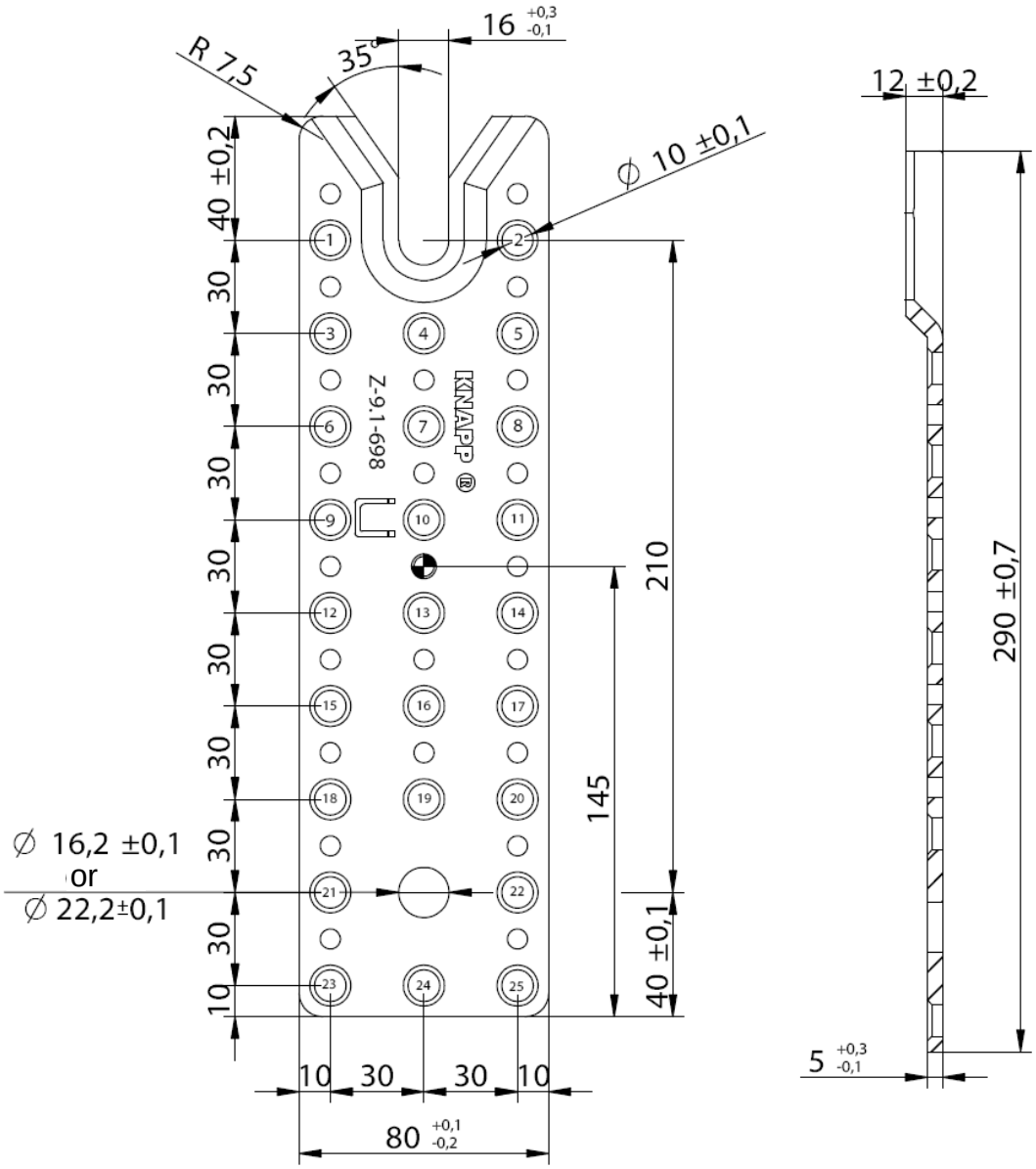
1:2

Screws
Header 1, 2, 6, 8, 12, 14, 18, 19
Joist 1, 2, 6, 8, 12, 14, 18, 19

dimensions in mm

Knapp Clip Connector RICON S 290/80

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



Centre of gravity of screw pattern

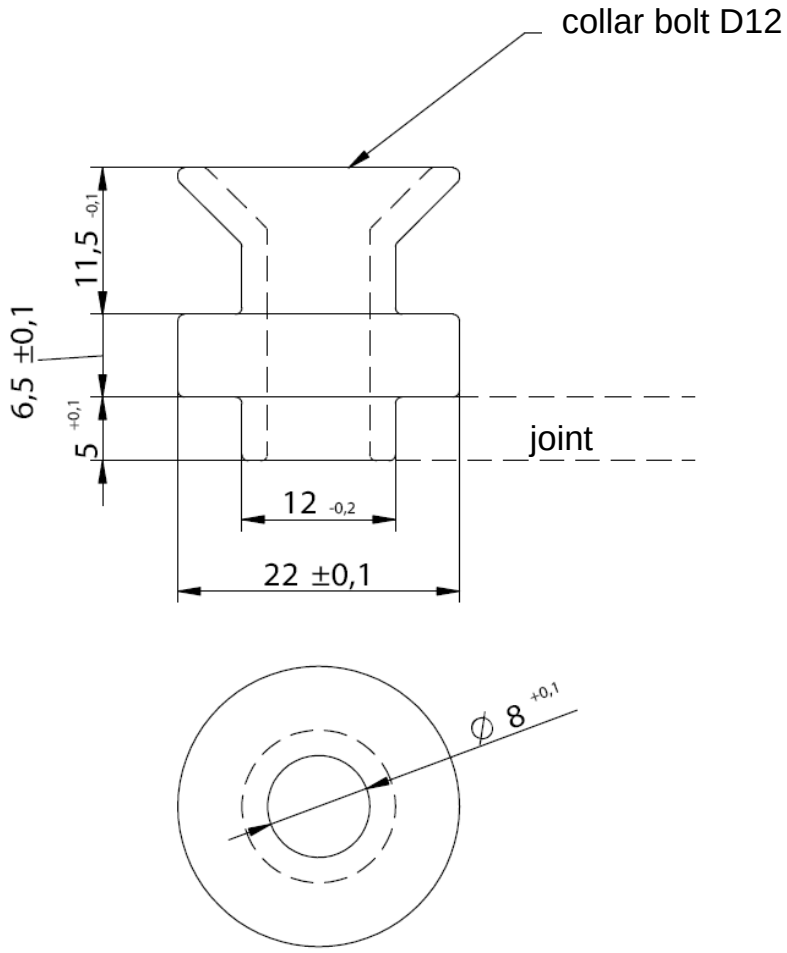
1:2

Screws
Header 1, 2, 6, 8, 15, 17, 21, 22
Joist 1, 2, 6, 8, 15, 17, 21, 22

dimensions in mm

Knapp RICON S 60 collar bolt D12

collar bolt of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with minimum yield strength R_{eH} of 410 MPa, minimum tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%

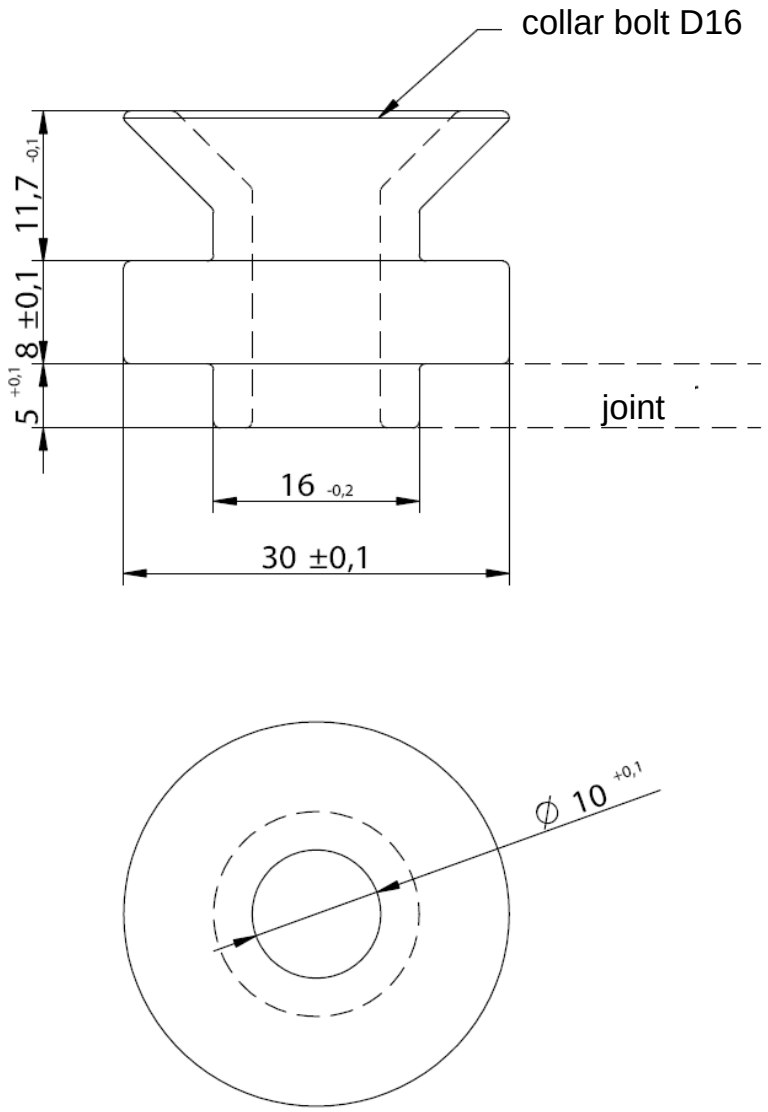


2:1

dimensions in mm

Knapp RICON S 80 collar bolt D16

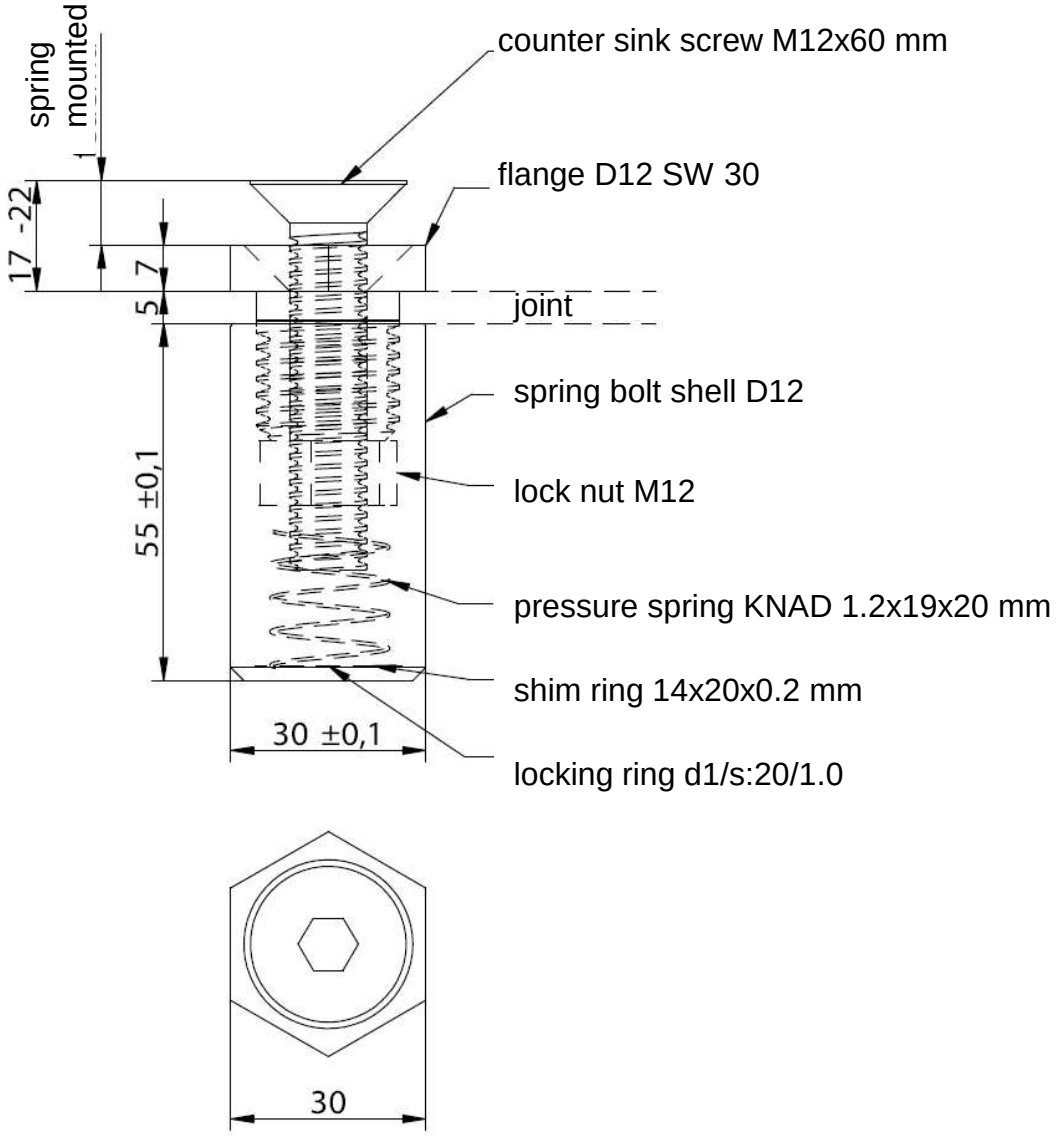
collar bolt of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with minimum yield strength R_{eH} of 410 MPa, minimum tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%



dimensions in mm

Knapp RICON S 60 spring retaining screw collar bolt M12

collar bolt and locknut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with minimum yield strength R_{eH} of 410 MPa, minimum tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN 14592; pressure spring of unalloyed spring steel with specification SM according to EN 10270-1, minimum tensile strength R_m of 1900 MPa, maximum tensile strength R_m of 2160 and minimum ultimate strain A_{80} of 40%;

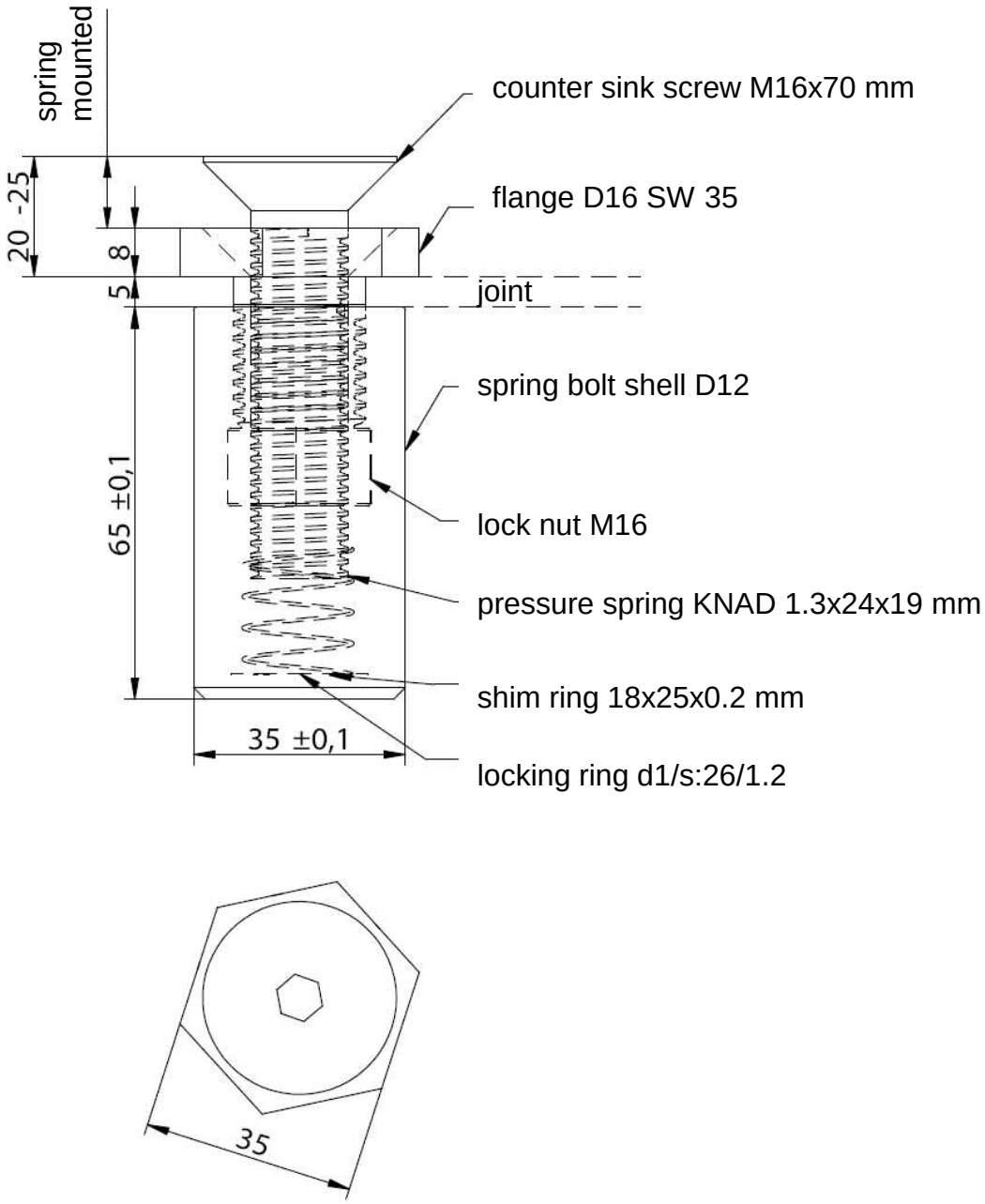


1:1

dimensions in mm

Knapp RICON S 80 spring retaining screw collar bolt M16

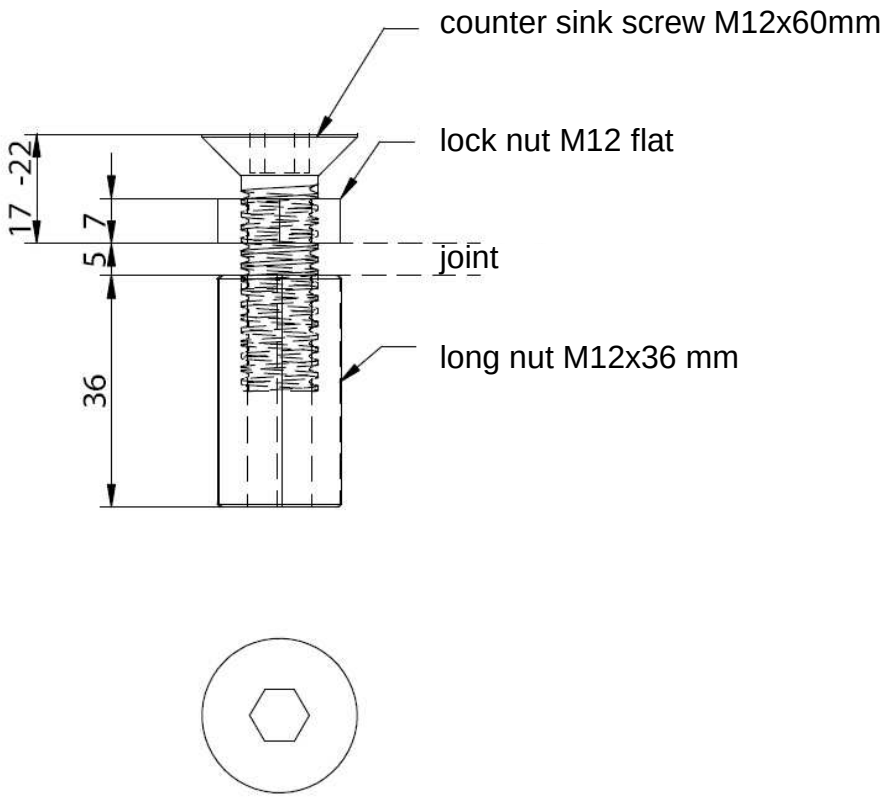
collar bolt and locknut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with minimum yield strength R_{eH} of 410 MPa, minimum tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN 14592; pressure spring of unalloyed spring steel with specification SM according to EN 10270-1, minimum tensile strength R_m of 1900 MPa, maximum tensile strength R_m of 2160 and minimum ultimate strain A_{80} of 40%;



dimensions in mm

Knapp RICON S 60 retaining screw bolt M12

retaining screw bolt, locknut and longnut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with minimum yield strength R_{eH} of 410 MPa, minimum tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN 14592

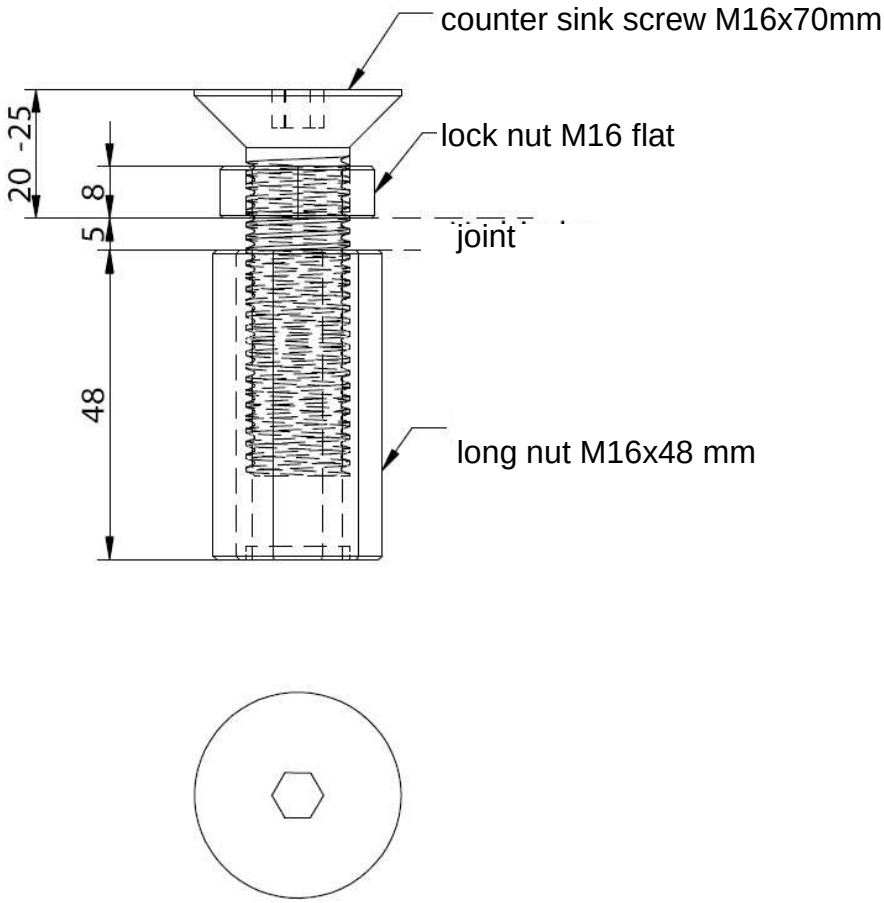


1:1

dimensions in mm

Knapp RICON S 80 retaining screw bolt M16

retaining screw bolt, locknut and longnut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with minimum yield strength R_{eH} of 410 MPa, minimum tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN 14592



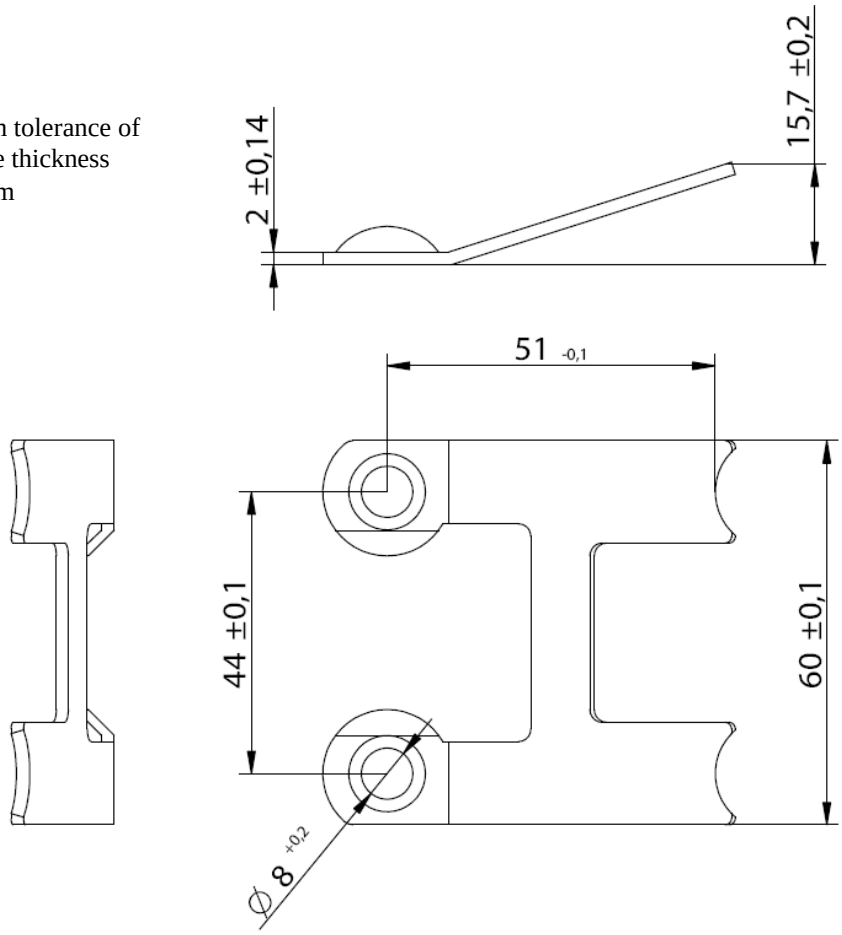
1:1

dimensions in mm

Knapp RICON S 60 clip lock

2.0 mm thick stainless steel grade X 12CrNi177 according to EN 17224-2:1995-11 with minimum tensile strength R_m of 1350 MPa

Maximum tolerance of steel plate thickness ± 0.14mm



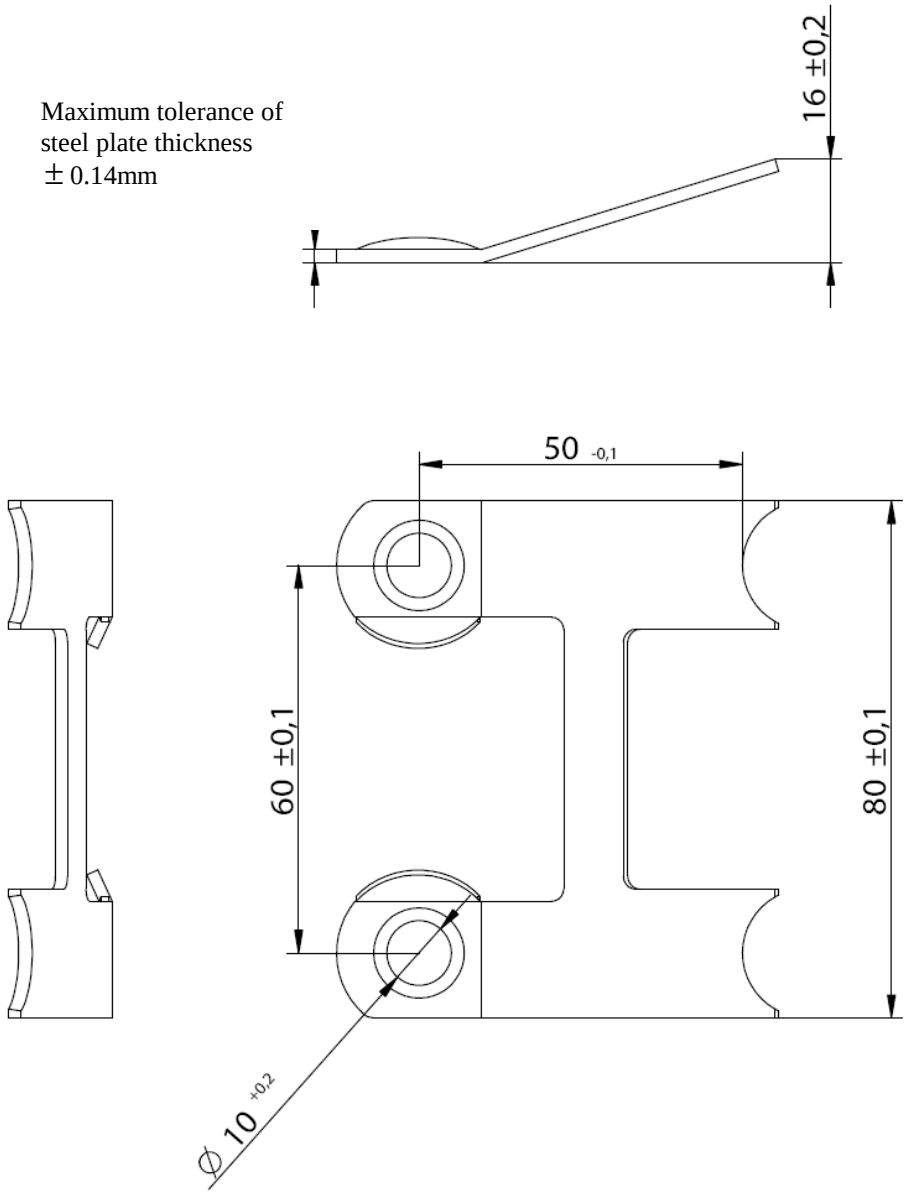
1:1

dimensions in mm

Knapp RICON S 80 clip lock

2.0 mm thick stainless steel grade X 12CrNi177 according to EN 17224-2:1995-11 with minimum tensile strength R_m of 1350 MPa

Maximum tolerance of steel plate thickness ± 0.14mm

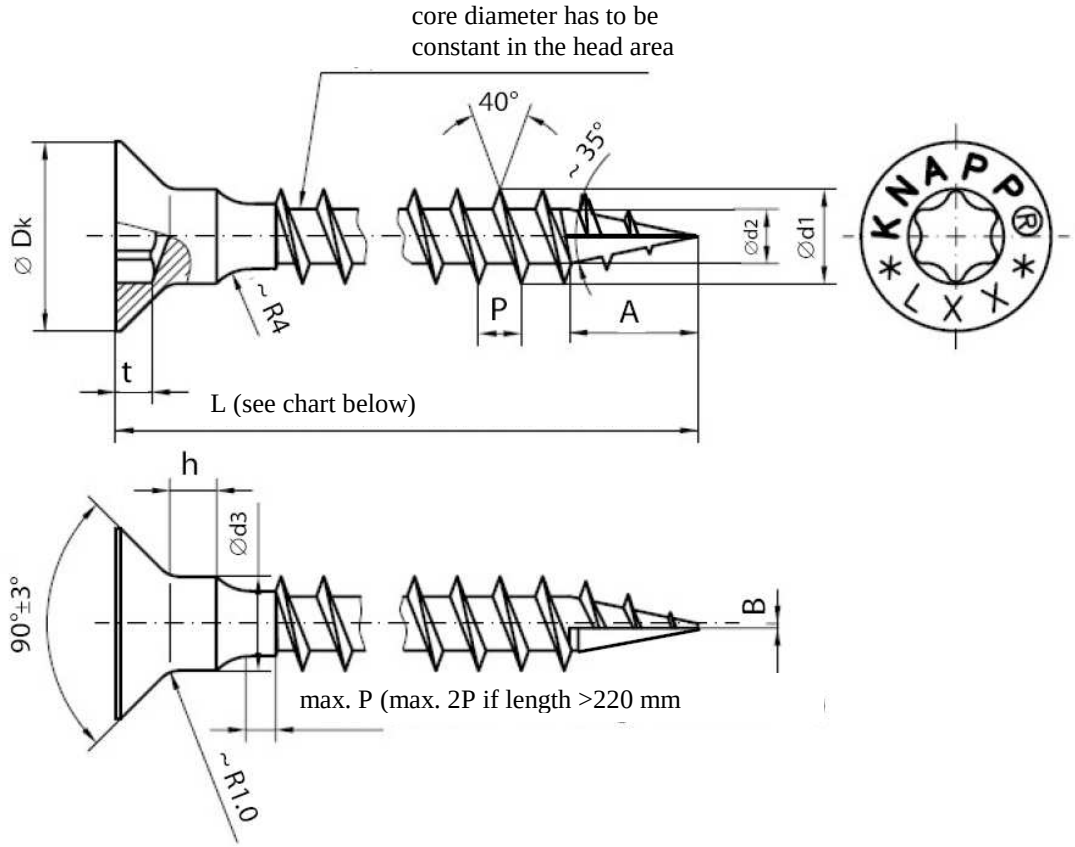


1:1

dimensions in mm

Knapp RICON S Screw Diameter 8 mm and 10 mm

Screws according to EN 14592 manufactured of carbon steel according to specifications on file at ETA Danmark, corrosion protection according to Eurocode 5-1-1; minimum torque $M_{t,u,k}$ for screw diameter 8 mm is 30Nm and for screw diameter 10 mm is 50Nm



RICON S 60							
nominal ∅ d1	wire ∅	bolt ∅	external ∅ d1	core ∅ d2	gradient P	milling length A	centrepitch B
8.0	5.67-5.79	5.77-5.85	8.0 -0.3	5.3 -0.3	3.6 ± 0.18	11 ± 1.5	0.1 +0.5

nominal ∅ d1	head ∅	joining height h	joining ∅ d3	drive	m	t	nominal length L	nominal length L
8.0	15.0 -0.8	3.00 ± 0.5	7.4 ± 0.1	6Lobe 40-253	6.8	3.05-3.42	80 -1.5	160 -1.5

