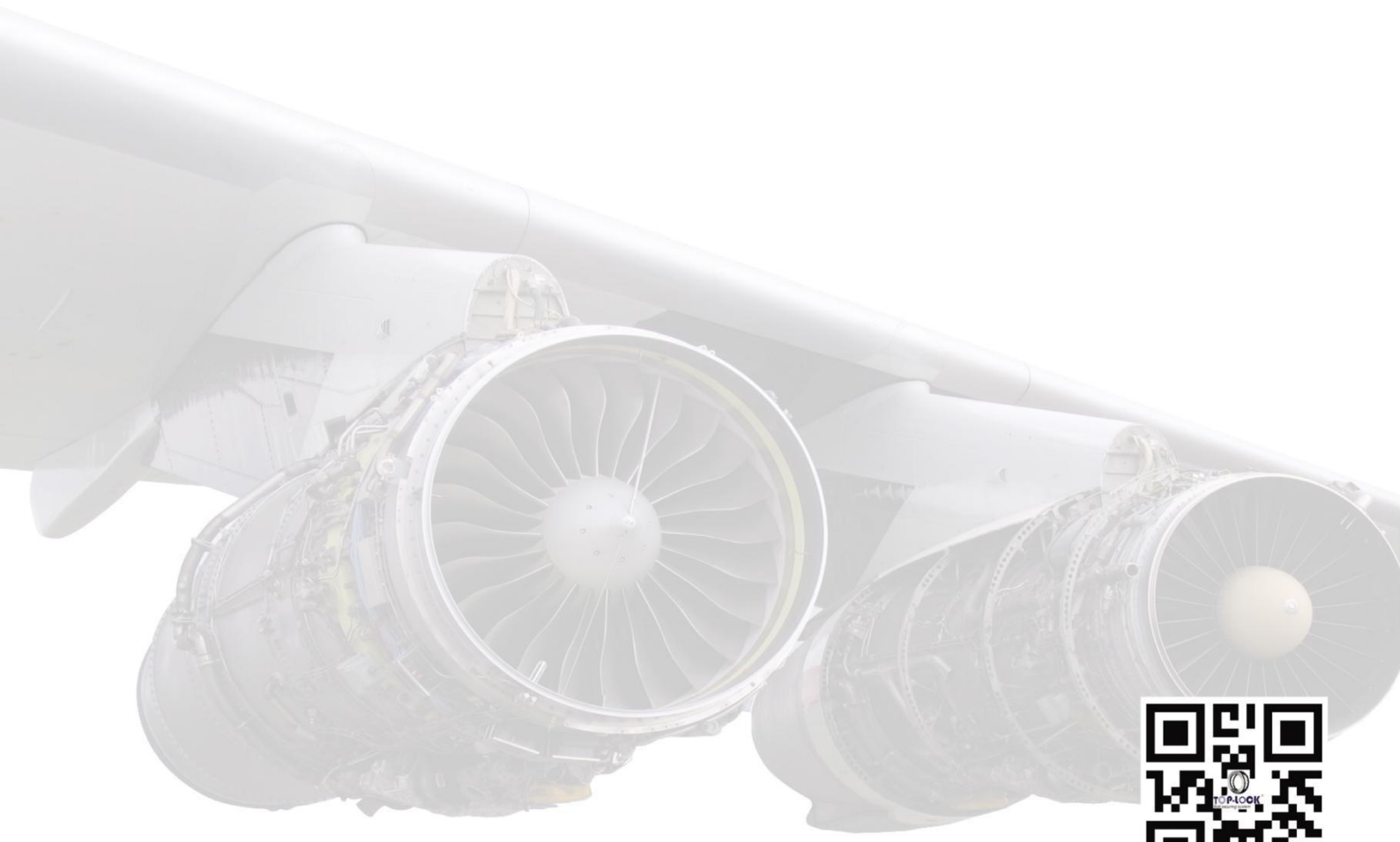
SANKE

TOP-LOCK®

Bolt securing system

The true expert to solve the problem of fasteners loose



WWW.TOPLOCK.ORG

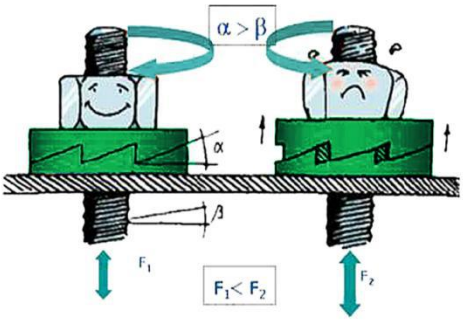
TOP-LOCK®
Bolt securing system

To ensure the integrity of fastener thread systems, SanKe TOP - LOCK® security system of SanKe TOP - LOCK® works by using tension rather than friction,which has been the basis for most traditional fastening methods. This ensures the securing of threaded systems.

SanKe TOP - LOCK®security system consists of two identical flat washers which have a set of cams on one side and a radial knurling on the other side.

Product working principle

The angle of inclination α of the washer cam is bigger than the pitch β of the screw thread. When the fastener is tightened, the knurled surfaces grip both the bearing surface of the fastener and the material into which the screw is being fastened. The larger angle of the cam α, compared to the smaller angle of the screw thread β, will not allow the screw to loosen because of the tension caused by the cam lifting.

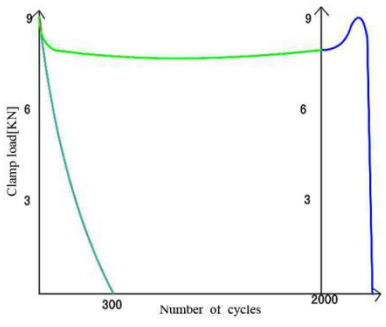


Advantages

Thanks to its own know-how and the lab tests carried out, SanKe TOP - LOCK® can ensure the following main advantages of its SanKe TOP - LOCK® security system:

· Best locking performance in the presence of vibrations and dynamic loads
· The system works independently from the type of lubrication used and guarantees a secure locking in dry as well as in lubricated conditions. However, SanKe TOP - LOCK® recommends the use of a high quality lubricant in order to maximize the performance of this fastening system
· Reusable without loss of performance
· Locking of fixing elements with high as well as low pre-load
