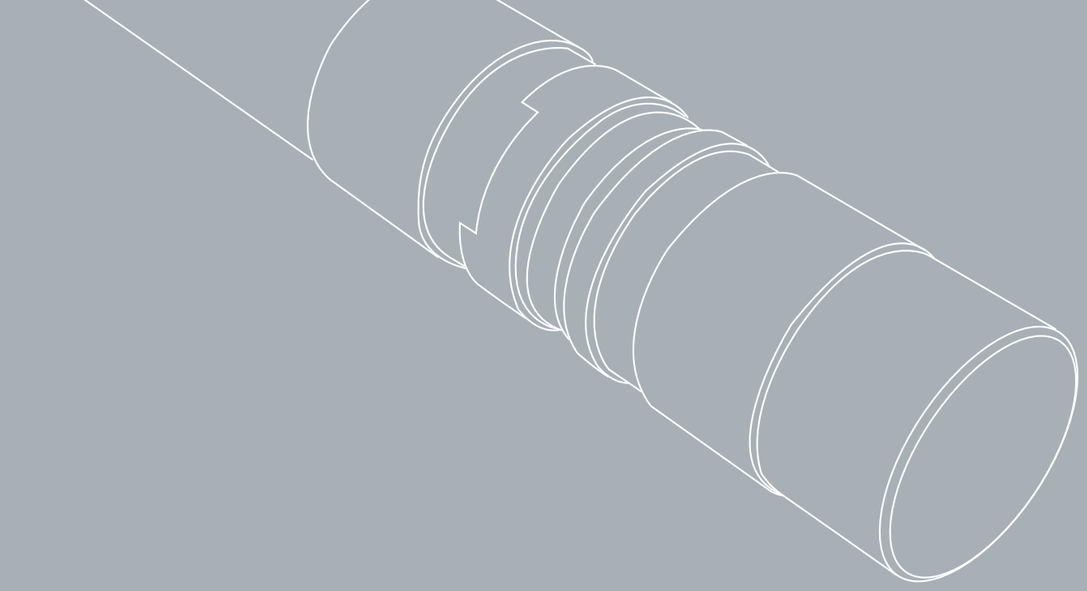
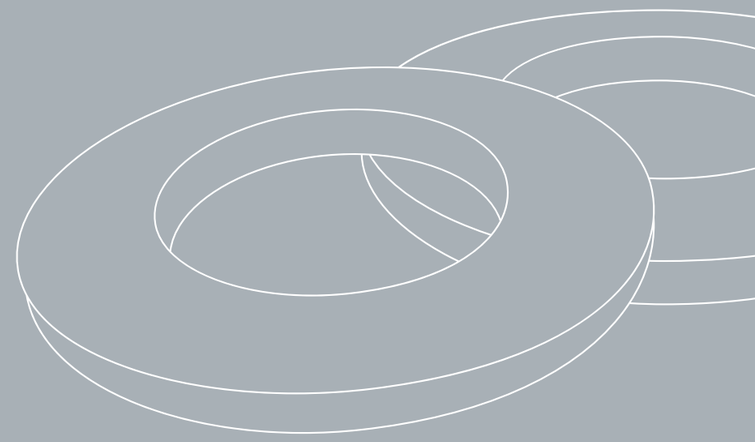


