RADIAL

REMOVABLE CONNECTOR FOR BEAMS AND PANELS

VIDEO CALCULATION TOOL DESIGN REGISTERED ETA-24/0062

PREFABRICATION AND DISASSEMBLY

By pre-installing the connectors at the factory, fastening on site is reduced to a few simple steel bolts for maximum installation reliability. Disassembling the connection is quick and easy.

TOLERANCE

By using RADIALKIT components, it is possible to have a tensile connection with exceptional installation tolerance. The connection remains concealed in the wall thickness.

BEAMS, WALLS AND COLUMNS

Ideal for making connections for either walls, beams and columns (gerber saddles, hinge joints, etc.). Ideal for hybrid timber-to-steel structures.

MODULAR BUILDINGS

The concealed connection is ideal for prefabricated buildings with volumetric modules.

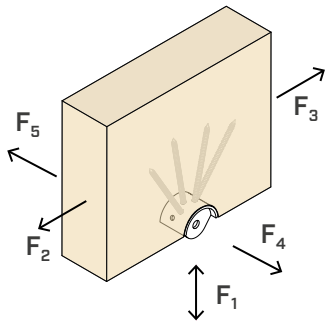
USA, Canada and more design values available online.

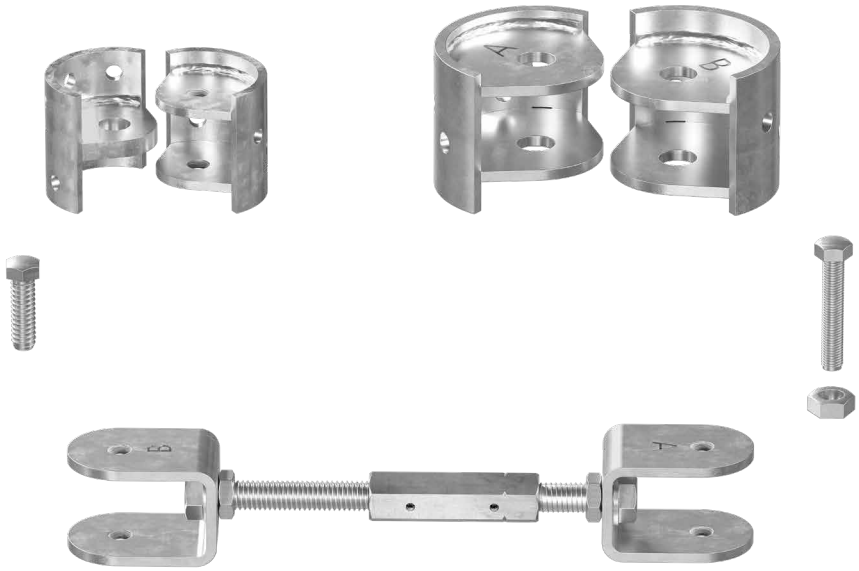
SERVICE CLASS SC1 SC2

MATERIAL

S355 Fe/Zn12c S355 + Fe/Zn12c carbon steel

EXTERNAL LOADS





FIELDS OF USE

Connections between CLT or LVL panels resistant in all directions.
Hinge connections between glulam beams.
Highly prefabricated and demountable construction systems.

Can be applied to:

- CLT or LVL walls and floors
- solid timber, glulam or LVL beams or columns

RADIALKIT

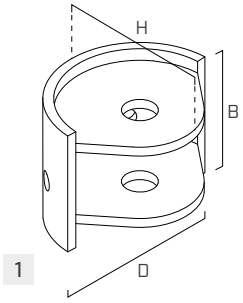
It makes it possible to create tensile connections for walls, without the need to fix screws on site. The connection is completed by inserting the bolts from inside the building without the need for external scaffolding.

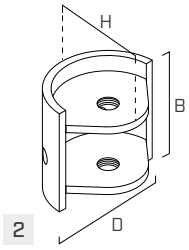
BRACINGS

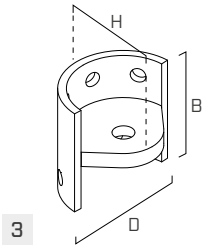
The RADIAL60S connector is ideal for fastening steel bracing to timber beams or columns.

CODES AND DIMENSIONS

RADIAL





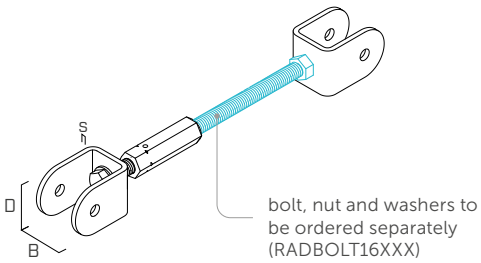


	CODE	D [mm]	B [mm]	H [mm]	*D [in]*	*B [in]*	*H [in]*	pcs
1	**RADIAL90**	90	65	74	*3 1/2*	*2 9/16*	*2 15/16*	10
2	**RADIAL60D**	60	55	49	*2 3/8*	*2 3/16*	*1 15/16*	10
3	**RADIAL60S**	60	55	49	*2 3/8*	*2 3/16*	*1 15/16*	10

RADIALKIT FOR SPACED FASTENING

CODE	D [mm]	B [mm]	s [mm]	*D [in]*	*B [in]*	*s [in]*	pcs
RADIALKIT90	60	60	6	*2 3/8*	*2 3/8*	*1/4*	5
RADIALKIT60	40	51	5	*1 9/16*	*2*	*3/16*	5

The standard bolt connecting the two forks must be ordered separately.

