



OVAKO

**WEAR RESISTANCE
FOR YOUR ADVANTAGE**

WR-STEEL®



SHAPE YOUR WAY TO UNBEATABLE WEAR RESISTANCE

As a pioneer in boron steel and steel for mining applications, we are on a mission to optimize the wear resistance of your products. We encourage you to take advantage of the broadest range in Europe with a full span of hardness intervals. More than just reducing costs, our innovative wear-resistant steel grades can open up new engineering possibilities. Whether you're making steel plows, buckets, rock drilling tools or actually processing the rock, your success is our success.



Our WR-Steel gives you a wear resistant advantage that covers a wide range of hardness levels, dimensions and steel grades. The whole idea is to combine cost efficiency in the manufacturing stage with just the right wear resistance in your end product.

HOT-ROLLED ROUND AND FLAT BAR

In the manufacturing stage, you want to be able to form, shape and weld the steel to fit your engineering needs precisely. The beauty of our boron steel is that you can easily shape our hot-rolled round and flat bar to your needs and then achieve a more than doubling of the hardness when it is later quenched and tempered. This is due to the addition of very small amounts of boron to replace expensive alloys. But it's also related to the steel's consistent quality, tight process controls and good repeatability.

SPECIAL PROFILES

By using hot-rolled special profile bar that is tailored to your wear-resistance needs, you can often lower costs by eliminating or minimizing manufacturing steps. We offer a wide range of both symmetrical and asymmetrical shapes in different dimensions.

KEY BENEFITS OF WR-STEEL

- Proven superior wear resistance
- Broad range of hardness intervals (350–650 HV)
- Right properties after rolling or heat treating
- Cost-effective due to optimized alloy content for different end applications
- Wide range of steel grades in different dimensions
- Reliable partner with centuries-old steelmaking heritage

TURN OUR SOFT STEELS INTO HARD-HITTING PERFORMERS

No two heat-treating facilities or forging shops have exactly the same needs. That is why we offer more than 30 types of boron steel that can be flexibly tailored for your needs – and more than 680 special profiles close to net shape. It's all about giving you just the right flexibility and efficiency to optimize your operations.

You might be overseeing a highly automated operation where furnace temperatures and quenching times are all pre-set by a computer. Or maybe you're at a more traditional shop where the skill and experience of the staff is something you're known for in providing a superior steel end product.

CONSISTENT QUALITY – BATCH AFTER BATCH

Either way, you depend on a consistent level of quality to get the same high-quality hardening result – batch after batch. Many customers tell us this is why they turn to Ovako for our WR-Steel. They also appreciate the fact that our R&D team can provide hands-on advice on how to optimize the alloying process or improve the heat-treating. Add a bit more or less alloy and you can achieve just the right hardening properties after quenching and tempering. It's something we've been doing for more than 100 years and a reason why our customers keep on coming back.

AVOID GAS CUTTING AND TOOL WEAR

Just as important is the flexible choice you get from our wide range of special profiles – from single bevel and arrowhead to grouser bar. Whether you are manufacturing

ground engaging tools, plows or buckets, you can often work very close to net shape. This saves a lot of processing time and ensures that your staff can work more efficiently.

Processing benefits of Ovako WR-Steel

BENEFITS	TYPICAL EFFECTS
Flexible choice	Many sizes of hot-rolled flat bar and round bar with > 680 special profiles and growing.
Consistent quality	No variations from batch to batch due to even steel quality and rigorous process controls.
Easier to shape and mold	Softer steel prior to quenching and tempering due to low level of alloying elements that impair cold formability.
Saves time; more efficient	Eliminate costly and time-consuming advanced machining by using our hot-rolled bar or close-to-net-shape special profiles.
Energy savings	Less costly due to lower tempering temperature; many boron steels can be water quenched.
Save your tools	Ease of machining of softer material helps to reduce tooling costs.
Easier to weld	Favorable weldability due to low carbon content and lower amounts of alloying elements.





39 RPM

**SLIH
HITS**

643,500

198,000

REVS

WELCOME TO EXTREME REALITY

Talk is cheap. What counts today are results. Especially in the extreme world of wear resistant steel parts. So rather than just promising you that our WR-Steel grades can save money by extending your service life, we decided to put them to the test.

In an ideal world, we'd measure the real-life results of our WR-Steel out on farms, in mines and on earth moving equipment. For obvious reasons, this was not possible. Instead, we turned to the independent Swerea KIMAB Test Facility to simulate extreme industrial conditions and see how we measure up against other hardening and pre-hardened steels.

