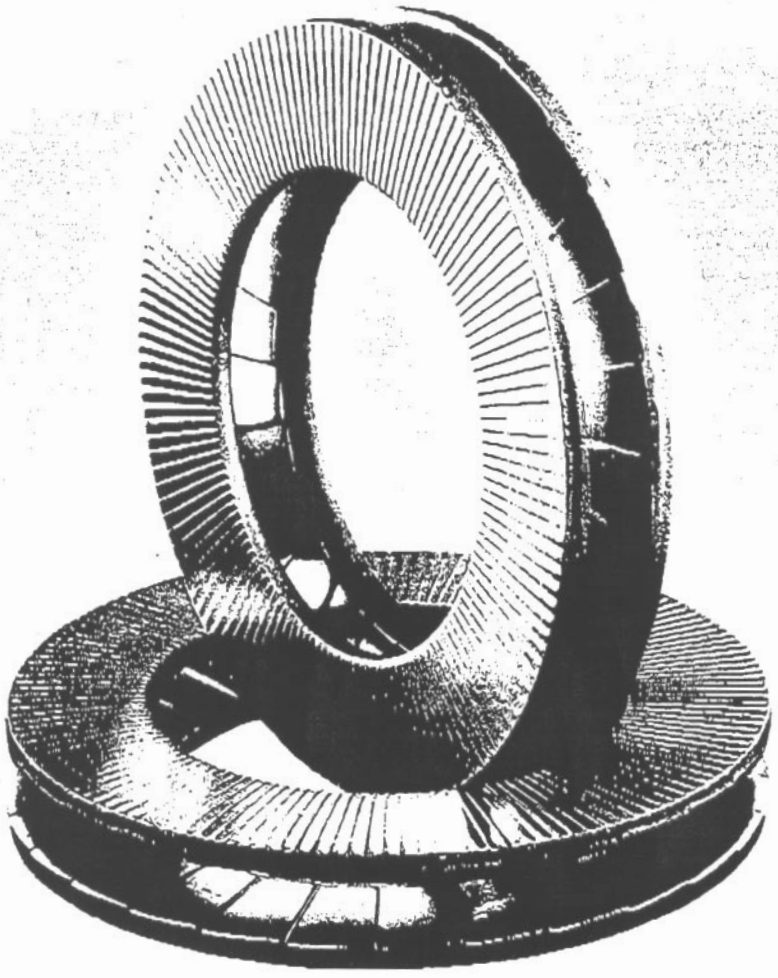
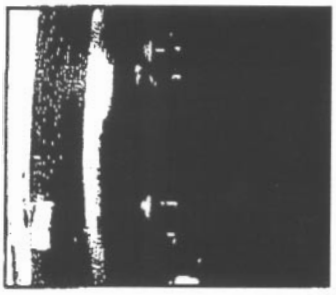
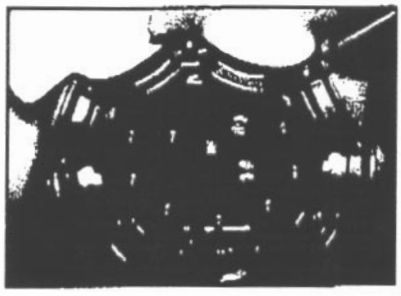
NORD-LOCK®

Bolt securing system



This unique bolt securing system uses tension to make the bolt self-locking





Nord-Lock® Dimensions

STAINLESS STEEL SS 2343 (corresponding to EN 1.4436, AISI 316)

