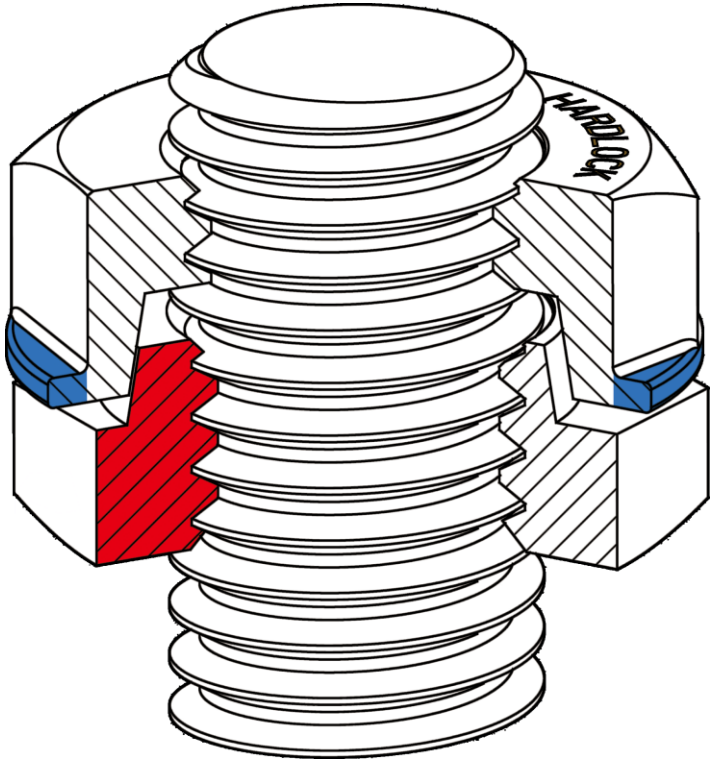
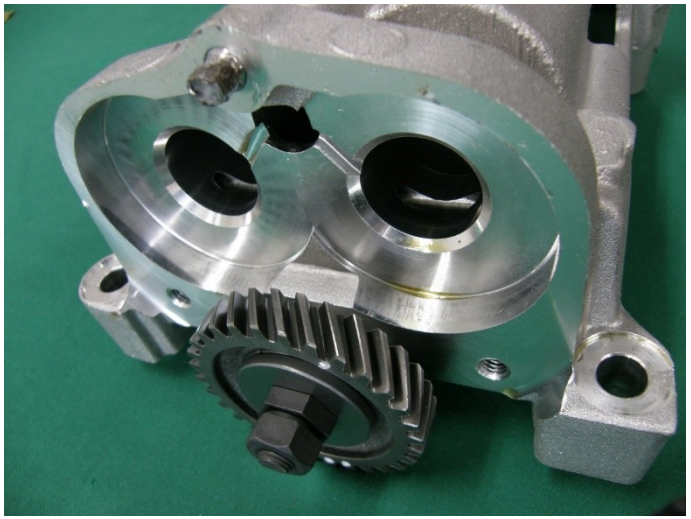


HARDLOCK® Solution

Motor Vehicle Applications

Transmission shaft

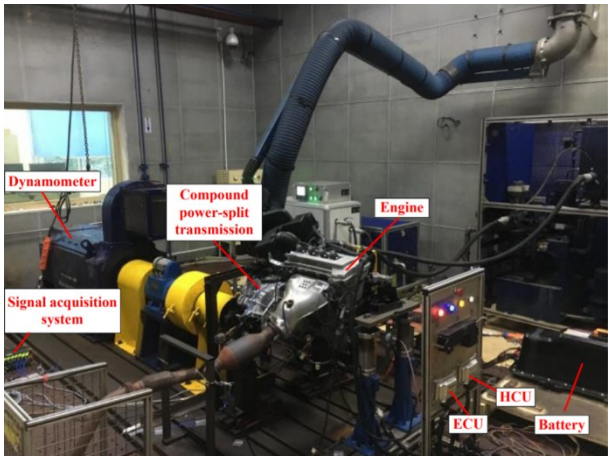


Transmission manufactured by
Daewoo, Korea for Korea GM
HLN-B M10x1.25
Convex: SCM435
Concave: SS400

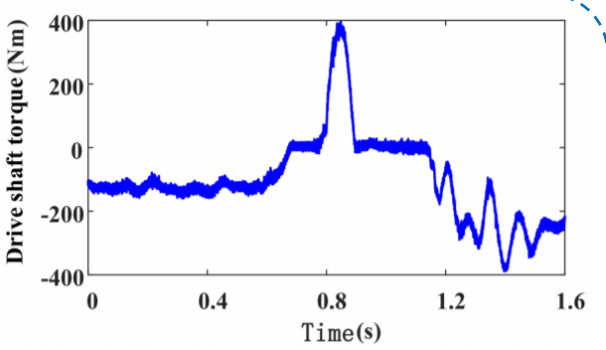
GM Daewoo had to recall a certain SUV Wagon type because of engine transmission shaft issues. These issues were traced back to the flange nut which had came loose due to **heavy vibration occurring on vehicle startup**. HARDLOCK Nut was employed as an immediate solution to the problem.