· Can be used with any kind of bolt/nut of any class of resistance [up to12.9]
· No retightening required
· No risk of hydrogen embrittlement
· Assembly-friendly system as the pieces are delivered pre-glued [cams face against cams face]

Vibration test with SanKe TOP-LOCK®[Junker Test]



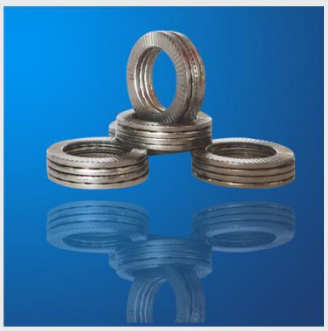
Key

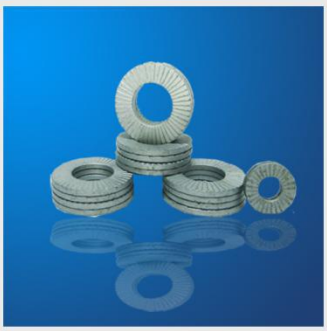
Bolt M8 with TOP-LOCK®washers at 50% of yield point

Bolt M8 without washer

Behavior of clamping force during the untightening of the bolt lclick effect

Test parameters:
Bolt M8 class of8.8
Clamp load:9.1KN
Clamp lenght:14mm
Surface treatment：
Delta Protekt®KL100+VH301
Lubrication：oil SAE 30






Performances

The TOP - LOCK®washers of SanKe TOP - LOCK® ensure the ultimate fastening performance for joints under extreme vibrations ordynamic loads.

The exceptional securing performances of TOP - LOCK® washers are guaranteed by the following technical features:

· The unique cam angle α of the washer is larger than the pitch angle β of the screw thread

· The coefficient of friction of the outside knurled surface of the washer is much higher than the coefficient of friction of the cam surface

· The hardness of TOP - LOCK®washers is higher than the strength of all classes of bolt/nut (8.8, 10.9 and 12.9)

· This unique cam system uses tension to create high force in a fastened joint that is subjected to vibrations

The independent German Institute Materialprufungsamt Nordrhein-Westfalen [MPA NRW] carried out a vibration test with the TOP - LOCK® washers according to the Standard DIN 65151 (Junker Test) and certified that it is in conformity with the requirements of the Standard DIN25201:2010 Part 4, Enclosure B [certificate n. 110042 11 11—01].