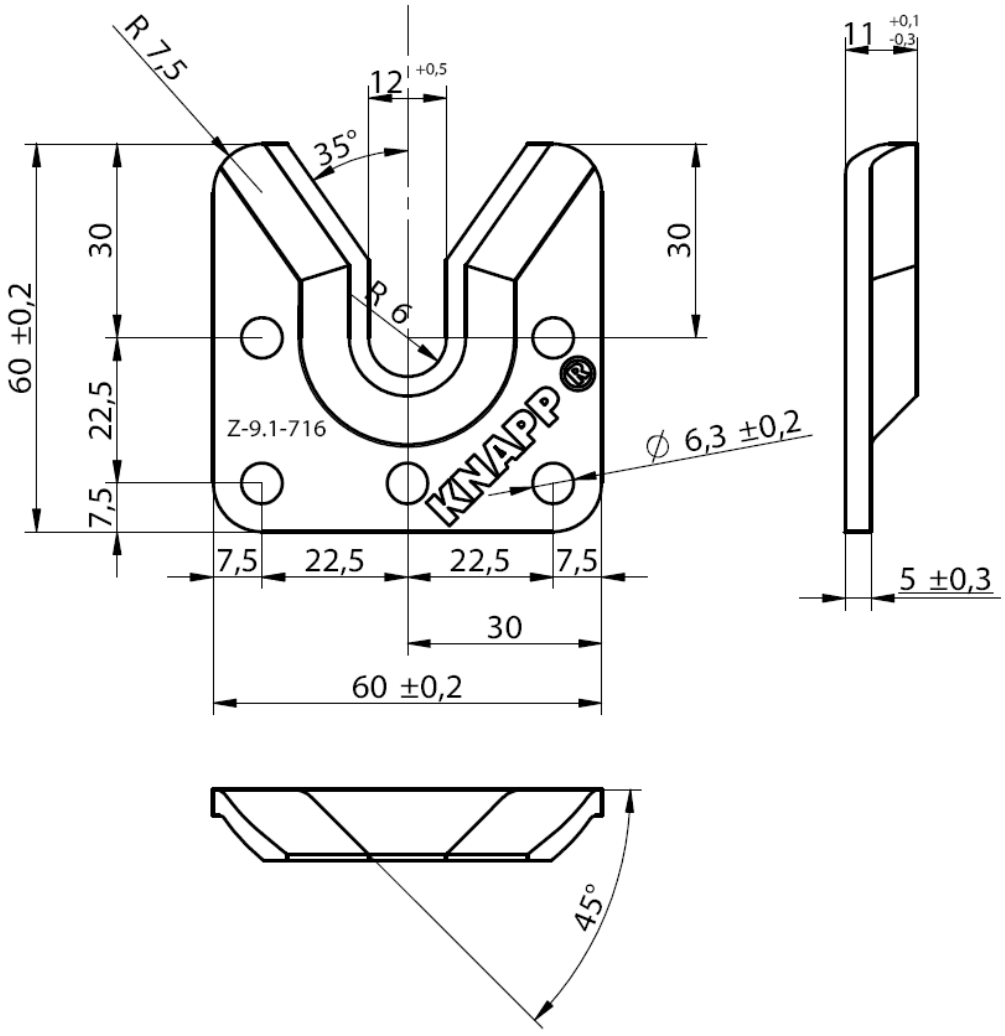
RICON S 80							
nominal ∅ d1	wire ∅	bolt ∅	external ∅ d1	core ∅ d2	gradient P	milling length A	centrepitch B
10.0	6.95-6.98	6.96-7.05	10,0 -0.3	6.3 -0.3	4.5 ± 0.18	13 ± 1.5	0.1 +0.5

nominal ∅ d1	head ∅	joining height h	joining ∅ d3	drive	m	t	nominal length L	nominal length L
10.0	18.5 -0.9	3.20 ± 0.5	9.4 ± 0.1	6Lobe 40-250	6.8	3.43-3.80	100 -1.8	200 -1.8

dimensions in mm

Knapp Clip Connector WALCO V 60

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1

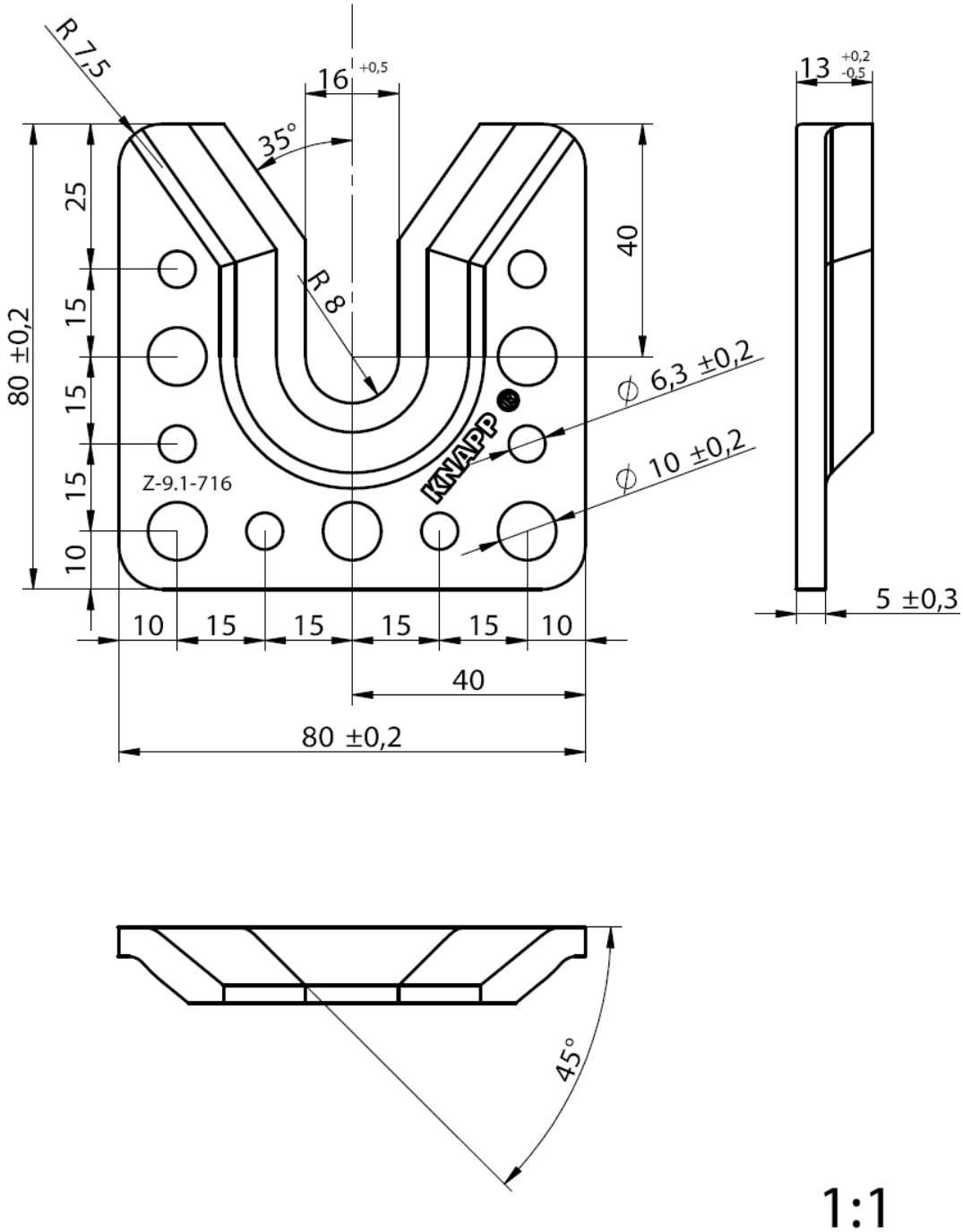


1:1

dimensions in mm

Knapp Clip Connector WALCO V 80

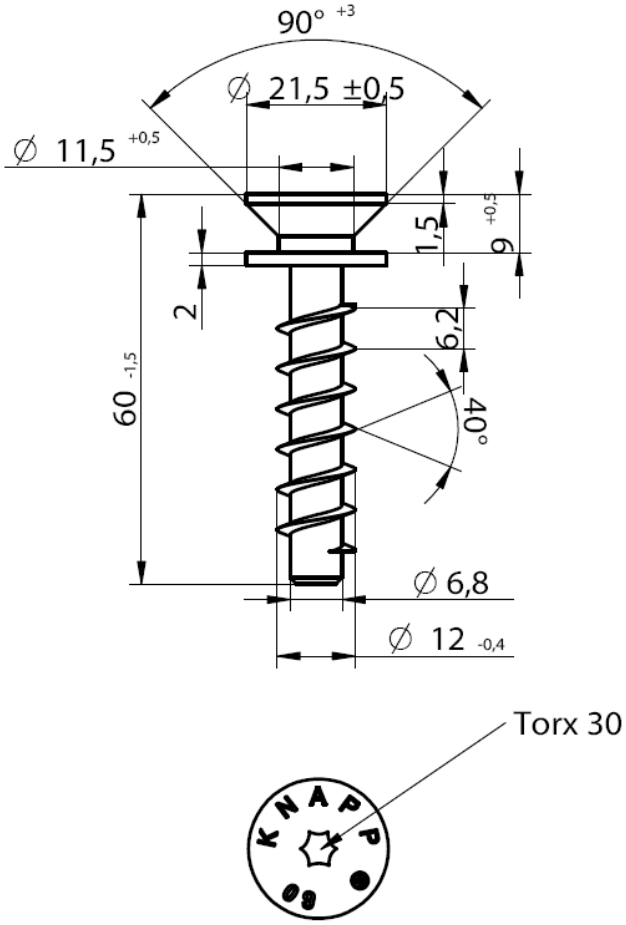
5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



dimensions in mm

Knapp Clip Connector WALCO V Collar Screw KS 12x60

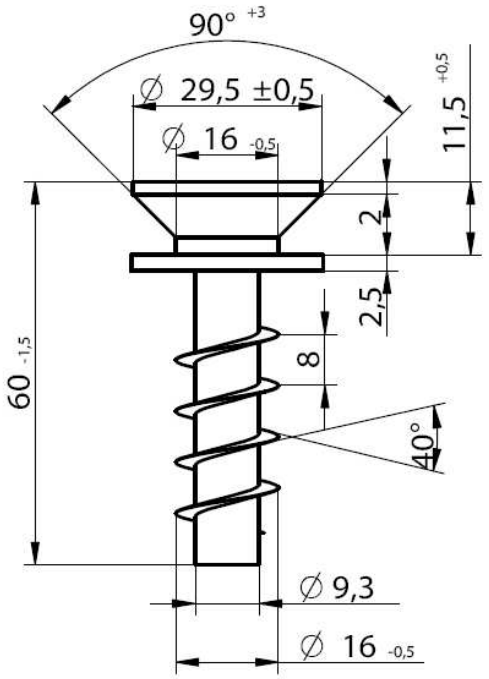
Screws according to EN 14592 with minimum tensile capacity $R_{t,u,k}$ of 29 kN

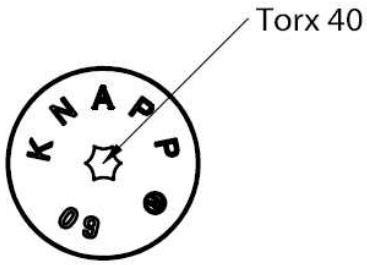


dimensions in mm

Knapp Clip Connector WALCO V Collar Screw KS 16x60

Screws according to EN 14592 with minimum tensile capacity $R_{t,u,k}$ of 48 kN



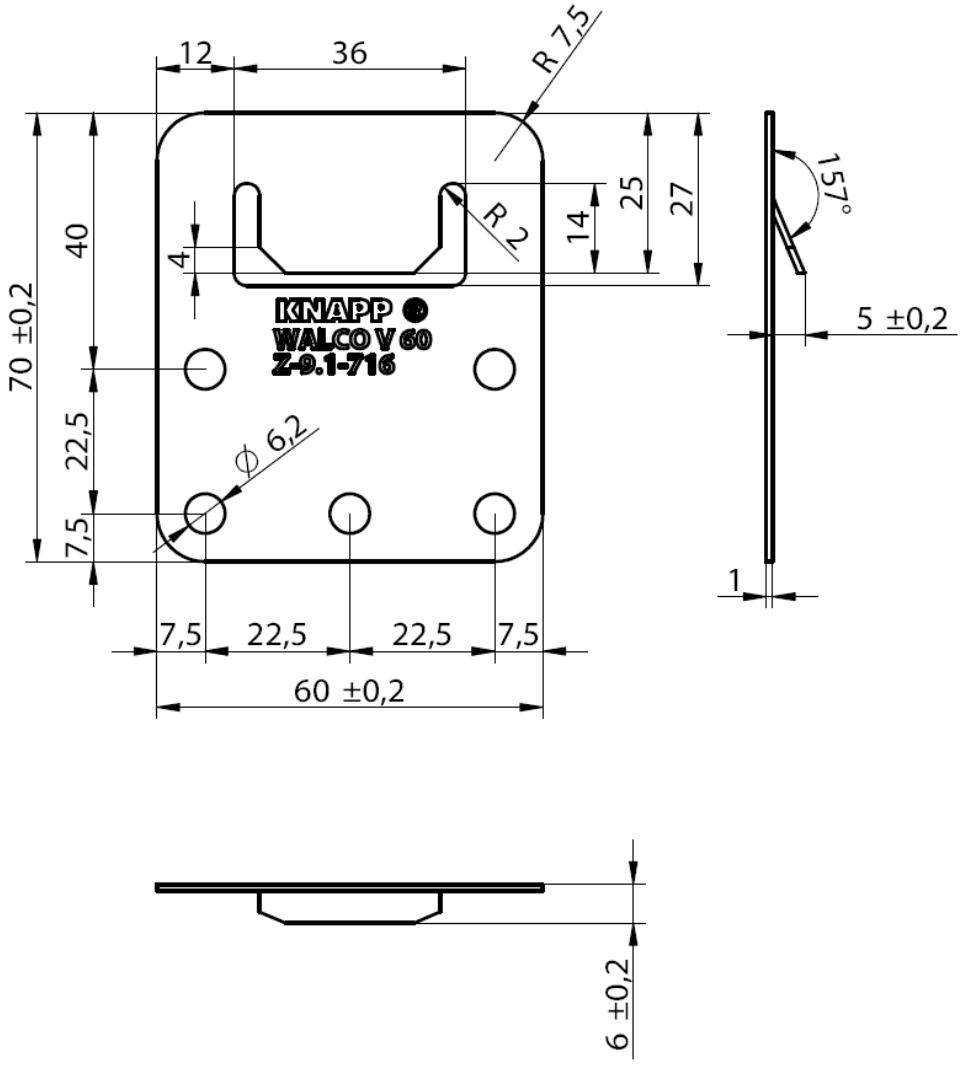


1:1

dimensions in mm

Knapp WALCO V clip lock V60

1.0 mm thick stainless steel grade X10CrNi 18-8 material number 1.4310 according to DIN EN 10151 with minimum tensile strength R_m of 1100 MPa

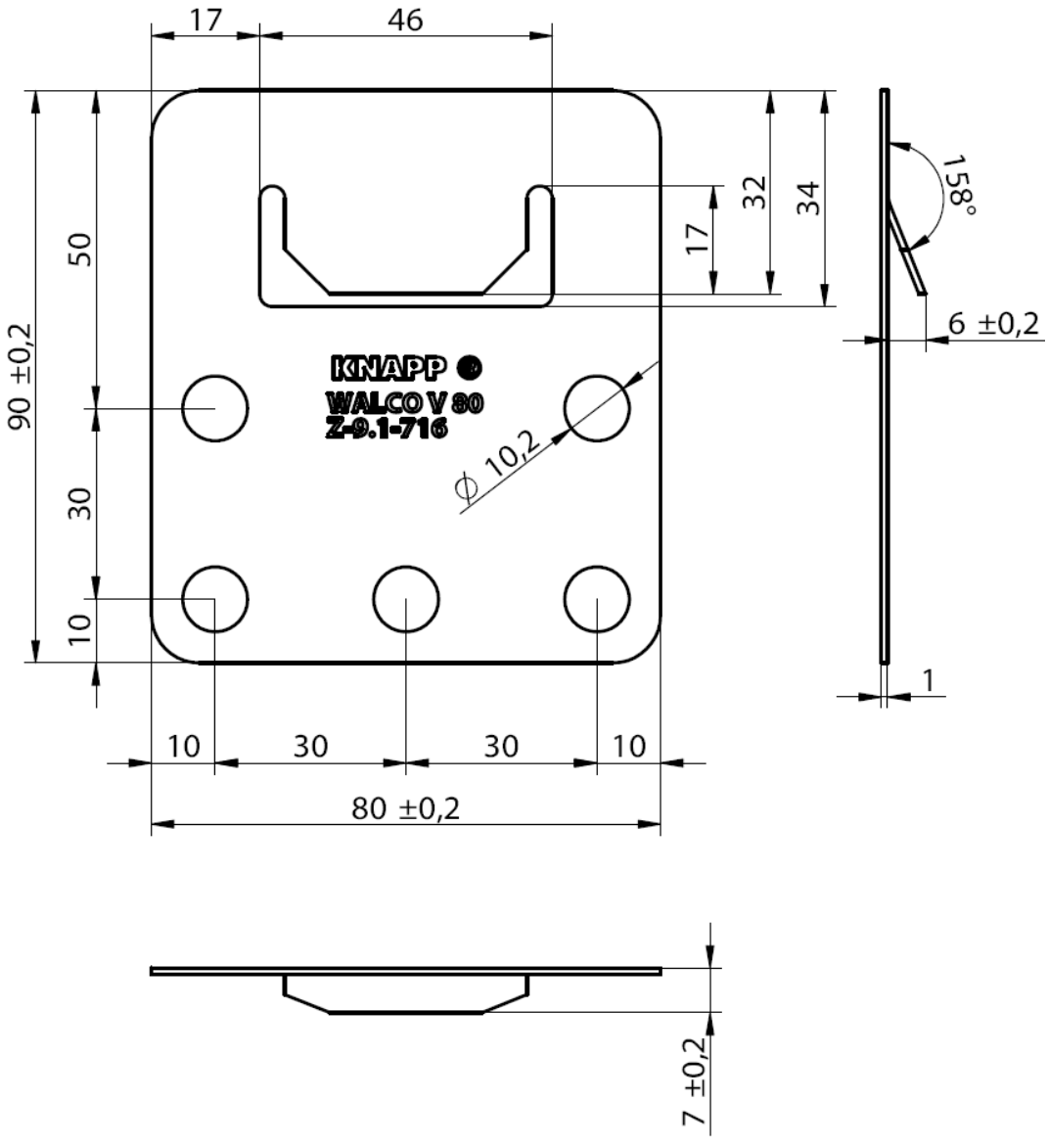


1:1

dimensions in mm

Knapp WALCO V clip lock V80

1.0 mm thick stainless steel grade X10CrNi 18-8 material number 1.4310 according to DIN EN 10151 with minimum tensile strength R_m of 1100 MPa

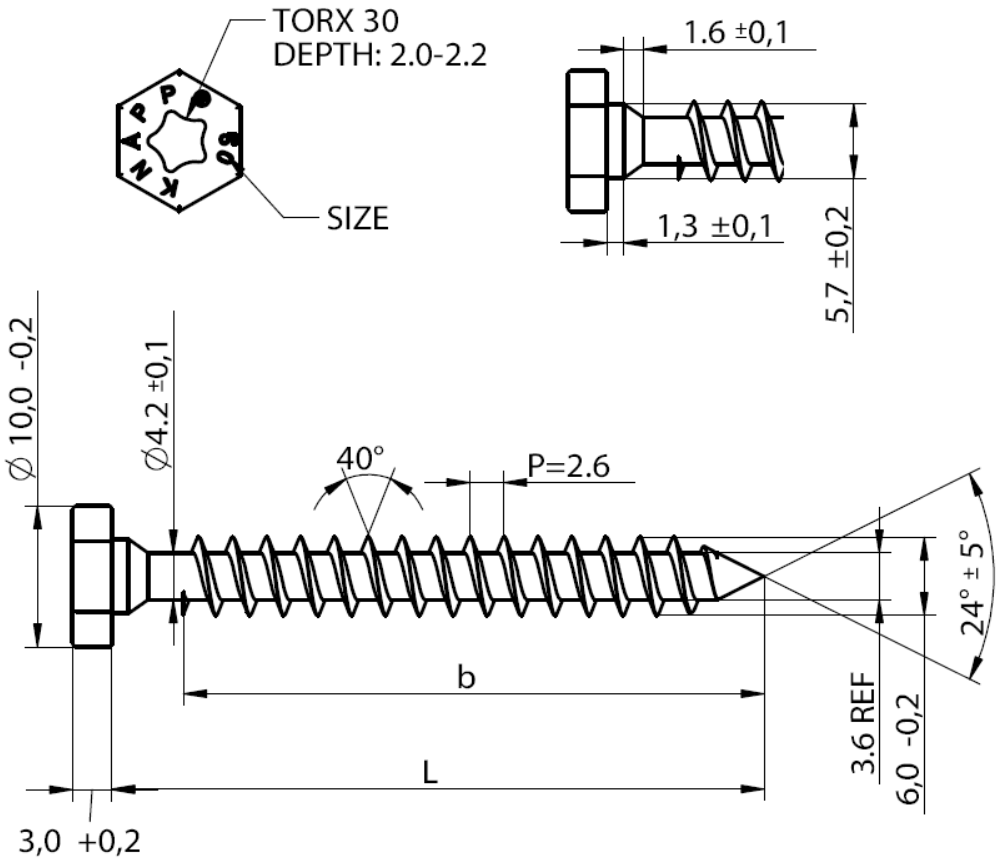


1:1

dimensions in mm

Knapp WALCO V PH Screw 6 x 50, 6 x 80

Screws according to EN 14592 manufactured of carbon steel according to SSH specifications K17, K20 or K22 on file at ETA Danmark, minimum torque $M_{t,u,k}$ of 10.5 Nm and corrosion protection according to Eurocode 5



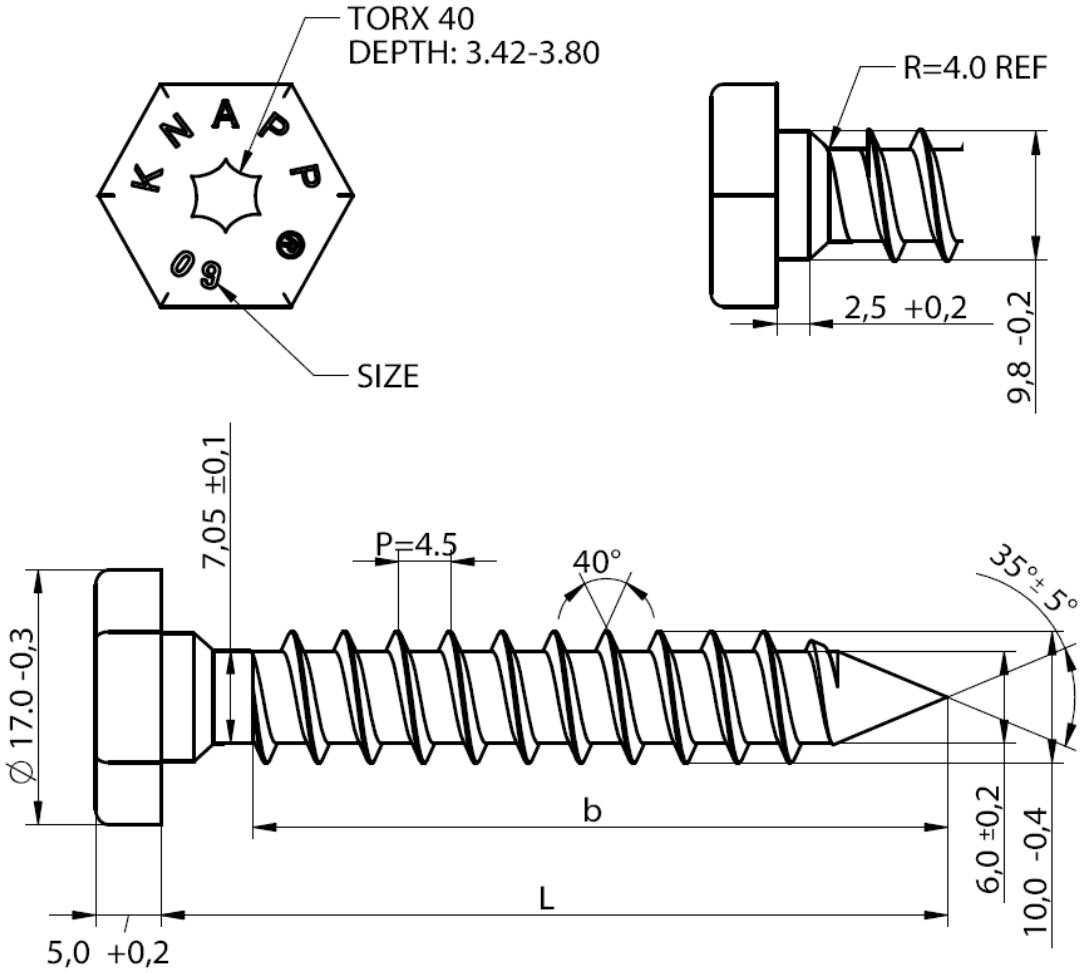
Pos	L	b
1	50,0 -1,5	45,0 -1,0
2	80,0 -3,0	76,0 -1,0

2:1

dimensions in mm

Knapp WALCO V PH Screw 10 x 60, 10 x 100

Screws according to EN 14592 manufactured of carbon steel according to SSH specifications K17, K20 or K22 on file at ETA Danmark, minimum torque $M_{t,u,k}$ of 40 Nm and corrosion protection according to Eurocode 5



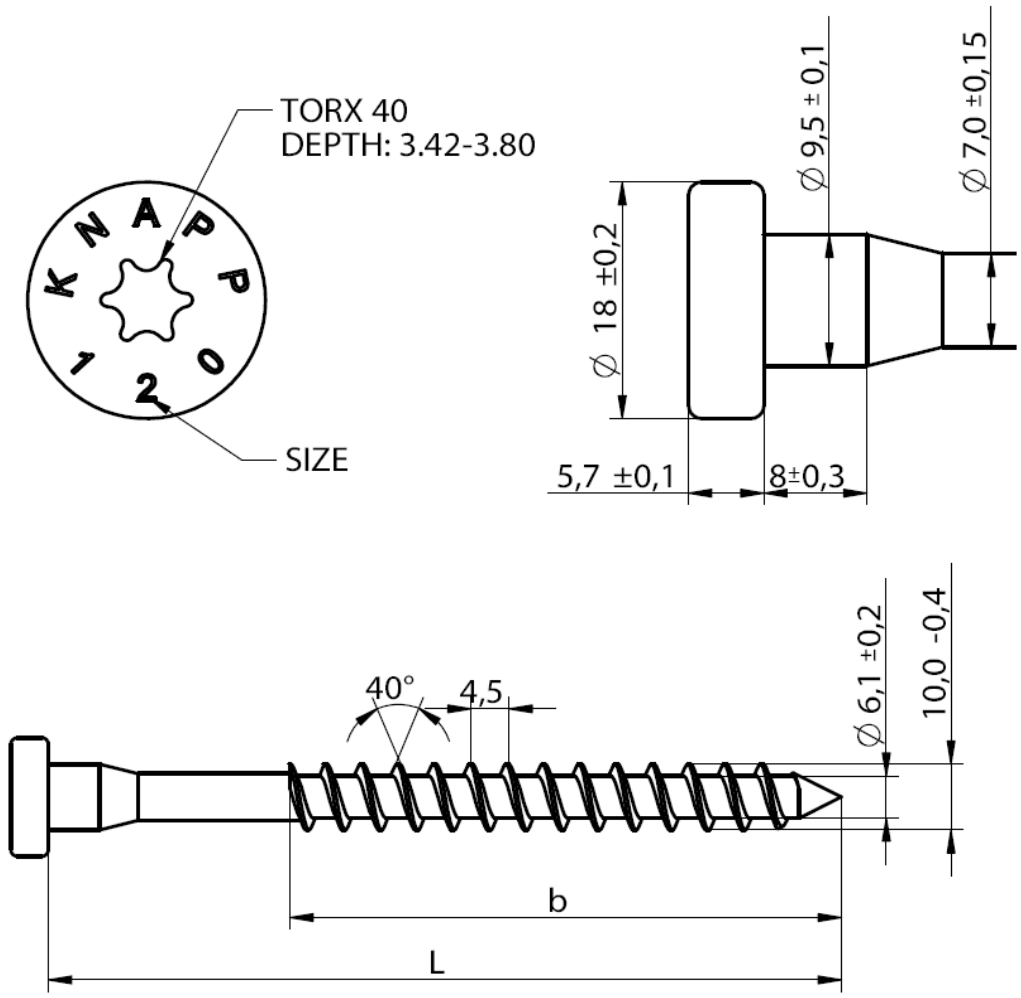
Pos	L	b
1	60,0 -1,5	50,0 ±1,0
2	100,0 -3,5	90,0 ±1,0

2:1

dimensions in mm

Knapp WALCO V PH Screw 10 x 60, 10 x 100

Screws according to EN 14592



Pos	L	b
1	80,0 ±3,5	54,0 ±2,0
2	120,0 ±3,5	84,0 ±2,0

1:1

dimensions in mm

Annex B
Design values of load-carrying- capacities

B.1 Design capacities of timber-to-timber connector joints.

The downward and the upward directed forces are assumed to act in the middle of the joist. The force F_{45} is assumed to act at a distance e_{45} from the centre of gravity of the fasteners.

Force F_1 for Knapp Clip Connectors GIGANT, RICON and RICON S:

$$F_{1,Rd} = n_{ef} \cdot \min\left\{F_{ax,Rd}; F_{t,Rd}; F_{1,KCC,Rd}\right\} \tag{B.1.1}$$

Force F_1 for Knapp Clip Connectors WALCO V:

$$F_{1,Rd} = \min\left\{2 \cdot F_{ax,Rd}; 2 \cdot F_{t,Rd}; F_{ax,CS,Rd}; 2 \cdot F_{1,KCC,Rd}\right\} \tag{B.1.2}$$

Force F_2 or F_3 for Knapp Clip Connectors GIGANT, RICON and RICON S:

$$F_{23,Rd} = \min\left\{\sum_{i=1}^{n} F_{v,J,Rd}^{i}; \frac{1}{\sqrt{\left(\frac{1}{\sum_{i=1}^{n} F_{v,H,Rd}^{i}}\right)^2 + \left(\frac{1}{k_{H,2} \cdot F_{ax,H,Rd}}\right)^2}}; F_{23,KCC,Rd}\right\} \tag{B.1.3}$$

Force F_2 or F_3 for Knapp Clip Connectors WALCO V:

$$F_{2,Rd} = \min\left\{F_{v,CS,Rd}; n \cdot F_{v,Rd}; F_{23,KCC,Rd}\right\} \tag{B.1.4}$$

Force F_{45} for Knapp Clip Connectors GIGANT, RICON and RICON S:

$$F_{45,Rd} = \min\left\{\begin{array}{l} \dfrac{F_{v,J,Rd}}{\sqrt{\left(\frac{1}{n_{45}} + \frac{e_{J,45}}{a_1}\right)^2 + \left(\frac{e_{J,45}}{a_2}\right)^2}} \\ \dfrac{F_{v,H,Rd}}{\sqrt{\left(\frac{1}{n_{45}} + \frac{e_{H,45}}{a_1}\right)^2 + \left(\frac{e_{H,45}}{a_2}\right)^2 + \left(\frac{F_{v,H,Rd}}{k_{H,45} \cdot F_{ax,H,Rd}}\right)^2}} \\ F_{45,KCC,Rd} \end{array}\right. \tag{B.1.5}$$

An effective number of screws n_{45} is used, for Knapp Clip Connectors RICON based on the load-carrying capacity of 8 mm screws, see Table C.1. Only for Knapp Clip Connectors RICON, a reinforcing plate may be used. In this case, the load-carrying capacity of the reinforcing plate $F_{45,RC,Rd}$ may be added to $F_{45,Rd}$.

$$F_{45,RC,Rk} = 4,0\ \text{kN} \tag{B.1.6}$$

Force F_{45} for Knapp Clip Connectors WALCO V:

$$F_{45,Rd} = \min\left\{F_{v,CS,Rd}; 2 \cdot F_{v,Rd}; F_{45,KCC,Rd}\right\} \quad \text{(B.1.7)}$$

Where:

$F_{ax,Rd}$ Design withdrawal capacity of a tensile screw

$$F_{ax,Rd} = \frac{k_{mod}}{\gamma_M} \cdot \frac{0{,}52 \cdot \sqrt{d} \cdot \ell_{ef}^{0,9} \cdot \rho_k^{0,8}}{1{,}2 \cdot \cos^2\alpha + \sin^2\alpha} \quad \text{(B.1.4)}$$

$F_{ax,CS,Rd}$ Design withdrawal capacity of a collar screw (WALCO V) according to eq. (B.1.4)

d outer thread diameter of a screw in mm;

ℓ_{ef} point side penetration length of the threaded part in mm; for screws parallel to the grain in the joist ℓ_{ef} should be at least 50 % larger than ℓ_{ef} in the header;

ρ_k characteristic density in kg/m³;

α angle between grain direction and screw axis;

n_{ef} effective number of screws;

$n_{ef} = \frac{a_c}{a_c - e_1}$ for Knapp Clip Connectors GIGANT and RICON;

$n_{ef} = \frac{2 \cdot a_c}{a_c - e_1}$ for Knapp Clip Connectors RICON S;

a_c spacing between the tensile screws of Connectors GIGANT, RICON and RICON S, see Table C.1;

e_1 distance between load F_1 and the tensile screw considered (see Figure B.1). e_1 is positive if F_1 acts within the length a_c, otherwise e_1 is negative;

$F_{t,Rd}$ Design screw tensile capacity;

$F_{1,KCC,Rd}$ Design capacity of the Knapp Clip Connector, characteristic values see Table C.1.

