

HEICO-LOCK®

Assembly Instructions



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1.) Inspection of the type of bolt parts for compatibility with HEICO-LOCK®

The standard versions of HEICO-LOCK® Wedge Lock Washers (WLW) must only be combined with bolts with metric ISO coarse thread (DIN 13) or UNC thread (ANSI B1.1) in the correct nominal sizes. For bolts with fine thread and other thread types, please contact us before use. Special designs of HEICO-LOCK® WLW might be required.

In unfastened condition, the HEICO-LOCK® WLW must make full-surface contact with the underside of the bolt head. The shaft or thread diameter and the radius at the transition zone between bolt head and bolt shaft, as well as the internal diameter of the HEICO-LOCK® WLW must be taken into account.

Bolts and nuts made of carbon steel (strength categories acc. to DIN EN ISO 898-1: 8.8, 10.9 and 12.9 and < 8.8 or equal) are secured using HEICO-LOCK® WLW made of heat-treated steel (Mat.No. 1.1191 acc. to EN 10027). Stainless steel bolting components (e. g. acc. to ISO 3506 A2-70 and A4-80 or equal) are secured using HEICO-LOCK® stainless steel WLW (Mat.No. 1.4404 acc. to EN 10027).

The use of plain washers in combination with HEICO-LOCK® WLW is generally not recommended. However, in case that installation of a plain washer is required, it must be fixed such that it cannot rotate around the bolt axis (i.e. by form-closed contact).

***Info:** If the HEICO-LOCK® WLW is integrated on a non-fixed plain washer, the plain washer may turn on the mating material due to vibration so that the securing effect of the HEICO-LOCK® WLW is eliminated.*

Integration of additional securing elements or securing methods is superfluous (e.g. gluing of the thread for screw-in joints) and is not recommended.

***Info:** The securing function of the HEICO-LOCK® WLW is based on the movement option between the wedge surfaces of the individual washers and the resulting impairment of the detachment process due to the wedging effect and/or the increase of tightening force in case of rotation of the bolt into the direction of detachment (cf. item 8). Additional locking measure for the thread would lever out the HEICO-LOCK® WLW!*

2.) Visual inspection of the bolting components and the HEICO-LOCK® Wedge Lock Washers

Are bolt and nut free from dirt?

Can the thread be easily turned in? Any damage at the thread (e.g. kinks, dents) does not interfere with turning in?

***Info:** Soiling and damage in the thread may increase the assembly torque and thus affect the assembly tightening force to be achieved! The same applies for painted threaded holes. If possible, cover threaded holes before painting.*

For initial assembly, unused bolts should be used.

Info: With used bolts, technicians are mostly unaware of any previous mechanical loads or stresses. Often, previous damage is difficult to identify. Therefore, we recommend using new bolts!

Have the HEICO-LOCK® Wedge Lock Washers been glued in pairs? If this is not the case, make sure to insert the individual washers in the correct position. Wedge surfaces on the inside and radial fins on the outside (see Figure 1).

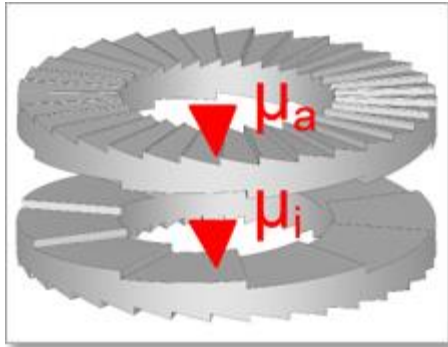


Figure 1: Orientation of the individual washers

Info: Addition of glue between the individual washers of HEICO-LOCK® WLW ensures insertion of washers with correct orientation and does not have any effect on their securing function (cf. item 8).

3.) Ambient conditions

Depending on the ambient conditions, different materials are recommended for HEICO-LOCK® WLW and the bolt parts.

For general application cases we recommend HEICO-LOCK® Wedge Lock Washers made of heat-treated steel (Mat.No. 1.1191 acc. to EN 10027) in combination with bolt parts made of steel with appropriate corrosion protection.

Info: HEICO-LOCK® WLW made of heat-treated steel are coated with zinc flake coating (fZnnc 720 h acc. to ISO 10683), which provides appropriate corrosion protection under normal ambient conditions.

In acidic ambience, in case of contact with chemical substances, or in tap water we recommend using HEICO-LOCK® WLW made of stainless steel. Resistance must be verified for individual cases.

If used in sea water or in off-shore areas, we recommend using HEICO-LOCK® WLW made of 254 SMO® (Mat.No. 1.4547 acc. to EN 10027) or INCONEL® / Alloy 718 (Mat.No. 2.4668 acc. to EN 10027).

From application temperatures above 200°C, HEICO-LOCK® WLW made of stainless steel (Mat.No. 1.4404 acc. to EN 10027) or 254 SMO® (Mat.No. 1.4547 acc. to EN 10027) must be used. For temperatures above 500°C, HEICO-LOCK® WLW made of INCONEL® / Alloy 718 (Mat.No. 2.4668 acc. to EN 10027) are available and can be used in temperatures of up to 700°C. Evaluation of individual application cases may be required. Please contact us.

With very low ambient temperatures HEICO-LOCK® WLW made of heat-treated steel (Mat.No. 1.1191 acc. to EN 10027) can be used up to temperatures as low as -40°C. For even lower application temperatures, we recommend using HEICO-LOCK® WLW made of stainless steel (Mat.No. 1.4404 acc. to EN 10027), 254 SMO® (Mat.No. 1.4547 acc. to EN 10027), INCONEL® / Alloy 718 (Mat.No. 2.4668 acc. to EN 10027) suitable up to minimum application temperatures of -200°C. Evaluation of individual application cases may be required. Please contact us.