The test showed that the TOP - LOCK®washers safely lock screws/bolt connections: the clamp force stays almost constant after 2000 cycles and just a minimal amount of tension dissipates at the beginning of the test due to the normal settlement of the fastened joint.

To develop the optimal results of the TOP - LOCK® washers our R&D Department used the Junker Test Machine, in accordance with DIN 65151 Standard, to verify the performance of our washers in the presence of vibrations. After exhaustive testing with the Junker Test Machine.SanKe TOP - LOCK®succeeded in engineering a top performing product in the presence of vibration and dynamic load.

The following diagram shows the optimal security performances of TOP - LOCK®washers in the presence of vibrations. The blue diagram clarifies that is necessary to increase the clamping force in order to untighten the bolt after 2000 vibration cycles (click effect).

USING INSTRUCTIONS

Those two washers are supplied glued together, in order to avoid any orientation mistake during assembly.

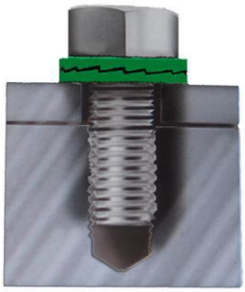
In case of reuse, the correct positioning of the washers-cams face against cams face-has to be checked.

· NOT to be used in case of underlying surface which can move[e.g: presence of flat washer between the TOP-LOCK® washer and the underlying surface]
· NOT to be used in case of too soft underlying surfaces[e.g· wood or plastic]
· NOT to be used in presence of very high settlements
· NOT to be used in case of underlying surfaces which have a higher hardness than the TOP-LOCK® washers
· NOT to be used in case of self-locking nuts and threadlockers
· NOT to be used with“ left turning” threads

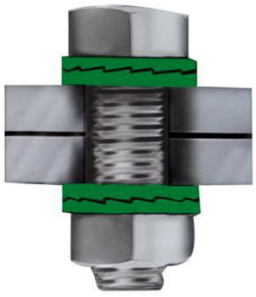
ASSEMBLY GUIDE

Positioning

stud bolts



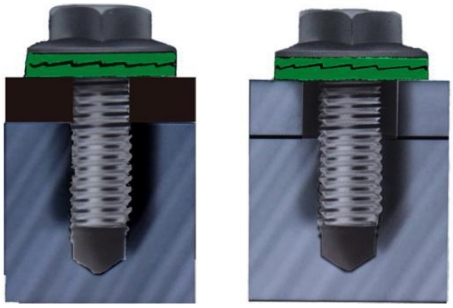
tapped holes



through holes

counter bores

Positioning with large/slotted holes and soft underlying surfaces [rubber, varnished surfaces,etc...].

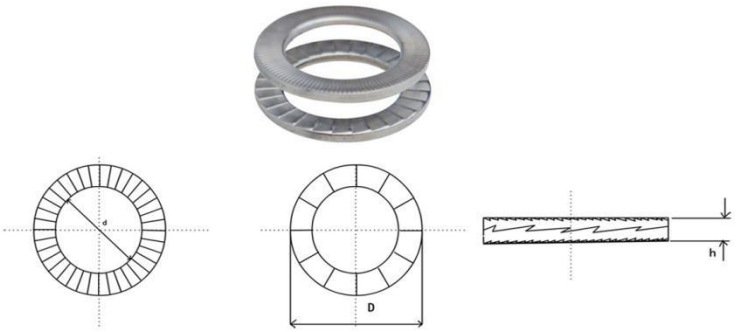


For these applications it is recommended to assemble washers with an enlarged external diameter combined with screws or nuts with flanged head in order to reduce the unit load on the underlying surface.