Washer size	Bolt size Metric	Bolt size UNC	$Ø_i$ (mm)	$Ø_o$ (mm)	Thickness T (mm)	Min. package pairs	Weight, kg per 100 pairs
NL3 ss	M3	#5	3,4	7,0	2,2	200	0,04
NL3.5 ss	M3.5	#6	3,9	7,6	2,2	200	0,04
NL4 ss	M4	#8	4,4	7,6	2,2	200	0,04
NL5 ss	M5	#10	5,4	9,0	2,2	200	0,06
NL6 ss	M6		6,5	10,8	2,2	200	0,09
NL6 sp ss	M6		6,5	13,5	2,2	200	0,16
NL1/4" ss		1/4"	7,2	11,5	2,2	200*	0,09
NL1/4" sp ss		1/4"	7,2	13,5	2,2	200*	0,15
NL8 ss	M8	5/16"	8,7	13,5	2,2	200	0,12
NL8 sp ss	M8	5/16"	8,7	16,6	2,2	200	0,23
NL3/8" ss		3/8"	10,3	16,0	2,2	200*	0,17
NL3/8" sp ss		3/8"	10,3	21,0	2,2	200*	0,39
NL10 ss	M10		10,7	16,0	2,2	200	0,16
NL10 sp ss	M10		10,7	21,0	2,2	200	0,38
NL11 ss	M11	7/16"	11,4	18,5	2,2	200	0,25
NL12 ss	M12		13,0	19,5	2,2	200	0,24
NL12 sp ss	M12		13,0	25,4	3,2	100	0,85
NL1/2" ss		1/2"	13,5	19,5	2,2	200*	0,35
NL1/2" sp ss		1/2"	13,5	25,4	3,2	100*	0,83
NL14 ss	M14	9/16"	15,2	23,0	3,2	100	0,53
NL14 sp ss	M14	9/16"	15,2	30,7	3,2	100	1,39
NL16 ss	M16	5/8"	17,0	25,4	3,2	100	0,63
NL16 sp ss	M16	5/8"	17,0	30,7	3,2	100	1,17
NL18 ss	M18		19,5	29,0	3,2	100	0,82
NL3/4" ss		3/4"	20,0	30,7	3,2	100*	0,96
NL3/4" sp ss		3/4"	20,0	39,0	3,2	100*	2,00
NL20 ss	M20		21,4	30,7	3,2	100	0,89
NL20 sp ss	M20		21,4	39,0	3,2	100	1,97
NL22 ss	M22	7/8"	23,4	34,5	3,2	100	1,20
NL22 sp ss	M22	7/8"	23,4	42,0	3,2	50	2,26
NL24 ss	M24		25,3	39,0	3,2	100	1,65
NL24 sp ss	M24		25,3	48,5	3,2	50	3,79
NL1" ss		1"	27,9	39,0	3,2	100*	1,39
NL1" sp ss		1"	27,9	48,5	3,2	50*	2,93
NL27 ss	M27		28,4	42,0	6,8	50	3,39
NL27 sp ss	M27		28,4	48,5	6,8	25	5,52
NL30 ss	M30	1 1/8"	31,4	47,0	6,8	50	4,34
NL33 ss	M33	1 1/4"	34,4	48,5	6,8	25	4,13
NL36 ss	M36	1 3/8"	37,4	55,0	6,8	25	5,78
NL39 ss	M39	1 1/2"	40,4	58,5	6,8	25	6,37
NL42 ss	M42		43,2	63,0	6,8	25	7,50
NL45 ss	M45	1 3/4"	46,2	70,0	9,0	*	15,0
NL48 ss	M48		49,6	75,0	9,0	*	17,2
NL52 ss	M52	2"	53,6	80,0	9,0	*	19,2
NL56 ss	M56	2 1/4"	59,1	85,0	9,0	*	20,1
NL60 ss	M60		63,1	90,0	9,0	*	22,2
NL64 ss	M64	2 1/2"	67,1	95,0	9,0	*	24,4
NL68 ss	M68		71,1	100,0	9,0	*	27,2
NL72 ss	M72		75,1	105,0	9,0	*	29,7
NL76 ss	M76	3"	79,1	110,0	9,0	*	32,2
NL80 ss	M80		83,1	115,0	9,0	*	34,8

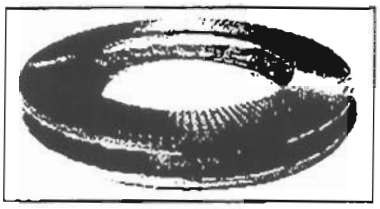
Nord-Lock® washers come as pre-assembled pairs.

* After inquiry

NORD-LOCK®
Bolt securing system

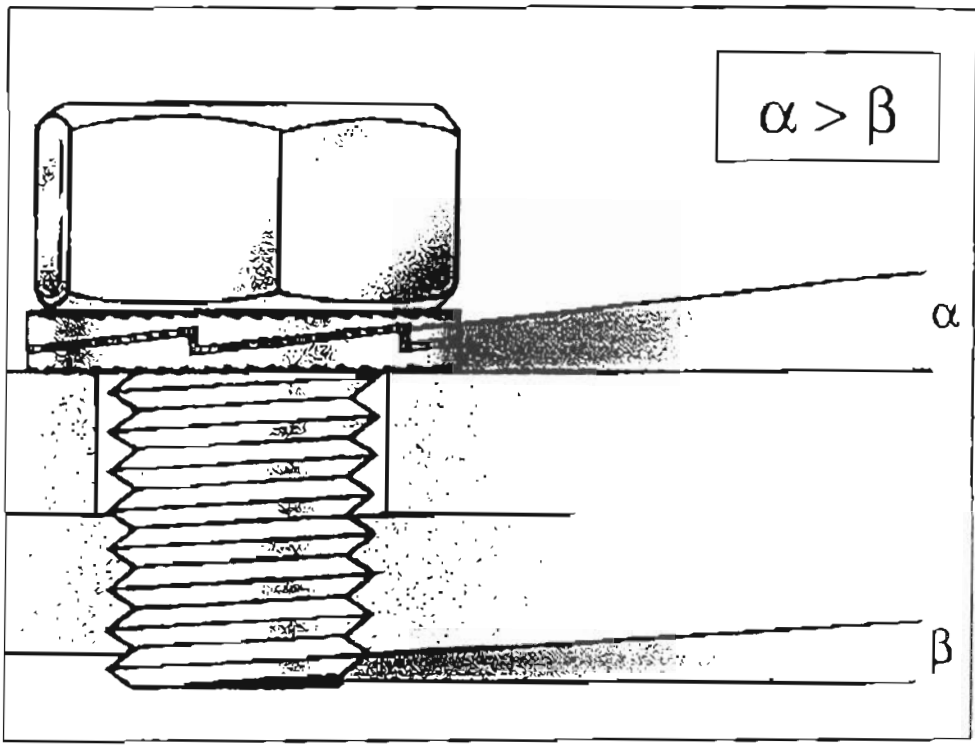
www.nord-lock.com

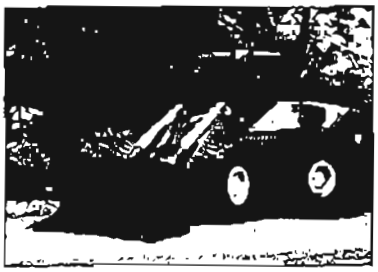
The small details provide the best locking effect



Nord-Lock® has cams on one side with a greater rise than the pitch of the bolt. In addition, Nord-Lock® has radial teeth on the opposite side. The washers are installed in pairs, cam face to cam face.