<Reference for vibration during engine start-up process>

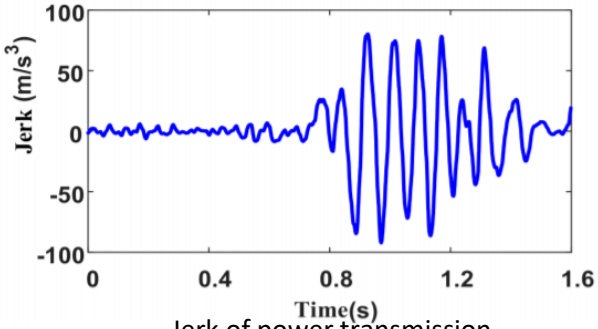
Although the test was conducted for a compound power-split hybrid electric vehicle, real dynamic characteristics of the factors of system shock and vibration during the engine start-up process will be of reference to the behaviour of transmission shaft.
The results showed that the engine's pulsating torque was the main reason for system jerk and vibration during the engine start-up process and the excessive intake manifold pressure before the engine's ignition was one of the main reasons for the large output torque ripple.



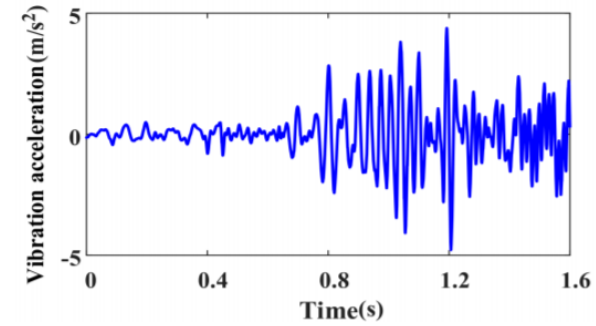
Powertrain test bench system for PSHEV
(Power-Split Hybrid Electric Vehicle)



Driveshaft torque



Jerk of power transmission

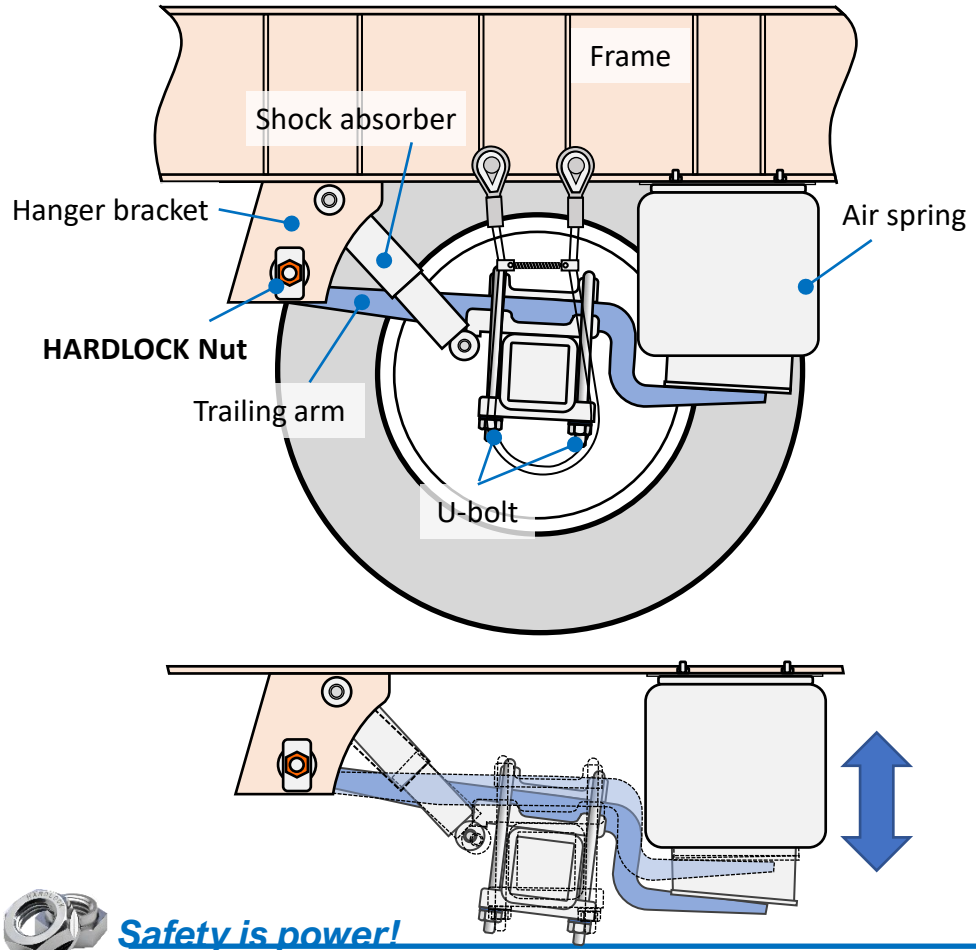


Vibration of power transmission

- Authority -
Yanzhao Su, Minghui Hu, Jin Huang, Ling Su and Datong Qin 'Experimental and Characteristic Analysis during the Engine Start-Up Process for a Compound Power-Split Hybrid Electric Vehicle' *Appl. Sci. 2021, 11, 1846*

Spring bolt nut of trailing arm for truck air suspension (1)

HARDLOCK Nuts are employed for securing the spring bolt for trailing arm of air suspension for trucks. The trailing arms transfer the wheel forces to the air suspension hanger bracket and are positioned in it through a steel bush. Whilst air suspension is always used for the pure vertical movement, the body rolling of the vehicle and one-sided driving through dips or obstacles are compensated by the trailing arms.

