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Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-10/0189 of 2019/03/29

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	Knapp Clip Connectors Type GIGANT 120, 150 and 180, Type RICON 60/16, 60/30, 60/40, 70/20, 80/30, 80/40, 100/30, 100/40, 120/30, 120/40, 140/30, 140/40, 160/30 and 160/40, Type RICON S 60/140, 60/170, 60/200, 60/230, 80/200, 80/230, 80/260, 80/290 and 80/390 Type WALCO 40, 60/V60, 80/V80 and V80L
Product family to which the above construction product belongs:	Three-dimensional nailing plate (concealed beam hangers)
Manufacturer:	Knapp GmbH Wassergasse 31 A-3324 Euratsfeld Tel.: +43 (0) 7474 79910-0 Telefax: +43 (0) 7474 79910-99 Internet: www.knapp-verbinder.com
Manufacturing plant:	Knapp GmbH Wassergasse 31 A-3324 Euratsfeld
This European Technical Assessment contains:	199 pages including 4 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	Guideline for European Technical Approval (ETAG) No. 015 Three Dimensional Nailing Plates, April 2013, used as European Assessment Document (EAD).
This version replaces:	The previous ETA with the same number issued on 2016-03-03

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product

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

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 or corrosion resistant steel castings GX5CrNi 19-10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa.

Dimensions, hole positions and typical installations are shown in Annex A.

2 Specification of the intended use in accordance with the applicable EAD

The connectors are intended for use in making end-grain to side-grain connections, end-grain to end-grain and side-grain to side-grain connections in load bearing timber structures, as a connection between a wood based joist and a solid timber (softwood or hardwood) or wood based header, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled. They are also intended for use in making an end-grain or side-grain connection between a timber joist and a steel member or concrete.

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

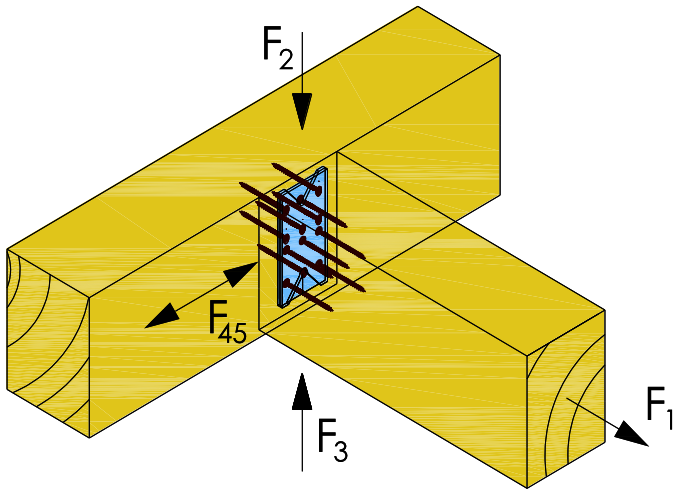
- Structural solid timber of soft- or hardwood according to EN 338 / EN 14081,
- Glulam made of soft- or hardwood, classified according to EN 1194 / EN 14080, or with ETA or national approval
- LVL according to EN 14374 or ETA
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- Cross laminated timber and similar structural glued products according EN16351 or ETA.
- Engineered wood products and solid wood panels according to EN13986 or ETA, the provisions of the ETA of the engineered wood product apply
- Engineered wood products according to ETA if the ETA of the product includes provisions for the use of self-tapping screws, the provisions of the ETA of the engineered wood product apply.

However, the calculation methods are only allowed for a characteristic wood density of up to 500 kg/m^3 for softwood and 590 kg/m^3 for hardwood. 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. In end-grain to side-grain 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 $M_v = F_d \times (b_H/2+e)$ 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, (Eurocode 5). The stainless steel connectors are for use in timber structures subject to conditions defined by the service classes 1, 2 and 3 of EN 1995-1-1:2008, (Eurocode 5). The fasteners (screws and bolts) to be used shall be made from suitable material.

KNAPP clip connectors with ≥ 60 µm zinc-coating and screws with ≥ 15 µm zinc-coating are intended to be used for concealed connections in climatic conditions equivalent to swimming pool facilities with fresh water (this use does not apply to facilities with mineral or brine baths).

Details of the corrosion protection system are deposited at ETA-Danmark.

The scope of the brackets regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the concealed beam hangers of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex B
Stiffness	See Annex B
Ductility in cyclic testing	No performance assessed
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The concealed beam hangers are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
3.3 Hygiene, health and the environment (BWR3)	
Influence on air quality	The product does not contain/release dangerous substances specified in TR 034, dated March 2012**)
3.8 General aspects related to the performance of the product	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, 2 and 3
Identification	See Annex A

*) See additional information in section 3.8 – 3.9.

**) In addition to the specific clauses relating to dangerous substances contained in this European technical Assessment, 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 Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

3.9 Methods of verification

The characteristic load-carrying capacities are based on the characteristic values of the connectors and the steel plates.

According to EN 1990 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity can be determined by reducing the characteristic values of the load-carrying capacity with different partial factors.

Therefore, to obtain design values according to the Eurocodes or appropriate national codes of practice, the capacities have to be multiplied with different partial factors for the material properties and – for the connectors mounted in wood – also the coefficient k_{mod} that takes into account the load duration class.

Thus, the characteristic or design values of the load–carrying capacity are determined also for timber failure $F_{Rk,H}$ (obtaining the embedment strength of connectors subjected to shear or the withdrawal capacity of the most loaded connector, respectively (see Annex B) as well as for steel plate failure $F_{KCC,Rd}$. The design value of the load–carrying capacity is the smaller value of both load–carrying capacities.

$$F_{Rd} = \min\left\{\frac{k_{mod} \cdot F_{Rk,H}}{\gamma_{M,H}}; F_{KCC,Rd}\right\}$$

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for steel or timber, respectively, are also correctly taken into account.

3.10 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, and to a concrete member by concrete dowels.

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.

3.11 Aspects related to the performance of the product

3.11.1 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 12. The steel employed is DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 235 MPa.

3.11.2 Corrosion protection in service class 3.
In accordance with ETAG 015 the stainless steel connectors are produced from 5 mm thick corrosion resistant steel castings. The steel employed is GX5CrNi 19- 10 according to EN 10283:2010-06 with minimum yield strength R_e of 175 MPa.

3.12 General aspects related to the fitness for use of the product

Knapp Clip Connectors GIGANT, RICON, RICON S WALCO V and WALCO 40 are manufactured in accordance with the provisions of this European Technical Assessment using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

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 $M_{ec} = R_{joist} \times b_H/2$ shall be considered at the strength verification of the header.

  R_{joist} Reaction force from the joists
  b_H Width of header

- For a header with joists from both sides but with vertical forces which differ more than 20% 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, 2018-07-26 and 2018-11-10.
- 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, 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.
- The screws shall be driven into softwood without predrilling for:
  - RICON (Ø5 mm) and RICON S
  - WALCO V60

  or after pre-drilling:
  - RICON (Ø8 mm)
  - WALCO V80 and WALCO 40
  - GIGANT

  The screws shall be driven into hardwood after pre-drilling.
  The drill hole diameters are:

Outer thread diameter	Drill hole diameter	
	Softwood	Hardwood
5,0	3,0	3,5
6,0	4,0	4,0
8,0	5,0	6,0
10,0	6,0	7,0
KS12x60	8,0	9,0
KS16x60	12,0	13,0

Wood to steel and wood to concrete

The above mentioned rules for wood to wood connections are applicable also for the connection between the joist and the steel-header or concrete-header.

- The connector joint is designed in accordance with Eurocodes 2, 3, 5 or 9 or an appropriate national code.
- The connector plate shall be in close contact with the steel or concrete over the whole face. There shall be no intermediate layers in between, except static calculations are made for the interlayer.
- The bolt shall have a diameter not less than the hole diameter minus 2 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.
- Concrete bolts shall be in accordance with an ETA based on ETAG 001

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/638/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking

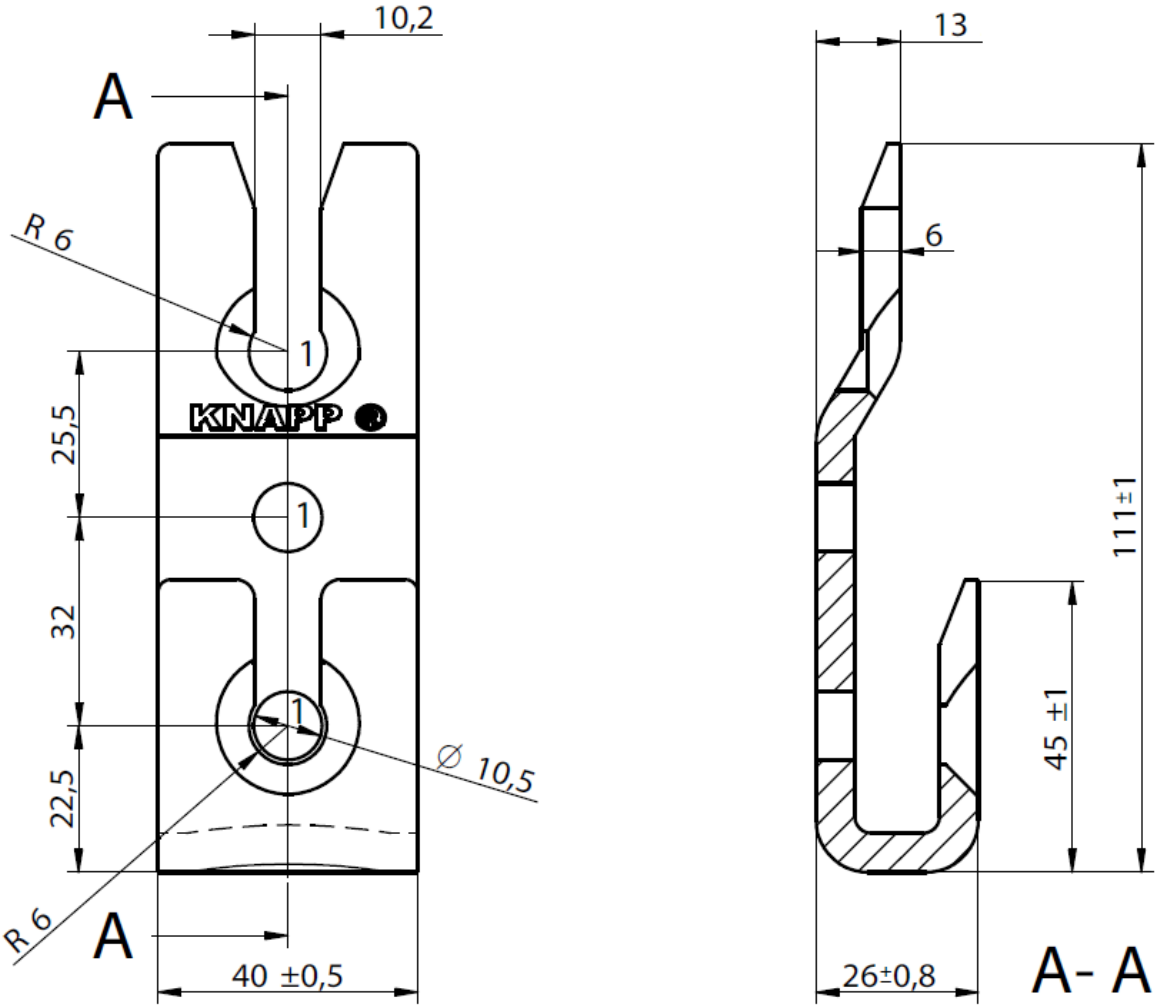
Issued in Copenhagen on 2019-03-29 by

Thomas Bruun
Managing Director, 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, with yield strength R_e of 235 MPa.
Pre-galvanized steel plate with coating Fe/Zn 12



Without clip lock

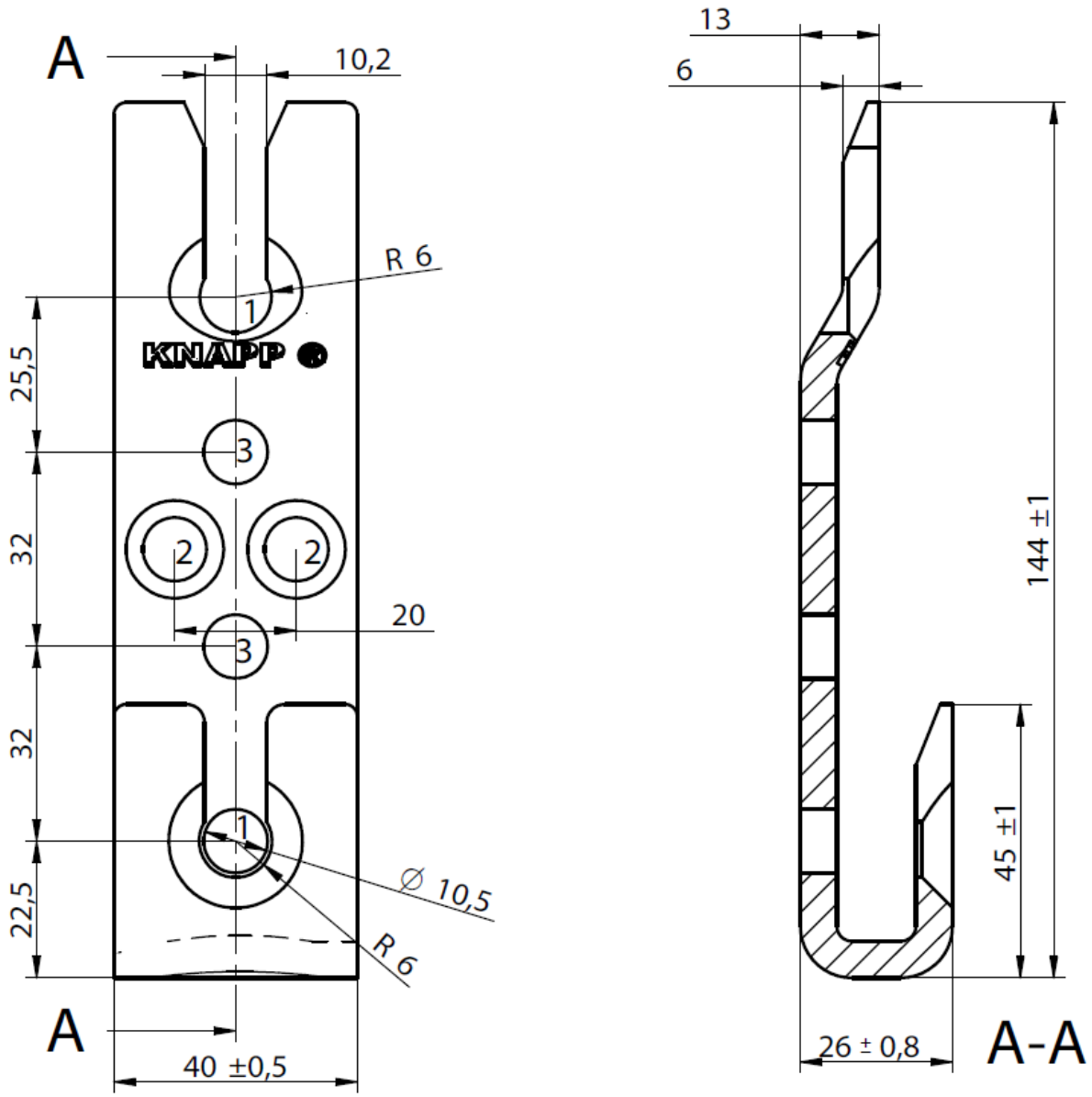
3 screws in header (side grain) using hole pattern 1, with KNAPP® SK 10x80 or 10x120
3 screws in end grain using hole pattern 1, with KNAPP® SK 10x120 or SK 10x200

With clip lock

3 screws in header (side grain) using hole pattern 1 with KNAPP® SK 10x80 or 10x120
3 screws in end grain using hole pattern 1 with KNAPP® SK 10x120 or SK 10x200

KNAPP® Clip Connector GIGANT 150/40

6.0 mm thick steel, grade DD13 according to EN 10111, with yield strength R_e of 235 MPa.
Pre-galvanized steel plate with coating Fe/Zn 12

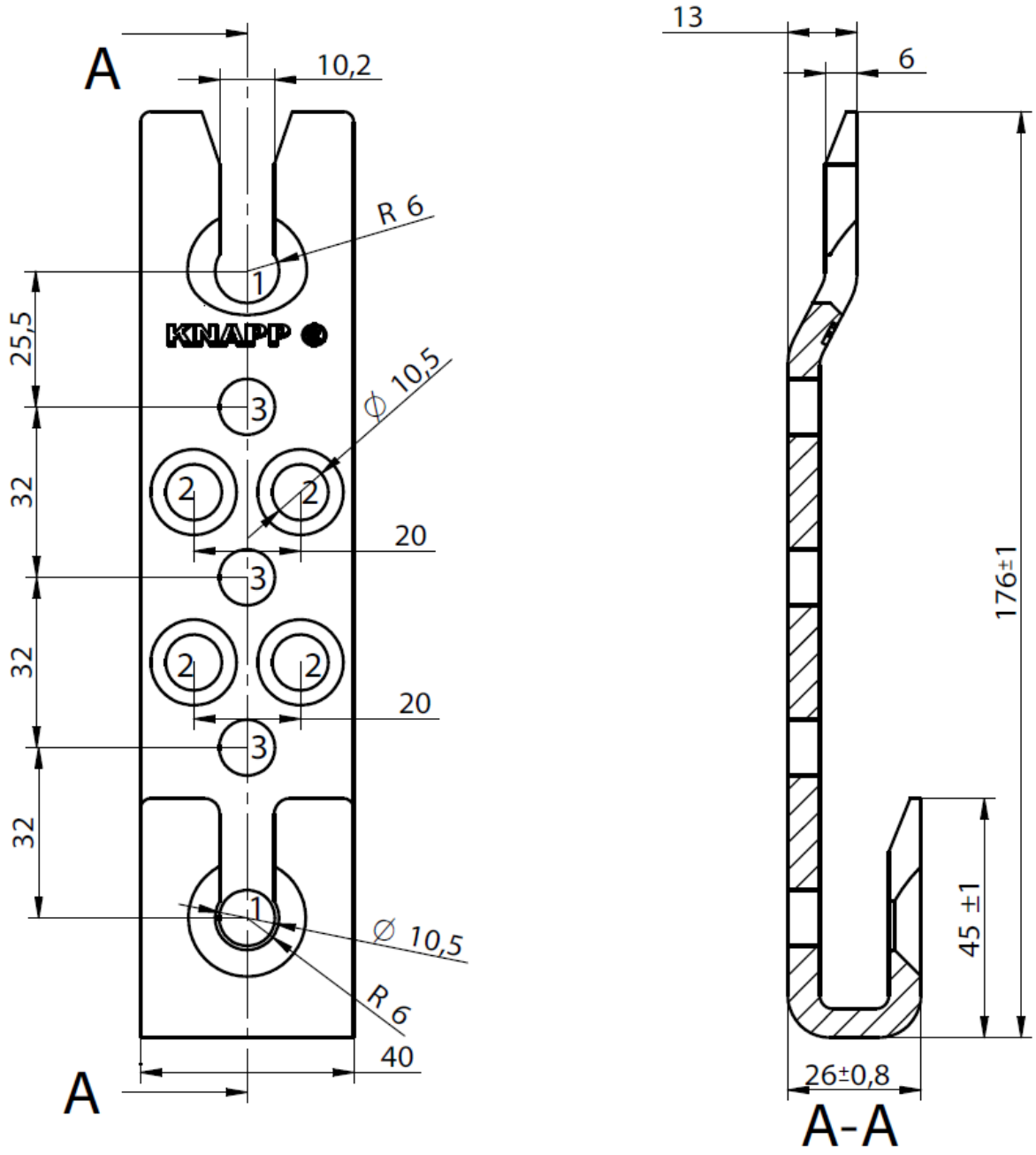


Without clip lock
4 screws in header (side grain) using hole pattern 1 and 2 with KNAPP® SK 10x80 or 10x120
4 screws in end grain using hole pattern 1 and 2 with KNAPP® SK 10x120 or SK 10x200

With clip lock
4 screws in header (side grain) using hole pattern 1 and 2 with KNAPP® SK 10x80 or 10x120
4 screws in end grain using hole pattern 1 and 3 with KNAPP® SK 10x120 or SK 10x200

KNAPP® Clip Connector GIGANT 180/40

6.0 mm thick steel, grade DD13 according to EN 10111, with yield strength R_e of 235 MPa.
Pre-galvanized steel plate with coating Fe/Zn 12

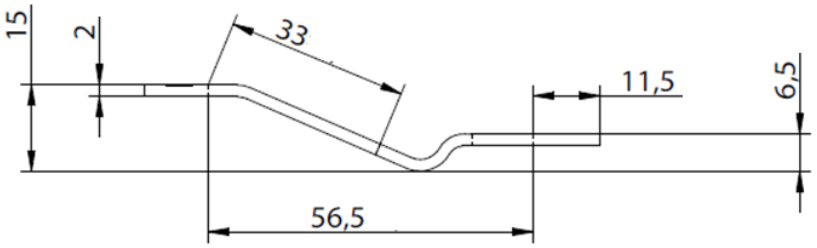


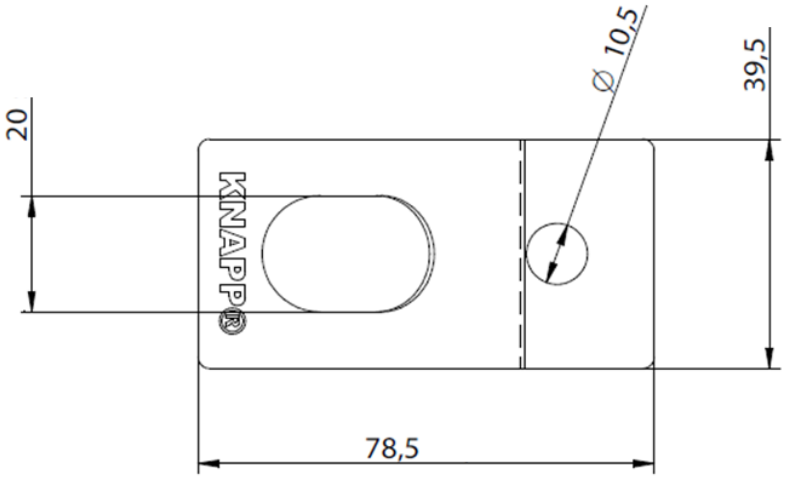
Without clip lock
6 screws in header (side grain) using hole pattern 1 and 2 with KNAPP® SK 10x80 or 10x120
6 screws in end grain using hole pattern 1 and 2 with KNAPP® SK 10x120 or SK 10x200

With clip lock
6 screws in header (side grain) using hole pattern 1 and 2 with KNAPP® SK 10x80 or 10x120
5 screws in end grain using hole pattern 1 and 3 with KNAPP® SK 10x120 or SK 10x200

KNAPP® GIGANT clip lock

2.0 mm thick steel grade S500MC according to EN 10149-2: with yield strength R_e of 500 MPa, tensile strength R_m of 580 MPa, maximum tensile strength R_m of 700 and ultimate strain A80 of 6%
Corrosion protection by pre-galvanizing, chromate conversion coating, and sealing according to specifications on file at ETA Danmark

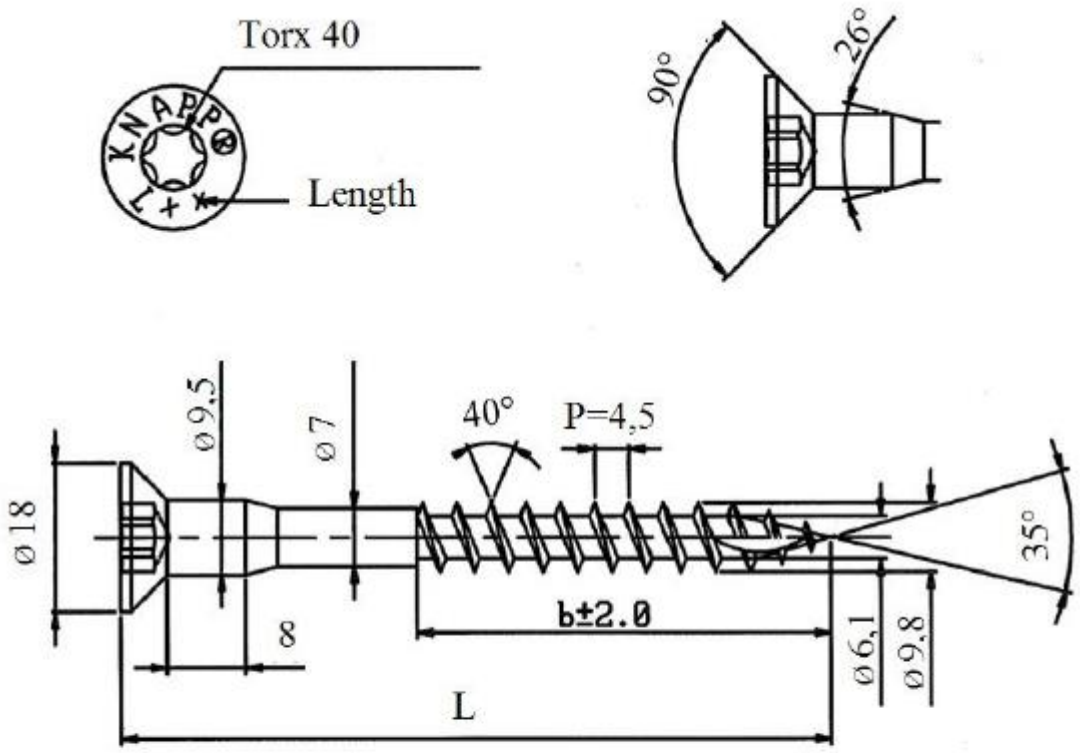




dimensions in mm

KNAPP® GIGANT screw SK 10x80, SK 10x120, SK 10x200

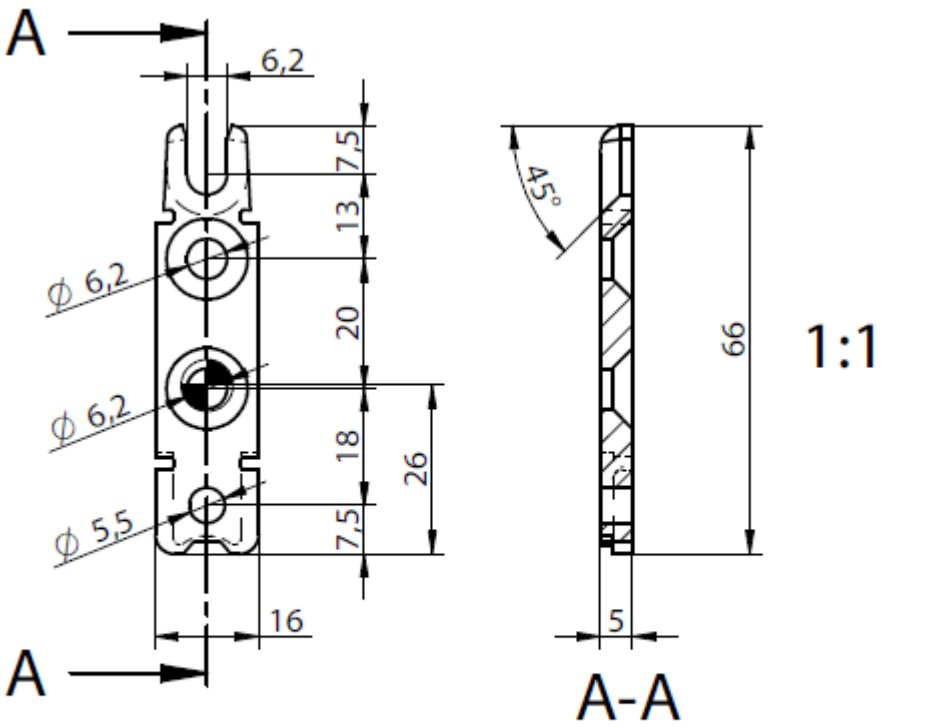
Screws according to EN 14592 manufactured of carbon steel, tension $f_{tens,k}$ of 32 kN, torque $M_{t,u,k}$ of 45 Nm, yield moment M_{yk} of 35 kNm and corrosion protection according to Eurocode 5;



L	b
80 -1,5	54 ± 2
120 -1,75	84 ± 2
200 -1,8	164 ± 2

KNAPP® Clip Connector RICON® 66/16

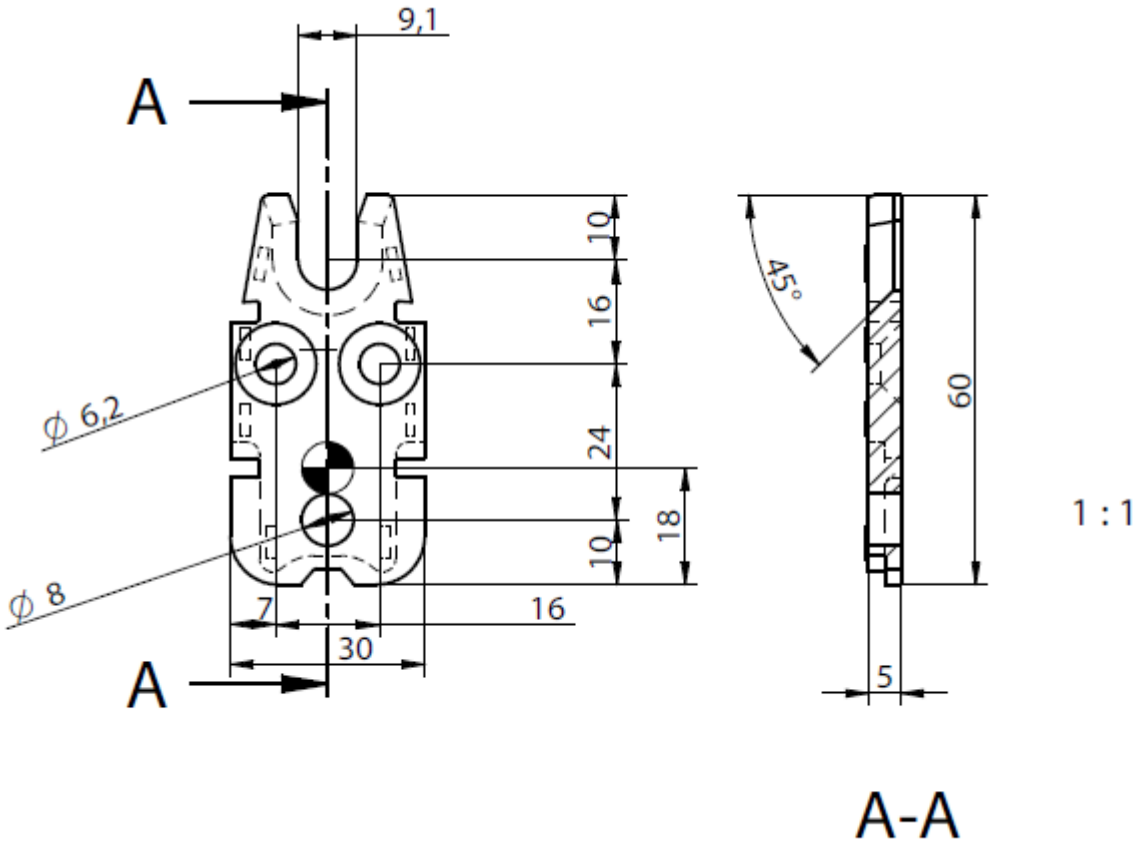
5.0 mm thick stainless steel grade GX5CrNi 19-10 with minimum yield strength R_e of 175 MPa



Center of gravity

KNAPP® Clip Connector RICON® 60/30

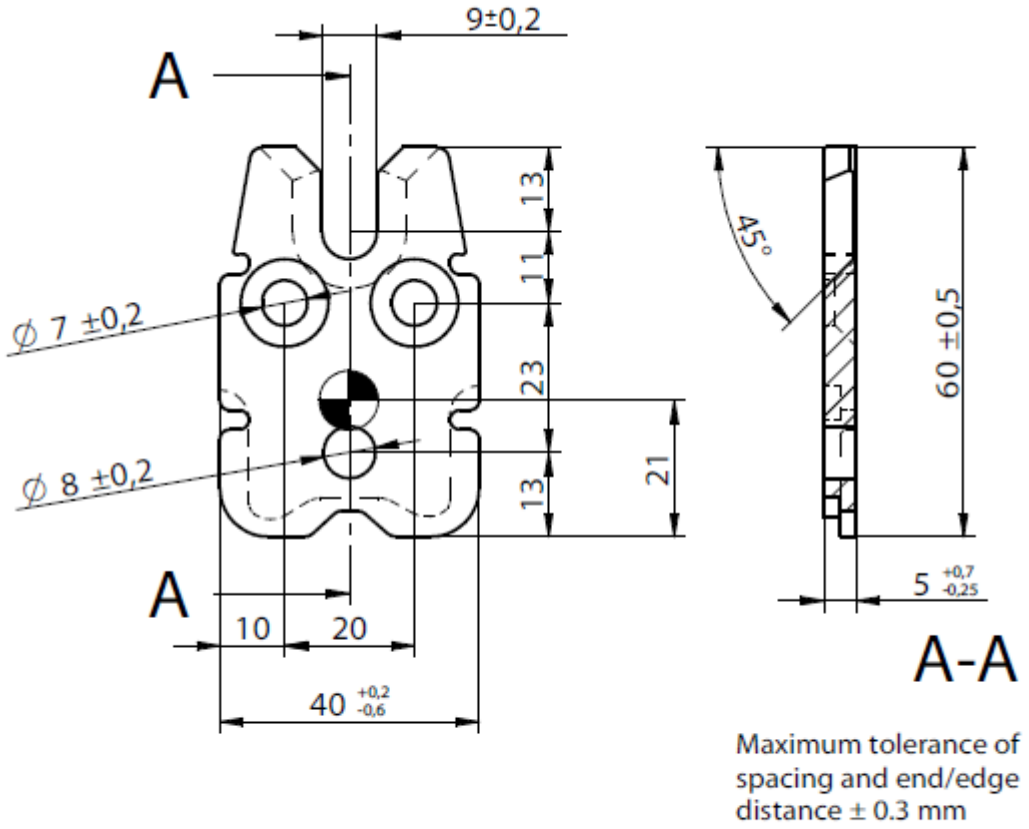
5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



KNAPP® Clip Connector RICON® 60/40

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

5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa

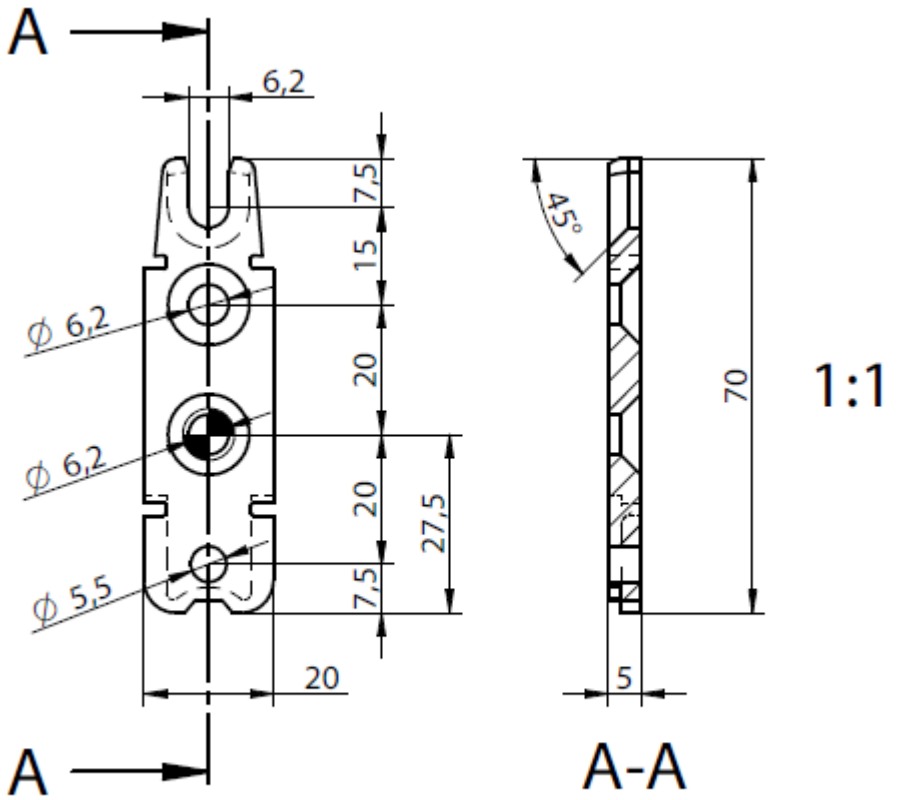


1:1 dimensions in mm

Optional small ribbing for RICON 60/40 to 160/40 arranged around conter sunk holes

KNAPP® Clip Connector RICON® 70/20

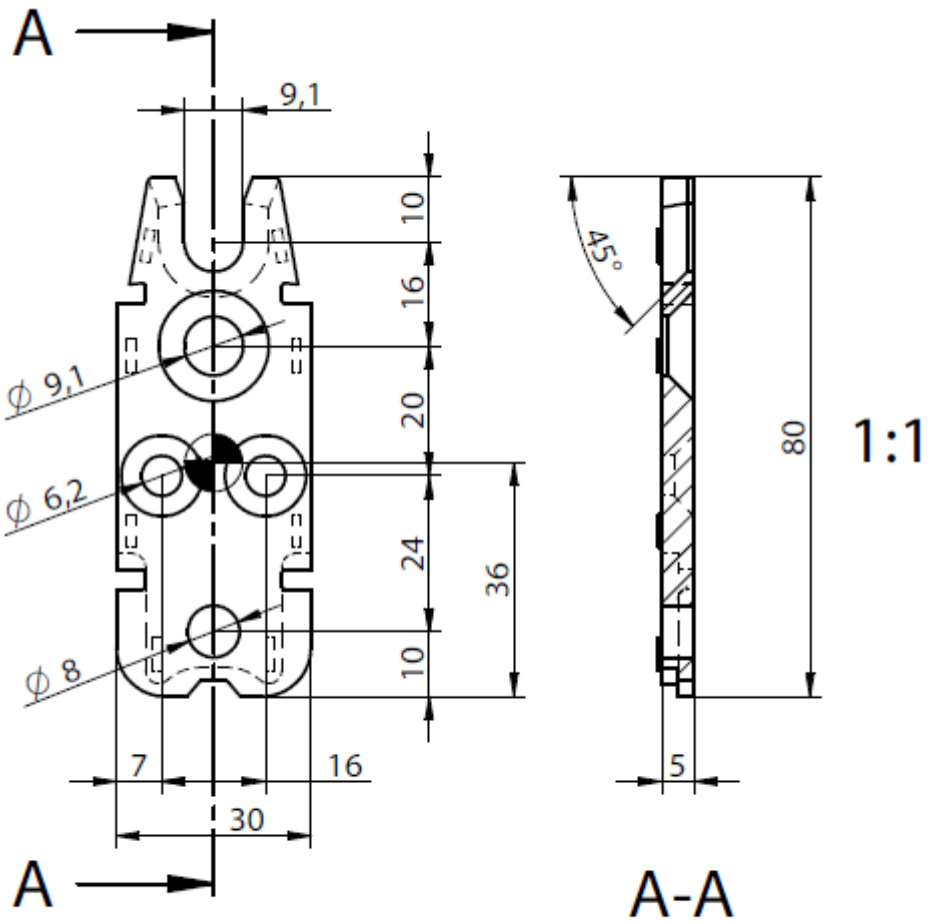
5.0 mm thick stainless steel grade GX5CrNi 19-10 minimum yield strength R_e of 175 MPa



dimension in mm

KNAPP® Clip Connector RICON® 80/30

5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa

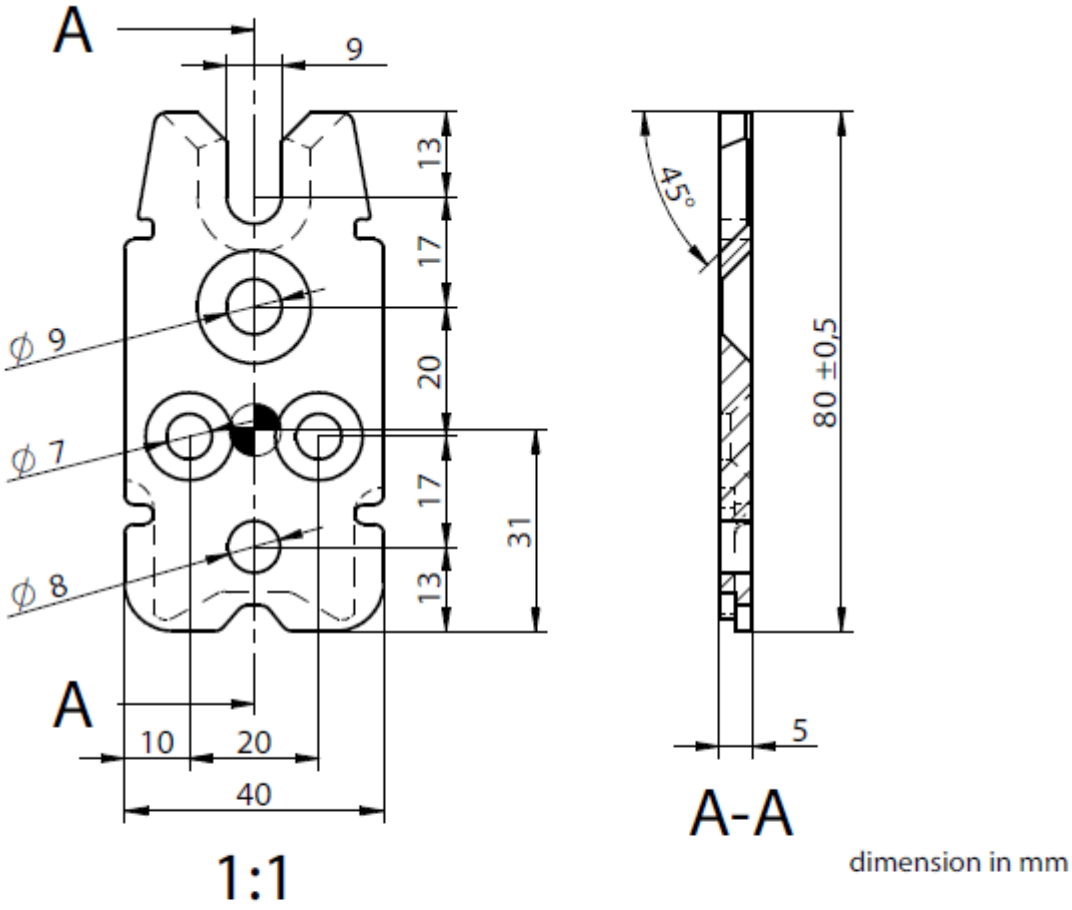


dimension in mm

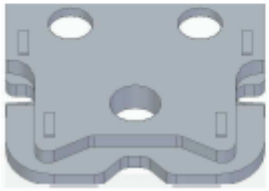
KNAPP® Clip Connector RICON® 80/40

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

5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa

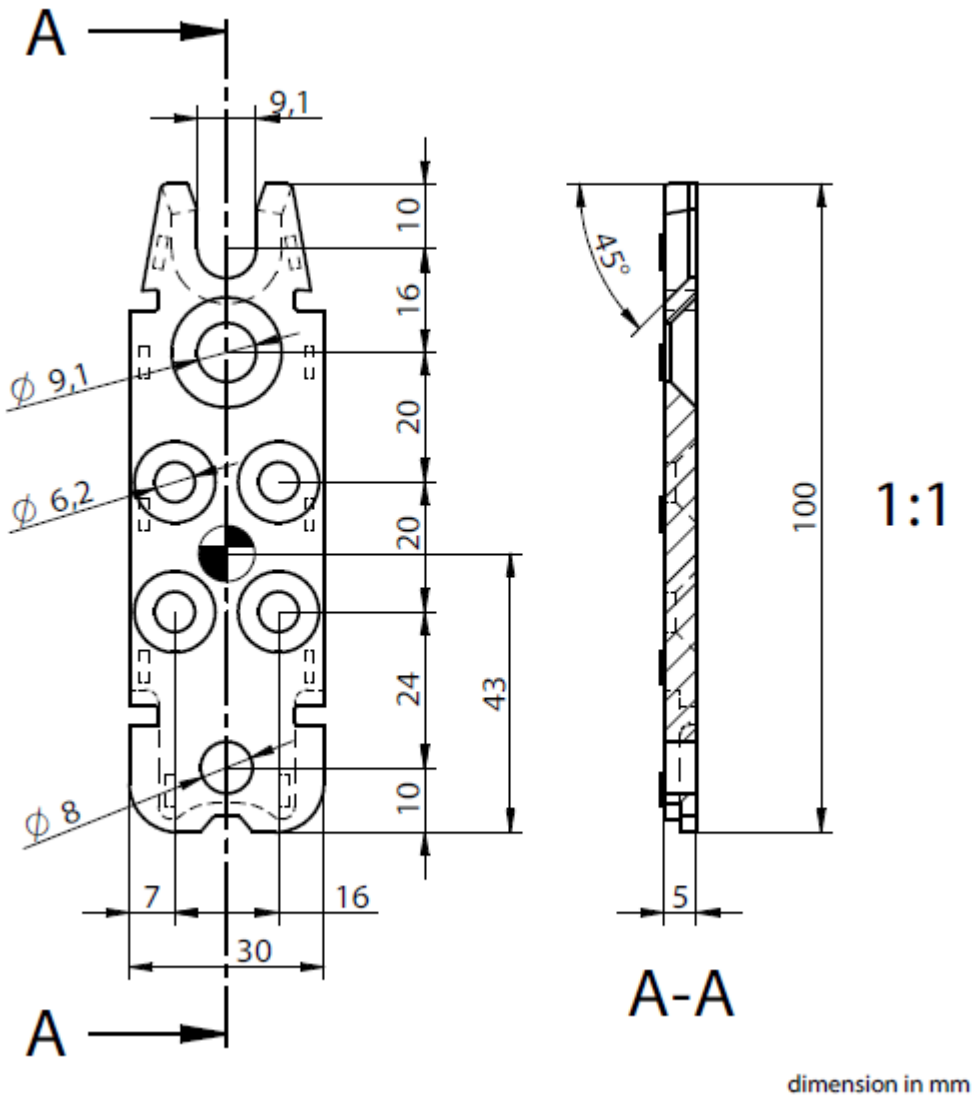


Stainless steel: Small ribbing for RICON 80/40 to 160/40 arranged along the bottom contour



KNAPP® Clip Connector RICON® 100/30

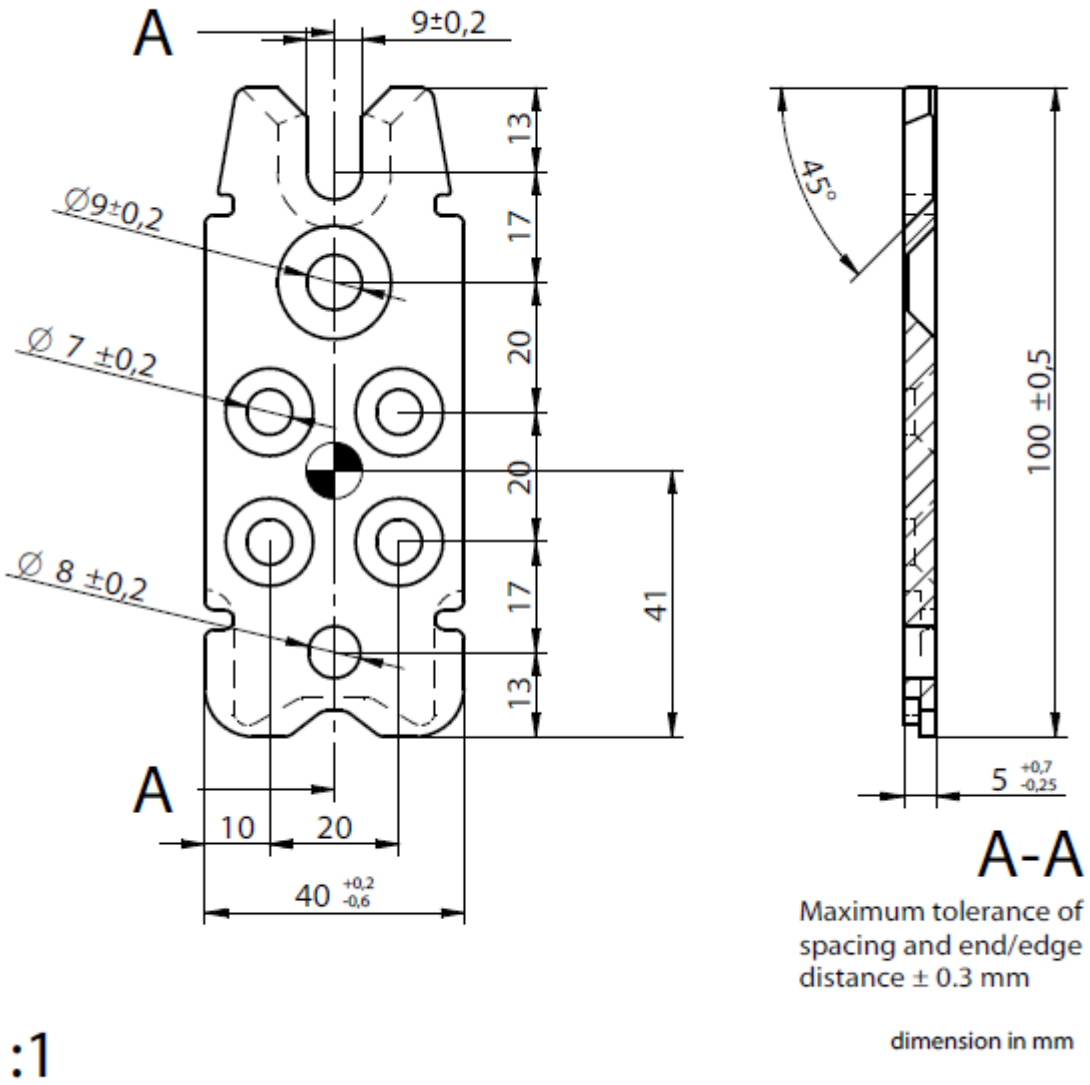
5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



KNAPP® Clip Connector RICON® 100/40

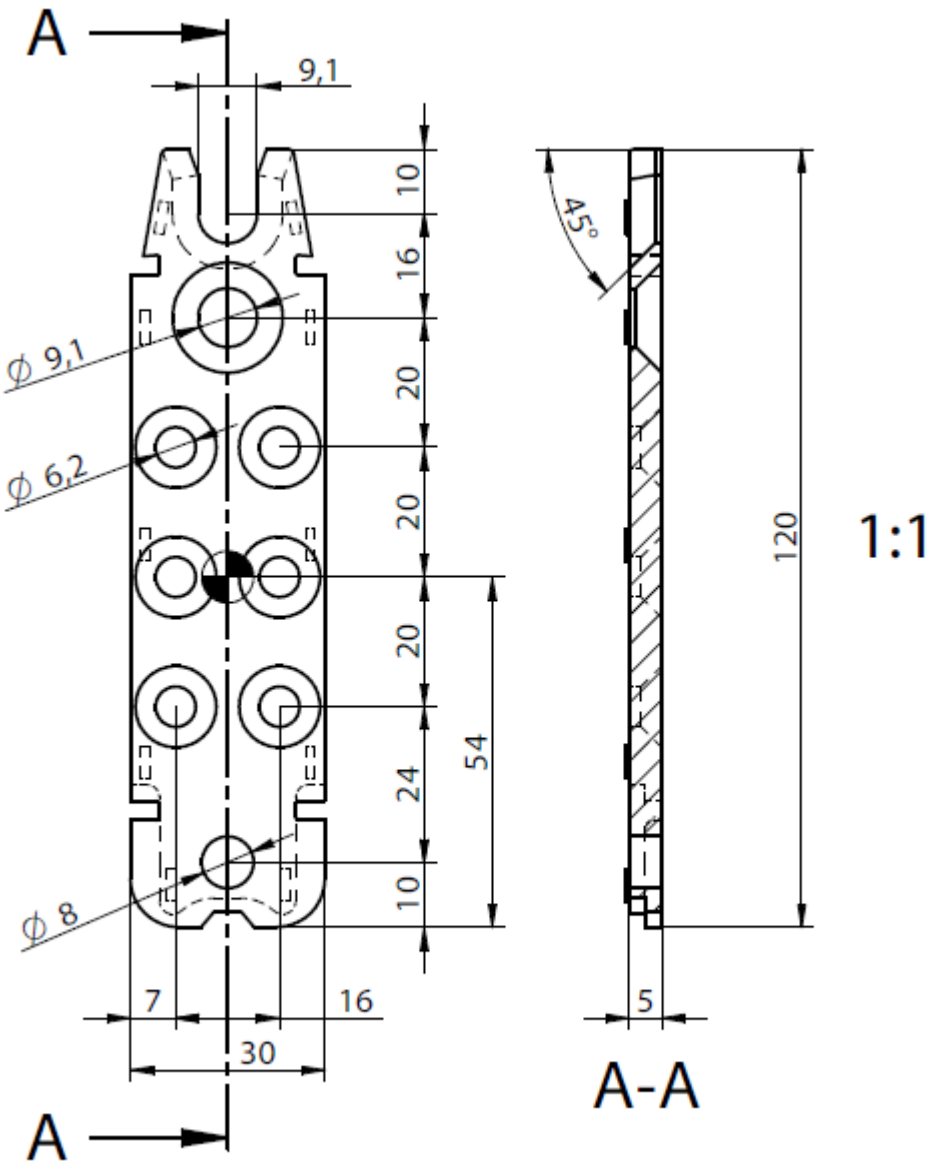
5.5 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5

5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



KNAPP® Clip Connector RICON® 120/30

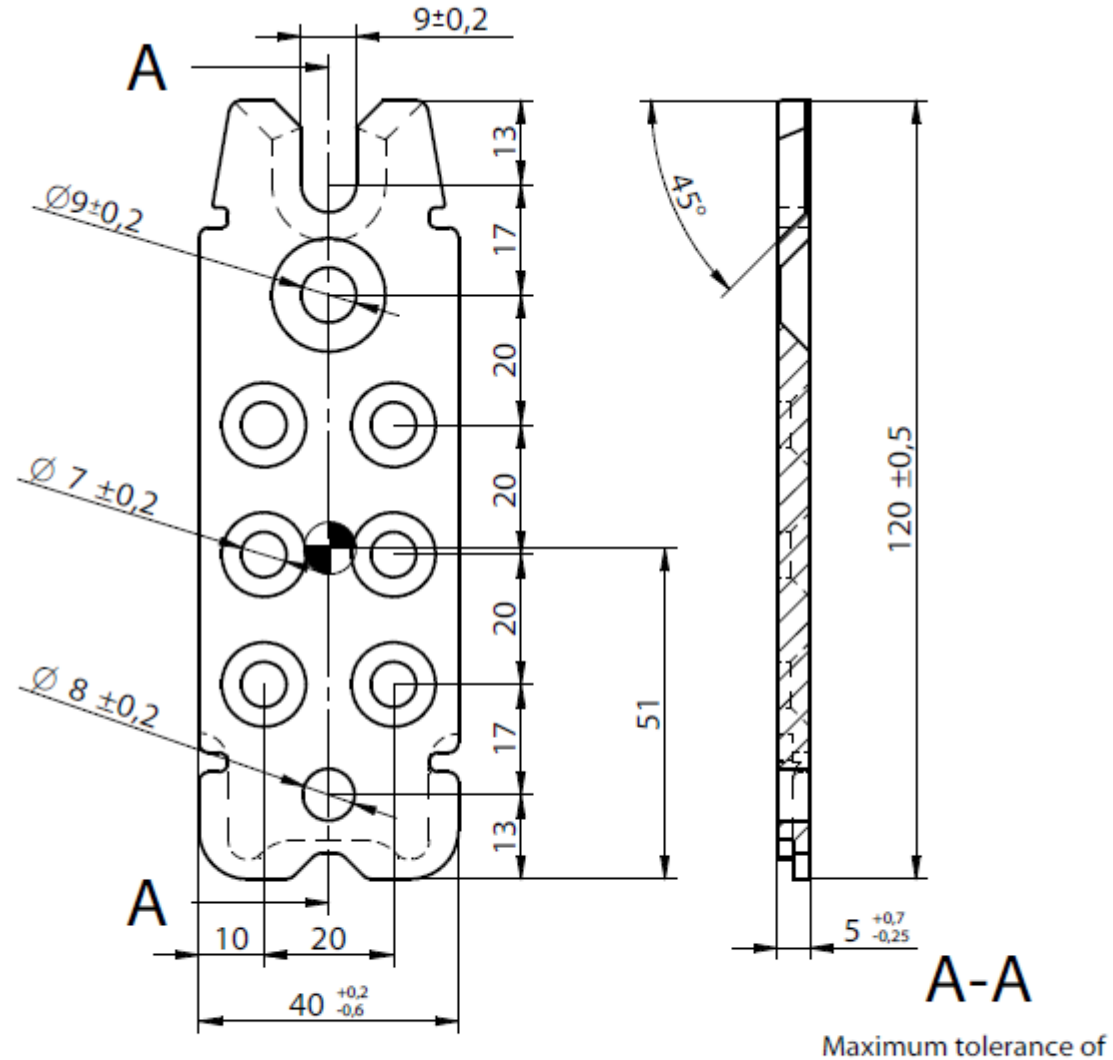
5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



KNAPP® Clip Connector RICON® 120/40

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

5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



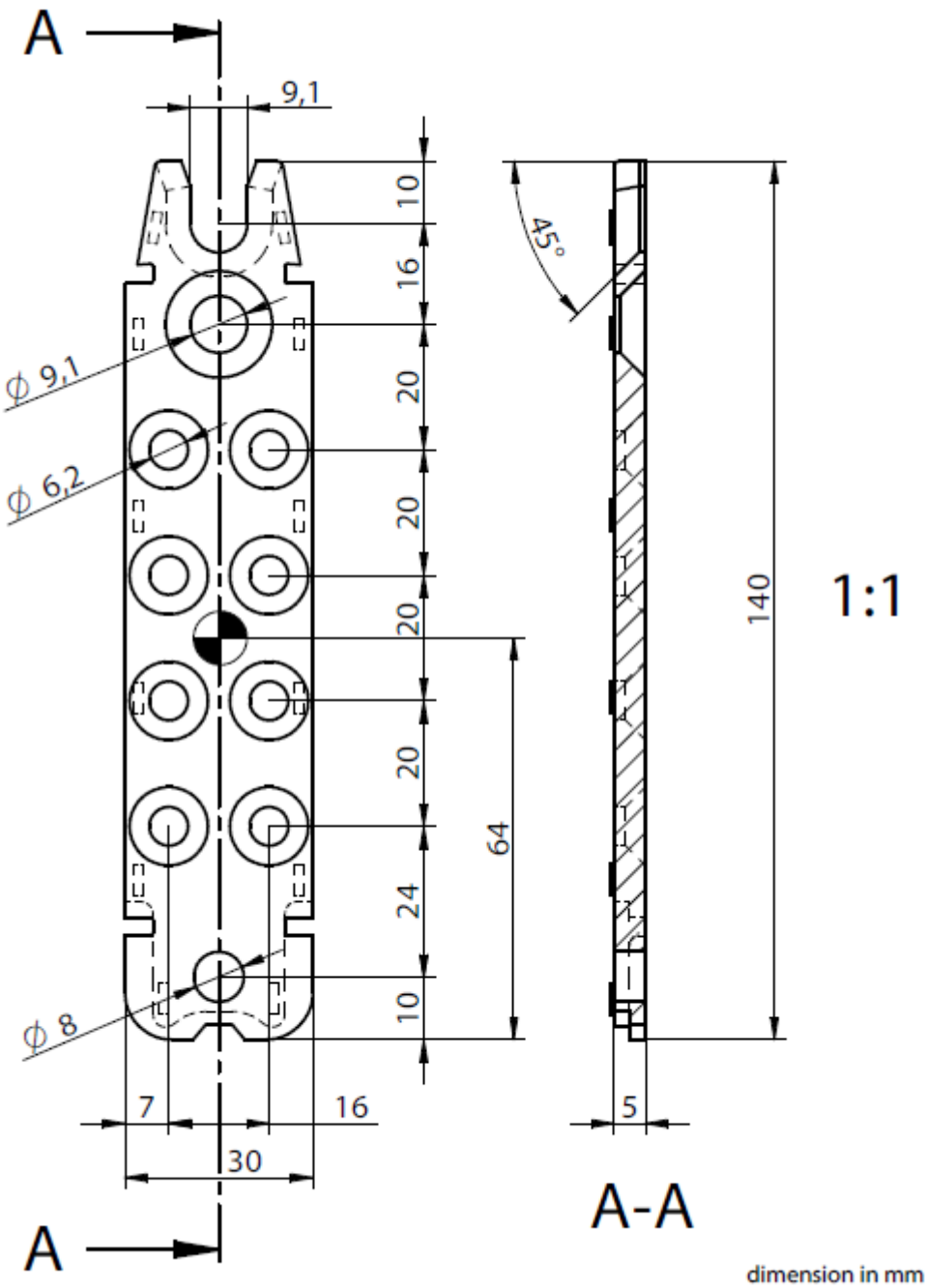
Maximum tolerance of spacing and end/edge distance ± 0.3 mm

1:1

dimension in mm

KNAPP® Clip Connector RICON® 140/30

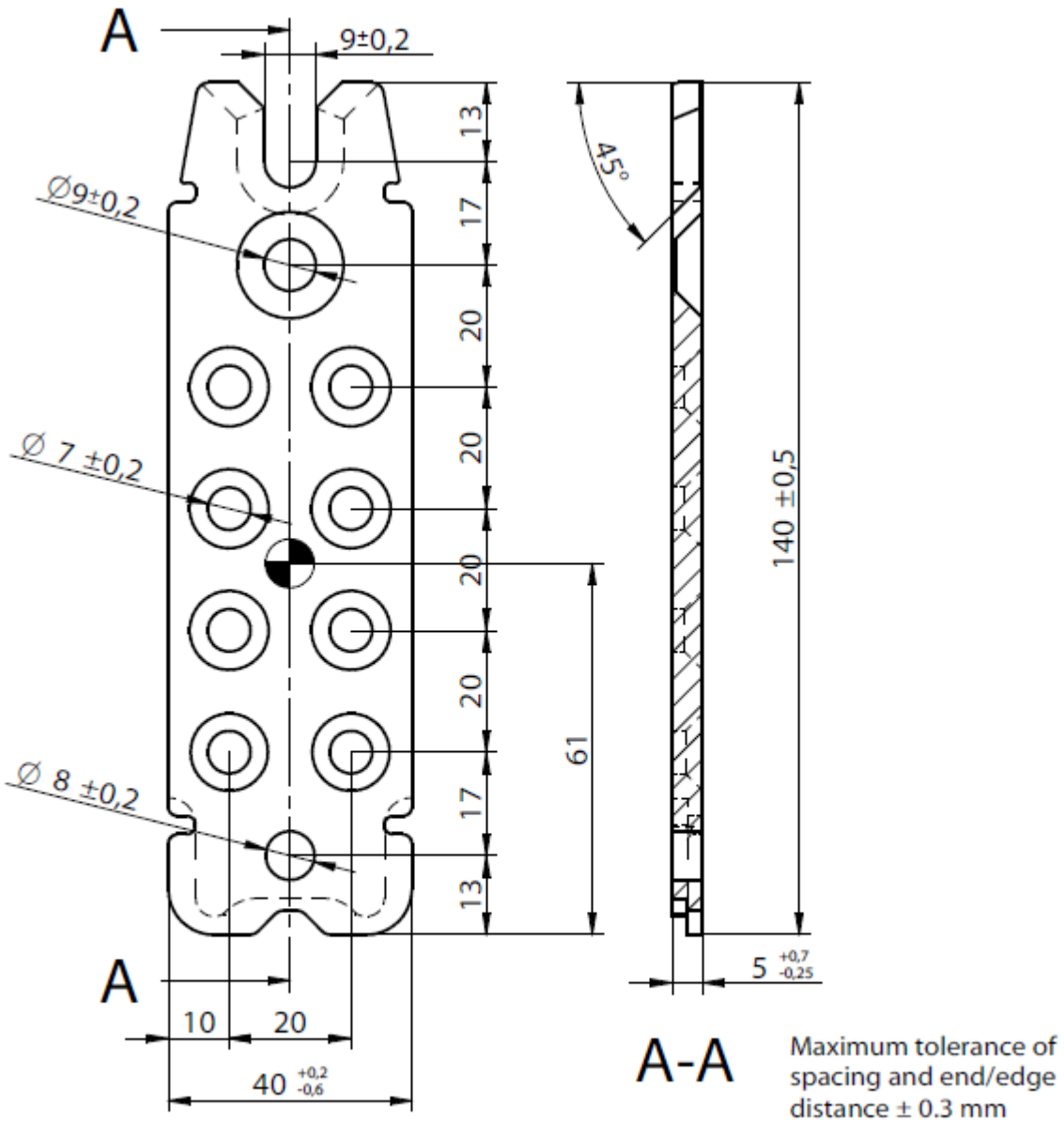
5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



KNAPP® Clip Connector RICON® 140/40

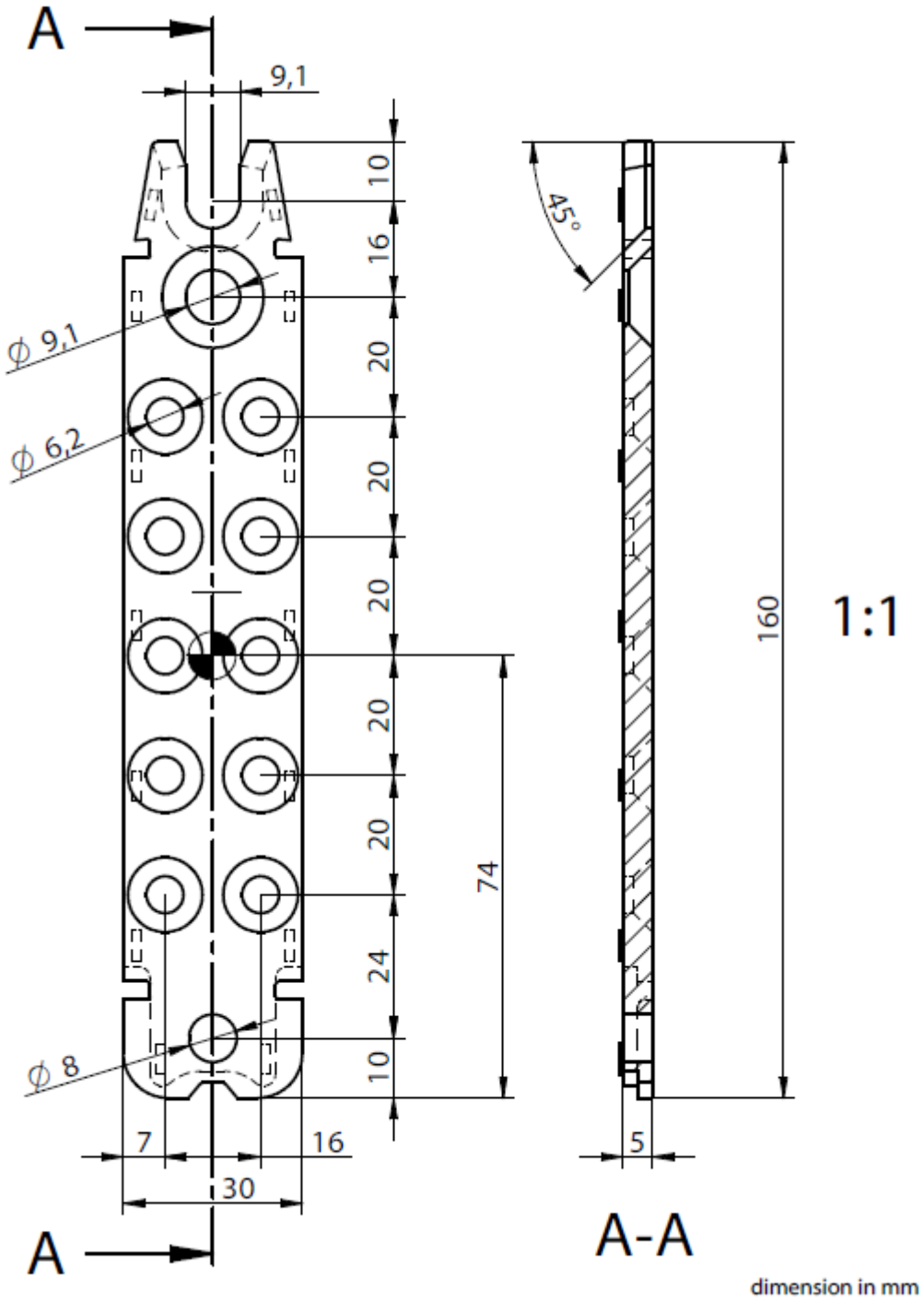
5.5 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5

5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



KNAPP® Clip Connector RICON® 160/30

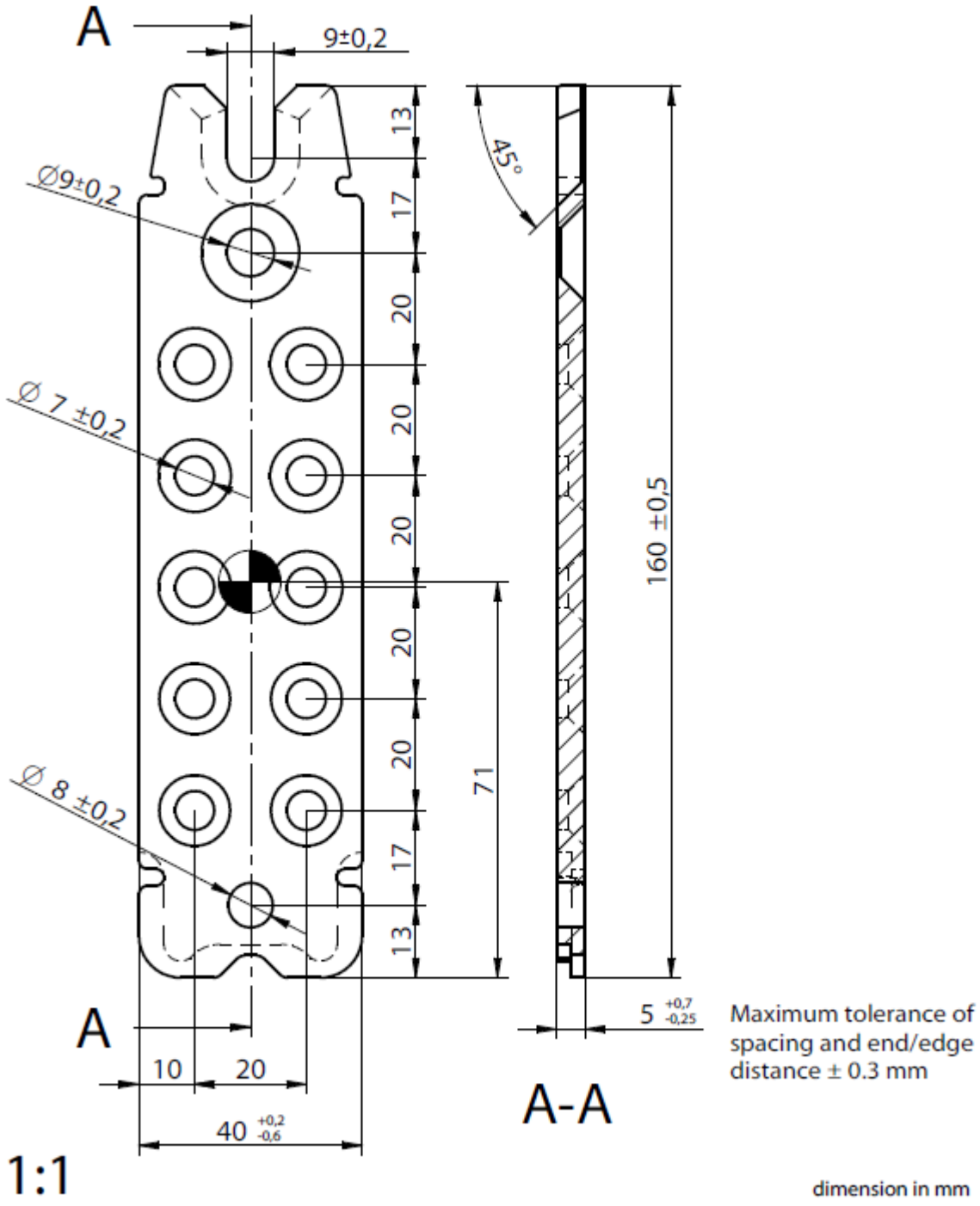
5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa



KNAPP® Clip Connector RICON® 160/40

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

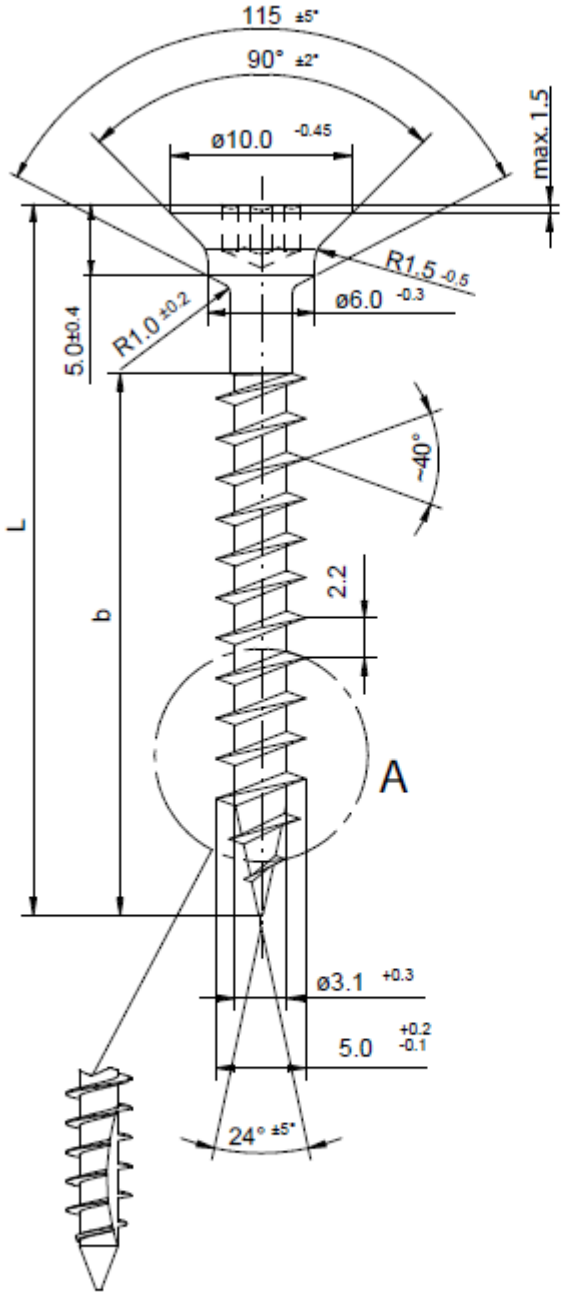
5.0 mm thick stainless steel grade GX5CrNi 19-10 (AISI304) with minimum yield strength R_e of 175 MPa

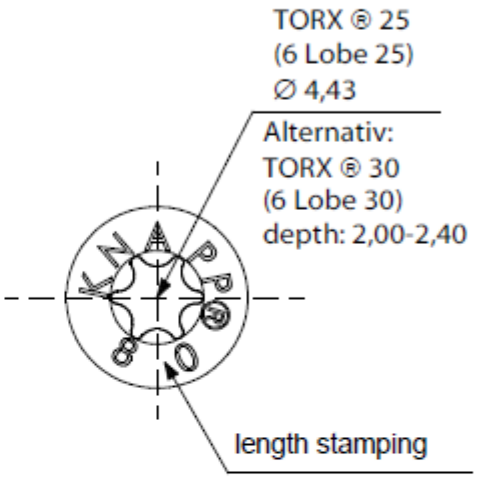


KNAPP® RICON® screw SK 5x40, SK 5x50, SK 5x60, SK 5x80, SK 5x120

Carbon steel screws according to EN 14592 manufactured minimum tension $f_{tens,k}$ of 7,5 kN, minimum torque $M_{t,u,k}$ of 6 Nm, minimum yield moment $M_{y,Rk}$ of 3,9 Nm
Carbon screws corrosion protection according to Eurocode 5

Stainless steel screws according toX3CrNiN17-8 manufactured minimum tension $f_{tens,k}$ of 5,9kN, minimum torque $M_{t,u,k}$ of 6 Nm, minimum yield moment $M_{y,Rk}$ of 4,4 Nm





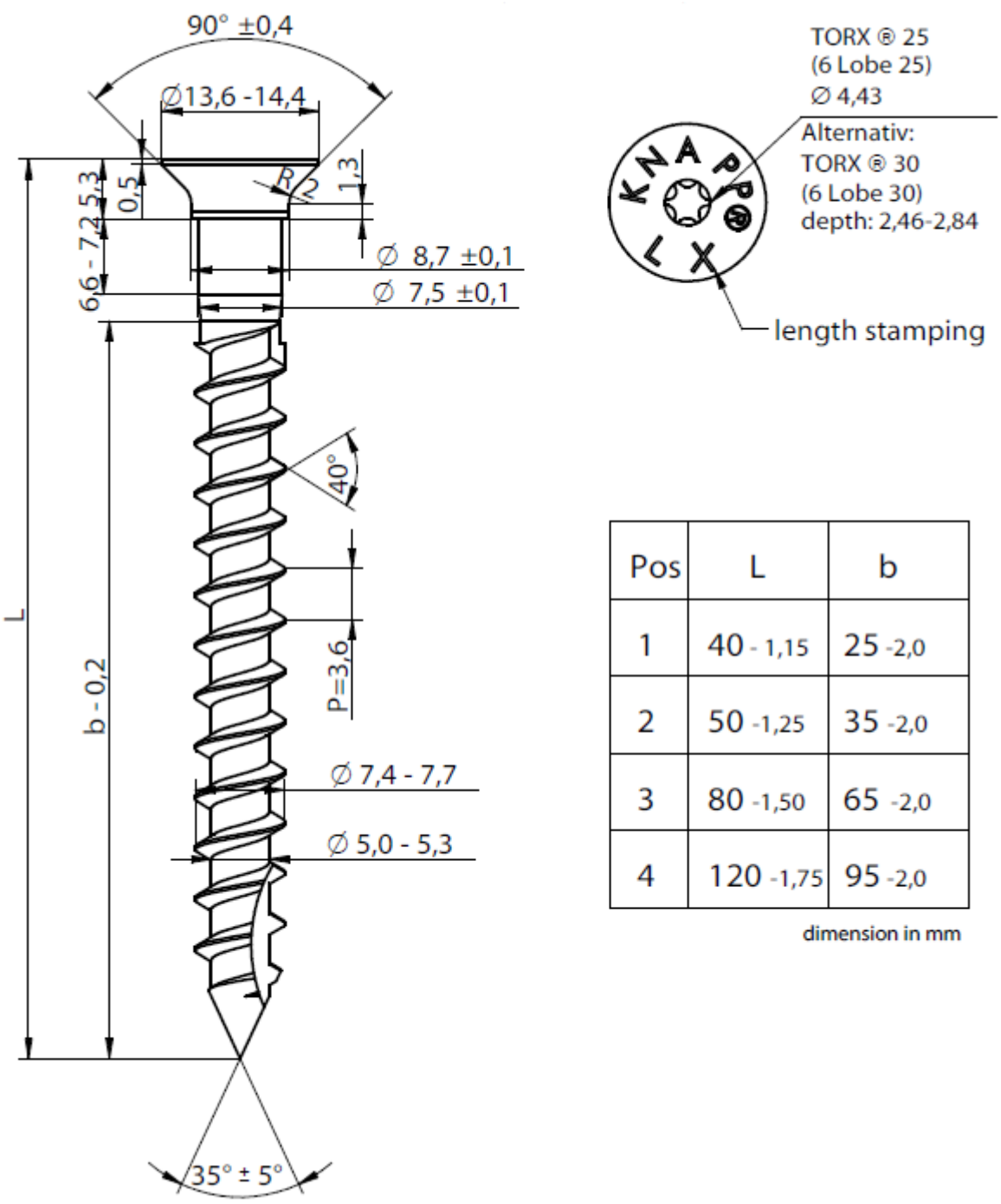
Pos	L	b
1	40 - 1,25	30 +1,0
2	50 -1,25	40 +1,0
3	60 -1,50	50 + 1,0
4	80 -1,75	70 + 1,0
5	120 -1,75	110 + 1,0

dimension in mm

KNAPP® RICON® screw SK 8x40, SK 8x50, SK 8x80, SK 8x120

Carbon steel screws according to EN 14592 manufactured minimum tension $f_{tens,k}$ of 15 kN, minimum torque $M_{t,u,k}$ of 20 Nm, minimum yield moment $M_{y,Rk}$ of 13,4 Nm
Carbon screws corrosion protection according to Eurocode 5

Stainless steel screws according to X3CrNiN17-8 manufactured minimum tension $f_{tens,k}$ of 15,1 kN, minimum torque $M_{t,u,k}$ of 20 Nm, minimum yield moment $M_{y,Rk}$ of 15 Nm



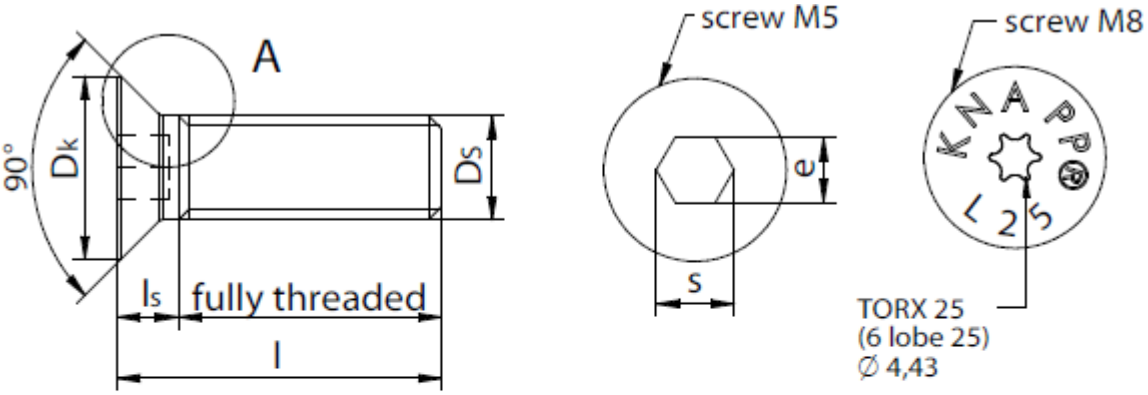
Pos	L	b
1	40 - 1,15	25 -2,0
2	50 -1,25	35 -2,0
3	80 -1,50	65 -2,0
4	120 -1,75	95 -2,0

dimension in mm

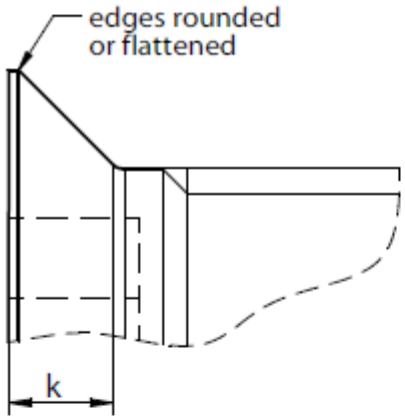
KNAPP® RICON® screw M5, M8 for DA and EAR

Screws according to ISO 10642 manufactured of steel grade 8.8 according to EN ISO 898-1;
Corrosion protection according to Eurocode 5

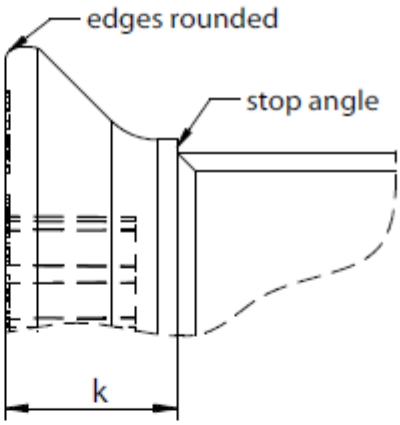
Stainless steel screws according to X3CrNiN17-8



Detail A screw M5



Detail A screw M8



Carbon steel screws:

Typ	l	ls	Dk	Ds	k	e	s
M5x20	20 ± 0,5	3,1	10 ± 0,4	5 6g	3,1	3,5	3
M5x25	25 ± 0,5	3,1	10 ± 0,4	5 6g	3,1	3,5	3
M8x20	20 ± 0,5	6,7	15,2 ± 0,4	8 6g	5,0	5,8	5
M8x25	25 ± 0,5	7,8	14 ± 0,4	8 6g	5,3	TORX®25,∅ 4,43	

