Ferro-Titanit®
Powder metallurgical composites

Swiss Steel Group

Ferro-Titanit® - highly wear-resistant, light, machinable, hardenable

Ferro-Titanit® represents the trademark of Deutsche Edelstahlwerke for powder-metallurgically produced composite materials that allow machining and hardening. The materials combine the properties of tool steel and tungsten-carbide alloys, thus closing a material gap.

Ferro-Titanit® consists of up to 50% by volume titanium carbide embedded in a metal matrix tailored to the specific application.

In addition to an extreme hardness of 3200 HV, the titanium carbides are characterized by very high chemical resistance, low density and thermal conductivity, a high Young's modulus and electrical conductivity.

In soft-annealed condition, the composite Ferro-Titanit® can be processed by the established methods of machining.

Hardened (up to 70 HRC) Ferro-Titanit® is the ideal and economical solution for problems of wear.

Ferro-Titanit® production route:
from powder to green-compact to
sintered end product

7 reasons for Ferro-Titanit®

Hardenable up to 70 HRC
A simple heat treatment comparable to steel enables the high hardness values due to the alloy system used. As a result, the tools achieve exceptionally long tool life, which allows savings to be made, for example, by reducing changeover operations.

Low-distortion hardening
At less than 0.1%, dimensional distortion after hardening is extremely low. Machining in the annealed as-delivered condition can therefore be carried out very close to the finished dimensions, so that reworking in the hardened condition need only amount to a few hundredths of a millimeter. The prerequisite for this is that hardening is preferably carried out in a vacuum furnace in order to achieve optimum service properties and avoid negative influence zones on the surface (e.g. oxidation).

Good combination with steel
The compounds are obtained by composite sintering, composite brazing or hot isostatic pressing. In a combination, Ferro-Titanit® is only where it is needed - in the area subject to wear. The steel as a carrier material allows material savings, offers higher toughness and can be machined more cost-effectively.

Remanufacturing of used tools
Used tools and wear parts can be annealed as often as required and processed into new parts, since no negative structural changes such as grain growth occur. Minor reworking in the annealed condition quickly creates replacements for failed tool or wear parts (e.g. reworking a drawing tool to a larger profile).

Machinability
In the soft-annealed as-delivered condition, conventional machining operations such as turning, milling, drilling, sawing, etc. are possible with conventional tools. The given guidelines must be observed.

Low tendency to adhesive and abrasive wear
The titanium carbides in Ferro-Titanit® (approx. 50% by volume) do not react with other materials. Thus, Ferro-Titanit® is less prone to galling, or adhesive wear. In addition, the high TiC hardness of 3200 HV (approx. 30% higher than the tungsten carbide of hard metal) allows a significant increase in abrasion resistance.

Low specific weight
Ferro-Titanit® is 50% lighter than tungsten carbide and even 15% lighter than steel. This results in considerable advantages, e.g. for dynamically stressed rotating components.

Ferro-Titanit® C-Spezial

Chemical composition in mass-%

Carbide phase TiC	C	Cr	Mo	Fe
33.0	0.65	3.0	3.0	balance

Physical properties

Density in g/cm³	6.5
Thermal conductivity at 20°C in W/(mK)	20.5
Specific electrical resistance at 20 °C in (Ω mm²)/m	0.75
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 100 °C	9.2
20 °C - 200 °C	9.1
20 °C - 300 °C	9.8
Measuring frequency in Hz	Damping Q^{-1} (10^{-5})
2600	14
7100	22
22000	16

Microstructure

Titanium carbide + martensite

Applications

All cold work applications in cutting and forming operations, e.g. for cutting and punching tools, bending dies, extrusion punches, deep-drawing dies, coining dies, clamping jaws, cutting bushes, tools for processing steel, non-ferrous metals, aluminum, etc., as well as machine elements such as rollers, rolls, guide rails, which are subject to high wear stress.

Characteristics

The binder phase consists of a cold work steel with 3% Cr and 3% Mo. This comparatively low percentage of alloys causes a low tempering resistance: above around 200°C, the hardness drops significantly. In comparison with the other grades, C-Special is the best to machine.

Mechanical properties

Compression strength in MPa	3800
Bending fracture in MPa	1500
Young‘s modulus in GPa	292
Shear modulus in Gpa	117
Service hardness in HRC	~ 69

Further data on mechanical properties upon request

Magnetic properties

Magnetic saturation polarization in mT	920
Coercive field strength in kA/m	5.0
Remanence in mT	315

Soft annealing

Annealing temperature in °C	Cooling	Hardness in HRC	Transformation range in °C
750 (10 h)	Furnace	~ 49	800 - 852

Hardening

Hardening temperature in °C	980 - 1100
Hardening medium	Vacuum
Quenching	≥ 1 bar N_2

It is advisable to preheat the parts to the hardening temperature over several stages (e.g. 400 °C, 600 °C, 800 °C) to ensure uniform heating of the hardened parts and to avoid heating stress cracks.

Compared to tools made of steel, the soaking time at hardening temperature must be significantly longer (approx. double to triple). However, harmful grain growth is prevented by the rigid titanium carbide skeleton.
This implies that slightly higher hardening temperatures and longer holding times are more acceptable than insufficient hardening.