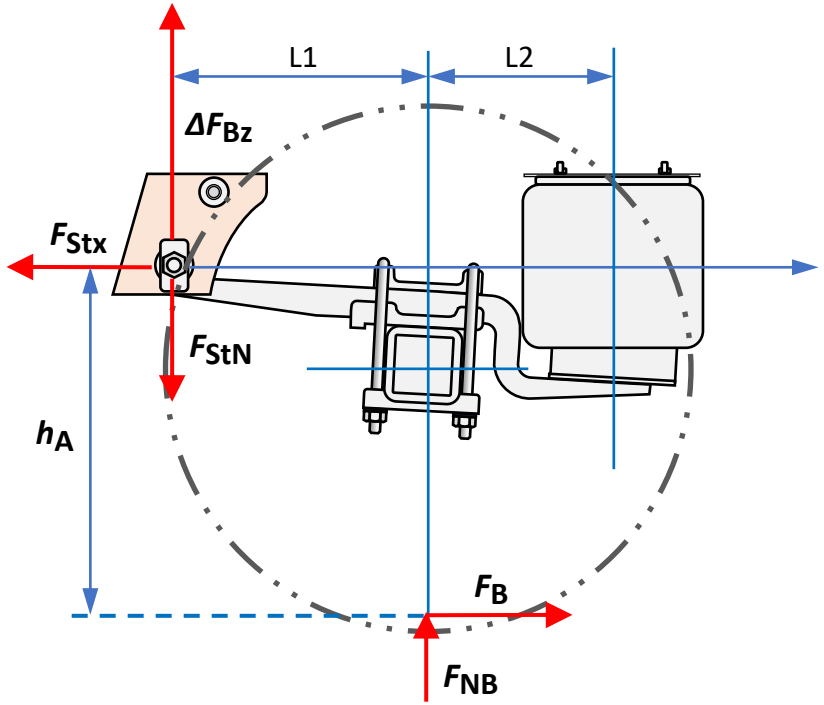


IBERO, Brazil
HARDLOCK Nut 1 1/8-7 ASTM A194 2H

Spring bolt nut of trailing arm for truck air suspension (2)

The vertical forces are distributed across **hanger brackets** and air bags. Longitudinal forces from uneven road surface and due to breaking as well as lateral forces are exclusively applied to the vehicle frame through the **hanger bracket**.

Forces applied to spring bolt when breaking



F_{NB}: Wheel force on ground during breaking(N)

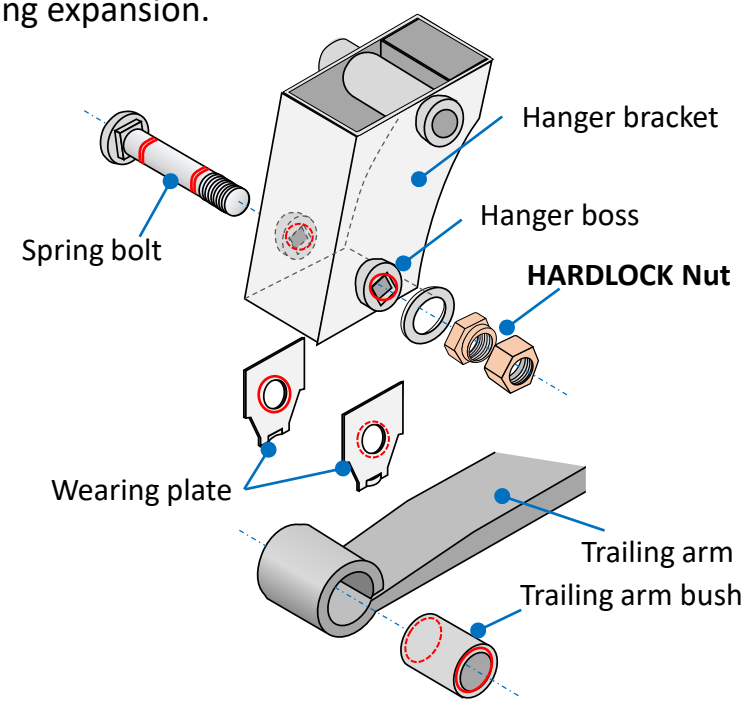
F_{StN}: Force from wheel force on ground (N) $\quad F_{StN} = F_{NB} \times \frac{L2}{L1 + L2}$

ΔF_{Bz}: Reaction force from breaking torque (N) $\quad \Delta F_{Bz} = \frac{FB \times hA}{L1 + L2}$

F_{Stx}: Total force on the hanger bracket in direction X (N)

HARDLOCK Nut use on a spring bolt

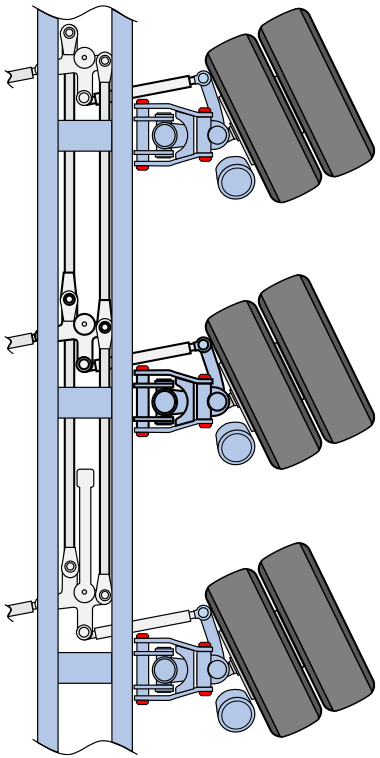
The components composing the pivot point assembly tend to be worn due to the load concentration (marked in red in the drawing). **Worn components cause reduction of a clamp force that will lead to rotational loosening for ordinary lock nuts**, and then result in further increase of play and wearing. Air suspension is subject to legal inspection every three months in Japan and the lock nut must be re-tightened at the time. Wearing is inevitable even for HARDLOCK Nut assembly, but its **no rotational loosening characteristics irrespective of clamp force** will contribute to minimizing wearing expansion.



