

The Ovako logo consists of the word "OVAKO" in a bold, blue, sans-serif font. A thin orange horizontal line is positioned directly beneath the letters "A" and "K".

OVAKO

The text "OVAKO ROCK DRILLING STEEL" is displayed in a large, bold, sans-serif font. "OVAKO ROCK" is in blue, and "DRILLING STEEL" is in orange. The text is centered within a white rectangular area that has a slight drop shadow, making it stand out against the background image of a rock drill.

OVAKO ROCK DRILLING STEEL

OPTIMIZED STEEL FOR PROFITABLE PERFORMANCE



SUPERIOR SOLUTIONS FOR EVERY COMPONENT

Heavy impact. High frequency hammering. Extreme abrasion. Having owned and operated our own mines, we understand how vital the right steel properties are to handling extreme loads in every part of the drill string. This is why every product we deliver starts directly in our steel mills with your specific load case and manufacturing process. And finishes only with the optimal material and format for cost-effective manufacturing of each rock drilling component.

The punishing conditions of percussive drilling can push the limits of most materials. And heavy mechanical loads are only the beginning. High impact energies at high frequency are a major source of fatigue. High temperatures result from impact energy losses. And abrasive, erosive and adhesive wear are constant risks. Handling any of these varying demands at a single point along the drill string is difficult enough – which makes optimizing for the entire drilling system an extremely complex challenge.

Load case

Engineered for specific loads

At Ovako, we've specialized over many decades in analyzing the dominant loads for each of these parts and components, and testing for individual applications in our labs. Your most critical fatigue properties are controlled in our metallurgy, and followed by performance measurements through RBF (Rotating Bending Fatigue) testing, along with special methods combining impact load with various wear loads. The result is a fit-for-purpose steel with tightly controlled performance properties, making it possible to pre-calculate your components' life time for highly automated and repetitive processes.

Ovako's range of rock drilling products are tailored to meet your tool production needs in three key application areas:

TOP HAMMER DRILLING

All parts of the top hammer drill string, including shank adapters, drill rods, rod ends and couplings, and drill bits.