Tempering

Tempering temperature in °C	150
Service hardness in HRC	~ 69

Stress-relieving

In case of heavy machining, stress-relief annealing at approx. 600 - 650 °C with subsequent furnace cooling is recommended after rough machining.

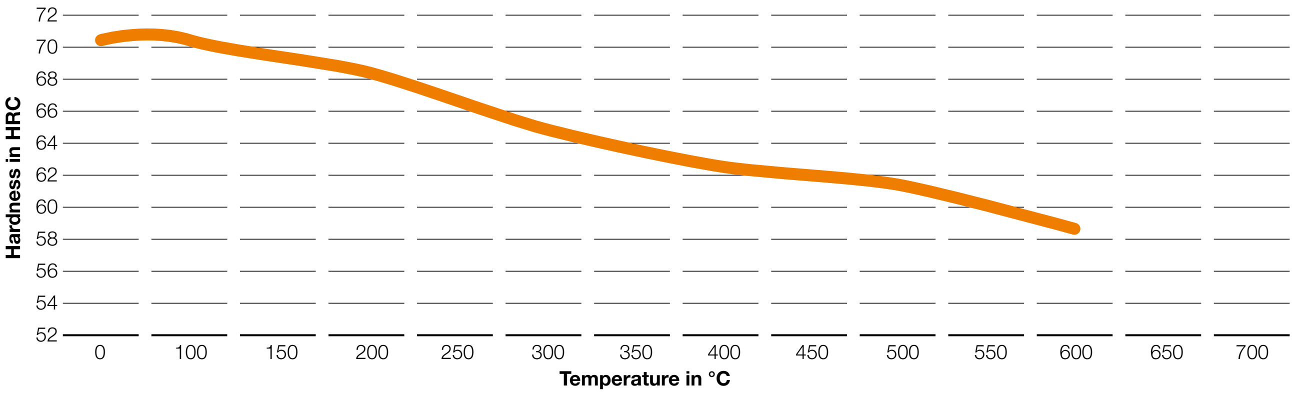
Dimensional changes

After hardening and tempering, a slight dimensional change of less than 0.1% can be expected for C-Special.

Note

No tempering temperature other than the one specified should be selected, as higher tempering temperatures significantly reduce wear resistance and resistance to pick-up, and do not justify the minor benefit of improved toughness.

Tempering diagramm



Ferro-Titanit® WFN

Chemical composition in mass-%

Carbide phase TiC	C	Cr	Mo	Fe
33.0	0.75	13.5	3.0	balance

Physical properties

Density in g/cm³	6.5
Thermal conductivity at 20°C in W/(mK)	18.2
Specific electrical resistance at 20 °C in (Ω mm²)/m	0.91
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 100 °C	10.6
20 °C - 200 °C	11.6
20 °C - 300 °C	12.2
20 °C - 400 °C	12.4
20 °C - 500 °C	12.7
20 °C - 600 °C	12.9
Measuring frequency in Hz	Damping Q^{-1} (10^{-5})
2600	27
7100	33
22000	27

Mechanical properties

Compression strength in MPa	3800
Bending fracture in MPa	1500
Young‘s modulus in GPa	292
Shear modulus in Gpa	117
Service hardness in HRC	~ 69

Further data on mechanical properties upon request

Microstructure

Titanium carbide + martensite

Applications

All cold work in cutting and forming operations. In particular for tools and wear parts required to have a high tempering resistance up to 450 °C, as well as elevated corrosion resistance: guide rollers in wire and bar rolling, injection molds in plastics processing, nozzles for steam-jet equipment, valve components, tube drawing dies, extrusion dies for the production of aerosol cans, cold rolls.

Characteristics

Due to the chromium and molybdenum content of 13.5% and 3 % respectively, WFN features a high tempering resistance up to about 450 °C, high hot hardness and also good corrosion resistance.

Magnetic properties

Magnetic saturation polarization in mT	590
Coercive field strength in kA/m	9.2
Remanence in mT	160

Soft annealing

Annealing temperature in °C	Cooling	Hardness in HRC	Transformation range in °C
750 (10 h)	Furnace	~ 51	890 - 970

Hardening

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

It is advisable to preheat the parts to the hardening temperature over several stages (e.g. 400 °C, 600 °C, 800 °C) to ensure uniform heating of the hardened parts and to avoid heating stress cracks.

Compared to tools made of steel, the soaking time at hardening temperature must be significantly longer (approx. double to triple). However, harmful grain growth is prevented by the rigid titanium carbide skeleton.
This implies that slightly higher hardening temperatures and longer holding times are more acceptable than insufficient hardening.

Stress-relieving

In case of heavy machining, stress-relief annealing at approx. 600 - 650 °C with subsequent furnace cooling is recommended after rough machining.

Dimensional changes

After hardening and tempering, shrinkage may occur in WFN due to unconverted residual austenite. This can be corrected / prevented by deep cooling in liquid nitrogen or repeated tempering since a complete microstructural transformation causes a slight increase in the initial dimensions.
In either case, the dimensional change is less than 0.1 %.