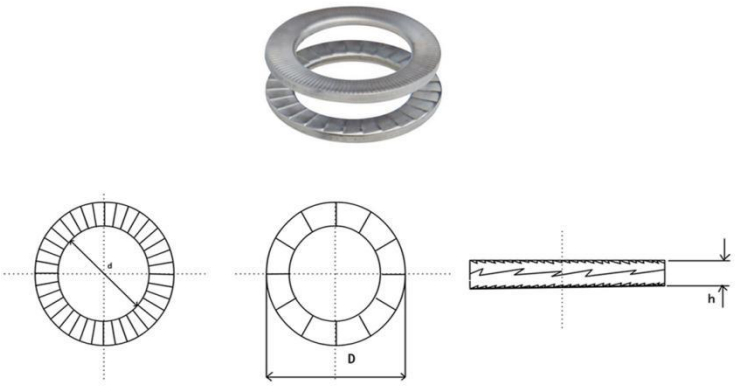
DIMENSIONS and PACKAGING

The SanKe TOP - LOCK® curing system is available in two versions:

· Standard external diameter (normal series)suitable also for counter-sunk bolts.



·Enlarged external diameter (large series) suitable for varnished surfaces and soft materials. These washers are preferably to be applied with flanged bolts/screws.



MATERIALS and SURFACE TREATMENTS

The SanKe TOP-LOCK® securing system is available in different materials and surface treatments;all in compliance with the regulations of RoHs/ELV and Reach.

Materials

· Carbon steel, hardness 465—550 HV 10 after hardening and tempering

· Stainless Steel AISI 316L according to EN 10088-1.4404,surface hardness≥550 HV 0.05 after surface hardening [Kolsterising®]

· Stainless Steel 254 SMO®according to EN 10088-1.4547,surface hardness ≥600 HV 0.05 after surface hardening [Kolsterising®]

· Inconel® 718 according to DIN 17444—2.4668, surface hardness≥620 HV 0.05 after surface hardening [Kolsterising®]

· Other materials are available upon customer's request [Hastelloy® C-276, etc...]

Surface Treatments

· Delta Protekt® KL100+ VH301 Cr6 free,red corrosion resistance min.600 hours [salt spray corrosion test according to ISO 9227]

· Mechanical Zinc-plating+sealing Cr6 free,red corrosion resistance min 600 hours [salt spray corrosion test according to ISO 9227]

· Other surface treatments according to minimum amount orders

Attention

The lubrication effect

TOP - LOCK ® lock washer popularizes to use good quality lubricating oil. For example: GTP600 or Molykote ® 1000 to reduce friction, to minimize the additive load deviations and to prevent corrosion.

Repeated use

TOP - LOCK ® lock washer can be reused under normal circumstances,But under the condition of high temperature, we don't suggest to reuse.Please lubricate them before reuse.

Temperature influence

TOP - LOCK ® lock washer just likes the corresponding materials of bolts/nuts,has the same temperature characteristic. When the temperature is above 200 ℃, the hardness of TOP - LOCK ® lock washer will decrease;When the temperature is above 500 ℃,the hardness of washer-- stainless steel (A4), begin to reduce;When the temperature is above 700 ℃, we recommend the TOP - LOCK ® lock washer with the material is Inconel ® 718.

Load area computation

The load area[mm2] under the washer,must be greater than the quotient of the clamping pressure[N] divided by the yield strength[N/mm2].

$$\text{Load area[mm2]} > \frac{\text{clamping pressure[N]}}{\text{yield strength[N/mm2]}}$$

Application industry

TOP-LOCK® lock washer is suitable for these facilities which ones often in a state of shock. Such as:

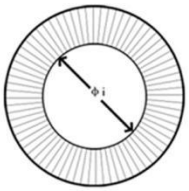
Automobile industry: cars, trucks ,buses
Shipping industry
Compressor
Military
Construction machinery
Mining equipment
Wind power equipment
Oil drilling rig (land or sea)
Agricultural machinery
Public facilities
Casting industry
Rail transit
Casting industry
Drilling machine
Drive system



