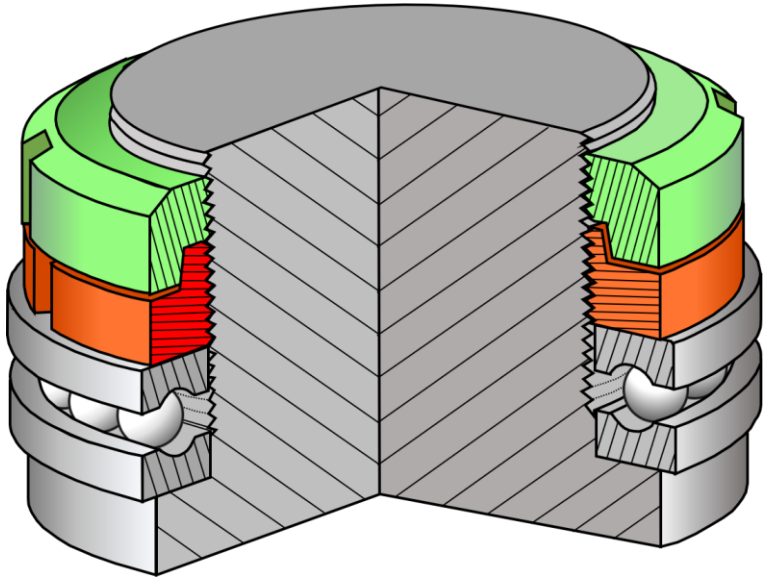
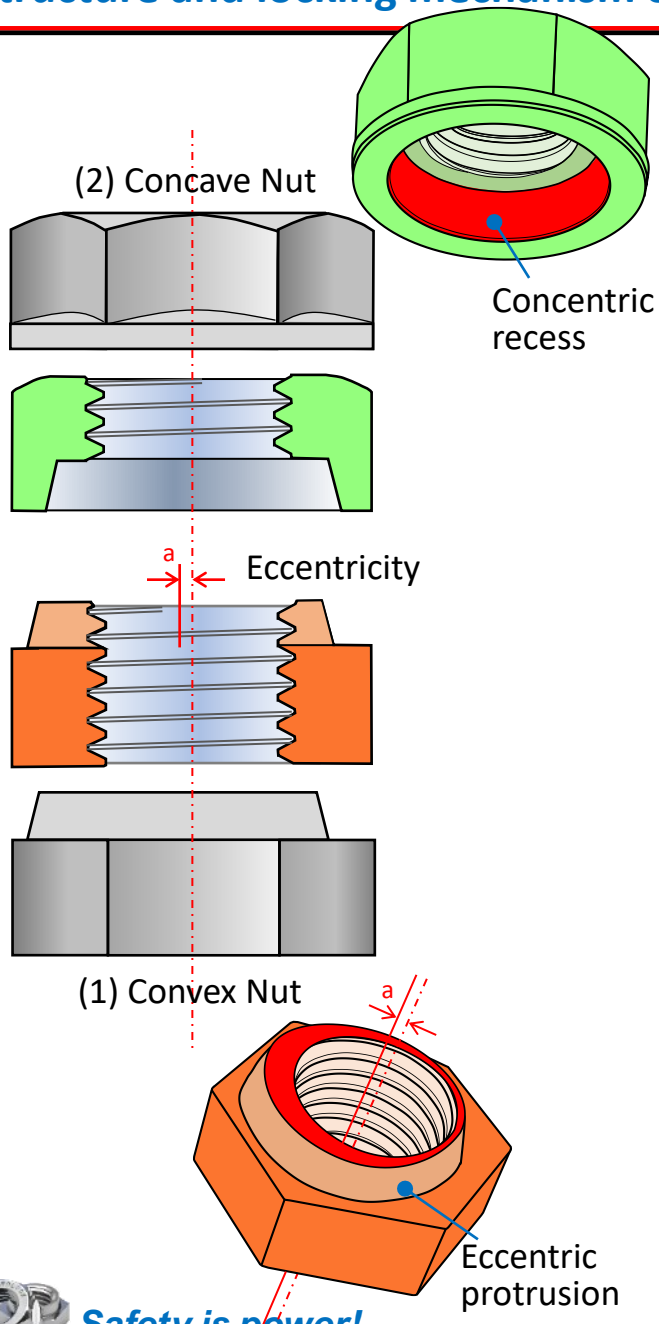
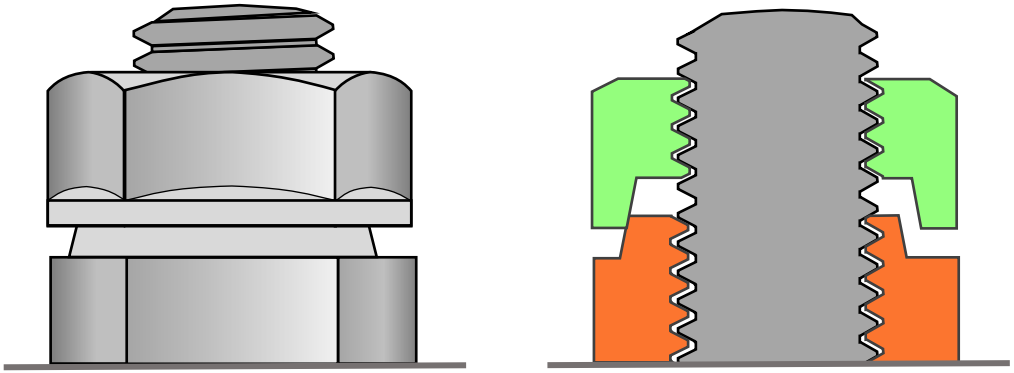


