Operating instructions

Micro Platform Processing Centre
Micro Vario

KERN

Version 5.2

Read the instructions prior to performing any task!

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Translation of the original operating instructions
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Information about the manual

These *operating instructions* as well as the *Heidenhain user manual for the CNC control*, a *maintenance and service manual* and a transportation and installation instructions are supplied for the operation of the CNC high-precision processing centre.

Together, these manuals enable the safe and efficient use of the machine. They are a fundamental part of the machine and must be kept in the immediate vicinity of the machine so that they are accessible to personnel at all times.

The personnel must read and understand these manuals before starting any work. Compliance with all specified safety information and operating instructions in these manuals is a basic requirement for safe working conditions.

The local occupational safety regulations and general safety rules for the machine's area of application also apply.

Optional components

Optional components or machine versions that do not belong to the scope of delivery of the machine may be depicted or described in this manual.

Customer service

Our customer service can assist you with technical information:

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Please be prepared to provide the following information in conjunction with any questions:

- *Machine model*
- *Serial number of the machine*
- *Version number of the software*
- *In case of problems: exact description or exact error messages*

The type and serial number are located on the type plate (↳ Chapter 15.10 “Type plate” on page 180).

In addition, we are always interested in information and experiences derived from using the system and that may be of value for the improvement of our products. Please contact our customer service for that purpose.

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1 Brief overview of the machine and its components

1.1 Machine, front view

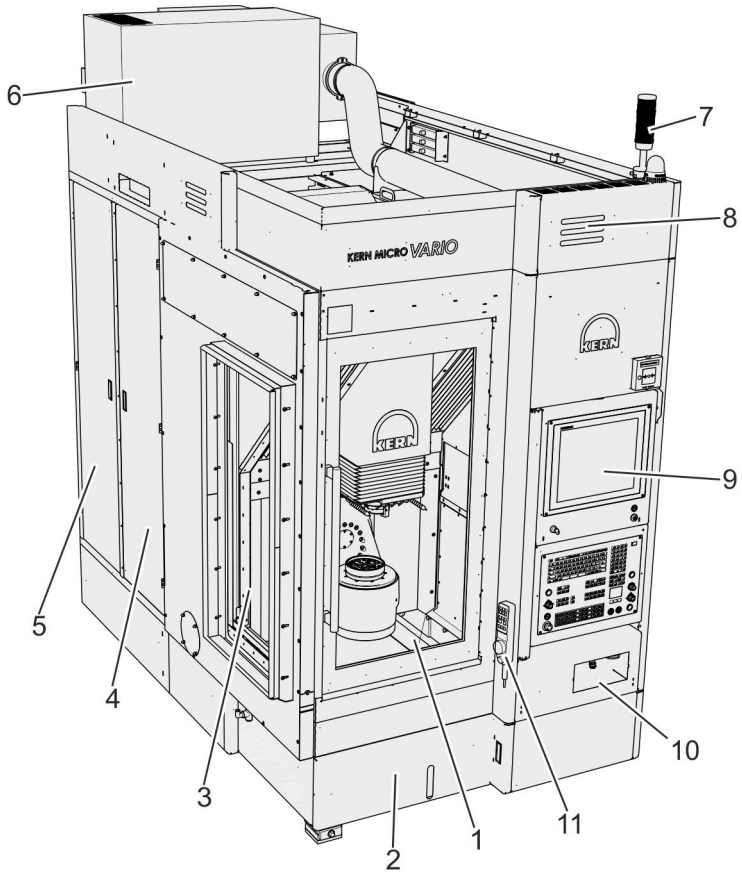

Fig. 1: Overview of the front

1 Sliding door to the work area (↳ *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*)
3 Connection area for an external workpiece changer (option) (↳ *Chapter 3.6.4 “Connection for external workpiece changer” on page 76*)
4 Lubrication service area (↳ *Chapter 3.3 “Service area” on page 53*)
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9 Swivelling control panel with touch function (↳ *Chapter 3.5.2 “Control panel” on page 60*)
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11 Electronic hand wheel (option)

