VGU

45° WASHER FOR VGS

ELC-4645 ESR-4645 UKTA-0836 22/6195 ETA-11/0030

SAFETY
The VGU washer makes possible to install VGS screws at a 45° angle on steel plates. Washer head assessd in ELC-4645 listing report.

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

CANADIAN DESIGN VALUES
USA, EU and more design values available online.

VIDEO MANUALS

DIAMETER [mm] 9 | **9** | **13** | 13

MATERIAL

VGU WASHER

Zn ELECTRO PLATED electrogalvanized carbon steel

EC1 DRY C2 T2

VGU EVO WASHER

C4 EVO COATING carbon steel with C4 EVO coating

EC1 EC3 C4 T3

METAL-to-TIMBER recommended use:

NO IMPACT

TORQUE LIMITER

$M_{ins,rec}$

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

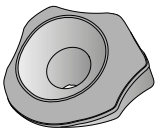
FIELDS OF USE

- 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

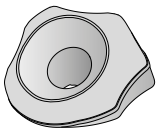
CODE	screw [mm]	$d_{V,S}$ [mm]	pcs
VGU945	VGS Ø9	5	25
VGU1145	VGS Ø11	6	25
VGU1345	VGS Ø13	8	25



$d_{V,S}$ = pre-drilling hole diameter (G< 0.55).

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 (G< 0.55).

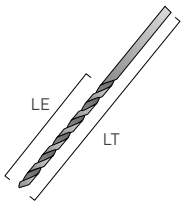
JIG VGU TEMPLATE

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

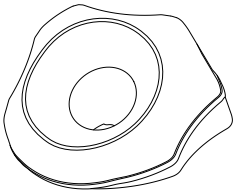
See www.rothoblaas.com for the technical data sheet.

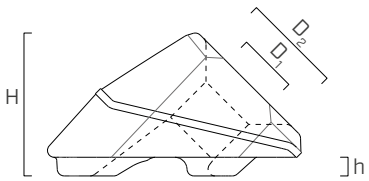
HSS WOOD DRILL BIT

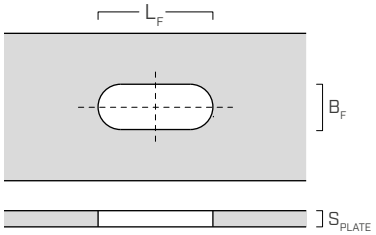
CODE	d_V [mm]	TL [mm]	SL [mm]	pcs
F1599105	5	150	100	1
F1599106	6	150	100	1
F1599108	8	150	100	1



GEOMETRY

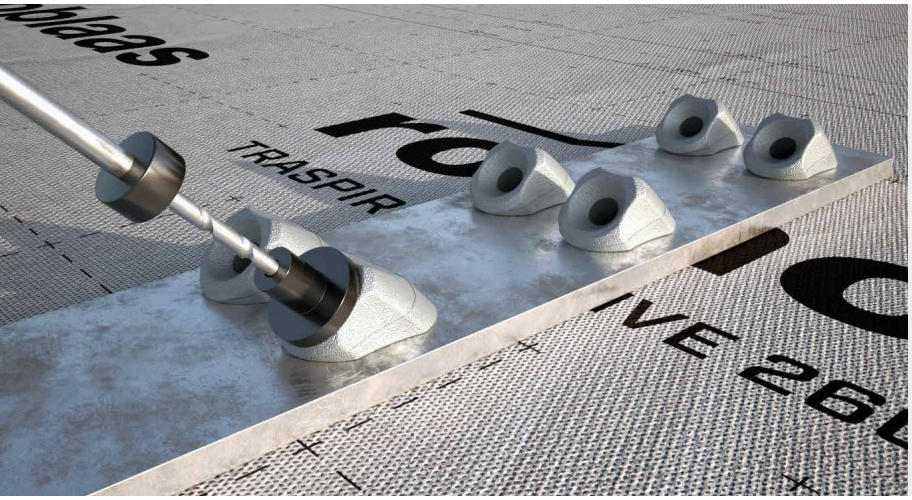






Washer			VGU945 VGUEVO945	VGU1145 VGUEVO1145	VGU1345 VGUEVO1345
VGS screw diameter	d_1	[mm]	9,0	11,0	13,0
VGS screw pre-drilling hole diameter(1)	$d_{V,S}$	[mm]	5,0	6,0	8,0
Internal diameter	D_1	[mm]	9,70	11,80	14,00
External diameter	D_2	[mm]	19,00	23,00	27,40
Base heigth	h	[mm]	3,00	3,60	4,30
Global heigth	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]	3,2 ÷ 12,7	4,8 ÷ 14,3	4,8 ÷ 14,3