Info: It must always be ensured that also bolting components suitable for the respective ambient conditions are used. Bolting parts and HEICO-LOCK® WLW used together should be made of similar materials. E.g. HEICO-LOCK® made of heat-treated steel must be combined with steel bolting parts, and HEICO-LOCK® made of stainless steel must be combined with stainless steel bolting parts. For high temperatures, the corresponding bolting parts must be made of heat-resistant or high-temperature resistant materials (DIN EN 10269 and DIN 267-29). For low temperatures, the corresponding bolting parts must be made of low-temperature resistant materials (DIN EN 10028, DIN EN 10222, DIN EN 10269 and DIN 267-29).

4.) Surface condition and surface hardness of fastened parts

In general, the surface of fastened parts, particularly the areas in contact with HEICO-LOCK® WLW, must be free from coarse soiling and as even and smooth as possible before assembly.

With great paint or coat thicknesses (> 250 µm) the efficiency of HEICO-LOCK® Wedge Lock Washers must be verified by experiments. If possible, the bolt joint using HEICO-LOCK® WLW should be fastened prior to painting or coating.

Info: With very thick surface coats, there is a risk that the radial teeth on the outside of the HEICO-LOCK® WLW may not indent into the base material. Consequently, the securing effect of the HEICO-LOCK® WLW may be eliminated due to cohesive or adhesive tearing of the coating or the paint layer.

The surface hardness of the fastened parts must be lower than that of HEICO-LOCK® Wedge Lock Washers and not exceed a hardness value of max. 460 HV (approx. 46 HRc) for using HEICO-LOCK® WLW out of heat treated steel. For application with HEICO-LOCK® out of stainless steels the max. surface hardness of the mating parts should not exceed 520 HV (approx. 50 HRc).

With soft mating material, we recommend using a HEICO-LOCK® WLW with large contact surface (HLB-XX) in combination with flange bolts and/or flange nuts to reduce the surface pressure.

5.) Type of bolt joints and geometry of the threaded hole

For bolt-and-nut joints a HEICO-LOCK® WLW must be integrated below the bolt head and between the nut and component, respectively (see. Fig. 2a).

For tapped thread joints it is sufficient to integrate one HEICO-LOCK® wedge lock washer pair below the bolt head (see. Fig. 2b). Additional locking of the thread (e.g. by means of adhesive) is not required (cf. item 1).

For threaded rod joints the HEICO-LOCK® WLW must be integrated below the nut(s) (cf. Fig. 2c).

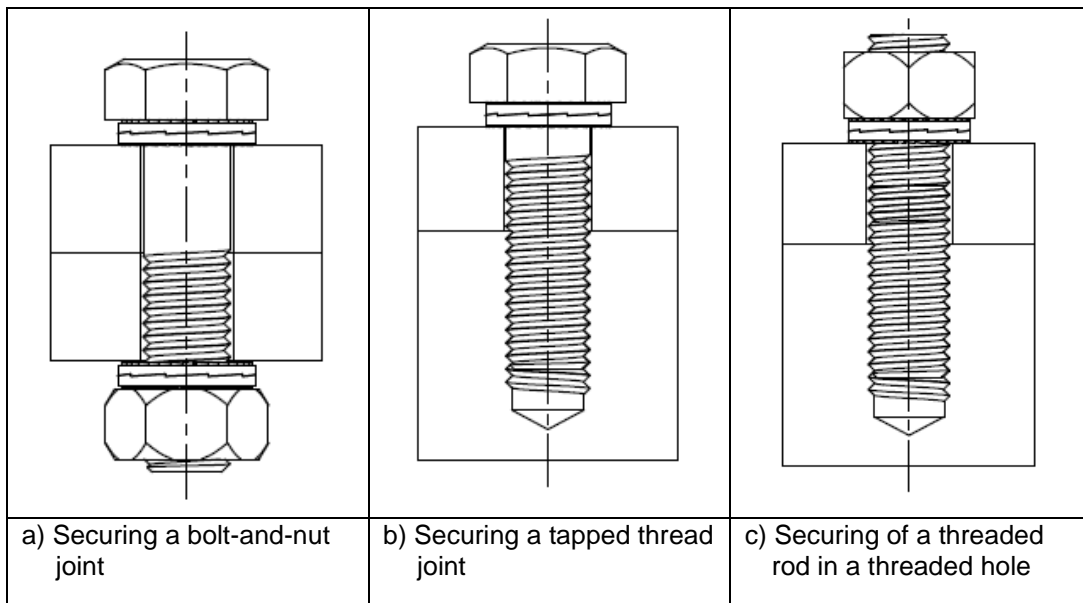


Figure 2: Assembly based on the type of bolted joint

With round or countersunk holes (see. Fig. 3a) it is possible to use HEICO-LOCK® WLW with small contact surface (HLS-XX).

With slot holes we recommend using a HEICO-LOCK® WLW with large contact surface (HLB-XX). Use of flanged bolts and/or flanged nuts is also possible, as necessary (Fig. 3b).