1.2 Machine, rear view

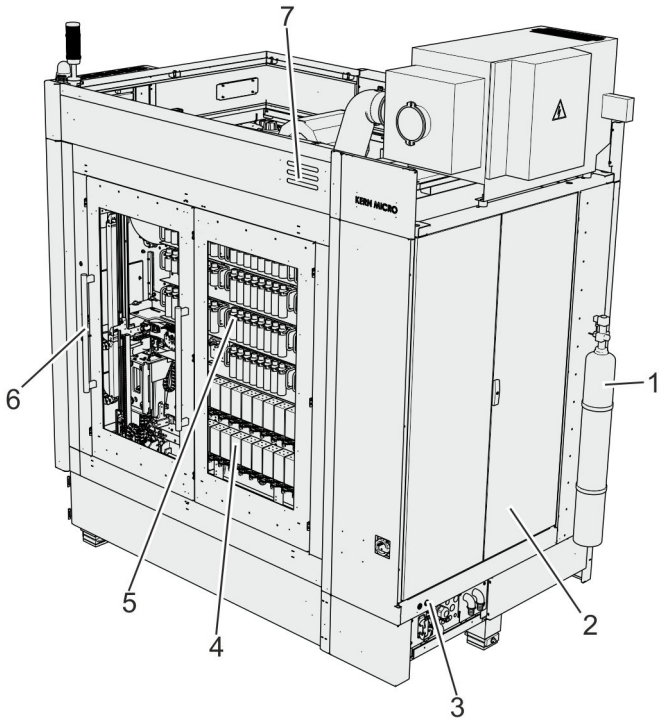

Fig. 2: Overview of the rear (example)

1 Extinguishing agent tank for fire extinguisher (option)
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3 Supply connections *Chapter 3.6.1 “Supply connections” on page 73*
4 Workpiece changer (option)
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6 Tool changer access door
7 Strip light status display