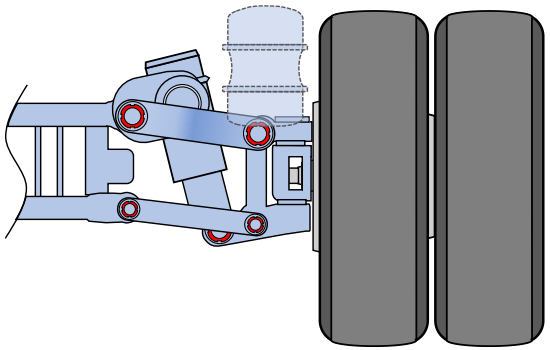
Multi axles trailer steering systems with hydraulic suspension (1)

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

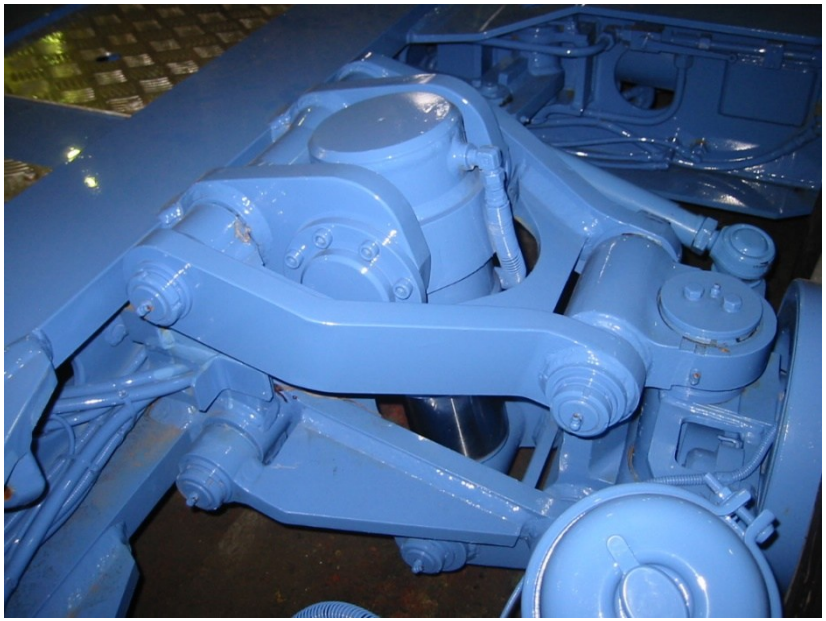
Especially for hydraulic suspension type, their complicated mechanism make it difficult for ordinary lock nuts (in combination with toothed lock washers) to withstand vibrations and stress from every aspect.
Lock nuts were welded to prevent frequent rotational loosening on the shaft, resulted in making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



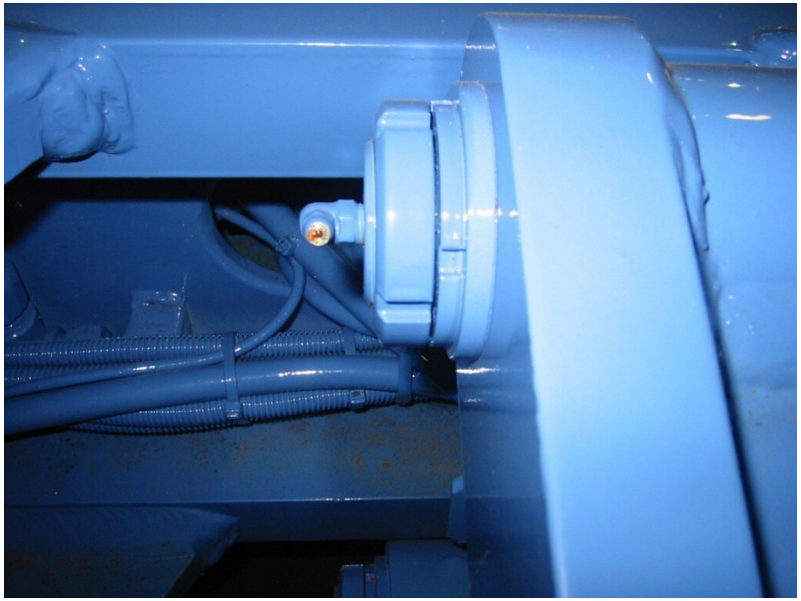
HARDLOCK Bearing Nuts (HLB) have been employed to fix the joints on the steering wheel arms showing more integrity staying tight even when exposed to the harshest drives, and leading to a major reduction in maintenance times.