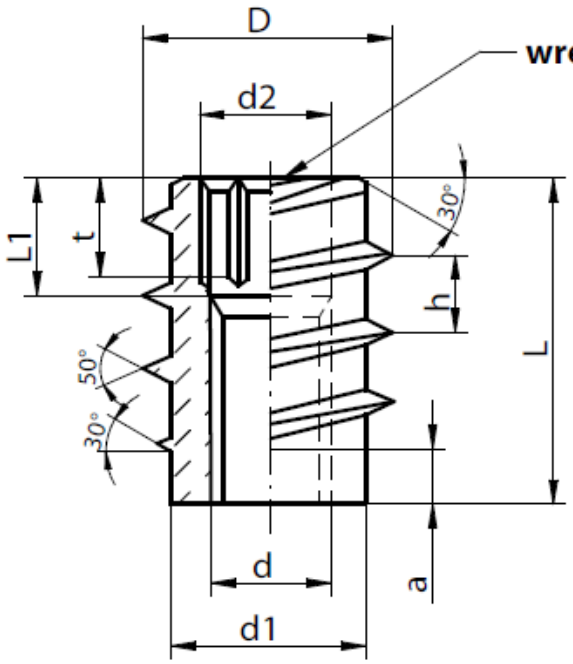
Stainless steel screws:

Typ	l	ls	Dk	Ds	k	e	s
M5x16	16 ± 1,0	5,0 +0,5	10 -0,45	5 6g	2,65 ±0,2	TORX®25,∅ 4,43	
M8x18	18 ± 1,0	5,0 +0,5	12 -0,45	8 6g	2,65 ±0,3	TORX®25,∅ 4,43	

dimension in mm

KNAPP® RICON® insert

Steel grade 11SMnPb30 according to EN 10087 or EN 10277-3 with yield strength R_{eH} of 440 MPa, tensile strength R_m of 560 MPa, maximum tensile strength R_m of 810 and ultimate strain A80 of 6% for inside/outside thread nut M5 or with yield strength R_{eH} of 410 MPa, tensile strength R_m of 510 MPa, maximum tensile strength R_m of 760 and ultimate strain A80 of 7% for inside/outside thread nut M8;
Corrosion protection according to Eurocode 5

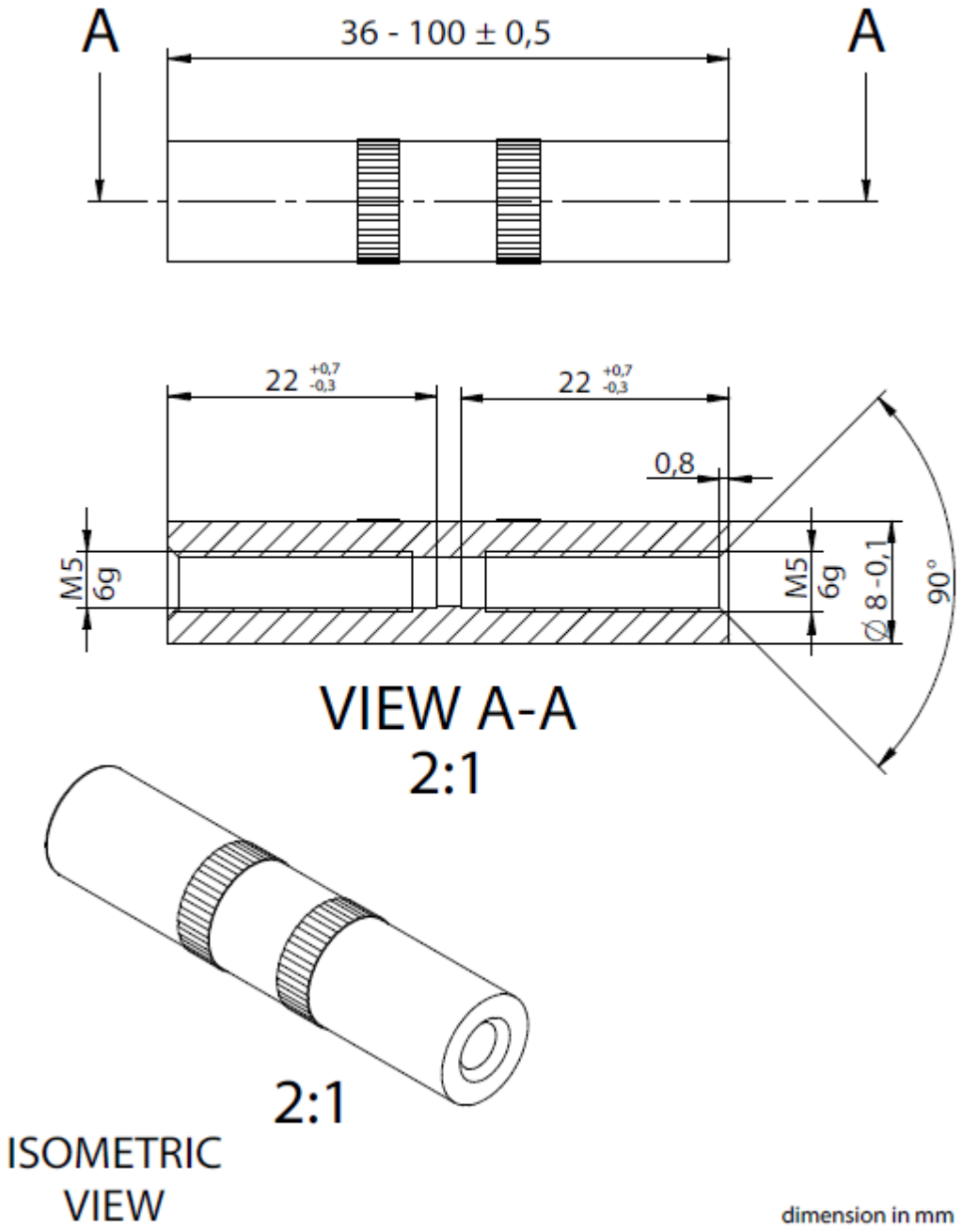


D	L	d	d1	d2	L1	SW	t	h	a
10 ± 0,3	14 ± 0,3	M5 6g	7,5 ± 0,3	5,25 ± 0,2	5 ± 0,5	5	4 ± 0,5	3 ± 0,2	2 ± 0,3
14 ± 0,3	18 ± 0,3	M8 6g	11,5 ± 0,3	8,4 ± 0,2	6 ± 0,5	8	5 ± 0,5	3,5 ± 0,2	3 ± 0,3

dimensions in mm

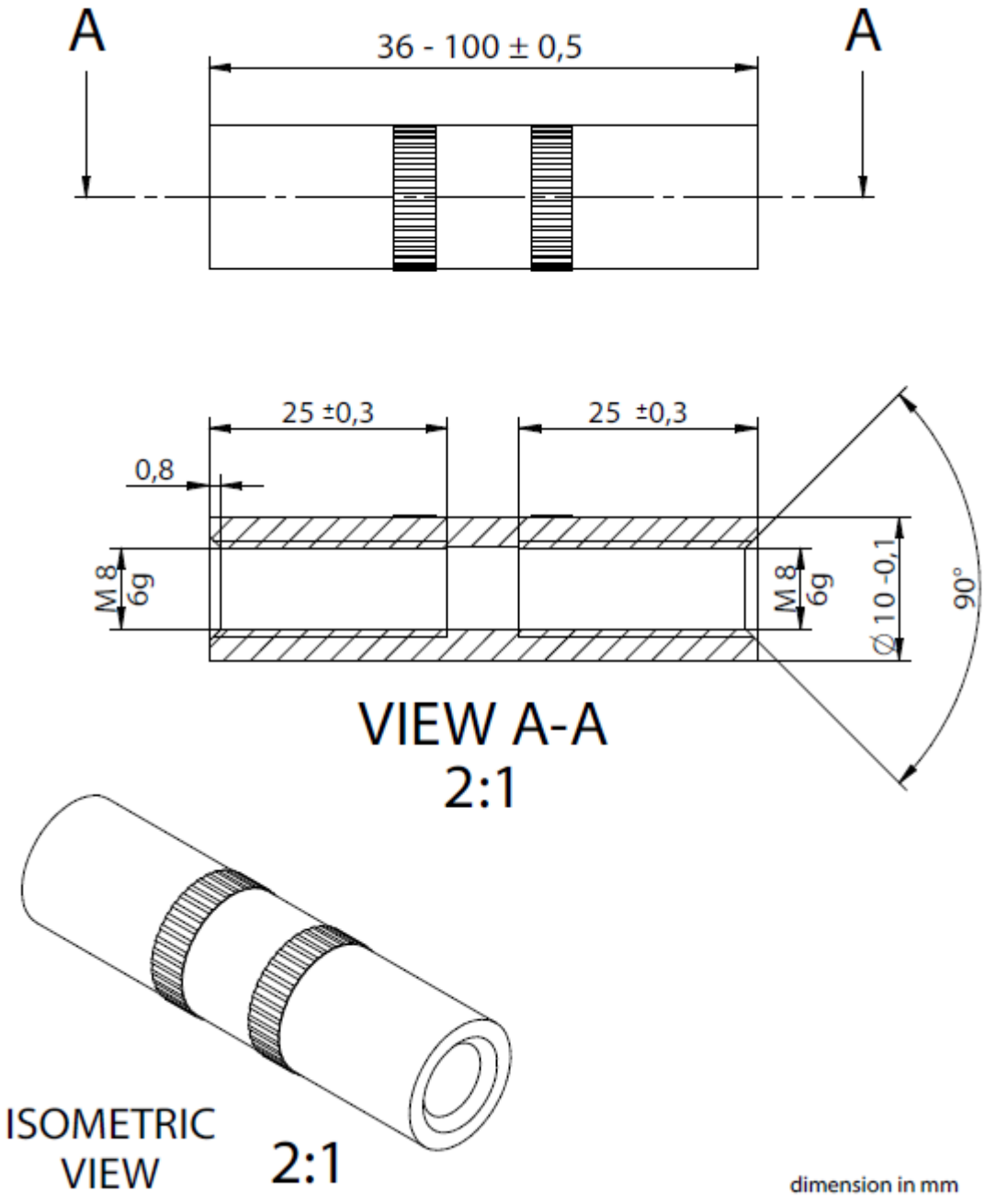
KNAPP® RICON® connection nut M5 for RICON® 60/40 DA

Steel grade 11SMnPb30 according to EN 10087 or EN 10277-3 with yield strength R_{eH} of 440 MPa, tensile strength R_m of 560 MPa, maximum tensile strength R_m of 810 and ultimate strain A80 of 6%;
Corrosion protection according to Eurocode 5 (≥ 5 µm zinc coating);



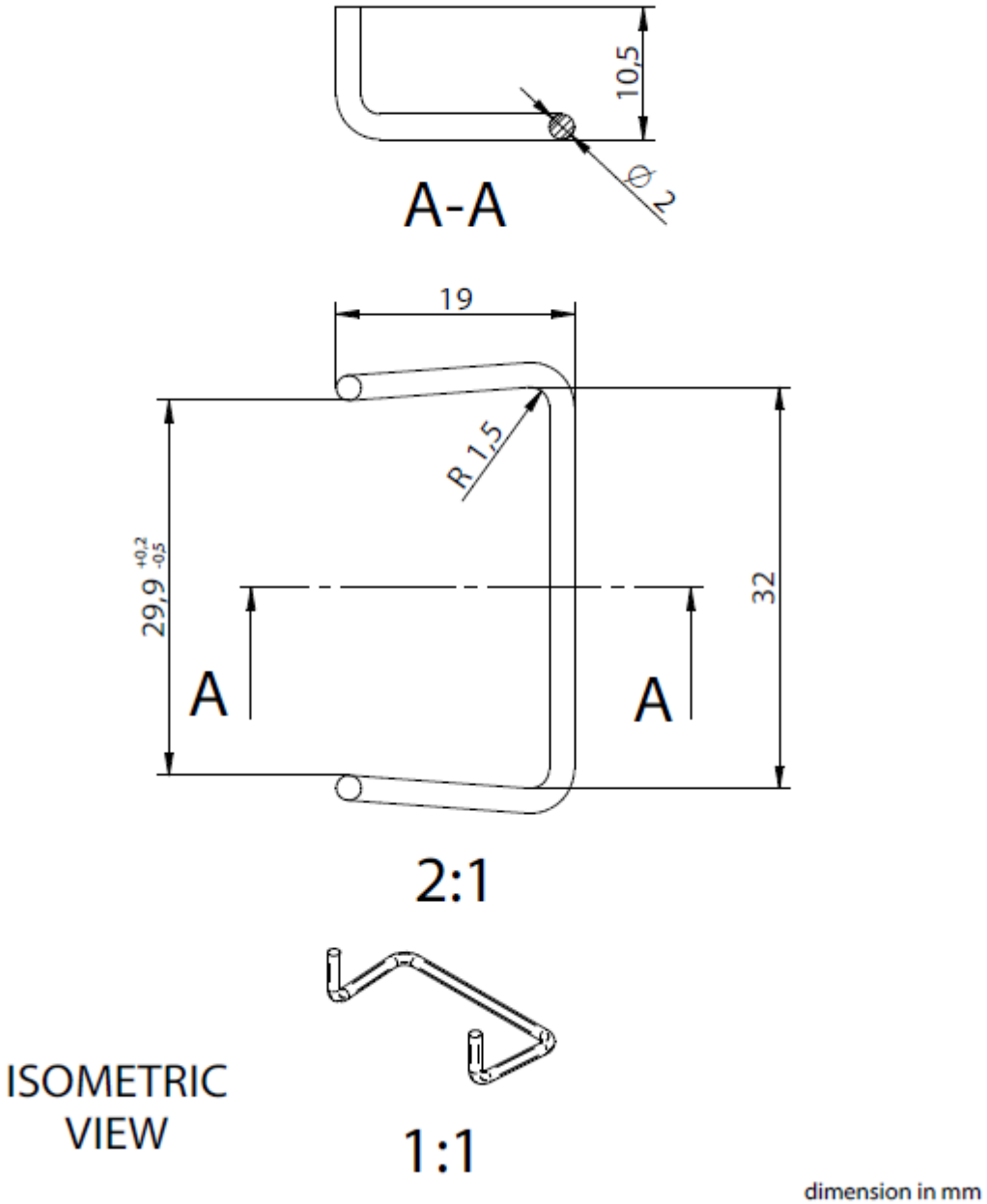
KNAPP® RICON® connection nut M8 for RICON® DA

Steel grade 11SMnPb30 according to EN 10087 or EN 10277-3 with yield strength R_{eH} of 440 MPa, tensile strength R_m of 560 MPa, maximum tensile strength R_m of 810 and ultimate strain A80 of 6%;
Corrosion protection according to Eurocode 5 (≥ 5 µm zinc coating);



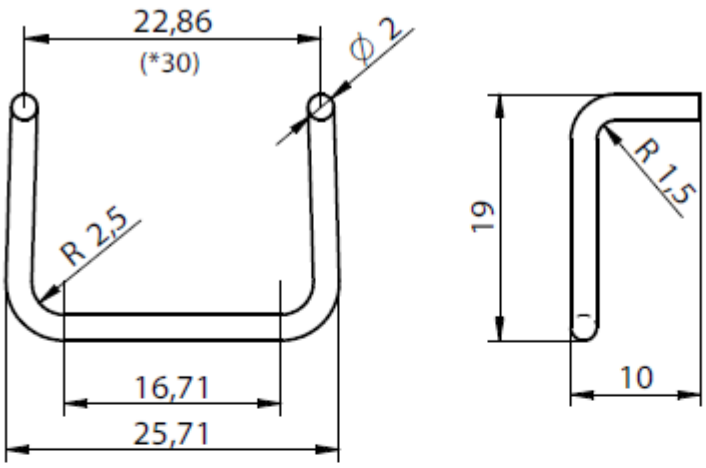
KNAPP® RICON® 40 stirrup

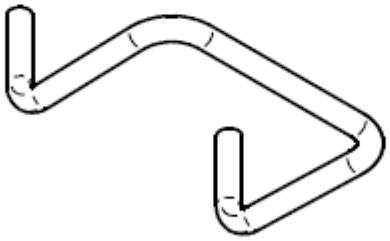
2.0 mm thick stainless steel wire grade X10CrNi18-8 according to EN 10088-1with tensile strength R_m of 1700 MPa and tensile strength R_m of 1950 MPa



KNAPP® RICON® 30 stirrup

2.0 mm thick stainless steel wire grade X10CrNi 18-8 (AISI 302, material No. 1.4310) according to EN 10088-1with tensile strength R_m of 1700 MPa and tensile strength R_m of 1950 MPa



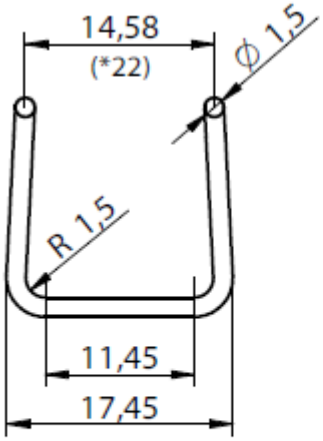


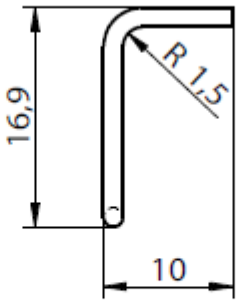
ISOMETRIC VIEW

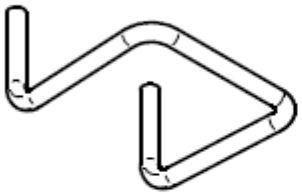
dimension in mm

KNAPP® RICON® 20 stirrup

1,5 mm thick stainless steel wire grade X10CrNi 18-8 (AISI 302, material No. 1.4310) according to EN 10088-1with tensile strength R_m of 1700 MPa and tensile strength R_m of 1950 MPa





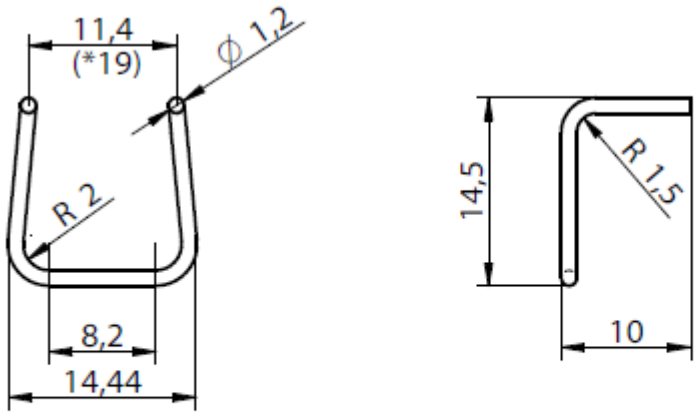


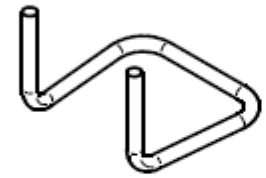
ISOMETRIC VIEW

dimension in mm

KNAPP® RICON® 16 stirrup

1.2 mm thick carbon steel according to EN 10270/1 with minimum tensile strength R_m of 2170 MPa and maximum tensile strength R_m of 2400 MPa
Corrosion protection according to Eurocode 5



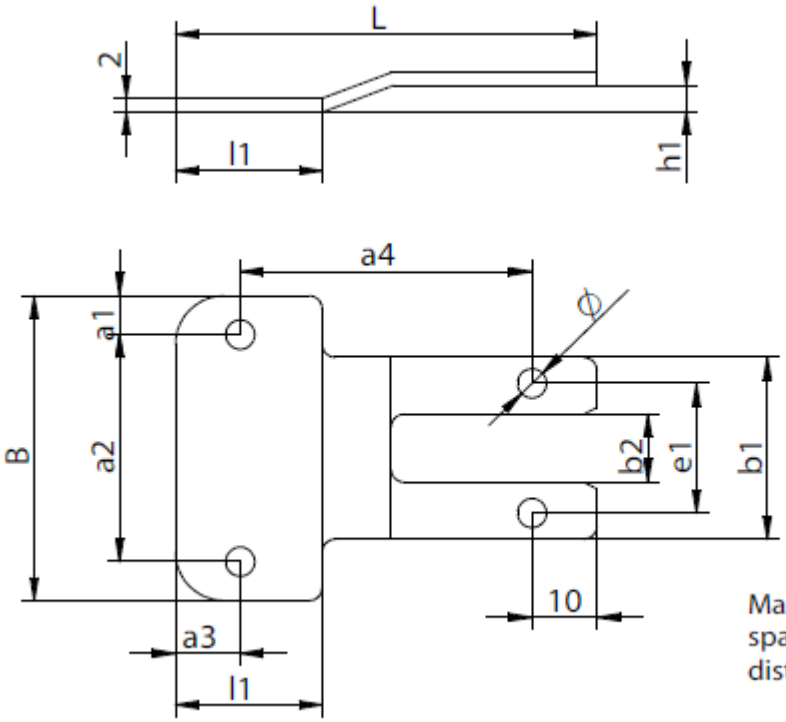


ISOMETRIC VIEW

dimension in mm

KNAPP® RICON® single reinforcing plate

2.0 mm thick stainless steel wire grade X5CrNi18-10according to EN 10088-2



Maximum tolerance of spacing and end/edge distance ± 0.2 mm

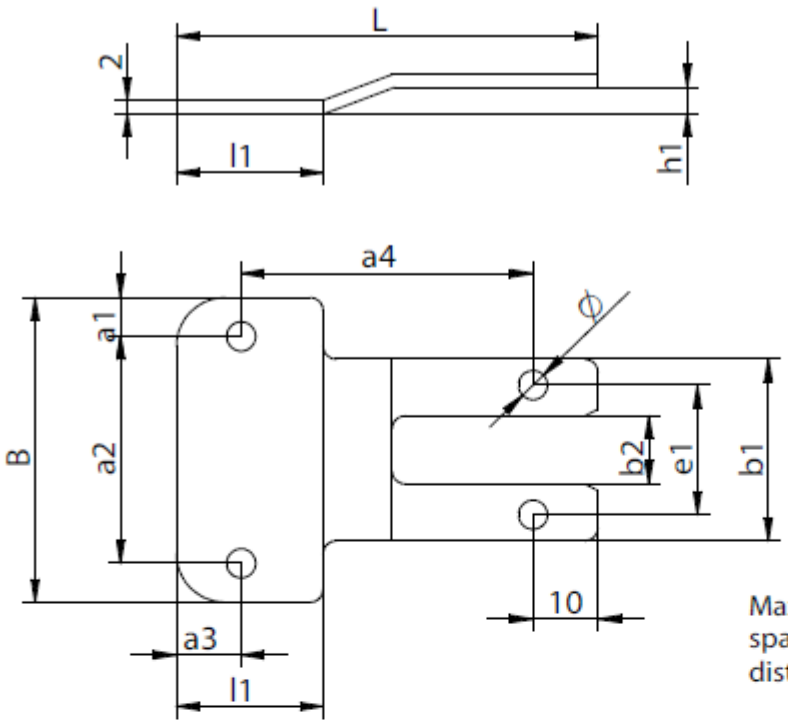
Maximum tolerance of steel plate thickness ± 0.14 mm

Dimension of reinforcement plates	basic profile 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
* new company name RP-Technik since 2013							

dimension in mm

KNAPP® RICON® single reinforcing plate

2.0 mm thick stainless steel wire grade X5CrNi18-10according to EN 10088-2



Maximum tolerance of spacing and end/edge distance ± 0.2 mm

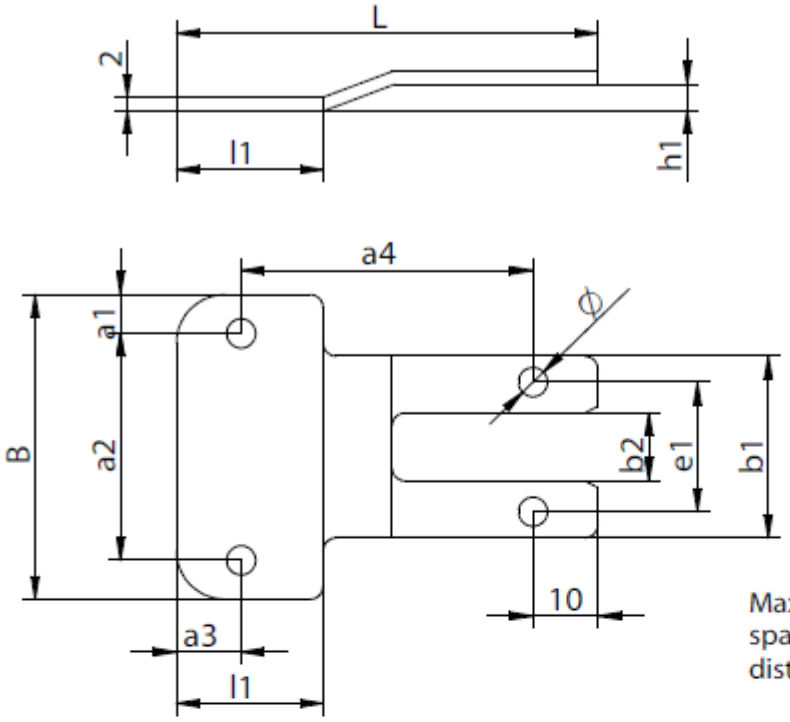
Maximum tolerance of steel plate thickness ± 0.14 mm

dimension of reinforcement plates	basic profiles by producer RAICO Bautechnik GmbH			
	41/40	41/40	47/40	67/60
Approval:	Z-14.4-516 / ETA-13/0765			
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

dimension in mm

KNAPP® RICON® single reinforcing plate

2.0 mm thick stainless steel wire grade X5CrNi18-10 according to EN 10088-2



Maximum tolerance of spacing and end/edge distance ± 0.2 mm

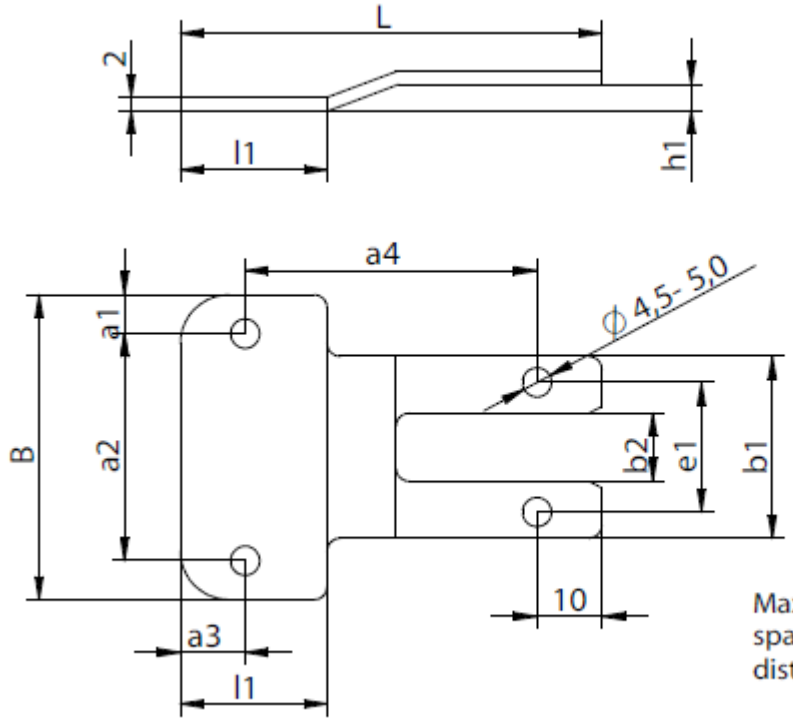
Maximum tolerance of steel plate thickness ± 0.14 mm

Dimension of reinforcement plates	basic profiles by producer SCHÜCO International KG				
	FW50	FW50	FW60	FW60	FW60
Approval:	Zulassung Z-14.4-745				
post / header - size H [mm]	50	55	60	65	68
B [mm]	47 ± 0,1	47 ± 0,1	47 ± 0,1	47 ± 0,1	47 ± 0,1
L [mm]	63 ± 0,1	65,5 ± 0,1	68 ± 0,1	70,5± 0,1	72± 0,1
b1 [mm]	30,5 ± 0,1	30,5 ± 0,1	30,5 ± 0,1	30,5 ± 0,1	30,5 ± 0,1
b2 [mm]	10,5 ± 0,1	10,5 ± 0,1	10,5 ± 0,1	10,5 ± 0,1	10,5 ± 0,1
l1 [mm]	22,6 ± 0,1	25,1 ± 0,1	27,6 ± 0,1	30,1 ± 0,1	31,6± 0,1
a1 [mm]	6	6	6	6	6
a2 [mm]	35	35	35	35	35
a3 [mm]	8	8	8	8	8
a4 [mm]	45	47,5	50	52,5	54
e1 [mm]	20	20	20	20	20
h1 [mm]	5	5	5	5	5

dimension in mm

KNAPP® RICON® single reinforcing plate

2.0 mm thick stainless steel wire grade X5CrNi18-10 according to EN 10088-2



Maximum tolerance of spacing and end/edge distance ± 0.2 mm

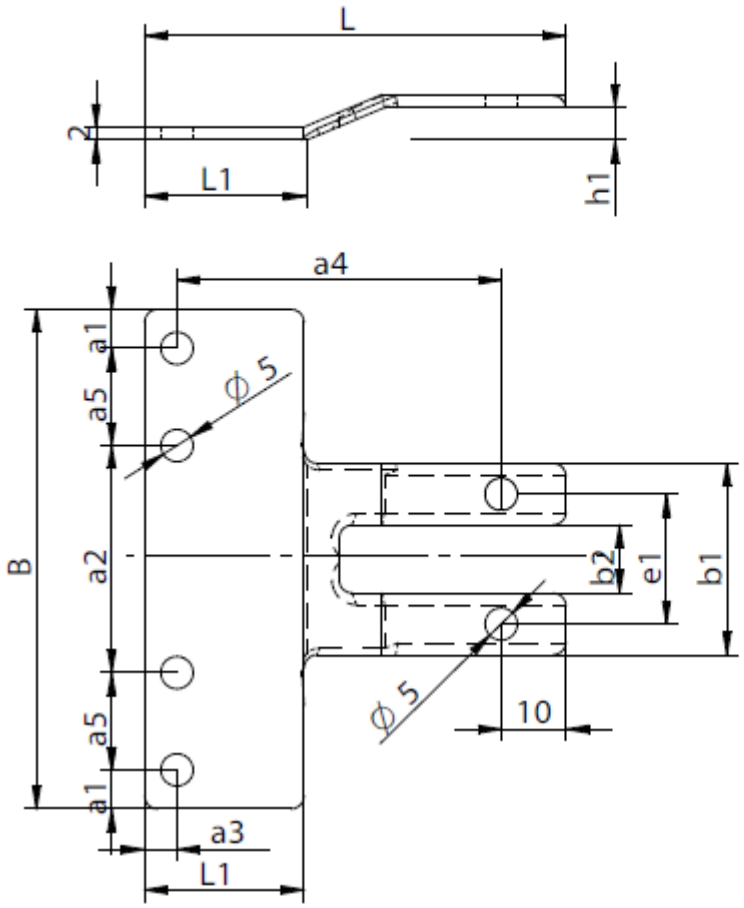
Maximum tolerance of steel plate thickness ± 0.14 mm

Dimension of reinforcement plates	Minimum dimensions of the reinforcing plate with the same load capacity for another ALU profiles depending on the post thickness			
post / header - size H [mm]	50	55	60	80
B [mm]	47 ± 0,1			
L [mm]	63 ± 0,1	65 ± 0,1	68 ± 0,1	70± 0,1
b1 [mm]	28 ± 0,1			
b2 [mm]	10 ± 0,1			
l1 [mm]	22,5 ± 0,1	25 ± 0,1	27,5 ± 0,1	37,5 ± 0,1
a1 [mm]	6			
a2 [mm]	35			
a3 [mm]	10			
a4 [mm]	43	47,5	50	52,5
e1 [mm]	20			
h1 [mm]	4			

dimension in mm

KNAPP® RICON® single reinforcing plate

2.0 mm thick stainless steel wire grade X5CrNi18-10 according to EN 10088-2



Maximum tolerance of spacing and end/edge distance ± 0.2 mm

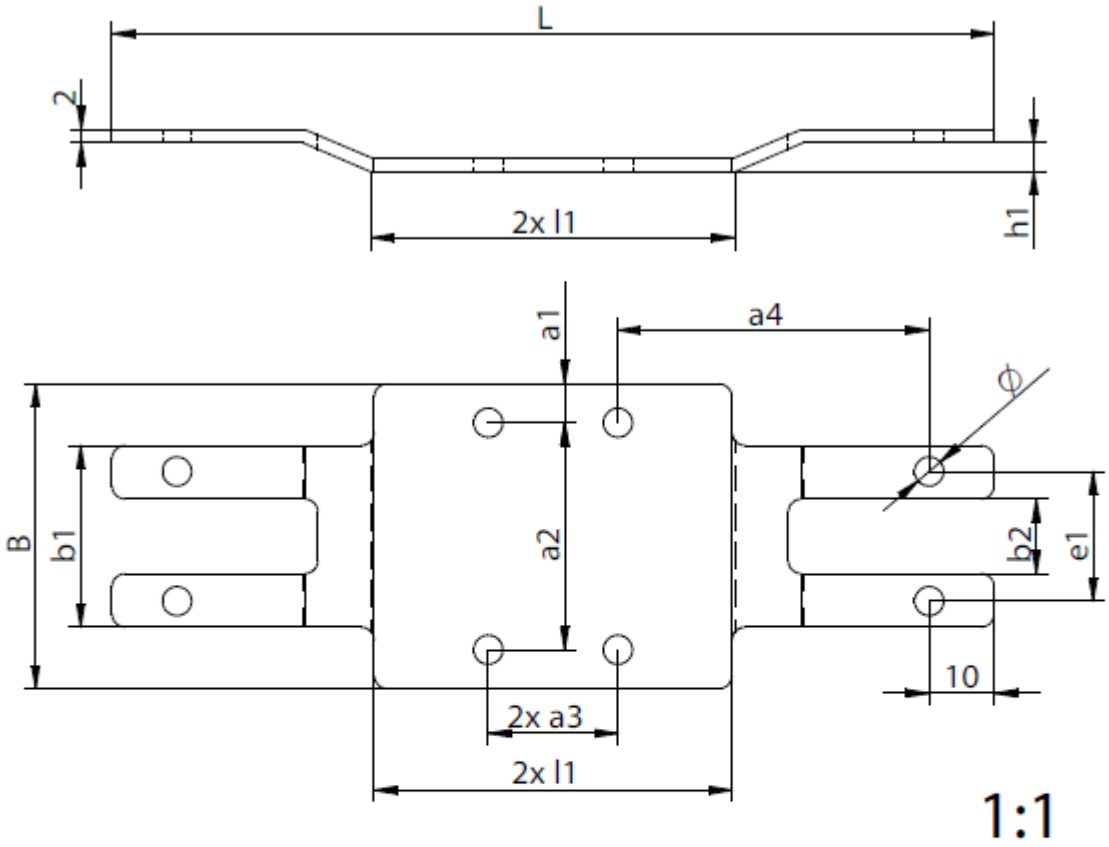
Maximum tolerance of steel plate thickness ± 0.14 mm

Dimension of reinforceme	basic profiles by producer Batimet		
	TM50	TM60	TM80
Approval:			
post / header - size H [mm]	50	60	80
B [mm]	77 ± 0,1		
L [mm]	60 ± 0,1	65± 0,1	75± 0,2
b1 [mm]	29,5 ± 0,1		57,5 ± 0,2
b2 [mm]	10,5 ± 0,1		
l1 [mm]	19,6 ± 0,1	24,6 ± 0,1	34,6 ± 0,2
a1 [mm]	6		
a2 [mm]	35		
a3 [mm]	5		18
a4 [mm]	45	50	47
a5 [mm]	15		
e1 [mm]	20		46
h1 [mm]	5		

dimension in mm

KNAPP® RICON® double reinforcing plate

2.0 mm thick stainless steel wire grade X5CrNi18-10 according to EN 10088-2



dimension of reinforcement plates	basic profiles by producer
	see single reinforcement plate

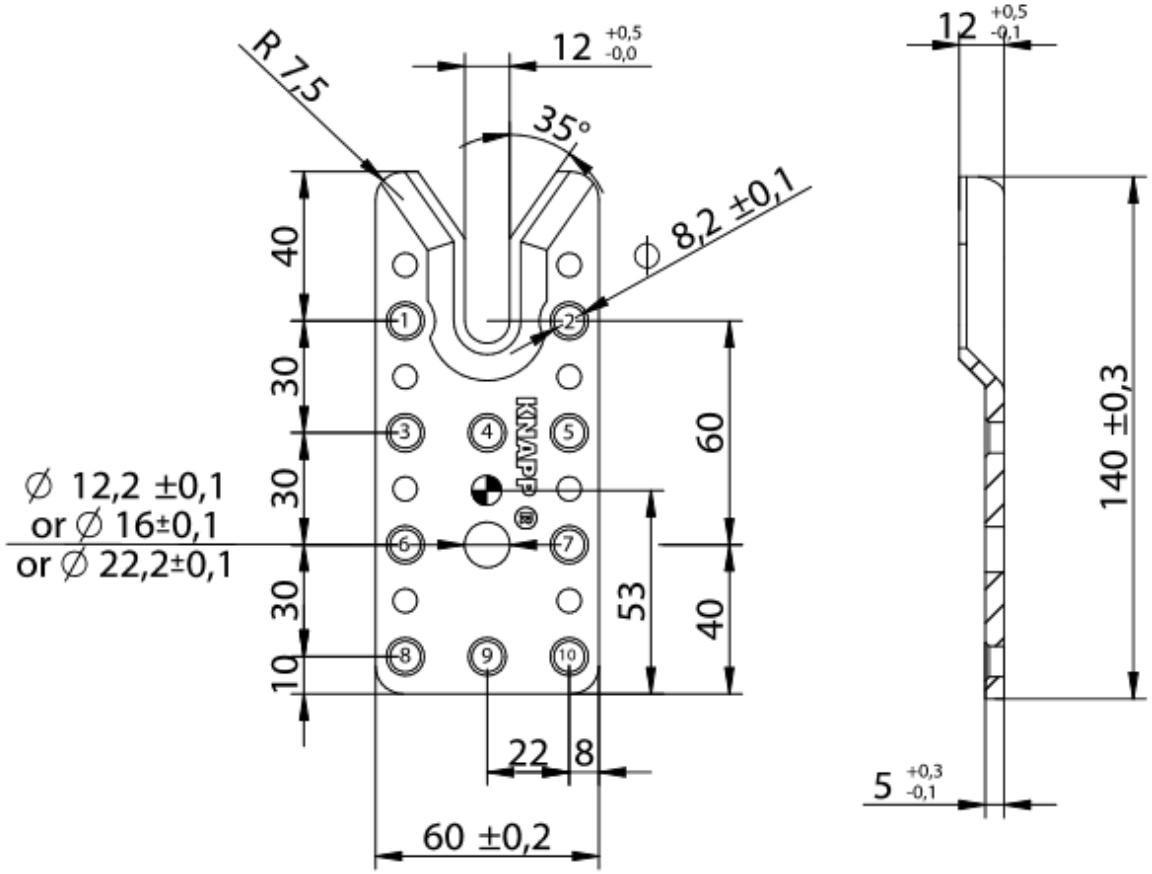
Maximum tolerance of spacing and end/edge distance ± 0.2 mm

Maximum tolerance of steel plate thickness ± 0.14 mm

dimension in mm

KNAPP® Clip Connector RICON® S 140/60 EK, GK, VK

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

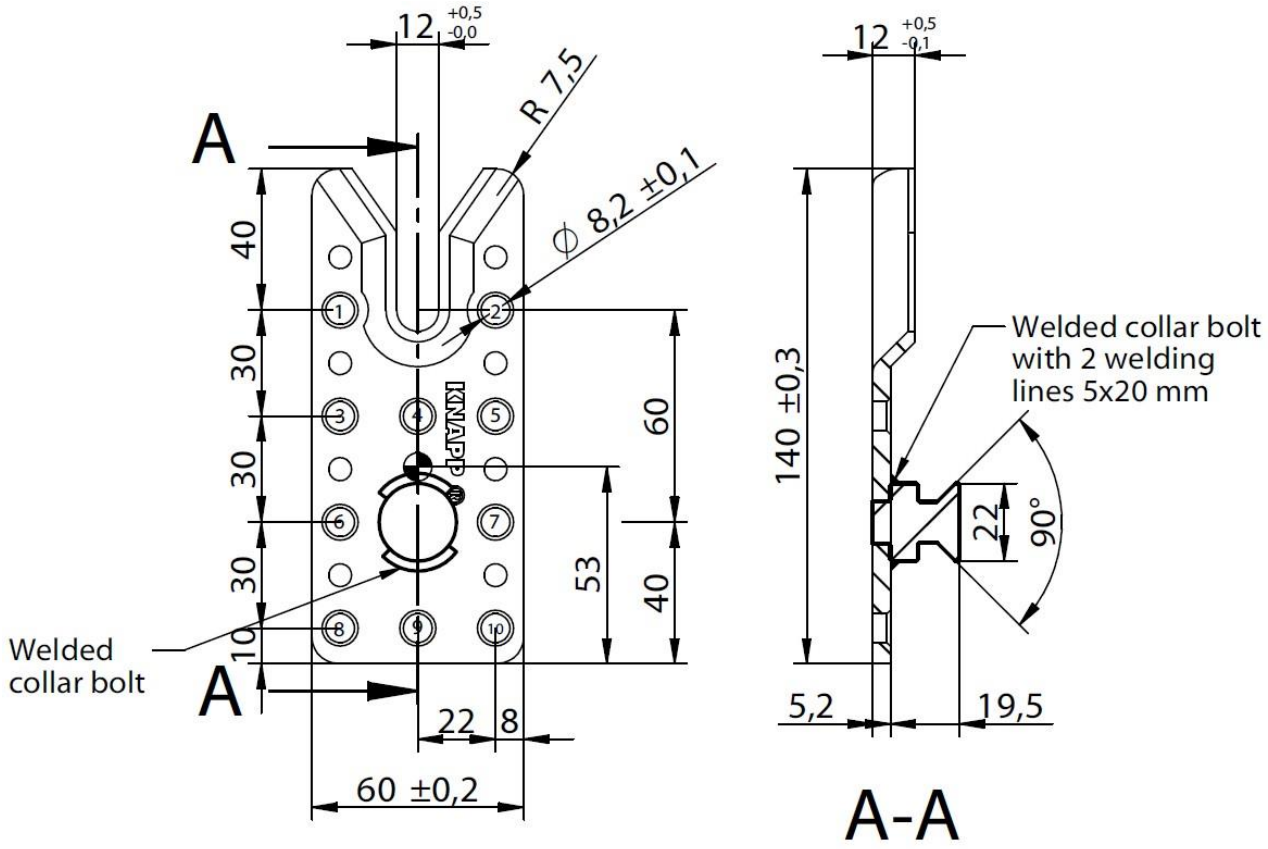


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

10 screws in Header / Joist

KNAPP® Clip Connector RICON® S 140/60 VS

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

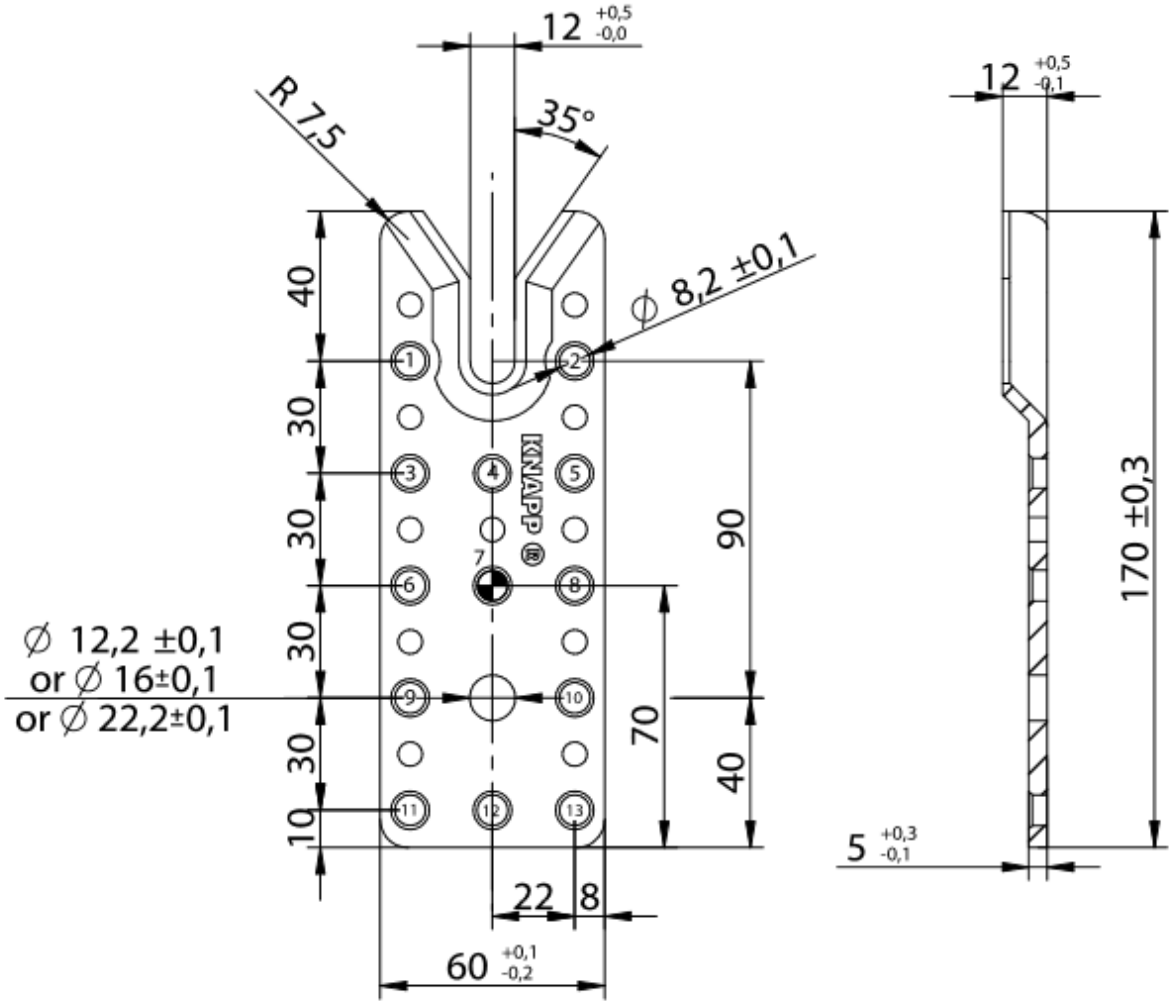


Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

10 screws in Header / Joist

KNAPP® Clip Connector RICON® S 170/60 EK, GK, VK

5.2 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

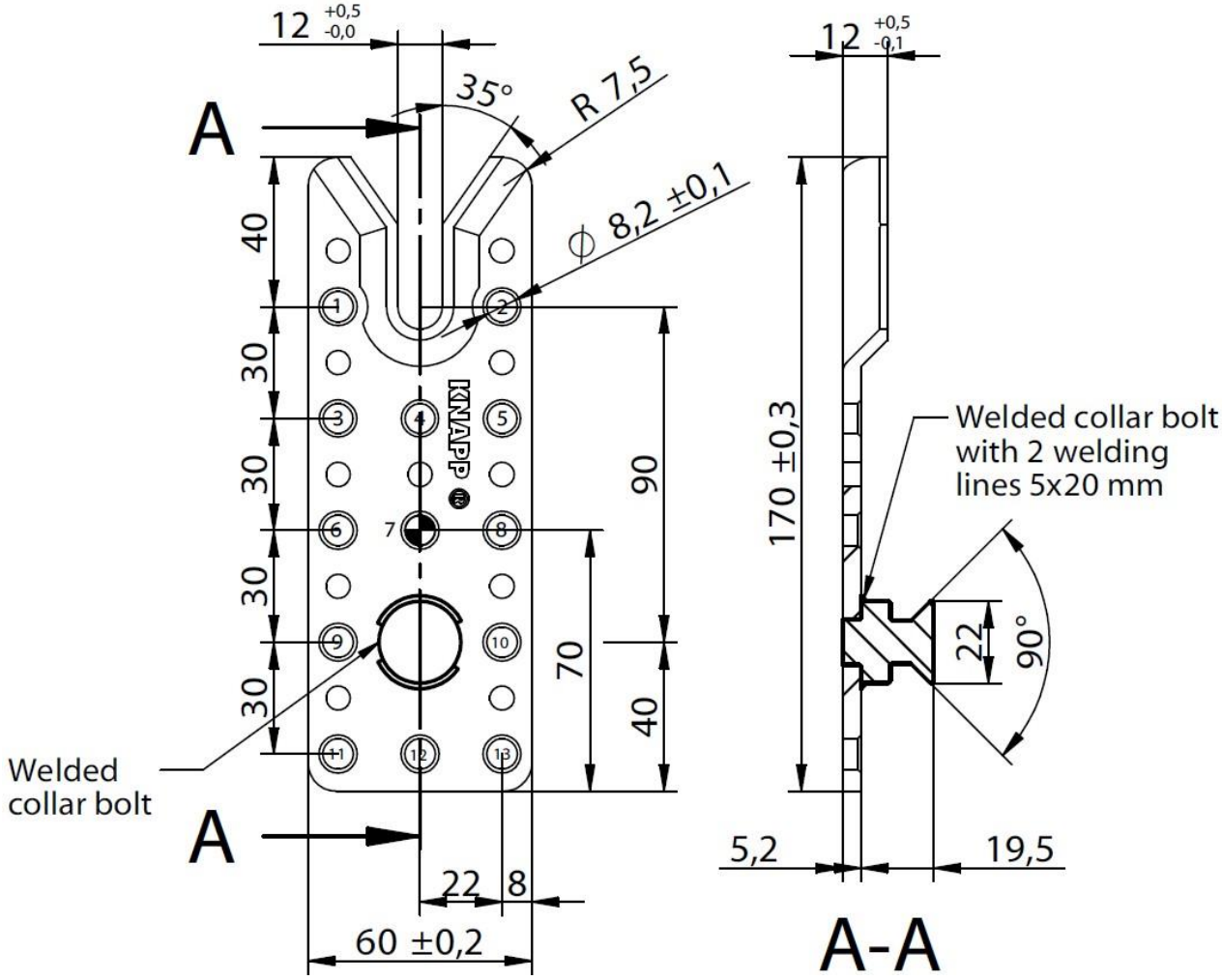


Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

13 screws in Header / Joist

KNAPP® Clip Connector RICON® S 170/60 VS

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

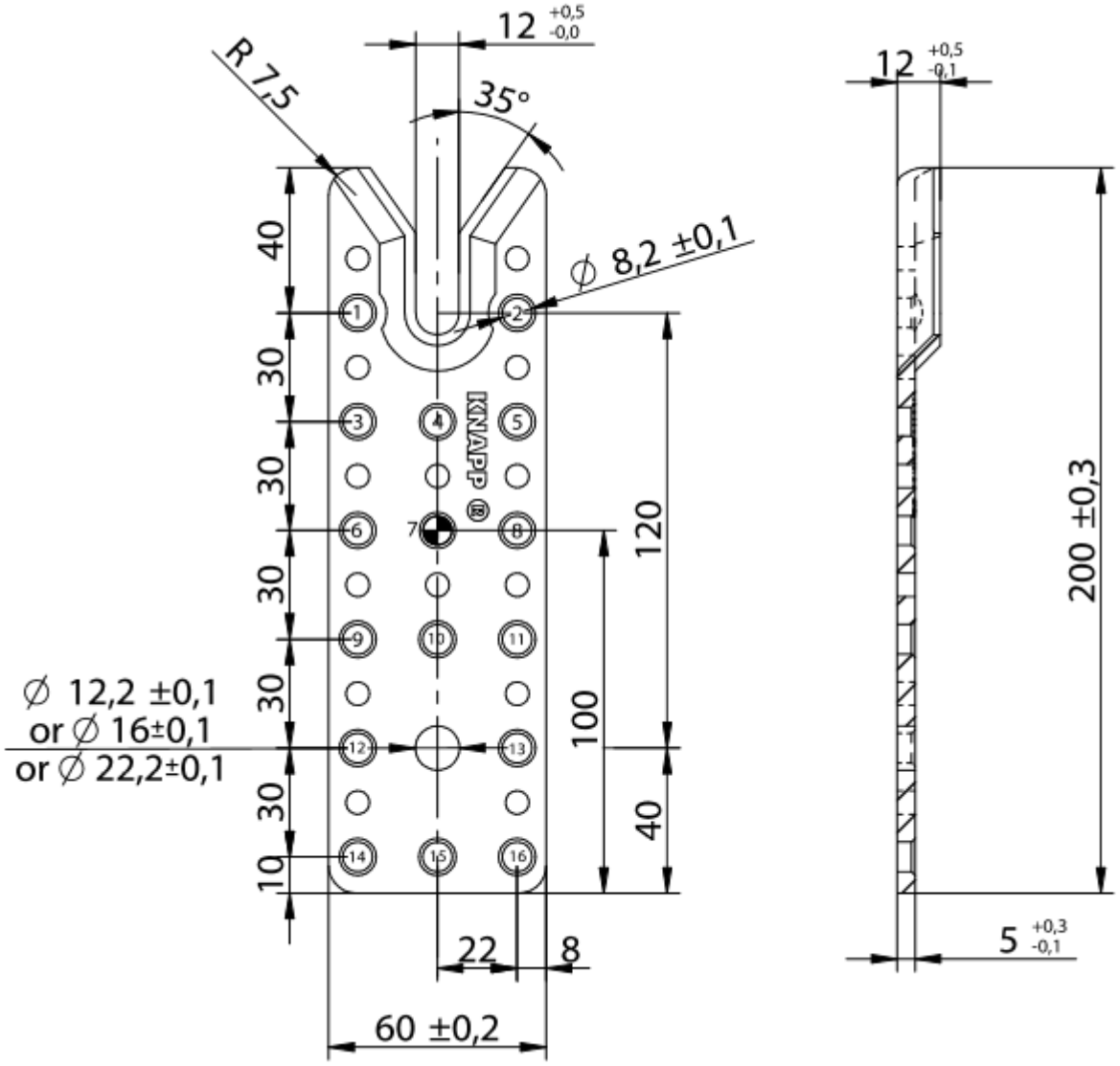


Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

13 screws in Header / Joist

KNAPP® Clip Connector RICON® S 200/60 EK, GK, VK

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

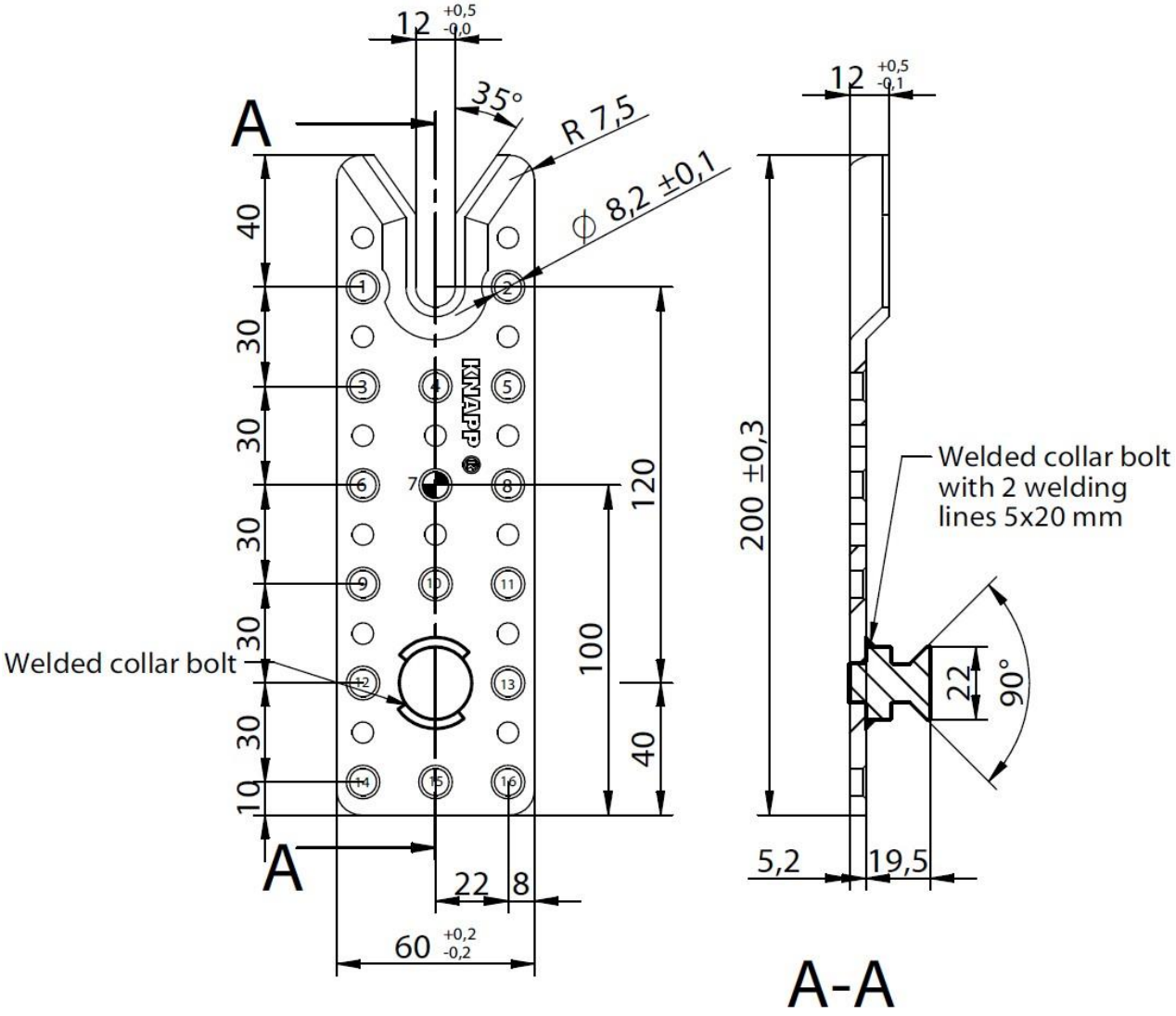


◓ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

16 screws in Header / Joist

KNAPP® Clip Connector RICON® S 200/60 VS

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

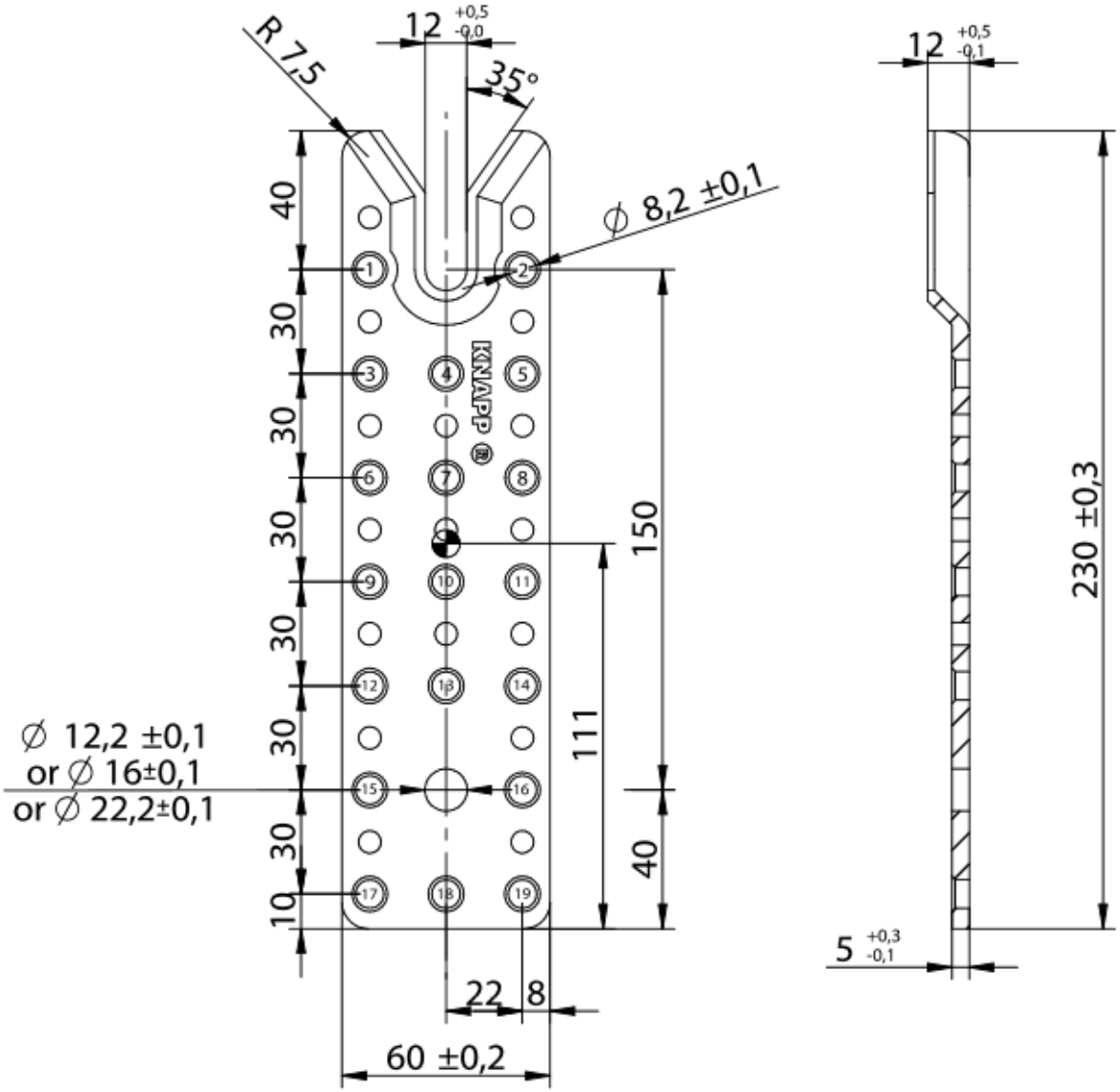


Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

16 Screws in Header / Joist

KNAPP® Clip Connector RICON® S 230/60 EK, GK, VK

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

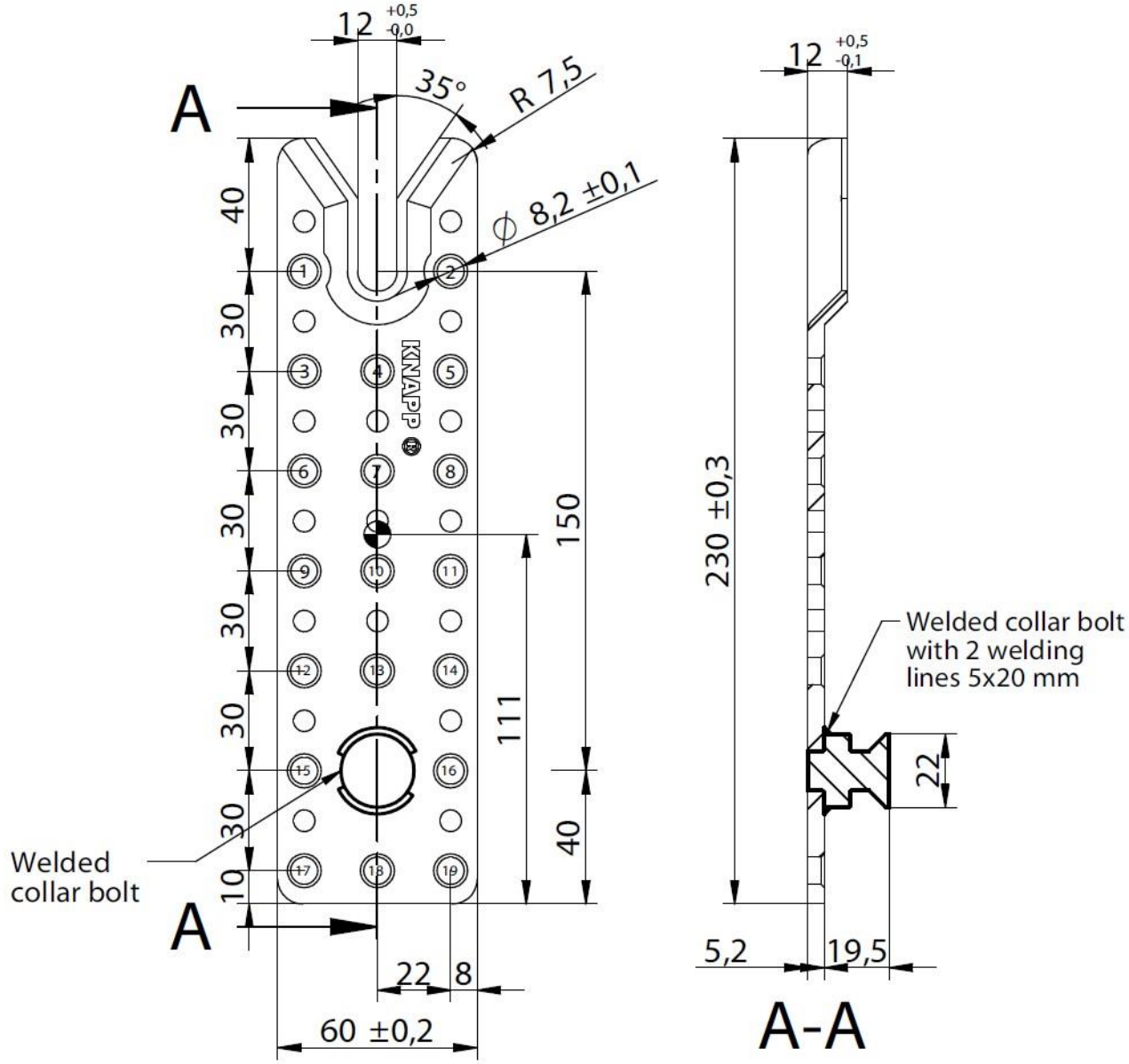


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

19 screws in Header / Joist

KNAPP® Clip Connector RICON® S 230/60 VS

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

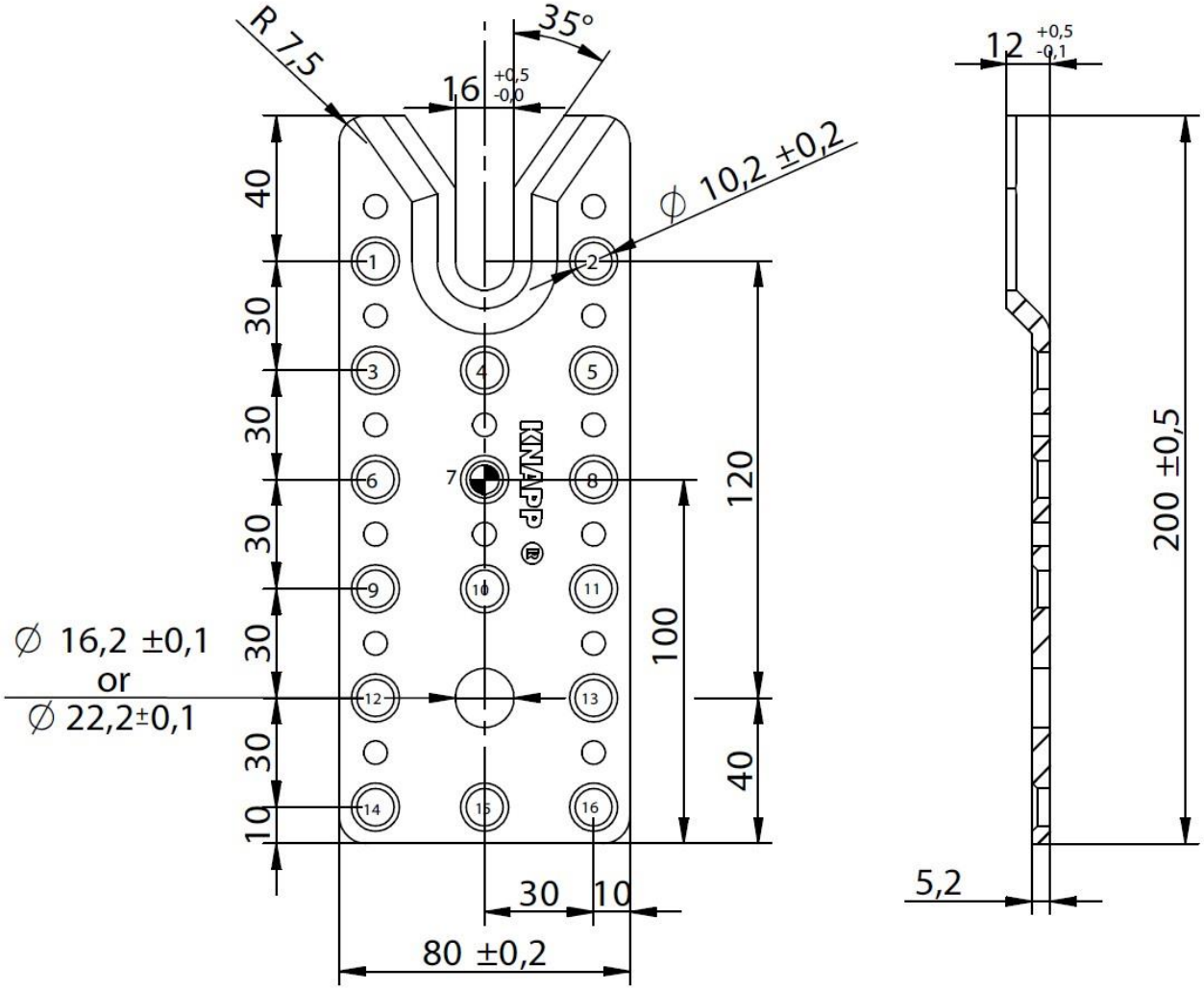


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

19 screws in Header / Joist

KNAPP® Clip Connector RICON® S 200/80 EK, GK, VK

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

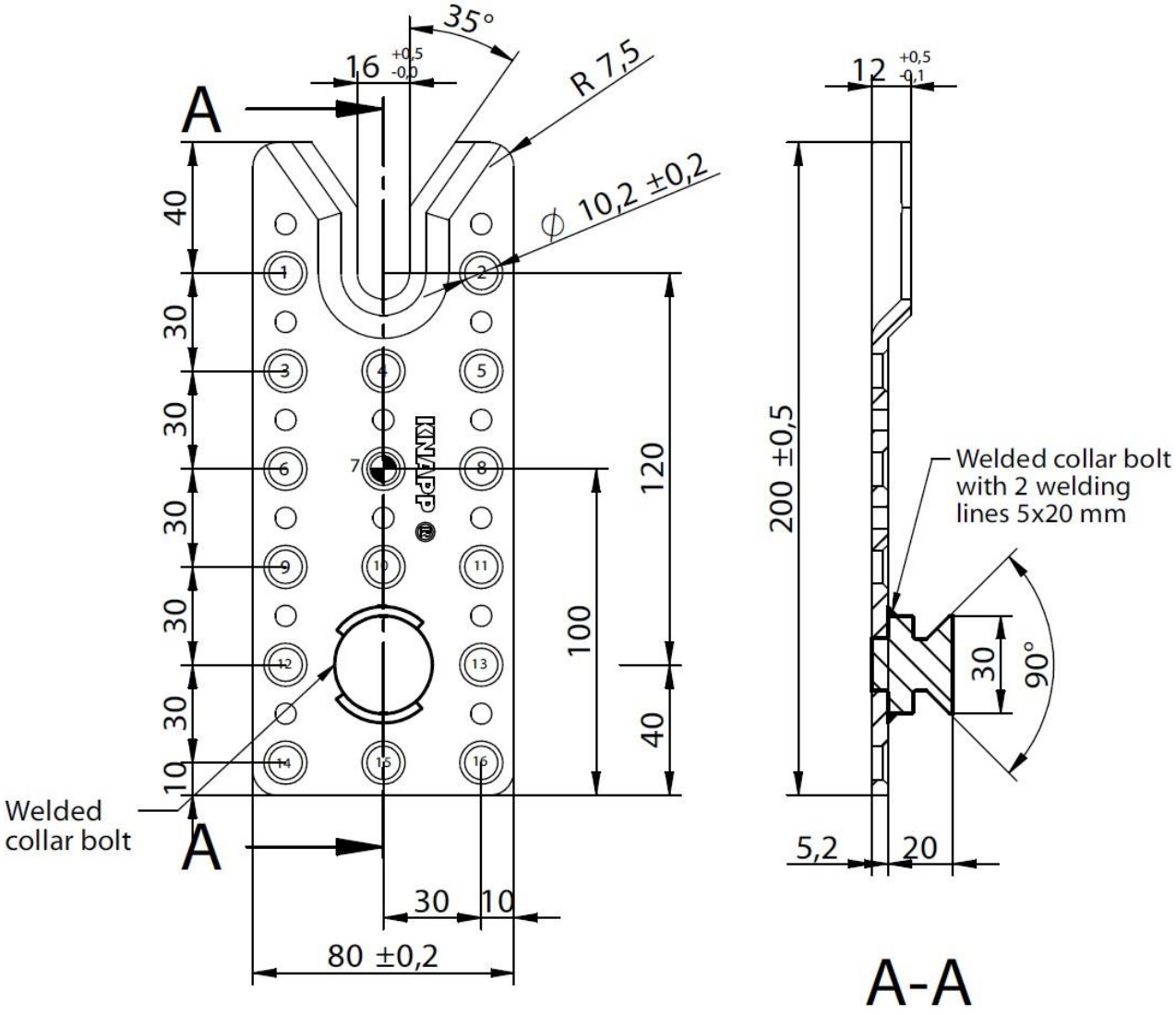


Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

16 screws in Header / Joist: position

KNAPP® Clip Connector RICON® S 200/80 VS

5.2 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 255 MPa;
Corrosion protection according to Eurocode 5-1-1

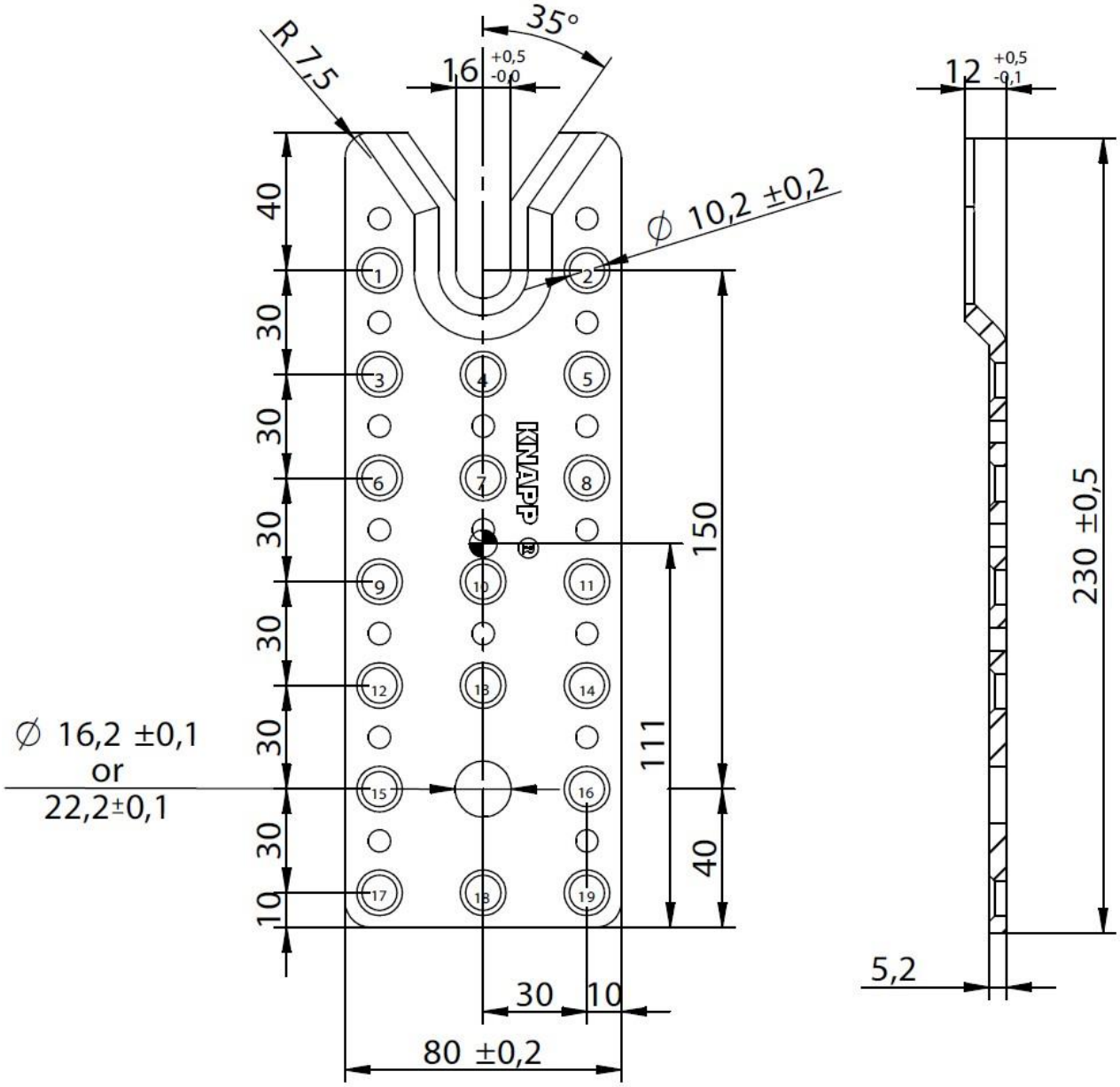


Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

16 screws in Header / Joist

KNAPP® Clip Connector RICON® S 230/80 EK, GK, VK

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

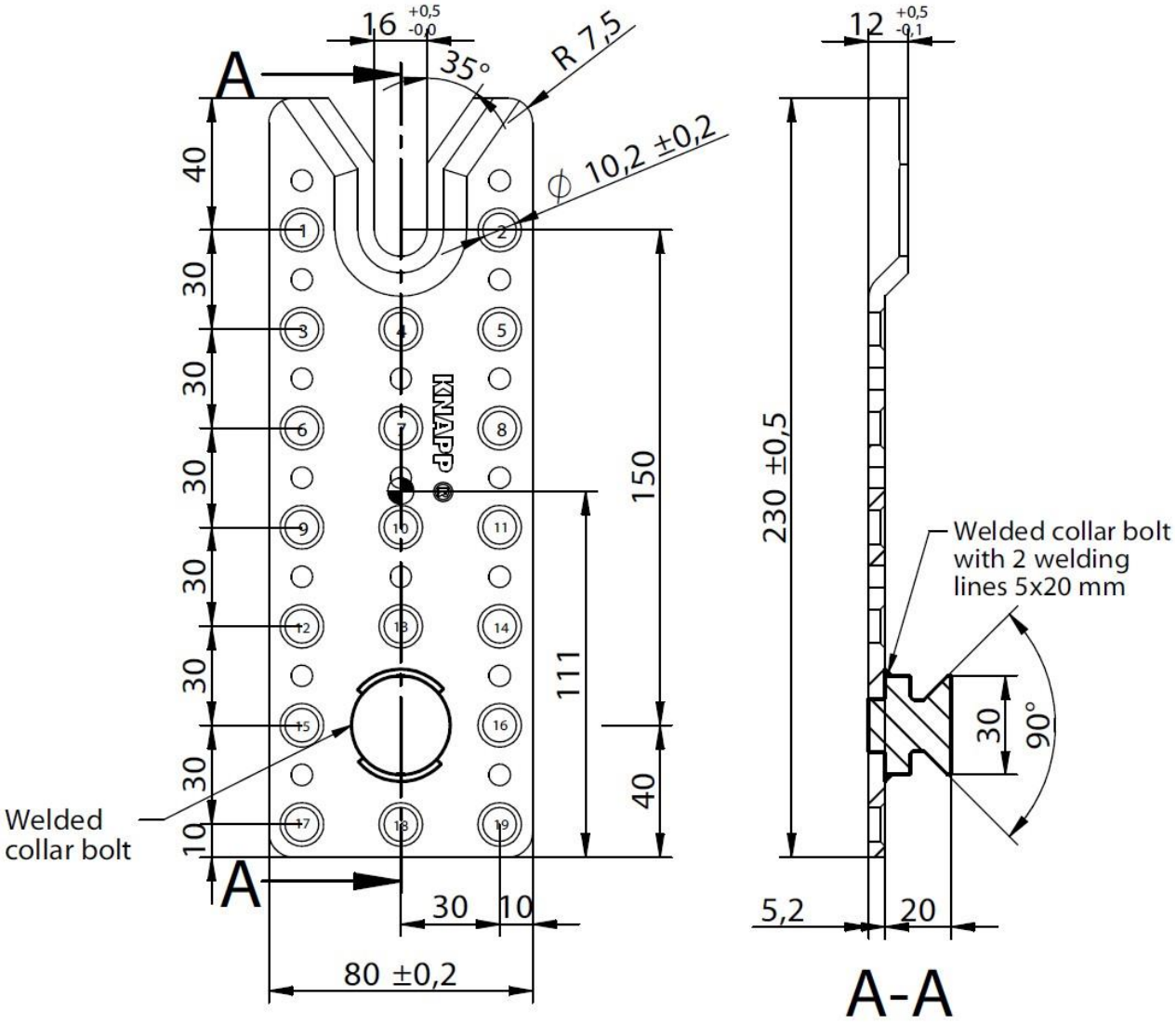


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

19 screws in Header / Joist

KNAPP® Clip Connector RICON® S 230/80 VS

5.2 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 255 MPa;
Corrosion protection according to Eurocode 5-1-1