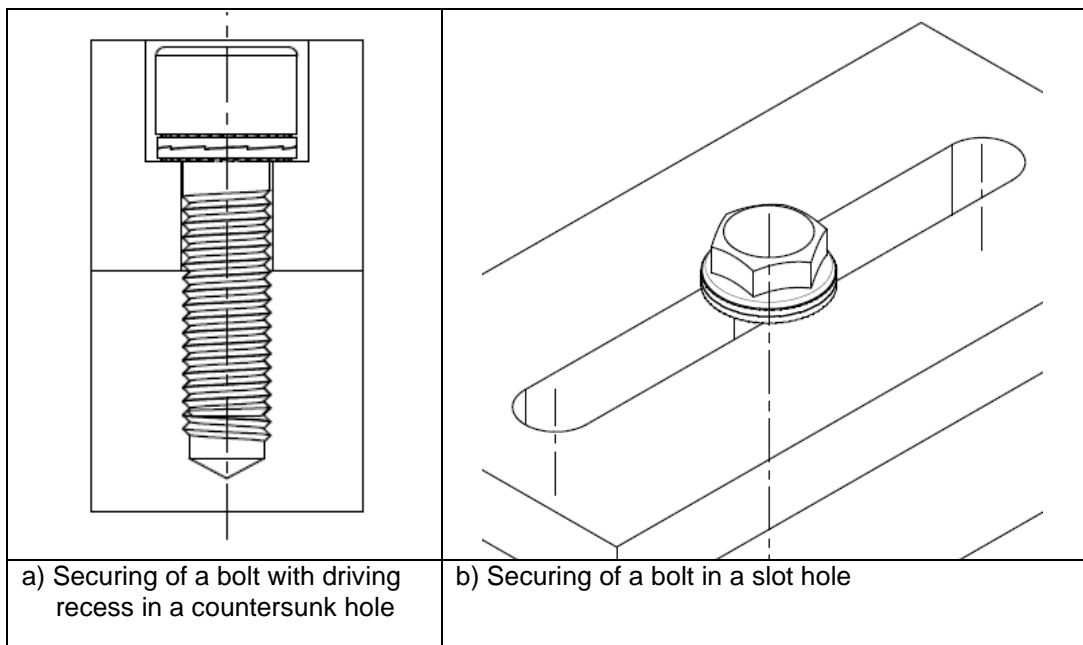


Figure 3: Assembly based on the geometry of the threaded hole

6.) Lubrication of the bolted joint

We recommend lubricating the bolted joint at the engaged thread and at the bearing surfaces of the bolt head and the nut (depending on the side that is tightened) prior to assembly in order to maintain the assembly tightening torque and/or the assembly tightening force within a certain range.

Info: Threads with a thick coating may get stuck. Stainless steel threads (e.g. A2 and A4) are prone to cold welding or “seizure”. Use a suitable lubricant.

7.) Tightening the bolted connection

We urgently request you to use at least one calibrated, adjustable torque wrench for assembly, in order to ensure correct tightening/fastening of the bolted connection. We strongly advise against purely “manual” assembly (“feeling the torque”).

If, for assembly of the bolted joint, another tightening force than that recommended by HEICO in item 9 is required, please contact us. Experimental examination may be required for individual cases.

Info: A minimum tightening force is required to ensure that the radial teeth on the outer face make correct form-closed connection with the mating material! The HEICO-LOCK® WLW meet the criteria of the test regulations according to E-DIN 25201-4, Annex B. According to these regulations, sufficient securing effect is available at a tightening force of 50% of the maximum assembly tightening force (acc. to VDI 2230-1, Table A1) with varying transversal load at a defined amplitude of the transversal shift during 2000 load reversal cycles on a vibration test stand acc. to DIN 65151, provided that at least 80% of the tightening force is maintained in the bolted connection at the beginning of the test (50% $F_{M,max}$).

The recommended tightening torque values are based on the assumed friction values under the coating and lubrication conditions specified. In individual cases the tightening torques required for obtaining the assembly tightening force must be verified by means of a tightening torque/force test using the original installation set-up.

For assembly of bolt-and-nut joints, one side (either the bolt head or the nut) must be locked or fixed while the joint is tightened from the opposite side.

8.) Functioning of the HEICO-LOCK[®] Wedge Lock Washers

After assembly (taking into account the information given above) the radial teeth on the outer faces of the HEICO-LOCK[®] Wedge Lock Washers indent into the mating material and the bolt head / nut faces (see Fig. 4) and make a form-closed connection due to the greater surface hardness of the washer.

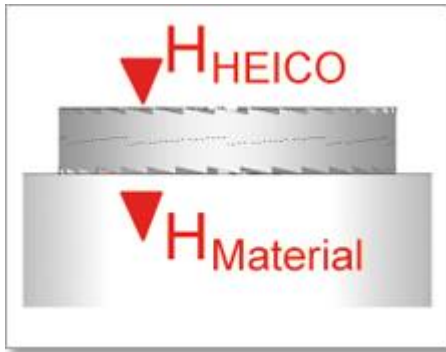


Figure 4: Indentation of the HEICO-LOCK[®] WLW due to greater surface hardness

Due to the form-closed indentation of the radial teeth on the outer faces into the respective mating surface, rotating movement is only possible by means of the wedge surfaced on the inner faces due to the lower friction value compared to the outer faces (Fig. 5).

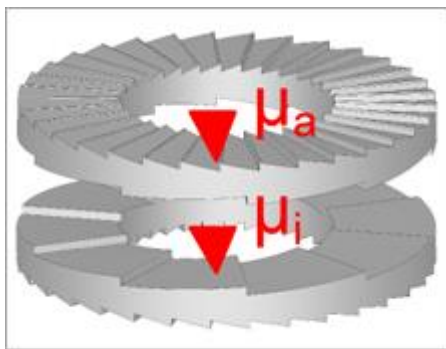


Figure 5: Different friction values at the inner and outer faces, respectively

The securing principle of HEICO-LOCK[®] WLW is based on the angles present at the wedge surfaces, which are greater than the pitch angle of the thread (see. Fig. 6). In case that the bolt detaches due to self-loosening by rotation, the wedge effect causes self-retention.

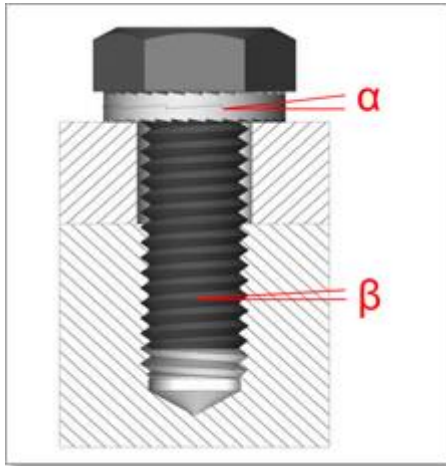


Figure 6: Wedge angle greater than pitch angle

Info: The angle at the wedge surface of the HEICO-LOCK[®] WLW is adjusted to the pitch angle of the bolt (ISO coarse thread or UNC thread) in the corresponding nominal size.

