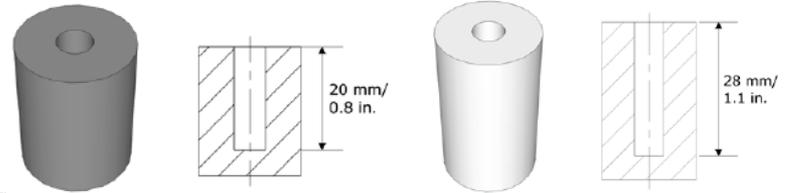


Sleeve adjustment tool

- Available in two versions , with different depths

Use the Sleeve Adjustment tool in order to:

- Ensure correct insertion of milling bit
- Ensure equal bit height when replacing a milling bit
- Safe operation , the sharp part of the milling bit is protected.



Chuck and chuck changing tool

Chuck can be ordered from : <https://store.esko.com/en/store/kongsberg-bits-blades/milling-accessories>

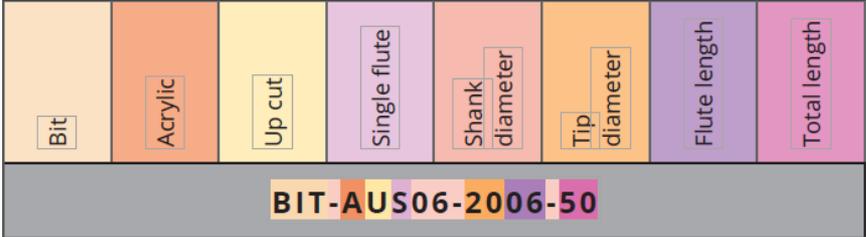
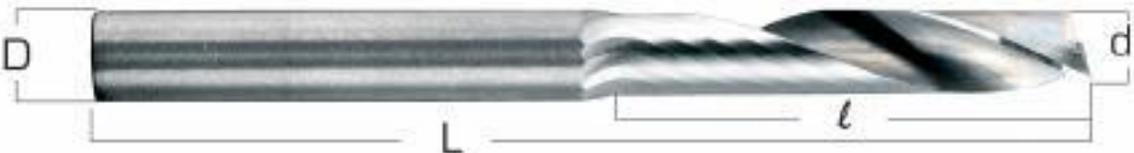
Chucks for HF62



Chuck changing tool HF62 42455642 (12 mm)



Characteristics



Multi Purpose bit

- Can be obtained as Single flute bit , Up and Down cut. (3 and 6mm Shank)
- Multi purpose (MP) Bits have a high wear resistance and are suitable for most materials. It is optimized for durability and longevity
- The Multi purpose bits can be identified by a small tooth at the tip of the bits.
- **Coating:** Special variant of Multi purpose milling bit , coated for better performance in different materials like Aluminium and Ac



Acrylic bit



- Can be obtained as Single flute bit , Up and Down cut. (3 , 6 and 8 mm Shank)
- A bits have cutting edgdes with a very high degree of sharpness and polish for acrylic , plastic ,wood etc.
- Optimized for materials where you really need that clean edge ,since it has a sharper cutting edge then the Multi purpose bit that is more fragile and will threfore wear out faster.

Engraving bit:



- **Engraving** is the practice of incising a design onto a hard, usually flat surface by cutting grooves
- Milling bits for acrylic , other syntetic materials an wood , produces a bottom groove depends on diameter.
- Is being delivered with 6 mm shank

Folding bit:



- Bits that makes groove with a small flat surface in the bottom for better folding.

Diamond Polish bit



- Special milling bit polishing edges of acrylic and similar materials. This bit gives a nice and shiny finishing of your material.
- These bits can be purchased as 6 and 14 mm cutting length and 6mm shank size.
- Acrylic are the most used material and that gives the best optimal result.

Radius Bit

- Special radius bit for rounding outer corners with a given radius.
- It has be designed for trough cut and rounding corner in materials.



