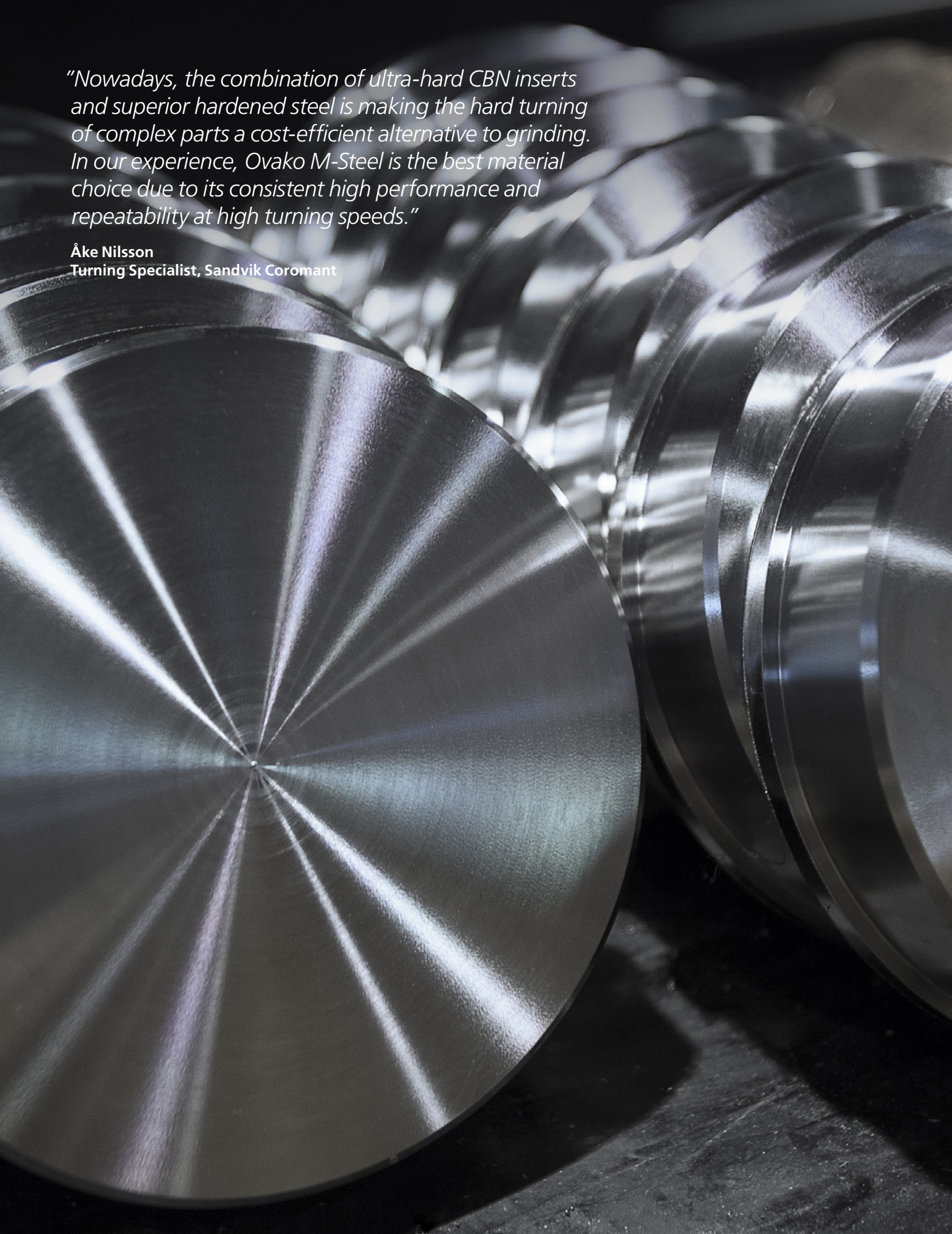


A close-up photograph of a CNC machine tool, specifically a turning operation. The tool is a dark, multi-fluted cutting tool with a sharp, golden-colored tip. It is positioned to cut a cylindrical metal workpiece. The workpiece is highly reflective, showing bright highlights and deep shadows. The background is a blurred industrial setting. The overall color palette is dominated by metallic blues, greys, and oranges.