HARDLOCK Bearing Nut



Multi axles trailer steering systems with hydraulic suspension (2)



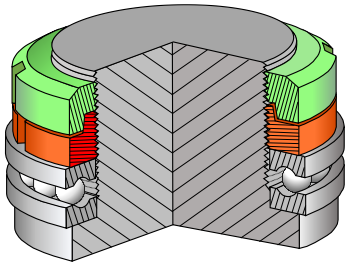
HLB M35 S45C

HLB used for Multi Axles Trailer Steering System

(HARDLOCK Nut M16x1.5 Class8)
HLB M25x1.5 S45C
HLB M30x1.5 SS400
HLB M30x1.5 S45C
HLB M35x1.5 SS400
HLB M35x1.5 S45C
HLB M40x1.5 SS400
HLB M40x1.5 S45C
HLB M60x2.0 S45C
HLB M70x2.0 S45C
HLB M80x2.0 S45C
HLB M85x2.0 S45C

Explanation of **HARDLOCK Bearing Nut (HLB)**

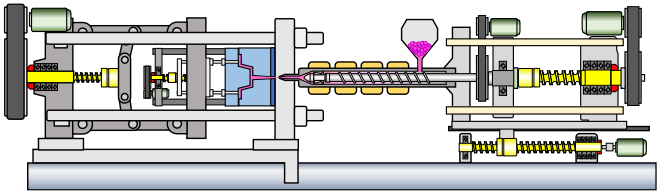
taking as an example use on Ball Screws of Injection Molding Machines



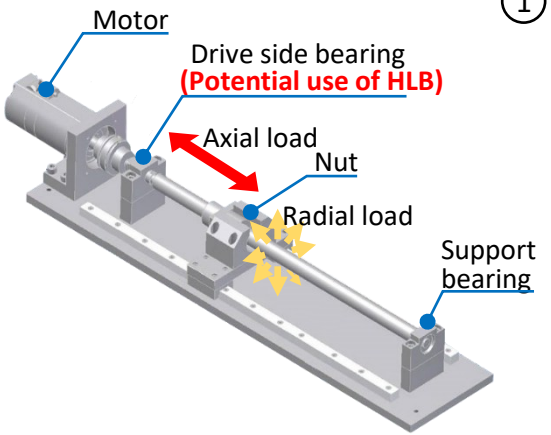
HARDLOCK Bearing Nut (HLB) has the same locking mechanism as **HARDLOCK Nut (HLN)**. One of the features of HARDLOCK mechanism shall be highlighted for the use in fixing rotating shafts; **the locking power is irrelevant to clamp force** and it can be fixed even in the middle of a shaft.

The ball screws for the injection molding machine are required to bear **high load and rotary movement starting/stopping at high speed within a short distance**, which places high demands on **bearings** and **lock nuts** as well.

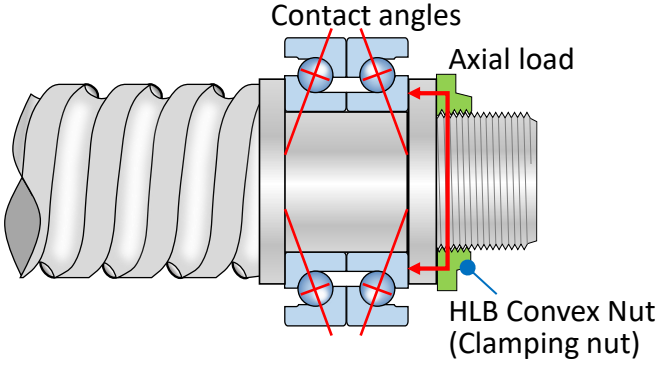
Applications such as injection molding machines, robots and machine tool spindles require precision rotary motion with a higher degree of stiffness and positional accuracy. To achieve this, a sustained load must be applied to the bearings during assembly to remove excess play - that is called **preload**.



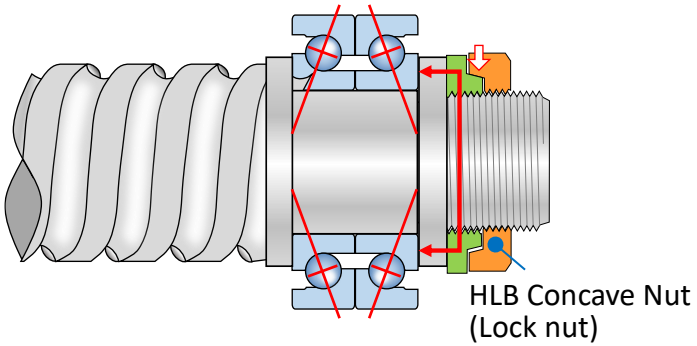
Schematic diagram of injection molding machine using servo motors and ball screws



① Exact preload can be achieved by torque control tightening on the HLB Convex Nut