Four flute folding bit



- Made for make folding in grey board and similar materials.
- can be obtained in different degrees , 60 , 90,120.

Braille bit



- Bit for use with braille tool. Used for harder materials like aluminium , etc.
- The supplied milling bit is heavily unbalanced and should not be run faster than 20.000 RPM to avoid excessive wear to the milling spindle!
- This also means that you should not use this bit when warming up the milling spindle as the warm up sequence exceeds 20.000rpm.



Multipass

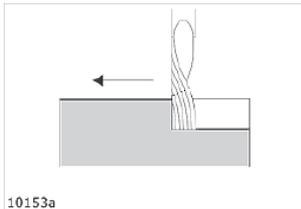
Multiple passes will put less stress in material and create less pulling forces.

Rule of thumb says don't mill deeper than 0.8 - 1,5 diameter size of the bit and defines how much material you can extract per pass.

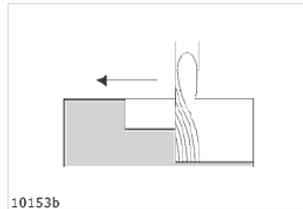
Dense material requires more power and creates more heat, you therefore need to take less material. Low dense material requires less power and creates less heat and you can there for take more material per pass.

Multi pass is also to make sure that there is no waste on the table after you finished your job.

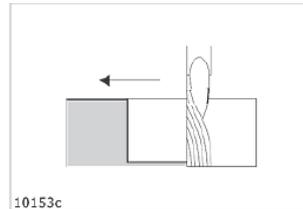
Multi pass milling



10153a
1. pass



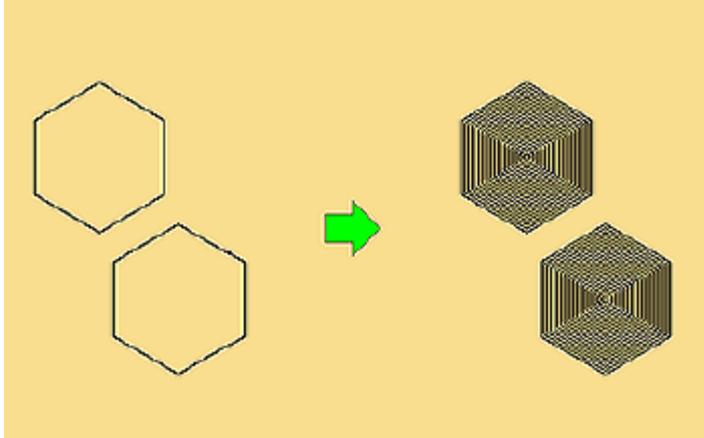
10153b
2. pass



10153c
3. pass - mill through and clean
the path (**Web Thickness**).

