

Steel grade specification

OvaX 200

General information

OvaX 200 is an ingot cast air hardening steel that is suitable for case hardening, nitriding or quenching and tempering. It is specially designed for applications with high cleanliness demands and where isotropic properties are required. The steel is made according to a new process that modifies the inclusion morphology, i.e. a lower number of elongated sulfides and reduced size and distribution of oxides, both in average and in spread. This provides OvaX 200 with excellent toughness and fatigue properties in both the longitudinal and in the transverse directions. Furthermore, the micro segregation is reduced by increased soaking time and increased top cropping.

By using air-hardening or gas quenching it is possible to reduce the amount of quenching distortion. Additionally the use of quenching medias such as oil and salt can be avoided, which improves both safety and environment.

Nominal chemical composition

	C %	Si %	Mn %	P %	S %	Cr %	Ni %	Mo %
Min	0.14		1.20			2.10	0.45	0.45
Max	0.17	0.30	1.40	0.020	0.002	2.30	0.55	0.55

Steel cleanliness

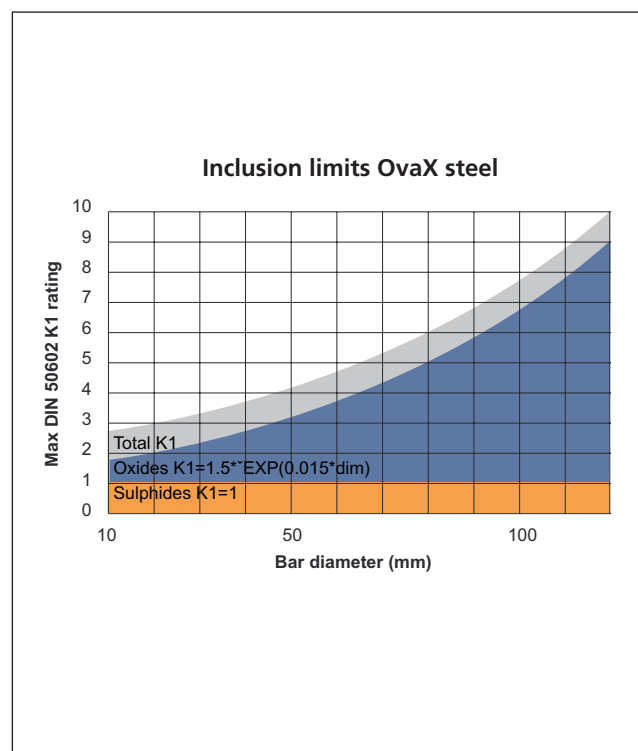
Internal quality class: IQ

Micro inclusions

Applied standard:	DIN 50602 K1
Sampling:	Six random sample from final dimension.
Limits:	Dimension dependent, the average rating of six samples will not exceed the limits in the right graph.

Macro inclusions

Applied standard:	ISO 3763 (Blue fracture)	10 MHz UST (internal)
Sampling:	Statistical testing on billets. three samples per tested heat	
Limits:	<1 mm/dm ²	Max 32 defects/dm ³ >0.2mm FBH



Heat treatment recommendations

Heat treatment		Temperature	Cooling/quenching
Hot forging		850-1200°C	Slowly or in air
Soft annealing		750°C	Slowly to 650°C in 8h
Carburizing		860-1000°C	Directly hardened in air or by gas quenching
Hardening	Q&T ¹⁾	860-1000°C	Directly hardened in air or by gas quenching
	A C ²⁾	840-870°C	
		860-890°C	
Tempering	Q&T ¹⁾	500-710°C	In air
	A C ²⁾	150-200°C	
Nitiding		510°C	In air
Nitrocarburizing		565°C	In air

1) Quenched and tempered. 2) As carburized.

Typical mechanical properties

Tensile

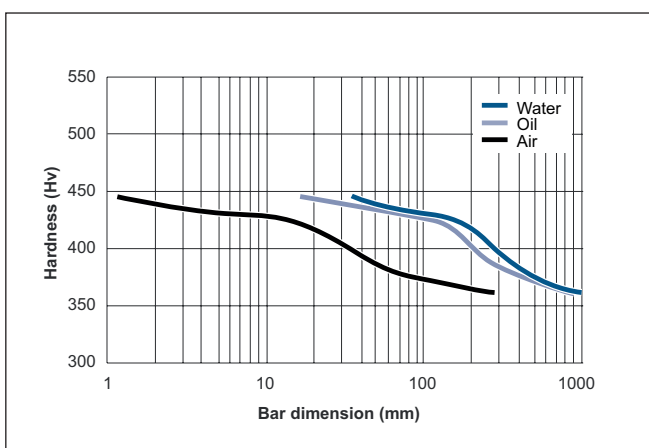
Condition	Hardness	Yield strength R _{p0,2} (MPa)	Ultimate tensile strength R _m (MPa)	Elongation A ₅ (%)
Q&T	230 HB	650	730	20
Hot rolled	350 HB	860	1200	10
Water quenched	430 HB			

