



OVAKO

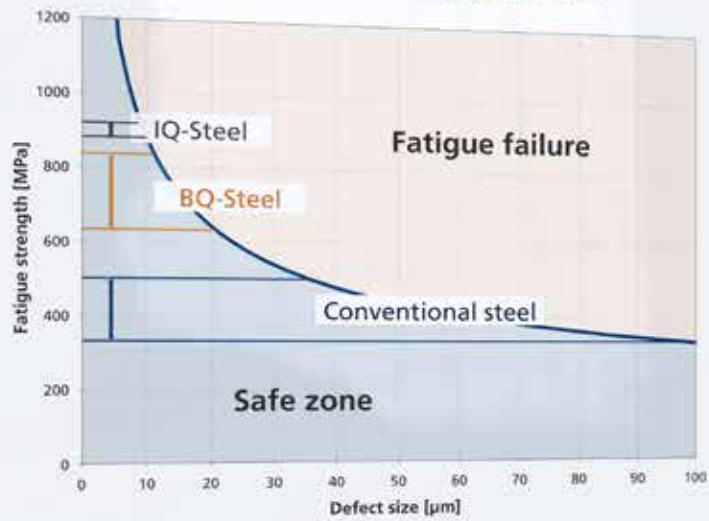
**PURITY CREATES
DESIGN OPPORTUNITIES
BQ-STEEL® AND IQ-STEEL®**

YOUR CHALLENGE

Whether you're designing tomorrow's hybrid cars or engineering new solutions for heavier loads, you need optimized engineering steels. Failure is simply not an option. Increasingly, our customers are requesting cleaner and smarter materials – with a cost advantage! That is why we've further developed our Bearing Quality Steel (BQ-Steel®) and Isotropic Quality Steel (IQ-Steel®). Inclusion controlled for consistent quality. Just the right balance between strength and toughness. In short, advanced materials that open up new design opportunities and give you a competitive edge.



WHAT STEEL PROPERTIES CAN GIVE YOU MORE DESIGN FREEDOM?



OUR SOLUTION

The solution can be summed up in three words: Purity creates opportunity. To understand this, see the diagram to the left. It represents data collected from thousands of tests. As you can see, improvements in purity result in big design opportunities. That's good news for any designer who has relied on old standards, when in fact modern steel practices have opened up for a new level of performance. Thanks to the properties of BQ-Steel and IQ-Steel, which now close the gap to remelted steels, you can economically slim down your gears, bearings and other steel parts to meet new design requirements. For instance, a gearbox can be made lighter, with higher power density, to make room for other space-competing systems. All by simply using cleaner steel that consistently delivers lower levels of impurities – in every batch. Produced with the help of large-scale, air-melt steel production.

RETHINK YOUR DESIGN OPPORTUNITIES WITH OUR BQ-STEEL

Longer performance. Higher loads. Zero defects. As a bearing maker, you've no doubt seen how design requirements are getting tougher. The good news is that there is a wide range of Ovako bearing quality BQ-Steel so reliable and fatigue-resistant it's causing the industry to rethink what is possible.

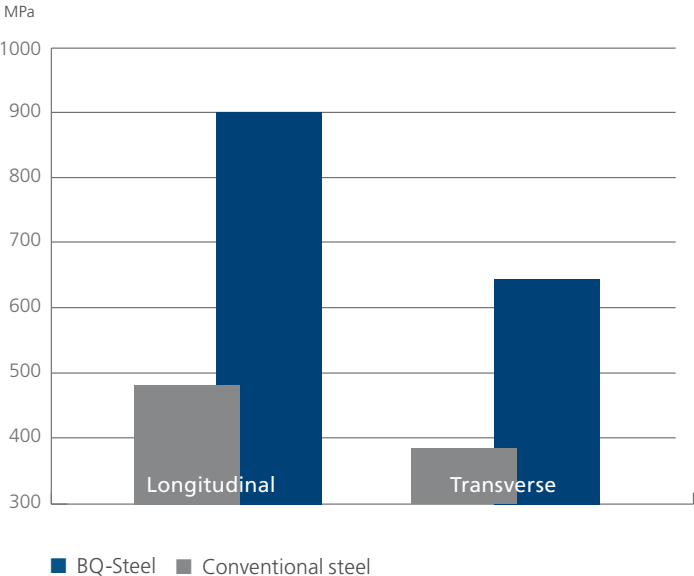
Bearings are subject to the toughest of working conditions. The steels used today to master such requirements – with a focus on many conflicting properties and total production economy – are the result of many decades of development. In many ways, the vastly improved performance of today's bearings is due to these advances in steel technology.

