FLAME

FURNITURE AND LANGUAGE
INNOVATIVE INTEGRATED LEARNING
FOR SECTOR ATTRACTIVENESS
AND MOBILITY ENHANCEMENT

Module 4

Machines and tools

FLAME

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Module 4
Machines and tools

AIM OF THE UNIT

The aim of this Unit is to explain certain aspects of the cutting process. The unit describes handheld machines and tools, as well as line production machines and tools. Information about basic maintenance completes the Unit. The main machining/working properties of the materials to be cut, wood and wood-based panels that influence processing, are clarified at the beginning.

LEARNING OUTCOMES

Knowledge
cutting and sharpening techniques
manual tools
woodworking machines
basic maintenance

Skills
using and carrying out basic tool and equipment maintenance
applying fluid and solid coatings with manual tools
choosing machines for technological tasks

LEARNING PLAN

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ESCO PROFILES

7522 – Cabinet-makers and related workers
7523 – Woodworking-machine tool setters and operators
7534 - Upholsterers and related workers
8172 – Wood processing plant operators
2141 – Maintenance & repair engineers (machinery maintenance and repair workers)
9329 – Factory hands – manufacturing labourers not elsewhere classified

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Unit 4.1

Materials intended to be processed in furniture production

EDUCATIONAL APPROACH


Course book


Additional readings


External links


Exercises and games

CONTENT

Solid wood materials 5
Wood based materials 6

ASSESSMENT


Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.24 total of the module

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Unit 4.1 Materials intended to be processed in furniture production

This Unit discusses materials intended *to be processed in furniture production*. These materials are divided into two groups:

- Solid wood materials
- Wood-based materials

Solid wood materials intended to be processed in furniture production are obtained by machining trunks and their smaller parts. The dimensions of the materials depend on the subsequent production of final products. The final materials used in production must be dried before they are used.

Wood-based materials (wood deliverables) are produced by gluing wood elements together. Wood elements supposed to be glued have different sizes and shapes. The materials obtained from them differ in physical and mechanical properties. Generally speaking, they can have different applications or the same ones as in furniture production.

Solid wood materials

There are two groups of solid wood species:

- **Softwood (1)**
- Hardwood

Further, hardwood species are divided into:

- **diffuse porous (2)**
- **ring porous (3)**

Diffuse porous wood types have various shaped vessels situated throughout the trunk. Ring porous types usually have large vessels, which are formed at the start of the growing season.

Softwood (coniferous) species have needles, and hardwood (deciduous) species have leaves. They are very different in structure, as well as physical and mechanical properties. Some of them are characterised by having just sapwood and some are characterised by having the trunk divided into: sapwood and heartwood. Sapwood conveys water with mineral salts and collects backup substances. This is the outer layer of the trunk if the tree has a heartwood. Heartwood is the inner part of a log, which does not have living cells, does not fulfil physiological functions and does not transport water.

Wood is a natural composite built mainly of thin fibres or tracheids laid along the trunk. This divides wood into three basic anatomical directions: longitudinal, tangential, and radial. Wood differs in its physical and mechanical properties along these directions. This has very important differences in terms of the resistance during machining, the form of the chips and the final surface quality. Hence, three cutting directions can be distinguished: longitudinal, perpendicular, and tangential. We obtain different surfaces depending on the direction in which we cut the wood. These surfaces have different forms. This is especially important for furniture design.

Wood is sensitive to water. It shrinks or swells when exposed to water. However, it does so to different degrees depending on the anatomical direction. This is very important for processing in furniture production.

Due to the "natural" characteristics of the wood, wood is a difficult material to predict. Certain features may suggest its properties, but it cannot be a basis to characterise wood as a construction material. We can highlight the following defects in wood: **warping (4)**, twist and cheeks, **spoilt or loose knots (5)**, irregular shape, resin canals and red/false heartwood.

Wood-based materials

Wood-based materials are produced by gluing elements together: small boards/planks, veneers, flakes/strands, particles, and fibres. Different wood-based materials are produced by gluing these elements together. They usually have the shape of a board, that is why wood-based materials are called wood-based panels or simply panels.