1.3 Machine, interior view of work area

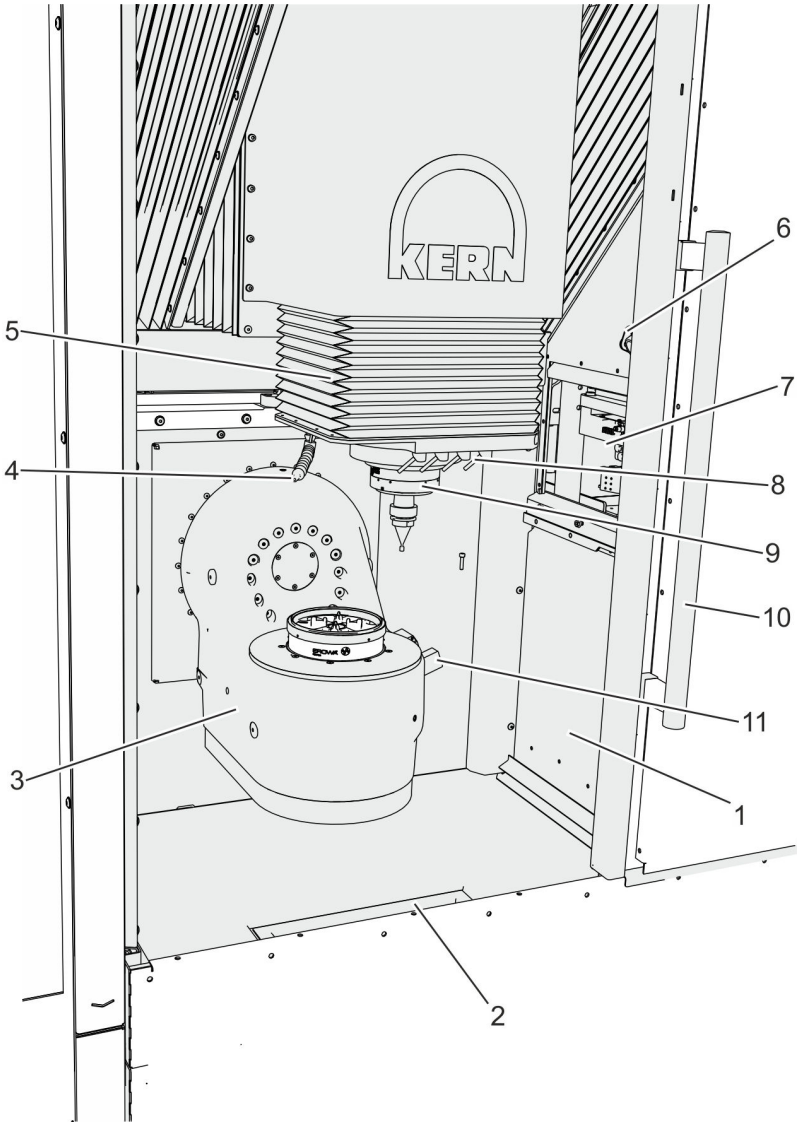

Fig. 3: Work area with sliding door open

1 Workpiece changer flap (option)
2 Chip outlet
3 Turn and tilt unit (option) (*Chapter 3.2.4 “Turn and tilt unit” on page 43*)
4 Blow-off connection for dry processing (option)
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6 Receiver for infrared workpiece sensor (option)
7 Tool changer flap (*Chapter 3.2.7 “Tool changer” on page 45*)
8 Cooling lubricant nozzles
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10 Sliding door handle
11 Laser tool measuring system (*Chapter 3.2.8 “Laser tool measuring” on page 46*)

1.4 Functional description

The CNC high-precision processing centre is used for complex, three-dimensional machining of metal or plastic shaped pieces. The structural design enables machining in the form of milling, drilling, boring, reaming and thread cutting. The tool head can be moved along three axes (X-, Y- and Z-axis).

The workpiece is clamped onto the NC clamping plate.

The workpiece is clamped onto the turn/tilt unit. This can also carry out a tilting movement (B-axis) and/or a turning movement (C-axis).

The personnel set up the machine and control, program and monitor the machining from a control panel on a rotating and pivoting bearing. Portable control is also possible by means of an electronic hand wheel.

2 Safety

2.1 Symbols in this manual

Safety information

Safety instructions in this manual are indicated by symbols. The safety instructions are introduced by signal words, which express the extent of the hazard.

DANGER!
This combination of symbol and signal word indicates an immediate dangerous situation which will result in death or severe injuries if it is not averted.

WARNING!
This combination of symbol and signal word indicates a potentially dangerous situation which may result in death or severe injuries if it is not averted.

CAUTION!
This combination of symbol and signal word indicates a potentially dangerous situation which may result in minor injuries if it is not averted.

NOTICE!
This combination of symbol and signal word indicates a potentially dangerous situation which may result in damage to property if it is not averted.

ENVIRONMENT!
This combination of symbol and signal word indicates potential environmental hazards.

Safety information in the operating instructions

Safety information can refer to specific, individual operating instructions. Such safety information is embedded in the operating instructions so that it does not disrupt the flow of reading when performing the operation. The signal words described above are used.

Example:

1. Loosen the screw.
2. **CAUTION!**
   Pinching hazard at the cover!

   Carefully close the cover.
3. Tighten the screw.

Special safety instructions

The following symbols are used in safety instructions to draw the attention to special hazards:

Warning signs	Type of danger
	Warning - danger of crushing.
	Warning – high-voltage.
	Warning – flammable substances.
	Warning – hot surface.
	Warning – laser radiation.
	Warning – harmful or irritating substances.
	Warning – danger zone.

Tips and recommendations

This symbol highlights useful tips and recommendations as well as information for efficient and fault-free operation.

Additional symbols

The following symbols are used in this manual to highlight operating instructions, results, lists, references, and other elements:

Symbol	Explanation
	Step-by-step operating instructions
⇨	Results of procedural steps
	Reference to an external document
	References to sections in this manual
■	Lists without a specified sequence
[Button]	Operating elements (e.g. buttons, switches), display elements (e.g. signal lights)
“Display”	Screen elements (e.g. buttons, assignment of function keys)

2.2 Intended use

The CNC-controlled 3-axis or 5-axis processing centre is used exclusively for the following:

- The complex, three-dimensional machining of metal or plastic shaped pieces by milling, drilling, boring, reaming and thread cutting
- The execution of measuring and digitalisation tasks (option)

The intended use includes compliance with all the information in this manual.

Any use that goes beyond or differs from the intended use constitutes misuse.

WARNING!

Danger due to misuse!

Misuse of the machine can result in dangerous situations.