Impact toughness

Condition	Hardness	KV RT (J)	KV -20 (J)	KV -40 (J)
Q&T	230 HB			60
Hot rolled	350 HB		20	
Hardened	435 HB	80	60	

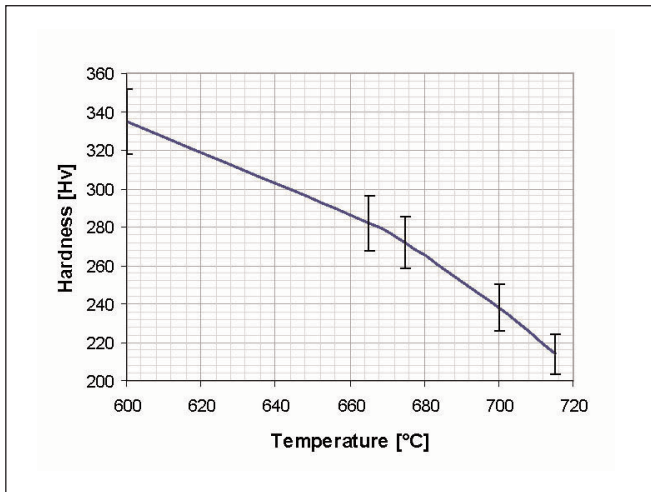
Hardenability

The hardenability describes the steel's ability to harden during cooling. It is generally measured as the steel's hardness versus cooling rate or dimension.



Hardenability of OvaX 200 calculated from CCT measurements and two-dimensional quenching of a bar. Each curve corresponds to different cooling medias.

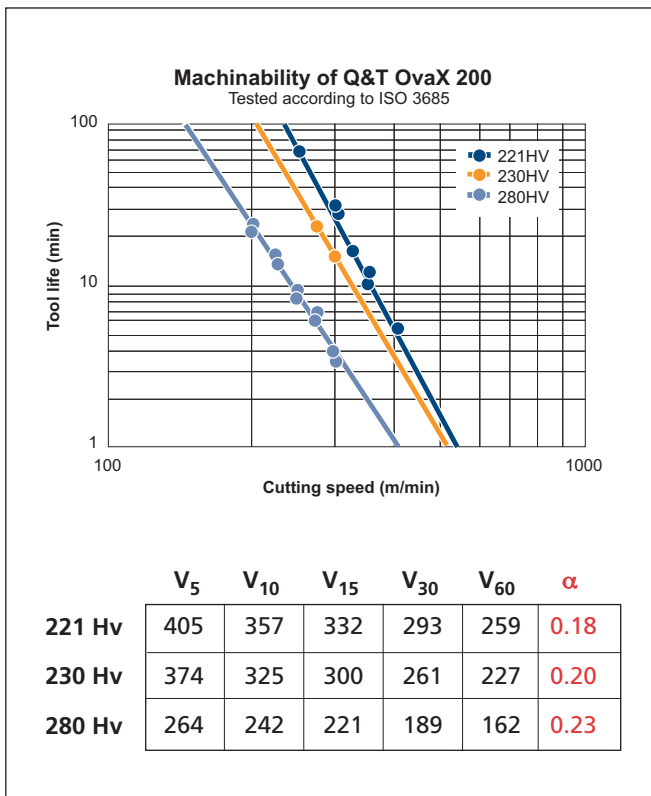
Tempering response



Tempering response for OvaX 277 after air hardening in production and tempered one hour at different tempering temperatures.

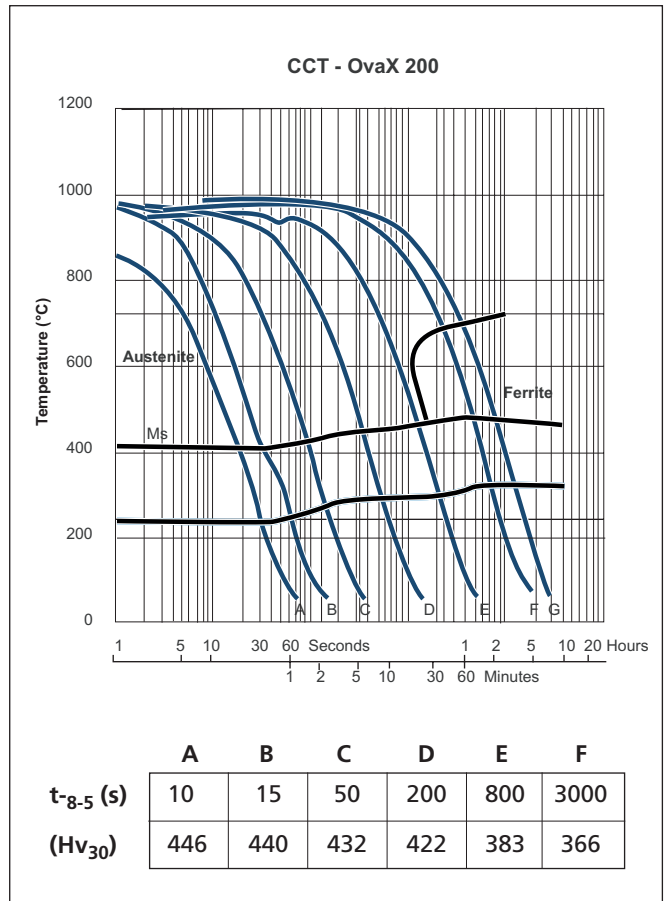
Machinability

The modified inclusion morphology in OvaX 200 provides very good machinability. The reduced size of harmful inclusions means less wear on the cutting tool, and thereby longer tool life.



