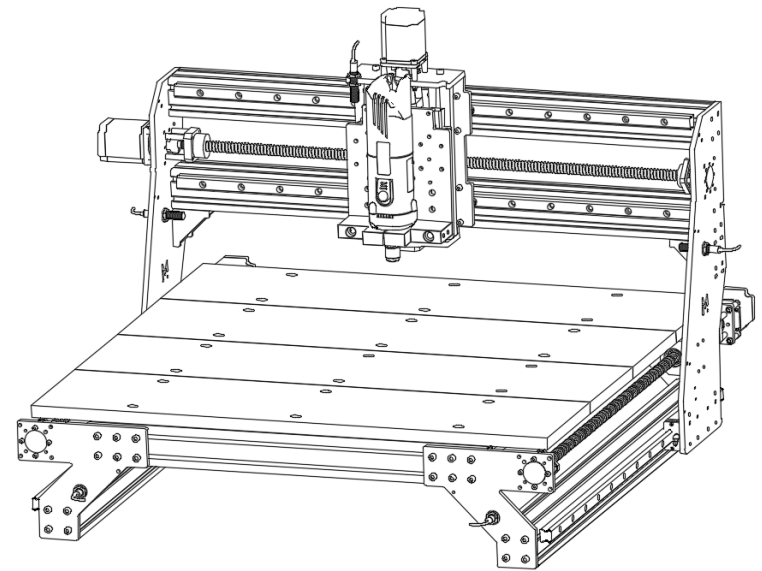


MEKANIKA

CNC MILLING MACHINE

PRO-SERIES - USER MANUAL



MAINTENANCE

GENERAL INFORMATION

Prior to commissioning the Mekanika Pro CNC Milling Machine, it has to be ensured that the machine is in a technically perfect and well-maintained condition. Always ensure that the machine is not powered if you want to perform adjustment or maintenance works. For this purpose, disconnect the power plug.

Sharp-edged cutting tools must also be dismounted prior any maintenance work to avoid a risk of injury.

Remove workpieces you have clamped onto the machine table, including the clamping system.

Only use high quality tools during your maintenance work.

Lubrication of Ball Screws and linear rails

A linear system has to be sufficiently lubricated in order to work properly and to avoid excessive wear or overheating. The required lubrication interval is determined by the environmental conditions. Generally, lubrication is required every 100 to 200 operating hours. A guideline for the lubrication interval is approx. 1 cm³ lubrication per ball screw nut. We recommend using lithium-based greases, which perform well in high-load applications and have good stability against oxidation.

RECOMMENDED MAINTENANCE WORK

The Mekanika Pro CNC machine is, to a good extent, maintenance-free. Handle your CNC system with care in order to ensure a long service life. Regular maintenance has a substantial impact on the service life of your machine. Frequently clean the CNC system with a cloth.

Ball screws and linear guides are to be regularly checked, cleansed of dirt and lubricated if necessary.

Clean the electronics area, including screen, keyboard and mouse from dust and impurities.

Regularly clean the fan filter of the control unit. A clogged filter might result in overheating inside the box, potentially leading to permanent damage to the electronic components.

SPARE PARTS

All parts of the machine and of the control box can be purchased individually as spare parts.

Please contact us directly about this.

When ordering spare parts, please provided the information on the machine model, size and part number available in accordance with the building instructions.

TRANSPORTATION & STORAGE

TRANSPORT

If you want to transport the machine, please pay special attention to its dimensions. You might need additional people for transportation. Never lift heavy loads above people!

Avoid a unilateral load of the machine frame!

PACKAGING

If you do not want to reuse the packaging material of the machine and its components, please separate it according to the disposal conditions on site and take it to a collection centre for recycling or dispose of it.

STORAGE

If the machine or its components is not used for a longer period of time, please observe the following points regarding storage:

- Only store the machine and the components in closed rooms.
- Protect the machine and the components against humidity, wetness, cold, heat and direct sun radiation.
- Store the machine and its components dust-free and cover it if necessary.
- The storage place must not be subjected to vibrations.

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GENERAL INFORMATION

CONTACT FOR CUSTOMER INFORMATION

Mekanika SRL
Rue de Birmingham 102
1070 Anderlecht
Belgium
E-mail: info@mekanika.io

If you encounter any issue or have any question regarding your machine, contact us and we'll get back to you within 24 hours.