OVAKO

**MACHINE LESS,
MAKE MORE**

M-STEEL®



"Nowadays, the combination of ultra-hard CBN inserts and superior hardened steel is making the hard turning of complex parts a cost-efficient alternative to grinding. In our experience, Ovako M-Steel is the best material choice due to its consistent high performance and repeatability at high turning speeds."

Åke Nilsson
Turning Specialist, Sandvik Coromant

M STANDS FOR MAKING MORE MONEY – YOURS!

Good news. Our popular M-Steel now lets you save even more money than before. The advantages, which are especially pronounced in automated turning or drilling processes, are confirmed by SWEREA KIMAB, an independent research institute. In short, by using our M-Steel concept in a smart way you stay ahead of the competition.

For more than 30 years, we've said that M-Steel is the ultimate choice when you need superior machinability. Now, we'd like to emphasize that "M" also stands for Making Money. How do we know? Case after case, from more than 400 customers, confirms the significant bottom-line savings.

30–40% cost savings

Some of you report a 30-40% reduction in total machining costs, compared with conventional steel bar. Others tell us that our M-Steel enables the hard turning of case hardened steel with Cubic Boron Nitride (CBN) inserts at roughly double the speeds previously possible. Remarkably, at higher speeds, crater wear on the tool edge is actually reduced and the life of the cutting tool is improved by 2-3 times!

Repeatability through consistency

The success of M-Steel is due to a close collaboration with you, cutting experts and our own R&D team. The superior machining properties of M-Steel are based on the careful selection of raw materials and accurate control of the process

– from recycled scrap to hot rolling and final treatment. This is essential in automated serial production, since it means you avoid changing machine settings such as cutting speeds, feed rates and tools.

Let us help you make money

More than just providing you with treated non-alloy or low-alloy M-Steel products, we invite you to share our knowledge gathered over many years. Our service team is happy to advise you on steel types, inserts, material supply, logistics and more. All to help you start making even more money.

Benefits of M-Steel

- Enables automation and faster machining
- Extends your tool life
- M-Steel treatment can be applied to most steel grades
- Complies with standards yet adds superior machining properties
- Up to 50% faster throughput
- Unmatched quality consistency

THE SECRET TO HIGHER PRODUCTIVITY

Until now, it was unthinkable for many metalworking shops to boost productivity through automation. Robots were expensive and hardened steels often delivered uneven tolerances, poor chip formation and high vibration levels. Operators had to be on standby 24/7. For Jarkko Haavisto, Managing Director at Juhani Haavisto Oy, this all changed with M-Steel, which enables unmanned production and productivity gains of up to 30% – day and night!

Mention the word “automation” and you think of longer series production of similar parts. But automation can also be used for shorter series production to free up skilled staff to handle other machining operations. This, at least, was the reasoning by Juhani Haavisto Oy, a custom engineering sub-contractor that supplies parts to the Nordic pulp and paper, mining and process industries.

Modern shaft production

Founded in 1987 in the town of Kotka, Finland, Juhani Haavisto Oy today has 52 employees with annual sales of €7.5 million. The family owned company is always looking for ways to streamline and modernize its highly varied production. For the shafts it was producing, it decided to establish a new manufacturing cell to optimize productivity using unmanned production.

Clever Finnish ingenuity

In the past, according to Managing Director Jarkko Haavisto,

production of shafts had required three steps and had been fraught with problems relating to straightness, vibration, high carbide insert tool wear and long chips. The idea was now to use a bit of clever Finnish ingenuity to save money and time by combining a robot, standard CNC machine and superior material – in just one step. But which material would be best?

Cost savings through automation

A test was made of M-Steel-treated 42CrMo4 + QT Ø100 mm bar (1091 mm length) against three other European producers. The steels were comparable in composition and mechanical properties according to EN10083-3. While the cutting speed could be increased by 20% for all steels, the M-Steel-treated bar had far fewer problems with straightness, vibrations and chip performance – and the tool life was extended by five times (Page 5). Out of all tested materials only M-Steel could be considered for automated production. “The cost savings for us is quite dramatic,” adds Haavisto, who shared a calculation he made (below).

