



PERFECTA's Knife Advisory Service

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Brief guidance on knives

As a result of the steadily growing variety of paper grades with their many different additives the industry uses for their production, knife performance criteria have to meet higher and higher requirements.

Knives used on cutting machines can be characterized by two main properties:

The material used for their cutting edges.

Knife geometry (bevel angle).

On this basis, we can distinguish among the following knife groups:

Tool steel (Swedish steel)

(The carbon content in unalloyed tool steel grades is between 0.5 % and 1.5 %, with small quantities of tungsten also often being contained.)

Superspeed steel knives

(Superspeed steel (HSS) knives characterize a group of alloyed tool steel grades containing a maximum carbon content of 2.06 % and up to 18 % of tungsten and other alloying elements such as molybdenum, vanadium, cobalt, nickel and titanium.)

Tungsten carbide knives (WIDIA) and their sub-grades:

Standard carbide, fine-grained and micrograin carbide knives.

(Carbide is a material that consists of tungsten carbide and cobalt as its main components.

It is made in a sintering process under high temperatures and high pressure.)

Furthermore, **special knives** for particular applications such as non-stick knives (e. g. for cutting pressure-sensitive labels), bonded knives etc. are in use.

When you purchase a knife, its original price, its average number of cuts (lifetime), associated knife changing expenditure, resharpening costs and the average amount of material removed from the cutting tip in millimetres should be included into your calculation (refer to "Grinding Costs for Standard and Super-Fine Micrograin Carbide Knives".)

The number of cuts before resharpening depends on quite a variety of different factors. The most significant ones are:

- the knife type,
- the cutting material (a decisive factor that can considerably shorten lifetime),
- treatment by the operator,
- the maintenance condition and the place of installation of the cutter,
- the feed height,
- the knife speed.

An **HSS (superspeed) knife** for a P115 guillotine has a height of 140 mm, with the maximum amount of material removed by resharpening being of the order of 32 mm. At a material removal rate of 0.49 mm per grinding process, the knife can be resharpened about 65 times.

A **carbide knife** for a P115 guillotine has a height of 140 mm, with the maximum amount of material removed by resharpening being of the order of 16 mm. At a material removal rate of 0.4 mm per grinding process, the knife can be resharpened about 40 times.

The knife splits the material into two sections and pushes them apart.

In this connection, the bevel angle on the knife cutting edge is an important parameter.

The more obtuse this angle is, the more force must be applied for cutting.

The force that acts on the knife itself increases to the same extent.

Therefore, we can say:

Soft material → acute knife bevel angle.

Hard material → obtuse knife bevel angle.