When loosening the joint using a wrench, the clamp load increases intermittently when the bolt head is forced over the wedge surfaces (see Fig. 7), also referred to as the “clicking” effect.

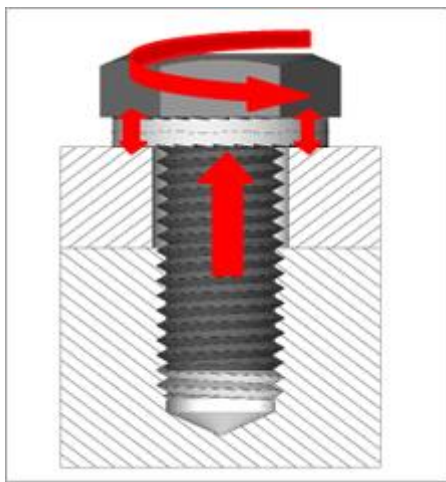


Figure 7: Increase of clamp load during loosening

9.) Quick reference guide for assembly

1. Inspect bolt parts for soiling and damage.
2. Check for correct positioning / orientation of the HEICO-LOCK® WLW (not applicable with glued individual washers).
3. Check for correct matching of the HEICO-LOCK® WLW and the bolt head or the nut, as well as the threaded rod, if applicable.
4. Choose the correct material for HEICO-LOCK® WLW depending on the ambient conditions (we recommend agreement with the manufacturer).
 - a. HEICO-LOCK® WLW made of heat-treated steel (1.1191) with zinc flake coating for normal ambient conditions from -40°C up to 200°C.
 - b. HEICO-LOCK® WLW made of stainless steel (1.4404) for application in corrosive, non-acidic ambient conditions from -200°C up to 500°C.
 - c. HEICO-LOCK® WLW made of 254 SMO® (1.4547) for application in acidic (chlorides, e.g. sea water) ambient conditions from -200°C up to 500°C.
 - d. HEICO-LOCK® WLW made of INCONEL® / Alloy 718 (2.4668) for temperatures above 500°C to maximum 700°C. Minimum temperature - 200°C.
5. The surface hardness of the fastened components must be lower than the hardness value of HEICO-LOCK® WLW. We recommend a maximum surface hardness of 430 HV (approx. 44 HRC). With soft mating material, use HEICO-LOCK® WLW with large contact surfaces (HLB-XX) in combination with flange bolts and/or flange nuts.
6. With great coating or paint thicknesses the function must be verified by experiment.
7. Select the appropriate model of HEICO-LOCK® WLW depending on the geometry of the threaded hole.
 - a. With round or countersunk holes use HEICO-LOCK® WLW with small contact surface (HLS-XX).
 - b. With slot holes use HEICO-LOCK® WLW with large contact surface (HLB-XX). Use in combination with flanged bolts/nuts, if required.
8. Positioning and orientation of HEICO-LOCK® WLW depending on the bolt type.
 - a. HEICO-LOCK® WLW below bolt head or nut for bolt joints.
 - b. HEICO-LOCK® WLW below bolt head and nut for bolt-and-nut joints.
 - c. HEICO-LOCK® WLW below the nut for assembly of a threaded rod in a threaded hole.
 - d. HEICO-LOCK® WLW below the nut for assembly of a threaded rod in a through hole.
9. The surface of fastened parts, particularly the areas in contact with HEICO-LOCK® WLW, must be free from coarse soiling and as even and smooth as possible.
10. The engaged thread, as well as the bolt head and nut contact faces must be lubricated using a suitable lubricant. This must be ensured in any case for stainless steel materials due to their tendency for “seizure”.
11. Tighten the bolted joint applying the assembly torque required for generating the assembly tightening force using a torque wrench with a dial or with “clicking” sound. The torque depends on friction (surface coating, lubrication, etc.). Torque recommendations are merely guiding values. The individually required assembly tightening torque must be established by experiment.

10.) Torque recommendations

10.1) HEICO-LOCK® recommended tightening torque values for ISO coarse thread:

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **carbon steel** C45E (1.1191), through-hardened, zinc flake coated (flZnnc)
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **8.8** acc. to ISO 898-1
 surface coating (bolt/nut): **phosphated (uncoated)**

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M3x0.5	3	HL-3	2.4	1.3	543	1.0	2.0	1.3	449	1.0
M3.5x0.6	3.5	HL-3.5	3.3	2.1	731	1.5	2.7	2.1	604	1.5
M4x0.7	4	HL-4	4.2	3.1	947	2.3	3.5	3.1	783	2.3
M5x0.8	5	HL-5	6.8	6.0	1 530	4.4	5.6	6.0	1 265	4.5
M6x1	6	HL-6	9.7	10.5	2 171	7.7	8.0	10.5	1 795	7.8
M8x1.25	8	HL-8	17.6	25.1	3 950	18.5	14.5	25.3	3 265	18.6
M10x1.5	10	HL-10	27.8	49.5	6 258	36.5	23.0	49.9	5 173	36.8
M12x1.75	12	HL-12	40.4	84.8	9 093	62.5	33.4	85.7	7 517	63.2
M14x2	14	HL-14	55.4	135.8	12 457	100.2	45.8	137.3	10 297	101.3
M16x2	16	HL-16	75.2	207.0	16 906	152.7	62.2	210.2	13 975	155.0
M18x2.5	18	HL-18	95	300	21 418	221	79	303	17 706	224
M20x2.5	20	HL-20	121	418	27 241	308	100	424	22 519	313
M22x2.5	22	HL-22	150	569	33 762	419	124	578	27 910	426
M24x3	24	HL-24	174	732	39 225	540	144	742	32 426	547
M27x3	27	HL-27	227	1 062	51 121	783	188	1 079	42 260	796
M30x3.5	30	HL-30	277	1 447	62 383	1 067	229	1 469	51 570	1 084
M33x3.5	33	HL-33	343	1 943	77 180	1 433	284	1 978	63 802	1 459

