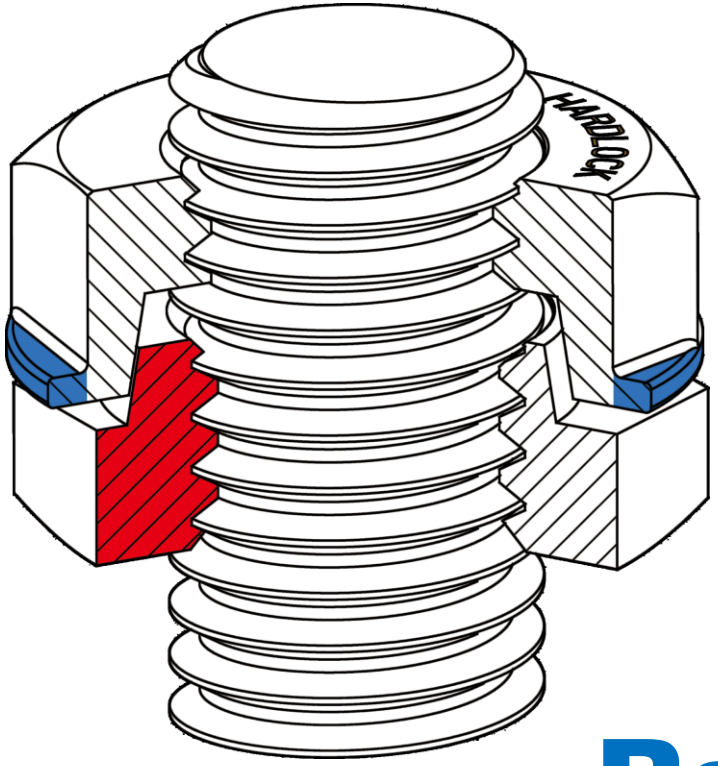
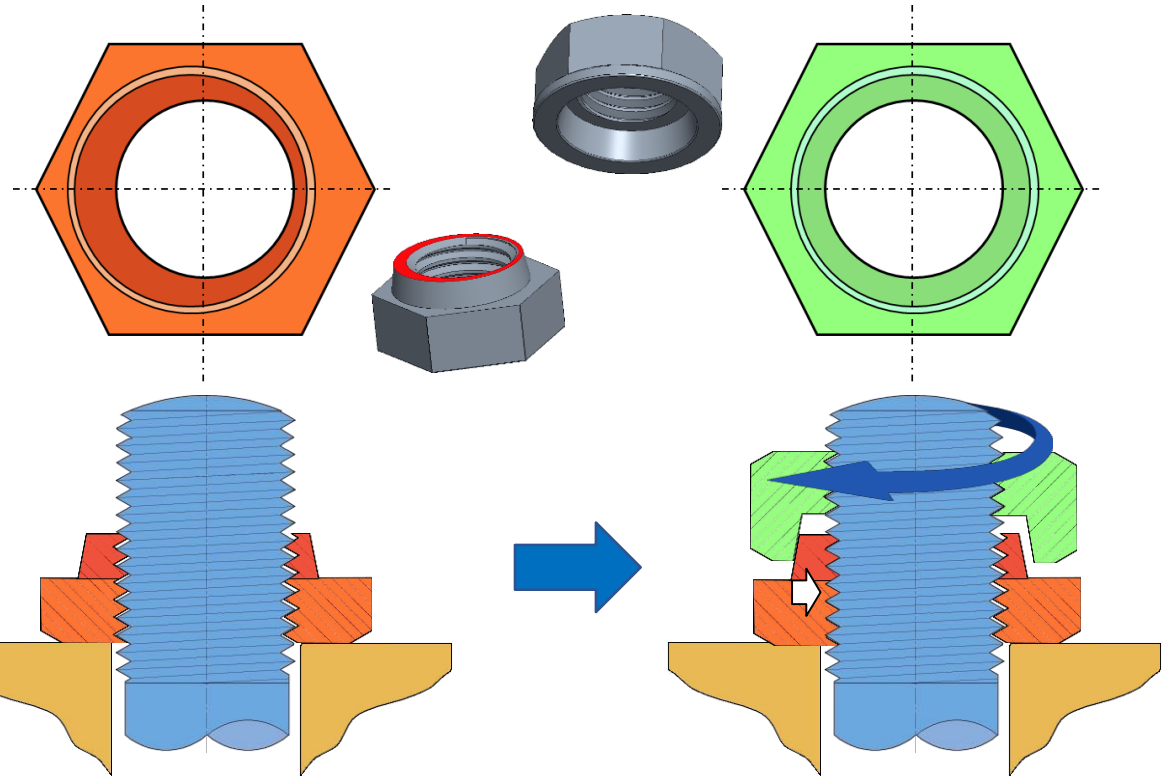