Acute bevel angle



Soft material



Obtuse bevel angle



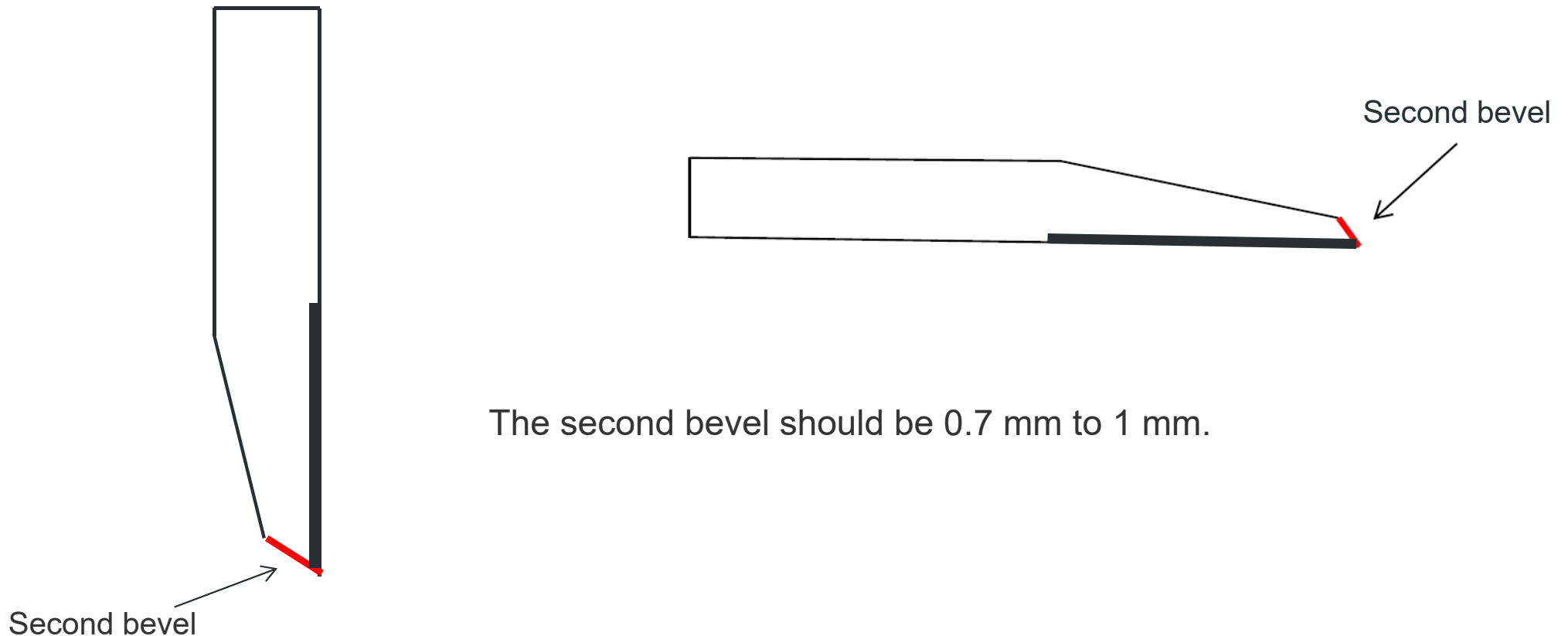
Hard material

To encounter varying hardness of the stock to be cut, providing the knife with a second bevel is recommended.

For this purpose, the knife cutting edge must be chamfered at a second angle.

Thus, the cutting edge tip can absorb the resistance of hard cutting stock much easier.

Bulged soft material applies less pressure on the acute overall knife angle.



The second bevel should be 0.7 mm to 1 mm.

Trouble occurring/cutting problems and their avoidance

Both the knife and the machine are a complex cutting system.

Many factors of this unit can affect the cutting quality.

Based on our experience, we have listed a few problems and their probable causes to assist you in overcoming any potential trouble.

It goes without saying that a properly installed and maintained machine is the fundamental precondition for a good cutting result. For this reason, lubrication at regular intervals as indicated in the lubrication schedule contained in the User's Manual of each machine is of vital importance. Worn-out guideways and poorly ground or overloaded knives are the origin of most of the cutting problems that can occur during cutting. In this connection, handling also play a decisive role, i. e. the pile should be well and carefully aligned on the backgauge. The clamping pressure should be adjusted on the size and type of the material to be cut.

When cutting business cards (small sizes), you should feed stock under both sides of the clamp.

For printed paper, you should orient towards the lay side of the sheet in the printing press (often, the sheets have trim marks, i. e. continuous lines of 5 mm to 7 mm in length that are some 3 mm away from the useful surface). In other words, the first cut should made opposite to the edge that was seized by the grippers in the printing press, the pile just being laid against the narrow cutting rakes of the backgauge. After that, the paper pile must be turned around 90 degrees so that the feeder side (print mark) lies against the backgauge, i. e. will be cut opposite to the printing press lay side.

Sharp knives are a fundamental precondition for quality cutting.

You can recognize blunt knives by

- the cut edges of the sheets sticking together;
- the cut edges having dark stains, and the pile looking raw (ripping);
- the typical cutting sound being no longer audible, and by hearing a sharp bang while the lowermost sheet is being cut through.