HARDLOCK® Solution

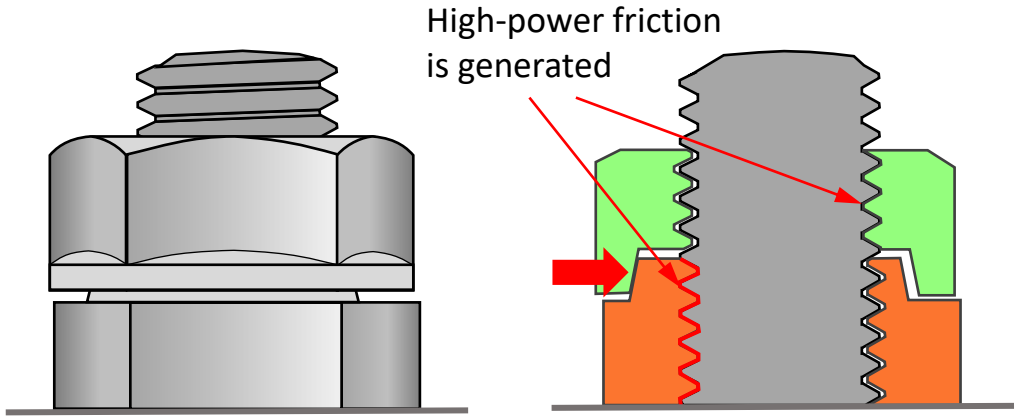
Multi-Axle Trailer Applications

Structure and locking mechanism of HARDLOCK Nut (HLN)





The first nut **(1) Convex Nut** (clamping nut) has an **eccentric conical protrusion** on the upper surface. The Convex Nut that has the same strength class as a regular hexagon nut is to be tightened to the appropriate torque for the application.
The Concave Nut is screwed down manually by hand until it no longer turns.



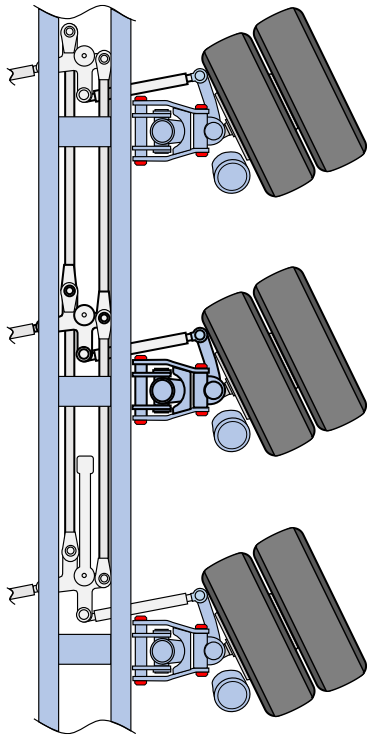
The second nut **(2) Concave Nut** (locking nut) is designed with a concentric conical recess that contacts the protrusion of Convex Nut to generate a strong perpendicular load with resultant elimination of the play (gap) between the Convex Nut and bolt.

