Strip steel for edge applications

SANDVIK
Steel

Always looking for the optimum solution

For many of our customers, edge applications are a major business. We have one interest in common: to manufacture quality products as efficiently and as economically as possible.

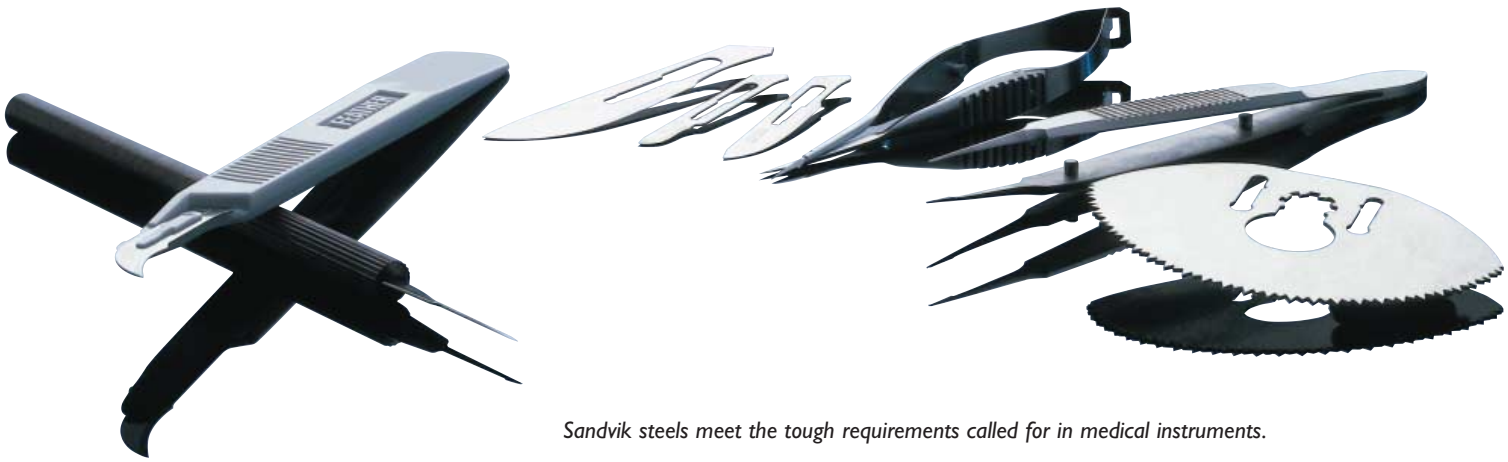
We hope this brochure will be useful to you.

Below are some of the considerations when choosing a steel grade:

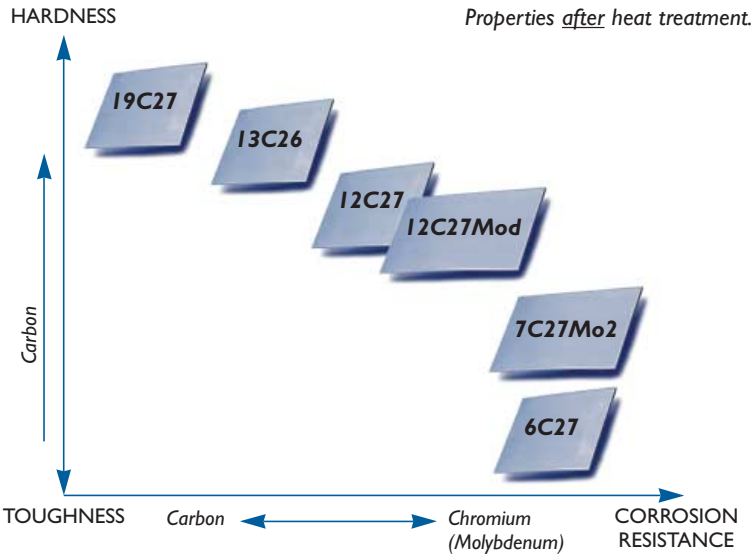
- application area of the product
- chemical composition of the material
- cold-rolled or hardened and tempered condition
- demands on hardness, toughness, corrosion and wear resistance
- requirements for size, surface finish and tolerances
- after-treatment, e.g. heat treatment, grinding or further processing
- particular customer needs