Changing the knife in due time will save you a lot of trouble:

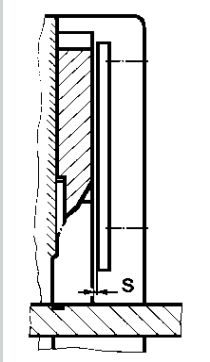
- The cutting machine will be spared.
- The knife will last longer since it will not be ground down so much.
(Overloading can lead to some irreparable knife damage!)
- Cutting quality will be better.
- Resharpening costs will become less.

This list can only be a part of the variety of potential problems.

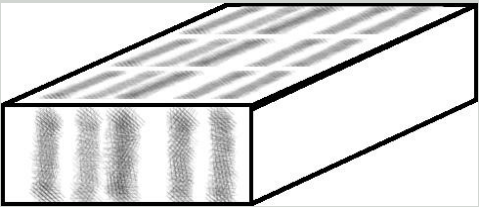
Please feel free to ask us for advice, as we are always eager to solve with you any problems that might occur.

Troubleshooting (1)

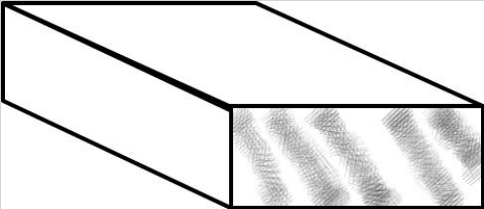
Continuously documented knife changing can avoid a lot of cutting problems.

Problem	Symptoms	Cause	Remedy
<p>Rubbing of the knife</p> <p>The gap between the cutting side and the clamp front edge must be very small (less than 0.4 mm). (Refer to "Mushroom-shaped cutting".)</p> 	<p>The cutting side of the knife is rubbing on the clamp front edge, producing marks at the cutting (back) side of the knife.</p>	<p>The knife is blunt and is forced off as a result of the growing pressure.</p>	<p>Replace the knife with a freshly resharpened one at shorter intervals.</p>
		<p>Wrong bevel angle.</p>	<p>Reduce the bevel angle.</p>
		<p>Excessive pile height, the knife has not been straightened or honed.</p>	<p>Reduce the pile height, consult your resharpeners.</p>
		<p>The knife is being overloaded (short-wave deformation). The knife dimensions are out of tolerance.</p>	<p>Purchase a new knife. Every cheap knife needs not necessarily be good!</p>
		<p>The play in the clamp and/or in the knife beam guidance are/is too big.</p>	<p>Readjust the play in the guide-ways. This applies to earlier machine models or to such machines that have not been lubricated sufficiently.</p>

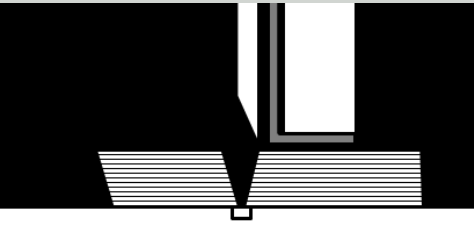
Troubleshooting (2)

Problem	Symptoms	Cause	Remedy
<p>Wavy cutting Vertical shading</p> 	<p>Wavy zones can be seen and felt.</p>	<p>Thick printing at various positions within the sheets causes big thickness differences on the paper sheets. This causes uneven clamping in areas that contain more printing ink. At such more dense positions that are slightly cambered, the knife cuts worse.</p>	<p>Placing a felt or foam plate between the hold-down and the paper pile can lead to uniform clamping. Perfecta offers suitable foam plates.</p>
		<p>In parts of the knife that are overheated during grinding, soft zones are created that will get dull very soon.</p>	<p>Have the knife resharpened correctly and with sufficient coolant supply. Any soft zones must be entirely removed (refer to the grinding instructions).</p>
		<p>Too acute a bevel angle will cause cambering at densely printed areas.</p>	<p>Regrind the knife for a bigger bevel angle (e. g. 22° to 24°).</p>
		<p>Inconsistent paper quality or paper thickness.</p>	<p>Use different paper.</p>
		<p>Blunt knife.</p>	<p>Replace the knife with a freshly resharpened one.</p>


Troubleshooting (3)

Problem	Symptoms	Cause	Remedy
Diagonal shading 	Diagonal shading Wavy zones can be seen and felt in the cutting direction of the knife.	In parts of the knife that are overheated during grinding, soft zones are created that will get dull very soon.	Have the knife resharpened correctly and with sufficient coolant supply. Any soft zones must be entirely removed.
		Too acute a bevel angle will cause cambering at densely printed areas.	Regrind the knife for a bigger bevel angle (e. g. 22° to 24°).
		The knife (material) is too soft.	Use a different type of knife (CARBIDE).
		The knife cutting edge is chipping.	Change the knife.