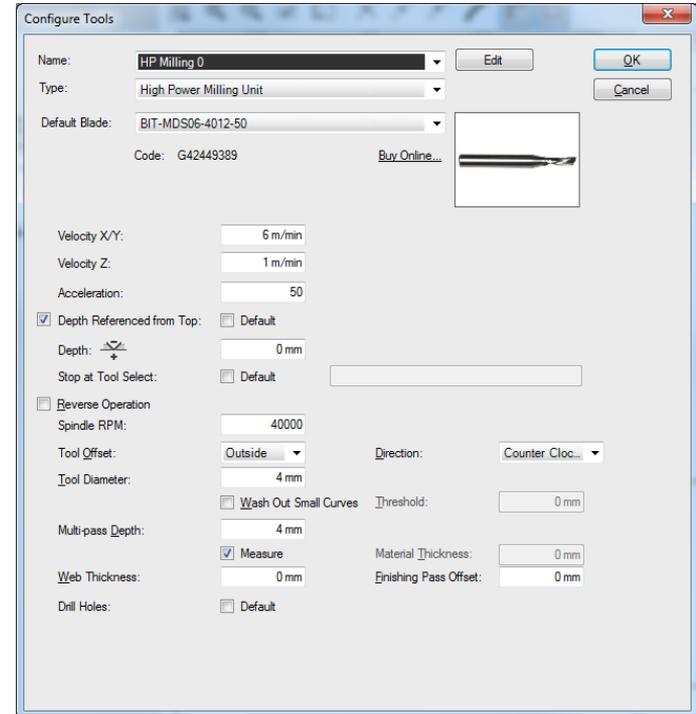
Wash out small curves

- Use this function to wash out all closed curves smaller than the Threshold value
- Use layer type Wash out , designed to millout entire area of a closed curve (see below)



Depth Reference from top

- Useful for engraving milling and partly cut
- Also required if depth in % used



Web thickness

Using a web thickness means leaving a thin web on the bottom of the milling path. This little web will be taken away in an additional and final milling pass.

The values for web thickness should be as small as possible. Advised value is 0,3mm.

Depending on the quality of the underlay, this value might need to be increased slightly.

When should web thickness be used?

You can use web thickness as an additional cleanup pass. Especially when milling materials that create a lot of fine dust (such as MDF)

It should always be used when milling small pieces. That will help to prevent the pieces from moving

It should always be used if the finishing pass is activated.

Finishing pass

Activating the finishing pass will add an extra milling pass while taking away a minimum amount of material from the edge of the sample.

If a material needs to be milled in several passes, a finishing pass might be required to make sure that the different milling steps are not visible on the side of the material.

Using a finishing pass makes sense with very dense materials (such as acrylic)

Advised value is 0,1mm.

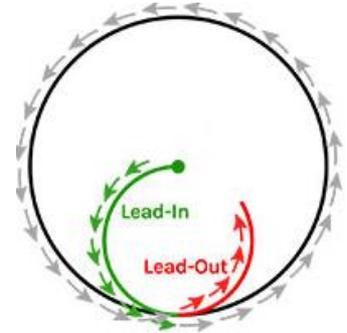
On pieces smaller than 20x20cm a finishing pass should always be used in combination with web thickness to avoid pieces from moving.

Stop at tool select

- Execution will stop when this tool is selected , waiting for operator intervention
- Beneficial when bit change is required during production.

Lead in / Lead out

- Adding Lead-in/Lead-out to a curve opens and extends the curve dynamically at production time so that cutting begins and ends inside or outside the path.
- This is important for routing because the initial plunge into, and final lift out of the material may produce cutting results which are inconsistent with the rest of the part.
- The radius should be large enough to account for the diameter of the Milling Bit



Milling / cutting direction

The Quality of both edges in your milling slot will never be exactly the same. The best result is depending on your material.

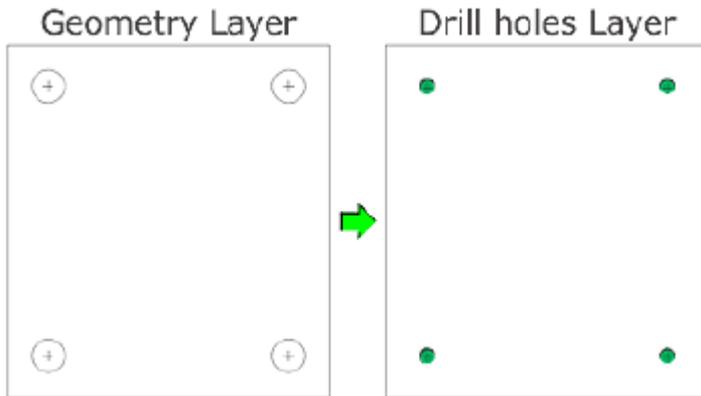
Milling direction can therefore be set to clockwise (CW) or counter clockwise (CCW). In general for most materials, CCW gives the better result for outer curves and CW for inner curves

