

SANMAC® 4541 BILLETS

TIETOLOMAKE

Sanmac® 4541 is a titanium-stabilized austenitic chromium-nickel steel with improved machinability

STANDARDS

- 321
- S32100
- 1.4541
- 1.4541
- X 6 CrNiTi 18 10

Product standards

- EN 10088-3
- ASTM A-314

Suitable for the production of flanges etc. according to ASTM A-182 Grade F321.

Certificates

Status according to EN 10 204/3.1

CHEMICAL COMPOSITION (NOMINAL) %

C	Si	Mn	P	S	Cr	Ni	Mo	Others
0.03	0.6	1.8	≤0.040	≤0.030	17.5	9.5	-	Ti>5x(C+N)

APPLICATIONS

Sanmac® 4541 is used for a wide range of industrial applications, where steels of type AISI 304/304L have insufficient corrosion resistance.

Industrial categories	Typical applications
Chemical industry	Flanges
Food industry	Valves
Petrochemical industry	Fittings
Pulp and paper industry	Couplings
Nuclear industry	Rings
	Seals
	Bolts and nuts
	Shafts

Industrial categories	Typical applications
	Forgings
	Discs

FORMS OF SUPPLY

Sizes and tolerances

Round-cornered square, as well as round billets, are produced in a wide range of sizes according to the following tables. Larger sizes offered on request.

Surface conditions

Square billets

Unground, spot ground or fully ground condition.

Round billets

Peel turned or black condition.

Square billets

Size	Tolerance	Length
mm	mm	m
80	+/-2	4 - 6.3
100, 114, 126, 140, 150	+/-3	4 - 6.3
160, 180, 195, 200	+/-4	4 - 6.3
>200 - 350	+/-5	3 - 5.3

Sizes and tolerances apply to the rolled/forged condition.

Peel turned round billets

Size	Tolerance	Length
mm	mm	m
75 - 200 (5 mm interval)	+/-1	max 10
>200 - 450	+/-3	3 - 8

Unground round billets

Size	Tolerance	Length
mm	mm	m
77 - 112 (5 mm interval)	+/-2	max 10
124, 134	+/-2	max 10
127, 147, 157	+/-2	max 10
142, 152, 163	+/-2	max 10
168, 178, 188	+/-2	max 10
183, 193	+/-2	max 10

Other products

- Hollow bar (Sanmac®)

MECHANICAL PROPERTIES

Testing is performed on separately solution annealed and quenched test pieces. The following figures apply to material in the solution annealed and quenched condition.

At 20°C (68°F)

Metric units

Proof strength		Tensile strength	Elong.	Contr.	HB
R _{p0.2} ^{a)}	R _{p1.0} ^{a)}	R _m	A ^{b)}	Z	
MPa	MPa	MPa	%	%	
≥210	≥245	515-700	≥40	≥50	≤215

Imperial units

Proof strength		Tensile strength	Elong.	Contr.	HB
R _{p0.2} ^{a)}	R _{p1.0} ^{a)}	R _m	A ^{b)}	Z	
ksi	ksi	ksi	%	%	
≥30.5	≥35.5	75-101.5	≥40	≥50	≤215

1 MPa = 1 N/mm²

a) R_{p0.2} and R_{p1.0} correspond to 0.2% offset and 1.0% offset yield strengths, respectively.

b) Based on L₀ = 5.65 √S₀ where L₀ is the original gauge length and S₀ the original cross-sectional area.

Impact strength

Due to its austenitic microstructure, Sanmac® 4541 has very good impact strength both at room temperature and at cryogenic temperatures.

Tests on bar have demonstrated that the steel fulfils the requirements (60 J (44 ft-lb) at -196°C(-320°F)), according to the European standards EN13445-2(UFPV-2) and EN 10272.