NOTICE

All instructions, warranties and other collateral documents are subject to change at the sole discretion of Mekanika SRL.

Please visit www.mekanika.io on your product page to access up-to-date informations and documents.

MEANING OF TERMS USED

The following terms are used throughout this operating manual to indicate various levels of potential harm when operating this machine. The safety symbols, and their explanations, deserve your careful attention and understanding.

The safety warnings themselves do not eliminate any danger. The instructions or warnings they give are not substitutes for proper accident prevention measures.

NOTICE

Procedures which, if not properly followed, create a possibility of physical property damage and a little or no possibility of injury.

CAUTION

Procedures which, if not properly followed, create a probability of physical property damage and a possibility of serious injury.

WARNING

Procedures which, if not properly followed, create a probability of property damage, collateral damage, serious injury or death or create a high probability of superficial injury.

Read the entire operating manual in order to become familiar with the features of the machine and how to operate them. Failure to operate the machine correctly can result in damage to the machine, personal property and cause serious injury, electric shock and/or fire.

SAVE ALL WARNINGS AND INSTRUCTIONS FOR FUTURE REFERENCE.

TECHNICAL DATA

DIMENSIONS & WEIGHT

Model	Footprint	Height	Weight
PRO-S	850 x 850mm	650mm	55 kg
PRO-M	850 x 1250mm	650mm	62 kg
PRO-L	1250 x 1250mm	650mm	69 kg

TECHNICAL SPECIFICATIONS

Working Area	630 x 630mm 630 x 1030mm 1030 x 1030mm
Z Clearance Height	105mm (without spoilerboard)
Z Travel Distance	110mm
Linear Guides	HGR20 linear rails with carriages
Drive system	SFU 16mm Ball screws
Accuracy	< 0.1mm
Maximal Travel Speed	10.000mm/min
Motors (X, Y1, Y2, Z)	4 High-torque Nema23 stepper motors
Limit switches	6 NC PNP inductive sensors
Structure	High quality aluminium profiles and digitally manufactured steel plates
Controller & Software	PlanetCNC software installed and pre-configured on a Raspberry Pi 4B
Interface	7" LCD Touchscreen & bluetooth keypad
Spindle	AMB 1400 FME-P DI (software controlled spindle)

OPERATION

COMMISSIONING AND SAFE OPERATION

The machine and all connected components have to be wired correctly and be in perfect condition.

The operator must have completely read and understood the entire documentation of the relevant machine model and its corresponding instructions. Furthermore, he must have been trained in operating the machine as well as its accessories and has to be familiar with the use of a CNC Milling Machine and CNC software in general.

The workplace needs to be compliant with the applicable regulations and provisions of the respective industry.

The operator must use a dust shoe to prevent access to the cutting tool and be protected from ejection of chips while machining.

All axes feature inductive sensors to provide end stop according to ISO 13854 "Safety of machinery - Minimum gaps to avoid crushing of parts of the human body", in order to avoid hand or finger crushes.

MACHINE WORK SURFACE

There is no spoilerboard included in our kit. At first, a simple MDF wood panel is enough to get a grasp on CNC machining. When being more experienced, we suggest building a threaded insert grid on a surfaced spoilerboard. If you intend to machine hard material and use a lubrication system on the machine, we suggest you purchase an aluminium T-slot profiles worktable, as MDF will swell in contact with water.

CLAMPING THE WORKPIECE

The workpiece must be secured directly on the machine table using clamping devices.

If you want to mill through the material and produce cut-outs, we recommend the use of suitable material as spoilerboard. It is placed under the workpiece and protects the machine table from potential damage.

The workpiece should be sufficiently clamped in order to prevent it from unintentional shifting during processing.

Never hold the workpiece with your hands during the operating process. There is a high risk of serious injury!

OPERATION OF THE CNC SYSTEM

The entire CNC system is controlled and operated via a Raspberry Pi.

The operator must have completely read and understood the entire documentation of the CNC control software before commissioning the CNC system.

For further questions regarding the applied control software, please contact the respective software manufacturer at <https://planet-cnc.com/>

GENERAL INSTRUCTIONS

FOREWORD

These operating instructions explain how the Mekanika Pro CNC Milling Machine works and inform you about the correct handling of the machine.