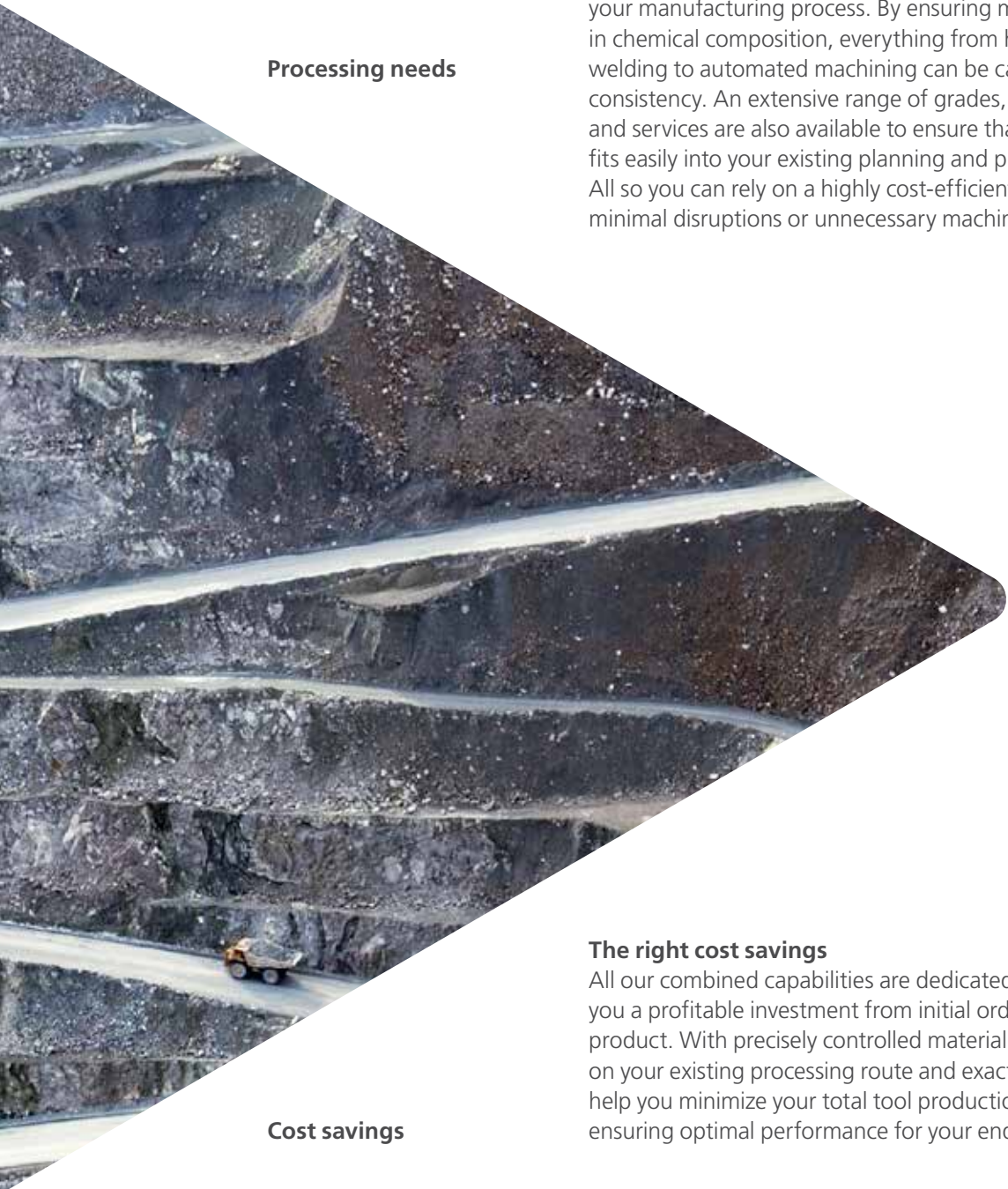
DTH AND RC DRILLING

All parts of the DTH drill string from tubes and end pieces down to all parts of the hammer and bit, as well as RC drill tubes.

ROTARY AND DIAMOND CORE DRILLING

Tools for rotary drilling and diamond core drilling such as raise bore cutters, tricone bits and legs, PDC bits, diamond core bits and core retrieval systems.





Processing needs

Tailored for your processing route

The same levels of control and predictability carry through to your manufacturing process. By ensuring minimal variations in chemical composition, everything from heat treatment and welding to automated machining can be carried out with high consistency. An extensive range of grades, shapes, formats and services are also available to ensure that your delivery fits easily into your existing planning and processing route. All so you can rely on a highly cost-efficient supply chain with minimal disruptions or unnecessary machining.