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **carbon steel** C45E (1.1191), through-hardened, zinc flake coated (flZnnc)
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **8.8** acc. to ISO 898-1
 surface coating (bolt/nut): **phosphated (uncoated)**

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M36x4	36	HL-36	404	2 505	90 887	1 848	334	2 549	75 133	1 880
M39x4	39	HL-39	483	3 226	108 584	2 380	399	3 288	89 763	2 425
M42x4.5	42	HL-42	555	3 990	124 735	2 943	459	4 063	103 114	2 997
M45x4.5	45	HL-45	646	4 961	145 332	3 659	534	5 059	120 141	3 731
M48x5	48	HL-48	729	6 005	163 933	4 429	603	6 117	135 518	4 512
M52x5	52	HL-52	870	7 671	195 612	5 658	719	7 831	161 706	5 776
M56x5.5	56	HL-56	1 005	9 554	225 902	7 047	831	9 749	186 746	7 191
M60x5.5	60	HL-60	1 169	11 795	262 847	8 700	967	12 059	217 287	8 894
M64x6	64	HL-64	1 325	14 215	297 785	10 485	1 095	14 532	246 169	10 718
M68x6	68	HL-68	1 512	17 538	339 996	12 935	1 250	17 915	281 064	13 214
M72x6	72	HL-72	1 713	20 874	385 004	15 396	1 416	21 353	318 270	15 749
M76x6	76	HL-76	1 925	24 600	432 809	18 144	1 592	25 197	357 789	18 584
M85x6	85	HL-85	2 449	33 448	550 595	24 670	2 025	34 451	455 159	25 410

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **carbon steel** C45E (1.1191), through-hardened, zinc flake coated (flZnnc)
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **10.9** acc. to ISO 898-1
 surface coating (bolt/nut): **phosphated (uncoated)**

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M3x0.5	3	HL-3	3.5	2.0	797	1.5	2.9	2.0	659	1.5
M3.5x0.6	3.5	HL-3.5	4.8	3.0	1 074	2.2	3.9	3.0	888	2.2
M4x0.7	4	HL-4	6.2	4.5	1 391	3.3	5.1	4.5	1 150	3.3
M5x0.8	5	HL-5	10.0	8.8	2 248	6.5	8.3	8.9	1 858	6.5
M6x1	6	HL-6	14.2	15.4	3 189	11.4	11.7	15.5	2 636	11.4
M8x1.25	8	HL-8	25.8	36.8	5 802	27.2	21.3	37.1	4 796	27.4
M10x1.5	10	HL-10	40.9	72.7	9 191	53.6	33.8	73.3	7 598	54.1
M12x1.75	12	HL-12	59.4	124.5	13 355	91.9	49.1	125.9	11 040	92.9
M14x2	14	HL-14	81.4	199.5	18 296	147.1	67.3	201.7	15 124	148.8
M16x2	16	HL-16	110.4	304.0	24 830	224.2	91.3	308.7	20 526	227.7
M18x2.5	18	HL-18	136	427	30 505	315	112	432	25 217	318
M20x2.5	20	HL-20	173	595	38 797	439	143	604	32 073	446
M22x2.5	22	HL-22	214	810	48 086	597	177	823	39 751	607
M24x3	24	HL-24	249	1 043	55 866	769	205	1 057	46 183	780
M27x3	27	HL-27	324	1 512	72 809	1 115	268	1 537	60 189	1 134
M30x3.5	30	HL-30	395	2 061	88 849	1 520	327	2 093	73 448	1 544
M33x3.5	33	HL-33	489	2 767	109 923	2 041	404	2 818	90 870	2 078

Symbols:

μ_a : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **carbon steel** C45E (1.1191), through-hardened, zinc flake coated (flZnnc)
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **10.9** acc. to ISO 898-1
 surface coating (bolt/nut): **phosphated (uncoated)**

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M36x4	36	HL-36	576	3 568	129 445	2 632	476	3 630	107 008	2 677
M39x4	39	HL-39	688	4 595	154 650	3 389	569	4 682	127 844	3 454
M42x4.5	42	HL-42	790	5 683	177 652	4 191	653	5 787	146 859	4 268
M45x4.5	45	HL-45	921	7 066	206 988	5 211	761	7 205	171 110	5 314
M48x5	48	HL-48	1 039	8 553	233 480	6 308	859	8 712	193 010	6 426
M52x5	52	HL-52	1 239	10 926	278 599	8 058	1 024	11 154	230 309	8 227
M56x5.5	56	HL-56	1 431	13 607	321 739	10 036	1 183	13 885	265 971	10 241
M60x5.5	60	HL-60	1 665	16 800	374 358	12 391	1 377	17 175	309 470	12 667
M64x6	64	HL-64	1 887	20 246	424 118	14 933	1 560	20 697	350 604	15 265
M68x6	68	HL-68	2 154	24 978	484 237	18 423	1 781	25 516	400 303	18 820
M72x6	72	HL-72	2 439	29 729	548 339	21 927	2 016	30 412	453 294	22 431
M76x6	76	HL-76	2 742	35 036	616 425	25 841	2 267	35 886	509 578	26 468
M85x6	85	HL-85	3 448	47 638	784 181	35 136	2 884	49 067	648 256	36 190

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **carbon steel** C45E (1.1191), through-hardened, zinc flake coated (flZnnc)
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **12.9** acc. to ISO 898-1
 surface coating (bolt/nut): **phosphated (uncoated)**