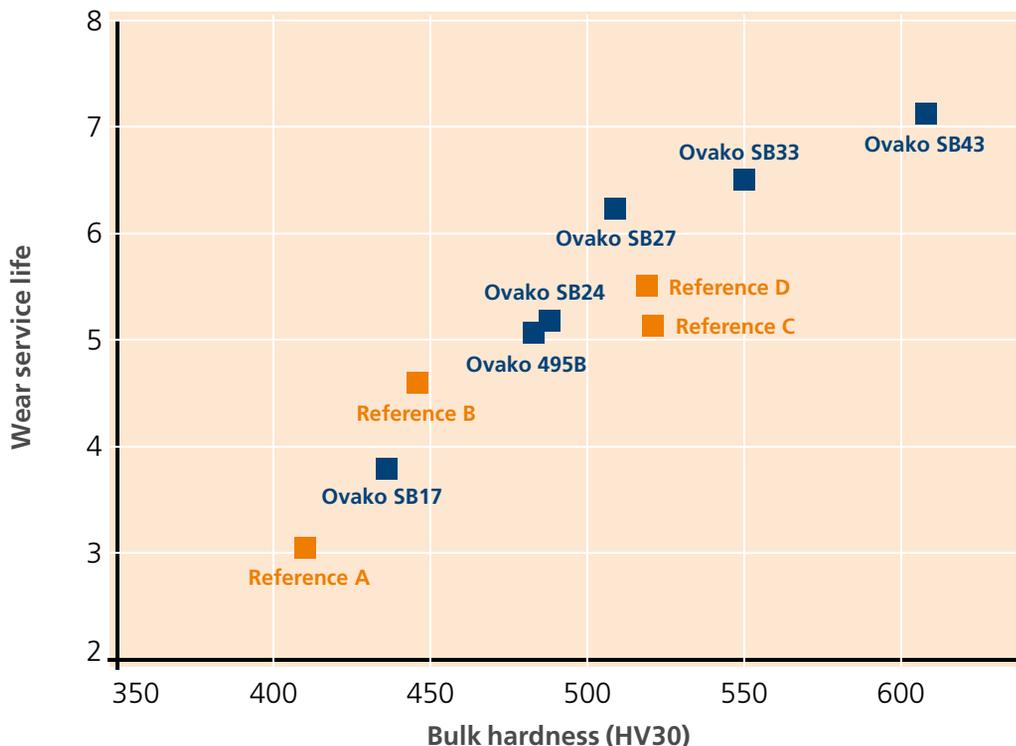
275 HOURS OF PUNISHMENT

At Swerea KIMAB, it's known as The Drum Test. For our R&D team, it's a perfect opportunity to gather new data on wear resistance to further develop our WR-Steel. The idea is simple: mount 46 steel samples along the circumference of a large rotating steel drum, add granite stones 16–22 mm in size and let it rotate at 39 rpm for 275 hours. The stones tumble and

slide to simulate a typical industrial abrasive environment. Then we measured, studied and compared the wear results of the sliding stones on the steel samples.

"The Drum Test simulates abrasive sliding wear and provides us with a good relative performance indicator for prolonging service life. And of course, a longer service life means fewer parts replacements and ultimately a cost-reduction."

Paul Janiak M.Sc. IWE, Swerea KIMAB AB, Manager, Joining Technology



Wear service life = Total accumulated weight reduction of reference grade (mild steel) / accumulated weight reduction of the corresponding grade.

BECOMING MASTERS OF WEAR

Many hours of working with the Drum Test in Swerea Kimab and extensive studies on the matter, taught us a lot about the nature of sliding wear simulation and finally blossomed in design, and developing the Ovako Abrasion Test Machine (Ovako ATM). Investigating the dominant wear micro-mechanisms in real-life applications with SEM and surface analysis by our R&D team, and combining our knowledge about the wear tests in this complicated design, enable the Ovako Abrasion test a perfect simulator of reality in hard abrasive situations.

The machine accommodates 16 samples, as they are rotating and sinking in a bath of abrasives, with a direct contact and holder-free configuration. The special aspects of this state of the art wear test machine are:

- Flexibility of sample shape from flat to round bar
- Flexible rotational speed
- Flexible contact angle between samples and abrasives in order to control the degree of impact needed, according to the desirable wear application
- Temperature control of the samples during the test
- Smart and user friendly control panel, with high safety level
- Direct contact between samples without interfere of holders, which results in simulating the wear application very close to reality





"We test, study and evaluate wear service life of steel in different applications, and use this knowledge to understand the process and develop the future wear resistant steel. "

Ph.D. Mersedeh Ghadamgahi
Research Engineer Group R&D



"Ovako is easy to work with. They're close at hand, speak our language and know our operation. One of the benefits of our relationship is that they perform theoretical testing and we conduct the practical testing. Then we compare results, allowing us to come up with the best solution – and they're always open to change."