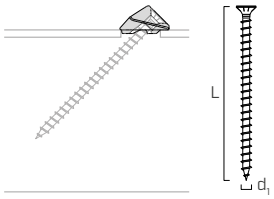
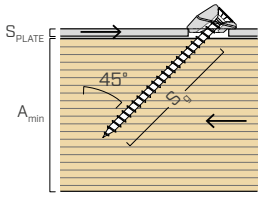
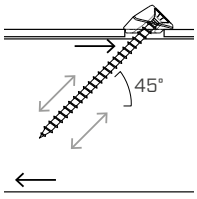
(1)Pre-drilling valid for wood with G< 0.55.
(2)For thicker plates than those indicated in the table it is necessary to carry out a countersink in the lower part of the steel plate.
Recommended Ø5 mm guide hole (of minimum length 50 mm) for VGS screws of length L > 300 mm.



HELPS WITH INSTALLATION

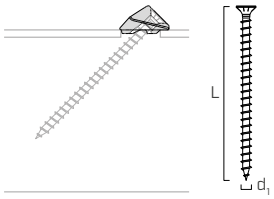
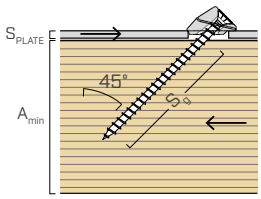
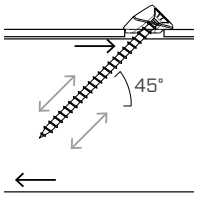
The JIG VGU template makes it easy to prepare a 45° angle pre-drill, thus facilitating subsequent tightening of the VGS screws inside the washer. A pre-drill length of at least 20 mm is recommended.

SLIDING[1][2]

geometry	steel-to-timber	steel tension
		

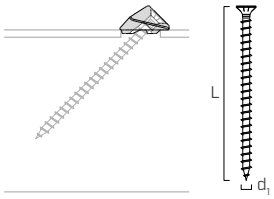
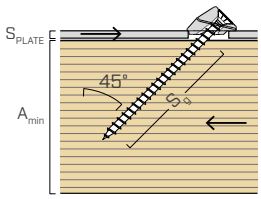
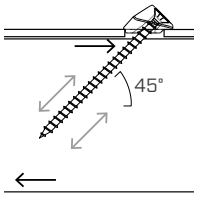
VGU VGU EVO	VGS/VGS EVO d_1 [mm] [in]	VGS/VGS EVO L [mm]	VGS/VGS EVO L [in]	S_{PLATE} [mm] [in]	S_g [mm]	A_{min}[3] [mm]	factored lateral resistance N_r[4] G 0.35 [kN]	G 0.42 [kN]	G 0.49 [kN]	G 0.55 [kN]	factored tension resistance T_{rs}[5] [kN]
VGU945 VGUEVO945	9 *0.36*	100	*4*	3,2 *1/8*	70	70	2,97	3,44	3,89	4,26	12,61
		120	*4 3/4*		90	85	3,82	4,42	5,00	5,48	
		140	*5 1/2*		110	100	4,67	5,40	6,11	6,70	
		160	*6 1/4*		130	115	5,51	6,38	7,22	7,92	
		180	*7 1/8*		150	125	6,36	7,36	8,33	9,14	
		200	*8*		170	140	7,21	8,34	9,44	10,35	
		220	*8 5/8*		190	155	8,06	9,33	10,55	11,57	
		240	*9 1/2*		210	170	8,91	10,31	11,66	12,79	
		260	*10 1/4*		230	185	9,76	11,29	12,77	14,01	
		280	*11*		250	200	10,61	12,27	13,88	15,23	
		300	*11 3/4*		270	210	11,45	13,25	14,99	16,45	
		320	*12 5/8*		290	225	12,30	14,23	16,10	17,66	
		340	*13 3/8*		310	240	13,15	15,22	17,21	18,88	
		360	*14 1/4*		330	255	14,00	16,20	18,32	20,10	
		380	*15*		350	270	14,85	17,18	19,43	21,32	
		400	*15 3/4*		370	285	15,70	18,16	20,54	22,54	
		440	*17 1/4*		410	310	17,39	20,12	22,76	24,97	
		480	*19*		450	340	19,09	22,09	24,98	27,41	
		520	*20 1/2*		490	370	20,79	24,05	27,20	29,85	
		560	*22*		530	395	22,48	26,01	29,42	32,28	
		600	*23 5/8*		570	425	24,18	27,98	31,64	34,72	
		100	*4*	12,7 *1/2*	55	60	2,33	2,70	3,05	3,35	
		120	*4 3/4*		75	75	3,18	3,68	4,16	4,57	
		140	*5 1/2*		95	90	4,03	4,66	5,27	5,79	
		160	*6 1/4*		115	105	4,88	5,64	6,38	7,00	
		180	*7 1/8*		135	115	5,73	6,63	7,49	8,22	
		200	*8*		155	130	6,58	7,61	8,60	9,44	
		220	*8 5/8*		175	145	7,42	8,59	9,71	10,66	
		240	*9 1/2*		195	160	8,27	9,57	10,82	11,88	
		260	*10 1/4*		215	175	9,12	10,55	11,93	13,10	
		280	*11*		235	190	9,97	11,53	13,04	14,31	
		300	*11 3/4*		255	200	10,82	12,52	14,15	15,53	
		320	*12 5/8*		275	215	11,67	13,50	15,27	16,75	
		340	*13 3/8*		295	230	12,51	14,48	16,38	17,97	
		360	*14 1/4*		315	245	13,36	15,46	17,49	19,19	
		380	*15*		335	260	14,21	16,44	18,60	20,40	
		400	*15 3/4*		355	270	15,06	17,42	19,71	21,62	
		440	*17 1/4*		395	300	16,76	19,39	21,93	24,06	
		480	*19*		435	330	18,45	21,35	24,15	26,50	
		520	*20 1/2*		475	355	20,15	23,31	26,37	28,93	
		560	*22*		515	385	21,85	25,28	28,59	31,37	
		600	*23 5/8*		555	415	23,54	27,24	30,81	33,80	