Cost savings

The right cost savings

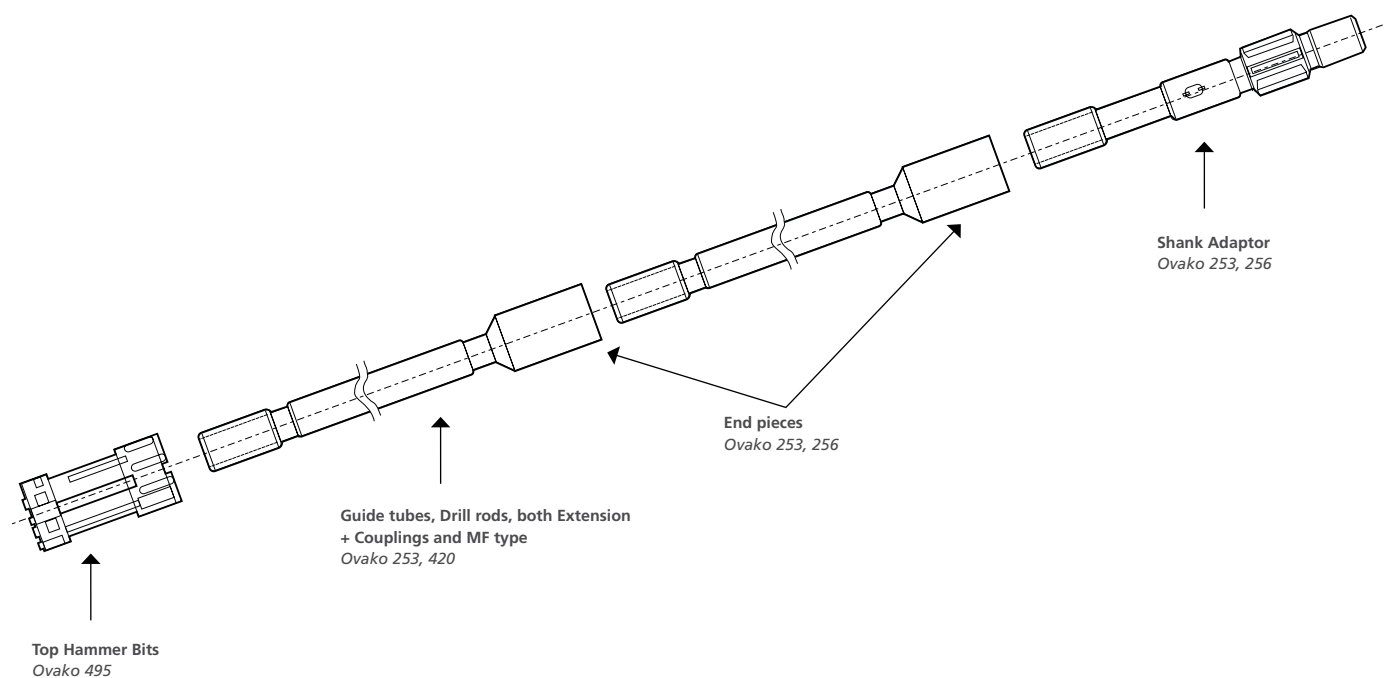
All our combined capabilities are dedicated to guaranteeing you a profitable investment from initial order to finished product. With precisely controlled material properties based on your existing processing route and exact load case, we help you minimize your total tool production costs while ensuring optimal performance for your end products.

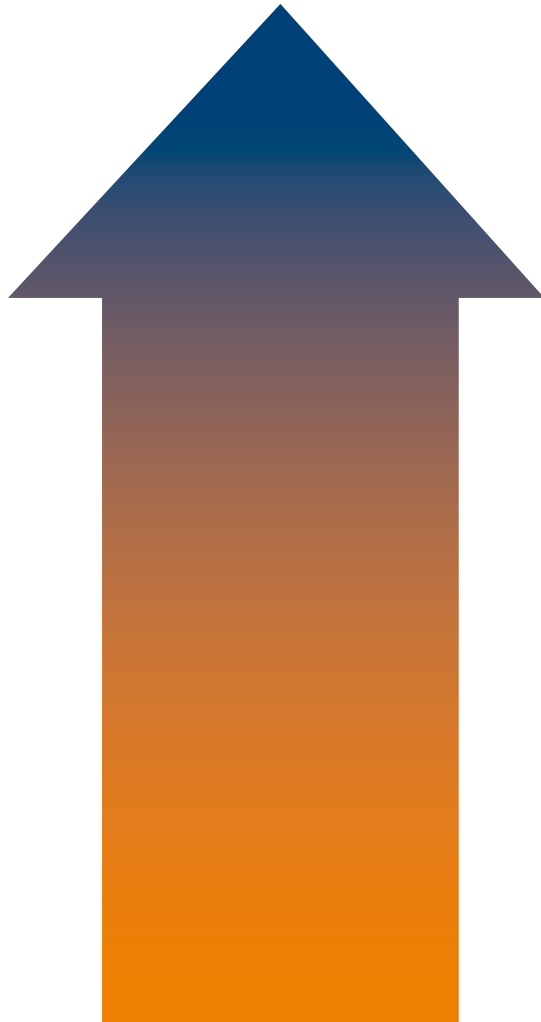
TOP HAMMER STEELS OPTIMIZED FOR YOUR NEEDS

From shank adaptor to drill bit, we've devoted decades to developing, testing and delivering the optimal materials for all top hammer drill string components. So when it comes to the complex impact, wear and fatigue properties your products demand, no one has a broader range of solutions than Ovako.