- Do not use the machine in a potentially explosive atmosphere.
- Do not process flammable materials.
- Do not use the machine for grinding work if the machine is not equipped with the “jig grinding package” option.
- Never use flammable cooling lubricants without the fire extinguishing system installed.
- Operate the machine only with approved lubricants, cooling media and cooling lubricants.
- Do not process materials that produce explosive or toxic dust (e.g. magnesium, titanium or special aluminium alloys).
- Do not operate the machine or its components outside a building.
- Do not convert, retool or modify the machine or its individual components.
- Do not process materials that are structurally similar to wood with the machine.
- Do not operate the machine without the extraction system running.
- Never operate the machine with non-approved tools (detailed information is contained in the performance data overview).
- Change the programming of the machine software only after consulting the manufacturer.
- Never operate the machine with non-approved tool clamping systems.
- Never exceed the permitted workpiece limitations.

NOTICE!

The precision of the machine can be achieved only if the operating and installation conditions are observed ↳ Transportation and installation instructions – Requirements of the installation site.

The precision of the machine can be achieved only if the operating and installation conditions are observed.

2.3 Personnel requirements

2.3.1 Qualifications

The various tasks described in this manual impose different requirements on the qualifications of personnel who are entrusted with these tasks.

WARNING!

Danger due to insufficient qualification of personnel!

Insufficiently qualified personnel cannot asses the risks associated with handling the machine and subject themselves and others to the danger of severe or fatal injuries.

– Only have tasks performed by personnel who are qualified to perform these tasks.
– Keep insufficiently qualified personnel out of the work area.

Only personnel of whom it can be expected that they perform these tasks reliably, are approved for all tasks. Persons whose capability to react is impaired, for instance through drugs, alcohol, or medication, are not approved.

In this manual the qualifications for personnel listed below are specified for the different tasks:

Electrician
Due to their specialized professional training, knowledge and experience as well as knowledge of industry standards and regulations specific to the industry, electricians are in a position to work on electrical systems and to identify and avert potential risks on their own.

Electricians are specifically trained for the working environment in which they work and are familiar with the relevant standards and regulations.

Machine operator
Machine operators have been trained in CNC machining technology and have attended a special instruction/training course by Kern Microtechnik GmbH about the machine and the assigned tasks and potential hazards in the event of improper conduct. This enables the machine operator to carry out advanced operating, maintenance and repair work in a professional and safe manner. This includes the following work:

- Switching the machine on and off
- Teaching/setting up the machine
- Safe clamping of workpieces
- Operating and programming the machine control system

- Creating CNC programs to process and create complex workpiece geometries
- Processing of workpieces in the different machine operating modes
- Processing of complex workpieces which require various types of intervention by the machine operator during the program sequence
- Elimination of certain faults that are intended to be remedied by the machine operator (see error table in operating instructions)
- Preparation and initial setup (calibration) of processing tools
- Replacement of tools
- Cleaning the machine
- Performing measurements and digitalisation
- Performing certain maintenance work

Machine operators authorised for teaching mode
Such personnel have qualifications that are comparable to those of machine operators. However, they also have additional qualifications in handling teaching mode and are authorised to make certain changes to the control functions.

Machine operators authorised for teaching mode have been instructed in the specific hazards that can occur in this operating mode.

Maintenance personnel
Maintenance personnel are familiar with the execution of advanced work necessary for operating and servicing as well as troubleshooting of the machine. Maintenance personnel have taken part in special training provided by Kern Microtechnik GmbH, during which the necessary knowledge of the individual machine components was taught.

Furthermore, due to their training, knowledge, and experience as well as knowledge of the industry-specific standards and regulations, maintenance personnel are in a position to professionally and safely perform work on pneumatic and hydraulic systems:

- Planning, installing, monitoring and servicing of hydraulic and pneumatic system components and systems
- Execution of safety inspections on these components
- Analysis of errors and faults in pneumatic and hydraulic machines, equipment, and systems and their remedy

2.3.2 Unauthorised persons

WARNING!

Risk to life for unauthorised persons due to hazards in the danger and working zone!

Unauthorised persons who do not meet the requirements described here will not be familiar with the dangers in the working zone. Therefore, unauthorised persons face the risk of serious injury or death.

– Unauthorised persons must be kept away from the danger and working zone.
– If in doubt, address the persons in question and ask them to leave the danger and working zone.
– Cease work while unauthorised persons are in the danger and working zone.

2.3.3 Training

The owner must train personnel on a regular basis. Execution of the training must be logged for better traceability.

- Date of training
- Name of the trained person
- Content of the training
- Name of the instructor
- Signatures of the trained person and of the instructor

2.4 Residual risks

The following section describes remaining risks which can arise from the machine even with proper use.