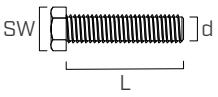


FASTENERS

Full thread BOLT - hexagonal head steel 8.8 EN 15048

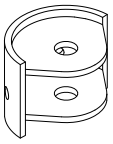
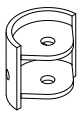
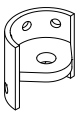
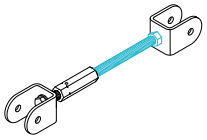
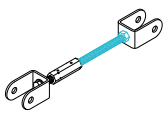
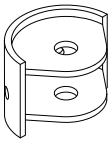
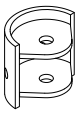
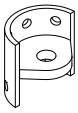
CODE	d [mm]	L [mm]	SW [mm]	*d [in]*	*L [in]*	*SW [in]*	pcs
RADBOLT1245 (*)	M12	45	19	*1/2*	*1 3/4*	*3/4*	100
RADBOLT1260	M12	60	24	*1/2*	*2 3/8*	*15/16*	50
RADBOLT1670	M16	70	24	*5/8*	*2 3/4*	*15/16*	25
RADBOLT16140	M16	140	24	*5/8*	*5 1/2*	*15/16*	25
RADBOLT16160	M16	160	24	*5/8*	*6 1/4*	*15/16*	25
RADBOLT16180	M16	180	24	*5/8*	*7 1/8*	*15/16*	25
RADBOLT16200	M16	200	24	*5/8*	*8*	*15/16*	25
RADBOLT16220	M16	220	24	*5/8*	*8 5/8*	*15/16*	25
RADBOLT16240	M16	240	24	*5/8*	*9 1/2*	*15/16*	25
RADBOLT16300	M16	300	24	*5/8*	*11 3/4*	*15/16*	25

(*)Steel 10.9 EN ISO 4017.



type	description		d [mm]	support	page
LBS HARDWOOD EVO	C4 EVO round head screw on hardwoods		7		572
VGS	fully threaded countersunk screw		9		575
ULS125	washer		M12-M16	-	176
MUT 934	hexagonal nut		M12-M16	-	178

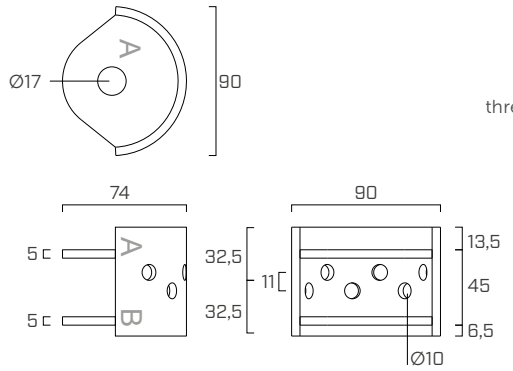
COMPONENT COUPLINGS TABLE

	 RADIAL90	 RADIAL60D	 RADIAL60S	 RADIALKIT90(*)	 RADIALKIT60(*)
 RADIAL90	1x  RADBOLT1670 (10.9)	-	-	2x  RADBOLT1670 (8.8) 1x  RADBOLT16XXX	-
 RADIAL60D	-	-	1x  RADBOLT1245 (10.9)	-	2x  RADBOLT1260 (8.8) 1x  RADBOLT16XXX
 RADIAL60S	-	1x  RADBOLT1245 (10.9)	1x  RADBOLT1245 (10.9)	-	-

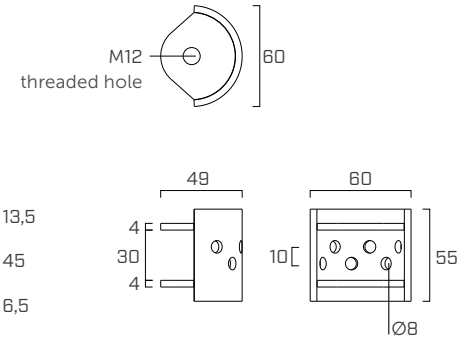
(*)XXX represents the thickness of the interposed layer (e.g. floor thickness).

GEOMETRY

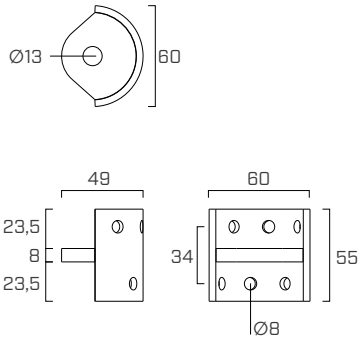
RADIAL90



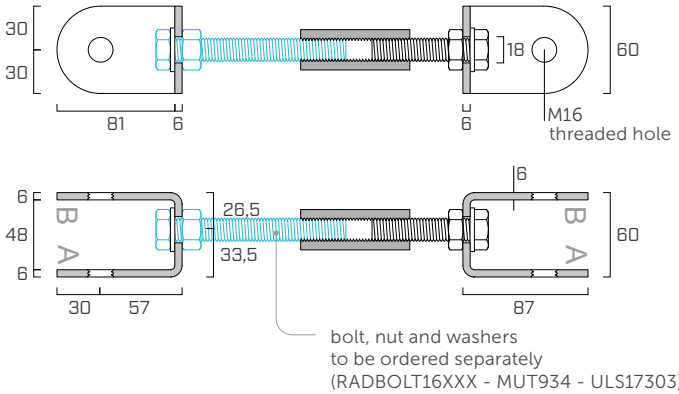
RADIAL60D



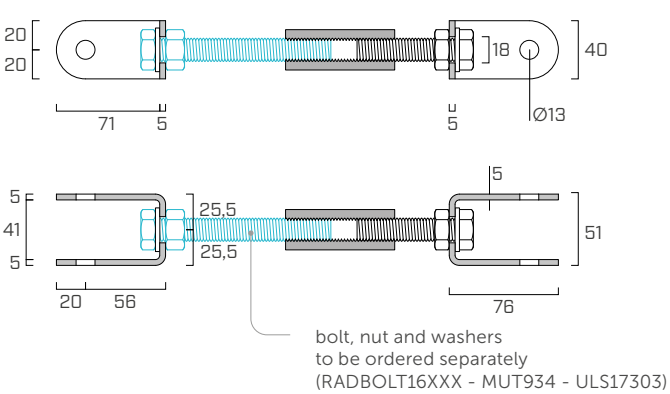
RADIAL60S



RADIALKIT90



RADIALKIT60



The connecting bolt must be ordered separately.
The length corresponds to the layer of timber interposed, for example:

- in the case of a 160 mm thick CLT floor, the RADBOLT bolt length will be 160 mm (panel thickness);
- in the case of an CLT floor and XYLOFON profiles 160+6+6 mm thick, the length of the RADBOLT bolt will be 160 mm (panel thickness) by reducing the part of the thread inserted in the central tensioner;
- maximum adjustable range +12/-8 mm with bolt length in standard configuration. The correct pull-through of the bolts through the inspection holes on the tensioner must always be verified.