As a steel partner to the world's leading bearing producers, we are often deeply involved in new market developments. For more than 100 years, we've been working to meet the industry's ever-increasing performance demands. Today we can offer a very wide range of Bearing Quality steels, based on either the higher performing ingot cast qualities or, for slightly lower requirements, continuous cast qualities.

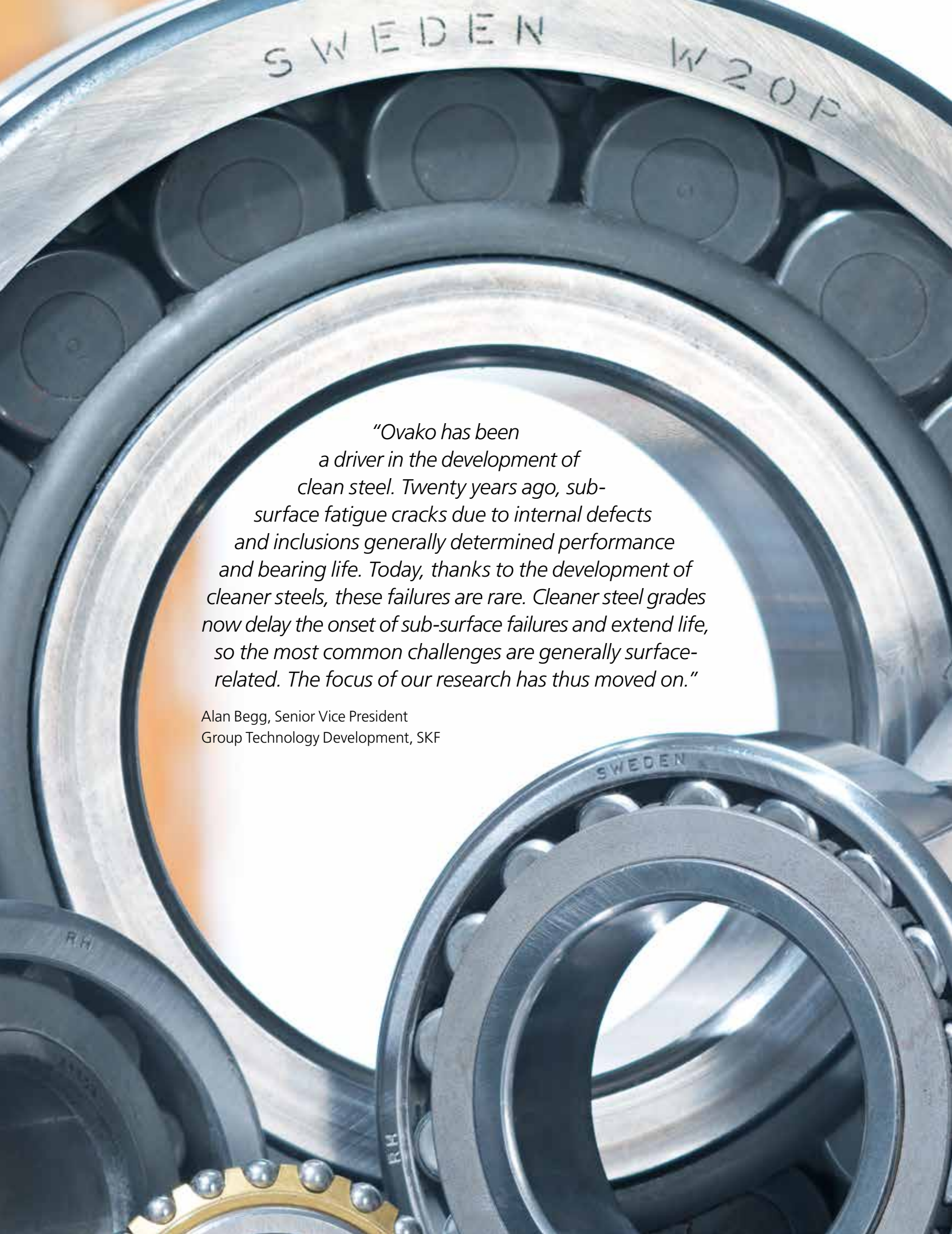
It is the clean and consistent properties of our steel grades that customers tell us they value most. We achieve this by securing high-quality raw materials and ensuring purity and consistency across the entire production chain – from melt to rolling and finished component. As part of the process, we verify that the quality of the BQ-Steel will result in superior fatigue properties. Rotating bending fatigue testing (below left) is an important and frequently used technique.