$F_{v,Rd}$ Design lateral load-carrying capacity per shear plane per fastener according to EN 1995-1-1 8.2.3 for thick outer steel plates in the joist or in the header indicated by the indices J or H, where the embedding strength is as follows;

$f_{h,k}$ characteristic embedding strength for joist or header screw;

$f_{h,k} = (0{,}033 + 0{,}049 \cdot \alpha/90°) \cdot \rho_k \cdot d^{-0,3}$ in Mpa;

$F_{v,CS,Rd}$ Design load-carrying capacity of a collar screw according to EN 1995-1-1 8.2.3 for thin outer steel plates;

$F_{ax,H,Rd}$ Design axial capacity of an outer header screw according to EN 1995-1-1 8.7.2, for Knapp Clip Connectors RICON for the 8 mm screw;

n number of screws per connector plate;

$k_{H,2}$ form factor, see Table C.1;

$F_{23,KCC,Rd}$ Design capacity of the Knapp Clip Connector, characteristic values see Table C.1.

n_{45} effective number of screws per connector plate for load F_{45};

e_{45} Distance between the force F_{45} and the centroid of the fasteners in the joist or in the header indicated by the indices J or H;

a_1, a_2 connector dimensions, see Table C.1;

$k_{H,45}$ form factor, see Table C.1;

$F_{45,KCC,Rd}$ Design capacity of the Knapp Clip Connector, characteristic values see Table C.1.

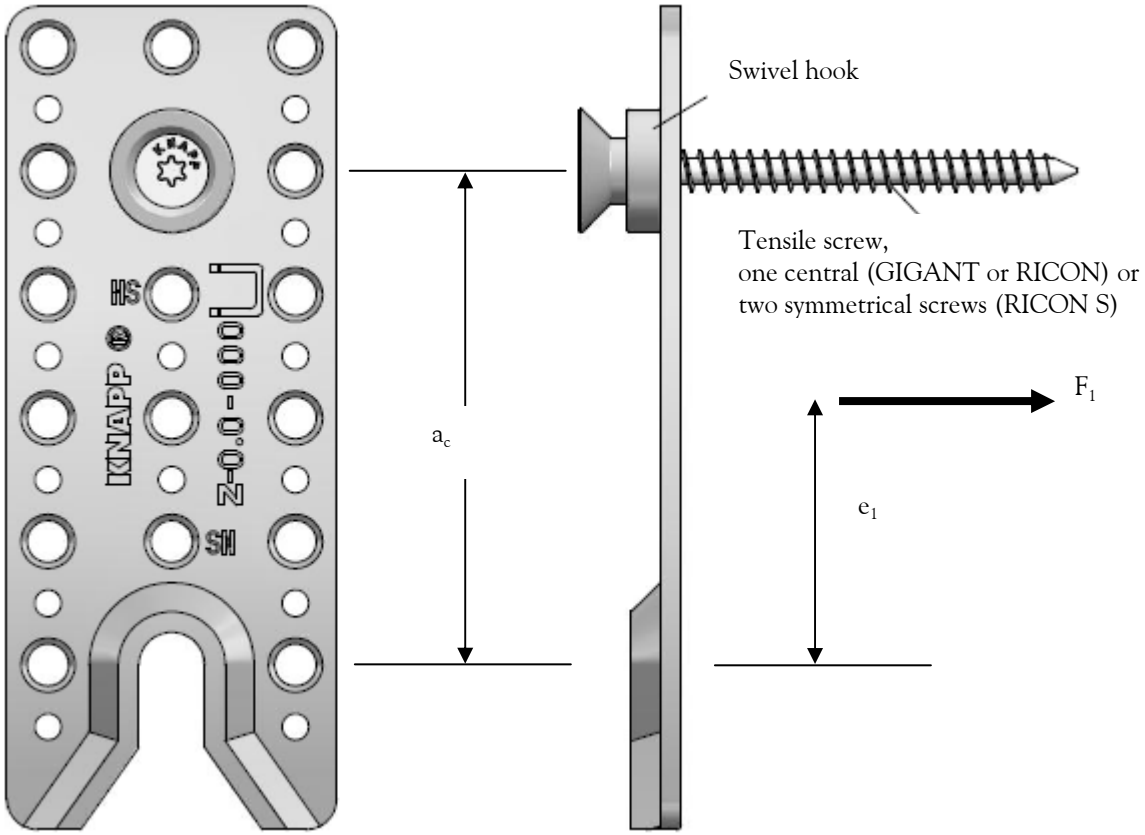


Fig. B.1: Definition of e_1

Combined forces

In case of combined forces the following inequality shall be fulfilled:

$$\left(\frac{F_{1,Ed}}{F_{1,Rd}}\right)^2 + \left(\frac{F_{23,Ed}}{F_{23,Rd}}\right)^2 + \left(\frac{F_{45,Ed}}{F_{45,Rd}}\right)^2 \leq 1 \qquad \text{(B.1.8)}$$

B.2 Design capacities of connector joints with bolts

For connector plates connected to a steel member or to a timber member using bolts or interconnection nuts the assumptions for the calculation of the load-carrying capacity of the connection are:

- The transfer of force from the joist to the connector plate is as for a wood-wood connection, see clause B.1;
- The bolts or interconnection nuts shall always be arranged as the screws they are replacing;
- No washers are required.

The static behaviour is the same as for a wood-wood connection with screws. The bolt capacities replace the respective header screw capacities in equations B.1 to B.7.

B.3 Connection stiffness

The following slip moduli K_{ser} are to be used for Knapp Clip Connectors joints:

Load direction F1

Knapp Clip Connectors GIGANT:	K_{ser} = 8,0 kN/mm
Knapp Clip Connectors RICON:	K_{ser} = 12,0 kN/mm
Knapp Clip Connectors RICON S:	K_{ser} = 25,0 kN/mm
Knapp Clip Connectors WALCO V:	K_{ser} = 4,0 kN/mm

Load directions F_2, F_3 or F_{45}

For a centrical load parallel to the plane of the connector plates, the slip modulus for joints with Knapp Clip Connectors may be calculated as:

Knapp Clip Connectors GIGANT, RICON and RICON S:

$$K_{ser} = 0,07 \cdot \sum_{i=1}^{n} \rho_k \cdot d_i^{0,8} \qquad \text{(B.3.1)}$$

Where:

ρ_k The lower value of the characteristic density of the joist or header;

n Number of screws in the joist or header connection;

d_i Outer thread diameter;

Knapp Clip Connectors WALCO V:	K_{ser} = 1,0 kN/mm

For an excentric load parallel to the plane of the connector plates, the slip modulus for joints with Knapp Clip Connectors GIGANT, RICON and RICON S may be calculated as:

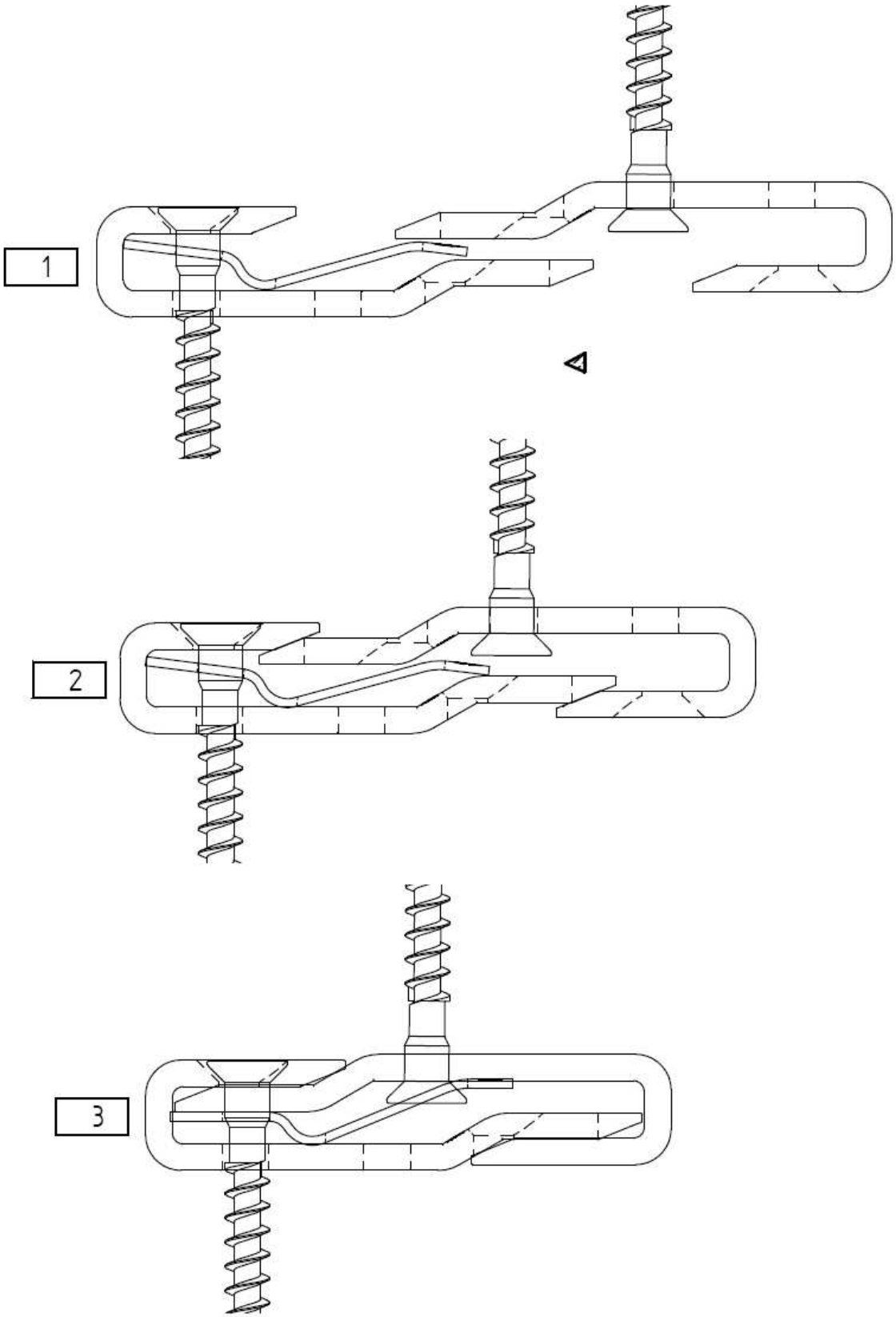
Knapp Clip Connectors GIGANT:	K_{ser} = 1,0 kN/mm
Knapp Clip Connectors RICON without reinforcing plate:	K_{ser} = 1,0 kN/mm
Knapp Clip Connectors RICON with reinforcing plate:	K_{ser} = 2,5 kN/mm
Knapp Clip Connectors RICON S:	K_{ser} = 4,0 kN/mm

Annex C
Characteristic capacities $F_{KCC,Rk}$, form factors k_H, dimensions a_c, a_1, a_2 and numbers n_{45}

Knapp Clip Connectors	$F_{1,KCC,Rk}$ [kN]	$F_{2,KCC,Rk}$ [kN]	$F_{3,KCC,Rk}$ [kN]	$F_{45,KCC,Rk}$ [N]	$k_{H,2}$	$k_{H,45}$	a_c [mm]	a_1 [mm]	a_2 [mm]	n_{45}
GIGANT 120/40	6,2	17,0	12,0	12,0	2,55	2,22	58	56	∞	3
GIGANT 150/40 without clip lock		24,0	-	16,0	4,74	2,22	90	91	422	4
GIGANT 150/40 with clip lock			12,0		4,95	2,96	90	98	∞	4
GIGANT 180/40 without clip lock		33,0	-	20,0	8,84	3,46	122	140	882	6
GIGANT 180/40 with clip lock			12,0		8,15	3,70	122	151	∞	5
RICON 60/40	5,9	6,0	n_{CL} · 2,7	4,0	2,30	3,42	34	33	42	1,9
RICON 80/40		11,0		8,0	4,68	4,75	54	43	81	2,9
RICON 100/40		14,0		10,0	9,34	6,83	74	73	213	3,8
RICON 120/40		18,0		12,0	15,7	8,92	94	110	434	4,8
RICON 140/40		18,0		12,0	23,7	11,0	114	155	771	5,7
RICON 160/40		18,0		12,0	33,3	13,1	134	209	1247	6,6
Double RICON 80/40		11,0		8,0	23,2	8,17	134	181	1145	4,8
Double RICON 100/40		14,0		10,0	44,9	12,3	174	319	2619	6,7
Double RICON 120/40		18,0		12,0	73,3	16,5	214	487	4953	8,5
RICON S 140/60	9,0	34,0	18,0	34,0	10,7	8,25	60	313	683	10
RICON S 170/60					18,3	10,6	90	438	1240	13
RICON S 200/60					27,8	13,0	120	590	2061	16
RICON S 230/60					39,3	15,3	150	771	3210	19
RICON S 200/80		50,0		50,0	27,8	17,3	120	665	1678	16
RICON S 230/80					39,3	20,5	150	835	2548	19
RICON S 260/80					52,9	23,6	180	1045	3704	22
RICON S 290/80					68,4	26,8	210	1284	5189	25
WALCO V 60 WALCO V 80		17,0	5,0	17,0	-	-	-	-	-	-
n_{CL}: Number of clip locks in RICON connections, n_{CL} = 1 or n_{CL} = 2										

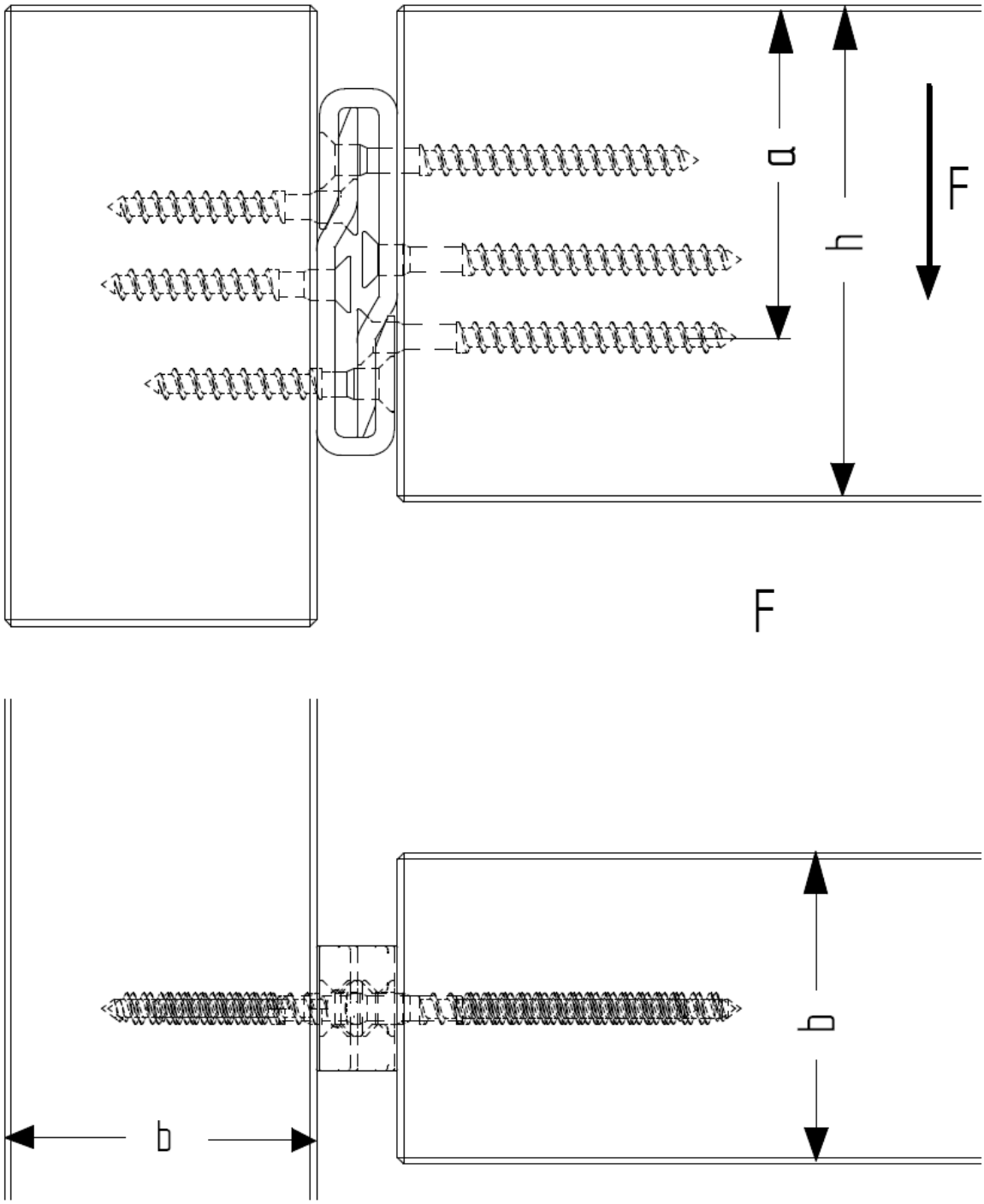
Annex D
Installation of connectors

GIGANT
Functional principle clip lock



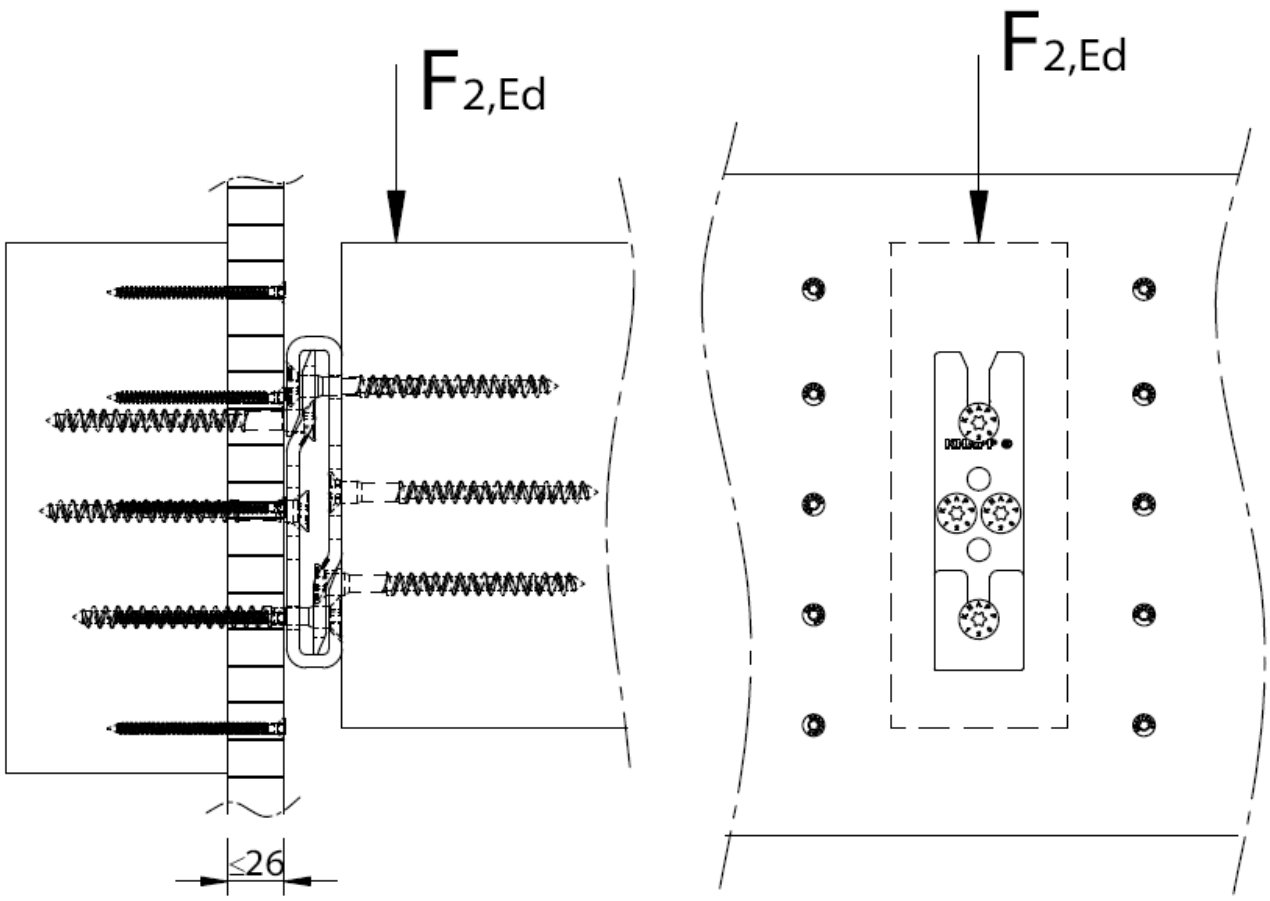
GIGANT

Wood-to-wood joint



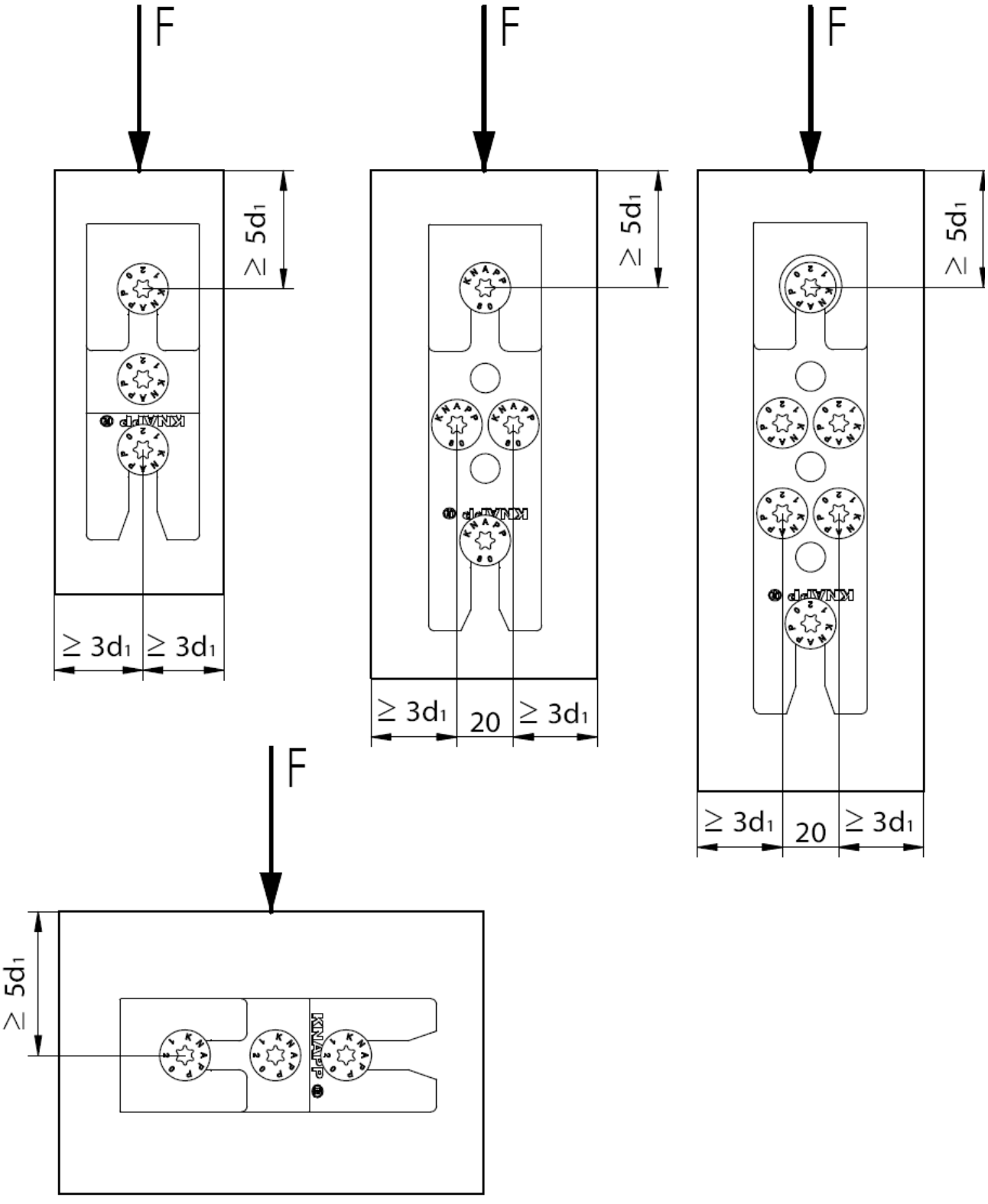
GIGANT

joint with interlayer



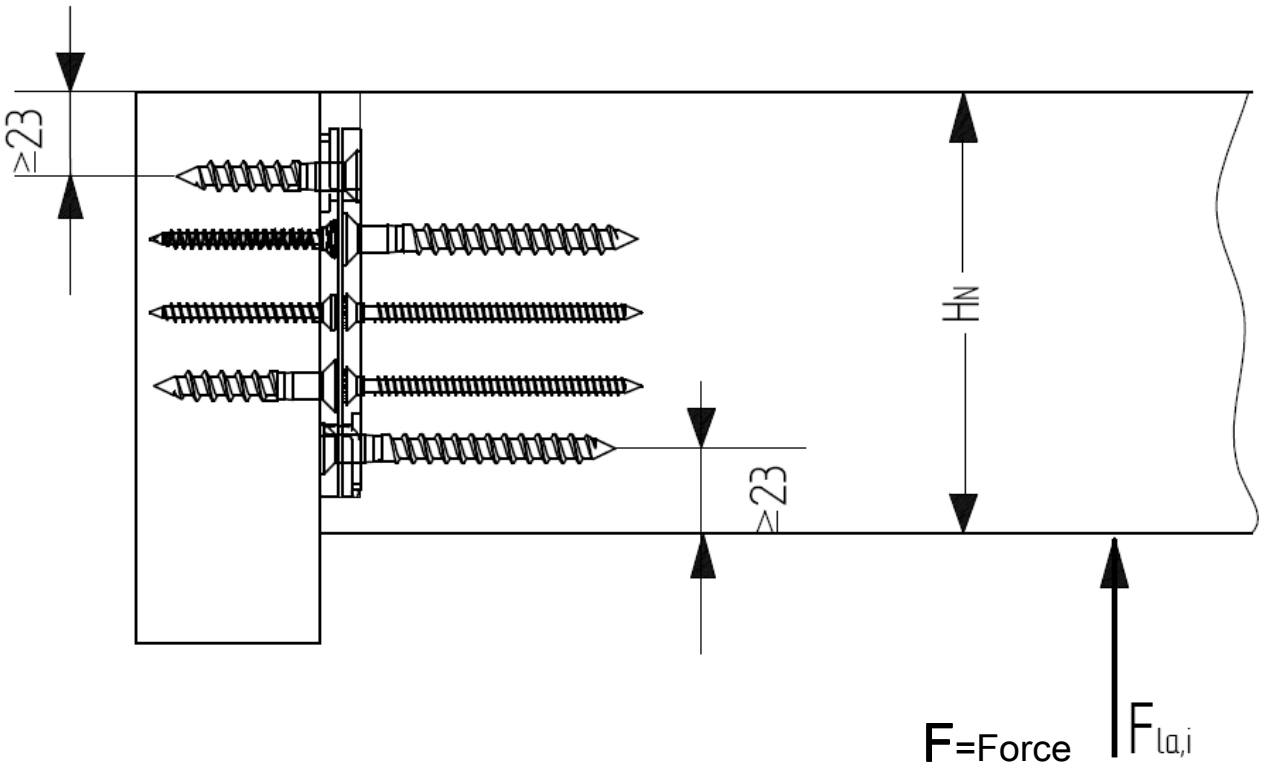
GIGANT

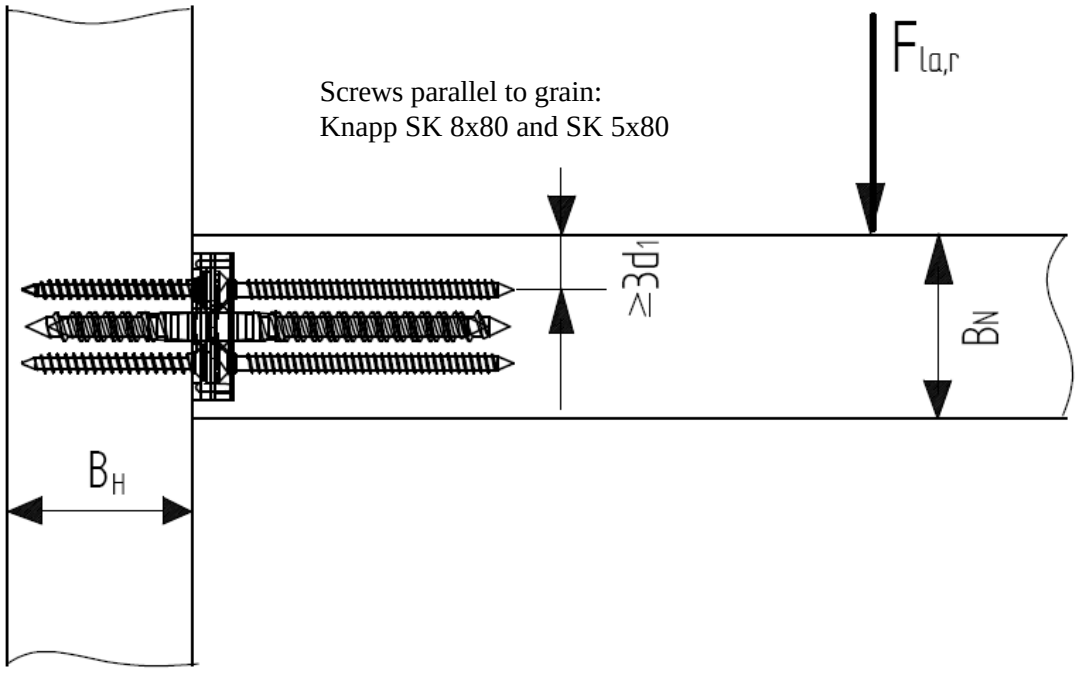
Minimum edge distances for joists



RICON

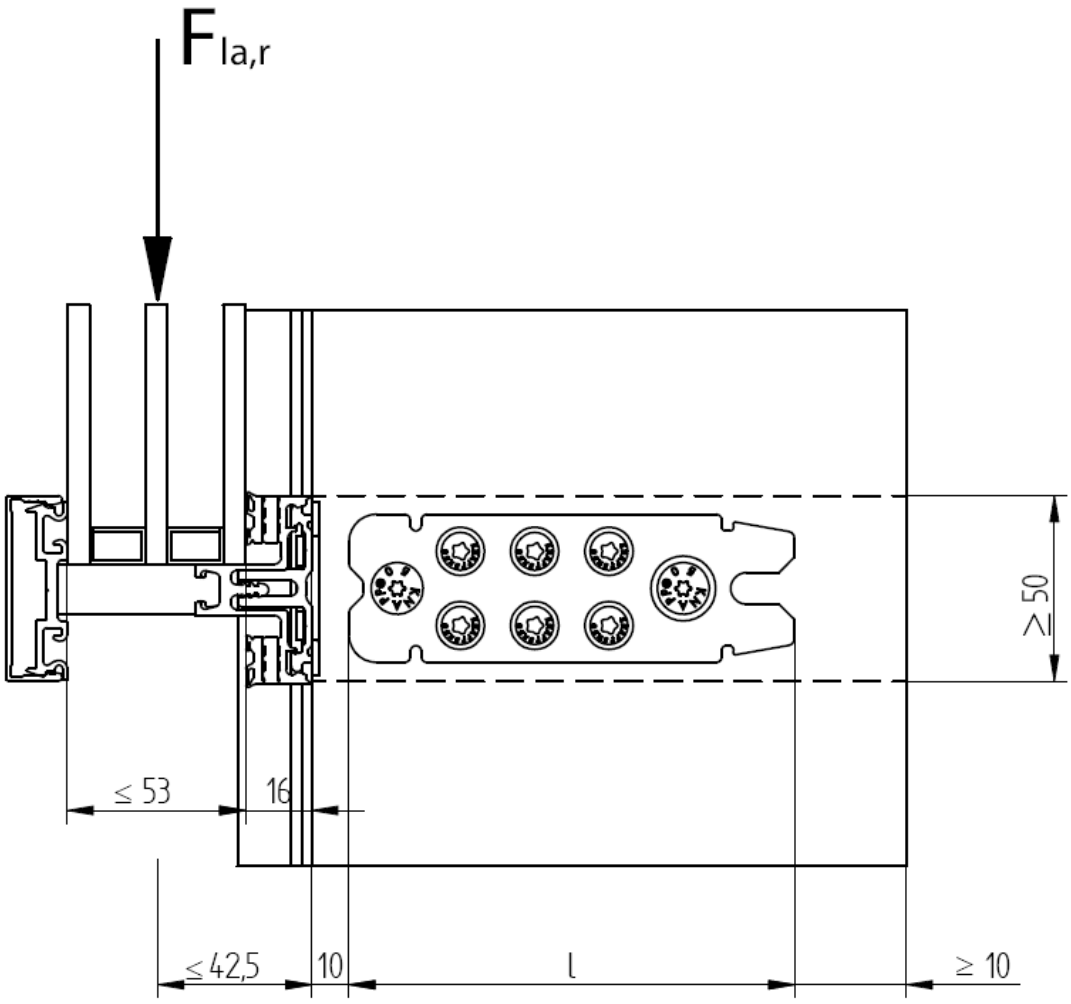
Wood-to-wood joint





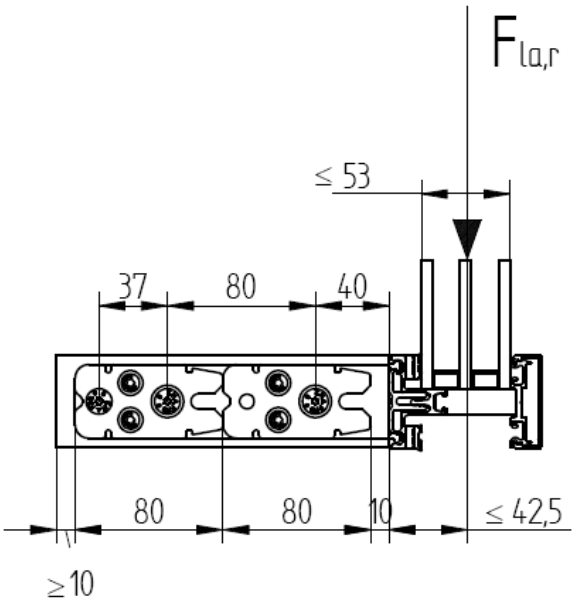
RICON

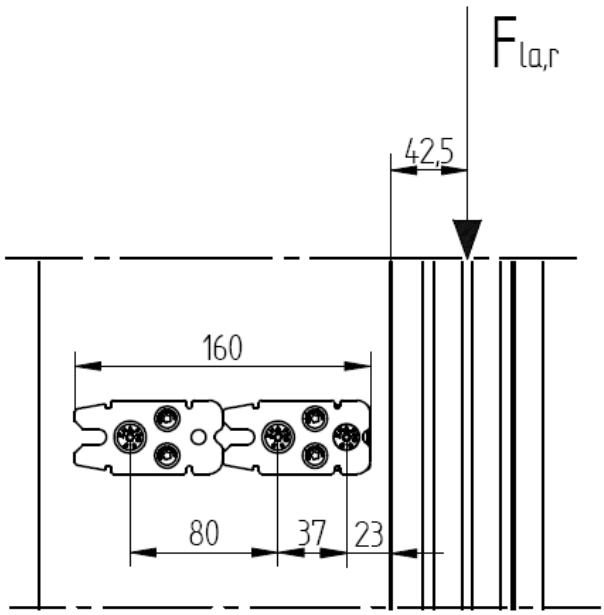
Minimum cross-section width and connector plate position requirements