Whether you're looking to increase your product's life time, enable drilling with higher energy inputs or create tailor-made drill bits for specific applications, our wide range of grades and clean mining steels can be optimized for any performance needs. Combine this with near-net shape and pre-cut components, and we ensure that

your delivery can enter straight into production with no extra re-tooling, waste or machine wear. Whatever your ultimate goals, you can always rely on the industry's most consistent chemical compositions to guarantee repeatable processes with predictable results.





**YOUR SUPERIOR
END PRODUCT**

YOUR SUPERIOR END PRODUCTS

- Extended life time and fatigue resistance
- Increased energy input in drilling
- Tailor-made, fit-for-purpose bits
- Predictable component lifespan for automated drilling
- Optimized ID in drill bars for improved air flow and reduced string weight

**YOUR PROCESSING
NEEDS**

YOUR MINIMIZED PROCESSING TIME AND COSTS

- Cost-efficient machining
- Tailored steels for specific processes
- Reliable, repeatable processing
- Precise friction welding in hollow drill bars
- Improved machinability in hollow drill bars
- Improved friction welding from more concentric OD and ID of HDB

**OVAKO CUSTOMIZED
SERVICES**

OVAKO CUSTOMIZED SERVICES

- Simplified supply chain with EDI forecasting and order handling
- Optimized lead times
- Integrated stocking solutions
- Complete status overview with OvaTrack

**OVAKO TAILORED
PRODUCT GEOMETRIES**

**OVAKO TAILORED GEOMETRIES
AND PRE-PRODUCED COMPONENTS**

- Near-net-shape and pre-cut components
- Wide range of sizes and formats

**OVAKO MATERIAL
CAPABILITIES**

WIDE SELECTION OF OVAKO OPTIMIZED STEELS

- Ovako clean mining steels (IQ-Steel® and BQ-Steel®)
- Material properties tailored for your processing route
- Tight chemical consistency for reliable automation

SPECIFIC PRODUCT TOP HAMMER DRILLING HOLLOW DRILL BAR

Nominal	Ovako optimized OD	Ovako optimized OD tolerance +/-	Ovako optimized ID	Ovako optimized ID tolerance +/-	Ovako optimized kg/m	Weight saving vs. others
R32 x 9.2	32.2	0.25	9.4	0.3	5.85	0.40%
R32 x 11.7	32.2	0.25	12	0.3	5.5	0.90%
R39 x 14.5	39	0.25	14.9	0.3	8.05	0.40%
R39 x 10.3	39	0.25	10.5	0.3	8.70	0.40%
R46 x 17	45.7	0.25	17.5	0.3	11.03	1.10%
R52 x 21.5	51.9	0.25	22	0.4	13.67	1.30%
R60 x 22.6	59.6	0.3	24	0.4	18.42	3.30%
R70 X 22.5	69.6	0.3	23.9	0.4	26.41	Outside other normal process range