The wood-based elements glued together can form:

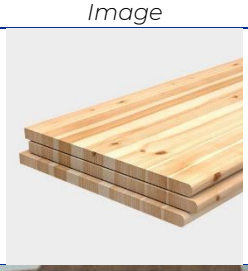
- Small boards/planks ► block boards – block boards can be produced just in the shape of furniture boards (6) or **covered with other materials (7)**. If they are produced only from wooden elements, the wood to be applied must have very good quality as it will be visible. To produce block boards (laminated block boards), lower quality wood can be applied as the block will be covered with other materials with a more appealing aesthetic.

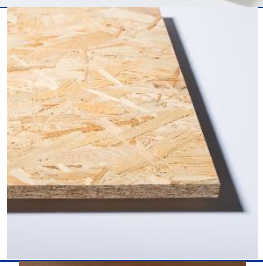
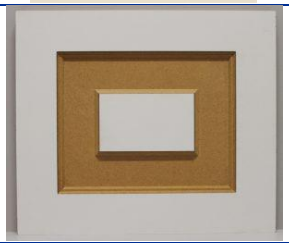
- Veneers ► **plywood (8)** – plywood is produced when uneven numbers of veneers are glued together. The veneers are thus arranged with successive layers of fibres at right angles. In principle, all wood species can be used to produce plywood. If mixed species are used, they must be arranged symmetrically from the centre of the board.

- Flakes/strands ► **Oriented Strands Boards (OSB)(9)** and OSB-like Flakeboards – these boards are made of long, flat small wooden chips. There are various types of these panels. They are typically used in construction. In furniture production they are used to manufacture upholstery furniture. However, in new designs they are used as a basic decorative material in furniture making.

- Particles ► **particleboards (10)** – this is the most popular material in furniture production. Its popularity is due to its low price, of course, compared to others wood-based materials. The low price is due to the fact that it is produced from the lowest quality wood or recycled materials. Hence particleboards are of very low quality. This makes them difficult to use in order to manufacture furniture. They also limit the design of furniture. They must be refined with materials to cover them.

- Fibres ► fibreboards – fibreboards are very popular in furniture production especially for profiling the furniture parts. The most popular way to apply shaped furniture parts is in furniture front manufacturing, especially fronts for kitchen furniture. For this purpose **medium density fibreboards (MDF) (11)** are used. **High-density fibreboards (HDF) (12)** are another kind of fibreboard widely used in furniture production. They are usually applied to produce the bottom part of drawers or the rear panels of chests (box, body).

SOLID WOOD MATERIALS		
Keyword	*Description*	*Image*
(1) Softwood	Pine wood (*Pinus sylvestris*)	
(2) Diffuse porous hardwood	Beech wood (*Fagus sylvatica* L.)	
(3) Ring porous hardwood	Oak (*Quercus* L.)	
(4) Wood warping	This is a deviation from flatness of wood as a result of asymmetrical stress and uneven shrinkage	
(5) Wood knot	Spoiled wood and loose knot in pine wood	
WOOD BASED MATERIALS		
Keyword	*Description*	*Image*
(6) Furniture boards	High-quality wooden elements glued together.	
(7) Block boards (laminated block boards)	Low-quality wooden elements glued together then covered with MDF, HDF or plywood, for example.	

(8) Plywood	Uneven number of veneers glued together at a right angle	
(9) Oriented strand board (OSB)	These boards are made of long, flat small wooden chips.	
(10) Particleboard	Three layers particleboard covered with a decorative layer.	
(11) Medium density fibreboard (MDF)	Shaped furniture front	
(12) High density fibreboard (HDF)	Bottom part of drawers	

Unit 4.2
Handheld machines

EDUCATIONAL APPROACH


Course book


Additional readings


External links


Exercises and games

ASSESSMENT


Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.24 total of the module

CONTENT

Handheld machines 10

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Unit 4.2 Handheld machines

Handheld machines

Handheld machines, commonly known as power tools, are designed to be operated by hand as they are not stationary. These can be with a cord or cordless (battery powered), for the woodworking industry and for DIY woodworking. Electric units are typically used, except for in rooms where there is an increased risk of explosion (due to dust, solvents etc.). These tools are not typically used in the main production chain, but are widely used for in situ adjustments and manufacturing, like kitchen furnishing, fittings, wall panels etc.