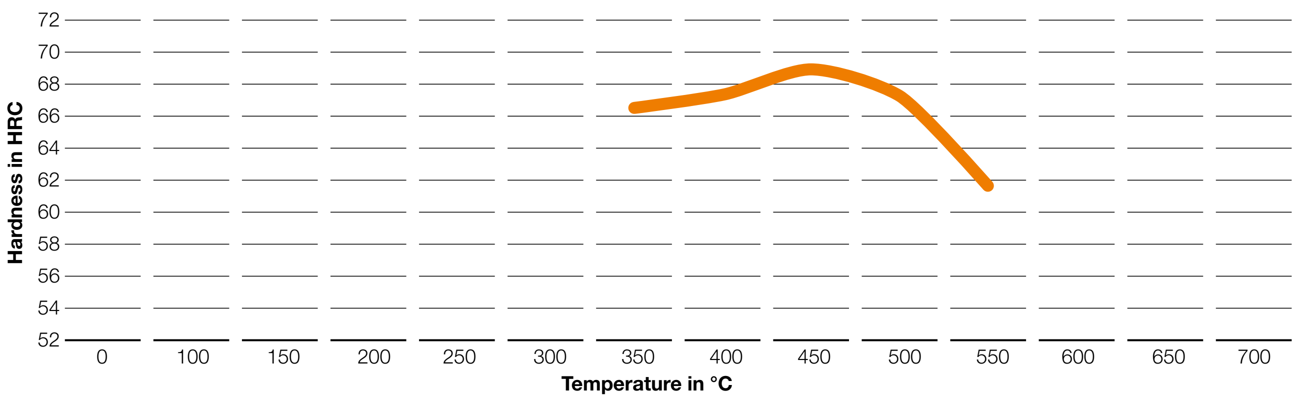
Note

No tempering temperature other than the one specified should be selected, as higher tempering temperatures significantly reduce wear resistance and resistance to pick-up, and do not justify the minor benefit of improved toughness.

Tempering

Tempering temperature in °C	460
Service hardness in HRC	~ 69

Hardness in HRC



Ferro-Titanit® S

Chemical composition in mass-%

Carbide phase TiC	C	Cr	Mo	Fe
32.0	0.50	19.5	2.0	balance

Physical properties

Density in g/cm³	6.5
Thermal conductivity at 20°C in W/(mK)	18.8
Specific electrical resistance at 20 °C in (Ω mm^2)/m	0.75
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 400 °C	9.7
Measuring frequency in Hz	Damping Q^{-1} (10^{-5})
2600	19
7100	25
22000	18

Mechanical properties

Compression strength in MPa	3700
Bending fracture in MPa	1050
Young's modulus in GPa	290
Shear modulus in Gpa	116
Service hardness in HRC	~ 67

Further data on mechanical properties upon request

Microstructure

Titanium carbide + martensite

Applications

Components which, in addition to high wear resistance, must also feature high corrosion resistance, e.g. pumps, meter trains, thrust washers, bearings, etc.

Characteristics

Due to the high chromium and low carbon content, this grade is recommended for elevated demands on corrosion resistance.

Magnetic properties

Magnetic saturation polarization in mT	620
Coercive field strength in kA/m	9.8
Remanence in mT	108

Soft annealing

Annealing temperature in °C	Cooling	Hardness in HRC	Transformation range in °C
750 (10 h)	Furnace	~ 51	800 - 850

Hardening

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

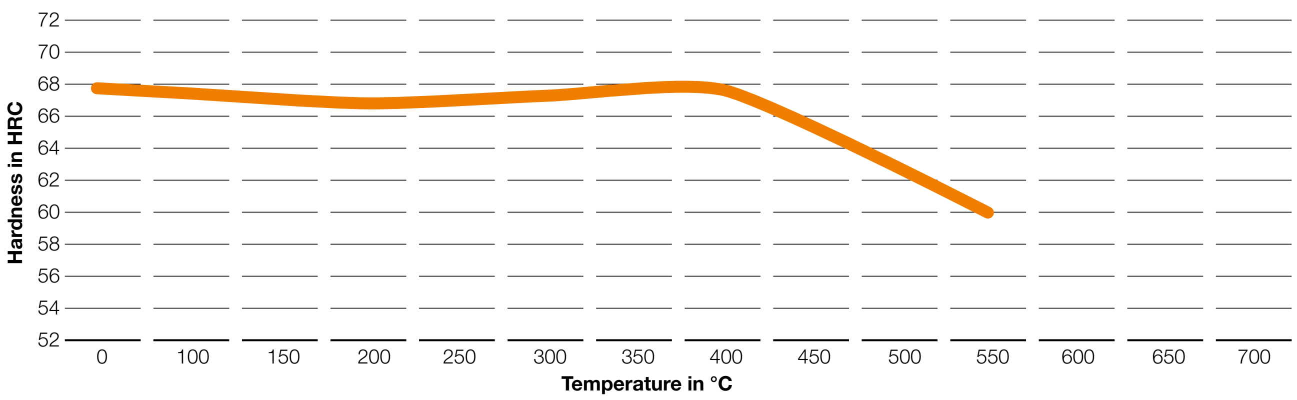
It is advisable to preheat the parts to the hardening temperature over several stages (e.g. 400 °C, 600 °C, 800 °C) to ensure uniform heating of the hardened parts and to avoid heating stress cracks.