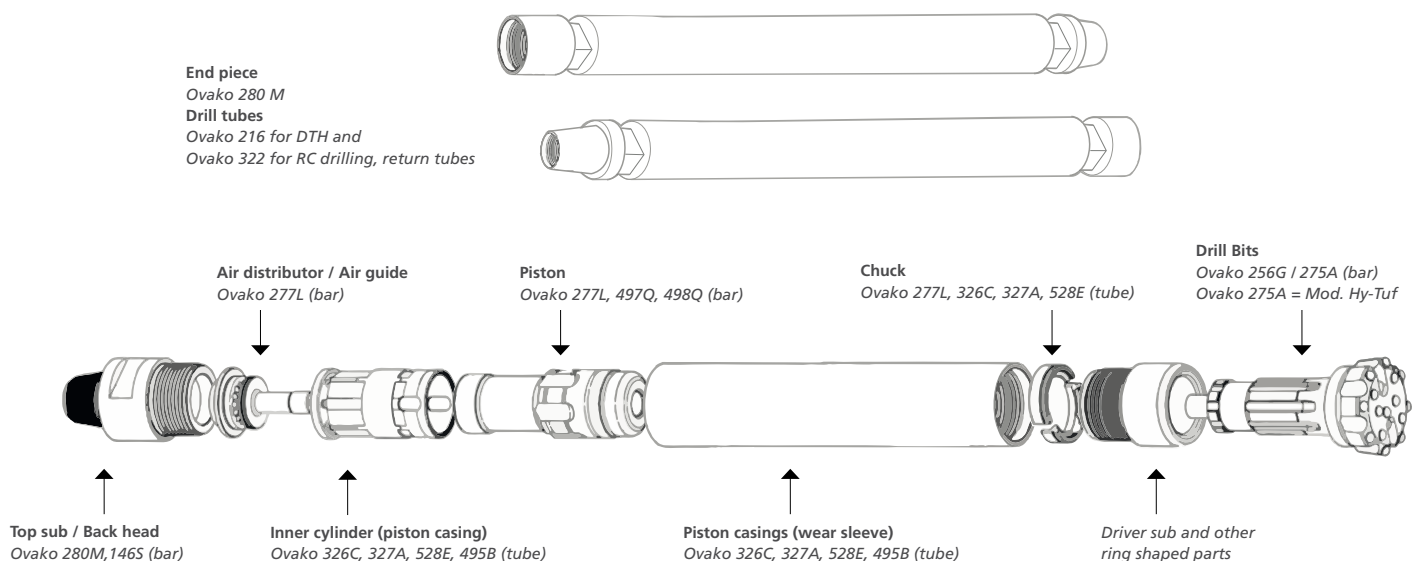
DTH DRILLING

THE SMARTER WAY TO WITHSTAND WEAR & IMPACT

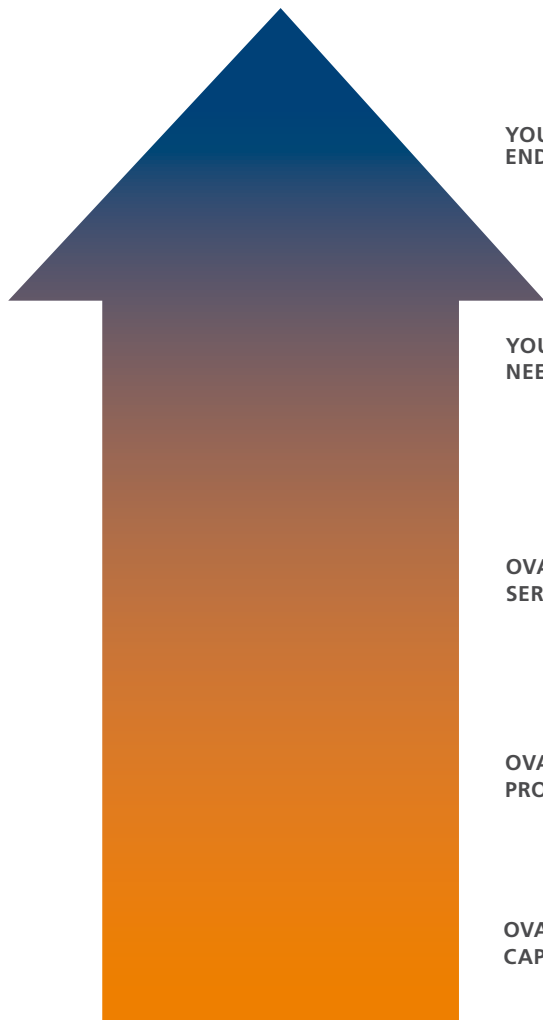
Fit-for-purpose drill bit steels. Tailored drill tube products. Or a patented steel for cost-efficient impact resistance on par with single remelts. Across the full range of processing and performance requirements, our wide variety of customized DTH drilling steels gives your products – and your business – a lasting competitive edge.

Every part of the DTH drill string is subjected to unique impact forces, together with abrasive and erosive wear. Whether it's subs, chucks, drill tubes, end pieces, piston cylinders or casings, we can advise on precisely the right grades and formats for each component. This includes a wide selection of wear-resistant and clean steels such as IQ-Steel, which gives the same performance as single

remelts but at a fraction of the cost. Our tube products are also uniquely suited to challenging applications like RC exploration drill tubes, where resistance to erosion wear from dust is essential. And, of course, every Ovako product is delivered tailored to your existing production processes to give you full control over everything from pre-machining and handling to machining and processing.



