

16NiCrS4 All

General Information

16NiCrS4 is an case hardening steel with good dimension stability, high toughness and improved machinability.

Ovako 146S is an ingot cast steel. The chemical composition is well controlled to give the steel a controlled hardenability towards the high end (HH). It has reduced silicon content for reduced propensity for internal oxidation during carburizing. Regulated sulphur content ensures good machinability properties.

4730 is an contious cast steel. The chemical composition is well controlled to give the steel a controlled hardenability towards the low end (HL). For improved machinability this steel is processed according to our M-Steel concept.

Similar designations

SS 2511, 16NCD5 (AFNOR), 637 A 16 (BS), 16NC6 (AFNOR), BS 637M17 M

Chemical composition

Variant	Cast	Weldability		C %	Si %	Mn %	P %	S %	Cr %	Ni %	Mo %
146S	IC	CEV 0.81 _{max}	Min	0.13	0.05	0.70	-	0.035	0.60	0.80	0.05
		Pcm 0.4 _{max}	Max	0.25	0.15	1.10	0.025	0.050	1.20	1.40	0.20

Mechanical Properties

Variant	<div><div></div><div>Condition</div></div>	Format	Dimension [mm]	Yield strength min [MPa]	Tensile strength [MPa]	Elongation A ₅ [%]	Hardness
146S	+U	Round bar	24 < 190	650*	840 typical	15	260 HB typical
	+A	Round bar	24 < 190	-	-	-	170 HB typical
	+Q	Round bar	< 30	490*	800-1200	8	260-380 HB