- The basic power tool, used for cutting and grooving lumber and panel, is the circular saw, called a **track saw (13)** when equipped with a linear guide. This saw is usually used with a variety of saw blades, most commonly with a rip blade, crosscut blade and panel blade (for plywood, chipboard, etc.).

- For angular crosscuts, the best solution is **mitre saw (14)**. The mitre saw is usually provided with two indexes, which allow for accurate adjustments of both the horizontal and vertical cutting angles, along with the depth of cut. This tool is typically used to cut angles at 90, 60, 45 and 30 degrees, however one can use any within the range of 0-90 degrees. The most commonly used saw blades are those to crosscut wood, metal, and plastic.

- **Jigsaws (15)** are another kind of saw. This saw is used for cross-cuts, bevel, mitre, and plunging cuts and scrolling curved cuts in various materials, but the main aim is to cut shapes, as these saw are hand driven. The most commonly used saw blades used are offered in a wide variety, for metal, wood, composites and for softer materials and the blades are easily interchangeable.

- The **planer (16)** is used to smooth the surface of the wood, and to reduce the thickness of the material. With low cutting depth planers might be also used to smooth rough grain or eliminate saw marks. Sometimes, in construction work, planers are also used for tapering wood and as a jointer. Usually planers have two to four rotating blades on its base. The blades are usually for wood only and are made of high-speed steel, however tungsten carbide blades for high-density hardwoods are also available.

- **Belt sanders (17)** are typically used for rough sanding, in order to remove larger amounts of material. The tool is typically constructed without any type of limiter, as such it requires skill to operate as the guidance and pressure are provided by hand. Some belt sanders can be mounted upside-down. In this case, the element to be sanded is moved over the belt. Typically belt sanders are used only for very rough surfaces and especially in construction works to level surfaces, as well as for shaping and rounding.

- **A disc sander (18)**, sometimes called an orbital sander, uses a round (or square in the case of orbital sanders) foot with a sheet of sandpaper moving in an orbital motion. These sanders are used for light sanding, finishing sanding, prepping for paint and renovation work. Sometimes these power tools are called finish sanders, due to their applications.

- One of the most versatile portable tools is a **router (19)**, mainly due to vast number of router bit types and application possibilities. The main application is to rout holes or

grooves in material, also plane or profile edges and numerous other applications, especially in cabinet making.

- The most popular tool, present in any production environment or household, is a **drill (20)**. This tool comes in both cordless and cord varieties, depending on the power required for the current job. This power tool operates with an electric motor and spins the chuck with mounted drill bits or almost any other equipment such as screwdriver bits or nut adapters.

- Joinery tasks in power tools are often made with the most capable tool in this matter – a **biscuit joiner (21)**. The uses of this machine range from joining two pieces of wood together, up to quite complex tasks. These machines are nowadays replacing mortise and tenon joints, due to their simplicity and accuracy. This tool offers a nearly unlimited number of types available on the market, however they all have similar applications.

HANDHELD MACHINES		
Keyword	*Description*	*Image*
(13) Track saw	Handheld saw used for straight, rip and bevel cuts. It can be used in guided or manual mode	
(14) Mitre saw	The mitre saw is used for making crosscuts, straight and at angles, thanks to the saw mounted on a swing and pivot arm	
(15) Jigsaw	Power tool used to make shape and bevel cuts	

(16) Planer	A planer is a handheld power tool for surface planing (or thicknessing) of wood	
(17) Belt sander	Belt sanders are used for shaping and rough finishing of wood	
(18) Disc sander	Disc sanders are used for finishing wood before painting or sanding the paint itself	

(19) Router	Routers are used mostly to rout grooves or holes in solid material; however their application is almost limitless	
(20) Drill	Drills are most commonly used for drilling and turning screws or nuts at the assembly stage	
(21) Biscuit joiner	A biscuit joiner is a fast and accurate replacement for a manually made mortise and tenon joint.	