The machinability for three different hardness levels for OvaX 200; tested according to the ISO 3685 standard. Using a SNMA 120408 in type P15 cutting tool, a CSRNL holder, a feed rate at 0.4 mm/r and a cutting depth of 2.5 mm. The wear criteria of this test is a VB₀ mean of 0.3 mm.

Transformation diagram

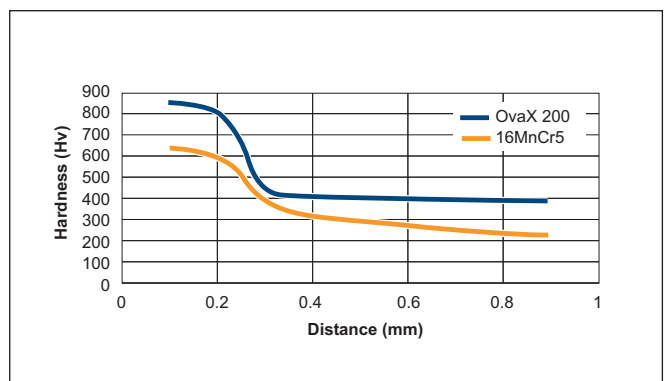


CCT diagram of OvaX 200 made by dilatometry. Samples were austenitized at 1000°C for ten minutes. Then exponentially cooled with different t₋₈₋₅ (cooling time between 800°C and 500°C). Heat number used was R7001. Hardness and t₋₈₋₅ value are given in the table.

Nitriding

OvaX 200 is well suited for nitriding. It is alloyed to get high nitriding rate and a high surface hardness.

The hardness profile of OvaX 200 compared to 16MnCr5 after gas nitriding in 50h at 510°C. Used gas was ammonia with a atmospheric dissociation of 50-60%



Welding

OvaX 200 is specially designed to have very good welding properties. The combination of the process (clean steel) and a low carbon content provides OvaX 200 with a good resistance against hydrogen cracking after welding, meaning that the steel can be welded without preheating up to fairly large dimensions. The steel's high hardenability and good toughness properties provide a heat-affected zone that meets the high stated demands for the bulk material.

- For the best results welding should be continuous, and slowly cooled in ambient air conditions.
- Preheat before welding. If the welding is performed in a damp environment or if the temperature is below 5°C the preheating temperature should be increased by 25°C.
- Consumables should be selected on the basis of strength and toughness requirements of the weld joint. A consumable with low strength, that still fulfills the strength requirements, minimizes the residual stresses over the weld. The consumable should also be selected with a as similar as possible chemical composition as the base material.
- Hydrogen content should not exceed 5ml/100g weld metal.
- Post heat treatment is a good alternative to preheating. It should be performed at 200°C, directly after welding, holding for 5 min/mm material thickness, for at least one hour.

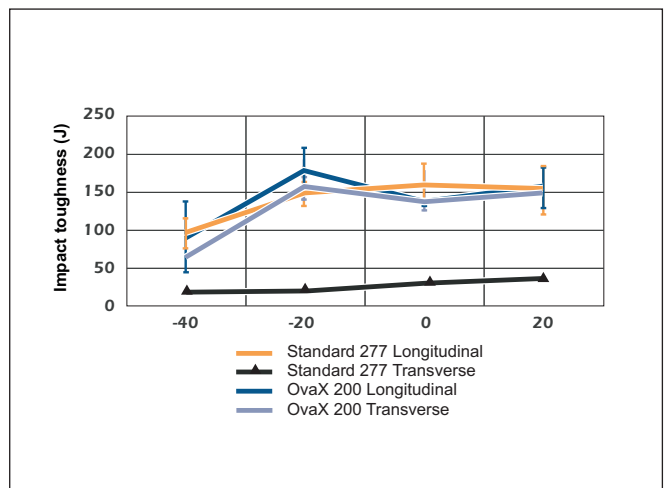
Recommended working temperatures for welding with ferritic consumables:

Combined wall thickness (mm)						
10	20	30	40	50	60	70 80
RT	75°C				100°C	

The recommended preheating temperatures are based upon a heat input around 1.7KJ/mm and that the hydrogen content does not exceed 5ml/100g weld metal.

Impact toughness

OvaX 200 are made according to a process that modifies the inclusion morphology in the steel; providing it with smaller and less elongated inclusions. The result is a more isotropic steel. For impact toughness this means that the transverse values are in level with the longitudinal. The graph compares the impact toughness for OvaX 200 with 277 with normal bearing quality (BQ).



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Disclaimer

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