In order to reduce risks of personal injury and property damage and avoid dangerous situations, the safety instructions listed here and the safety instructions in the other sections of these instructions must be followed.

2.4.1 General hazards at the workplace

Noise

WARNING!

Risk of injury due to noise!

During standard operation, the noise emission level of the machine falls in a non-hazardous range. However, the noise level may increase during the processing of specific materials and/or work piece geometries or tool/material combinations. This may cause hearing impairment.

– Always wear ear protection during those work processes.
– Only remain in a hazardous zone for as long as necessary.
– Check whether changing certain parameters (e.g. rotational speed, cutting speed) may reduce the noise impact.

Accumulation of fluid

CAUTION!

Risk of injury due to slipping on accumulated fluid!

Slipping on accumulated fluid, e.g. leaked cooling lubricant on the floor may cause falls. A fall may cause injuries.

– Immediately clean up fluid accumulations with suitable means.
– Wear slip-resistant safety shoes.
– Post warnings and instructional signs in the direct area or close to an area where fluids may potentially accumulate on the ground.

Dirt and scattered objects

CAUTION!

Risk of injury due to tripping over dirt and scattered objects!

Accumulations of dirt and scattered objects represent kidding and tripping hazards. A fall may cause injuries.

– Always keep work area clean.
– Remove machine or assembly parts and tools that are no longer needed (e.g. tensioning tools, broom, shovel) from the work area, particularly if they are close to the ground. Store them outside of the work area so that they do not present a source of hazards.

2.4.2 Risks due to electrical charges

Electricity

DANGER!

Risk of fatal injury due to electric power!

Touching of electrically charged parts presents an immediate risk of fatal injury due to electric shock. Damage to the insulation or to individual system components may present a risk of fatal injury.

– Work on the electrical system may only be carried out by trained electricians.
– Switch off the power supply immediately if the insulation is damaged and initiate repair measures.
– Keep moisture away from electrically charged components. Moisture can cause a short-circuit in the system.

Residual voltage

WARNING!

Risk of fatal injury due to residual voltage!

For 5 minutes after the main switch has been switched off, there is still a dangerous residual charge on the machine. Some areas of the switch and supply cabinet are permanently energised to 230 VAC.

– Wait until the residual voltage has dissipated before starting any work on electrical components.

2.4.3 Mechanical risks

Safety equipment

DANGER!

Danger of fatal injury if safety equipment is manipulated!

There is a danger of coming into contact with moving machine parts if safety equipment at the machine is bypassed or rendered unusable. This poses a danger of fatal injury.

– Never bypass or disable safety devices.
– Immediately shut down the machine and inform the responsible superior if manipulated safety equipment is detected at the machine.

Teaching mode

WARNING!

Risk of injury due to moving parts during teaching mode!

Moving parts of the individual axes can cause serious injuries during teaching mode at reduced speeds.

– Do not reach into moving parts during set-up or carry out work in immediate proximity of moving parts.
– Never enter the work area (e.g. for cleaning).
– Do not climb on the machine during operation.

Sharp edges and pointed corners

CAUTION!

Risk of injury on sharp edges and pointed corners!

Sharp edges and pointed corners on cutting tools, workpieces, and chips can cause abrasions and cuts on the skin.

– Handle tools with care and in accordance with their intended use.
– Consider the respective weight during the transport of tools and workpieces.
– When manually handling tools, secure sharp edges with protective covers and/or transport tools in a transport container.

Unsuitable tools

WARNING!

Risk of injury due to unsuitable tools!

If processing tools are used that are not designed for the relevant rotational speeds there is a risk that the tools will splinter and/or be ejected. This may cause serious injuries. In addition, there is a risk that heavy tools or tools with a large projecting length reach their resonance frequency. This can damage the seat of the tools and parts of the tool can be ejected.

– Clamp the tools so that they are as short as possible.
– Only use finely balanced tools.
– Only use tools with maximum speeds or circumferential speeds that are above the maximum spindle rotational speed.
– Only use tools that comply with the requirements of the applicable standards (EN ISO 15641).

2.4.4 Risks due to high temperatures

Hot surfaces

WARNING!

Risk of injury due to hot surfaces!

Tools, workpieces, chips, and surfaces of motors heat up during operation. They present of risk of inflicting burn injuries.

– Allow cooling-off time before working on hot components.
– Only touch hot tools, workpieces, motors, and chips while wearing protective gloves.