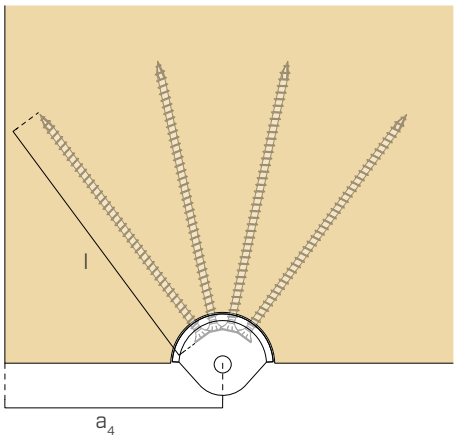
INSTALLATION

FASTENERS

type	screws	number of screws [pcs]
RADIAL90	VGS Ø9	4-6
RADIAL60D	LBSHEVO Ø7	4-6
RADIAL60S	LBSHEVO Ø7	4-6

MINIMUM DISTANCE FROM THE END [1]

type	screws	l [mm]	$a_{4,min}$ [mm] 4 screws	$a_{4,min}$ [mm] 6 screws
RADIAL90	VGS Ø9	200	155	215
		220	160	230
		240	175	245
		260	185	265
		280	195	285
		300	205	300
		320	220	320
		340	230	335
		380	255	370
RADIAL60D **RADIAL60S**	LBSHEVO Ø7	120	110	135
		160	120	170
		200	145	205

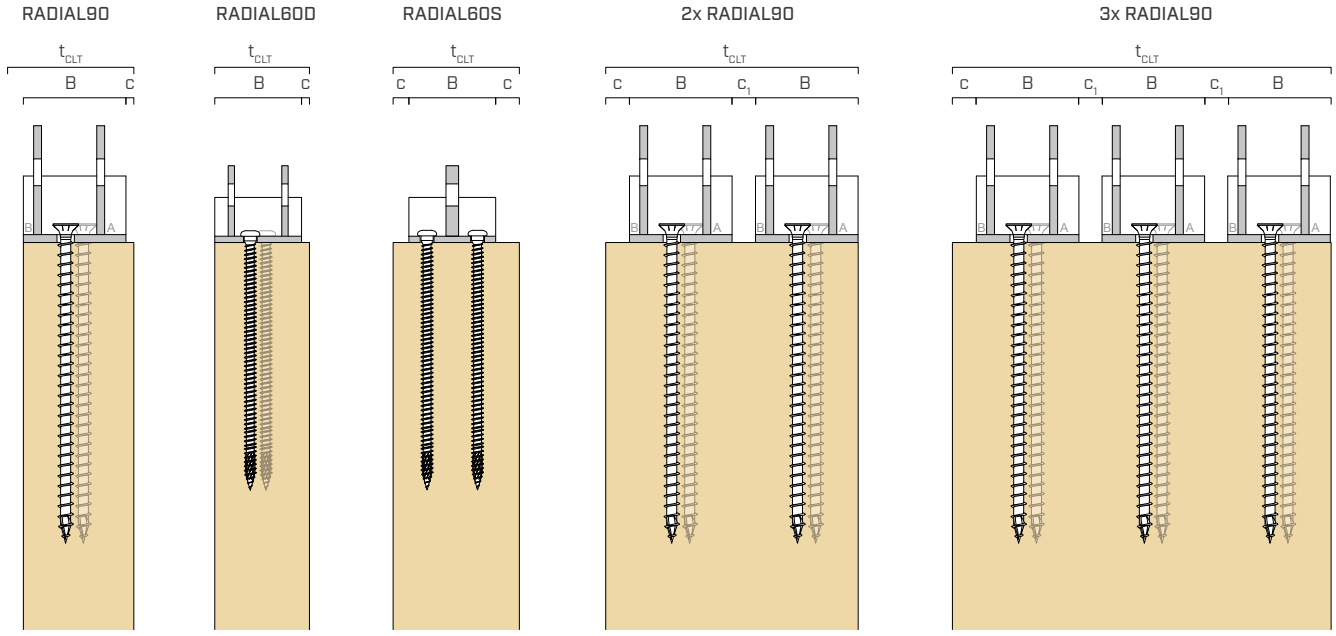


MINIMUM DISTANCE FROM THE EDGE [1] - SINGLE CONNECTORS

type	screws	B [mm]	$t_{CLT,min}$ [mm]	c_{min} [mm]
RADIAL90	VGS Ø9	65	80	0
RADIAL60D	LBSHEVO Ø7	55	60	0
RADIAL60S	LBSHEVO Ø7	55	80	10

MINIMUM DISTANCE FROM THE EDGE [1] - COUPLED CONNECTORS

type	screws	B [mm]	$t_{CLT,min}$ [mm]	c_1 [mm]	c_{min} [mm]
2x RADIAL90	VGS Ø9	65	160	15	0
3x RADIAL90	VGS Ø9	65	240	15	0