Today, our range of tube, bar and ring is ideal for all the main components of a rolling bearing – and we meet all international quality standards. As a result of tight collaboration with our key customers, we've also been able to establish long-term business agreements and customize our logistical and EDI solutions. A main challenge now is finding new ways to apply the benefits of Bearing Quality steel in applications other than bearings.

Rotating bending fatigue



Many of the world's leading truck and trailer manufacturers rely on extremely clean BQ-Steel qualities to keep their vehicles rolling – day in and day out.



“Ovako has been a driver in the development of clean steel. Twenty years ago, sub-surface fatigue cracks due to internal defects and inclusions generally determined performance and bearing life. Today, thanks to the development of cleaner steels, these failures are rare. Cleaner steel grades now delay the onset of sub-surface failures and extend life, so the most common challenges are generally surface-related. The focus of our research has thus moved on.”

Alan Begg, Senior Vice President
Group Technology Development, SKF

MAXIMIZE FATIGUE STRENGTH AND BE SUSTAINABLE AT THE SAME TIME

We are living in a demanding world. Like never before, the pressure is on to reduce fuel consumption and cut emissions – while still maintaining high performance. This global trend is causing a fundamental rethink of engineering standards and the use of steel material for smaller, lighter and more powerful gears, driveshafts and other parts.

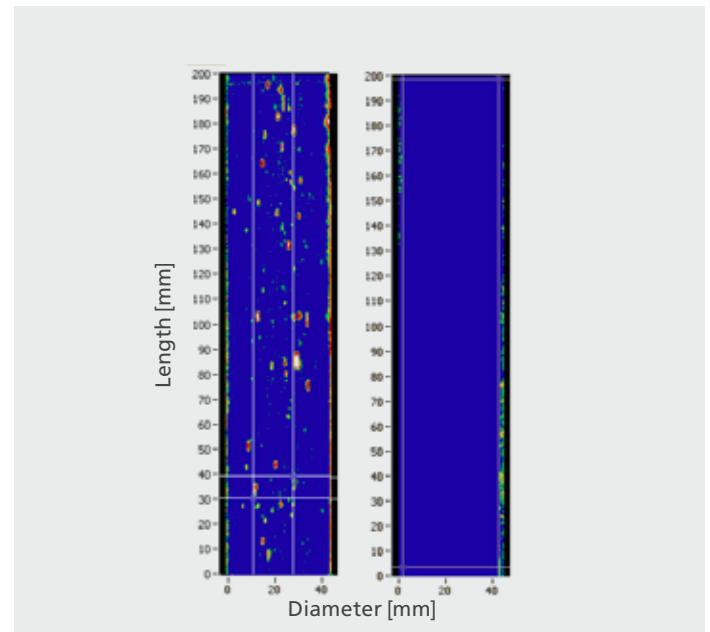
Not only do you need to meet new regulatory requirements, but your steel parts need to keep on going virtually forever. No fatigue cracks. No internal defects. No detrimental inclusions. Just smooth operation. But when selecting the right steel quality for high-load applications, it's not always easy to know all the functional properties as well as the cost versus quality implications.

This is where knowledge and experience come into play. As one of the world's largest manufacturers of through-hardening bearing steels, we pride ourselves on working as a true partner to our customers. It's all about taking a customized approach to each customer's needs.

