



The certified and proven locking nut for RAIL TRACKS & TRAIN CARS applications

Where you can find the advantage of HARDLOCK Solutions:

- (1) Switching from welding to improve workability of maintenance
- (2) Difficult to re-tighten or inspect the bolted joints once they are installed
- (3) Strict safety is required
- (4) Joints are not or very small preloaded
- (5) Necessary to retrofit to existing bolts

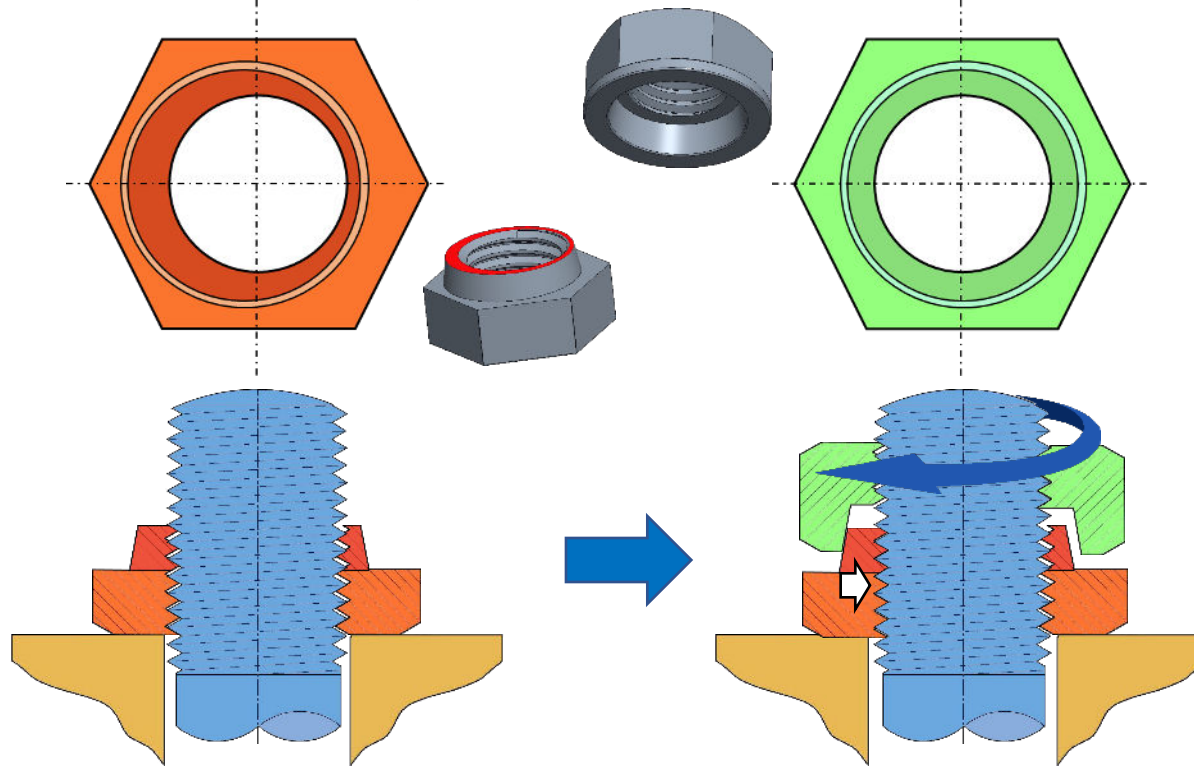


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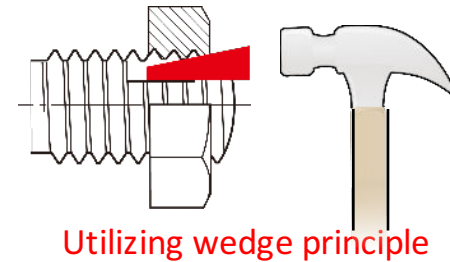
Structure of HARDLOCK Nuts

HLN consists of two nuts,



The first nut **Convex Nut** (clamping nut) has an eccentric 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 second nut **Concave Nut** (locking nut) is designed with a concentric 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.



The shear stress generated by HARDLOCK mechanism is proven by the finite element analyses to prevent the bolt loosening.