Sandvik has been manufacturing special steels for more than a century and we have extensive experience of how various steel grades behave under the most demanding conditions. Our research and development facilities are among the largest and most advanced in the world. Above all, we pride ourselves on being able to produce our steels in fully integrated steel mills, from the steel melt to the finished product. Where special steel properties are called for, we can tailor our strip products to meet customer-specific demands.

This has enabled us to build our experience in the field and explains why we believe we can offer you the optimum product solution.



Sandvik steels meet the tough requirements called for in medical instruments.



The right steel grade for the right application

Sandvik has concentrated on six of its stainless chromium steel grades to meet the needs of many different edge applications. Listed below are their main properties after heat treatment with examples of applications. More technical details about these various steel grades are available on separate data sheets.

6C27
PROPERTIES: *a common grade with good corrosion resistance and low hardness, mainly used for applications where the need for wear resistance is low.*
APPLICATIONS: *cold-rolled strip steel for utility knives such as slicers, potato peelers, butter knives and for complicated forms intended for subsequent piece hardening.*

7C27Mo2
PROPERTIES: *generally the same properties as in 6C27, but with improved corrosion resistance.*
APPLICATIONS: *cold-rolled strip steel for the same type of utility knives as 6C27; hardened and tempered strip steel for industrial knives, medical instruments and saws.*

12C27Mod
PROPERTIES: *a grade with good wear resistance and corrosion resistance, well suited to the manufacture of kitchen tools.*
APPLICATIONS: *cold-rolled strip steel used for carving knives, bread knives, butchers' knives, mixer blades, scissors and pruning shears; hardened and tempered strip steel for industrial knives.*

12C27
PROPERTIES: *a grade with high hardness and good wear resistance.*
APPLICATIONS: *cold-rolled strip steel for products such as hunting and fishing knives, pocket knives, skate blades and ice drills; hardened and tempered strip steel for industrial knives and skates.*

13C26
PROPERTIES: *generally the same properties as in 12C27, but with slightly higher hardness but less corrosion resistance.*
APPLICATIONS: *cold-rolled strip steel used for the manufacture of razor blades, surgical knives and meat knives.*

19C27
PROPERTIES: *a grade with very high hardness and wear resistance.*
APPLICATIONS: *cold-rolled strip steel used for the production of industrial knives for cutting synthetic fibre, paper, plastic film, fabrics and carpets.*

Chemical composition
The chemical composition of a steel grade decides many of the parameters, which are important for further processing of the steel into the finished product. The table shows the composition of the Sandvik steel grades for edge applications. Listed below are a few guidelines to selecting a steel grade:

- for good corrosion resistance, choose a grade with low carbon content
- for high hardness, choose a grade with medium to high carbon content
- for good wear resistance, choose a grade with high carbon content
- very good corrosion resistance can not be combined with very high hardness
- the heat-treatment process is vitally important in achieving the correct properties
- the level of hardness can have an affect on toughness

SANDVIK GRADE	CHEMICAL COMPOSITION, %		
	C	Cr	Mo
6C27	0.32	13.7	
7C27Mo2	0.38	13.5	1.0
12C27Mod	0.52	14.5	
12C27	0.60	13.5	
13C26	0.68	13.0	
19C27	0.95	13.5	

Properties which ensure long life are extremely important in steels for industrial knives.

What happens in the process chain?

When the desired properties have been met, the strip will be taken out of the process chain and is ready for delivery. There are two alternatives, cold-rolled and the hardened and tempered condition.