Nord-Lock® is a pair of washers with a wedge-locking action meeting DIN 25 201 which is a unique method using tension instead of friction. The rise of the cams between the two Nord-Lock® washers is greater than the pitch of the bolt. In addition, there are radial teeth on the opposite side. When the bolt and/or nut is tightened, the teeth grip and seat the mating surfaces.
The Nord-Lock® washer is locked in place, allowing movement only across the face of the cams. The tension created makes the bolt/nut self-locking so it cannot move.





Where are they used?

- Construction equipment
- Automotive industry
- Agriculture equipment
- Off-road
- Manufacturing equipment
- Mining
- Oil industry
- Railroad equipment
- Trucking industry
- Utilities
- Power plants
- Process industries

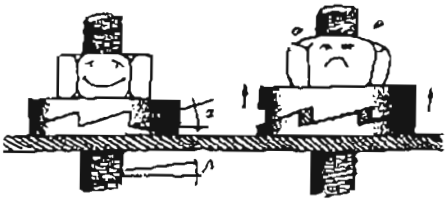
Security test

A quick test of the locking function is to tighten and loosen the fastener. When un-tightening, the cam overriding "click" effect must occur. **The locking effect can never be judged by measuring the break-away-torque** since the friction is lower between the cam faces. The break-away torque is less than the tightening torque.

Temperatures

The Nord-Lock® washers have the same temperature characteristics as the bolts and nuts of corresponding material quality.
Steel starts to degrade at temperatures over 200°C and stainless steel starts to degrade at temperatures over 500°C as do the nuts/bolts.

The key is the difference in angles. Here you see what happens when a nut attempts to loosen. The pair of washers expand more than the corresponding pitch of the thread. Nord-Lock® washers positively lock the fastener in a joint which is subjected to any vibration or dynamic loads.



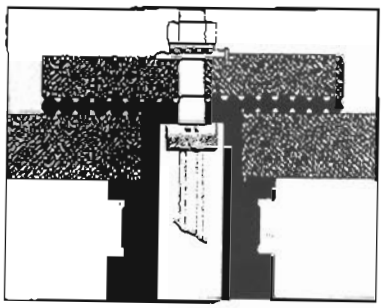
Nord-Lock® maintains the bolt tension with the highest possible safety

Junker vibration test

One method for testing the security of a bolted joint is the Junker-vibration test. The preload (bolt tension) is measured by a load cell and vibrating motions are generated radially through the bolt.

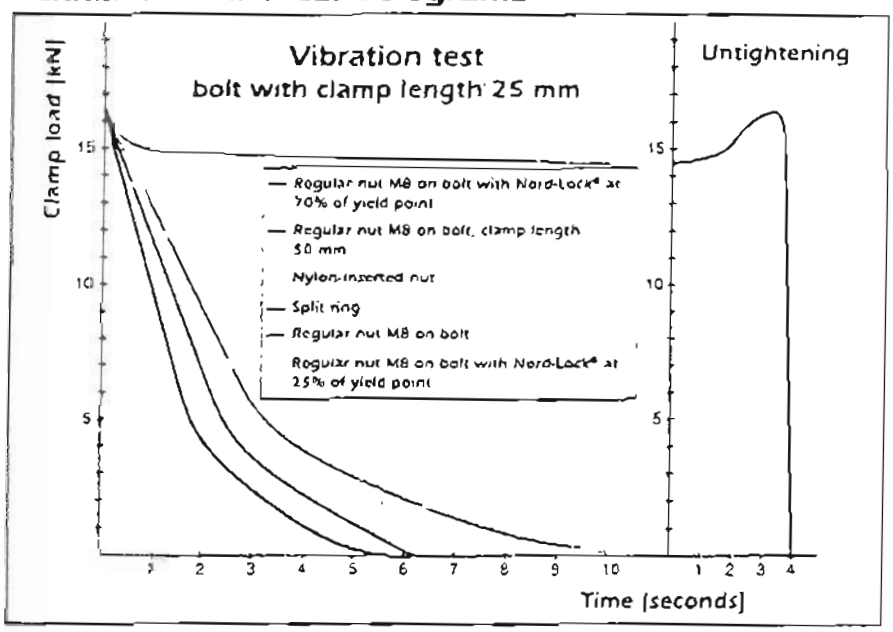
Nord-Lock® together with a standard nut achieves a locking that is superior to other locking hardware e.g. nylon-inserted nuts. Bolts that are locked by friction in the thread lose most of their preload through vibrations while those locked with Nord-Lock® present a minor loss of preload which is caused mainly by settlement in the thread.

