

45° WASHER FOR VGS

SAFETY

The VGU washer makes possible to install VGS screws at a 45° angle on steel plates. Washer marked CE as per ETA-11/0030.

PRACTICALITY

The ergonomic shape ensures a firm, precise grip during installation. Three versions of washer, compatible with VGS in diameter 9, 11 and 13 mm, are available for plates of variable thickness. The use of the VGU allows the use of inclined screws on plate without resorting to countersunk holes on the plate, which is generally a time-consuming and costly operation.

C4 EVO COATING

VGU EVO is coated with a surface treatment resistant to high atmospheric corrosivity.

Compatible with VGS EVO diameter 9, 11 and 13 mm.



VGU



VGU EVO



DIAMETER [mm] 9 13 15

MATERIAL



electrogalvanized carbon steel



carbon steel with C4 EVO coating



METAL-to-TIMBER recommended use:



M_{ins,rec}

VIDEO

Scan the QR Code and watch the video on our YouTube channel



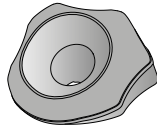
FIELDS OF USE

- timber based panels
- solid timber
- glulam (Glued Laminated Timber)
- CLT and LVL
- high density woods
- steel construction
- metal plates and profiles

CODES AND DIMENSIONS

VGU WASHER

CODE	screw [mm]	$d_{v,s}$ [mm]	pcs
VGU945	VGS Ø9	5	25
VGU1145	VGS Ø11	6	25
VGU1345	VGS Ø13	8	25



$d_{v,s}$ = pre-drilling hole diameter (softwood)

JIG VGU TEMPLATE

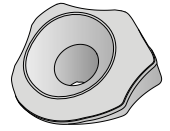
CODE	washer [mm]	d_h [mm]	d_v [mm]	pcs
JIGVGU945	VGU945	5,5	5	1
JIGVGU1145	VGU1145	6,5	6	1
JIGVGU1345	VGU1345	8,5	8	1



For more information see page 409.

VGU EVO WASHER

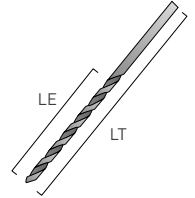
CODE	screw [mm]	$d_{v,s}$ [mm]	pcs
VGUEVO945	VGSEVO Ø9	5	25
VGUEVO1145	VGSEVO Ø11	6	25
VGUEVO1345	VGSEVO Ø13	8	25



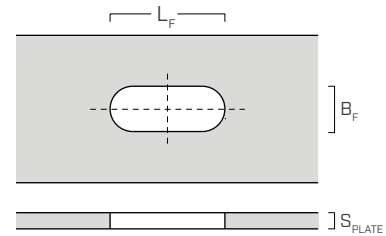
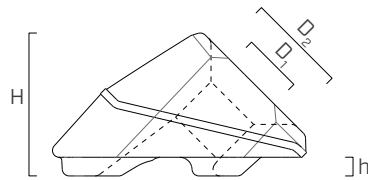
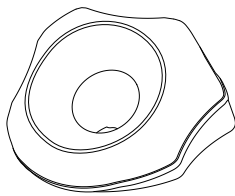
$d_{v,s}$ = pre-drilling hole diameter (softwood)

HSS WOOD DRILL BIT

CODE	d_v [mm]	TL [mm]	SL [mm]	pcs
F1599105	5	150	100	1
F1599106	6	150	100	1
F1599108	8	150	100	1



GEOMETRY



Washer		VGU945 VGUEVO945	VGU1145 VGUEVO1145	VGU1345 VGUEVO1345	
VGS screw diameter	d_1	[mm]	9,0	11,0	13,0
VGS screw pre-drilling hole diameter ⁽¹⁾	$d_{v,s}$	[mm]	5,0	6,0	8,0
Internal diameter	D_1	[mm]	9,70	11,80	14,00
External diameter	D_2	[mm]	19,00	23,00	27,40
Base height	h	[mm]	3,00	3,60	4,30
Global height	H	[mm]	23,00	28,00	33,00
Slotted-hole length	L_F	[mm]	33,0 ÷ 34,0	41,0 ÷ 42,0	49,0 ÷ 50,0
Slotted-hole width	B_F	[mm]	14,0 ÷ 15,0	17,0 ÷ 18,0	20,0 ÷ 21,0
Steel plate thickness ⁽²⁾	S_{PLATE}	[mm]	3,0 ÷ 12,0	4,0 ÷ 15,0	5,0 ÷ 15,0

⁽¹⁾ Pre-drilling valid for softwood.