Customers tell us they appreciate our more comprehensive approach to accelerating business results. Some have Six Sigma programs that measure quality-related parameters and strive for near perfection in their own operations. It's a disciplined, data-driven approach that appeals to us, too, since it's in our nature to constantly monitor and improve our steel-making process.

Maximizing performance requires an in-depth knowledge of how the steelmaking process can influence the steel properties. Our through-hardening BQ-Steel are optimized for high fatigue strength, good toughness and excellent wear resistance. Each production step is controlled with a high degree of precision to minimize the content of harmful non-metallic inclusions.

We improve fatigue strength by carefully controlling cleanliness and using key technologies such as magnetic induction stirring and vacuum degassing in the secondary metallurgy, as well as controlled casting. The process may vary slightly depending on the grade, but our objective remains the same: to produce pure steel with an optimized balance between quality and economy.



10MHz immersed ultrasonic testing of Ø65 mm carburizing steel bar. Conventional steel vs. BQ-Steel.



“We identified a need for a high-quality gear steel to be used on a critical high-load timing gear application for one of the most powerful mining engines in the world. Ovako responded rapidly, providing technical support on material selection and helping to develop, cast and roll the steel ahead of schedule – at a guaranteed cleanliness level.”

Global Supply Quality Leader
Fortune 500 Engine Manufacturer

IMAGINE GETTING PURE PERFORMANCE IN ALL DIRECTIONS

Left. Right. Center. That's right, steel components are increasingly getting hit today by high loads in all directions. Manufacturing them with conventional steel can be risky since the difference between their ability to handle traverse and longitudinal loads may be detrimental to the component itself.

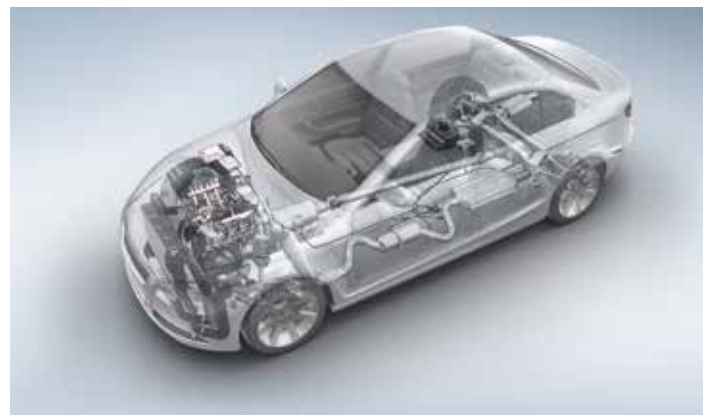
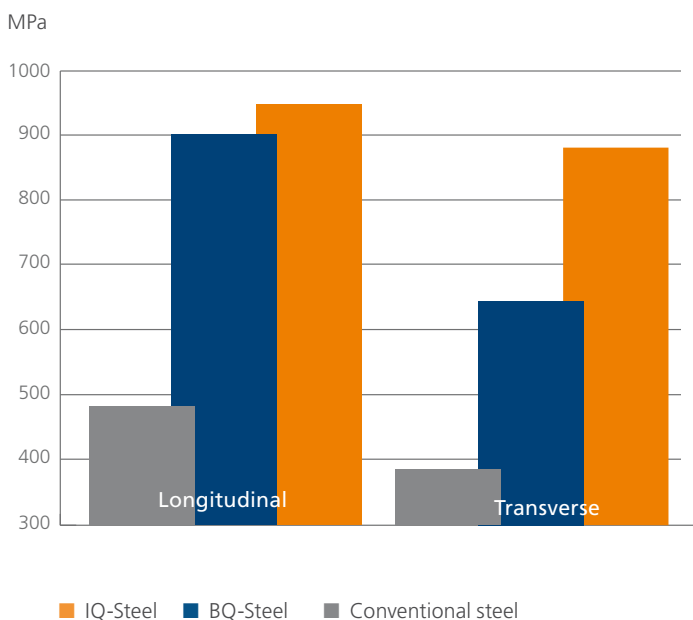
That is why some of the world's most demanding OEMs and forging shops are using IQ-Steel grades to handle the strain of higher and more complex loads. With a steel that offers performance in all directions, they can achieve lighter, more efficient and compact designs. They get a pure and highly consistent quality that is ideal for extreme pressures and temperatures where cracking or defects are simply not an option.

