HARDLOCK®

Register of International Marks

Self-Locking Nut

HARDLOCK NUT INTRODUCTION

FEATURES OF HARDLOCK NUT

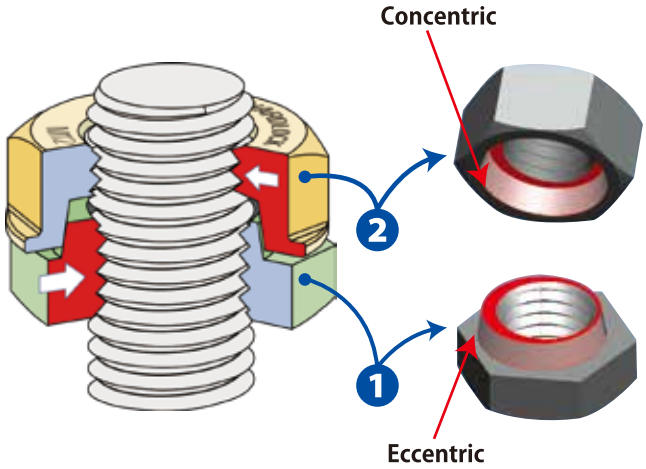
- ◆ Reusable without reduction in performance !
- ◆ Full torque management and completely fastened even with ZERO (0) clamp load !
- ◆ Available in various materials and surface treatments tailored to the environment !
- ◆ No special tools required for installation !

LOCKING MECHANISM

HARDLOCK NUT consists of two nuts, the first nut "Convex Nut" ①(clamping nut) has a truncated protrusion arranged off-center on the upper surface.

The second nut "Concave Nut" ②(locking nut) is designed with a concentric conical recess for locking the two nuts together.

By tightening the concave nut onto the convex nut, a strong perpendicular load will be applied to the bolt from both sides.

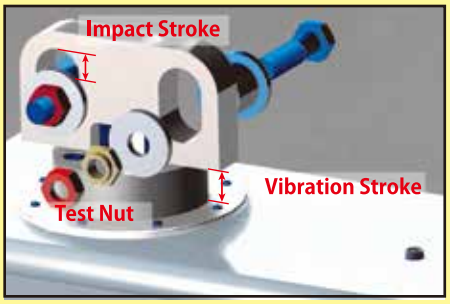


PROVED SUPERIOR IN A VARIETY OF LOOSENING TESTS

1) Accelerated vibration test conforming to NAS 3350/3354 (National Aerospace Standard)

To determine the capability of fasteners to withstand accelerated vibration condition.

Assembly of NAS testing machine



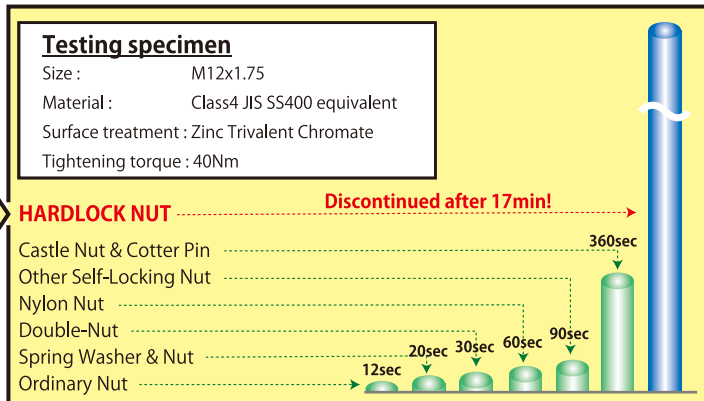
Testing conditions

Testing frequency : 1,780c.p.m
Vibration stroke : 11mm
Impact stroke : 19mm

Test results

Testing specimen

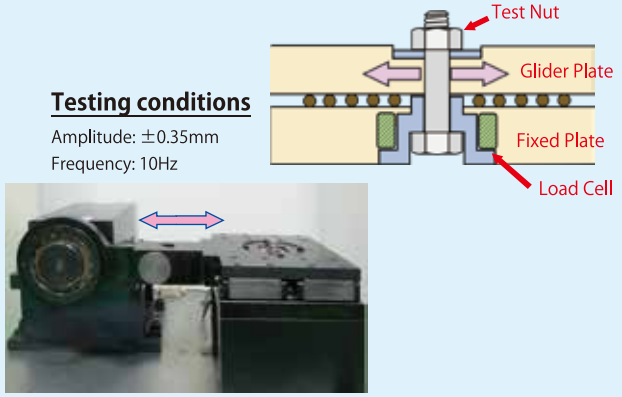
Size : M12x1.75
Material : Class4 JIS SS400 equivalent
Surface treatment : Zinc Trivalent Chromate
Tightening torque : 40Nm



2) Junker Vibration Test

The test bench applies a transverse cyclic vibration to the glider plate, and the clamp load is measured in real time and plotted on a graph.