⁽²⁾ For thicker plates than those indicated in the table it is necessary to carry out a countersink in the lower part of the steel plate. Recommended Ø5 mm guide hole (of minimum length 50 mm) for VGS screws of length $L > 300$ mm.



HELPS WITH INSTALLATION

The JIG VGU template makes it easy to prepare a 45° angle pre-drill, thus facilitating subsequent tightening of the VGS screws inside the washer. A pre-drill length of at least 20 mm is recommended.

STRUCTURAL VALUES | STEEL-TO-TIMBER JOINT

geometry		SLIDING										
		timber						steel				
VGS/VGS EVO		3 mm			8 mm			12 mm			-	
VGU VGU EVO	d ₁ [mm]	L [mm]	S _g [mm]	A _{min} [mm]	R _{V,k} [kN]	S _g [mm]	A _{min} [mm]	R _{V,k} [kN]	S _g [mm]	A _{min} [mm]	R _{V,k} [kN]	R _{tens,45,k} [kN]
S _{PLATE}		3 mm			8 mm			12 mm			-	
VGU945 VGUEVO945	9	100	75	75	6,03	70	70	5,63	65	65	5,22	17,96
		120	95	85	7,63	90	85	7,23	85	80	6,83	
		140	115	100	9,24	110	100	8,84	105	95	8,44	
		160	135	115	10,85	130	110	10,45	125	110	10,04	
		180	155	130	12,46	150	125	12,05	145	125	11,65	
		200	175	145	14,06	170	140	13,66	165	135	13,26	
		220	195	160	15,67	190	155	15,27	185	150	14,87	
		240	215	170	17,28	210	170	16,88	205	165	16,47	
		260	235	185	18,88	230	185	18,48	225	180	18,08	
		280	255	200	20,49	250	195	20,09	245	195	19,69	
		300	275	215	22,10	270	210	21,70	265	205	21,29	
		320	295	230	23,71	290	225	23,30	285	220	22,90	
		340	315	245	25,31	310	240	24,91	305	235	24,51	
		360	335	255	26,92	330	255	26,52	325	250	26,12	
		380	355	270	28,53	350	265	28,13	345	265	27,72	
		400	375	285	30,13	370	280	29,73	365	280	29,33	
440	415	315	33,35	410	310	32,95	405	305	32,54			
480	455	340	36,56	450	340	36,16	445	335	35,76			
520	495	370	39,78	490	365	39,38	485	365	38,97			
560	535	400	42,99	530	395	42,59	525	390	42,19			
600	575	425	46,21	570	425	45,80	565	420	45,40			
S _{PLATE}		4 mm			10 mm			15 mm			-	
VGU1145 VGUEVO1145	11	80	50	55	4,91	-	-	-	-	-	-	26,87
		100	70	70	6,88	60	60	5,89	55	60	5,40	
		125	95	85	9,33	85	80	8,35	80	75	7,86	
		150	120	105	11,79	110	100	10,80	105	95	10,31	
		175	145	125	14,24	135	115	13,26	130	110	12,77	
		200	170	140	16,70	160	135	15,71	155	130	15,22	
		225	195	160	19,15	185	150	18,17	180	145	17,68	
		250	220	175	21,61	210	170	20,63	205	165	20,13	
		275	245	195	24,06	235	185	23,08	230	185	22,59	
		300	270	210	26,52	260	205	25,54	255	200	25,04	
		325	295	230	28,97	285	220	27,99	280	220	27,50	
		350	320	245	31,43	310	240	30,45	305	235	29,96	
		375	345	265	33,88	335	255	32,90	330	255	32,41	
		400	370	280	36,34	360	275	35,36	355	270	34,87	
		425	395	300	38,79	385	290	37,81	380	290	37,32	
		450	420	315	41,25	410	310	40,27	405	305	39,78	
475	445	335	43,71	435	330	42,72	430	325	42,23			
500	470	350	46,16	460	345	45,18	455	340	44,69			
525	495	370	48,62	485	365	47,63	480	360	47,14			
550	520	390	51,07	510	380	50,09	505	375	49,60			
575	545	405	53,53	535	400	52,55	530	395	52,05			
600	570	425	55,98	560	415	55,00	555	410	54,51			