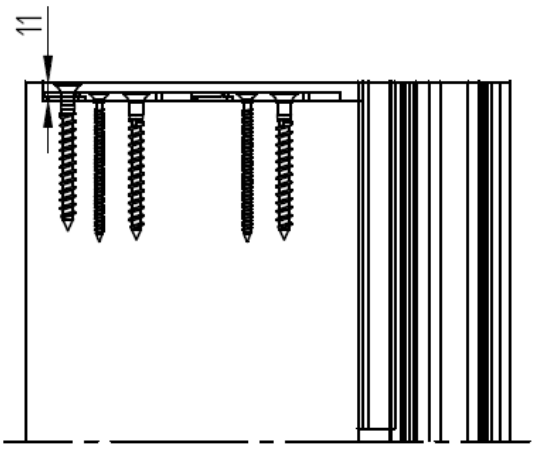


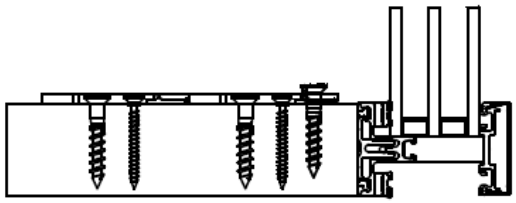
RICON

2 X RICON 80/40 EA in series



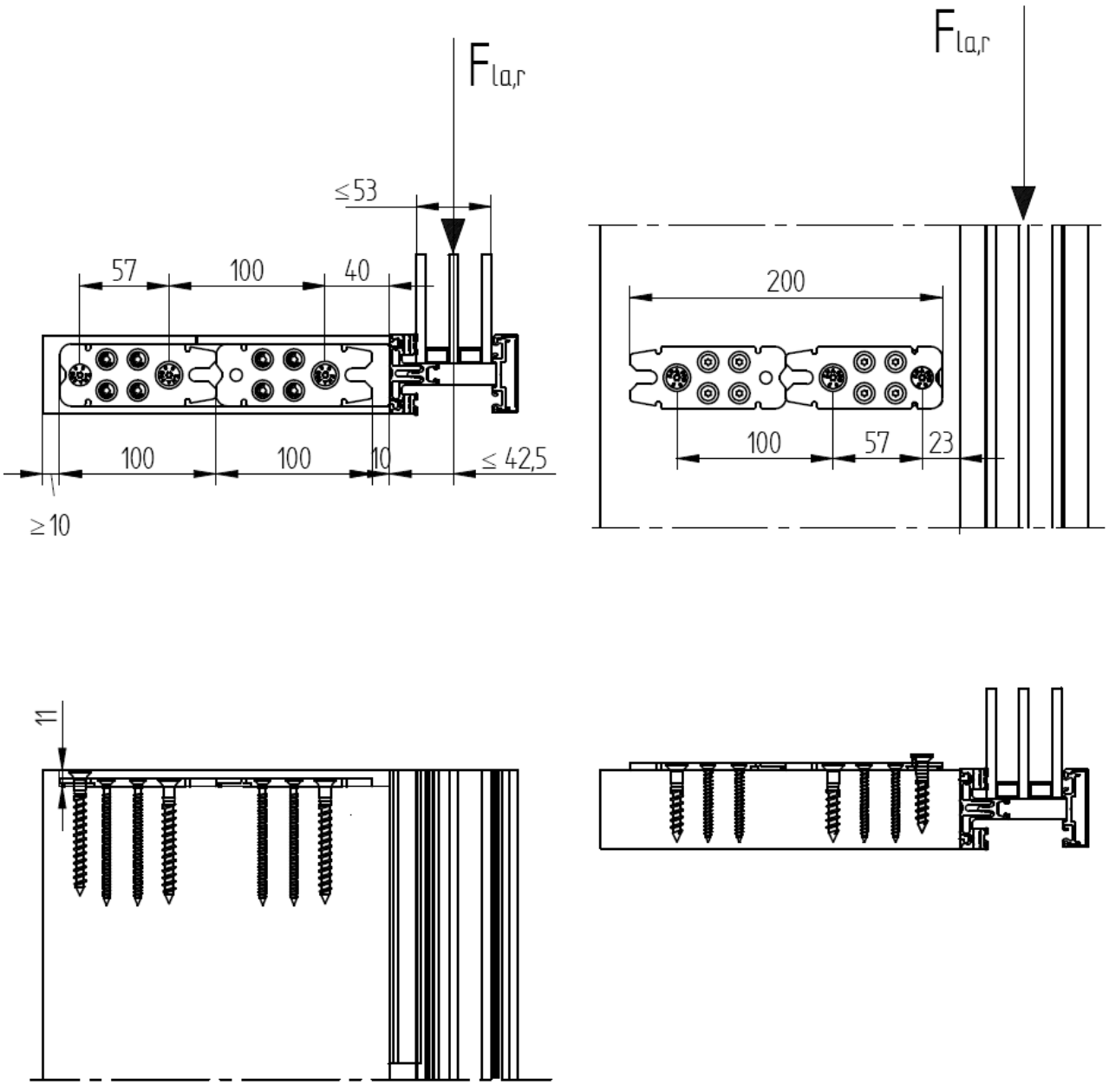






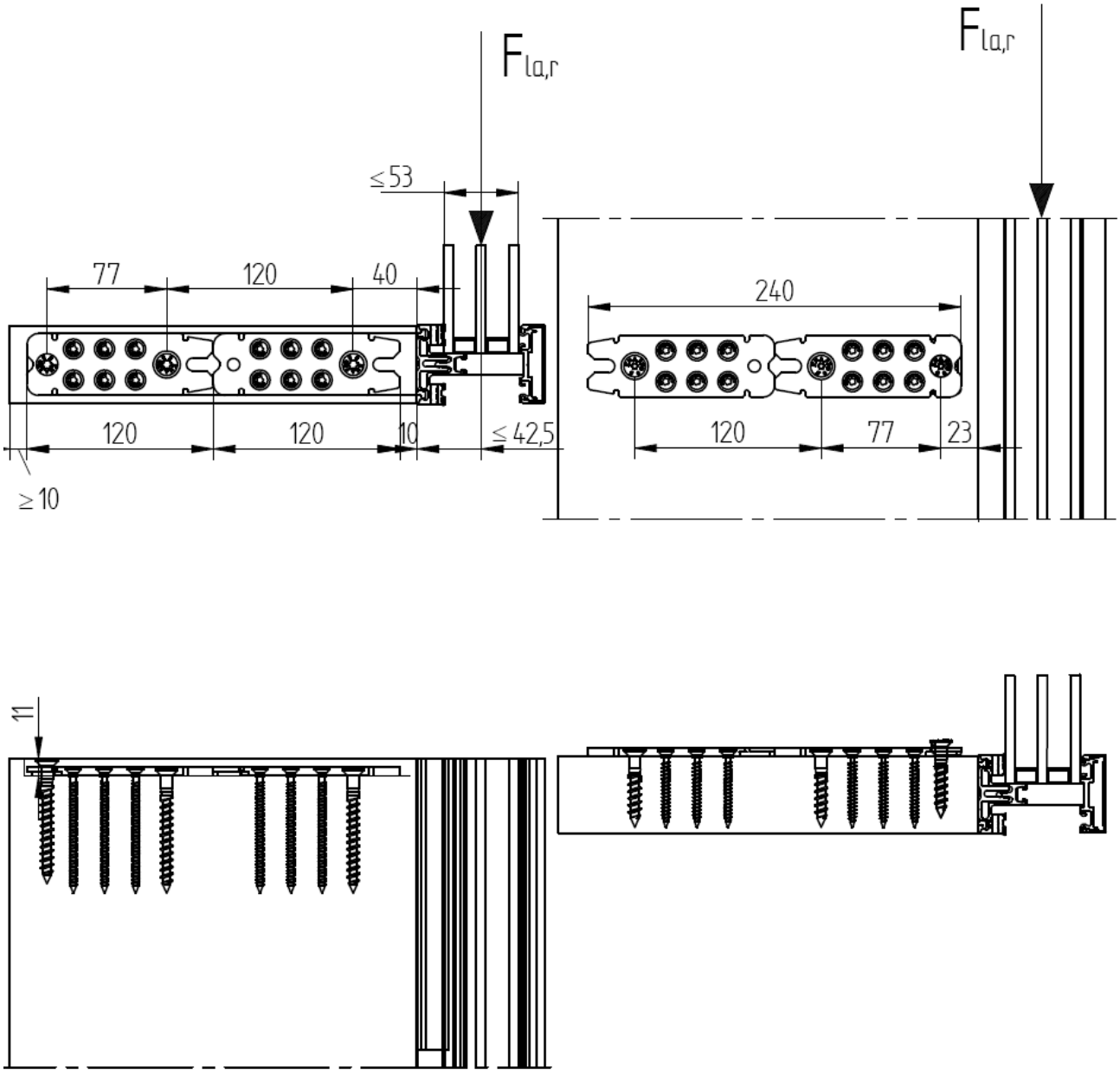
RICON

2 X RICON 100/40 in series



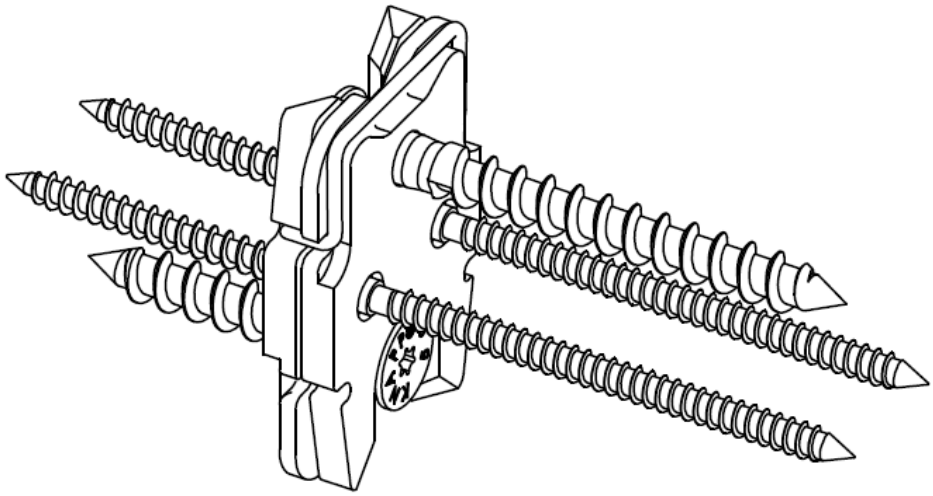
RICON

2 X RICON 120/40 in series



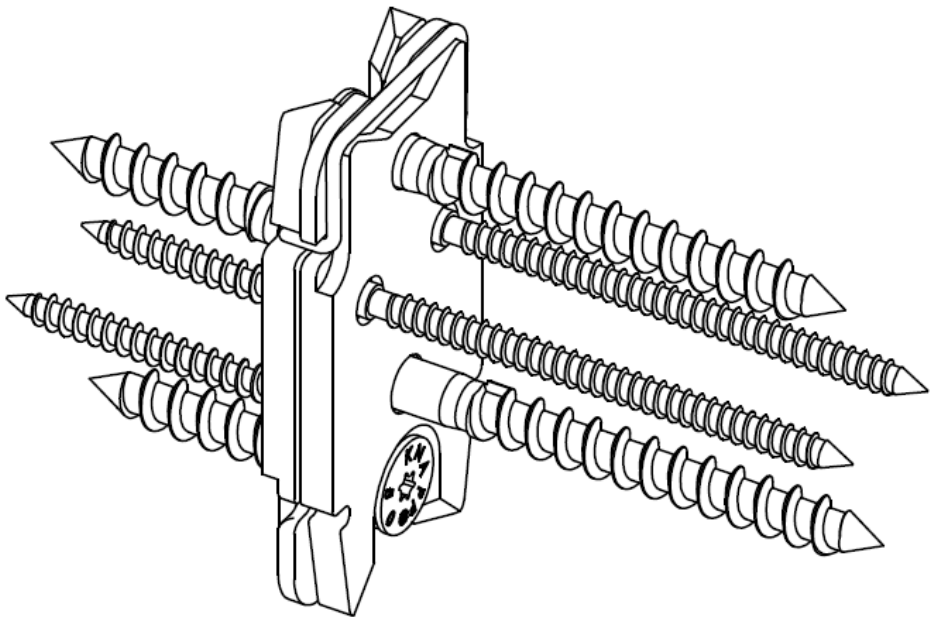
RICON

RICON 60/40 wood-to-wood joint



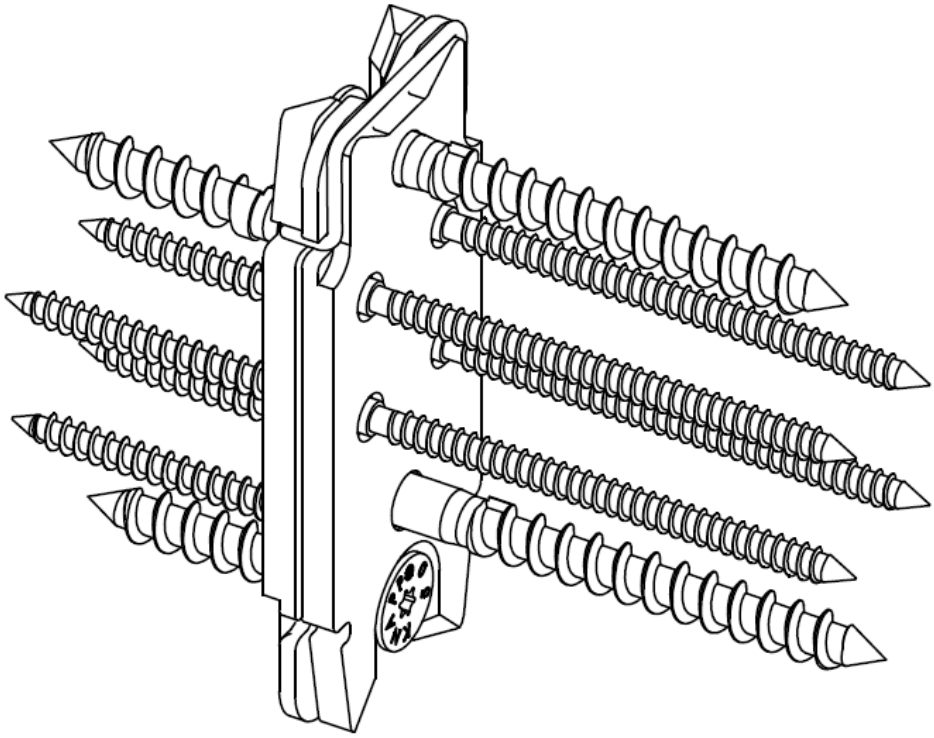
RICON

RICON 80/40 wood-to-wood joint



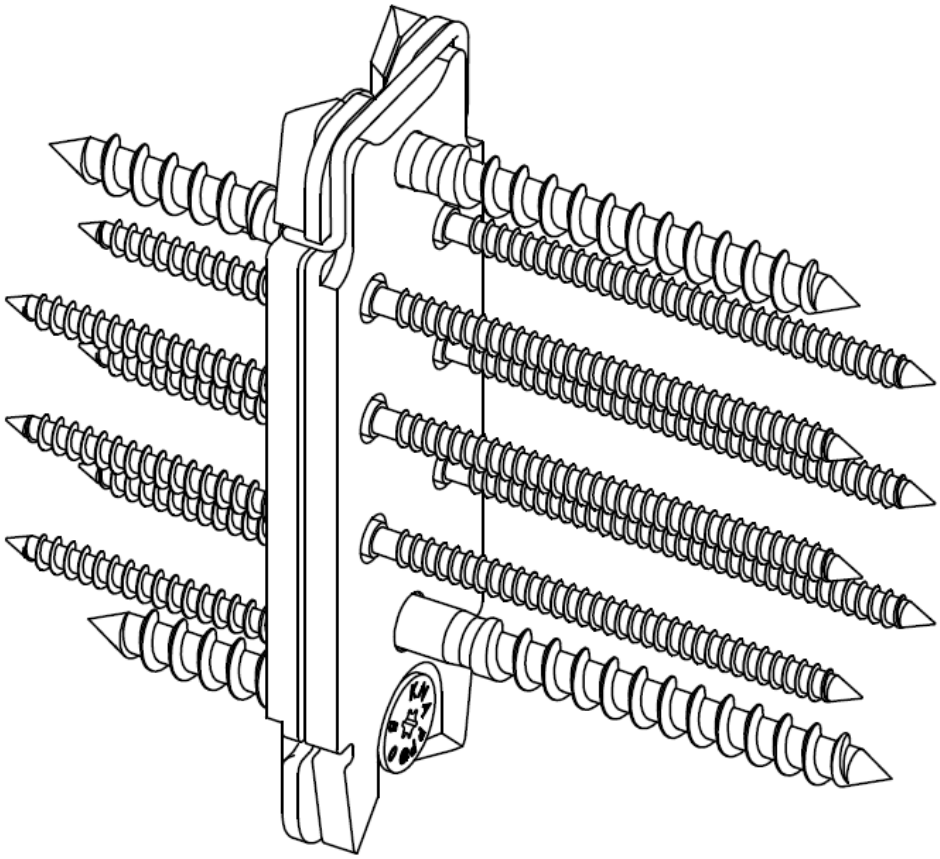
RICON

RICON 100/40 wood-to-wood joint



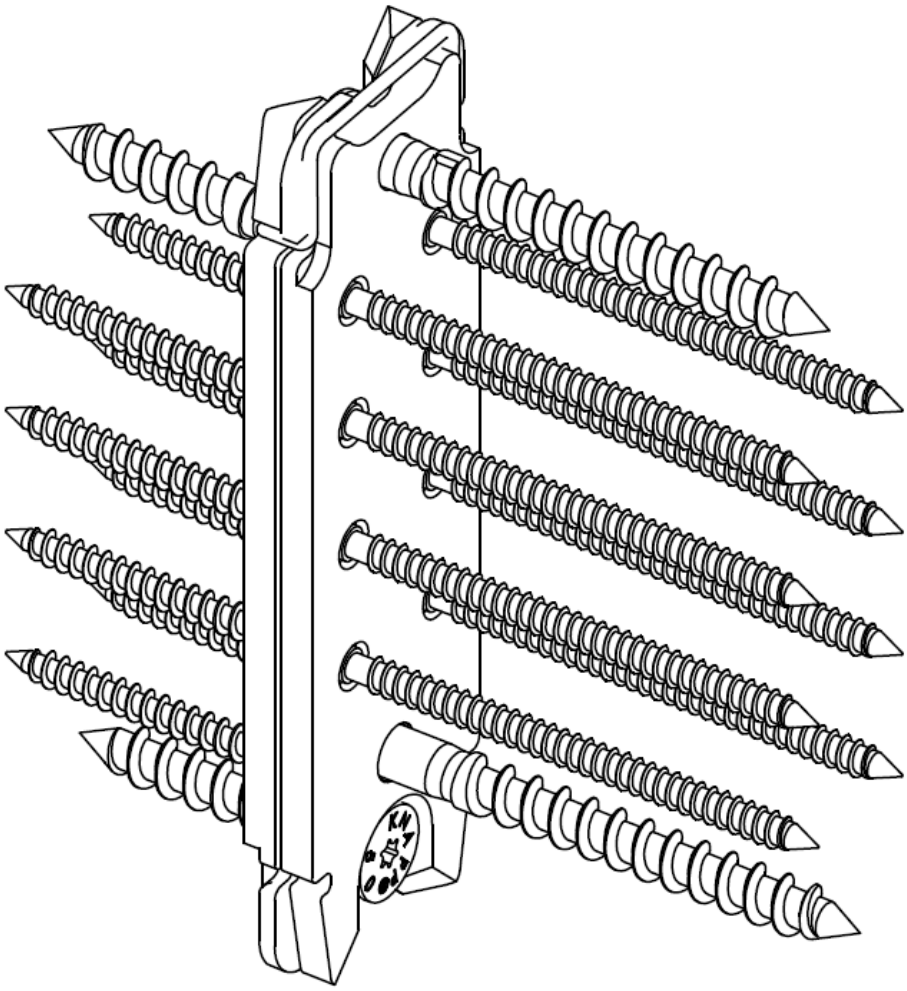
RICON

RICON 120/40 wood-to-wood joint



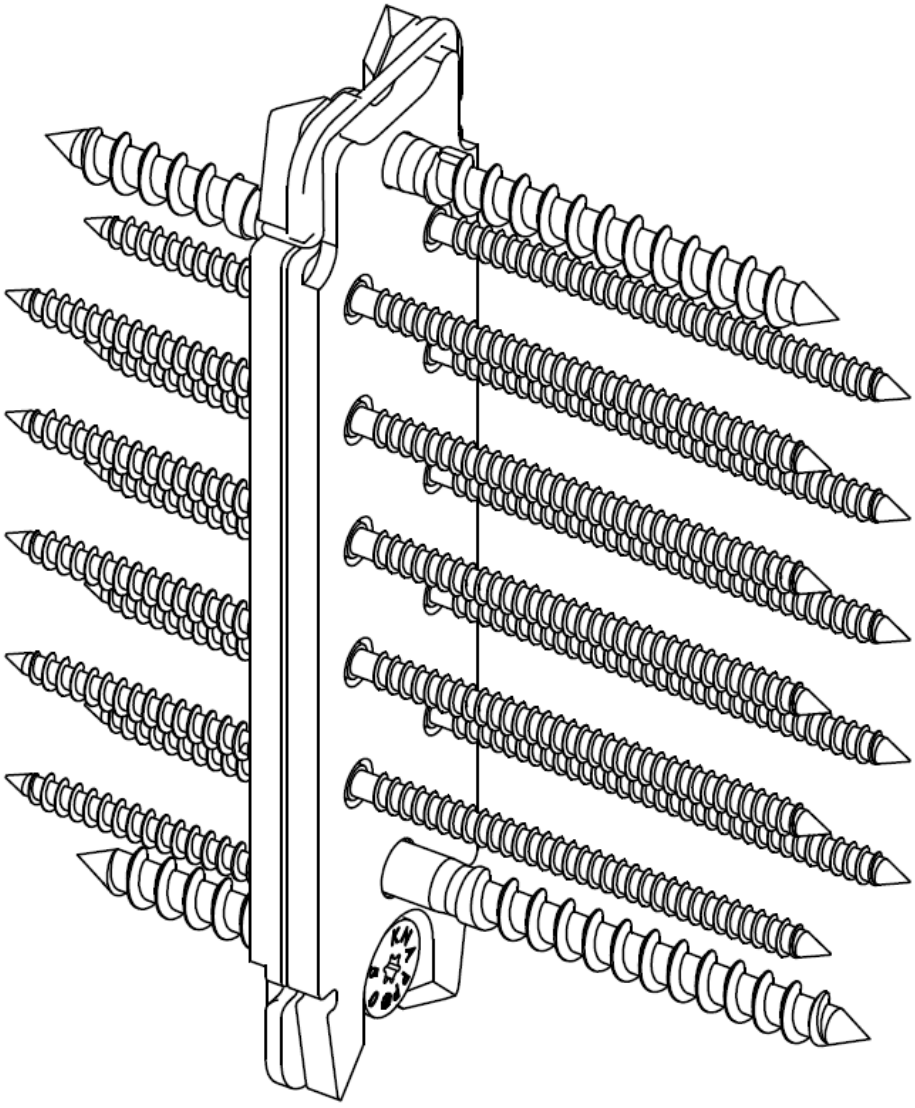
RICON

RICON 140/40 wood-to-wood joint



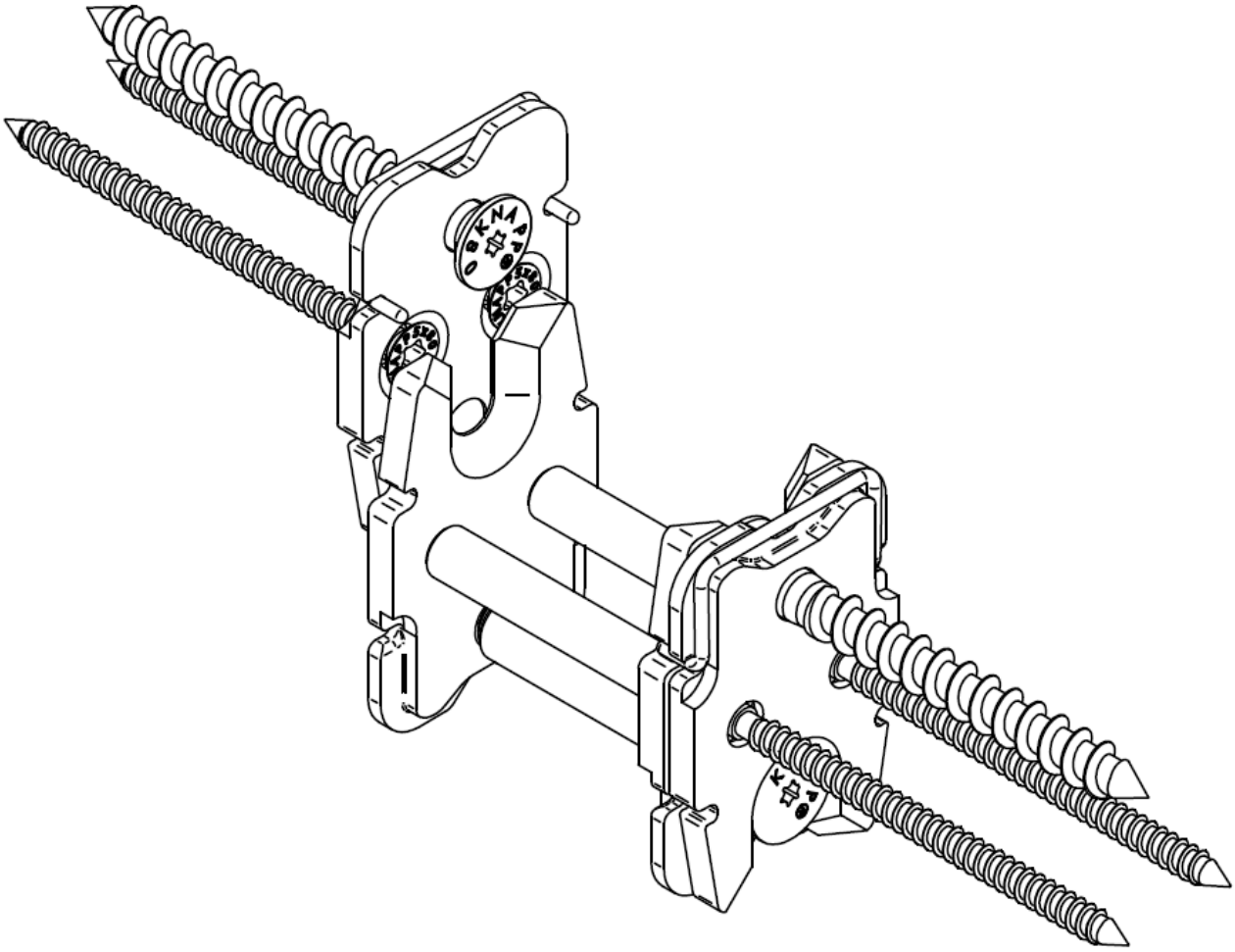
RICON

RICON 160/40 wood-to-wood joint



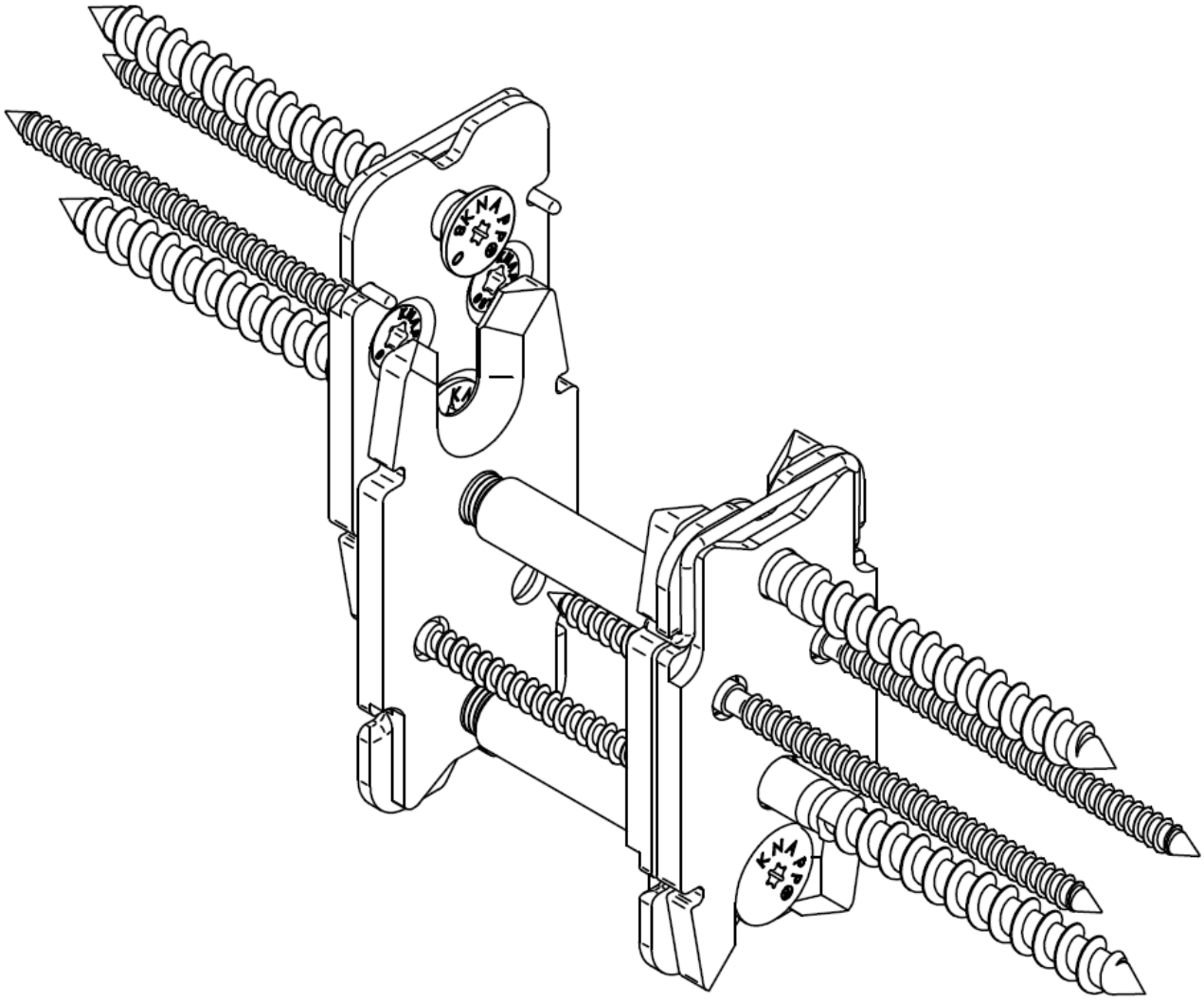
RICON

RICON 60/40 wood-to-wood joint with connection nut



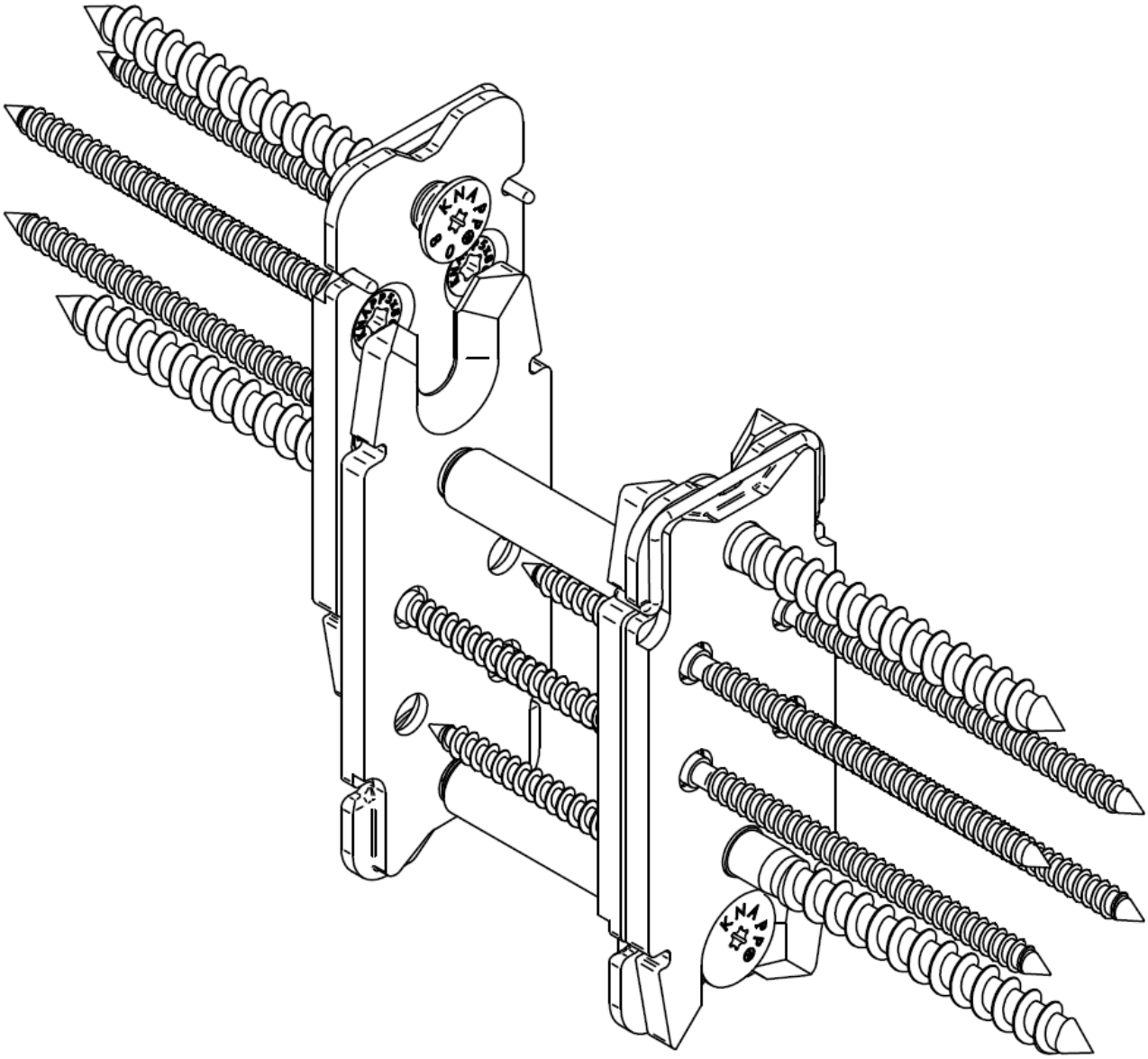
RICON

RICON 80/40 wood-to-wood joint with connection nut



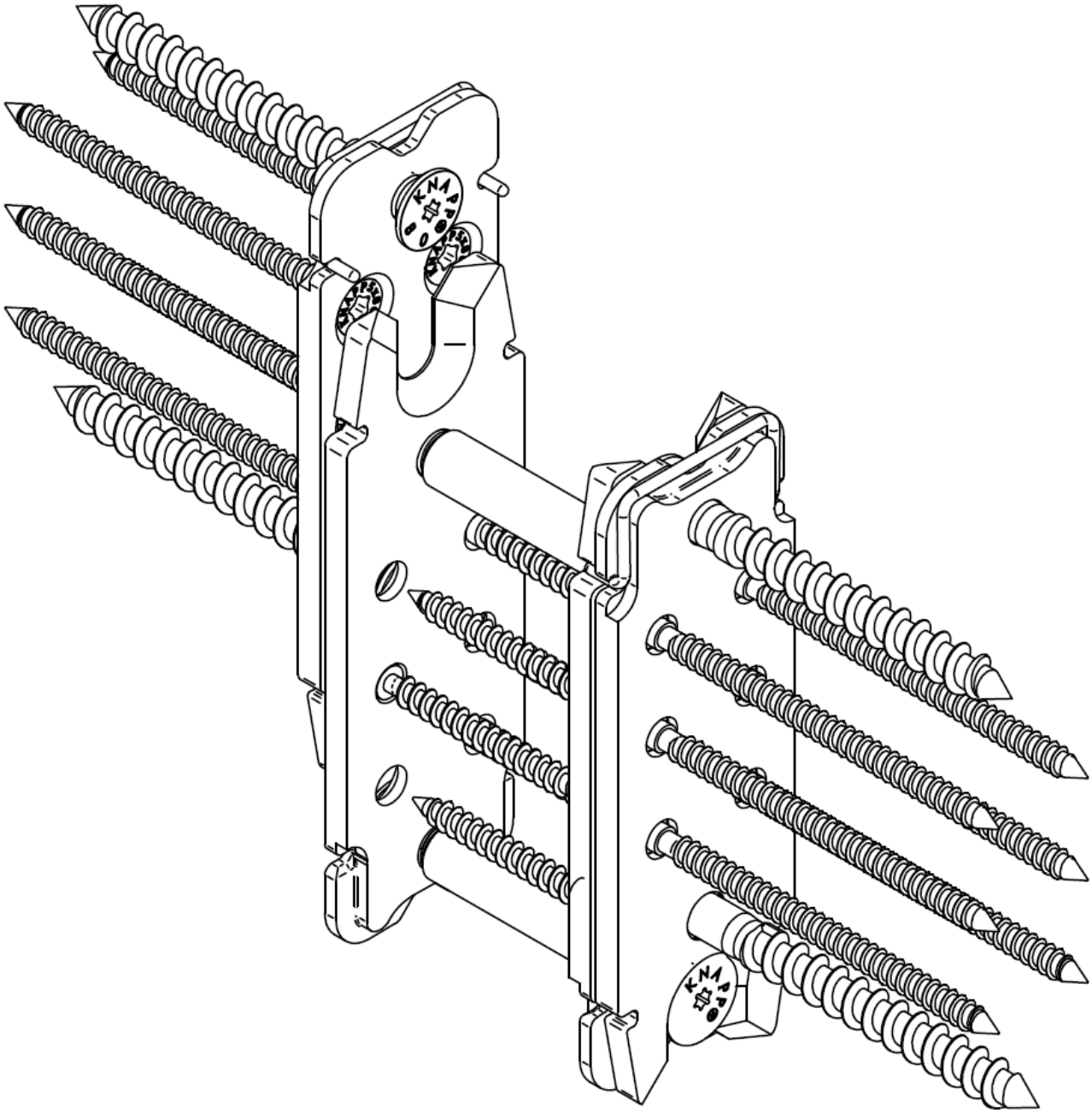