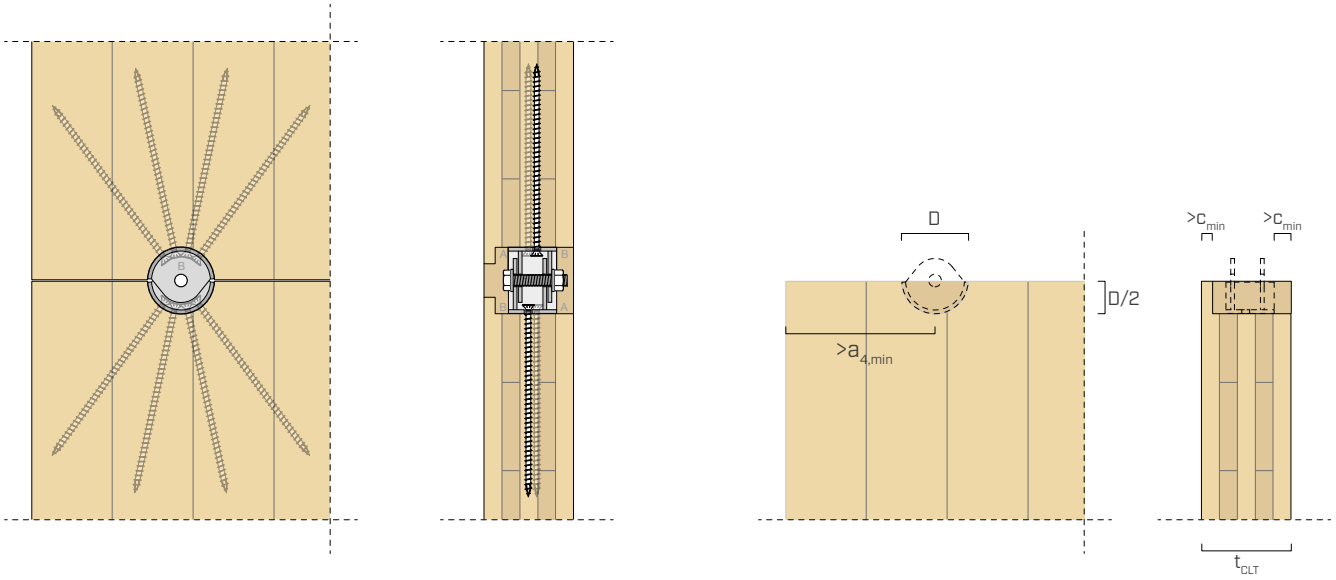


NOTES

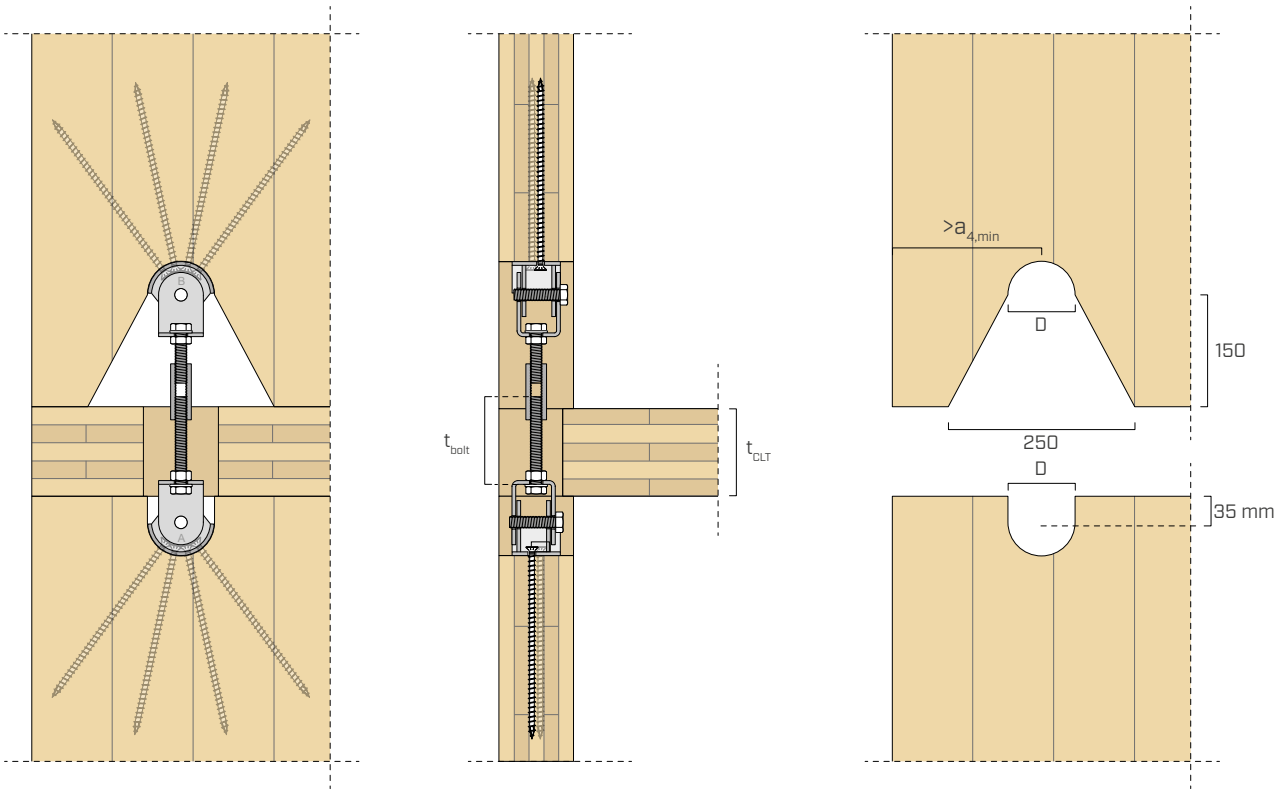
(1) Minimum dimensions refer to application on CLT panels. The distances of the fasteners to the ends and edges must be observed for application on glulam beams. The actions of transverse forces orthogonal to the grain that may introduce splitting phenomena must also be checked.

ROUTING IN TIMBER ELEMENTS[1]

DIRECT FASTENING



SPACED FASTENING



NOTES

(1) The processing geometries shown in the images represent possible geometries for the most common applications. In the case of inter-storey spacing fastening, the geometry allows the tensioner to be adjusted from inside the building. Depending on the specific requirements, the processing can be modified while respecting the minimum distances indicated in the relevant section.