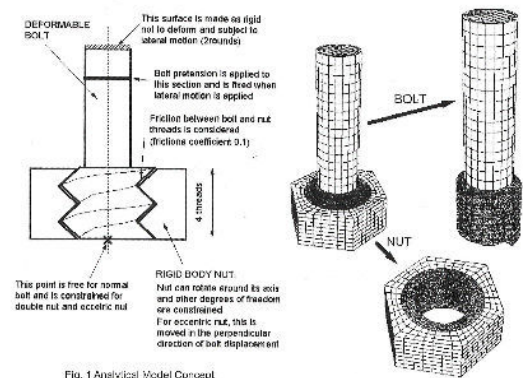


Fig. 1 Analytical Model Concept

Fig. 3 Finite Element Model

2005 ASME Pressure Vessels and Piping Division Conference
July 17-21, 2005, Denver, Colorado USA
PVP2005-71333

Analytical Research on Mechanism of Bolt Loosening Due to Lateral Loads

Toshiyuki SAWA
Yasumasa SHOJI



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Comparison of connecting methods

		Arc Welding	Spot Welding	Adhesive	Bolt/Nut
1	Ease of connecting activity	✗	✗	✓ ✓	✓ ✓
2	Ease of disassembling	✗	✗	✗	✓ ✓
3	Connecting different materials	✗	✗	✓ ✓	✓
4	Strain/deformation	✗	✗	✓ ✓	○
5	Heat resistance	✓ ✓	✓ ✓	○	✓ ✓
6	Airtightness/water tightness	✓	✗	✓ ✓	✗
7	Insulating performance	✗	✗	✓ ✓	✗
8	Vibration resistance	✓	✓	✓	○
9	Time to connect	○	✓	✗	✓
10	Affection on product weight	✓	✓	✓ ✓	✗
11	Cost of facilities	✗	✗	✓ ✓	✓ ✓

HARDLOCK Nut can turn a weakness into a strength.



Poor
 Acceptable
 Good
 Very good



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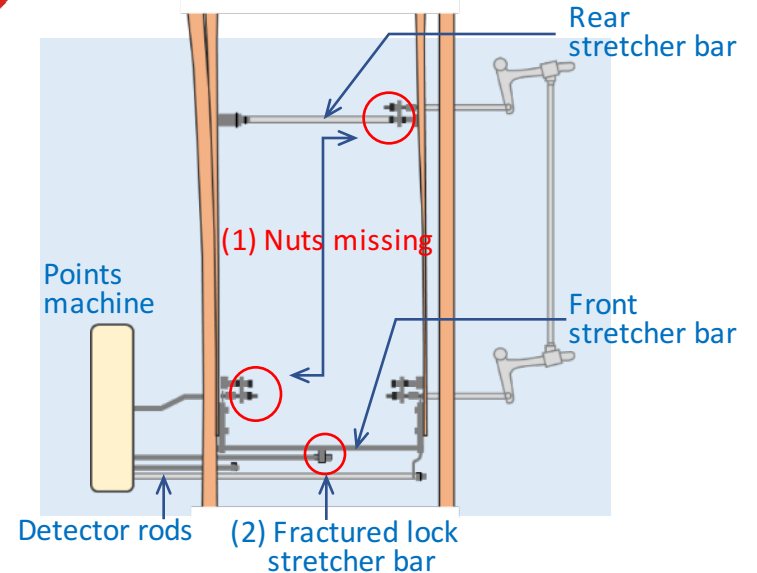
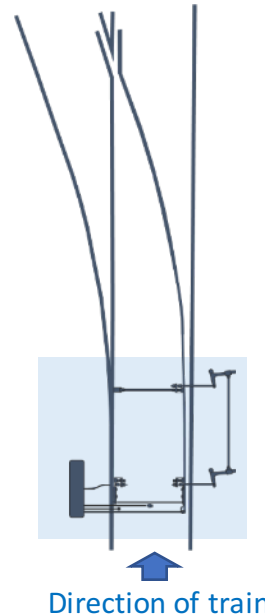
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HARDLOCK Nuts on TRACK (1)

Improvements with **stretcher bars**

(Network Rail & London Underground, UK)

On 10 May 2002 a train travelling from London Kings Cross derailed at Potters Bar when passing over points, causing 7 deaths and injury over 70 people.