Odd Geir Aarre
Procurement Manager, Kverneland, Norway

THE PERFECT MATCH FOR YOUR ENGINEERING AMBITIONS

Many of our customers have very high ambitions. Whether manufacturing plows or ground-engaging tools, they're not only setting high goals but working to exceed them. Their secret? A relentless attention to quality and wear-resistant steel engineering materials that give a lasting advantage.

Building a global reputation takes time and commitment. As one customer put it: "Quality does not happen by accident. You need to constantly innovate in order to open up new engineering opportunities and develop new products." When steel parts keep on working, it means fewer customer complaints and more repeat business. Word spreads. Over time, you build up a reputation in your industrial sector for providing flawless performance.

CUSTOMIZED HEAT TREATMENT

The beauty of WR-Steel is that it provides an easier way to optimize the performance of each part. A steel tooth. An edge. A blade. Each with just the right combination of strength and toughness. No compromises. Another customer told us: "We appreciate the even, pure quality of your steel because it ensures that we get good repeatability in our quenching furnaces." They further noted that the softness of our bar and special profiles lets them easily shape and harden the steel to achieve just the right level of wear resistance.

LET'S MAKE IT BETTER TOGETHER

Our diverse WR-Steel program is well adapted for most needs. And our R&D team welcomes the opportunity to work

with you to develop specialized steel alloys or to help improve heat treatment steps to boost your productivity.



Dedicated to "the future of farming", the Kverneland Group of Norway is a leading global developer and marketer of agricultural equipment, producing some 5,000 plows annually. Their slogan, "Under the paint: Only heat-treated parts", highlights the importance they assign to hardening individual steel parts.

IT TAKES A LOT TO WEAR US DOWN

Day in and day out, Ovako engineering steel is used for some of the world's most challenging applications. In particular, our WR-Steel is used in wear resistant parts for agriculture, forestry, off-road vehicles, construction equipment and more. Why? Because the steel's consistent and even quality puts it in a league of its own.

Another big advantage of our wear-resistant boron steel is that it eliminates or minimizes time-consuming machining and other heat treating steps. You can choose from a diverse range of hot-rolled flat bar or special profiles that are close to net shape. If you need to punch, drill or shape the steel, it's an advantage to do this in the steel's soft condition since it saves wear and tear on your tools.

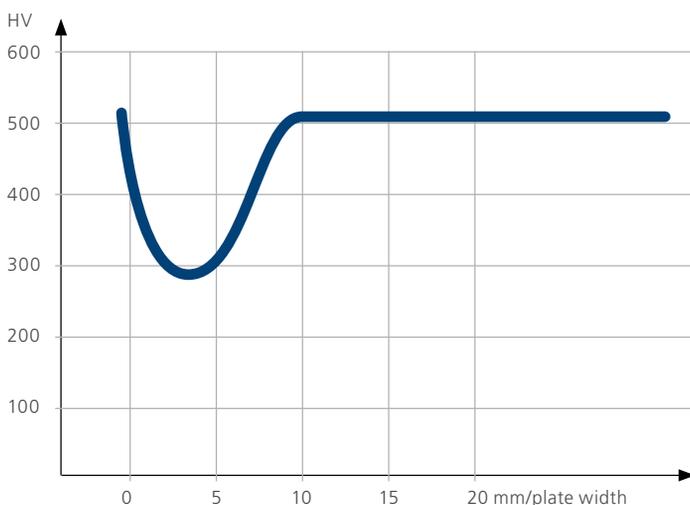
MAKING THE SWITCH

When using pre-hardened wear plate, there is another factor that needs to be taken into consideration – a factor that has caused several steels part manufacturers to

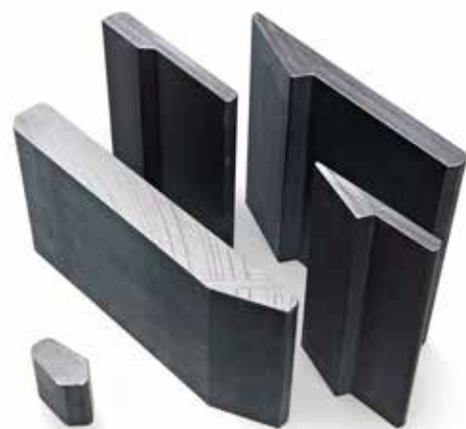
switch over to our softer bars or special profiles: When gas cutting wear plate, there will always be areas of reduced hardness close to the cutting edge.