Measure

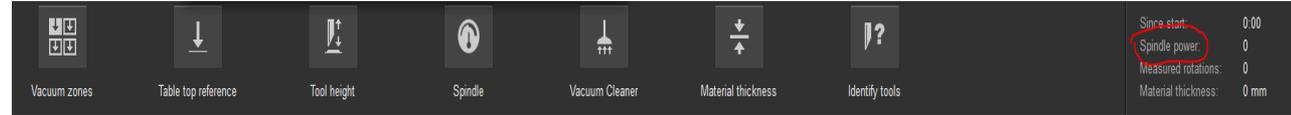
- Specify if the material thickness should be taken from the material thickness measurement performed at the beginning of the job. If not, specify the thickness.
- Material thickness is used when calculating the depth of each pass.

Drill holes

- When you specify that a layer should drill holes , holes will be drilled in center of closed curves
- Geometry (circles) will be covered into holes and drilled.



Spindle power



- Current Milling Spindle power usage , as a %-Value of maximum
- Advantageous to keep track of the value during production , High values or fluctuations may indicate :
 1. Mill bit become worn out
 2. Issues with waste removal
 3. To low Rpm
 4. Slow or to fast Speed X/Y
 5. Issues with vacuum hold down

Selecting the correct bit Diameter

- **The first consideration** you need to take when selection bit diameter is the details you want to achieve. The bit diameter sets the details you can achieve in the inner corners of your job.
- **The second consideration** is the number of passes you will have to perform.
- As a general rule, the depth possible for each pass is equal to 1-1,5 times the bit diameter (material depending, There will be materials where either a smaller or a larger depth step is appropriate.).
- A bigger bit also has a bigger chip removal and will therefore be more productive.
- For material under 5mm or when working with small pieces (job) you should select a small diameter bit. The smaller diameter bits will give less chance for material movement.

Waste removal

- in order to maintain a satisfying production without too many interruptions , it is beneficial to plan and prepare the waste flow , make sure :
 1. Vacuum cleaner is emptied and prepared
 2. Lower the suction house and adjust the reduction valve
 3. No leakage in hoses or obstructions that makes movement or flow difficult or impossible.
 4. Consider to use multipass function if there is any uncertainty about the Mill bit's ability to remove the waste. (especially bit with narrow flute channel)

Vacuum hold down.

- With wrong parameters small curves may move. Typically letters are complicated to cut without them getting shifted and destroyed due to the push-force from the bit.

Check/try following:

- Close unused vacuum zones (if applicable)
- Open the “false air” valve on the vacuum cleaner (to ensure piece isn’t sucked up by the vacuum cleaner force)
- Use web thickness
- Make sure to have the starting point at the end of a straight line, meaning not after a corner.
- Try to reduce the acceleration, as this value is also the “stop speed” too high will give a high push-force from the bit.

Sound & vibration

- Milling is a lot about feeling , sense of hearing is a key element
- Observe the sound when spindle start up:
 1. if the sound got noticeable change in characteristic during accelerating , might be unbalanced bit added or worn bearings
 2. If the sound got noticeable change in characteristic during production , possible case might be vibration due to (a) low Rpm (b) long flute length © high speed (d) worn out bit

Rpm & Speed control

- **Cutting speed (Vel.)**

surface speed or simply *speed* is the speed difference (relative velocity) between the cutting tool and the surface of the workpiece it is operating on.