As shown in the diagram below, conventional steels deliver considerably lower fatigue performance in the transverse direction than IQ-Steel. That is partly due to the rolling process whereby the inclusions are often stretched

into long and potentially harmful bands. By contrast, IQ-Steel is designed to perform differently: The inclusions are fragmented into small and therefore harmless particles.

The development of IQ-Steel involved high-frequency immersion ultrasonic testing that enables us to check for inclusions as small as 25 micrometers. This testing method was an instrumental part of the research that led to Ovako's Head of R&D winning the prestigious Kami Prize in Sweden and IQ-Steel to be included in part of an exhibition on leading innovations. More importantly, it ensures that our customers always get a very high and consistent quality level.

Rotating bending fatigue



More than half of the newly registered cars in Europe had diesel engines and many are using IQ-Steel. Diesel experts at Bosch use IQ-Steel grades in the cylinder heads of the Bosch common rail pumps, which need to handle extremely high pressure and loads.



"The IQ-Steel grades are very important for our Diesel Systems division. With their high degree of purity, the homogeneous distribution of carbides and the most stable steel quality concerning segregation and microinclusions, the DS division is able to produce pumps with high pressure and long lifetimes."

Dr. Ing. Mourad Moalla
Diesel Systems division
Robert Bosch GmbH

A SMARTER PATH TO FREEDOM OF DESIGN WITH OUR IQ-STEEL

Are you still designing steel components to accommodate the shortcomings of conventional or remelted steels? With conventional steel, you may get your costs down but strength and fatigue properties will be lacking. Remelted steels are a safer bet, but they are costly. What do you do?

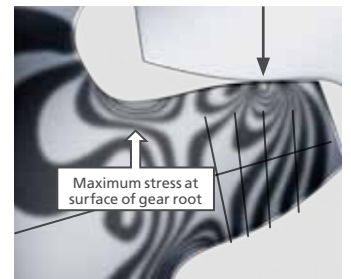
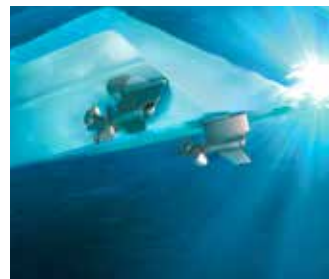
Fortunately, there is a smarter way: IQ-Steel. Developed specifically to meet the stress demands of high-performing mechanical parts, this isotropic-quality steel is ideal for gears, camshafts and other steel parts. Thanks to a unique manufacturing process, IQ-Steel has few large inclusions or other impurities, meaning it can handle high mechanical forces in all directions.

The IQ-Steel process can be applied to a wide variety of steels. It is well proven in service in many applications, giving precisely the solution our customers demand, along with new beneficial properties. For example, IQ-Steel can be combined with a type of steel that gives very little oxidation depth compared to conventional steels, resulting in corresponding improvements to surface properties. This could potentially eliminate surface enhancement processes such as shot peening.

Increasingly, we hear from customers in the marine, transmission, engine, light and heavy vehicle and wind power sectors, that standard engineering steels are no longer suitable for tougher jobs. The pressure is on to create lighter, stronger and more compact designs. The problem with conventional steels is that they're produced in a process where inclusions will be present in the steel's rolling direction. As a result, they have poor fatigue and impact properties in the transverse rolling direction.

The beauty of IQ-Steel is that you get equal performance in all directions. When designing a gear, for example, you don't need an extra-healthy safety margin, thicker walls or spacing

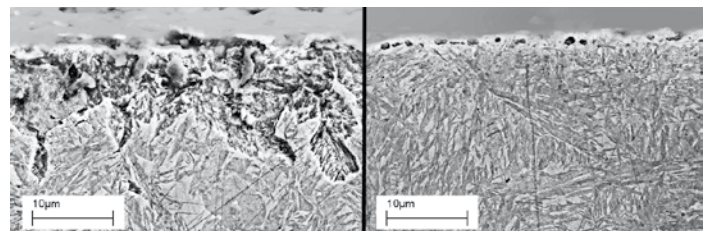
to guard against failure. As one customer commented: "In hybrid drives, more things need to share the same space under the hood, so you need cost-efficient steel that enables compact, light and strong design."