Tolerances and finishes

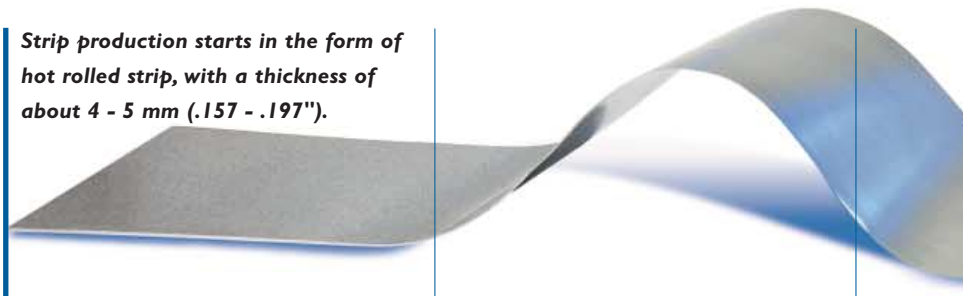
Generally speaking both thickness and width tolerances are improved with further processing of the strip.

The roughness of the surface will also improve. At the start, the surfaces of hot-rolled strip are rough. The subsequent cold-rolling process improves the tolerances, and the surface finish becomes finer. Grinding and polishing may sometimes be needed.

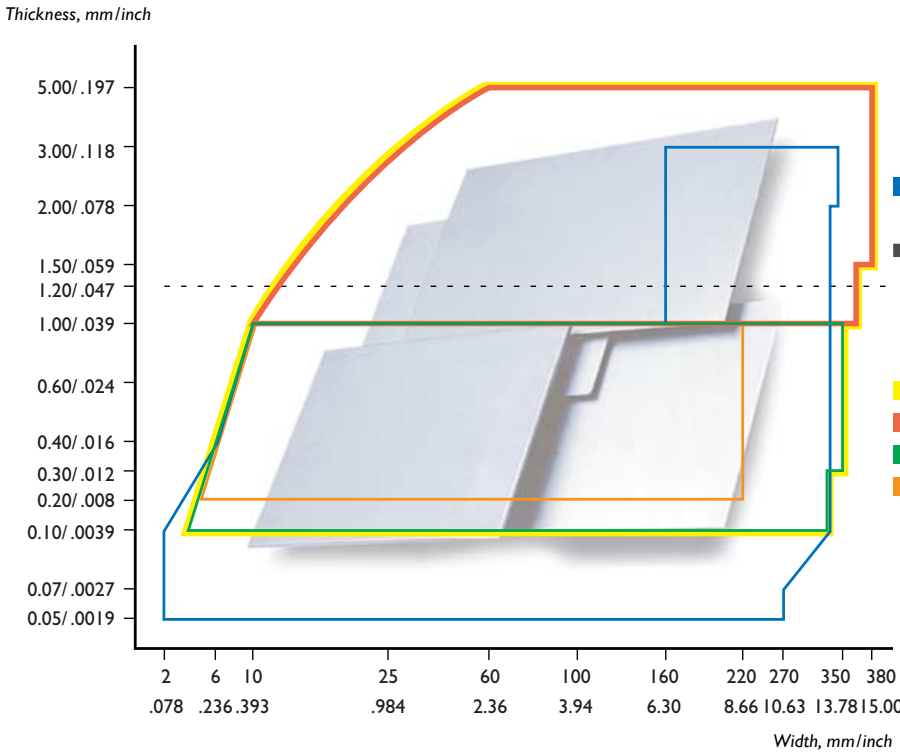
Additional general information is available for the various steel grades in the brochure Special Strip Steel, ref. no. S-300-ENG.

We are, of course, able to offer tailor-made specifications.

Strip production starts in the form of hot rolled strip, with a thickness of about 4 - 5 mm (.157 - .197").