Compared to tools made of steel, the soaking time at hardening temperature must be significantly longer (approx. double to triple). However, harmful grain growth is prevented by the rigid titanium carbide skeleton.
This implies that slightly higher hardening temperatures and longer holding times are more acceptable than insufficient hardening.

Tempering

Tempering temperature in °C	180
Service hardness in HRC	~ 67

Tempering diagram



Stress-relieving

In case of heavy machining, stress-relief annealing at approx. 600 - 650 °C with subsequent furnace cooling is recommended after rough machining.

Dimensional changes

After hardening and tempering, shrinkage may occur due to unconverted residual austenite. This can be corrected / prevented by deep cooling in liquid nitrogen or repeated tempering since a complete microstructural transformation causes a slight increase in the initial dimensions.
In either case, the dimensional change is less than 0.1 %.

Note

No tempering temperature other than the one specified should be selected, as higher tempering temperatures significantly reduce wear resistance and resistance to pick-up, and do not justify the minor benefit of improved toughness.

Ferro-Titanit® Nikro 128

Chemical composition in mass-%

Carbide phase TiC	Cr	Co	Ni	Mo	Fe
30.0	13.5	9	4	5	balance

Physical properties

Density in g/cm³	6.6
Thermal conductivity at 20°C in W/(mK)	
RT	11.2
100 °C	15.4
200 °C	17.8
300 °C	18.7
Specific electrical resistance in (Ω mm²)/m	
20 °C	1.0
100 °C	1.12
200 °C	1.17
300 °C	1.21
400 °C	1.25
500 °C	1.31
600 °C	1.67
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 100 °C	8.3
20 °C - 200 °C	8.9
20 °C - 300 °C	9.3
20 °C - 400 °C	9.6
20 °C - 500 °C	9.9
20 °C - 600 °C	10.2
Measuring frequency in Hz	Damping Q^{-1} (10^{-5})
2600	10.0
7100	15.2
14000	11.9
22000	10.9

Microstructure

Titanium carbide + nickel martensite

Applications

Well suited for use in the processing of abrasive plastics as granulating knives, perforated plates, injection nozzles, dies as well as screws and bushings. Wear resistant rings in centrifugal pumps, charging heads and circular cutters in canning machines.

Characteristics

The matrix structure consists of a precipitation-hardenable nickel martensite of high toughness. The chromium content of 13.5 % provides good corrosion resistance. Finish machining is performed in the solution-annealed, as-delivered condition. Subsequent age hardening at a relatively low temperature of 480 °C can be carried out, for example, in an air circulation furnace or an electrically heated chamber furnace. Due to the low temperature, the workpiece remains extremely dimensionally stable with low risk of distortion.

Magnetic properties

Magnetic saturation polarization in mT	740
Coercive field strength in kA/m	3.7
Remanence in mT	190

Mechanical properties

Compression strength in MPa	3600
Bending fracture in MPa	1200
Young's modulus in GPa	294
Shear modulus in Gpa	117
Service hardness in HRC	~ 62

Further data on mechanical properties upon request

Solution annealing

Annealing temperature in °C	Cooling	Hardness in HRC
850 (2 - 4 h vacuum)	1 - 4.5 bar N_2	~ 53

Ferro-Titanit® Nikro 128 is supplied in solution annealed condition and can be machined to final dimension in this condition, as neither distortion nor dimensional changes are to be expected due to the low aging temperature.

Age hardening

Ageing temperature in °C	480 (6 – 8 h)
Service hardness in HRC	~ 62

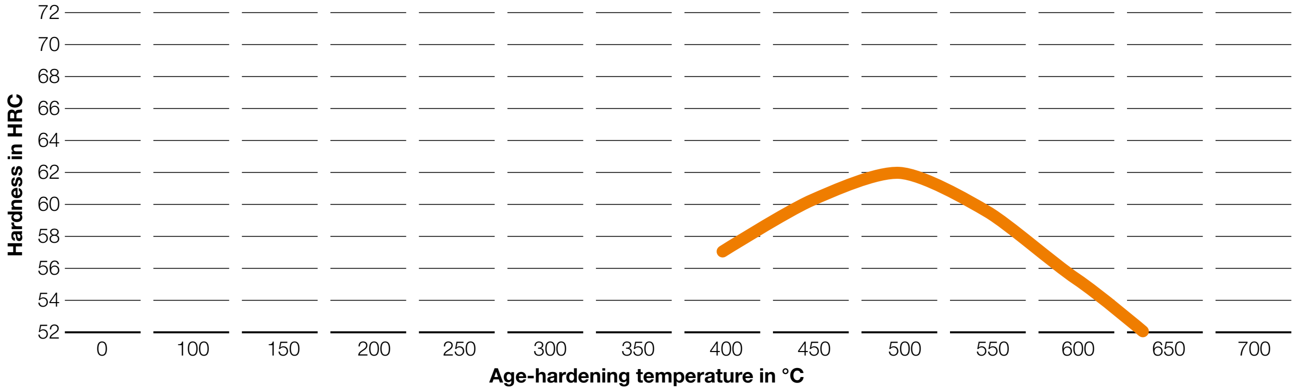
Note

Carburizing atmospheres must be avoided during heat treatment.

The linear shrinkage during ageing generally amounts to 0.02 mm/m.