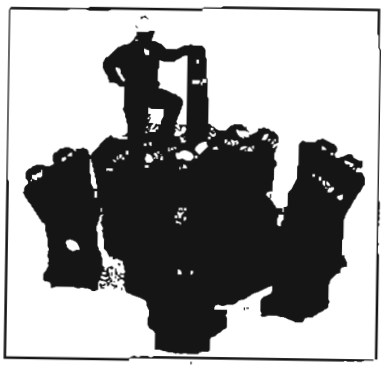
Even after moderate tightening the bolt is safely locked when using Nord-Lock®. Recommended torque figures (see page 7) are based on tests in our own laboratory with calibrated torque transmitters and load cells.

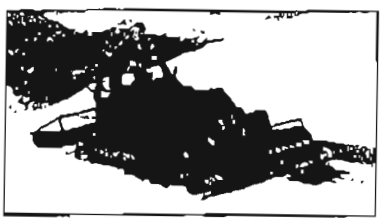


Amplitude:	±0,3 mm
Frequency:	40 Hz
Standard clamp length:	25 mm
Hardness of mating material.	HRA 63–65

Junker vibration test diagrams

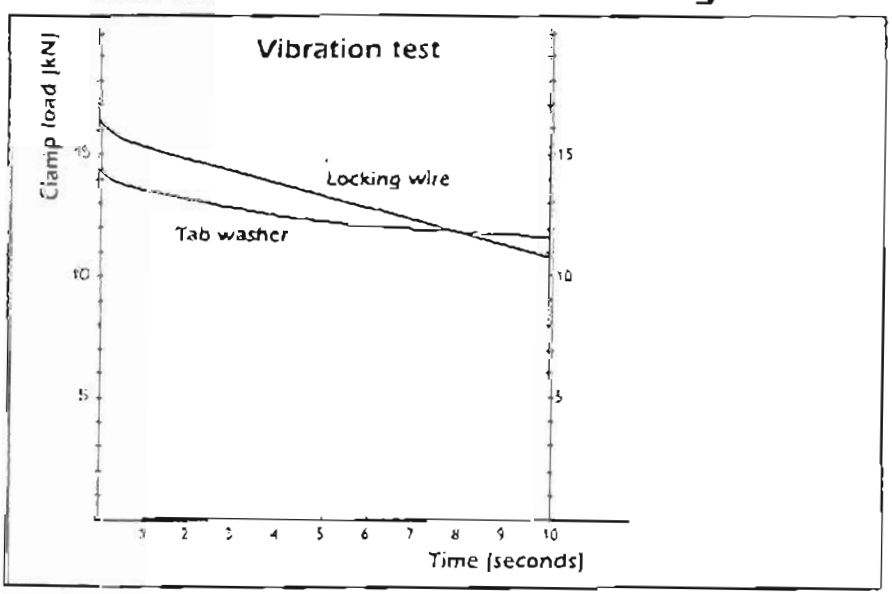






The Nord-Lock® washers have been used in various industries for many years with excellent results

Vibration test with tab washer and locking wire



Locking wire

Tab washer

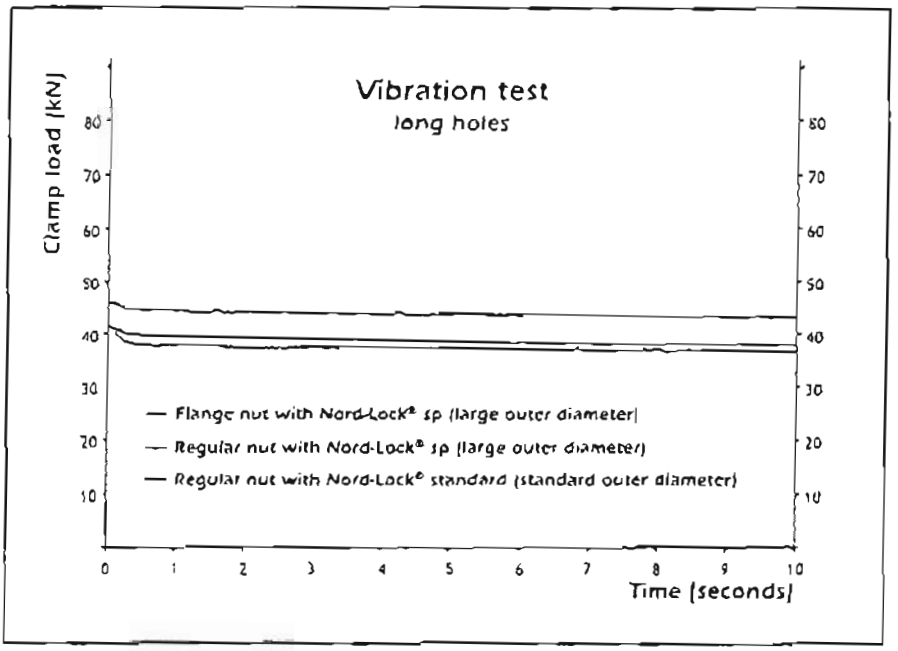
Examples of Nord-Lock® used in combination with long holes
From top picture:
- Flange nut with NL sp (large outer diameter)
- Regular nut with NL sp (large outer diameter)
- Regular nut with NL standard (regular outer diameter)

Long holes and softer materials

In order to cover as much surface as possible it is recommended to use flanged nuts and bolts in combination with Nord-Lock® washers with a large outer diameter.