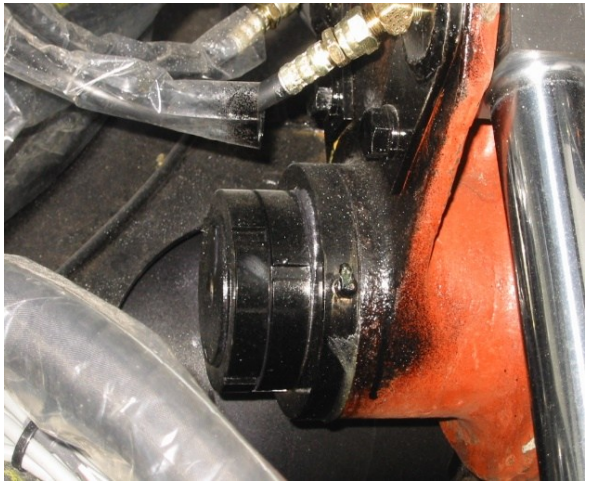


② HLB Concave Nut will lock the Convex Nut regardless of the amount of preload

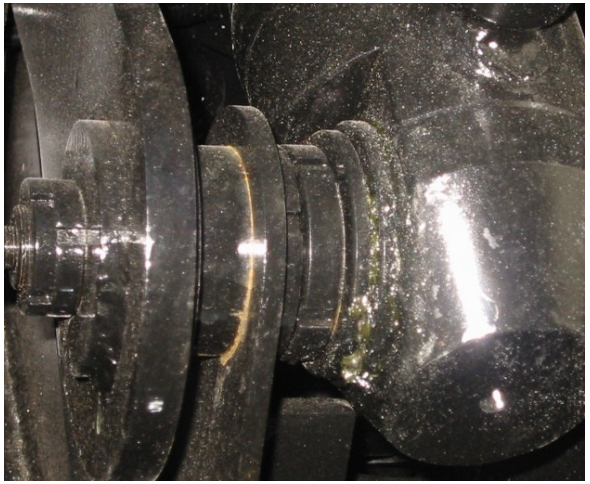


HLB can be tightened to exact torque required to generate correct **preload** and at the same time stay still to support the bearings that carry **high axial load represented by thrust and reaction force**.

HLN & HLB used in Concrete Pump Truck (1)

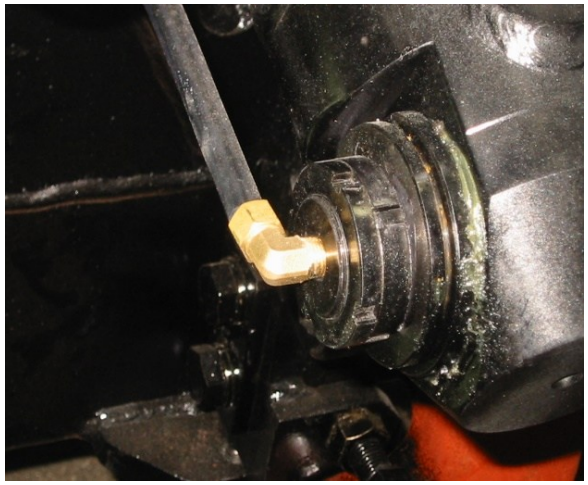


Bucket Holder Fastening HLB M35

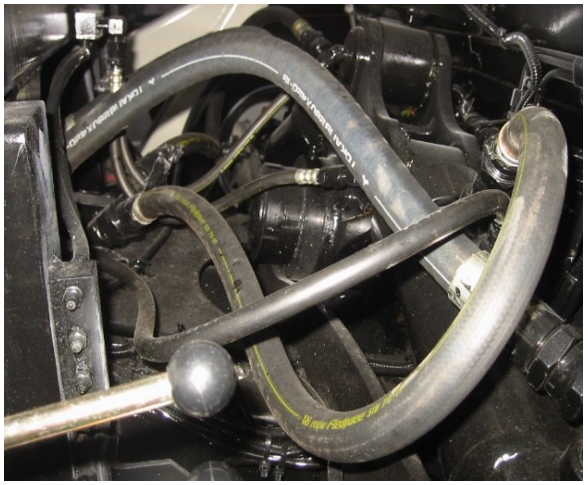


Hydraulic Cylinder Moving Element
HLB M30 & M50

Ready Mixed Concrete Bucket



Hydraulic Cylinder Head Section
HLB M35



Hydraulic Cylinder Bracket Section
HLB M80

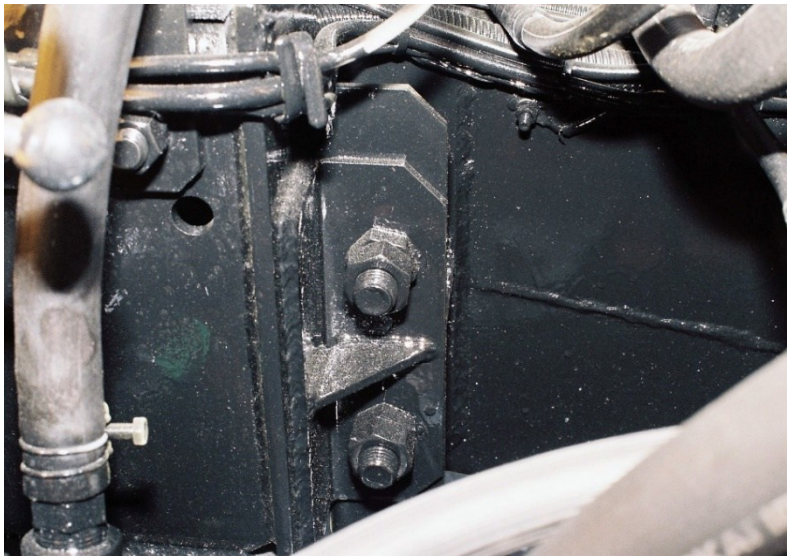
HLN & HLB used in Concrete Pump Truck (2)

Pump unit valve

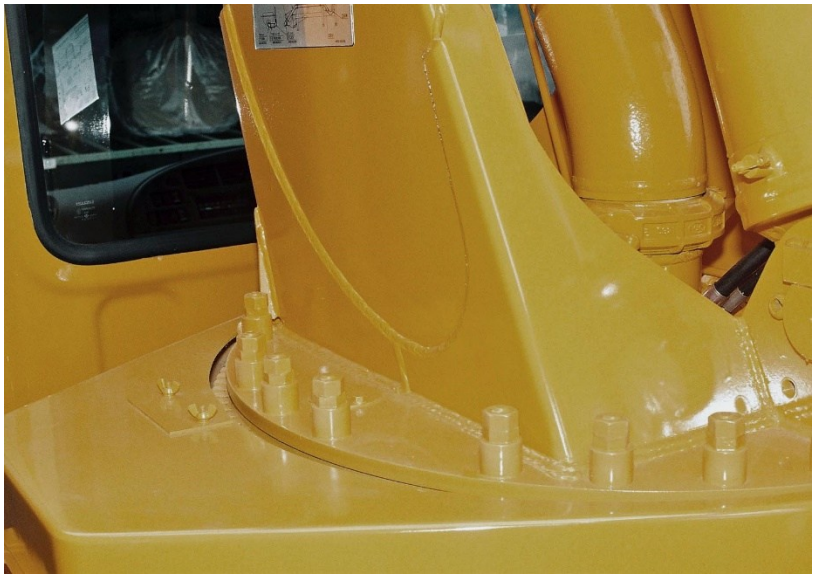
HLN-R M20 S45C

HLN & HLB used in Concrete Pump Truck (3)