$Rp_{0.2}$ * R_{eh} , ** R_{eL}

Transformation temperatures

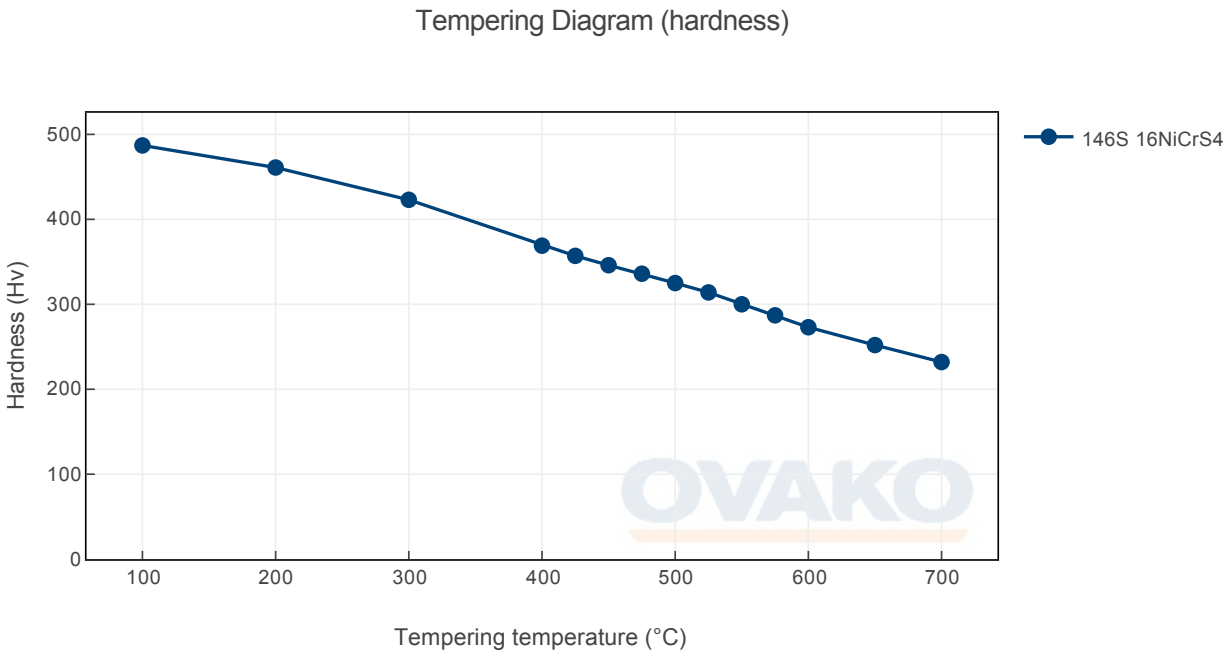
	Temperature °C
AC1	714
AC3	799

Heat treatment recommendations

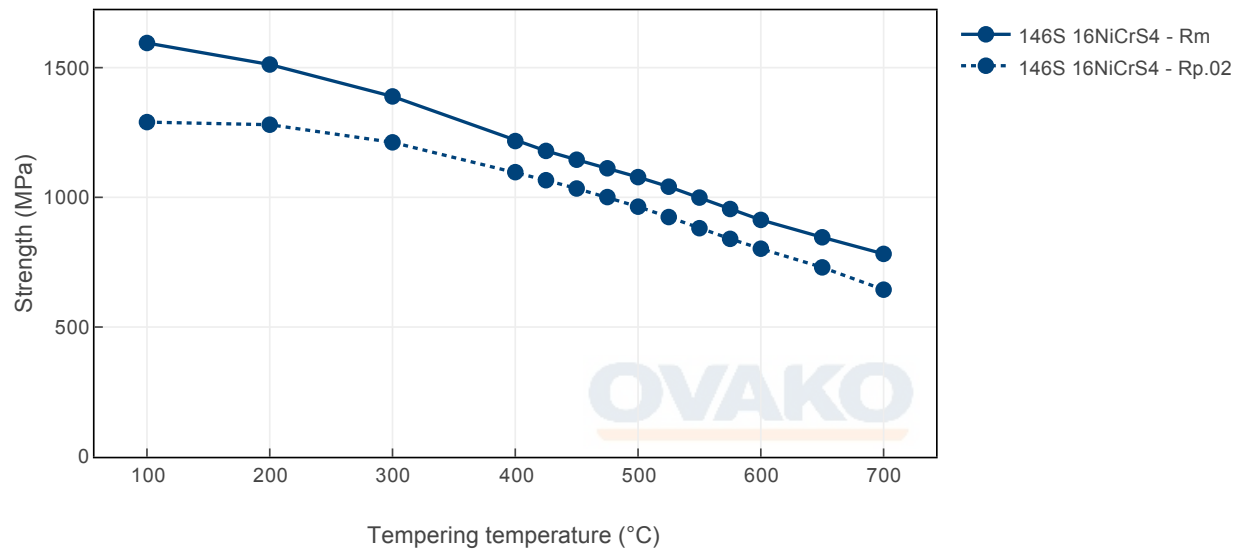
Treatment	<div><div></div><div>Condition</div></div>	Temperature cycle	Cooling/quenching
Hot forging	+AR	Soaking at 800 - 1200°C	In air
Normalizing	+N	860 - 890°C	In air
Soft annealing	+A	600 - 670°C / 2h	In air
Quenching	+Q	Hardening temperature 840 - 890°C	In oil
Carburizing	+Q	Hardening as carburized soaking 780 - 830°C	In oil
Tempering	+QT	Soaking at 160 - 250°C 1hr	In air

Heat Treatment Guide generated Graphs

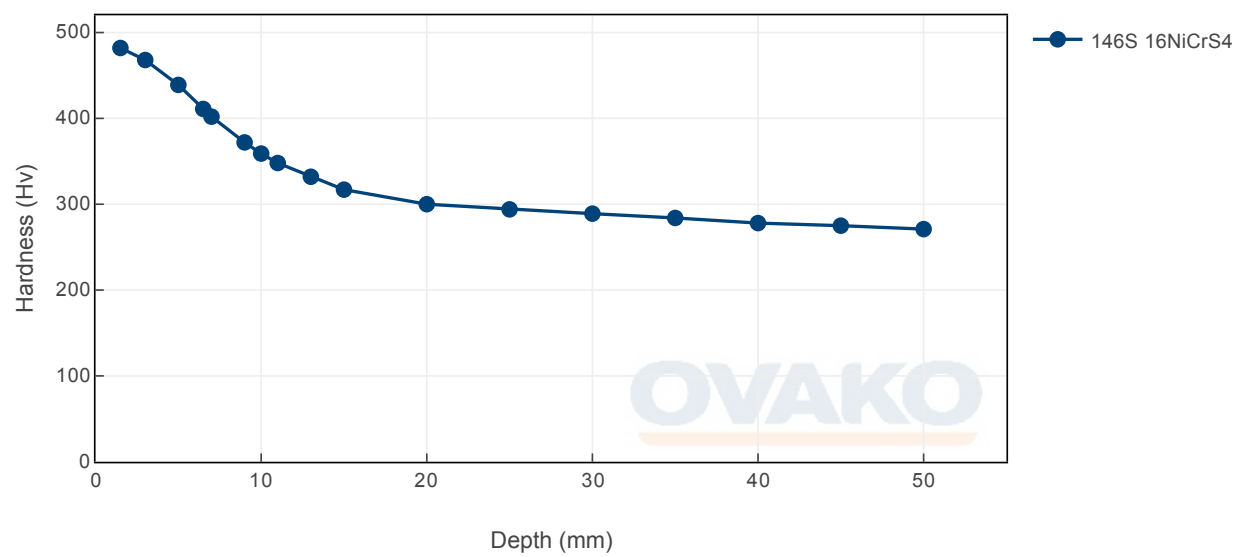
The following graphs are generated from a theoretical model. For further info see the Heat treatment guide module. Select a specific grade version for individual display.