SLIDING[1][2]

geometry	steel-to-timber	steel tension
		

VGS/VGS EVO							factored lateral resistance N_r[4]				factored tension resistance T_{rs}[5]
							G				
VGU VGU EVO	d_1 [mm] *[in]*	L [mm]	L *[in]*	S_{PLATE} [mm] *[in]*	S_g [mm]	A_{min}[3] [mm]	0.35 [kN]	0.42 [kN]	0.49 [kN]	0.55 [kN]	[kN]
VGU1145 VGUEVO1145	11 *0.44*	80	*3 1/8*	4,8 *3/16*	40	50	2,07	2,40	2,71	2,98	16,38
		100	*4*		60	65	3,11	3,60	4,07	4,47	
		125	*4 15/16*		85	85	4,41	5,10	5,77	6,33	
		150	*6*		110	100	5,70	6,60	7,47	8,19	
		175	*6 7/8*		135	120	7,00	8,10	9,16	10,05	
		200	*8*		160	135	8,30	9,60	10,86	11,91	
		225	*8 7/8*		185	155	9,59	11,10	12,56	13,78	
		250	*10*		210	170	10,89	12,60	14,25	15,64	
		275	*10 7/8*		235	190	12,18	14,10	15,95	17,50	
		300	*11 3/4*		260	205	13,48	15,60	17,65	19,36	
		325	*12 3/4*		285	225	14,78	17,10	19,34	21,22	
		350	*13 3/4*		310	240	16,07	18,60	21,04	23,08	
		375	*14 3/4*		335	260	17,37	20,10	22,74	24,94	
		400	*15 3/4*		360	275	18,67	21,60	24,43	26,81	
		425	*16 3/4*		385	295	19,96	23,10	26,13	28,67	
		450	*17 3/4*		410	315	21,26	24,60	27,83	30,53	
		475	*18 11/16*		435	330	22,55	26,10	29,53	32,39	
		500	*19 3/4*		460	350	23,85	27,60	31,22	34,25	
		525	*20 11/16*		485	365	25,15	29,10	32,92	36,11	
		550	*21 5/8*		510	385	26,44	30,60	34,62	37,98	
		575	*22 5/8*		535	400	27,74	32,10	36,31	39,84	
		600	*23 5/8*		560	420	29,03	33,59	38,01	41,70	
		80	*3 1/8*	14,3 *9/16*	25	40	1,30	1,50	1,70	1,86	
		100	*4*		45	55	2,33	2,70	3,05	3,35	
		125	*4 15/16*		70	70	3,63	4,20	4,75	5,21	
		150	*6*		95	90	4,93	5,70	6,45	7,07	
		175	*6 7/8*		120	110	6,22	7,20	8,14	8,94	
		200	*8*		145	125	7,52	8,70	9,84	10,80	
		225	*8 7/8*		170	145	8,81	10,20	11,54	12,66	
		250	*10*		195	160	10,11	11,70	13,24	14,52	
		275	*10 7/8*		220	180	11,41	13,20	14,93	16,38	
		300	*11 3/4*		245	195	12,70	14,70	16,63	18,24	
		325	*12 3/4*		270	215	14,00	16,20	18,33	20,10	
		350	*13 3/4*		295	230	15,30	17,70	20,02	21,97	
		375	*14 3/4*		320	250	16,59	19,20	21,72	23,83	
		400	*15 3/4*		345	265	17,89	20,70	23,42	25,69	
		425	*16 3/4*		370	285	19,18	22,20	25,11	27,55	
		450	*17 3/4*		395	300	20,48	23,70	26,81	29,41	
		475	*18 11/16*		420	320	21,78	25,20	28,51	31,27	
		500	*19 3/4*		445	335	23,07	26,70	30,20	33,14	
		525	*20 11/16*		470	355	24,37	28,20	31,90	35,00	
		550	*21 5/8*		495	375	25,66	29,70	33,60	36,86	
		575	*22 5/8*		520	390	26,96	31,20	35,29	38,72	
		600	*23 5/8*		545	410	28,26	32,70	36,99	40,58	