Hot operating supplies

WARNING!

Risk of injury due to hot operating supplies!

Operating supplies can reach high temperatures during operation. If hot operating supplies come into contact with skin, this can cause severe burns.

– Always wear heat-resistant work clothing and protective gloves when working with operating supplies.
– Before commencing any work with operating supplies, check whether they are hot. If necessary, allow them to cool down.

2.4.5 Risks due to high pressure

Pressurised components

WARNING!

Risk of fatal injury due to pressurised components!

Pressurised components of the pneumatic or hydraulic circuit may exhibit uncontrolled movements when handled improperly due to the stored energy and may cause serious injuries.

- Work on the pressurised systems must only be carried out by maintenance personnel.
- Completely depressurise the pressurised systems before starting any work on them. Completely relax pressure reservoir.
- Always ensure that fluids cannot be discharged unintentionally.
- Defective components that are pressurised during operation must be immediately replaced by the maintenance personnel.

2.4.6 Danger of fire

Flammable materials

DANGER!

Danger of fire due to flammable cooling lubricants and materials!

There is a danger of fire whenever cooling lubricants (e.g. petroleum) or materials (e.g. graphite) are used in the machine. Fires can cause fatal injuries.

- Do not smoke within the vicinity of the machine. Do not handle fire or other sources of ignition.
- Avoid whirling up flammable dust.
- Make sure a fire extinguishing system is installed if flammable cooling lubricants or materials are used.
- Make sure the machine has a suitable extraction system.

2.4.7 Risks due to chemicals

Cooling lubricants

WARNING!

Risk of health hazards due to cleaning agents and cooling lubricants!

Cleaning agents and cooling lubricants that are used in the machine contain ingredients that cause poisoning, allergies, skin irritation, and eye damage. After prolonged use, bacteria and germs can develop in the cooling lubricant.

- Adhere to safety data sheets of the manufacturer in the appendix.
- When handling cooling lubricants, always wear the specified personal protective gear.
- Avoid spilling and formation of mist.
- Avoid skin contact with cooling lubricant. Thoroughly wash the skin after work and use skin care lotion.
- Do not eat, drink or smoke during work.
- Change cooling lubricant and cooling lubricant filter on a regular basis.

Lubricants

WARNING!

Risk of health hazards due to lubricants!

Contact with lubricants can trigger allergies and skin irritations.

- Always wear protective gloves when handling lubricants.
- Do not ingest, do not breathe in vapours.
- Wash eyes thoroughly with a lot of water if they come into contact with lubricant; seek medical help if necessary.
- After skin contact, wash off the area using a lot of water and soap.
- Observe the safety data sheets of the lubricant manufacturer.

Vapours and dust

WARNING!

Risk due to harmful vapours and dust!

Cooling lubricant vapours or machining dust may contain ingredients that cause poisoning, allergies, skin irritations, and eye damage.

– Observe the safety data sheets for the materials used.
– Only use materials that are hazardous to health if an extraction system (option) is installed.

2.4.8 Risks due to radiation

Laser category 2

WARNING!

Risk of injury due to laser!

A laser measuring system for tool measuring is located in the machine's work area. The laser measuring system uses a Class 2 laser. The light of the laser of this category can cause damage to the eye and skin irritations when viewed intentionally and for prolonged periods.

– Do not look directly into the laser beam on purpose and for longer period of time.
– Take reflections of the laser beam on reflecting workpieces into account.

2.5 Safety systems

WARNING!

Risk of fatal injury due to non-functioning safety equipment!

If safety equipment is not functioning or is disabled, there is a risk of severe or fatal injuries.

– Before commencing work, check that all safety equipment is fully functioning and correctly installed.
– Never disable or bypass safety equipment.
– Ensure that all safety equipment is accessible at all times.

Emergency-stop button

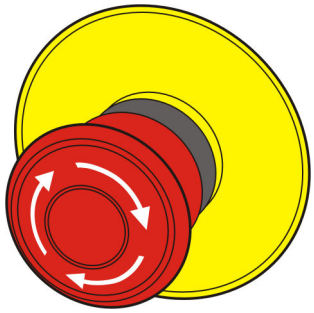


Fig. 4: Emergency-stop button

Pressing the emergency-stop button shuts down the machine in a controlled manner. The energy supply is maintained to achieve shut-down. The energy supply is only switched off when the machine has come to a standstill. After an emergency-stop button has been pressed, it must be unlocked by turning it in order to enable a restart.