At high temperatures

Metric units

Temperature	Proof strength		Tensile strength
	R _{p0.2}	R _{p1.0}	R _m
°C	MPa	MPa	MPa
	min.	min.	min.
100	175	205	440
200	155	185	390
300	135	167	375
400	125	156	375
500	119	149	360

Imperial units

Temperature	Proof strength		Tensile strength
	R _{p0.2}	R _{p1.0}	R _m
°F	ksi	ksi	ksi
	min.	min.	min.
200	25.4	29.7	63.8

Imperial units			
Temperature	Proof strength		Tensile strength
	R _{p0.2}	R _{p1.0}	R _m
°F	ksi	ksi	ksi
	min.	min.	min.
400	22.5	26.8	56.6
600	19.6	24.2	54.4
800	18.1	22.5	54.4
1000	17.2	21.6	52.2

MACHINING

General

Sanmac® stands for Sandvik Machinability Concept. In Sanmac® materials, machinability has been improved without jeopardizing properties, such as corrosion resistance and mechanical strength.

Improved machinability is brought about by:

- Optimized non-metallic inclusions
- Optimum chemical composition
- Optimized process and production parameters

Detailed recommendations for the choice of tools and cutting data, for turning, thread cutting, parting/grooving, drilling, milling and sawing, are provided in the brochure S-029-ENG.

Machining chart

The diagram shows the ranges, within which data should be chosen in order to obtain a tool life of 10 minutes minimum, when machining the austenitic Sanmac® 4541. The ranges are limited in the event of low feeds, because of unacceptable chip breaking. In the case of high cutting speeds, plastic deformation is the most dominant cause of failure. When feed increases and the cutting speed falls, edge chattering (chipping) increases significantly. The diagram is applicable for short cutting times. For long, continuous cuts, cutting speeds should be reduced somewhat.

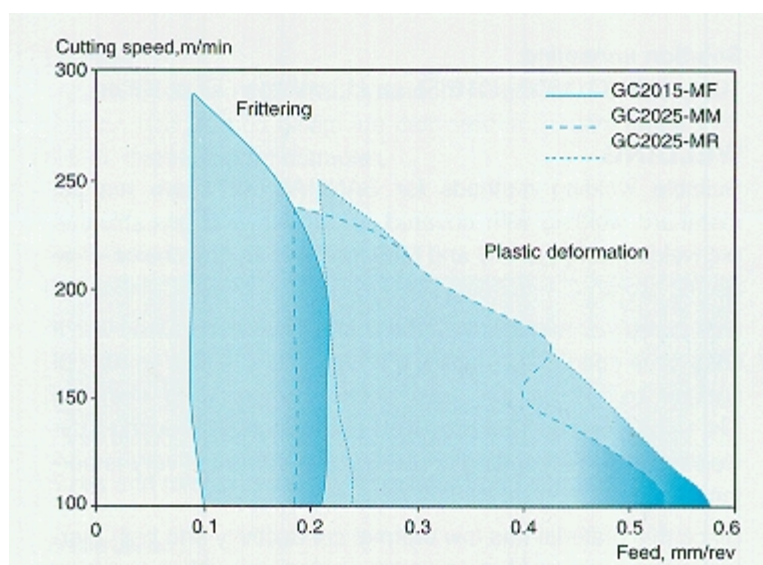


Figure 1. Machining chart for Sanmac 4541.

The lowest recommended cutting speed is determined by the tendency of the material to stick to the insert (built-up edge), although the integrity of insert clamping and the stability of the machine are also of great significance.

It is important to conclude which wear mechanism is active, in order to optimize cutting data with the aid of the diagram.

Turning Sanmac® 4541

Recommended insert and cutting data (starting values)

Insert Geometry	Grade	Cutting data	Cutting speed	Application
		Feed	m/min	
		mm/rev.		
MF	GC2015	0.15	240	Finishing, copy turning
MM	GC2025	0.25	210	Medium machining
MR	GC2025	0.30	180	Medium-to-rough machining under less stable conditions

Drilling Sanmac® 4541

The recommended methods for drilling give the most cost effective results for the respective diameter ranges. When producing holes with diameters larger than 58 mm, short hole drilling is used up to 58 mm, followed by internal turning, up to the desired diameter. Cutting data for internal turning should be chosen in accordance with the turning recommendations. The recommendations for drilling are applicable for a tool life of 30 minutes.