SLIDING[1][2]

geometry	steel-to-timber	steel tension
		

VGS/VGS EVO							factored lateral resistance N_r[4]				factored tension resistance T_{rs}[5]
							G				
VGU VGU EVO	d_1 [mm] *[in]*	L [mm]	L *[in]*	S_{PLATE} [mm] *[in]*	S_g [mm]	A_{min}[3] [mm]	0.35 [kN]	0.42 [kN]	0.49 [kN]	0.55 [kN]	[kN]
VGU1345 VGUEVO1345	13 *0.52*	80	*3 1/8*	4,8 *3/16*	35	50	2,15	2,49	2,81	3,08	22,60
		100	*4*		55	65	3,37	3,91	4,41	4,84	
		150	*6*		105	100	6,44	7,46	8,42	9,24	
		200	*8*		155	135	9,50	11,01	12,43	13,63	
		250	*10*		205	170	12,56	14,56	16,44	18,03	
		300	*11 3/4*		255	205	15,63	18,11	20,45	22,43	
		350	*13 3/4*		305	240	18,69	21,66	24,46	26,83	
		400	*15 3/4*		355	275	21,76	25,21	28,47	31,23	
		450	*17 3/4*		405	310	24,82	28,76	32,48	35,62	
		500	*19 3/4*		455	345	27,89	32,31	36,48	40,02	
		550	*21 5/8*		505	380	30,95	35,86	40,49	44,42	
		600	*23 5/8*		555	415	34,01	39,41	44,50	48,82	
		80	*3 1/8*	14,3 *9/16*	20	40	1,23	1,42	1,60	1,76	
		100	*4*		40	50	2,45	2,84	3,21	3,52	
		150	*6*		90	90	5,52	6,39	7,22	7,92	
		200	*8*		140	125	8,58	9,94	11,23	12,31	
		250	*10*		190	160	11,64	13,49	15,24	16,71	
		300	*11 3/4*		240	195	14,71	17,04	19,24	21,11	
		350	*13 3/4*		290	230	17,77	20,59	23,25	25,51	
		400	*15 3/4*		340	265	20,84	24,14	27,26	29,91	
		450	*17 3/4*		390	300	23,90	27,69	31,27	34,30	
		500	*19 3/4*		440	335	26,97	31,24	35,28	38,70	
		550	*21 5/8*		490	370	30,03	34,79	39,29	43,10	
		600	*23 5/8*		540	405	33,09	38,34	43,30	47,50	