Unit 4.3

Tools for handheld machines

EDUCATIONAL APPROACH


Course book


Additional readings


External links


Exercises and games

ASSESSMENT


Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.24 total of the module

CONTENT

Tools for handheld machines 16

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Unit 4.3 Tools for handheld machines

Tools for handheld machines

Tools for handheld machines (so called power tools) need to be especially easy to change. They can be reusable or single use. Single-use tools are rather cheap. So, it would not be worthwhile to sharpen them. The sharpening process requires several operations including: cleaning, mounting, and setting the sharpener, in addition to time and labour costs. Single-use tools are for manufacturers who would like to keep constant product dimensions. If they are symmetric they can be reversible. Tools for handheld machines are made of high-speed steel (HSS) or carbides.

Handheld tools have mandatory markings. These markings relate to product certifications, personal protection and usage parameters. Product certification markings address the danger of electric shock or fire, as well as the quality of the product itself. Personal protection is primarily about protecting the eyes and ears, as well as breathing. The description of the parameters is primarily information about the tool's materials and geometry as well as the values of the maximum processing parameters that can be used. Due to globalisation, the descriptions are often available in several languages.

There are various handheld machines, which are more or less widely used in production. There are standard productions with popular handheld machines or rare specific productions with specialised machines. Tools are divided into three groups:

- those that cut in the gap forming a kerf, hence the length of the cutting edge is shorter than the length of the material being cut
- those that form the surface of materials; their cutting edge length is greater than the width of the material being cut,
- sandpaper.

There include: circular saws, jigsaws, biscuit joiner, drills, lathe knifes, planer blades and router bits. Sandpaper forms a separate group.

Below we present more information about the most commonly used tools. Other tools of similar construction are likewise marked and used:

- **Circular saw (22)**
  Circular saws are used to divide materials into two elements. They are used for straight cuts. They have three cutting edges: one main edge and two side cutting edges. The two side cutting edges are responsible for the quality how the wood is processed. The main cutting edge is responsible for selecting the material from the front of the saw to form a kerf. Circular saws for handheld machines have a **feed limiter (23)**, except for the cutting teeth. The feed limiter is positioned lower than the main cutting edge. Hence, its radius of rotation is smaller than the radius of rotation of the main cutting edge. There is about a 1.5 mm difference in height of the main cutting edge and the feed limiter. This is the maximum feed per tooth value. Therefore, the machine tool operator cannot increase the feed speed. This is for the operator's own safety.
  There are standard safety markings on the circular saw. Personal protection is about protecting your eyes and ears as well as breathing. The description of the parameters concerns: the tool's material, the number of teeth, the geometry of the teeth, the maximum rotation speed in revolutions per minute, the circular saw diameter, the diameter of the clamping hole on the spindle and the product certifications. Circular saw teeth are sharpened from the rake and clearance faces.

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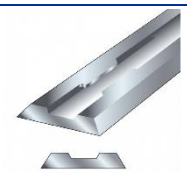
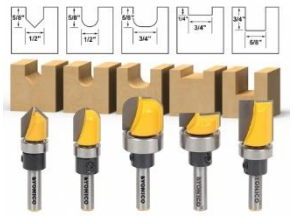
- Electric planer knifes
  There are hand planers and electric planers. Nowadays, electric planers are more popular. Electric planers are quicker, easier to set up and do not require much experience. That is why **blades (24)** for electric planers are available. There are reusable, **reversible (25)** and single-use blades. Reusable blades (25) and single-use blades have similar shape. They are strait with one cutting edge. Reusable blades are sharpened on the clearance face side. Reversible planer blades are becoming more and more popular. They are similar to single-use one-edge blades. Their advantage is of course two blades instead of one. They can be easily reversed by turning the blade over.

- **Router bits (26)**
  Router bits (milling cutters) have the largest variety of shapes among these tools. They are used to create profiles/amazing shapes on furniture elements. Anything that can be imagined can be designed. Router bits can have a single blade or can be multi-blade. They are sharpened from the rake face.