From the technical investigation, the derailment was due to the failure of the points contributed by the following factors:

- (1) Nuts to secure the end of the stretcher bar for both rear and front were absent
- (2) The lock stretcher bar failed by fatigue through one of the boltholes

HARDLOCK Nut M30/M20 Class 8

After testing to carry out vibration experiments on stretcher bar assemblies, **Network Rail** has adopted **M30 HARDLOCK Nuts** for adjustable stretcher bars since Oct 2003 and followed by their successful use, **M20 HARDLOCK Nuts** have been used for fixed stretcher bars throughout the UK rail network including **London Underground** since 2008.



Over half a million HARDLOCK Nuts have been installed with 0% failure.



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HARDLOCK Nuts on TRACK (2)

Improvements with jointed track

(Network Rail, UK)



On 12 Jul 2013, a passenger train travelling at about 137km/h derailed on pointwork at the northern end of Brétigny-sur-Orge station, France. Seven people were killed and 32 were injured.



Derailed was caused by the failure of bolted joint of the fishplate, where **three of its four bolts had loosened**. The loose fishplate resulted in the obstruction of the flangeway.

Proactive approach of Network Rail: Loss of pre-load leads to broken bolts and carries a potential derailment risk.

During the period between **2013-2016**, Network Rail took a proactive step and conducted extensive testing on many solutions for suitability for fishplates application, including the final test specific to track conditions.



The final testing stage conducted 250,000 cycles over 16 hours

The results showed HARDLOCK demonstrated the best performance in both static and simulation tests

HARDLOCK solution also offers several cost benefits compared to the current one in use.



Petrol driven machine can only be operated for 8 minutes in every hour



Special cutting machinery is often required for the removal process

HARDLOCK Nut Rim M24/M27 Class 8

Sep 2017: HARDLOCK is given official approval for use on jointed track

No powered equipment is required for installation and removal of HARDLOCK Nuts, which reduces the risk of RSI - Repetitive Strain Injury & HAVS - Hand-Arm Vibration Syndrome as well as the installation time.

In addition, HARDLOCK can be retrofitted to existing bolts.



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HARDLOCK Nuts on TRACK (3)

Improvements with rods locking for switch machines

(New York City Subway)



In late 2017 as a part of modernizing the New York subway, a consultant pointed out that a number of switch machine failures resulted from the loosening of nuts on lock and detection rodding.

HARDLOCK Nuts were tested on the existing machines on site with ensuring initial torque is kept at the Concave nut.

HARDLOCK Nut 3/4", 1", 1 1/4" ASTM A194 2H

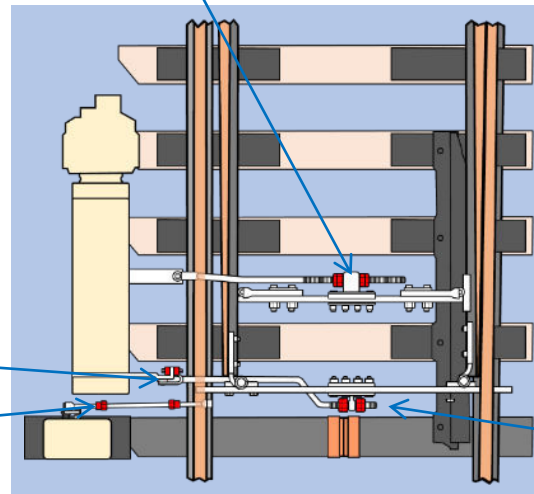
HARDLOCK Nuts are approved for use on all switch machines in service at MTA.



Installed at the training school



Throw Rod (1 1/4")



Model 5 Switch Machine

Lock Rod (Short) (3/4")

Detector Rod (1")



Lock Rod (Long) (1 1/4")



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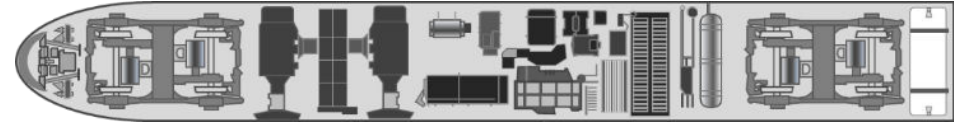


HARDLOCK Nuts on TRACK (4)

Improvements with underfloor equipment mounting
(Japanese Bullet Train: Shinkansen)



HARDLOCK Nuts have replaced **welding** to fix underfloor equipment of Shinkansen since 1992, which makes possible a tremendous amount of reduction in maintenance work after every 750,000 miles running (1.2mil km).



