Ferro-Titanit® WFN

Chemical composition

Carbide phase	Binder phase (main components)			
TiC	**C**	**Cr**	**Mo**	**Fe**
33.0	0.75	13.5	3.0	Balance

(guideline values in % by weight)

Microstructure

Titanium carbide + martensite

Characteristic properties

Because of its 13.5% chromium and 3% molybdenum content, WFN has a high tempering resistance up to around 450 °C, as well as high-temperature hardness and good corrosion resistance. The thermal expansion coefficient is adjusted to that of steel through the 1% aluminium alloy addition. Lower stresses thereby occur when non-permanent and permanent joints are heated, reducing the risk of cracking.

Mechanical properties
hardened + tempered

Density	Compression strength	Bending fracture	Modulus of elasticity	Shear modulus	Service hardness	Further data on the mechanical properties upon request
g/cm^3	MPa	MPa	MPa	MPa	HRC	
6.5	3600	1200	294000	122000	approx. 69	

Physical properties

Thermal expansion coefficient between 20 and … °C in $10^{-6} \cdot °C^{-1}$

100	200	300	400	500	600
10.6	11.6	12.2	12.4	12.7	12.9

Thermal conductivity at 20 °C in $W \cdot cm^{-1} \cdot °C^{-1}$
0.182

Measuring frequency (Hz)	Damping Q^{-1} (10^{-5})
2600	27
7100	33
22000	27

Electrical resistivity at 20 °C in $\Omega \cdot mm^2 \cdot m^{-1}$
0.91

Magnetic properties

Magnetic saturation polarisation	Coercive field strength	Remanence
mT	$kA \cdot m^{-1}$	mT
590	9.2	160

Use

All cold work applications in cutting and forming engineering. In particular for tools and wearing parts required to have a high tempering resistance up to 450 °C as well as elevated corrosion resistance, e.g. guide rollers for wire rod and bar steel rolling, injection moulds for plastics processing, jets for steam-jet equipment, valve components, tube drawing dies, extrusion dies for the manufacture of aerosol cans, cold rollers.

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Annealing

Annealing temperature °C	Cooling	Hardness after annealing HRC	Transformation range °C
Soft 750 (10 h)	Furnace	approx. 51	890 – 970

Stress-relieving

If extensive machining is required, it is advisable, after rough-machining, i.e. before finish-machining, to stress-relief anneal at around 600 – 650 °C, followed by cooling in the furnace.

Hardening

Hardening temperature °C	Hardening medium	Quenching
1080	Vacuum	1 bar N_2

Heating to hardening temperature is advisably performed over several preheating stages (e.g. 400 °C, 600 °C, 800 °C) in order to ensure uniform soaking of the parts that are to be hardened and to avoid any cracking induced by thermal stress. The selected soaking time at hardening temperature must be longer than for steel tools (roughly twice to three times). Because of the rigid titanium carbide skeleton, deleterious grain growth as found in tool steel and high-speed steel cannot occur during the heat treatment. It is hence possible to accept slightly higher hardening temperatures and longer soaking times rather than insufficient hardening.

Tempering

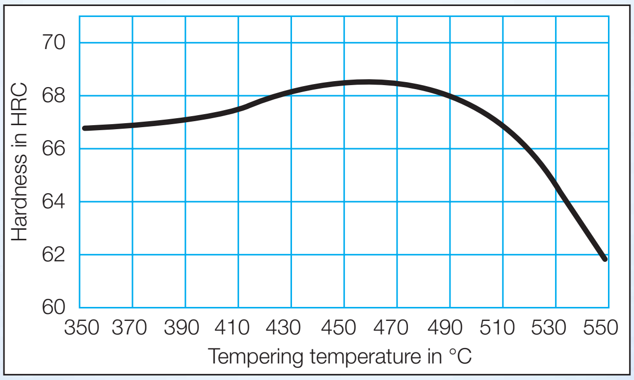
Tempering temperature °C	Service hardness HRC
460	approx. 69

In order to avoid cracking induced by hardening stresses, parts that have been hardened must be tempered immediately after quenching or cooling to around 50 °C and held at tempering temperature for at least 2 hours, followed by cooling in air.

Dimensional changes

The WFN grade exhibits a reduction in dimensions due to retained austenite. The dimensions are increased in this grade, however, by deep-cooling in liquid nitrogen or also repeated tempering. The change in dimensions is less than 0.1% in each case.

Tempering curve



Note:
No tempering temperature other than the one indicated should be selected, as the strong, negative influence on the resistance to wear and pick-up does not justify the minor benefit of toughness improvement.