HARDLOCK®
Solution

Rail Tracks & Train Cars Applications

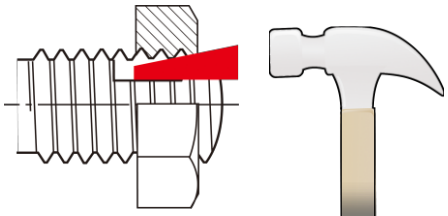
Structure of HARDLOCK Nuts

HLN consists of two nuts,



The first nut **Convex Nut** (clamping nut) has an eccentric protrusion on the upper surface

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



Utilizing wedge principle

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

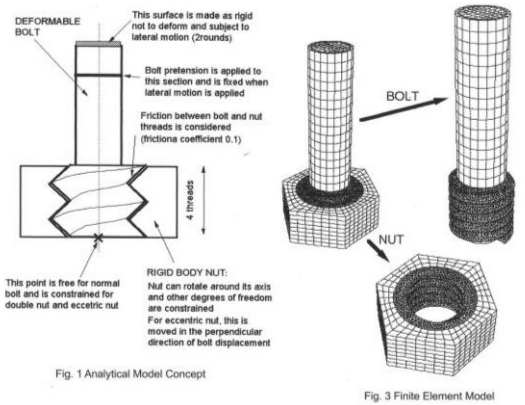


Fig. 1 Analytical Model Concept

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

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. → ✓✓

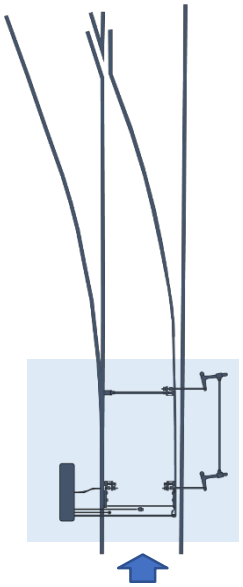
✗ Poor ○ Acceptable ✓ Good ✓✓ Very good

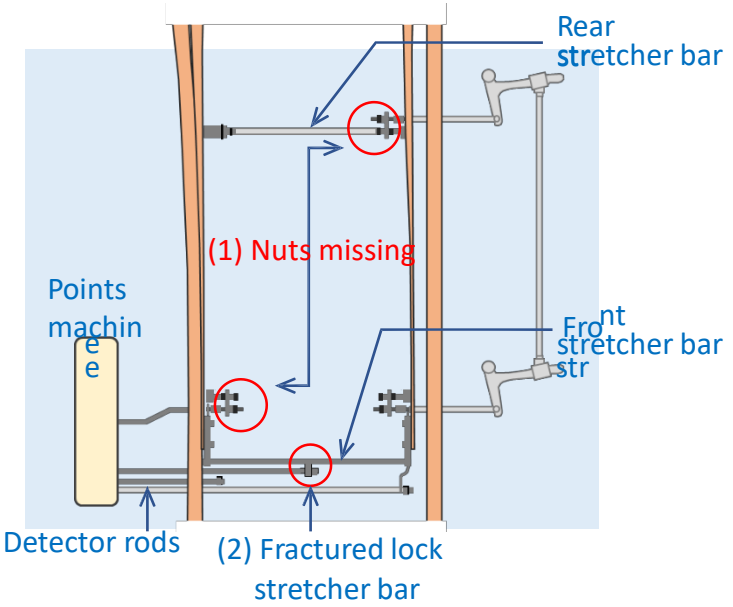
HARDLOCK Nuts on TRACK (1)

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 7deaths 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.

Safety is power!

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.

Derailment 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.

HARDLOCK Nuts on TRACK (3)

Improvements with **rods locking for switch machines**

(New York City Subway)

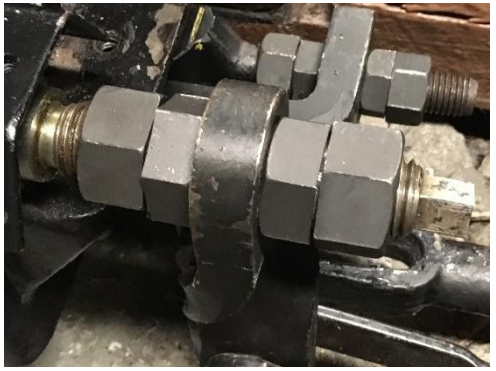
In late 2017 as a part of modernizing the New York subway, a consultant pointed out that a number of switch machine failures resulted from the loosening of nuts on lock and detection rodding.