Switched from welding to HARDLOCK



300 Series
Built: 1990 - 1998



700 Series
Built: 1997 - 2006



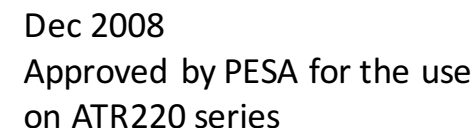
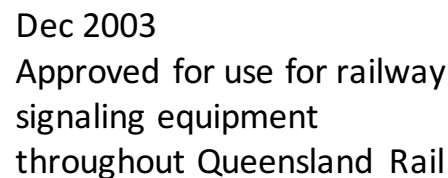
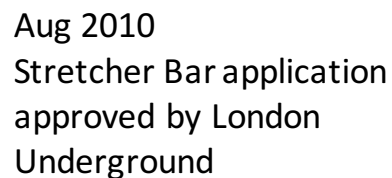
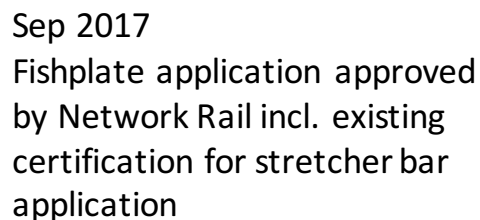
E2 Series
Built: 1995 - 2010



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HARDLOCK Nuts have been given official approval for use on rail tracks and train cars.



HARDLOCK Nuts on RAILROAD CARS (1)

The British Rail 395 Series



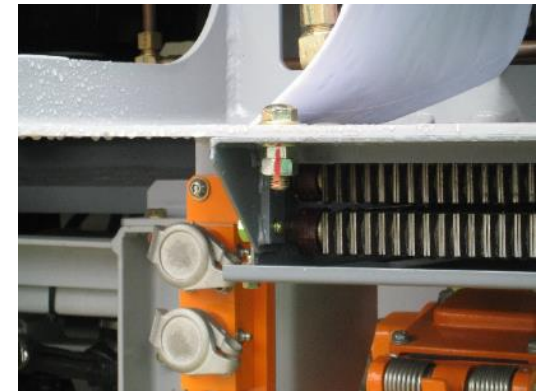
Dual-voltage electric multiple unit(EMU)
Manufacturer: Hitachi
Max speed: 140mph (225km/h)
Operator: Southeastern
Number of Built: 29
Year Built: 2007 - 2009
Cars per Set: 6



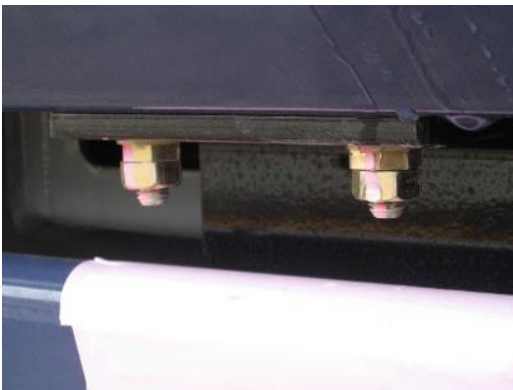
Coupler base M36 Class 10



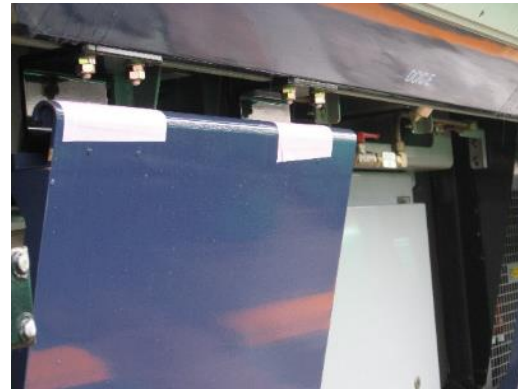
M12/M16



M12



Cover plate holder M10 Class 4



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HARDLOCK Nuts on RAILROAD CARS (2)