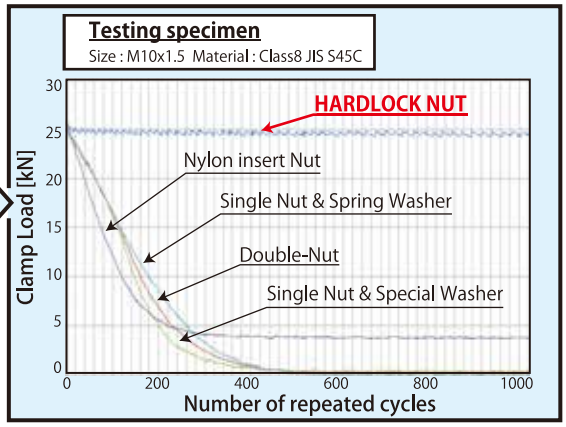
Section through of Junker test machine



Testing conditions

Amplitude: ±0.35mm
Frequency: 10Hz

Comparison of the self-loosening behavior of fasteners



CASE EXAMPLE OF COST REDUCTION

Although initial cost is higher than standard bolted connection, HARDLOCK Nut provides significant reduction in **total maintenance cost** by eliminating re-tightening work with resultant decrease in maintenance frequency and time.

Flywheel fastening for VIBRATING SCREEN (Mining company in Brazil)

Vibrating screens are used in mining industry to separate feeds containing solids and crushed rocks/ores by force of vibration generated from a flywheel, consequently always being exposed to severe vibration.

Vibrating Screen

Pendulum flywheel installed with ordinary nuts

Installed with HARDLOCK nuts

Reduction of yearly Maintenance cost (per 1 machine)

M24×3.0 C8 48 pcs / machine	Initial Cost (Rough estimate)
Ordinary Nut	US$ 57.6 US$1.2×48 pcs
HARDLOCK Nut	US$ 240 US$5×48 pcs
Cost Difference	+US$ 182.4

Maintenance Cost					
(a)	(b)	(c)	(d)=(a)×(b)×(c)	(e)	(f)=(d)×(e)
Engineers	Maintenance hours	Maintenance per year	Man-Hour per year	Labor Cost (/hour)	Maintenance Cost per year
5 (Engineers)	4 (hours)	12 (times)	240(MHRS)	US$ 20	US$ 4,800
5 (Engineers)	**1** (hour)	**1** (time)	5(MHRS)	US$ 20	US$ 100
					-US$ 4,700

Maintenance cost reduced by up to 98%

Railway joint applications (Railway company in Japan)

Two rails are bolted to join together on a track. A force as strong as 500G is applied when a train passes, this causes heavy stress on the joint as well as strain from expansion and contraction of the rail.

Installed with ordinary nuts

Installed with HARDLOCK nuts

HARDLOCK nut can produce significant locking effect even with a low torque of 250 -300Nm, compared to 500Nm for an ordinary nut. This also contributes to decrease of bolt breakage by creating a fine balance in the rail joint as if it allows the joint to "breathe" and relieves it from stress.

Reduction of yearly Maintenance cost (for 500 joints)

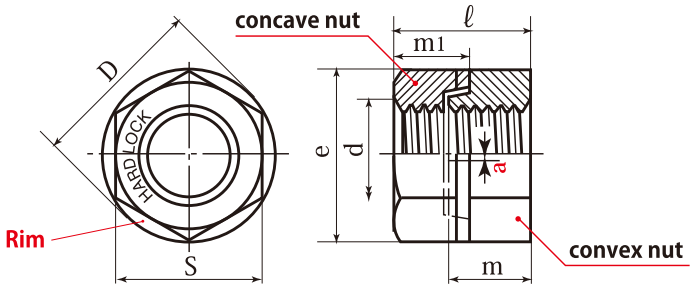
M20×2.5 C8 w/bolt & washer 500 joints×2 rails×4 sets 4,000 sets	Initial Cost (Rough estimate)
Ordinary Nut	US$ 18,000 US$4.5×4,000 pcs
HARDLOCK Nut	US$ 32,000 US$8×4,000 pcs
Cost Difference	+US$ 14,000