Troubleshooting (4)

Problem	Symptoms	Cause	Remedy
<p>Overcutting</p> 	<p>After cutting, the lower sheets are longer than the upper ones.</p>	<p>The knife is blunt.</p>	<p>Replace the knife with a freshly resharpened one.</p>
		<p>Wrong bevel angle.</p>	<p>Soft paper: Regrind a smaller bevel angle (e. g. 22° to 20°).</p> <p>Hard paper: Regrind a bigger bevel angle (e. g. 22° to 24°).</p>
		<p>The clamping pressure is too high: While the knife is penetrating deeper into the paper pile, the growing density of the latter causes deflection of the knife.</p>	<p>Reduce the clamping pressure.</p> <p>Note: On the TS cutter models, you can store a clamping pressure parameter in the program.</p>
		<p>The cutting path is not vertical despite any efforts you take.</p> <p>Options in the machine</p>	<p>Correct the cutting path.</p> <p>Use a tilting backgauge that can compensate a deviating cutting path or hold the paper with the back-gauge-mounted hold-down</p>

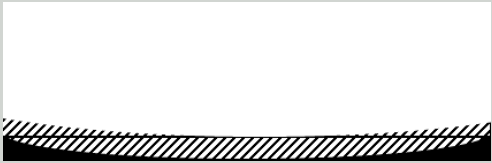
Troubleshooting (5)

Problem	Symptoms	Cause	Remedy
<p>Undercutting</p> 	<p>After cutting, the lower sheets are shorter than the upper ones.</p>	<p>The clamp pressure is too low: The lower sheets are forced outward during cutting.</p>	<p>Increase the clamping pressure.</p> <p>Note: On the TS cutter models, you can store a clamping pressure parameter in the program.</p>
		<p>The bevel angle is too big.</p>	<p>Reduce the bevel angle.</p>
		<p>Rough or uneven stock: For example, gummed labels or embossed material.</p>	<p>Adjust the clamping pressure correspondingly.</p>
		<p>The cutting path is not vertical despite any efforts you take.</p>	<p>Correct the cutting path.</p> <p>Use a tilting backgauge that can compensate a deviating cutting path.</p>

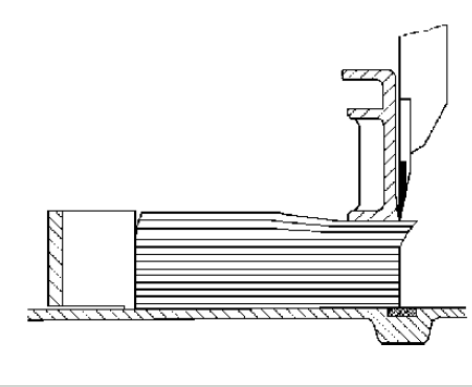
Troubleshooting (6)

Problem	Symptoms	Cause	Remedy
Concave cutting 	The paper sheets are longer at their ends than in the middle.	At the paper ends, the pile is pressed down more than in the middle.	Check the edges of the clamp and place a felt or foam plate underneath, if necessary, to obtain more even distribution of the clamping pressure. Perfecta offers various magnetic compensation plates.
		This is due to how the stock has been processed, to damp material, or to stress in the paper (pasteboard).	If you obtain a concave cutting result make a second cut.