TOKAISPRING

Disc springs for the main spindle on machining centers

www.tokaibane.com

i-MC Compact



TOKAISPRING

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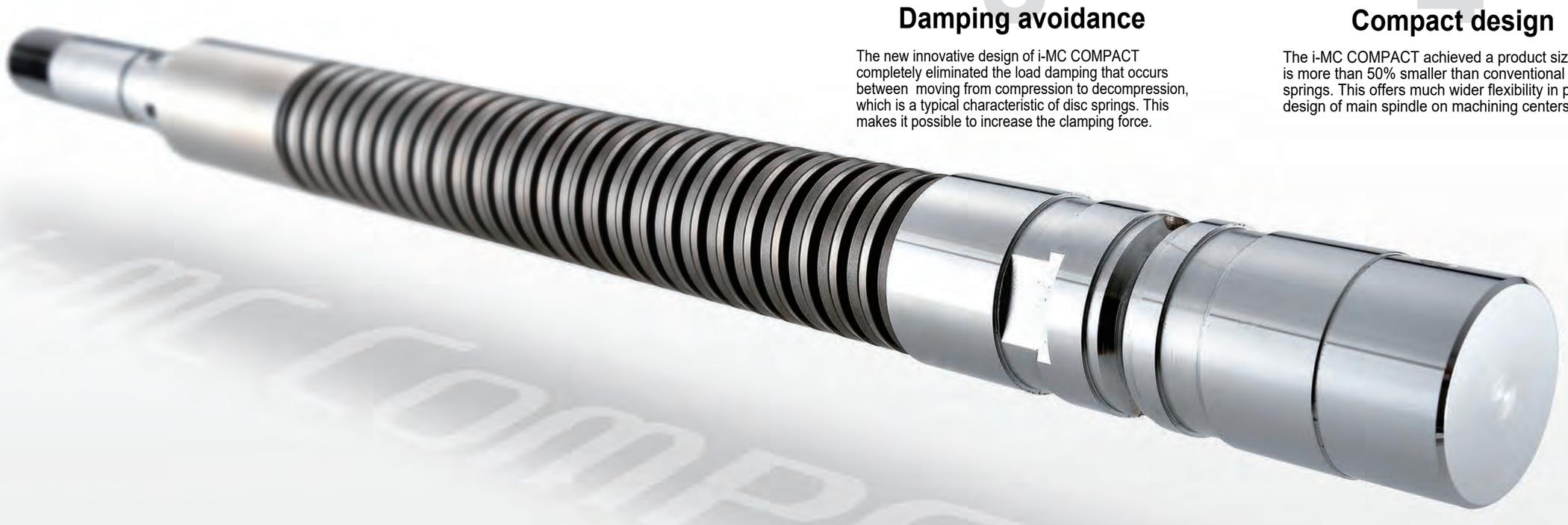
The ultimate main spindle disc spring

i-MC COMPACT

i-MC spring series has established a strong trust and reputation as disc springs for the main spindle on machining centers among manufacturers. i-MC COMPACT is a new and innovative product of i-MC spring series.
Long-life performance, compact performance and balance performance.
In all of these aspects, this new product achieves the ideal form of disc springs for the main spindles on machining centers.



6 million times

Longer lifespan

The i-MC COMPACT achieved product lifespan at least three times longer than conventional disc springs. This makes more than 6 million usage possible.

50%

Compact design

More than 50% smaller in size of i-MC COMPACT compared with the previous i-MC springs requires much smaller spaces for main spindles.

65%

Balanced performance

The i-MC COMPACT can support ultra-high-speed rotation with only 65% of imbalance of conventional disc springs. In addition, even after 2 million usages, there is almost no deterioration in balanced performance.

70 models

Wide range of adoption

Since the launch of the i-MC COMPACT five years ago, it has been adopted for more than 70 different machining center models.
(As of April 2016)

i-MC COMPACT

Four performance factors

1

Longer lifespan

The i-MC COMPACT offers more than three times longer lifespan compared with conventional disc springs available today. This long lifespan of the product is ideal for mains spindle of machining centers.

2

Balanced performance

The i-MC COMPACT offers high performance and efficiency. The i-MC COMPACT offers the ultimate balanced performance to even at ultra-high-speed rotation.

3

Damping avoidance

The new innovative design of i-MC COMPACT completely eliminated the load damping that occurs between moving from compression to decompression, which is a typical characteristic of disc springs. This makes it possible to increase the clamping force.

4

Compact design

The i-MC COMPACT achieved a product size that is more than 50% smaller than conventional disc springs. This offers much wider flexibility in product design of main spindle on machining centers.

Creating the ultimate disc spring for main spindles

Excellence in research, development, testing and technical support

Tokai spring continues its research, development and testing to make the i-MC COMPACT an ultimate disc spring for main spindles on machining center.

We also provide an engineering support for designers of machining center manufacturing.

Industry's first! Testing facilities dedicated to main spindle disc springs

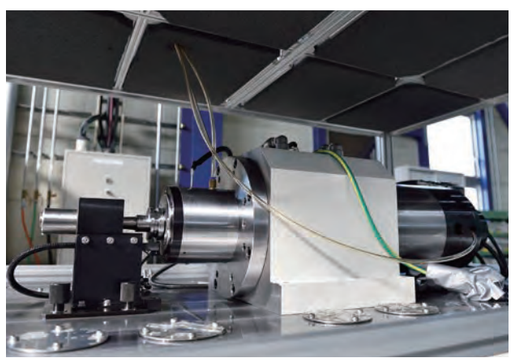
Testing equipment that replicate operational environments close to real work situation as possible

Dedicated fatigue testing equipment

Investigating the mechanisms of breakage

There were cases that a disc spring that did not break in repeated testing on general spring fatigue testing equipment easily broke in real working situations.
We identified that the mechanisms and operations applied in a fatigue testing equipment were significantly different compared with the actual conditions inside a machining center. To solve this problem, Tokaibane developed and installed dedicated fatigue testing equipment that replicate the actual operational environ-ments inside the main spindles of machining centers.
This made it possible to investigate the true mechanisms of disc spring breakage in the main spindles on machining centers. Based on this analysis, we developed a system to evaluate the effectiveness of countermeasures against the potential breakage.