- **Revolutions per minute (RPM)**

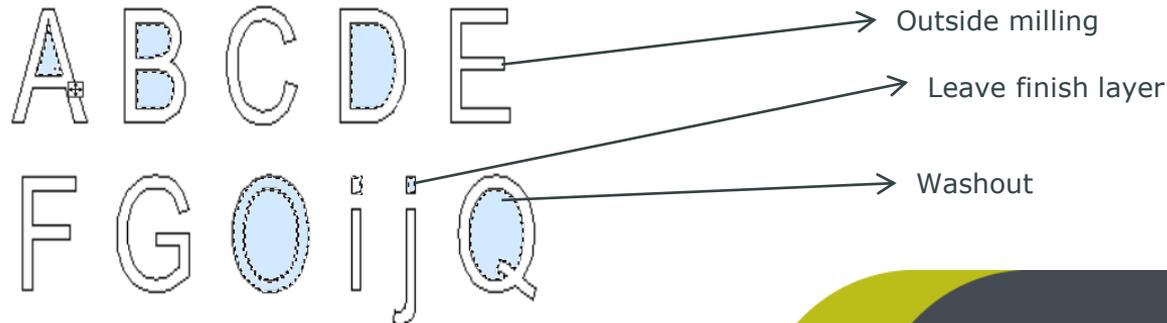
RPM (abbreviated: rev/min, r/min, or $r \cdot \text{min}^{-1}$) is a measure of the frequency of a rotation. It annotates the number of turns completed in one minute around a fixed axis. It is used as a measure of rotational speed of a mechanical component.

- How do operator calculate Speed`s and Rpm`s ?

1. Use provided tooling preset
2. You can rely on sound or feel.
3. The thicker the chip that is sliced away the more heat the chip can be carried away from the bit
4. Melted/Burned material or charred endmill - Lower RPM or Increase your feed speed

Handle small pieces

- close the valve on the vacuum cleaner.
- Use of non slip underlay or application tape underneath.
- The use of web thickness may be beneficial for to prevent the small pieces from moving during milling.
- Edit start and end point (try to avoid end in a curve)
- Be aware that certain areas of the table top has a weaker vacuum due to zone division.
- Outside milling: for details that need not be handled specifically for vacuum .
- Washout: For tiny detail who can clog the hose \ gallow.
- Leave finish layer: Tiny detail especially dot\ apostrophe which may disappear in Extractors



Milling / Cutting direction

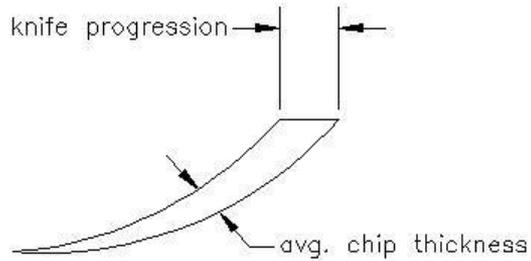
- The Quality of both edges in your milling slot will never be exactly the same. The best result is depending on your material.
- Milling direction can therefore be set to clockwise (CW) or counter clockwise (CCW). In general for most materials, CCW gives the better result for outer curves and CW for inner curves

Define bit durability.

- A technique that can be used is to monitor the bit from when it's brand new with chosen preset until the time when spindle power moves up (which may indicate the bit become blunt /wear) . In order to be able to complete this test, it is required to use same type /batch of material and never change it`s preset.
- The core of this test is and form a picture of future production costs and consumable needs.

