

Rolling a Low-Cost Lock Bolt

by:

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An invitation to look at a new solution to the old problem of bolt loosening — request to roll and sell it under a licensing arrangement.

We might think there are no technical improvements left to be made on a bolt. But let's think again—what about the problem of loosening? It is a fact of mechanical life that bolts loosen. Many techniques for keeping bolts tight have appeared. From the point of view of practical usage, cost effectiveness and the ability to truly prevent loosening, making better bolts is an old, but new problem.

Nissei invites you to look at its fresh solution, the PLBv2. PLBv2 (Perfect Lock Bolt, version 2) relies on double nuts and multiple threads rolled onto a single shaft.

For fasteners such as bolts, loosening is the enemy. The need for periodic tightening and problems arising when bolts need to be replaced or re-used is common. In the battle against loosening, many solutions have been attempted—all, until now, mediocre. Relying on friction to prevent bolts from loosening is not good enough. A mechanical solution built into the structure of the bolts is what is needed.

Principles and Features of PLBv2

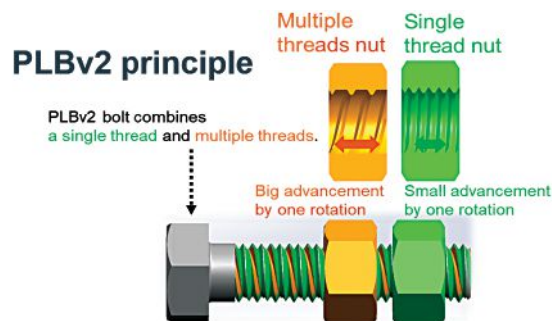
Here is one mechanical method to protect against loosening. Roll the lead of each bolt with two different threads, then add one nut to follow each thread. Because the lead that the inner nut follows is bigger than the one for the outer nut, when vibration inevitably makes the nuts start to rotate loose, the inner nut will be blocked by the outer nut. This is because the lead followed by the outer nut is more closely-packed, and so the outer nut must rotate more slowly. This is mechanical blocking.

High Lock Performance

The lock bolt that Nissei has developed and named PLBv2 has been tested and conforms to international standard *ISO16130*. For the specified vibration criterion relative residual clamp force of 2000 cycles, other companies' products received a rating of "Acceptable loss of clamp force", which in *ISO16130* terms means they perform adequately from 85% at best to 40% of the time. PLBv2 is rated *ISO16130* "Good self-locking behaviour", meaning performance is good 93% of the time.

Practicality & Ease of Use

A major value of PLBv2, above and beyond its lock properties, is practicality in actual use. By tightening the outer nut, the inner nut is also tightened. Both nuts, one action. With ordinary double nuts, each nuts must be tightened individually. With PLBv2, the inner nut follows the outer nut naturally. It is like having to fasten only one nut instead of two. No PLBv2-specific tools are required, ordinary tools do the job. Ease and practicality in usage are additional advantages of PLBv2.



Manufacturing Method

How to mass produce bolts with two separate and distinct threads? It cannot be done reliably by cutting threads into the bolt shaft, but it can be done with thread rolling. Nissei, an innovative maker of rolling machinery located in Yamanashi Prefecture in Japan, has tackled this problem to produce uniform and reliable bolts that cannot be loosened by normal vibration: PLBv2.

Machines that could make dies capable of rolling a complicated pattern were not readily available when we started our Perfect Lock Bolt project, in 2018 we used round dies, then in 2019 we tried plane-type flat dies, developing new techniques one after the other. By 2020, our focus was on shortening the time it takes to make the bolts. We envisioned planetary dies as the means to this end. All in all, it has taken 15 years to reach the level at which our machines can roll two kinds of threads—simultaneously—on one lock bolt.



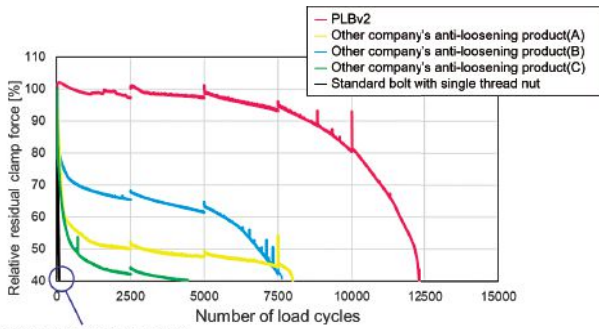
Evaluation Tests

Nissei have tested to quantitatively evaluate the combined results of lock performance and workability under *ISO16130*, which are important for users to use.

