LC 200 N

Chemical Composition

C	0.3%	Cr	15.0%
Mo	1.0%	Mn	1.0%
Ni	0.5%	N	0.5%

LC 200 N

LC 200 N is a high nitrogen alloyed tool steel which exhibits superior corrosion resistance combined with high toughness even at a hardness up to 60 HRc. LC 200 N combines the PESR - (Pressurised Electric Slag Remelting) Process with a smart forging technology. This process route offers an amazing increase in cleanliness and fine structure. By this, a very fine and homogeneous micro-structure can be achieved. Main advantages of this steel is its excellent machinability and excellent machinability and excellent polish-ability as well as a high dimensional stability after heat treatment. For this reason, LC 200 N is a soltion for tools facing high static and dynamical load under a high corrosive environment at higher temperatures. Compared to standard tool steels like 1.2316, 1.4112 and 1.4125, LC 200 N exhibits higher corrosion resistance and toughness as well as a higher tempering resistance up to 500°C at an operating hardness of 58-60 HRc.

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Rectangular sections from 25mm³ up to 430 x 430 x 150mm can be delivered fine milled on all six faces to -0+0.1mm and with squareness guaranteed to 0.1mm/m.

Typical Applications

- Cutting tools
- Punches and dies
- Fine blanking tools
- Shears, rotary shears
- Sinter pressing dies
- Cold extrusion dies
- Broaching tools
- Reamers
- Milling tools

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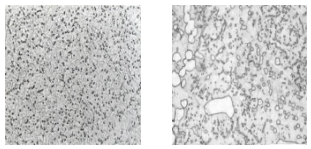
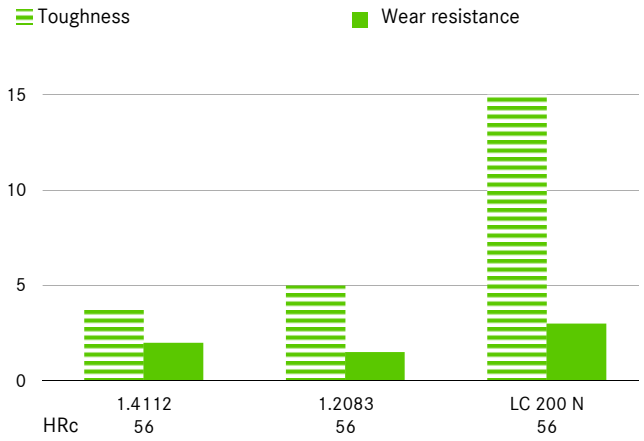
STRUCTURE OF LC 200 N COMPARED TO 1.4112

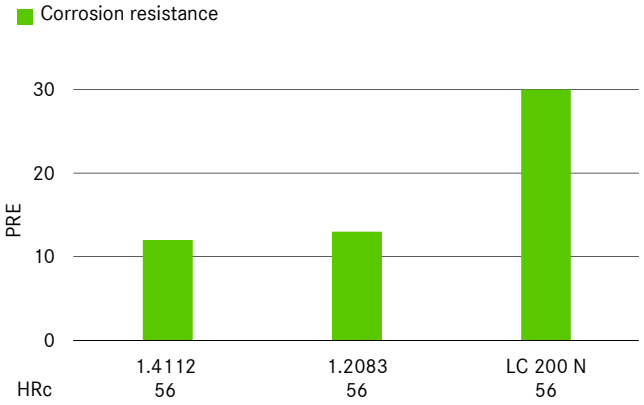


(magnification 1000 x etched)

WEAR RESISTANCE / TOUGHNESS



CORROSION RESISTANCE



PHYSICAL PROPERTIES

Modulus of Elasticity E [GPa]	214
Density [kg/dm³]	
soft annealed	7.72
hardened	7,67
Specific heat capacity [kJ/(kg*K)]	
-196 °C	$17{,}17 \times 10^{-2}$
10 °C	$48{,}59 \times 10^{-2}$
120 °C	$54{,}03 \times 10^{-2}$
Linear expansion coefficient [mm/mm/K] over a temperature range of	
20 – 120 °C	$10{,}8 \times 10^{-6}$
Thermal conductivity [W/m*K] at	
10 °C	13,8 (58HRc) 20,8 (32 HRc)
120 °C	15,0 (58HRc) 21,8 (32 HRc)

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HEAT TREATMENT

Soft Annealing

Heat LC 200 N uniformly to 780-820°C in controlled atmosphere furnaces or with suitable protective media. Hold at temperature for approximately two to four hours and cool slowly in the furnace. The annealed hardness is lower than 300 HB.

Stress Relieving

Rough machined material is stress relieved by heating to 600-650°C. Once complete heat penetration has been reached (minimum 2 hours), the material is allowed to cool in the furnace to approximately 350°C followed by cooling in air. Hardened material is stress relieved at 15-30°C for 2 hours below last tempering temperature followed by cooling in air.