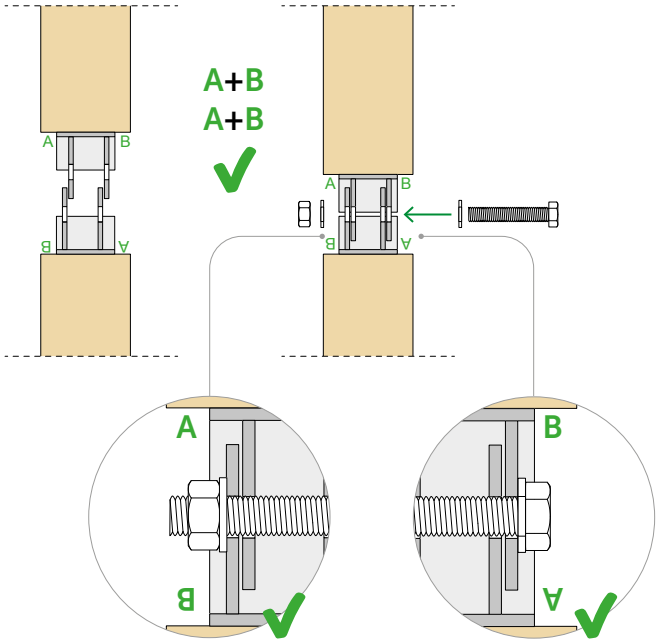
By adopting this geometry, the length of the RADBOLT16XXX bolt corresponds to the thickness of the interposed CLT floor, the same rule also applies in the case of resilient profiles positioned between the floor and walls (with a maximum thickness of 6mm per single interposed profile). If different geometries are used, the assumptions and choice of bolt length must be checked and adjusted.

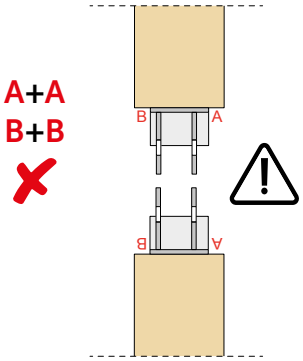
ELEMENTS COUPLING

The connectors of the RADIAL family can be coupled according to two main schemes: **direct** or **spaced**.
The first involves the direct fastening of two connectors (RADIAL90+RADIAL90 or RADIAL60S+RADIAL60D) by means of a bolt. Depending on the model, the holes in the flanges can be either threaded or smooth so as to allow coupling with the necessary tolerances.
The spaced fastening, which can be used, for example, in the case of assembly with the interposition of a floor, requires the use of a KIT that includes not only the metal forks but also the adjustment system. This does not include the completion bolt, which can be ordered separately depending on the thickness of the interposed layer.

RADIAL90

direct fastening



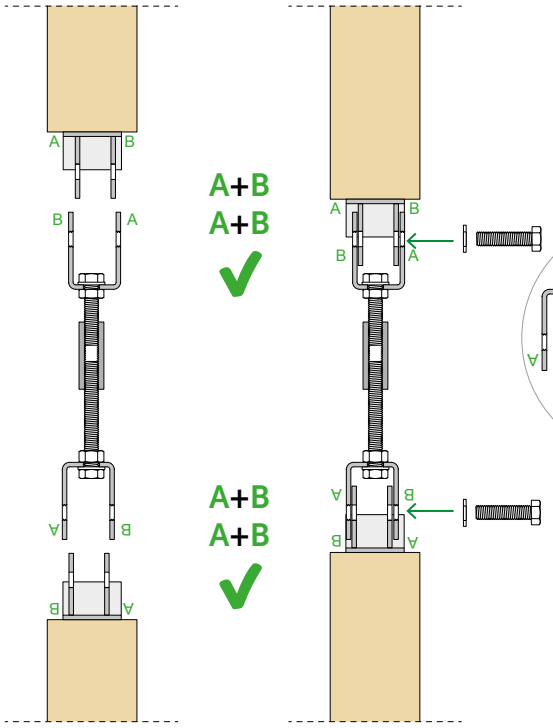


The RADIAL 90 connector features an asymmetrical geometry to ensure a high-performance coupling in terms of stiffness and strength.
For this reason, special attention must be paid to the orientation of the connector during installation. The letters identifying the outer faces of the RADIAL connectors must be different (e.g. **A** and **B**).

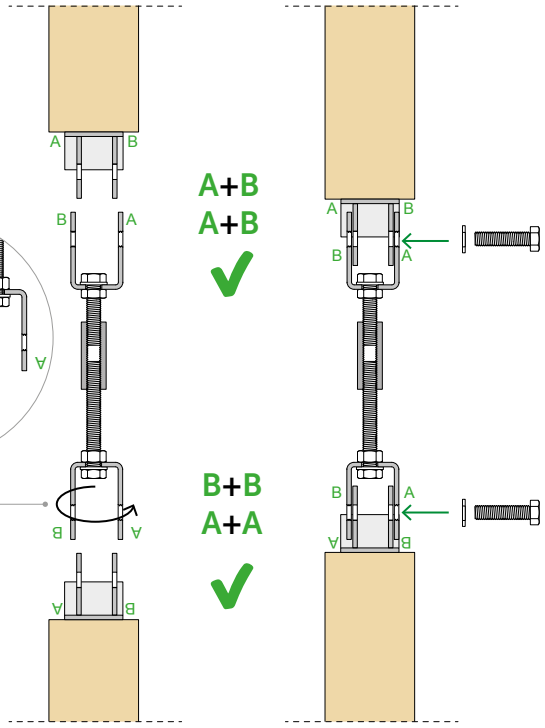
RADIAL90+ RADIALKIT90

In the case of spaced fastening, rotating the fork plate ensures correct positioning even if the connector was positioned in the opposite direction.