Please read these operating instructions as well as all accompanying documents in their entirety before commissioning of the system.

It is imperative to adhere to the safety instructions listed in these operating instructions at all times.

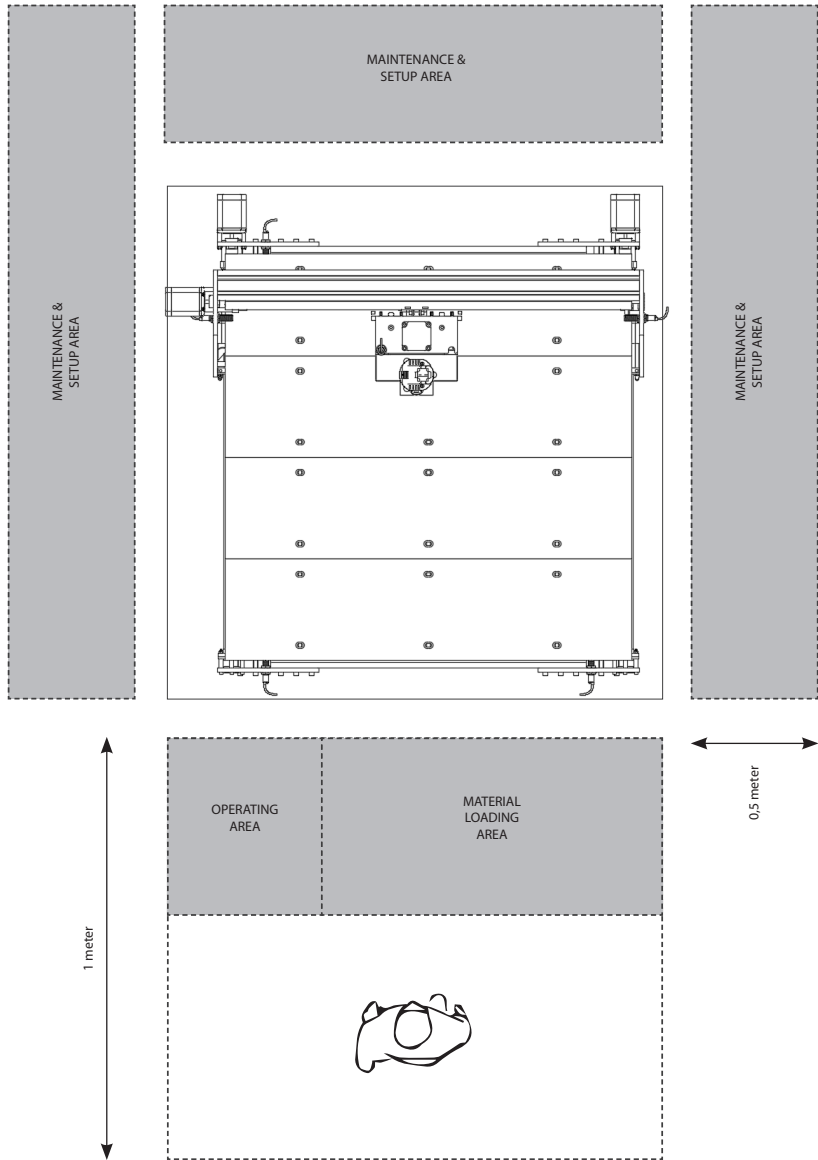
Should any doubts or the need for further information arise, do not hesitate to contact us prior to the use of the machine.