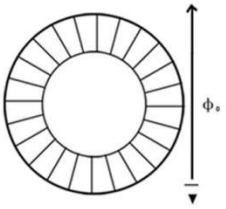




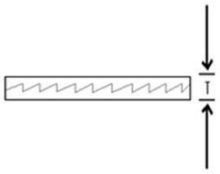
Lock washer specification table -----(Steel)						
Size	Model	British system Model	Smallest packaging	Φi [mm]	Φo [mm]	Thickness [mm]
M3	TL3	#5	200	3.4	7.0	1.8
M3.5	TL3.5	#6	200	3.9	7.6	1.8
M3.5	TL3.5sp	#6	200	3.9	9.0	1.8
M4	TL4	#8	200	4.4	7.6	1.8
M4	TL4sp	#8	200	4.4	9.0	1.8
M5	TL5	#10	200	5.4	9.0	1.8
M5	TL5sp	#10	200	5.4	10.8	1.8
M6	TL6		200	6.5	10.8	1.8
M6	TL6sp		200	6.5	13.5	2.5
	TL1/4″	1/4″	200	7.2	11.5	1.8
	TL1/4″sp	1/4″	200	7.2	13.5	2.5
M8	TL8	5/16″	200	8.7	13.5	2.5
M8	TL8sp	5/16″	200	8.7	16.6	2.5
	TL3/8″	3/8″	200	10.3	16.6	2.5
	TL3/8″sp	3/8″	200	10.3	21.0	2.5
M10	TL10		200	10.7	16.6	2.5
M10	TL10sp		200	10.7	21.0	2.5
M11	TL11	7/16″	200	11.4	18.5	2.5
M12	TL12		200	13.0	19.5	2.5
M12	TL12sp		100	13.0	25.4	3.4
	TL1/2″	1/2″	200	13.5	19.5	2.5
	TL1/2″sp	1/2″	100	13.5	25.4	3.4
M14	TL14	9/16″	100	15.2	23.0	3.4
M14	TL14sp	9/16″	100	15.2	30.7	3.4
M16	TL16	5/8″	100	17.0	25.4	3.4
M16	TL16sp	5/8″	100	17.0	30.7	3.4
M18	TL18		100	19.5	29.0	3.4
M18	TL18sp		100	19.5	34.5	3.4
	TL3/4″	3/4″	100	20.0	30.7	3.4
	TL3/4″sp	3/4″	100	20.0	39.0	3.4
M20	TL20		100	21.4	30.7	3.4
M20	TL20sp		100	21.4	39.0	3.4
M22	TL22	7/8″	100	23.4	34.5	3.4
M22	TL22sp	7/8″	50	23.4	42.0	4.6
M24	TL24		100	25.3	39.0	3.4
M24	TL24sp		50	25.3	48.5	4.6
	TL1″	1″	100	27.9	39.0	3.4
	TL1″sp	1″	50	27.9	48.5	4.6
M27	TL27		50	28.4	42.0	5.8
M27	TL27sp		25	28.4	48.5	5.8
M30	TL30	1 1/8″	50	31.4	47.0	5.8
M30	TL30sp	1 1/8″	25	31.4	58.5	6.6
M33	TL33	1 1/4″	25	34.4	48.5	5.8
M33	TL33sp	1 1/4″	25	34.4	58.5	6.6
M36	TL36	1 3/8″	25	37.4	55.0	6.6
M36	TL36sp	1 3/8″	25	37.4	63.0	6.6
M39	TL39	1 1/2″	25	40.4	58.5	6.6
M42	TL42		25	43.2	63.0	6.6
M45	TL45	1 3/4″	25	46.2	70.0	7.0
M48	TL48		25	49.6	75.0	7.0
M52	TL52	2″	25	53.6	80.0	7.0
M56	TL56	2 1/4″	10	59.1	85.0	7.0
M60	TL60		10	63.1	90.0	7.0
M64	TL64	2 1/2″	10	67.1	95.0	7.0
M68	TL68		1	71.1	100.0	9.5
M72	TL72		1	75.1	105.0	9.5
M76	TL76	3″	1	79.1	110.0	9.5
M80	TL80	3 1/8″	1	83.1	115.0	9.5
M85	TL85		1	88.1	120.0	9.5
M90	TL90		1	92.4	130.0	9.5
M95	TL95		1	97.4	135.0	9.5
M100	TL100	4″	1	103.4	145.0	9.5
M105	TL105		1	108.4	150.0	9.5
M110	TL110		1	113.4	155.0	9.5
M115	TL115		1	118.4	165.0	9.5
M120	TL120		1	123.4	170.0	9.5
M125	TL125		1	128.4	173.0	9.5
M130	TL130	5″	1	133.4	178.0	9.5