RICON

RICON 100/40 wood-to-wood joint with connection nut



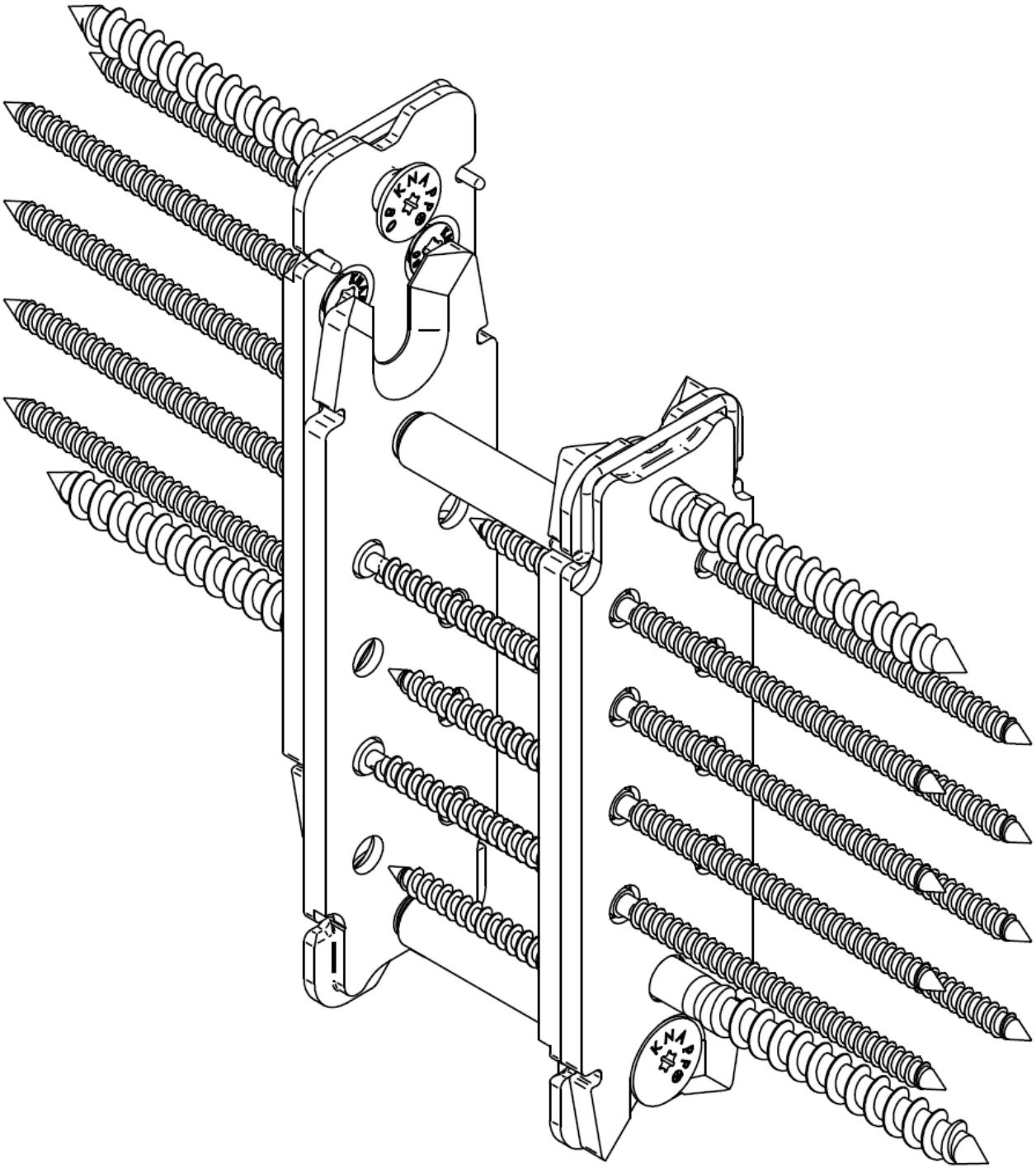
RICON

RICON 120/40 wood-to-wood joint with connection nut



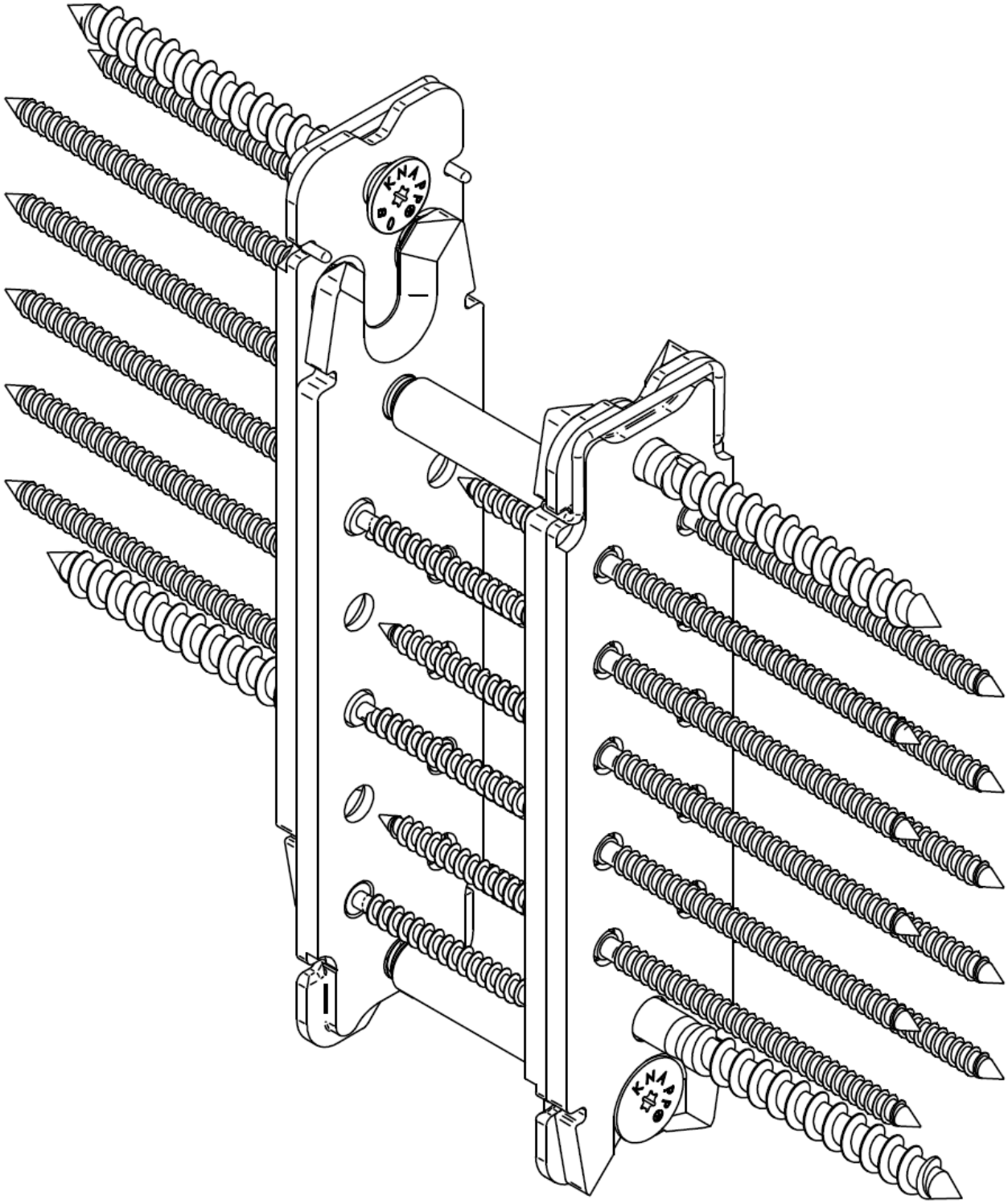
RICON

RICON 140/40 wood-to-wood joint with connection nut



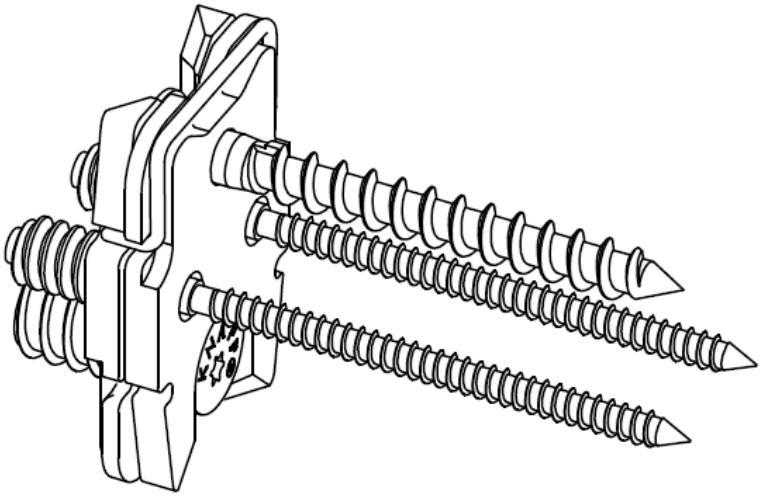
RICON

RICON 160/40 wood-to-wood joint with connection nut



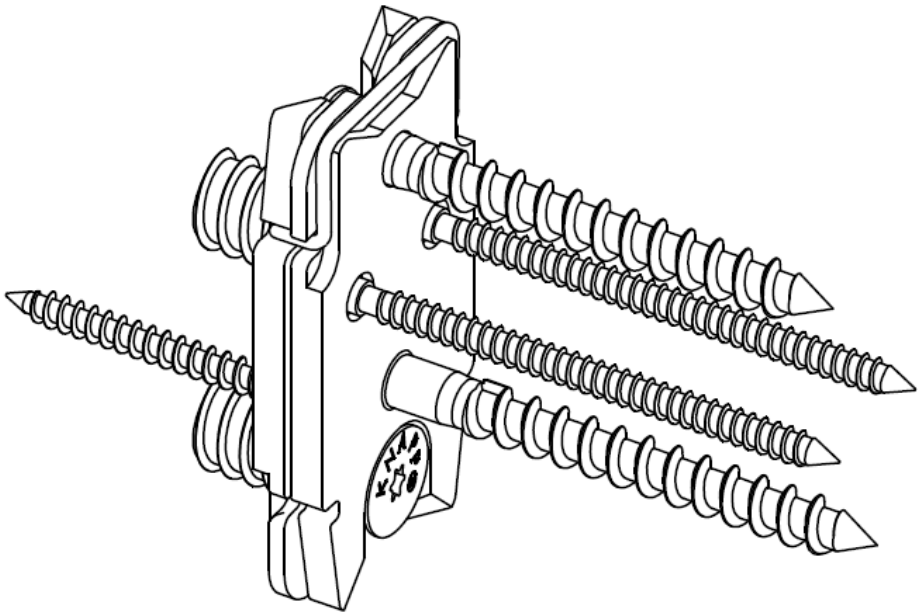
RICON

RICON 60/40 EAR single joint with insert



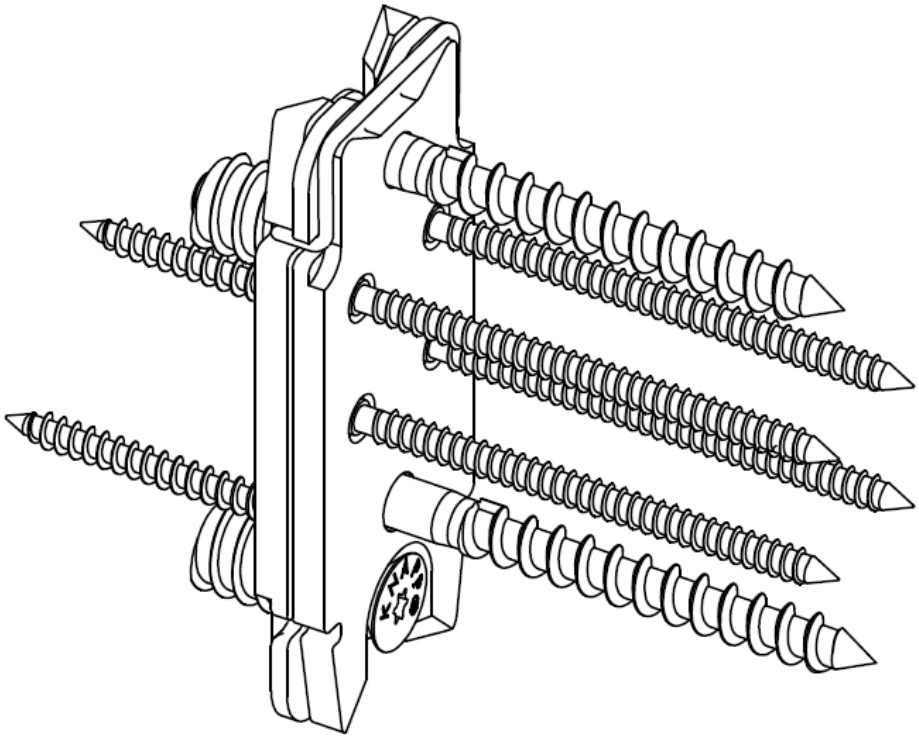
RICON

RICON 80/40 EAR single joint with insert



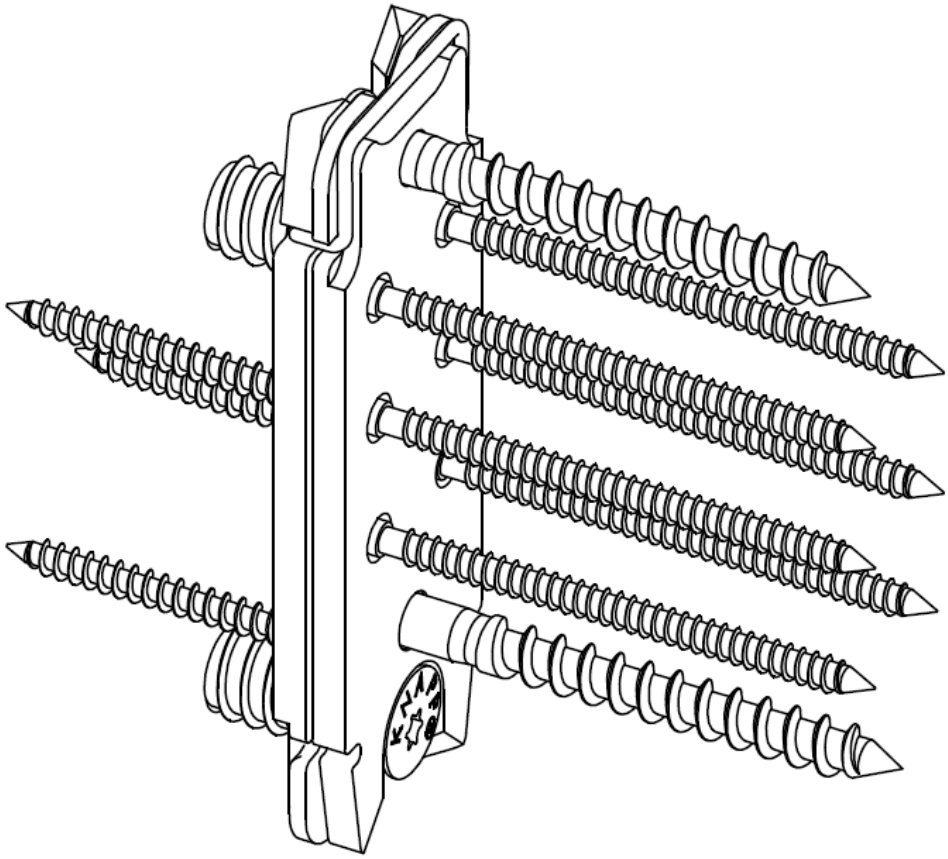
RICON

RICON 100/40 EAR single joint with insert



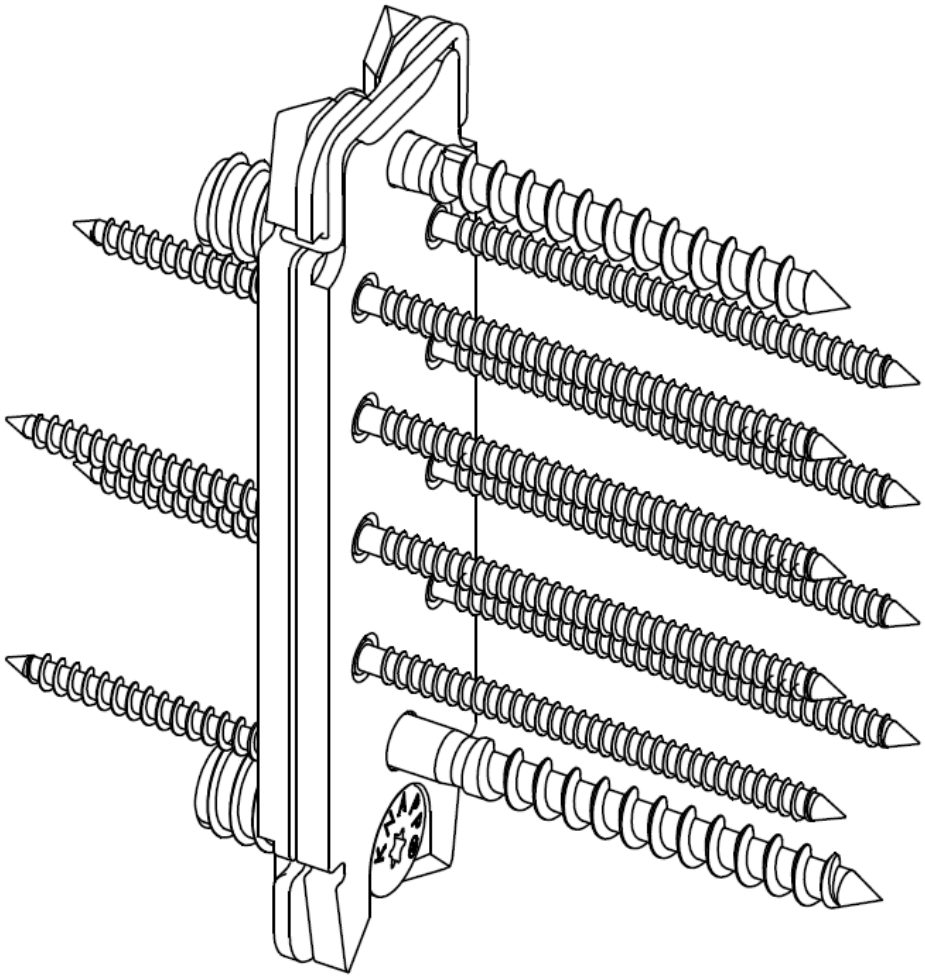
RICON

RICON 120/40 EAR single joint with insert



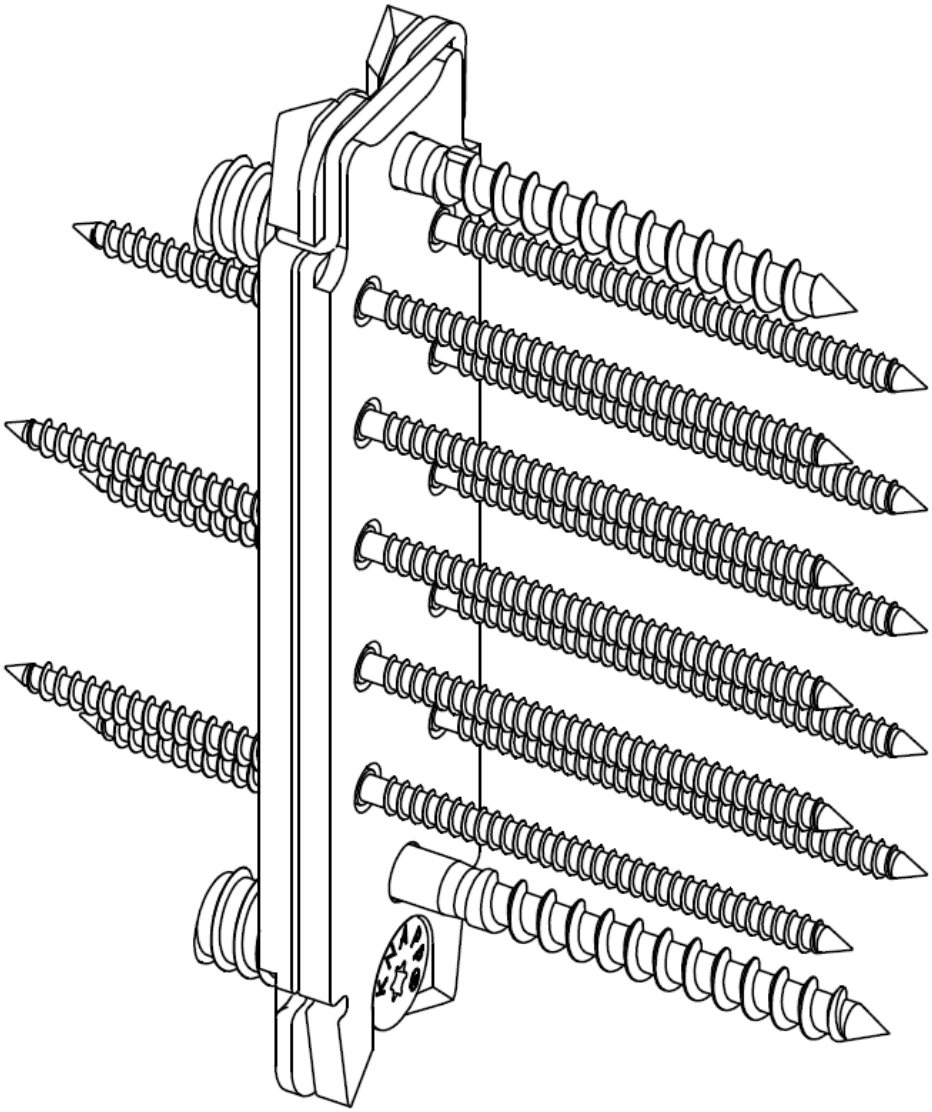
RICON

RICON 140/40 EAR single joint with insert



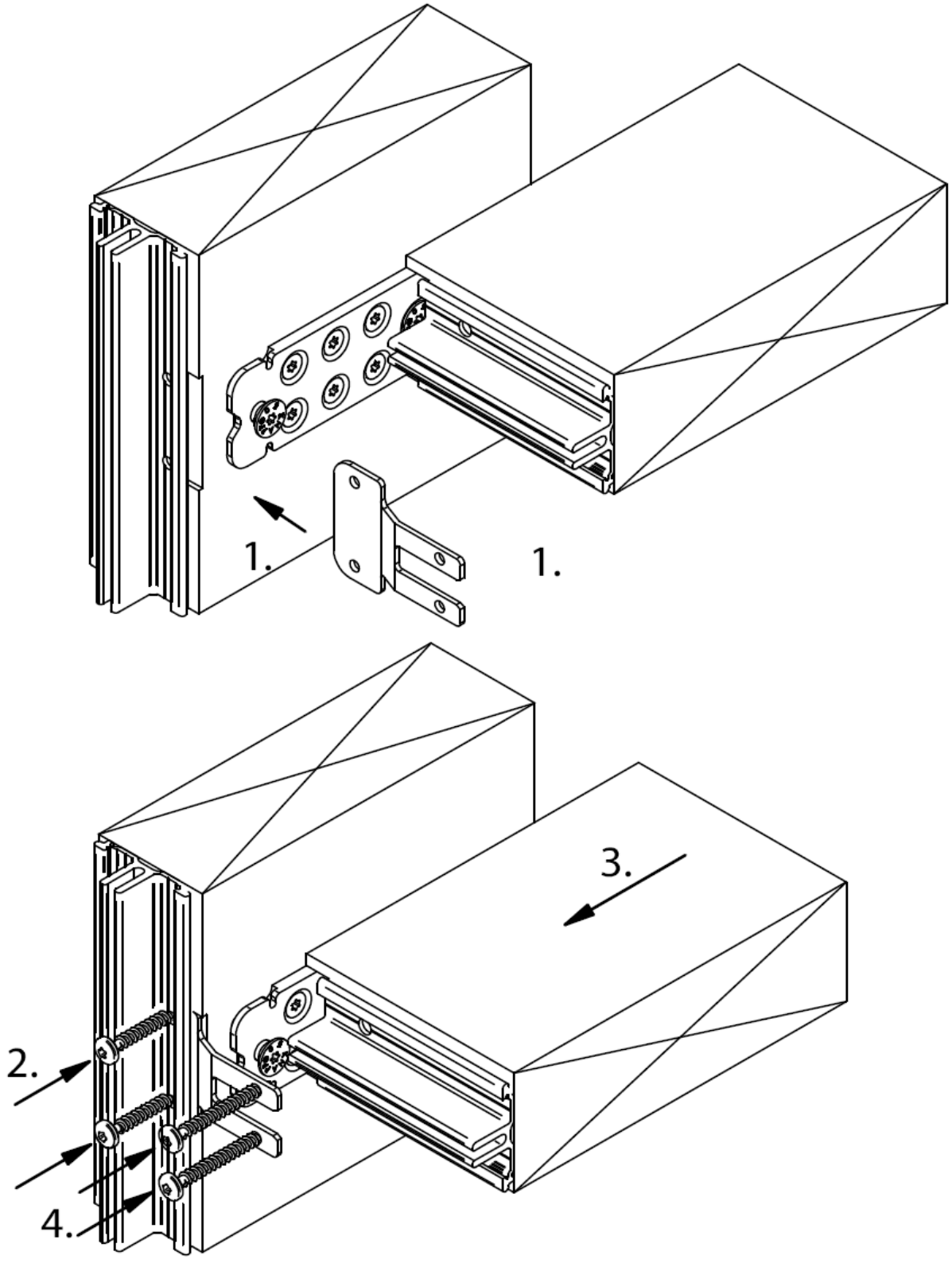
RICON

RICON 160/40 EAR single joint with insert



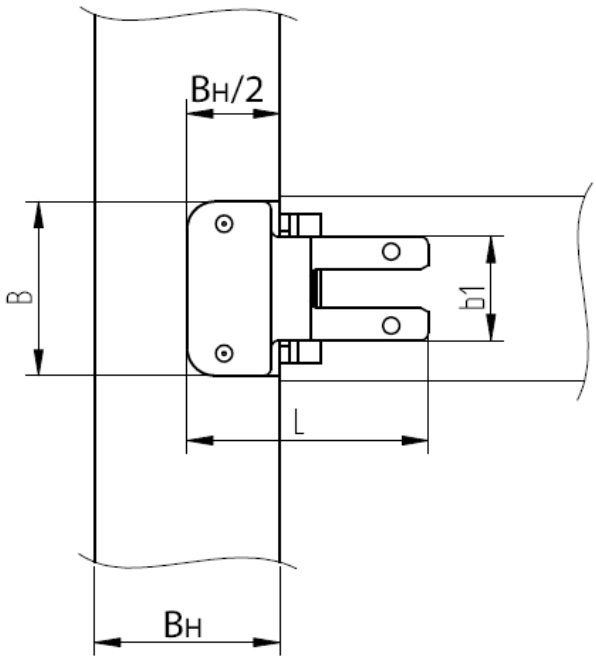
RICON

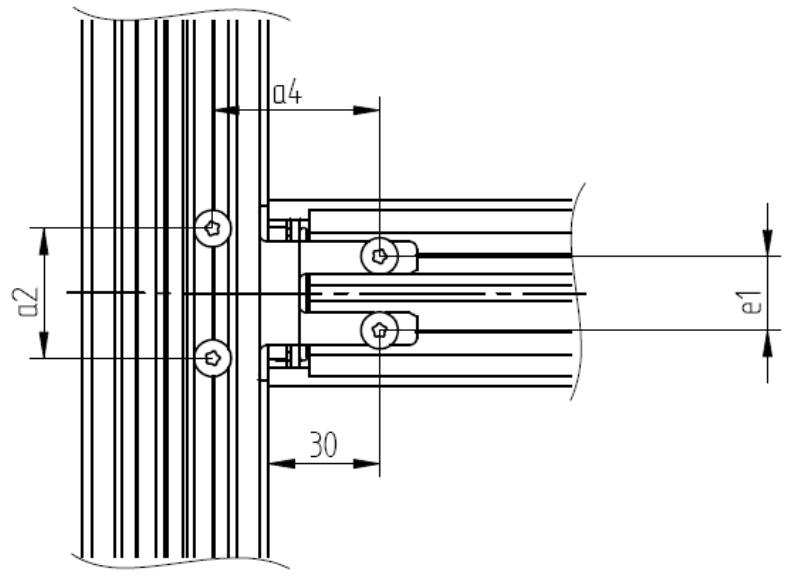
RICON reinforcing plate installation process



