



**WHITE PAPER:**

# **The Importance of Hardened Raceways**

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## Introduction

In this white paper, we will be discussing the importance of metal hardening methods on Kingpinless caster raceways. RWM is the original inventor, patent holder and world leader in Kingpinless casters. Kingpinless casters must be hardened to perform as intended. There are two methods commonly used: “through hardened” and “case hardened”. Therefore, this white paper will lay out the different methods of metal hardening in the caster industry and will investigate which process is the most beneficial to prolonging the life of your investment.

## Why is Hardening Relevant in the Caster Industry?

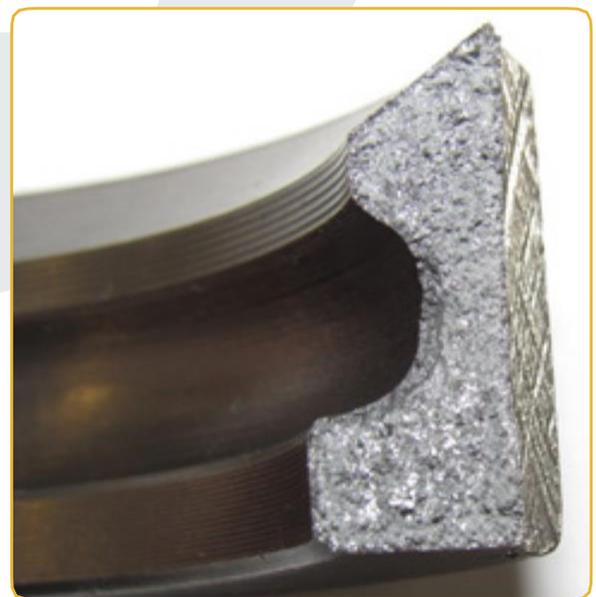
The hardening process is used on the caster raceway to increase the life of the caster. This is achieved by giving it more durable properties to resist premature wear as well as impact forces which can cause cracking and even total failure. As hardened steel ball bearings operate within the raceway it is critically important that the raceway be hardened to resist brinelling (Dimpling or indentations into the metal by the ball bearings) which creates excessive play in the bearing and “catches” in the rotation of the raceway itself.

You generally run into 3 common raceway finishes:

- Un-treated or non-hardened (This should not be considered for Kingpinless Raceways)
- Through hardening
- Case hardening

## Case Hardening

Case hardening is the process of hardening the surface of a metal by infusing elements into the material’s surface. This forms a thin layer of harder alloy. It is commonly found in the manufacturing of machine and wear parts. The case hardening procedure is suitable for both carbon and alloy steels. Case hardened steel is formed by diffusing carbon (carburization), nitrogen (nitriding) and/or boron (boriding) into the outer layer of the steel at high temperature, and then heat treating the surface layer to the desired hardness and desired case depth. The steel is subjected to heating at a specific temperature for a specific duration until it has turned bright red. While the steel is soft, it is submitted into a carbon compound that covers the outer



The edge of the steel has been case hardened giving it a harder outside skin while leaving the inside layer malleable.

layer. More than one dipping and re-heating cycles may be necessary to reach the adequate amount of carbon in the steel. Following this process, the steel is reheated and quenched in water for final hardening. This creates an outer shell of stronger and harder steel while the inner core remains capable of flexing under load to prevent cracking and total failure under duress.

## Through Hardening

Steels having a carbon content between 0.3% and 0.8% are capable of being through hardened. As the carbon content increases, so does the degree of hardness of the metal. Hardening occurs during the heat treating process when the steel is quenched (cooled) rapidly. The temperature varies for different alloys but it is generally in the range of 1500-1900 degrees Fahrenheit. The process of through hardening integrates the hardening procedure throughout the entirety of the piece of metal being treated (Hence “Through” hardening). It strengthens the treated product, but is less resistant to stress and impact due to the harder nature of the entire treated metal.

## What Happens When You Don't Harden?

If no hardening treatment is applied to the raceway of the caster, the hardened ball bearings will wear into the soft metal causing brinelling. Brinelling is when a permanent indentation is caused on the raceway surface. This occurs far easier on a raw metal surface as opposed to a surface which has been hardened. Once the ball bearings cause brinelling this causes additional slack or play within the raceway. This play worsens over time which can lead to catastrophic failure. This leads to early replacement of a non-hardened product.

The through hardening process, which most caster manufacturer's use, provides for substantially better durability than no hardening treatment at all. This process as defined above, is applied throughout the entirety of the metal. While lasting longer than no hardening, it has a potential downside. Since the treated metal is hardened throughout, the raceway is more prone to cracking due to the hard nature of the metal. It does not have as much elasticity to absorb shock and is less resistant to such stress. Should the raceway crack due to an impact the entire caster can fail leading to significant downtime and replacement cost.

## Hardened Raceway Versus Unhardened

We recently tested a Hardened Kingpinless Raceway against an Unhardened Kingpinless Raceway. We submitted both to a 2 hour Drum Test, with obstacles, per ICWM Standards at 1500 pounds and the evidence is shocking!

After just a short 2 hour period on a drum test, with an obstacle, the “economical” kingpinless raceway shows significant signs of brinelling due to the non-hardened raceway. This caster is now useless. The raceway will continue to break down and experience the following:

- Shortened Service Life
- Swivel Chatter
- Inability to Swivel
- Poor Ergonomics
- COMPLETE CASTER FAILURE

However, the hardened raceway shows absolutely no sign of wear after enduring the same test. We are the Creator and Originator of the Kingpinless Caster. We subject our casters to many different tests including an 8 hour, no obstacle drum test in addition to the standard 2 hour obstacle drum test this rig performed.

- Extended Service Life
- Hardened Raceways
- ABSOLUTELY NO FAILURE



Competitor's non-heat treated Raceway after 2 hour obstacle test



RWM 65 Series heat treated Raceway after 2 hour obstacle test



Images compare the non-heat treated caster (left) and the heat treated caster (right)

## The Takeaway

There are 3 methods of treating metal found throughout the caster industry. Of the three methods, non hardened surfaces are the most economical however provide no enhancements for wear and tear or impact performance and should be avoided for Kingpinless Casters. This has been an alarming trend amongst some competitors as a means to lower up front pricing. In the long term this greatly reduces the quality of the product, lowers service life and decreases return on investment as the casters require routine replacement from wear. The through hardened treatment is a major step up, but it is still susceptible to certain weaknesses such as cracking because as the metal becomes harder it loses malleability which is what enhances resistance to shock or stress. Casters with case hardened raceways are the best in the caster industry at resisting both wear and impact forces. For this reason RWM utilizes case hardening for our U.S. manufactured Kingpinless caster products.