See page 9 for our full steel grade selection.



YOUR SUPERIOR END PRODUCT

YOUR SUPERIOR END PRODUCTS

- Extended life time and fatigue resistance
- Tailor-made, fit-for-purpose bits
- Reduced drill string weight with fatigue resistance
- Reliable, cost-efficient performance

YOUR PROCESSING NEEDS

YOUR MINIMIZED PROCESSING TIME AND COSTS

- Cost-efficient, repeatable processing
- Reduced material costs with tight tolerances

OVAKO CUSTOMIZED SERVICES

OVAKO CUSTOMIZED SERVICES

- Simplified supply chain with EDI forecasting and order handling
- Optimized lead times
- Integrated stocking solutions
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OVAKO TAILORED PRODUCT GEOMETRIES

OVAKO TAILORED GEOMETRIES AND PRE-PRODUCED COMPONENTS

- Near-net-shape and pre-cut components
- Tightly controlled tolerances and concentricity
- Wide range of sizes and formats

OVAKO MATERIAL CAPABILITIES

WIDE SELECTION OF OVAKO OPTIMIZED STEELS

- Ovako clean mining steels (BQ-Steel and IQ-Steel)
- Material properties tailored for your processing route
- Tight chemical consistency for reliable automation

DTH DRILLING – DRILL TUBES

Typical nominal sizes, alternative sizes on request

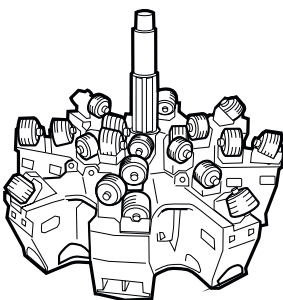
OD (inch)	OD (mm)	Wall (mm)	Wall (mm)	Ovako 216	Ovako 322
	70		6.3	Yes	Yes
3	76.2	4	6.3	Yes	Yes
3.5	88.9	6.3	8.8	Yes	Yes
4	101.6	6.3	8.8	Yes	Yes
4.5	114.3	8.8		Yes	Yes
5	127	8.8		Yes	Yes

ROTARY DRILLING BEYOND STANDARD

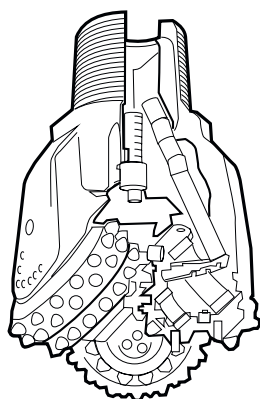
To ensure the highest performance at the lowest total cost, the right choice of steel grade is only the beginning. Thanks to tighter control of steel chemistry in our mills, Ovako rotary drilling steels go beyond international standards to give you the superior metallurgical consistency you need for reliable, repeatable manufacturing and use.

Your customers depend on the right steel to handle deep drilling without costly stoppages or tooling changes. Whether it's Tricone bits or PDC's, shaft opening by raise boring, or even within diamond core exploration drilling, we supply optimized materials in bars, tubes or forged

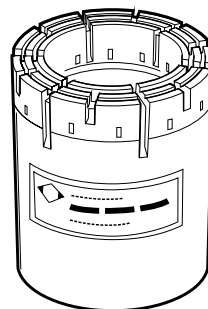
rings for some of the most challenging drilling conditions imaginable. The advantages are largely due to our unique ability to ensure minimal alloy variation in every batch we produce – giving manufacturers like you a superior combination of reliability and production economy.