RICON

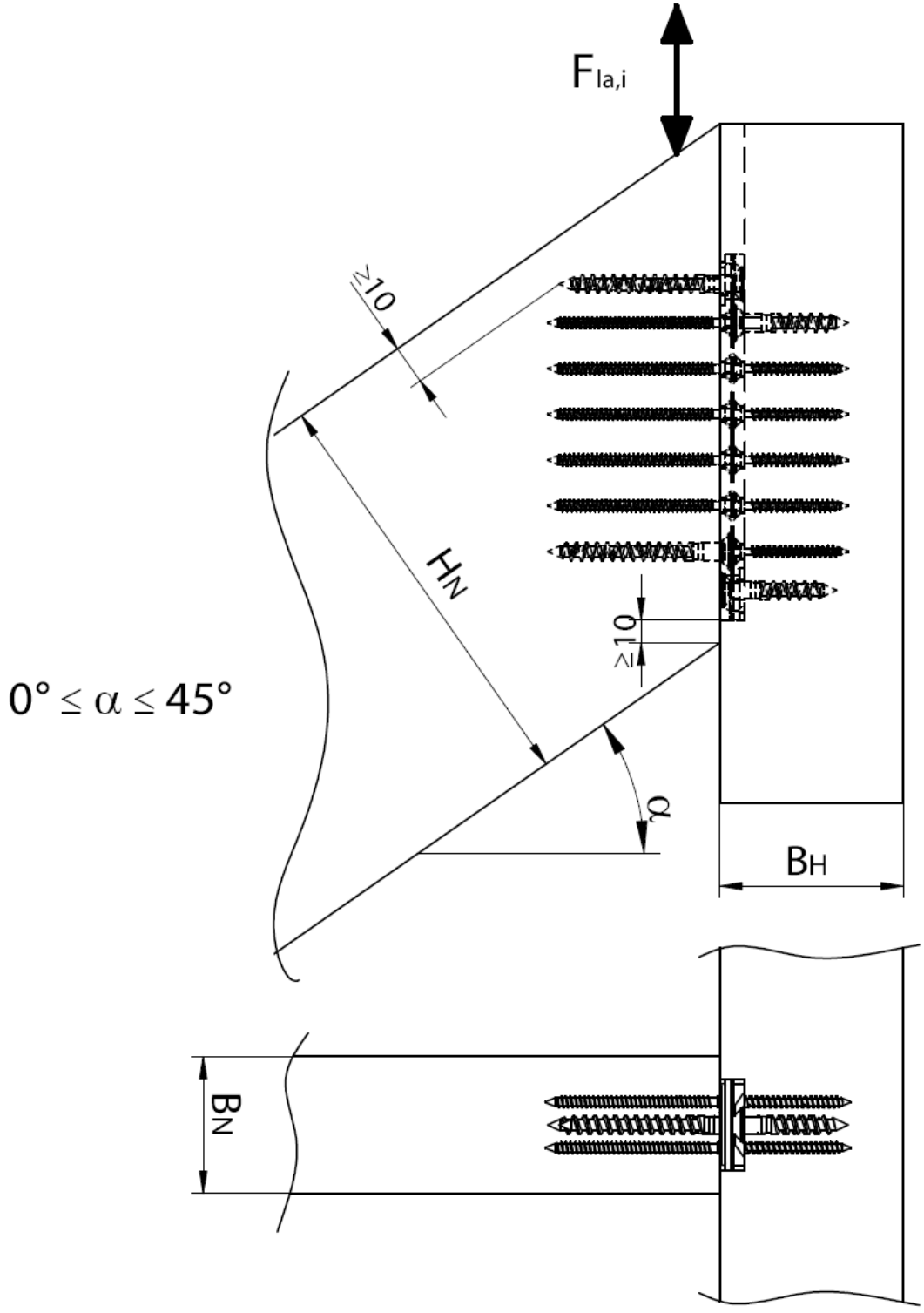
RICON reinforcing plate hole positions





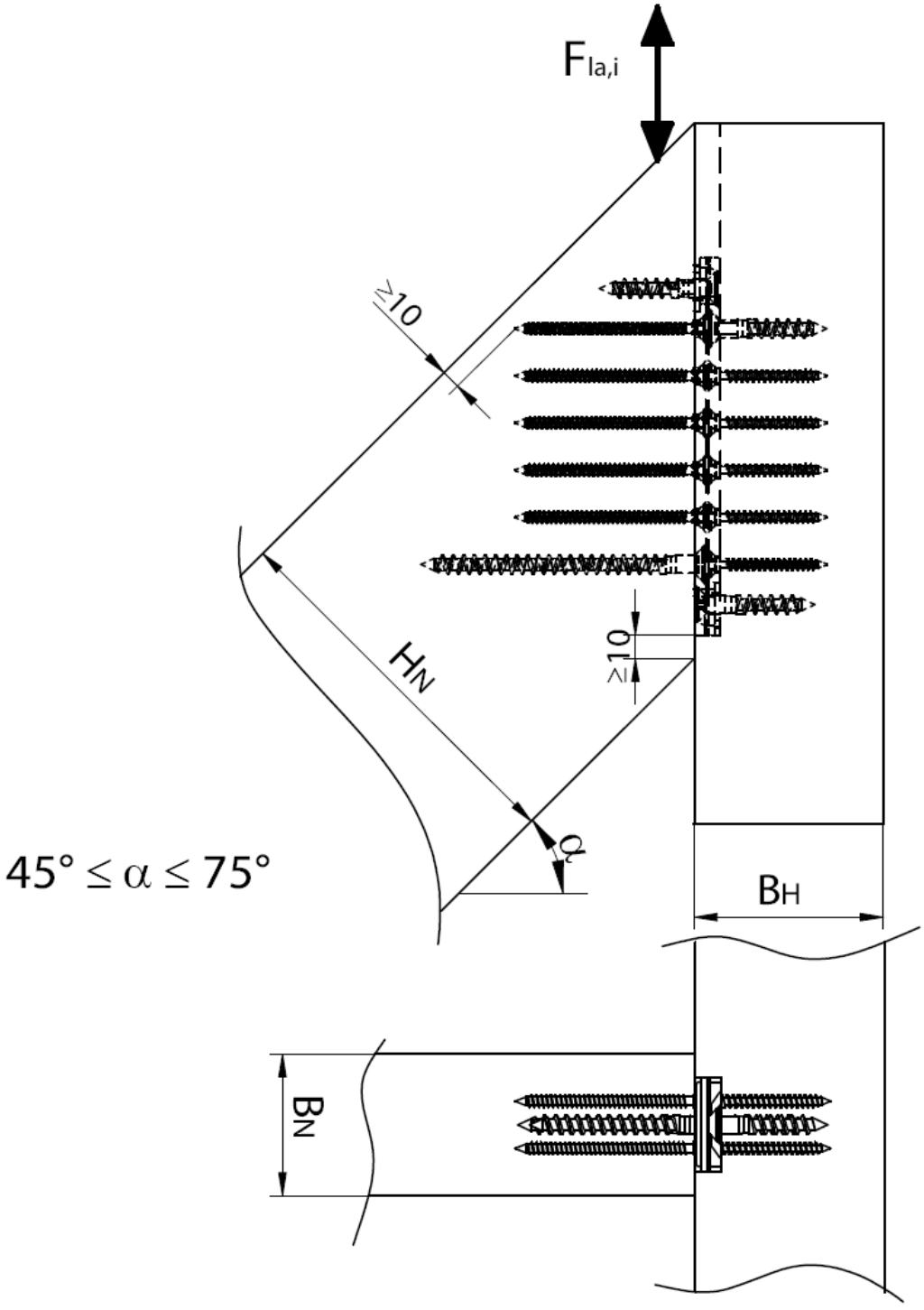
RICON

Tilted joints
α < 45°



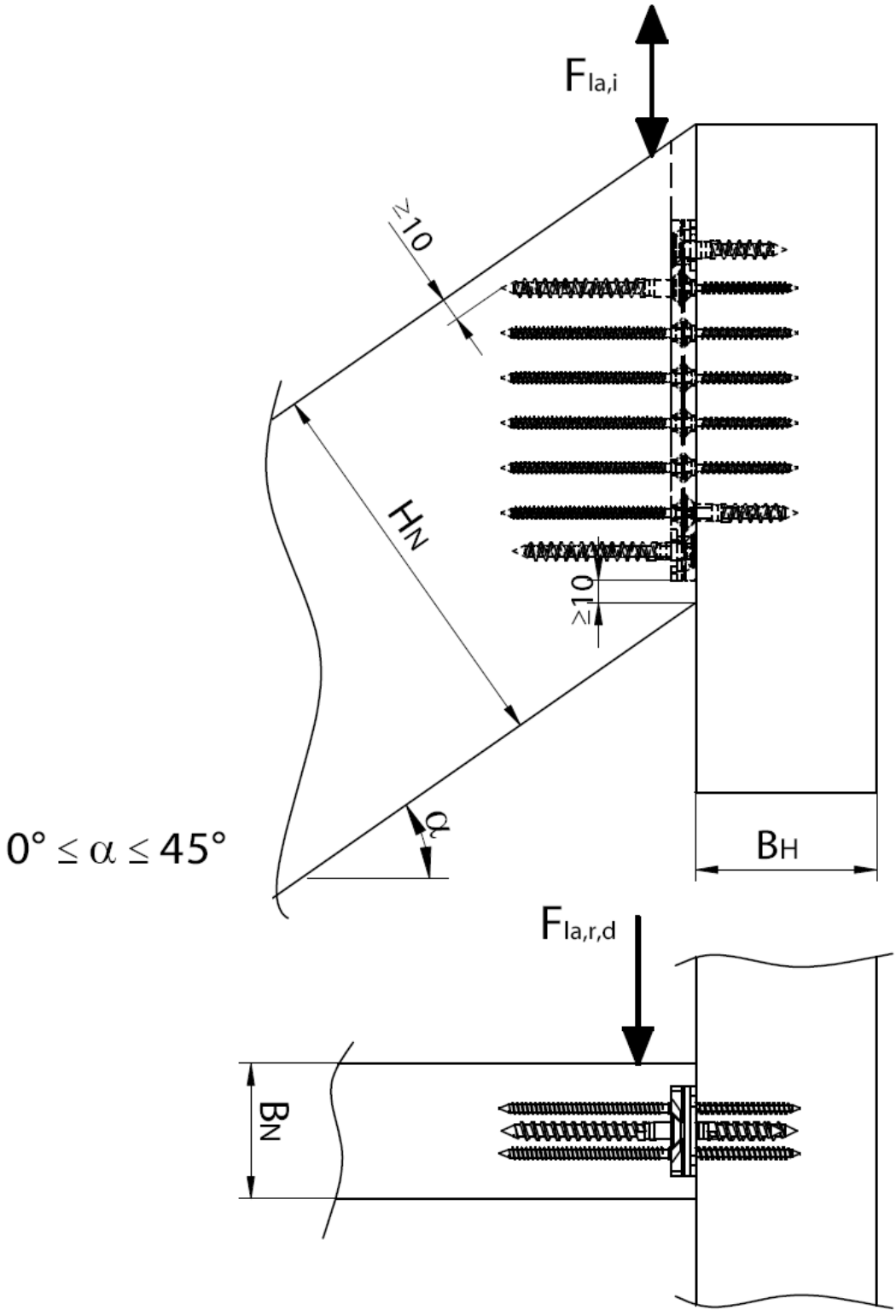
RICON

Tilted joints
$\alpha \geq 45°$



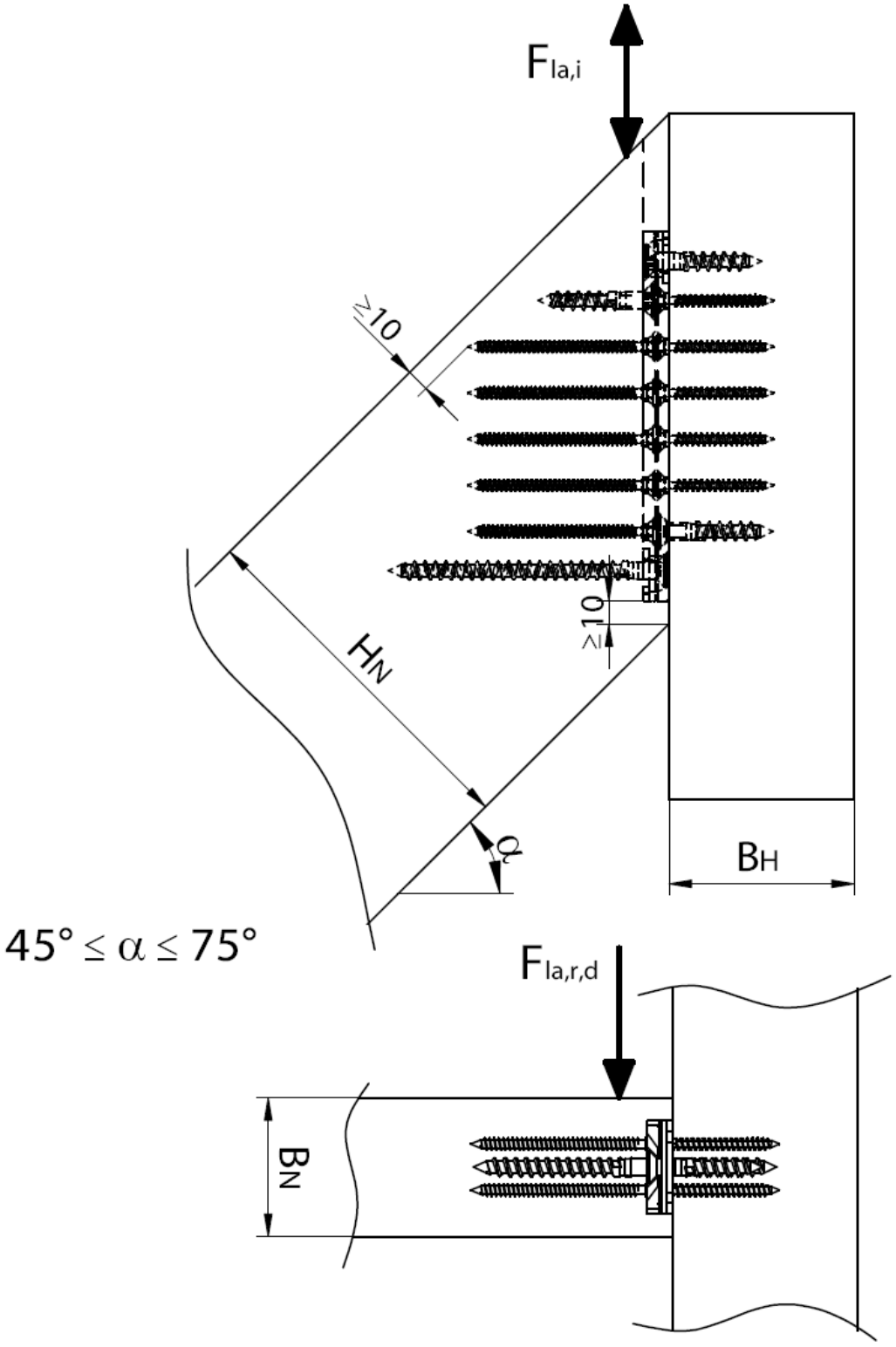
RICON

Tilted joints
α < 45°



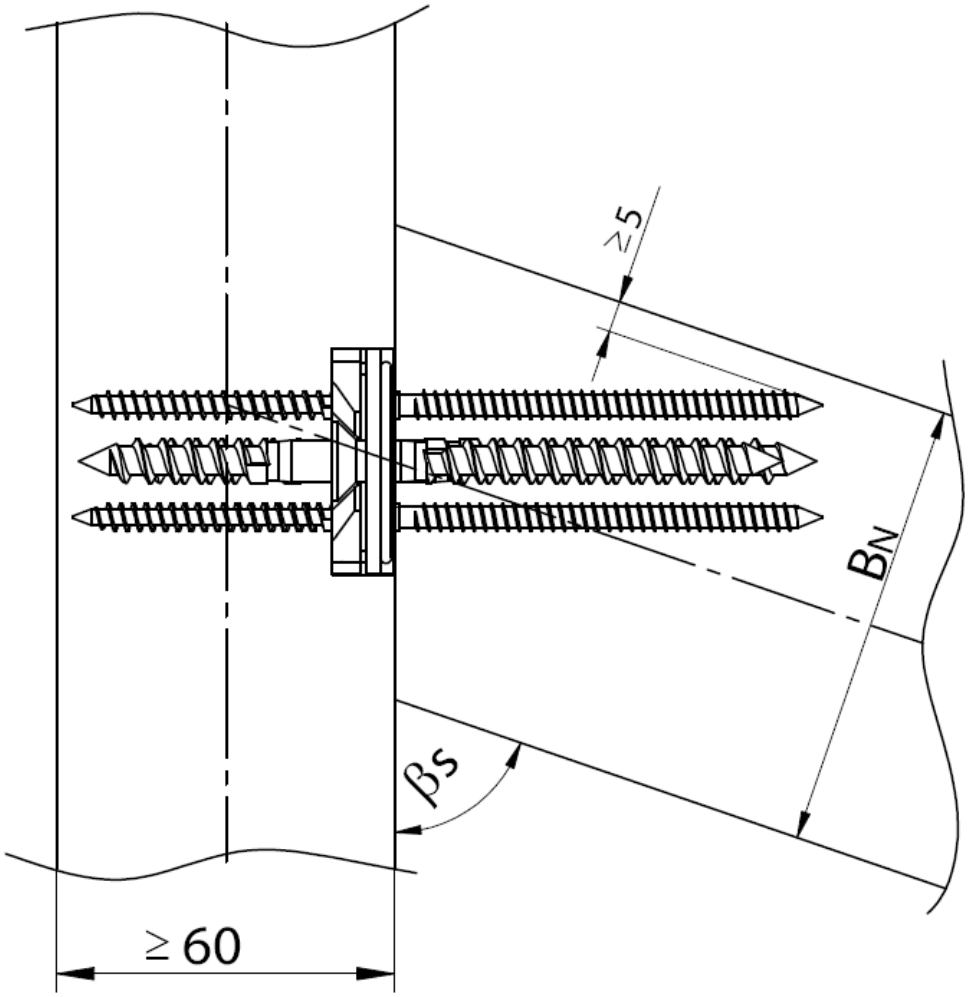
RICON

Tilted joints
$\alpha \geq 45°$



RICON

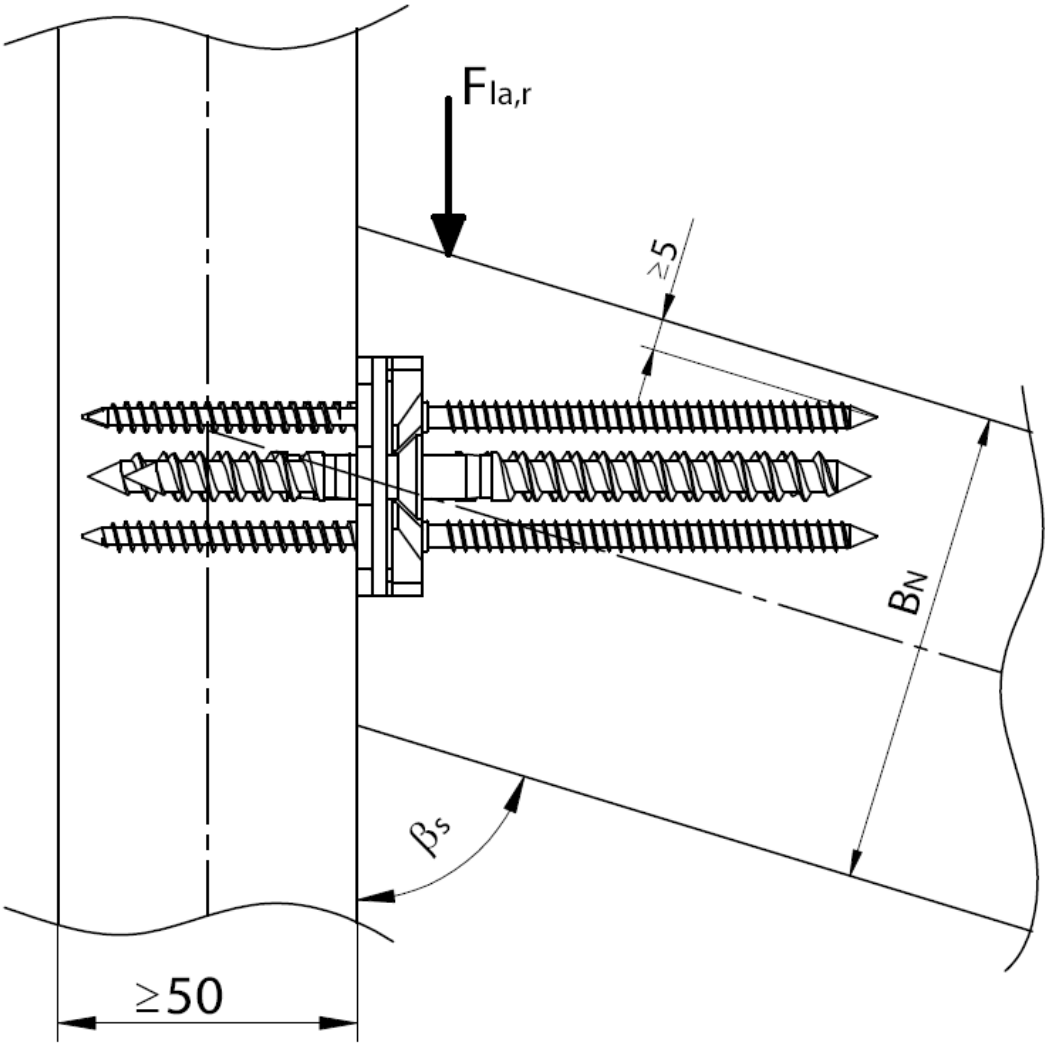
Tilted joints



width B_N	angle β_S
50 mm	83°
80 mm	71°

RICON

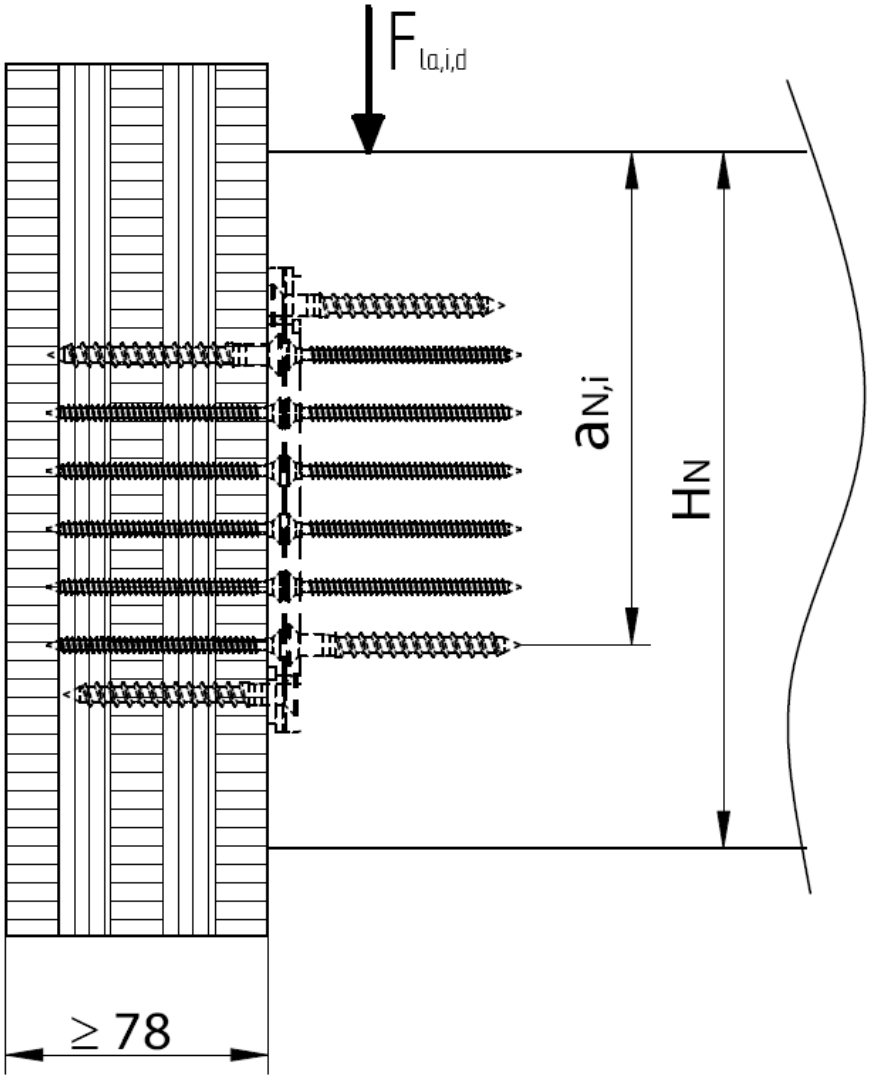
Tilted joints



width B_N	angle β_S
50 mm	84°
80 mm	73°

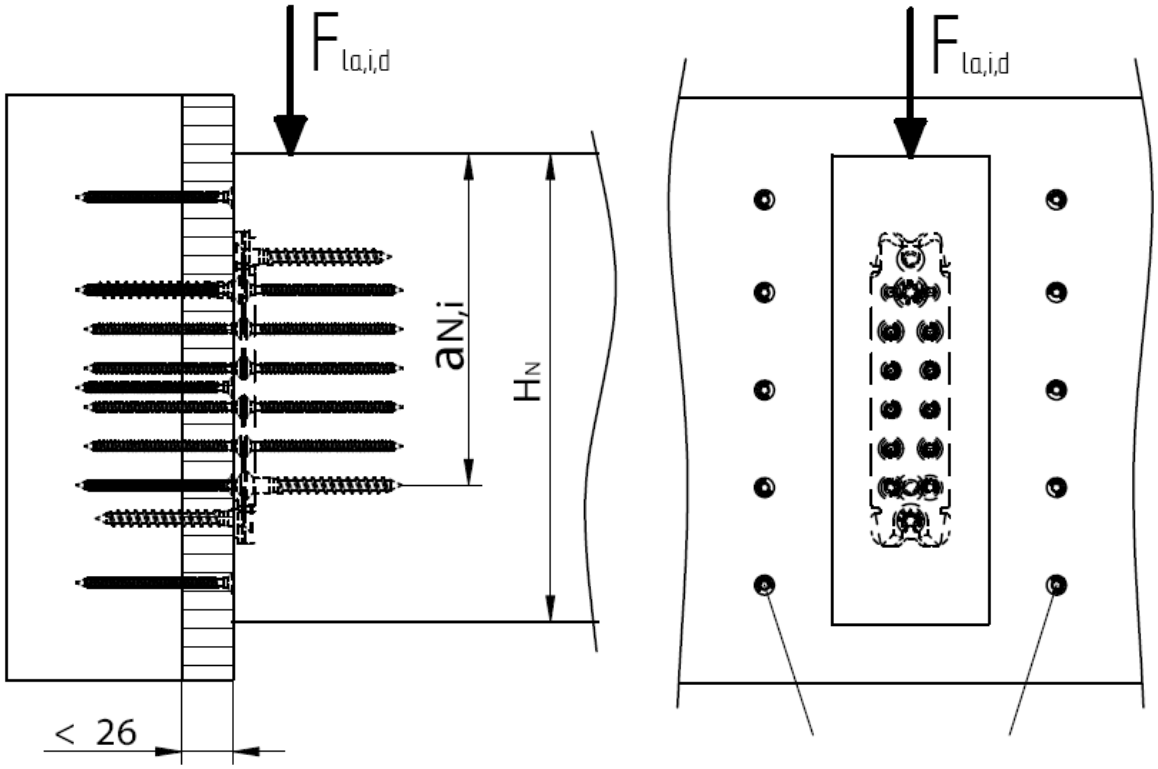
RICON

Joint with cross laminated timber header



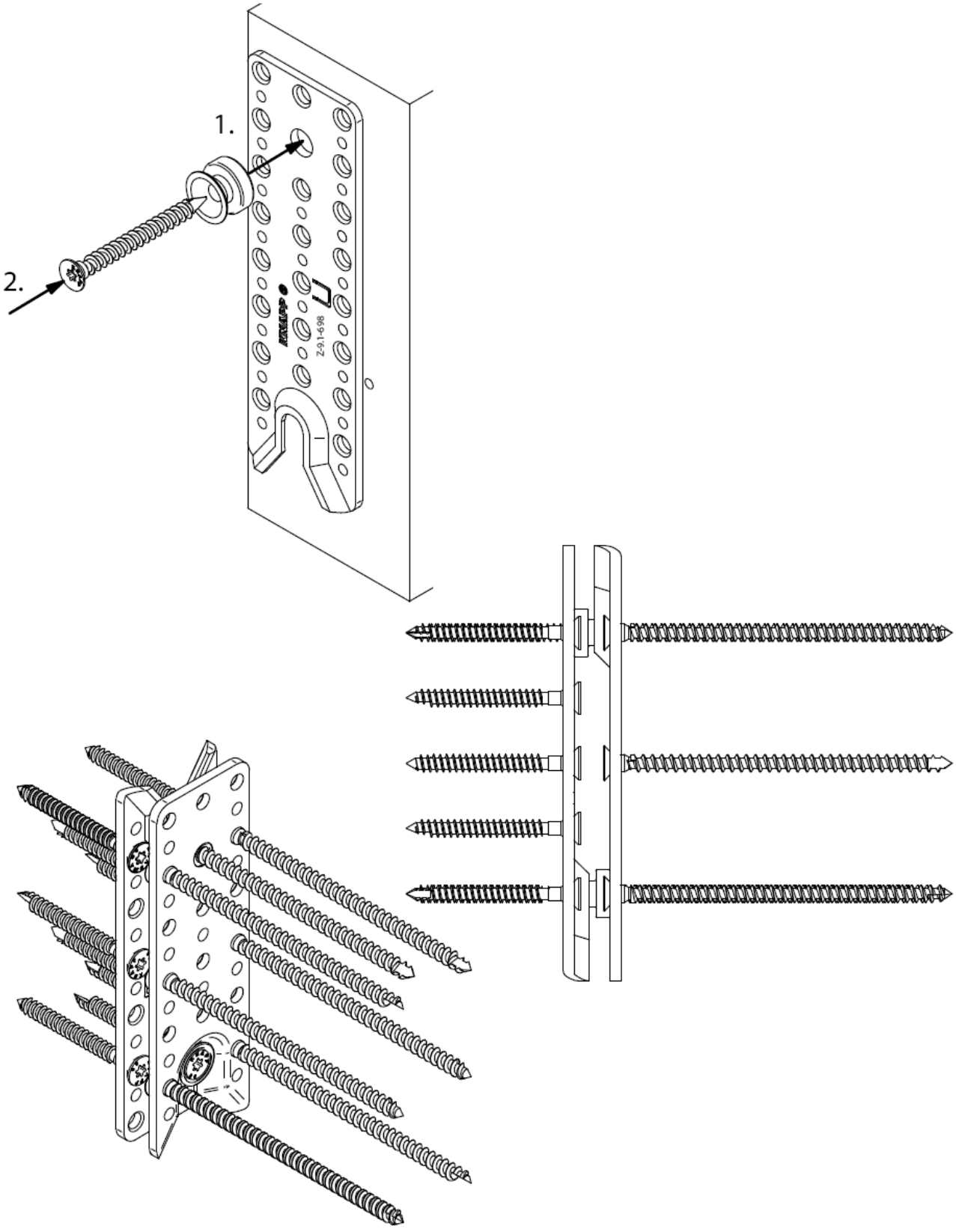
RICON

Joint with interlayer



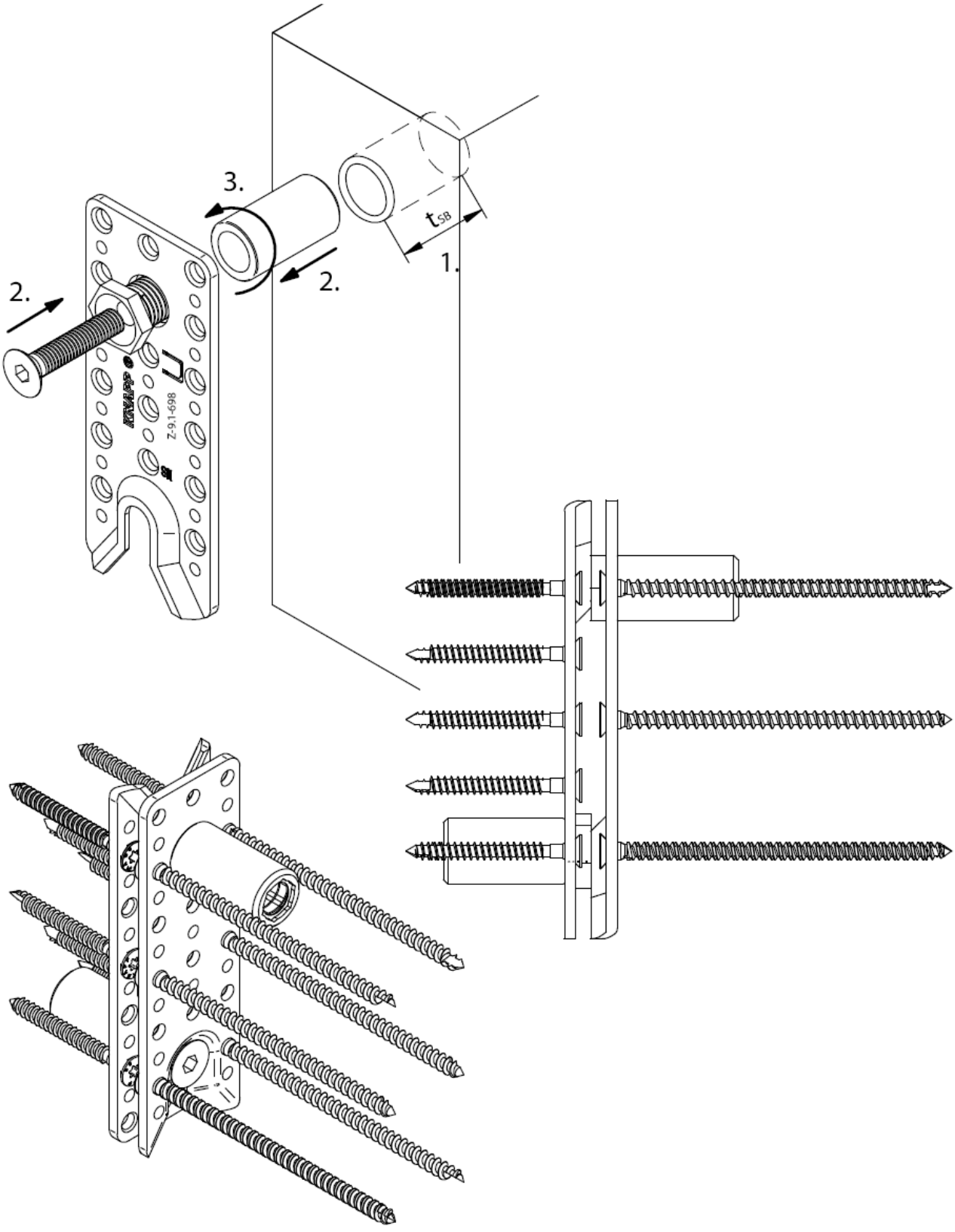
RICON S

Installation collar bolt



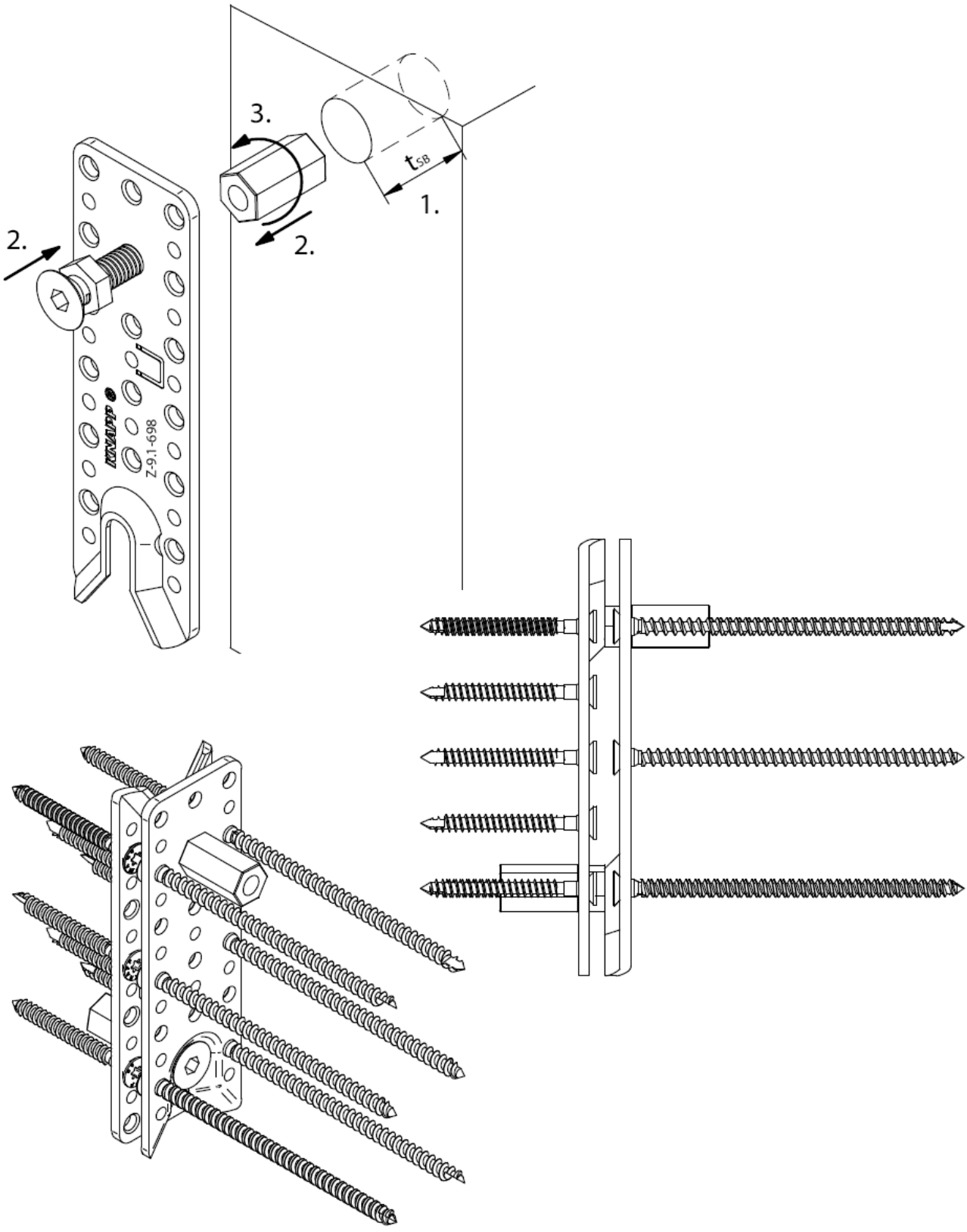
RICON S

Installation spring retaining screw collar bolt



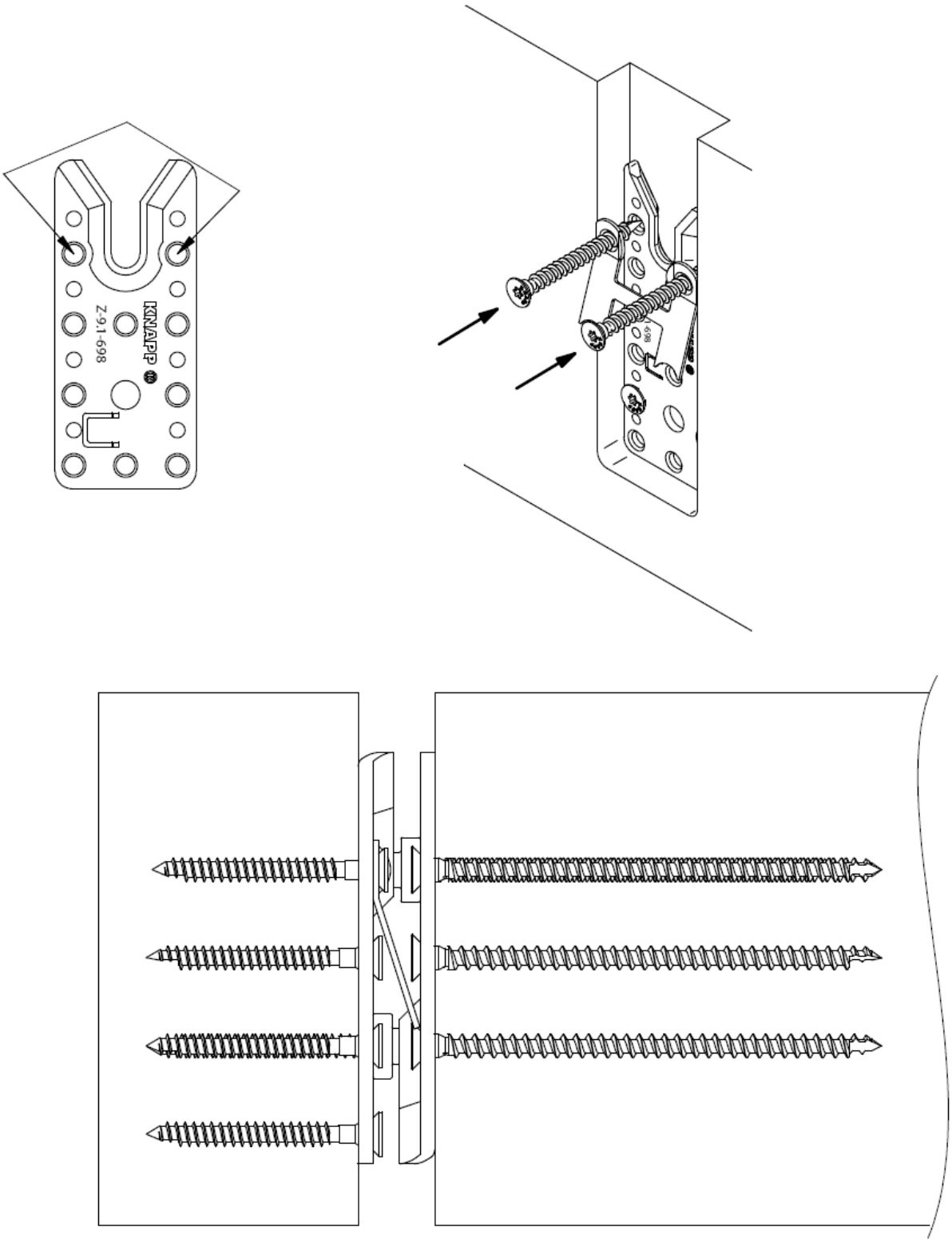
RICON S

Installation retaining screw bolt



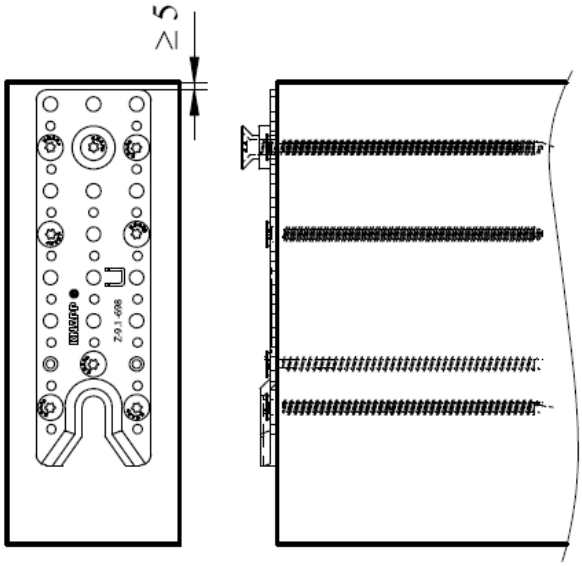
RICON S

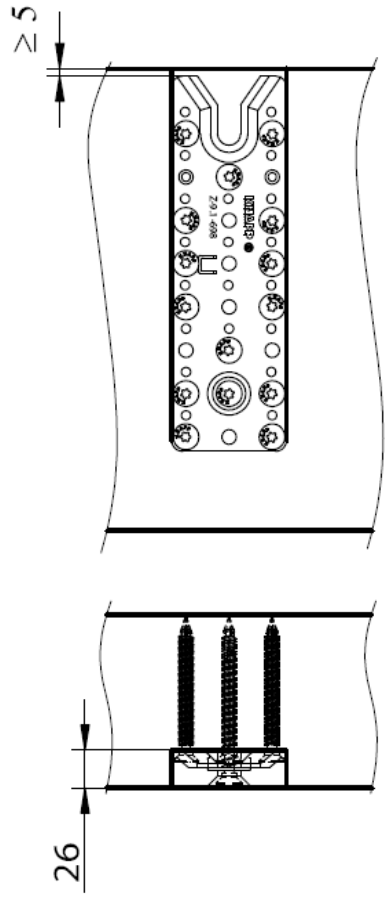
Installation clip lock



RICON S

Minimum cross-section sizes



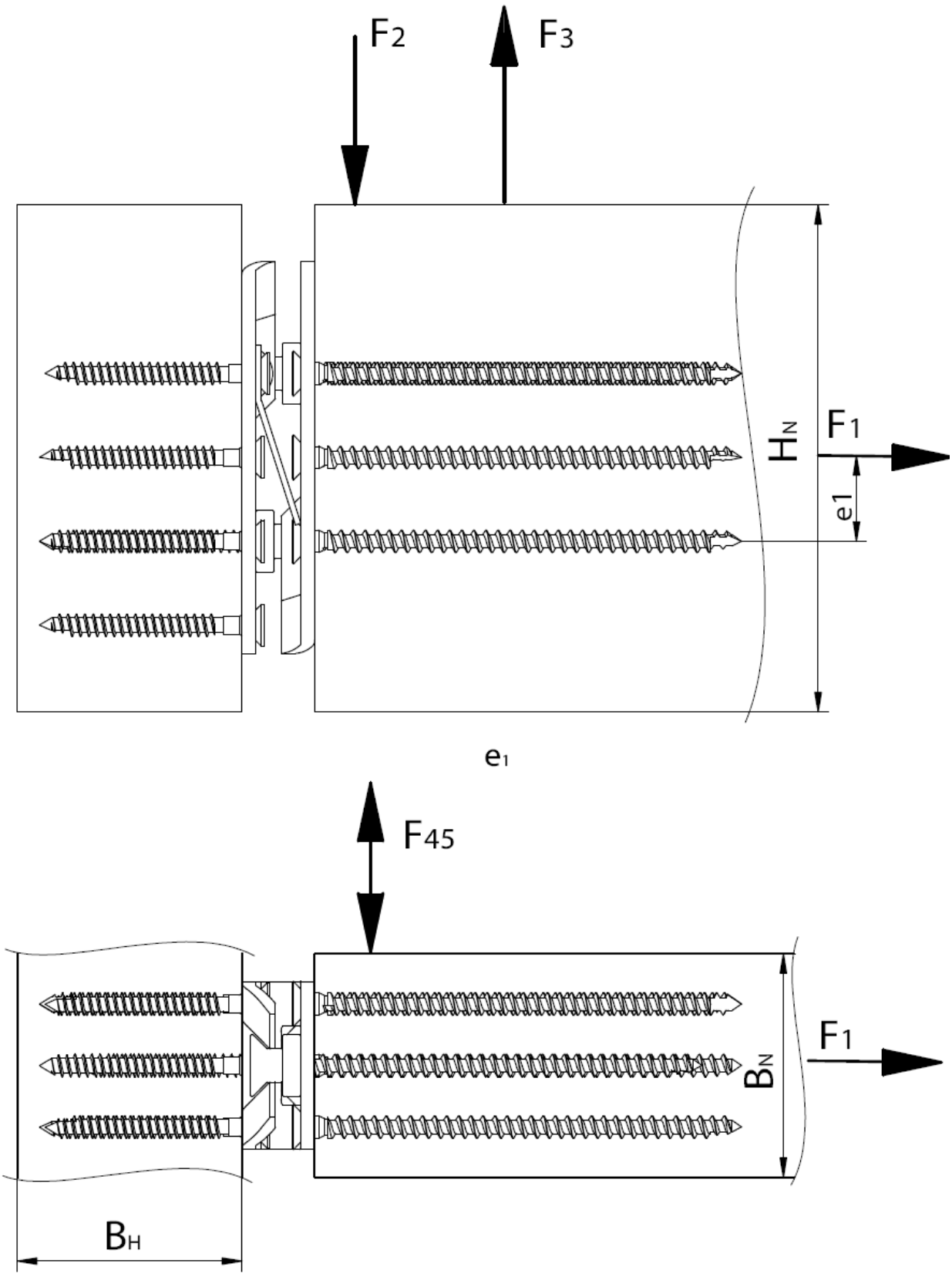


minimum coss sectional area:

joint sizes		minimum cross section	
width	height	width	height
60	140	100	160
60	170	100	190
60	200	100	220
60	230	100	250
80	200	120	230
80	230	120	260
80	260	120	290
80	290	120	320