Normally a standard bolt and standard Nord-Lock® washer will work, however, it is recommended to make a tightening test to determine the depths of the impressions around the hole area.

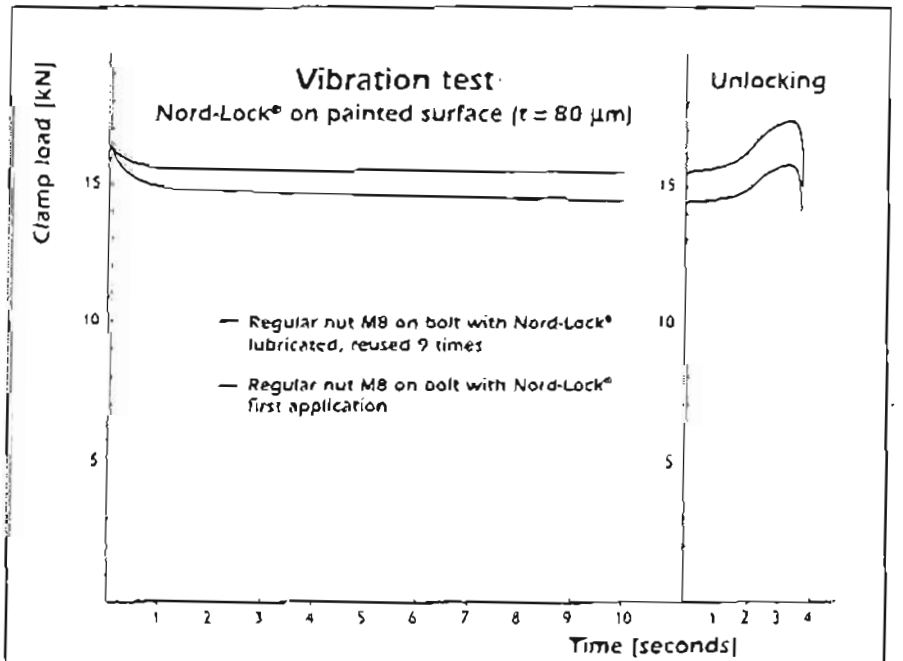
Vibration test with long holes



Painted surfaces

When tightening towards a painted surface sliding may occur towards the paint if there is a thick and soft layer of paint. If the paint is hard, sliding will occur between the upper washer and bolt head/nut. In both cases there will be a positive locking effect since sliding in off-torque direction will be on the cam faces of the washers where the friction is lower than on the serrated surfaces.

Vibration test with lubricated bolt and painted surface

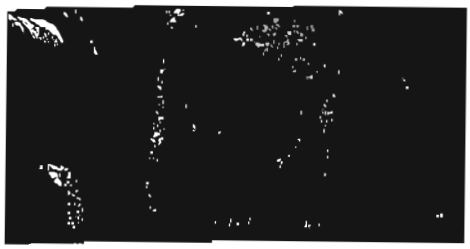


Painted surface after use of Nord-Lock® with large outer diameter.

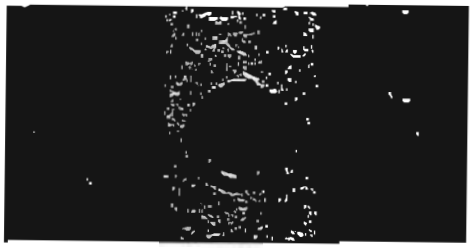
Painted surface after use of Nord-Lock® with standard diameter.

Corrosion resistance

Corrosion test according to SS-ISO 9227



Electro zinc yellow chromate after 144 hours



Dacromet® after 400 hours

Reusability

Since sliding always occurs between the Nord-Lock® washers and the head of the bolt/nut when tightening, and between the cam faces of the washers when untightening, the friction will not increase under the nut/bolt as with other serrated fasteners.

In combination with 8.8 bolt/nut Nord-Lock® can be reused up to 5 times if the washers are lubricated before re-assembly. On high-grade and stainless steel, bolt/nut reuse is not recommended.

Laboratory tests

Test report no. 375-1300-91 carried out by the German TÜV confirms that after two million cycles the tension is maintained. An inspection of the washers showed that Nord-Lock® could be used safely.

The Nord-Lock® manufacturer will support you in most cases as far as torque/load ratios and security tests during severe vibration in their simulators.

Please contact your local Nord-Lock® agent for consultations, you can find them at www.nord-lock.com.

Hardness

Materials	Range	Electro zinc ISO2081 (ISO/FDIS/ZnBC2C)	Dacromet	Non-coated
Standard steel	NL3–NL42	HRA 75 ±4%	HRA 73 ±4%	
(through hardened)	NL45–NL130	HRA 72 ±4%		
Stainless steel (A4)	NL3 ss–NL80 ss			HV0,05 > 520

Stainless steel specifications of A4

Norm	C ≤ %	Si ≤ %	Mn ≤ %	P ≤ %	S ≤ %	Cr %	Mo %	Ni %
SS 2343	0,05	1,00	2,00	0,045	0,030	16,0 – 18,5	2,50 – 3,00	10,5 – 14,0
EN 1.4436	0,07	1,00	2,00	0,045	0,025	16,5 – 18,5	2,50 – 3,00	11,0 – 14,0
AISI 316	0,08	1,00	2,00	0,045	0,025	16,0 – 18,0	2,00 – 3,00	10,0 – 14,0

Nord-Lock® washers are made of stainless steel SS 2343

Pre-assembled

Nord-Lock® washers are available as pre-assembled pairs. A standard hot melt glue (NATIONAL 281E) is used between the Nord-Lock® washers.