Chip load / chip size

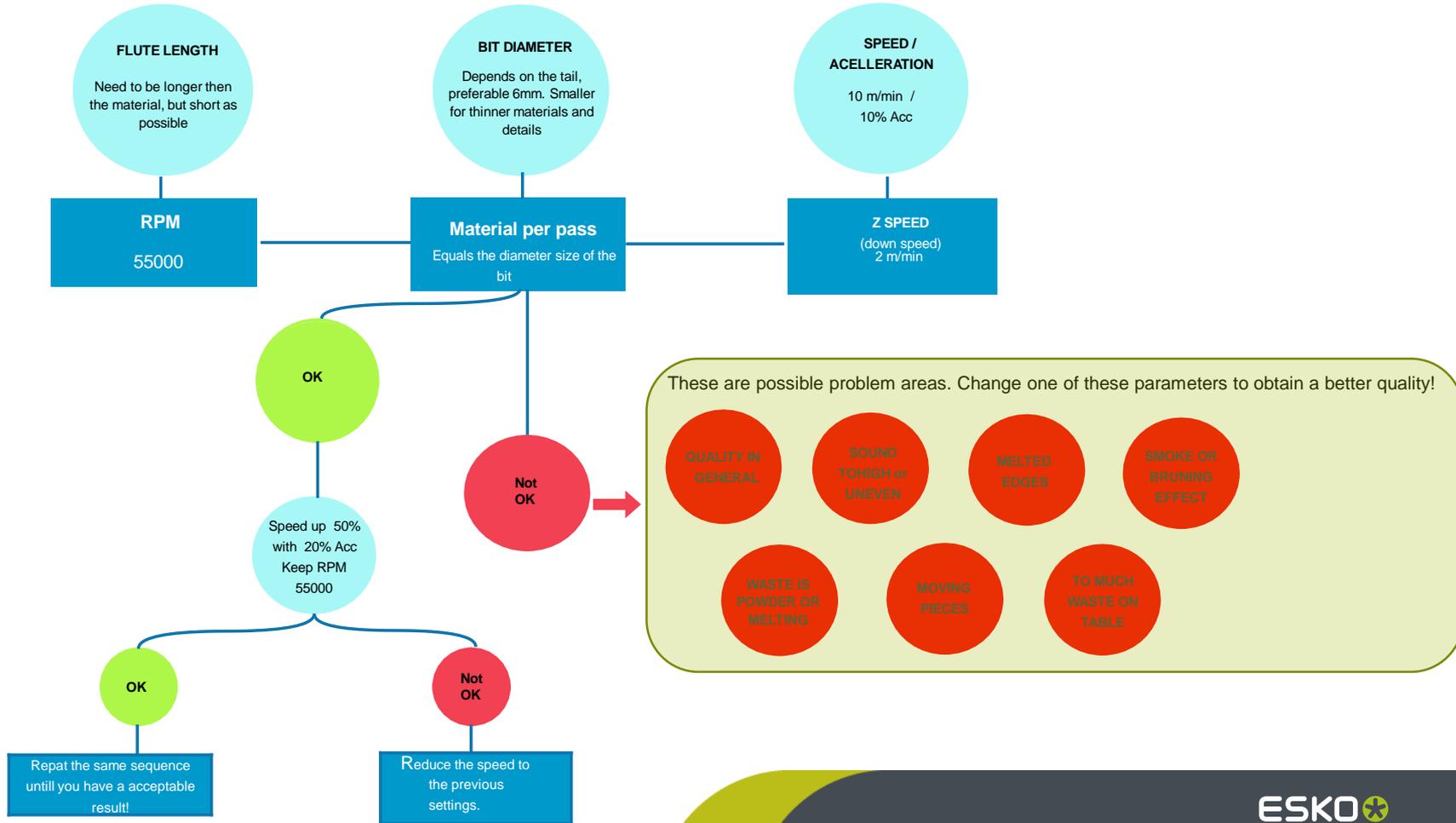
- **Chip Load** or Feed Per Tooth is the theoretical length of material that is fed into each cutting edge as it moves through the work material.



Flute lenght

- To achieve maximum milling precision you need to select the correct flute length suitable for your material thickness.
- The flute length need to be bigger then the material thickness but as short as possible to assure that you can run at the optimal feed rate.
- Selection a too long bit:
 - Could create vibration influencing the edge quality.
 - Vibration will create excessive heat.
 - Vibration will wear out you spindle in the long run
 - Will increase chances of bit breaking or force you to slow down feed rate.
- Select a flute length as close as possible to the thickness of the material you are going to use. A too long bit will create unnecessary vibrations and shorten the spindle lift time
- Flute length should be as close to the material thickness as possible but never shorter then the material.

How to get a good Milling result .



How to get a good Milling result.