AVOIDING THE SOFT ZONE

This so-called "soft zone" (see diagram) extends from the cutting edge a short distance into the plate and can have an adverse effect on the service life of the wear component. This is particularly detrimental for smaller steel components that are more susceptible to weakening along the cut edge. The availability of flat bar or profiles that are very close to the desired end shape avoids this situation.



As shown, the hardness profile from a gas cut edge declines significantly around the edge of the plate where the cut occurs. This can be avoided with WR-Steel in the form of hot-rolled bar or special profiles that require less cutting where wear resistance is critical.



Borox is a leading Nordic industrial heat-treating facility that uses Ovako WR-Steel to ensure a high level of quality in its end production. Equipped with four quenching furnaces, CNC equipment and drilling machines, it produces steel wear parts for buckets, ground engaging tools and other demanding products.



"We've tested other unhardened steels, but still find the consistent quality of Ovako's WR-Steel grades, in every batch, to be in a class of its own. We also value the fact that they're constantly developing new grades that give us even more design freedom and ensure that we deliver premium parts to our customers."

Jan Svanborg
Founder and Procurement Manager
Borox AB, Sweden

3 METALLURGIES. BILLETS, BLOOMS AND INGOTS. 30 BORON STEEL GRADES. 680 PROFILES. AND THAT'S JUST THE START.

As one of Europe's largest suppliers of wear-resistant boron and mining steels, we are continually expanding our range to give you more choice and flexibility. At present, we offer more than 30 types of boron steel and 680 different profiles – and the selection keeps on growing.

HOT-ROLLED ROUND BAR

Our hot-rolled round bar is characterized by close tolerances, excellent straightness as well as roundness,

good surfaces and low decarburization. Diameters range from 13 mm to 200 mm in many sizes.

HOT-ROLLED FLAT BAR

Eliminate costly manufacturing steps with our hot-rolled flat bar or special profiles in both symmetrical and asymmetrical sizes. Flats with welding chamfers and rounded corners

often deliver high cost savings compared to machining or gas cutting, which can weaken edges. Widths range from 12 mm to 270 mm and thickness from 5 mm to 60 mm.

Hot-rolled tubes

Our tube products are characterised by uniform properties, close tolerances and small machining

allowances. Ovako's tubes and hollow bars are used when there are stringent demands on the material.

SPECIAL PROFILES IN STOCK

SINGLE BEVEL



Profile	Size	Steel grade
P4-0036	150 x 16	SB 27M12CB
P4-0035	150 x 20	
P4-0059	200 x 20	
P4-0060	200 x 25	
P4-0101	200 x 30	
P4-0061	250 x 25	
P4-0062	250 x 30	
P4-0063	270 x 30	
P4-0064	270 x 35	
P4-0231	300 x 30	
P4-0099	300 x 35	
P4-0100	300 x 40	

ARROWHEAD



Profile	Size	Steel grade
P4-0025	101 x 23	SB 27M12CB
P4-0003	151 x 32	
P4-0338	203 x 32	

GROUSER BAR



Profile	Size	Steel grade
P7-0019	30 x 16	SB 24M13B
P7-0020	40 x 22	SB 27M12CB
P4-0020	42 x 24	
P4-0019	50 x 27	
P4-0018	65 x 30	
P4-0017	68 x 37	
P4-0016	75 x 45	
P4-0355	89 x 43.5	