GENERAL PRINCIPLES

- The reference factored lateral resistance for self-tapping screws has been determined following the guidelines in Clause 12.12 of the CSA-O86 2024 listed values are based on standard long term load duration factor (K_D = 1.0), dry service condition factor (K_{SF} = 1.0), and treatment factor (K_T = 1.0).
- The factored thread withdrawal resistance were evaluated considering a penetration length of S_g, as shown in the table. For intermediate values of S_g it is possible to linearly interpolate.
- The steel plate is assumed to be ASTM A36 with a minimum ultimate tensile strength, f_u, equal to 58 ksi (400 MPa).
- VGS screws must be positioned in accordance with the minimum distances.
- G is the mean relative density according to CSA-O86 2024 Table A12. Most common wood species are assumed such as Northern species (G = 0.35), Spruce-Pine-Fir (G = 0.42), Douglas Fir (G = 0.49), and Southern Pine (G = 0.55).
- As part of the connection design, the designer must size and verify both the structural wood members and the steel plates separately.
- Check VGS INSTALLATION INSTRUCTIONS on Rothoblaas's website or inside the product box for the complete installation indications.

NOTES

(1) Factored withdrawal resistances were calculated with the entire threaded portion of the screw, (in millimeters), minus the tip length, L_{tip}.The length of the tip is equal to the nominal diameter of the respective fasteners, d_1, as specified in Table 2C of the ELC-4645 report. Factor for fastener axis-to-grain angle, J_α, and the factor for dowel bearing effect for laterally loaded connections, J_W, varies according to connection geometry.

(2) Lateral resistances are factored and according to CSA-O86 2024 Clause 12.12.10. Values apply to dry service conditions and are representative of a single screw.

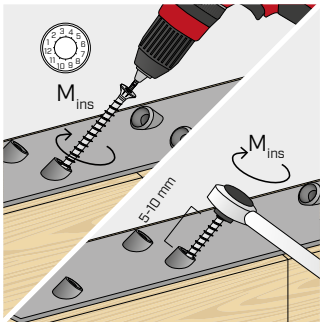
(3) The fixable thickness (A) is calculated as the sum of the projected lengths of S_g and L_{tip}, plus an additional 15 mm.

(4) The 45° inclined screw is intended to work in withdrawal and the resulting resistance of the connection is given by the projection of the withdrawal resistance (along screw axis) onto the shear plane. For fully threaded screws, the head pull-through resistance is not relevant to the connection capacity; instead, thread withdrawal governs.

(5) Factored lateral resistance values (N_r) must be compared to the factored tension resistance of the screw (T_{rs}), with the lower value determining the governing resistance.

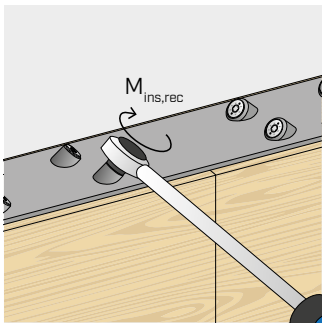
INSTALLATION INSTRUCTIONS

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

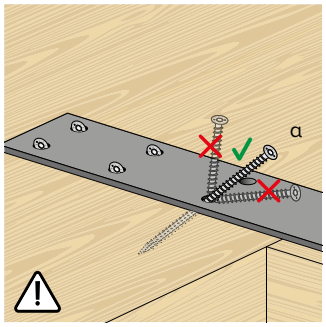


Ensure correct tightening. We recommend the use of torque-controlled screwdrivers, e.g. with **TORQUE LIMITER**. Alternatively, tighten with a torque wrench.

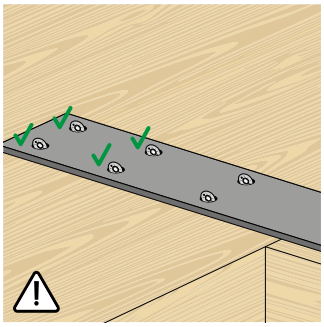
VGS	d_1 [mm]	$M_{ins,rec}$ [Nm]
Ø9	9	20
Ø11 L < 400 mm	11	30
Ø11 L ≥ 400 mm	11	40
Ø13	13	50



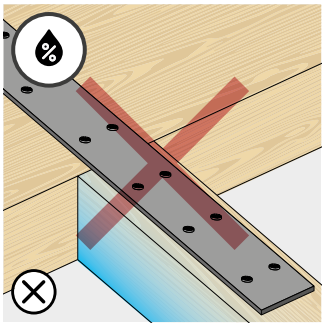
After installation, the fasteners can be inspected using a torque wrench.