spaced fastening

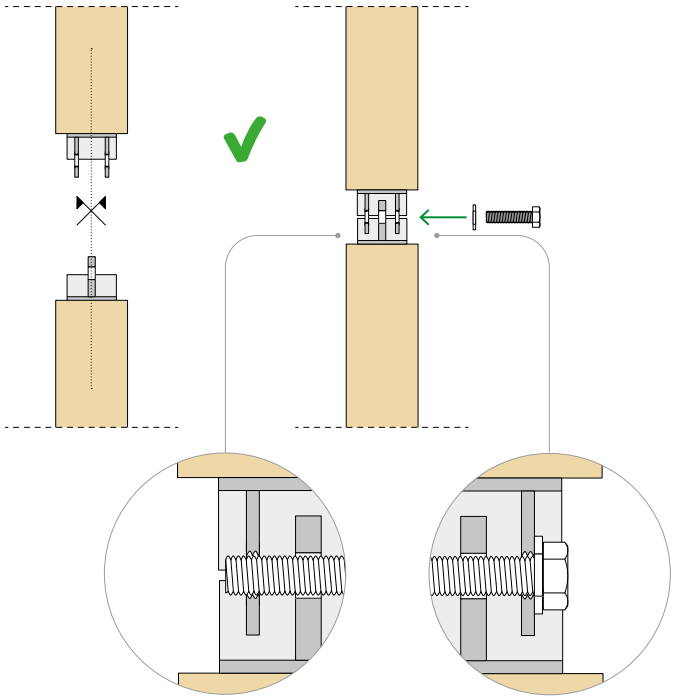


spaced fastening



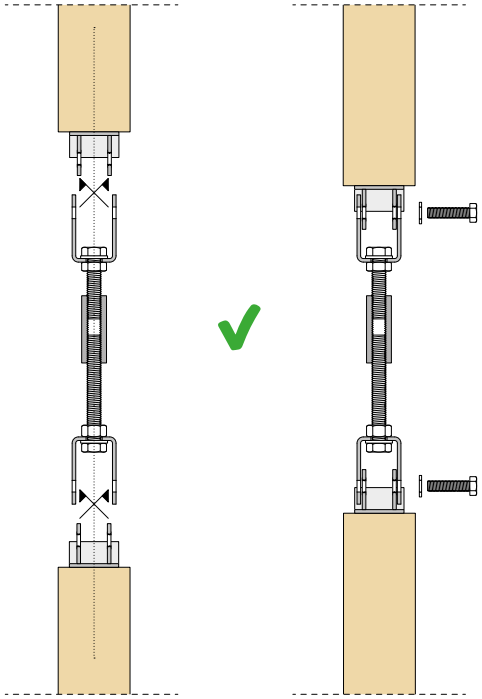
RADIAL60D + RADIAL60S

direct fastening



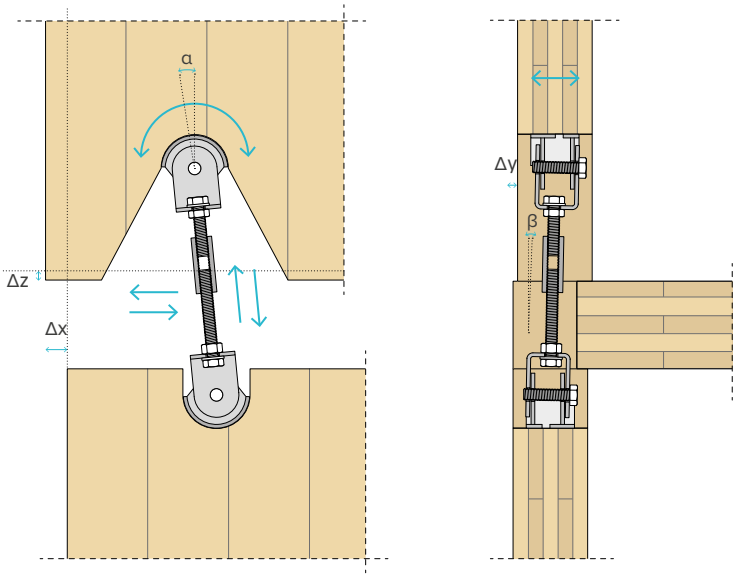
RADIAL60D+ RADIALKIT60

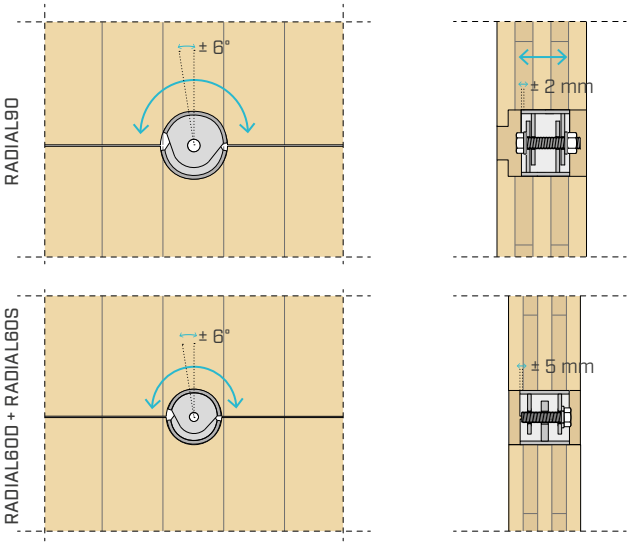
spaced fastening

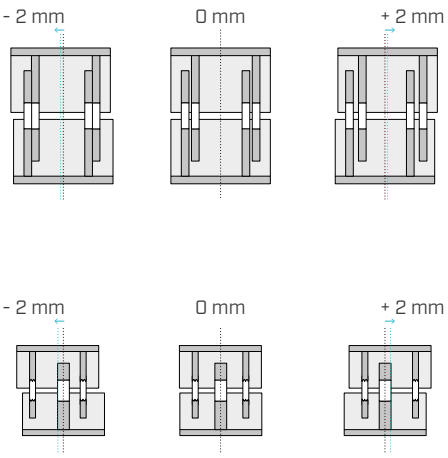


TOLERANCES

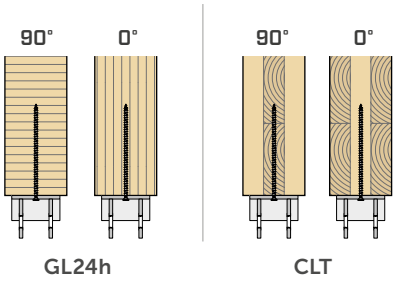
RADIAL connectors are designed to suit both prefabrication off-site and placement on site. Tolerances along the transverse direction and rotation around the centre of the connector are guaranteed.
In the case of the spaced connection, the construction tolerance is further increased by the presence of a distance adjustment system that allows a considerable inclination of the rod.