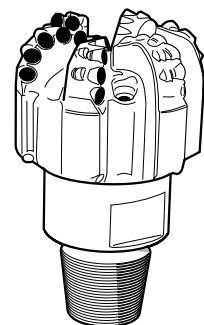
Raise boring cutter
Ovako 253D, 254S/ASTM 9315



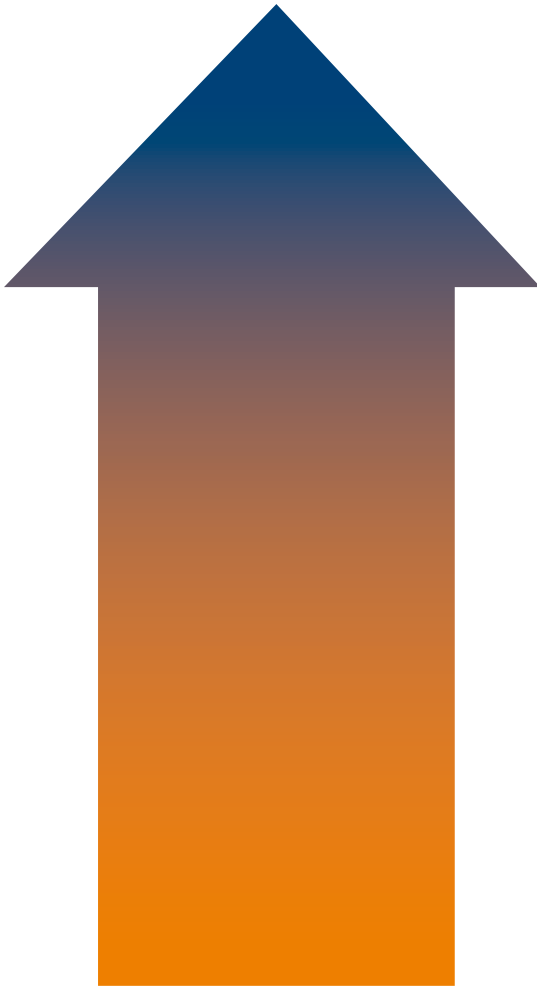
Rotary drillbit
Cones ASTM 9313-15/4815
Ovako 253D, 4708, 4707
Legs/body ASTM 8720
Ovako 152E, 4524, 4766



Diamond core drilling
Ring bit base material
Ovako 280, 322D, 326C



PDC drill bit
Bit material
Ovako 322D, 326C, 355B



**YOUR SUPERIOR
END PRODUCT**

YOUR SUPERIOR END PRODUCTS

- Extended life time and fatigue resistance
- Competitive price/performance ratio
- Smallest variation in steel properties to supports automated drilling

**YOUR PROCESSING
NEEDS**

YOUR MINIMIZED PROCESSING TIME AND COSTS

- Cost-efficient, repeatable processing
- Precise friction welding
- Reduced material costs with tight tolerances

**OVAKO CUSTOMIZED
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- Near-net-shape and pre-cut components
- Tightly controlled tolerances and concentricity
- Wide range of lengths and formats

**OVAKO MATERIAL
CAPABILITIES**

WIDE SELECTION OF OVAKO OPTIMIZED STEELS

- Ovako clean mining steels (BQ-Steel)
- Ovako wear-resistant steels (WR-Steel®)
- Material properties tailored for your processing route
- Tight chemical consistency for reliable automation

OVAKO MINING STEEL GRADES

For further information about these and other Ovako grades, see our Steel Navigator on www.ovako.com