GENERAL SAFETY WARNINGS FOR THE USE OF MACHINES

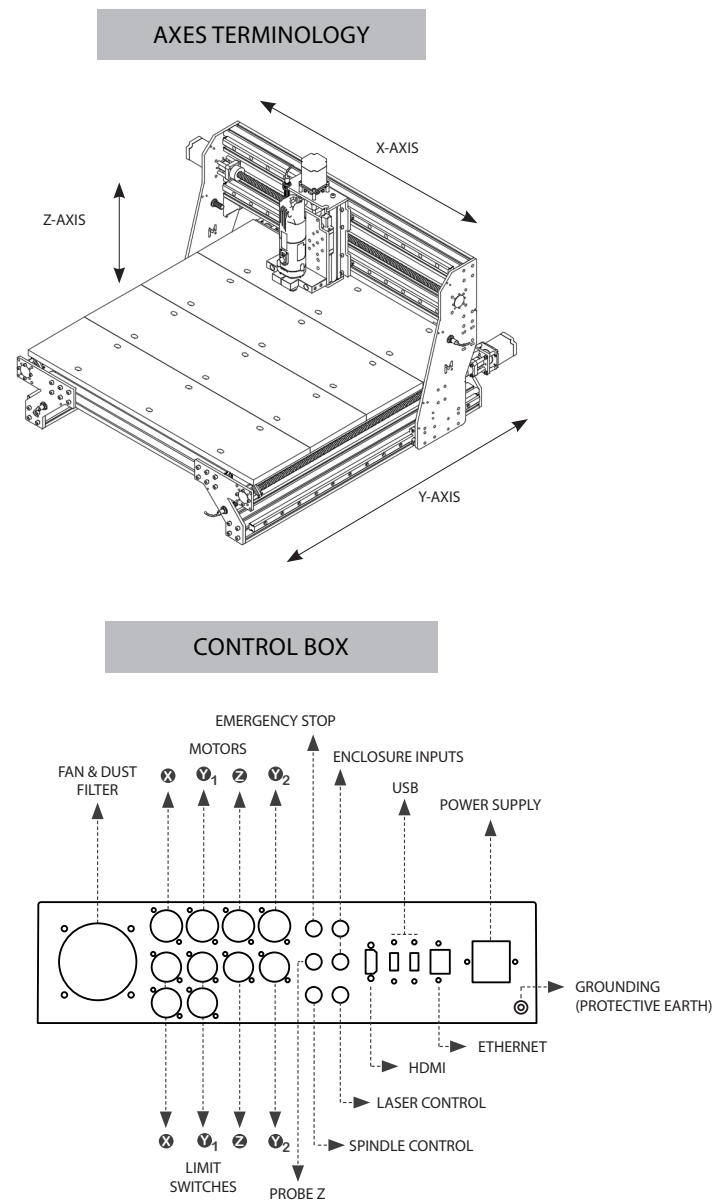
PERSONAL SAFETY	NOTICE	All persons who operate the machine must have read and fully understood all relevant safety and operating instructions. Misunderstanding may result in personal injury.
	CAUTION	Dress properly. Do not wear loose clothing or jewellery. Pin your hair above your shoulders so that it cannot get caught in the linear guides or moving parts.
	CAUTION	Stay alert, watch what you are doing and use common sense when operating a machine. Do not use a machine while you are tired and/or under the influence of drugs, alcohol or medication. A moment of inattention while operating a machine may result in serious personal injury.
	CAUTION	Use personal protective equipment. Always wear eye protection. Protective equipment, such as a suitable dust mask or ear protection, reduces the risk of injuries.
	CAUTION	This machine is controlled by a computer. During operation, it cannot be controlled directly. Lack of caution or expertise as well as program errors can lead to unexpected movements.
	CAUTION	Do not touch the motors as they can heat up significantly during operation.
	CAUTION	Never place any parts of the tool or accessories in your mouth as this can lead to serious injuries.

WORK AREA SAFETY	NOTICE	Keep work area clean and well lit. Cluttered or dark areas are prone to accidents.
	NOTICE	Operate the machine only in interior spaces on a solid, horizontal table or workbench.
	CAUTION	Keep children and bystanders at a distance while operating the machine. Distractions can cause you to lose control and can result in accidents.
	CAUTION	Do not operate the machine in explosive atmospheres, such as in the presence of flammable liquids, gases or dust. Machines can create sparks which may ignite the dust or fumes.
ELECTRICAL SAFETY	NOTICE	Do not expose the machine to moisture. The machine is only suitable for indoor use.
	WARNING	Machine plugs must match the outlet. Never modify the plug in any way. Be careful if you use adapter plugs with a grounded machine. Unmodified plugs and matching outlets will reduce the risk of electric defects and malfunctions
USE OF THE MACHINE	NOTICE	Do not leave a running machine unattended and power off the spindle if you need to leave. It is safe only when the spindle comes to a complete stop and is disconnected from the main power.
	NOTICE	Use the machine and accessories in accordance with these instructions, taking into account the working conditions and the work to be performed. Use of the machine for operations different from those intended could result in a hazardous situation with high probability of superficial injury.
	NOTICE	Never use dull or damaged end mills. Sharp end mills must be handled with care. Damaged end mills can snap during use. Dull end mills require more force to cut the tool, possibly causing the end mill to break.
	NOTICE	The speed and feed of the end mill when carving, routing or cutting is very important. Always observe the recommended speed and feed for a particular end mill/machine/operation configuration.
	NOTICE	Do not allow familiarity gained from frequent use of your machine to become commonplace. Always remember that a careless fraction of a second is sufficient to inflict severe injury.