Example of switching to HLB from Toothed Lock Washer

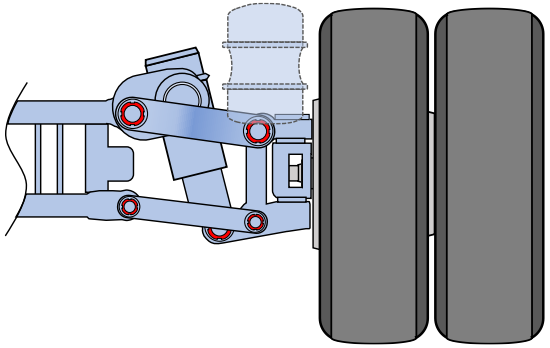
Multi axles trailer steering systems with hydraulic suspension

Multi-axle trailer has a group of axles whose wheels are simultaneously steered to improve maneuverability during negotiating sharp turn.

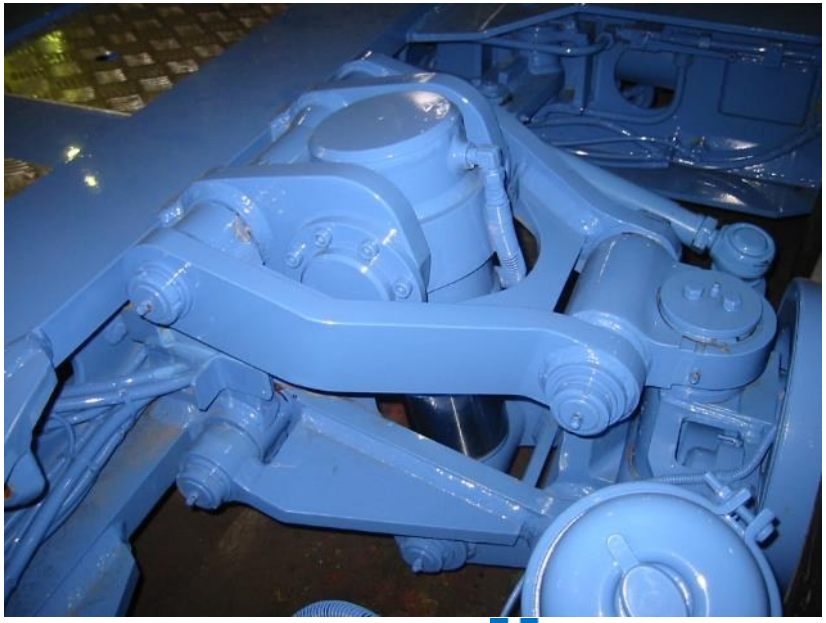
Especially for hydraulic suspension type, their complicated mechanism make it difficult for ordinary lock nuts (in combination with toothed lock washers) to withstand vibrations and stress from every aspect. Lock nuts were welded to prevent frequent rotational loosening on the shaft, resulted in making disassembly difficult during maintenance.



HARDLOCK Bearing Nuts (HLB) are employed to fix the joints on the steering wheel arms showing more integrity staying tight even when exposed to the harshest drives, and leading to a major reduction in maintenance times.



HARDLOCK Bearing Nut



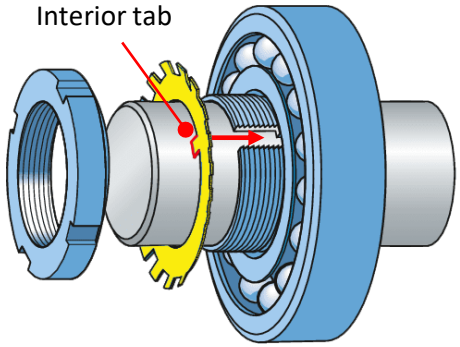
Comparison between Toothed Lock Nut and HLB (1)