Maintenance Cost					
(a)	(b)	(c)=(b)×12	(d)=(a)×(c)	(e)	(f)=(d)×(e)
Engineers	Maintenance per month	Maintenance per year	Man-day per year	Labor Cost (/day)	Maintenance Cost per year
3 (Engineers)	3 (days)	36 (days)	108(man-day)	US$ 300	US$ 32,400
2 (Engineers)	**1** (day)	**12** (days)	24(man-day)	US$ 300	US$ 7,200
					-US$ 25,200

Maintenance cost reduced by up to 77%

HARDLOCK NUT DIMENSION TABLE1

HLN-R : RIM TYPE



HLN-R is our standard series with improved workability by adding a Rim to the Concave nut.

Unit : mm

Nominal size d	Thickness				Width across flats		e	Overall height	Rim dia.	Unit weight	Recommended tightening torque for the concave nut (N-m)
	Convex nut		Concave nut					ℓ	D	(g)	
	m		m1		s						
	Basic	Tolerance	Basic	Tolerance	Basic	Tolerance	approx.	approx.	approx.	approx.	Common to all (Min - Max)
M5×0.8	4	0.1 / -0.15	4	0.5 / -0.2	8	0 / -0.2	9.2	7.2	9.2	1.9	2 - 3
M6×1.0	5	±0.3	5	0 / -0.3	10	0 / -0.6	11.5	8.5	11.5	4	4 - 5
M8×1.25	6.5	0 / -0.58	6.5	0 / -0.58	13	0 / -0.7	15.0	10.8	15.0	8.9	9 - 13
M10×1.5	8	0 / -0.58	8	0 / -0.58	17	0 / -0.7	19.6	13.2	19.6	18	18 - 24
M12×1.75	10	0 / -0.58	9.3	0 / -0.58	19	0 / -0.8	21.9	16.0	21.9	26	27 - 39
M16×2.0	13	±0.9	11	0 / -0.7	24	0 / -0.8	27.7	21.2	27.7	46	70 - 100
M20×2.5	16	±0.9	14.5	0 / -0.7	30	0 / -0.8	34.6	26.7	34.6	93	120 - 200
M22×2.5	18	±0.9	15.6	0 / -1.2	32	0 / -1	37.0	29.9	37.0	115	150 - 250
M24×3.0	19	±0.9	17.6	0 / -1.2	36	0 / -1	41.6	32.4	41.6	183	160 - 300
M27×3.0	21	±1.0	17.6	0 / -1.2	41	0 / -1	47.3	33.5	47.3	243	250 - 390
M30×3.5	23	±1.0	18.6	0 / -1.2	46	0 / -1	53.1	36.5	53.1	312	270 - 440

External dimensions : JIS B1181(2004) / ISO 4302(Width across flats only)
Screw thread tolerances : JIS B0209(2001) / ISO 965 6H
・In the case of HDZ, please tighten the concave nut 50% more than the above torque value due to the high torque coefficient.

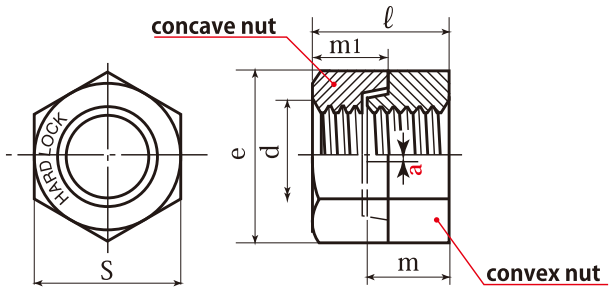
AVAILABLE STEEL GRADE :