RECOMMENDED WORKPLACE LAYOUT



MACHINE REFERENCES



USE OF THE MACHINE	NOTICE	Don't forget to clean the spindle's air vents by using compressed air. Excessive accumulation of chips and dust inside the motor housing may cause electrical failures.
	CAUTION	Do not reach in the area of the rotating tool. The proximity of the rotating tool to your hand may not always be obvious.
	CAUTION	Never try to reach the limit sensors while the machine is moving, it could lead to the crushing of your hand or fingers.
	CAUTION	Do not alter or misuse the tool. Any alteration or modification is a misuse and may result in serious personal injury.
	CAUTION	Disconnect the plug from the power source before you make any adjustments, change accessories, or store the tool. Such preventive safety measures reduce the risk of starting the power tool accidentally.
	CAUTION	Store the machine out of the reach of children and do not allow persons unfamiliar with these instructions to operate the machine. Machines are dangerous in the hands of untrained users.
	CAUTION	If the workpiece or end mill gets jammed, immediately press the emergency stop button. Wait for all moving parts to stop and turn off the spindle with the power switch, then free the jammed material. Do not try to do this with the spindle turned on.
	CAUTION	Do not touch the end mill or collet after use. After usage they are too hot to be touched with bare hands.
CARE OF THE TOOLS	CAUTION	Before starting any machining operation, always have the workpiece securely clamped. Never attempt to hold the workpiece with your hands or using any accessories. These tools can jam easily in the material, and can kickback, causing loss of control resulting in serious injury.
	NOTICE	Properly maintain the tools you use. Check for misalignment or binding of moving parts, breakage of parts and any other conditions that may affect the machine's operation. If damaged, have the machine repaired before use. Many accidents are caused by poorly maintained machines.
	NOTICE	Have your machine serviced by a qualified repair person using only identical replacement parts.

ADDITIONAL SAFETY MEASURES	CAUTION	Depending on the application field of the machine (private or commercial), observe the applicable occupational safety and health, safety and accident prevention and environmental regulations.
	WARNING	<p>Some dust created while machining certain types of material can contain chemicals known to cause cancer, birth defects or other reproductive harm. Always inform yourself on the material you have at hand before machining it. Some examples of these chemicals are: lead from non-ferrous metals with lead content, carbonate from carbon fibre, arsenic and chromium from chemically-treated lumber.</p> <p>Your risk from exposures to these varies, depending on how often you perform this type of work. To reduce your exposure to these chemicals: work in a well ventilated area, and work with approved safety equipment, such as those dust masks that are specially designed to filter out microscopic particles.</p>

PROTECTIVE MEASURES

The Mekanika Pro CNC Machine has been designed for advanced users and is only to be operated by technically skilled adults.

The machine is only to be used in a technically perfect condition, which is to be ensured by the user prior to each operation.

The emergency switch as well as, if applicable, additional safety devices, always need to be easily accessible and fully functional.

The use of air and water lubrication systems is allowed. Please take into consideration that if you are using an MDF spoilerboard (machine worktable), the MDF panel will swell and be damaged by the water.

ASSEMBLY & SYSTEM SETUP

ENVIRONMENTAL CONDITIONS

The machine is solely suitable for the operation in dry, interior spaces.

Keep the environmental temperature of the machine dust-free. High dust exposure can cause damages to the system.

The humidity should be within normal limits for humidity indoors (40 to 60 %). Protect the machine against wetness and humidity.

The ideal environmental temperature for the system lies between 18°C to 25°C, respectively from 64°F to 77°F.

Particularly protect the electronics against overheating by avoiding direct sun radiation or indirect heating up nearby a radiator.

MACHINE POSITIONING

Place the machine on a suitable table or on a machine stand. In order to provide a comfortable working height, we recommend a working height of approx. 840 mm. For a torsion-free stand, the surface of the machine stand needs to be solid and even. **The machine is to be secured in a way that it cannot shift or fall down.**

All movable parts of the machine must be able to operate collision-free.