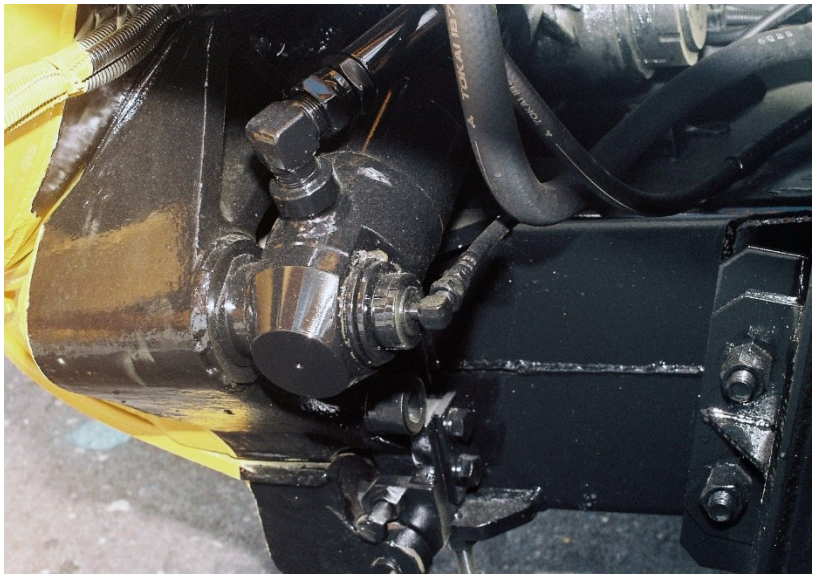
Piston type concrete pump



Chassis fixture HLN-B M10~M30 SS400/S45C

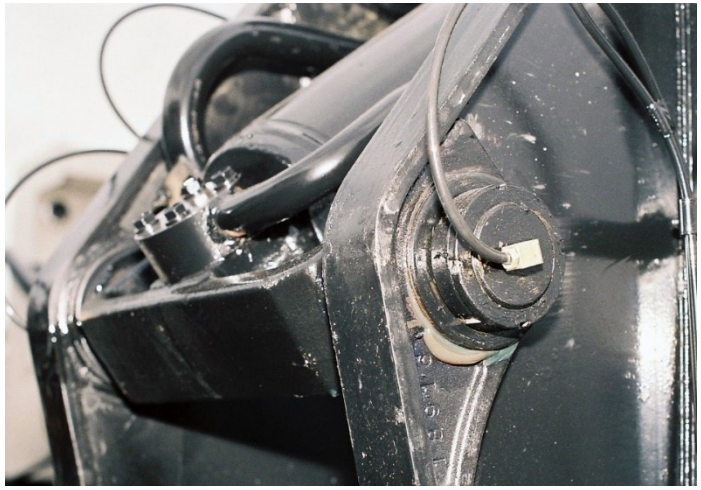


Crane turret HLN-B M16,M18 S45C

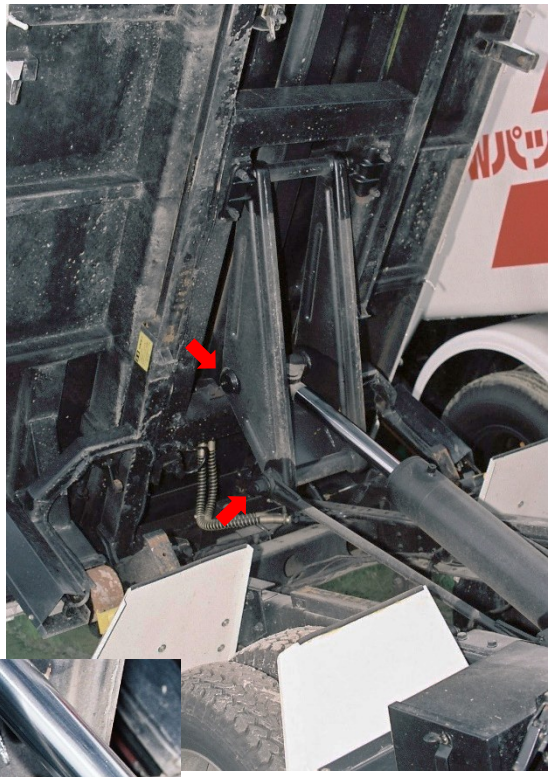


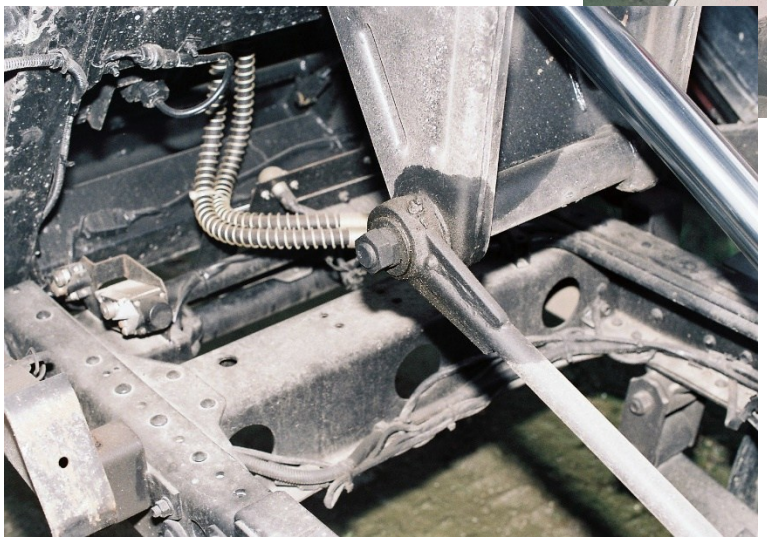
Valve cylinder head HLB M40

HLN & HLB used in Dump Truck



Damp truck trunnion HLB M160 S45C

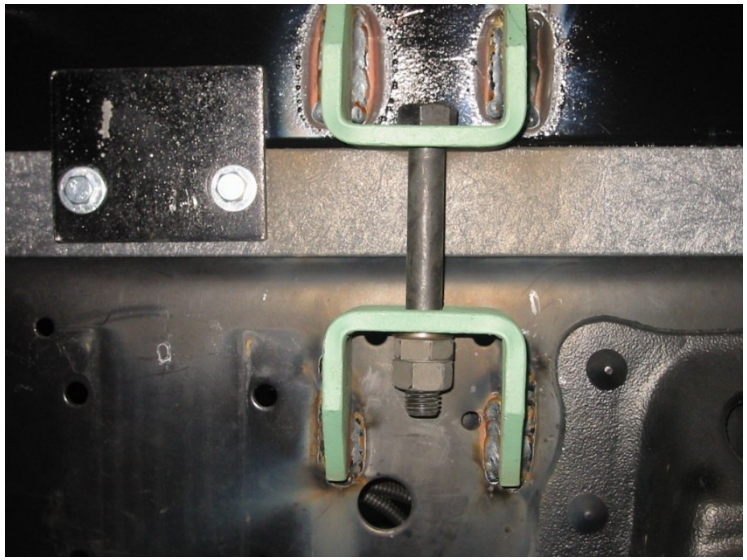