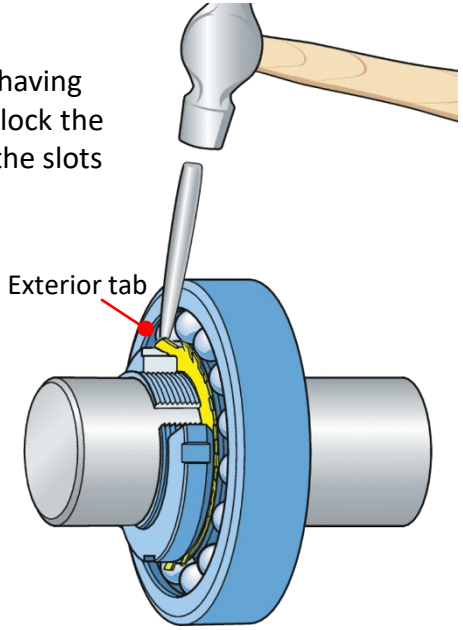
1. Comparison Table

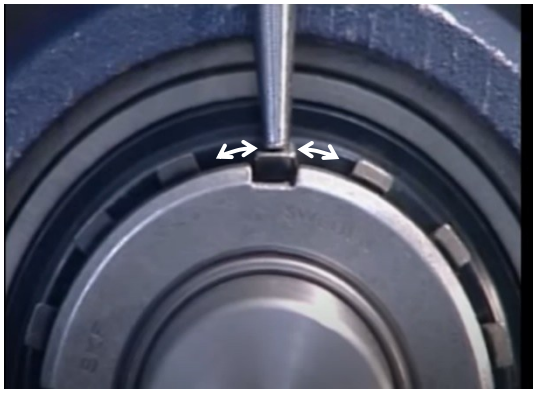
	Toothed Lock Washer	HLB
Installation	- Requires machining of keyway into shaft - Requires adjustment to align one of the tabs with one of the slots (also require different tooling) --> Refer to '2. Installation of Toothed Lock Washer'	- No need of keyway - Consisting of 2 components which use the same tool
Maintaining clamp force	Can stop rotational loosening, but only maintain clamp force to such an extent that it may be acceptable depending on particular application --> Refer to '3. Vibration Test using Junker Test Bench J900'	- No rotational loosening and the locking behaviour is acceptable to any applications - Locking behaiviour is irrelevant to clamp force
Fatigue Failure	Tabs are susceptible to fracture with long-term use --> Refer to '4. Normal-reverse Rotation Endurance Test on Lock Nut'	Basically no fracture occurs unless strong impact load is applied to

2. Installation of Toothed Lock Washer

Toothed Lock washers are used to prevent Lock Nut from rotating by having an interior tab that locks into the shaft keyway and exterior tabs that lock the nut in position when one of the washer tabs is bent over into one of the slots around the circumference of the nut.







The slot and tab shall be adjusted in an alignment

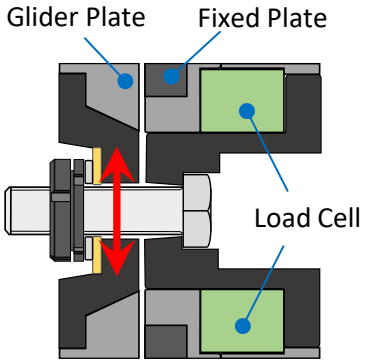
Comparison between Toothed Lock Nut and HLB (2)

3. Vibration Test using Junker Test Bench J900

(1) Product under test

Size: M20xP1.0
Material: JIS S45C
Finish: Manganese Phosphate (HLB, Ordinary Lock Nut)
Zinc Trivalent Chromate (Other Self-Lock Lock Nut)

Vibrationmaster J900 allows the testing and verification of fasteners in accordance with DIN 25201-4 and ISO 16130 for the self-loosening behaviour under dynamic load



Test fixture

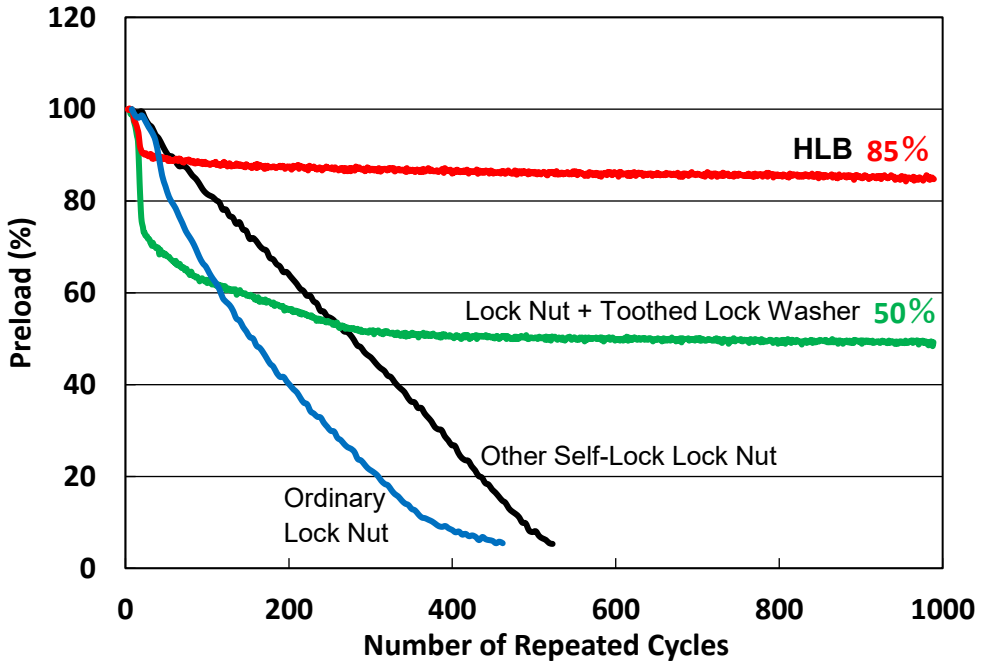
The specimen is exposed to transverse motion creating cyclic vibration