We would like to point out that the material Nikro 128 is prone to cracking during further processing by wire-cutting. We recommend that you refrain from wire-cutting or use reduced parameters. We reserve the right to reject claims if the use of wire-cutting results in cracks without actual material defects.

Age-hardening diagram



Ferro-Titanit® Nikrodur

Chemical composition in mass-%

Carbide phase TiC+NbC	Cr	Co	Ni	Mo	Fe
35.0	13.5	9.0	5.0	7.0	balance

Physical properties

Density in g/cm³	6.55
Thermal conductivity at 20°C in W/(mK)	
RT	11.2
100 °C	12.2
200 °C	14.3
300 °C	15.4
Measuring frequency in Hz	Damping Q^{-1} (10^{-5})
6700	20.0
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 100 °C	8.4
20 °C - 200 °C	8.7
20 °C - 300 °C	9.0
20 °C - 400 °C	9.2
20 °C - 500 °C	9.4
20 °C - 600 °C	9.7

Microstructure

Titanium carbide + niobium carbide + nickel martensite

Applications

Well suited for use in the processing of abrasive plastics as granulating knives, perforated plates, injection nozzles, dies as well as screws and bushings. Wear resistant rings in centrifugal pumps, charging heads and circular cutters in canning machines.

Nikrodur was specially developed for use as perforated plates. Compared to Nikro 128, Nikrodur is characterized by higher wear resistance and lower thermal conductivity, resulting in longer service life.

Mechanical properties

Compression strength in MPa	2785
Bending fracture in MPa	1200
Young's modulus in GPa	300
Shear modulus in Gpa	120
Service hardness in HRC	~ 65

Further data on mechanical properties upon request

Characteristics

The use of titanium carbide and niobium carbide results in very good wear properties with reduced thermal conductivity. The matrix structure consists of a precipitation hardenable nickel martensite with high toughness. The chromium content of 13.5 % results in good corrosion resistance. Finishing is carried out in the solution-annealed, as-delivered condition. Subsequent age-hardening takes place at a relatively low temperature of 480 °C and can be carried out, for example, in an air circulation furnace or electrically heated chamber furnace. Due to the low ageing temperature, the workpiece remains extremely dimensionally stable and features minor distortion.

Solution annealing

Annealing temperature in °C	Cooling	Hardness in HRC
850 (2-4h vacuum)	1 - 4.5 bar N_2	~ 55

Ferro-Titanit® Nikrodur is supplied in solution annealed condition and can be machined to final dimension in this condition, as neither distortion nor dimensional changes are to be expected due to the low aging temperature.

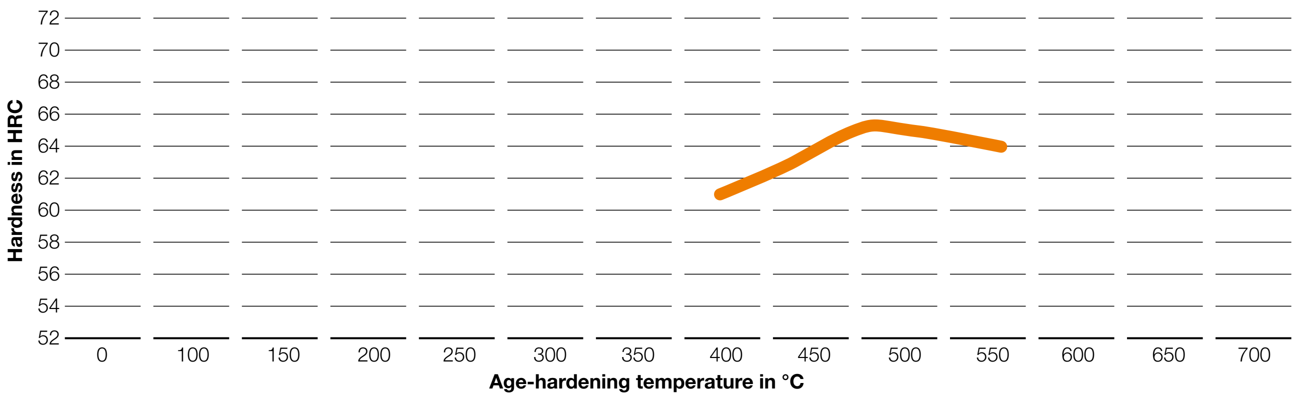
Age hardening

Ageing temperature in °C	480 (6 – 8 h)
Service hardness in HRC	~ 65

Note

Carburizing atmospheres must be avoided during heat treatment.
The linear shrinkage during ageing generally amounts to 0.02 mm/m.
We would like to point out that the material Nikro 128 is prone to cracking during further processing by wire-cutting. We recommend that you refrain from wire-cutting or use reduced parameters. We reserve the right to reject claims if the use of wire-cutting results in cracks without actual material defects.