		SLIDING											
geometry		timber						steel					
VGS/VGS EVO													
VGU	VGU EVO	d ₁	L	S _g	A _{min}	R _{V,k}	S _g	A _{min}	R _{V,k}	S _g	A _{min}	R _{V,k}	R _{tens,45,k}
		[mm]	[mm]	[mm]	[mm]	[kN]	[mm]	[mm]	[kN]	[mm]	[mm]	[kN]	[kN]
		S _{PLATE}		5 mm			10 mm			15 mm			-
VGU1345 VGUEVO1345	13	100	100	65	65	7,54	55	60	6,38	-	-	-	37,48
		150	150	115	100	13,35	105	95	12,19	100	90	11,61	
		200	200	165	135	19,15	155	130	17,99	150	125	17,41	
		250	250	215	170	24,96	205	165	23,79	200	160	23,21	
		300	300	265	205	30,76	255	200	29,60	250	195	29,02	
		350	350	315	245	36,56	305	235	35,40	300	230	34,82	
		400	400	365	280	42,37	355	270	41,21	350	265	40,63	
		450	450	415	315	48,17	405	305	47,01	400	305	46,43	
		500	500	465	350	53,97	455	340	52,81	450	340	52,23	
		550	550	515	385	59,78	505	375	58,62	500	375	58,04	
600	600	565	420	65,58	555	410	64,42	550	410	63,84			

GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2014 standard in accordance with ETA-11/0030.
- The design sliding strength of the joint is either the timber-side design strength (R_{V,d}) and the design strength on the steel side projected (R_{tens,45,d}), whichever is lower:

$$R_{V,d} = \min \left\{ \begin{array}{l} \frac{R_{V,k} \cdot k_{mod}}{Y_M} \\ \frac{R_{tens,45,k}}{Y_{M2}} \end{array} \right.$$

- The coefficients Y_M and k_{mod} should be taken according to the current regulations used for the calculation.
- For the mechanical resistance values and the geometry of the screws, reference was made to ETA-11/0030.
- Sizing and verification of the timber elements and metal plates must be done separately.
- The screws must be positioned in accordance with the minimum distances.
- For the correct realization of the joint, the fastener head should be fully embedded into the VGU washer.
- The characteristic sliding strengths were evaluated by considering a minimum penetration length of S_g, as shown in the table, considering a minimum penetration length of 4·d₁. For intermediate values of S_g or S_{PLATE} it is possible to linearly interpolate.
- The characteristic sliding strengths were evaluated by considering an angle ε of 45° between the grains of the timber element and the connector.
- The VGU washer is over-resistant compared to the strength of the VGS/VGSEVO screw.
- For the calculation process a timber characteristic density ρ_k = 385 kg/m³ has been considered.

For different ρ_k values, the strength values in the table (withdrawal, compression, sliding and shear) can be converted via the k_{dens} coefficient.

$$R'_{ax,k} = k_{dens,ax} \cdot R_{ax,k}$$

ρ _k [kg/m ³]	350	380	385	405	425	430	440
C-GL	C24	C30	GL24h	GL26h	GL28h	GL30h	GL32h
k _{dens,ax}	0,92	0,98	1,00	1,04	1,08	1,09	1,11

Strength values thus determined may differ, for higher safety standards, from those resulting from an exact calculation.