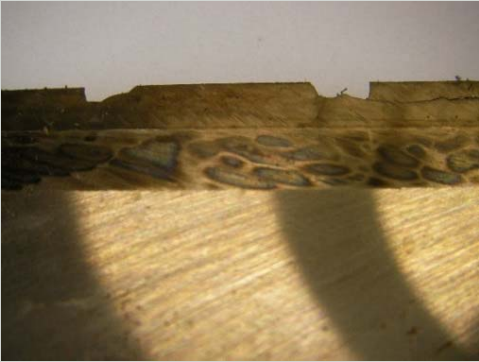
Troubleshooting (7)

Problem	Symptoms	Cause	Remedy
Convex cutting 	<p>The paper sheets are shorter at their ends than in the middle.</p>	<p>In the middle, the pile is pressed down more than at the paper ends.</p>	<p>Check the edges of the clamp and place a felt or foam plate underneath, if necessary, to obtain more even distribution of the clamping pressure.</p>
		<p>This is due to how the stock has been processed, to damp material, or to stress in the paper (pasteboard).</p>	<p>If you obtain a convex cutting result make a second cut.</p>

Troubleshooting (8)

Problem	Symptoms	Cause	Remedy
<p>Mushroom-shaped cutting</p> 	<p>Only the uppermost sheets are longer than the rest of the pile (mushroom shape).</p> <p>This phenomenon occurs mainly in connection with soft, voluminous paper (low grammages) that is pressed down very much and when the knife cutting edge is dull.</p>	<p>The clamping pressure at the knife cutting position is too low.</p>	<p>Increase the clamping pressure.</p> <p>Perfecta offers a <i>backgauge-mounted hold-down</i> option that can additionally keep the pile in position at the backgauge to pre-vent sheets from being pulled out.</p>
		<p>Insufficient friction among the sheets (air between the sheets).</p>	<p>Use the cutter's <i>air expulsion</i> function.</p>
		<p>The gap between the clamp front edge and the knife back is too big.</p>	<p>On Perfecta machines, this gap is less than 0.4 mm.</p> <p>Knives that are out of tolerance or grinding down the knife back (in case of damage) are other factors that can cause this problem.</p>

Troubleshooting (9)

Problem	Symptoms	Cause	Remedy
<p>Chipping of the knife cutting edge</p> 	<p>Visible chipping of the knife cutting edge.</p>	<p>Too acute a bevel angle that is not suitable for such material.</p>	<p>Increase the bevel angle or chamfer it (double bevel).</p>
		<p>Too much grinding heat ingress leads to premature chipping due to hot cracks. Previous chipping has not been ground off sufficiently (microcracks are mostly longer and must also be ground off).</p>	<p>Have the knife resharpened correctly and with sufficient coolant supply. Any destroyed zones must be entirely removed.</p>
		<p>The knife has already been ground down too much, and the insert is no longer stable in the carrier material.</p>	<p>Replace the knife.</p>
		<p>The knife is cutting too deeply into the cutting stick.</p> <p>The cutting stick quality is insufficient for the knife in use.</p> <p>Remnants of chipping in the cutting stick.</p>	<p>Turn around or change the cutting stick and readjust the cut-through position.</p>
		<p>Contaminations in the paper or raw pasteboard and a knife grade that is not suitable to cut such material.</p>	<p>Increase the bevel angle or chamfer it(double bevel).</p> <p>Do not use CARBIDE knives.</p>

Comparison of Lifetime

Grade	Number of possible cuts before the (next) knife resharpening (Cuts)
Standard Chromium Steel	1,000 1,500
HSS Steel (Superspeed Steel)	> 3,000
Carbide (Standard)	> 10,000
Fine-Grained Carbide	> 16,000
Micrograin Carbide	up to 30,000