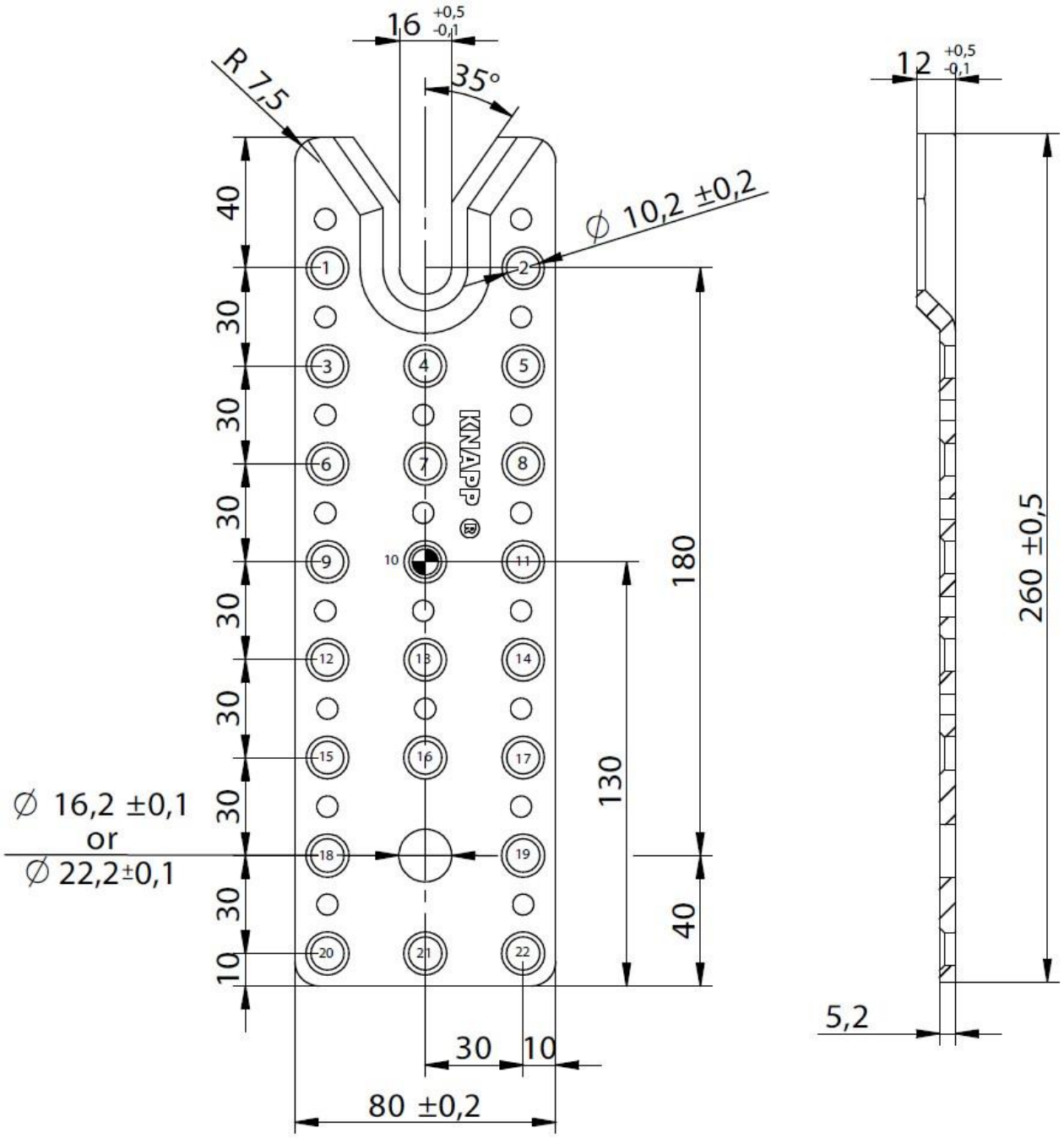


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

19 screws in Header / Joist

KNAPP® Clip Connector RICON® S 260/80 EK, GK, VK

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

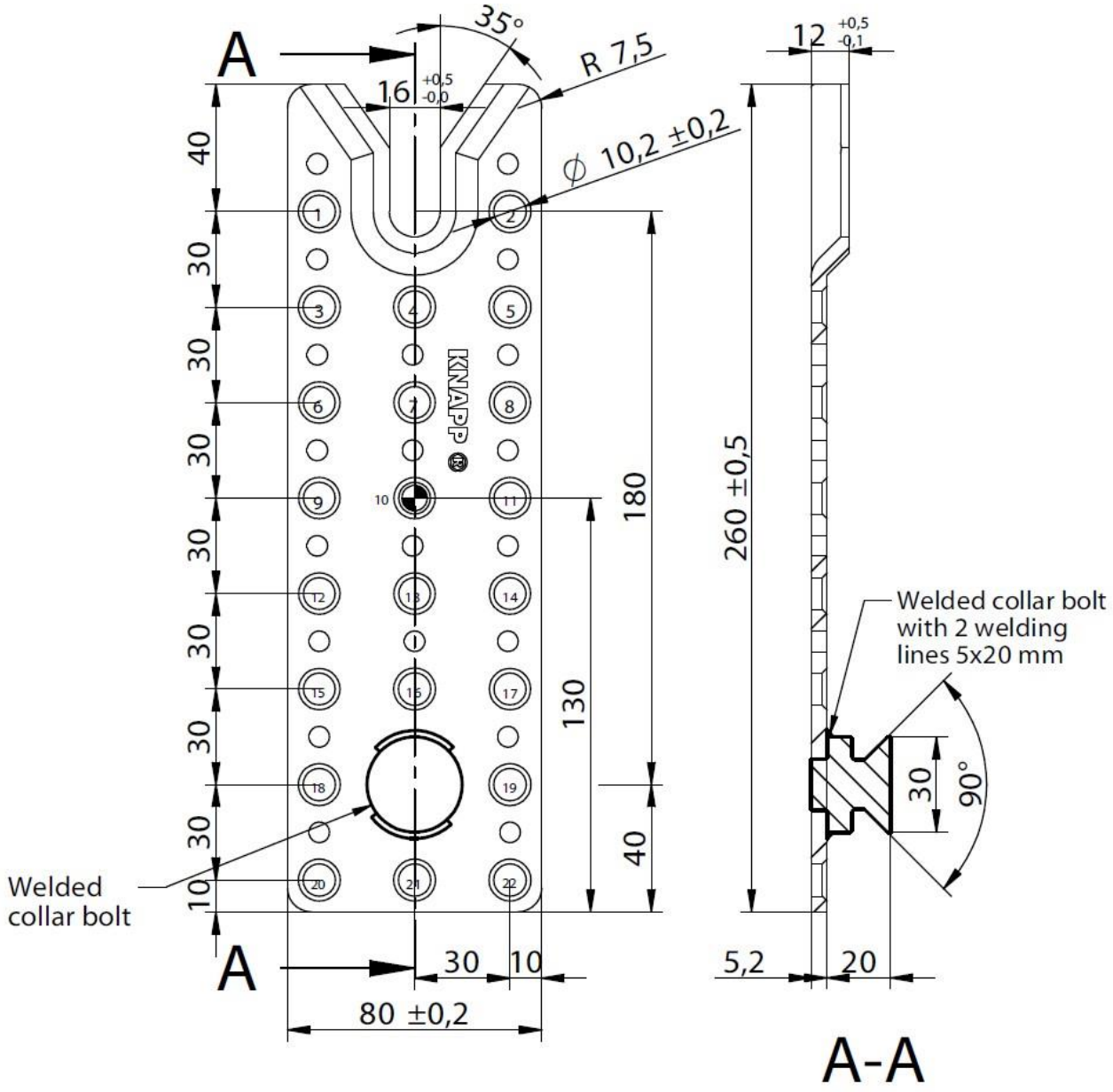


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

22 screws in Header / Joist

KNAPP® Clip Connector RICON® S 260/80 VS

5.2 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 255 MPa;
Corrosion protection according to Eurocode 5-1-1

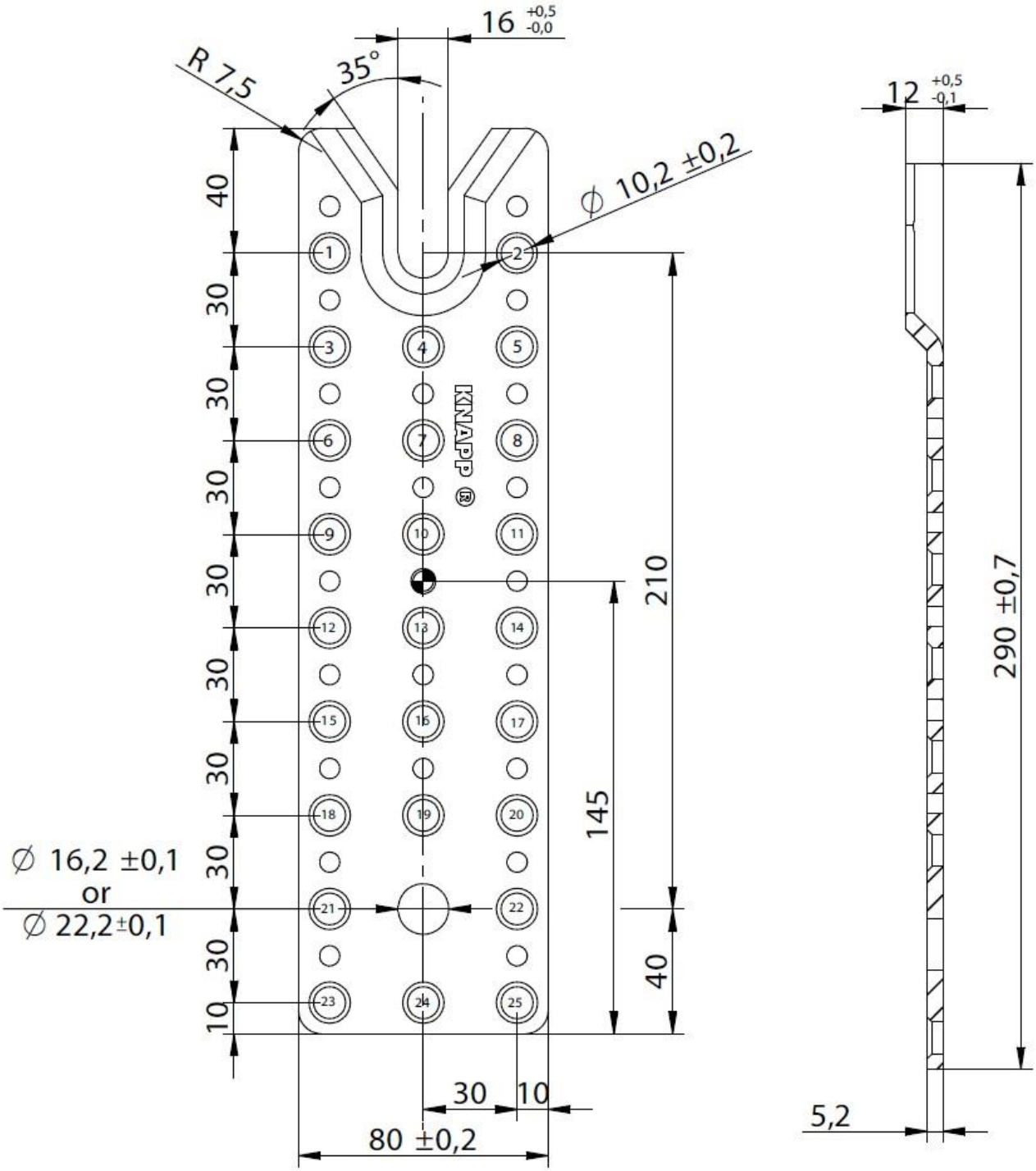


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

22 screws in Header / Joist

KNAPP® Clip Connector RICON® S 290/80 EK, GK, VK

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

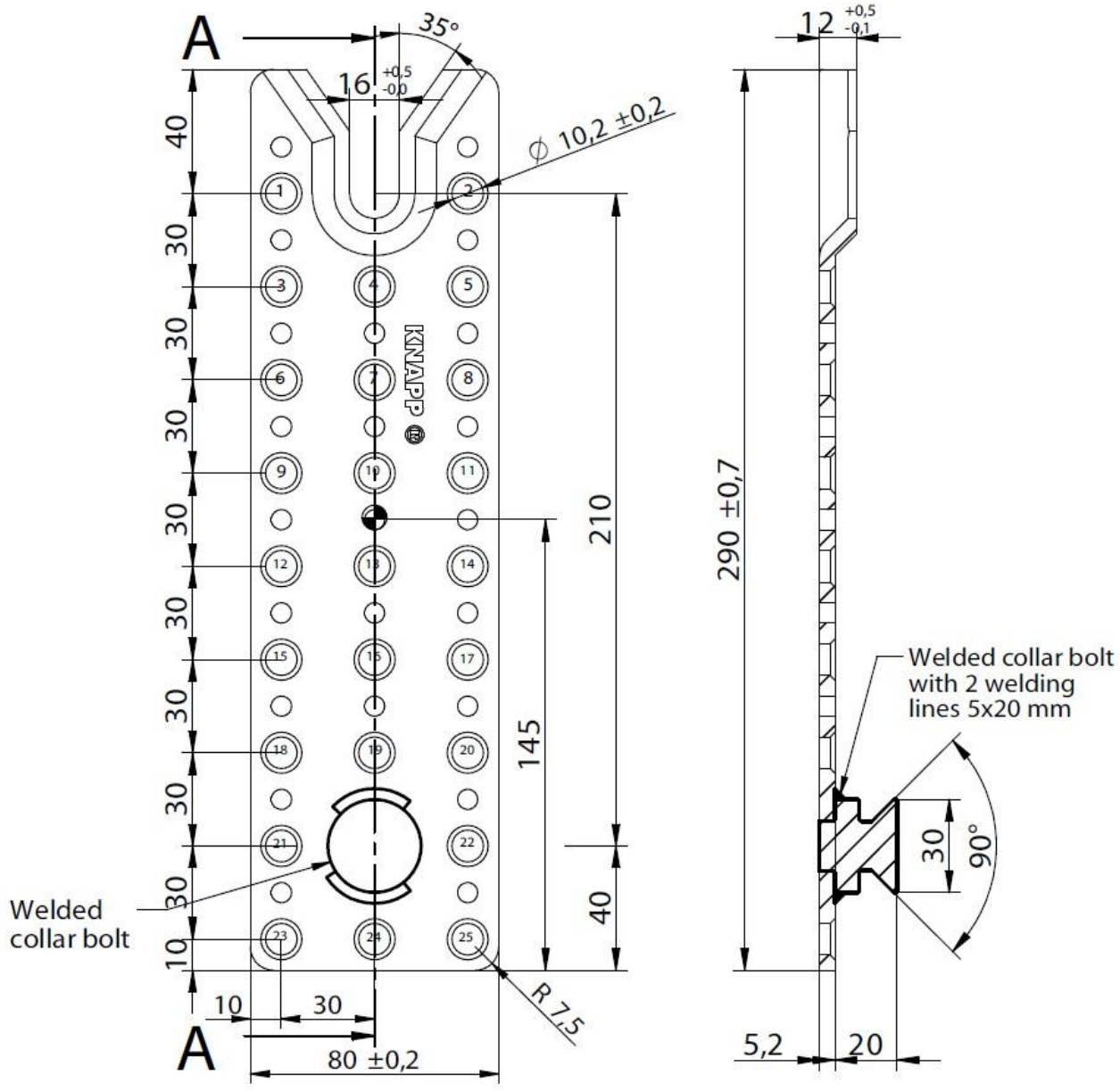


◒ Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2

25 screws in Header / Joist

KNAPP® Clip Connector RICON® S 290/80 VS

5.2 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 255 MPa;
Corrosion protection according to Eurocode 5-1-1

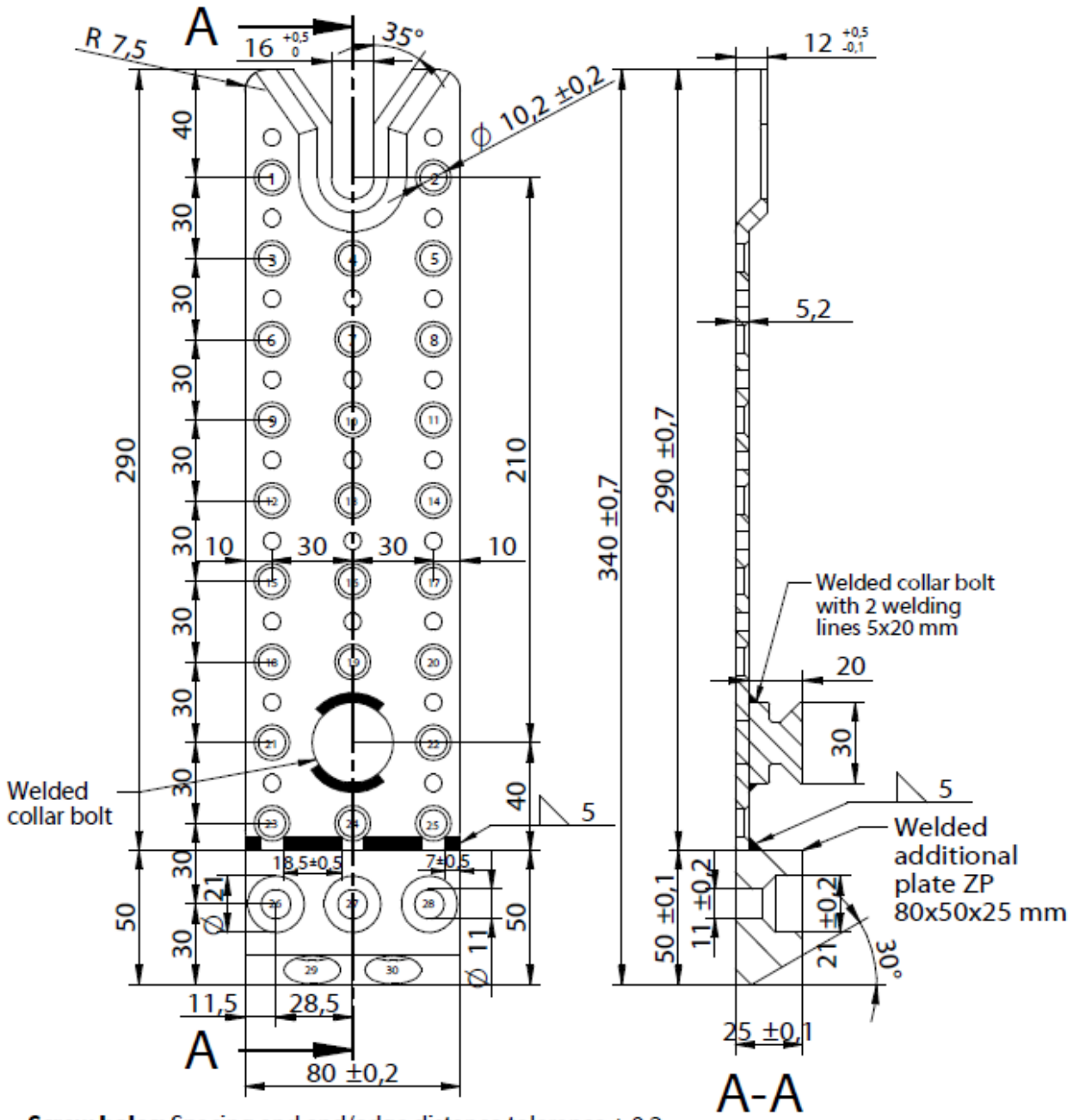


Centre of gravity of screw pattern
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

25 screws in Header / Joist

KNAPP® Clip Connector RICON® S 390/80 VS + ZP

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength R_e of 255 MPa; Corrosion protection according to Eurocode 5-1-1



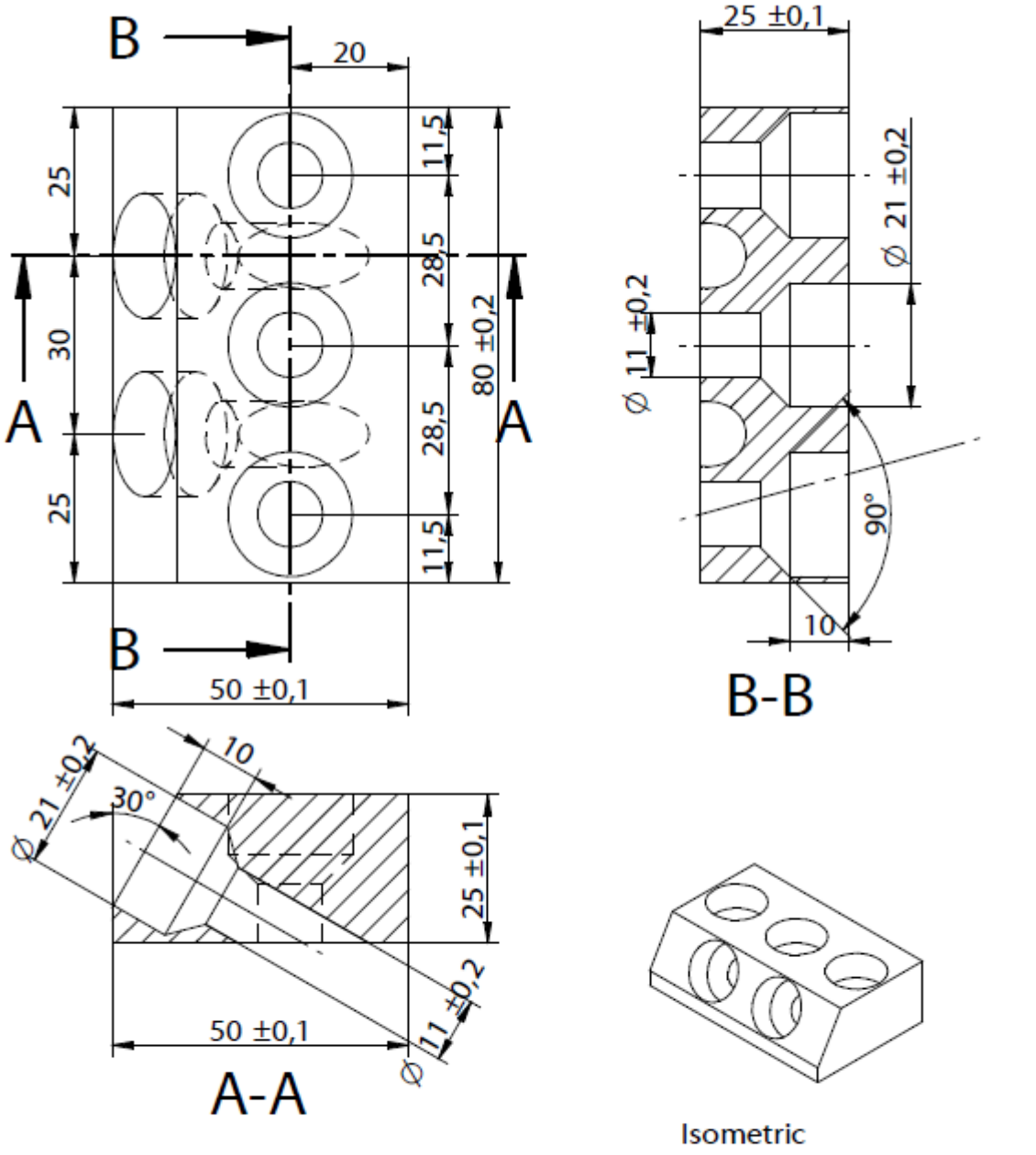
Screw holes: Spacing and end/edge distance tolerance ± 0,2
Welded collar bolt with 2 welding lines 5x20 mm

dimensions in mm

Screws in Header / Joist:
Max. 28 screws - position:
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,25,26,27,28
(Header/column: CS 10x100; Joist CS 10x200 or CS 10x300)
Oblique holes: 29, 30
(Header CS ≥10x400; Joist CS ≥ 10x450)

KNAPP® RICON® S 390x80 additional plate (ZP) 80x50x25

Additional plate of steel grade S235JR+AR accpording to EN 10025-2/2004 with minimum yield strength R_{eH} of 225 MPa, minimum tensile strength R_m of 360 MPa, maximam tensile strength R_m of 510 and minimum ultimate strain A_{80} of 26/24%
Corrosion protection according to Eurocode 5-1-1

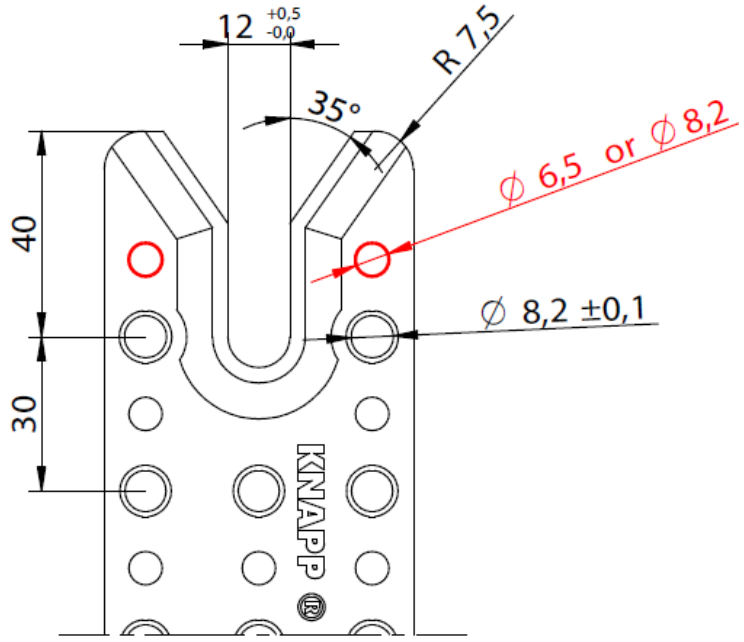


dimensions in mm

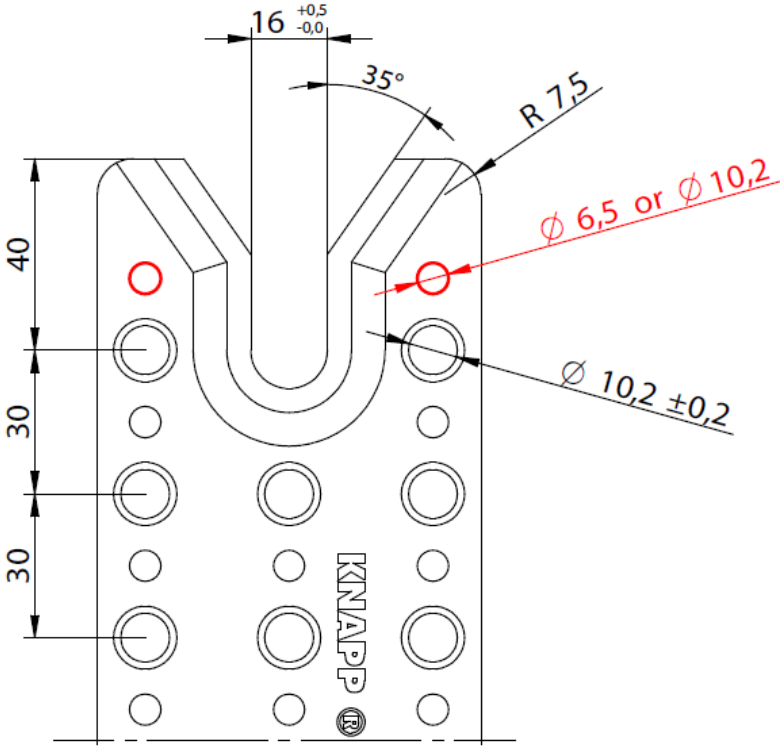
KNAPP® Clip Connector RICON® S 60 / RICON® S 80

Alternative screw position for uppest two screws (holes in red color):

RICON® S 60

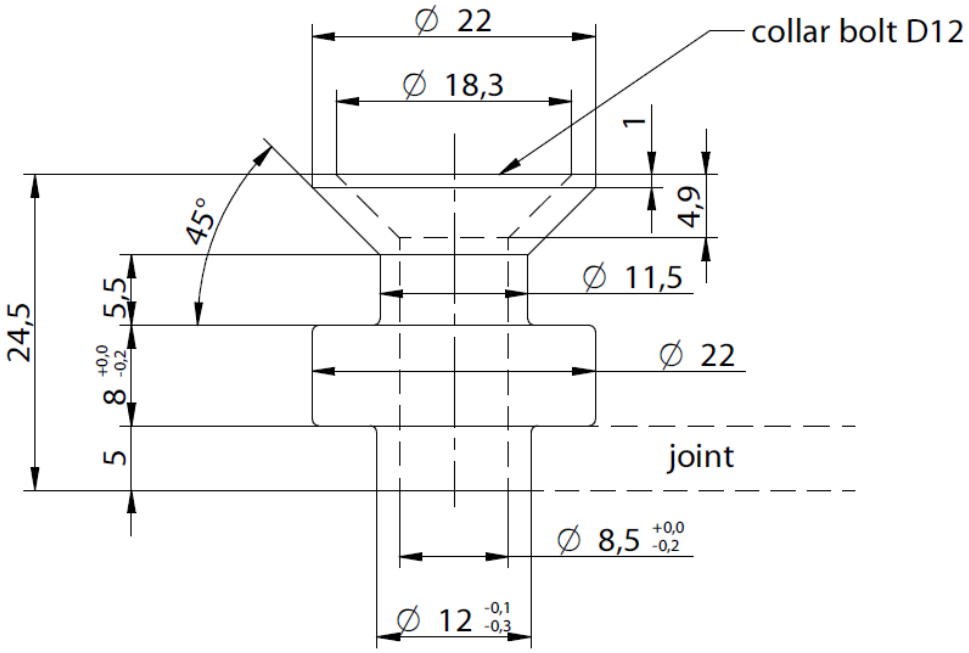


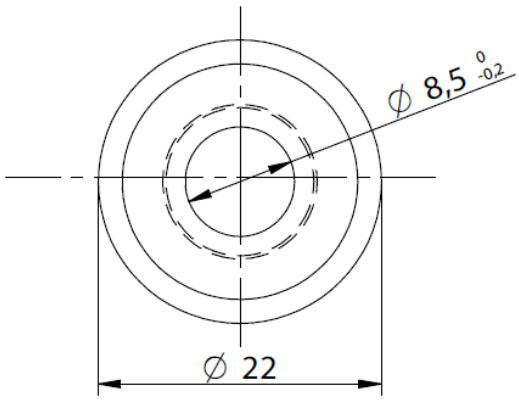
RICON® S 80:



KNAPP® RICON® S 60 collar bolt D12

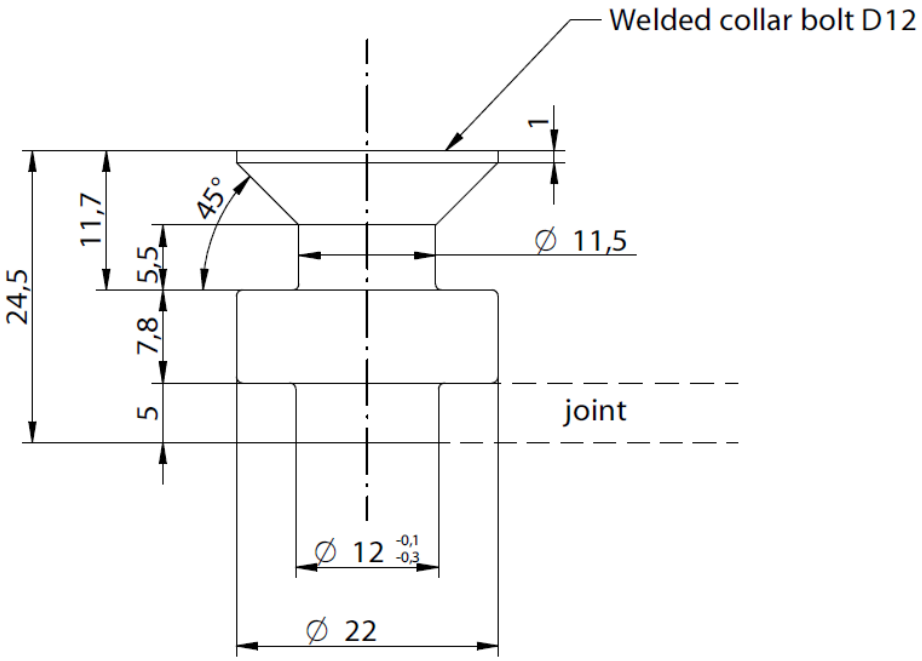
Collar bolt of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and ultimate strain A_{80} of 7%;
Corrosion protection according to Eurocode 5-1-1 (≥ 5 µm zinc coating)

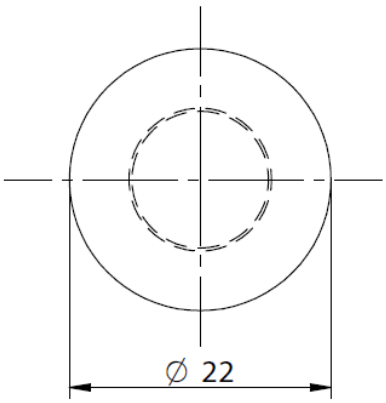




KNAPP® RICON® S 60 welded collar bolt D12 and for WALCO 60

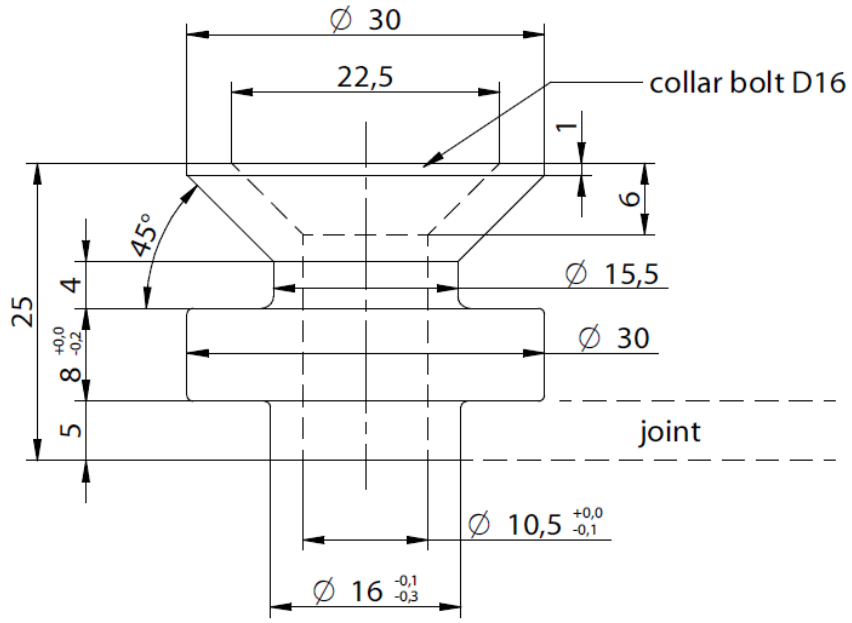
Collar bolt of steel grade16MnCr5 according to EN 10084 with HBW values 156 – 207
Corrosion protection according to Eurocode 5-1-1;

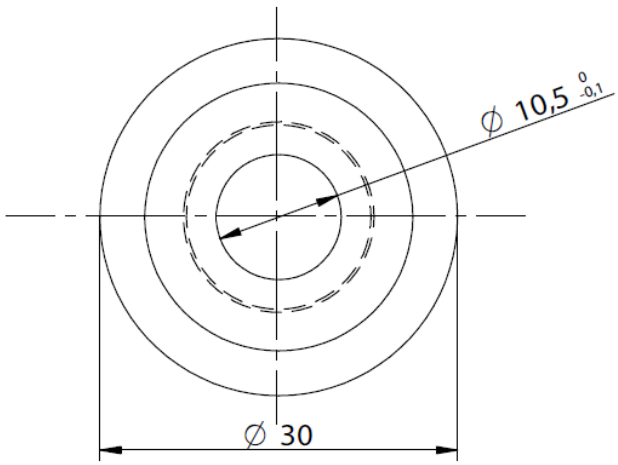




KNAPP® RICON® S 80 collar bolt D16

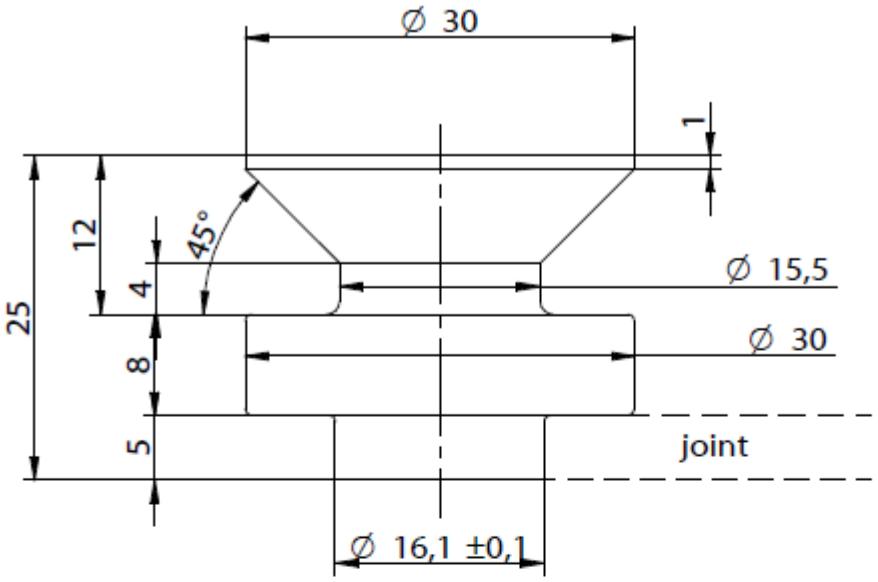
Collar bolt of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 MPa and ultimate strain A_{80} of 7%;
Corrosion protection according to Eurocode 5-1-1 (≥ 5 µm zinc coating);

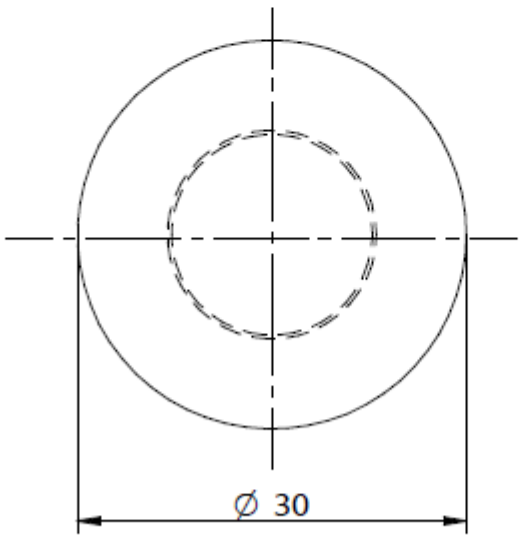




KNAPP® RICON® S 80 welded collar bolt D16 (VS) and for WALCO 80

Collar bolt of steel grade16MnCr5 accpording to EN 10084 with HBW 156-207
Corrosion protection according to Eurocode 5-1-1



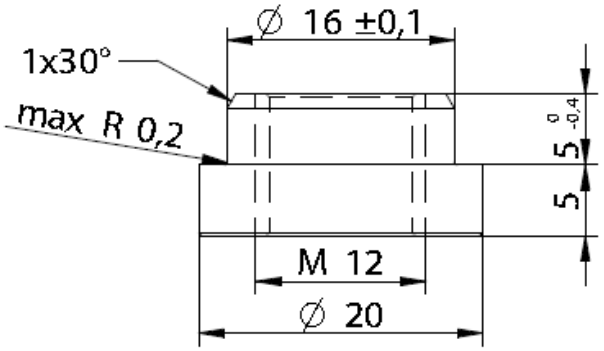


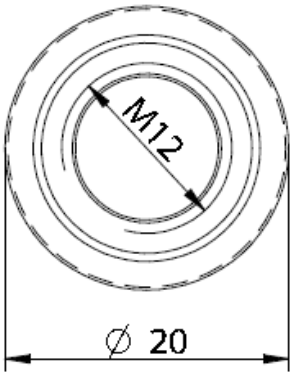
2:1

tolerance ± 0.5
dimensions in mm

KNAPP® RICON® S 60 press nut M12 as retaining screw collar bolt M12

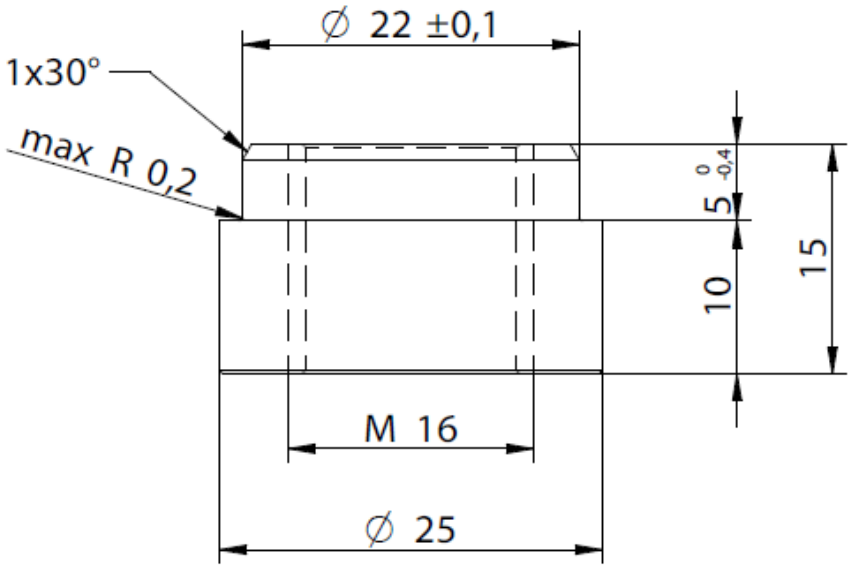
Press nut of pre-galvanized steel grade C45Pb according to EN 10277-2 with minimum yield strength $R_{p0,2}$ of 410 MPa, tensile strength R_m of 650 MPa, maximum tensile strength R_m of 1000 MPa and ultimate strain A_{80} of 7%.
Corrosion protection according to Eurocode 5-1-1 (≥ 5 µm zinc coating);

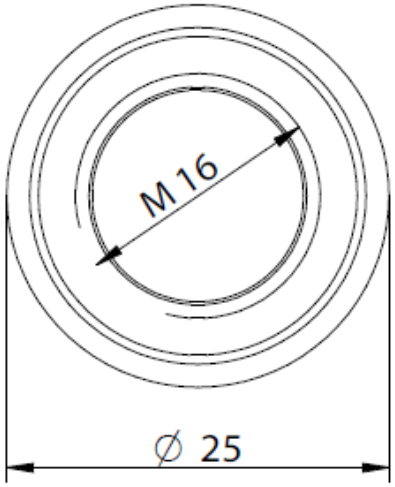




KNAPP® RICON® S 80 press nut M16 as retaining screw collar bolt M16

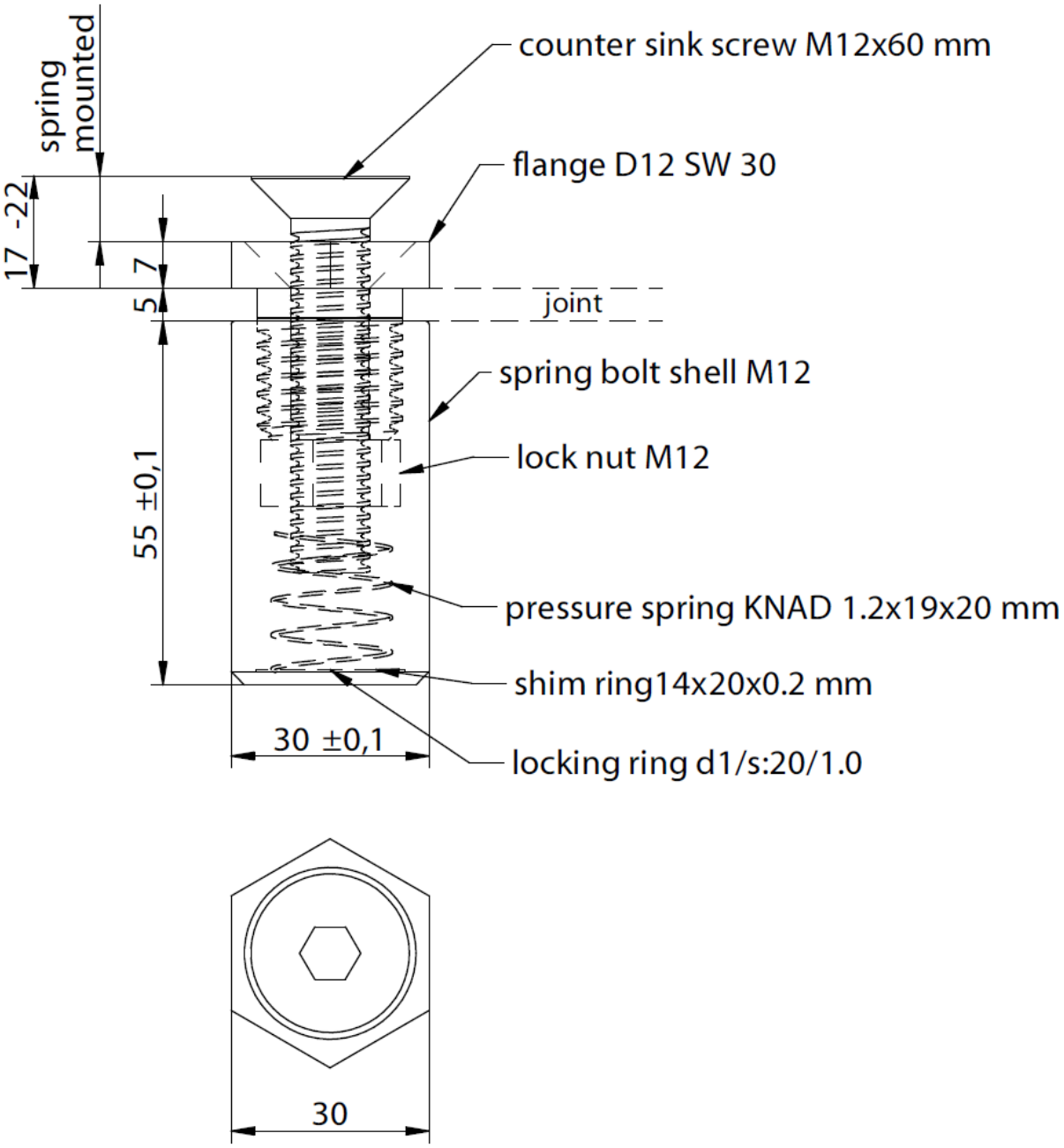
Press nut of pre-galvanized steel grade C45Pb according to EN 10277-2 with minimum yield strength $R_{p0,2}$ of 410 MPa, tensile strength R_m of 650 MPa, maximum tensile strength R_m of 1000 MPa and ultimate strain A_{80} of 7%.
Corrosion protection according to Eurocode 5-1-1 (≥ 5 µm zinc coating);





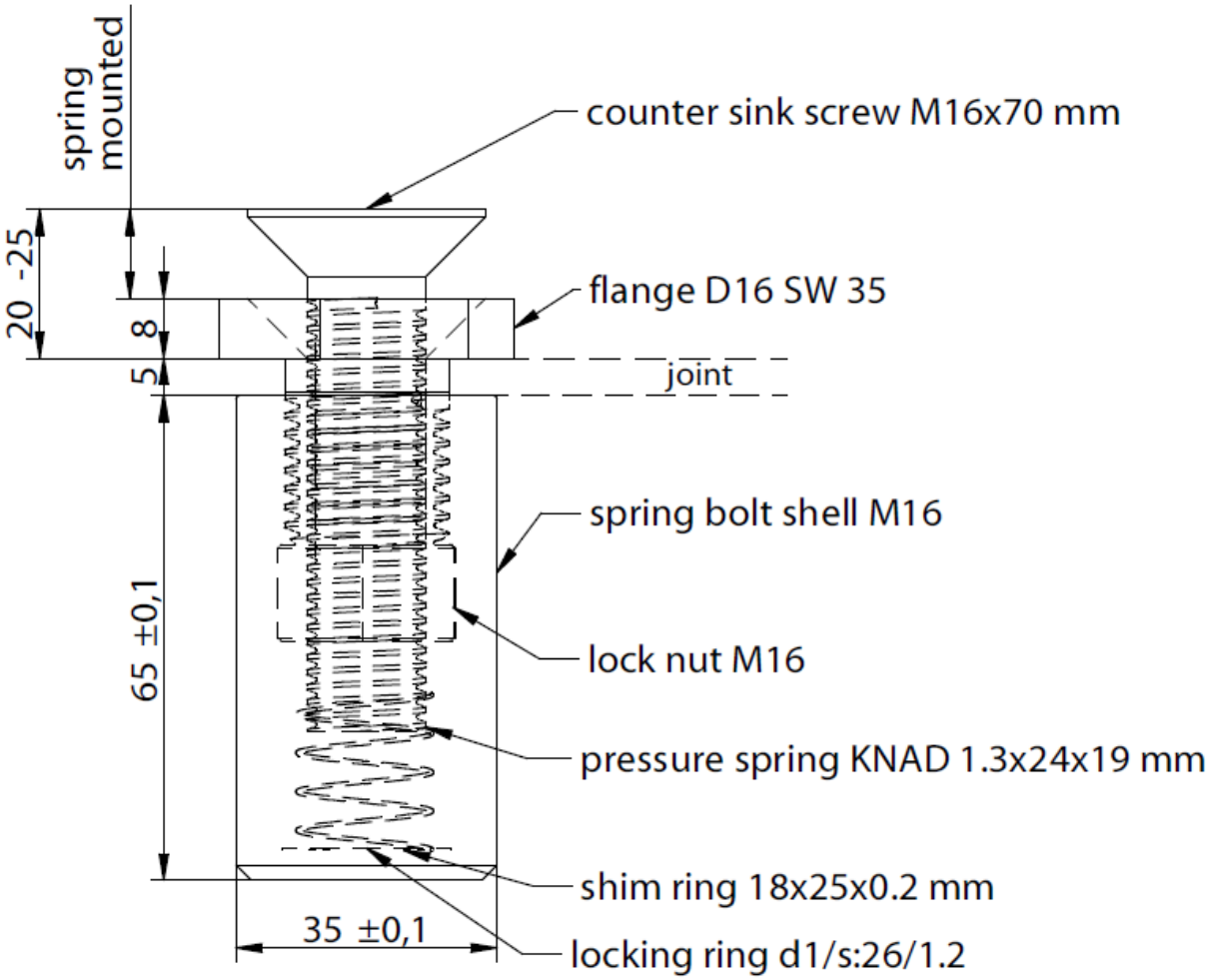
KNAPP® RICON® S 60 spring retaining screw collar bolt M12

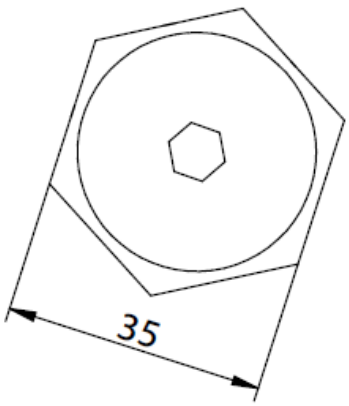
Collar bolt and locknut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and ultimate strain A80 of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN ISO 898-1; pressure spring of unalloyed spring steel with specification SM according to EN 10270-1, tensile strength R_m of 1900 MPa, maximum tensile strength R_m of 2160 and ultimate strain A_{80} of 40%;



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 yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and ultimate strain A80 of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN ISO 898-1; pressure spring of unalloyed spring steel with specification SM according to EN 10270-1, tensile strength R_m of 1900 MPa, maximum tensile strength R_m of 2160 MPa and ultimate strain A_{80} of 40%;

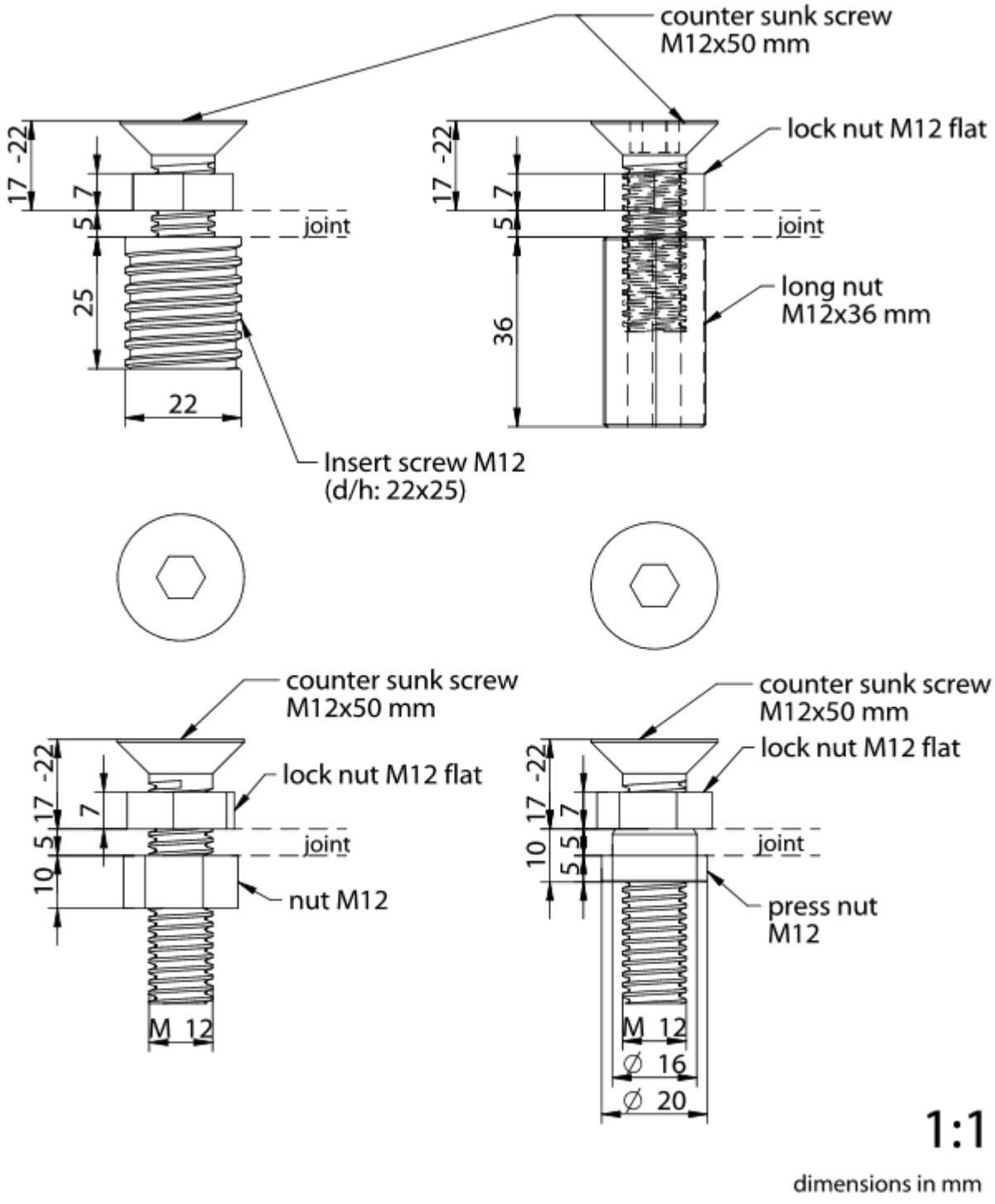




KNAPP® RICON® S 60 retaining screw collar bolt M12 **with insert screw or long nut with press nut or nut M12**

Retaining screw bolt, locknut and longnut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 MPa and ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN ISO 898-1.

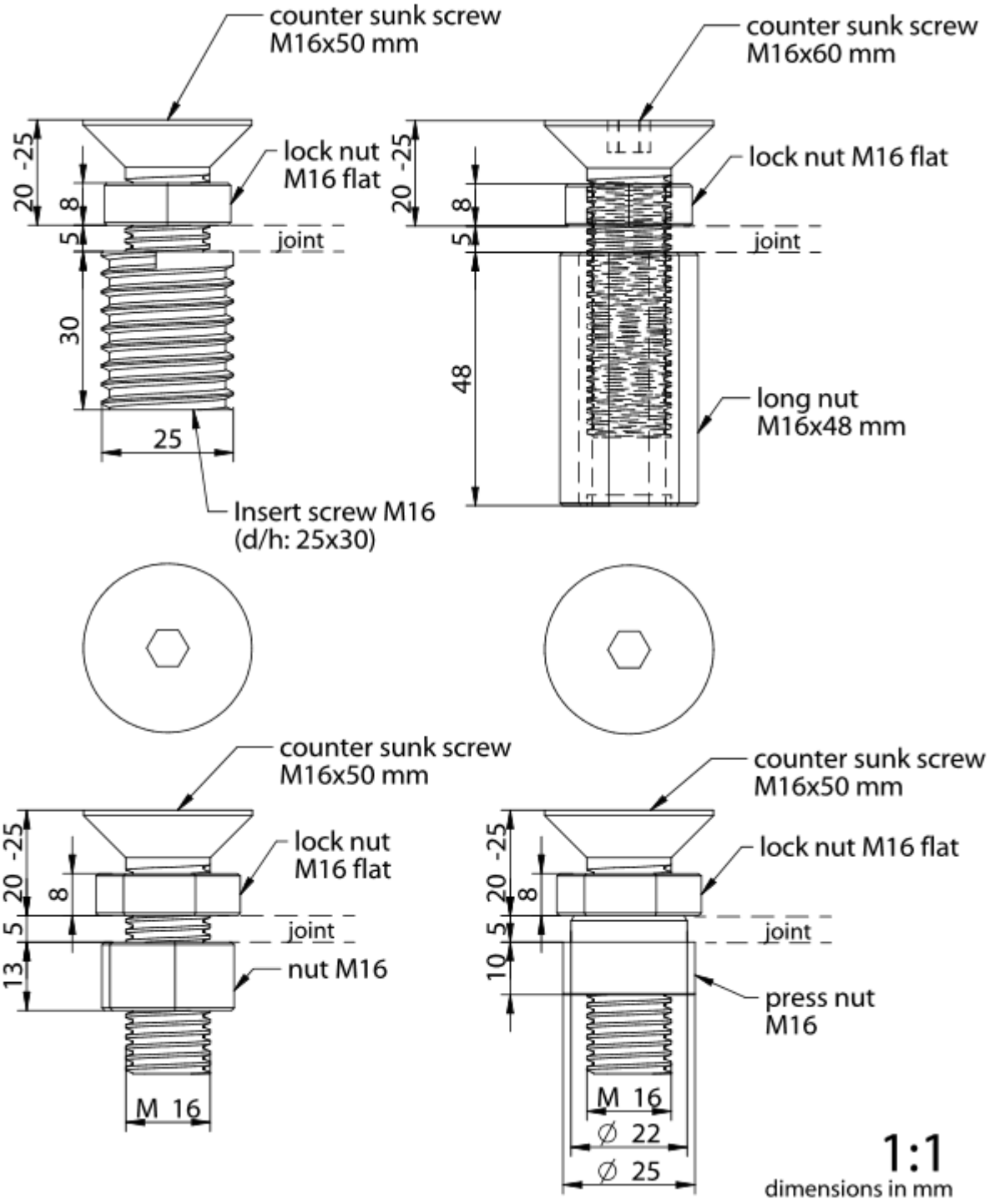
The material properties of the press nut M12 is defined on page 54. The steel grade of the nut M12 is 8 (acc. to EN ISO 898-1; EN ISO 4032); the nut M12 can be fixed by a welding point or similar method (e.g. with adhesive) to avoid turning at the assembly process.



KNAPP® RICON® S 80 retaining screw collar bolt M16 **with insert screw or long nut with press nut or nut M16**

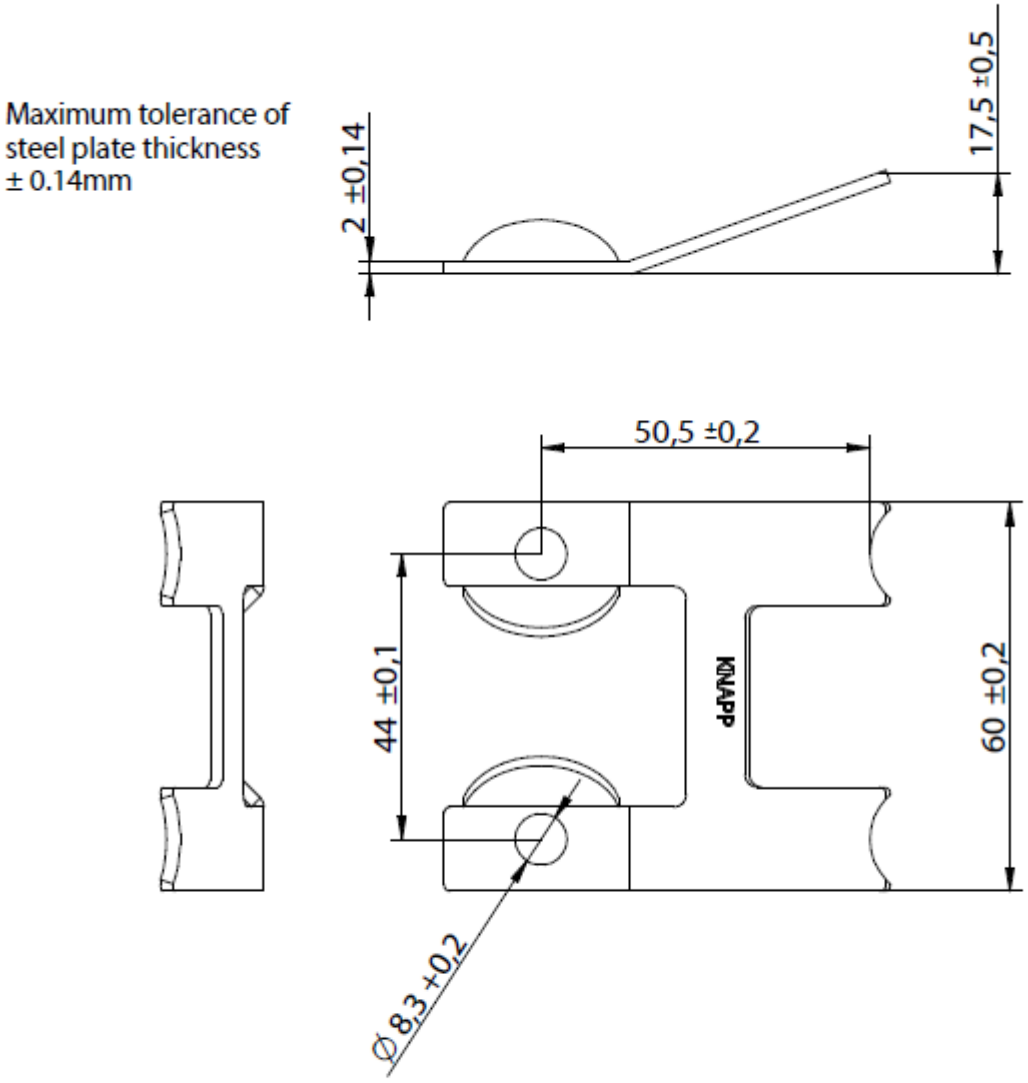
Retaining screw bolt, locknut and longnut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 MPa and minimum ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN ISO 898-1

The material properties of the press nut M16 is defined on page 55. The steel grade of the nut M16 is 8 (acc. to EN ISO 898-1; EN ISO 4032); the nut M16 can be fixed by a welding point or similar method (e.g. with adhesive) to avoid turning at the assembly process.



KNAPP® RICON® S 60 clip lock

2.0 mm thick stainless steel grade X10CrNi 18-8 (AISI 302, material No. 1.4310) according to EN 17224-2:1995-11 with minimum tensile strength R_m of 1200 MPa

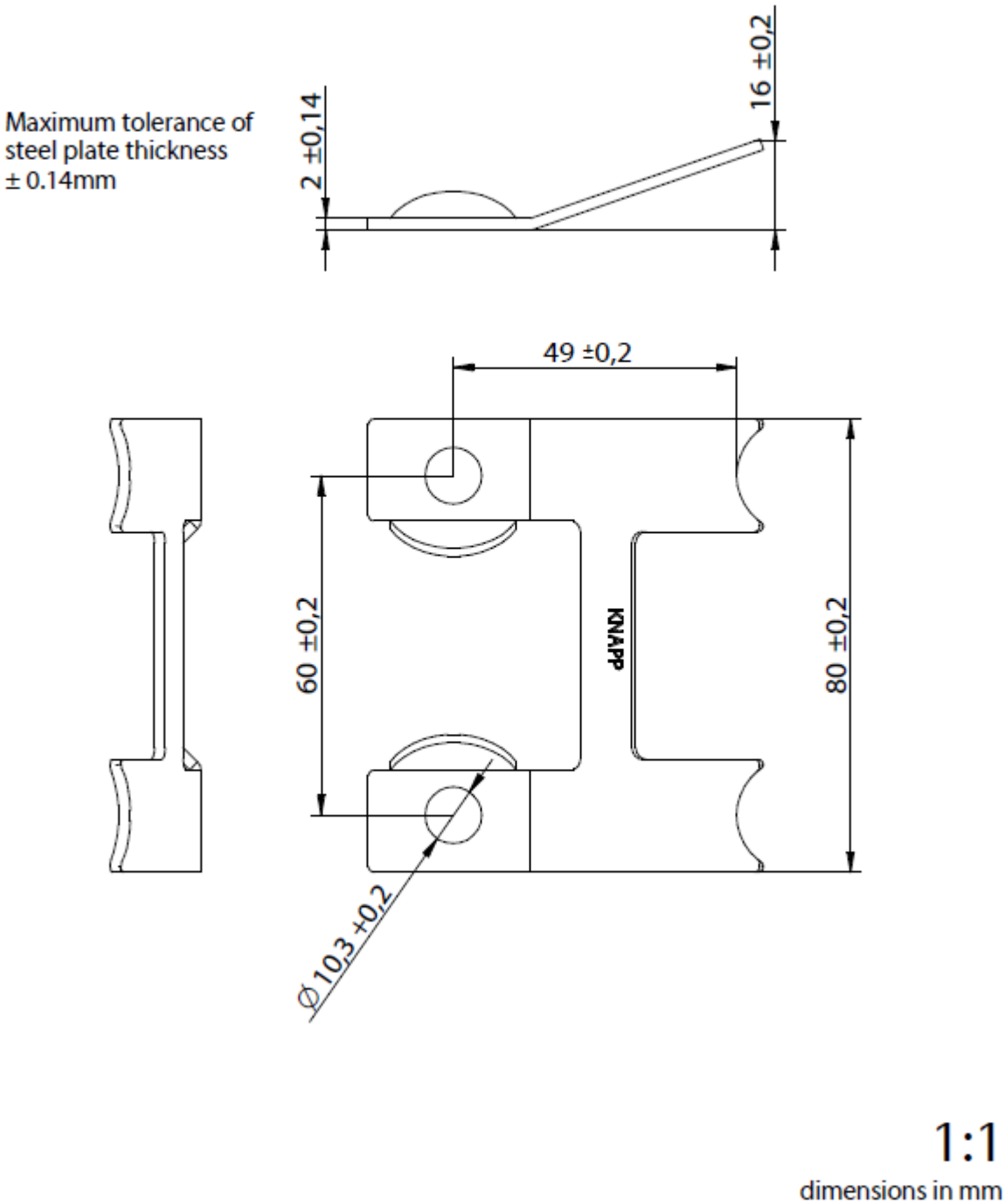


1:1

dimensions in mm

KNAPP® RICON® S 80 clip lock

2.0 mm thick stainless steel grade X10CrNi 18-8 (AISI 302, material No. 1.4310) according to EN 17224-2:1995-11 with minimum tensile strength R_m of 1200 MPa

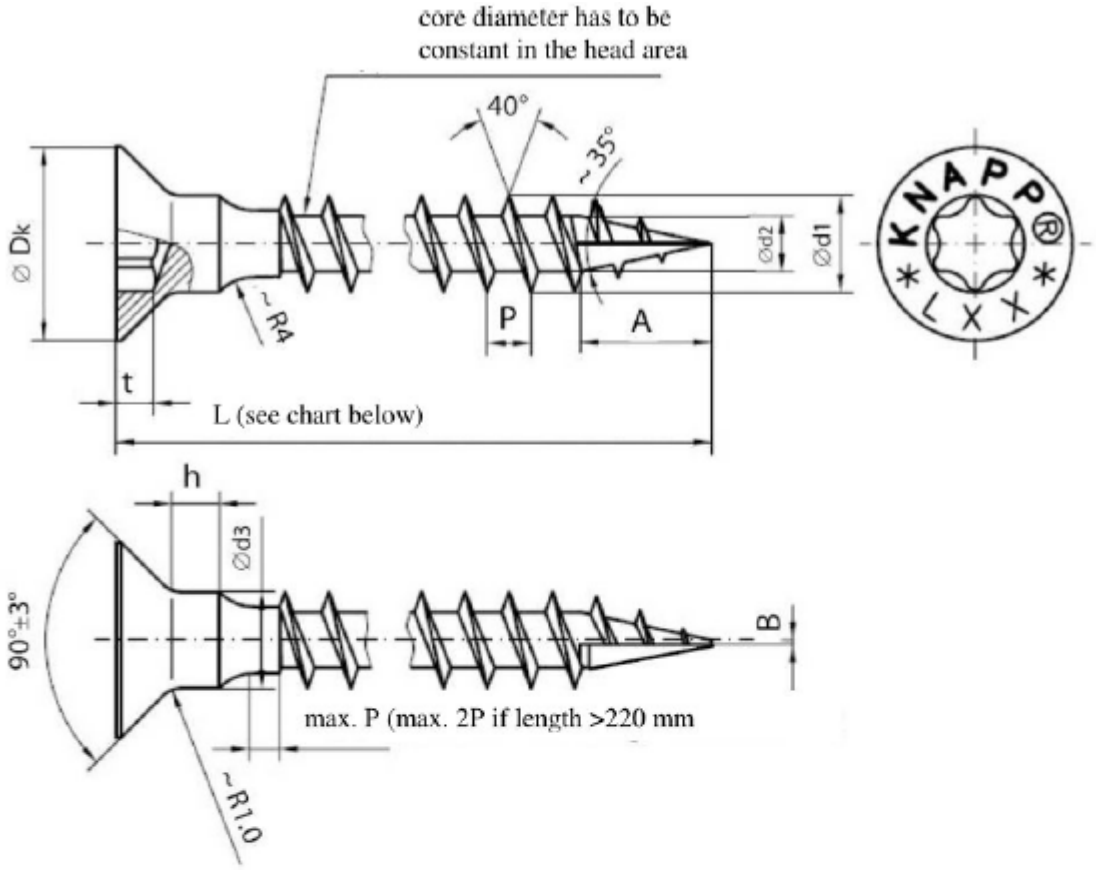


1:1

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 tension $f_{tens,k}$ of 20 kN and minimum torque $M_{t,u,k}$ of 30 Nm and yield moment $M_{y,k}$ = 20 Nm for screw diameter 8 mm; for screw diameter 10 mm is minimum tension $f_{tens,k}$ of 32 kN and minimum $M_{t,u,k}$ = 50 Nm and yield moment $M_{y,k}$ = 35 Nm



RICON® S60							
nominal Ø d1	wire Ø	bolt Ø	external Ø d1	core Ø d2	gradient P	milling length A	centreptich 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 Ø d1	head Ø	joining height h	joining Ø d3	drive	m	t	nominal length L	nominal length L
8.0	15.0-0.8	3.00±0.5	7.4±0.1	6Lobe40-253	6.8	3.05-3.42	80-1.5	160-1.5
							50-1,5	240 -1,8

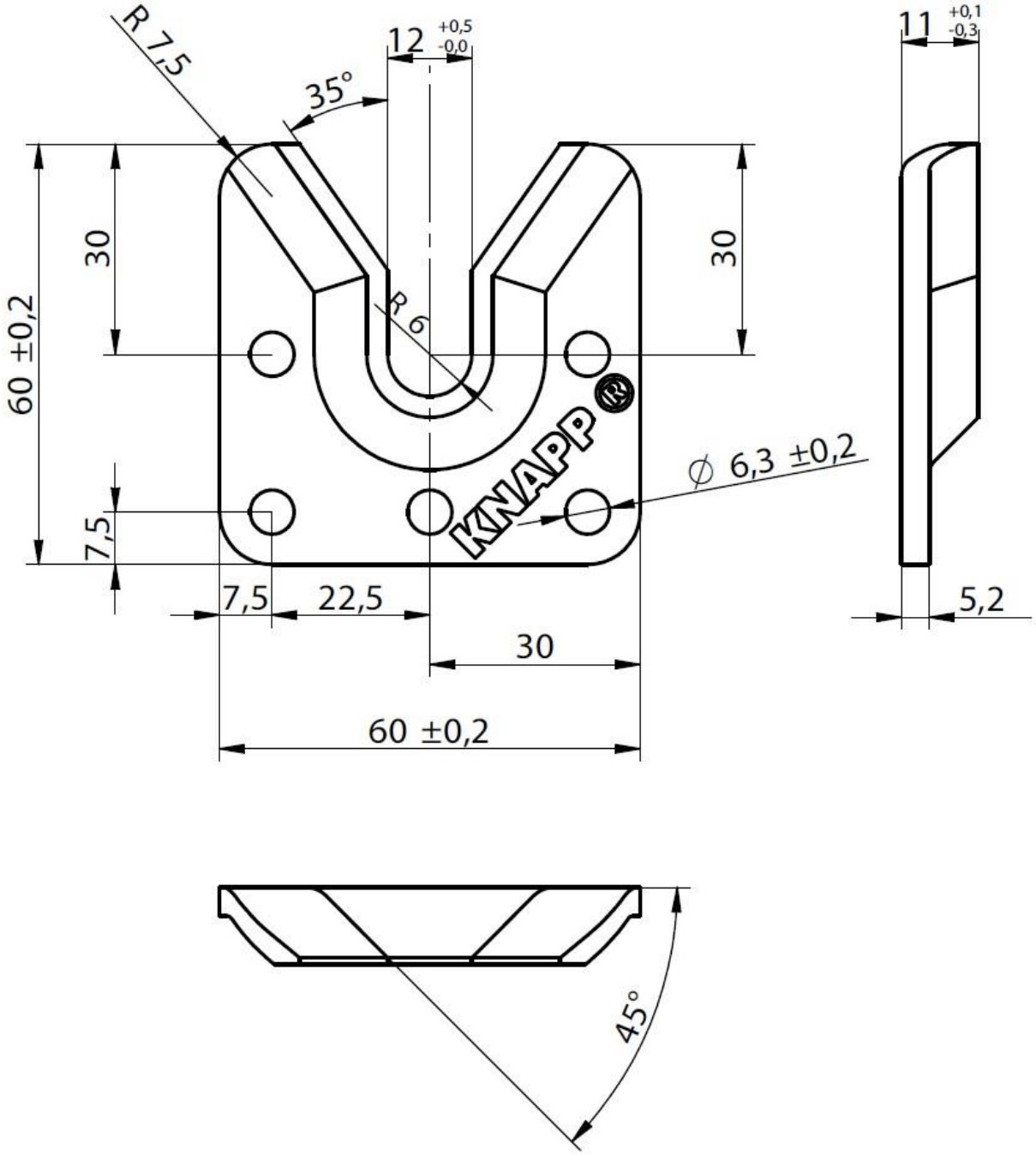
RICON® S80							
nominal Ø d1	wire Ø	bolt Ø	external Ø d1	core Ø d2	gradient	milling	centreptich
10.0	6.95-6.98	6.96-7.05	10.0-0.3	6.3-0.3	4.5±0.18	13±1.5	0.1+0.5

nominal Ø d1	head Ø	joining height h	joining Ø d3	drive	m	t	nominal length L	nominal length L
10.0	18.5-0.9	3.20±0.5	9.4±0.1	6Lobe40-250	6.8	3.43-3.80	100-1.8	200,-1.8
							60-1.5	300 -1.8

dimensions in mm

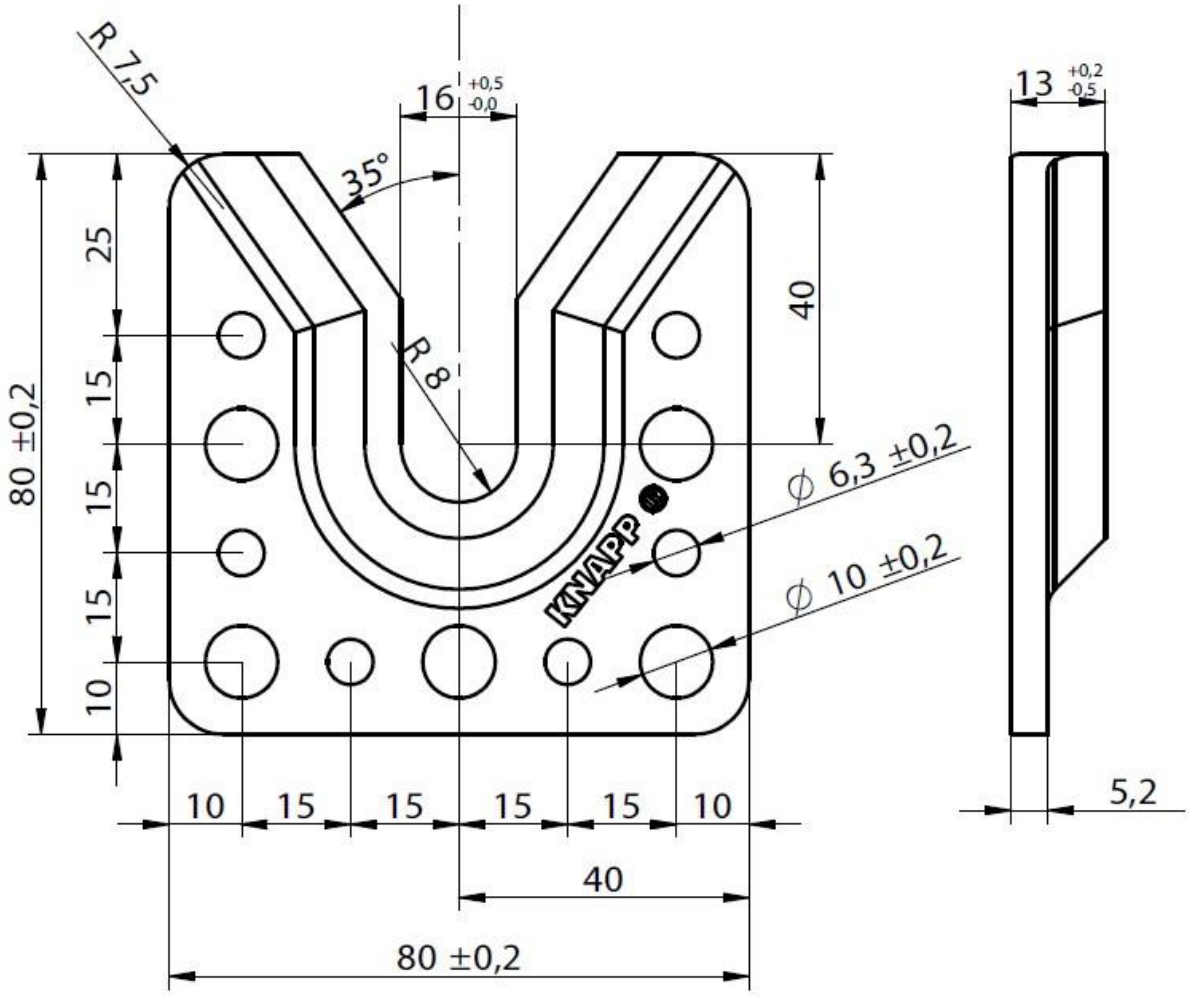
KNAPP® Clip Connector WALCO® V 60

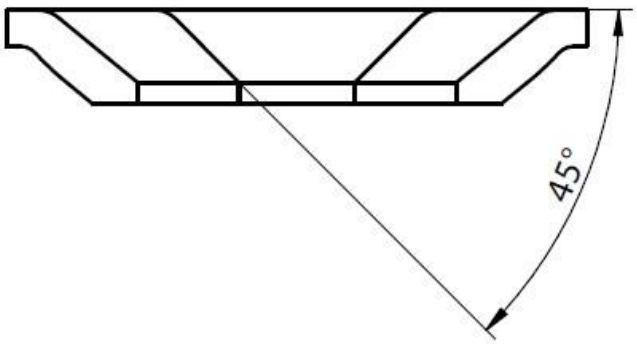
5.2 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1



KNAPP® Clip Connector WALCO® V 80

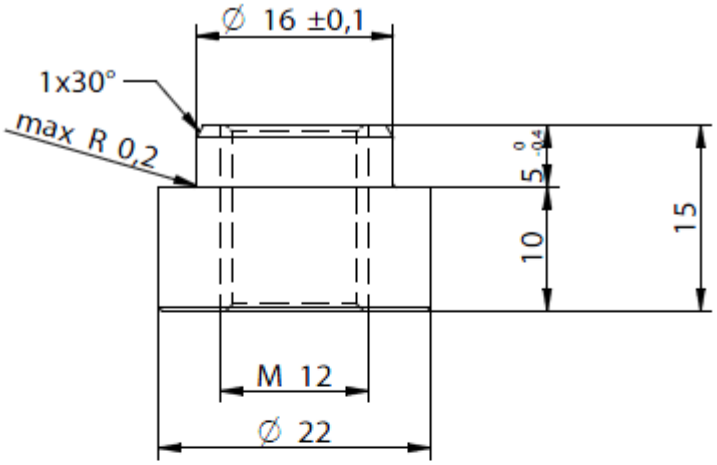
5.2 mm thick steel grade DD13 according to EN 10111:2008-06 with yield strength R_e of 235 MPa;
Corrosion protection according to Eurocode 5-1-1

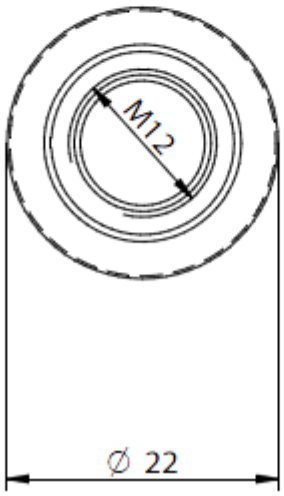




KNAPP® WALCO® V threaded sleeve for WALCO 60 base plate

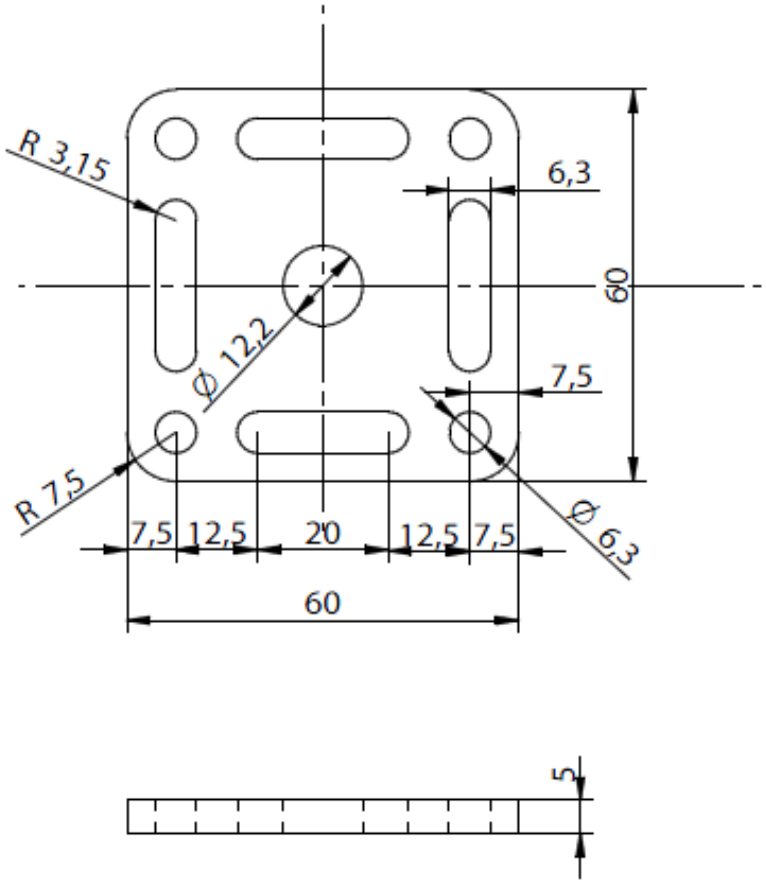
M12 threaded sleeve of pre-galvanized steel grade 16MnCrS5 according to EN 10277-4 with HBW values 156 - 207
Corrosion protection according to Eurocode 5-1-1 (>5mm zinc coating)





KNAPP® Clip Connector WALCO® 60 VS base plate

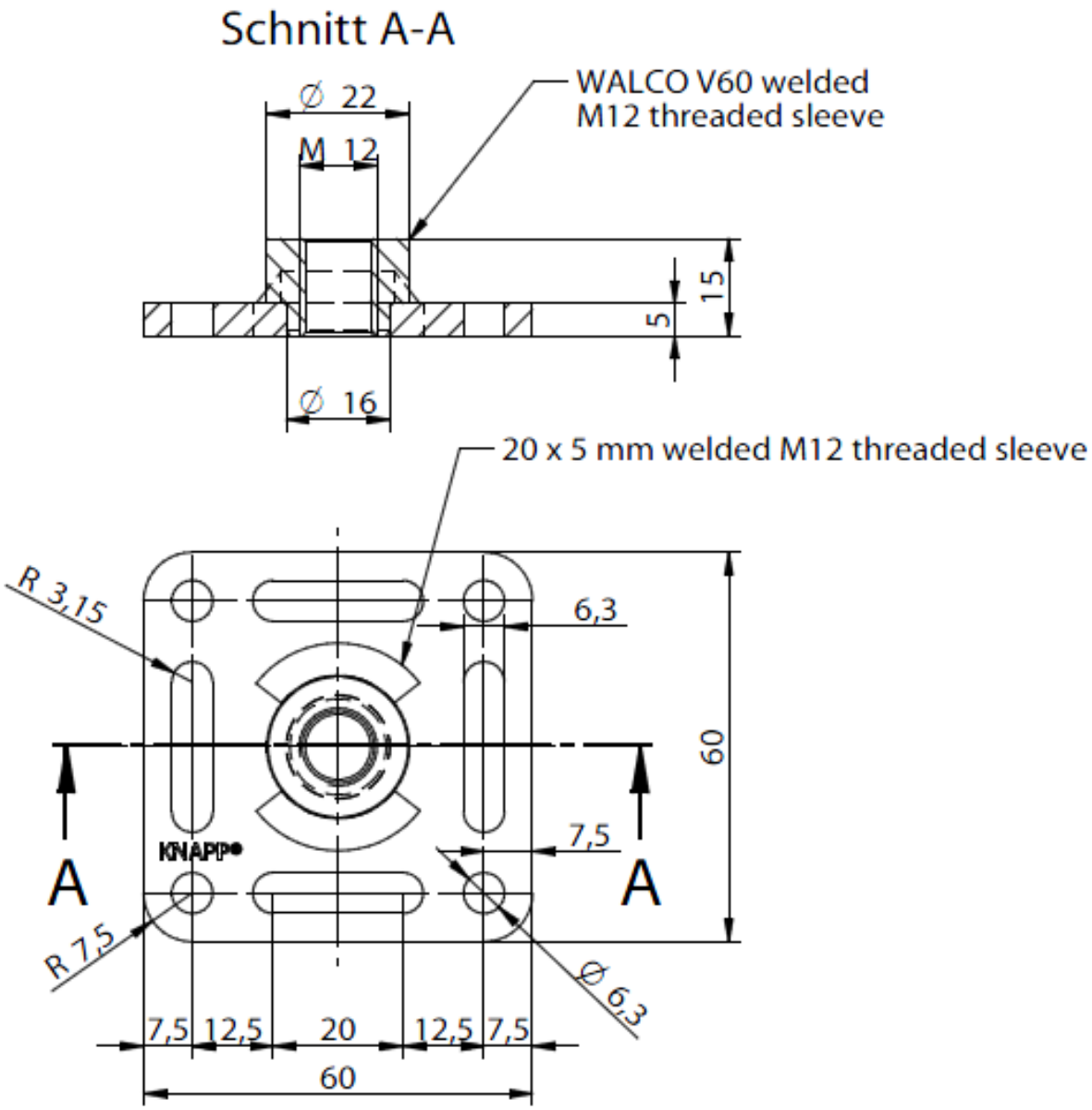
5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength Re of 235 MPa; Corrosion protection according to Eurocode 5-1-1