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

Installed at the training school

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

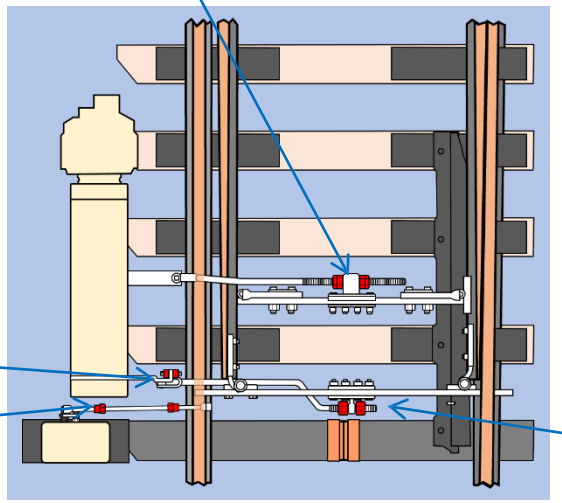
HARDLOCK Nuts are approved for use on all switch machines in service at MTA.



Throw Rod (1 1/4")

Lock Rod (Short) (3/4")

Detector Rod (1")



Model 5 Switch Machine

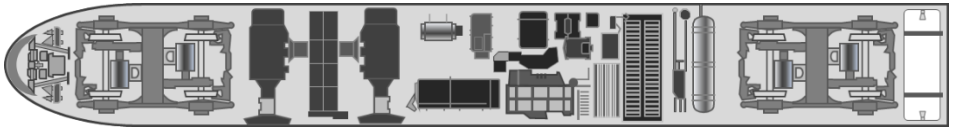
Lock Rod (Long) (1 1/4")

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 750,000miles running (1.2mil km).