(2) Test Conditions

Initial Clamp Force: 17.2kN (10-20% of yield point for 8.8 bolt)
(Lower clamp force was set on the assumption of the case where much preload can not be applied)
Transverse displacement: +/-1.25mm
Test frequency: 2Hz (to prevent galling)
Test cycles: 1000 cycles
Lubrication: All the threads and engagement part of HLB were lubricated

(3) Test Results

Toothed Lock washers can surely prevent rotational loosening against vibration, but the reduction of preload to some extent is inevitable.



4. Normal-reverse Rotation Endurance Test on Lock Nut

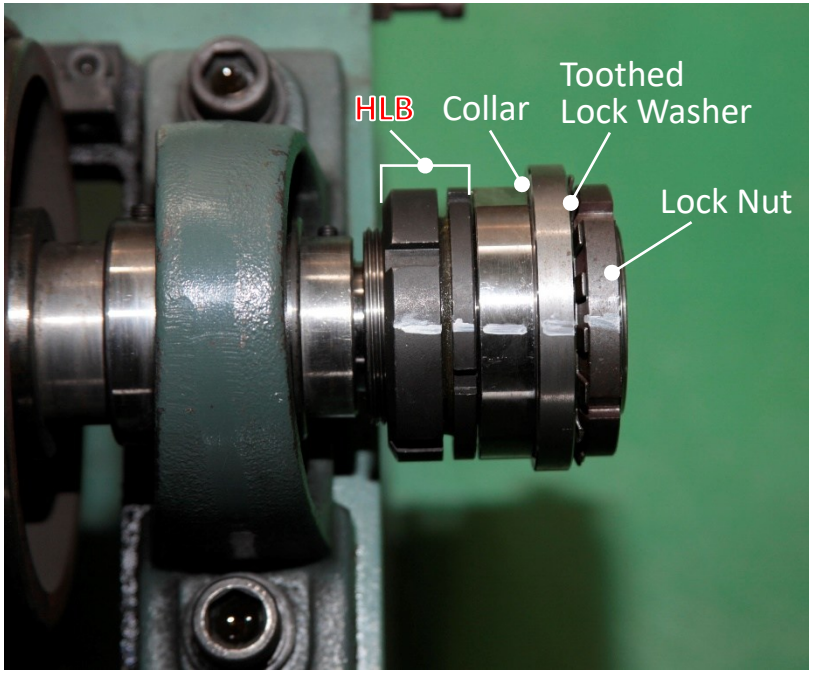
(1) Test Conditions

Specimen: M55xP2.0 (JIS S45C)
Rotating Speed: 2,300rpm
One Cycle: 10 seconds
(Normal ROT-Stop-Reverse ROT-Stop)
Stop time: 0.30 sec (Normal rotation)
0.27 sec (Reverse rotation)
Fictitious Force at the time of stopping:
0.29Nm (Normal rotation)
0.32Nm (Reverse rotation)

(2) Test Results

Specimen	Specimen No.	Test Results
Lock Nut + Toothed Lock Washer	1	Loosening occurred in about 150,000 cycles
	2	Loosening occurred in about 120,000 cycles
HLB	1	**No loosening occurred in 1mil cycles**
	2	**No loosening occurred in 1mil cycles**

Testing machine



Specimens set on the test shaft