Strength Class	Class 4		Class 8	Class 10	A2-70
Steel Grade	Low carbon steel		Medium carbon steel	Chromium Molybdenum steel	Stainless steel 304
Applicable Standard	JIS SS400 equivalent		JIS S45C	JIS SCM435	JIS SUS304 equivalent
	ASTM A563 Gr. A equivalent		ASTM A194 Gr. 2H equivalent	ASTM A194 Gr. 7 equivalent	ASTM A194 Gr. 8 equivalent
Surface finish	Zinc plating trivalent chromate	Hot Dip Galvanized (HDZ35)	Manganese Phosphate	Manganese Phosphate	—
M5×0.8	✓	—	—	—	✓
M6×1.0	✓	—	—	—	✓
M8×1.25	✓	✓	✓	✓	✓
M10×1.5	✓	✓	✓	✓	✓
M12×1.75	✓	✓	✓	✓	✓
M16×2.0	✓	✓	✓	✓	✓
M20×2.5	✓	✓	✓	✓	—
M22×2.5	✓	✓	✓	✓	—
M24×3.0	✓	✓	✓	✓	—
M27×3.0	✓	✓	✓	✓	—
M30×3.5	✓	✓	✓	✓	—

Other Materials or fine pitches are available in Basic Normal type. Other surface finishes are available upon request.
Medium carbon steel Concave nut (Rim) is used in combination with Class 10 Convex nut.

HARDLOCK NUT DIMENSION TABLE2

HLN : BASIC TYPE



HLN-B is the original series of HARDLOCK NUT.

Unit : mm

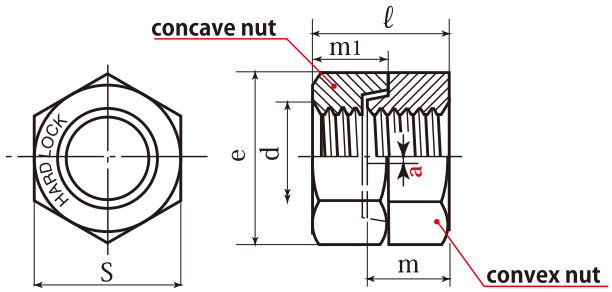
Nominal size	Pitch		Thickness				Width across flats		e	Overall height	Unit weight	Recommended tightening torque for the concave nut (N-m)
			Convex nut		Concave nut							
	p		m		m1		s			(g)		
d	Coarse	Fine	Basic	Tolerance	Basic	Tolerance	Basic	Tolerance	approx.	approx.	approx.	Common to all (Min - Max)
M6	1.0	0.75	5	±0.48	5	±0.48	10	0 -0.6	11.5	9.2	3.3	4 - 5
M8	1.25	1.0	6.5	±0.58	6.5	±0.58	13	0 -0.7	15.0	12.0	8.6	9 - 13
M10	1.5	1.25	8	±0.58	8	±0.58	17	0 -0.7	19.6	14.4	17.6	18 - 24
M12	1.75	1.25	10	±0.58	10	±0.58	19	0 -0.8	21.9	17.9	27.3	27 - 39
M14	2.0	1.5	11	±0.7	11	±0.7	22	0 -0.8	25.4	19.9	39	40 - 58
M16	2.0	1.5	13	±0.9	12	±1.0	24	0 -0.8	27.7	23.2	52.8	70 - 100
M18	2.5	1.5	15	±0.9	14	±1.0	27	0 -0.8	31.2	26.7	80	100 - 150
M20	2.5	1.5	16	±0.9	15	±1.0	30	0 -0.8	34.6	28.2	105	120 - 200
M22	2.5	1.5	18	±0.9	17	±1.0	32	0 -1	37.0	32.3	130	150 - 250
M24	3.0	2.0	19	±0.9	18	±1.0	36	0 -1	41.6	33.9	180	160 - 300
M27	3.0	2.0	21	±1.0	21	±1.0	41	0 -1	47.3	37.9	246	250 - 390
M30	3.5	2.0	23	±1.0	23	±1.0	46	0 -1	53.1	41.9	375	270 - 440
M33	3.5	2.0	25	±1.0	20	0 -1.5	50	0 -1	57.7	39.4	411	290 - 490
M36	4.0	3.0	28	±1.0	21	0 -1.5	55	0 -1	63.5	41.9	532	340 - 590
M39	4.0	3.0	30	±1.2	23	0 -1.5	60	0 -1.2	69.3	45.7	681	390 - 640
M42	4.5	4.0	33	±1.2	25	0 -1.5	65	0 -1.2	75.0	50.2	892	440 - 690
M45	4.5	4.0	35	±1.2	27	0 -1.5	70	0 -1.2	80.8	54.2	1,115	490 - 740
M48	5.0	4.0	37	±1.2	29	0 -1.5	75	0 -1.2	86.5	58.2	1,393	540 - 780
M52	5.0	4.0	41	±1.2	31	0 -1.5	80	0 -1.2	92.4	63.7	1,708	590 ~ 830
M56	5.5	4.0	44	±1.2	34	0 -1.5	85	0 -1.4	98.1	68.7	2,047	640 ~ 880
M64	6.0	4.0	50	±1.5	38	0 -1.5	95	0 -1.4	110	77.0	2,795	690 ~ 930