TL3-TL8 Φi±0.1mm
TL10-TL42 Φi±0.2mm
TL45-TL130 Φi+0.5/-0.0mm



TL3-TL24 Φo±0.2mm
TL27-TL42 Φo±0.3mm
TL45-TL130 Φo+0.0/-2.0mm

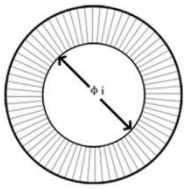


TL3-TL24 T±0.25mm

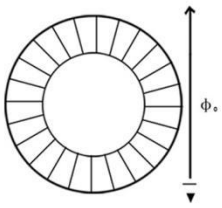
TL45-TL130 T±0.75mm

Note: if the size change failed to notice in advance, Please refer to the actual size.
Note: there is a tolerance + / - 0.0 0.5 mm for the washer with thickness is 6.6 mm.

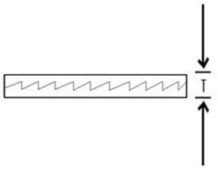
Lock washer specification table ------(Stainless steel)						
Size	Model	British system Model	Smallest packaging	Φi [mm]	Φo [mm]	Thickness [mm]
M3	TL3ss	#5	200	3.4	7.0	2.2
M3.5	TL3.5ss	#6	200	3.9	7.6	2.2
M3.5	TL3.5spss	#6	200	3.9	9.0	2.2
M4	TL4ss	#8	200	4.4	7.6	2.2
M4	TL4spss	#8	200	4.4	9.0	2.2
M5	TL5ss	#10	200	5.4	9.0	2.2
M5	TL5spss	#10	200	5.4	10.8	2.2
M6	TL6ss		200	6.5	10.8	2.2
M6	TL6spss		200	6.5	13.5	2.0
	TL1/4″ss	1/4″	200	7.2	11.5	2.2
	TL1/4″spss	1/4″	200	7.2	13.5	2.2
M8	TL8ss	5/16″	200	8.7	13.5	2.0
M8	TL8spss	5/16″	200	8.7	16.6	2.0
	TL3/8″ss	3/8″	200	10.3	16.6	2.0
	TL3/8″spss	3/8″	200	10.3	21.0	2.0
M10	TL10ss		200	10.7	16.6	2.0
M10	TL10spss		200	10.7	21.0	2.0
M11	TL11ss	7/16″	200	11.4	18.5	2.2
M12	TL12ss		200	13.0	19.5	2.0
M12	TL12spss		100	13.0	25.4	3.0
	TL1/2″ss	1/2″	200	13.5	19.5	2.0
	TL1/2″spss	1/2″	100	13.5	25.4	3.2
M14	TL14ss	9/16″	100	15.2	23.0	3.0
M14	TL14spss	9/16″	100	15.2	30.7	3.2
M16	TL16ss	5/8″	100	17.0	25.4	3.0
M16	TL16spss	5/8″	100	17.0	30.7	3.2
M18	TL18ss		100	19.5	29.0	3.2
M18	TL18spss		100	19.5	34.5	3.2
	TL3/4″ss	3/4″	100	20.0	30.7	3.2
	TL3/4″spss	3/4″	100	20.0	39.0	3.2
M20	TL20ss		100	21.4	30.7	3.0
M20	TL20spss		100	21.4	39.0	3.2
M22	TL22ss	7/8″	100	23.4	34.5	3.2
M22	TL22spss	7/8″	50	23.4	42.0	3.2
M24	TL24ss		100	25.3	39.0	3.2
M24	TL24spss		50	25.3	48.5	3.2
	TL1″ss	1″	100	27.9	39.0	3.2
	TL1″spss	1″	50	27.9	48.5	3.2
M27	TL27ss		50	28.4	42.0	6.8
M27	TL27spss		25	28.4	48.5	6.8
M30	TL30ss	1 1/8″	50	31.4	47.0	6.8
M30	TL30spss	1 1/8″	25	31.4	58.5	6.8
M33	TL33ss	1 1/4″	25	34.4	48.5	6.8
M36	TL36ss	1 3/8″	25	37.4	55.0	6.8
M39	TL39ss	1 1/2″	25	40.4	58.5	6.8
M42	TL42ss		25	43.2	63.0	6.8
M45	TL45ss	1 3/4″	25	46.2	70.0	6.8
M48	TL48ss		25	49.6	75.0	6.8
M52	TL52ss	2″	1	53.6	80.0	9.0
M56	TL56ss	2 1/4″	1	59.1	85.0	9.0
M60	TL60ss		1	63.1	90.0	9.0
M64	TL64ss	2 1/2″	1	67.1	95.0	9.0
M68	TL68ss		1	71.1	100.0	9.0
M72	TL72ss		1	75.1	105.0	9.0
M76	TL76ss	3″	1	79.1	110.0	9.0
M80	TL80ss	3 1/8″	1	83.1	115.0	9.0