Pros and Cons of Various Knife Grades

Grade	Advantages	Disadvantages
Standard (tool steel, so-called "Swedish steel") <i>(Not offered by PERFECTA.)</i>	<ul style="list-style-type: none"> – Cheap to buy. – Grinding and straightening do not require any specific experience. – The knife cutting edge does rarely chip. 	<ul style="list-style-type: none"> – Only 1,000 cuts are possible → frequent resharpening is necessary. – Frequent resharpening causes more machine downtime → leading to production standstill.
HSS Steel <i>Standard knife for Perfecta cutters</i>	<ul style="list-style-type: none"> – Universal knife for a wide range of materials. – Lasting three to four times longer than a tool steel knife. – The purchase price is only slightly higher than that for a tool steel knife. 	<ul style="list-style-type: none"> – Does not last as long as a carbide knife.
Carbide The smaller the grain size of the microstructure is, the harder is the cutting edge and the longer the lifetime, however, the more likely tends the cutting edge to chipping.	<ul style="list-style-type: none"> – All carbide knives have a better surface quality than steel knives. – Better cutting results and less paper dust. – Long life → less frequent resharpening. – Owing to the long life of the knife, the machine can stay in operation for a long time, without the knife needing replacement. 	<ul style="list-style-type: none"> – High purchase price compared with standard or HSS knives. – Resharpening, straightening and handling require a lot of skills and experience since the material is harder. – Caution should be exercised when specific materials (recycling paper or pasteboard that can provoke chipping) are being cut.

Original Data for Calculating the Costs for a Perfecta 115 Knife

Optimum knife data for obtaining high cutting quality and for cutting paper normally used in print shops (no cardboard).

For other materials such as grey board the number of cuts before the next resharpening operation can drastically reduce.

Knife Parameter	HSS Knife	Carbide Knife
Length	1350 mm	1350 mm
Height when new	140 mm	140 mm
Height when ground down	108 mm	127 mm
Material removed during resharpening	0.49 mm	0.40 mm

Examples of Overall Costs of Standard and Super-Fine Micrograin Carbide Knives for 100,000 Cuts

	Standard Knife (Tool Steel)	HSS Knife	Micrograin Carbide
Price	Approx. € 240 Not offered by Perfecta.	€ 415	€ 942
Grinding costs incl. straightening and honing	Approx. € 21	Approx. € 21	Approx. € 85
Maximum number of possible re-sharpening operations per knife	70	65	40
Knife changing costs	€ 45	€ 45	€ 45
Number of cuts	1,000	4,000	16,000
Number of knife changing cycles until 100,000 cuts are reached	100	25	6.25
OVERALL COSTS	Approx. € 6,943	Approx. € 1,823	Approx. € 960

Various Types of Cutting Sticks

The cutting stick is the counterpart of the machine knife.

The material of the cutting stick must be tough but not too hard. The cutting stick should be replaced or turned around after the knife has come deep enough to make the lowermost sheets of a pile tear off.

Also, whenever you change the knife you should always turn around or replace the cutting stick.

For this purpose, adjust the eccentric knife setting cams (refer to the "Help" function of the TS machine) so that the knife is at the topmost position on the knife beam.

Caution: The knife must not cut too deeply into the cutting stick. Readjust the eccentric cams more frequently (refer to the *electromotoric knife lowering* option) and turn around the cutting stick at regular intervals.

The cutting stick consumption mainly depends on the stock to be cut. One can say: The harder the stock is, the higher is the consumption of cutting sticks.

As a reference: The cutting stick should be turned around or replaced every 1,000 to 1,500 cuts.

This will extend knife lifetime and avoid cutting edge chipping. Low-grade PVC cutting sticks should not be used.

Cutting Sticks

On earlier PERFECTA machine models (SEYPA) straight and 16 mm x 16 mm square cutting sticks are normally used.

Later Perfecta series machines require wavy cutting sticks that are 4.5 mm x 10.5 mm in size. For all machine models, Perfecta offers cutting sticks with the following product properties:

Grey colour, RAL 7032:

Material: high-heat stabilized homopolymeric polypropylene

Hardness (acc. to DIN 53505, Shore D): 76 / 77

Used for standard, HSS and carbide knives.

White/yellow colour:

Material: Cast polyamide 6 as per DIN 7728.

Hardness (acc. to DIN 53505, Shore D): 82 / 83

Used for three-knife trimmers, carbide and bonded knives.

If you should have any further questions please feel free to ask for our "Cutting Primer" or call +49-3591-556-460 to contact our Service Department.

**Thank you very much
for your kind attention.**