Short hole drilling, diameter 12.7 - 58 mm

Coromant U-drill, R416.2

Insert Geometry	Grade	Cutting data, Feed	Cutting speed
		mm/rev.	m/min
-53	Central insert GC1020	-	-
-53	Peripheral insert GC1020*	0.04-0.18	150
-53	Peripheral insert GC3040**	0.04-0.18	200

* GC1120 for diameters below 17.5 mm

** stable conditions, otherwise use GC1020 and cutting speed 180 m/min

Drilling with Sandvik Coromant Delta C drill, diameter 3 - 12.7 mm

Code R415.5. Grade GC1220

(diameter range 3 - 20 mm)

Cutting data, Feed*	Cutting speed
mm/rev.	m/min
0.08-0.22	40

* The lower feed value should be selected for smaller diameters.

Drilling with high speed steel (HSS) drill

(diameter 1-3 mm)

Cutting data, Feed*	Cutting speed**
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mm/rev.	m/min
0.03-0.09	8-15

* The lower feed value should be selected for smaller diameters

** The higher cutting speed should be selected for coated drills

Milling Sanmac® 4541

Use of optimum cutting data means that milling can be carried out at cutting speeds above those where there is a risk of built-up edge formation. Dry milling results in long tool life. If coolant is needed (e.g. when the surface cannot be reached in the dry condition) the cutting speed must be reduced by approximately 40-60% to prevent tool wear due to increased thermal load on the inserts.

Milling with CoroMill cutters 1)

Roughing Geometry/Grade	Cutting speed	Finishing Geometry/Grade	Cutting speed
	m/min		m/min
MM-2030	180	ML-2030	225

1) Starting values for dry machining.

Threading Sanmac® 4541

Indexable inserts can be used for external thread cutting of all diameters. Threading with screw-cutting dies or die heads is economical only for small diameters. For internal threading with short and normal cutting lengths, thread cutting with indexable inserts is recommended above a hole diameter of 12 mm. For long cutting lengths, thread cutting with indexable inserts is recommended for hole diameters above 20 mm.

Thread turning

Due to the tendency of austenitic materials to work harden, radial infeed is recommended. A generous flow of cutting fluid should also be used, partly to obtain a reliable process and partly to guide the chip. The recommendations apply to a tool life of 30 minutes.

Insert Geometry	Grade	Cutting speed
		m/min
All-round	GC1020	150

Thread tapping

Compared with uncoated threading taps, coated threading taps can improve productivity by up to 100%. For the advantages of coated threading taps to be realized, a generous flow of cooling fluid must be used. The recommendations apply to a tool life of 30 minutes.

Cutting speed
m/min
4-15

The higher range of cutting data should be chosen for coated threading taps

Sawing of Sanmac® 4541

Cutting with bandsaws or cold saws gives the best cutting economy. If the demand for surface smoothness is great, circular sawing is preferable.

Band sawing gives high productivity, is flexible and incurs low investment costs.

When band sawing Sanmac® 4541, the Sandflex Cobra type 3851 bimetallic bandsaw blades, which is available

from Bahco Group (formerly Sandvik Saws and Tools), is recommended.

Tooth spacing should be selected according to the dimensions of the material to be cut, and stated in TPI (the number of teeth per in.). The TPI should be reduced for thicker dimensions. For a bar dimension of D = 150 mm, 2/3 TPI or 1/2 TPI is recommended.

Cutting speed
m/min
45-50

Feed is regulated to obtain a good chip form.

Disclaimer: Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions. Continuous development may necessitate changes in technical data without notice. This datasheet is only valid for Sandvik materials.