Age-hardening diagram



Ferro-Titanit® Nikro 143

Chemical composition in mass-%

Carbide phase TiC	Ni	Co	Mo	Fe
30.0	15.0	9.0	6.0	balance

Physical properties

Density in g/cm³	6.7
Thermal conductivity at 20-80 °C in W/(mK)	18.1-18.9
Specific electrical resistance at 20 °C in (Ω mm^2)/m	0.806
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 100 °C	8.0
20 °C - 200 °C	8.7
20 °C - 300 °C	8.9
20 °C - 400 °C	9.1
20 °C - 500 °C	9.4
20 °C - 600 °C	9.8
20 °C - 700 °C	9.4
20 °C - 800 °C	8.5
20 °C - 900 °C	9.2
20 °C - 1000 °C	9.7

Microstructure

Titanium carbide + nickel martensite

Applications

Well suited for all types of tools for forming which are subjected to particularly high wear and bending stresses up to 500 °C. For wear parts on machines and apparatus. Special use in the processing of plastics as pelletizing knives, extruder screws, injection nozzles, etc.

Characteristics

The matrix structure consists of a precipitation-hardenable nickel martensite of high toughness. Finish machining is performed in the solution-annealed, as-delivered condition. Subsequent age hardening at a relatively low temperature of 480 °C can be carried out, for example, in an air circulation furnace or an electrically heated chamber furnace. Due to the low temperature, the workpiece remains extremely dimensionally stable with low risk of distortion.

Mechanical properties

Compression strength in MPa	2400
Bending fracture in MPa	1450
Young's modulus in GPa	280
Shear modulus in GPa	117
Service hardness in HRC	~ 63

Further data on mechanical properties upon request

Magnetic properties

Magnetic saturation polarization in mT	1580
Coercive field strength in kA/m	31.8
Remanence in mT	230

Solution annealing

Annealing temperature in °C	Cooling	Hardness in HRC
850 (2 - 4 h vacuum)	1 - 4.5 bar N_2	~ 53

Age hardening

Ageing temperature in °C	480 (6 – 8 h)
Service hardness in HRC	~ 63

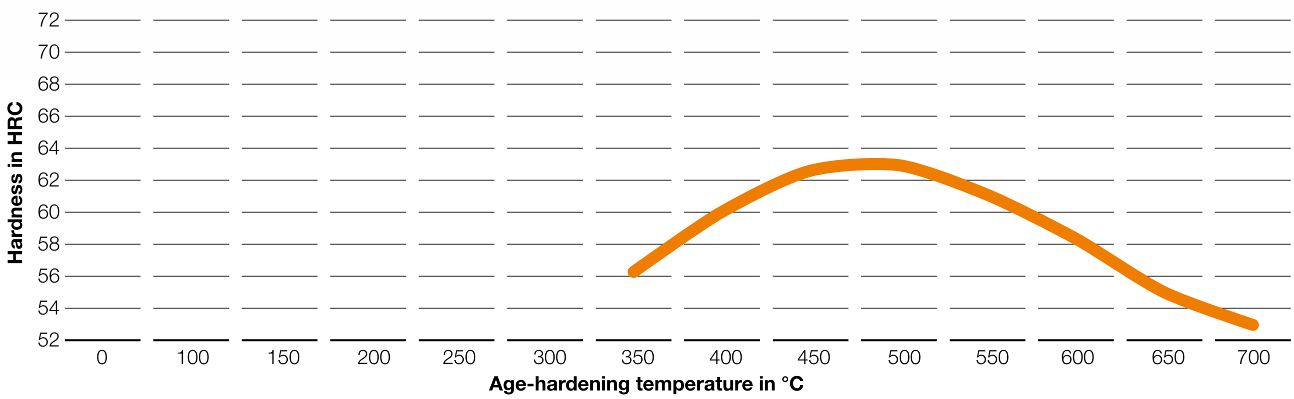
Note

Carburizing atmospheres must be avoided during heat treatment.

The linear shrinkage during ageing generally amounts to 0.02 mm/m.

We would like to point out that the material Nikro 128 is prone to cracking during further processing by wire-cutting. We recommend that you refrain from wire-cutting or use reduced parameters. We reserve the right to reject claims if the use of wire-cutting results in cracks without actual material defects.

Age-hardening diagram



Ferro-Titanit® Cromoni

Chemical composition in mass-%

Carbide phase TiC	Cr	Mo	Ni
22.0	20.0	15.5	balance

Physical properties

Density in g/cm³	7.4
Thermal conductivity at 20 °C in W/(mK)	12.4
Specific electrical resistance at 20 °C in (Ω mm²)/m	1.53
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 100 °C	9.0
20 °C - 200 °C	10.0
20 °C - 300 °C	10.5
20 °C - 400 °C	10.8
20 °C - 500 °C	11.1
20 °C - 600 °C	11.5
Measuring frequency in Hz	Damping Q^{-1} (10^{-5})
2.400	6
6.600	7
21.000	11

Mechanical properties

Compression strength in MPa	1500
Bending fracture in MPa	1300
Young's modulus in GPa	277
Service hardness in HRC	~ 54

Further data on mechanical properties upon request

Microstructure

Titanium carbide + austenite

Applications

This austenitc grade is used for applications requiring perfect non-magnetizability, a high wear resistance and maximum corrosion and oxidation resistance.

Characteristics

Supplied in solution heat treated condition. Cromoni is non-magnetizable, even after ageing up to 900 °C. In addition to high wear resistance, this alloy features extreme corrosion and scale resistance as well as high tempering resistance. These features are best with finely ground or polished surfaces.