Total cost savings through automation with M-Steel (including investment for 1 robot)

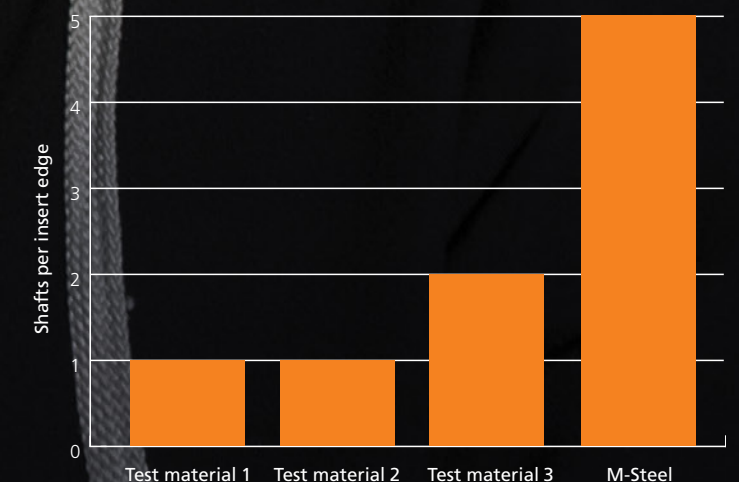
OLD SETUP	Three steps in machining, always manned operation, ordinary steel		
		TIME	COST PER PIECE
Machine costs	€ 20 /h	1.2 h	€ 24
Labor costs	€ 25 /h	1.2 h	€ 30
Tools	€ 10 /h	1.2 h	€ 12
Materials	€ 1 /kg	68 kg	€ 68
			€ 134

NEW SETUP	Done in one, automated operation, M-Steel		
		TIME	COST PER PIECE
Machine costs	€ 30 /h	0.75 h	€ 24.50
Labor costs	€ 25 /h	0.1 h	€ 2.50
Tools	€ 2 /h	0.75 h	€ 1.50
Materials	€ 1.1 /kg	68 kg	€ 74.80
			€ 101.30

“You can hear the difference when using bar made from M-Steel – quiet, efficient and making money.”

Jarkko Haavisto, Managing Director
Juhani Haavisto Oy, Kotka, Finland

Productivity comparison test:
M-Steel versus three other 42CrMo4 grades



PROTECTIVE FILM ALLOWS FOR HIGHER CUTTING SPEED

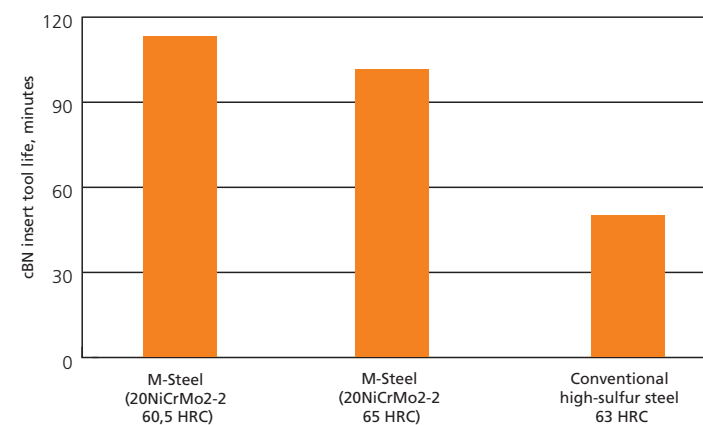
With the development of new tool materials, such as CBN inserts, it is possible to turn materials in hardness over 55 HRC. So-called hard part turning is gradually removing the need for grinding and separate, more expensive, heat treatments.

There are many opinions about the suitability of different grades of case-hardened steels for hard part turning. One key question is the link between tool life and wear mechanisms on the cutting edge. Another relates to inclusion levels and machinability. Rather than speculating, we asked an independent test institute to put some carburized steels to the test.