High-speed rotation testing equipment

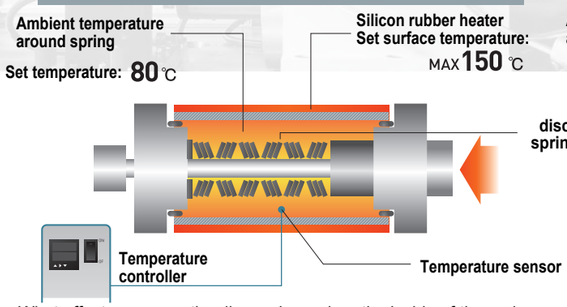


Complete replication of the high speed rotation and compression operations

The disc springs in the main spindles on machining centers are not only subjected to repeated compression operations but also high speed rotation. It was assumed that the rotation operation will not affect the lifespan or performance of the disc springs. However, we assumed that movement of the lubrication grease due to the centrifugal force resulting from the rotation would have had an effect on the disc spring performance and/or lifespan of the disc springs. With this assumption, Tokaibane developed and installed a dedicated disc spring fatigue testing equipment that can replicate the actual rotation operation (MAX 20,000 min^{-1}).
This equipment enabled us to test disc springs replicating the actual high speed rotation and compression in real work situation.

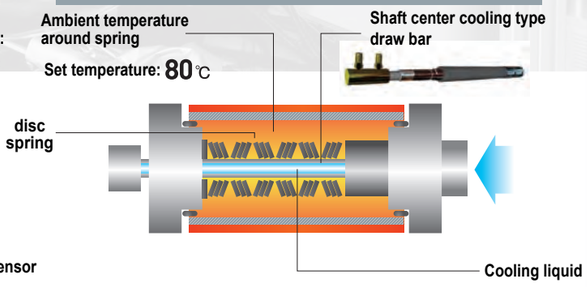
Research and development specifically for disc springs for main spindles

Fatigue testing under the high temperature environment



What effects occur on the disc springs when the inside of the main spindle of a machining center reaches a high temperature? What response measure should be taken in that case? To solve issues such as these, Tokaibane can implement fatigue testing with reproduction of the high temperature environment. We then make proposals that accurately describe those effects and their countermeasures.

Fatigue testing under the condensation environment



How are disc springs affected by the condensation that forms inside the main spindle of a machining center? This was also a big question.
Tokaibane can also implement fatigue testing that reproduces this condensation environment.
Proposals can be made for any assumed conditions.

Surface treatment on draw bar

A draw bar is an integral part to be used with disc springs. The quality and surface treatment of the bar has a significant effect on the disc spring performance. What is the optimal surface treat-ment of draw bars? Tokaibane applied its accumulated data of its fatigue testing to identify the most effective surface treatment of the bar. We propose the surface treatment for draw bars that will maximize the i-MC performance.

Comparative testeing of grease

Another important factor in disc spring performance is a selection of the grease to lubricate disc springs.
What is the optimal grease to be used inside the main spindle of a machining center? We propose the optimal grease based on the knowhow we have obtained through repeated comparative tests on each product.

Research specifically about machining centers to achieve even longer life

Research on draw bar profiles

Even though a cylindrical rod profile is seen natural, Tokaibane thought there is a potential improvements. We found from testing that there is a possibility of dramatically improving the lifespan of disc springs by using draw bars with special cross-sections that are not circular. We have a belief that there is a potential to increase lifespan of disc springs. Tokaibane will keep working to achieve this goal. Please wait for a news!

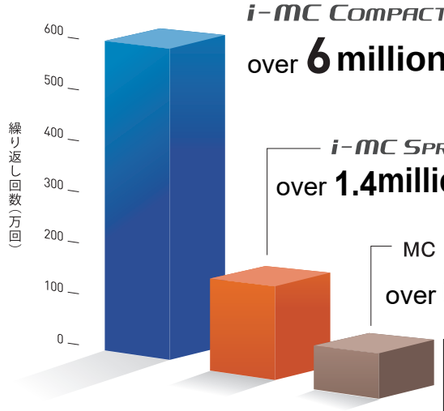
Creating the ultimate disc spring for main spindles

The ultimate disc spring for main spindles - Proof of evidence

Tokai spring believes that the i-MC COMPACT is the ultimate disc spring for main spindles on machining centers. Here are the reasons why!