QUALITY IN
GENERAL

SOUND
TONGH or
UNEVEN

MELTED
EDGES

SMOKE OR
BRUNING
EFFECT

WASTE IS
POWDER OR
MELTING

MOVING
PIECES

TO MUCH
WASTE ON
TABLE

- The smaller the bit diameter, the smaller the channel created in the material during milling.
- The faster the milling speed the less time the spindle has to clean out the channel.
- The more material you take per milling pass, the more waste gets created.
- When milling small pieces you can open the milling valve to reduce the extraction of the vacuum cleaner



Acrylic

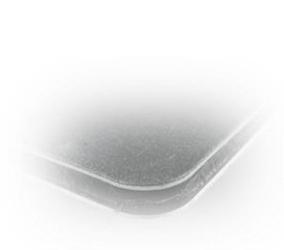
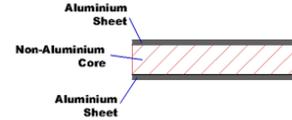
Acrylic sheets have outstanding physical, mechanical, optical, chemical resistant, and thermal properties. Acrylic is sold under different trade names, such as Plexiglas and Perspex and is often used for high-end applications.

Its fantastic properties make it the perfect choice for applications from sign making to glazing, furniture to sculptures. Available in clear and a wide range of colors.

The most common acrylic plastic is polymethyl methacrylate (PMMA), which is sold under the brand names of Plexiglas, Perspex.

Acrylic fibers are synthetic fibers made from a polymer (polyacrylonitrile). Acrylic plastic sheets are formed by a process known as bulk polymerization. In this process, the monomer and catalyst are poured into a mold where the reaction takes place. Two methods of bulk polymerization may be used: batch cell or continuous. Batch cell is the most common because it is simple and is easily adapted for making acrylic sheets in thicknesses from 0.06 to 6.0 inches (0.16-15 cm) and widths from 3 feet (0.9 m).

ACM



Aluminum composite material (ACM) is the ideal product for corporate branding. Can be shaped with milling and folding technique which allows a variety of shapes and design to be manufactured.

ACM is a sandwich material consisting of two thin aluminum sheets bonded to a low density polyethylene core. ACM is commonly used for sign and display applications with 2, 3, or 4 mm thickness.

ACM is a sandwich material consisting of two thin aluminum sheets bonded to a low density plastic core.

Be aware that ACM (aluminum composite material) comes in a large range of different qualities and our experience is that most of them can be milled successfully with our equipment, very often you can improve the feed rate and life length of the bit by using the LubriCool (option) function on the router head.

We have also experienced that some qualities are really difficult to mill, hence if doubt you should always get the material tested.

Aluminium



- Aluminum is a lightweight, durable, and corrosion-resistant metal that is electrically conductive. It comes in a vast number of different alloys, each with different physical and thermal properties. Some of these alloys are easily cast, wrought, machined, or extruded. Other alloys are extremely strong, ductile, or resistant to stress cracking. The most commonly used, general-purpose alloy is 6061 aluminum, and it's our favorite alloy for milling because it's a great blend of strength and machinability. It's strong enough to be used for many applications but soft enough to mill
- If you want a metal sign, an Aluminum sign is the perfect choice. High quality, long durability and are perfect as outdoor signs.
- Text and image are printed digitally, and the sign is given a final coating of UV-protective laminate. Aluminum signs are available in a reflective option, which is perfect for use as road signs.
- Aluminum signs can be fixed to a wall or other flat surface using a screw, standoff or adhesive tape.

MDF

Medium density fiberboard (MDF) is an engineered wood product made by breaking down hardwood or softwood residuals into wood fibers, often in a defibrator, combining it with wax and a resin binder, and forming panels by applying high temperature and pressure.

MDF is generally denser than plywood. It is made up of separated fibers but can be used as a building material similar in application to plywood.

Speed and feedrate : apparently low speed and feedrate due to heat and waste issues
(25000-27000 rpm vel. 5-10 m/min)

MDF is made from wood fibers. Those would be tiny pieces of hardwood or softwood. These is mixed with some resin and wax, then heated up and pressed it together - MDF.