West Japan Railway 225 Series



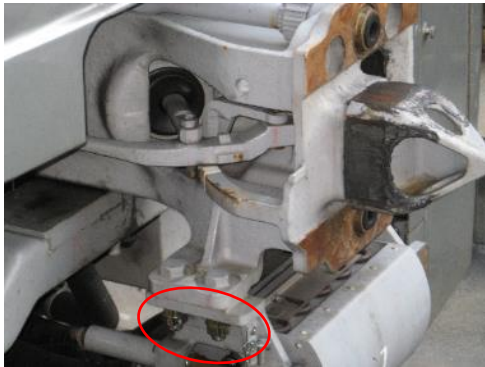
Dual-voltage electric multiple unit(EMU)

Max speed: 81.3mph (130km/h)

Operator: West Japan Railway (JR-West)

Manufacturer: Kawasaki Heavy Industries, Kinki Sharyo

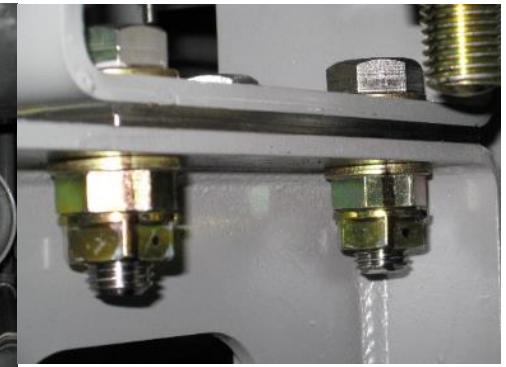
Year Built: 2010 -



Coupler M20



Coupler Hanging Block M20



Equipment Hanging M20



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HARDLOCK Nuts on RAILROAD CARS (3)

Taiwan High Speed Rail (THSR) 700T



Electric Multiple Unit (EMU) train derived from the Japanese Shinkansen family
Entered service: 2007
Operator: Taiwan High Speed Rail Company
Max speed: 186mph (300km/h)



Coupler M33 Class 4



Cover Plate Holder M10 Class 10



Equipment Hanging Underside M10 - M30, Class 4, 8, A2



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HARDLOCK Nuts on RAILROAD CARS (4)

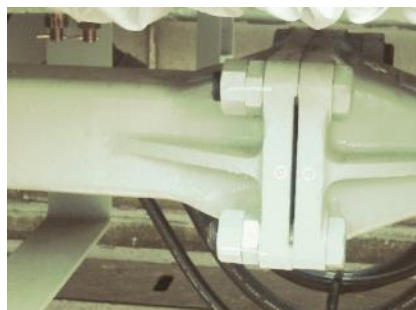
Various types of Shinkansen



Car manufacturers:

Kawasaki Heavy Industries
Mitsubishi Heavy Industries
Nippon Sharyo
Kinki Sharyo
Japan Transport Engineering
Hitachi
Niigata-transys

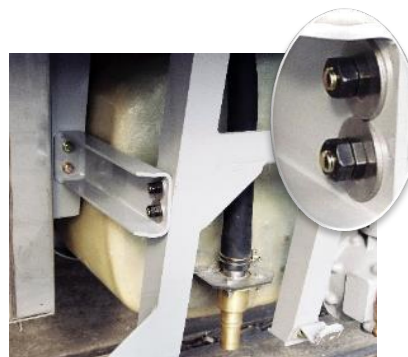
Equipment Mounting (to fix hanging bolts)
M10~30 C4, C8, A2



Coupler
M33 C4



Bearing Box
M20 C8



Fixing train car equipment
M6, M8 C4



Cover Plate Holder
M10 C4



Windshield Wiper
M16 C4 CR3 Black

Quantity of HARDLOCK Nuts
used on one car (E5 series)

Size	Material	Qty
M6x1.0	SS400	150
M8x1.25	SS400	280
M10x1.5	SS400	4,000
M16x2.0	SS400	580
M18x2.5	SS400	20
M20x2.5	SS400	700
M30x3.0	S45C	40
M6x1.0	SUS304	80
M12x1.75	SS400	1450



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