When Volvo Penta developed its new IPS "pod drive" system, with counter-rotating forward-facing propellers – operated by a joystick – it needed superior steel. Our IQ-Steel offers equal strength in all directions, enabling optimized powertrain performance.

16NiCrS4

158Q



As-carburized surface region of a standard carburizing steel and Ova-ko 158Q.

An aerial photograph of a speedboat moving across a vast, deep blue ocean. The boat is positioned in the lower right quadrant, leaving a prominent white wake that curves into a large, circular pattern. The water's surface is textured with small ripples, and the overall scene is captured from a high angle, emphasizing the scale of the wake.

“As a premium brand, Volvo Penta produces systems for extremely demanding marine and industrial applications. The load cases, combined with design demands, have to be optimized and always in the frontline of technology. When it comes to gear steel material, our clear view is that the cleanliness and in particular the inclusion control is crucial in determining design possibilities. The isotropic properties of IQ-Steel provide just those conditions and is thus our gear material of choice.”

Johan Wiklund, Gear Development Engineer
Volvo Penta



"A lot of factors go into manufacturing the right CV (constant velocity) axles for our clients. One of these is the quality of the steel, and steel we get from Ovako has provided us with a competitive edge. In fact, one of our client's drivers recently broke a world record with an axle we manufactured from Ovako steel."

Frank Rehak, President
The Drive Shaft Shop

NEVER BEND UNDER PRESSURE

Punch the accelerator of a dragster, rally car or NASCAR and you quickly understand the need for strong, lightweight and resilient steel materials. Pushed to the breaking point, the axles, driveshafts and other key components must constantly outperform the competition. Failure is simply not an option. A pure, high-performance steel can make all the difference.

Our track record says it all: no race car using Ovako steel has ever broken down or failed to finish a race. Period. This is no easy feat when you consider that some engines are packing up to 3,000 horsepower – more than 10 times the power of a standard car. Consider, for example, that drag racers can accelerate from 0 to 300 mph in a matter of seconds, placing enormous stress on axles – enough to snap the axle of a standard car like a toothpick. But thanks to the high fatigue strength of our ultra-clean steels, it's now possible to provide exceptional torsional resilience, enabling the car to repeatedly handle extraordinarily high load stresses.

For years, we've provided the racing industry with extremely clean, specialized engineering steels of the highest quality. For top racing teams across the globe, our steels are used to design and build world-class engines and gearboxes – everything from camshafts and gears to axles, drive shafts and other high-performance components. You might be able to bend the rules of gravity, but never the steel.

JUST IMAGINE THE POSSIBILITIES

It's a fact. Pure engineering steels open endless new design opportunities – with highly favorable economy. Whether you're designing a next-generation rolling bearing, drive shaft, gear cog, transmission or other steel part, the right steel material can give you plenty of design freedom.

Actually, our highly pure Ovako BQ-Steel and IQ-Steel encompass all steel types – from carburizing steel, nitriding steel, Q&T steel and spring steel to through-hardening bearing steel. That means we are used to working with industries ranging from automotive and wind to rail and marine. What is your next challenge? Let's talk possibilities.



BQ-Steel and IQ-Steel benefits vs. conventional steel

BENEFITS	BQ-STEEL TYPICAL EFFECTS	IQ-STEEL TYPICAL EFFECTS
Improved bending fatigue strength in simple load cases	30-90 % stronger depending on steel used today	40-100 % stronger depending on steel used today
Improved bending fatigue strength in multi-axial load cases	Up to 70 % stronger depending on steel used today	Up to 130 % stronger depending on steel used today
Typical application of weight reduction	Existing generations of end-user systems	Next-generation end-user systems
Typical design change possibilities	Moderate design adjustments on existing generations of end-user systems	Facilitates major design changes on next-generation end-user systems
Enhanced macroscopic defect control via immersion ultrasonic testing	Secures consistent quality level for end-user products	Secures consistent quality level for end-user products



SELECTION GUIDE

Due to the extensive nature of the IQ-Steel and BQ-Steel range, it is impossible to specify all available sizes and types on this page. Most product forms can be supplied either as ingot cast or continuous cast, with IQ-Steel supplied only as ingot cast. However, to give you an overview, we've compiled maximum and minimum sizes and shapes for Ovako bar, tube and ring.