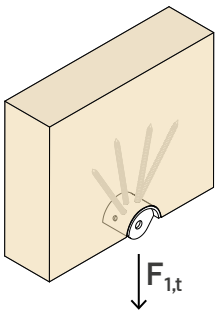


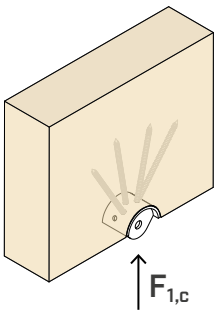




STRUCTURAL VALUES | F_1







TENSILE JOINT - RADIAL

		TIMBER[1]				STEEL	
type	fastening	$R_{1,t\ k\ timber}$ GL24h		$R_{1,t\ k\ timber}$ CLT		$R_{1,k\ steel}$	γ_{steel}
		0°	90°	0°	90°		
	[pcs Ø x L]	[kN]	[kN]	[kN]	[kN]	[kN]	
RADIAL90	4 - VGS Ø9x260	65,3	85,8	60,5	85,8	113,5	γ_{M2}
	6 - VGS Ø9x320	95,9	109,9	93,4	109,9		
RADIAL60D	4 - LBSHEVO Ø7x200	38,3	58,4	35,5	54,2	60,0	
	6 - LBSHEVO Ø7x200	54,7	71,0	50,7	65,8		
RADIAL60S	4 - LBSHEVO Ø7x200	38,3	58,4	35,5	54,2	51,0	
	6 - LBSHEVO Ø7x200	54,7	71,0	50,7	65,8		

TENSILE JOINT - RADIALKIT

When using RADIAL with RADIALKIT the coupling must be verified according to the following table.

	STEEL	
type	$R_{1,k\ steel}$ [kN]	γ_{steel}
RADIALKIT90	85,6	γ_{M0}
RADIALKIT60	54,8	

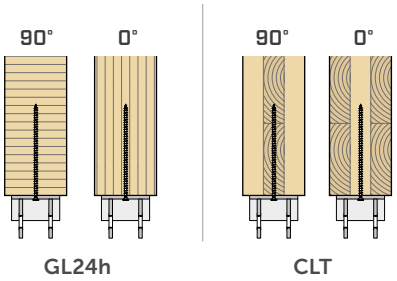
COMPRESSION JOINT - RADIAL

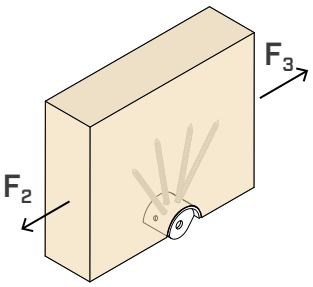
	TIMBER[1]			STEEL	
type	$R_{1,c\ timber}$ GL24h		$R_{1,c\ timber}$ CLT	$R_{1,k\ steel}$	γ_{steel}
	0°	90°			
	[kN]	[kN]	[kN]	[kN]	
RADIAL90	112,6	56,3	81,9	113,5	γ_{M2}
RADIAL60D	63,8	31,9	46,4	60,0	
RADIAL60S	63,8	31,9	46,4	51,0	

NOTES

(1) For CLT panels the strength is calculated for a characteristic density ρ_k=350kg/m^3, in the case of glulam (GL) they refer to a density of ρ_k= 385kg/m^3.

STRUCTURAL VALUES | $F_{2/3}$[2]



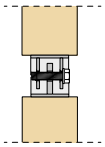
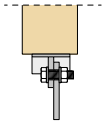
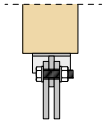


SHEAR JOINT - RADIAL

type	fastening	TIMBER[1] [2] $R_{2/3,k\ timber}$ GL24h 0° [kN]	GL24h 90° [kN]	CLT 0° [kN]	CLT 90° [kN]
RADIAL90	4 - VGS Ø9x260	51,2	56,7	53,4	60,3
	6 - VGS Ø9x320	71,4	74,0	76,3	79,8
RADIAL60D	4 - LBSHEVO Ø7x200	29,7	32,2	30,9	35,6
	6 - LBSHEVO Ø7x200	39,5	44,7	43,5	43.2
RADIAL60S	4 - LBSHEVO Ø7x200	29,7	32,2	30,9	35,6
	6 - LBSHEVO Ø7x200	39,5	44,7	43,5	43.2

STRUCTURAL VALUES | BOLTS

In the configurations shown in the table, the class 10.9 bolt shear verification must be carried out.

coupling		fastening	STEEL $R_{k\ steel}$ [kN]	STEEL γ_{steel}
	RADIAL60D + RADIAL60S	RADBOLT1245	38	γ_{M2}
	RADIAL60S + single plate[3]	RADBOLT1245	42,5	
	RADIAL60S + double plate[3]	RADBOLT1245	85,0	

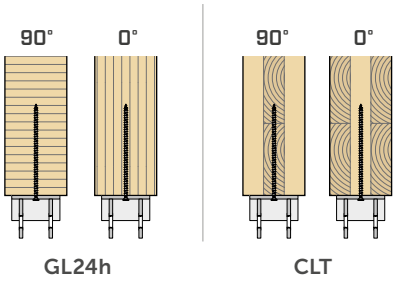
NOTES

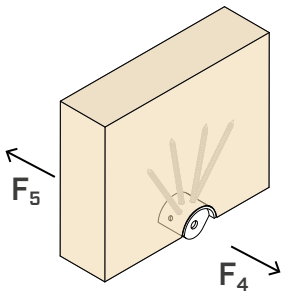
(1) For CLT panels the strength is calculated for a characteristic density ρ_k=350kg/m^3, in the case of glulam (GL) they refer to a density of ρ_k= 385kg/m^3.