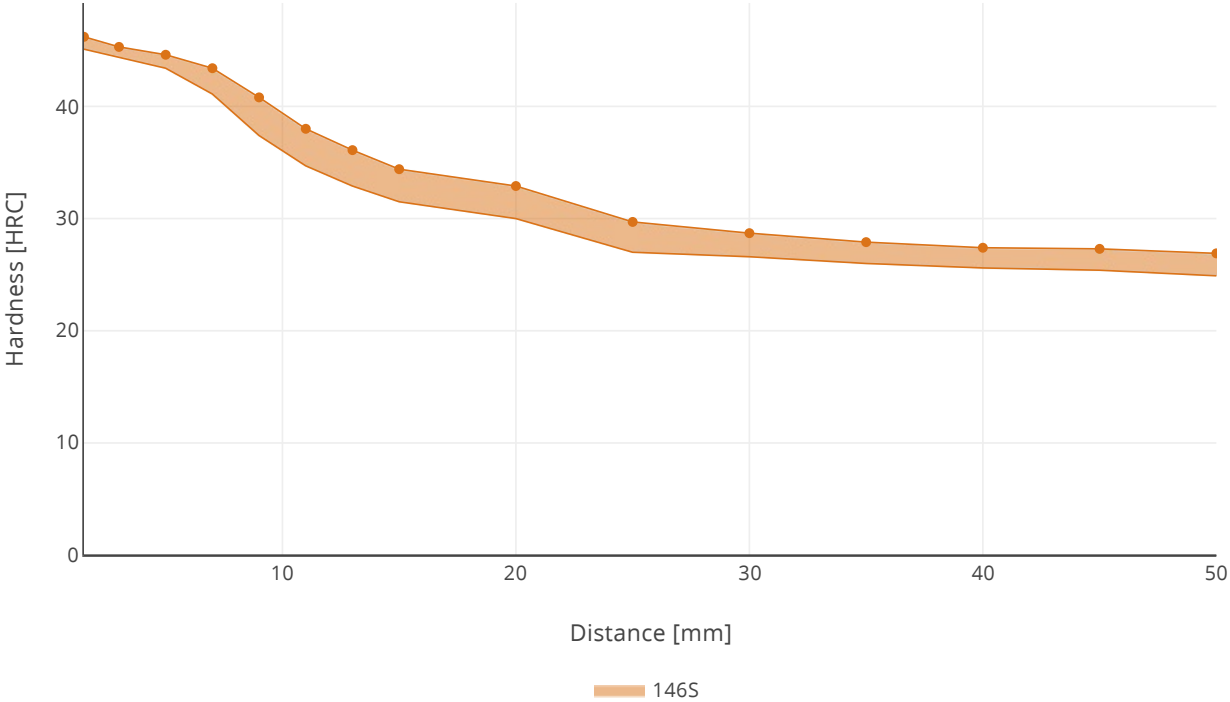
Tempering Diagram (strength)