HOT ROLLED, ANNEALED AND PICKLED	COLD ROLLED <15% REDUCTION
SURFACE ROUGHNESS R_a 3.0 µm THICKNESS TOLERANCES +/- 0.20mm (+/- .008")	SURFACE ROUGHNESS R_a 1.0 µm THICKNESS TOLERANCES +/- 0.06 - 0.09mm (+/-.002 - .004")
The strip is annealed and pickled. The surface is dull and there are standard hot rolled tolerances.	*By cold rolling, the strip is reduced by <15% to produce a bright-normal surface. The tensile strength is about 800 MPa (116 ksi), which means that thick strip can now be processed by blanking.* *For fine blanking, which calls for low tensile strength, the steel can be bright-annealed to max. 700 MPa (100 ksi).*



The size range of Sandvik strip steel for edge applications.

Hardened and tempered condition

Sandvik 6C27, 7C27Mo2, 13C26, 12C27 and 12C27Mod

Slit edges are only possible for dimensions below 1.2 mm (.047")

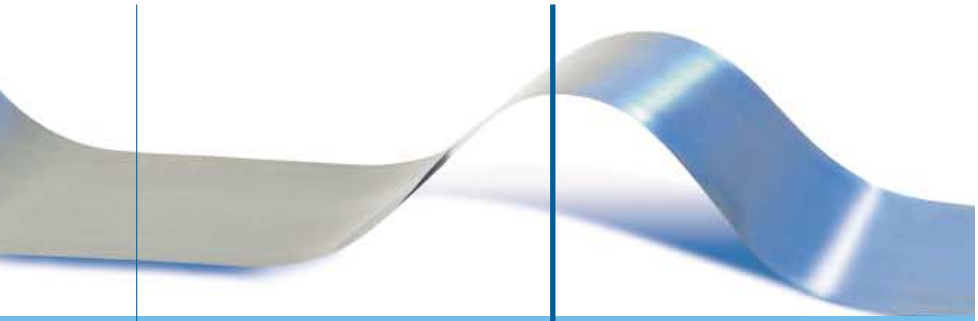
Cold rolled condition

Sandvik 6C27 and 7C27Mo2

Sandvik 12C27, 12C27Mod

Sandvik 13C26

Sandvik 19C27



COLD ROLLED >40% REDUCTION

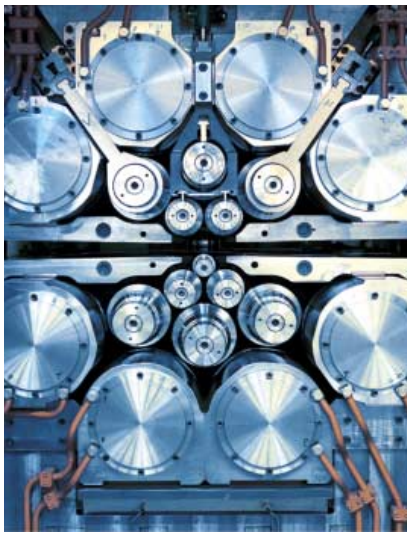
SURFACE ROUGHNESS
R_a < 0.5 µm
THICKNESS TOLERANCES
+/- 0.002- 0.06 mm (+/- .00008 - .002")

In the cold rolled, bright surface condition, and after a reduction of > 40%, different dimensions give alternative surface finishes. In this process the tensile strength can be tailored to customers' requirements, varying from 700 to 1000 MPa (100 - 140 ksi), where the higher value is mostly applicable to very thin products, approximately < 1.0 mm (.039").

HARDENED AND TEMPERED

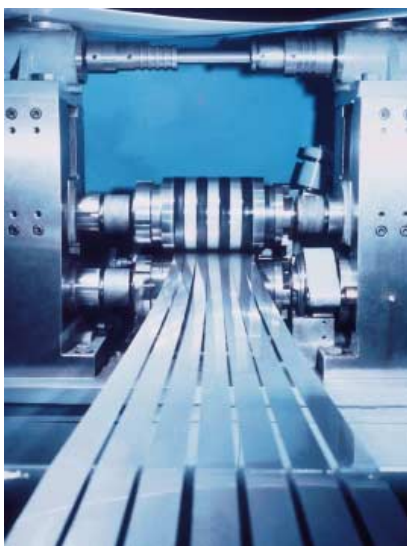
SURFACE ROUGHNESS
R_a 0.05-2.0 µm
THICKNESS TOLERANCES
+/- 0.002- 0.06 mm (+/- .00008 - .002")

Strip can also be delivered in a hardened and tempered condition. In the hardening lines, various properties can be built into the strip (surface finish, flatness etc.), which will remain with the strip into the finished product. Tensile strength varies between 1500 and 2100 MPa (218 - 304 ksi), depending on the steel grade, strip thickness and desired finish.