Hardening

Professional heating austenitizing temperature with common holding steps is recommended. Holding time varies from 20 to 40 minutes after complete homogenization. Generally, an all-around grinding tolerance of approximately 0.2mm needs to be considered in order to take care of any possibility of decarburization, denitrization or oxidation. Additionally, it is desirable to use a controlled atmosphere furnace or vacuum furnace with controlled chamber pressure typically used for high chromium alloyed materials.

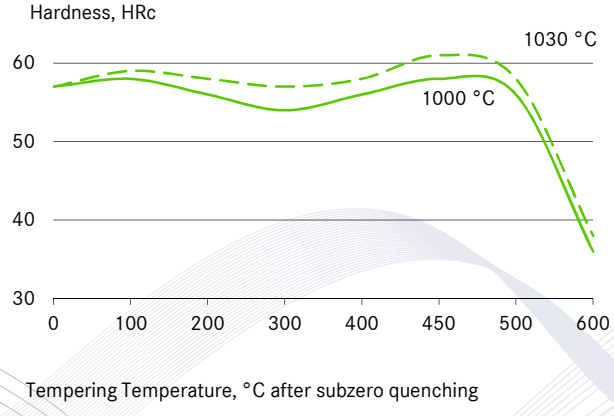
Quenching

Quenching can take place in hot bath at 540°C, oil or pressurized gas. Quenching in salt bath or oil leads to maximum hardness, whereas cooling in vacuum can lead to lower values of 1-2HRc. By use of vacuum quenching a minimum pressure of 6 bar is recommended. The appropriate pressure needs to be adjusted for complex tool shapes in order to minimise risk of cracking and tool distortion. For attaining ideal toughness properties, it is recommended to apply the hot bath quenching method. For attaining maximum hardness after quenching, the cooling rate between austenitizing temperature and 600°C needs to be maximised.

Tempering

Subzero treatment with minimum -80°C and a holding time of minimum 60 minutes is recommended as soon as the tools can be held comfortably in bare hands. For Austenitizing temperatures of higher than 1000°C, subzero treatment is mandatory. Alternatively, subzero treatment at -196°C (liquid nitrogen) for 30 minimum can be performed. Subsequently material needs to be tempered for 2 times for 2 hours at suited temperature to achieve target properties.

TEMPERING DIAGRAM



INSTRUCTIONS FOR HEAT TREATMENT

Preheating	750–780 °C
Austenizing	See chart below
Cooling	Quenching in oil, salt bath or air (min. 5 bar overpressure) to 550°C.
Tempering	2 x 2 hours (see chart below)

Hardness HRc ± 1	Austeniz-ing Temp. °C	Tempering °C	Corrosion resistance	Toughness
>58	1030*	160-180	++	0
55 - 58	1030*	220-300	++	++
>58	1030*	460-475	+	+
30 - 40	1000	550-620	+	+++

*Subzero quenching, -80 °C, 60 min, air

Heat treatment parameters need to be selected on basis of the aimed target combination of hardness, toughness and corrosion resistance.

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MACHINING DATA

TURNING

With carbide metal			
Cutting depth [mm]	0.5 – 1.0	1.0 – 4.0	4.0 – 8.0
Feed [mm/U]	0.1 – 0.2	0.2 – 0.4	0.6 – 0.6
Tools according ISO	P10, P20, M10	P20, M10, M20	P30, M20, K10
Cutting speed			
Cutting inserts	260 – 200	200 – 150	150 - 110
Soldered carbide metal	210 – 170	170 – 130	140 - 90
Coated cutting inserts			
ISO P25	Up to 240	Up to 210	Up to 160
ISO P35	Up to 210	Up to 160	Up to 140
Edge angle for soldered carbide metals			
Relief angle	6° - 8°	6° - 8°	6° - 8°
Chip angle	12° - 15°	12° - 15°	12° - 15°
Inclination angle	0°	0°	- 4°

HARDTURNING

Cutting material	cBN 3
Cutting plate geometry	SNGN 090308 T 02020
Cutting speed Vc[m/min]	125
Feed [mm/U]	0.1
Cutting depth [mm]	0.2
Setting angle	75°
Chip angle	- 6°
Relief angle	6°
Inclination angle	- 4°

TURNING

With high speed steel			
Cutting depth [mm]	0.5	3	6
Feed [mm/U]	0.1	0.5	1.0
Din-grade	**DIN S 10-4-3-10**		
Cutting speed [m/min.]	55 - 45	45 – 35	35 - 25
Relief angle	8° - 10°	8° - 10°	8° - 10°
Chip angle	14° - 18°	14° - 18°	14° - 18°
Inclination angle	0°	0°	- 4°

MILLING

With milling heads		
Feed [mm/tooth]	Up to 0.2	0.2 – 0.3
ISO P25	160 - 100	110 - 60
ISO P40	100 - 60	70 - 40
ISO P35	140 - 110	

DRILLING

With carbide metal			
Drilling diameter [mm]	3 - 8	8 – 20	20 - 40
Feed [mm/U]	0.02 – 0.05	0.05 – 0.12	0.12 – 0.18
Carbide metal	K10	K10	K10
Point angle	115° - 120°	115° - 120°	115° - 120°
Relief angle	5°	5°	5°

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