- For a connection with inclined screws in a metal plate application, the characteristic effective sliding load-bearing capacity for a row of n screws is equal to:

$$R_{ef,V,k} = n_{ef,ax} \cdot R_{V,k}$$

The n_{ef} value is given in the table below as a function of n (number of screws in a row).

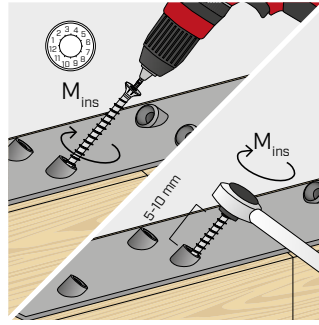
n	2	3	4	5	6	7	8	9	10
n _{ef,ax}	1,87	2,70	3,60	4,50	5,40	6,30	7,20	8,10	9,00

- For available VGS and VGS EVO screw sizes, see pages 164 and 180.

INSTALLATION INSTRUCTIONS

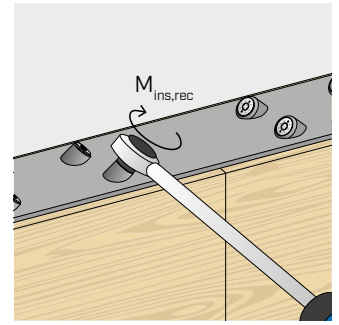


The use of pulse screw guns/impact wrenches is not permitted.

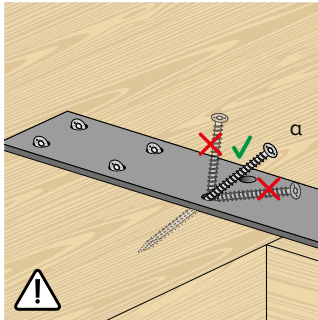


Ensure correct tightening. We recommend the use of torque-controlled screwdrivers, e.g. with TORQUE LIMITER. Alternatively, tighten with a torque wrench.

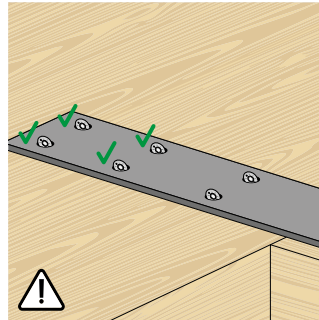
VGS	d ₁ [mm]	M _{ins,rec} [Nm]
Ø9	9	20
Ø11 L < 400 mm	11	30
Ø11 L ≥ 400 mm	11	40
Ø13	13	50



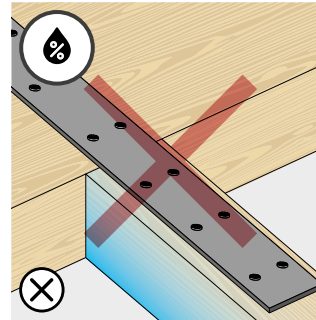
After installation, the fasteners can be inspected using a torque wrench.



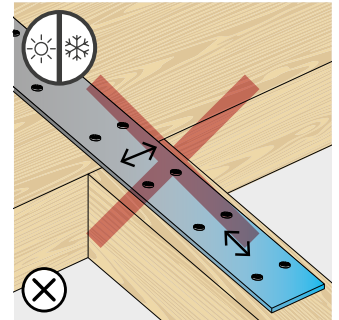
Avoid bending.



The installation of multiple screws must be performed to guarantee that loads are distributed evenly to all fasteners.

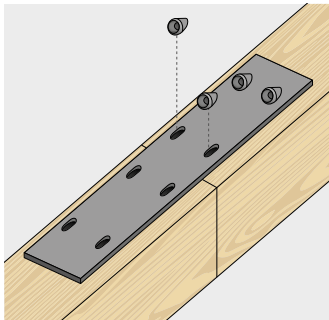


Shrinkage or swelling of timber elements due to changes in moisture content must be avoided.