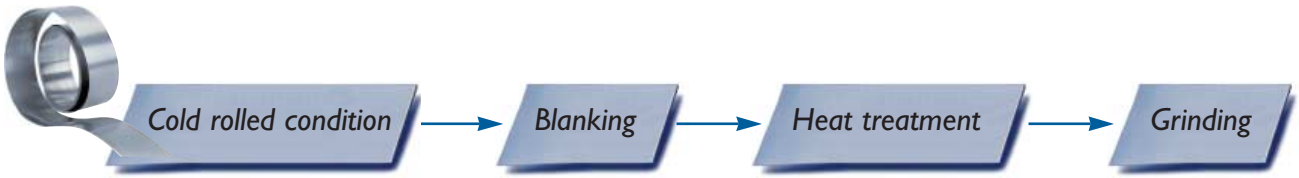
Cold rolling mill.

Slitting machine.



The choice is yours!

If you choose the raw material best suited for your application, you stand to gain product quality, manufacturing efficiency and economic yields. All Sandvik stainless chromium steel grades have been specifically developed to meet the demands of edge products for varying end uses – from industrial knives to household and utility knives, razor blades and medical instruments. Whatever your product, there is a Sandvik steel to suit.



BLANKING

Blanking is the most common way to cut a product profile out of strip material. It requires a tool of optimum hardness and design and makes this process most suitable for bulk production. Avoid distortion of the blanked product, as this will induce stresses in the material.

Blanking of strip in the hardened and tempered condition, especially in thick materials, calls for very rigid tools and frequent tool maintenance. Good lubrication and correct tool clearance reduce tool wear.

HEAT TREATMENT

Hardening and tempering of the steel is needed to achieve the correct finish and to meet the properties required by the end user. It is important that the process is carried out correctly, as any deviation can lower the quality of the edge.

Profiles and components in thicker material are normally cut out of cold-rolled material and piece-hardened after blanking. In the main, this process gives higher hardness than can be achieved in pre-hardening of strip steel for delivery in coils.

Heat-treatment recommendations for Sandvik's various steel grades are available on separate steel data sheets. They also contain detailed information about which parameters influence the heat treatment process and how to proceed if corrections have to be made.

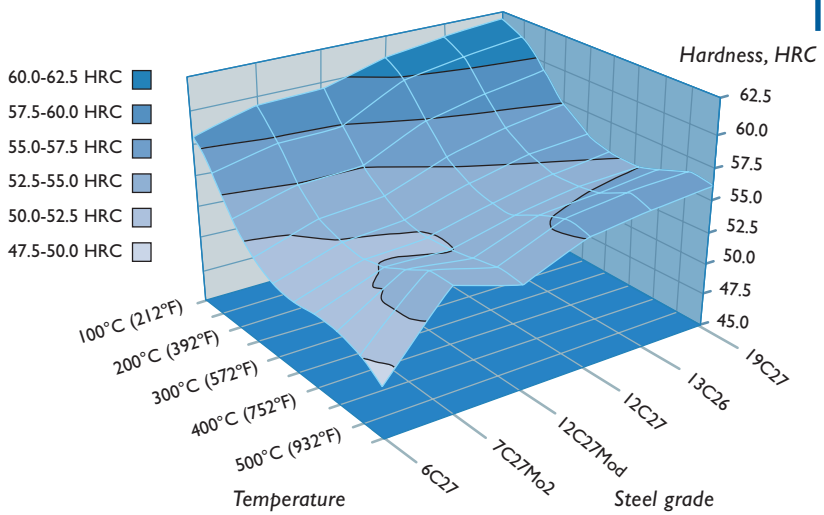
Our recommendations include a number of factors which influence the process:

- *austenitising, temperature and time*
- *cooling rate to avoid carbide precipitation*
- *deep freezing versus cooling to room temperature*
- *tempering, diagrams and temperature limits to avoid embrittlement and reduced corrosion resistance.*

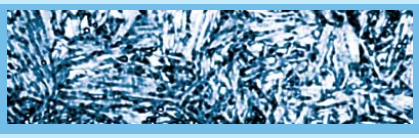
The illustration shows the effect of different tempering temperatures on hardness for various grades.

Hardening temperature 1060-1080°C (1940-1976°F), depending on grade and thickness, holding time 5 min, quenching in oil.

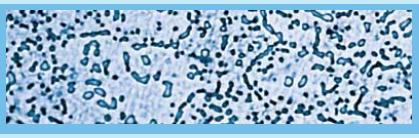
More detailed recommendations for Sandvik's various steel grades are available on separate data sheets.



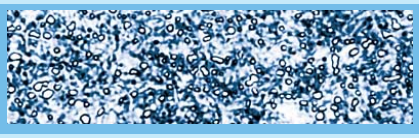
The figures show the importance of using the right hardening conditions to optimise the steel micro structure.



Too high hardening temperature ➔ coarse structure, high austenite content (30%), few carbides. Result: Low hardness and low wear resistance.

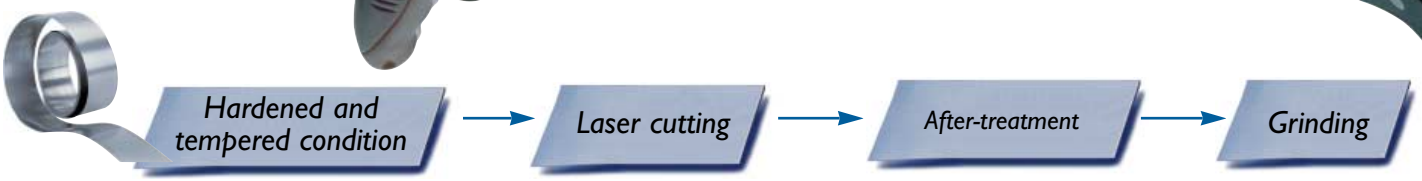


Too low cooling rate after the austenitising ➔ carbide precipitations in the grain boundaries. Result: Brittleness and reduced corrosion resistance.



Optimised hardening conditions ➔ optimal austenite content (15%), many uniformly distributed carbides. Result: Optimal combination of hardness, wear resistance, ductility and corrosion resistance.

Sandvik steel grades have been specially developed for a wide range of utility knives for professional use as well as for home and hobby use.



LASER CUTTING

Laser cutting is a flexible technique, which cuts out the component profile by melting the steel. It is well suited to prototype production and short production runs. It is comparatively slower than blanking, but the method makes it possible to cut out product profiles in thicker strip in the hardened and tempered condition.

Water-jet cutting is sometimes used as an alternative blanking method.

After-treatment

A certain heat treatment may be necessary, as laser cutting hardens the steel in the area of the edges and causes residual stresses which can make the material brittle. This treatment facilitates subsequent bending of the edge without causing cracks. If the material is to be hardened after cutting, no after-treatment is needed.

GRINDING

Grinding of the edges and the surface, if called for, give the steel its final finish. In grinding of chromium steels it is important to use the right kind of grinding wheel. A loosely bound wheel should be used. When the grinding force increases, soft wheels leave worn grains and hard tips emerge. So called all-round wheels become dull very quickly. When the cutting force increases, it produces heat which in turn results in lower hardness and reduced corrosion resistance, due to carbide precipitation.

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