Testing on the cutting edge

For this investigation, we selected two case hardened steels with approximately the same basic alloying properties and higher sulfur levels: Conventional steel (152A) and M-Steel (21NiCrMo2-2). Test pieces were then case hardened to surface hardness 58 – 65 HRC and later hard part turned using CBN inserts at different cutting speeds. SWEREA KIMAB, an independent test institute, conducted an investigation into the wear mechanisms of the insert edges, the surface smoothness achieved as well as chip formation.

Figure 1: Tool life at a cutting speed of 170 m/min.



M-Steel – best in test

The major conclusion of the study was that M-Steel proved to be, by far, the easiest-to-machine steel (Figure 1). How was such a big difference possible? It is proposed that the superior tool life is linked to protective deposits that form on the rake face during machining.

Beneficial protective film

While in conventional steel, hard non-metallic inclusions cause considerable tool wear, M-Steel treatment will change their composition, so that they instead form a protective film between the tool and chip interface (Figures 2,3).

Figure 2: Ridges in the CBN edge covered with Ca-aluminates are observed on the rake face with 20NiCrMo2-2 at 240-300 m/min.

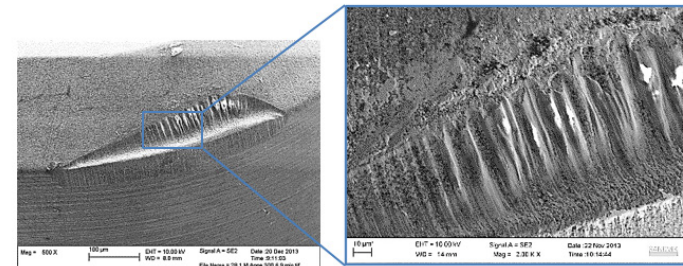
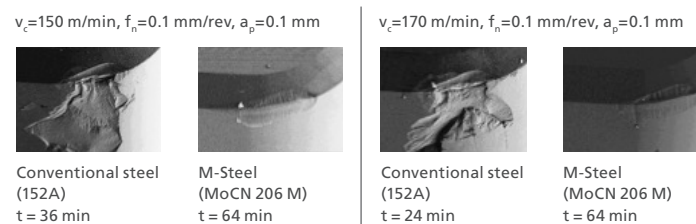


Figure 3: Crater wear comparison at 150 m/min and 170 m/min. Tests were interrupted at the time of tool failure and the surfaces of the inserts were then examined for limiting flank wear levels.



Source: SWEREA KIMAB is an independent Sweden-based test institute dedicated to applied research, development and problem-solving within the field of corrosion and metallic materials.

"M-Steel showed superior machinability compared to the other steels tested in this work."

Niclas Ånmark and Thomas Björk, KIMAB



PRECISION MACHINING FOR SAFER ROADS

For the series production of critical automotive parts or engineering components, you need bar that lets you do precision machining – with no surprises. Are your current bars straight enough for demanding applications? Do you get the right mix of hardness and toughness?

“With M-Steel, we increased our cutting speed, extended tool life and lowered cutting costs. I’ve never received a claim report for material fault.”

Gunnar Nyvaller, VBG Group

These are just a few of the questions posed to us by the VBG Group, a global manufacturer of safe and secure coupling equipment, mainly for truck-and-trailer combinations and center-axel trailers. Critical to these couplings is the steel coupling pin that connects the truck and trailer, ensuring that millions of these giant vehicles keep rolling safely down highways – year after year.

Safe and secure trucking

In the early 1990s, the VBG Group decided it wanted to change the steel grade it was using for some components, including the coupling pin. They were looking for faster and cheaper methods of production. They also wanted a material that would help them live up to their slogan, “the strong connection” – a commitment to safety and security on the roads.

Meeting stringent tests

In addition to its own testing, the company conducted stringent EC tests lasting two weeks and two million cycles, the equivalent to the lifetime of a truck. The material was then carefully examined for cracks. Not only did M-Steel pass the test, it helped boost cutting speed, extend tool life and lower cutting costs – ideal for a manufacturing floor where M-Steel rods are cut, machined and hardened by robots with minimal supervision.