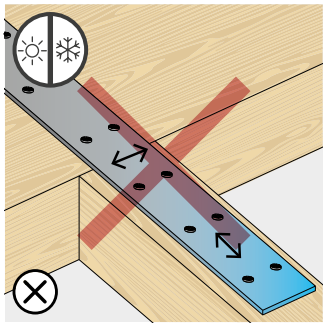
Avoid bending.



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

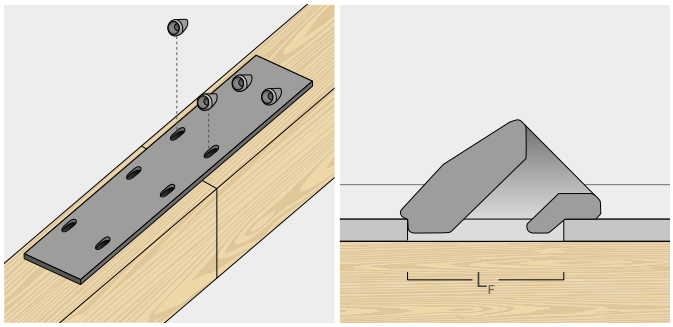


Shrinkage or swelling of timber elements due to changes in moisture content must be avoided.

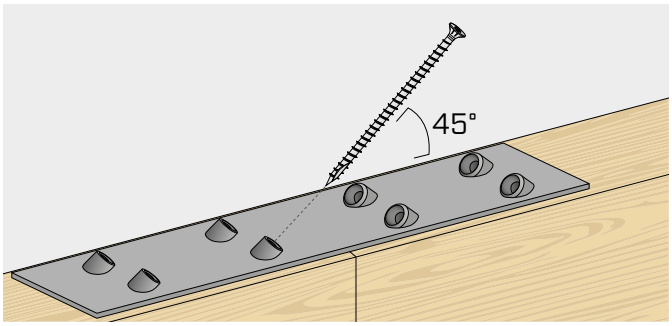


Avoid dimensional changes in the metal, e.g. due to large temperature fluctuations.

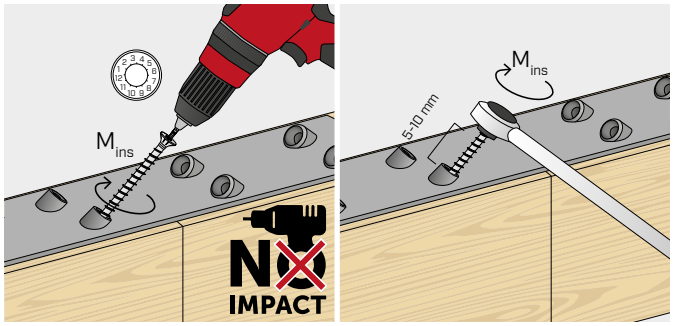
INSTALLATION WITHOUT PRE-DRILL



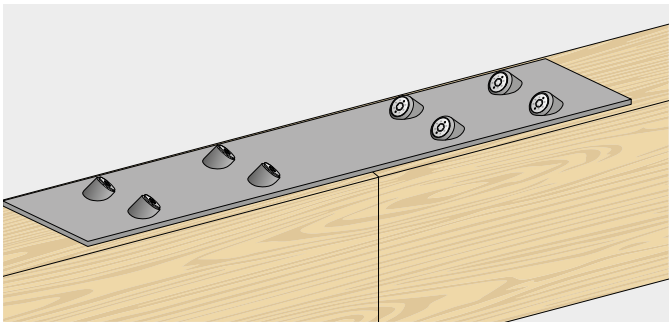
Place the steel plate on the wood and set the VGU washers in the slots provided.



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

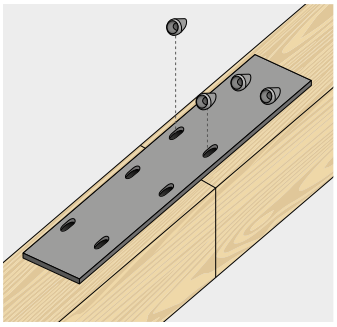


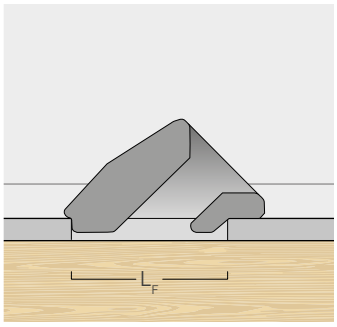
Screw in, ensuring correct tightening.