- Drills
  Drills are used to drill holes in the materials. Regardless of the shape of the tool with its blades, the effect will always be the same. The drill processing mechanism is similar to the router bit processing mechanism for the router bits that only work along the axis. We can distinguish between solid wood and block board drills for longitudinal and cross drilling. There are three main drill shapes: **cylindrical (27)**, mostly for hinges, **flat (28)**, and **step machining (29)** for stable machining. They have different builds but they have the same purpose or very similar ones.

- Sandpaper
  There are **disk (30)**, rectangular, **belt (31)** or **special shapes (32)** of sandpapers. Disk and rectangular sandpapers are intended tools for handheld machines. Apart from sand belts, sand papers are fastened with Velcro. This is the quickest way to change paper. Granularity is most often classified as thick (40-60), medium (80-120), fine (150-180), very fine (220-240) and super fine (from 280 and above).

TOOLS FOR HANDHELD MACHINES		
Keyword	*Description*	*Image*
(22) Circular saw	Circular saw with a feed limiter.	
(23) Feed limiter	Difference in the height of the main cutting edge and feed limiter.	
(24) Cutting edge blades	Single cutting edge blades	
(25) Reversible planer blade	By turning the blade, both sides can be used without sharpening	
(26) Router bits	Variety of shapes	
	Router bits and examples of machining effects	

(27) Cylindrical drill	Face drill	
		
	Drill for hinges	
(28) Flat drill	For large diameter drilling	
(29) Drill for step machining	This process makes the hole even	
(30) Disk sandpaper	Used for simple and oscillating sanders	
(31) Belt sandpaper	Used for flat sanding	
(32) Shaped sandpaper	Enables angles to be sanded	

Unit 4.4

Line production machines

EDUCATIONAL APPROACH


Course book


Additional readings


External links


Exercises and games

ASSESSMENT


Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

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Credits / 0.24 total of the module

CONTENT

Line production machines 21

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Unit 4.4 Line production machines

Line production machines

The typical wood used in the furniture includes various species of hardwoods, chipboard and fibreboard. Usually, in the case of wood, the material that enters the factory is comprised of simple boards, with random dimensions. These boards need to be edged and cut into the number of correctly sized pieces needed with the right dimensions. The initial process involving edging and cutting into length and width takes place in the rough mill.

- The first operation, usually done at the rough mill, involves cutting off all the possible wood defects which could affect the final material quality such as knots, checks, splits, decay, etc. This is done in the production line with an **optimising saw (33)**, also called cross-cut saw or cut-off saw. This is usually done manually, as the operator needs to judge whether the current defect needs to be cut off. This saw has other applications, including simply cutting the wood to length, which can be done automatically.

- After the optimising saw, the wood is usually cut into the required dimensions using a panel saw, either a **universal (34)** or **specialised panel saw (35)**. Wood panels are cut into the required sheets. Panel saws can have one main saw blade, but they are provided with a second scoring blade among with the main one to cut wood-based. The scoring blade is used to make grooves in the laminated boards and plywoods in order to provide chipping. For solid woods, smaller sliding table saws are typically used, due to the variable raw material sizes.

- For wood, in order to prepare for straightening, plane to thickness and profile elements for furniture or other framework, there is no substitute for the **four-sided planer (36)**. These are feed-through machines with 4 to 12 spindles in a row for the four-sided processing of workpieces through planing, cutting, moulding, etc.

- The most versatile machine used in the manufacturing process is the **CNC mill (37)**. These machines can be used for sawing (nesting), milling, drilling, edge finishing, 3D machining and even sanding, depending on the specialised aggregates or tools mounted. The trade-off for such versatility is relatively low efficiency, which causes these machines to be applied only for special operation that are not possible in high-yield machines.

- In the panel furniture production process, one of the most important pieces of equipment is the **edgebanding machine (38)**. As wood-based panels for furniture are usually laminated and finished on the sides, this machine combines multiple operations to finish also the edges in a single run. These operations are cut to size, while the edge is milled, glue is applied, the edge band is sometimes heated by laser, the edge band is pressed on the board, the excess band is milled, the radius is applied, and the edge is scraped, flushed and buffed. After these preparations the undrilled panels are ready for packaging.