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M3x0.5	3	HL-3	4.2	2.3	933	1.7	3.4	2.3	771	1.7
M3.5x0.6	3.5	HL-3.5	5.6	3.6	1 257	2.6	4.6	3.6	1 039	2.6
M4x0.7	4	HL-4	7.2	5.3	1 628	3.9	6.0	5.3	1 346	3.9
M5x0.8	5	HL-5	11.7	10.3	2 630	7.6	9.7	10.4	2 175	7.7
M6x1	6	HL-6	16.6	18.0	3 732	13.3	13.7	18.1	3 085	13.4
M8x1.25	8	HL-8	30.2	43.1	6 789	31.8	25.0	43.4	5 612	32.0
M10x1.5	10	HL-10	47.8	85.1	10 756	62.7	39.6	85.8	8 892	63.3
M12x1.75	12	HL-12	69.5	145.7	15 628	107.5	57.5	147.3	12 919	108.7
M14x2	14	HL-14	95.2	233.5	21 410	172.2	78.7	236.1	17 699	174.1
M16x2	16	HL-16	129.2	355.8	29 056	262.4	106.8	361.2	24 020	266.4
M18x2.5	18	HL-18	159	499	35 697	368	131	505	29 510	373
M20x2.5	20	HL-20	202	697	45 401	514	167	707	37 532	522
M22x2.5	22	HL-22	250	948	56 271	699	207	964	46 517	711
M24x3	24	HL-24	291	1 220	65 375	900	240	1 237	54 044	912
M27x3	27	HL-27	379	1 769	85 202	1 305	313	1 799	70 434	1 327
M30x3.5	30	HL-30	462	2 411	103 972	1 779	382	2 449	85 950	1 806
M33x3.5	33	HL-33	572	3 238	128 633	2 388	473	3 297	106 337	2 432

Symbols:

μ_a : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **carbon steel** C45E (1.1191), through-hardened, zinc flake coated (flZnnc)
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **12.9** acc. to ISO 898-1
 surface coating (bolt/nut): **phosphated (uncoated)**

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M36x4	36	HL-36	674	4 175	151 478	3 080	557	4 248	125 222	3 133
M39x4	39	HL-39	805	5 377	180 973	3 966	665	5 479	149 604	4 041
M42x4.5	42	HL-42	925	6 650	207 891	4 905	764	6 772	171 856	4 995
M45x4.5	45	HL-45	1 077	8 268	242 220	6 098	891	8 432	200 235	6 219
M48x5	48	HL-48	1 215	10 009	273 221	7 382	1 005	10 195	225 863	7 520
M52x5	52	HL-52	1 450	12 785	326 021	9 430	1 199	13 052	269 510	9 627
M56x5.5	56	HL-56	1 675	15 923	376 503	11 744	1 384	16 249	311 243	11 985
M60x5.5	60	HL-60	1 949	19 659	438 079	14 500	1 611	20 098	362 145	14 824
M64x6	64	HL-64	2 208	23 692	496 309	17 474	1 825	24 220	410 282	17 863
M68x6	68	HL-68	2 521	29 229	566 660	21 558	2 084	29 859	468 439	22 023
M72x6	72	HL-72	2 854	34 789	641 674	25 659	2 360	35 588	530 450	26 249
M76x6	76	HL-76	3 209	40 999	721 348	30 240	2 653	41 995	596 315	30 974
M85x6	85	HL-85	4.081.9	55 746	917 659	41 116	3 374	57 418	758 598	42 350

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **stainless steel** 1.4404 (316L), surface hardened
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **A2-70** acc. to ISO 3506-1
A4-70
 surface coating (bolt/nut): **blank**

lubrication:			molybdenum disulfide (MoS2)			
$\mu_G =$			0.14			
$\mu_K =$			0.15			
$\eta =$			0.65			
Thread designation	nominal diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M3x0.5	3	HL-3S	1.5	0.9	331	0.6
M3.5x0.6	3.5	HL-3.5S	2.0	1.4	445	1.0
M4x0.7	4	HL-4S	2.6	2.0	577	1.5
M5x0.8	5	HL-5S	4.1	4.0	933	2.9
M6x1	6	HL-6S	5.9	6.9	1 323	5.1
M8x1.25	8	HL-8S	10.7	16.5	2 407	12.2
M10x1.5	10	HL-10S	17.0	32.7	3 813	24.1
M12x1.75	12	HL-12S	24.6	56.1	5 541	41.4
M14x2	14	HL-14S	33.8	89.9	7 591	66.3
M16x2	16	HL-16S	45.8	137.4	10 302	101.3
M18x2.5	18	HL-18S	56	192	12 656	142
M20x2.5	20	HL-20S	72	269	16 097	198
M22x2.5	22	HL-22S	89	366	19 950	270
M24x3	24	HL-24S	103	470	23 179	347
M27x3	27	HL-27S	134	683	30 208	504
M30x3.5	30	HL-30S	164	930	36 863	686
M33x3.5	33	HL-33S	203	1 252	45 606	923

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **stainless steel** 1.4404 (316L), surface hardened
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **A2-70** acc. to ISO 3506-1
A4-70
 surface coating (bolt/nut): **blank**

		lubrication:		molybdenum disulfide (MoS2)		
		$\mu_G =$		0.14		
		$\mu_K =$		0.15		
		$\eta =$		0.65		
Thread designation	nominal diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M36x4	36	HL-36S	239	1 613	53 706	1 190
M39x4	39	HL-39S	285	2 079	64 163	1 533
M42x4.5	42	HL-42S	328	2 571	73 707	1 896
M45x4.5	45	HL-45S	382	3 199	85 878	2 359
M48x5	48	HL-48S	431	3 869	96 869	2 853
M52x5	52	HL-52S	514	4 951	115 589	3 652
M56x5.5	56	HL-56S	594	6 165	133 487	4 547
M60x5.5	60	HL-60S	691	7 623	155 319	5 622
M64x6	64	HL-64S	783	9 189	175 964	6 778
M68x6	68	HL-68S	894	11 312	200 907	8 343
M72x6	72	HL-72S	1 012	13 479	227 502	9 942
M76x6	76	HL-76S	1 138	15 902	255 751	11 729
M80x6	80	HL-80S	1 271	18 363	285 652	13 544