KNAPP® Clip Connector WALCO® 60 M12 welded

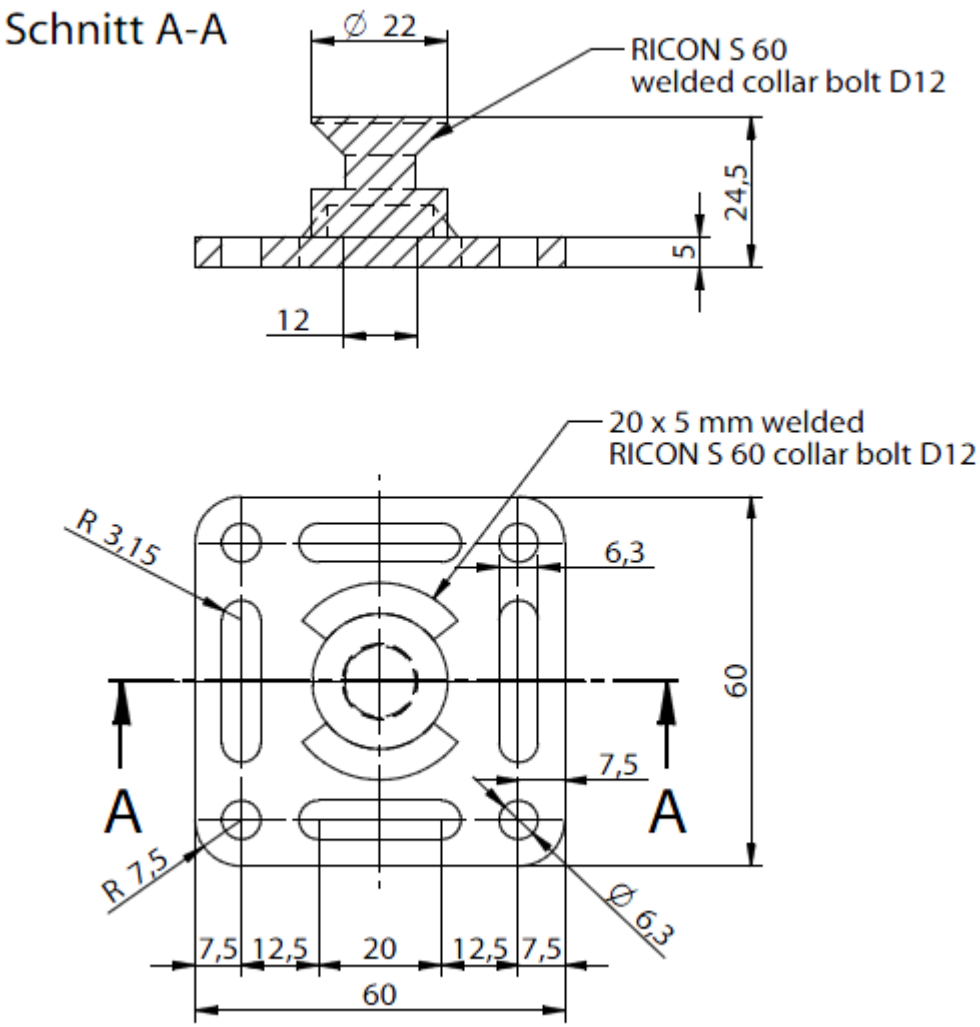
5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength Re of 235 MPa;

M12 threaded sleeve of pre-galvanized steel grade 16MnCrS5 according to EN 10277-4 with HBW values 156 - 20
Corrosion protection according to Eurocode 5-1-1



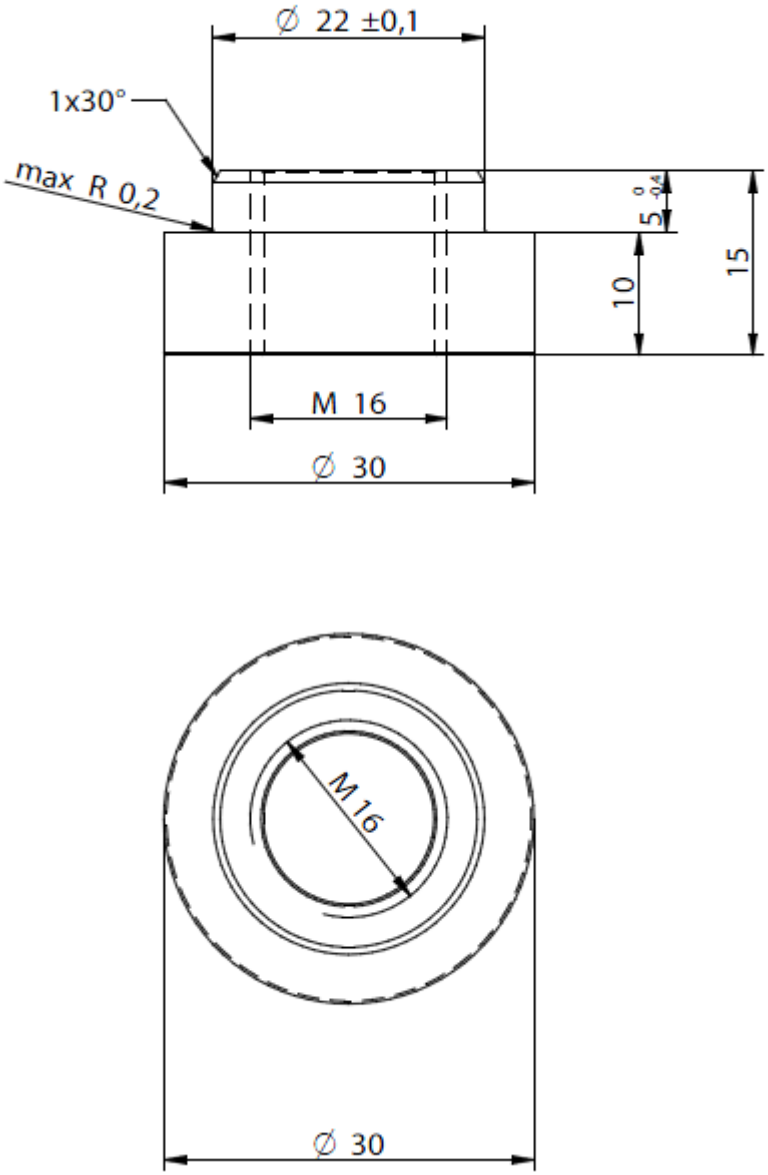
KNAPP® Clip Connector WALCO® 60 VS

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength Re of 235 MPa;
Collar bolt of steel grade 16 MnCr5 according to EN 10084 with HBW values 156-207
Corrosion protection according to Eurocode 5-1-1



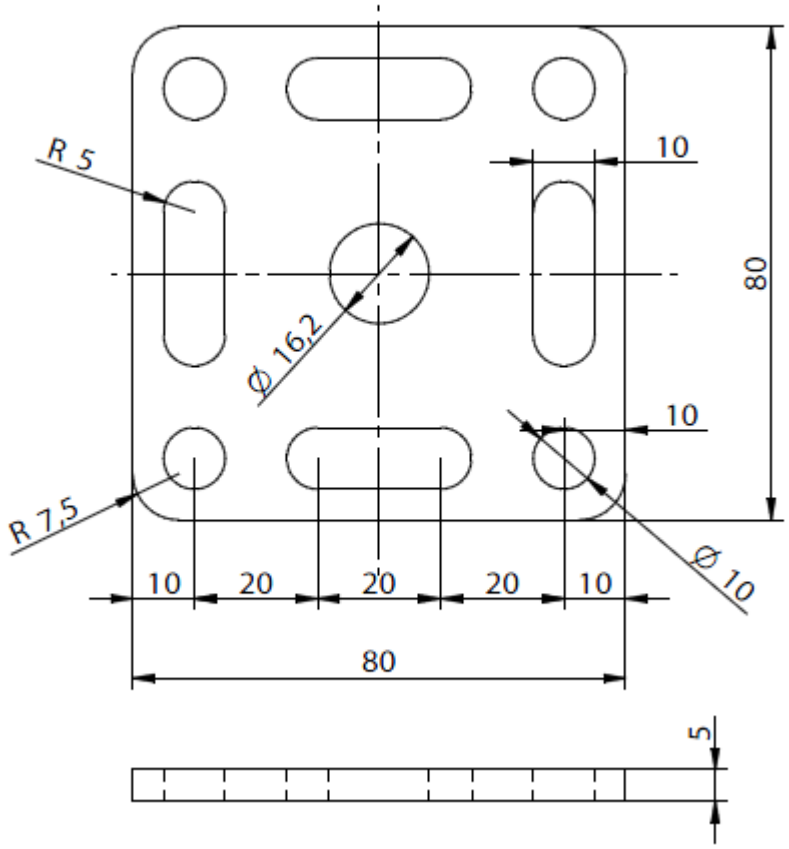
KNAPP® WALCO® V threaded sleeve for WALCO 80 base plate

M16 threaded sleeve of pre-galvanized steel grade 16MnCrS5 according to EN 10277-4 with HBW values 156 - 207
Corrosion protection according to Eurocode 5-1-1 (>5mm zinc coating)



KNAPP® Clip Connector WALCO® 80 VS base plate

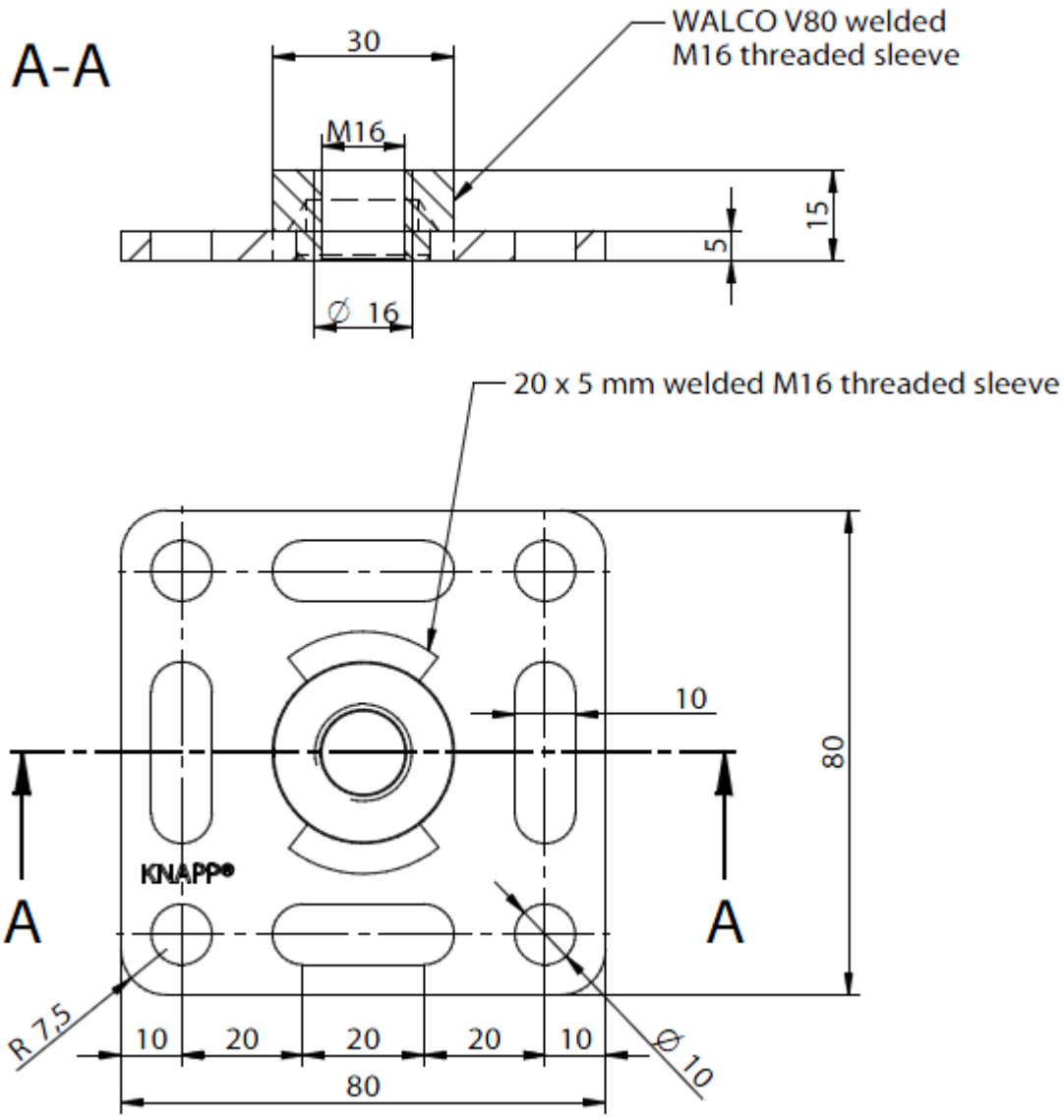
5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength Re of 235 MPa; Corrosion protection according to Eurocode 5-1-1



KNAPP® Clip Connector WALCO® 80 M16 welded

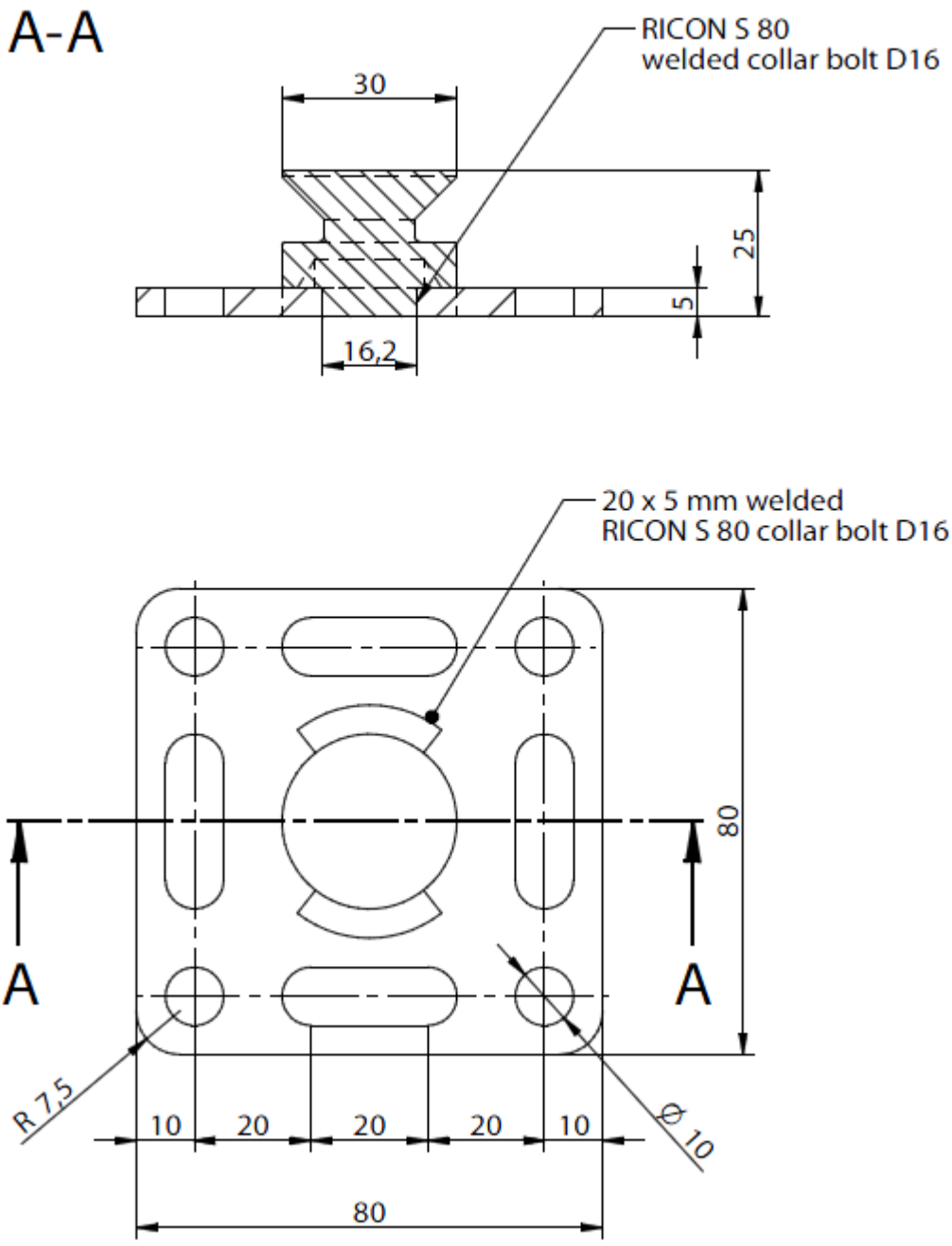
5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength Re of 235 MPa;

M12 threaded sleeve of pre-galvanized steel grade 16MnCrS5 according to EN 10277-4 with HBW values 156 - 20
Corrosion protection according to Eurocode 5-1-1



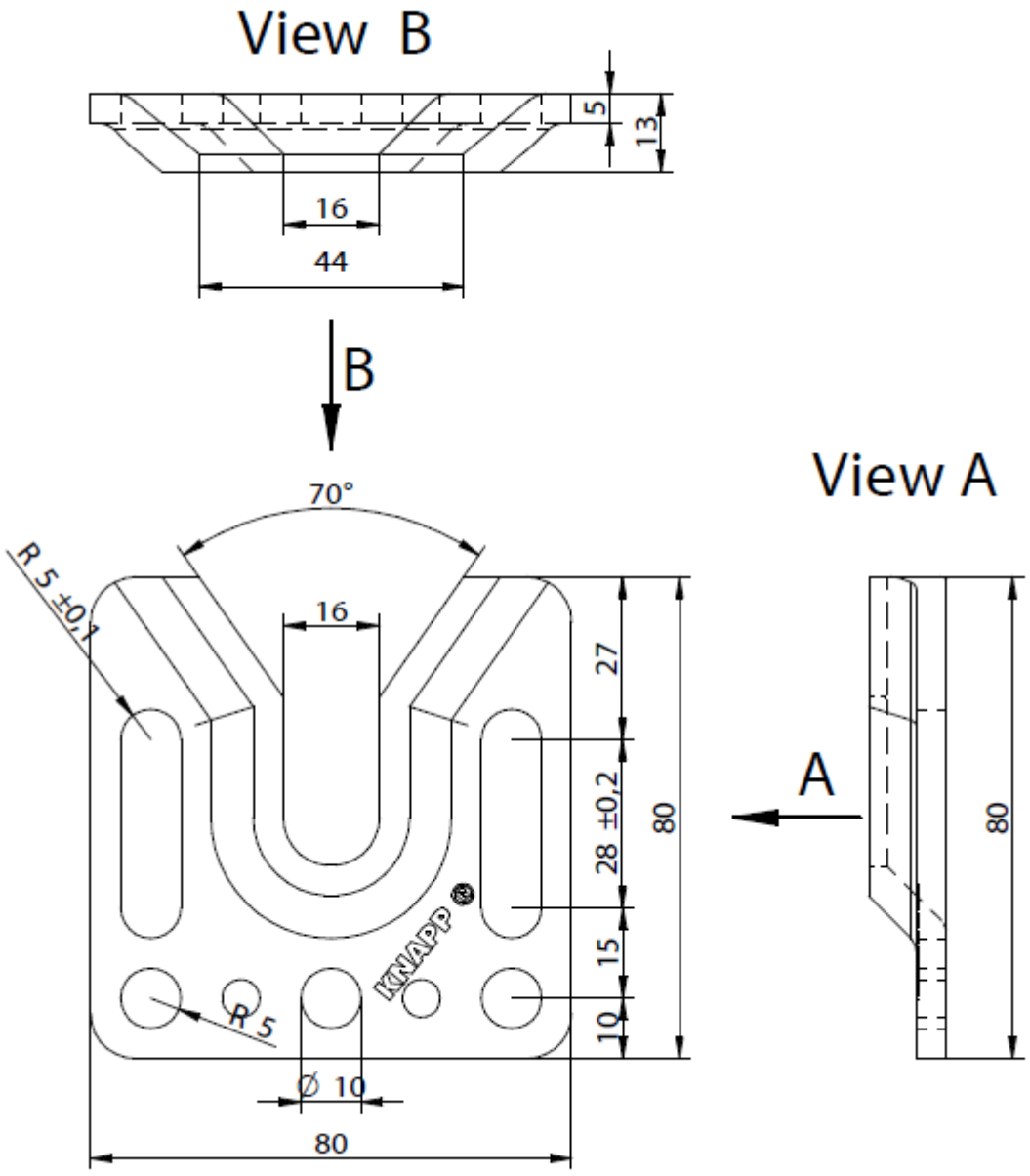
KNAPP® Clip Connector WALCO® 80 VS

5.0 mm thick steel grade DD13 according to EN 10111:2008-06 with minimum yield strength Re of 235 MPa;
Collar bolt of steel grade 16 MnCr5 according to EN 10084 with HBW values 156-207
Corrosion protection according to Eurocode 5-1-1



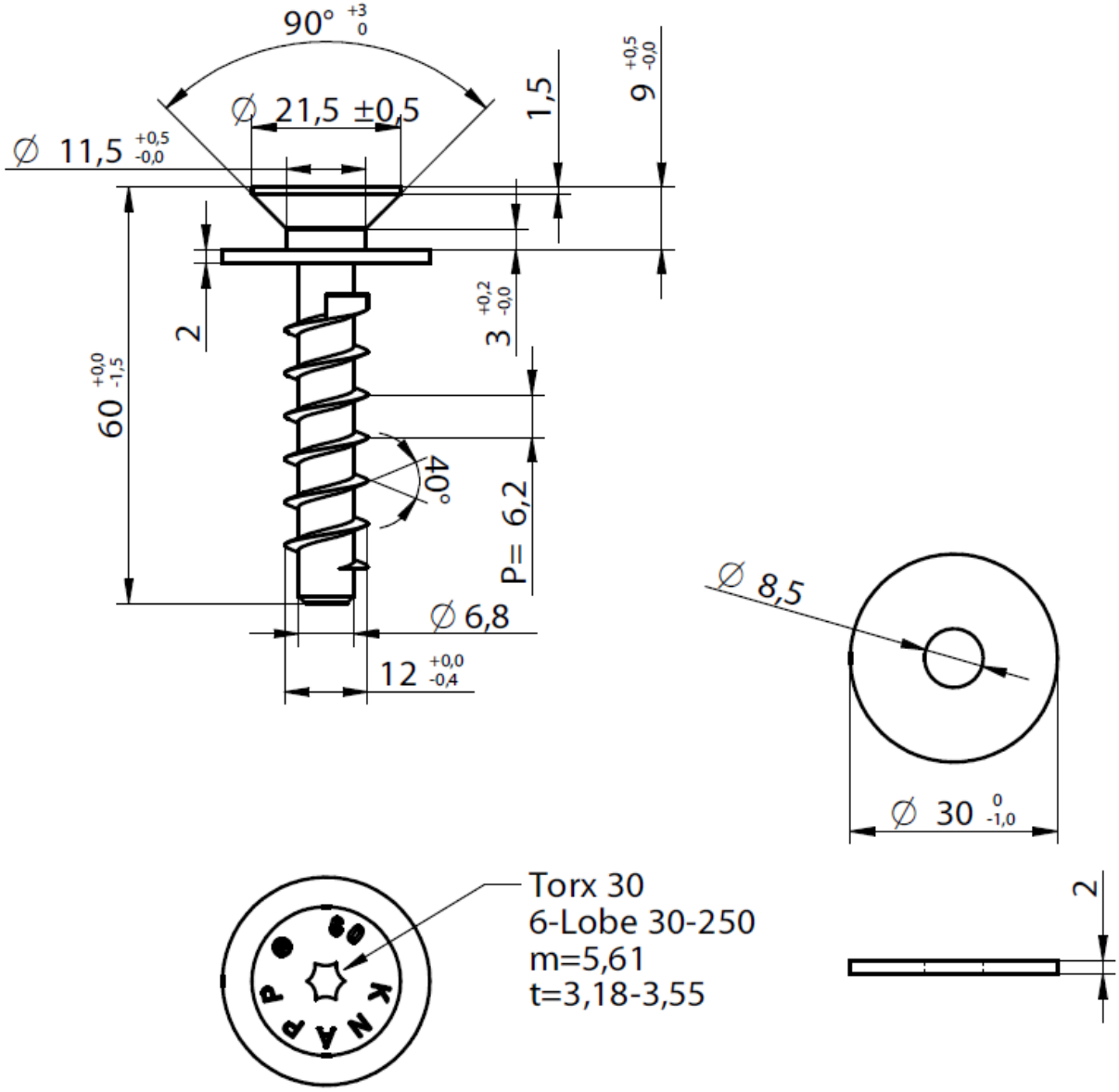
WALCO® V 80 oblong hole base plate

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



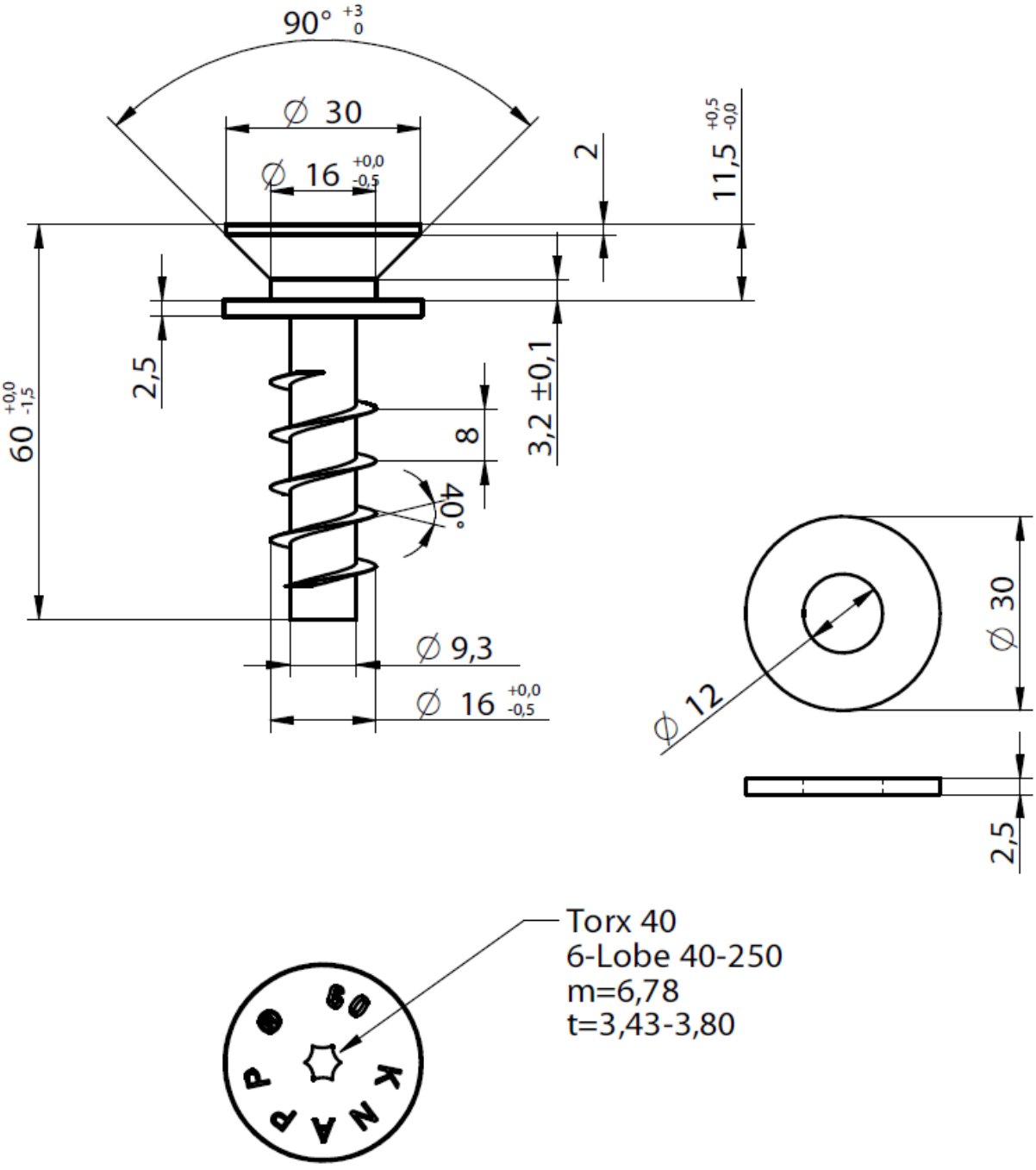
KNAPP® Clip Connector WALCO® V collar screw KS 12x60

Screws according to EN 14592 with tensile capacity $R_{t,u,k}$ of 29 kN; corrosion protection according to Eurocode 5;



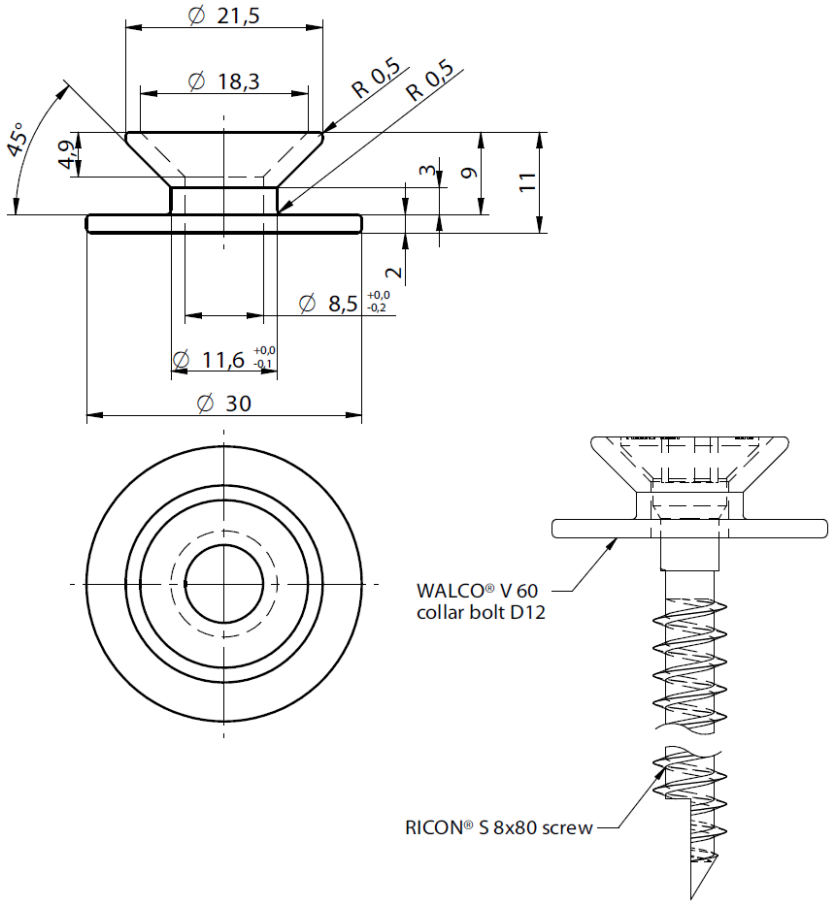
KNAPP® Clip Connector WALCO® V collar screw KS 16x60

Screws according to EN 14592 with tensile capacity $R_{t,u,k}$ of 48 kN; corrosion protection according to Eurocode 5 (≥ 5 µm zinc coating);



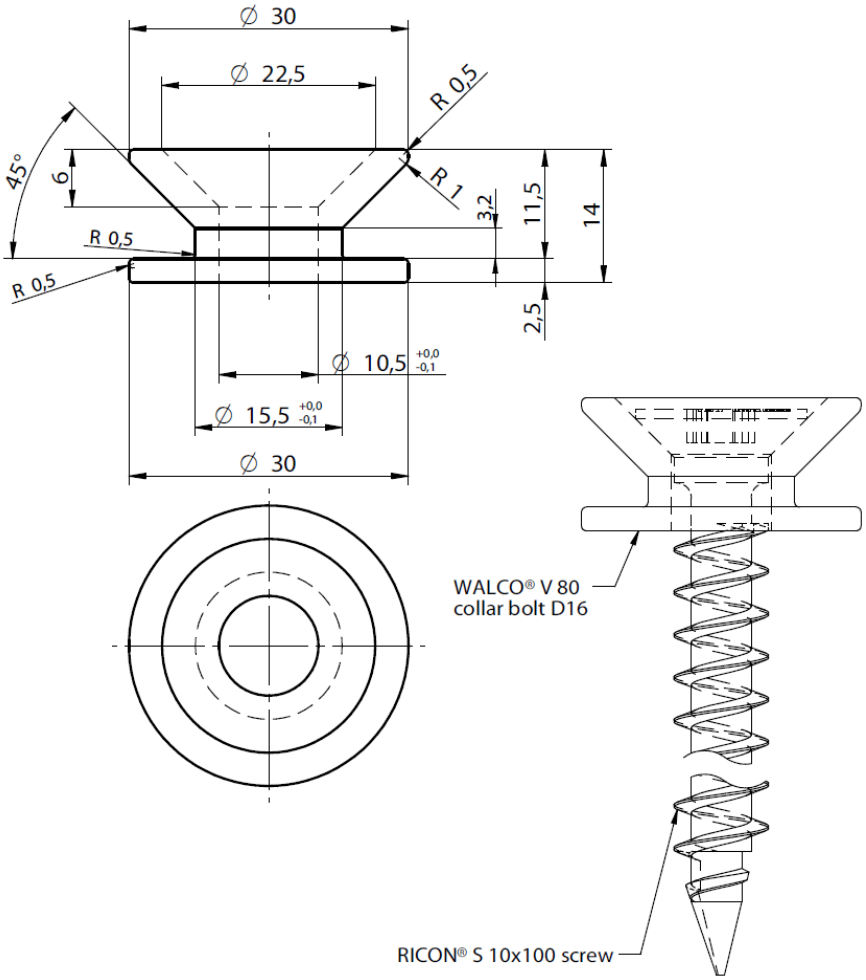
KNAPP® WALCO® V 60 collar bolt D12

Collar bolt of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A80 of 7%; corrosion protection according to Eurocode 5-1-1



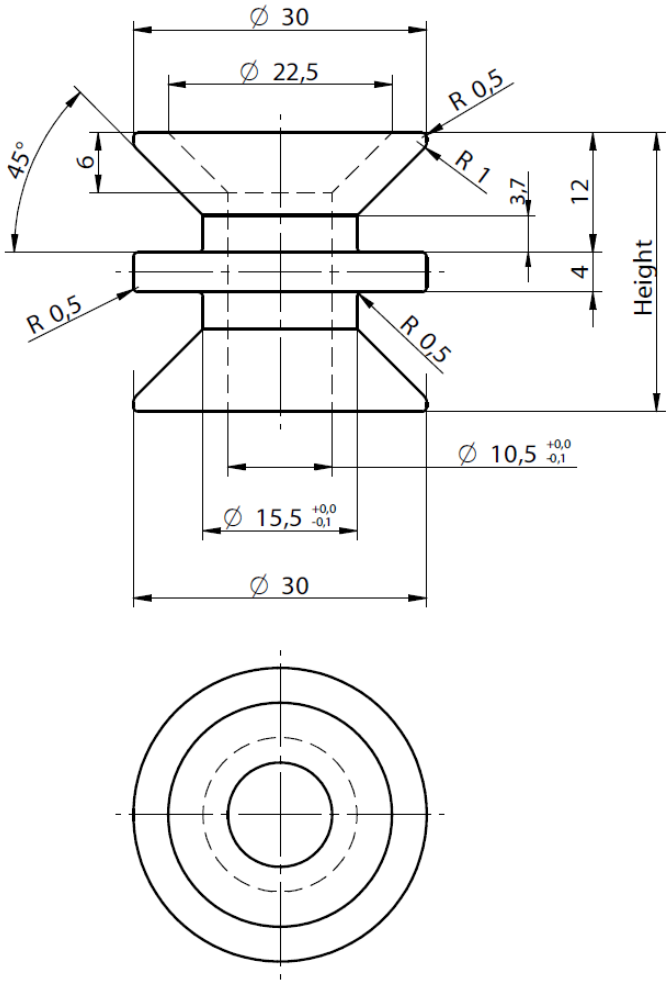
KNAPP® WALCO® V 80 collar bolt D16

Collar bolt of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%; Corrosion protection according to Eurocode 5-1-1 (≥ 5 µm zinc coating)



KNAPP® WALCO® V 80 double collar bolt D16 *)

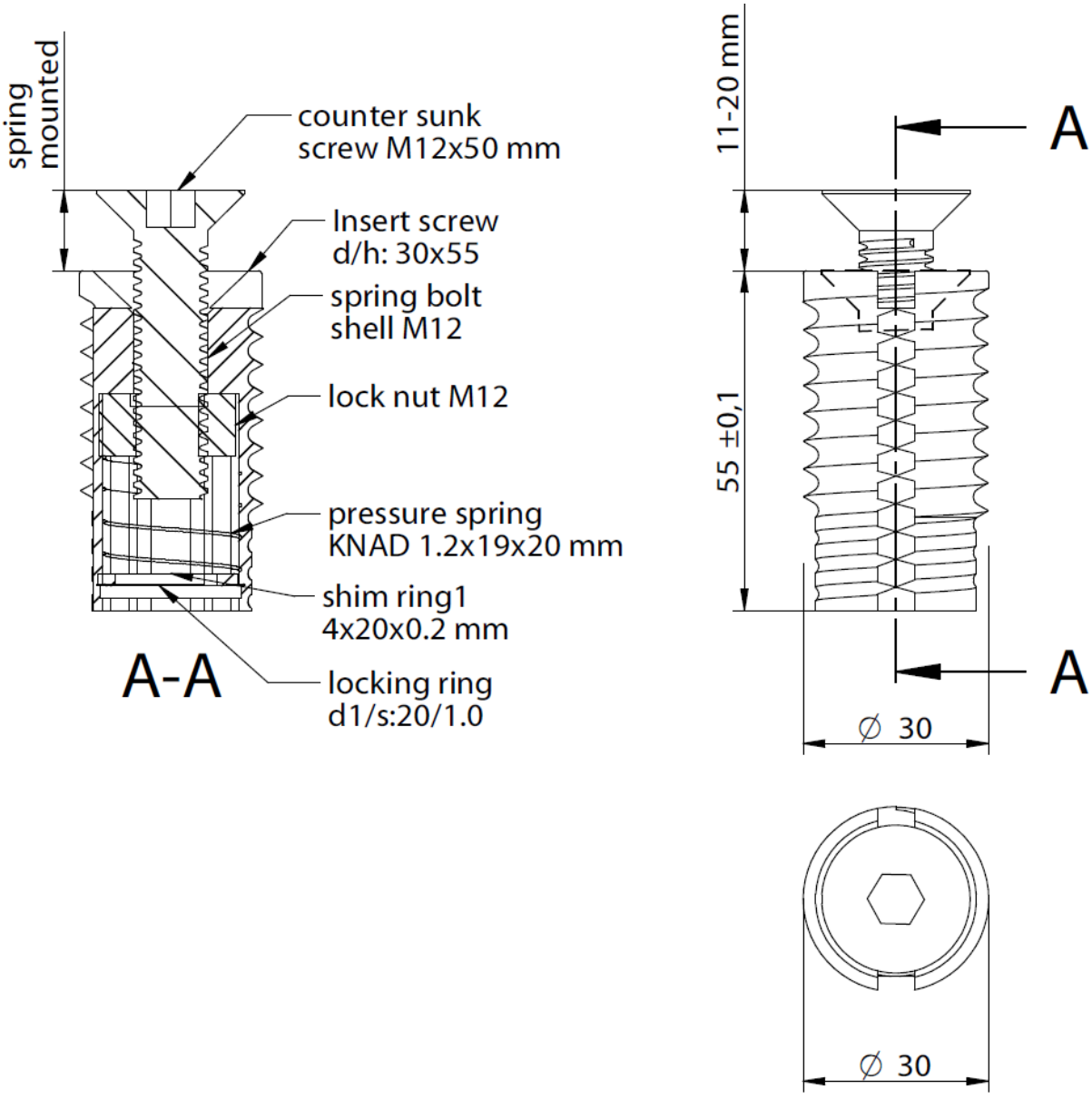
Collar bolt of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength R_m of 760 and minimum ultimate strain A_{80} of 7%; Corrosion protection according to Eurocode 5-1-1



*) KNAPP® WALCO® V60 double collar bolt D12 is in principal similar as the given drawing

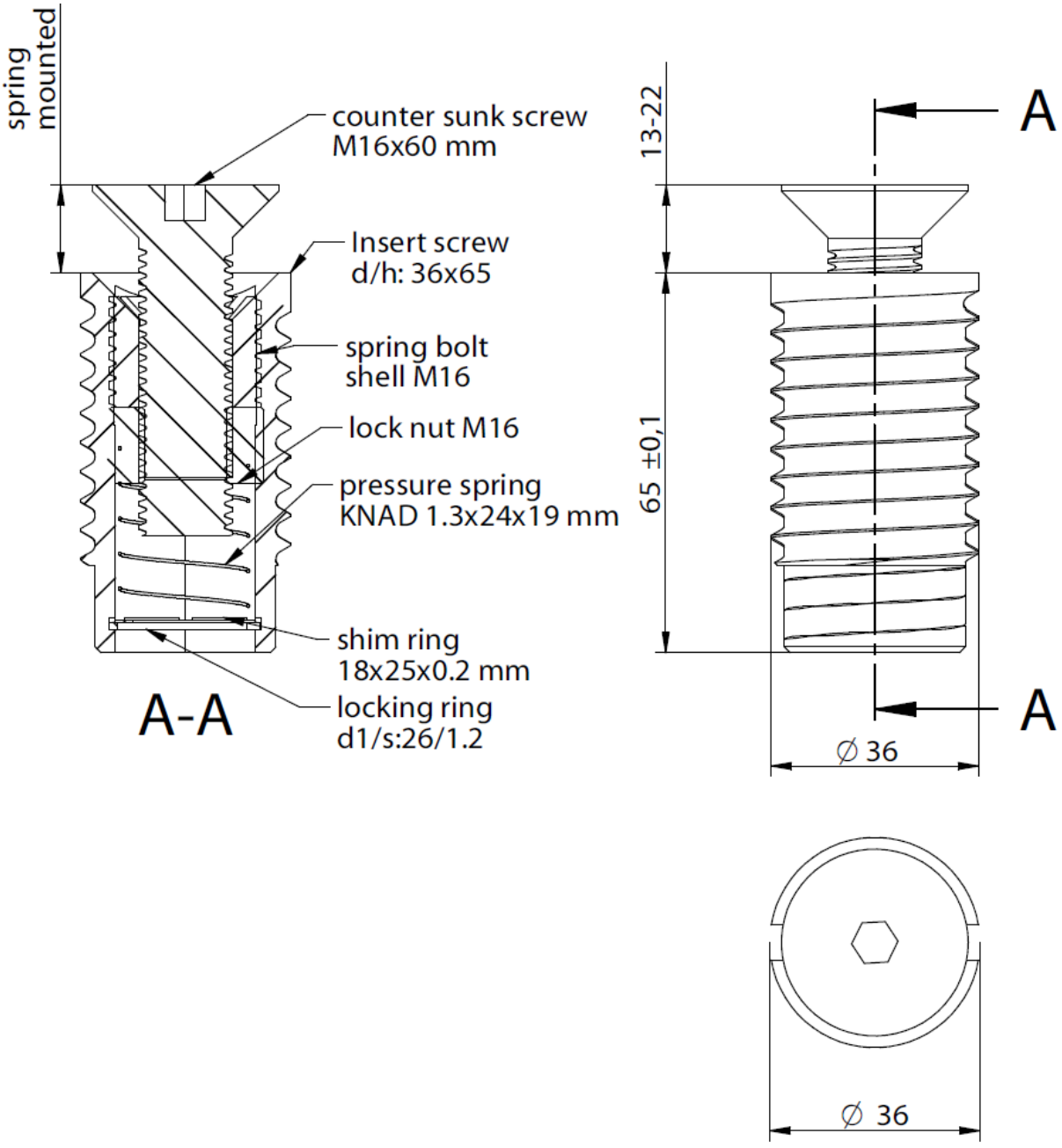
KNAPP® WALCO® V 60 spring retaining screw collar bolt M12

Collar bolt and locknut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength Rm of 760 and ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN ISO 898-1; pressure spring of unalloyed spring steel with specification SM according to EN 10270-1, tensile strength R_m of 1900 MPa, maximum tensile strength R_m of 2160 and ultimate strain A_{80} of 40%;



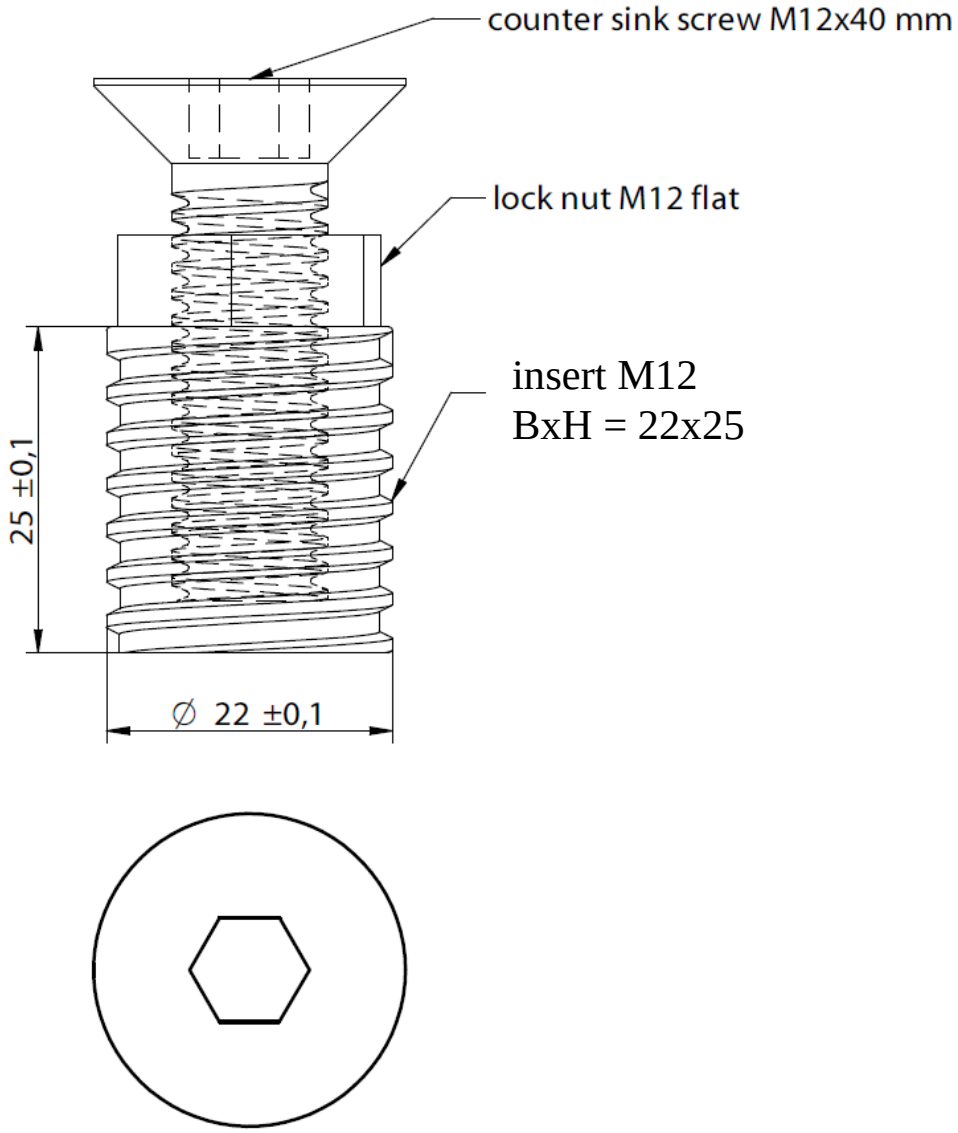
KNAPP® WALCO® V 80 spring retaining screw collar bolt M16

Collar bolt and locknut of pre-galvanized steel grade 11SMnPb30 according to EN 10277-3 with yield strength R_{eH} of 410 MPa, tensile strength R_m of 490 MPa, maximum tensile strength Rm of 760 and ultimate strain A_{80} of 7%; counter sink screw of pre-galvanized steel grade 8.8 according to EN ISO 898-1; pressure spring of unalloyed spring steel with specification SM according to EN 10270-1, tensile strength R_m of 1900 MPa, maximum tensile strength R_m of 2160 and minimum ultimate strain A_{80} of 40%;



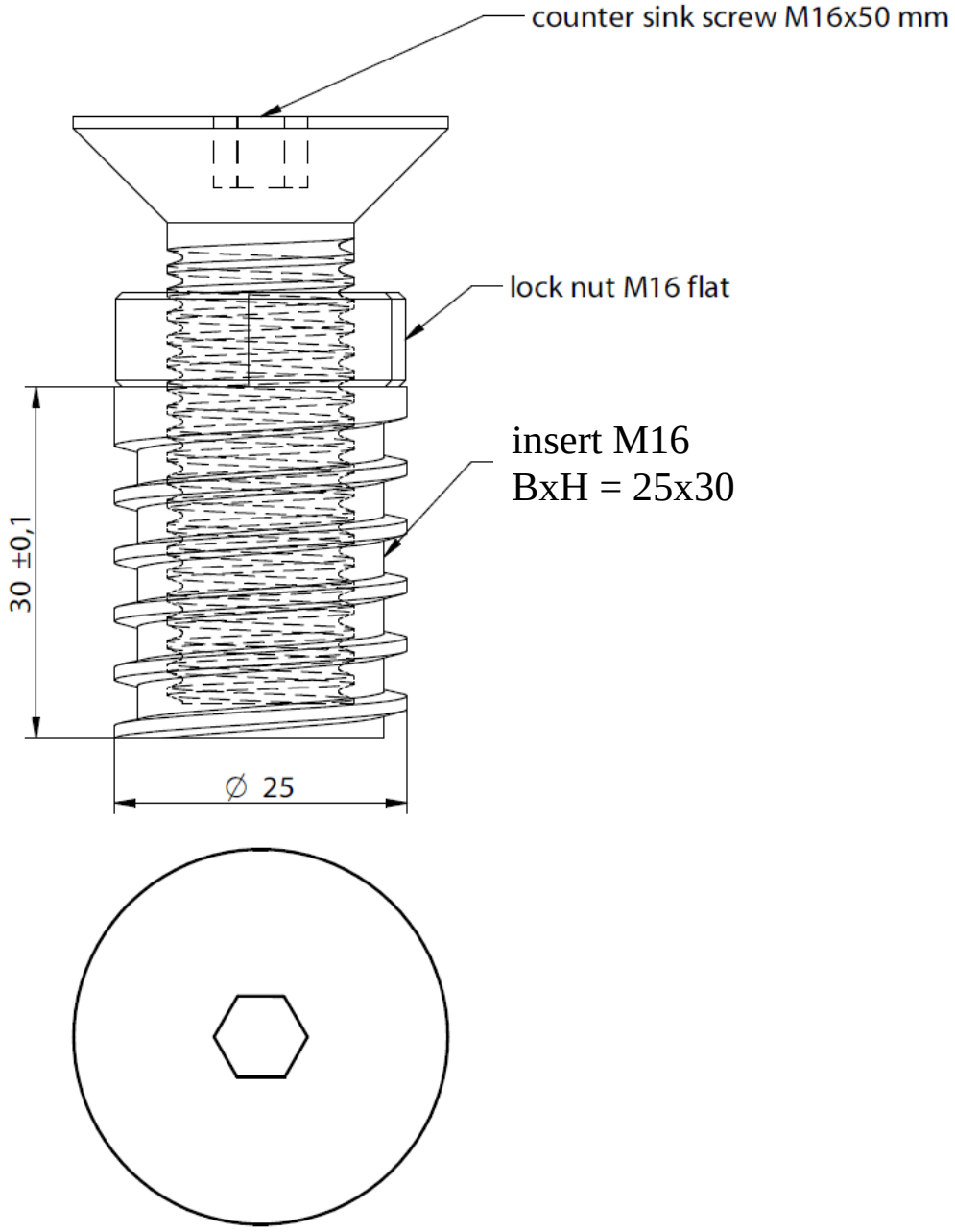
KNAPP® WALCO® V 60 retaining screw collar bolt M12

Retaining screw bolt, lock nut and insert of pre-galvanized steel grade according to EN ISO 898-1; counter sink screw and lock nut of pre-galvanized steel grade 8.8 according to EN ISO 898-1;
Corrosion protection according to Eurocode 5-1-1



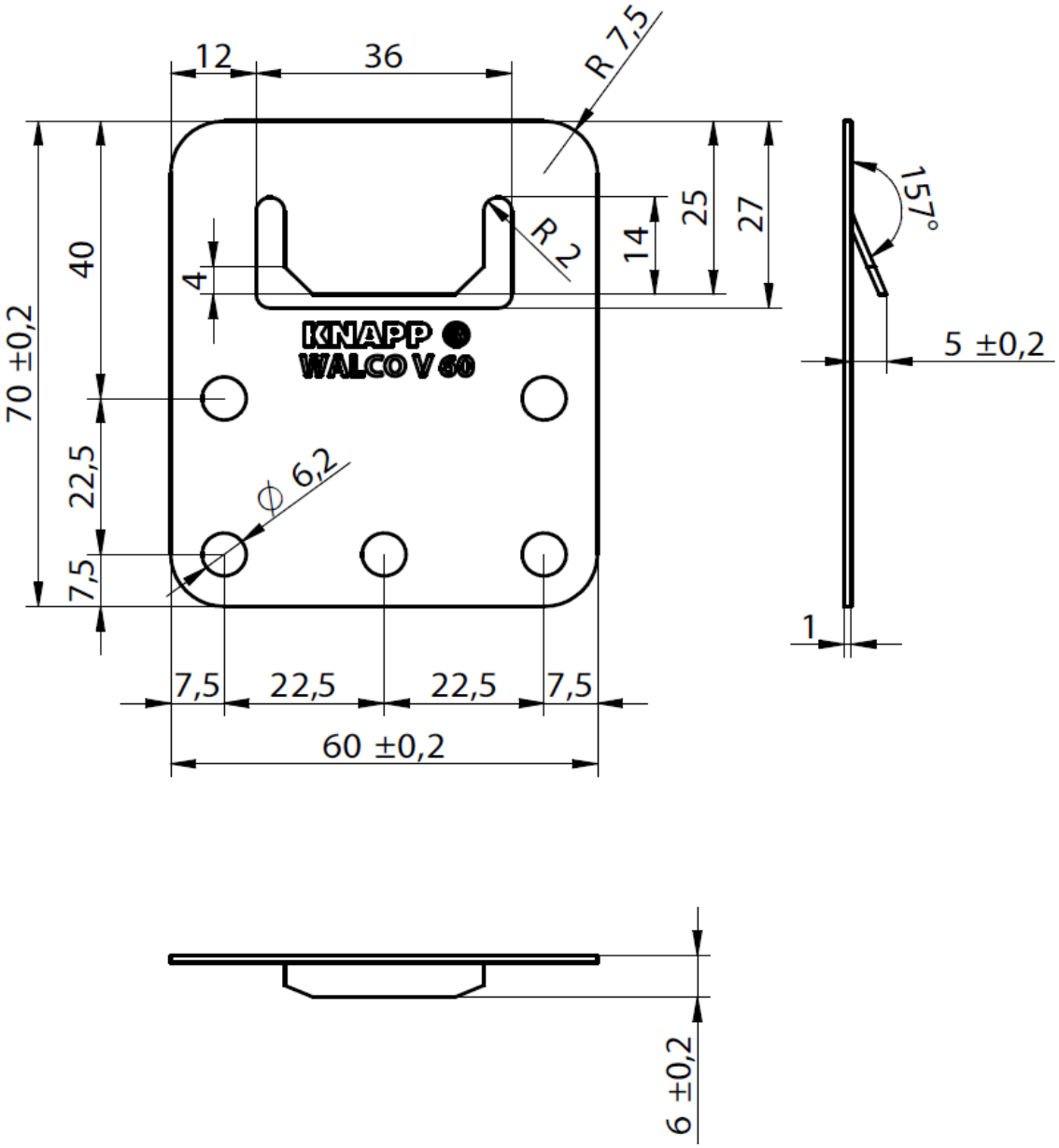
KNAPP® WALCO® V 80 retaining screw collar bolt M16

Retaining screw bolt, lock nut and insert of pre-galvanized steel grade according to EN ISO 898-2; counter sink screw and lock nut of pre-galvanized steel grade 8.8 according to EN ISO 898-1;
Corrosion protection according to Eurocode 5-1-1



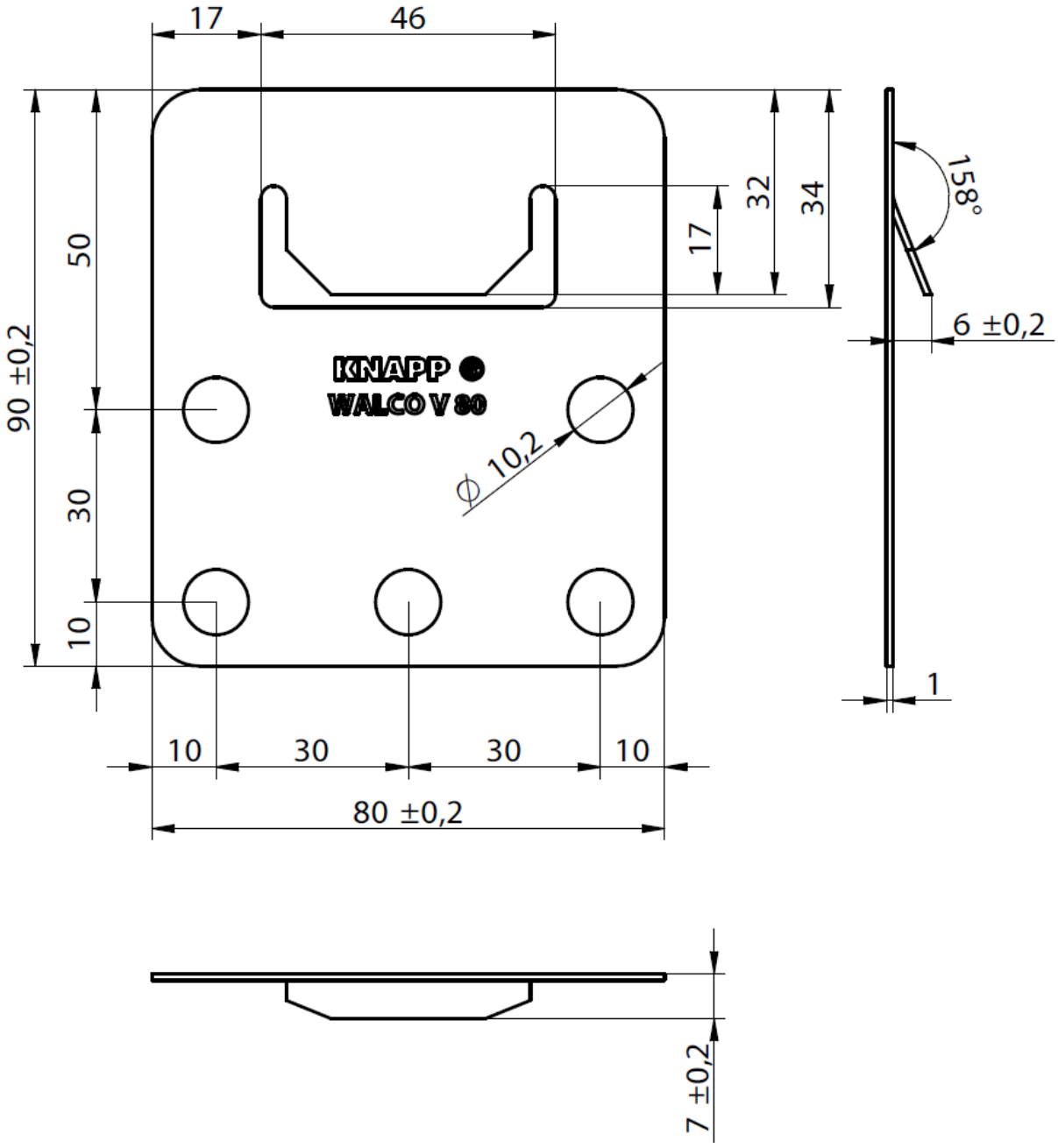
KNAPP® WALCO® V 60 clip lock

1.0 mm thick stainless steel grade X5CrNi18-10 material number 1.4301 according to EN 10151 with tensile strength R_m of 1100 MPa)



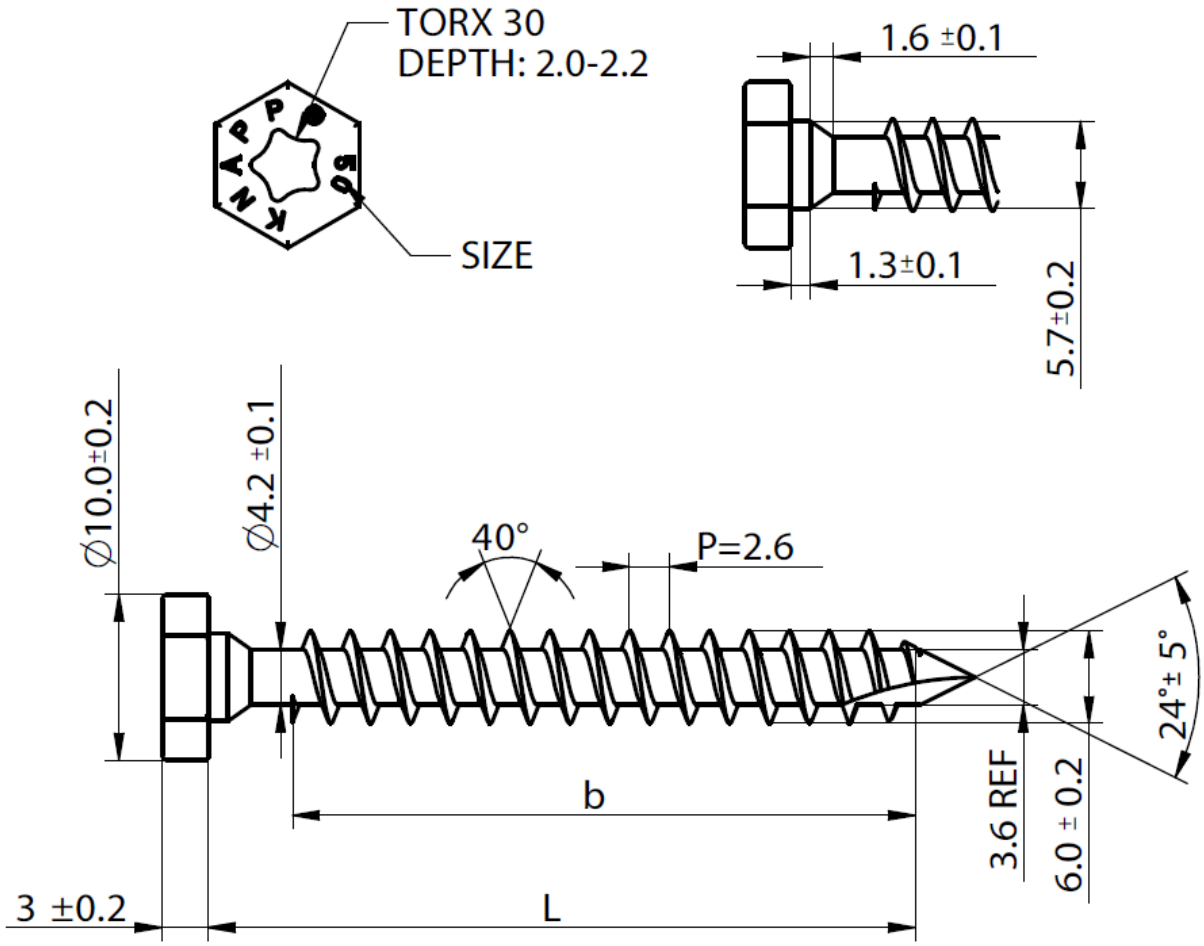
KNAPP® WALCO® V 80 clip lock

1.0 mm thick stainless steel grade X5CrNi18-10 material number 1.4301 according to EN 10151 with tensile strength R_m of 1100 MPa)



KNAPP® WALCO® V PH screw 6x50, 6x80

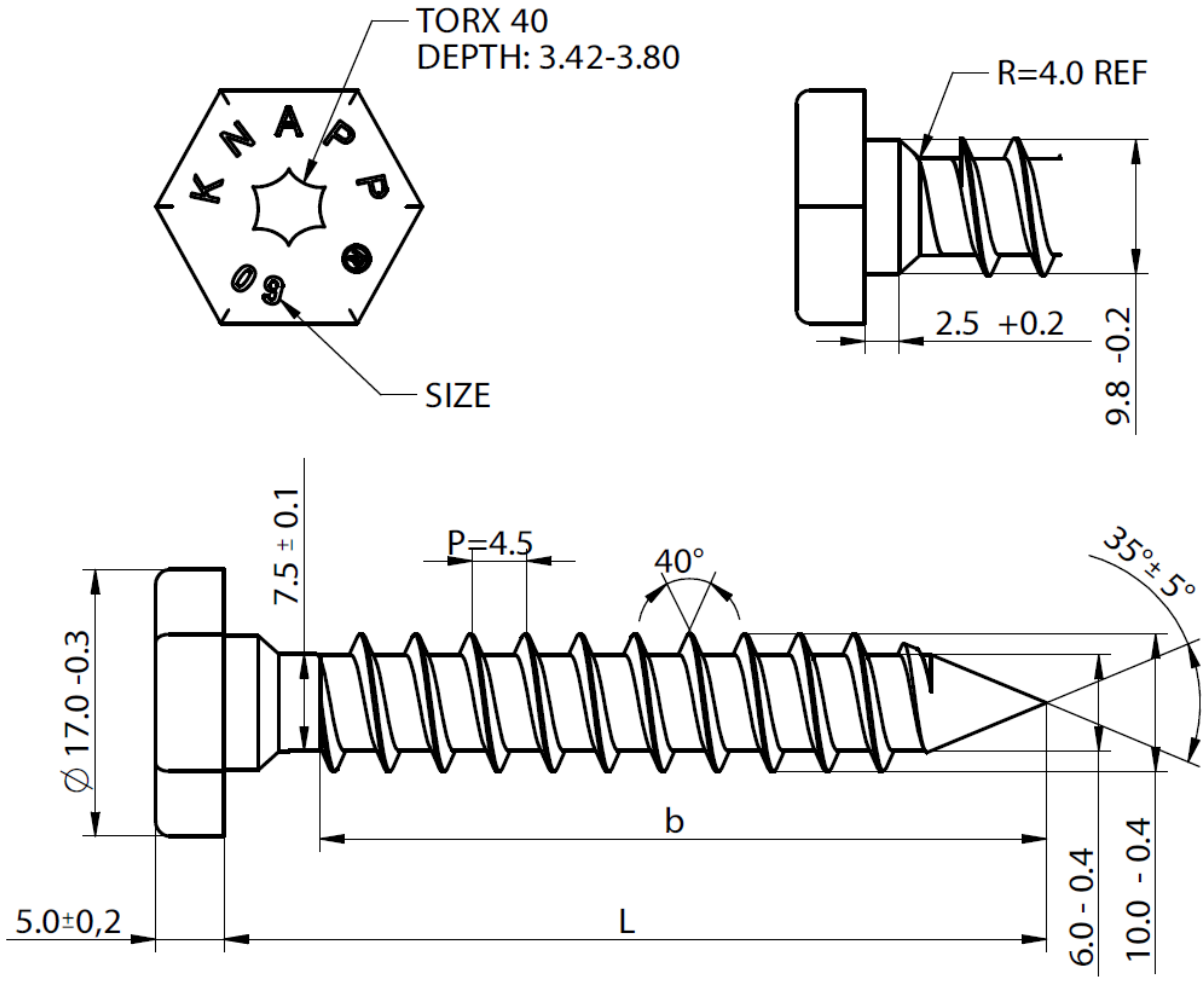
Screws according to EN 14592 manufactured of carbon steel, tension $f_{tens,k}$ of 10,5 kN and torque $M_{t,u,k}$ of 10,5 Nm; corrosion protection according to Eurocode 5-1-1;



L	50 – 1,5	80 – 3,0
b	45 -1,0	76 -1,0

KNAPP® WALCO® V PH screw 10x50, 10x60, 10x100

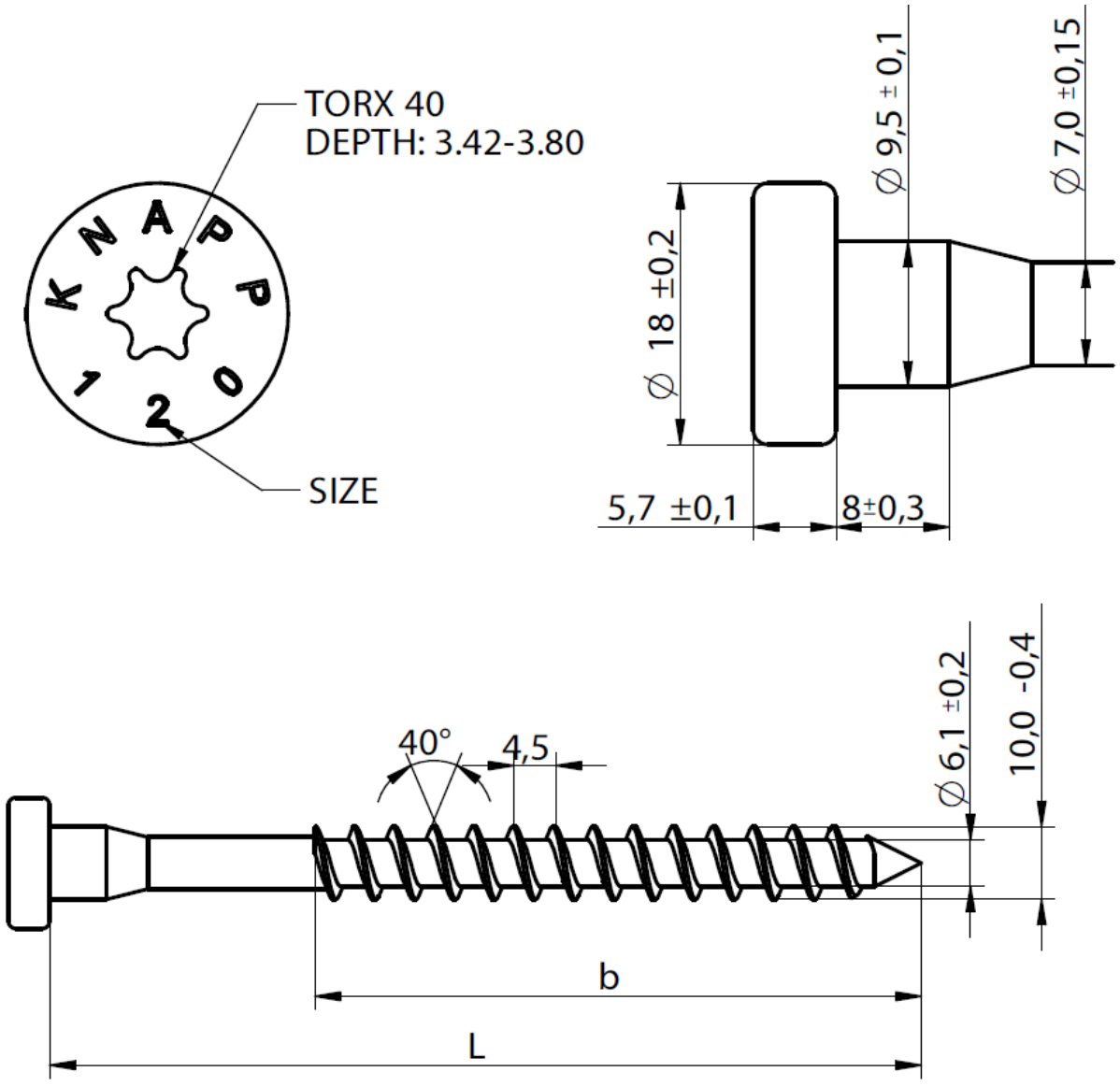
Screws according to EN 14592 manufactured of carbon steel, tension $f_{tens,k}$ of 24 kN and torque $M_{t,u,k}$ of 40 Nm; corrosion protection according to Eurocode 5-1-1;



L	50 – 1,5	60 – 1,5	100 – 3,5
b	40 ±1,0	50 ±1,0	90 ±1,0

KNAPP® WALCO® V PH screw 10x80, 10x120

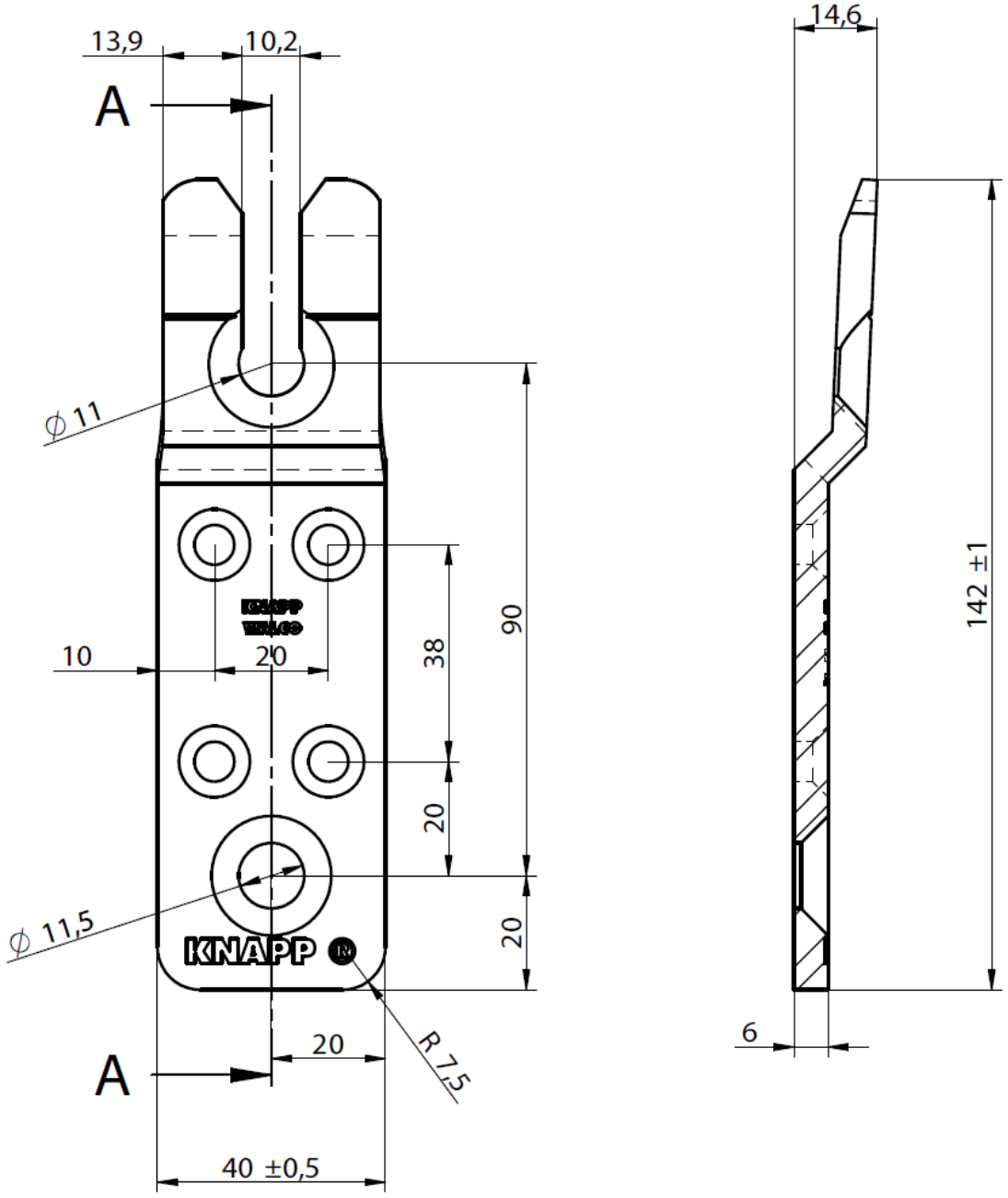
Screws according to EN 14592 manufactured of carbon steel, tension $f_{tens,k}$ of 24 kN and torque $M_{t,u,k}$ of 40 Nm; corrosion protection according to Eurocode 5-1-1;



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

KNAPP® Clip Connector WALCO® 40

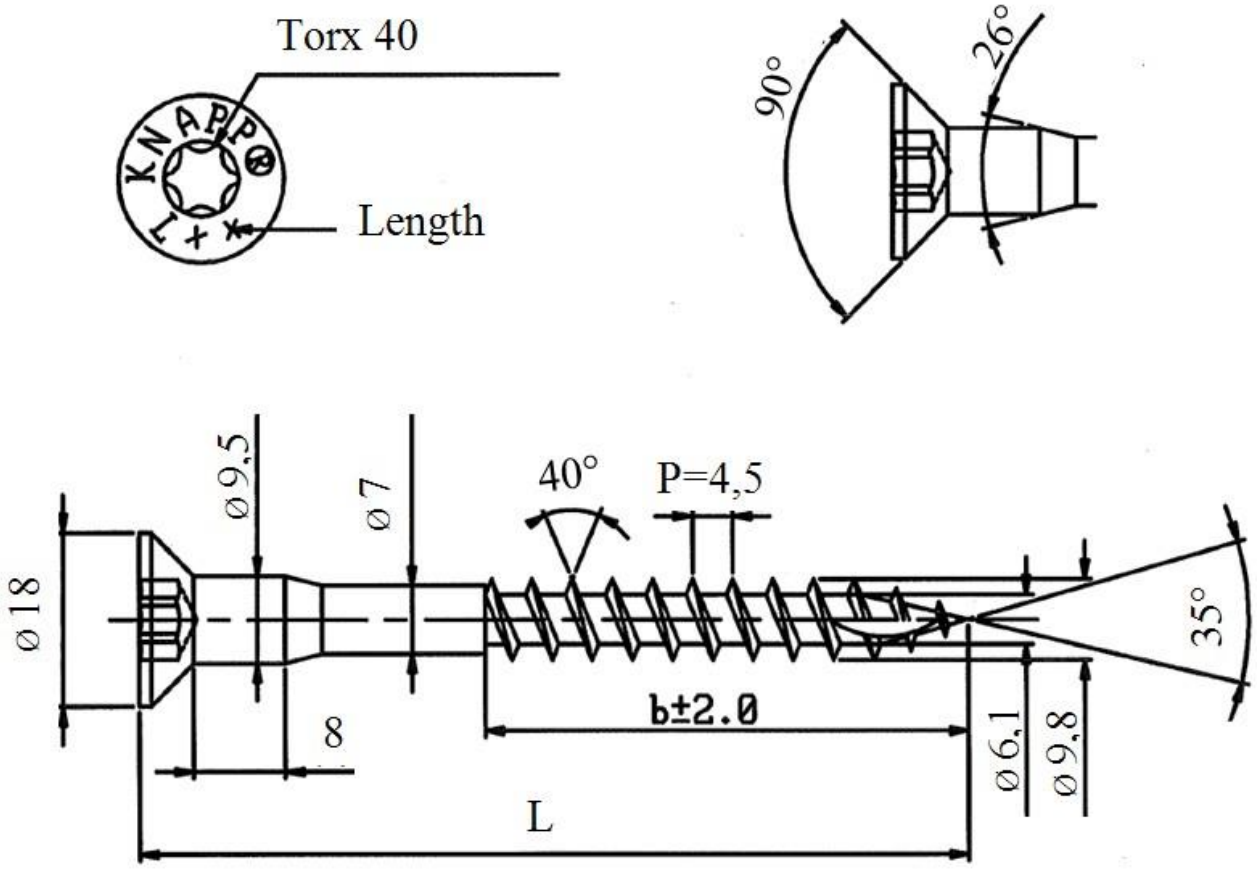
6.0 mm thick steel, grade DD13 according to EN 10111, with yield strength R_e of 235 MPa.
Pre-galvanized steel plate with coating Zn5C



dimensions in mm

KNAPP® WALCO 40 screw SK 10x60, SK10x80, SK 10x120

Screws according to EN 14592 manufactured of carbon steel, tension $f_{tens,k}$ of 30 kN, torque $M_{t,u,k}$ of 30Nm and corrosion protection according to Eurocode 5



L	b
60 -1,5	42
80 -1,5	54
120 -1,75	84

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:

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

Force F_1 for Knapp Clip Connectors WALCO V:

WALCO V with collar screw: $F_{1,Rd} = \min\left\{2 \cdot F_{ax,Rd}; 2 \cdot F_{t,Rd}; F_{ax,CS,Rd}; F_{1,KCC,Rd}\right\}$ (B.1.2a)

WALCO 40: $F_{1,Rd} = F_{1,KCC,Rd}$ (for k_{mod} = 0,9 and C24; see Table C.1) (B.1.2b)

WALCO V with base plate: $F_{1,Rd} = \min\left\{n_{ef} \cdot F_{ax,Rd}; n_{ef} \cdot F_{t,Rd}; F_{1,KCC,Rd}\right\}$ (B.1.2c)

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

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

$$F_{v,J,Rd} = \frac{k_{mod}}{\gamma_M} \cdot \min\left\{\begin{array}{l} f_{h,J,k} \cdot l_{ef,J} \cdot d \\ 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,J,k} \cdot d} + \frac{F_{ax,J,Rk}}{4} \\ f_{h,J,k} \cdot l_{ef,J} \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,J,k} \cdot d \cdot l_{ef,J}^2}} - 1\right] + \frac{F_{ax,J,Rk}}{4} \end{array}\right. \quad \text{(B1.3.1)}$$

$F_{ax,J,Rk}$ … tensile capacity of screw in the end grain of the joist:

$$F_{ax,J,Rk} = k_{ax} \cdot 0{,}52 \cdot \sqrt{d} \cdot \ell_{ef}^{0,9} \cdot \rho_k^{0,8} \quad \text{(B.1.3.1a)}$$

$k_{ax} = 1$ for $45° \le \alpha \le 90°$;

$k_{ax} = 0{,}3 + \frac{0{,}7 \cdot \alpha}{45°}$ for $0° \le \alpha \le 45°$;

$$F_{v,H,Rd} = \frac{k_{mod}}{\gamma_M} \cdot \min\left\{\begin{array}{l} f_{h,H,k} \cdot l_{ef,H} \cdot d \\ 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,H,k} \cdot d} + \frac{F_{ax,H,Rk}}{4} \\ f_{h,H,k} \cdot l_{ef,H} \cdot d \cdot \left[\sqrt{2 + \frac{4 \cdot M_{y,Rk}}{f_{h,H,k} \cdot d \cdot l_{ef,H}^2}} - 1\right] + \frac{F_{ax,H,Rk}}{4} \end{array}\right. \quad \text{(B1.3.2)}$$

$F_{ax,J,Rk}$ … tensile capacity of screw in the side grain of the header:

$$F_{ax,H,Rk} = k_{ax} \cdot 0{,}52 \cdot \sqrt{d} \cdot \ell_{ef}^{0,9} \cdot \rho_k^{0,8} \qquad \textbf{(B.1.3.2a)}$$

$k_{ax} = 1$ for $45° \le \alpha \le 90°$;

$$k_{ax} = 0{,}3 + \frac{0{,}7 \cdot \alpha}{45°} \text{ for } 0° \le \alpha \le 45°;$$

Only for Knapp Clip Connectors RICON S 390x80 VS + ZP, two additional inclined screws per connector plate may be used for load direction F_2. In this case, the load-carrying capacity of the inclined screws $F_{2,IS,Rd}$ may be added to $\sum_{i=1}^{n} F_{v,J,Rd}^{i}$ or to $\frac{1}{\sqrt{\left(\frac{1}{\sum_{i=1}^{n} F_{v,H,Rd}^{i}}\right)^2 + \left(\frac{1}{k_{H,2} \cdot F_{ax,H,Rd}}\right)^2}}$, respectively, but not to $F_{2,KCC,Rd}$.

$$F_{2,IS,Rd} = \frac{k_{mod} \cdot 40{,}0 \text{ kN}}{\gamma_M} \qquad \text{(B.1.3.3)}$$

Load capacity $F_{23,Rd}$ for RICON S connections depending on the number of screws.