Torque – Friction – Load

Of course a bolt will give different tensions due to surface conditions, though the applied torque is the same.

Available in

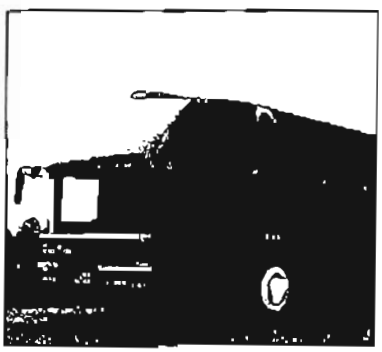
- Yellow zinc chromate (standard)
- Dacromet® coated
- Stainless steel SS 2343 (=AISI 316)
- Large and small outside diameter
- Pre-assembled

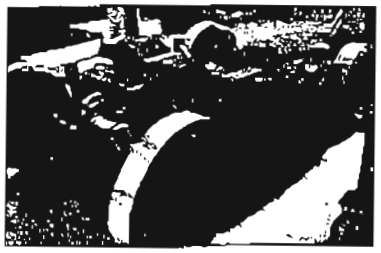
Available in a variety of sizes

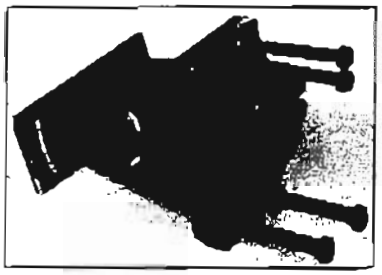
Steel: M3–M130, #5–5"
Stainless steel: M3–M80, #5–3 1/8"