External dimensions : JIS B1181(2004) / ISO 4302(Width across flats only)
Screw thread tolerances : JIS B0209(2001) / ISO 965 6H

HARDLOCK NUT DIMENSION TABLE3

HLN-B : BASIC TYPE

INCH THREAD SERIES



Unit : inch

Nominal Size -Threads per inch	Convex nut		Concave nut		Width across flats		e	Overall height	Unit weight	Recommended tightening torque for the concave nut (N-m)
	m		m1		s			ℓ	(g)	
	Max.	Min.	Max.	Min.	Max.	Min.	approx.	approx.	approx.	Min - Max
1/4-20 UNC	0.226	0.212	0.226	0.212	0.438	0.428	0.488	0.390	3.3	4 - 5
5/16-18 UNC	0.273	0.258	0.273	0.258	0.500	0.489	0.557	0.457	7.9	9 - 13
3/8-16 UNC	0.337	0.320	0.337	0.320	0.562	0.551	0.628	0.559	17.6	18 - 24
7/16-14 UNC	0.385	0.365	0.385	0.365	0.688	0.675	0.768	0.638	20.8	27 - 39
1/2-13 UNC	0.448	0.427	0.448	0.427	0.750	0.736	0.840	0.752	28.1	40 - 58
5/8-11 UNC	0.559	0.515	0.559	0.515	0.938	0.922	1.051	0.972	52.8	70 - 100
3/4-10 UNC	0.665	0.597	0.665	0.597	1.125	1.088	1.240	1.165	105	120 - 200
7/8-9 UNC	0.776	0.704	0.776	0.704	1.312	1.269	1.447	1.370	130	150 - 250
1-8 UNC	0.887	0.811	0.887	0.811	1.500	1.450	1.653	1.567	246	200 - 350
1 1/8-7 UNC	0.999	0.919	0.999	0.919	1.688	1.631	1.859	1.776	310	260 - 420
1 1/4-7 UNC	1.094	1.010	0.751	0.667	1.875	1.812	2.066	1.583	324	280 - 470
1 3/8-6 UNC	1.206	1.118	0.815	0.727	2.062	1.994	2.273	1.728	436	320 - 550
1 1/2-6 UNC	1.317	1.225	0.880	0.788	2.250	2.175	2.480	1.843	551	370 - 620
1 3/4-5 UNC	1.540	1.440	1.009	0.909	2.625	2.538	2.893	2.189	896	470 - 720
2-4.5 UNC	1.763	1.655	1.138	1.030	3.000	2.900	3.306	2.433	1,363	570 - 800

Dimensions…ASME/ANSI B18.2.2 1987(R1999)
Thread Requirements…ANSI B1.1a-1968 2B

INSTALLATION PROCEDURE :

1 Use a tightening tool (spanner, torque wrench etc.) to tighten the Convex Nut to the appropriate torque for the application. The Convex Nut has the same Strength Class as a regular hexagon nut and can therefore be tightened to its maximum limit.

2 Install the Concave nut onto the Convex nut by hand until it no longer turns. Prior to tightening of the Concave nut, make sure that there is about 1 thread pitch gap between the nuts. If not, please refrain from using HARDLOCK NUT with the current bolt.
If the space is narrower than that of 1 thread pitch, the nut would be unable to demonstrate sufficient locking effect. The same conditions apply to reuse.

3 Use a torque wrench to tighten the Concave nut to the recommended torque shown in this catalog.

4 Even after tightening the nuts correctly, there is a chance that there is a small gap between the nuts due to the tolerance of bolt diameter. However, even with or without a space, if tightened correctly as instructed in this installation procedure, the HARDLOCK NUT will produce sufficient locking effect.