Chemistry (typical)					
Similar international standard	Specific Ovako Grade	C	Si	Mn	S
16NiCrS4 EN353/815m17	146S	0.17		0.9	
S355	216S	0.14		1.2	
EN27 / 23NiCrMo12-5	253A	0.22		0.7	
EN27 / 23NiCrMo12-5	253L	0.24		0.65	
EN27 / 23NiCrMo12-5	253S	0.23		0.72	
EN27 / 23NiCrMo12-5	4722	0.24		0.65	
EN27 / 23NiCrMo12-5	4734	0.23		0.68	
AMS 9313	254R	0.13		0.7	
AMS 9315 En36c/832m13	254S	0.15		0.6	
AMS 9315	253D	0.15		0.55	
AMS 9315	4708	0.12		0.65	
18NiCrMo14-6	255G	0.16		0.55	
18NiCrMo14-6	255Q	0.16		0.55	
	256G	0.23		0.7	
AMS 6418	275A	0.24	1.55	1.4	0.008
AMS 6418	4802	0.25	1.6	1.4	0.025
	277L	0.15		1.3	
	277Q	0.15		1.3	
19MV6	280M	0.18		1.45	
19MV6	280T	0.18		1.5	
AISI 4130	222D	0.3		0.5	
AISI 4140	326C	0.4		0.95	
42CrMo4	327A	0.43		0.75	
42CrMo4	6082	0.42		0.75	
AISI 4340	355B	0.4		0.68	0.006
AISI 4340	6514	0.4		0.73	0.015
34CrNiMo6	365D	0.35		0.72	
34CrNiMo6	6499	0.34		0.65	
ASTM 8720 / 20NiCrMo2-2	152E	0.21		0.85	0.008
ASTM 8720 / 20NiCrMo2-2	4529	0.2		0.85	
ASTM 8720 / 20NiCrMo2-2	4766	0.18		0.9	
24CrMo13-6, BS 722 M 24	420G	0.24		0.5	
24CrMo13-6, BS 722 M 24	6023	0.24		0.48	
24CrMo13-6, BS 722 M 24	8312	0.24		0.55	
31NiCrMo13 4	453C	0.32		0.57	
48CrMo4-10F	495B	0.48		0.8	
48CrMo4-10F	6521	0.48		0.78	
300M	497Q	0.42		0.75	
EN30B	498A	0.3		0.5	
EN30B	498Q	0.3		0.5	
50CrMo4	528E	0.52		0.75	
50CrMo4	528Q	0.52		0.75	
AMS 4815	4815IC		Analysis after agreement		
	4707		Analysis after agreement		
100Cr6	803J	0.97		0.32	0.008

Cr	Ni	Mo	Other elements	Attribute Brand	Casting method
0.9	1.1	0.12			IC
					CC
1.3	2.9	0.24			IC
1.3	3	0.23			IC
1.31	2.9	0.24		BQ-Steel	IC
1.3	3	0.23			CC
1.33	2.58	0.23			CC
1.45	3.25	0.12		BQ-Steel	IC
1.3	2.9	0.24		BQ-Steel	IC
1.2	3.15	0.12		BQ-Steel	IC
1.4	3.2	0.12			CC
1.45	3.5	0.2		BQ-Steel	IC
1.45	3.5	0.2		IQ-Steel	IC
1.25	3.75	0.32		BQ-Steel	IC
0.35	1.8	0.42		BQ-Steel	IC
0.35	1.73	0.42			CC
2.2	0.5	0.5	V	BQ-Steel	IC
2.2	0.5	0.5	V	IQ-Steel	IC
0.4			V	M-Steel	CC
0.25			V	BQ-Steel	IC
1		0.21		BQ-Steel	IC
1		0.2		BQ-Steel	IC
1.1	0.2	0.25		BQ-Steel	IC
1.1		0.17		M-Steel	CC
0.8	1.82	0.25	V	BQ-Steel	IC
0.85	1.7	0.23			CC
1.45	1.45	0.25		BQ-Steel	IC
1.6	1.52	0.23			CC
0.57	0.57	0.25		BQ-Steel	IC
0.57	0.47	0.23			CC
0.5	0.5	0.47			CC
3.25		0.52			IC
3.1		0.47			CC
3.1		0.33			CC
1.12	3.2	0.24			IC
1.12	0.46	0.96	V	BQ-Steel	IC
1.1	0.45	0.95	V		CC
0.82	1.85	0.37	V	IQ-Steel	IC
1.32	4.05	0.22		BQ-Steel	IC
1.45	4	0.2		IQ-Steel	IC
1.05	0.21	0.21			IC
1.05		0.2		IQ-Steel	IC
					IC
					CC
1.45				BQ-Steel	IC

*) IC = Ingot Cast
CC= Conti Cast

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, rings and pre-components. Ovako has around 2,700 employees in more than 30 countries and sales of approximately EUR 900 million. Ovako is a subsidiary of Sanyo Special Steel and a member of Nippon Steel Corporation group, the third-largest steel producer in the world with more than 100,000 employees globally and a revenue of approximately EUR 50 billion. For more information, please visit us at www.ovako.com, www.sanyo-steel.co.jp and www.nipponsteel.com.

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