Jominy



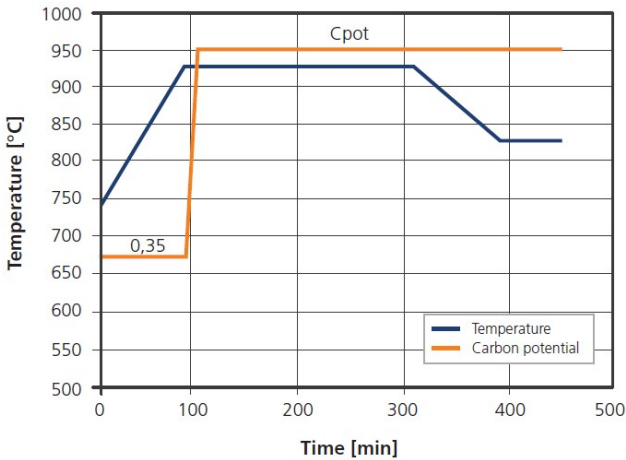
Hardenability



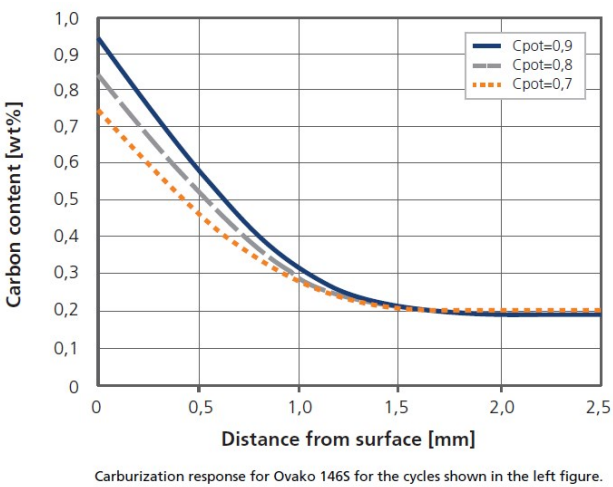
146S: Jominy hardenability according to ASTM A255. Average value with +/- standard deviation.

EN ISO 683-3 data is showing the +H version.