CASE EXAMPLE OF IMPROVEMENT

Railway〈Cars〉

Before

- In high speed rail cars, repeated impact of the rail coupling causes the nut to loosen and may even risk detachment.
- Damage to the friction ring also causes the nut to loosen.

After

- By using the HARDLOCK Nut, even under repeated impact, loosening is prevented and detachment has not occurred.
- Breakage of the friction ring is eliminated by using the HARDLOCK Nut and has been adopted by many rail car manufacturers.

Construction Equipment <Hydraulic Breaker>

Before

- Hydraulic breakers used at large mines and quarries used double nuts fastened with high torque. Severe vibration caused loosening on a daily basis.

After

- HARDLOCK Nut was used to overcome nut loosening at the appropriate tightening torque.
- The HARDLOCK Nut works with standard thread froms, and therefore no bolt specification changes were needed so the HARDLOCK Nut could be implemented quickly.

Railway <Turnout>

Before

- When a train passes, a force as large as 500G is applied to the switch, and even specially shaped double nuts used on the movable parts can become loose on a daily basis.
- While the switch (movable part) is essential to maintain the track gauge, it is extremely difficult to maintain the gauge of the track while preventing loosening.

After

- By using the HARDLOCK Nut, the maintenance cost associated with inspection and re-tightening was successfully reduced.
- The HARDLOCK Nut successfully maintained the gauge of the track and prevents loosening simultaneously. As a result, the Hardlock Nut has been adopted by all railway companies in Japan

Wind Power <Tower>

Before

- Wind turbine towers stand in areas of strong wind, due to irregular stresses caused by strong wind load, double nuts and spring washers are frequently used to prevent loosening.
- Nylon nuts are used to fasten the cable rack wiring inside the tower and the ends of the ladder, but loosening still occured, due to the micro vibrations caused by the blade rotation.

After

- By using the HARDLOCK Nut, the correct torque and bolt load could be managed at each of the fastening points.
- As a result, the frequency of routine maintenance was extended and the costs were significantly reduced.

Electrical Equipment <Switchboard Terminal Fastener>

Before

- Steps to prevent loosening had been used including double nuts and the use of spring washers but vibrations during transportation and micro vibrations that occur after installation had resulted in frequent loosening.

After

- After switching to the HARDLOCK Nut, all problems related to loosening were completely solved.
- Because loosening does not occur, both the number of inspections and re-tightening work has been significantly reduced resulting in labor savings.