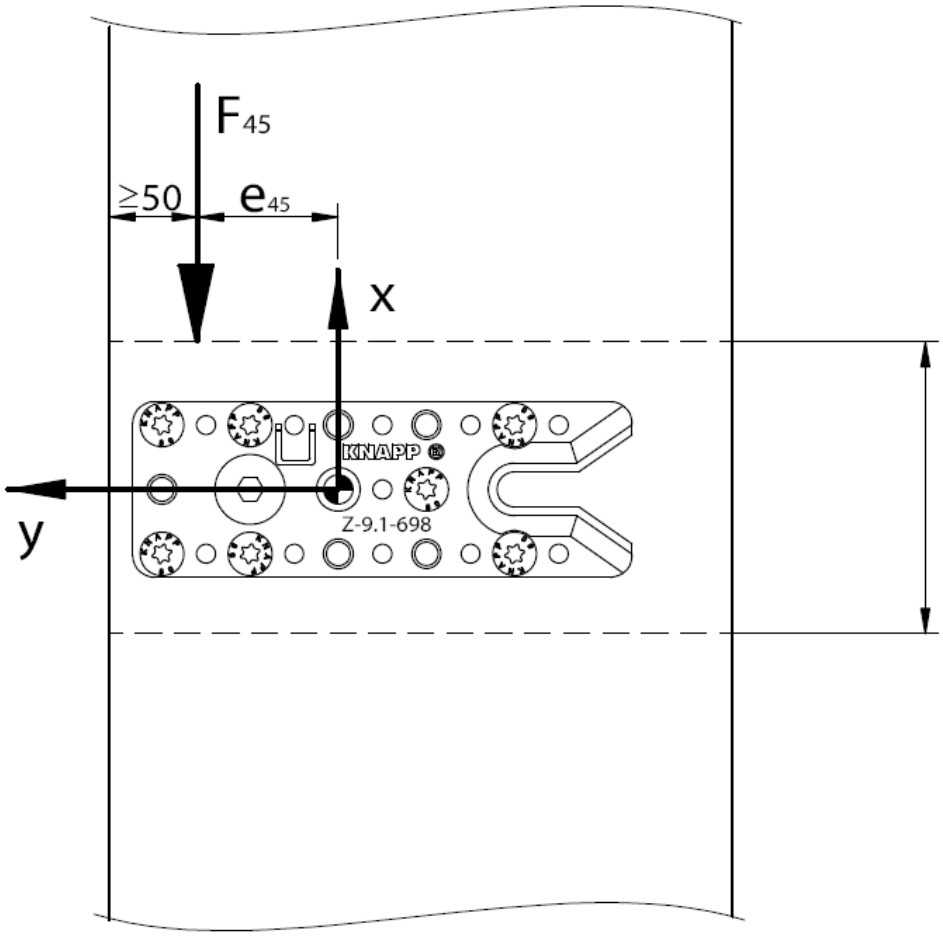
RICON S

Load directions



RICON S

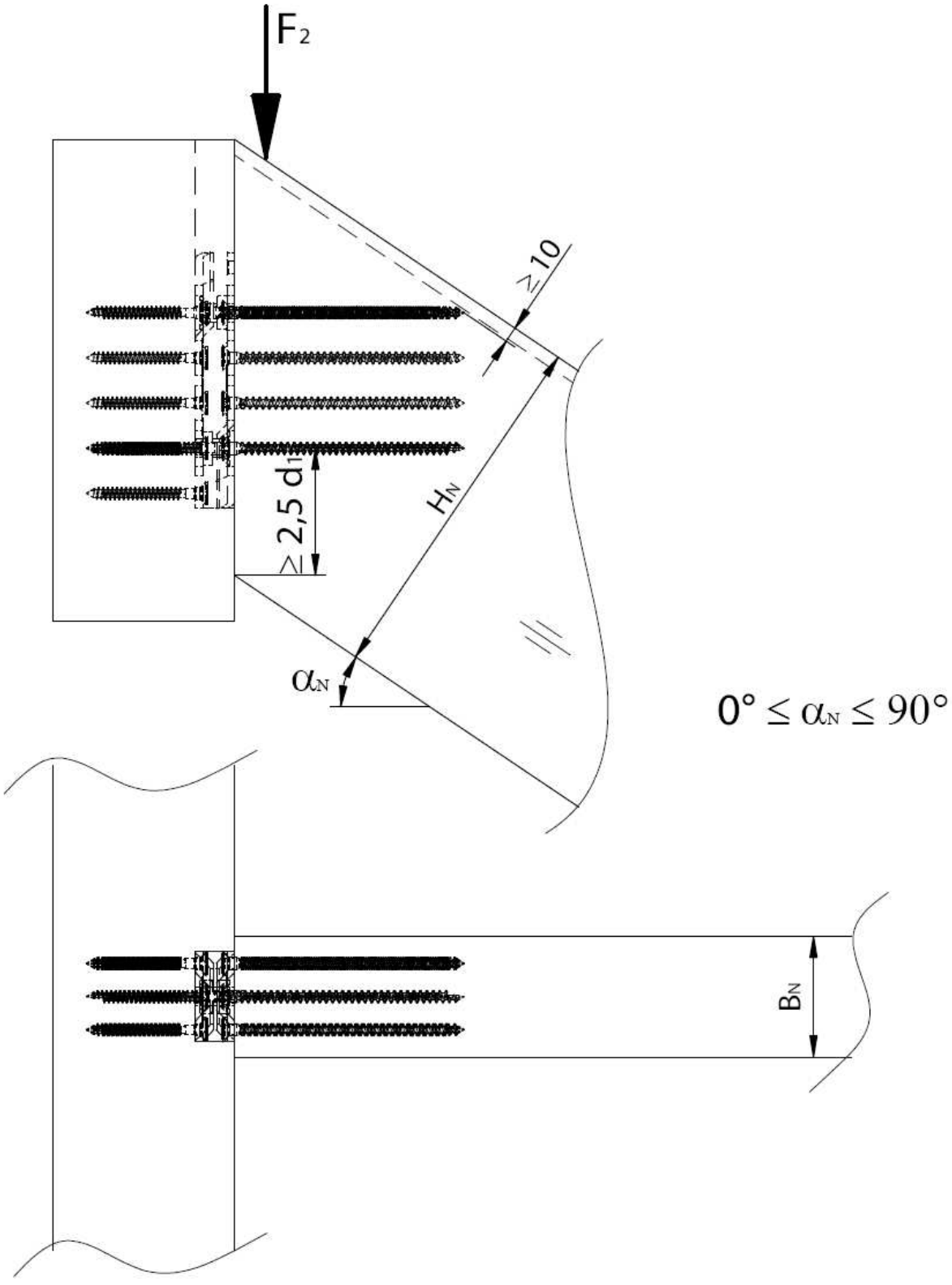
Excentric loading



Centre of gravity of screw pattern

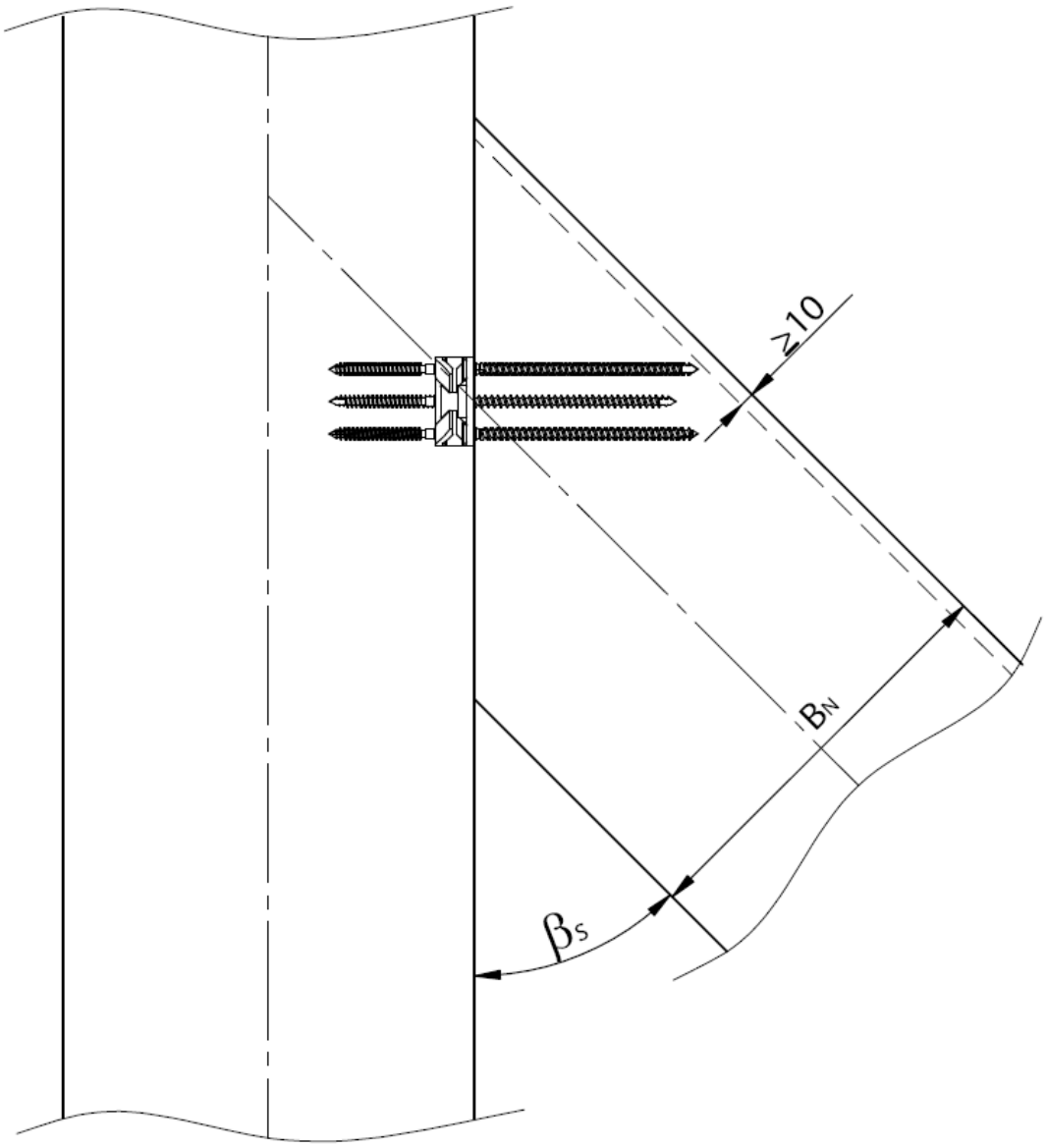
RICON S

Tilted joint



RICON S

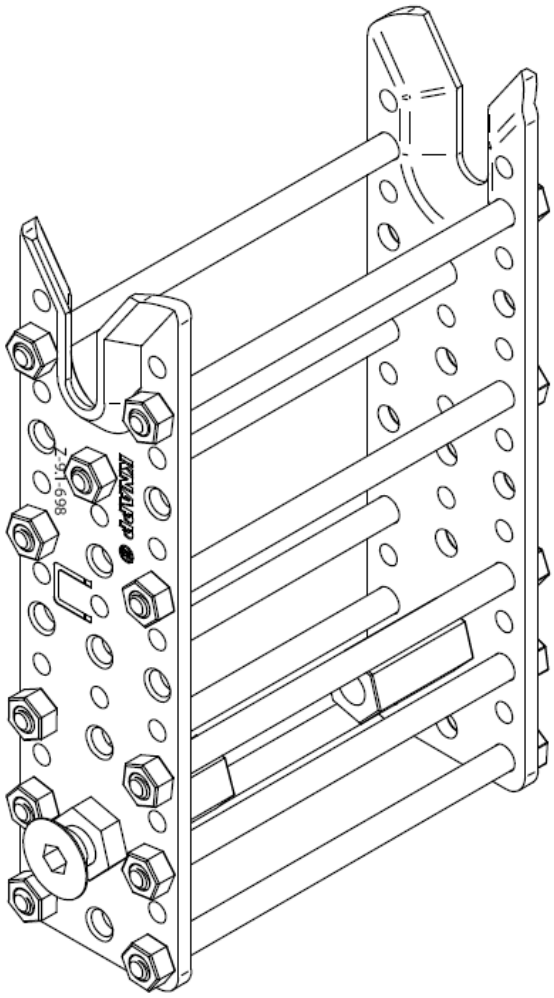
Tilted joint



$$35° \leq \beta_S \leq 90°$$

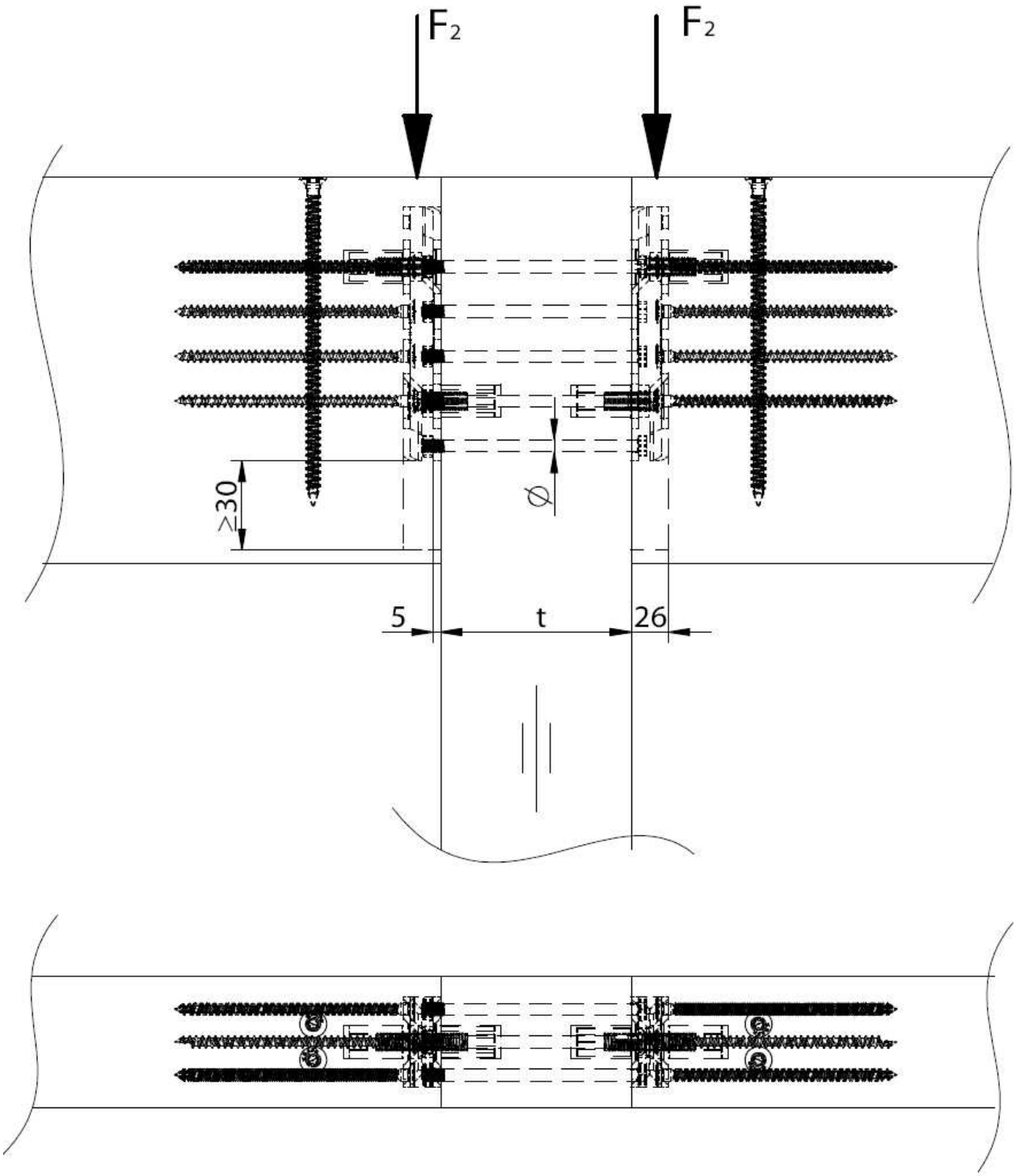
RICON S

Wood-to-wood joint with bolts



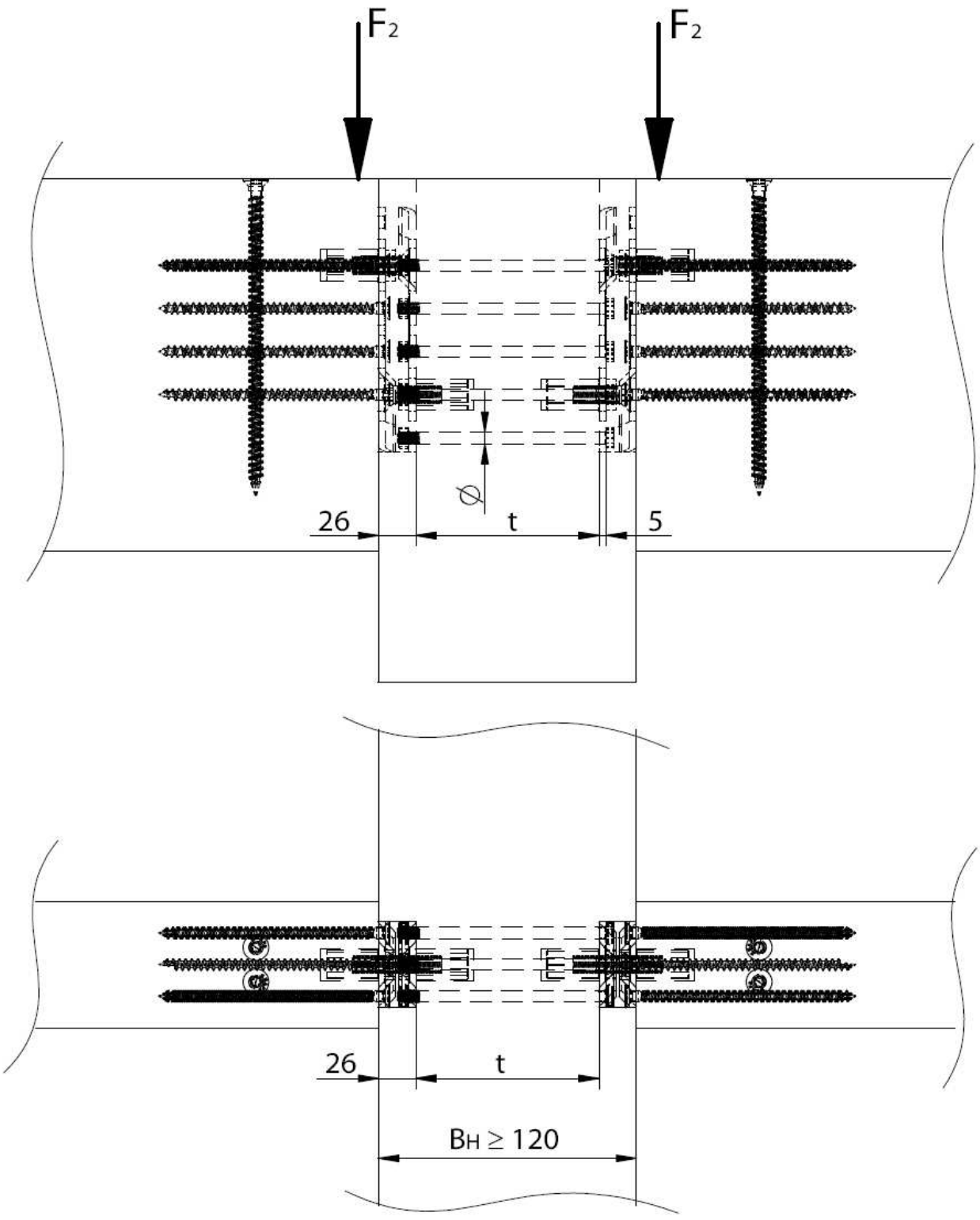
RICON S

Wood-to-wood joint with bolts and reinforcement screws in the joists



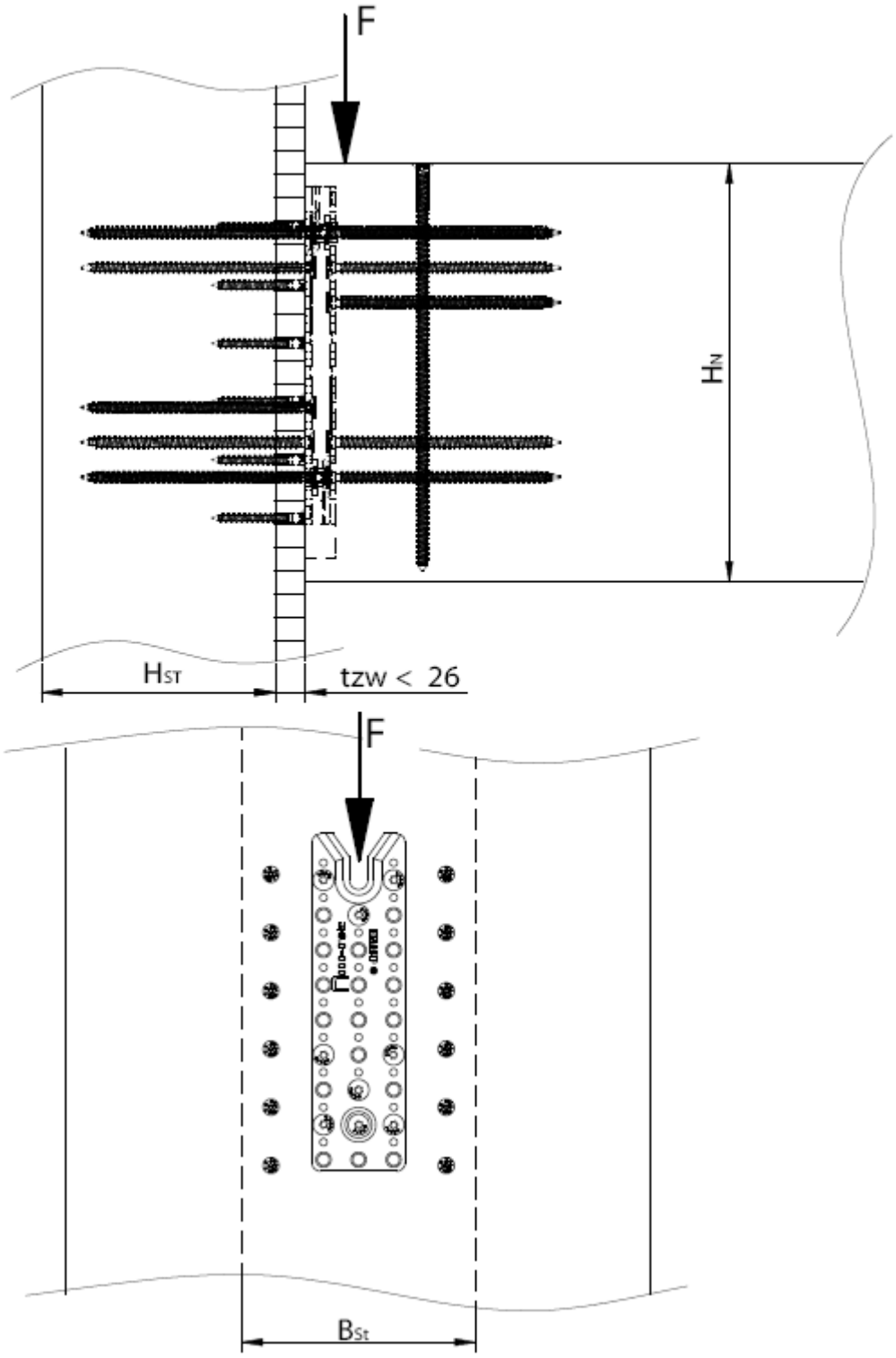
RICON S

Wood-to-wood joint with bolts and reinforcement screws in the joists



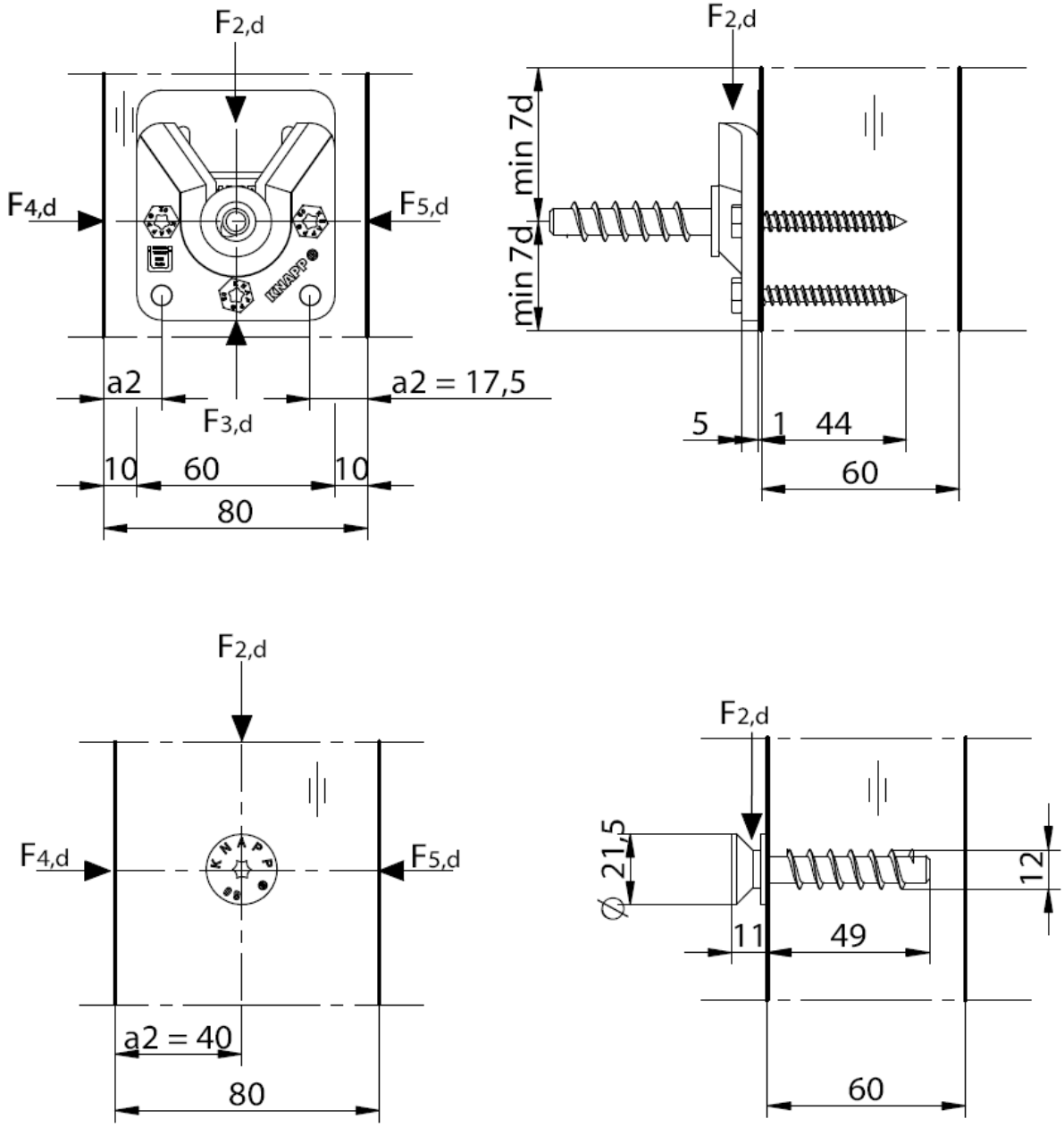
RICON S

Wood-to-wood joint main beam / secondary beam connection with interlayer