Knapp Clip Connector	Max. number of screws n_{max}
RICON S 140x60	10
RICON S 170x60	13
RICON S 200x60	16
RICON S 230x60	19
RICON S 200x80	16
RICON S 230x80	19
RICON S 260x80	22
RICON S 290x80	25
RICON S 390x80	28+4

Force F_2 or F_3 for Knapp Clip Connectors WALCO V with collar screw:

$$F_{2,Rd} = \min\left\{F_{v,CS,Rd}; n \cdot F_{v,Rd}; F_{23,KCC,Rd}\right\} \qquad \text{(B.1.4a)}$$

Force F_2 or F_3 for Knapp Clip Connectors WALCO 40:

$F_{2,Rd} = F_{2,KCC,Rd}$ (for k_{mod} = 0,9 and C24; see Table C.1) (B.1.4b)

Force F_{23} for Knapp Clip Connectors WALCO V with base plate:

$$F_{23,Rd} = \min\left\{ \frac{1}{\sqrt{\left(\frac{1}{\sum_{i=1}^{n} F_{v,V,Rd}^{i}}\right)^2 + \left(\frac{e \cdot z_{max}}{I_{p,V,ax} \cdot F_{ax,V,Rd}}\right)^2}} ; \frac{1}{\sqrt{\left(\frac{1}{\sum_{i=1}^{n} F_{v,BP,Rd}^{i}}\right)^2 + \left(\frac{e \cdot z_{max}}{I_{p,BP,ax} \cdot F_{ax,BP,Rd}}\right)^2}} ; F_{23,KCC,Rd} \right\} \quad \text{(B.1.4c)}$$

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

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

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 $F_{45,Rd}$.

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

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

WALCO V with collar screw: $F_{45,Rd} = \min\left\{F_{v,CS,Rd}; 2 \cdot F_{v,Rd}; F_{45,KCC,Rd}\right\}$ (B.1.7a)

WALCO 40: $F_{45,Rd} = F_{45,KCC,Rd}$ (for k_{mod} = 0,9 and C24; see Table C.1) (B.1.7b)

WALCO V with base plate:

$$F_{45,Rd} = \min\left\{ \begin{array}{l} \dfrac{F_{v,V,Rd}}{\sqrt{\left(\frac{1}{n} + \frac{e_{45} \cdot x_{max}}{I_{p,v}}\right)^2 + \left(\frac{e_{45} \cdot y_{max}}{I_{p,v}}\right)^2 + \left(\frac{e \cdot y_{ax,max} \cdot F_{v,V,Rd}}{I_{p,ax} \cdot F_{ax,V,Rd}}\right)^2}} \\ \dfrac{F_{v,BP,Rd}}{\sqrt{\frac{1}{n^2} + \left(\frac{e \cdot y_{ax,max} \cdot F_{v,BP,Rd}}{I_{p,ax} \cdot F_{ax,BP,Rd}}\right)^2}} \\ F_{45,KCC,Rd} \end{array} \right. \quad \text{(B.1.7c)}$$

Where:

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

$$F_{ax,Rd} = \frac{k_{mod}}{\gamma_M} \cdot k_{ax} \cdot 0{,}52 \cdot \sqrt{d} \cdot \ell_{ef}^{0,9} \cdot \rho_k^{0,8} \qquad \text{(B.1.4)}$$

$$k_{ax} = 1 \text{ for } 45° \le \alpha \le 90°;$$

$$k_{ax} = 0{,}3 + \frac{0{,}7 \cdot \alpha}{45°} \text{ for } 0° \le \alpha \le 45°;$$

$F_{ax,CS,Rd}$ 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;

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, RICON and RICON S (VK);

$n_{ef} = \frac{2 \cdot a_c}{a_c - e_1}$ for Knapp Clip Connectors RICON S (GK, EK, VS);

$n_{ef} = 4$ for Knapp Clip Connectors WALCO V with base plate with 4 screws in corners;

$n_{ef} = 1{,}2$ for Knapp Clip Connectors WALCO V60 with base plate with 2 screws in long holes;

$n_{ef} = 1{,}4$ for Knapp Clip Connectors WALCO V80 with base plate with 2 screws in long holes;

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;

$2 \cdot e$ distance between the load F_2 or F_3 and the shear plane between connector plate and timber member;

$F_{t,Rd}$ 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.

WALCO V: number of screws per plate, dimensions e, z_{max}, and polar moments $I_{p,V,ax}$, $I_{p,v}$, $I_{p,ax}$

WALCO V connector plate	n	2·e [mm]	z_{max} [mm]	$I_{p,V,ax}$ [mm²]	e_{45} [mm]	x_{max} [mm]	y_{max} [mm]	$y_{ax,max}$ [mm]	$I_{p,v}$ [mm²]	$I_{p,ax}$ [mm²]
V60 EH	4	< 64	22,5	1013	11,25	11,25	22,5	45	1266	2025
V60 VK	4	23	22,5	1013	11,25	11,25	22,5	45	1266	2025
V60 VS	4	23	22,5	1013	11,25	11,25	22,5	45	1266	2025
V80 EH	4	<102	30	1800	15	15	30	60	2250	3600
V80 VK	4	27	30	2025	15	15	30	60	2250	3600
V80 VS	4	27	30	1800	15	15	30	60	2250	3600
WALCO V base plate	n	2·e [mm]	z_{max} [mm]	$I_{p,BP,ax}$ [mm²]				$y_{ax,max}$ [mm]	$I_{p,v}$ [mm²]	$I_{p,ax}$ [mm²]
V60 EH	4	< 64	45	4050				45	2025	2025
V60 EH screws in long holes	2	< 64	45	2025				-	-	-
V60 VK	5	23	45	4556				45	2025	2025
V60 VS	4	23	45	4050				45	2025	2025
V80 EH	4	< 102	60	7200				60	3600	3600
V80 EH screws in long holes	2	< 76	60	3600				-	-	-
V80 VK	5	27	60	8100				60	3600	3600
V80 VS	4	27	60	7200				60	3600	3600

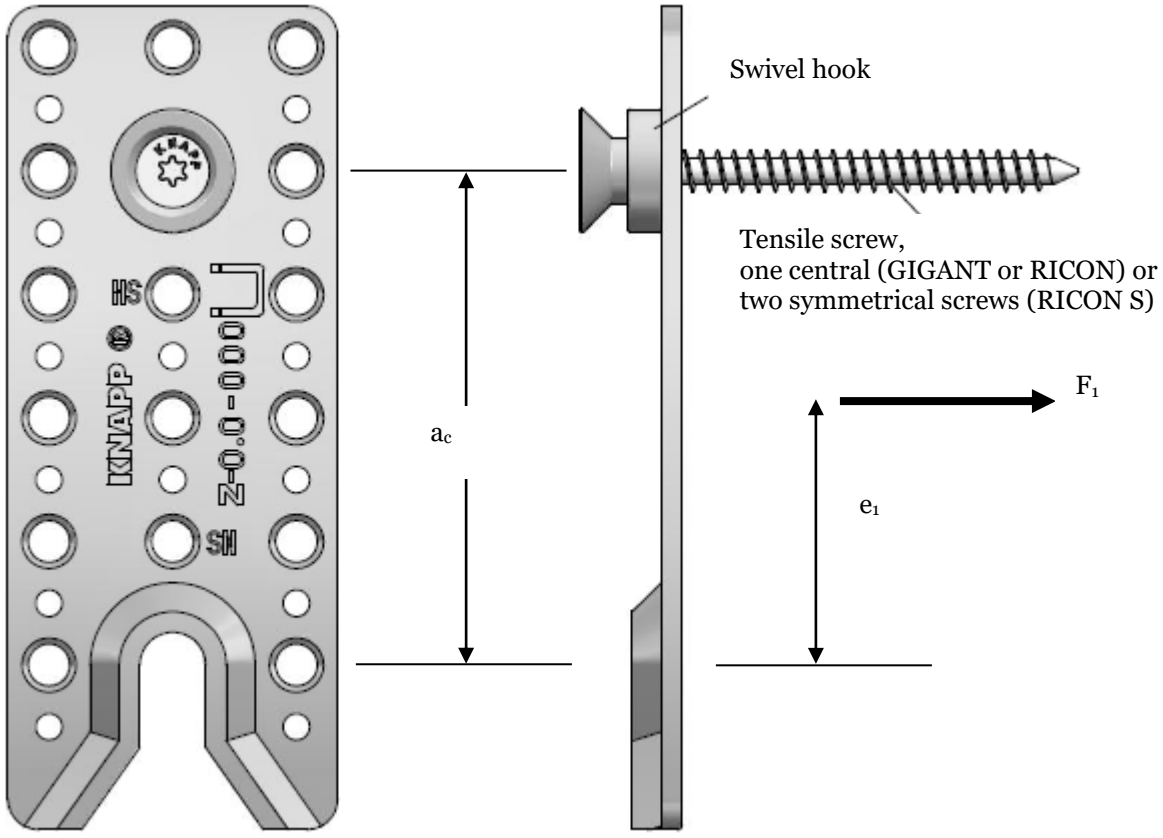


Fig. B.1: Definition of e_1

Combined forces

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

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

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 L/40: K_{ser} = 12,0 kN/mm
Knapp Clip Connectors RICON L/30: K_{ser} = 6,0 kN/mm
Knapp Clip Connectors RICON 66/16 and 70/20: K_{ser} = 5,0 kN/mm
Knapp Clip Connectors RICON S: K_{ser} = 25,0 kN/mm
Knapp Clip Connectors WALCO V with collar screw: K_{ser} = 4,0 kN/mm
Knapp Clip Connectors WALCO V with base plate: K_{ser} = 12,0 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:

$$K_{ser} = 0,02 \cdot \sum_{i=1}^{n} \rho_m^{1,5} \cdot d_i^{0,8} \qquad \text{(B.3.1)}$$

Where:

ρ_m The lower value of the mean 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 with collar screw: K_{ser} = 1,0 kN/mm

Knapp Clip Connectors WALCO V with base plate: $K_{ser} = \frac{F_{Rk}}{4,5\,\text{mm}}$

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 L/30 and L/40 without reinforcing plate: K_{ser} = 1,0 kN/mm
Knapp Clip Connectors RICON 66/16 and 70/20: K_{ser} = 0,25 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

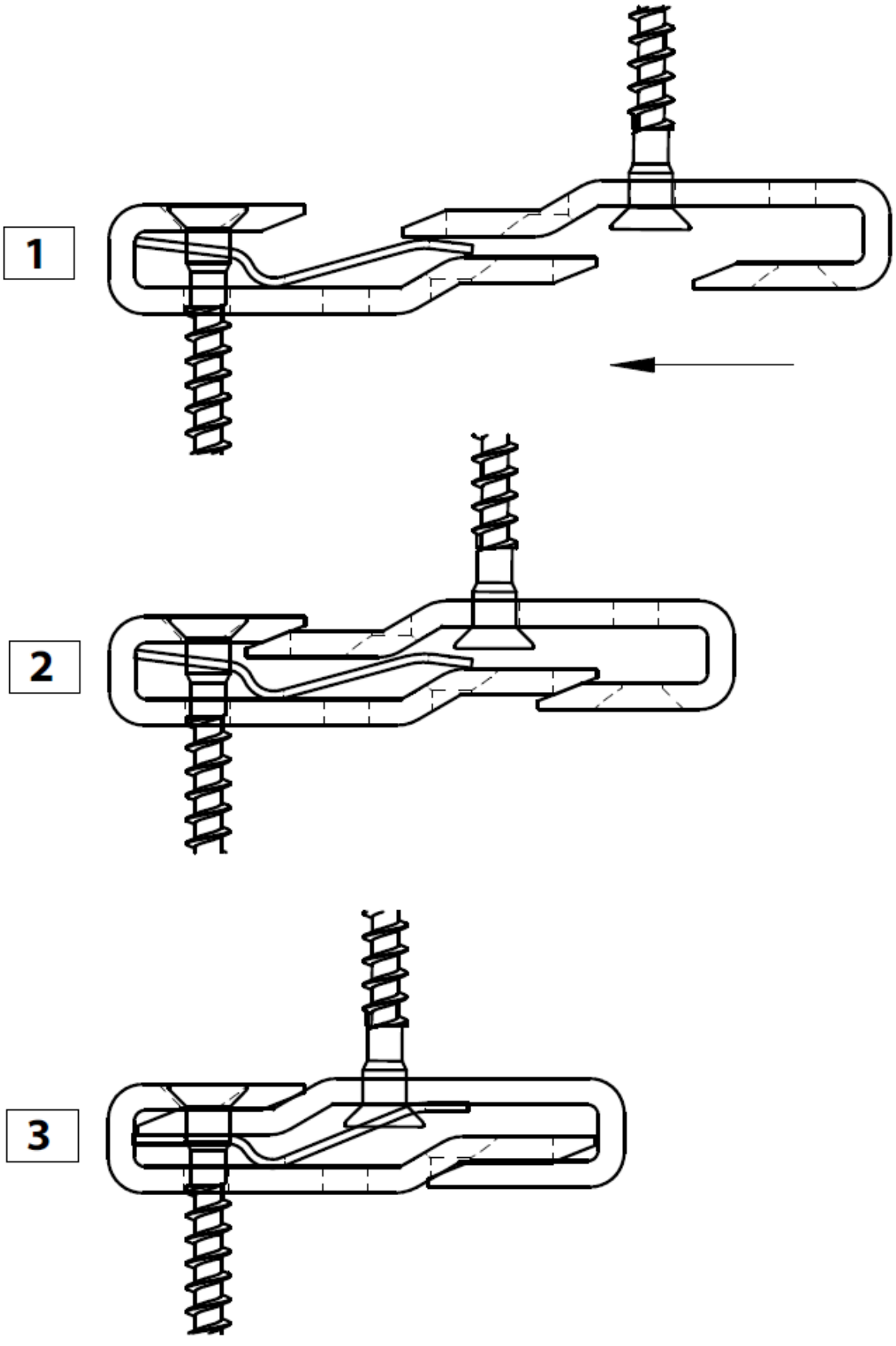
Annex C
Characteristic capacities $F_{KCC,Rk}$, form factors k_H, dimensions a_c, a_1, a_2 and numbers n_{45}

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 66/16	2,6	3,7	$n_{CL} \cdot 1,0$	2,5	4,33	1,16	51	23	-	2,7
RICON 70/20		3,7		2,5	4,46	1,16	55	25	-	2,7
RICON 60/30	4,1	4,5	$n_{CL} \cdot 1,9$	1,8	2,40	5,46	40	26	51	2,8
RICON 80/30		8,2		3,6	6,02	6,44	60	46	131	3,8
RICON 100/30		10,4		4,5	12,0	10,9	80	74	307	5,6
RICON 120/30		13,4		5,4	20,3	15,4	100	110	595	7,3
RICON 140/30		13,4		5,4	31,0	19,9	120	153	1025	9,1
RICON 160/30		13,4		5,4	44,0	24,4	140	205	1629	10,9
Double RICON 80/30 [1]		8,2		3,6	27,6	11,9	140	181	1414	6,6
Double RICON 100/30 [1]		10,4		4,5	56,5	20,9	180	317	3232	10,1
Double RICON 120/30 [1]		13,4		5,4	94,8	29,8	220	483	6114	13,7
Double RICON 140/30 [1]							260			
Double RICON 160/30 [1]							300			
RICON 60/40 carbon	5,9	6,0	$n_{CL} \cdot 2,7$	4,0	2,30	7,28	34	29	43	2,8
RICON 80/40 carbon		11,0		8,0	5,09	8,61	54	42	81	3,8
RICON 100/40 carbon		14,0		10,0	10,9	14,6	74	72	212	5,6
RICON 120/40 carbon		18,0		12,0	19,1	20,5	94	109	433	7,3
RICON 140/40 carbon		18,0		12,0	29,6	26,4	114	154	767	9,1
RICON 160/40 carbon		18,0		12,0	42,6	32,4	134	208	1241	10,9
Double RICON 80/40 carbon [1]		11,0		8,0	27,6	15,9	134	182	1140	6,6
Double RICON 100/40 carbon [1]		14,0		10,0	56,5	27,8	174	319	2603	10,1
Double RICON 120/40 carbon [1]		18,0		12,0	94,8	39,7	214	486	4918	13,7
Double RICON 140/40 carbon [1]							254			
Double RICON 160/40 carbon [1]							294			
RICON 60/40 stainless	4,4	4,5	$n_{CL} \cdot 2,7$	3,0	2,30	7,28	34	29	43	2,8
RICON 80/40 stainless		8,2		6,0	5,09	8,61	54	42	81	3,8
RICON 100/40 stainless		10,4		7,5	10,9	14,6	74	72	212	5,6
RICON 120/40 stainless		13,4		9,0	19,1	20,5	94	109	433	7,3
RICON 140/40 stainless		13,4		9,0	29,6	26,4	114	154	767	9,1
RICON 160/40 stainless		13,4		9,0	42,6	32,4	134	208	1241	10,9
Double RICON 80/40 stainless [1]		8,2		6,0	27,6	15,9	134	182	1140	6,6
Double RICON 100/40 stainless [1]		10,4		7,5	56,5	27,8	174	319	2603	10,1
Double RICON 120/40 stainless [1]		13,4		9,0	94,8	39,7	214	486	4918	13,7
Double RICON 140/40 stainless [1]							254			
Double RICON 160/40 stainless [1]							294			
RICON S 140/60	9,0	34,0 (60,0) [2]	5,0	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 (99,0) [2]		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
RICON S 390/80 VP		180			58,0	24,0	270	1581	7226	28
RICON S 390/80 VP + VS										
WALCO V 60, WALCO V 80		17,0	1,6	17,0	-	-	-	-	-	-
WALCO 40 (C24)	3,3	6,7	-	5,5	-	-	-	-	-	-
WALCO V80 oblong hole	-	-	-	8,0						
n_{CL}: Number of clip locks in RICON connections, $n_{CL} = 1$ or $n_{CL} = 2$										

1) … Characteristic and design values can be used for double RICON with distance or without distance between the two members
2) … $F_{2,KCC,Rd}$ = 60,0 kN for RICON S60 with welded collar bolt (VS) and retaining screw bolt (with insert screw, long nut, press nut or nut M12)
3) … $F_{2,KCC,Rd}$ = 99,0 kN for RICON S80 only with welded collar bolt (VS)

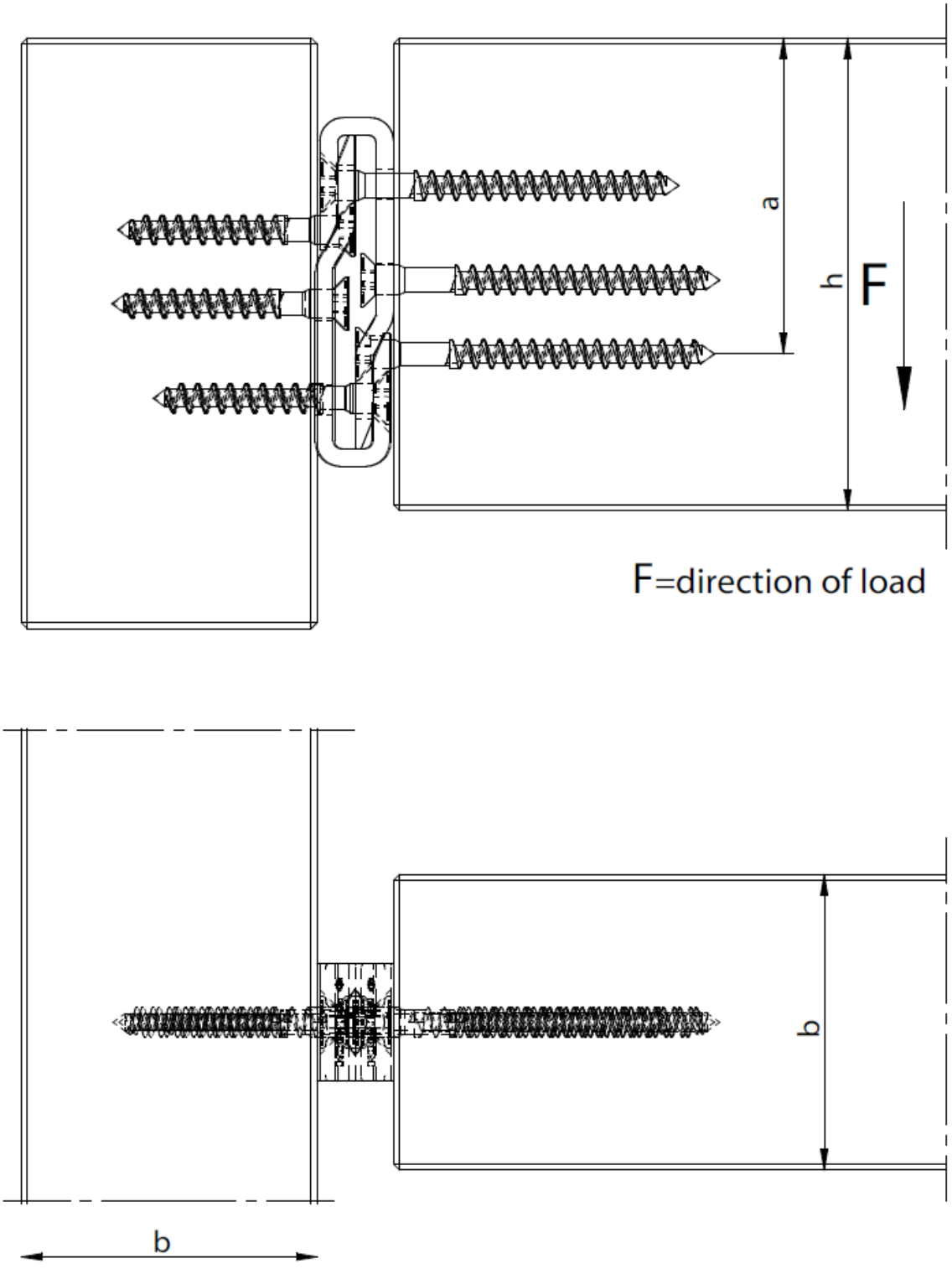
Annex D
Installation of connectors

GIGANT
Functional principle clip lock



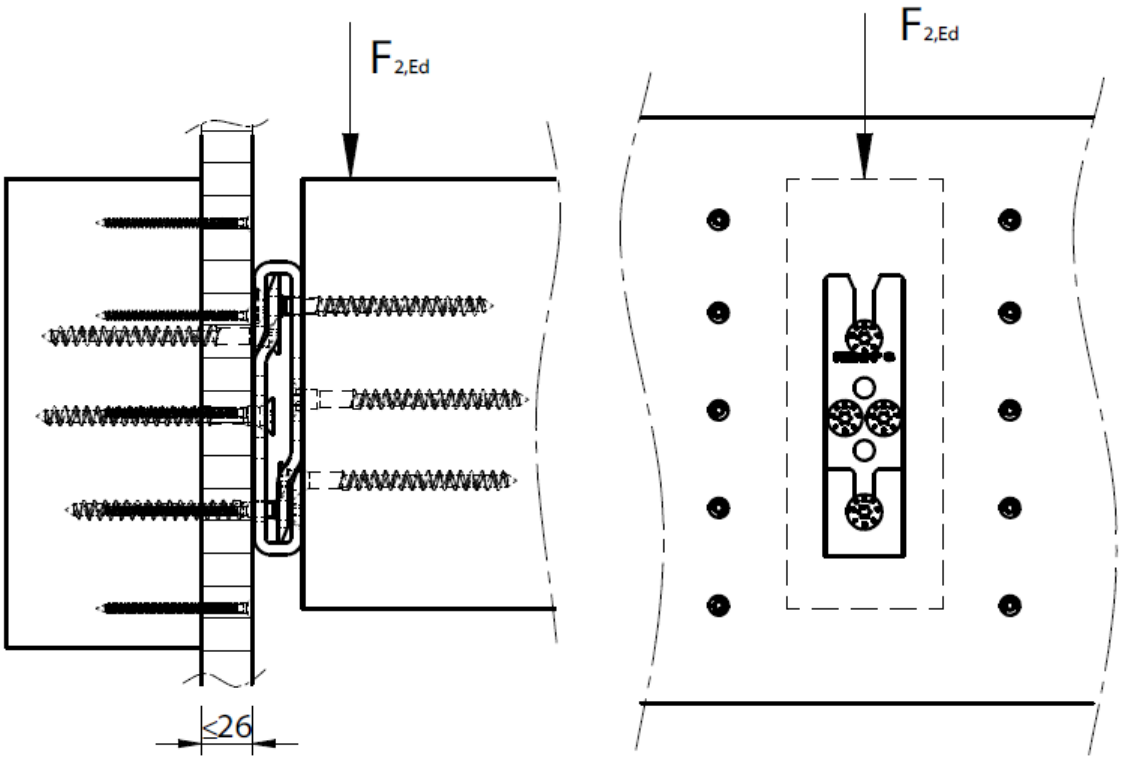
GIGANT

Wood-to-wood joint



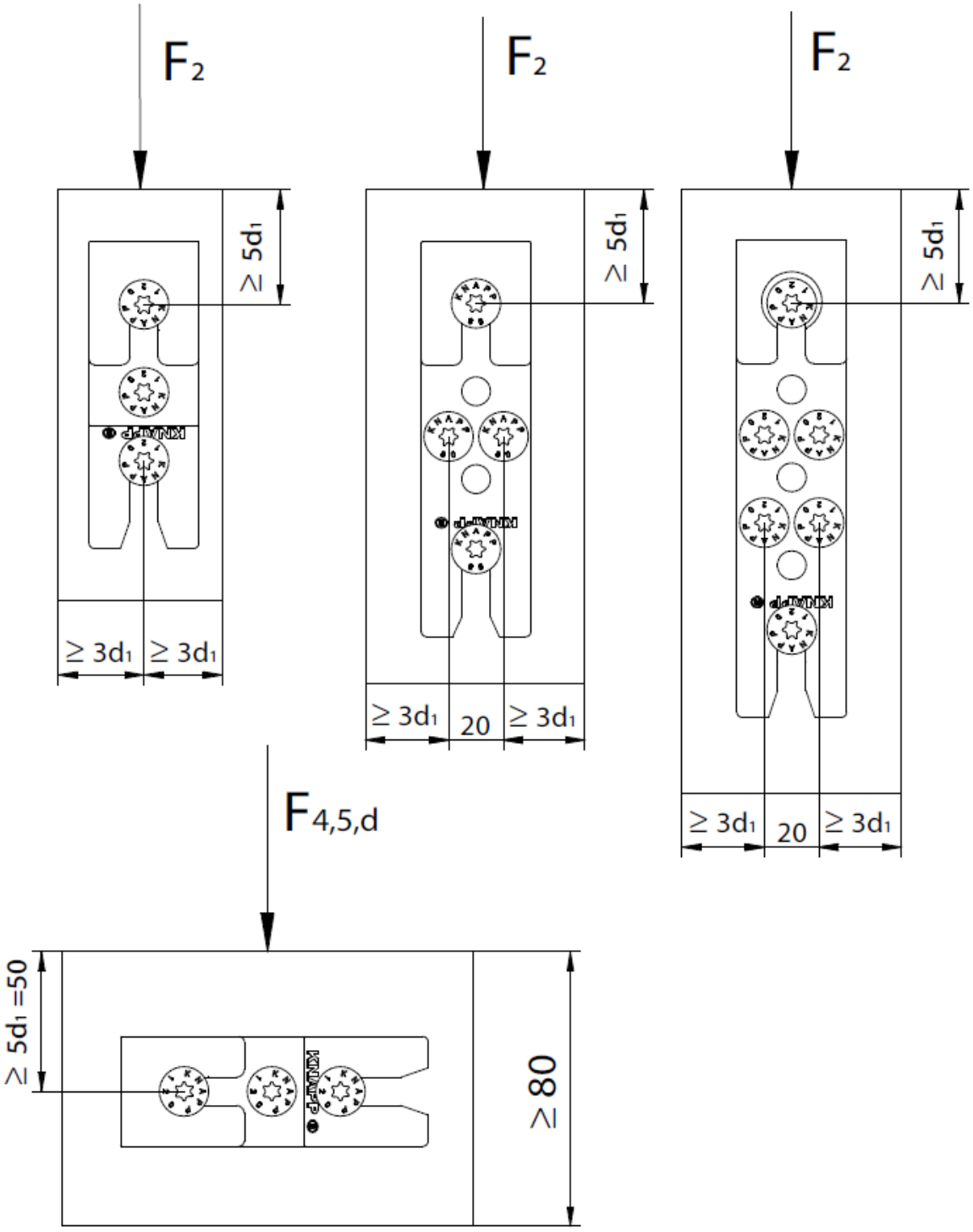
GIGANT

Joint with interlayer



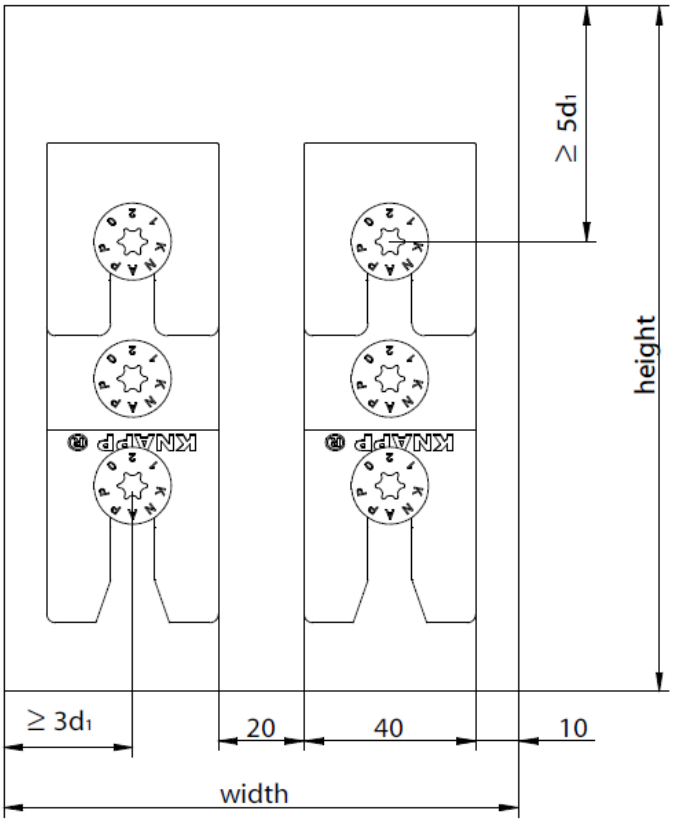
GIGANT

Minimum edge distances for joists



GIGANT

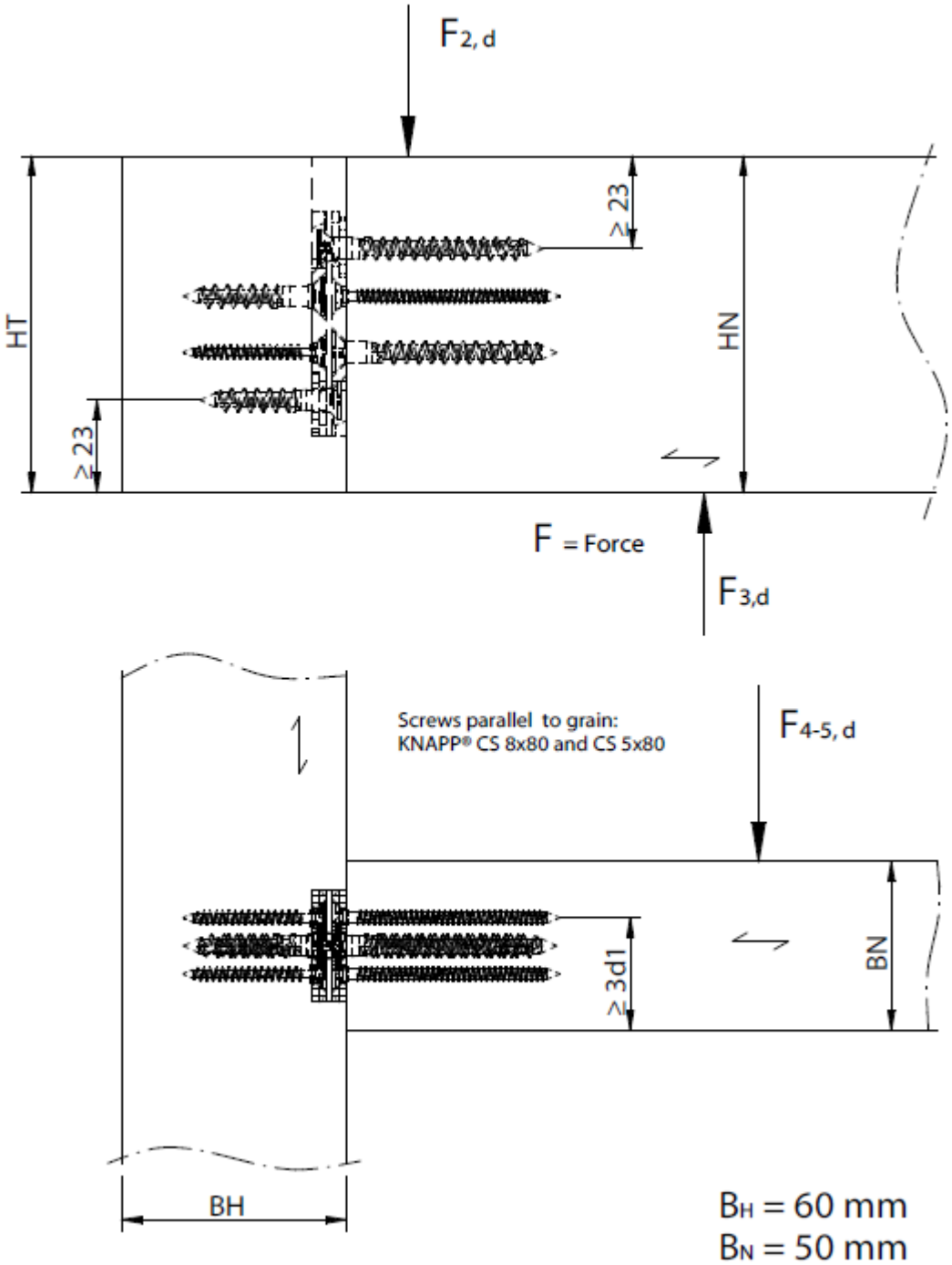
Double GIGANT connection



GIGANT		minimum cross section	
width	height	width	height
40	120	120	150
40	150	120	200
40	180	120	220

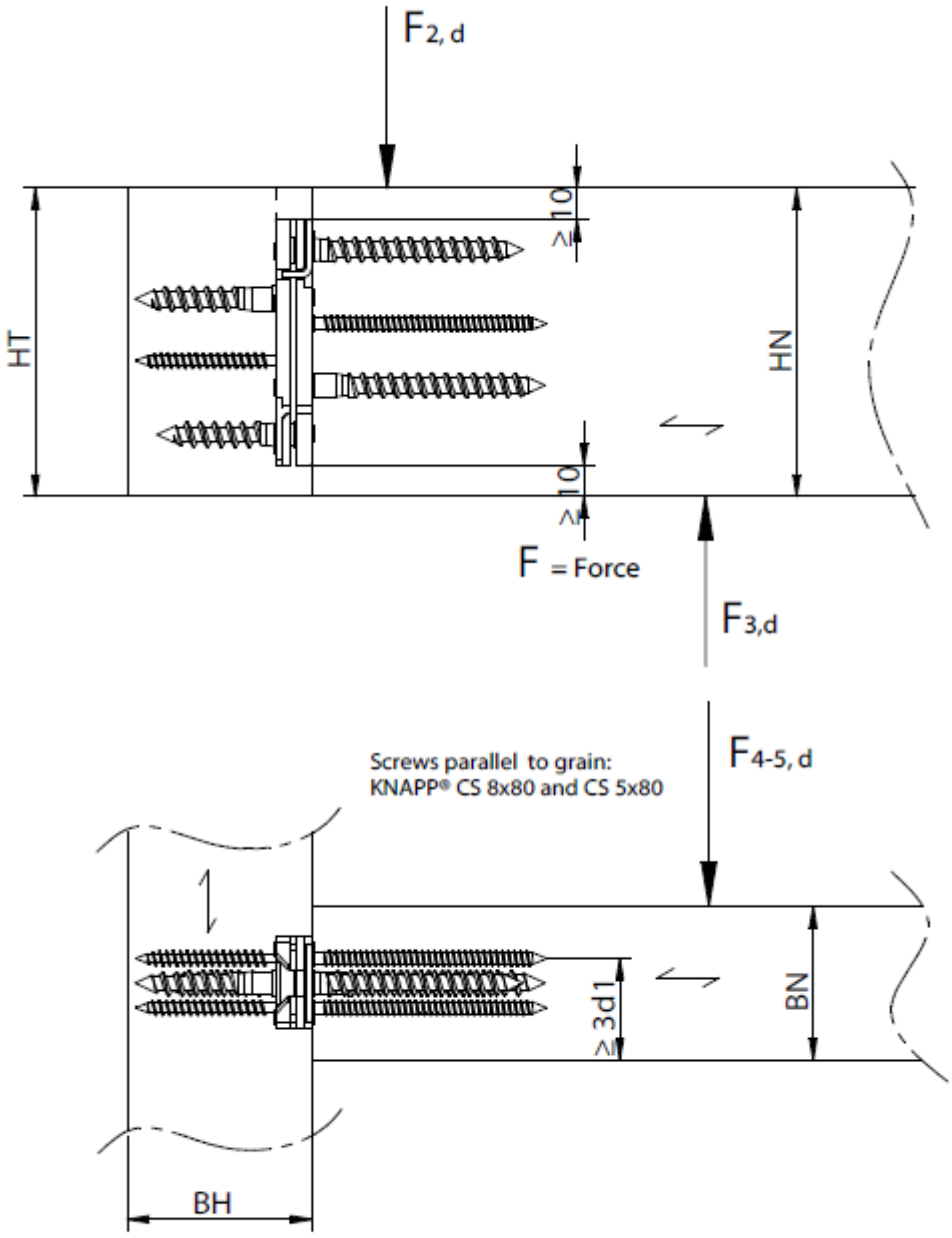
Double timber beam width of single GIGANT allows to calculate with double load $F_{2,Rd}$.

RICON® Series 40
Wood-to-wood joint – same timber depth HT=NT



RICON® Series 30

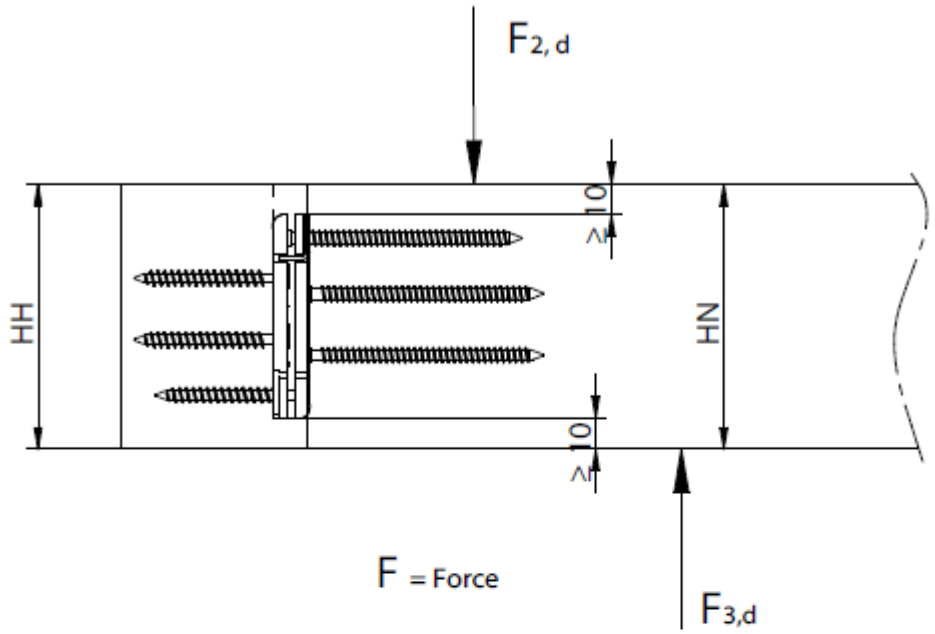
Wood-to-wood joint – same timber depth HT=NT

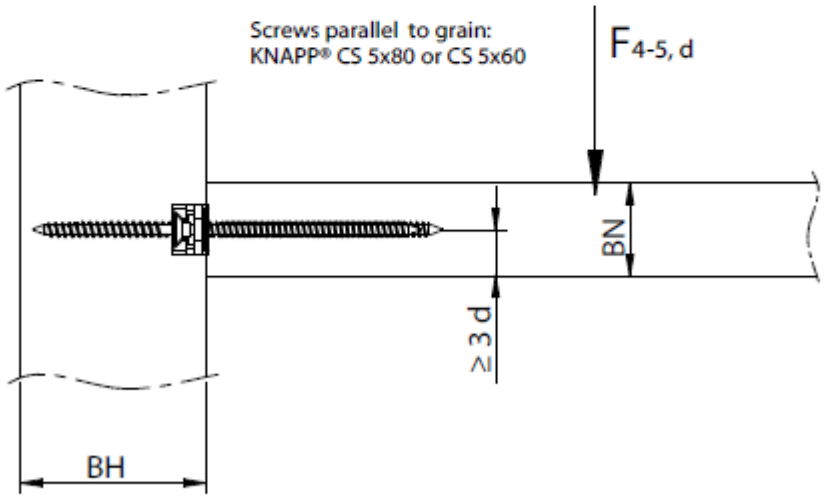


$B_H = 60$ mm
$B_N = 50$ mm

RICON® Series 16 and 20

Wood-to-wood joint – same timber depth HT=NT

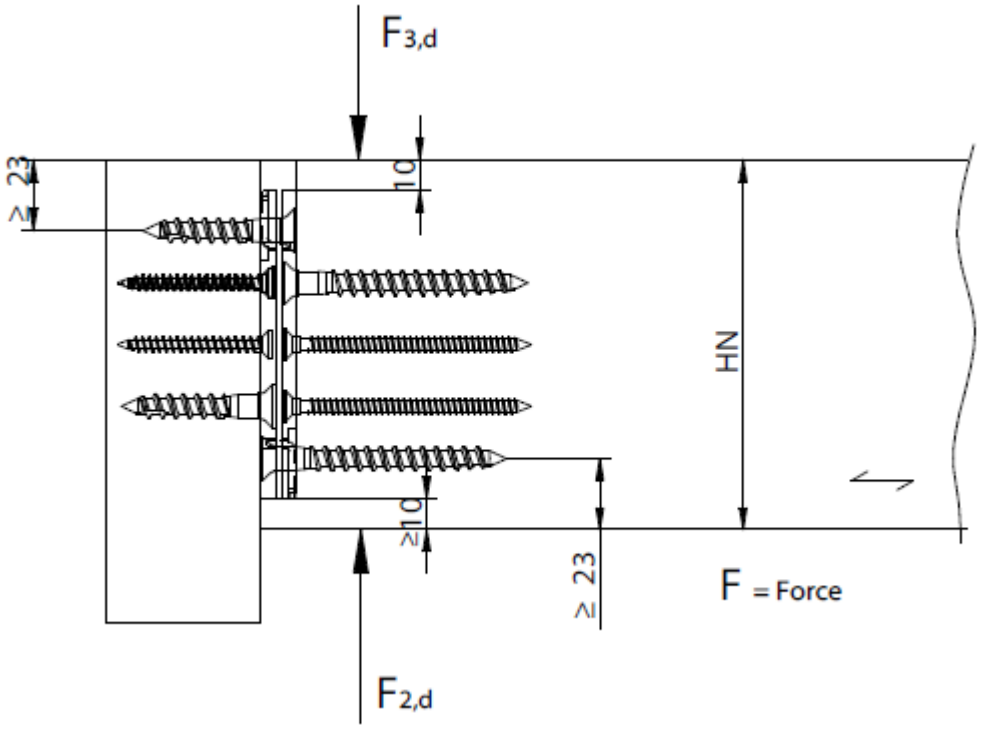


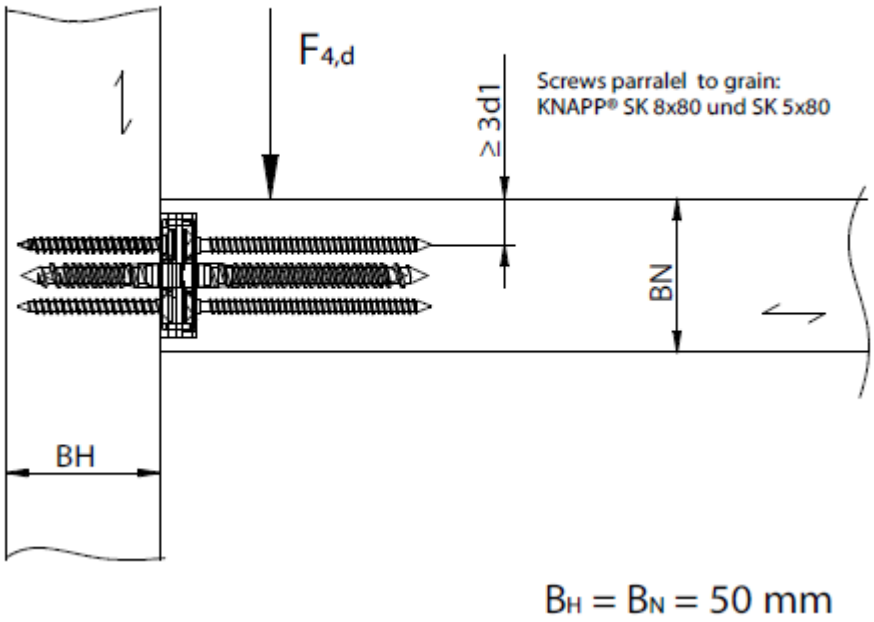


$B_H = 60$ mm
$B_N = 30$ mm

RICON® Series 40 and 30

Wood-to-wood joint middle latch

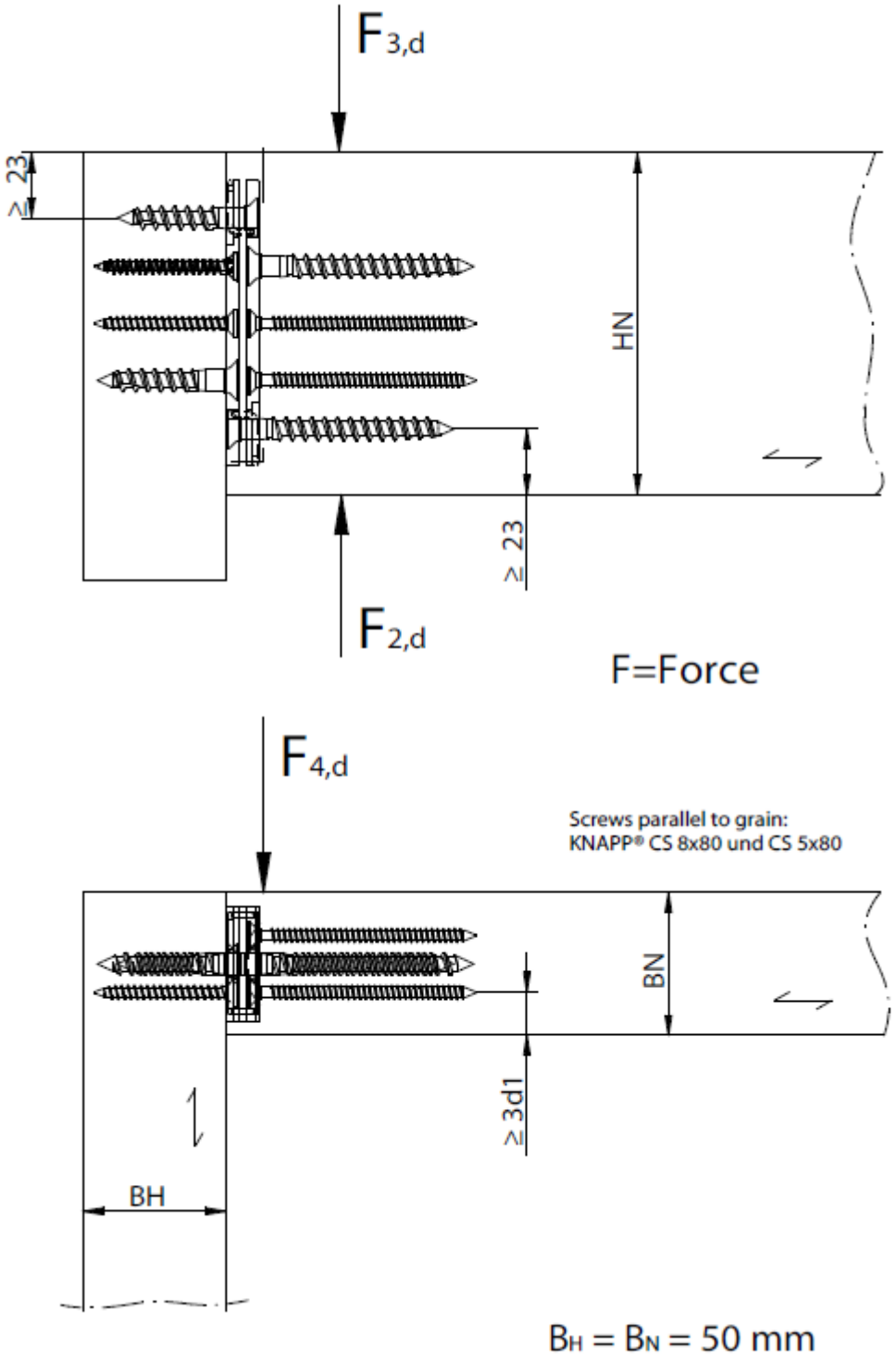




$B_H = B_N = 50$ mm

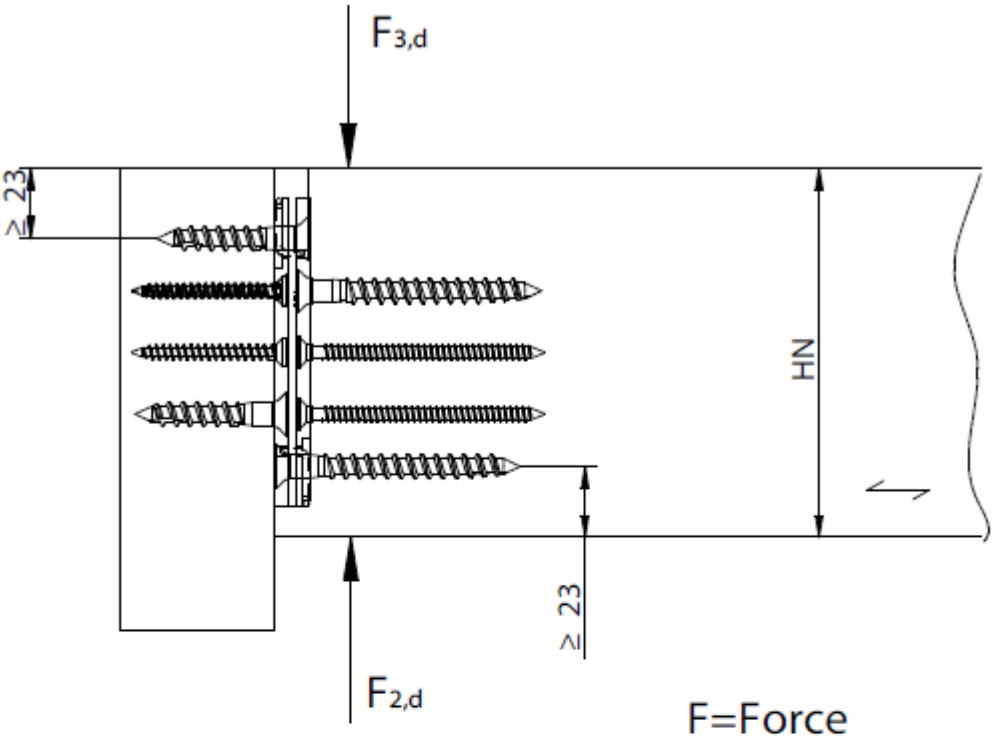
RICON®

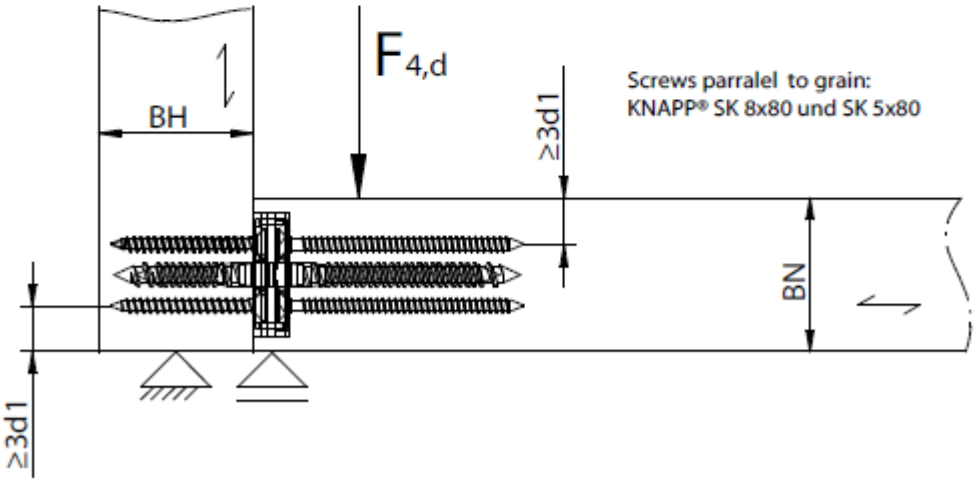
Wood-to-wood joint upper latch



RICON®

Wood-to-wood joint bottom latch

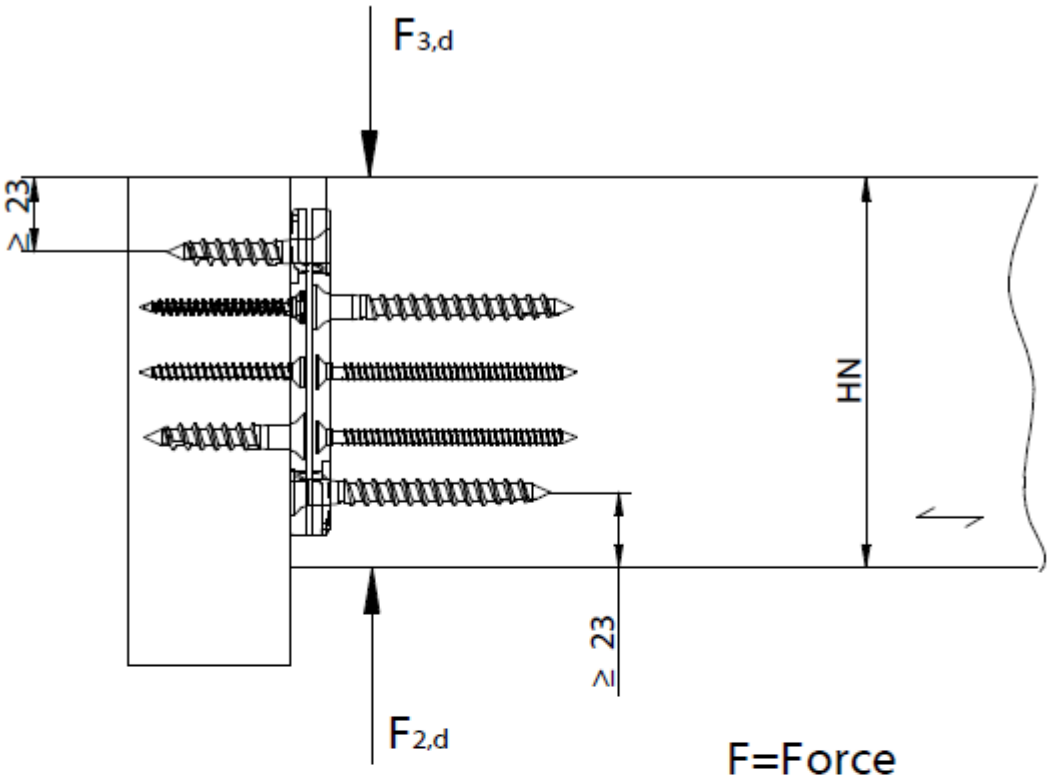


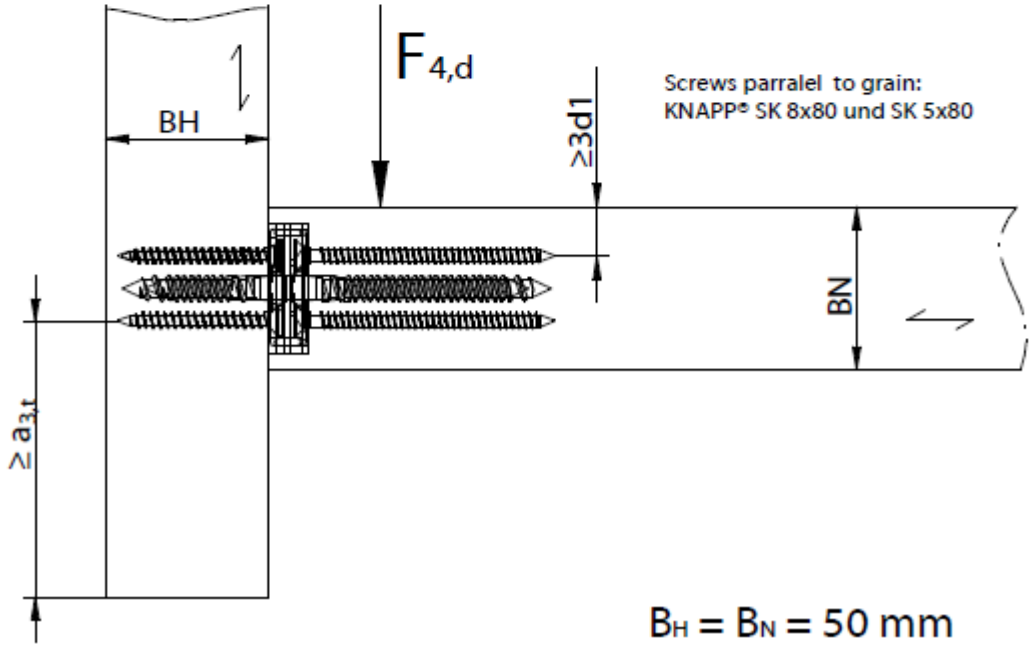


$B_H = B_N = 50$ mm

RICON®

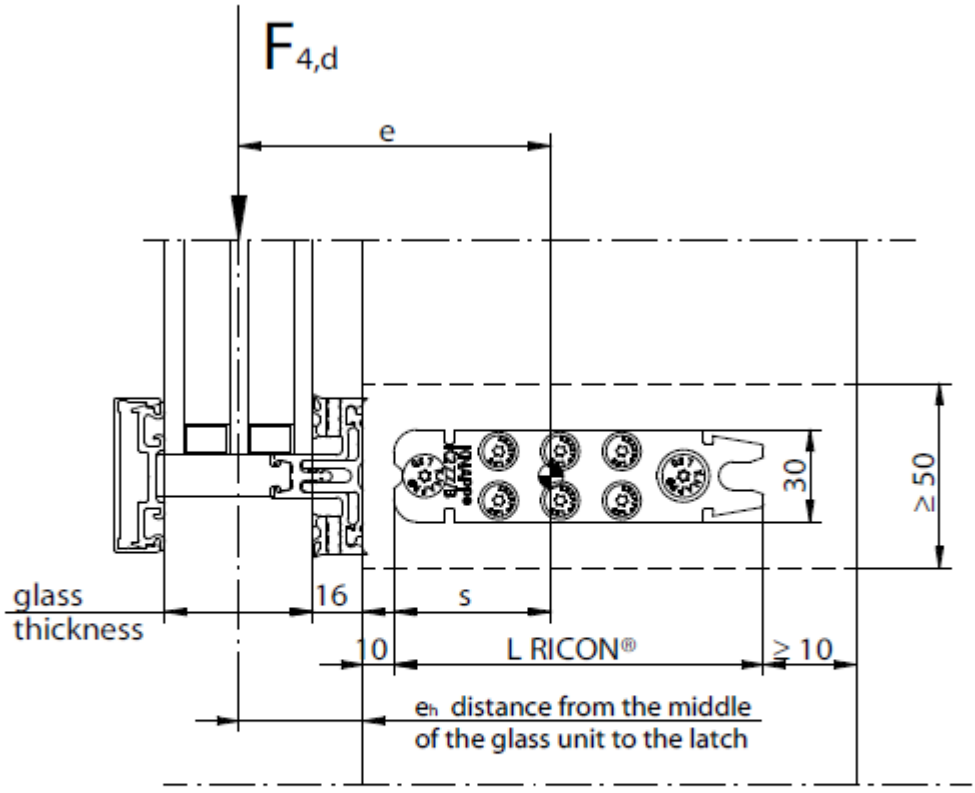
Wood-to-wood joint bottom latch





RICON® 30 Series

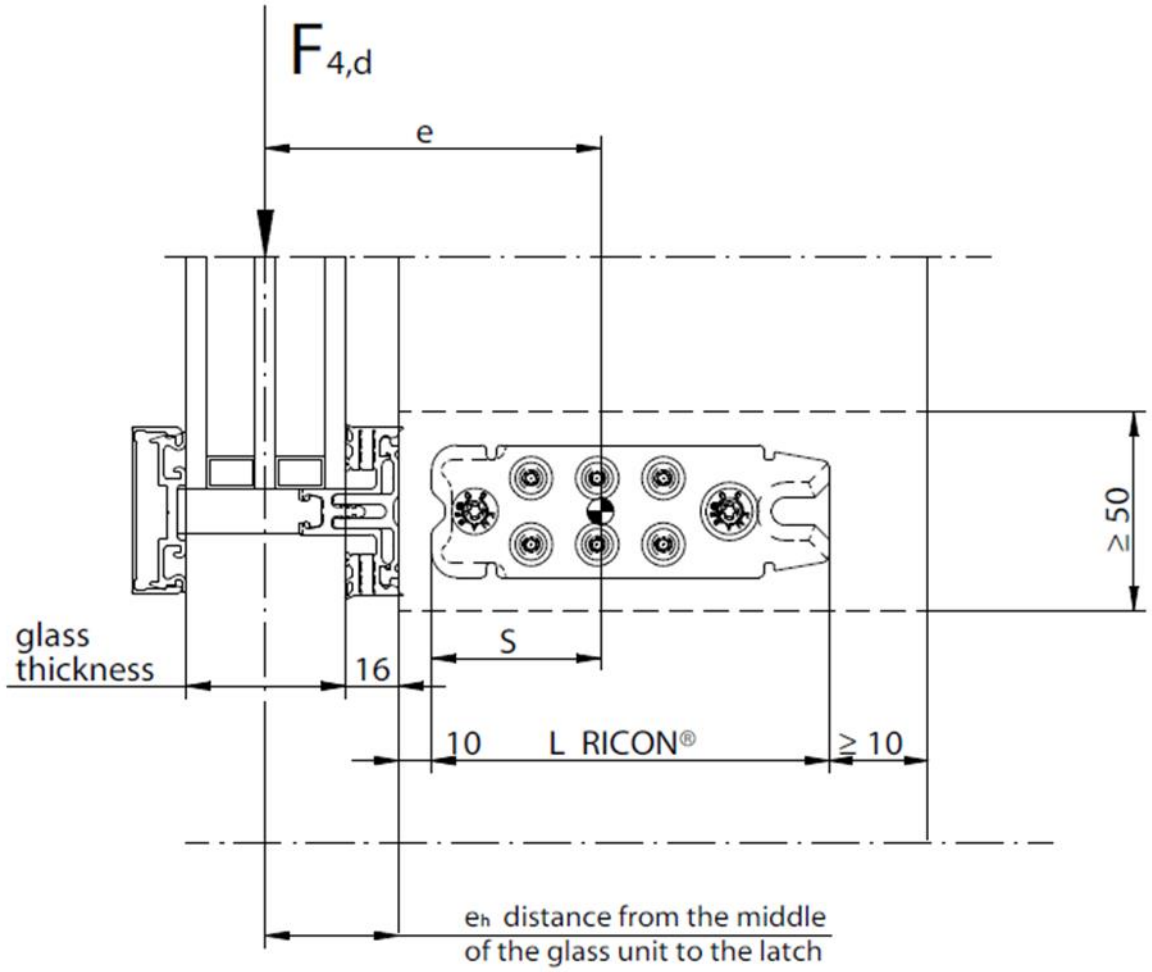
Minimum cross-section width and connector plate position requirements



Calculation of F_4 for eccentric load for glass thickness ≤ 53 mm: see formular B.1.5.
($e_h \leq 42{,}5$ mm)

RICON® 40 Series

Minimum cross-section width and connector plate position requirements



Calculation of F_4 for eccentric load for glass thickness ≤ 53 mm: see formular B.1.5. ($e_h \leq 42{,}5$ mm)

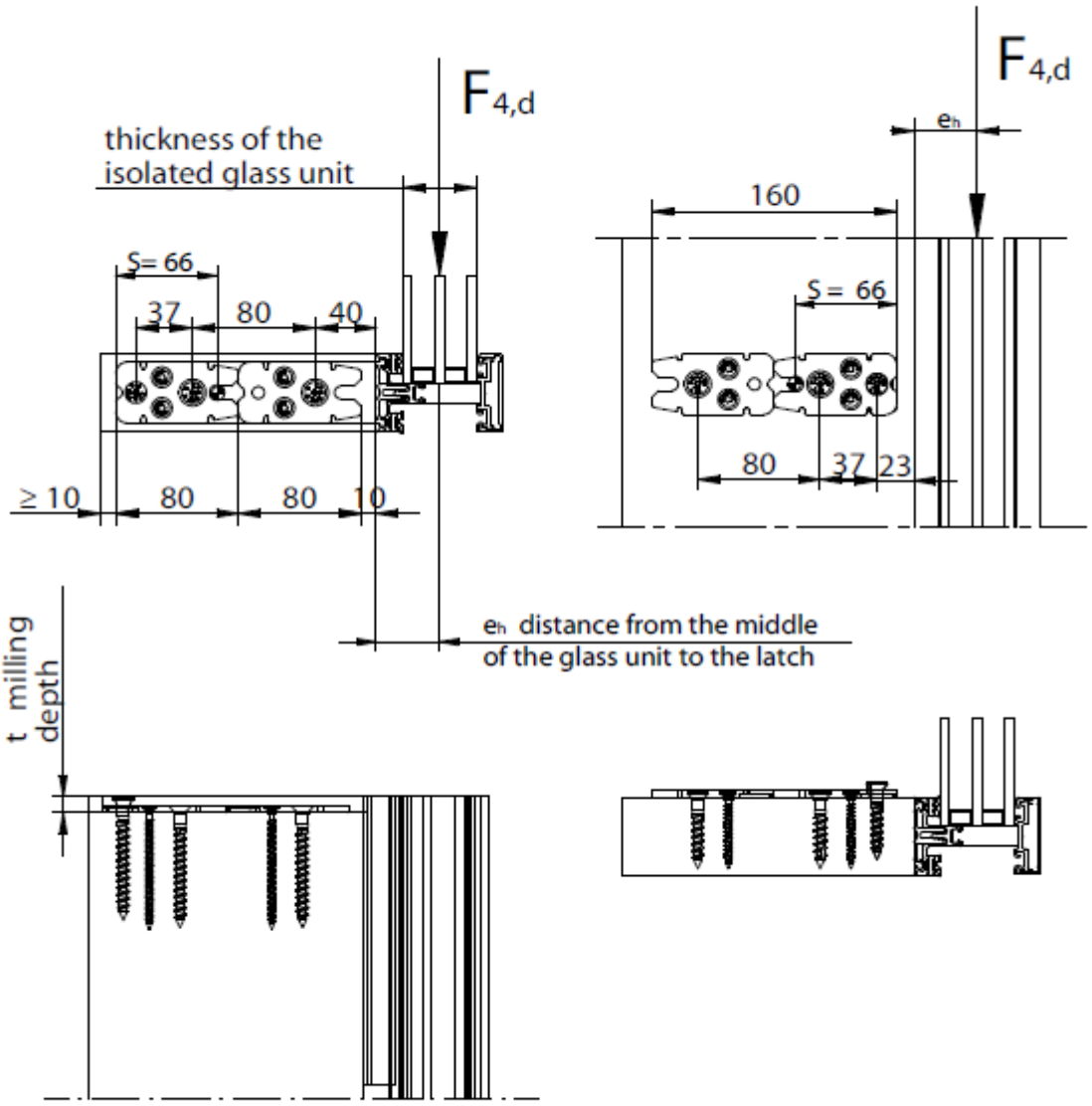
Calculation of F_4 for eccentric load for glass thickness > 53 mm:

$$F_{4,\,eccentric} = k_e \cdot F_{4,centric} \qquad k_e = \frac{1}{1 + e \cdot k_{eccentric}}$$

RICON®	single joint						double joints				
	60/40	80/40	100/40	120/40	140/40	160/40	80/40 80/40	100/40 100/40	120/40 120/40	140/40 140/40	160/40 160/40
$K_{eccentric}$	0,108	0,069	0,054	0,045	0,038	0,034	0,03	0,024	0,02	0,018	0,016
S	21	31	41	51	61	71	66	87	110	130	150