- In order to process double-sided workpieces, especially for profiling post-forming profiles, groove-tongue connections, tongue-mortise and other type of tenons, **Double-(39) or single-end tenoners** are used. As in the previous case, these can be equipped with cut-off saws, boring drills, milling, scoring and even sanding aggregates, in order to make a machined part ready for assembly.

- The **drilling and fitting-inserting machine (40)** for factory-assembled furniture consists of three main aggregates: a multiple-spindle drill, a glue injection device and a dowel insertion device. This combination provides unparalleled efficiency in pre-assembly processing. This machine can be replaced with a unit mounted on the CNC mill, as a separate aggregate, which has a dowel magazine and a glue injector and inserts the dowels after machining the faces/edges.

- For unfinished wood or panel-product, a machine to sand the surfaces of the flat workpieces must be used. Depending on the configuration, **wide belt sanders (41)** can be equipped with multiple grit sand belts, sanding pads, cross-belts, brushing units, and even a planing spindle to initially plane the surfaces.

- For painted products, **painting machines (42)** are used as the most efficient option for all processes. Depending on the type, painting machines can utilise curtain lacquering unit, or, more commonly, spray nozzles, occasionally combined with electrostatic effect to reduce waste. Workpieces can be coated as a pass-thru, or additional robotic CNC units are used in the case of more complex workpieces.

- For assembly procedures, finished workpieces are manually made into the final product. When greater efficiency and accuracy is needed, the pieces are assembled in **clamping machines (43)**. These units usually provide numerous pneumatic or hydraulic clamps, which allow the product to be properly positioned, with straight edges and angles, when assembling the furniture. For flat pieces, such as windows, the assembly or clamp tables are used, instead of frame or box tables.

LINE PRODUCTION MACHINES		
Keyword	*Description*	*Image*
(33) Optimising saw	Machine used for cutting off wood defects from the rough lumber, also used for cutting to length	
(34) Sliding table saw	Sliding table with manually operated saws used for individual panels or to cut solid wood to size.	
(35) Panel saw	Panel saws are used to cut panel products into correctly-sized parts.	
(36) Four-side planer	Machines with multiple spindles in a row for the four-sided processing of wood through planing, cutting, moulding.	
(37) CNC mill	The most versatile mill, which features numerical control for almost any machining operation	

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(38) Edgebanding machine	Edgebanding machines are used for sizing and edgebanding panel products with plastic or natural edges	
(39) Double end tenoner	This machine provides longitudinal and crosswise process cutting, sizing, profiling, rabbeting and grooving of the panel product	
(40) Drilling and fitting-inserting machine	Device to drill, inject glue and insert dowels (or any other fittings) into the drilled holes.	
(41) Wide belt sander	Sanding machines are used to sand of wide surfaces, as preparation for finishing, such as lamination or painting	
(42) Painting machine	Painting machines and robots are used for priming and coating furniture and window-door elements.	

(43) Clamping machine	Clamping machines are used to provide the final form of cabinets, providing the proper assembly force and the correct alignment	

Unit 4.5

Line production tools

EDUCATIONAL APPROACH


Course book


Additional readings


External links


Exercises and games

ASSESSMENT


Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.24 total of the module

CONTENT

Line production tools 27

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Unit 4.5 Line production tools

Line production tools

Line production tools have slightly different constrictions than tools for handheld machines, although the mechanisms of the working process are the same. The main differences are related to security and process parameters, as well as process settings:

- When processing on line production machines, employees must be away from the machining site, even though the life and wellbeing of the employee are not directly at risk. The machines feature alarm systems that will stop the entire line if the employee approaches the machining area.

- The process parameters on line production systems are of course much higher. Nowadays, feeding and rotation speeds can have almost no limits. There are milling machines which have feeding speeds in the range of 300 m/min. In this case, the problem is that the tools cannot withstand these process parameters.

- Even if an employee has a firm hold on a handheld machine on top of stable elements, the machine will not be considered fully fixed to the ground. Production machines are equipped with systems and clamps to ensure the complete stability of the tools and workpieces, regardless of whether they are stationary or moving.

Line production tools are made of high-speed steel (HSS), carbides and diamonds.