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **stainless steel** 1.4404 (316L), surface hardened
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **A4-80** acc. to ISO 3506-1
 surface coating (bolt/nut): **blank**

			lubrication: molybdenum disulfide (MoS2)			
			$\mu_G =$	0.14		
			$\mu_K =$	0.15		
			$\eta =$	0.65		
Thread designation	nominal diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M3x0.5	3	HL-3S	2.0	1.2	441	0.9
M3.5x0.6	3.5	HL-3.5S	2.6	1.8	594	1.3
M4x0.7	4	HL-4S	3.4	2.7	770	2.0
M5x0.8	5	HL-5S	5.5	5.3	1 243	3.9
M6x1	6	HL-6S	7.8	9.2	1 764	6.8
M8x1.25	8	HL-8S	14.3	22.1	3 209	16.3
M10x1.5	10	HL-10S	22.6	43.6	5 085	32.1
M12x1.75	12	HL-12S	32.9	74.8	7 388	55.2
M14x2	14	HL-14S	45.0	119.9	10 121	88.4
M16x2	16	HL-16S	61.1	183.2	13 736	135.1
M18x2.5	18	HL-18S	75	256	16 875	189
M20x2.5	20	HL-20S	95	359	21 462	264
M22x2.5	22	HL-22S	118	488	26 601	360
M24x3	24	HL-24S	137	627	30 905	462
M27x3	27	HL-27S	179	911	40 277	672
M30x3.5	30	HL-30S	219	1 240	49 150	915
M33x3.5	33	HL-33S	270	1 669	60 808	1 231

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

ISO metric thread

HEICO-LOCK® material: **stainless steel** 1.4404 (316L), surface hardened
 thread type: metric ISO coarse thread acc. to ISO 261
 screw product standard: ISO 4017 hex. cap screw
 strength class: **A4-80** acc. to ISO 3506-1
 surface coating (bolt/nut): **blank**

		lubrication:		molybdenum disulfide (MoS2)		
		$\mu_G =$	0.14			
		$\mu_K =$	0.15			
		$\eta =$	0.65			
Thread designation	nominal diameter d [mm]	HEICO-LOCK®	SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
M36x4	36	HL-36S	319	2 150	71 608	1 586
M39x4	39	HL-39S	381	2 772	85 551	2 044
M42x4.5	42	HL-42S	437	3 428	98 276	2 528
M45x4.5	45	HL-45S	509	4 265	114 504	3 146
M48x5	48	HL-48S	575	5 158	129 159	3 804
M52x5	52	HL-52S	686	6 601	154 119	4 869
M56x5.5	56	HL-56S	792	8 219	177 983	6 062
M60x5.5	60	HL-60S	921	10 163	207 092	7 496
M64x6	64	HL-64S	1 044	12 253	234 619	9 037
M68x6	68	HL-68S	1 192	15 082	267 876	11 124
M72x6	72	HL-72S	1 349	17 972	303 337	13 255
M76x6	76	HL-76S	1 517	21 203	341 001	15 639
M80x6	80	HL-80S	1 694	24 484	380 869	18 058

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
 torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

10.2) HEICO-LOCK® recommended tightening torque values for unified thread:

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

Unified thread

HEICO-LOCK® material:
thread type:
screw product standard:
strength class:
surface coating (bolt/nut):

carbon steel
UNC
ASTM B18.2.1
Grade 5
phosphated

C45E, through-hardened, zinc flake coated (flZnnc)
unified coarse thread acc. to ASME B1.1
hex. cap screw
acc. to SAE J429

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [Inch]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
UNC 1/4" - 20	1/4"	HL-1/4"	10.0	12.6	2 255	9.3	8.3	12.6	1 864	9.3
UNC 5/16" - 18	5/16"	HL-8	16.5	24.5	3 703	18.1	13.6	24.5	3 061	18.1
UNC 3/8" - 16	3/8"	HL-3/8"	24.3	42.1	5 461	31.0	20.1	42.3	4 515	31.2
UNC 7/16" - 14	7/16"	HL-11	33.3	65.3	7 491	48.2	27.5	65.8	6 193	48.5
UNC 1/2" - 13	1/2"	HL-1/2"	44.4	101.2	9 983	74.6	36.7	102.0	8 253	75.2
UNC 9/16" - 12	9/16"	HL-14	56.9	143.5	12 792	105.8	47.0	144.9	10 575	106.9
UNC 5/8" - 11	5/8"	HL-16	70.6	200.3	15 867	147.7	58.3	202.1	13 117	149.1
UNC 3/4" - 10	3/4"	HL-3/4"	104	351	23 460	259	86	355	19 393	262
UNC 7/8" - 9	7/8"	HL-22	144	562	32 361	414	119	569	26 751	420
UNC 1" - 8	1"	HL-1"	189	858	42 445	632	156	868	35 088	640
UNC 1 1/8" - 7	1 1/8"	HL-30	210	1 080	47 099	796	173	1 092	38 936	805
UNC 1 1/4" - 7	1 1/4"	HL-33	266	1 499	59 696	1 106	220	1 520	49 349	1 121
UNC 1 3/8" - 6	1 3/8"	HL-36	317	1 968	71 208	1 452	262	1 994	58 865	1 471
UNC 1 1/2" - 6	1 1/2"	HL-39	385	2 582	86 526	1 904	318	2 622	71 528	1 934