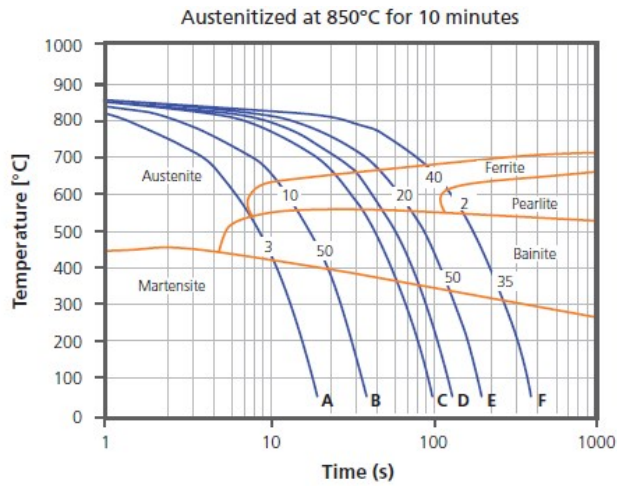
Heat treatment



Carburizing response

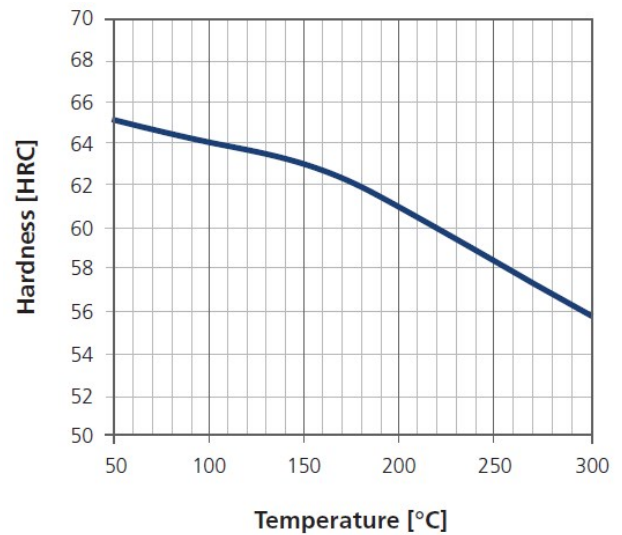


CCT



	A	B	C	D	E	F
t_{9-5} [s]	7.5	15	37.5	50	75	150
HV ₃₀	455	345	320	290	285	255

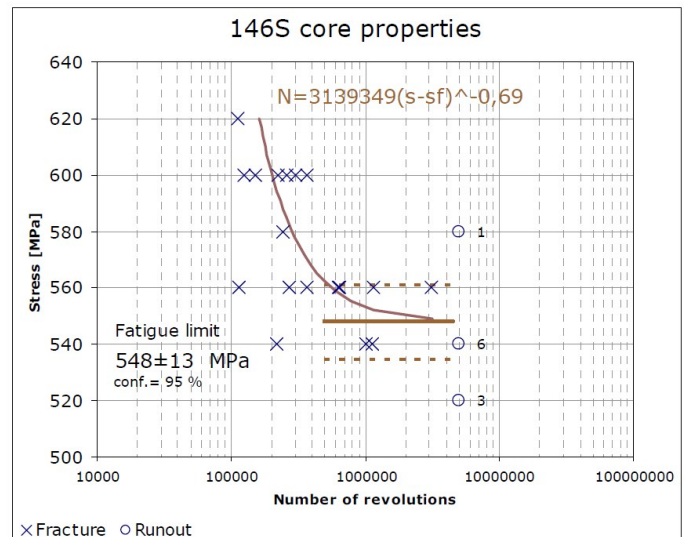
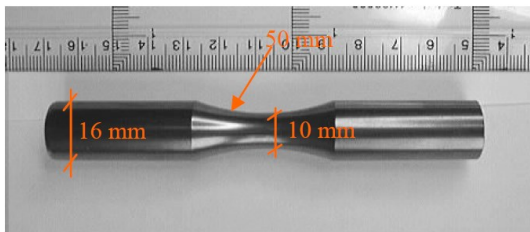
Tempering response



Tempering response for carburized surfaces of Ovako 146S after quenching and tempering one hour at different temperatures.

Fatigue properties

Test method:	Rotating beam
Test procedure:	Stair-case 20 MPa steps
Specimen:	Hourglass shape Ø 10 mm
Heat treatment:	Simulated core structure 925°C / 8h 820°C / 0.5h Oil quench 150°C / 1.5h
Hardness:	40 HRC



Steel cleanliness

Micro inclusions									Macro inclusions	
Applied standard	ASTM E45								Applied standard	ISO 3763 (Blue fracture)
Sampling	ASTM A295								Sampling	Statistical testing on billets
Maximum average	A		B		C		D		Limits	< 5 mm/dm ²
limits	Th	He	Th	He	Th	He	Th	He		
	2,5	1,5	1,0	0,5	0	0	0,5	0,5		

SUSTAINABILITY-ENVIRONMENTAL IMPACT DATA

At Ovako sustainability and reduction of our environmental impact is a major focus in everything we do. Further information is found [here](#).

In many international comparisons the crude steel Scope 1-2 emission is a key parameter, ie. the CO₂ emission from the steel works itself.

As of 1 January 2022 we carbon offset all our scope 1 and 2 volume shown below.

Steel works	Hofors	Smedjebacken	Imatra
CO2e/kg	120	62	76

To get the full picture of our products environmental impact we have to look at all of our CO₂ emission sources. Not only the steel work Scope 1-2 itself, but all operations downstream in our production, heating and heat treatment furnaces etc (full scope 1-2) as well as all the emission from input material, eg. alloys, scope 3.

Steel Grade	Format	Condition ⓘ	Scope 1-3 (CO2e kg /1000 kg steel)	Climate compensated Net emission = Scope 3 (CO2e kg /1000 kg steel) Scope 1 - 2 = 0 (compensated)
146S	Round bar	+AR	787	393
146S	Round bar	+SA	792	395
146S	Tube, wall	+AR	829	428
146S	Tube, wall	+SA	831	428
4730	Round bar	+AR	649	345

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Other properties (typical values)

Youngs module (GPa)	Poisson's ratio (-)	Shear module (GPa)	Density (kg/m3)
210	0.3	80	7800
Average CTE 20-300°C (µm/m°K)	Specific heat capacity 50/100°C (J/kg°K)	Thermal conductivity Ambient temperature (W/m°K)	Electrical resistivity Ambient temperature (µΩm)
12	460 - 480	40 - 45	0.20 - 0.25

Contact us

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For more detailed information please visit <http://www.ovako.com/en/Contact-Ovako/>

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