The main differences of line production tools and tools for handheld machines are:

- Circular saws
  Laminates, chipboards and MDF are the most popular materials in chest furniture production. They are covered with very hard but fragile layers. That is why **two circular saws (44)** are required to cut them. Therefore, there is a main **circular saw (45)** as well as a **scoring saw blade (46)**. Main saw has got group of teeth. One is conically shape and the second has a straight main cutting edge. The conical teeth are higher than those with straight cutting edges. This means that conic shaped teeth act first in the process, then the teeth with a straight cutting edge finish the work. The conic shaped teeth remove the material cut from the kerf. The teeth with straight cutting edges create the quality of the elements being cut.

  If the main saw contacts the underside of the laminate, the laminate will break. Therefore, this part of the panel should be processed first so that there is no contact. This is task for scoring saw. A scoring saw cut with feet (CWF) in opposite to the main saw that cut against feet (CAF). The scoring saw has a smaller diameter because it cuts a few millimetres of material, just laminate and a little bit of the panel. The scoring saw kerf width is slightly wider than the kerf of the main saw. This ensures that the main saw does not touch the bottom layer of the laminate. This means that the kerf width settings of the scoring saw must be very accurate. There are two methods to ensure this. One method is related to the conical teeth of the scoring saw. By adjusting the height of the saw, the width of the cut kerf can be accurately determined.

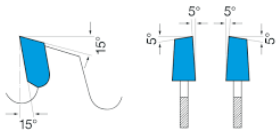
  The second way is to adjust the spacing of the two saws that make up one scoring saw. This build of scoring saw has alternate teeth.

- Planer knives
  Generally speaking, strait cutting edge planer knives for line production machines are very similar to electric planer knives. The differences appear in the planer knives for line production when the cutting knife is not positioned straight along the entire head. The basic example is a head with a **spiral cutting edge (47)**. In this case the knife is created with a number of small carbide tips. These tips have four cutting edges. Rotating them 90 degrees provides the possibility to have 4 new sharp cutting edges without sharpening.

- **Milling cutter (48)**
  There are various types of milling cutters. We can distinguish milling cutters with strait teeth, slot or face milling cutters. These differ primarily in the shape of the teeth, their position, how they are attached, as well as the method of work. Face milling cutters act along a spindle, but other cutters act perpendicularly to the spindle. Milling cutters are made of one material or separate cutting knives are mounted on the head. They can be single use or can be sharpened for re-use. They are usually sharpened on the rake face.

- **Bandsaw blades (49)**
  Handheld bandsaws are rarely used. They are very difficult to use and have few applications. The bandsaw blade is mounted between two rotating wheels, one of which moves forward. It has the form of an endless tape. This saw is used for cutting straight lines, but also curves. Bandsaw blades are sharpened from the rake and clearance faces.

- **Sandpaper (50)**
  Sandpapers for line production machines in form of disks or belts are larger than those used in smaller machines. The main differences involve grinding heads. They can be used for strait or profile grinding.

LINE PRODUCTION TOOLS		
Keyword	*Description*	*Image*
(44) Cutting set	This includes a main panel saw and a scoring saw blade	
(45) Main circular saw	This saw is called a main saw to cut laminates, chipboards and MDF	
(46) Scoring saw blade	This scoring saw blade has teeth in conical from	
	Alternating top bevel teeth of the scoring saw blade	
(47) Planer head	Spiral cutting edge created with a number of carbide tips	
(48) Milling cutter	Strait tooth milling cutter	

	Slot milling cutter	
	Face milling cutter	
(49) Bandsaw blade	Carbon flexback bandsaw blade	
(50) Sandpaper	Sandpaper to grind profiles	

Unit 4.6

Basic machine and tool maintenance

EDUCATIONAL APPROACH


Course book


Additional readings


External links


Exercises and games

ASSESSMENT


Quiz (at the end of the module)

DURATION

1

HOUR

ECVET

0.04

Credits / 0.24 total of the module

CONTENT

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Unit 4.6 Basic machine and tool maintenance

Basic machine and tool maintenance

Machine and tool maintenance is one of the key factors for a successful woodworking enterprise, and possibly the most overlooked one, in terms of planning, cost and time required. Maintenance procedures are relatively simple (at least those that can be performed in situ, without calling a specialised service) and can be summarised in a few points below.