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

Unified thread

HEICO-LOCK® material:
thread type:
screw product standard:
strength class:
surface coating (bolt/nut):

carbon steel
UNC
ASTM B18.2.1
Grade 8
phosphated

C45E, through-hardened, zinc flake coated (flZnnc)
unified coarse thread acc. to ASME B1.1
hex. cap screw
acc. to SAE J429

lubrication:			assembly paste				dry (delivery state)			
$\mu_G =$			0.10				0.15			
$\mu_K =$			0.16				0.18			
$\eta =$			0.75				0.62			
Thread designation	nom. diameter d [inch]	HEICO-LOCK®	SI Units		Imperial Units		SI Units		Imperial Units	
			Assembly preload F_m [kN]	Assembly torque M_A [Nm]	Assembly preload F_m [lbf]	Assembly torque M_A [lb ft]	Assembly preload F_m [kN]	Assembly torque M_A [Nm]	Assembly preload F_m [lbf]	Assembly torque M_A [lb ft]
UNC 1/4" - 20	1/4"	HL-1/4"	14.2	17.8	3 187	13.2	11.7	17.7	2 634	13.1
UNC 5/16" - 18	5/16"	HL-8	23.3	34.6	5 232	25.5	19.2	34.6	4 325	25.6
UNC 3/8" - 16	3/8"	HL-3/8"	34.3	59.4	7 717	43.8	28.4	59.7	6 379	44.0
UNC 7/16" - 14	7/16"	HL-11	47.1	92.2	10 586	68.0	38.9	93.0	8 751	68.6
UNC 1/2" - 13	1/2"	HL-1/2"	62.7	143.0	14 106	105.5	51.9	144.1	11 661	106.3
UNC 9/16" - 12	9/16"	HL-14	80.4	202.8	18 076	149.6	66.5	204.8	14 943	151.0
UNC 5/8" - 11	5/8"	HL-16	99.7	283.0	22 421	208.7	82.4	285.6	18 534	210.6
UNC 3/4" - 10	3/4"	HL-3/4"	147	495	33 150	365	122	501	27 404	370
UNC 7/8" - 9	7/8"	HL-22	203	794	45 727	586	168	805	37 801	593
UNC 1" - 8	1"	HL-1"	267	1 212	59 977	894	221	1 226	49 581	905
UNC 1 1/8" - 7	1 1/8"	HL-30	336	1 733	75 592	1 278	278	1 752	62 489	1 292
UNC 1 1/4" - 7	1 1/4"	HL-33	426	2 406	95 809	1 775	352	2 440	79 202	1 800
UNC 1 3/8" - 6	1 3/8"	HL-36	508	3 159	114 285	2 330	420	3 200	94 475	2 360
UNC 1 1/2" - 6	1 1/2"	HL-39	618	4 144	138 869	3 056	511	4 208	114 798	3 103

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018

HEICO-LOCK® WEDGE LOCK WASHERS



Torque Recommendations

Unified thread

HEICO-LOCK® material:
thread type:
screw product standard:
strength class:

stainless steel
UNC
ASTM B18.2.1
Alloy Group 1/2
Condition SH
(materials e.g. 304, 316)
none

1.4404 (316L), surface hardened
unified coarse thread acc. to ASME B1.1
hex. cap screw
acc. to SAE J429

surface coating (bolt/nut):

none

			lubrication:			
			molybdenum disulfide (MoS2)			
			$\mu_G =$	0.14		
			$\mu_K =$	0.15		
			$\eta =$	0.65		
Thread designation	nominal diameter d [inch]	HEICO-LOCK®	SI Units		Imperial Units	
			Assembly preload F_M [kN]	Assembly torque M_A [Nm]	Assembly preload F_M [lbf]	Assembly torque M_A [lb ft]
UNC 1/4" - 20	1/4"	HL-1/4"S	9.0	12.1	2 018	8.9
UNC 5/16" - 18	5/16"	HL-8S	14.7	23.6	3 314	17.4
UNC 3/8" - 16	3/8"	HL-3/8"S	21.7	40.7	4 887	30.0
UNC 7/16" - 14	7/16"	HL-11S	29.8	63.4	6 704	46.7
UNC 1/2" - 13	1/2"	HL-1/2"S	39.7	98.0	8 934	72.3
UNC 9/16" - 12	9/16"	HL-14S	50.9	139.3	11 448	102.8
UNC 5/8" - 11	5/8"	HL-16S	63.2	194.1	14 200	143.2
UNC 3/4" - 10	3/4"	HL-3/4"S	74	269	16 575	198
UNC 7/8" - 9	7/8"	HL-22S	102	431	22 863	318
UNC 1" - 8	1"	HL-1"S	133	656	29 988	484
UNC 1 1/8" - 7	1 1/8"	HL-30S	134	750	30 237	553
UNC 1 1/4" - 7	1 1/4"	HL-33S	170	1 044	38 324	770
UNC 1 3/8" - 6	1 3/8"	HL-36S	153	1 028	34 285	758
UNC 1 1/2" - 6	1 1/2"	HL-39S	185	1 350	41 661	996

Symbols:

μ_G : Coefficient of friction in the thread
 μ_K : Coefficient of friction on the bearing surface (HEICO-LOCK®)
 η : Utilization factor of the yield strength of the bolt by the preload

Conversion factors:

force: factor N → lbf : 0.22481
torque: factor Nm → lb ft : 0.73756

The friction affects the torque/preload ratio to a special degree. In critical cases of application a torque/preload test (e. g. acc. to ISO 16047) is strongly recommended. The calculated torque and preload values are recommendations which are made on the basis of assumed coefficients of friction especially those in the thread which are obtained from standards, specialist literature or internal testings. This does not release the user from the testing that is inevitable, given the diversity of possible influences in the processing and application of our products. Any legal guarantee of specific properties of suitability for any concrete operational purpose may not be assumed from the information provide. Status as of 01/2018