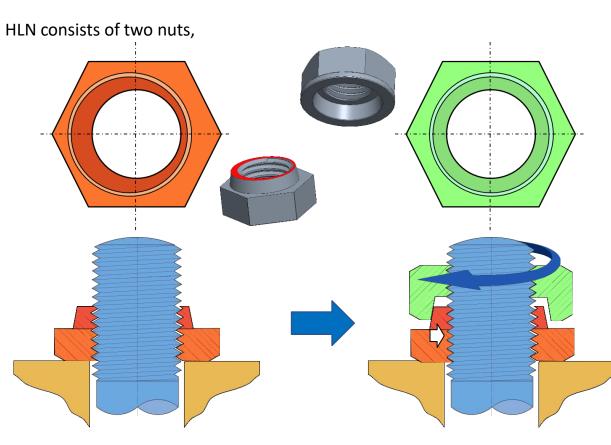




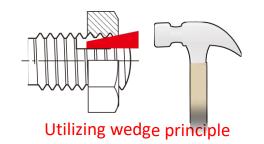
Rail Tracks & Train Cars Applications

Structure of HARDLOCK Nuts

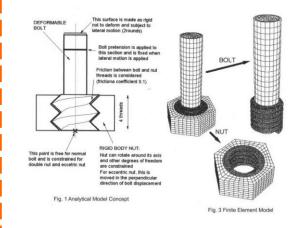


The first nut **Convex Nut** (clamping nut) has an eccentric protrusion on the upper surface

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



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



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





		Arc Welding	Spot Welding	Adhesive	Bolt/Nut	
1 Ease of co	nnecting activity	×	×		/	
2 Ease of dis	assembling	×	×	×	V V	
3 Connectin	g different materials	×	×	✓ ✓	V	
4 Strain/defo	ormation	×	×	✓ ✓	0	
5 Heat resist	tance	V	 Image: A start of the start of	0		
6 Airtightnes	ss/water tightness	Image: A start of the start	×	✓ ✓	×	HARDLOCK Nut can turn a weakness into
7 Insulating	performance	×	×		×	a strength.
8 Vibration r	resistance	Image: A start of the start	~	Image: A start of the start	0	🔶 🔽 🔽
9 Time to co	nnect	0	~	×	Image: A start of the start	
10 Affection of	on product weight	V	~	✓ ✓	×	
11 Cost of fac	ilities	×	×			
X Poor	Acceptable	/ Good	Very go	ood		





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.



HARDLOCK Nut M30/M20 Class 8

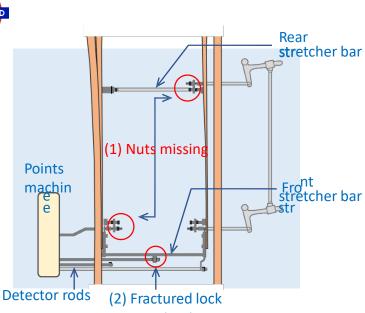
After testing to carry out vibration experiments on stretcher bar assemblies , Network Rail has adopted M30 HARDLOCK Nuts for adjustable stretcher bars since Oct 2003 and followed by their successful use, M20 HARDLOCK Nuts have been used for fixed stretcher bars throughout the UK rail network including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

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



NetworkRail

UNDERGROU



stretcher bar 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 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 **Brétignysur-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.



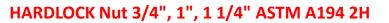


HARDLOCK Nuts on TRACK (3) Improvements with rods locking for switch machines (New York City Subway)



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.



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

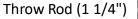


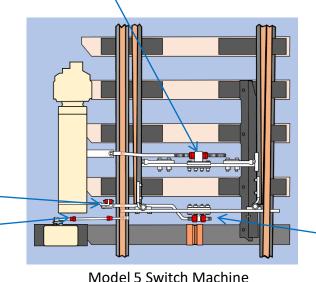


Installed at the training school



Lock Rod (Short) (3/4") Detector Rod (1")







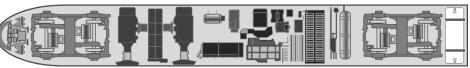
Lock Rod (Long) (1 1/4")





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

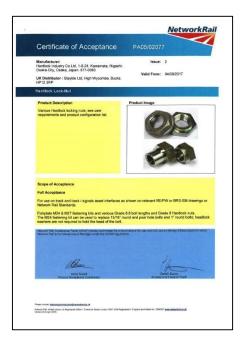




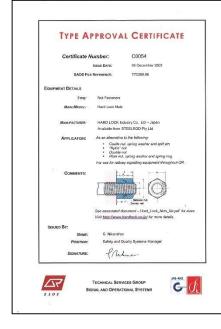


Certificate and Approvals

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



London L	Underground	Certifie	ct Registr			
		Printe	d on: 08 Mar	20		
Registration No.	432					
Title	Application of "Hardlock" nuts on RE/PWIS14 Adjustable stretchers					
Steb.es	Authorised For Use					
Supersedes ProductD	N/A					
Supanseded By ProductiD	N/A					
Data Authorised for Use	13 Aug 2010					
Primary Use	The intended primery use of Handlocks in this application is for Balfour Beetly adjustable strate bars, all he ber to bracket interface using M30 Handlock nuits. Iso cetters zing à yellow plated					
	near previoubing clamp times to be experied to a low adjustate better than an one life is a nut- warepresent you are not all is previous the the previous comparing times of the low relation that applies previous comparing that and the low tool to the previous comparing the low the therefore not appli- relation of the low tool to the low tool to the clamp of the low tool to the low tool to the clamp of the low tool to the low tool to the clamp of the low tool tool to the low tool clamp of the low tool tool tool to the low tool clamp of the low tool tool tool tool tool tool tool clamp of the low tool tool tool tool tool tool tool	ther bush, this means that 24 full of the 4 surface and ad in the first nut, which as mparied to a tacking nut ac fiscally out performs it. As 6 senging from a thick, the been jumkers instant, the hid configurations. The He revocemental benefits as a performation for asset	with normal rul are retying on 1 m vibrate losse migutation rely present a verse in tut amangem li halance he milock tut is a rulock tut is a the ourget Phill Up be used is a	he rg c y of Hard toos klass		
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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





Coupler base M36 Class 10



Cover plate holder M10 Class 4



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



M12/M16





M12





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









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



Sa<u>fety is nower</u>

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