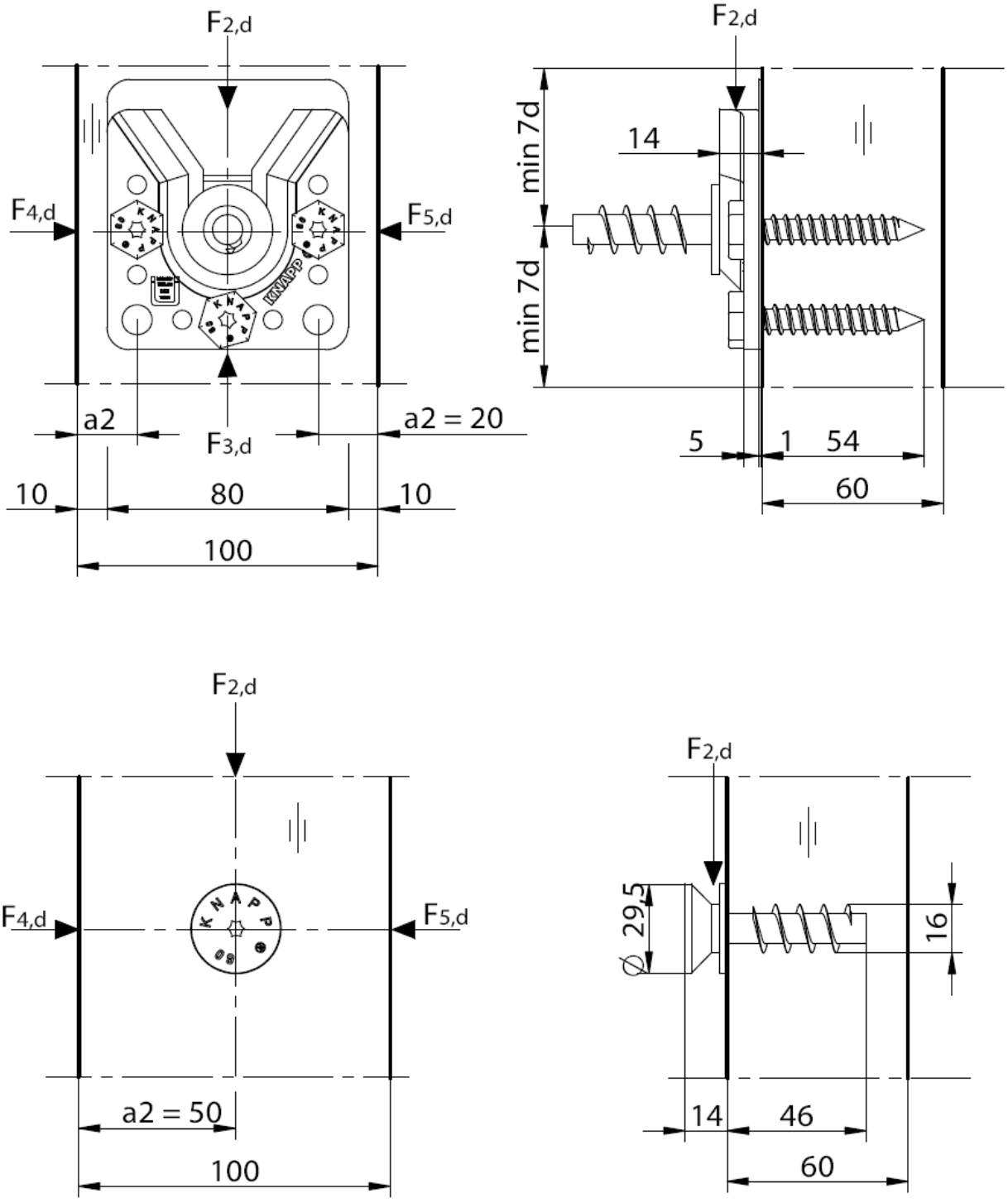
WALCO V

Minimum dimensions WALCO V 60



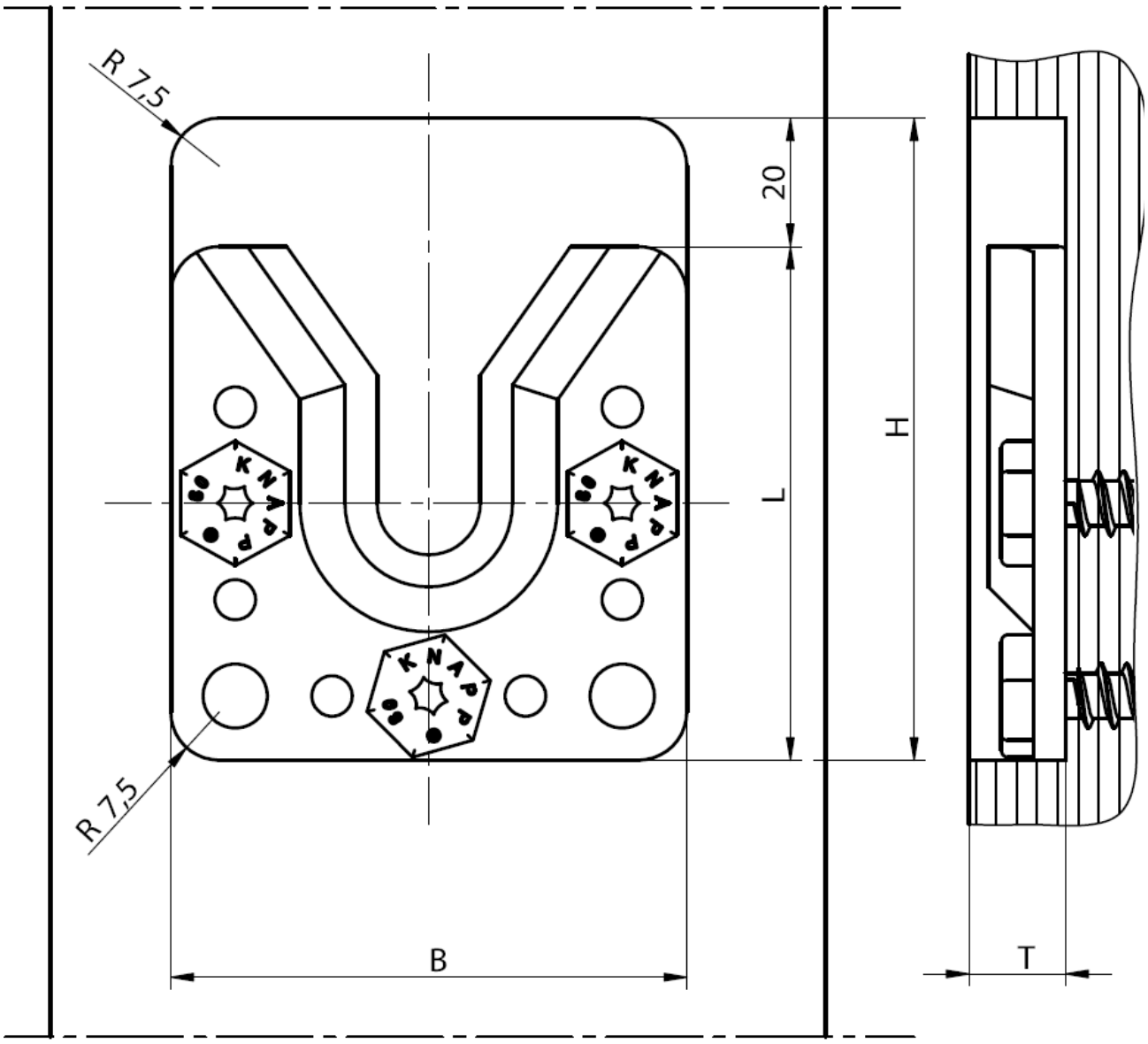
WALCO V

Minimum dimensions WALCO V 80



WALCO V

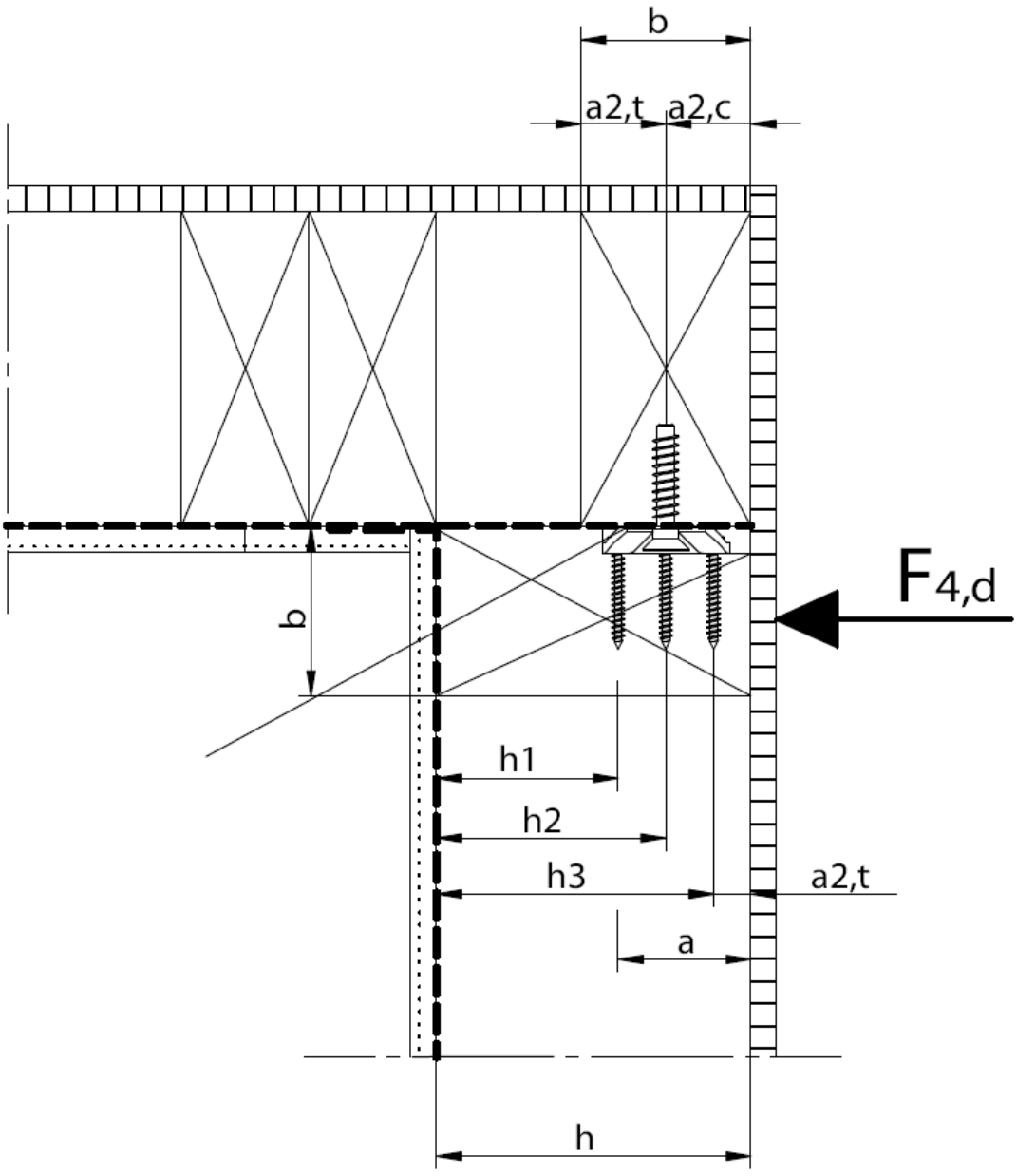
Minimum dimensions



minimum installation			
joint	measures width B	height H	depth T
Walco V60	60 mm	80 mm	≤ 13 mm
Walco V80	80 mm	100 mm	≤ 15 mm

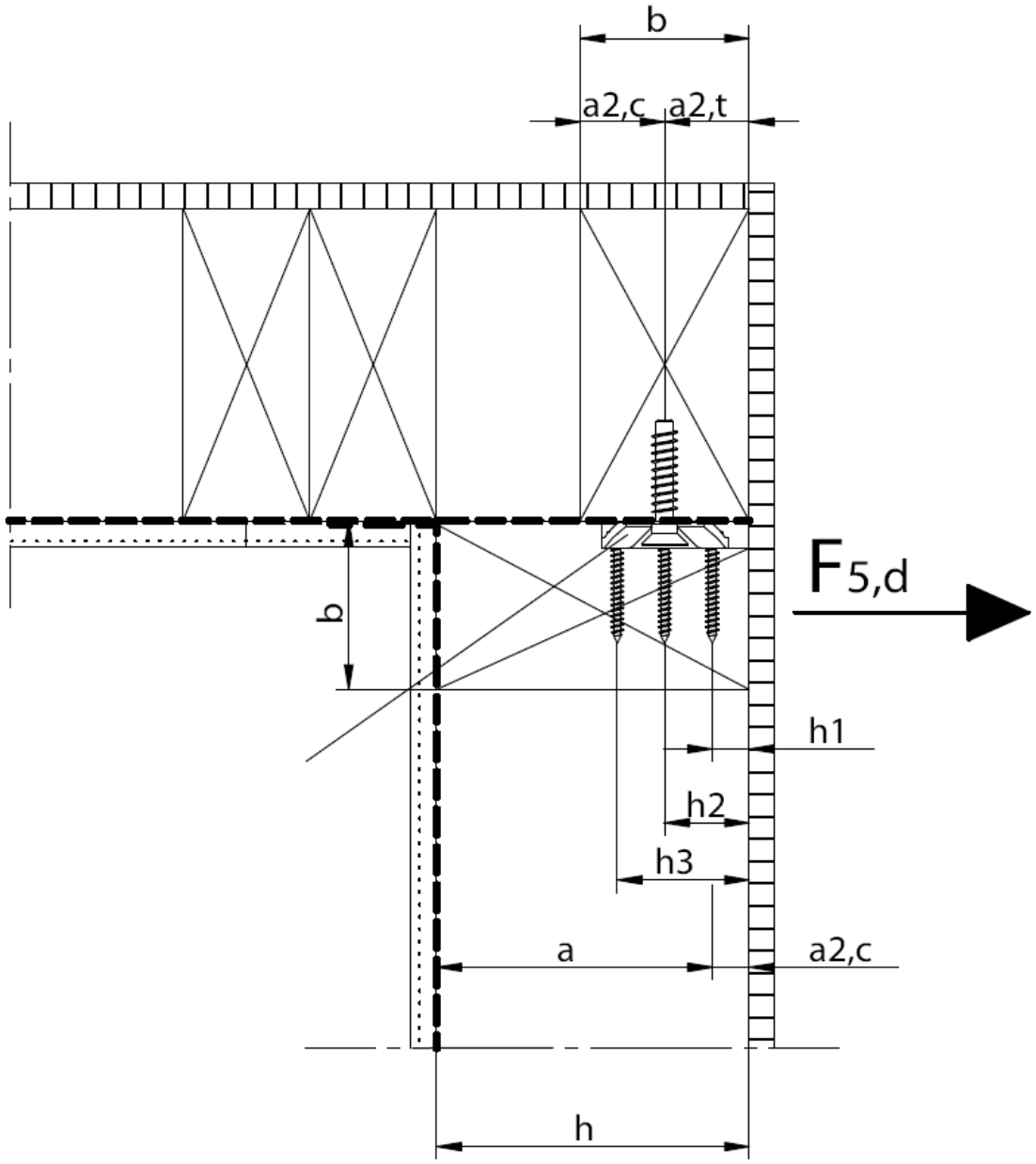
WALCO V

Load direction F_4



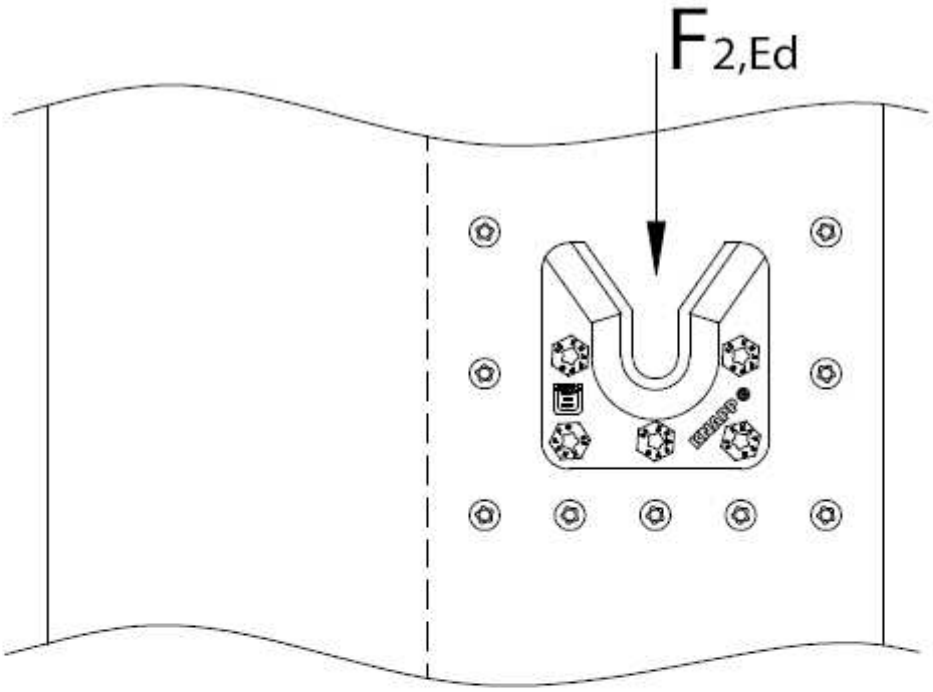
WALCO V

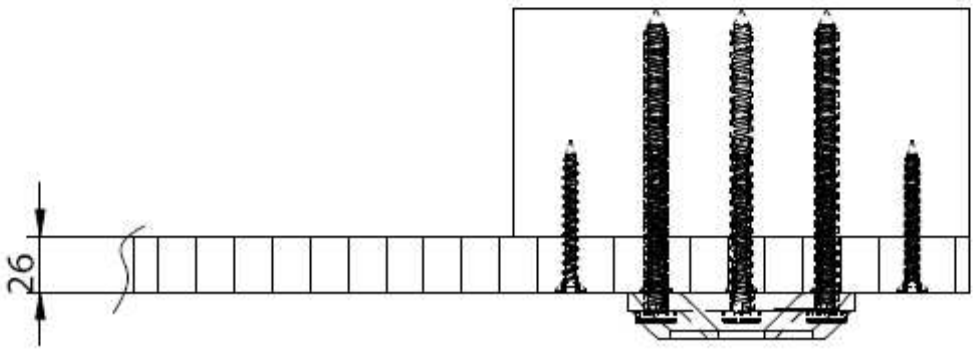
Load direction F_5



WALCO V

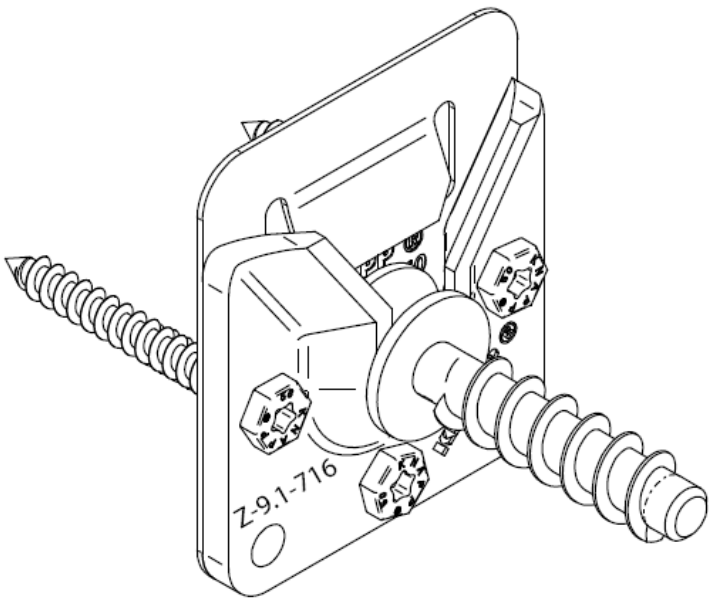
joint with interlayer





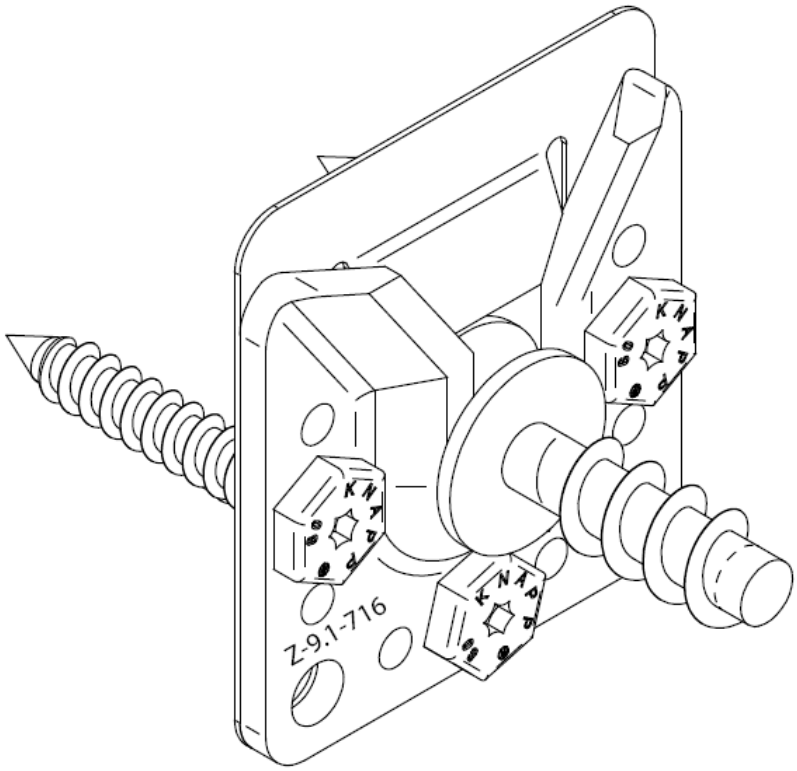
WALCO V

WALCO V 60 with collar screw



WALCO V

WALCO V 80 with collar screw



WALCO V

Functional principle clip lock