Hard and soft material

But it was the combination of hardness and softness in the material that made M-Steel particularly interesting, according to Marketing Manager Gunnar Nyvaller. The pin’s bulb is heated up to a greater hardness while the stem retains some softness. An overly hard stem would result in a more brittle material what would have a tendency to crack under pressure.



SELECT YOUR M-STEEL, PUT OUR RESOURCES TO WORK

What type of M-Steel can best optimize your process? Naturally, our round and square bar is available in a wide range of standard dimensions. But we can also tailor the process to suit your needs. Or provide it cut-to-length to fit the specific requirements of your machining center.

Making high-quality M-Steel products is only part of our job. Just as important is our collaboration with you to get a better understanding of your technical requirements. Our ability to finely control the purity of our steel, its hardenability, its heat treatment and its machinability are the key to successful M-Steel production.

The difference is knowledge

We encourage customers to tap into our comprehensive know-how and experience gained from different applications and production methods. Our ultimate goal is to optimise the steel performance for every application, and to come up with entirely new, cost-efficient material solutions. Our home base is Northern Europe, with three steelmaking plants and five

rolling mills – many of which have histories going back 300 years. We also have a well-developed logistic chain and network of sales offices across the globe.

25 mm to 200 mm

Our main focus for M-Steel is high-quality, low-alloyed engineering steels, with bar sizes of 25 mm on up to 200 mm and square bars up to 150 mm. Apart from round bar, we also supply square, flat and profile bar as well as tubes and rings. M-Steel can be produced in a wide variety of steel grades. There are only a very few limitations on steel grades which can't be produced as M-Steel. The chart below provides an overview of M-Steel specifications for some of our steel grades.

EN-standard* (Ovako standard)	Special feature	TYPICAL ANALYSIS						
		C	Si	Mn	Cr	Mo	Ni	Other
CASE-HARDENING STEEL								
16MnCr5	Alloyed steel suitable for heat treatment and carburizing.	0.2	0.2	1.2	1			
16NiCr54	Good toughness, controlled hardenability, good machinability.	0.2	0.2	0.6	0.8		1	
20NiCrMo2-2	Suitable for high performance carburizing and carbonitriding components.	0.2	0.3	0.9	0.6	0.2	0.5	
20MnCr5	Alloyed steel for parts with a required core tensile strength and good wearing resistance.	0.2	0.2	1.3	1.2			
GENERAL STRUCTURAL STEEL								
11SMn30	Will substitute leaded free cutting steels.	0.1	0.2	1.2				S
19MnVS6 (280M)	Good toughness, high hardenability and high strength.	0.2	0.4	1.5				V
20Mn5F		0.2	0.4	1.3				S
30MnVS6	Micro-alloyed cold heading steel.	0.3	0.5	1.4				V
C45E	Steel suitable for cold working and quenching and tempering.	0.5	0.3	0.7				
S355J0	A micro-alloyed construction steel with increased sulfur content. High machinability and weldability.	0.1	0.4	1.3				S
S355J2		0.1	0.4	1.3				S
S355J2 (550M and 520M)	Improved machinability and mechanical properties compared to regular S355J2. Better impact strength and tensile strength.	0.1	0.3	0.8				V
QUENCHING AND TEMPERING STEEL								
21CrMoV5-7F	Steel suitable for nitriding.	0.2	0.3	0.6	1.4	0.7		V
25CrMo4	Steel suitable for cold heading.	0.3	0.2	0.9	1.1	0.2		
34CrMo4	Alloyed steel suitable for heat treatment. High toughness.	0.3	0.3	0.8	1.1	0.2	1.3	
34CrNiMo6	Excellent combination of toughness, strength and weldability.	0.3	0.2	0.7	1.4	0.2		
7CrV5	Suitable for welding. Does not require post welding heat treatment.	0.1	0.3	1	4			Nb

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

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 2014 amounted to EUR 862 million, and the company had 2,925 employees at year-end. For more information, please visit us at www.ovako.com

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