

Machining of VOLTIS® -woven cotton cloth laminates and VOLTIS® - paper laminates

General

The machining guidelines apply to VOLTIS® woven cotton cloth laminates and VOLTIS® paper laminates. Small heat conductivity of the material determines the treatment. Carbide tools of the quality H1 proved best. As principle to each treatment is considered: as high a cutting velocity with small feed motion and small splinter as possible.

Cutting-tools must always be sharp, as otherwise rough intersection and peel off of the end layers can be the result.

Below indicated working values are to be understood as approximate values, which are to be adapted to the respective manufacturing conditions.

Resulting splinters should be exhausted off good.

Lubricating and cooling solvents are necessary only at thread cutting. Also at gear tooth forming of clamped gear wheels the use of cooling solvents can be planned. Cooling the working places with compressed air works also satisfactorily.

In order to prevent delamination and breaking out of the last material layer during drilling, turning, milling, a hard support plate made of wood or paper laminate should be present on the outgoing side of the tool.

Possibilities of machining

- Sawing

Hollow polished circular saws are suitable.

For larger material thicknesses and quantities: Circular saw blades with put on carbide plates.

Belt saws only for rough cutting of larger material thicknesses, as intersection become scratched.

Tools	Cutting-rate velocity (m/s)	Feed- of	Number diameter teeth pro inch	Blade- thickness (mm)	Blade - (mm)	Material- (mm)
Circular saw carbide	50 - 60	manually	3 - 4	300 - 350	5	to 40
Circular saw tool steel	50 - 60	manually	5 - 8	150 - 200	2,5	to 4
				200 - 300	3	to 10
				300 - 350	5	to 30
Belt saw set	25 - 35	manually	4 - 6	-	ca. 1	to 200

- Cutting

VOLTIS®-cotton cloth und VOLTIS®-paper laminates are cold cuttable up to approx. 0,5 mm thickness with a hit-cutter, which are equipped with a holding down clamp. Materials with a thickness of 0,5 to 2,5 mm have to be heated strongly. The hit-cutters should have a very flat cutting angel (approx. 1-2°). There should be no distance between cutter and holding down clamp.

- Turning

Turning steel with carbide plates are to be used, in exceptional cases also HSS tools (must often be regrinded because of rapid wear). Turning steel tools with the following polished section proved well.

In order to avoid splinterings, it is recommendable to present support plates at the outgoing side of the tool if possible

Tools	Cutting velocity (m/min.)	Feedrate (mm ⁻¹)
Carbide-turning steel	200	0,1 - 0,5
HSS		

- Drilling

Drilling perpendicular to the layers:

HSS drill with slim spiral (brass drill, pointed angle approx. 80 to 90°), with larger relief grinding than with metal drills. For larger quantities drills with carbide plates are to be preferred.

Tools are to be selected approx. 0,5 mm larger than the demanded nominal bore diameter (due to elasticity of the material drillings become closer after treatment). At deep drillings lift the drill several times because of splinter removal.

Drills parallel to layers:

In order to prevent splitting of the material, it is necessary to clamp perpendicularly to the layer direction. Pointed angle of the drill between 100° and 105°. Larger holes if possible pre-drill and then drill from both sides.

Cutting velocity:

Carbide tools: approx. 80 – 100 m/min.

HSS drills: approx. 40 – 70 m/min.

The feed rate is manually.

- Milling

Use carbide tipped milling cutter. Milling of gear wheels made of VOLTIS® cotton cloth laminates is possible also with normal milling cutter, whereby at the outgoing side of the tool a support plate made of wood, paper laminate etc. should be used if possible. Gear wheels can also be milled wet with an emulsion for striking down the milling dust and for cooling. To pare the gear wheels (with cooling agent) is possible also on scraping machines.

Tools	Cutting velocity (m/min.)	Feedrate (mm ⁻¹)
Carbide tipped milling cutter	80 - 120	0,5 - 0,8
HSS- milling cutter	40 - 90	0,5 - 0,8

- Threading

Threads can be cut by hand or on the turning lathe. Use support sharpening devices and thread profile drills for larger threads, thread taps with small allowance and splinter crusher groove for smaller internal threads.

Lubricant: oil, grease, paraffin or wax.

- Planing

The usual planing machines are sufficient for machining. Firm support plates on the steel outgoing side are necessary.

Tools	Cutting velocity (m/min.)	Feedrate (mm ⁻¹)
Carbide	50 - 60	0,4 - 0,8
HSS- steel	10 - 22	0,2 - 0,5

- Rubbing

Reamers with small number of teeth. Chip angle between 5° and 7°. Cutting bevel is so far to be taken off that the cutting velocity is approx.. 30 - 40 m/min.

- Pare

Tools similarly as for brass and cast iron. Doctor blades are to be sharpened and taken off cleanly.

- Grinding

Dry, with belt grinder approx. 270 - 420 m/min. for plate or discus with glued Carbo-all-around paper the peripheral speed is appr. 600 - 1800 m/min. For cooling the sharpening procedure is to be interrupted frequently.

- Polishing

With wobble plates using lightcolored polishing agent. Repolishing and shining with dry wobble plates. Peripheral speed approx. 1500 - 1800 m/min.

- Adherence

Rigid Laminates are perfectly joinable with special adhesive. Usually epoxy based cold and hot curing 2-component adhesives are used. Hot curing adhesives are to be preferred because of the better mechanical strength. Surfaces are to be roughened and degreased. Adherence is to be accomplished after the respective manufacturing specification

- Punching

Rigid Laminates are cold punchable up to 0.5 mm of thickness; paper laminates up to 3 mm and cotton cloth laminates up to 5 mm thickness must be preheated (preliminary heating in steam -, gas- or electricalheated furnaces resp. appropriate infrared ovens).

However in each case a generally constant heat distribution and a good warming up is necessary. The heating up should be constant and unique.

Temperatures depend on materials type and thickness and vary between 60 and 120°C. Materials are sufficient preheated, when they bend softly. At tool engineering the thermal expansion of the Rigid Laminates must be considered. (linear heat extension number: $25 - 30 \times 10^{-6} \text{ K}$)

The distance between stamps and plate is to be kept as close as possible, so that the punching edges of the parts become clean. The stamps must be always sharp and burr-free.

The width of the edges of punching lattice is 2 to 2,5, the web width between the cuts is 1 to 2 of the material thickness.

For close-tolerated parts complete cuts are appropriate, as for bigger quantities progressive dies are to be preferred because of their faster function. For small series and less exact parts cheaper razor cuts are used.