STANDARD BORON GRADES

Boron steel chemical composition

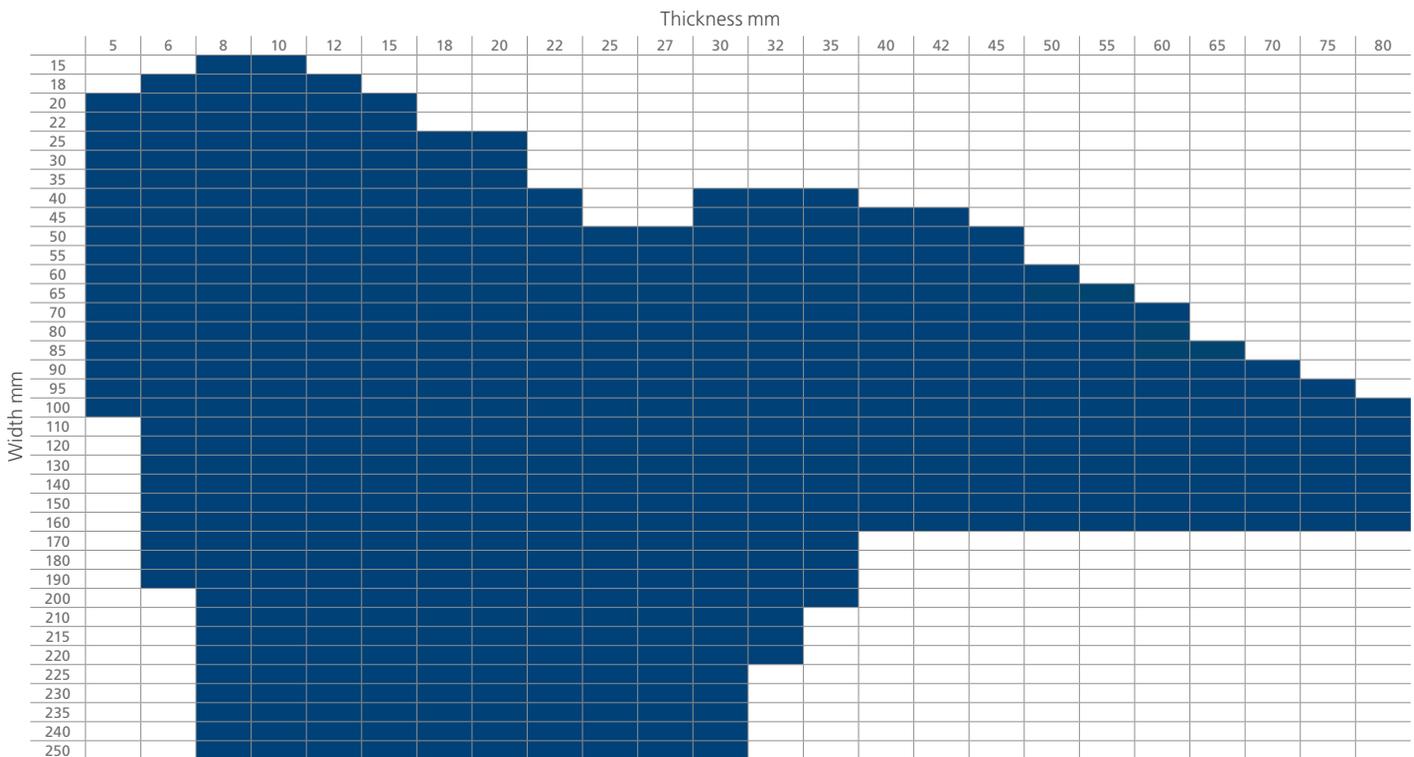
Boron steel chemical composition		Typical analysis				
Ovako standard	EN-standard*	C	Si	Mn	Cr	CEV
SB21M10B		0.21	0.2	1.0	0.2	0.4
SB24M13B	24MnB5F	0.24	0.3	1.3	0.2	0.5
SB27M12CB	27MnCrB5-2	0.27	0.2	1.2	0.5	0.6
SB30M12CB	30MnCrB5-2F	0.30	0.3	1.2	0.5	0.6
SB33M13CB	33MnCrB5-2	0.33	0.3	1.3	0.6	0.7
SB43M14B	43MnB6-3F	0.43	0.3	1.4		

* Designation followed by "F" is not an official EN standard grade but named according to the rules in EN 10027.

$$CEV = C + Mn/6 + (Ni + Cu)/15 + (Cr + Mo + V)/5$$

DIMENSIONS, HOT-ROLLED FLAT BAR

The diagram below provides an overview of the width and thickness of our hot-rolled flat bar.



ABOUT OVAKO

Ovako develops high-tech steel solutions for, and in cooperation with, its customers in the bearing, transport and manufacturing industries. Our steel makes our customers' end products more resilient and extends their useful life, ultimately resulting in smarter, more energy-efficient and more environmentally-friendly products. Our production is based on recycled scrap and includes steel in the form of bar, tube, ring and pre-components. Ovako is represented in more than 30 countries, and has sales offices in Europe, North America and Asia. Ovako's sales in 2016 amounted to EUR 781 million, and the company had 2,800 employees at year-end. For more information, please visit us at www.ovako.com

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