- Cleaning. First off, machinery typically works in the dusty environment, so all machinery is prone to collecting dust, in some cases, working units are placed in enclosures to prevent excessive dust build-up,. However, all work units and mechanical guides need to be cleaned occasionally according to the machine's maintenance guidelines. Keeping machines clean will then require either brushing off dust, blowing it off with a compressed **air gun (51)** or vacuuming the dust. Blowing the dust off is simplest method, and all the factories and shop have a compressed air installation, so this makes the procedure simpler. The latter option is preferred because the damage often occurs when fine dust is blown into the machine bearings and sliding pathways. Vacuuming (52) prevents fine dust from building up in the bearings and guides, so this is the preferential method. This method also protects the lungs of the maintenance team, so the use of industrial **vacuum cleaners (52)** is highly preferred – industrial dust extractors are typically used. Other than that, cleaning all electrical equipment is a safe fire- and explosion-proofing measure, given that wood dust particles are explosive. Sanders and saws usually require more maintenance – when sawing or sanding coniferous species, dust build-up should not be removed by any means of brushing, compressed air or vacuuming. Dust with wood resin forms huge, stone hard blocks, and it needs to be removed mechanically. Tool maintenance faces the same problems. Resin-dust build-up on any woodworking tools, causes them to lose their parameters, lose their balance, and dramatically increases working temperatures (friction coefficient). In all cases, practically all woodworking tools require regular cleaning, with the use of specially formulated **cleaning agents (53)**. In case of harder build-up or very complex tool shape, i.e. with internal cooling channels, **ultrasonic cleaners (54)** are used.

- Lubrication. First and foremost the points to be lubricated include air tools, clamps, and any other air-powered equipment. These units are usually piston-driven and this requires **lubrication** on a daily basis, using **air lubricators (55)**. The trouble with this type of lubrication is that the air also needs to be cleaned in order to be used in the airspray or in other equipment – this requires **air separators (56)** to be applied and periodically controlled. To lubricate mechanical parts, the days of periodically repacking and lubricating the bearings are gone – these are usually packed and sealed for life, so this action is not required. Everything else requires thorough cleaning – numerous types of **grease guns (57)** with numerous adapters are used for that purpose.

- Calibration and sharpening. As mentioned before, modern bearings are usually sealed for life, and do not require any maintenance, however, all rotating parts need to be checked for wear, which shows up in excessive play, so this is a point that must be considered. This can be accomplished by periodically checking the parts with a simple mechanical gage or an **electrical dial gauge (58)**. Tools must be sharpened and aligned almost every day. The blades can also be aligned with a dial gage, but it is time consuming and prone to setup errors, and this task is usually done with special

alignment jigs (59). The tools must also be **sharpened (60)** periodically – it can be done in situ, however modern tools are not always sharpened by simple grinding – in some cases an electro-erosion machine is needed. Regardless of the method, a tool grinder is a necessary piece of equipment for production maintenance. If a factory uses durable diamond tooling, an **erosion machine (61)** is used for sharpening.

BASIC MACHINE AND TOOL MAINTENANCE		
Keyword	Description	Image
(51) Air blow gun	Air guns are used to blow the excess dust off of machinery	
(52) Vacuum cleaner	Vacuum cleaners used in maintenance are often an industrial type of dust extractor.	
(53) Cleaning agent	Fluid used to clean the circular saw blades, cutters, cutterheads, and drill bits.	
(54) Ultrasonic cleaner	An ultrasonic cleaner is used for cleaning more complex tools	

(55)Air Lubricator	Unit used for air lubricant for pneumatic power tools.	
(56) Air separator	Unit used to clean air from lubrication, in order to use it for spray painting, etc.	

(57) Grease gun	Grease guns are used for lubricating moving machine parts	
(58) Dial gauge	Used to determine the mechanical accuracy and play of moving parts.	

(59) Alignment jig	Tool used to align the blades in cutterheads	
(60) Tool grinder	Machine used for to mechanically sharpen woodworking tools	
(61) Erosion machine	Machine used for sharpening diamond tools, with the electro-erosion method	

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