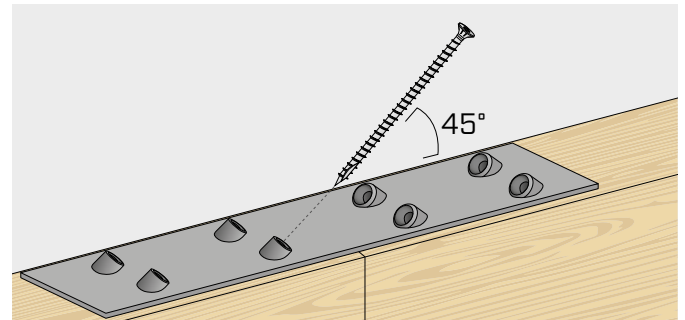
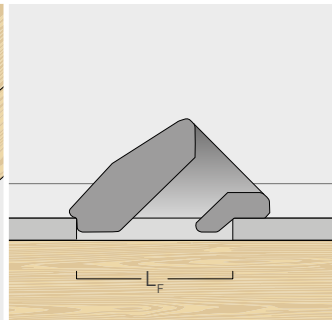


Avoid dimensional changes in the metal, e.g. due to large temperature fluctuations.

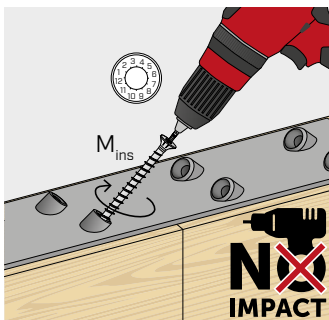
INSTALLATION WITHOUT PRE-DRILL



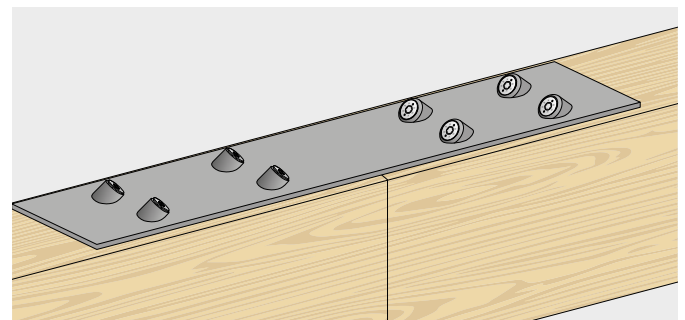
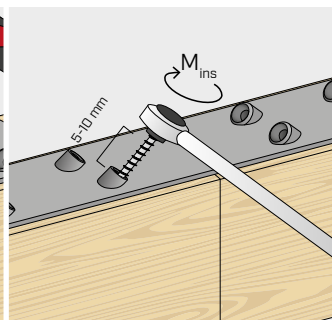
Place the steel plate on the wood and set the VGU washers in the slots provided.



Position the screw and respect the 45° angle of insertion.

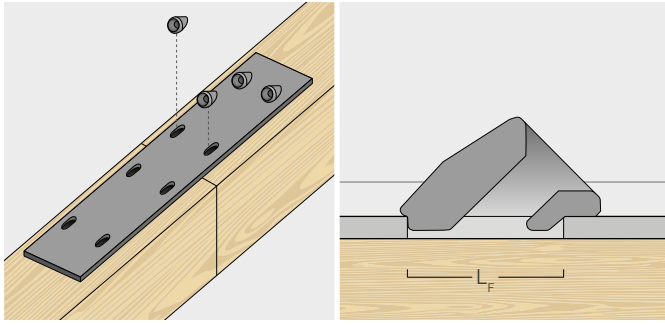


Screw in, ensuring correct tightening.

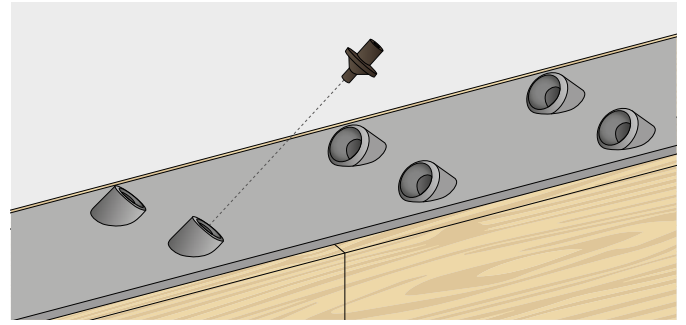


Perform the operation for all washers. The assembly must be performed so as to guarantee that the stress is evenly distributed among all the installed VGU washers.