(2) The steel-side failure mechanisms are over-resistance compared to the timber-side strength, so they are not shown in the table.

(3) Steel-side resistance refers to the case of connection with over-resistance plates. The geometry and strength of the connecting plates must be checked separately.

STRUCTURAL VALUES | TIMBER-TO-TIMBER | $F_{4/5}$ [2]





SHEAR JOINT - RADIAL

type	fastening	TIMBER[1] $R_{4/5,k\ timber}$ GL24h 0°	TIMBER[1] $R_{4/5,k\ timber}$ GL24h 90°	TIMBER[1] $R_{4/5,k\ timber}$ CLT 0°	TIMBER[1] $R_{4/5,k\ timber}$ CLT 90°
	[pcs Ø x L]	[kN]	[kN]	[kN]	[kN]
RADIAL90	4 - VGS Ø9x260	15,4	8,5	11,7	12,0
	6 - VGS Ø9x320	16,5	8,6	12,2	12,3
RADIAL60D	4 - LBSHEVO Ø7x200	12,4	7,0	9,5	9,8
	6 - LBSHEVO Ø7x200	13,5	7,2	10,0	10,2
RADIAL60S	4 - LBSHEVO Ø7x200	16,1	10,2	12,9	13,6
	6 - LBSHEVO Ø7x200	18,6	10,5	14,3	14,7

NOTES

(1) For CLT panels the strength is calculated for a characteristic density ρ_k=350kg/m^3, in the case of glulam (GL) they refer to a density of ρ_k= 385kg/m^3.

(2) The steel-side failure mechanisms are over-resistance compared to the timber-side strength, so they are not shown in the table.

GENERAL PRINCIPLES

- The design values are derived from the characteristic values determined in accordance with ETA-24/0062, ETA-11/0030 and EN 1995:2014 as follows.
- The design values are obtained as follows:

$$R_d = min \begin{cases} \frac{R_{k\ timber}\ or\ R_{k\ CLT} \cdot k_{mod}}{\gamma_M} \\ \frac{R_{k\ steel}}{\gamma_{M2}} \end{cases}$$

  The coefficients k_{mod}, γ_M and γ_{M2} should be taken according to the current regulations used for the calculation.
- The characteristic values of the load-bearing capacity $R_{k,timber}$ are determined by considering the strength formulations of the screws inserted in a layer with homogeneous timber grain direction. All screws connecting the RADIAL connector must be inserted in layers (even different ones) but with equal grain orientation.
- The strengths for lengths other than those indicated must be evaluated in accordance with ETA-24/0062, considering the effective pull-through depth of the threaded part, as:

  $l_{eff} = l$ -15 mm

- The minimum connector lengths are, 100 mm for 7 mm diameter screws and 180 for 9 mm diameter screws. The maximum density that can be used in verifications for timber or timber-based products is ρ_k=480kg/m^3.
- The calculation process used a timber characteristic density of ρ_k=385 kg/m^3 for glulam and ρ_k=350 kg/m^3 for CLT panels.
- For higher ρ_k values, the strength on timber side can be converted by the k_{dens} value:

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0,8}$$

- The formulations for verifying connections with LVL are reported in ETA-24/0062.
- In the case of loads perpendicular to the plane of the panel, it is recommended to check there are no brittle failures before reaching the connection strength.
- K_{ser} values refer to the individual connector. In the case of series coupling, the stiffness must be halved.

INTELLECTUAL PROPERTY

- RADIAL is protected by the following Registered Community Designs: RCD 015032190-0011 | RCD 015032190-0012 | RCD 015032190-0013.

STRUCTURAL VALUES | STIFFNESS[1]

TENSILE JOINT | $K_{1,t\ ser}$

type	fastening	$K_{1,t\ ser}$ GL24h		$K_{1,t\ ser}$ CLT	
		0°	90°	0°	90°
	[pcs Ø x L]	[N/mm]	[N/mm]	[N/mm]	[N/mm]
RADIAL90	4 - VGS Ø9x260	24100	31700	22400	31700
	6 - VGS Ø9x320	35500	40700	34500	40700
RADIAL60D	4 - LBSHEVO Ø7x200	19100	29200	17700	27100
	6 - LBSHEVO Ø7x200	27300	30200	25300	30200
RADIAL60S	4 - LBSHEVO Ø7x200	19100	27500	17700	27100
	6 - LBSHEVO Ø7x200	27300	27500	25300	27500

COMPRESSION JOINT | $K_{1,c\ ser}$

type	$K_{1,c\ ser}$ GL24h		CLT
	0°	90°	-
	[N/mm]	[N/mm]	[N/mm]
RADIAL90	187600	93800	136500
RADIAL60D	100000	53100	77300
RADIAL60S	91600	53100	77300

SHEAR JOINTS | $K_{2/3\ ser}$

type	fastening	$K_{2/3\ ser}$ GL24h		$K_{2/3\ ser}$ CLT	
		0°	90°	0°	90°
	[pcs Ø x L]	[N/mm]	[N/mm]	[N/mm]	[N/mm]
RADIAL90	4 - VGS Ø9x260	18200	20200	19000	21500
	6 - VGS Ø9x320	25500	26400	27200	28500
RADIAL60D	4 - LBSHEVO Ø7x200	17800	16500	17100	19700
	6 - LBSHEVO Ø7x200	24800	21900	24100	24000
RADIAL60S	4 - LBSHEVO Ø7x200	17800	16500	17100	19700
	6 - LBSHEVO Ø7x200	24800	21900	24100	24000

NOTES

(1) For CLT panels the strength is calculated for a characteristic density $\rho_{k=}$350kg/m^3, in the case of glulam (GL) they refer to a density of ρ_k= 385kg/m^3.