TL3ss–TL8ss Φi±0.1mm
TL10ss–TL42ss Φi±0.2mm
TL45ss–TL80ss Φi+0.5/−0.0mm



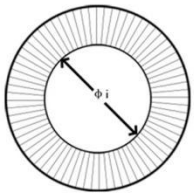
TL3ss–TL24ss Φo±0.2mm
TL27ss–TL42ss Φo±0.3mm
TL45ss–TL80ss Φo+0.0/−2.0mm



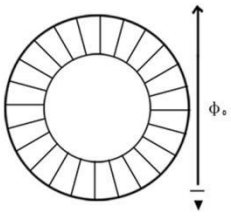
TL3ss–TL24ss T±0.25mm
TL27ss–TL42ss T+0.0/−0.5mm
TL45ss–TL80ss T±0.75mm

Note: if the size change failed to notice in advance, Please refer to the actual size.

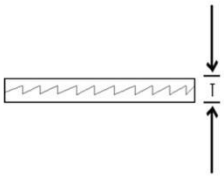
Lock washer specification table ------(254 SMO® steel)						
Size	Model	British system Model	Smallest packaging	Φi [mm]	Φo [mm]	Thickness [mm]
M3	TL3ss-254	#5	200	3.4	7.0	2.2
M3.5	TL3.5ss-254	#6	200	3.9	7.6	2.2
M3.5	TL3.5spss-254	#6	200	3.9	9.0	2.2
M4	TL4ss-254	#8	200	4.4	7.6	2.2
M4	TL4spss-254	#8	200	4.4	9.0	2.2
M5	TL5ss-254	#10	200	5.4	9.0	2.2
M5	TL5spss-254	#10	200	5.4	10.8	2.2
M6	TL6ss-254		200	6.5	10.8	2.2
M6	TL6spss-254		200	6.5	13.5	2.0
	TL1/4″-254	1/4″	200	7.2	11.5	2.2
	TL1/4″spss-254	1/4″	200	7.2	13.5	2.2
M8	TL8ss-254	5/16″	200	8.7	13.5	2.0
M8	TL8spss-254	5/16″	200	8.7	16.6	2.0
	TL3/8″ss-254	3/8″	200	10.3	16.6	2.0
	TL3/8″spss-254	3/8″	200	10.3	21.0	2.2
M10	TL10ss-254		200	10.7	16.6	2.0
M10	TL10spss-254		200	10.7	21.0	2.0
M11	TL11ss-254	7/16″	200	11.4	18.5	2.2
M12	TL12ss-254		200	13.0	19.5	2.0
M12	TL12spss-254		100	13.0	25.4	3.0
	TL1/2″ss-254	1/2″	200	13.5	19.5	2.2
	TL1/2″spss-254	1/2″	100	13.5	25.4	3.2
M14	TL14ss-254	9/16″	100	15.2	23.0	3.0
M14	TL14spss-254	9/16″	100	15.2	30.7	3.2
M16	TL16ss-254	5/8″	100	17.0	25.4	3.0
M16	TL16spss-254	5/8″	100	17.0	30.7	3.2
M18	TL18ss-254		100	19.5	29.0	3.2
M18	TL18spss-254		100	19.5	34.5	3.2
	TL3/4″ss-254	3/4″	100	20.0	30.7	3.2
	TL3/4″spss-254	3/4″	100	20.0	39.0	3.2
M20	TL20ss-254		100	21.4	30.7	3.0
M20	TL20spss-254		100	21.4	39.0	3.2
M22	TL22ss-254	7/8″	100	23.4	34.5	3.2
M22	TL22spss-254	7/8″	50	23.4	42.0	3.2
M24	TL24ss-254		100	25.3	39.0	3.2
M24	TL24spss-254		50	25.3	48.5	3.2
	TL1″ss-254	1″	100	27.9	39.0	3.2
	TL1″spss-254	1″	50	27.9	48.5	3.2
M27	TL27ss-254		50	28.4	42.0	5.8
M27	TL27spss-254		25	28.4	48.5	5.8
M30	TL30ss-254	1 1/8″	50	31.4	47.0	5.8
M33	TL33ss-254	1 1/4″	25	34.4	48.5	5.8
M36	TL36ss-254	1 3/8″	25	37.4	55.0	5.8
M39	TL39ss-254	1 1/2″	25	40.4	58.5	5.8