The routing of the machine cables, such as with the milling motor, has to be effected in a way that the cable cannot be clamped between the guide ways of the machine. For this purpose, use the cable chains we have set up for the different axis.

The machine has to be easily accessible and operable. Especially the emergency switch has to be easily accessible at all times.

Take care to ensure a sufficient illumination of the machine's location and the workplace surrounding the machine.

The control unit and the machine interface (screen & keypad) have to be placed in the vicinity of the machine in order to have both in clear view at all time.

MACHINE ASSEMBLY

Please follow carefully our attached mounting guide and datasheet in order to properly mount your Mekanika Pro CNC Milling Machine.

If you have any questions, please do not hesitate to contact us!

WORKPLACE

The workplace needs to provide enough space around the machine in order to work comfortably and to allow the machine to fully use its traveling paths. Additionally, a safe distance to possibly nearby positioned machines is to be maintained.

The location of the machine as well as the workplace surrounding the machine has to be sufficiently illuminated.

The control box and the interface items have to be placed in the vicinity of the machine in order to have both in clear view.

INTENDED USE OF THE MACHINE

The Mekanika Pro CNC Milling Machine is constructed for a permanent and regular application for professionals. Due to the machine stiffness, a variety of different materials, such as wood and non-ferrous metals, can be processed.

The plausible and reasonable scope of uses include:

- Manual movement mode, using a digital “jog” to move the machine along its 3 axes independently.
- Automatic “Homing” procedure, operated by the user by clicking a digital button. This procedure moves the machine sequentially on each of its axes in the following order: Z, X, Y, until it encounters the limit switches.
- Automatic “Square Gantry” procedure, activated by the user by clicking a digital button. This procedure moves the machine along its Y-axis, forward, until it touches its left and right limit sensors sequentially. The purpose of this procedure is to square the machine’s gantry with the Y axis.
- Measure Tool Length procedure, activated by the user by clicking on a numerical button. This procedure makes the machine descend at reduced speed along its Z axis until its tool comes into contact with a removable sensor previously placed by the user.
- Normal operating mode, where the machine moves automatically according to a machine code, called G-code, previously loaded by the user.
- Manual control mode using a terminal, the machine moves according to a machine code, called G-code, entered directly by the user.

The plausible and reasonable scope of interventions include:

- Manual movement of the machine to access certain zones.
- Manual rotation of the ball screws to align the X axis (gantry) with respect to the Y axis.
- Changing the cutting tool on the milling spindle.
- Attachment/removal of the dust shoe.
- Attachment/removal of the raw material to be machined on the work surface.
- Switching on, pausing and stopping a machine code (G-code).
- Connection/disconnection of external machine cables.
- Opening of the cable entry chains to access the cables.

PERSONAL PROTECTIVE EQUIPMENT

When working with the machine, the operator has to wear at least the following personal protective equipment and has to be compliant with the below-mentioned safety aspects:

- Safety glasses to protect the eyes against flying chips and other projections.
- Ear protection to protect the ears against noise.
- Safety shoes to protect the feet against falling objects.
- No wearing of clothes which can get caught in the machine, such as ties, scarves, wide sleeves. Roll up sleeves to prevent caught in moving parts. Additionally, jewellery, watches, rings and especially long necklaces and rings are to be dispensed with.
- Shoulder-length or longer hair must be secured with a hairnet or a hat in order to prevent it from getting caught in the linear guides and / or rotating tools.

Prior to all adjustments to the machine, such as to the spindle and to the control unit, its control or system-guided tools have to be disconnected from the power source.

Never hold the workpiece with your hands. It is mandatory to secure the workpiece on the worktable. Otherwise, there exists a high risk of injuries!

EMERGENCY STOP BUTTON

The emergency stop is located in a separate housing and is securely connected with the machine. In order to be able to intervene at all times, the emergency stop has to be positioned at a suitable place, as shown in the assembly guide.

By pressing the emergency stop switch, the emergency stop is triggered. The control of the machine is immediately interrupted. Additionally, the control software receives the signal to stop the operating process, freezing the user interface. The machine stops moving immediately and the spindle stops turning at the same moment.