Magnetic properties

Permeability µ	< 1.01

Solution annealing

Annealing temperature in °C	Cooling	Hardness in HRC
1200 (2 h vacuum)	4 bar N_2	~ 52

Age hardening

Ageing temperature in °C	800°C (6 h vacuum)
Service hardness in HRC	~ 53

Note

Machining according to guidelines at lowest cutting speed.

Ferro-Titanit® U

Chemical composition in mass-%

Carbide phase TiC	Cr	Ni	Mo	Fe
34.0	18.0	12.0	2.0	balance

Physical properties

Density in g/cm³	6.6
Thermal conductivity at 20 °C in W/(mK)	18.0
Specific electrical resistance at 20 °C in (Ω mm^2)/m	0.96
Thermal expansion coefficient in 10^{-6}/K	
20 °C - 800 °C	12.5

Mechanical properties

Compression strength in MPa	2200
Bending fracture in MPa	950
Service hardness in HRC	~ 51

Further data on mechanical properties upon request

Magnetic properties

Permeability µ	< 1.01

Microstructure

Titanium carbide + austenite

Applications

This austenitc grade is used for applications requiring perfect non-magnetizability along with high wear resistance.
Thanks to its excellent corrosion resistance, especially in chloride-containing media, it covers a wide range of applications in the chemical industry.

Characteristics

The binder phase of Ferro-Titanit® U is roughly equivalent to the austenitic steel X10CrNiMoNb 18 10 (DIN mat.no. 1.4580). Ferro-Titanit® U is non-magnetizable and, due to its high Cr- and Mo –content, shows excellent resistance to pitting corrosion in media containing chloride ions.
Due to the high titanium carbide content of 34 % by weight, or 45 % by volume, Ferro-Titanit® U exhibits excellent wear resistance.
In addtion, the Cr and Ni contents provide good scaling resistance and high-temperature strength.
Ferro-Titanit® U does not require additional heat-treatment

Machining instructions

Turning

Ferro-Titanit®	Tools at choice	Feed rate s = mm/rev.	cutting edge angle rake angle	inclination angle	clearance angle	cutting speed v = m/min
C-Spezial	Tungsten carbide coated, K 10 / K30, high-speed steel	0.02 - 0.1	6° / 15°	0° / -6°	6° / -11°	10
WFN		0.02 - 0.1	6° / 15°	0° / -6°	6° / -11°	8
S		0.02 - 0.1	6° / 15°	0° / -6°	6° / -11°	8
NIKRO 143		0.02 - 0.1	6° / 15°	0° / -6°	6° / -11°	5
NIKRO 128		0.02 - 0.1	6° / 15°	0° / -6°	6° / -11°	5
NIKRODUR		0.03 - 0.06	6° / 15°	0° / -6°	6° / -11°	4
U		0.02 - 0.1	6° / 15°	0° / -6°	6° / -11°	5
CROMONI		0.02 - 0.04	6° / 15°	0° / -6°	6° / -11°	2.5
all grades	ceramics, fiber-reinforced	~ 0.1 - 0.5	- 6°	- 6°	+ 6°	> 25

Milling

Ferro-Titanit®	Tools at choice	Feed rate, s = mm/tooth	cutting speed, v = m/min
C-Spezial	Tungsten carbide coated, K 10 / K30, high-speed steel	0.01 - 0.07	6 -12
WFN		0.01 - 0.07	6 -12
S		0.01 - 0.07	6 -12
NIKRO 143		0.01 - 0.07	6 -12
NIKRO 128		0.01 - 0.07	6 -12
NIKRODUR		~ 0.015	~ 4.5
U		0.01 - 0.07	6 -12
CROMONI		~ 0.01	2 - 5

Drilling

Ferro-Titanit®	Tools at choice	Feed rate s = mm/rev.	rake angle	cutting speed v = m/min
all grades	Tungsten carbide coated, K 10 / K30, high-speed steel	0.05	90 - 120°	2 - 4

Sawing*

Ferro-Titanit®	Tools at choice	Cutting capacity in mm²/min	Cutting speed in m/min	Feed rate in mm/min
C-Spezial	Bimetall M 42	900	12	Formula for feed calculation: Feed= cutting capacity / cutting wisth
WFN		800	10	
S		800	10	
NIKRO 143		600	10	
NIKRO 128		600	10	
NIKRODUR		200	5	
U		400	8	
CROMONI		200	5	

*band saw preferably; hack saw (in exceptional cases)

Recommended partition of saw bands according to saw cross section	Cutting width in mm	standard toothing in tooth/inch	Combi-toothing in tooth/inch
	< 30	10	8/12
	30 - 70	8	5/8
	70 - 120	4	4/6
	> 120	3	2/3

Note

Ferro-Titanit® should always be machined without coolant, regardless of the machining method.

Machining of Ferro-Titanit®

Grinding

The large amount of carbide and the high hardness of the titanium carbide make it understandable that special attention must be paid to the grinding process.

The decisive factor here is whether the carbides are in a soft-annealed or hardened steel binder phase. Grinding in the hardened state leads to significantly higher wear of the grinding wheels.

Corundum discs with ceramic bond, porous structure and fine grain have proved to be suitable.

For specific questions, please contact the grinding wheel manufacturer.

Diamond wheels made of nickel coated synthetic diamonds in a 75 c – 100 c concentrated synthetic bond with a diamond grit size of D 107 – D 151 are particularly recommended for finish grinding Ferro-Titanit® in hardened condition.