RICON®

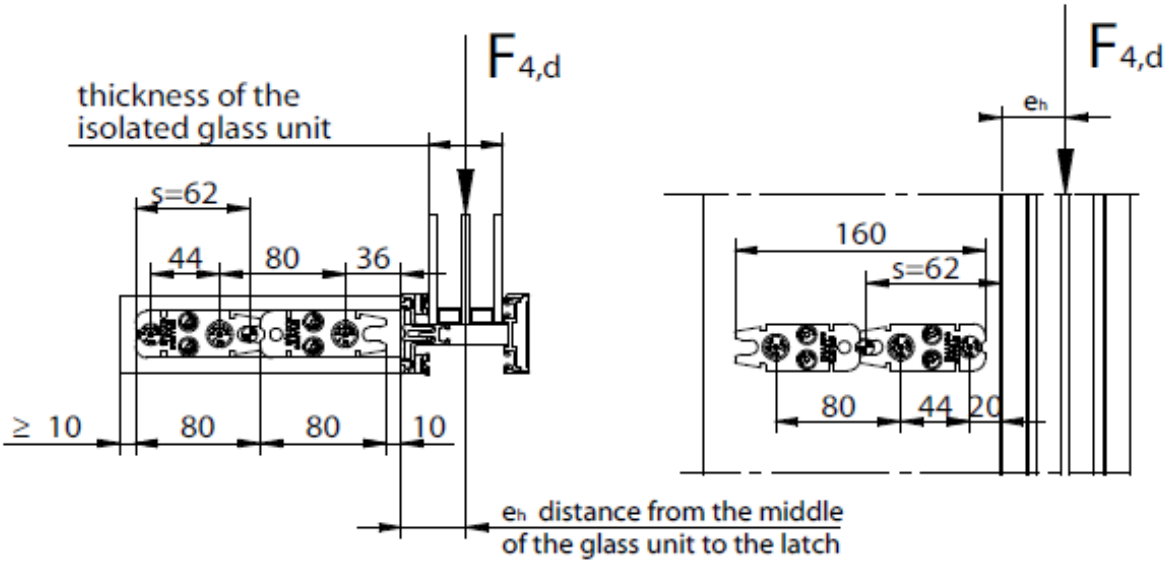
2x RICON® 80/40 EA in series

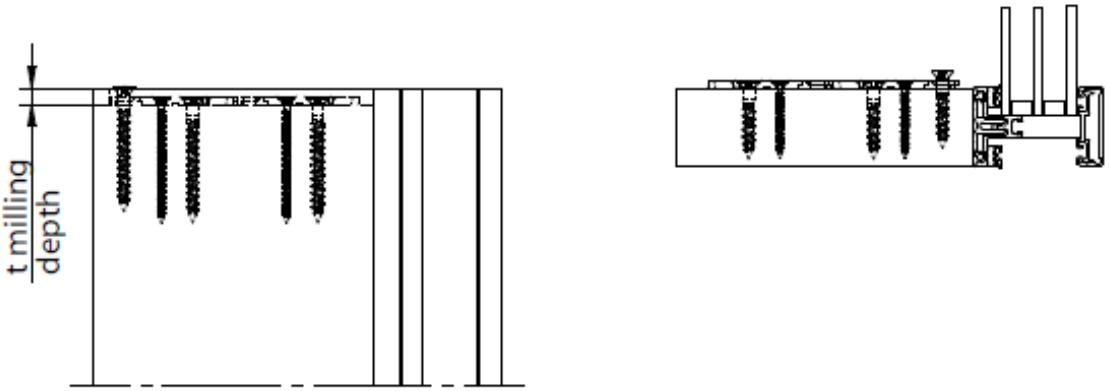


Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

2x RICON® 80/30 EA in series

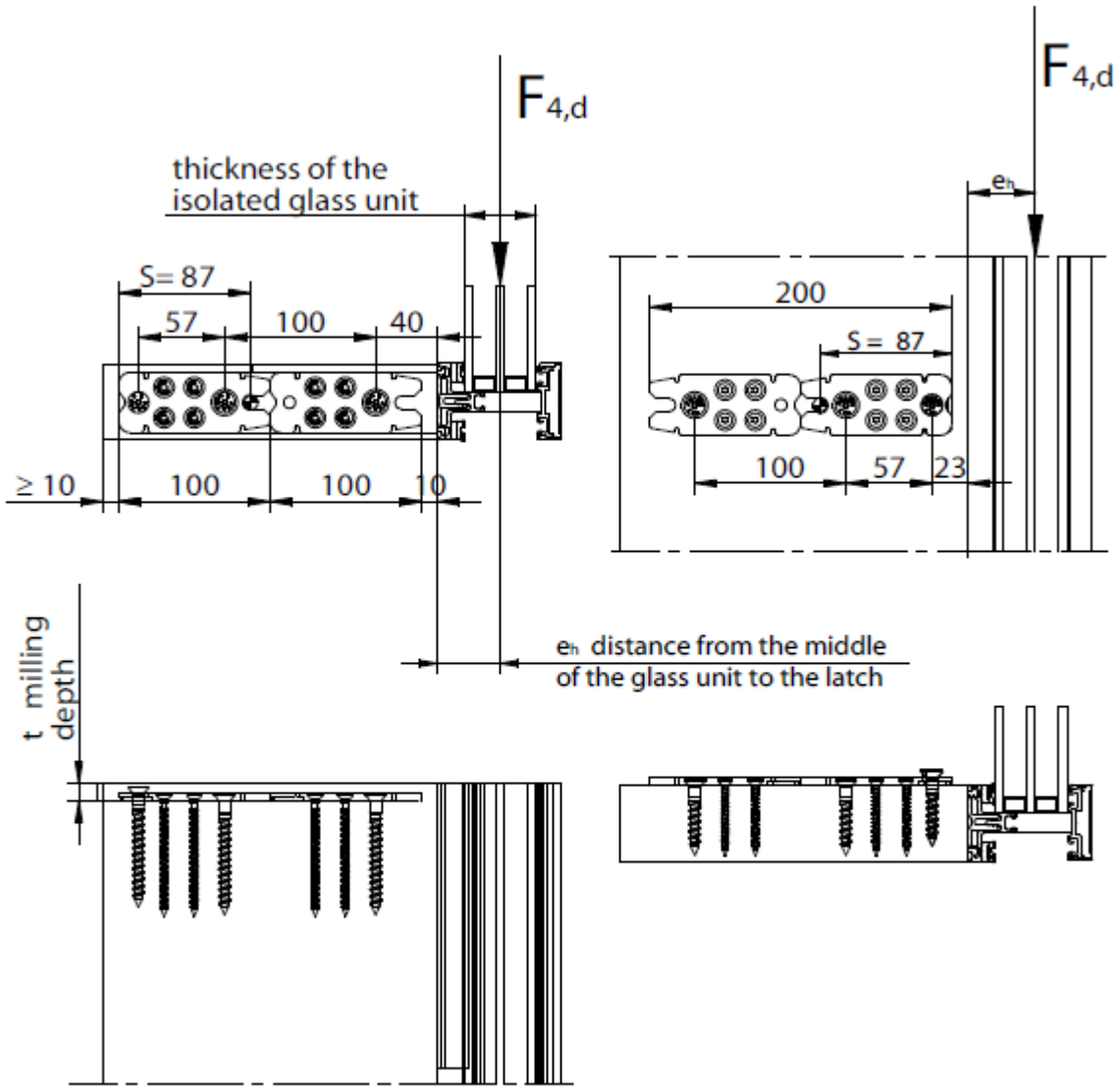




Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

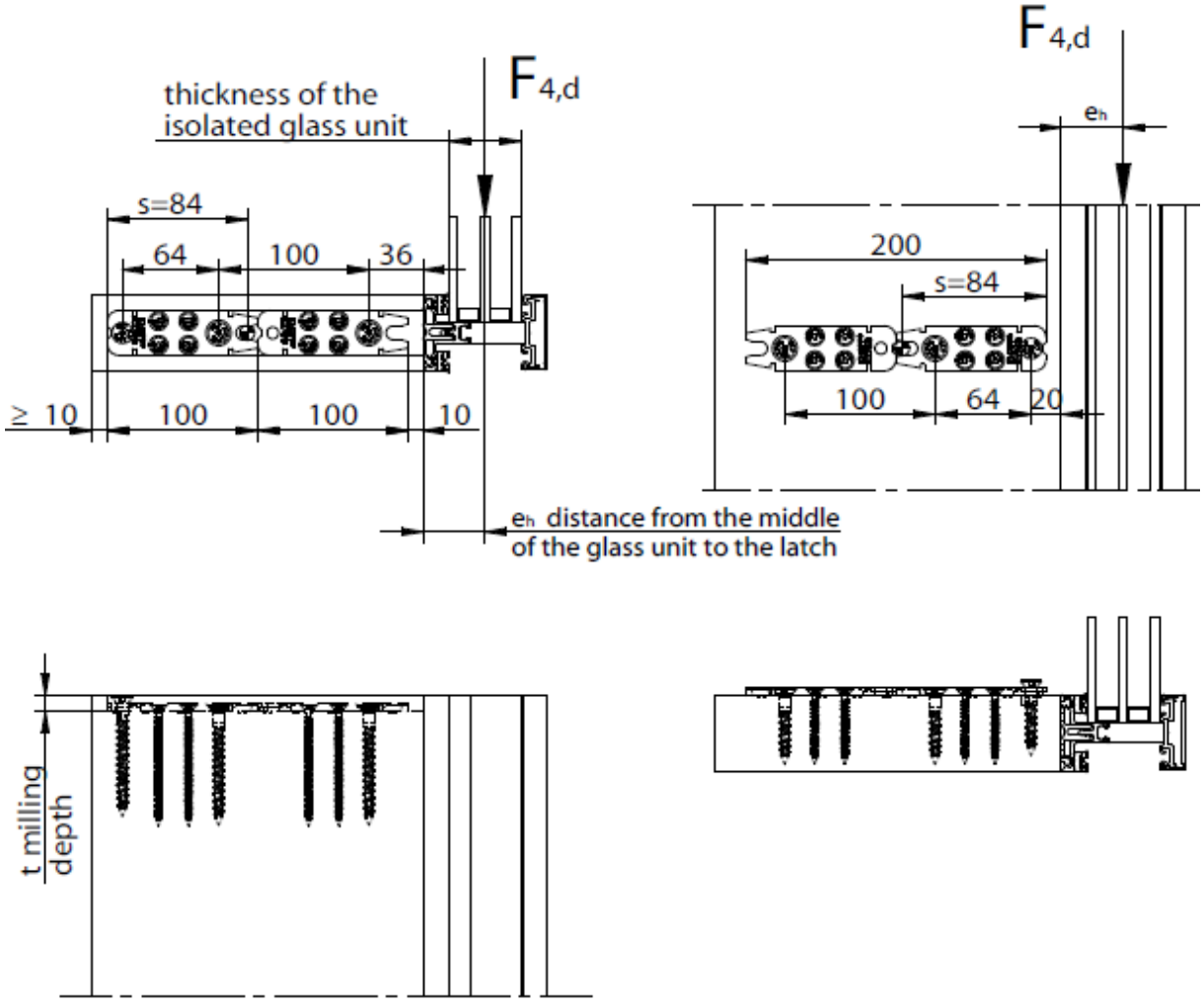
2x RICON® 100/40 EA in series



Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

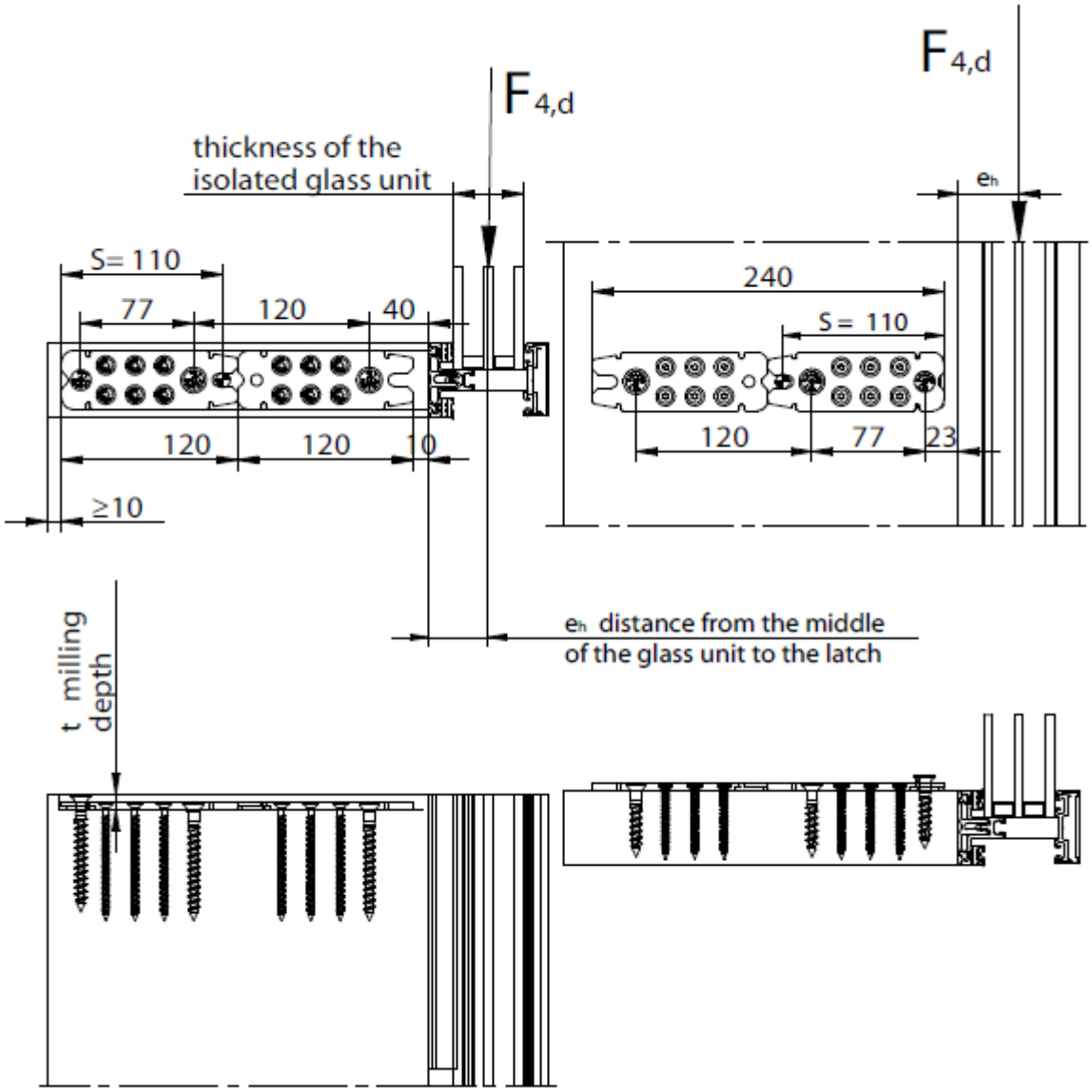
2x RICON® 100/30 EA in series



Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

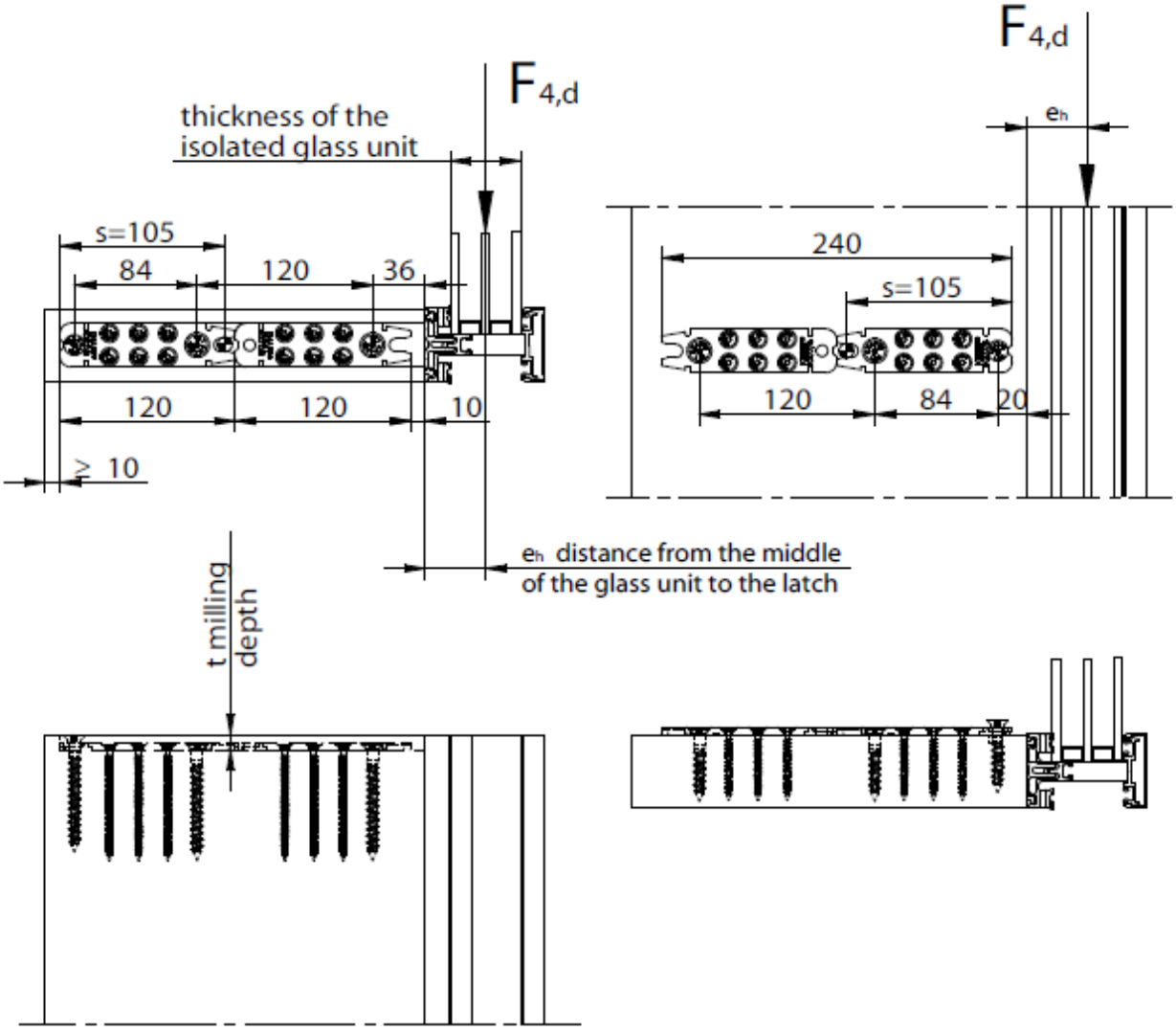
2x RICON® 120/40 EA in series



Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

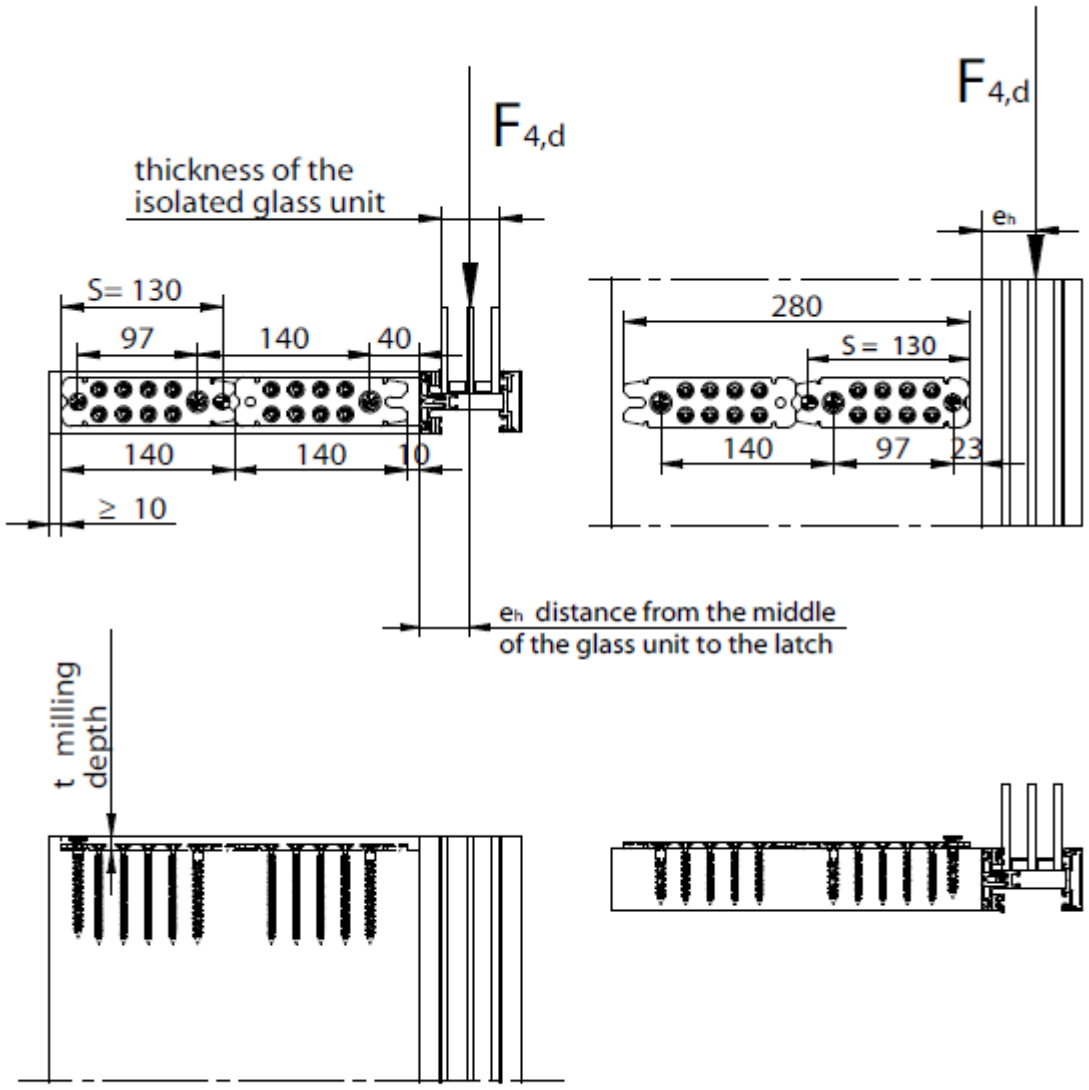
2x RICON® 120/30 EA in series



Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

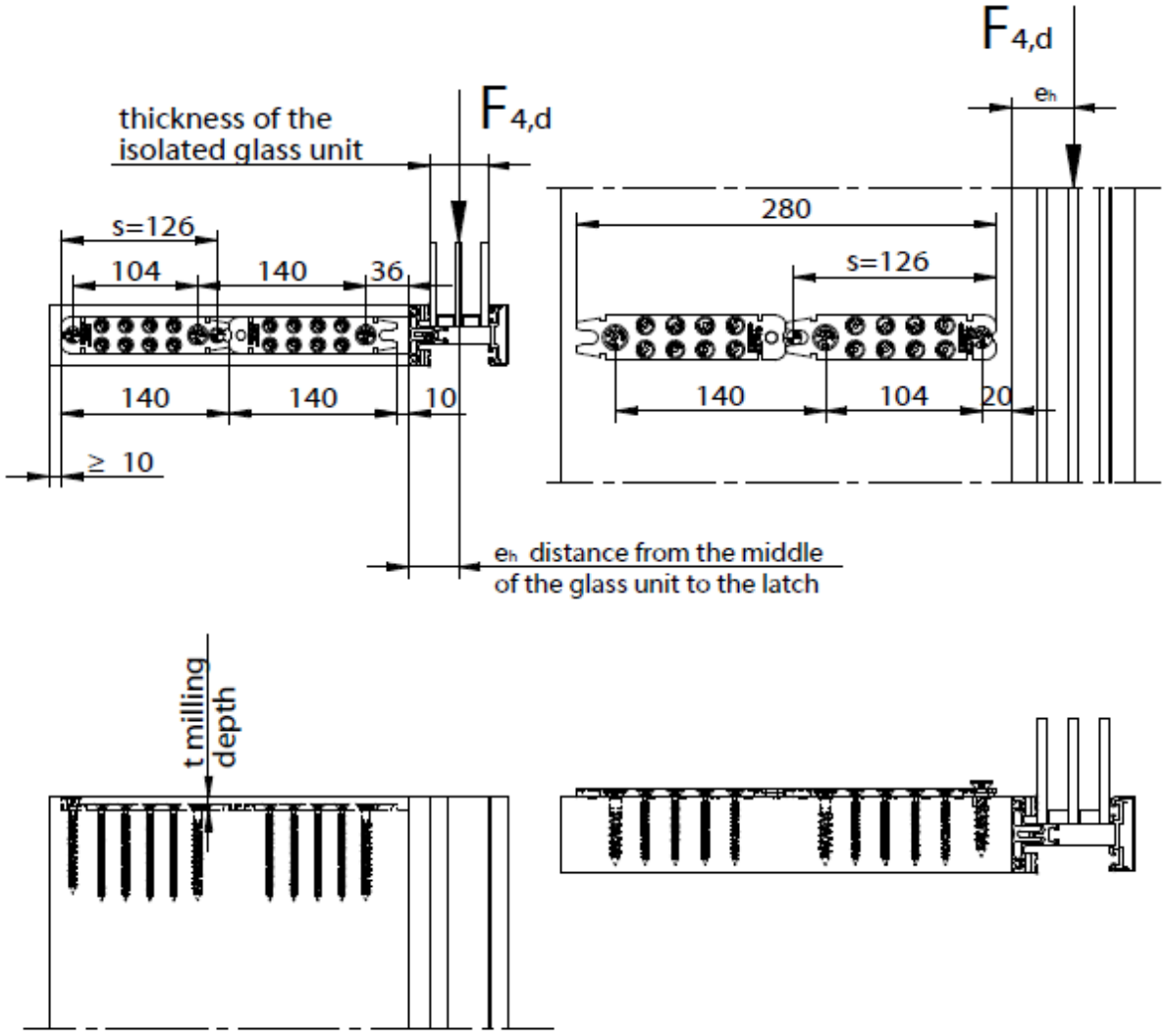
2x RICON® 140/40 EA in series



Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

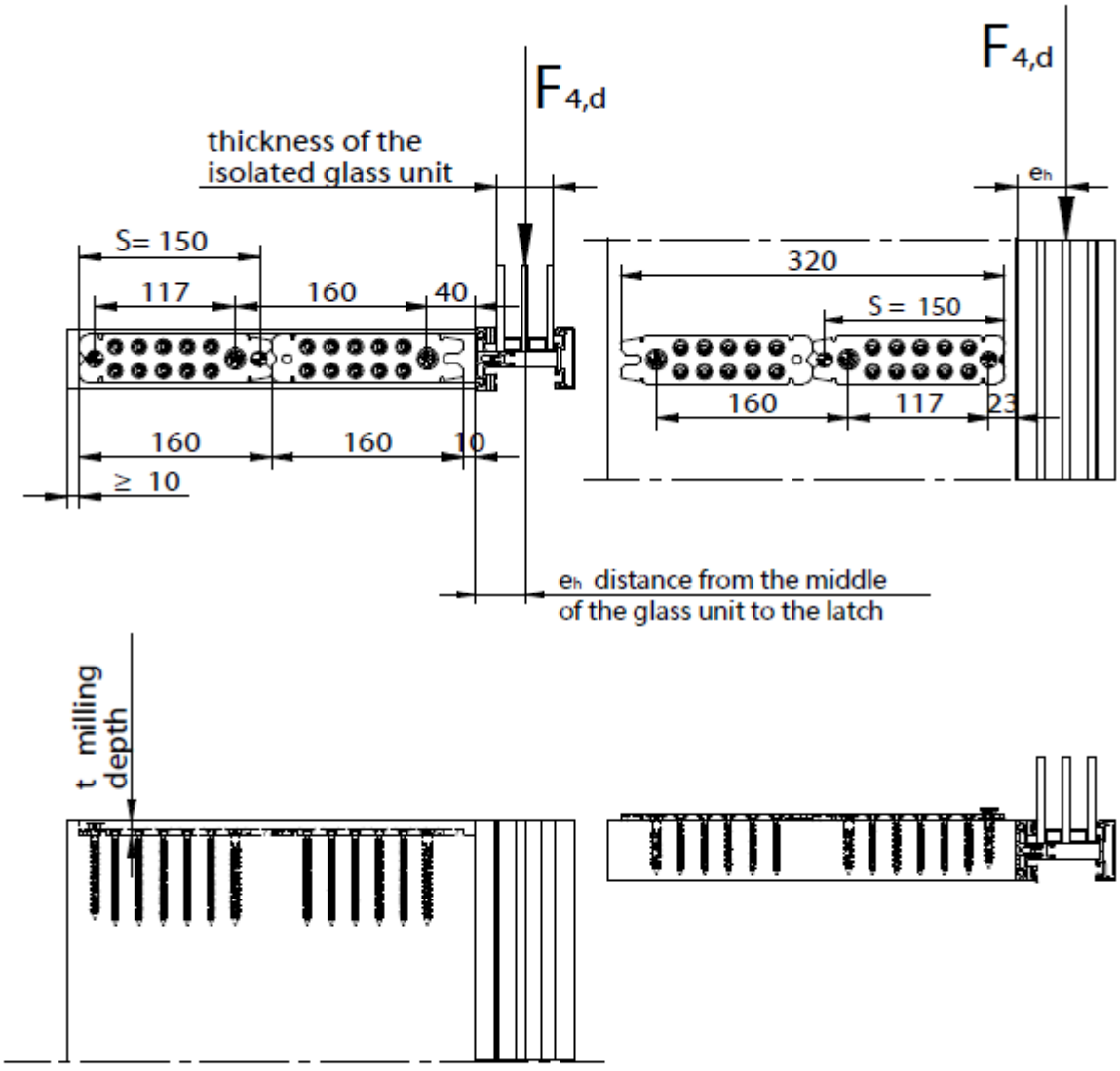
2x RICON® 140/30 EA in series



Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

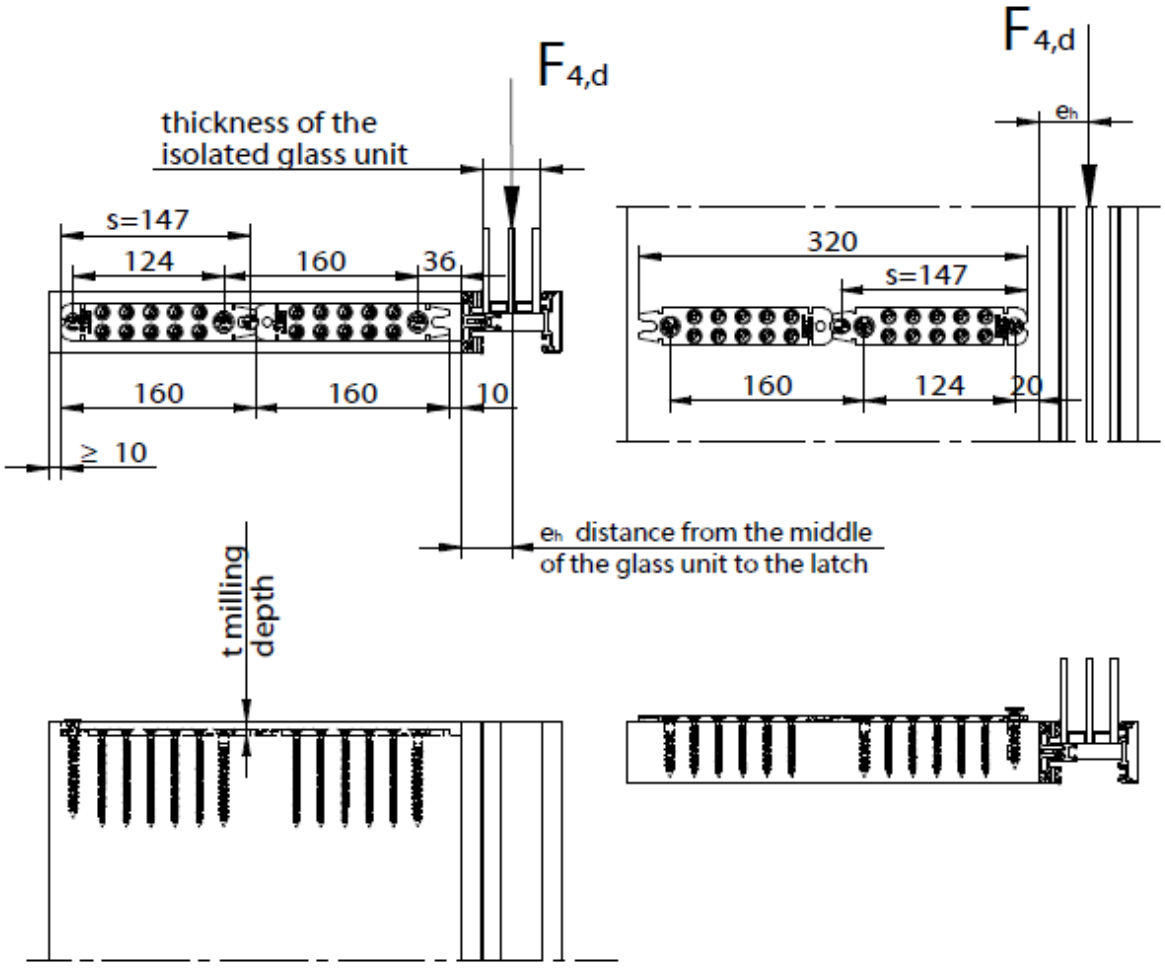
2x RICON® 160/40 EA in series



Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

2x RICON® 160/30 EA in series

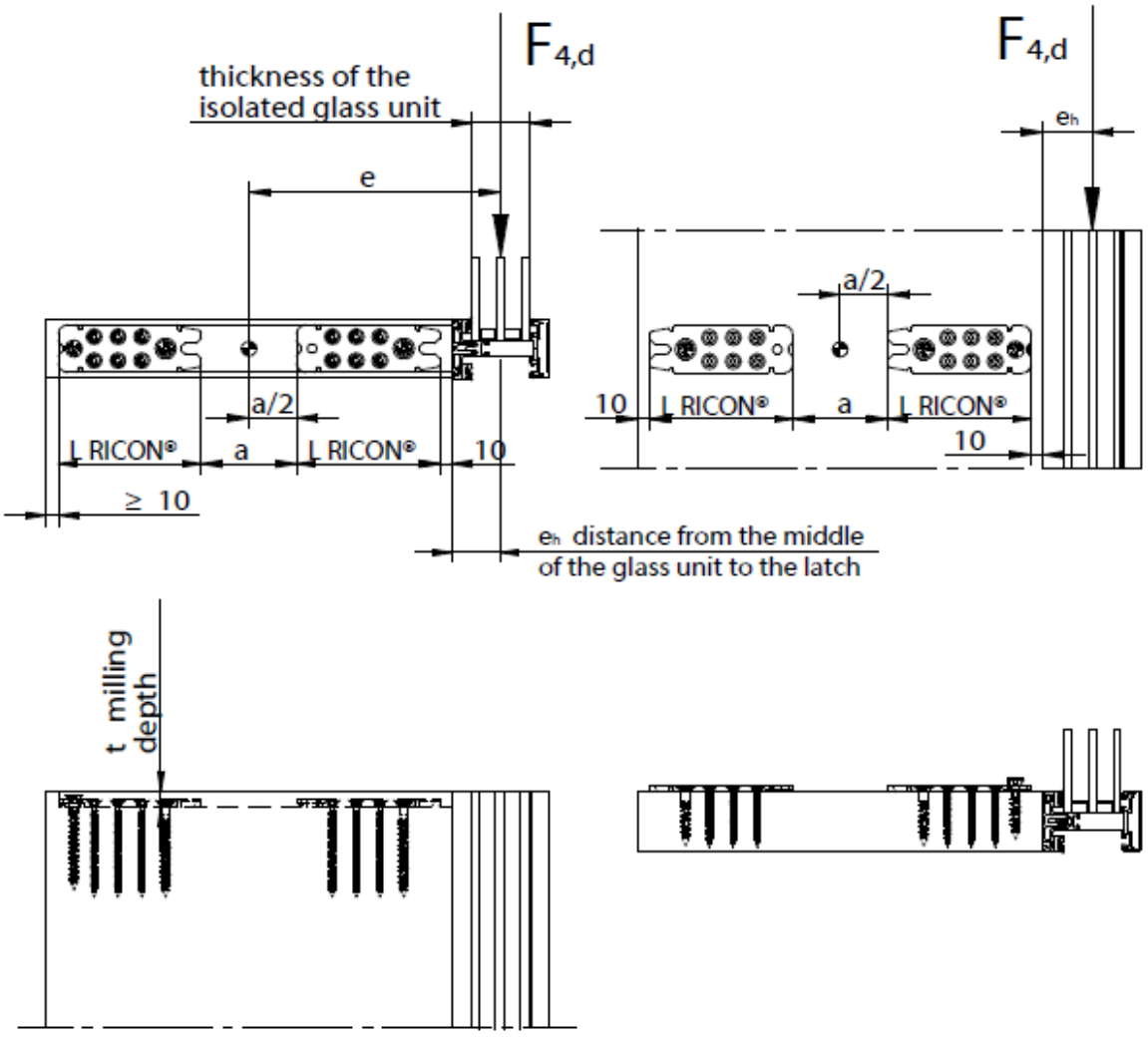


Calculation of $F_{4,d}$ see: page xxx (single RICON®)

RICON®

2x RICON® in series with distance

Series 30 and 40

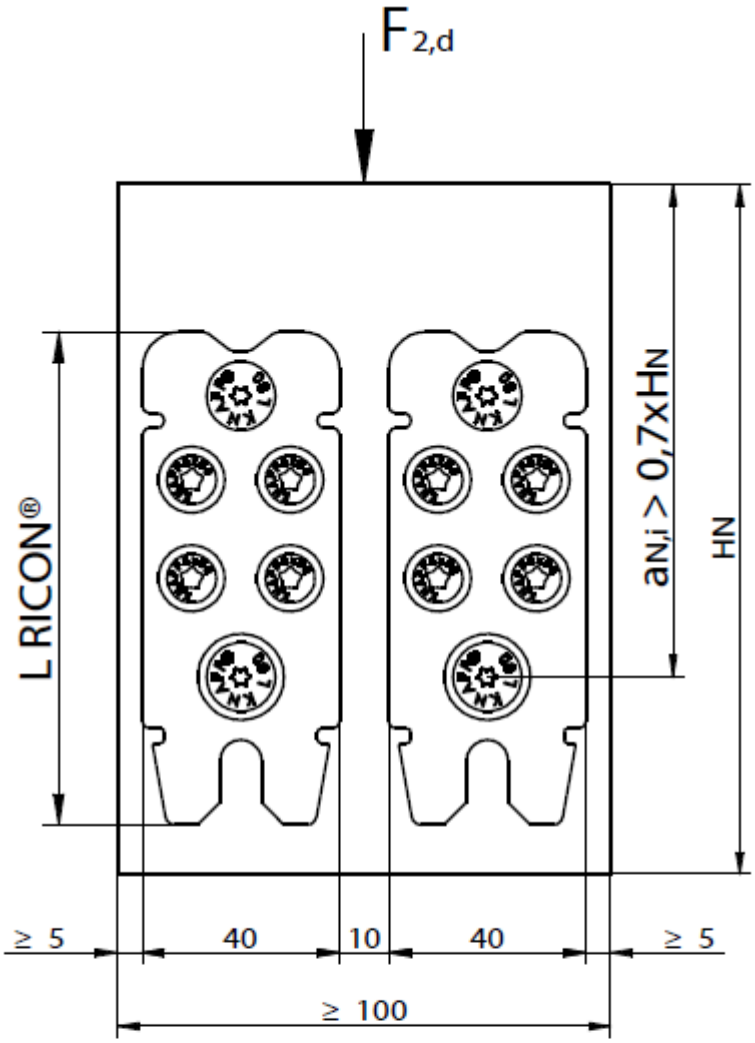


Calculation of $F_{4,d}$ see: page xxx (single RICON®)

For double RICON® in series with distance a/2 has to be added to the value for double joints without distance.

RICON® Series 40

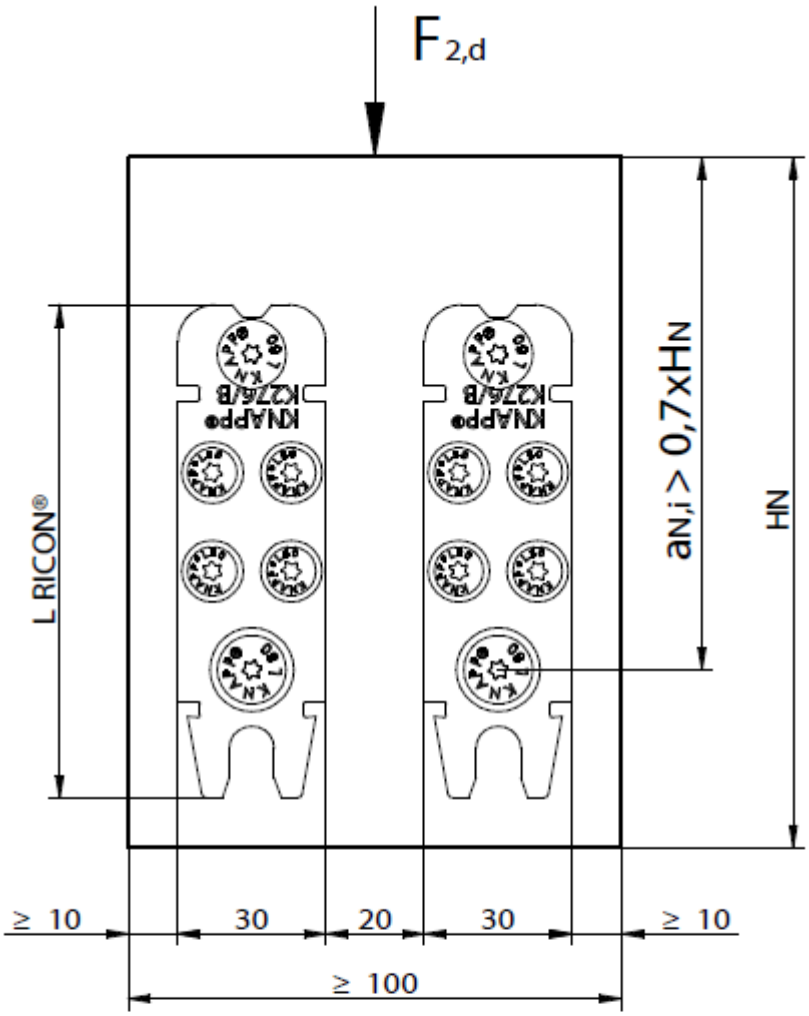
Double RICON® connection



RICON® sizes		minimum cross section	
width	height	width	height
40	60	100	100
40	80	100	120
40	100	100	140
40	120	100	140
40	140	100	160
40	160	100	180

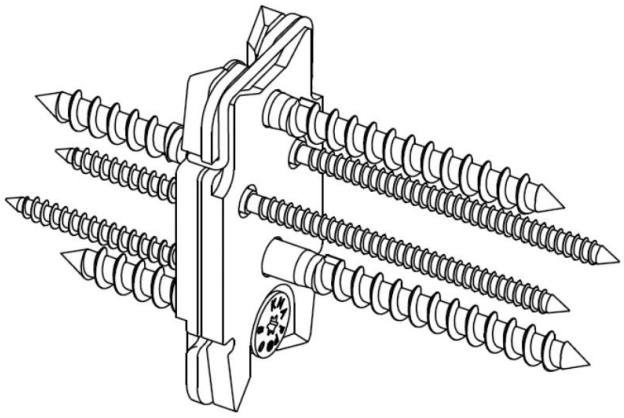
RICON® Series 30

Double RICON® connection



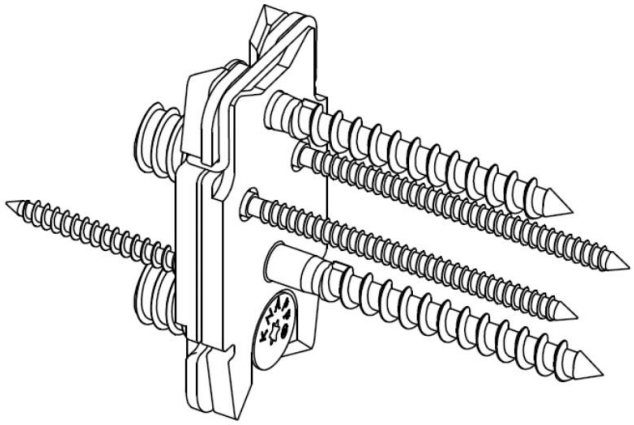
RICON® sizes		minimum cross section	
width	height	width	height
30	60	100	100
30	80	100	120
30	100	100	140
30	120	100	140
30	140	100	160
30	160	100	180

RICON®
RICON® single connection (EA) for wood-to-wood joint



RICON Connector size (Single connection EA)	Screws header / post (Standard screwing)	Screws joist (Standard screwing)
60x16	**3 CS 5x50**	**3 CS 5x80**
70x20	**3 CS 5x50**	**3 CS 5x80**
60x30; 60x40	**1 CS 8x50, 2 CS 5x50**	**1 CS 8x80, 2 CS 5x80**
80x30; 80x40	**2 CS 8x50, 2 CS 5x50**	**2 CS 8x80, 2 CS 5x80**
100x30; 100x40	**2 CS 8x50, 4 CS 5x50**	**2 CS 8x80, 4 CS 5x80**
120x30; 120x40	**2 CS 8x50, 6 CS 5x50**	**2 CS 8x80, 6 CS 5x80**
140x30; 140x40	**2 CS 8x50, 8 CS 5x50**	**2 CS 8x80, 8 CS 5x80**
160x30; 160x40	**2 CS 8x50, 10 CS 5x50**	**2 CS 8x80, 10 CS 5x80**

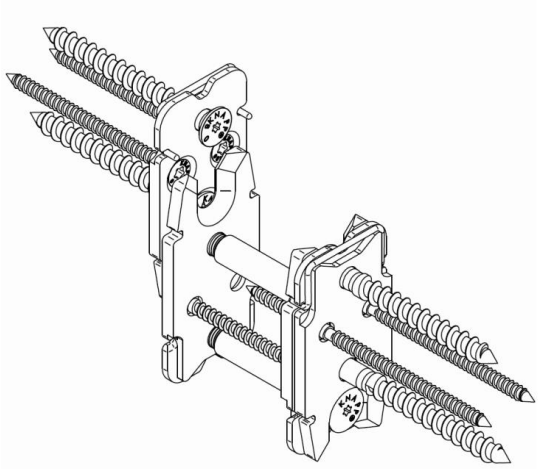
RICON®
RICON® single-double connection (EAR) for wood-to-wood joint



RICON Connector size (Single-double connection EAR)	Screws header / post (Standard screwing)	Screws joist (Standard screwing)
60x16	3 CS M5x20 / Insert screw M5x14	3 CS 5x80
70x20	3 CS M5x20 / Insert screw M5x14	3 CS 5x80
60x30 60x40	1 CS M8x25 / Insert screw M8x18 2 CS M5x20 / Insert screw M5x14	1 CS 8x80, 2 CS 5x80
80x30 80x40	2 CS M8x25 / Insert screw M8x18 1 CS 5x50	2 CS 8x80, 2 CS 5x80
100x30 100x40	2 CS M8x25 / Insert screw M8x18 2CS 5x50	2 CS 8x80, 4 CS 5x80
120x30 120x40	2 CS M8x25 / Insert screw M8x18 3 CS 5x50	2 CS 8x80, 6 CS 5x80
140x30 140x40	2 CS M8x25 / Insert screw M8x18 4 CS 5x50	2 CS 8x80, 8 CS 5x80
160x30 160x40	2 CS M8x25 / Insert screw M8x18 5 CS 5x50	2 CS 8x80, 10 CS 5x80

RICON®

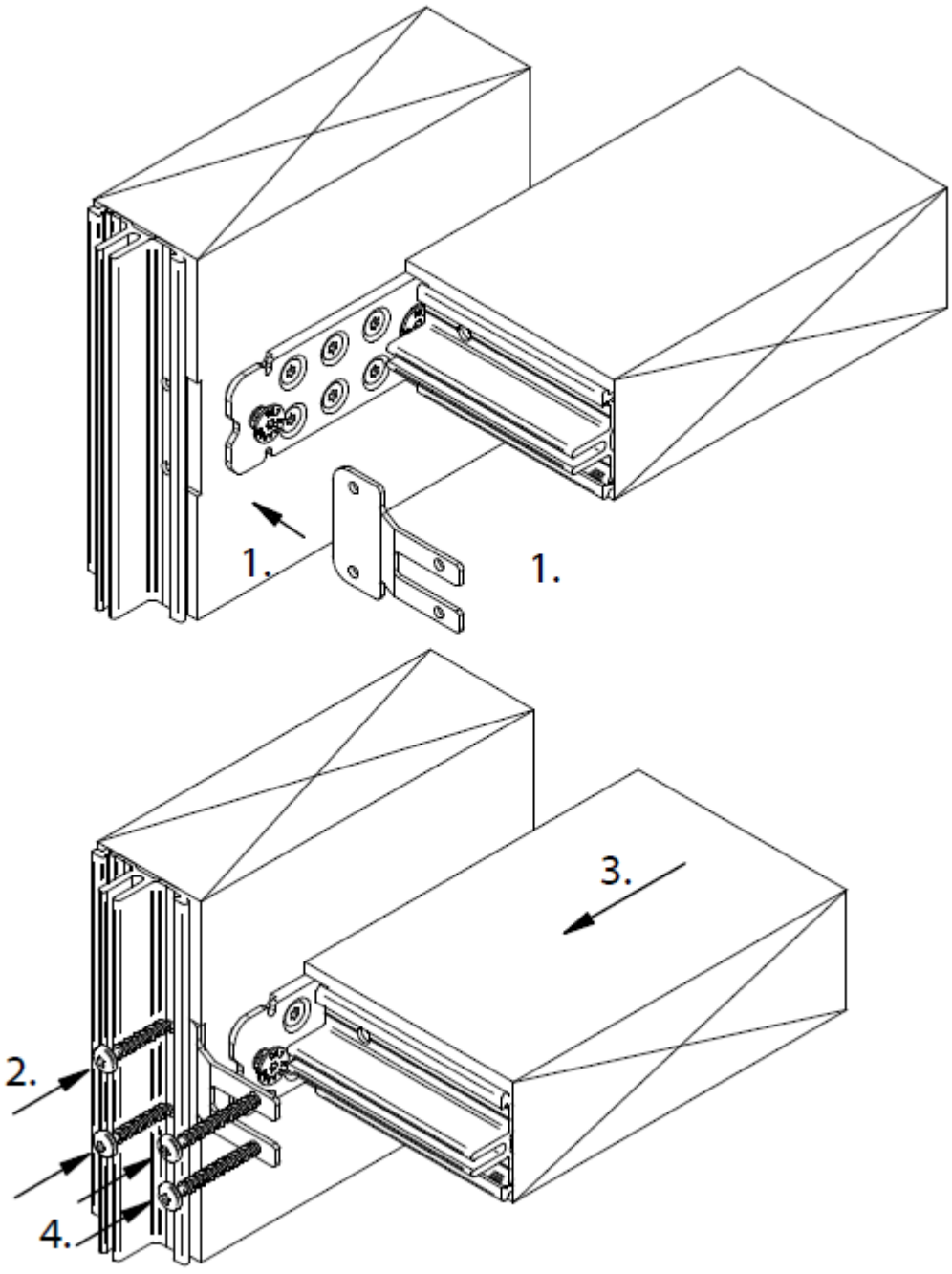
RICON® double connection (DA) for wood-to-wood joint with connecting nut (CN)



RICON Connector size (Double connection DA)	Screws header / post (Standard screwing)	Screws joist (Standard screwing)
60x16	6 CS M5x16 / 3 CN M5xL	6 CS 5x80
70x20	6 CS M5x16 / 3 CN M5xL	6 CS 5x80
60x30 60x40	2 CS M8x25 / 1 CN M8xL 4 CS M5x20 / 2 CN M5xL	2 CS 8x80, 4 CS 5x80
80x30 80x40	4 CS M8x25 / 2 CN M8xL 2 CS 5x50	4 CS 8x80, 4 CS 5x80
100x30 100x40	4 CS M8x25 / 2 CN M8xL 4 CS 5x50	4 CS 8x80, 8 CS 5x80
120x30 120x40	4 CS M8x25 / 2 CN M8xL 6 CS 5x50	4 CS 8x80, 12 CS 5x80
140x30 140x40	4 CS M8x25 / 2 CN M8xL 8 CS 5x50	4 CS 8x80, 16 CS 5x80
160x30 160x40	4 CS M8x25 / 2 CN M8xL 10 CS 5x50	4 CS 8x80, 20 CS 5x80

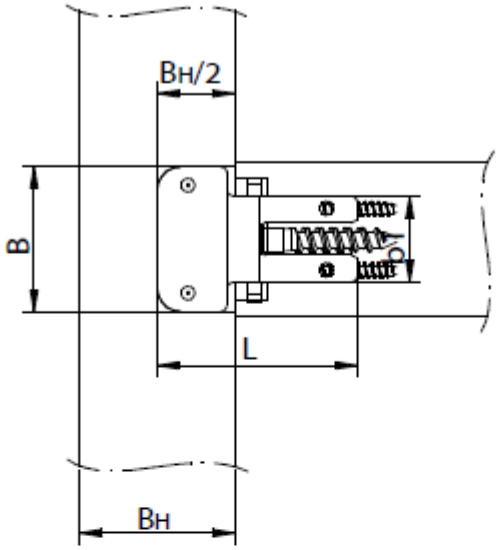
RICON®

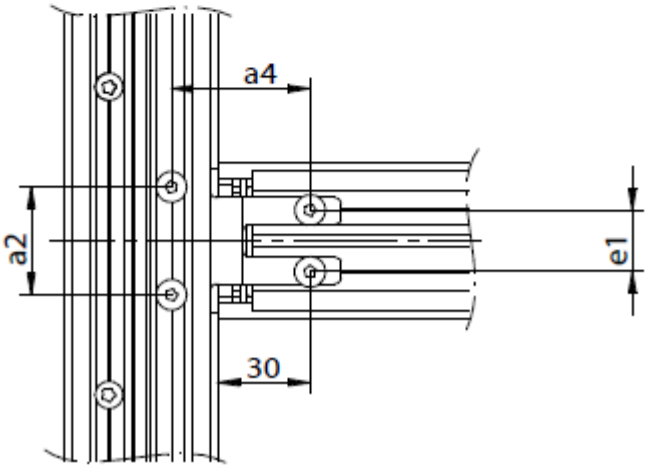
RICON® reinforcing plate installation process



RICON®

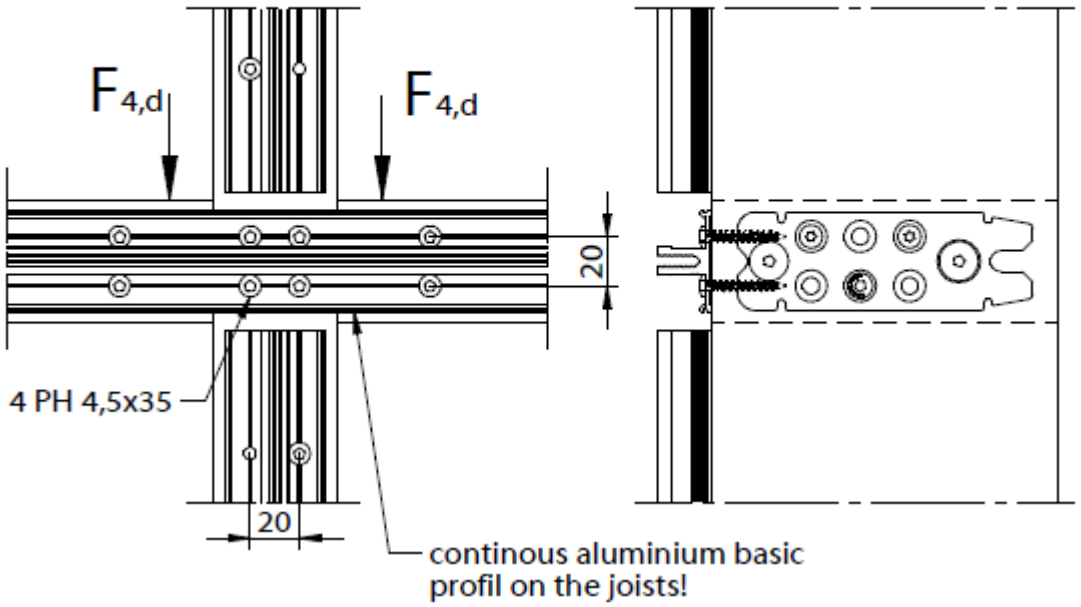
RICON® reinforcing plate drill-hole positions