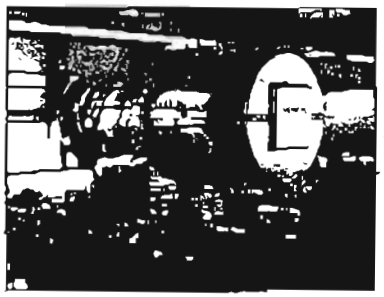
Dimension list

For a current dimension list, please visit **www.nord-lock.com.**



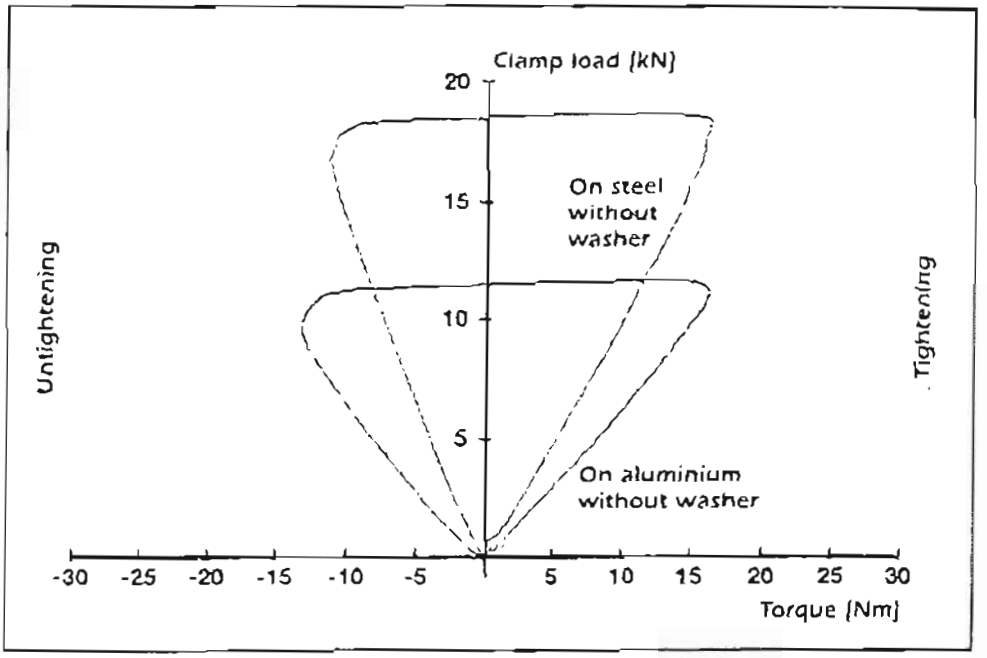






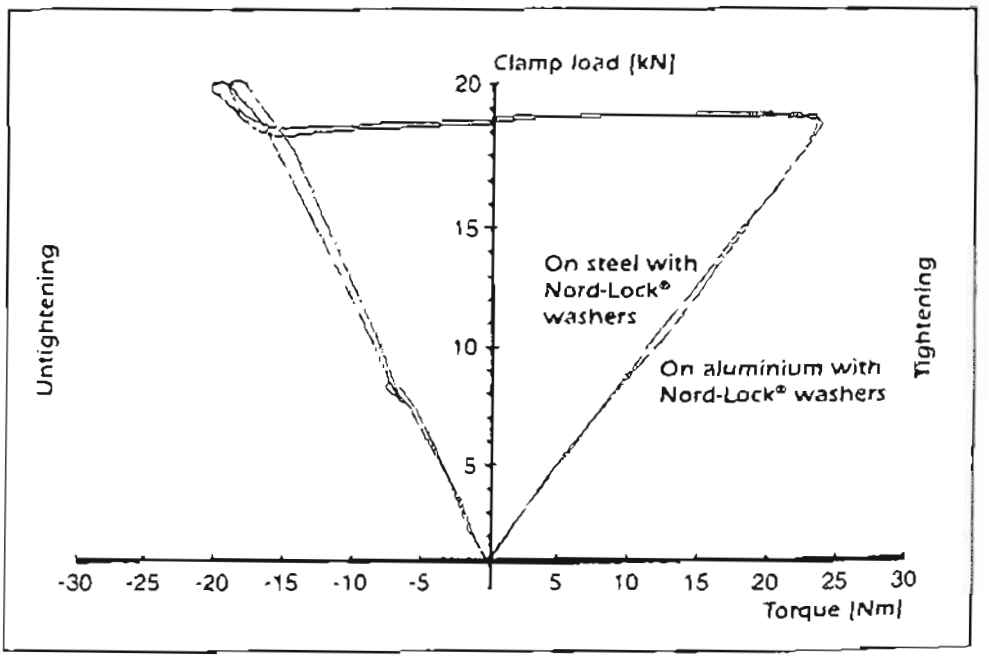
Torque – load diagrams

When using Nord-Lock® there is a great advantage by always tightening towards the same surface with the same hardness and coating. The deviation in clamping force will be minimized.



Regular nut M8 on steel

Regular nut M8 on aluminium



Regular nut M8 with Nord-Lock® on steel

Regular nut M8 with Nord-Lock® on aluminium

Dimensions

For a current dimensions list, please go to www.nord-lock.com

Recommended torque values

Nord-Lock® electro zinc plated/Dacromet® with electro zinc plated bolt 8.8

Washer size	Bolt size	Pitch (mm)	Oil on surface μ_g=0,12 G_f=0,75		MoS2 on surface μ_g=0,11 G_f=0,75		Dry surface μ_g=0,15 G_f=0,62	
			Torque (Nm)	Clamp load (kN)	Torque (Nm)	Clamp load (kN)	Torque (Nm)	Clamp load (kN)
NL3	M3	0,5	1,3	2,4	1,2	2,4	1,3	2,0
NL4	M4	0,7	3,0	4,2	2,7	4,2	3,0	3,5
NL5	M5	0,8	5,9	6,8	5,3	6,8	5,8	5,6
NL6	M6	1,0	10,3	9,6	9,3	9,6	10,2	8,0
NL8	M8	1,3	25	17,6	22	17,6	24,5	14,5
NL10	M10	1,5	47	28	42	28	46,6	23
NL12	M12	1,8	84	40	75	40	82,9	33
NL14	M14	2,0	133	55	119	55	131,8	46
NL16	M16	2,0	204	75	183	75	202,5	62
NL18	M18	2,5	284	92	255	92	282,0	76
NL20	M20	2,5	399	118	357	118	396,4	97
NL22	M22	3,0	554	145	497	145	549,5	120
NL24	M24	3,0	687	169	616	169	683,2	140
NL27	M27	3,0	1000	220	896	220	997,2	182
NL30	M30	3,5	1360	269	1220	269	1361	223
NL33	M33	3,5	1830	333	1640	333	1834	275
NL36	M36	4,0	2360	392	2110	392	2364	324
NL39	M39	4,0	3040	468	2720	468	3053	387
NL 42	M42	4,5	3837	546	3428	546	3803	451

Nord-Lock® electro zinc plated with non-plated bolt 10.9

Washer size	Bolt size	Pitch (mm)	Oil μ_g=0,14 G_f=0,71		MoS2 μ_g=0,14 G_f=0,75	
			Torque (Nm)	Clamp load (kN)	Torque (Nm)	Clamp load (kN)
NL3	M3	0,5	1,7	3,2	1,7	3,4
NL4	M4	0,7	3,8	5,6	3,9	5,9
NL5	M5	0,8	7,5	9,1	7,6	9,6
NL6	M6	1,0	13,0	12,8	13,2	13,6
NL8	M8	1,3	31	23	32	25
NL10	M10	1,5	59	37	60	39
NL12	M12	1,8	106	54	108	57
NL14	M14	2,0	169	73	172	78
NL16	M16	2,0	259	100	263	106
NL18	M18	2,5	361	123	367	130
NL20	M20	2,5	506	157	515	165
NL22	M22	3,0	703	194	715	205
NL24	M24	3,0	873	226	888	238
NL27	M27	3,0	1270	293	1290	310
NL30	M30	3,5	1730	358	1750	379
NL33	M33	3,5	2330	443	2360	468
NL36	M36	4,0	3000	522	3050	551
NL39	M39	4,0	3870	624	3930	659
NL 42	M42	4,5	4871	727	4946	767