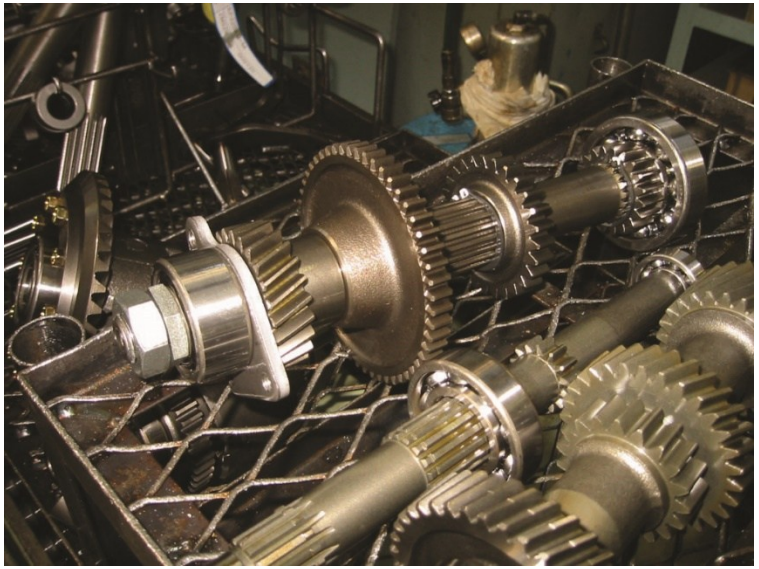
HLN used on Opposed Bracket for truck to connect car body and chassis

M16 S45C

M22 S45C



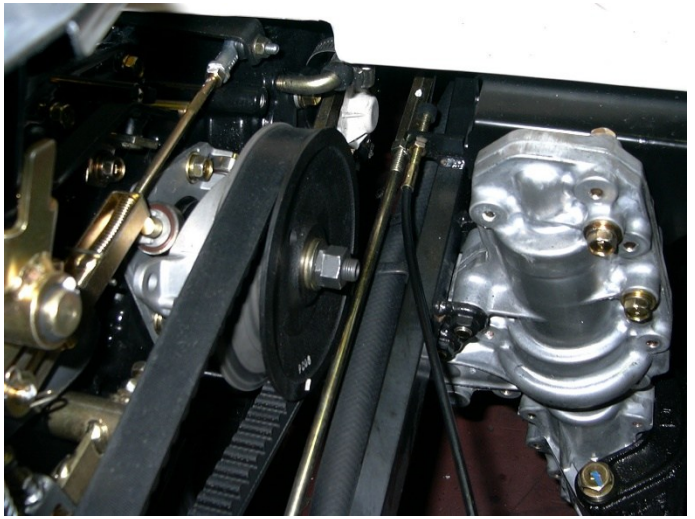
HLN used in Agricultural Machinery



Transmission gear shaft for Cultivator M16 Thin S45C

Tyne for Cultivator M10x1.25 SS400

Bumper for Rice planter Engine
M12 SUS304



Rice planter Engine counterpulley
M12 S45C