For a more comprehensive list, please refer to the Ovako Product Catalogue. Feel free to also call your local Ovako sales office for selection advice or to find out availability. We would be happy to hear from you!

HOT-ROLLED BAR

Available in a wide range of sizes and types, from round bar and special properties bar to profiles and ground bar.

Hot-rolled round bar

Characterized by close tolerances, excellent straightness as well as roundness, good surfaces and low decarburization, our hot-rolled round bar is ideally suited for forging and machining.

Diameters and lengths

Available in diameters 13 mm to 200 mm. Up to Ø 75 mm can be delivered at 1 mm intervals. Larger dimensions at 5 mm intervals. Standard bar length 6 meters, but can range from 3.5 to 18 meters.

Special properties bar

Commonly known as SP-Bar. Not limited to any specific steel grade. Opens new opportunities to use our advanced technology. By optimizing the properties of bar material, you can benefit from increased added value and substantial cost reductions in your manufacturing process.

Diameters and lengths

Available in diameters ranging from 13 mm to 50 mm. Lengths from 4 to 12 meters. Due to its extremely tight tolerances, SP-Bar can often replace peeled or drawn bar. You can also decrease the nominal size and get more manufactured pieces per ton of purchased SP-Bar.

Special profiles

By using hot-rolled special profile bar tailored to your needs, some manufacturing steps may be eliminated, lowering your costs. Our capability to hot-roll special profiles as required for the specific application may spare you several steps in your production process. Ovako manufactures special profiles both in symmetrical and asymmetrical shapes.

Diameters and lengths

Our special profiles are rolled in widths ranging from 15 mm to 270 mm and thickness from 5 mm to 60 mm. Profile bar can be marked with a customer logo or other information.

BRIGHT BAR

Available in a wide range of shapes, our bright bar grades eliminate processing steps and unnecessary stock build-up. You save time and money by relying on our highly efficient equipment and just-in-time production. For demanding applications, we can use our in-line ultrasonic equipment to inspect all the materials down to 0.7 mm Fbh.

Diameters and lengths

Diameters range from 11 to 106 mm, with tolerances down to IT6. Lengths range from 10 to 8,000 mm, with tolerances down to +/-0.05 mm. Delivery is made to your specific pallet size or bundled and wrapped with paper/plastic in 48 hours.

SEAMLESS TUBE AND HOLLOW BAR

Characterized by uniform properties, close tolerances and small machining allowances. Available in a range of sizes / diameters / wall tolerances, depending on whether they are hot-rolled, cold-worked or cold-worked and ground.

Tube diameters and lengths

Hot rolled tubes are available in lengths of 4 to 9 meters, while hot rolled peeled and cold worked (incl. ground) come in lengths of 1,8 to 9 meters. Outer diameters 25 - 243 mm and wall thicknesses from 3 to 52 mm.

ROLLED AND FORGED RINGS

Characterized by cylindrical or profiled geometries that are very close to the final shape of the finished component.

Dimensional sizes

Dimensional range 170 - 4,000 mm; weight range is 7 - 5,000 kg. Forged rings are also supplied up to 3,400 kg. Rings with lower widths other than those stated in the ring mill technical facts can often be rolled in multiples and parted.

Machined rings

Available in a wide range of individual rings or complete packages and for the entire size range.



Ovako is a leading European producer of engineering steel for customers in the bearing, transportation and manufacturing industries. Our production is based on recycled steel and includes steel in the form of bars, tubes, rings and pre-components. Ovako is represented in more than 30 countries and has sales offices in Europe, North America and Asia. Sales in 2013 amounted to EUR 850 million and the company had 2,995 employees. For further information please visit us at www.ovako.com

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