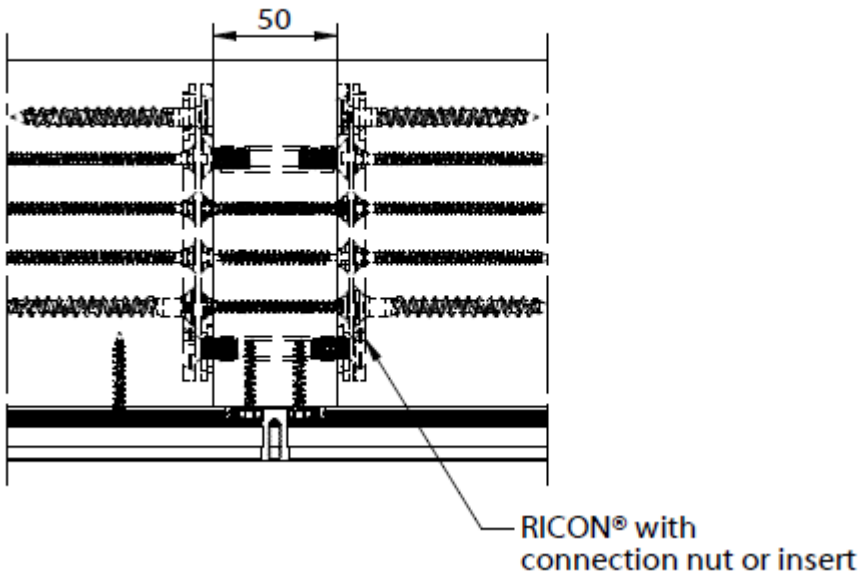




RICON®

RICON® double connection with continuous aluminium basic profile on the joists

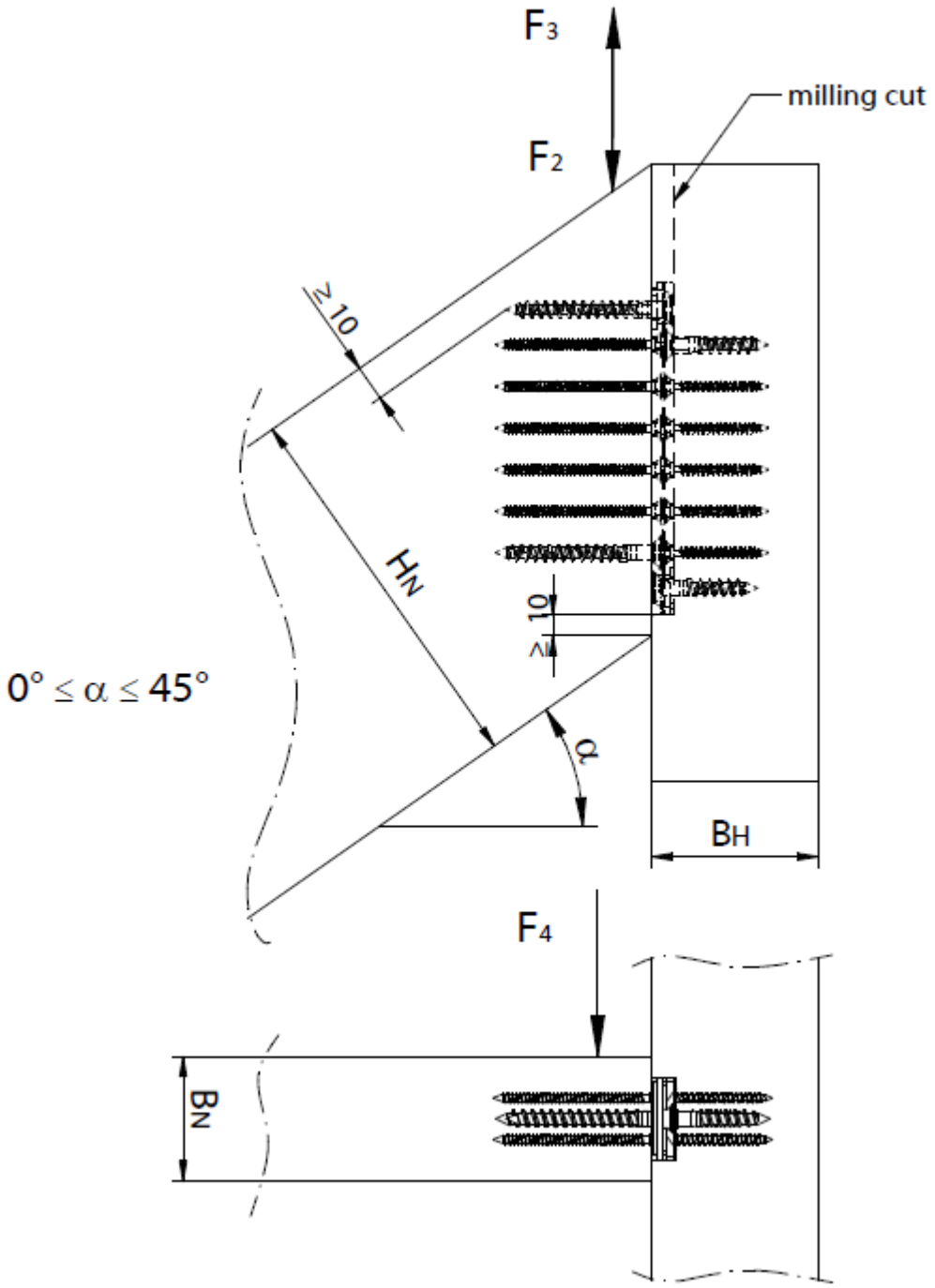




RICON®

Tilted joints/ milling cut in header

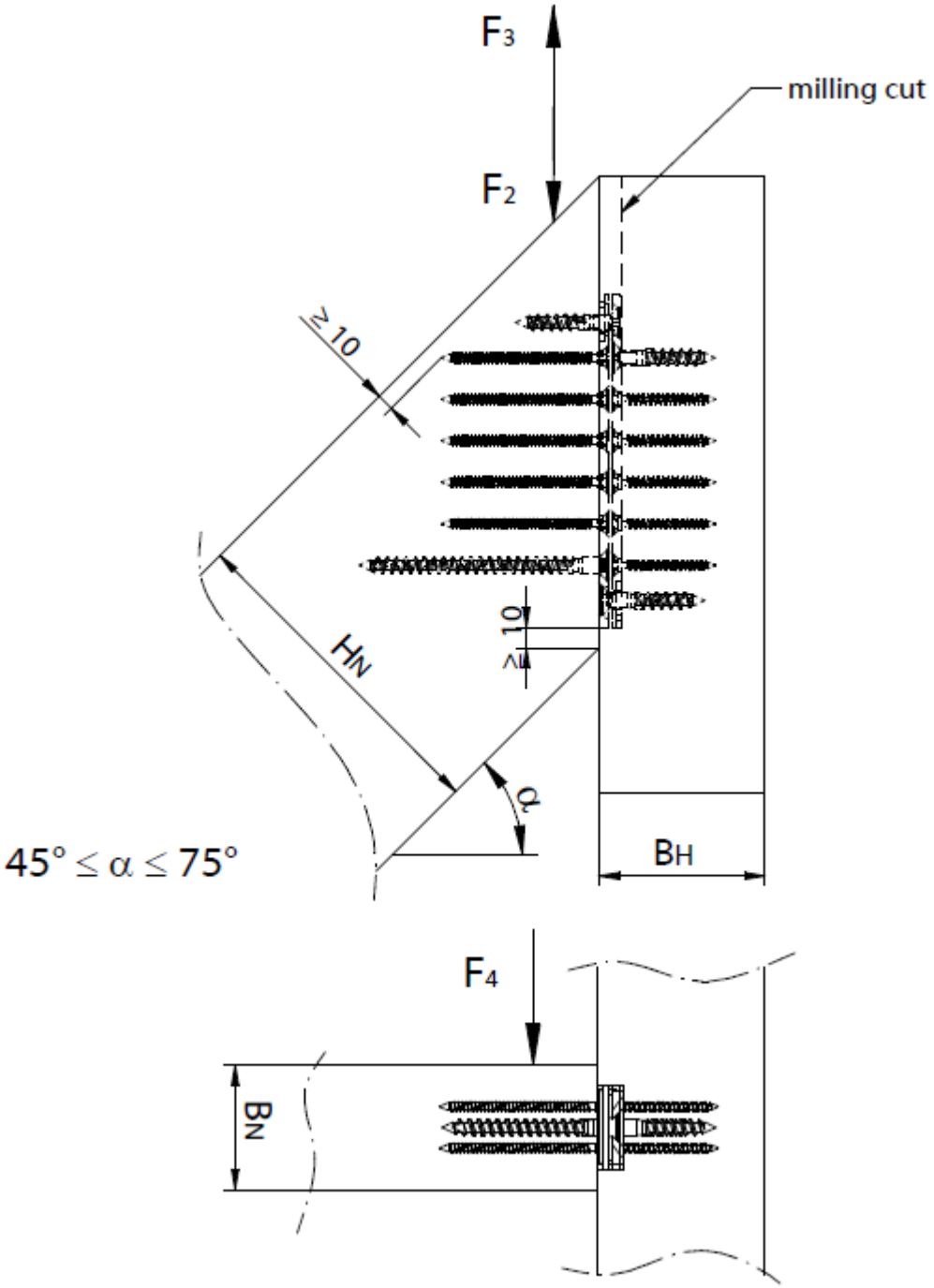
$\alpha \leq 45°$



RICON®

Tilted joints / milling cut in header

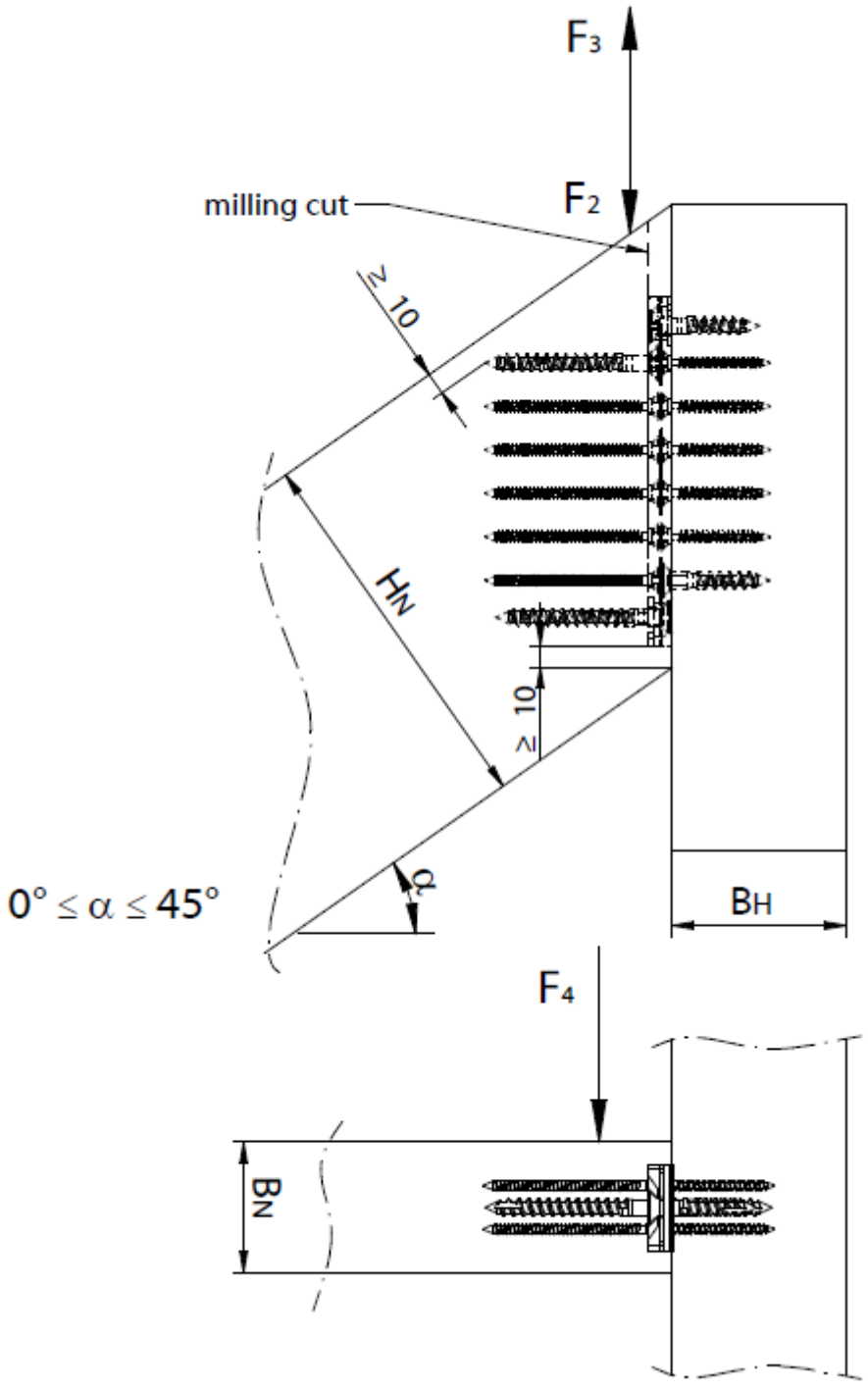
$\alpha \geq 45°$



RICON®

Tilted joints / milling cut in joist

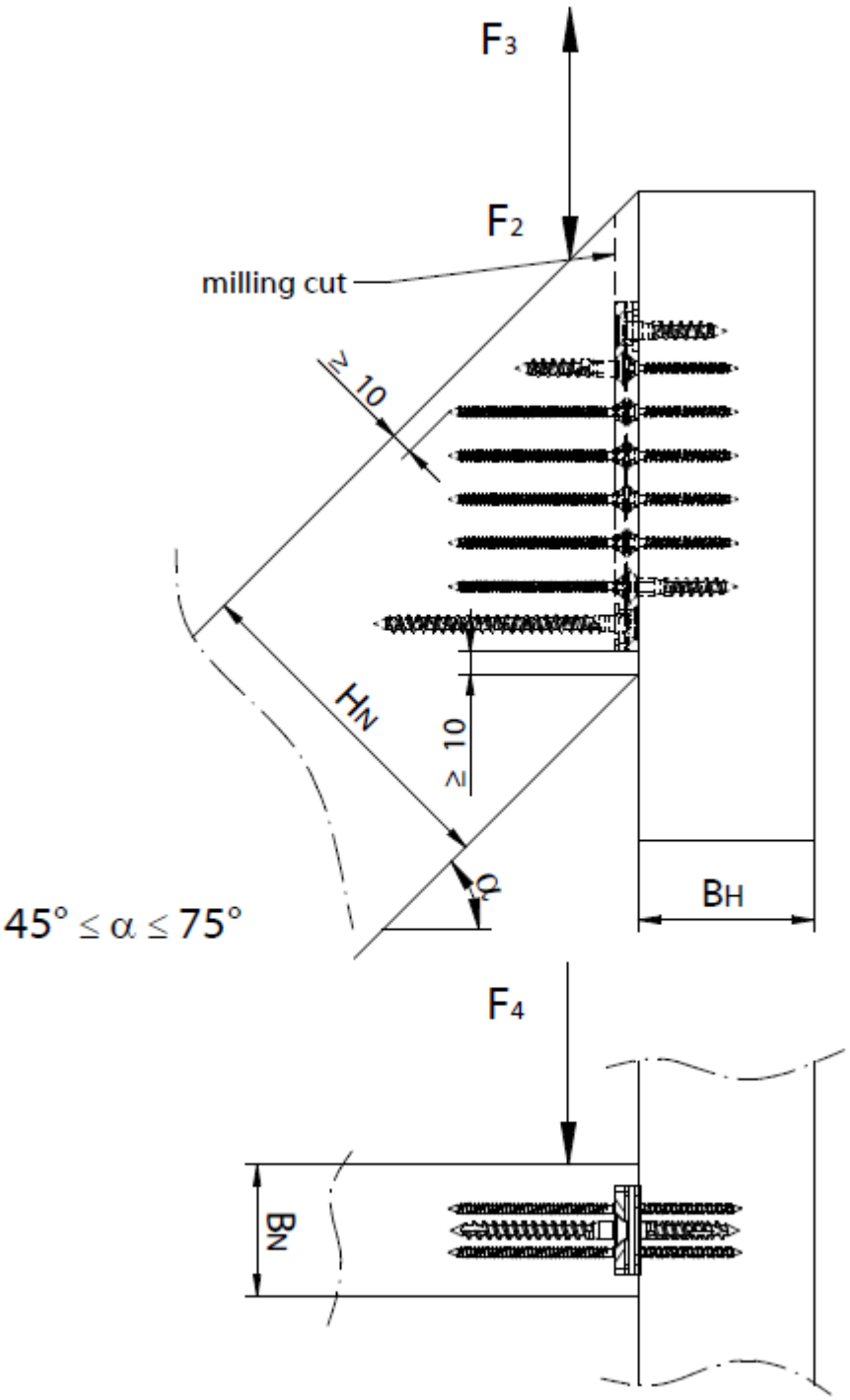
$\alpha \leq 45°$



RICON®

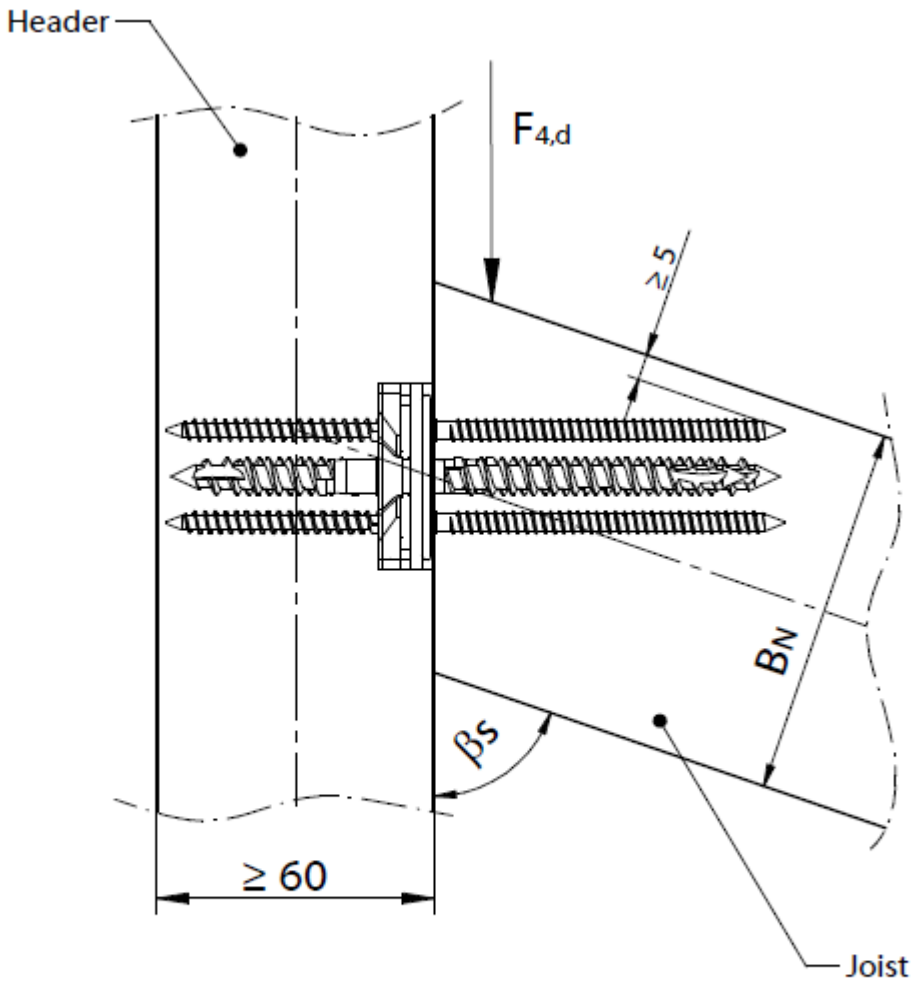
Tilted joints / milling cut in joist

$\alpha \geq 45°$



RICON®

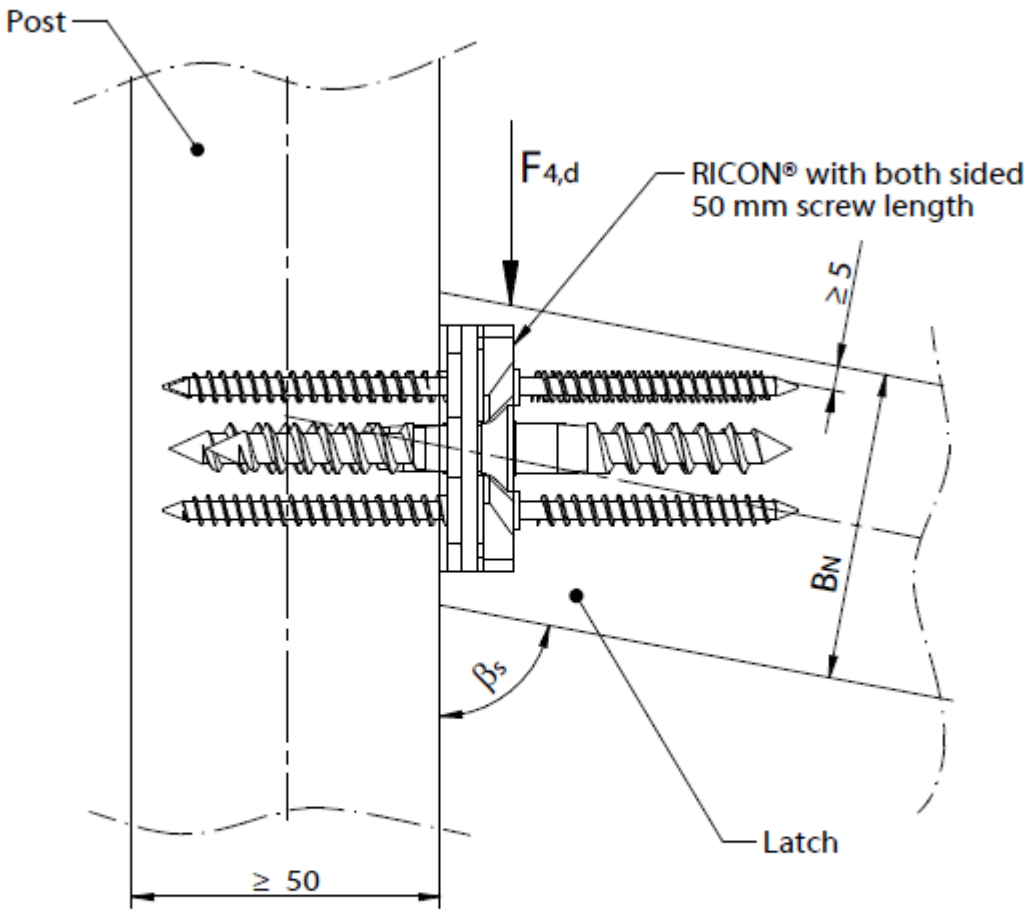
Tilted joints / milling cut in header



Breite B_N	Winkel β_S
50 mm	83°
80 mm	71°

RICON®

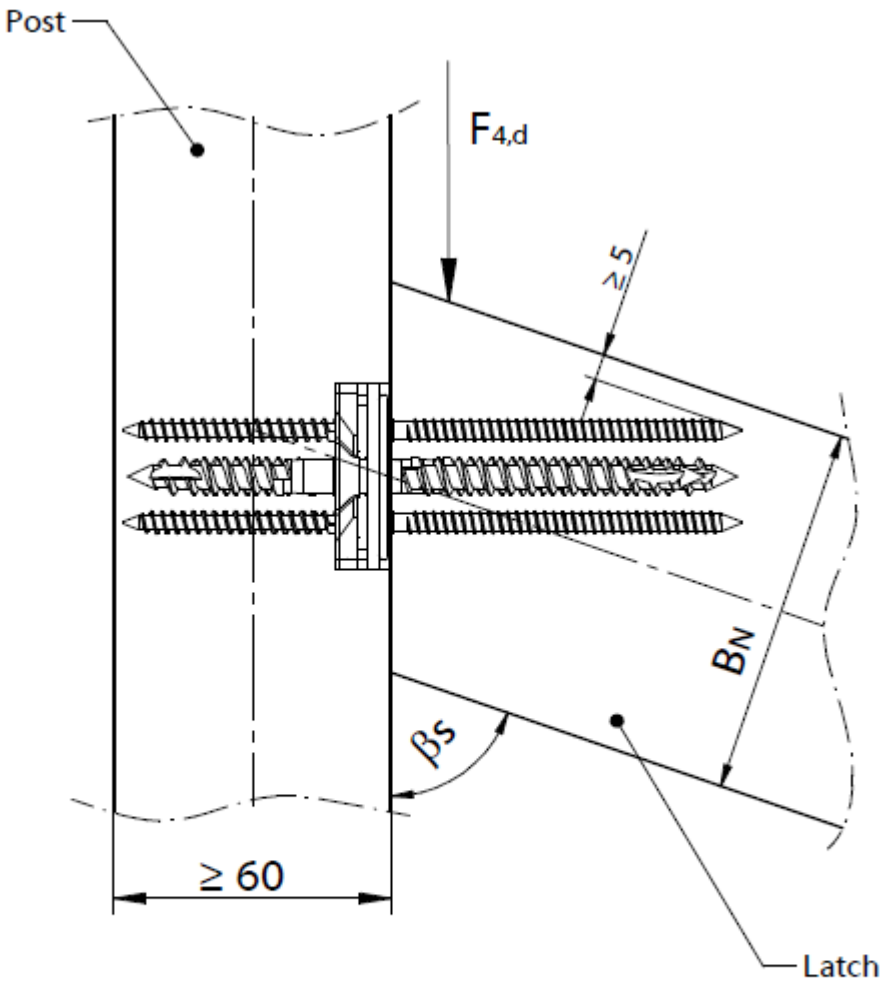
Tilted joints / milling cut in joist



width B_N	angle β_S
50 mm	80
60 mm	72
80 mm	45

RICON®

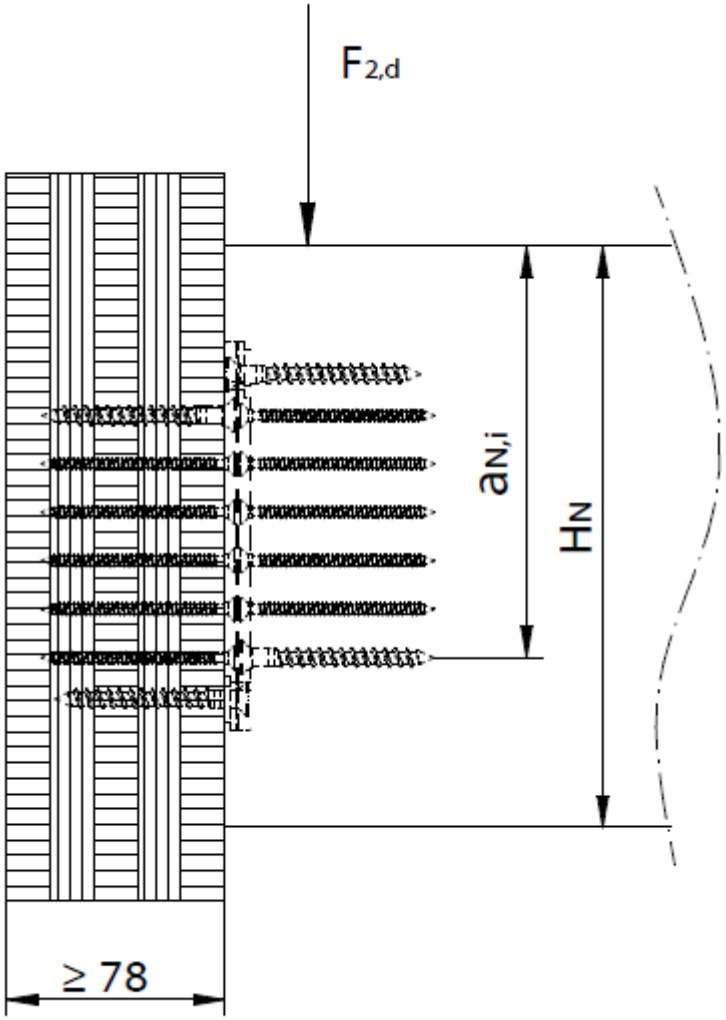
Tilted joints / milling cut in header



Breite B_N	Winkel β_S
50 mm	84°
80 mm	73°

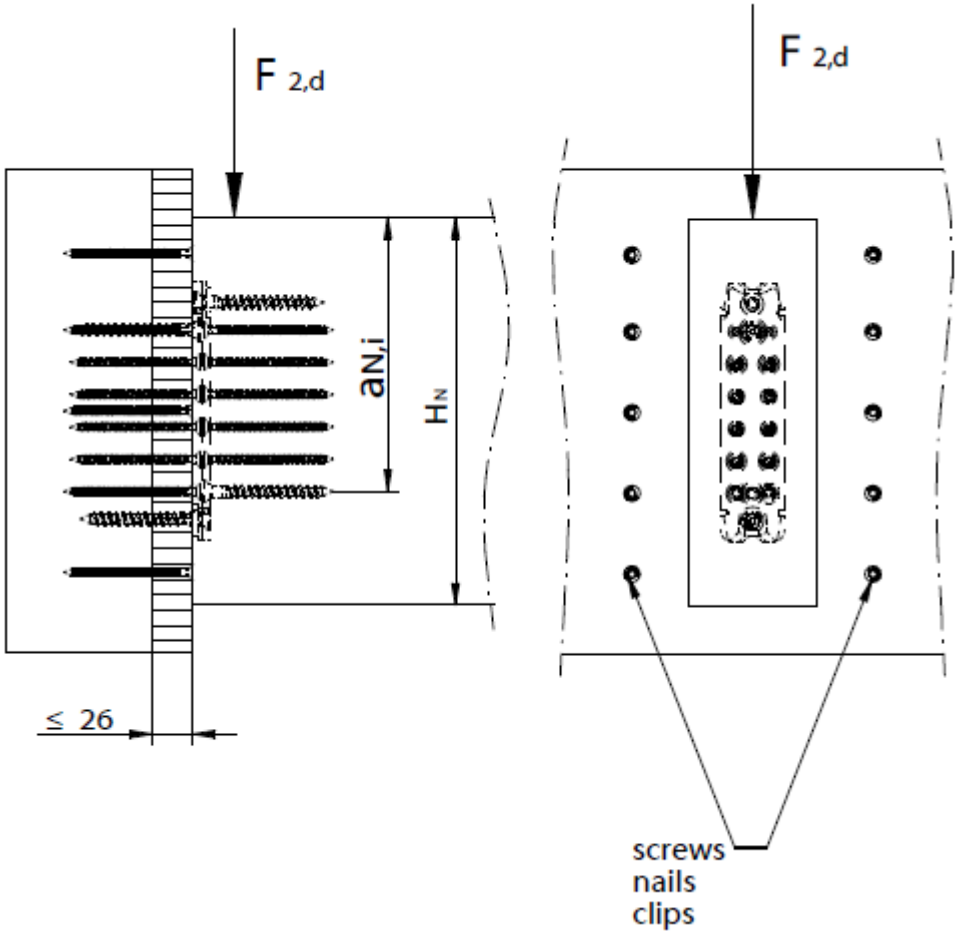
RICON®

Joint with cross laminated timber header



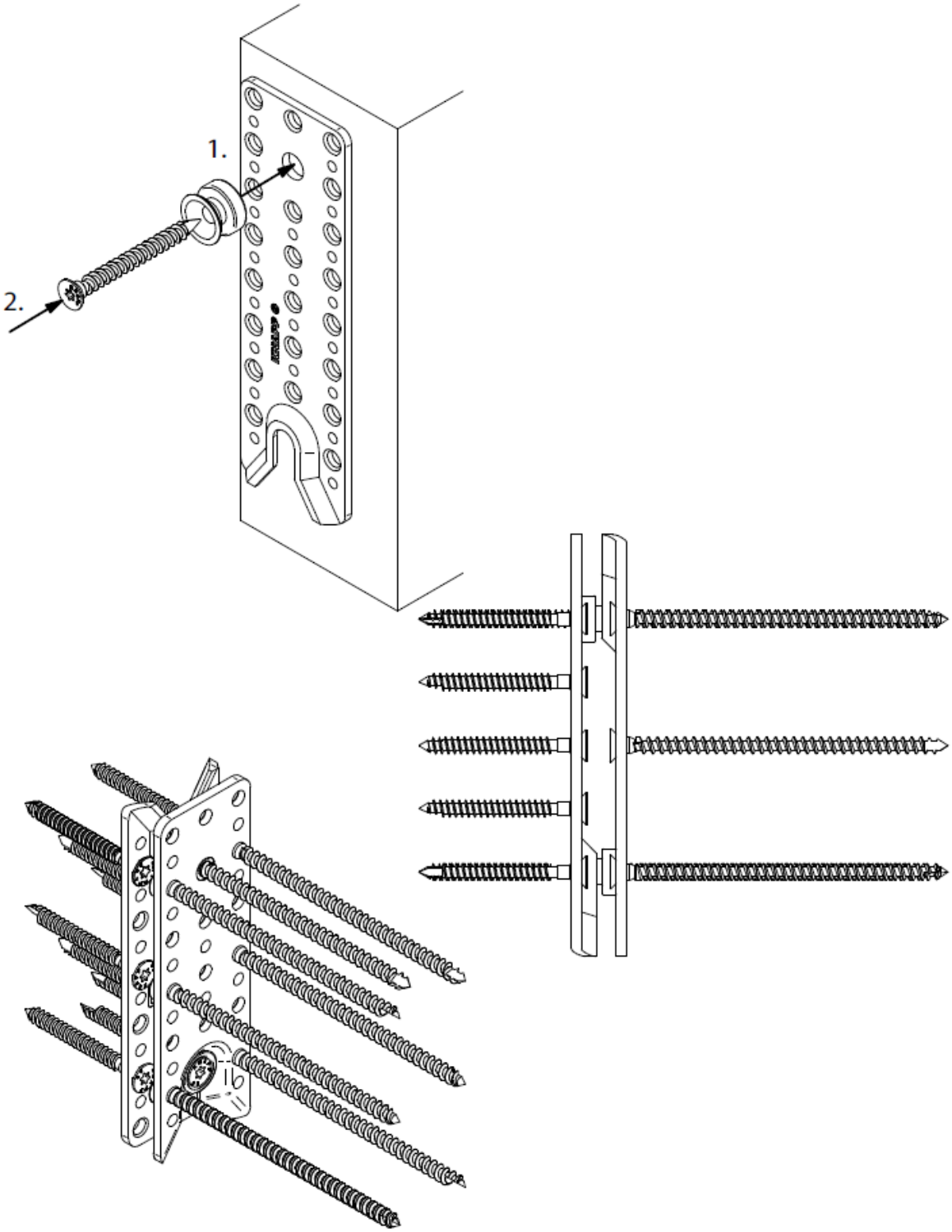
RICON®

Joint with interlayer



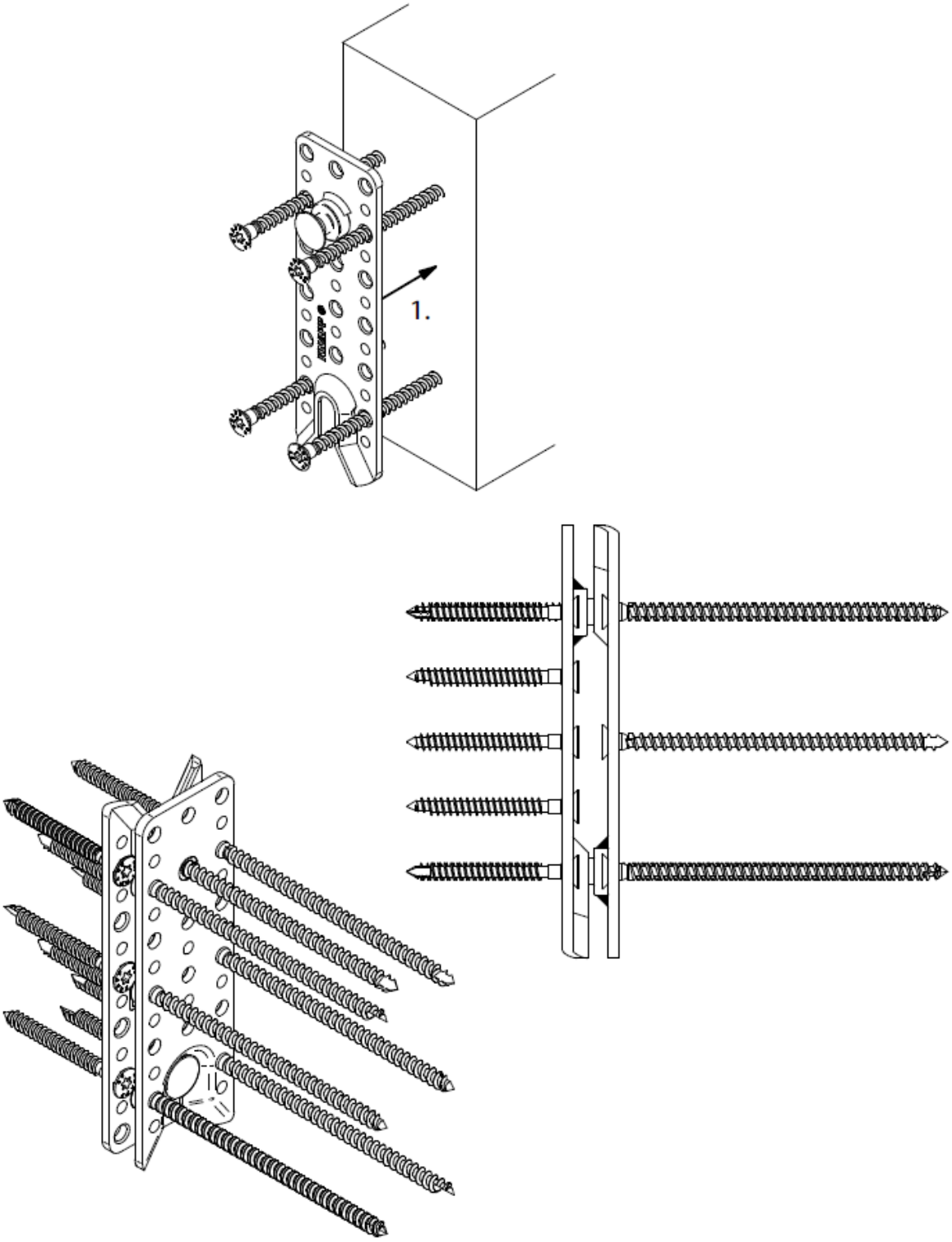
RICON® S

Installation collar bolt



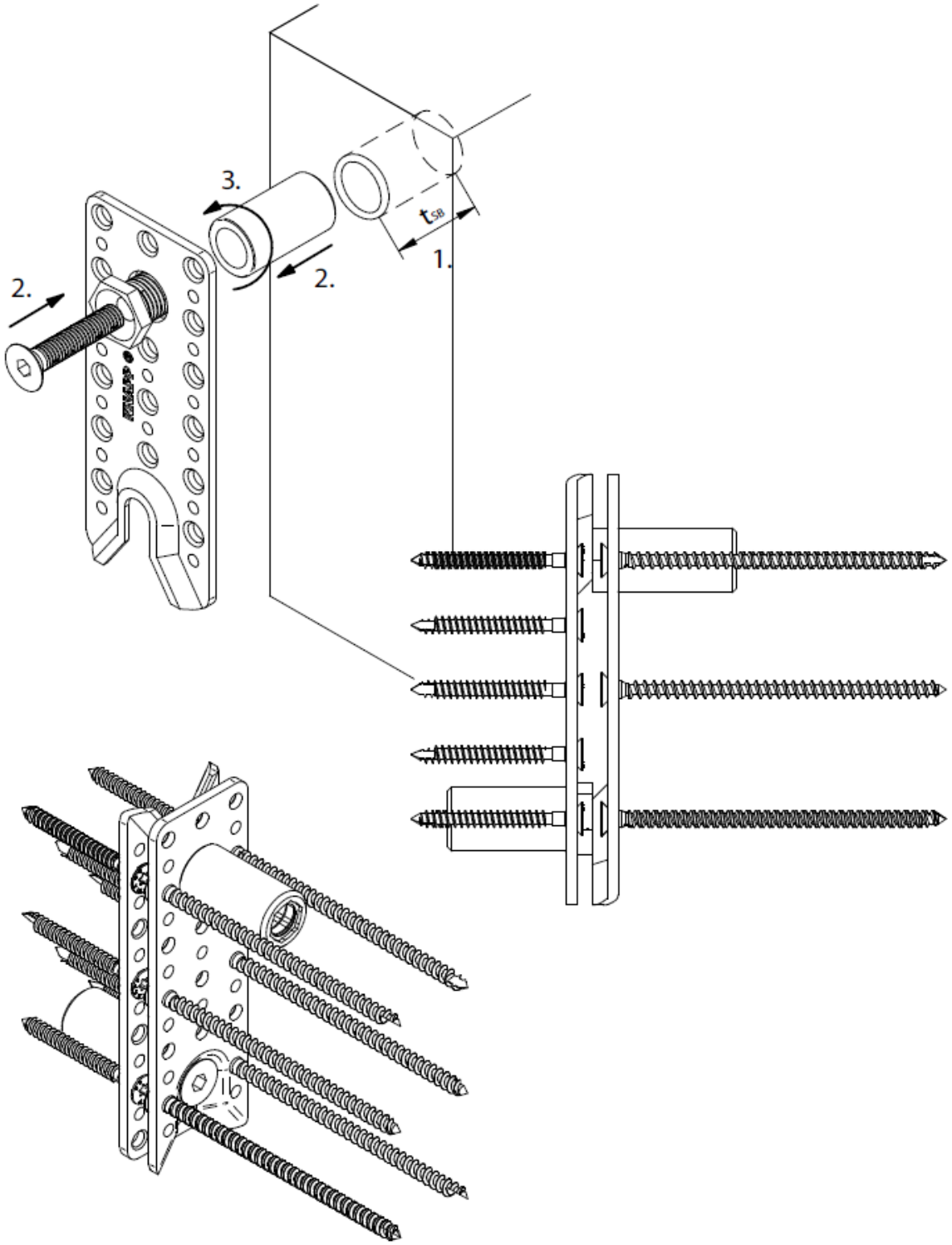
RICON® S

Installation welded collar bolt



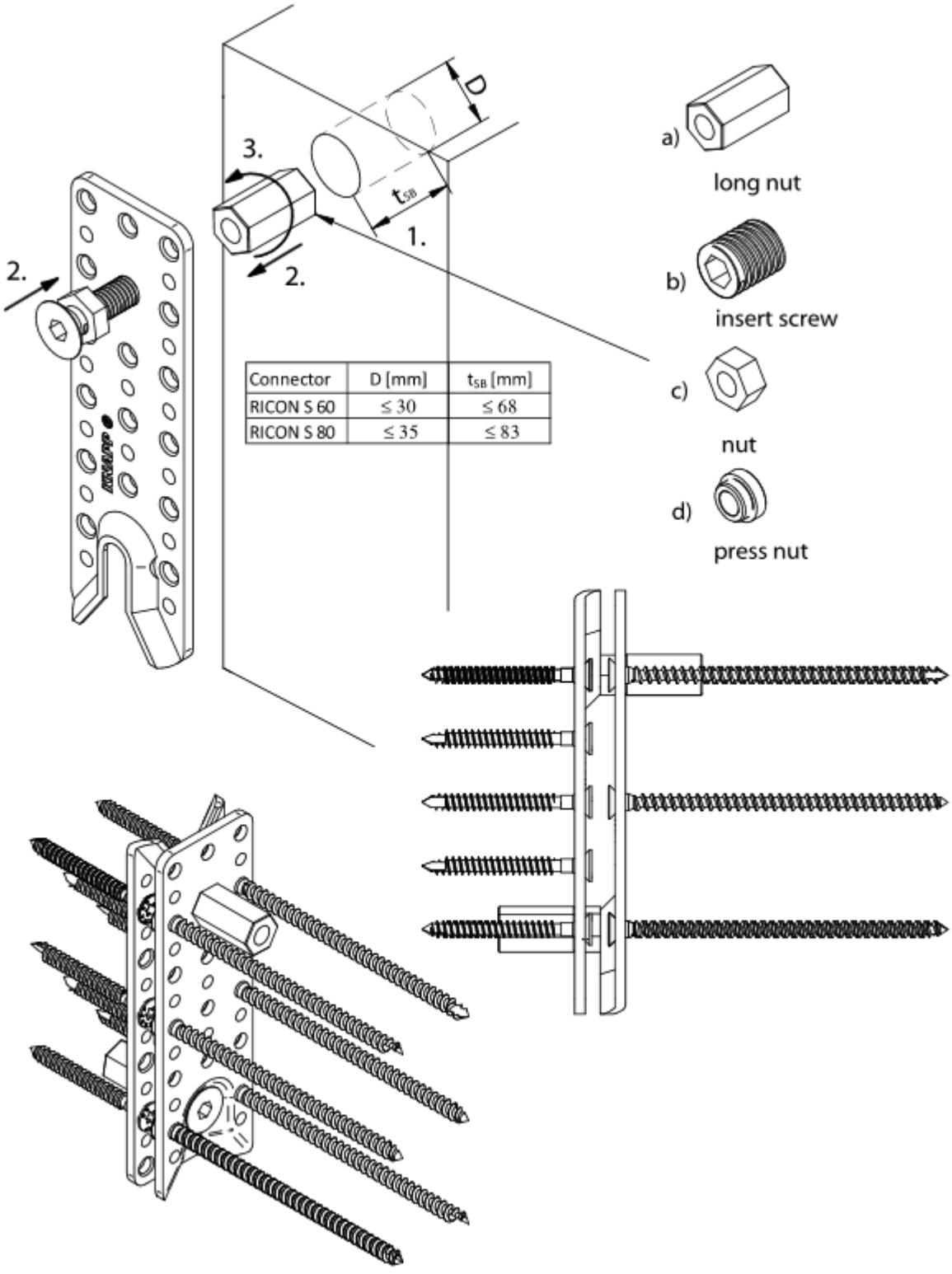
RICON® S

Installation spring retaining screw collar bolt



RICON® S

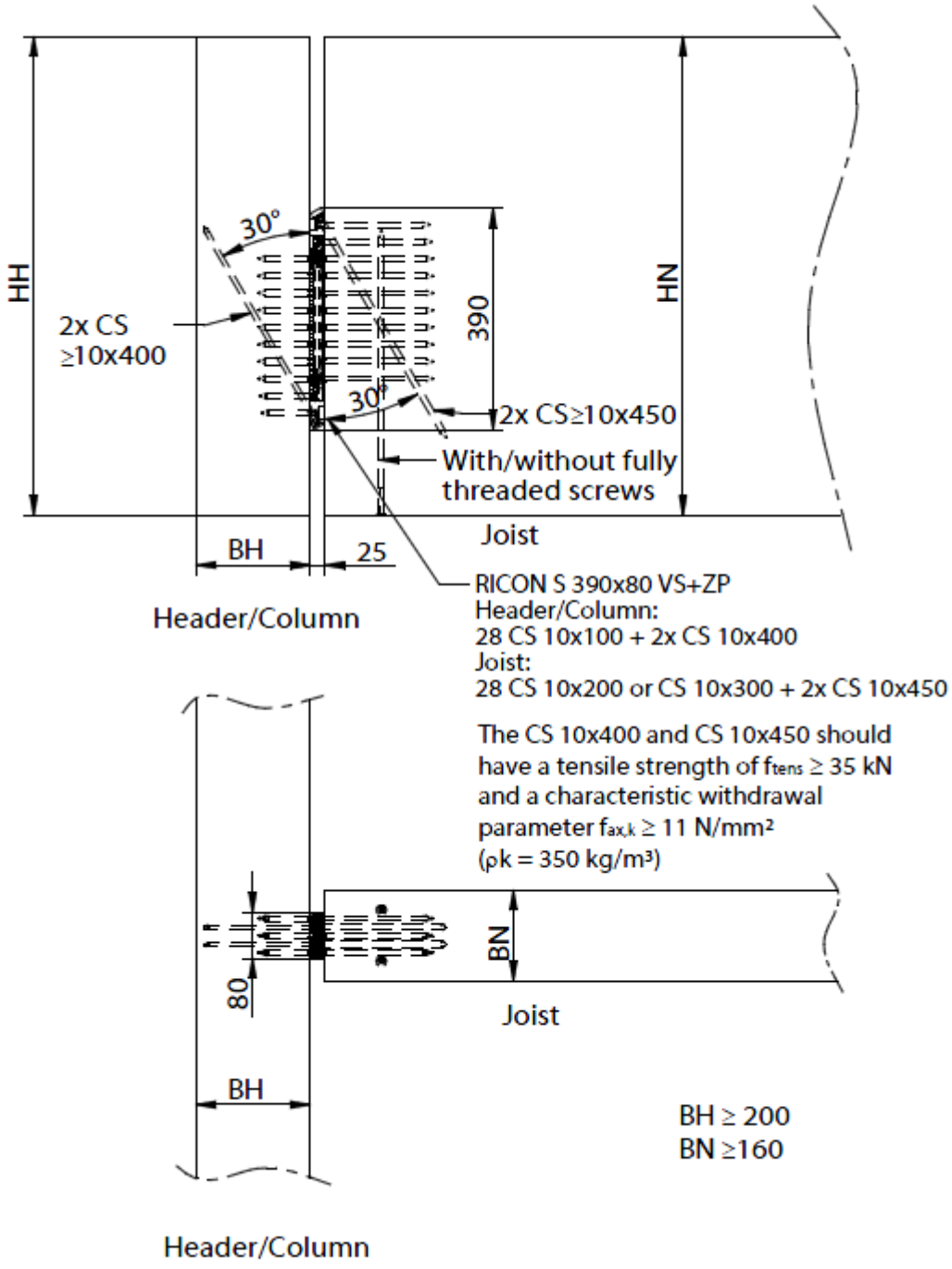
Installation retaining screw bolt



Connector	D [mm]	t_{SB} [mm]
RICON S 60	≤ 30	≤ 68
RICON S 80	≤ 35	≤ 83

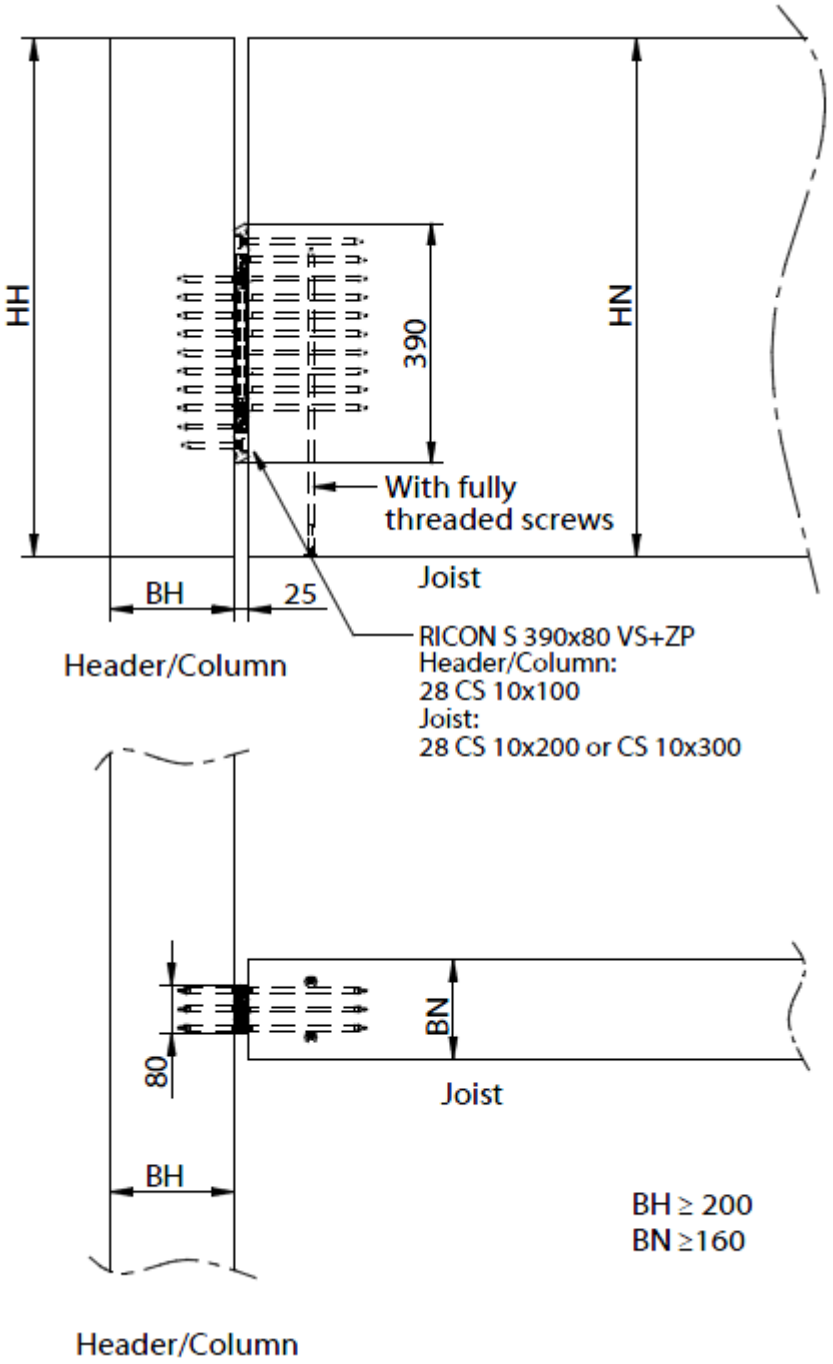
RICON® S

RICON® S 390x80 VS+ZP with 30° inclined screws
Header-joist-connection



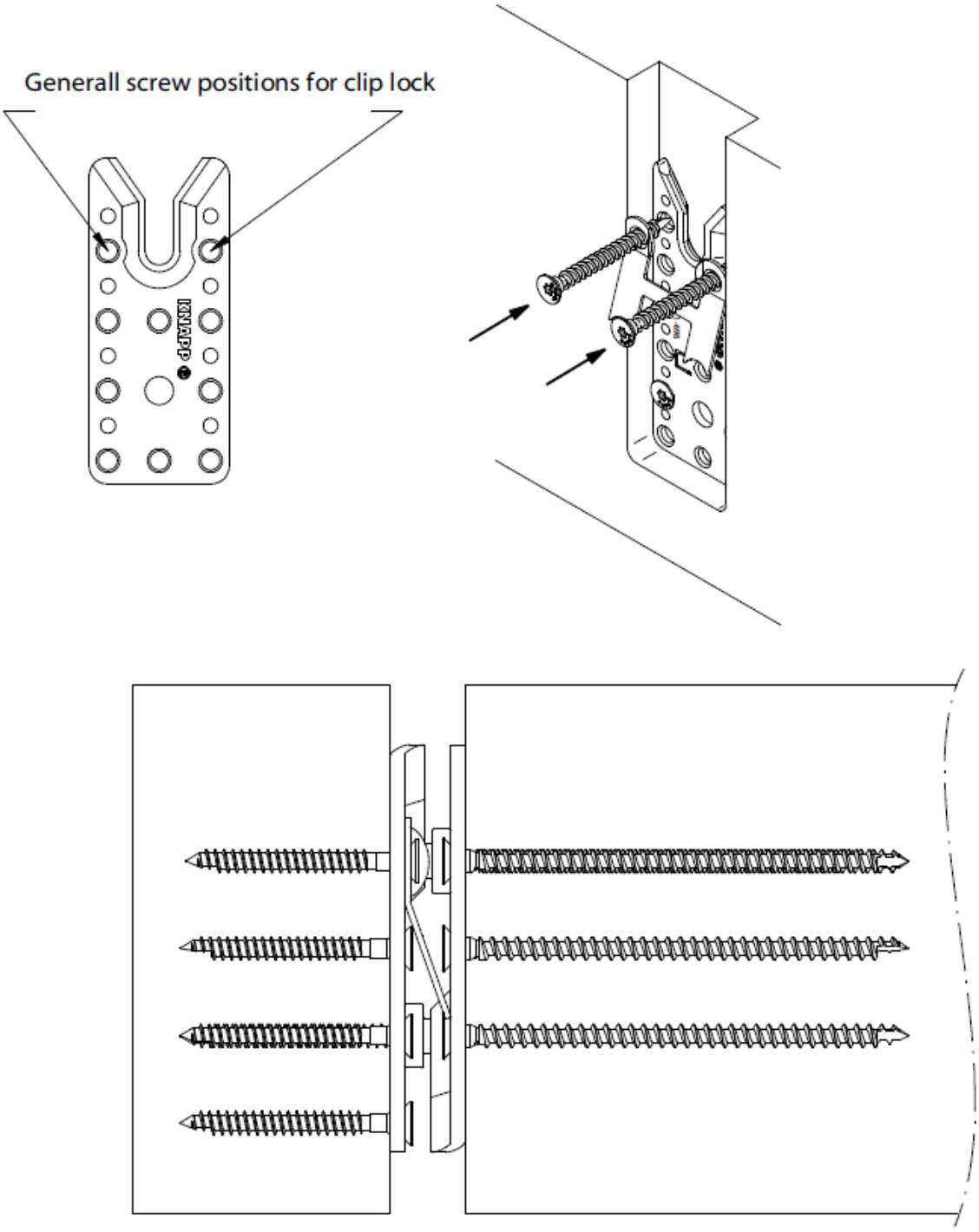
RICON® S

RICON® S 390x80 VS+ZP without 30° inclined screws
Header-joist-connection



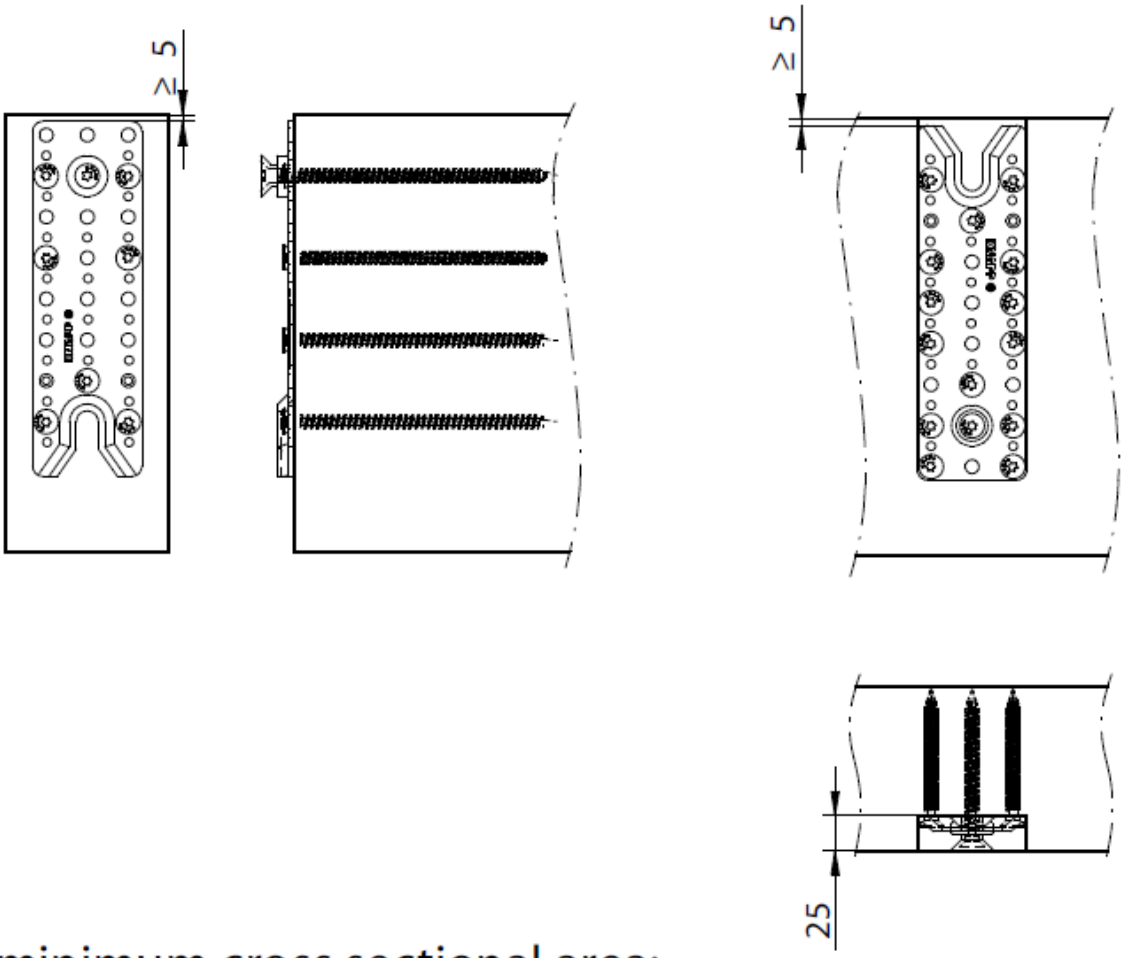
RICON® S

Installation clip lock



RICON® S

Minimum cross-section sizes

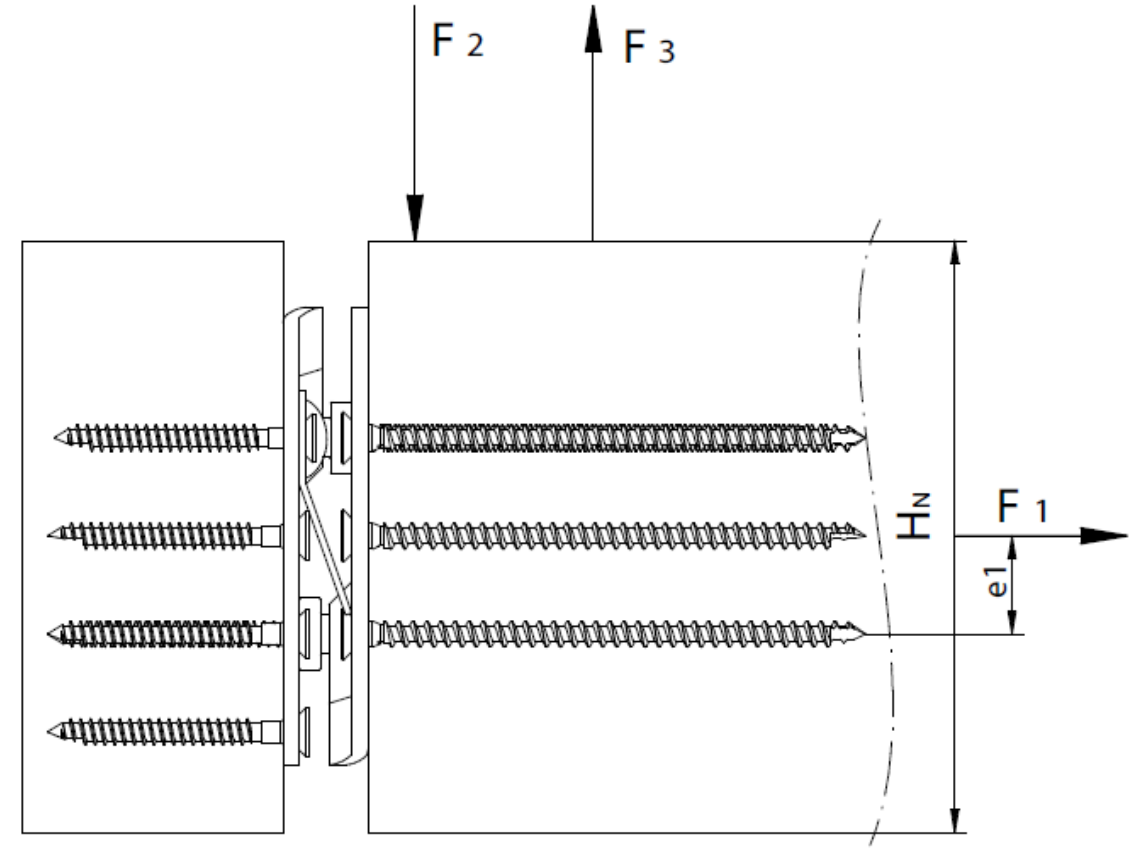


minimum cross sectional area:

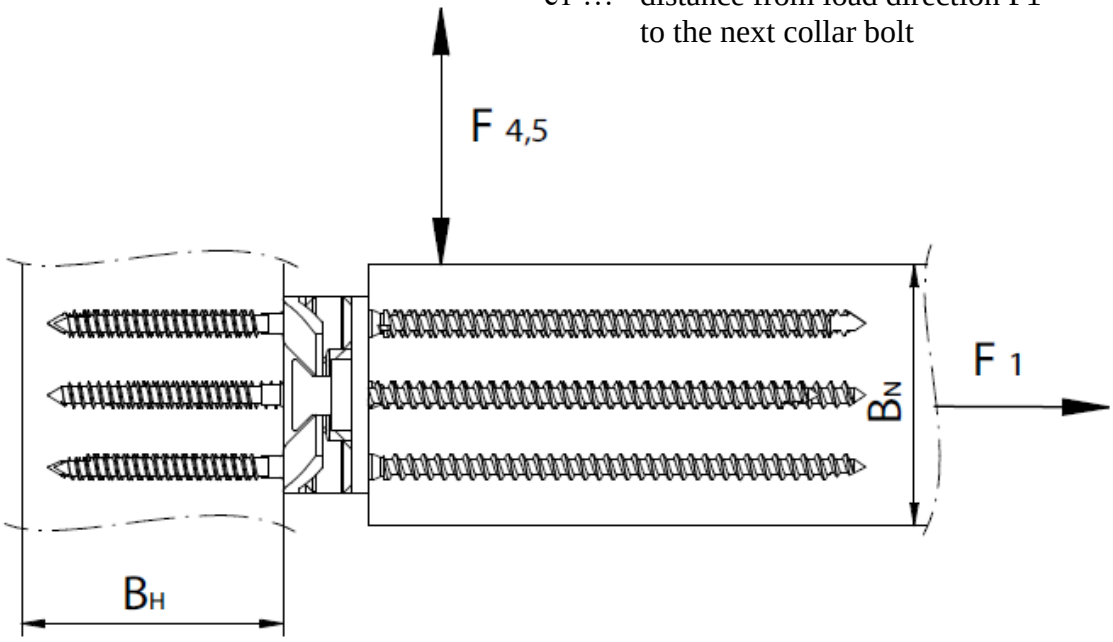
joint size		minimum cross section	
width	height	width	height
60	140	100	160
60	170	100	190
60	200	100	220
60	230	100	250
80	200	120	230
80	230	120	260
80	260	120	290
80	290	120	320

RICON® S

Load directions

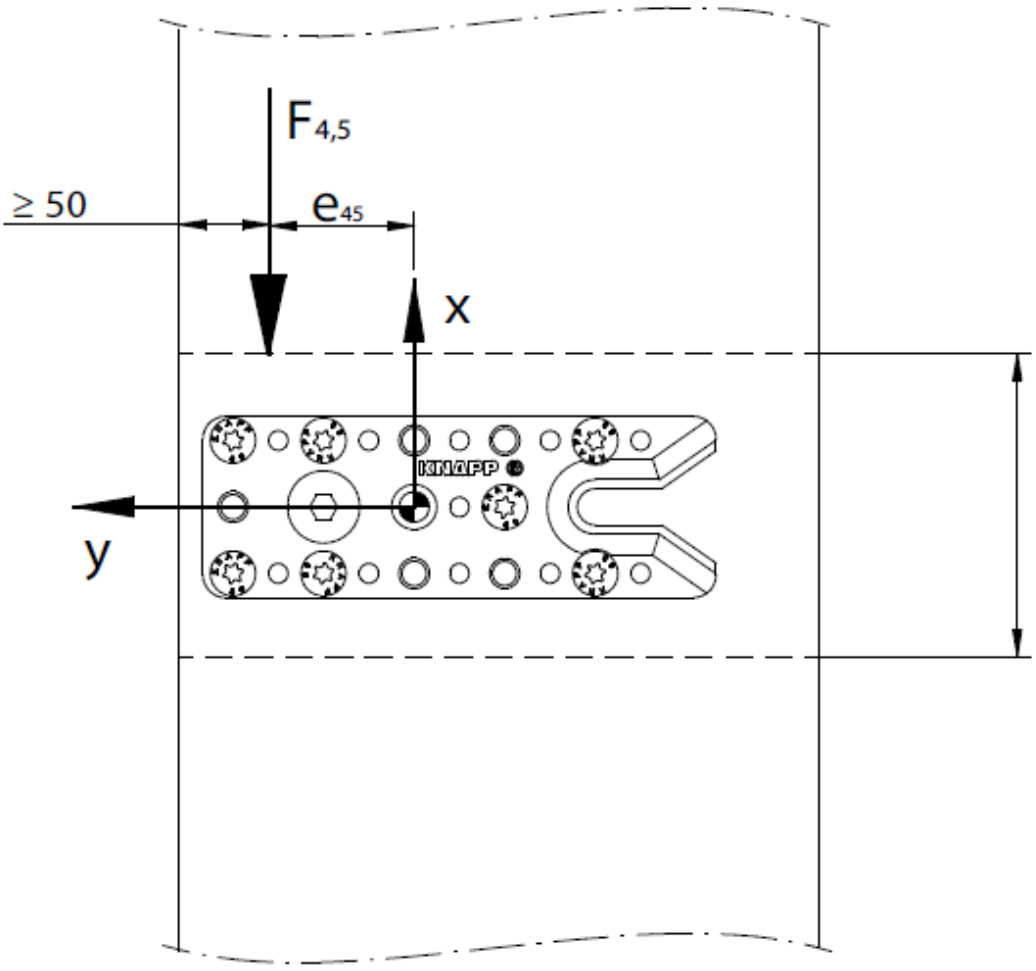


e1 … distance from load direction F1 to the next collar bolt



RICON® S

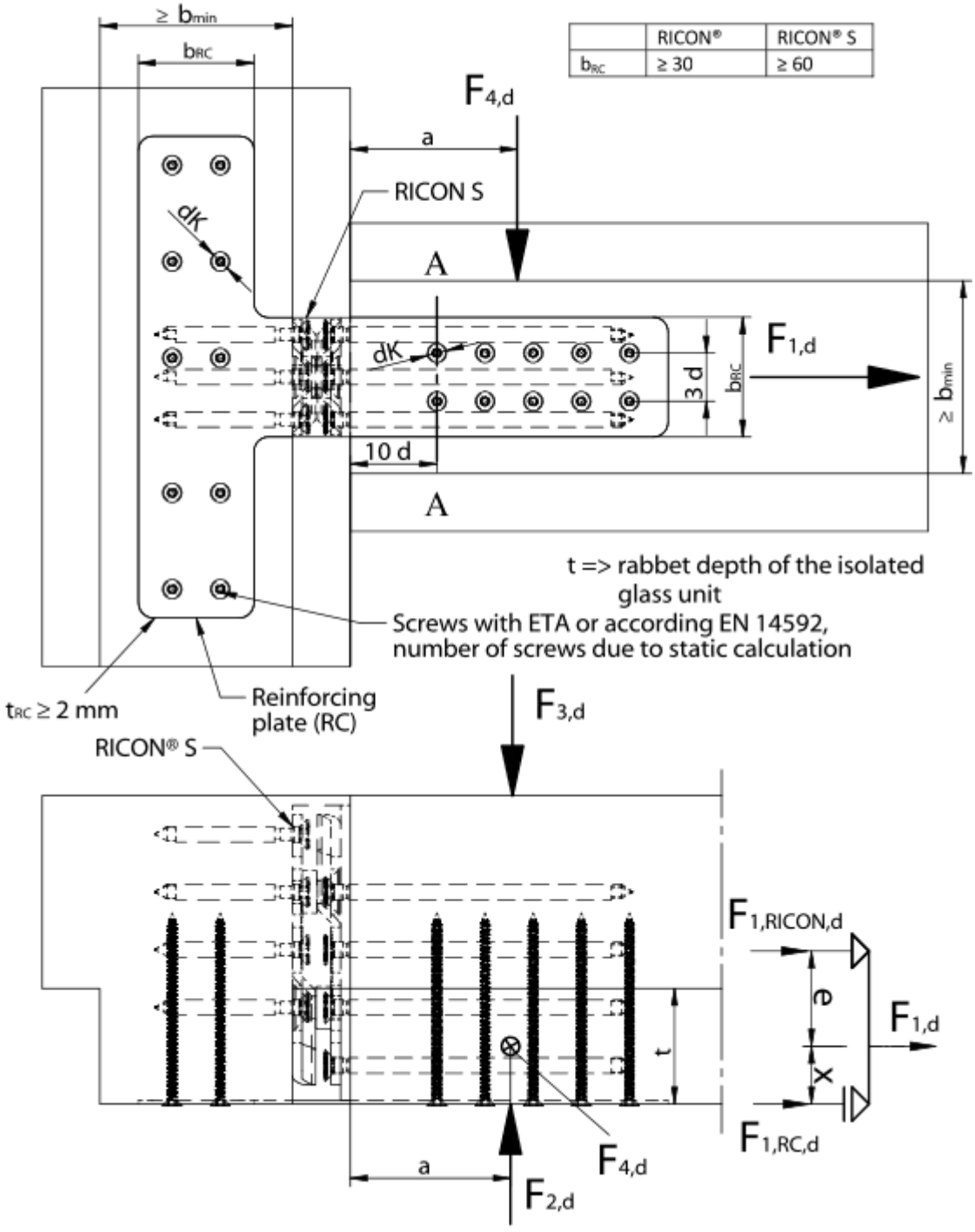
Eccentric loading



Centre of gravity of screw pattern

RICON® / RICON® S

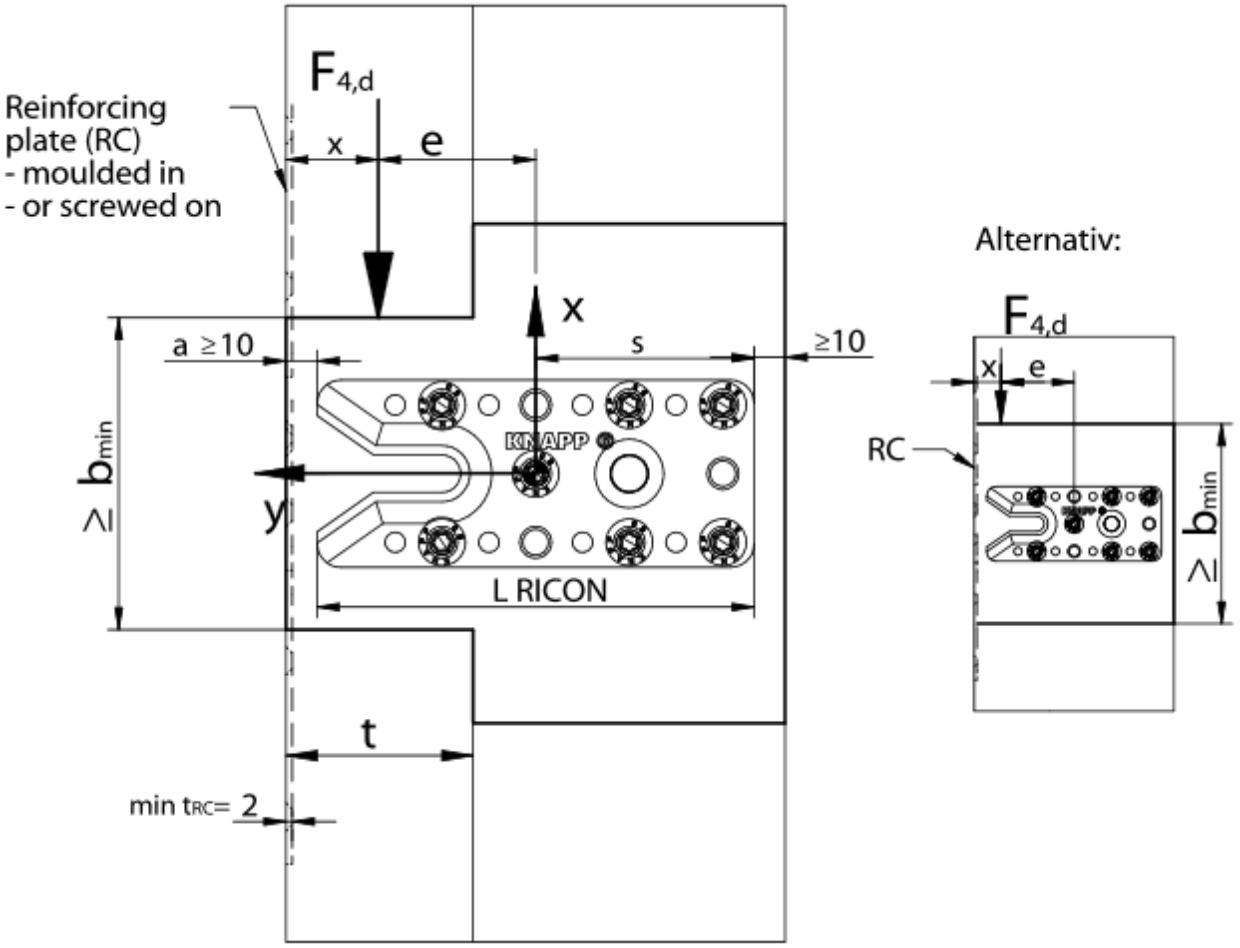
Eccentric loading with screwed on reinforcing plate (no alu basic profile)



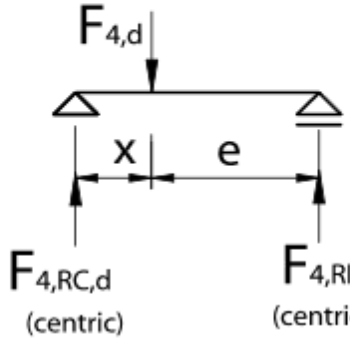
	RICON®	RICON® S
b_{RC}	≥ 30	≥ 60

RICON® / RICON® S

Static system of eccentric loaded RICON® / RCION® S with reinforcing plate:



$$x = (a + L_{RICON}) - (s + e)$$



$$F_{4,RC,d} = \frac{F_{4,d} \cdot e}{(e + x)}$$

$$F_{4,RICON,d} = \frac{F_{4,d} \cdot x}{(e + x)}$$

t => rabbet depth of the isolated glass unit
s => distance to the RICON / RICON S centroid

RICON® / RICON® S

Static calculation of eccentric loaded RICON® / RICON® S with reinforcing plate:

Calculation of the reaction $F_{4,RC,d}$ and $F_{4,RICON,d}$:

$$F_{4,RC,d} = \frac{F_{4,d} \cdot e}{(e + x)} \quad ; \; F_{4,RICON,d} = \frac{F_{4,d} \cdot x}{(e + x)}$$ (load F_1 is similar calculated)

$$x = (a + L_{RICON}) - (s + e)$$

Structural analysis RICON / RICON S connector:

$$\left(\frac{F_{4,RICON,d}}{F_{45,Rd}} \right) \leq 1{,}0$$ RICON / RICON S design value $F_{45,Rd}$ with $e_{45} = 0$

Structural analysis reinforcing plate screwing:

$$\left(\frac{F_{4,RC,d}}{n_{ef} \cdot F_{v,Rd}} \right) \leq 1{,}0 \qquad n_{ef} = n^{0,9}$$

$$F_{V,Rd} = \frac{k_{mod}}{\gamma_M} \cdot \min \begin{cases} 0{,}4 \cdot f_{h,k} \cdot l_{ef} \cdot d \\ 1{,}15 \cdot \sqrt{2 \cdot M_{y,Rk} \cdot f_{h,k} \cdot d} + \frac{F_{ax,Rk}}{4} \end{cases}$$

$$f_{h,k} = 0{,}082 \cdot \rho_k \cdot d^{-0,3}$$

$M_{y,Rk}$ (see DoP of screws with ETA, EN14592)

$$F_{ax,Rk} = n \cdot f_{ax,k} \cdot k_{ax} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{\rho_a} \right)^{0,8}$$; n=1; k_{ax}=1,0 at 45° - 90°; $l_{ef} = L_{screw} - t_{RC}$

σ_a = 350 kg/m³; $f_{ax,k}$ (screws with ETA)

Structural analysis of the reinforcing plate in section A-A (page 144):

$$\frac{\sigma_d}{R_{P,02,d}} = \frac{\frac{F_{res,d}}{A_n}}{R_{p,02,d}} \leq 1{,}0$$

$$F_{res,d} = \sqrt{F_{1,RC,d}^{\;2} + F_{4;RC,d}^2} \; ;$$

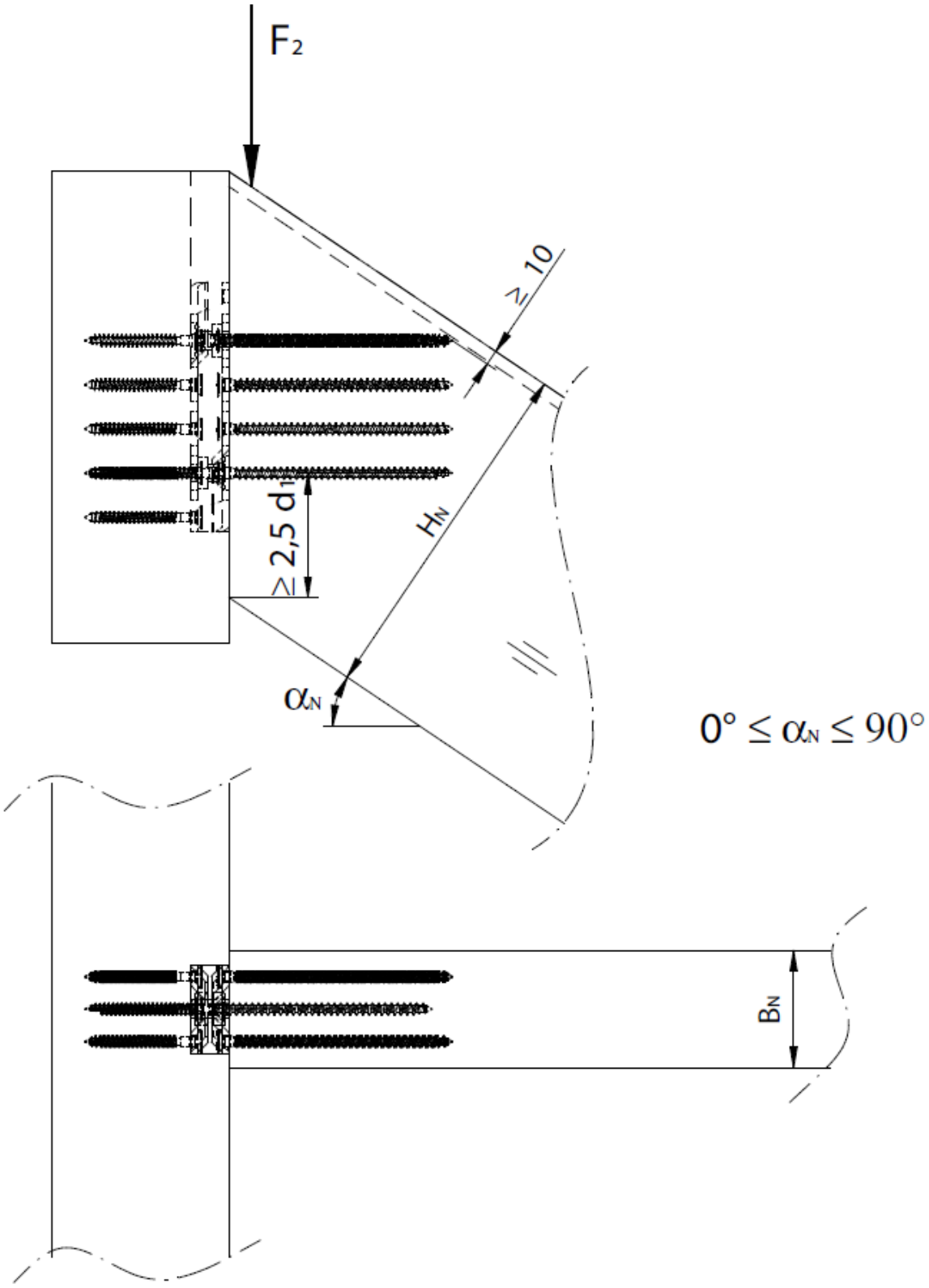
$$A_n = (b_{RC} - n \cdot d_K) \cdot t_{RC}$$

Structural analysis of RICON/ RICON S connection:

$$\left(\frac{F_{1,RICON,d}}{F_{1,Rd}} \right)^2 + \left(\frac{F_{2,d}}{F_{2,Rd}} \right)^2 + \left(\frac{F_{4,RICON,d}}{F_{4,Rd}} \right)^2 \leq 1{,}0 \text{ and } \left(\frac{F_{3,d}}{F_{3,Rd}} \right) \leq 1{,}0$$

RICON® S

Tilted joint

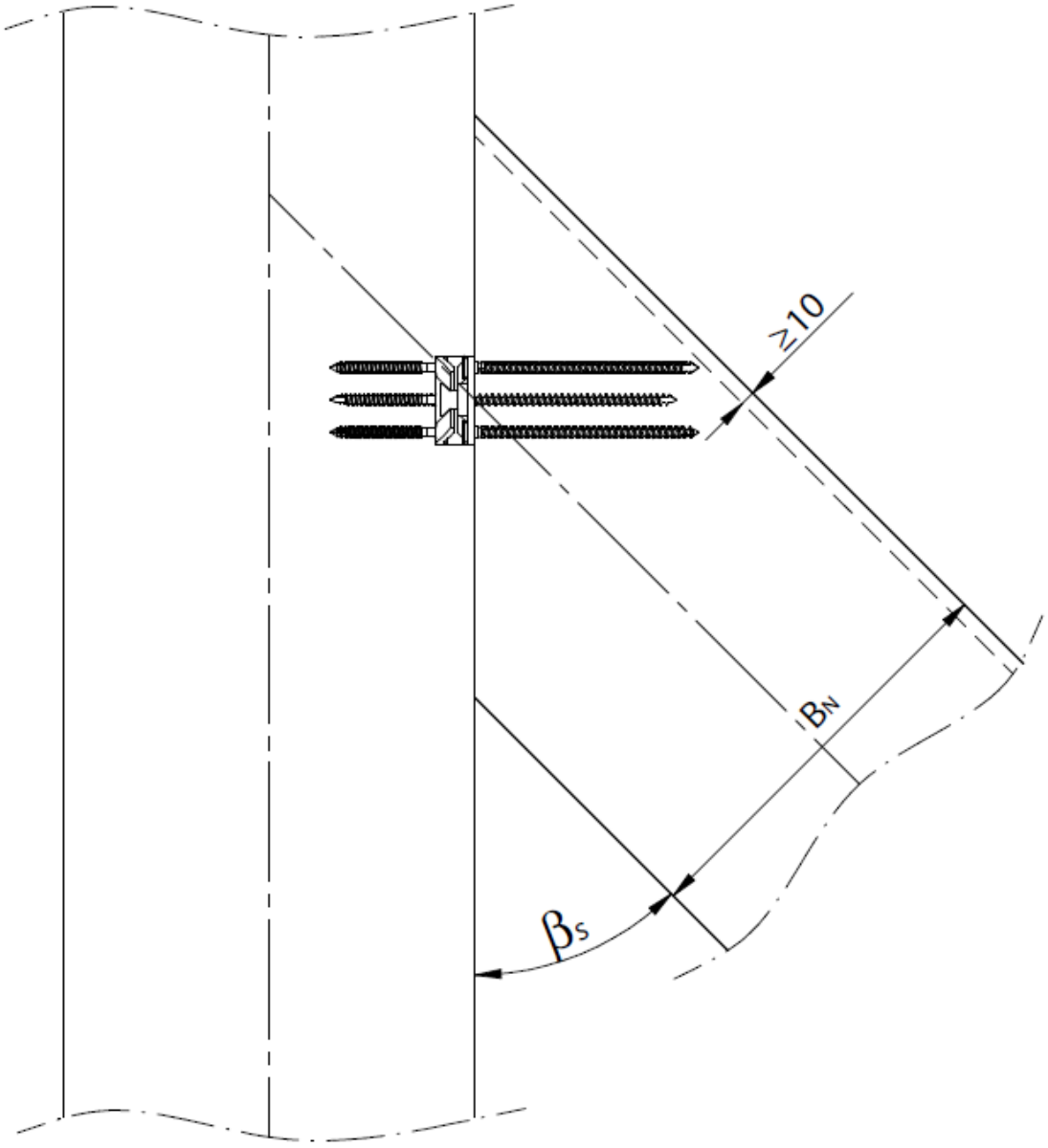


Screw length can be adopted to fit in secondary beam!

RICON® S

Tilted joint

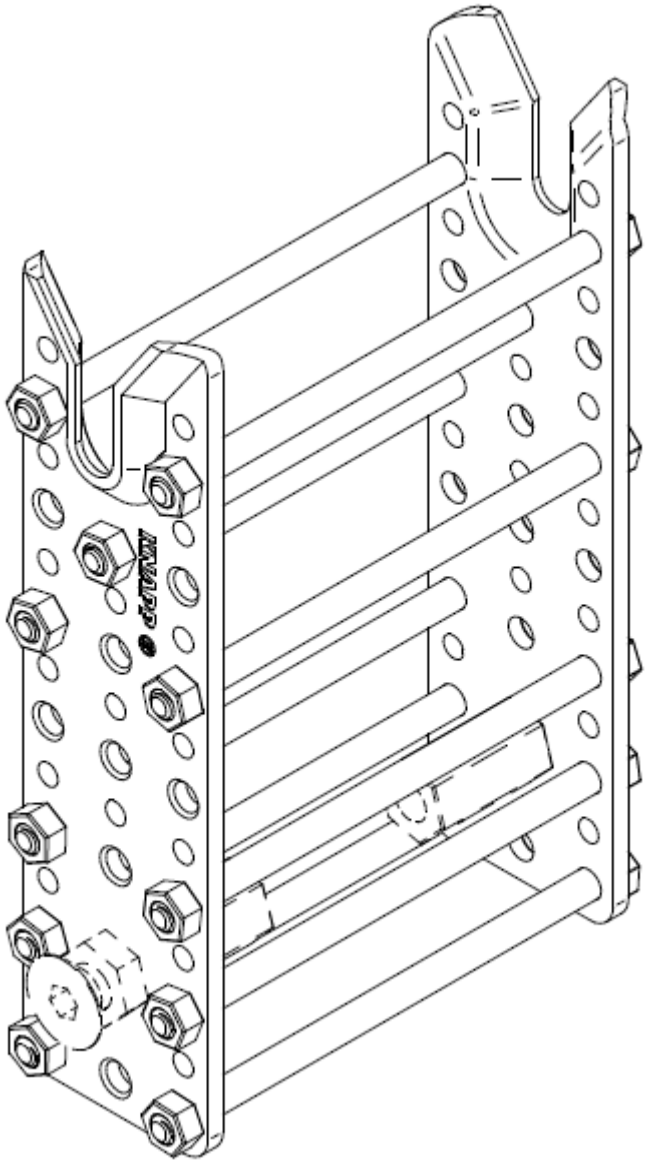
Screw length can be adopted to fit in secondary beam



$$35° \leq \beta_S \leq 90°$$

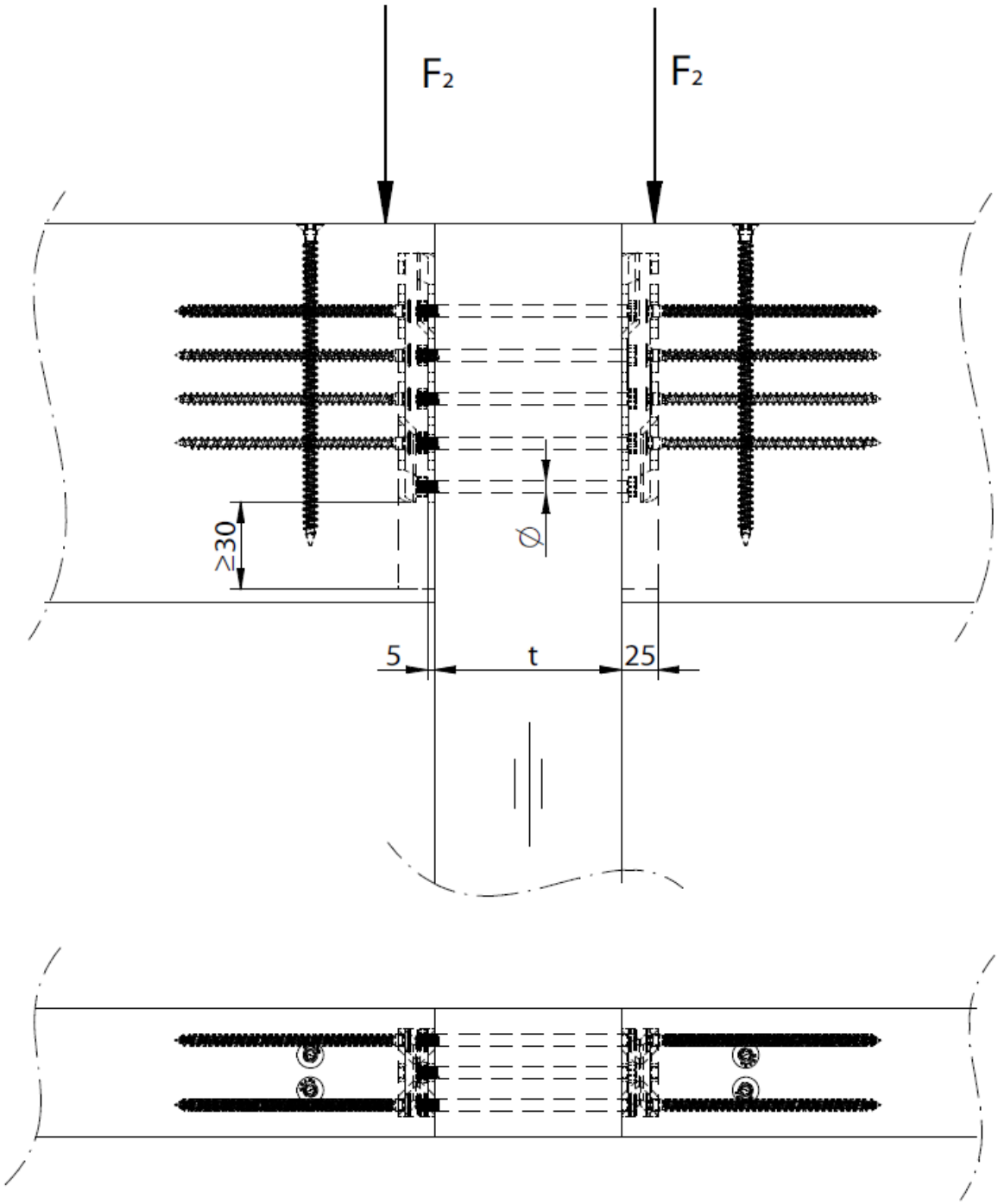
RICON® S

Wood-to-wood joint with bolts



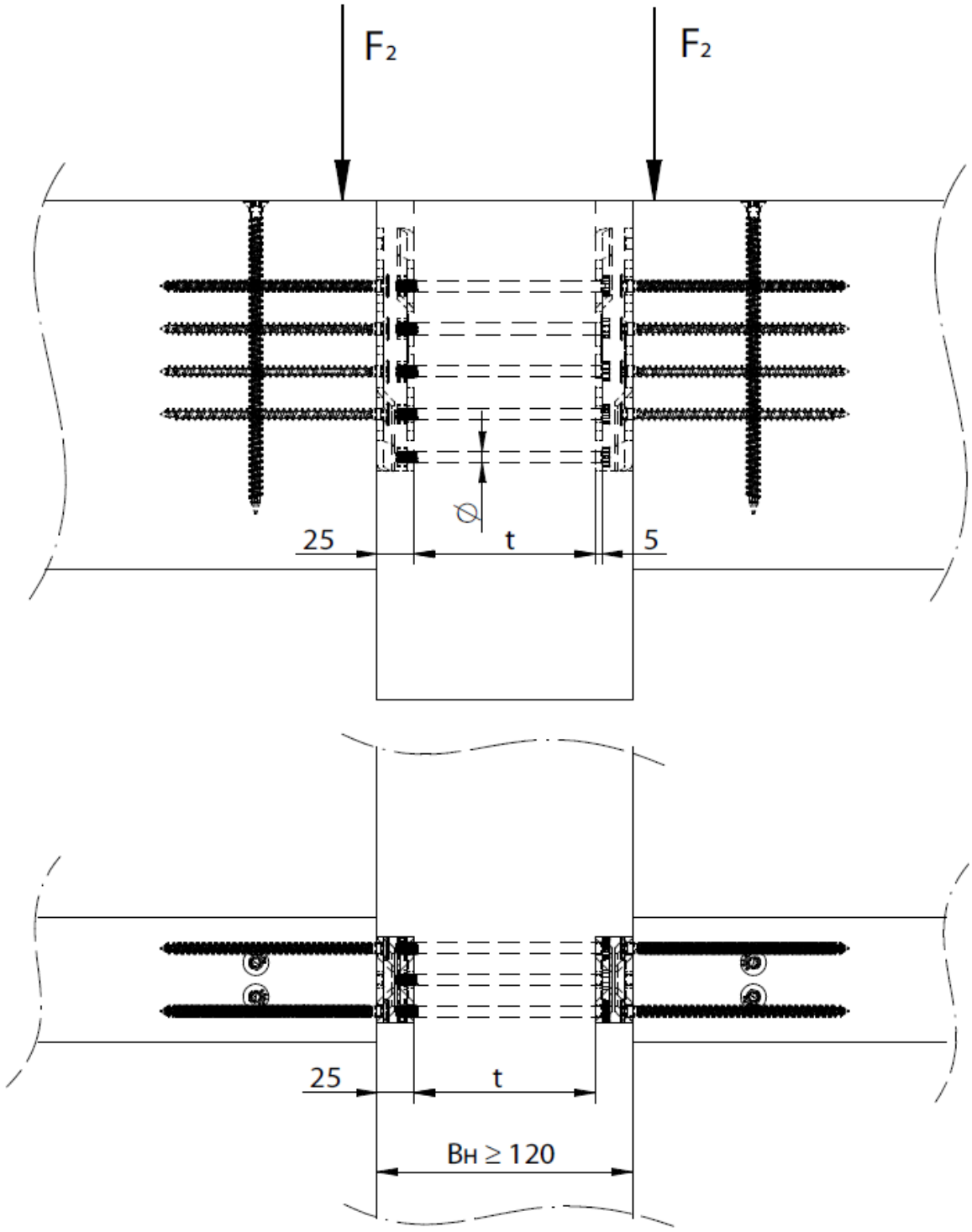
RICON® S

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



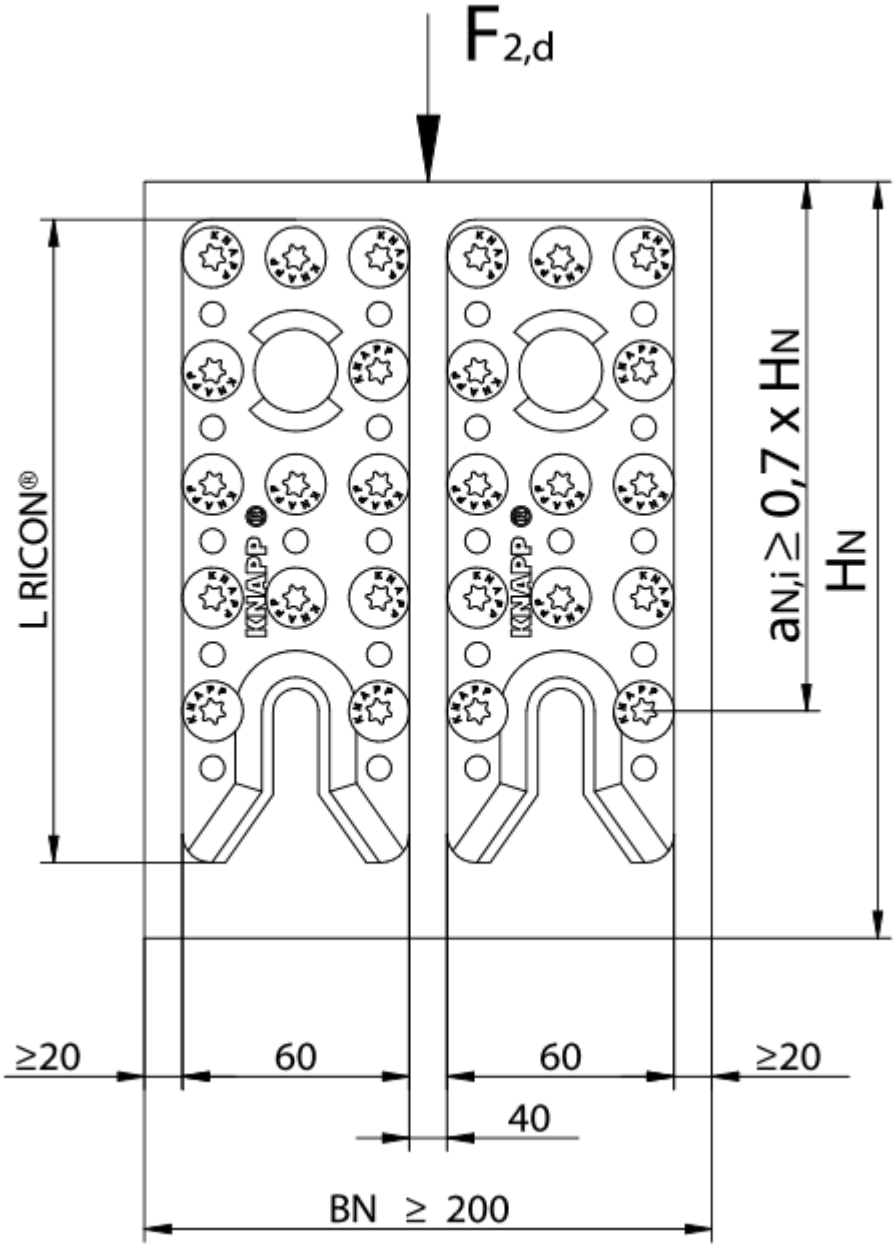
RICON® S

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



RICON® S

Double RICON® S60 connection



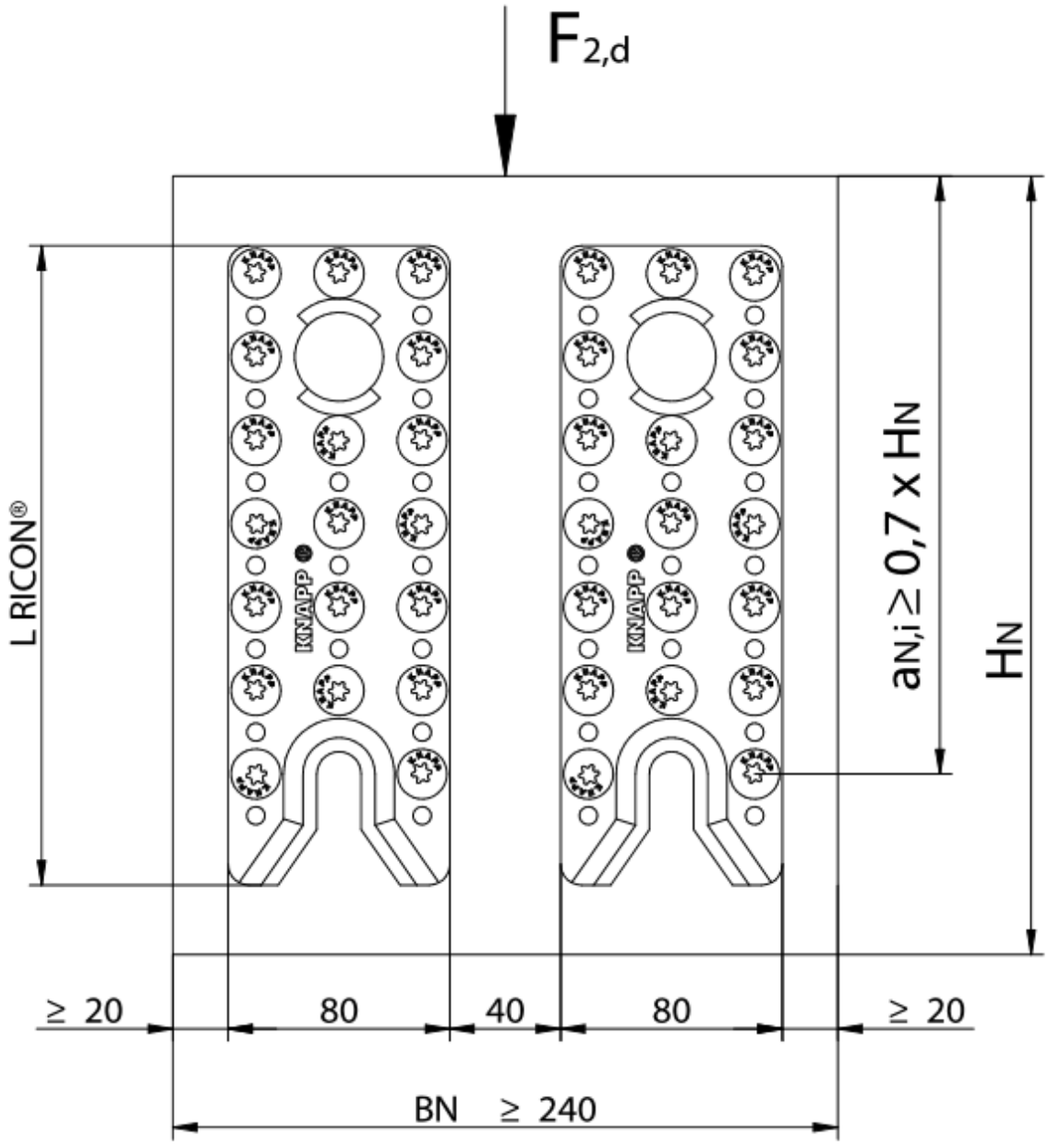
Double timber beam width of single RICON allows to calculate with double load $F_{2,Rd}$.

RICON® S60		Minimum cross section	
width	height	width	height
60	140	200	160
	170		190
	200		220
	230		250

RICON® S

Double RICON® S80 connection

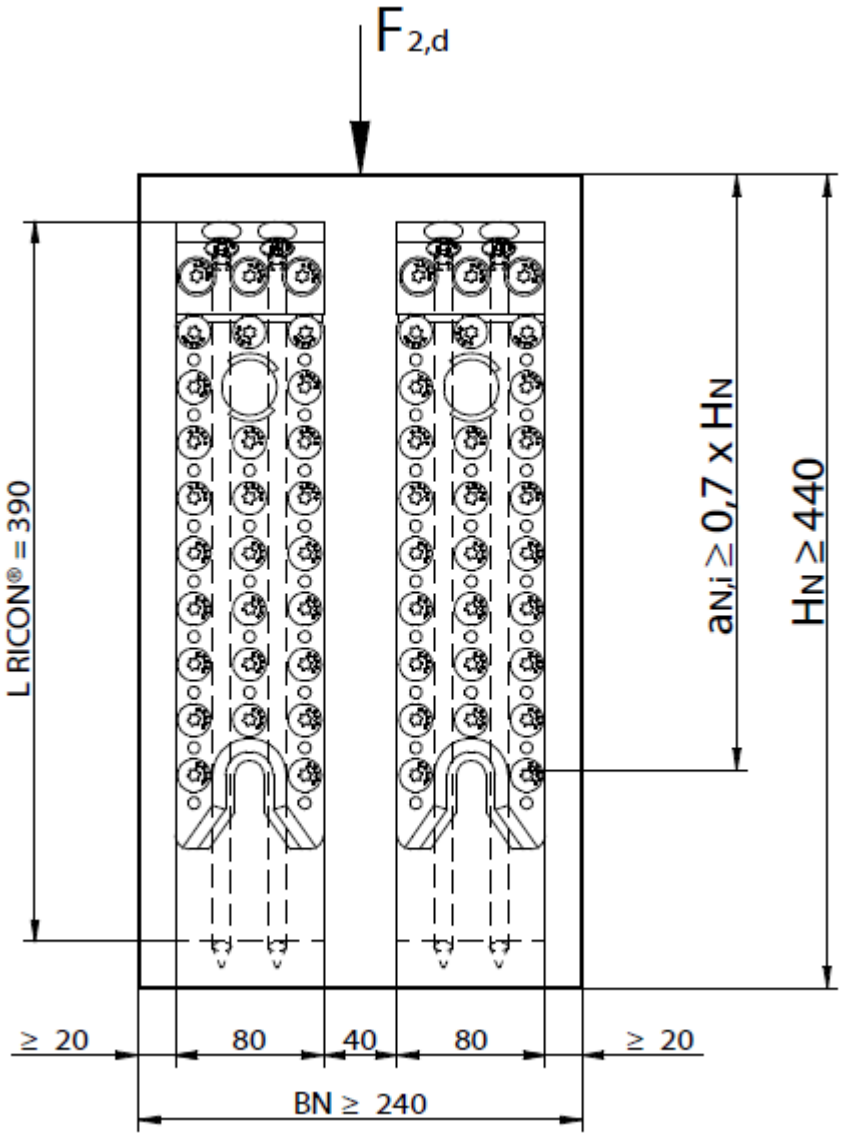
Double timber beam width of single RICON allows to calculate with double load $F_{2,Rd}$.



RICON® S80		Minimum cross section	
width	height	width	height
80	200	240	230
	230		260
	260		290
	290		320

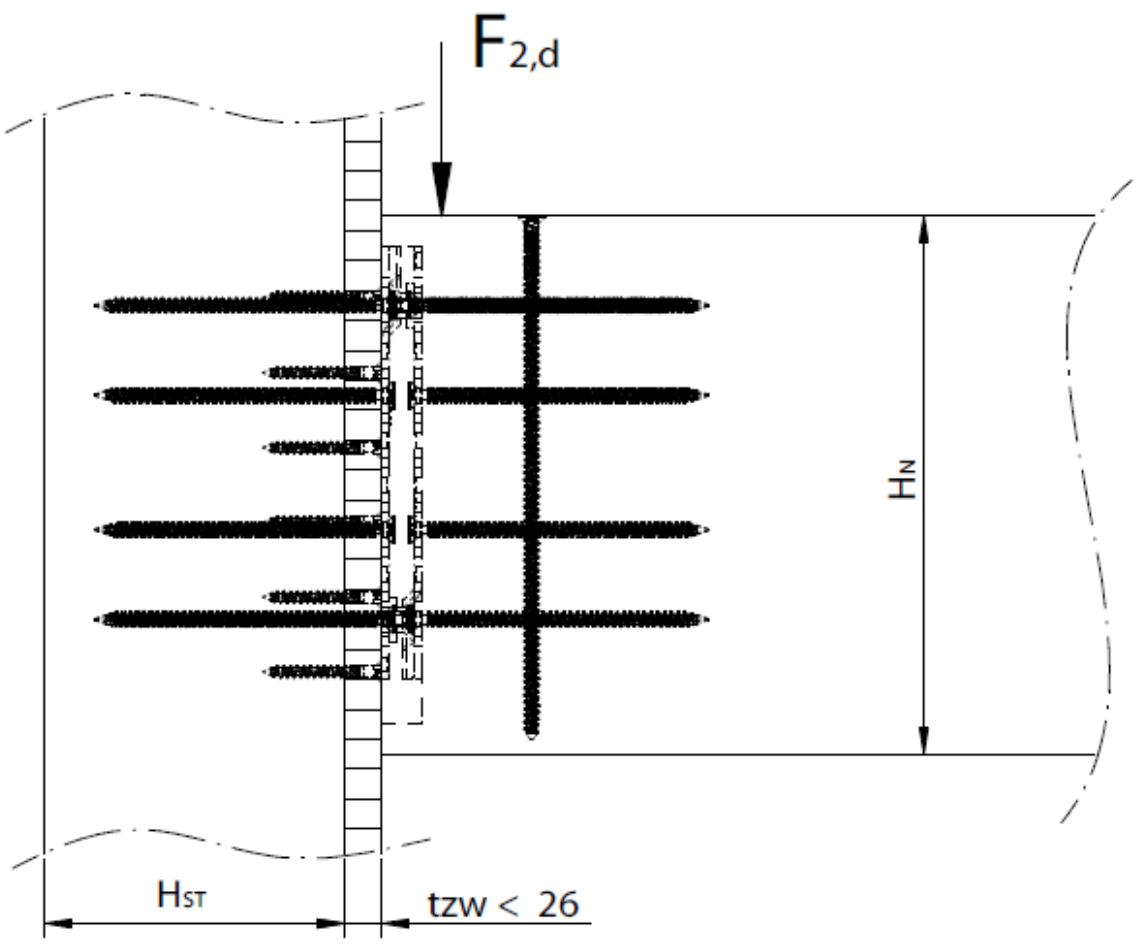
RICON® S

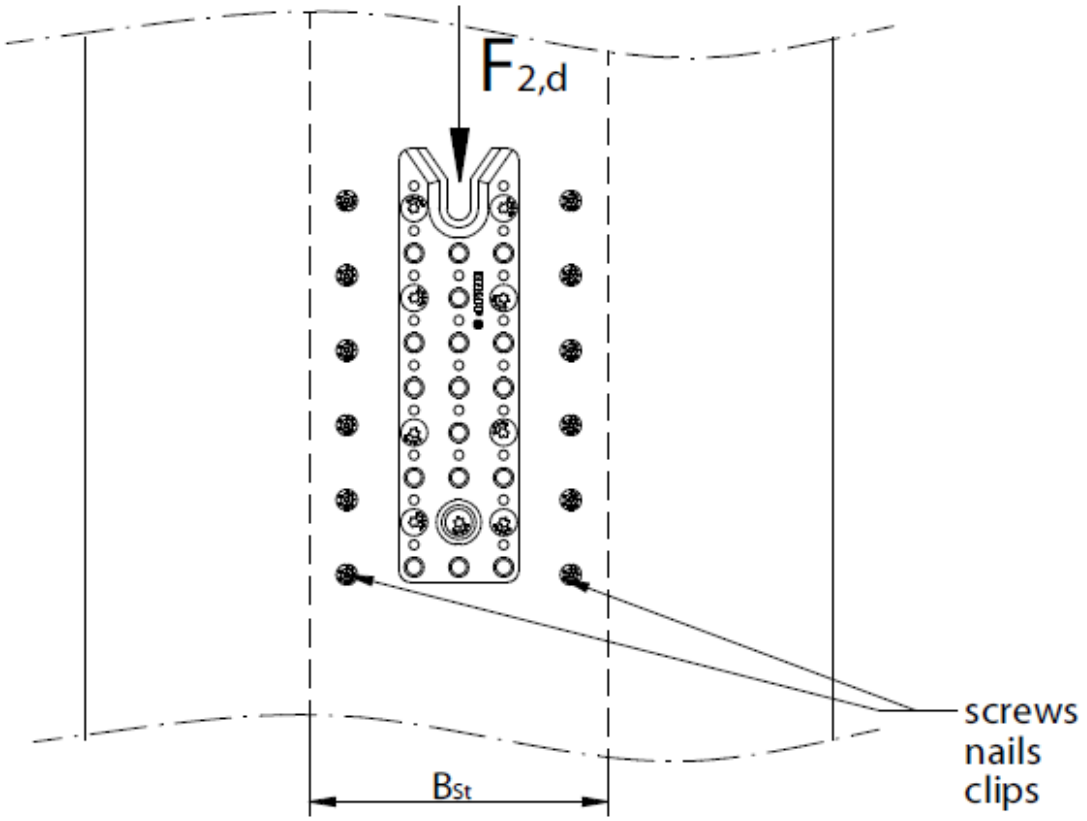
Double RICON® S 390x80 VS+ZP connection
Minimum cross section



RICON® S

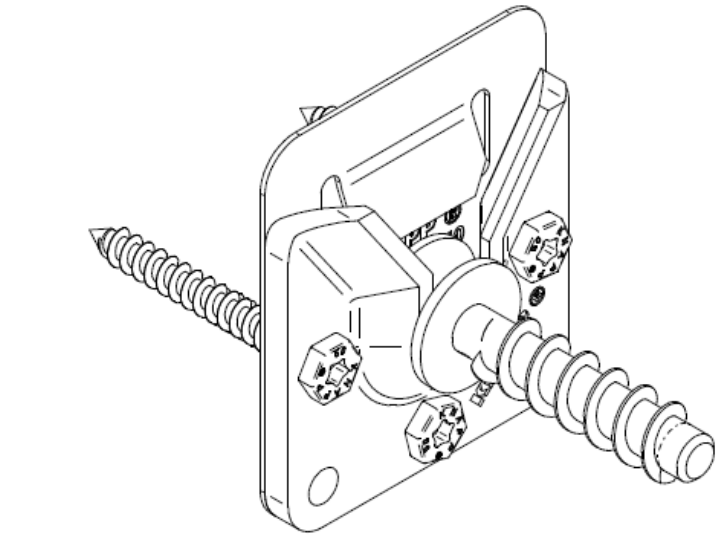
Wood-to-wood joint main beam / secondary beam connection with interlayer

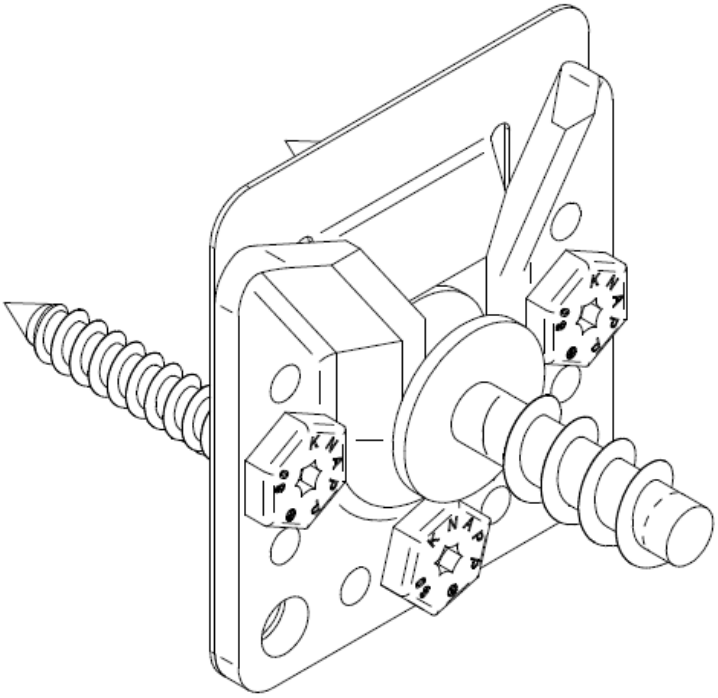




WALCO® V

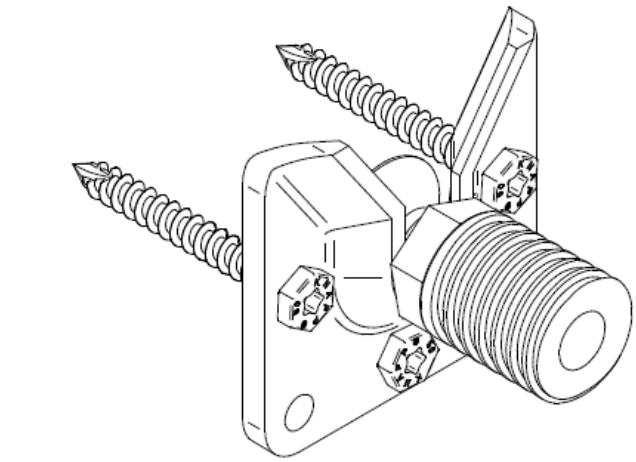
WALCO® V60 and V80 with collar screw

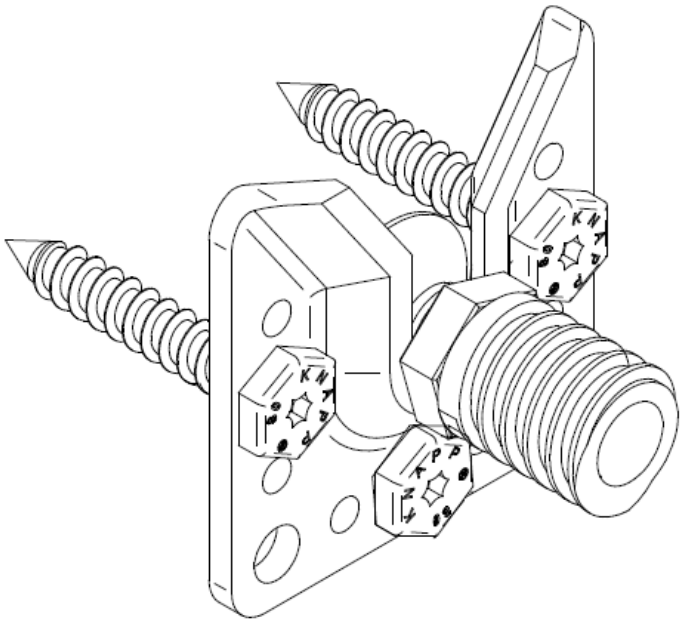




WALCO® V

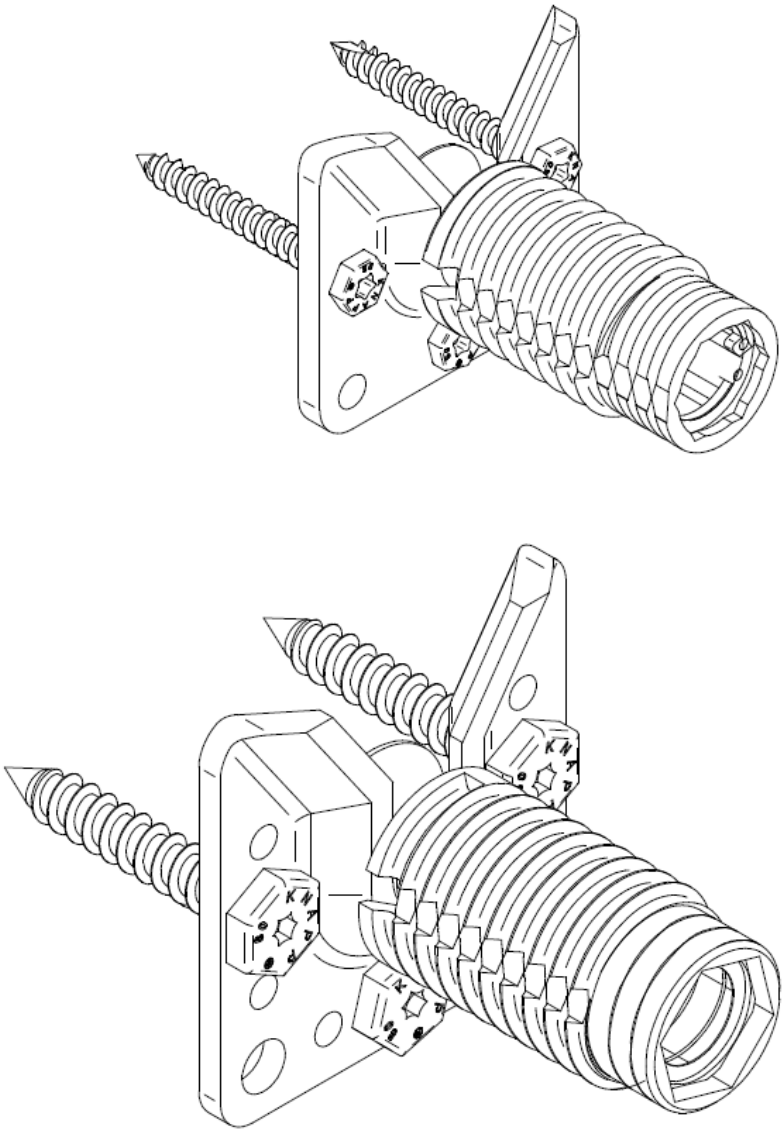
WALCO® V60 and V80 with retaining screw collar bolt





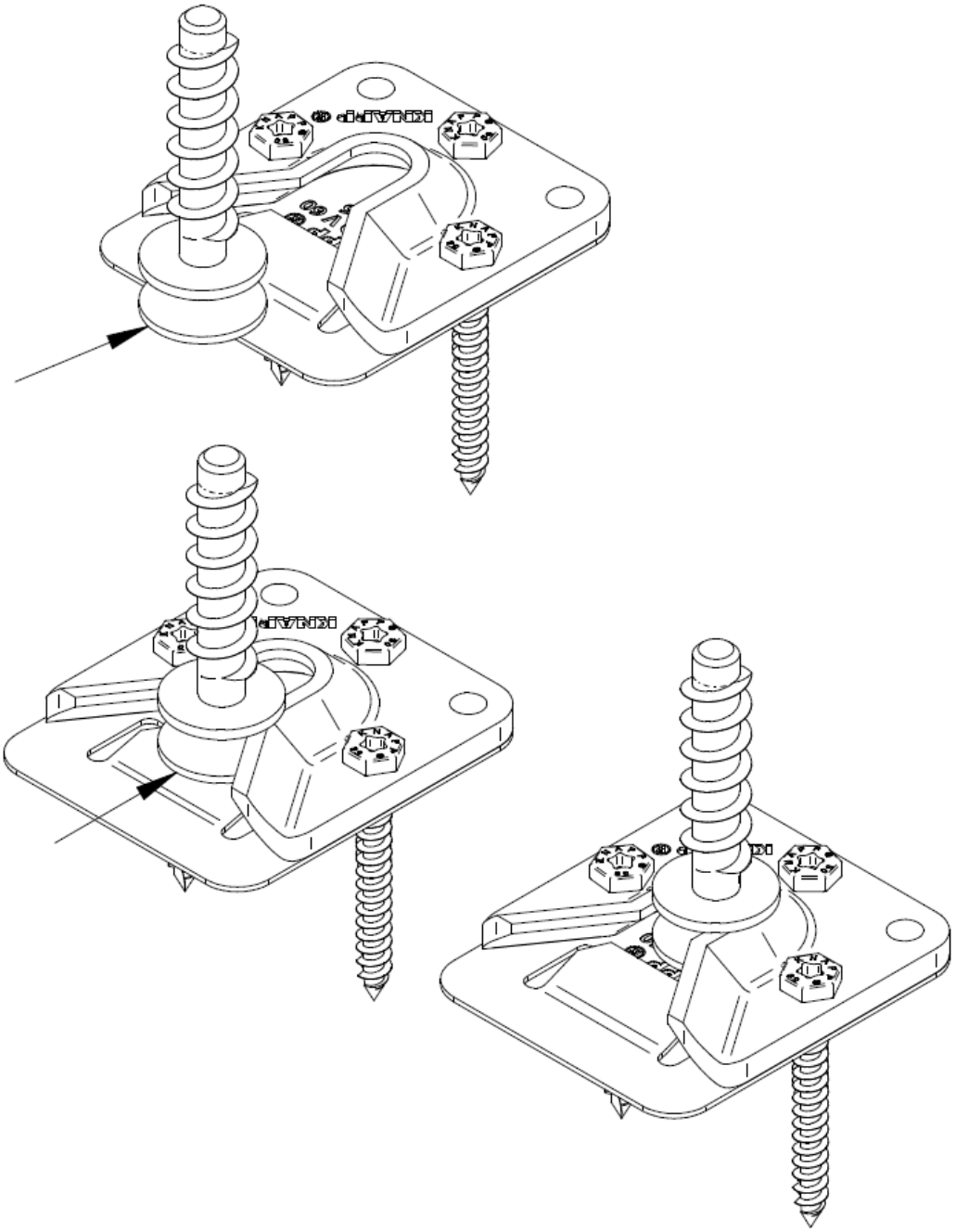
WALCO® V

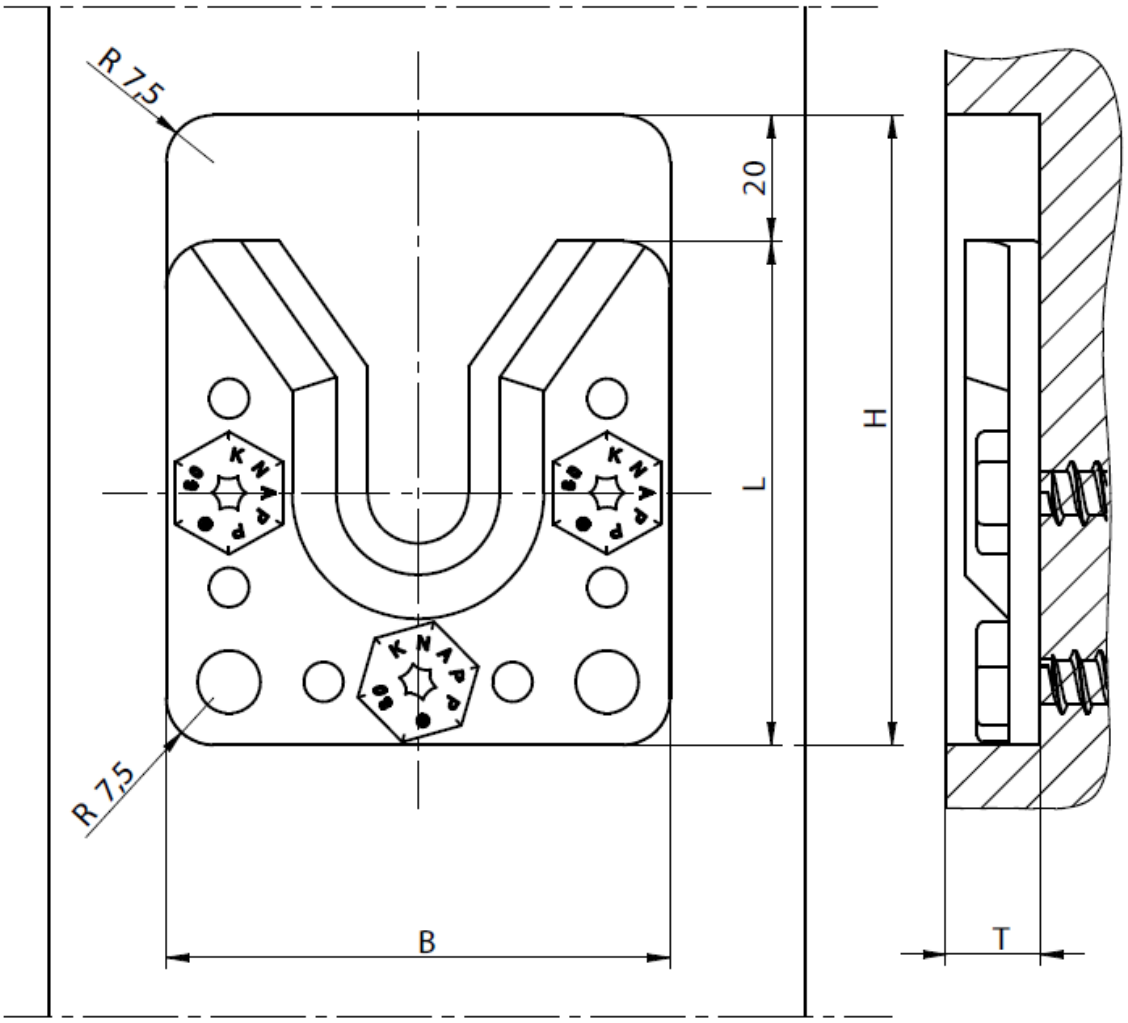
WALCO® V60 and V80 with spring retaining screw collar bolt