Testing Machine: Junker Test Bench
(J120T, Vibrationmaster)

Test Fastener Specifications
Nominal designation of thread: M12
Material: AISI-4135
Strength class: 10.9

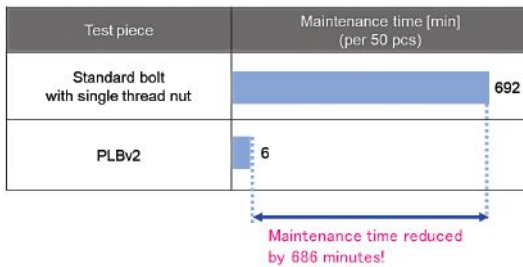
Vibration Test Conditions
Frequency: 12.5
Amplitude: ± 0.8
Lubricant: Rust inhibitor



Standard bolt with single thread nut lost clamp force(0%) at 74 load cycles

Test piece	Number of load cycles when loose
Standard bolt with single thread nut	74
PLBv2	12290
Other company's anti-loosening product(A)	8010
Other company's anti-loosening product(B)	7641
Other company's anti-loosening product(C)	4439

Test piece	Number of load cycles when loose	Number of times retightening (based on PLBv2)	Retightening time[s]	Maintenance time [min] (per 50 pcs)
Standard bolt with single thread nut	74	166	5	692
PLBv2	12290	1	7	6



Vibration Test Procedure

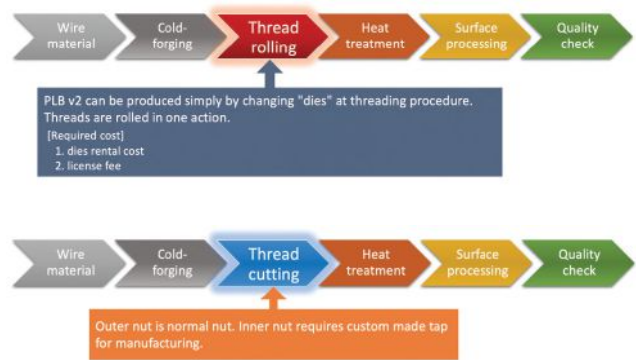
1. The test is conducted with a torque value of 42 Nm and a number of load cycles (N=2500).
2. Measure the initial axial force at the point of the reference torque of 42 Nm, and end the test when the force is 40% or less of the initial axial force.
3. Measure the number of load cycles at the end of the test.

The test results show that the PLBv2 did not loosen until 12290 cycles while the standard bolt loosened after 74 cycles. In other words, we can evaluate that the PLBv2 can save 166 times of retightening compared to the standard bolt.

Another major differentiating factor is that the PLBv2 has more than 80% residual axial force for up to 10000 cycles, whereas other company's anti-loosening products show a significant drop in residual axial force after 2500 cycles of vibration.

The table above also shows the results of multiplying the number of retightening cycles based on PLBv2 by the time and number of bolts to be retightened (50 pcs).

It is clear that the PLBv2 contributes to a significant reduction in maintenance costs compared to standard bolts.



In conclusion, the PLBv2 offers a significant reduction in labor costs due to its superior lock performance and ease of use compared to standard screws and other company's anti-loosening products.

Do You Want To Be a PLBv2 Producer in Your Area?

Nissei is not a bolt manufacturer, but a machine manufacturer of cylindrical die form rolling machines.

We can manufacture and sell PLBv2, but we have no experience in selling bolts. Therefore, it takes a lot of preparation for sales development.

In order to spread this safety assurance technology around the world as quickly as possible, we have decided to adopt a business model where we do not mass produce and sell PLBv2, but provide bolt manufacturers with the license to manufacture and sell it.

Bolt manufacturers can use the optional form rolling dies rented from us to manufacture PLBv2 in the same process as normal bolts with their existing production facilities.

Therefore, there is no need to introduce new machinery, and initial costs can be reduced.

For Further discussion, contact the author at Nissei in Japan or visit the company's website.

<https://www.nisseiweb.co.jp/e/products.php?page=plbv2>



Company Profile:

As form rolling professionals, **Nissei Co., Ltd.**, a Japan-based a joint-stock corporation, specializes in form rolling. Nissei takes pride in developing form rolling technology as the backbone of 21st century industry. The company will continue to raise the bar to the highest standards, and in so doing, contribute to society through win-win relationships with its clients. The company manufactures and/or sells the following brands of form rolling machines: **Comet, Galaxy and Aries**. The Nissei slogan is "Make each day's work sparkle with joy and excitement."

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