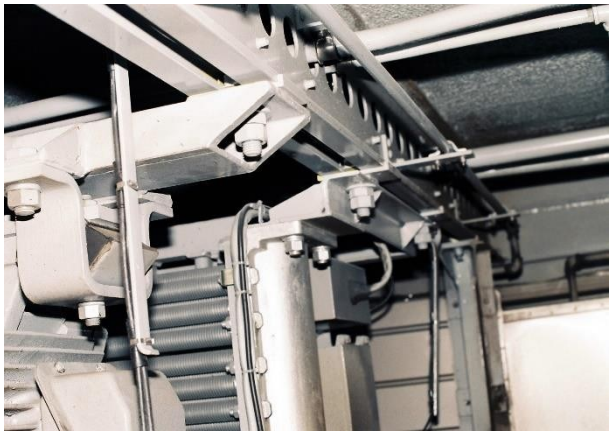


Switched from welding to HARDLOCK

300 Series
Built: 1990 - 1998

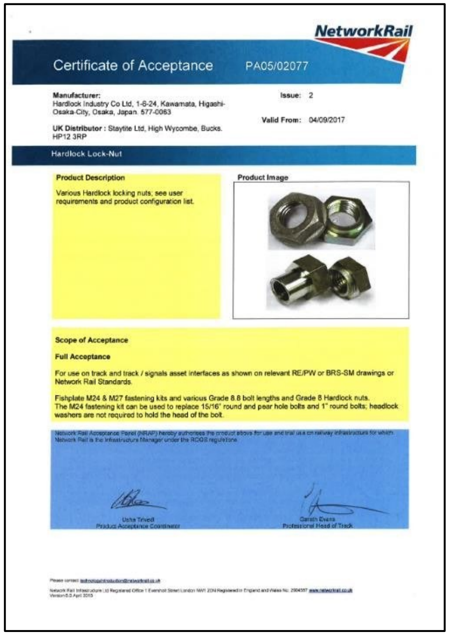
700 Series
Built: 1997 - 2006

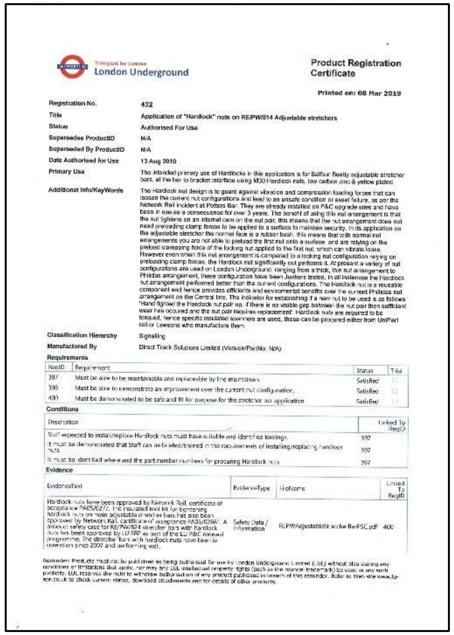
E2 Series
Built: 1995 - 2010

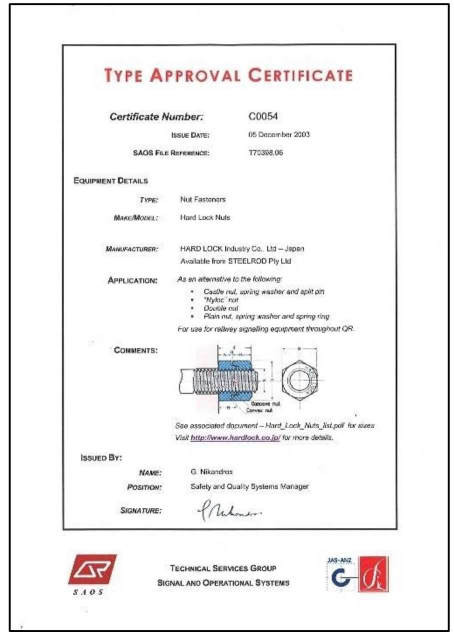


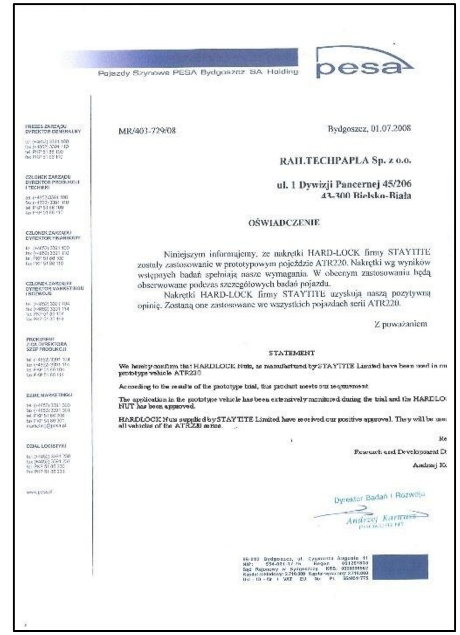
Certificate and Approvals

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


NetworkRail
Certificate of Acceptance PA05/02077
Hardlock Lock-Nut
Product Description
Product Image
Scope of Acceptance
Full Acceptance


London Underground
Product Registration Certificate


TYPE APPROVAL CERTIFICATE
Certificate Number: C0054
Issued By:
TECHNICAL SERVICES GROUP
SIGNAL AND OPERATIONAL SYSTEMS


pesa
RAILTECHPAPLA Sp. z o.o.
OŚWIADCZENIE
STATEMENT

Sep 2017
Fishplate application approved by Network Rail incl. existing certification for stretcher bar application

Aug 2010
Stretcher Bar application approved by London Underground

Dec 2003
Approved for use for railway signaling equipment throughout Queensland Rail

Dec 2008
Approved by PESA for the use on ATR220 series

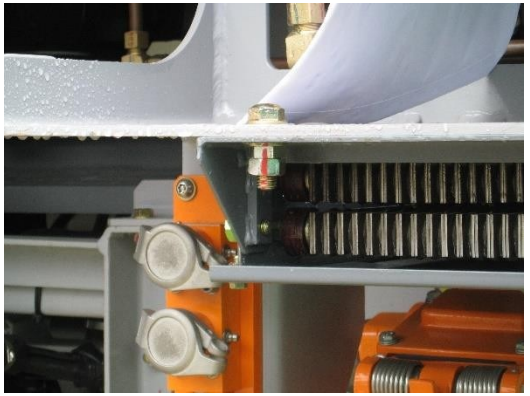
HARDLOCK Nuts on RAILROAD CARS (1)

The British Rail 395 Series

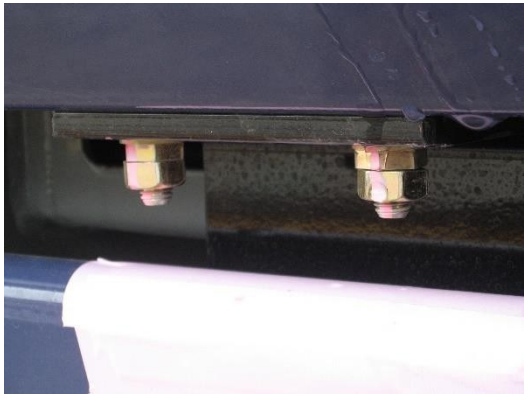
Dual-voltage electric multiple unit(EMU)
Manufacturer: Hitachi
Max speed: 140mph (225km/h)
Operator: Southeastem
Number of Built: 29
Year Built: 2007 - 2009
Cars per Set: 6