Wood



Wood is an anisotropic material, which means that it has different properties in different directions. For example, wood is considerably stronger in the direction of the fibers, i.e. following the length of the stem, than at right angles, across the grain. This is the case whether the load is caused by compression, tension or bending stresses in the wood.

The strength is also affected by the moisture in the wood, its temperature and the period under which it is stressed. A dry piece of wood is stronger than one with more moisture, and colder wood is stronger than warmer wood. The longer wood is placed under stress, the more its strength reduces.

Solid wood : Solid wood means that it is composed of wood with no particle board or wood fiber. It's the resulting board milled from the tree. Au naturel

Different Wood material



Plywood is a sheet material manufactured from thin layers or "plies" of wood veneer that are glued together with adjacent layers having their wood grain
Good quality plywood can be detected if internal knots have been punched out and filled with a birch plug.

Other hardwood material:

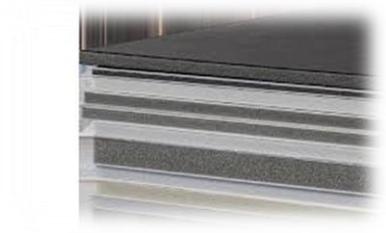
1. Wenge
2. Sapele
3. Mahogany
4. Sycamore
5. Amazakoue
6. Jatoba
7. Oak

Sandwich Material (paper core board)

Paper core board is a natural fiber-based board consisting of a recycled Kraft core sandwiched between printable white Kraft liners.

The unique fluted core enables a Paper core board sheet to be rapidly cut into any conceivable shape. Can be digitally printed or finished with decorative laminates to achieve stunning results.

The material is light weight, durable, clean and is not affected by moisture. The sheets are produced through extrusion of polypropylene plastics. The material is available in several thicknesses and weights. The material is especially suitable for re use and in return systems.



Foamed PVC



High-quality light weighed rigid foam sheets with excellent printing quality for a variety of applications in the field of visual communication.

The material is primarily used in the manufacturing of signs and displays which are used for promotion ads, as well as road signs.

Often white, slightly expanded closed-cell rigid PVC sheet material with a particularly fine and homogeneous cell structure and silky matt surfaces.

Polyvinyl chloride (PVC) and polyurea are mixed and molded together under controlled conditions.

The mixture of Polyvinyl chloride and polyurea has a good bond strength. Closed-cell PVC foam takes solid shape due to its linear structure.

Foam

Foam is an integral part of many packaging solutions to protect the product from vibration, shaking and dropping damages.

Every package that is transported will be subject to vibration of some sort, certain products are more sensitive to vibration than others.

- › Polyurethane (PU): It is an open celled foam used to protect light weight fragile items. Difficult to convert
- › Polyethylene (PE): Closed cells, easy to convert and often used as insert packaging to protects products against surface damage during shipping
- › Polystyrene (EPS): Closed cells but can have a tendency to melt. This type of foam is usually used to protect electronics and small appliances for products that are less fragile
- › Extruded polystyrene foam (XPS): Solid polystyrene crystals. Used for packaging protections of high value, high fragility products



Fretting

Fretting refers to wear and sometimes corrosion damage at the asperities of contact surfaces. This damage is induced under load and in the presence of repeated relative surface motion, as induced for example by vibration. The ASM Handbook on Fatigue and Fracture defines fretting as: "A special wear process that occurs at the contact area between two materials under load and subject to minute relative motion by vibration or some other force." Fretting tangibly downgrades the surface layer quality producing increased surface roughness and micropits; which reduces the fatigue strength of the components.

The amplitude of the relative sliding motion is often in the order from micrometers to millimeters, but can be as low as 3 to 4 nanometers.[1]

The contact movement causes mechanical wear and material transfer at the surface, often followed by oxidation of both the metallic debris and the freshly exposed metallic surfaces. Because the oxidized debris is usually much harder than the surfaces from which it came, it often acts as an abrasive agent that increases the rate of both fretting and a mechanical wear called false brinelling.