The capability appropriate for the ideal form of main spindle disc springs

Remarkable long lifespan of i-MC COMPACT



i-MC COMPACT
over **6 million** times

i-MC SPRING
over **1.4million** times

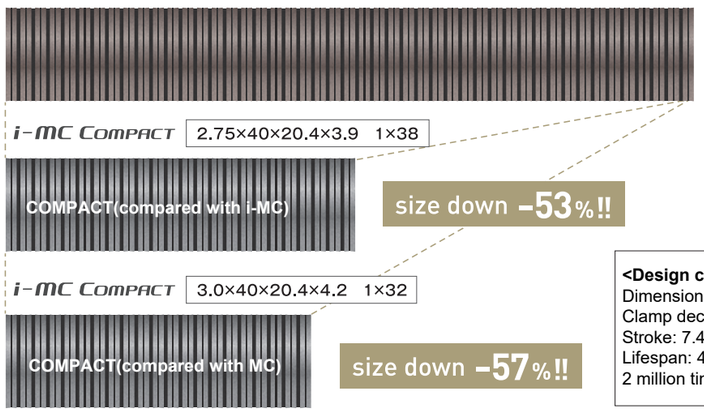
MC disc spring
over **0.7million** times

The figure on the left compares the design lifespans of the MC disc spring conventional machining center disc springs from Tokai spring, the i-MC springs and the i-MC COMPACT. The lifespan of the i-MC COMPACT is more than three times that of the conventional disc springs. It realizes a long lifespan of more than 6 million repetitions.

<Comparison with same dimensions, combination height, load and stroke>
Dimensions: 2 × 40 × 20.4 × 3.1　　Combination: 1 × 30
Clamp load: 3,000 N　　Stroke: 8.0 mm

Significant space saving through compact design

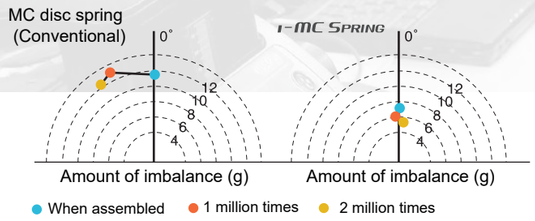
MC disc spring , *i-MC SPRING*　2×40×20.4×3.1　3×44



More than 50% smaller in size of i-MC COMPACT compared with the previous i-MC springs requires. This compact size offers an advantage in performance of on machining centers.

<Design conditions>
Dimensions: Outer diameter ø40 × Inner diameter ø20.4
Clamp decompression load: 8,500 N
Stroke: 7.4 mm
Lifespan: 4 million times (i-MC)
2 million times (MC disc spring)

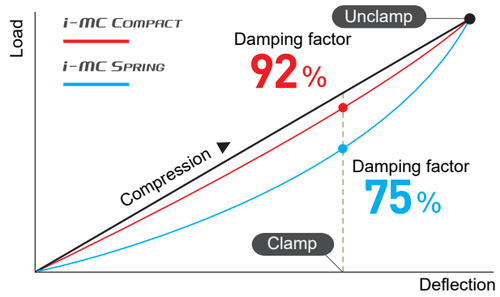
Excellent balanced performance at ultra-high speed rotation



The i-MC COMPACT demonstrate excellent balanced performance on high performance machining centers that require ultra-high-speed rotation. The amount of imbalance is reduced to around 65% that of the conventional Tokai spring disc springs for machining centers (the MC disc springs). In addition, even after 2 million usages the balance characteristic of the spring remains mostly unaltered.

* This data is a comparative measurement of the amount of imbalance on just the disc springs + spindle. It is not the amount of imbalance of the entire unit, which combines a motor, etc.

Thorough elimination of damping during clamping



The i-MC COMPACT eliminates the load damping during compression that occurs with normal disc springs. This realizes an increase to the clamp load (decompression).

【 i-MC COMPACT damping factor 】
i-MC COMPACT **92%**
i-MC SPRING **75%** (parallel 3)

Direct support from engineers! Technical support for the disc springs for the main spindles on machining centers

Tokai spring aims to provide detailed engineering and product supports by its engineer from the point of initial contact.

initial contact ＋ Response within six hours ＋ Customized engineering and product support to suit to customer requests

Our engineers will provide direct support from the point of inquiry. Please feel free to contact us.

Inquiries

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