If you want to deactivate the emergency stop status, reactivate the control by turning the emergency stop switch to the right. The operating process has to be restarted.

If you have any questions on this matter, please do not hesitate to contact us.

RESIDUAL RISK

Despite all safety precautions against the contact with rotating or hot tools and the protection from crushes, a residual risk remains due to a careless handling and automatic movements of the CNC system.

CHECKLIST FOR A SAFE USE OF THE MACHINE

BE PREPARED	WORK SAFE	FINISH RIGHT
<ul style="list-style-type: none"> Use appropriate personal protective equipment : <ul style="list-style-type: none"> - Safety Glasses - Hearing protection - Safety Shoes Remove rings, bracelets, watches and necklaces before work. Tie and confine long hair. Wear tight fitting clothing and roll up sleeves to prevent snagging. Inspect the equipment to ensure there are no obvious defects, damaged chucks , dull or cracked tools. Ensure you have the required knowledge of the use of a CNC milling machine. Do not use gloves. Check where the emergency stop button is located. 	<ul style="list-style-type: none"> Never plug or unplug cables from the control unit while the machine is powered. Ensure that the workpiece is firmly and securely clamped. Check that the tools are sharp and set correctly. Use a brush or a vacuum cleaner to clean chips off surfaces. Never reach into the machine while it is running and keep your hands away from any moving part during machining. Stand clear of the machine whenever it is operational. You should also warn other people near the risk of being too close to it Keep hands clear during manual adjustments. Whenever you are handling or passing tools, avoid touching the cutting edges 	<ul style="list-style-type: none"> When you are finished with your work, shut down the Raspberry Pi before turning off the power switch of the control unit (not doing so might corrupt the SD card). If the ball screws are dusty, blow them with pressurised air to keep them clean and greased. Clean the floor and work area around the machine. Clean and put away personal protection equipment. Tag any defective equipment and contact us if you encounter any trouble.

SAFETY SYMBOLS



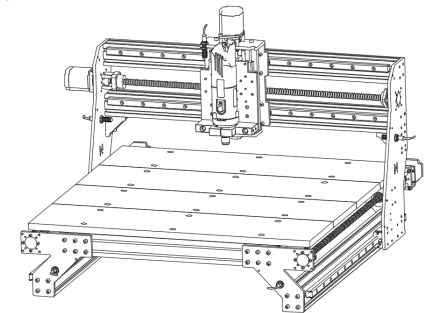
MACHINE DESCRIPTION

The Mekanika Pro CNC Milling Machine is a digitally controlled milling machine, which can be used for a regular processing of wood, plastics and non-ferrous metals.

The machine has three axes, which are offset by 90°. This way, it is possible to travel to any point within the working space. Each axis is equipped with one or two stepper motors and with one or two inductive sensors. The stepper motors drive the movable axes elements via the ball screws. The position of the axis is determined during the homing procedure, at the beginning of the job, with the aid of the inductive limit sensors.

The Mekanika Pro CNC Milling Machine is delivered as a kit and includes the following components:

- A 3-axis CNC router, with 4 motors and 6 inductive limit switches
- A plug-and-play electronic control unit, already assembled and tested, with its power cable (EU plug)
- A plug-and-play interface unit, composed of a touch screen and bluetooth keypad
- PlanetCNC software, pre-installed on a Raspberry Pi 4 and already configured (software used to control your machine)
- A lifetime license of PlanetCNC
- A power cable for the control unit (EU plug)
- An AMB 1400 FME-P DI spindle, which is controlled by the software
- A touch probe device to locate your workpieces easily
- All the basic tools necessary to assemble the machine
- A USB key



In addition to the above mentioned items, you will need the following ones in order to be able to properly use the machine:

- A **spoilerboard**. At first, a simple wood panel is enough to get a grasp on CNC machining and we don't think it's relevant to ship such a bulky object, which is easy to find at your local hardware shop. When being more experienced, we suggest building a threaded insert grid on a surfaced spoilerboard.
- A **vacuum cleaner and a dust shoe**, to help you work in a clean environment and to be protected from the rotating tool while the machine is working.
- A **CAM software**. You will need a Computer Aided Manufacturing software to translate your 3D models into a G-code readable by the machine. We suggest to use **Fusion360**.
- A **table** which can bear the weight of the machine. It needs to be robust and stiff, as vibrations will affect the precision of your cuts.