GENERAL TIGHTENING TORQUE FOR HEXAGON NUT

Size	Pitch	Stress Area	Strength Class			Clamp load	Tightening torque			Clamp load	Tightening torque			Clamp load	Tightening torque		
			Bolt		Nut												
				YP		YP×0.7	K=0.15	K=0.2	K=0.25	YP×0.8	K=0.15	K=0.2	K=0.25	YP×0.9	K=0.15	K=0.2	K=0.25
mm	mm	mm²		N/mm²		kN	N·m			kN	N·m			kN	N·m		
M6	1.0	20	8.8	640	Class8	9	8	11	14	10	9	12	15	12	10	14	17
			10.9	900	Class10	13	11	15	19	15	13	17	22	16	15	20	24
M8	1.25	37	8.8	640	Class8	16	20	26	33	19	22	30	37	21	25	34	42
			10.9	900	Class10	23	28	37	46	26	32	42	53	30	36	47	59
M10	1.5	58	8.8	640	Class8	26	39	52	65	30	45	59	74	33	50	67	84
			10.9	900	Class10	37	55	73	91	42	63	84	105	47	70	94	117
M12	1.75	84	8.8	640	Class8	38	68	91	113	43	78	104	130	49	87	117	146
			10.9	900	Class10	53	96	127	159	61	109	146	182	68	123	164	205
M14	2.0	115	8.8	640	Class8	52	108	144	180	59	124	165	206	66	139	185	232
			10.9	900	Class10	73	152	203	254	83	174	232	290	93	196	261	326
M16	2.0	157	8.8	640	Class8	70	169	225	281	80	193	257	322	90	217	289	362
			10.9	900	Class10	99	237	316	396	113	271	362	452	127	305	407	509
M18	2.5	192	8.8	640	Class8	86	232	310	387	98	265	354	442	111	299	398	498
			10.9	900	Class10	121	327	436	545	138	373	498	622	156	420	560	700
M20	2.5	245	8.8	640	Class8	110	329	439	549	125	376	502	627	141	423	564	706
			10.9	900	Class10	154	463	618	772	176	529	706	882	198	595	794	992
M22	2.5	303	8.8	640	Class8	136	448	597	746	155	512	682	853	175	576	768	960
			10.9	900	Class10	191	630	840	1,050	218	720	960	1,200	245	810	1,080	1,350
M24	3.0	353	8.8	640	Class8	158	569	759	949	181	651	867	1,084	203	732	976	1,220
			10.9	900	Class10	222	801	1,068	1,334	254	915	1,220	1,525	286	1,029	1,372	1,716
M27	3.0	459	8.8	640	Class8	206	833	1,110	1,388	235	952	1,269	1,586	264	1,071	1,428	1,785
			10.9	900	Class10	289	1,171	1,562	1,952	331	1,339	1,785	2,231	372	1,506	2,008	2,510
M30	3.5	561	8.8	640	Class8	251	1,131	1,508	1,885	287	1,292	1,723	2,154	323	1,454	1,939	2,424
			10.9	900	Class10	353	1,590	2,120	2,651	404	1,818	2,423	3,029	454	2,045	2,726	3,408
M33	3.5	694	8.8	640	Class8	311	1,539	2,052	2,565	355	1,759	2,345	2,931	400	1,979	2,638	3,298
			10.9	900	Class10	437	2,164	2,886	3,607	500	2,474	3,298	4,123	562	2,783	3,710	4,638
M36	4.0	817	8.8	640	Class8	366	1,976	2,635	3,294	418	2,259	3,012	3,765	471	2,541	3,388	4,235
			10.9	900	Class10	515	2,779	3,706	4,632	588	3,176	4,235	5,294	662	3,574	4,765	5,956
M39	4.0	976	8.8	640	Class8	437	2,558	3,410	4,263	500	2,923	3,898	4,872	562	3,289	4,385	5,481
			10.9	900	Class10	615	3,597	4,796	5,995	703	4,111	5,481	6,851	791	4,625	6,166	7,708
M42	4.5	1,120	8.8	640	Class8	502	3,161	4,215	5,269	573	3,612	4,817	6,021	645	4,064	5,419	6,774
			10.9	900	Class10	706	4,445	5,927	7,409	806	5,080	6,774	8,467	907	5,715	7,620	9,526
M45	4.5	1,310	8.8	640	Class8	587	3,962	5,282	6,603	671	4,527	6,036	7,545	755	5,093	6,791	8,489
			10.9	900	Class10	825	5,571	7,428	9,285	943	6,367	8,489	10,611	1,061	7,162	9,550	11,937
M48	5.0	1,470	8.8	640	Class8	659	4,742	6,323	7,903	753	5,419	7,225	9,031	847	6,096	8,129	10,161
			10.9	900	Class10	926	6,668	8,891	11,113	1,058	7,620	10,161	12,701	1,191	8,573	11,431	14,288
M52	5.0	1,760	8.8	640	Class8	789	6,150	8,200	10,251	901	7,029	9,371	11,714	1,014	7,907	10,543	13,179
			10.9	900	Class10	1,109	8,649	11,532	14,414	1,267	9,884	13,179	16,474	1,426	11,120	14,826	18,533
M56	5.5	2,030	8.8	640	Class8	909	7,639	10,185	12,732	1,039	8,731	11,641	14,552	1,169	9,822	13,096	16,370
			10.9	900	Class10	1,279	10,743	14,324	17,905	1,462	12,277	16,370	20,462	1,644	13,812	18,416	23,020
M64	6.0	2,680	8.8	640	Class8	1,201	11,526	15,368	19,210	1,372	13,173	17,564	21,955	1,544	14,819	19,759	24,699
			10.9	900	Class10	1,688	16,209	21,612	27,014	1,930	18,524	24,699	30,874	2,171	20,840	27,786	34,733

YP : Yield Point K : Torque coefficient

The tensile strength of HARDLOCK Convex nuts are completely the same as regular hexagon nuts.
Therefore,the above tightening torque value can be used when tightening the Convex nut.

HARDLOCK Industry Co., Ltd.

1-6-24, Kawamata, Higashi Osaka, Osaka, Japan 577-0063
TEL : +81-6-6784-1131
FAX : +81-6-6784-1161
https://www.hardlock.co.jp/en/
Email : h.office@hardlock.co.jp