WALCO® V

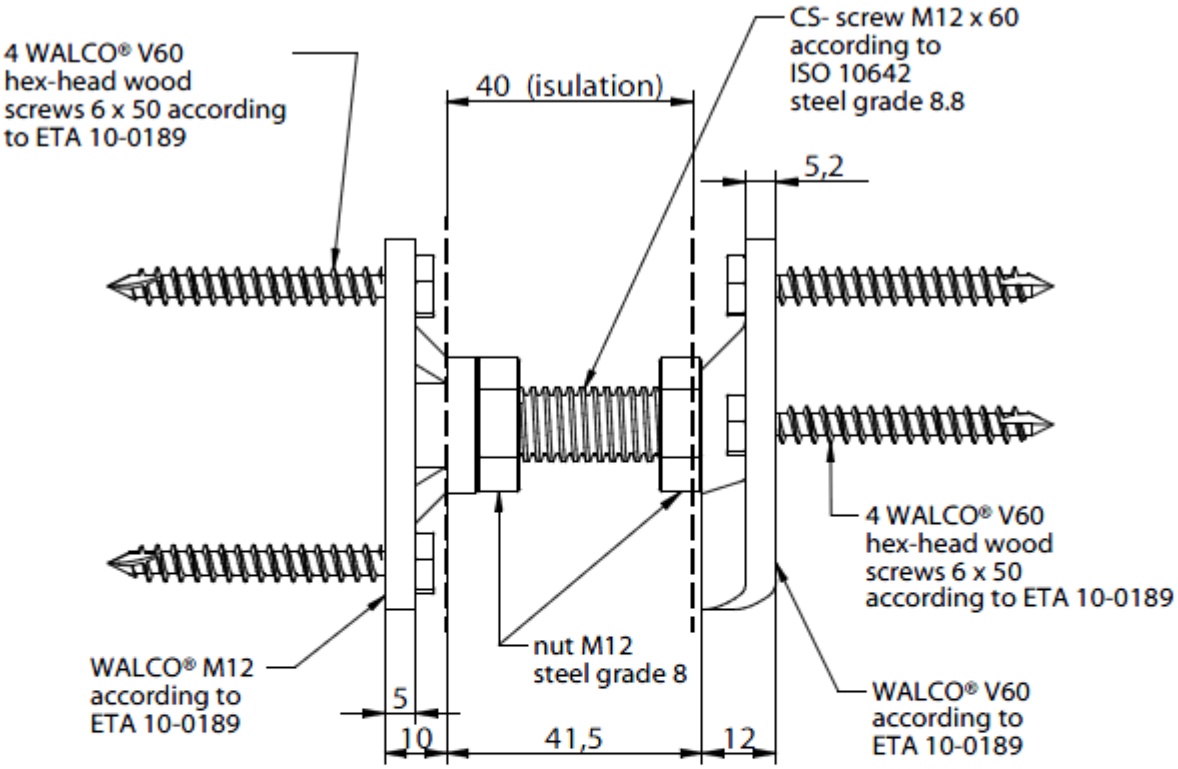
Functional principle clip lock

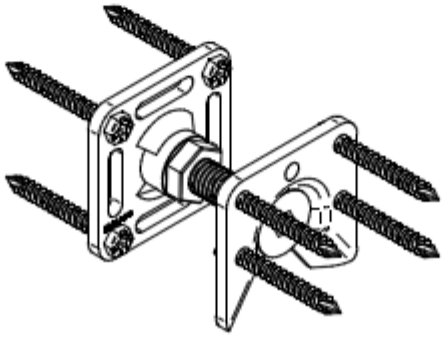




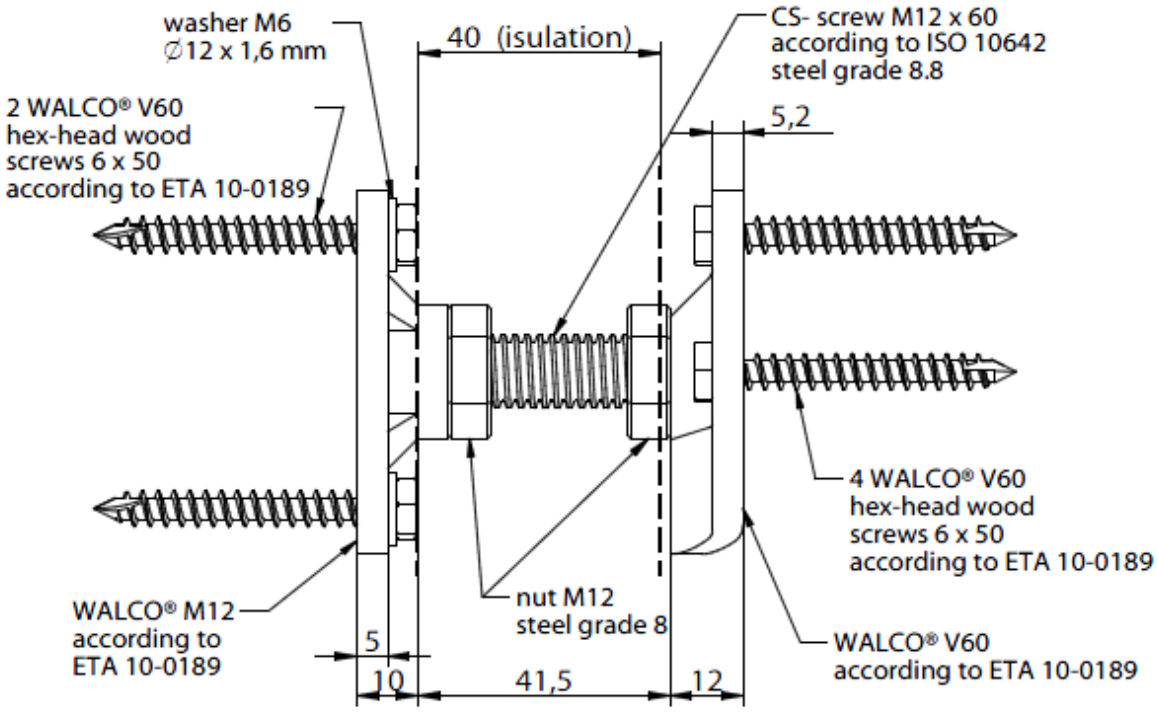
minimum installation			
Joint	measures width B	height H	depth T
WALCO® V60	60 mm	80 mm	≤ 13 mm
WALCO® V80	80 mm	100 mm	≤ 15 mm

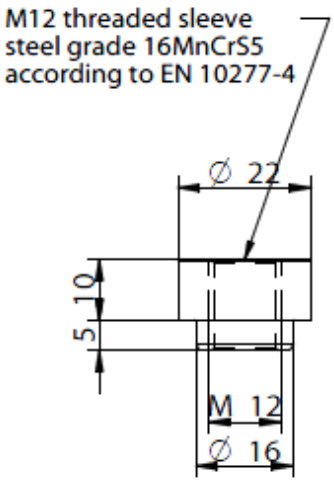
WALCO® 60 M12/V60

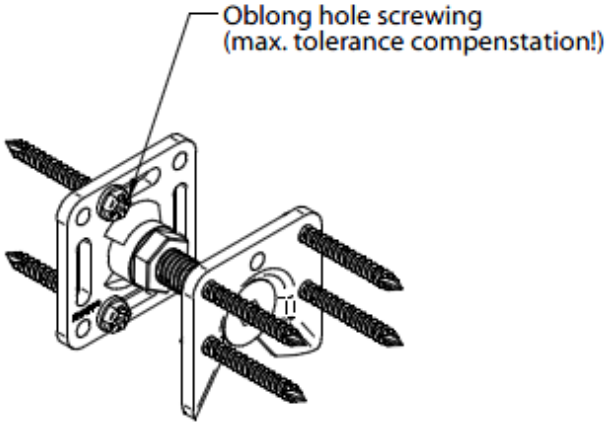




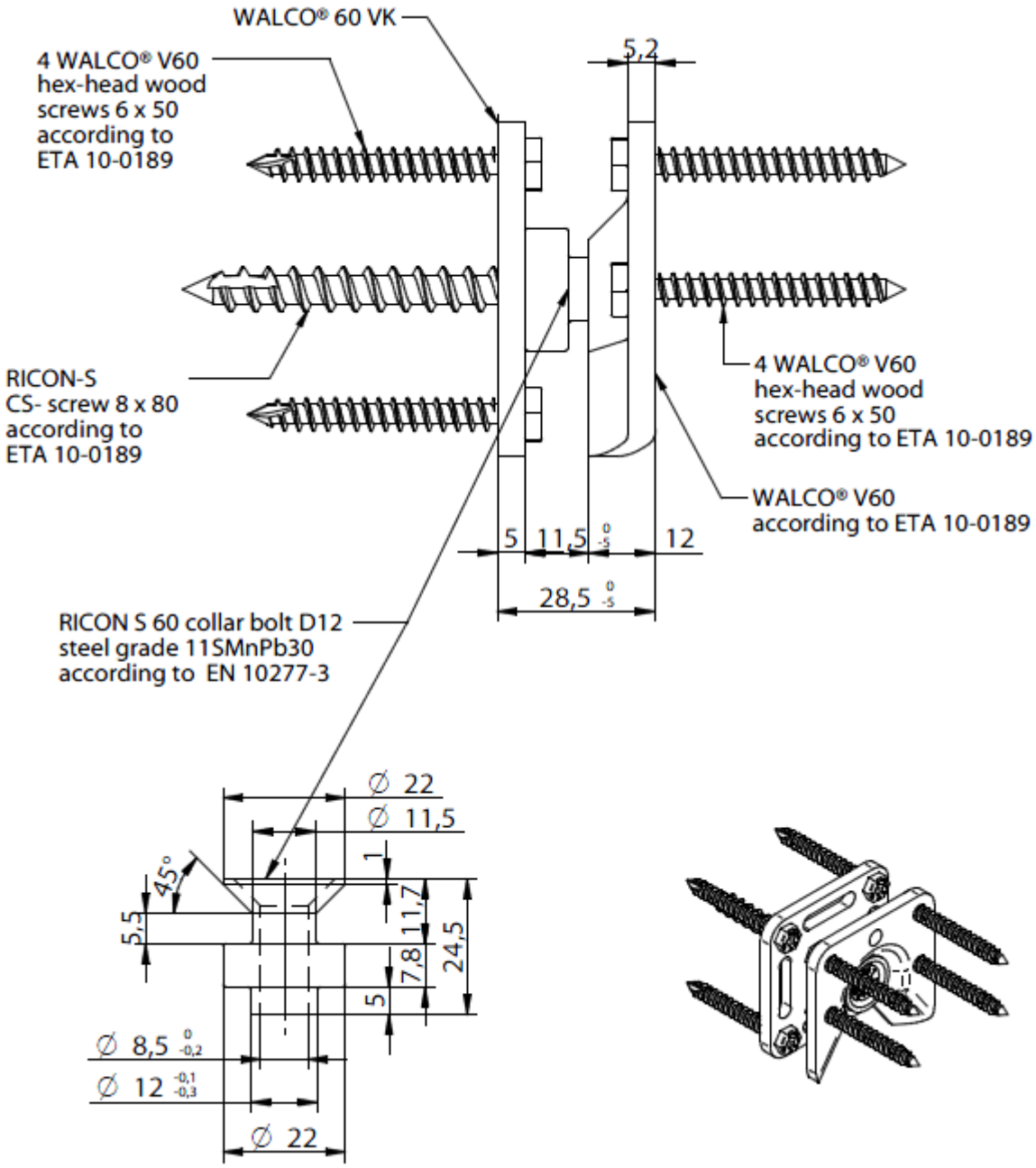
WALCO® V 60 M12 with oblong hole screwing/ V60



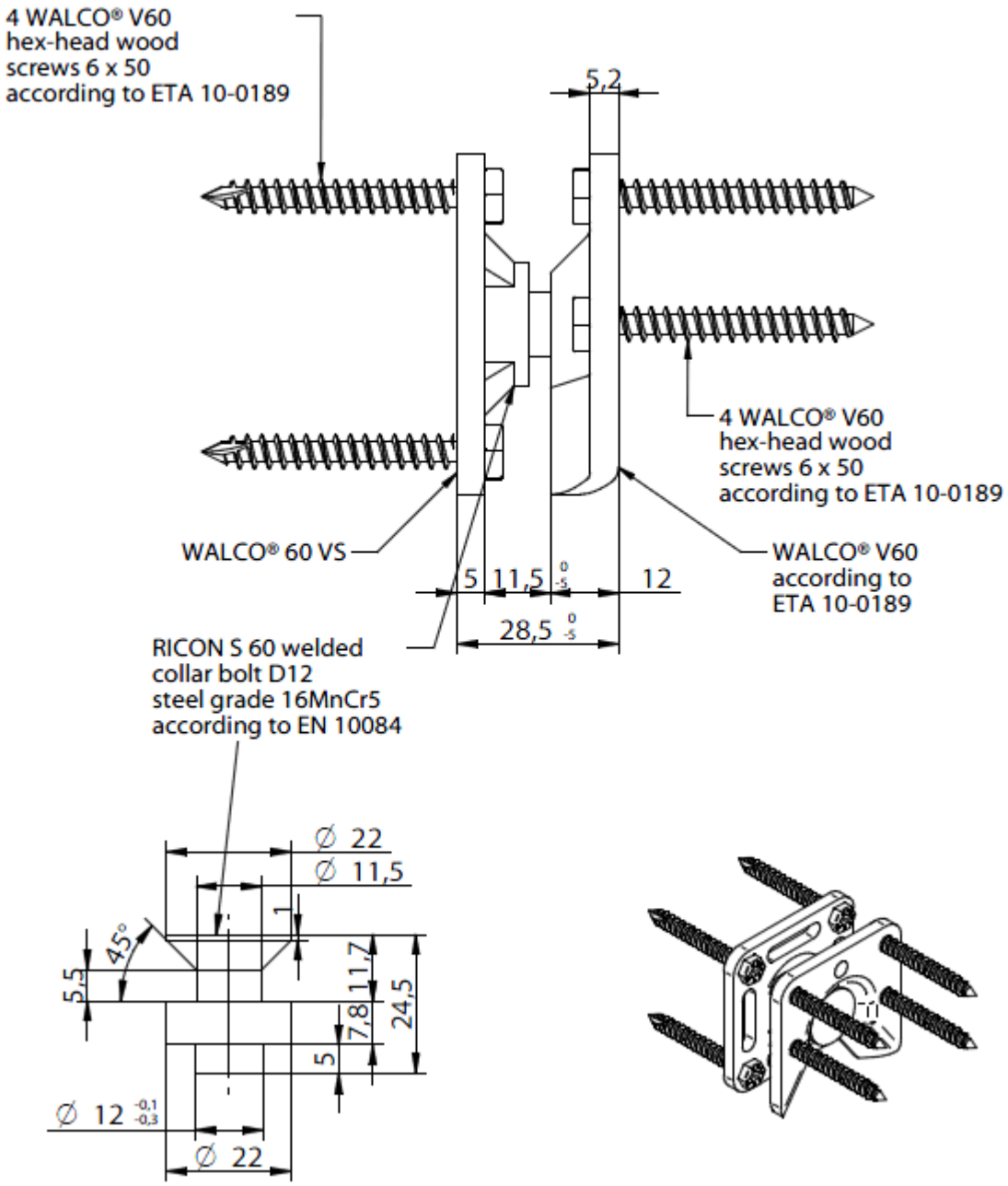




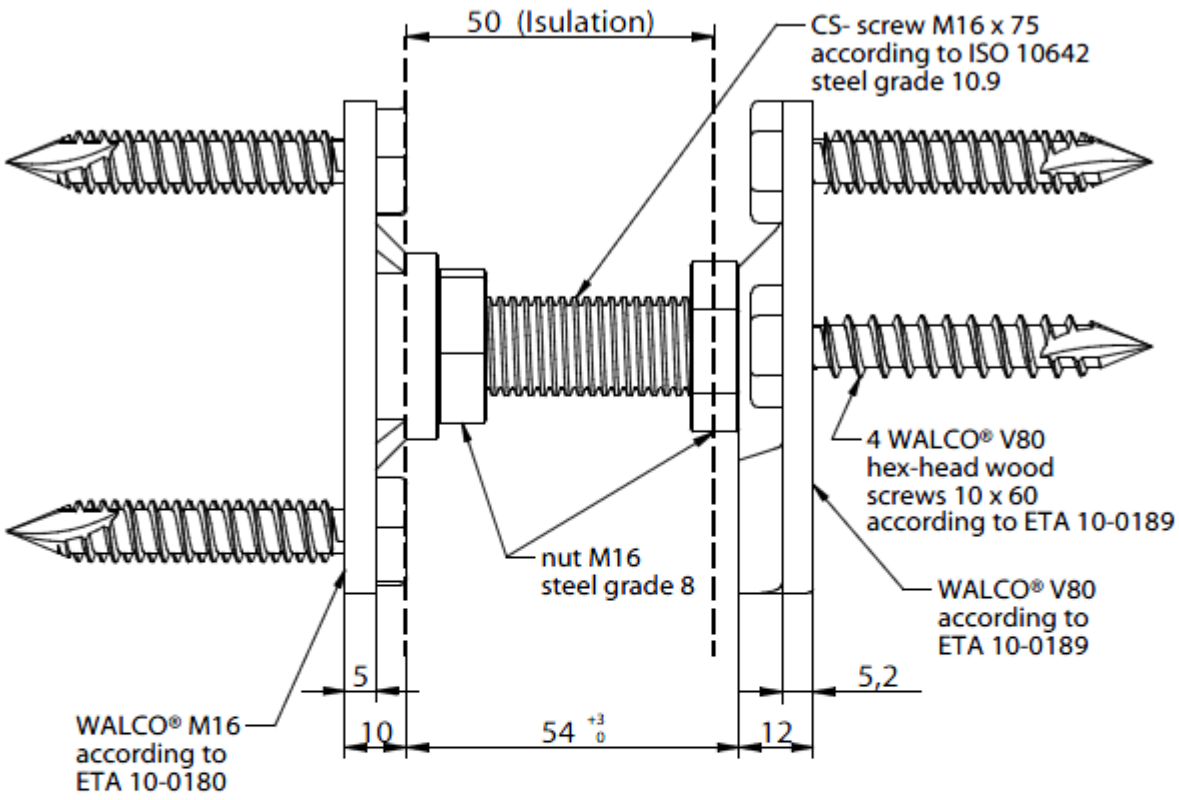
WALCO® 60 VK / V60

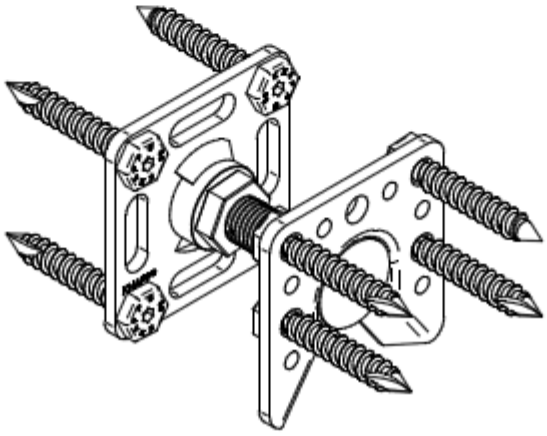


WALCO® 60 VS / V60

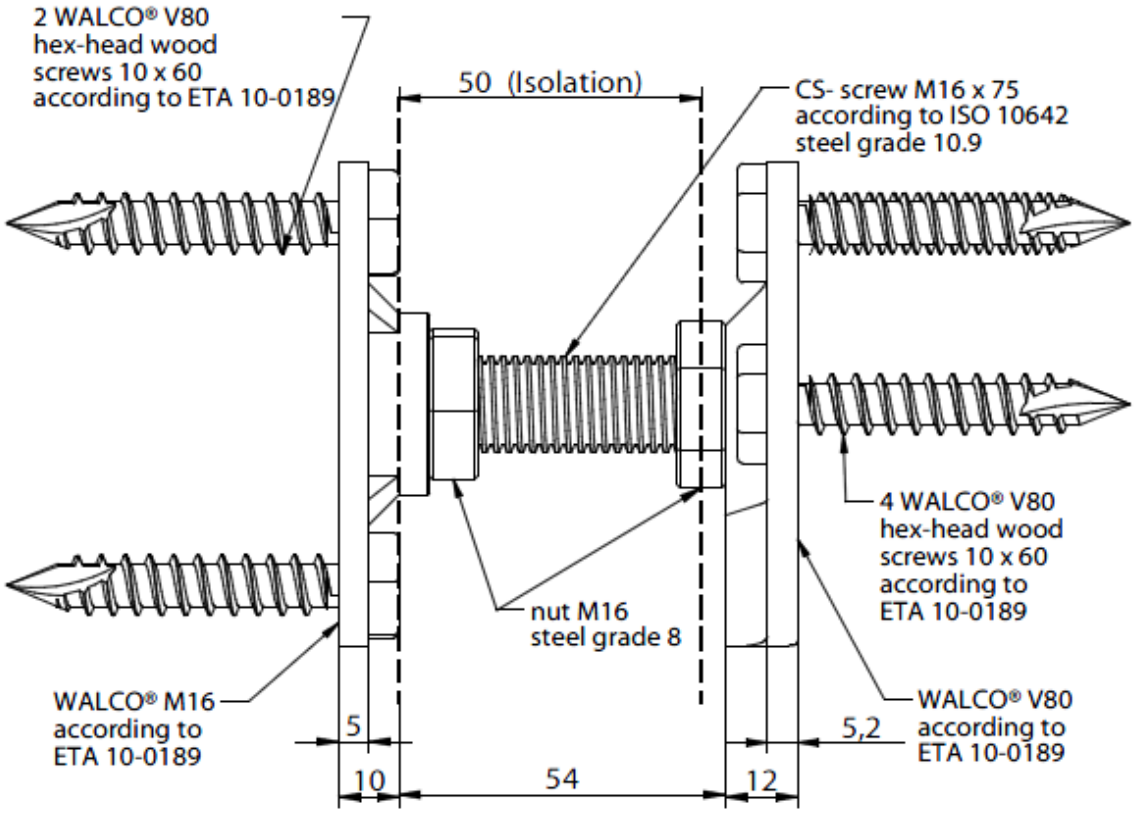


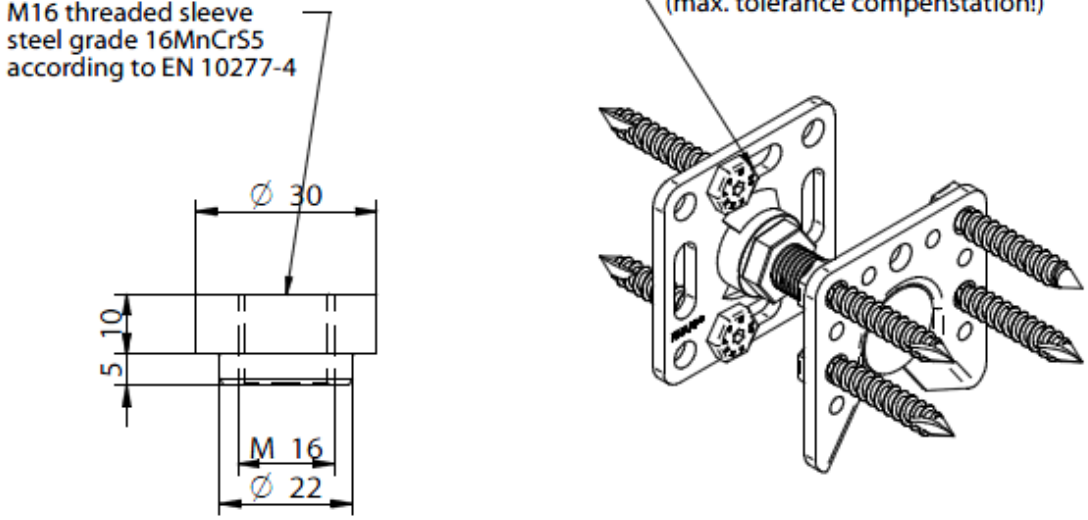
WALCO® 80 M16/V80



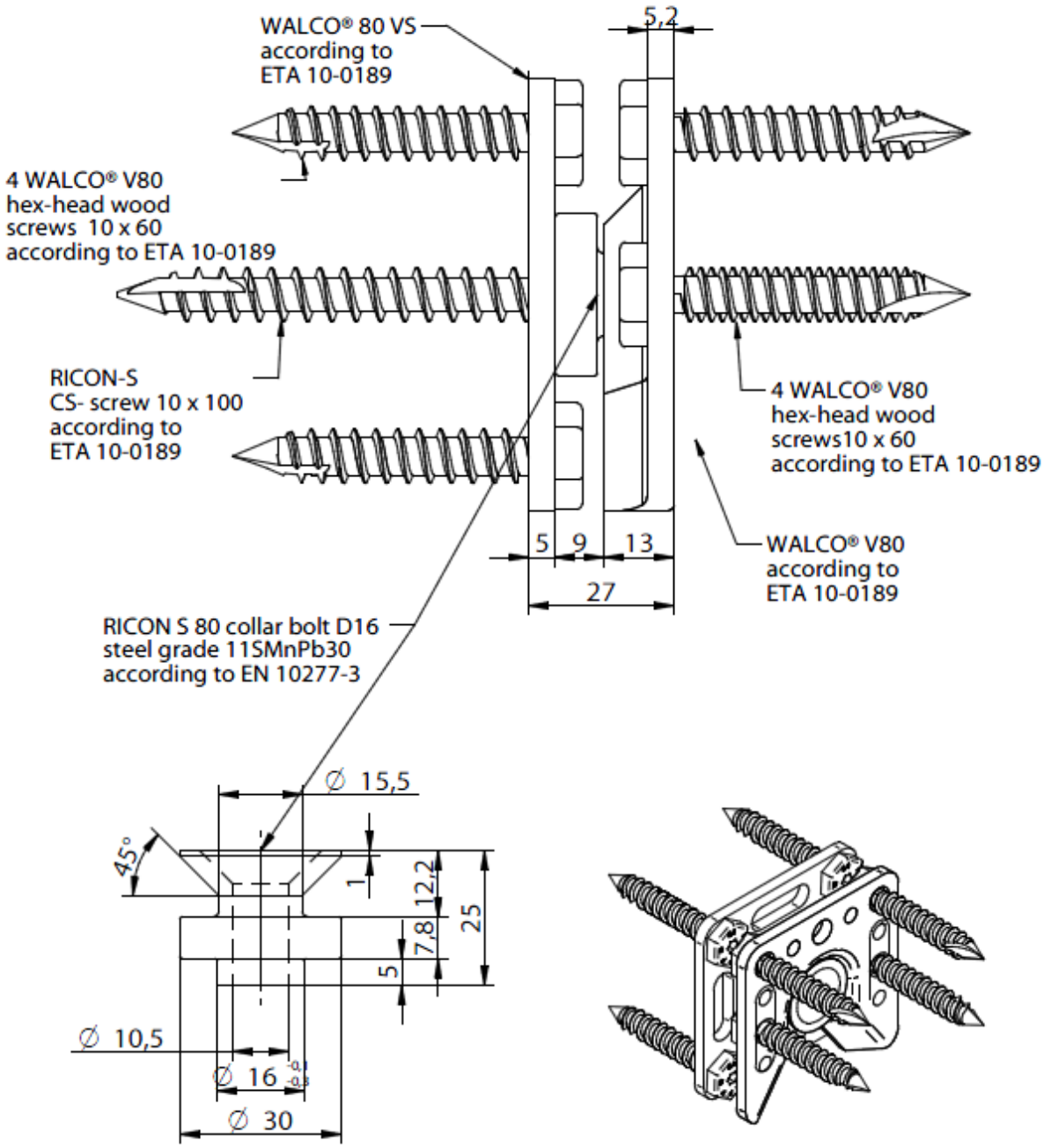


WALCO® V 80 M16 with oblong hole screwing / V80

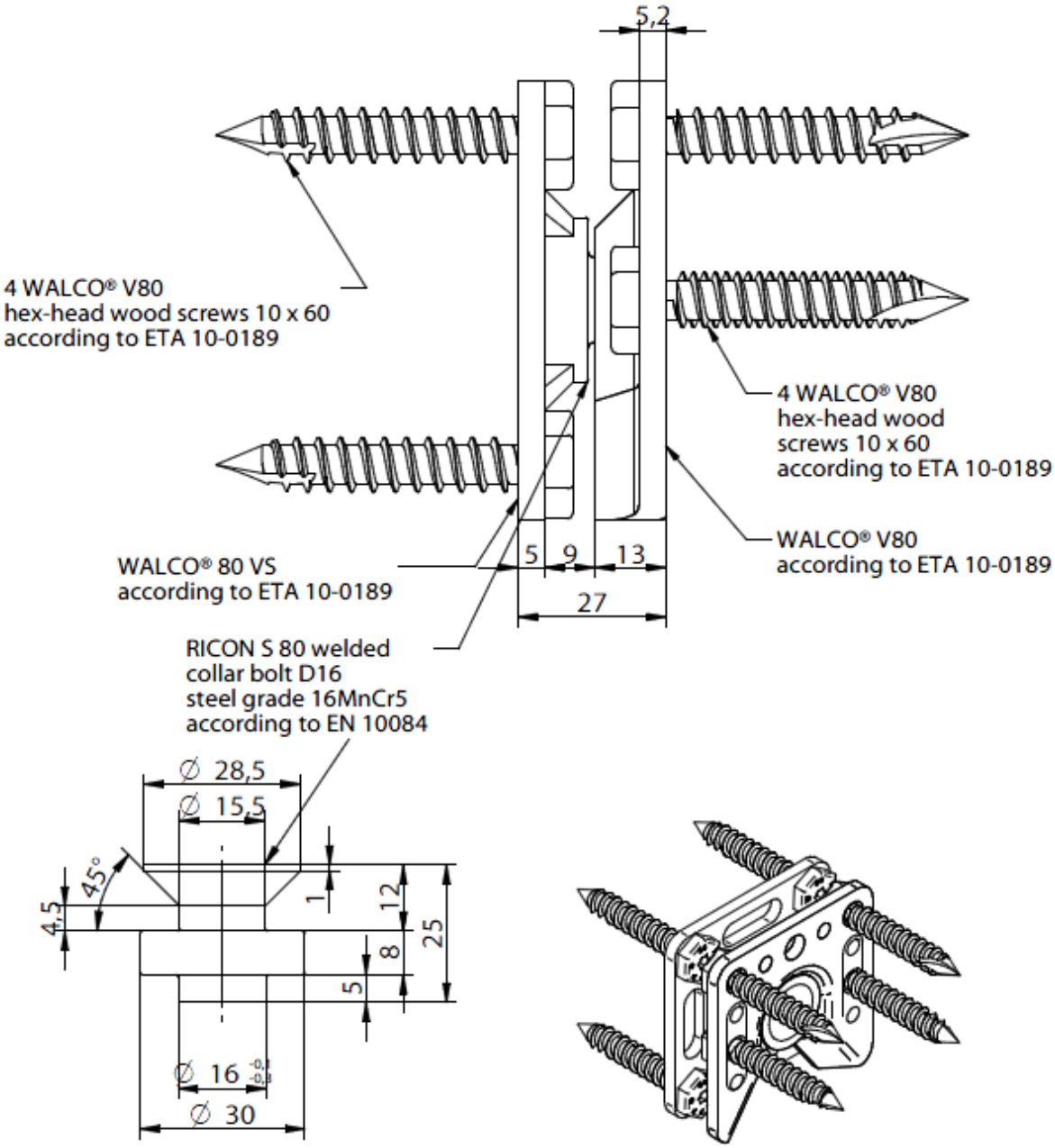




WALCO® 80 VK / V80

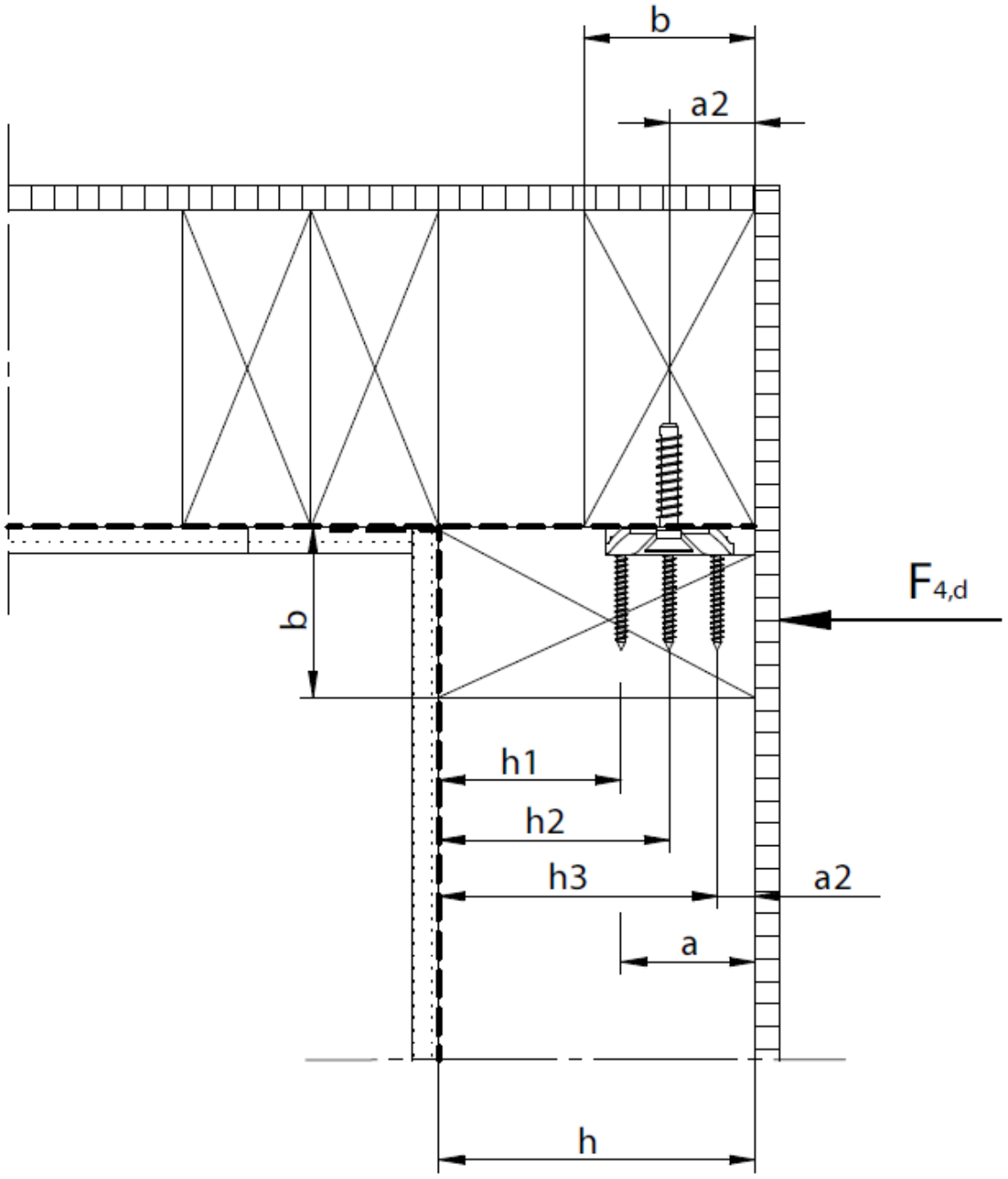


WALCO®80 VS / V80



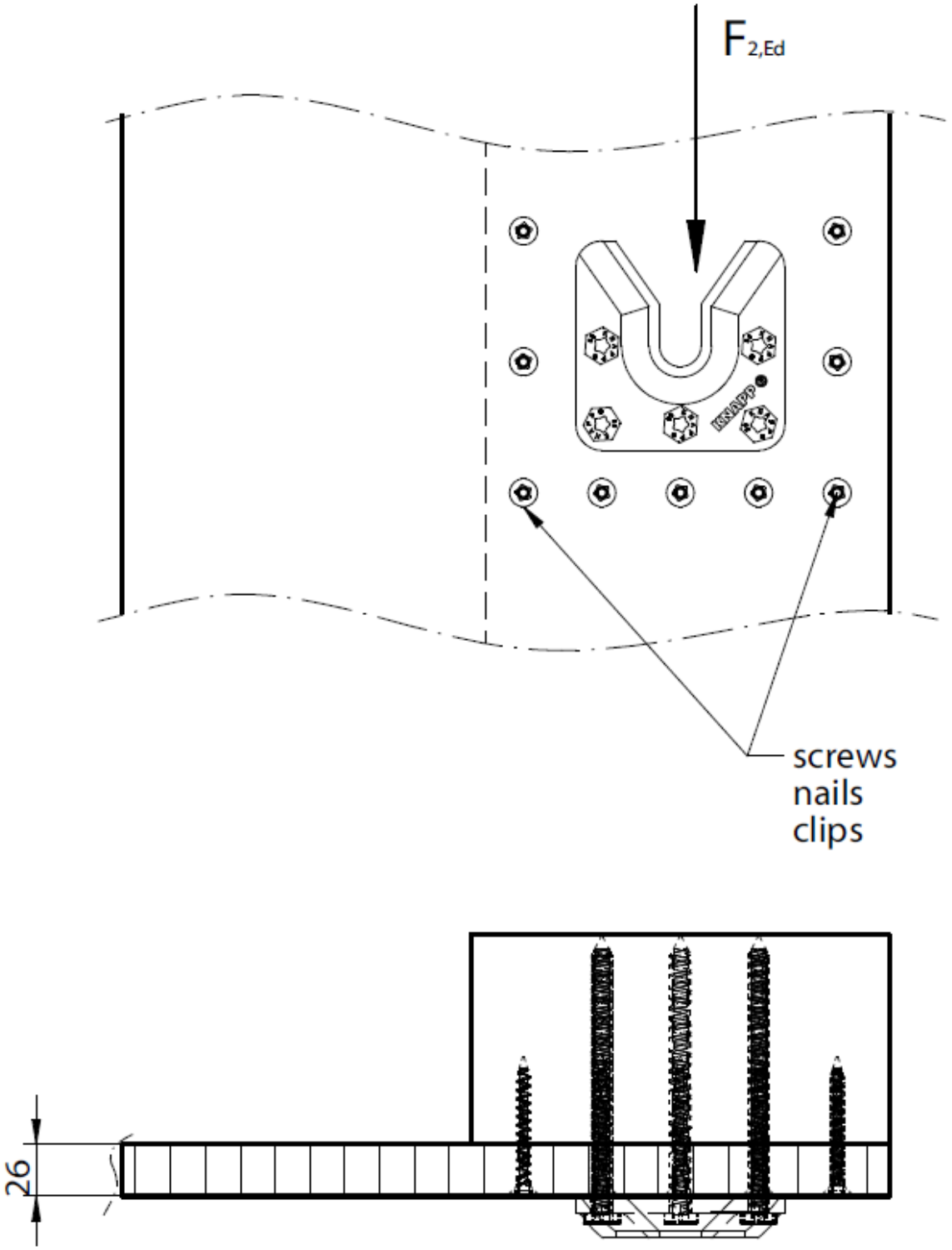
WALCO® V

Load direction F_4 (or opposite direction F_5)



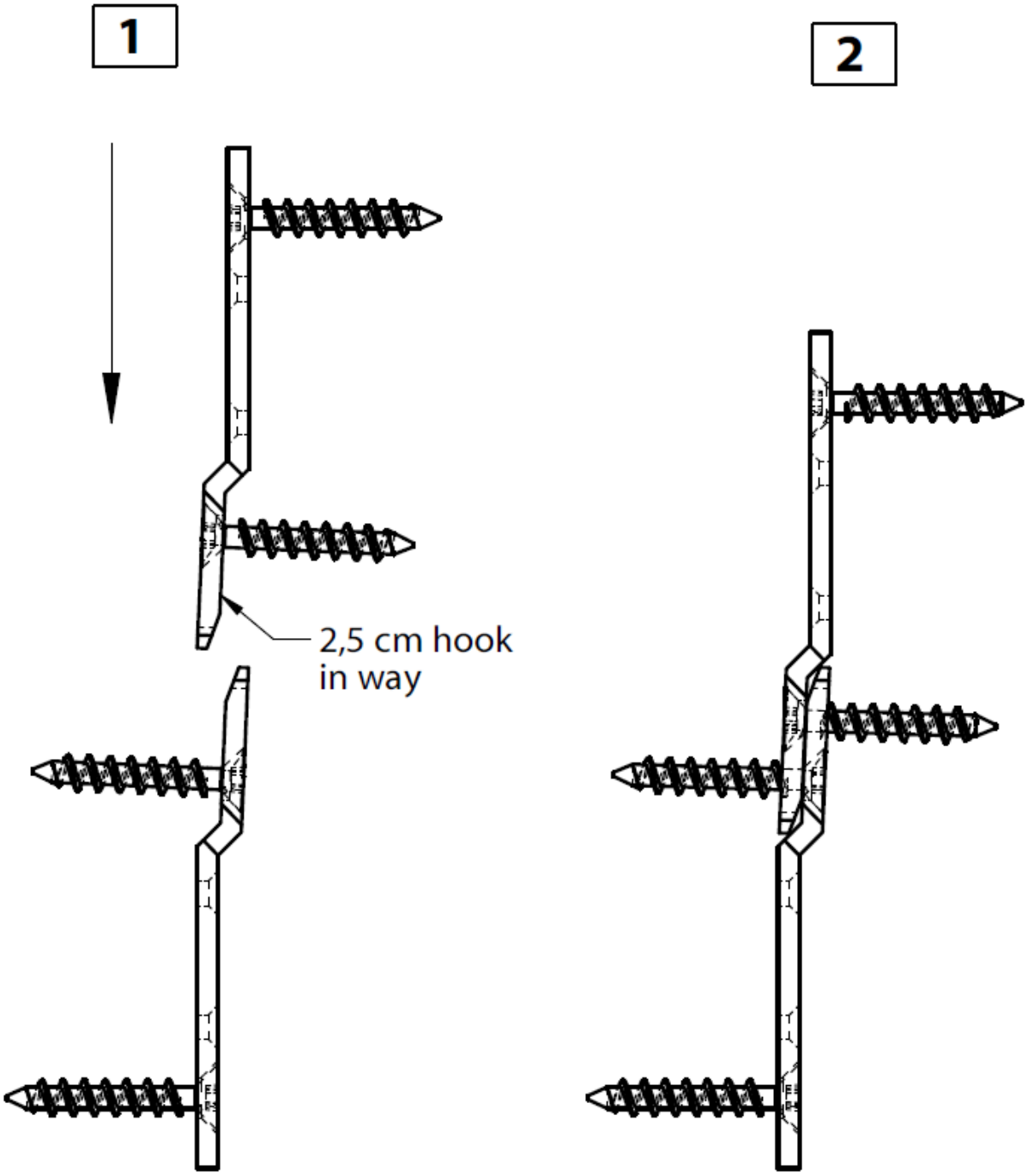
WALCO® V

Joint with interlayer



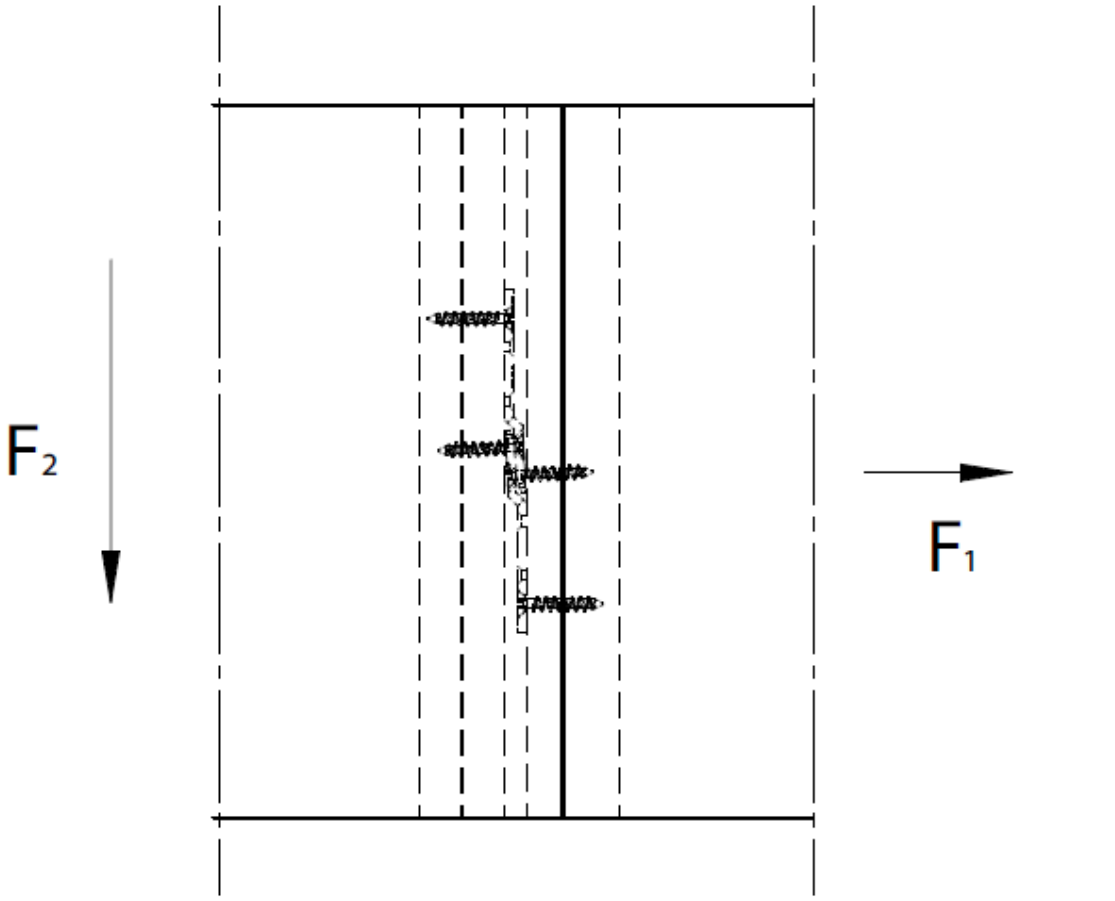
WALCO® 40

Functional principle

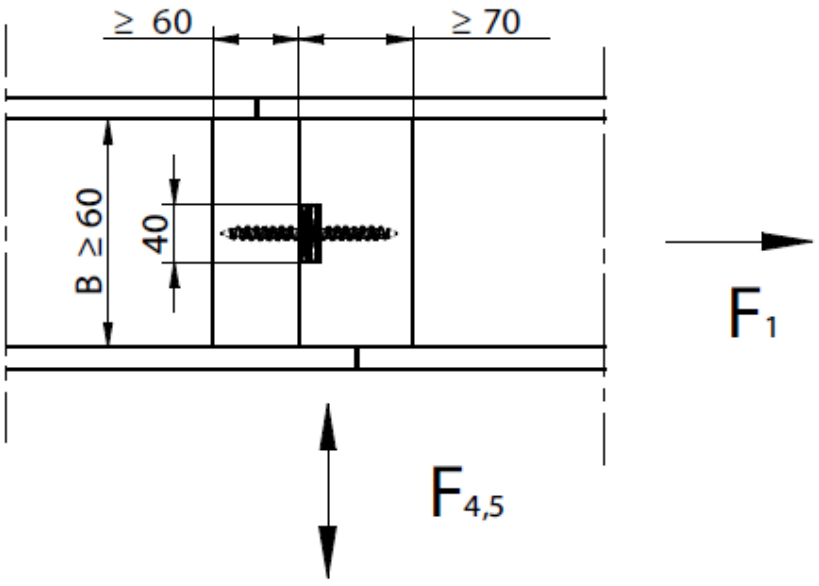


WALCO® 40

Wood to wood joint



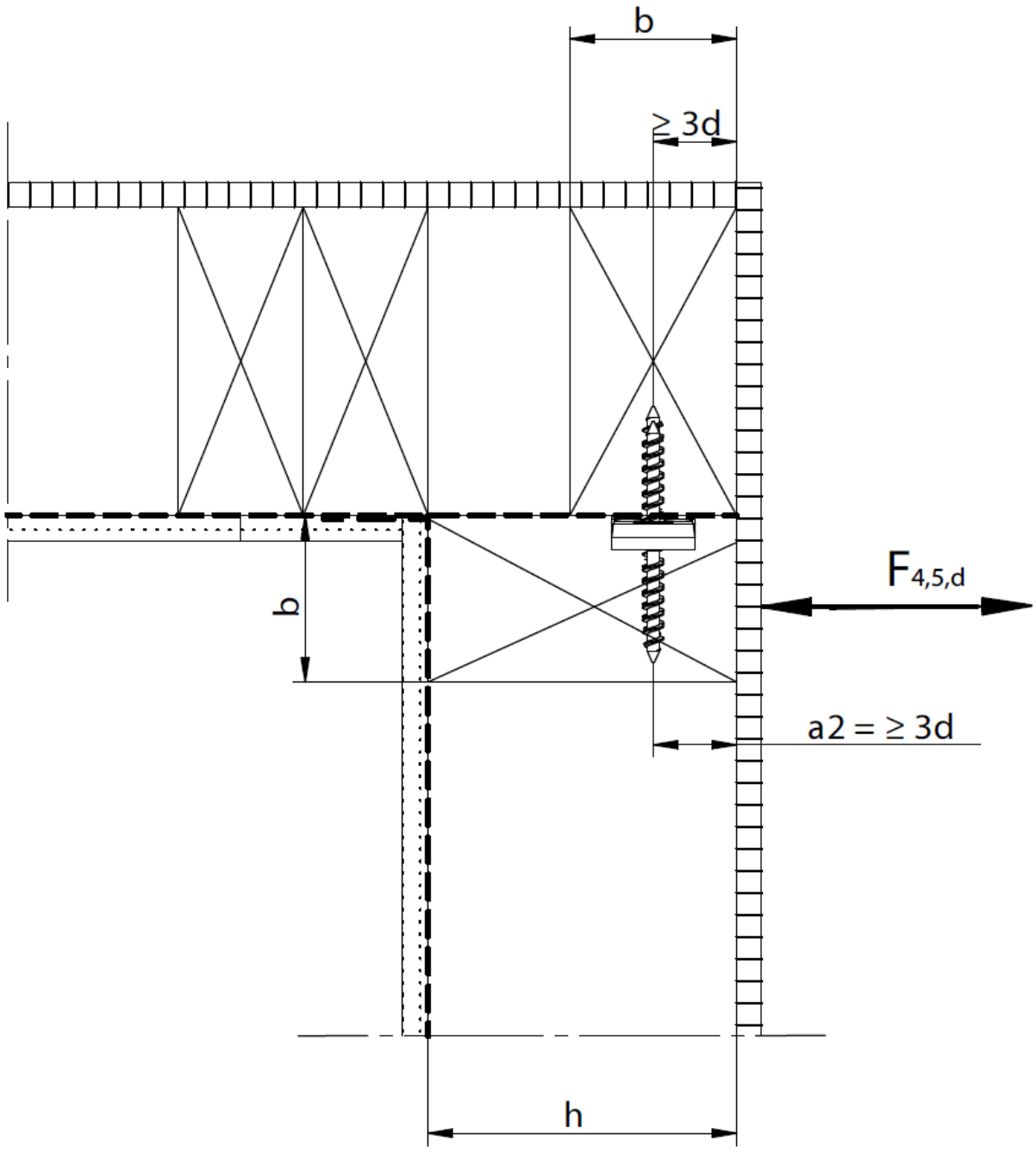
F=direction of load



4 CS 10x60

WALCO® 40

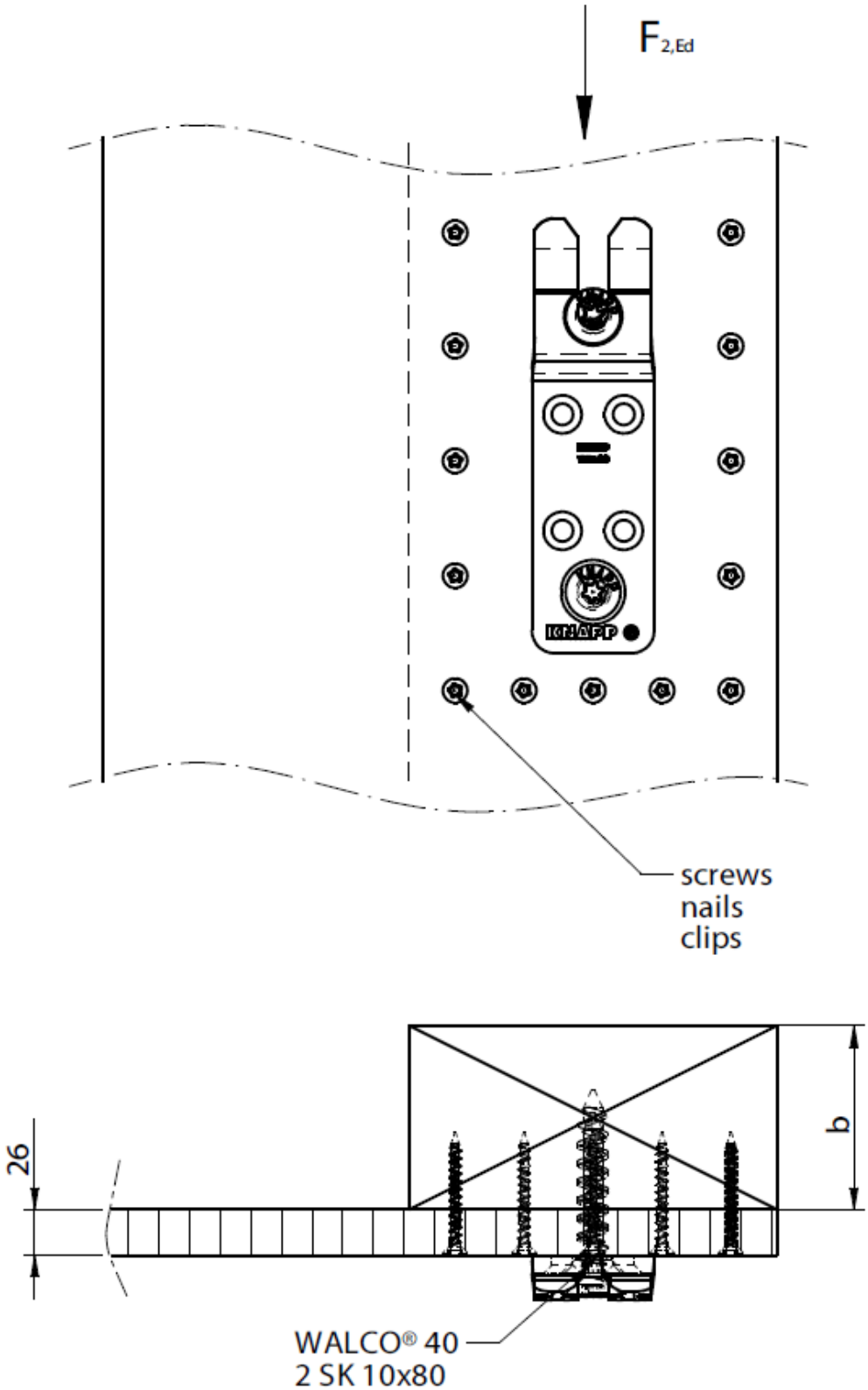
Load direction F_4 / F_5



4 CS 10x60

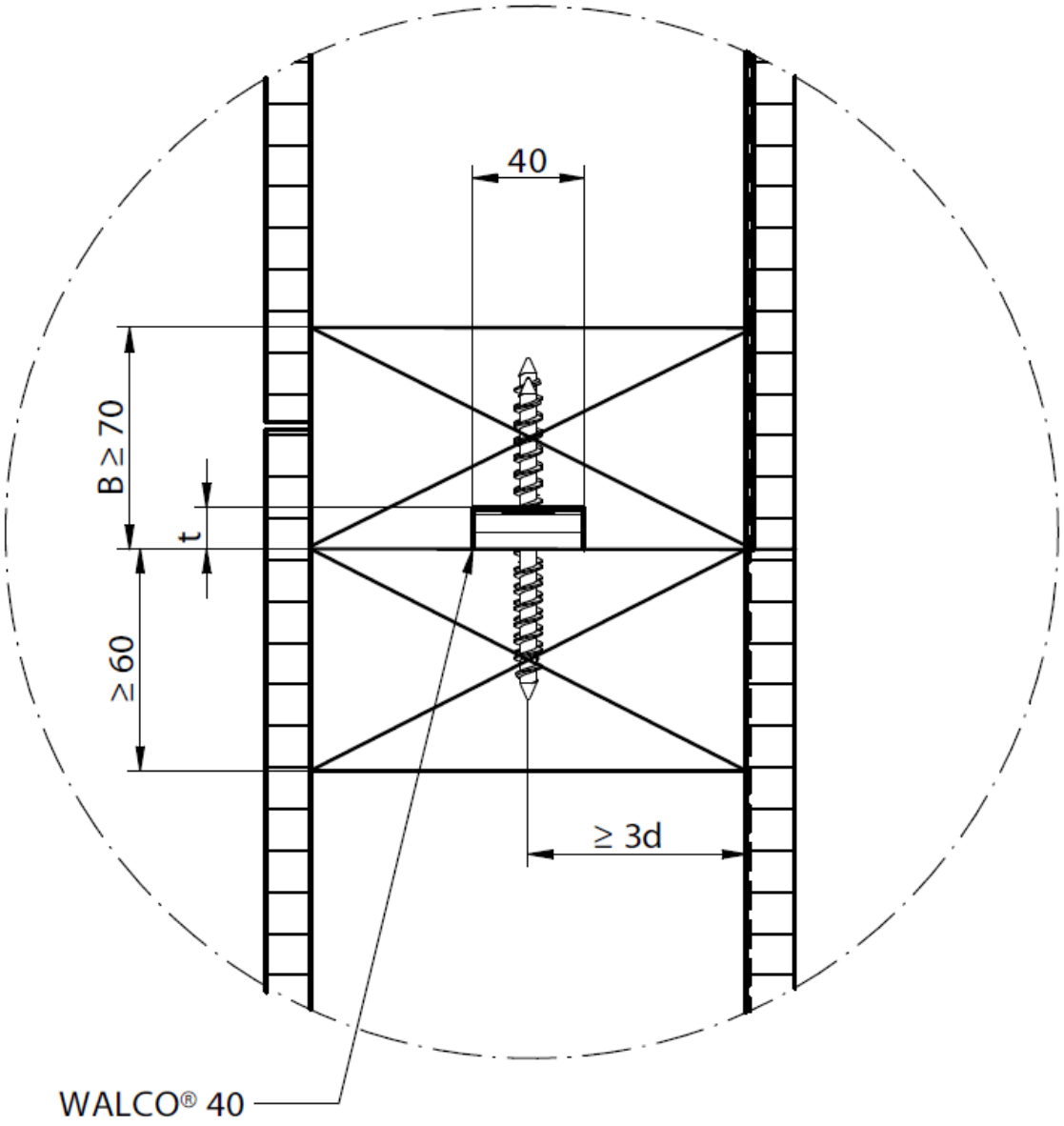
WALCO® 40

Joint with interlayer



WALCO® 40

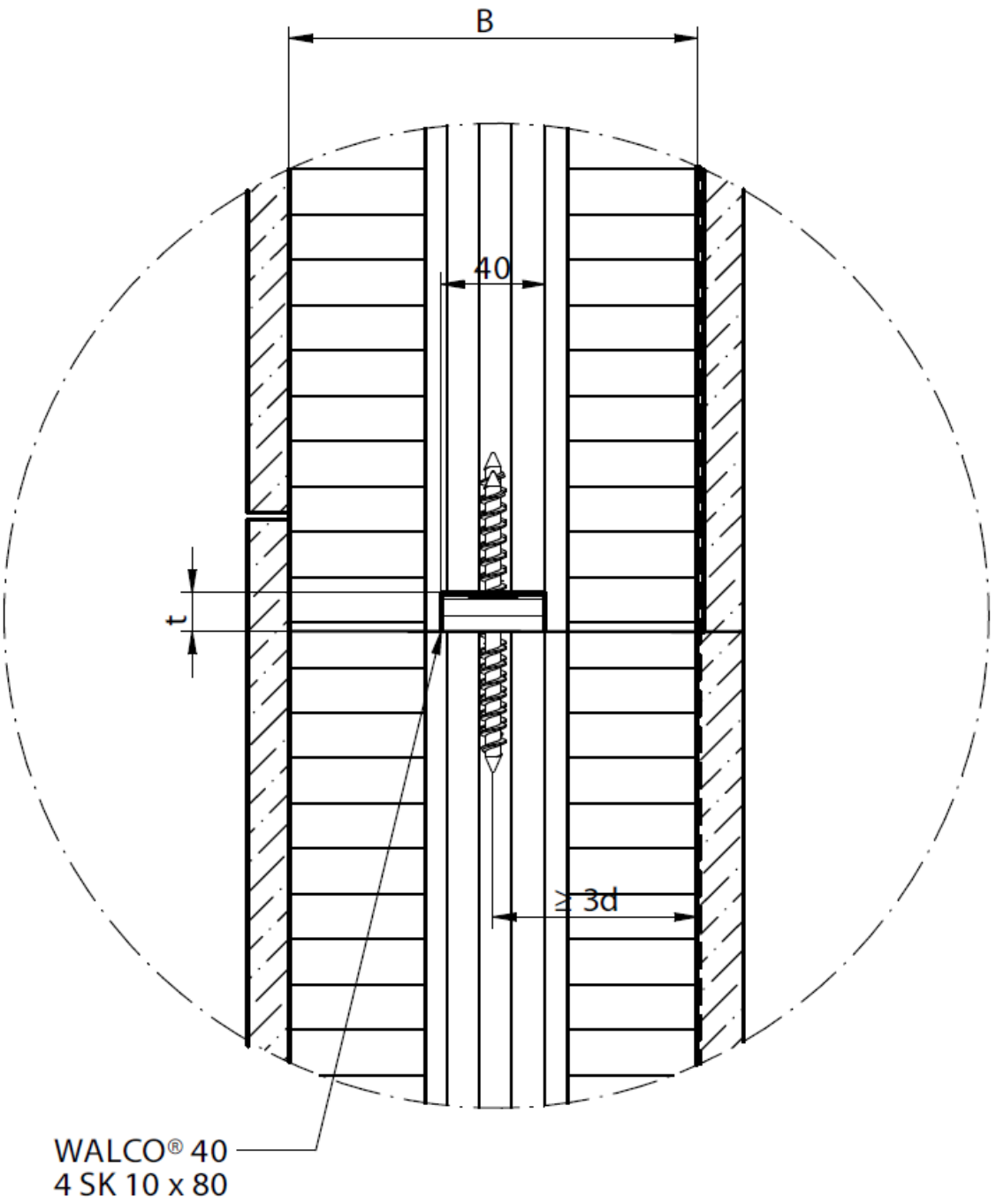
Wall to wall joint with structural solid timber / glulam



4 CS 10x60

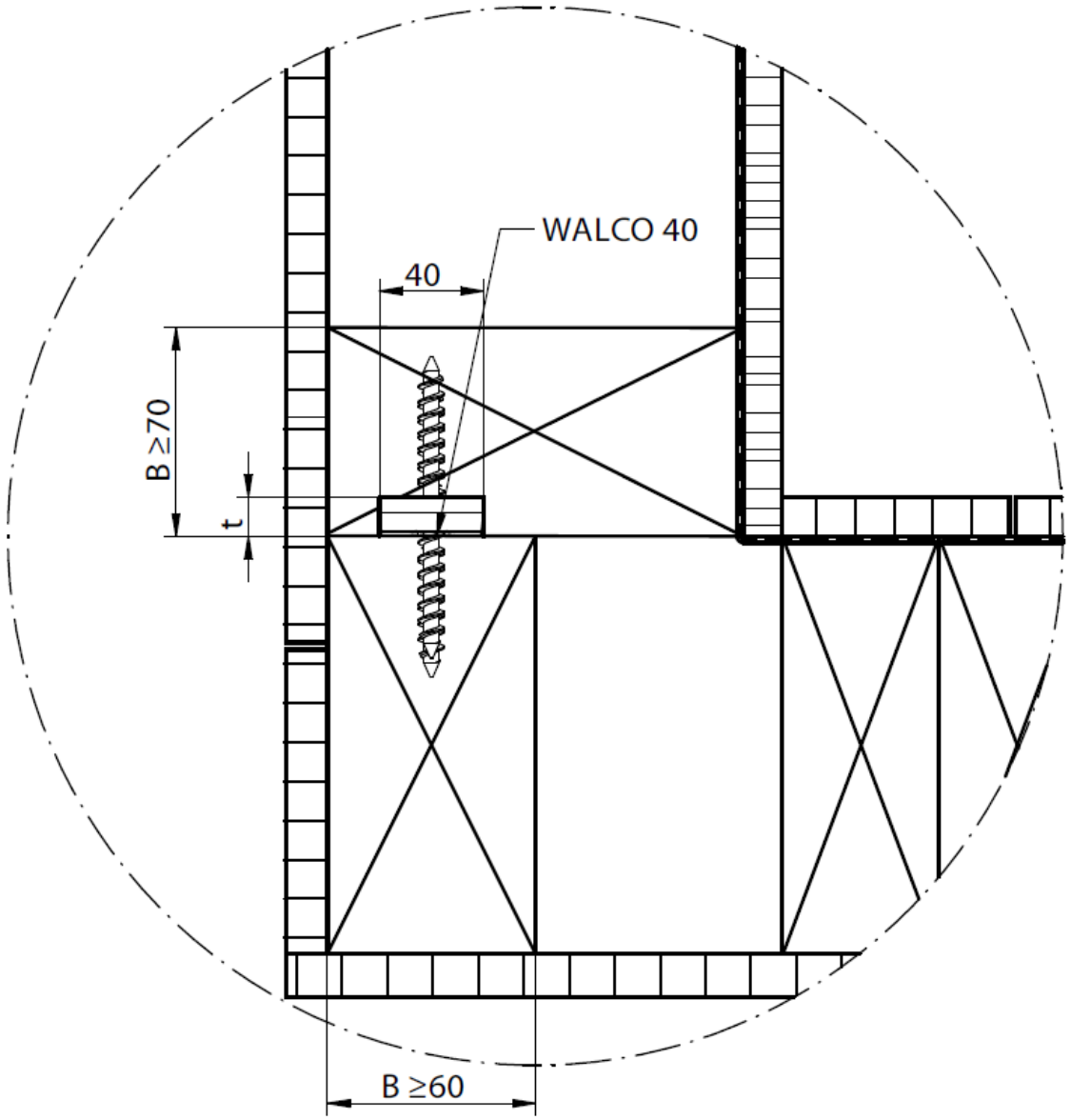
WALCO® 40

Wall to wall joint with CLT / similar structural glued products



WALCO® 40

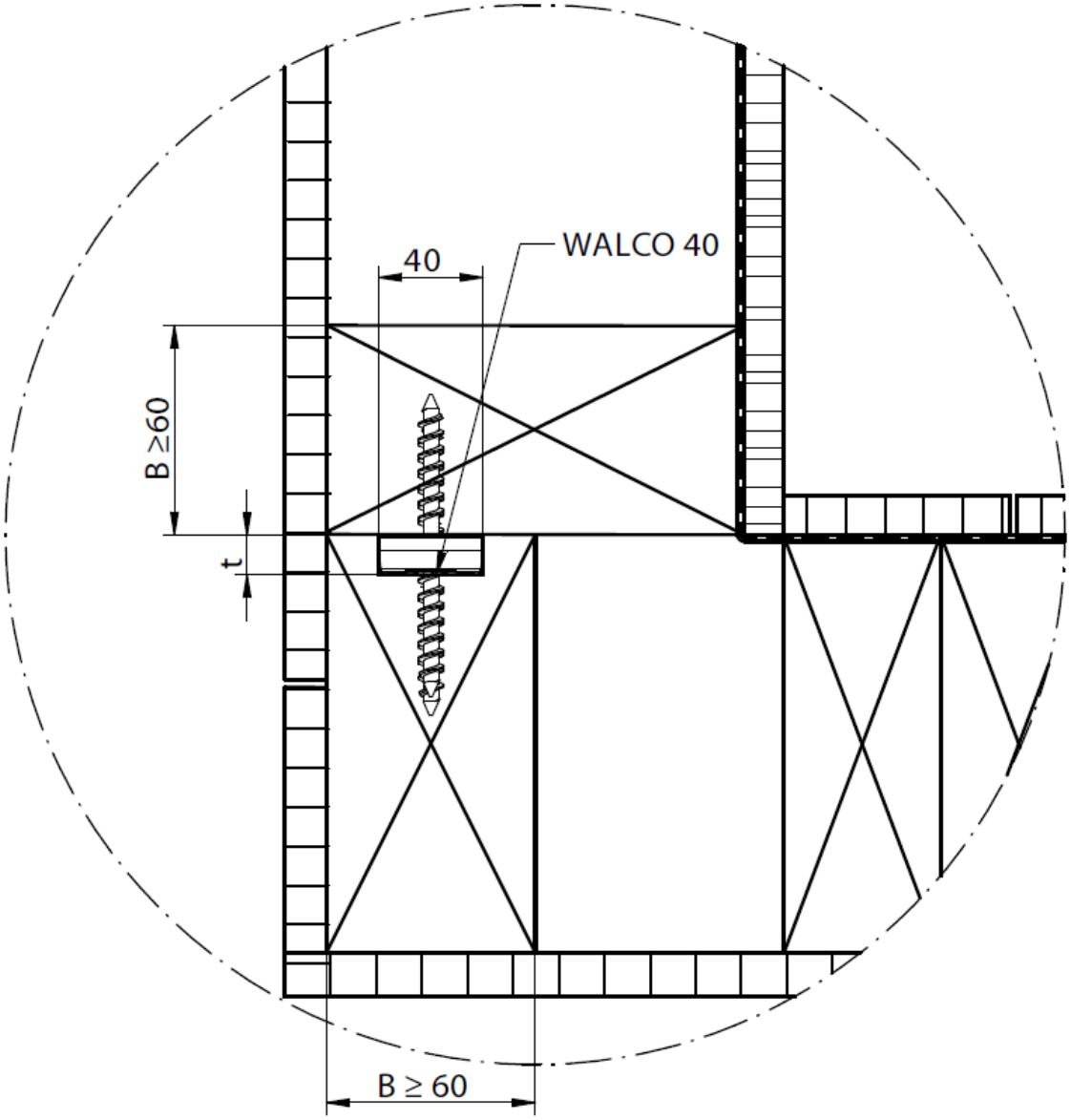
Corner joint with structural solid timber / glulam



4 CS 10x60

WALCO® 40

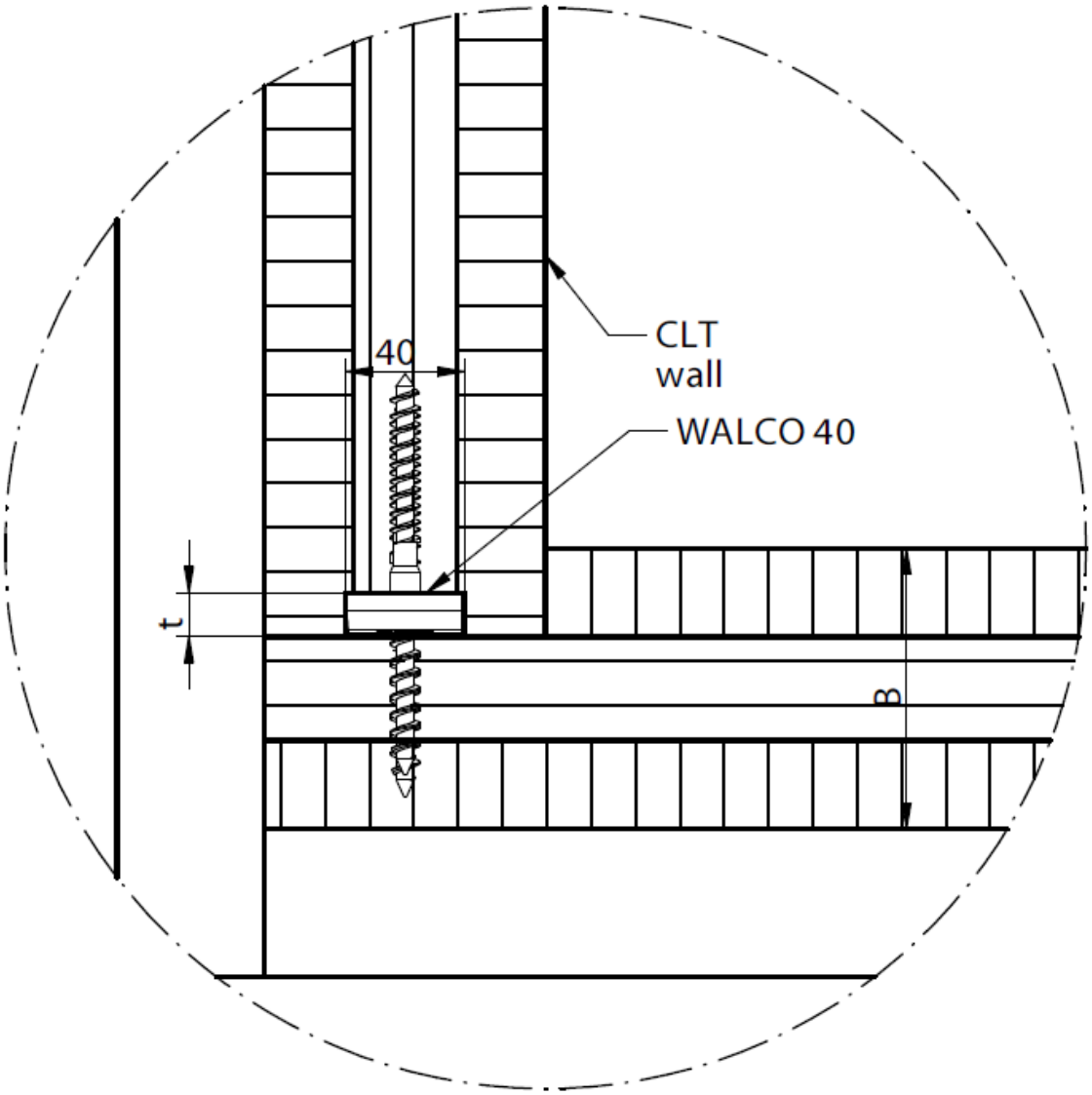
Corner joint with structural solid timber / glulam



4 CS 10x60

WALCO® 40

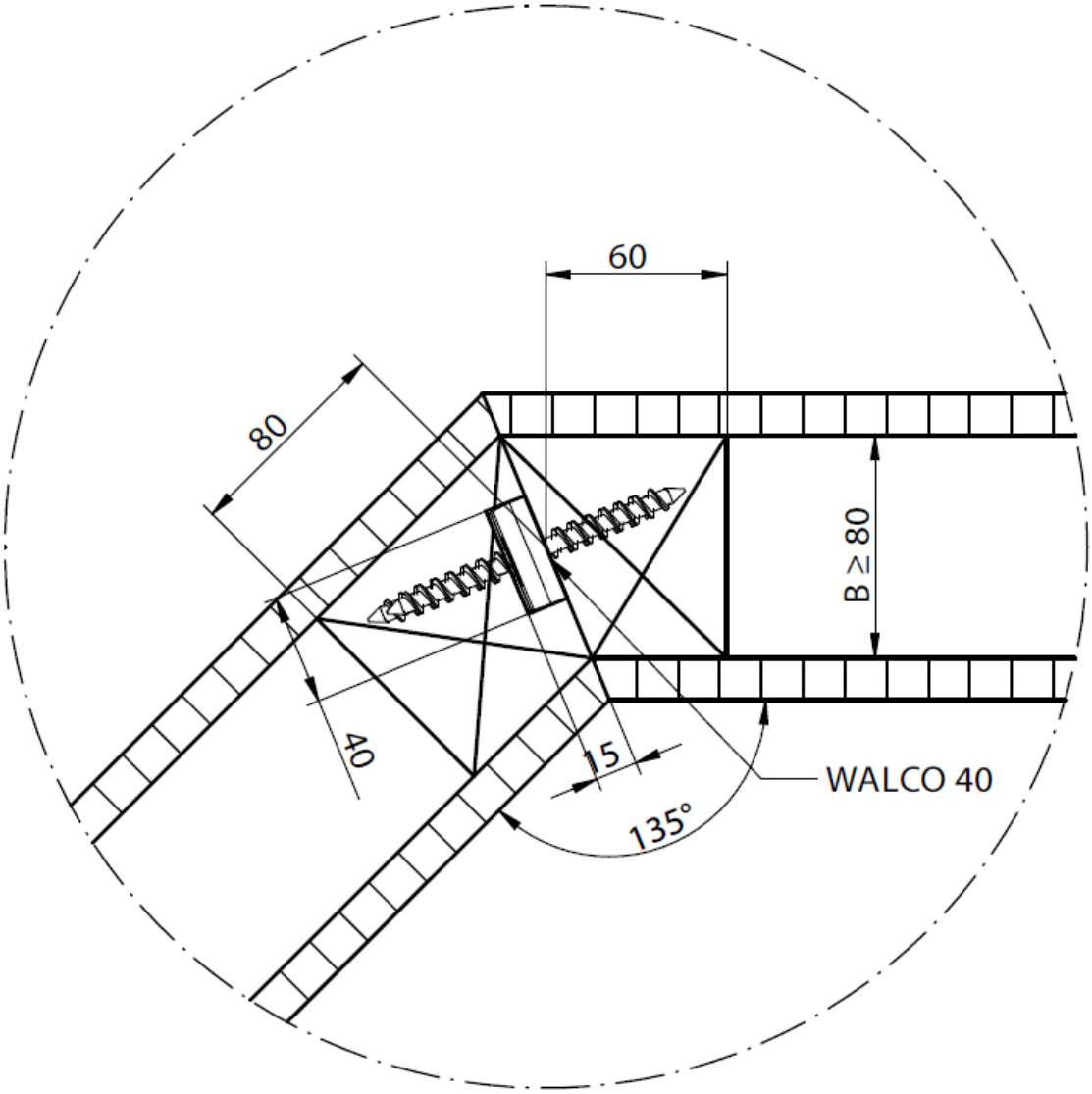
Corner joint with CLT / similar structural glued products



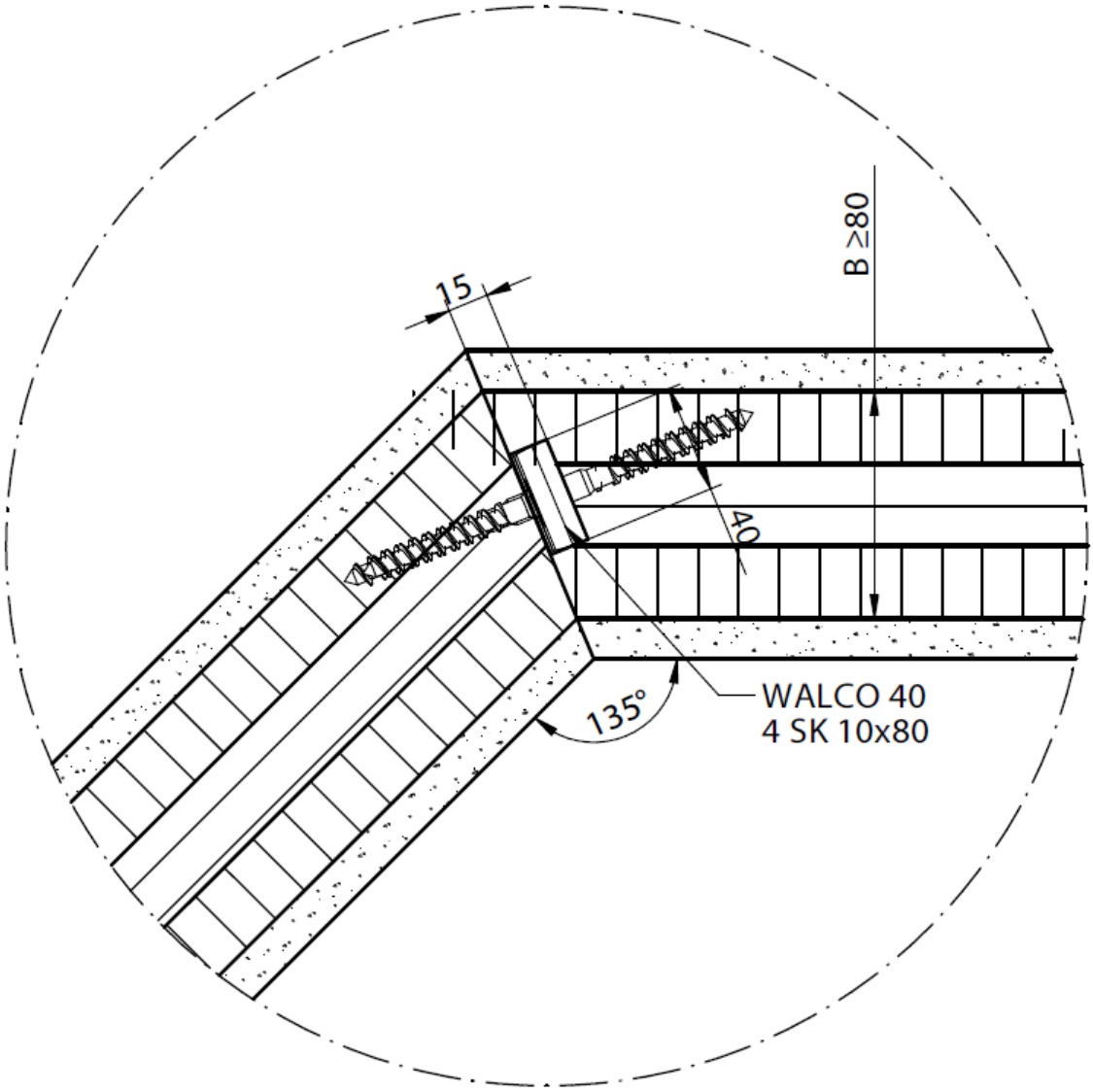
CS 10x60 for side grain
CS 10x80 for end grain (edge of CLT-wall)

WALCO® 40

Tilted joint with structural solid timber / glulam



4 CS 10x60

WALCO® 40

Tilted joint with CLT / similar structural glued products