Nord-Lock® electro zinc plated with non-plated bolt 12.9

Washer size	Bolt size	Pitch (mm)	Oil μ_g=0,14 G_f=0,71		MoS2 μ_g=0,15 G_f=0,75	
			Torque (Nm)	Clamp load (kN)	Torque (Nm)	Clamp load (kN)
NL3	M3	0,5	1,9	3,9	2,0	4,1
NL4	M4	0,7	4,4	6,7	4,6	7,1
NL5	M5	0,8	8,7	10,9	9,1	11,5
NL6	M6	1,0	15,1	15,4	15,8	16,3
NL8	M8	1,3	36	28	38	30
NL10	M10	1,5	68	44	71	47
NL12	M12	1,8	123	65	129	68
NL14	M14	2,0	195	88	205	93
NL16	M16	2,0	299	120	314	127
NL18	M18	2,5	417	147	438	156
NL20	M20	2,5	585	188	614	198
NL22	M22	3,0	812	232	853	245
NL24	M24	3,0	1010	271	1060	286
NL27	M27	3,0	1470	352	1540	372
NL30	M30	3,5	1990	430	2090	454
NL33	M33	3,5	2690	532	2820	562
NL36	M36	4,0	3470	626	3640	662
NL39	M39	4,0	4470	748	4690	791
NL 42	M42	4,5	5620	872	5905	821

Nord-Lock® stainless steel with stainless steel bolt

Washer size	Bolt size	Pitch (mm)	A4-70 MoS2 μ_g=0,14 G_f=0,65		A4-80 MoS2 μ_g=0,14 G_f=0,65	
			Torque (Nm)	Clamp load (kN)	Torque (Nm)	Clamp load (kN)
NL3	M3	0,5	0,8	1,5	1,0	2,0
NL4	M4	0,7	1,8	2,6	2,4	3,4
NL5	M5	0,8	3,6	4,2	4,8	5,5
NL6	M6	1,0	6,2	5,9	8,3	7,8
NL8	M8	1,3	14,9	10,7	19,8	14,3
NL10	M10	1,5	28	17	38	23
NL12	M12	1,8	50	25	67	33
NL14	M14	2,0	80	34	107	45
NL16	M16	2,0	123	46	164	61
NL18	M18	2,5	171	56	229	75
NL20	M20	2,5	241	72	321	96
NL22	M22	3,0	334	89	445	118
NL24	M24	3,0	415	103	553	138
NL27	M27	3,0	604	134	805	179
NL30	M30	3,5	820	164	1090	219
NL33	M33	3,5	1100	203	1470	271
NL36	M36	4,0	1430	239	1900	319
NL39	M39	4,0	1840	285	2450	381
NL 42	M42	4,5	2316	333	3089	443

μ_g=thread friction

G_f=ratio of yield point

1ft=0,3048 m

1lb=0,4536kg=4,450 N

1ftlb=0,3048x0,4536x9,81=1,356 Nm

Calculation of load area

The load area [mm²] under the washer must be larger than the clamp load [N] divided by the yield point [N/mm²] of the material.

$$\text{Load area [mm}^2\text{]} > \frac{\text{Clamp load [N]}}{\text{Yield point [N/mm}^2\text{]}}$$

Reuse

Always lubricate all fasteners before reusing! When reusing fasteners friction is always higher.

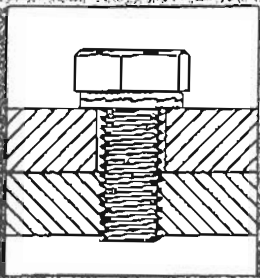
Design

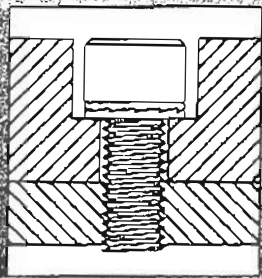
You can be aided in your design application by checking out the CAD library at **www.web2cad.de**

Nord-Lock® washers

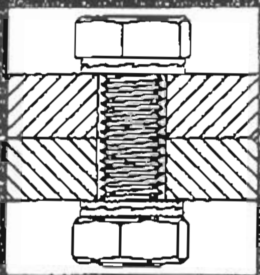
Nord-Lock® washers can be used on standard grade as well as high grade bolts.

Assembly examples

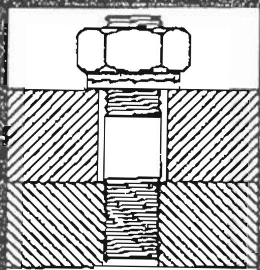




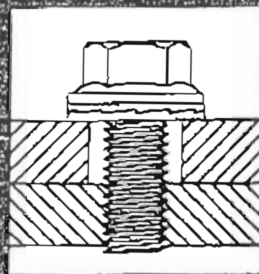
[illegible]



[illegible] the bolt [illegible] when tightening the nut.



[illegible] Nord-Lock® secures the joint.



[illegible] combination [illegible] Nord-Lock® [illegible] washers with larger outer diameter.

Advantages

- Resists loosening caused by vibration and dynamic loads
- Ease of assembly and disassembly
- Locking function is not lost by lubrication
- Positive locking at low or high preload levels
- Same temperature characteristics as standard bolt/nut
- Minimum surface marring or scratching
- Reusable
- Achieves maximum safety when locking fasteners

NORD-LOCK®

Bolt securing system