TL3ss-254-TL8ss-254 Φi±0.1mm
TL10ss-254-TL39ss-254 Φi±0.2mm



TL3ss254-TL24ss-254 Φo±0.2mm
TL27ss-254-TL39ss-254 Φo±0.3mm



TL3ss-254-TL39ss-254 T±0.25mm

Note: if the size change failed to notice in advance, Please refer to the actual size.

SanKe TOP-LOCK®GUIDELINE

	TOP-LOCK®in CARBON STEEL	TOP-LOCK®in STAINLESS STEEL	TOP-LOCK®in 254 SMO®	TOP-LOCK®in INCONEL®718
Type of material	Carbon Steel	EN10088	EN10088	DIN17744
Material number	—	1.4404 [AISl 316L] X2CrNiMo17-12-2	1.4547 XICrNiMoCuN20-18-7	2.4668 NiCr19Fe19Nb5Mn3
Environment of application	General applications in non aggressive environments and with low temperature.	For aggressive environment, non acid/chloride Environments No acid chlorine, fluoride, sulphuric	Applications in salt water, in presence of chloride. Food industries and medical tools.	Applications with high temperatures [e.g:turbines, turbo Compressors]. Excellent corrosion resistance in presence of acids and chlorides.
Material standard treatment	Quenched and tempered	Surfaced hardened [Kolsterlsing®]	Surfaced hardened [Kolsterlsing®]	Surfaced hardened [Kolsterlsing®]
Hardness	465- 550 HV10	⩾550 HV0.05	⩾600 HV0.05	⩾620 HV0.05
Standard surface treatment	Delta Protekt® base coat KL100 Top coat VH301GZ	None	None	None
Corrosion resistance	Corrosion resistance min. 600 hours red rust(1S09227]	—	—	—
Consistency screws and nuts	Up to 12.9	Up to A4-80	Up to A4-80	Up to A4-80
Temperature range(approximate)	From-20℃ to 200℃	From- 150℃ to 500℃	From- 150℃ to 500℃	From- 150℃ to 700℃
Available dimensions	From M3 up to M42 [from#5 up to 1 3/4″]	From M3 up to M42 [from#5 up to 1 3/4″]	From M3 up to M39 [from#5 up to 1 3/4″]	Upon customer's request
Available washers	Standard external diameter from M3 up to M42 [from #5 up to 1 1/2″] Enlarged external diameter from M3 up to M36 (from #5 up to 1 3/8″)	Standard external diameter from M3 up to M42 [from #5 up to 1 1/2″] Enlarged external diameter from M3 up to M30 (from #5 up to 1 1/8″)	Standard external diameter from M3 up to M39 [from #5 up to 1 1/2″] Enlarged external diameter from M3 up to M27 (from #5 up to 1″)	Upon customer's request

TOP-LOCK® Bolt securing system

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