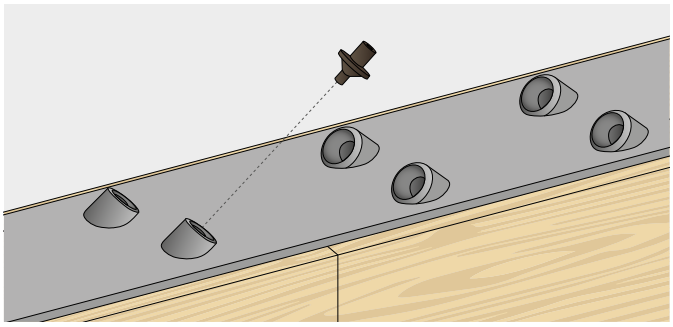
Perform the operation for all washers.
The assembly must be performed so as to guarantee that the stress is evenly distributed among all the installed VGU washers.

INSTALLATION WITH THE AID OF A PRE-DRILL TEMPLATE

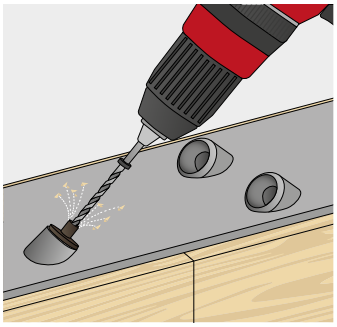


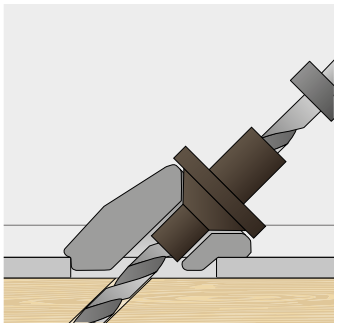


Place the steel plate on the wood and set the VGU washers in the slots provided.

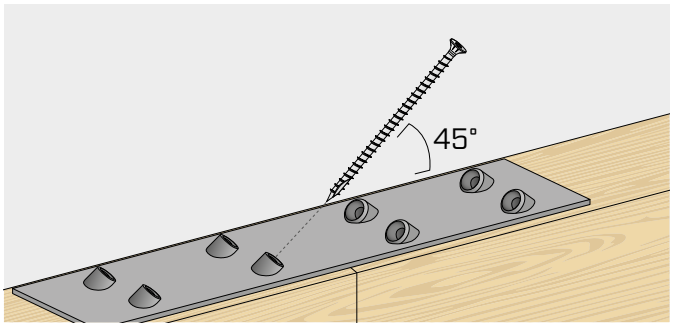


Use the VGU JIG template of the correct diameter by positioning it in the VGU washer

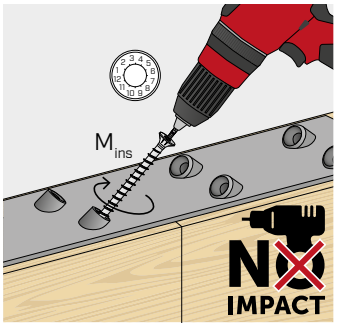


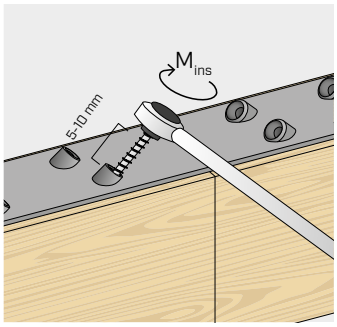


Using the pre-drill template, prepare a pre-drill/guide hole (at least 50 mm length) using an appropriate tip

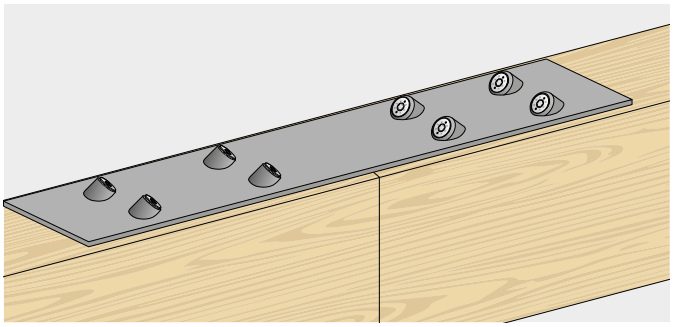


Position the screw and respect the 45° angle of insertion.





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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