Coupler base M36 Class 10

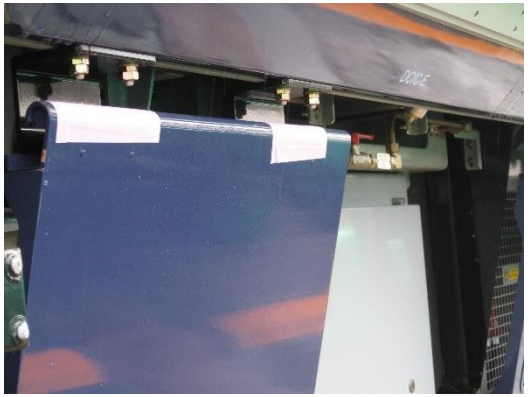
M12/M16



M12



Cover plate holder M10 Class 4

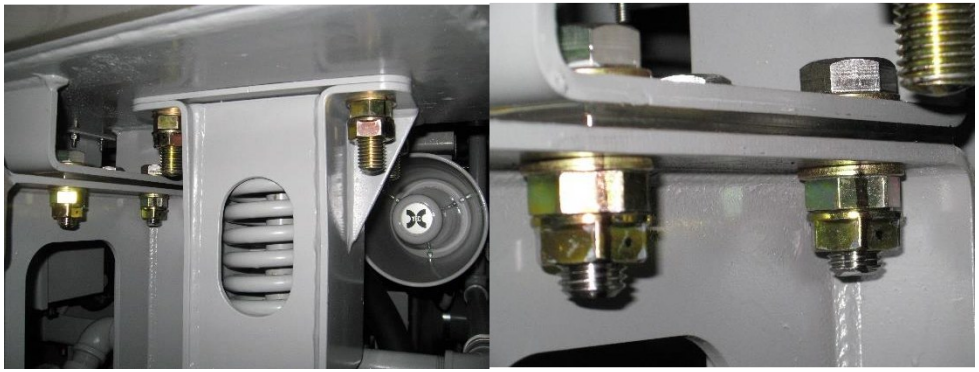


HARDLOCK Nuts on RAILROAD CARS (2)

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

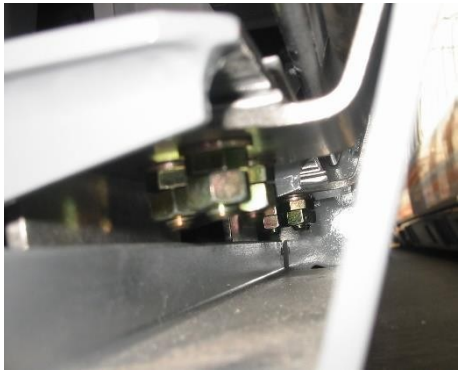
Equipment Hanging M20

HARDLOCK Nuts on RAILROAD CARS (3)

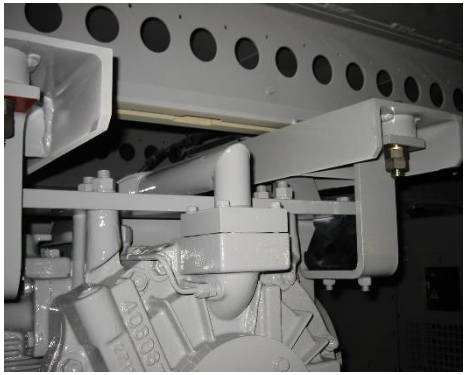
Taiwan High Speed Rail (THSR) 700T

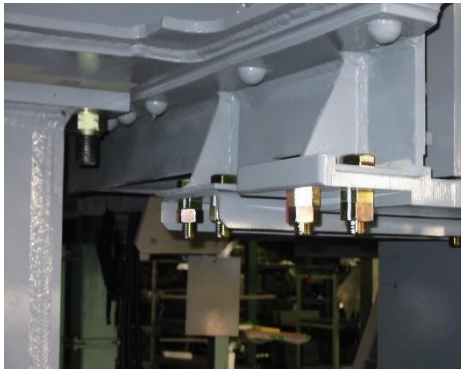
Electric Multiple Unit (EMU) train derived from the Japanese Shinkansen family
Entered service: 2007
Operator: Taiwan High Speed Rail Company
Max speed: 186mph (300km/h)

Coupler M33 Class 4



Cover Plate Holder M10 Class 10





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