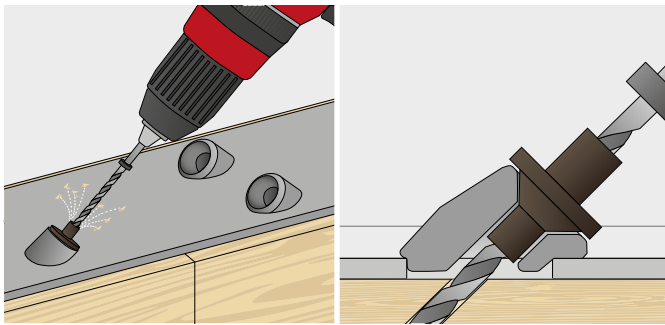
INSTALLATION WITH THE AID OF A PRE-DRILL TEMPLATE



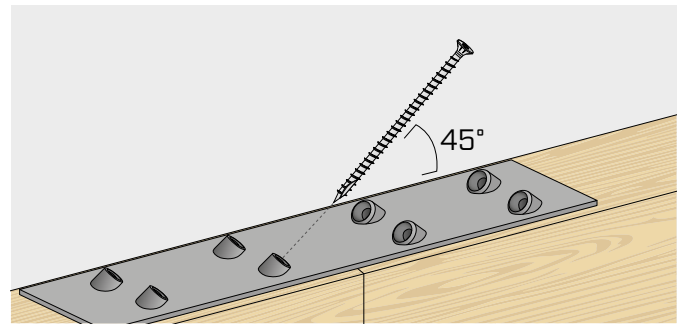
Place the steel plate on the wood and set the VGU washers in the slots provided.



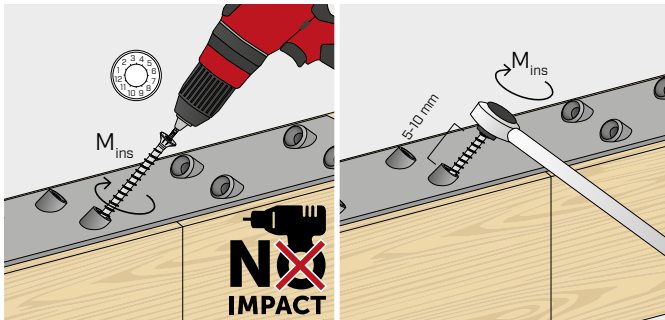
Use the VGU JIG template of the correct diameter by positioning it in the VGU washer



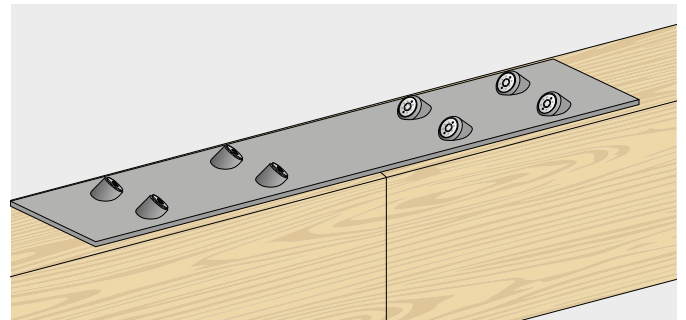
Using the pre-drill template, prepare a pre-drill/guide hole (at least 50 mm length) using an appropriate tip



Position the screw and respect the 45° angle of insertion.



Screw in, ensuring correct tightening.



Perform the operation for all washers.
The assembly must be performed so as to guarantee that the stress is evenly distributed among all the installed VGU washers.

Theory, practice and experimental campaigns:
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