The following basic rules should be observed during grinding:

1. grind with a powerful, flushing coolant jet reaching as close as possible to the contact point between the wheel and the workpiece.
2. select the smallest possible infeed.

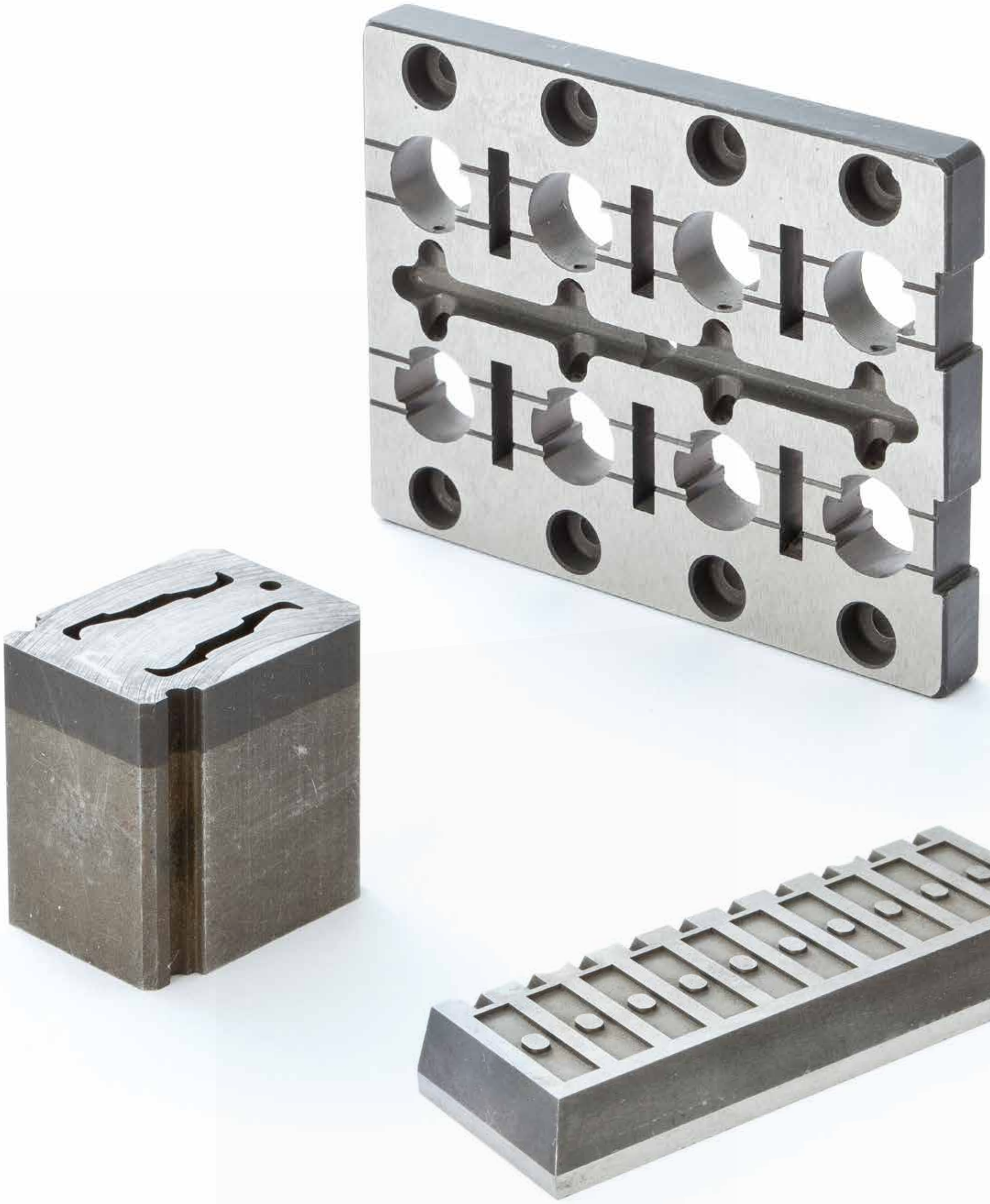
Polishing

With the high-grade Ferro-Titanit® carbid-alloyed materials, the surface quality is decisive for the service life of tools and machine parts.
After grinding, polishing with diamond polishing paste is generally recommended in order to achieve an optimum surface finish: pre-polishing with diamond fine grit D 15 (10 – 25 µm), final polishing with D 3 (2 – 5 µm). If necessary, polishing with D 1 (1 – 2 µm) can be can be added subsequently.

EDM (Electrical discharge machining)

Ferro-Titanit®, tool steels and carbide are subject to the same influences during electrical discharge machining. The overall behavior during EDM of Ferro-Titanit® tends to be analogous to that of tool steels.

Depending on the applied current, spark erosion causes more or less severe damage to the tool surfaces. Ferro-Titanit® should therefore be finish eroded with low pulse energy. The spark-erosive roughing should be followed by a finishing process and a fine finishing process to obtain the lowest possible surface roughness and crack-free condition. After EDM, reworking must be performed and, if possible, followed by a stress relieving treatment in order to relieve the stresses created during melting.



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