WARNING!

Risk of fatal injury due to residual voltage!

For 5 minutes after the emergency-stop button has been pressed, there is still a dangerous residual charge on the machine. Furthermore, 230 VAC are permanently applied to the (optional) fire extinguishing system and to sections of the switch and supply cabinet.

– Wait until the residual voltage has dissipated before starting any work on electrical components.

WARNING!

Risk of fatal injury due to unintentional restart!

An unintentional restart of the machine can cause serious or fatal injuries.

– Prior to the restart, ensure that the cause for the emergency stop has been eliminated and that all safety features have been installed and are functional.
– Only unlock the emergency-stop button when the risk has been eliminated.

Emergency-stop buttons are located at the following positions:

- On the control panel
- On the manual operating device
- On the emulsion mist and oil mist extraction system

Main switch

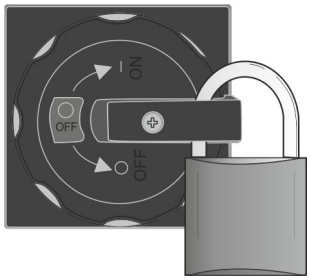


Fig. 5: Main switch, example secured against restart

Turning the main switch to the "0" position immediately turns off the energy supply. This does not trigger an emergency stop. Certain sections of the switch and supply cabinet remain energised when the main switch is switched off.

WARNING!

Risk of fatal injury due to unintentional restart!

An unintentional restart can cause serious or fatal injuries.

– Prior to the restart, ensure that there is no person in the hazard zone and that all safety features have been installed and are functional.

Safety doors with safety panes

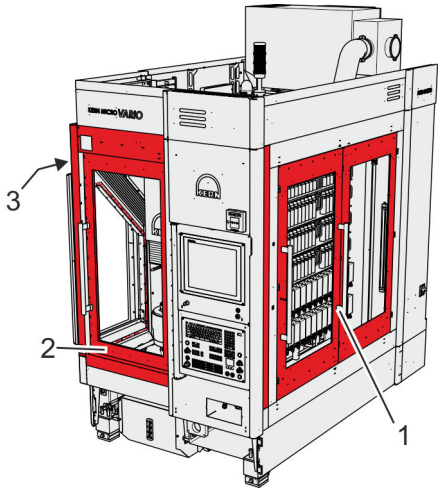


Fig. 6: Safety doors with safety panes

1 Safety door at the tool changer
2 Front safety door at the work area
3 Side safety pane at the work area (option)

Safety doors with safety panes separate the danger zones. They protect persons from chips, tool parts, workpiece parts and cooling lubricants, or against contact with moving parts. Safety doors can be opened only when the machine is in a safe state.

NOTICE!

The side safety door made of polycarbonate is subject to aging. It needs to be replaced regularly. There is a sticker on the pane with the date when the replacement needs to be made.

WARNING!

Risk of injury due to damage to the safety panes if the cutting speed is too high!

If the permitted cutting speed (2,000 m/min) is exceeded or if the replacement intervals of the safety panes are not complied with, the retention capability of the protective panes at the work area will no longer be sufficient.

This can cause severe injuries caused by ejected parts.

– Never exceed the maximum permitted cutting speed.
– Comply with the replacement interval prescribed for the safety panes.

Door securing mechanisms

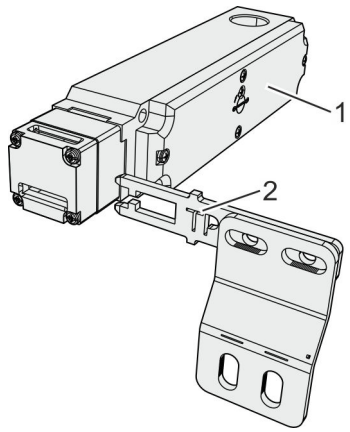


Fig. 7: Safety limit switch

1 Safety limit switch
2 Actuator

The doors on the machine are equipped with door securing switches (Fig. 7). While the machine is in operation, they fulfil the following functions:

- They lock the machine and prevent it from starting when the doors are open.
- They prevent the doors opening while the machine is running.

In teaching mode, the individual axes can be moved with an open sliding door at the work area, however, the feed rate is limited.

Monitored flaps

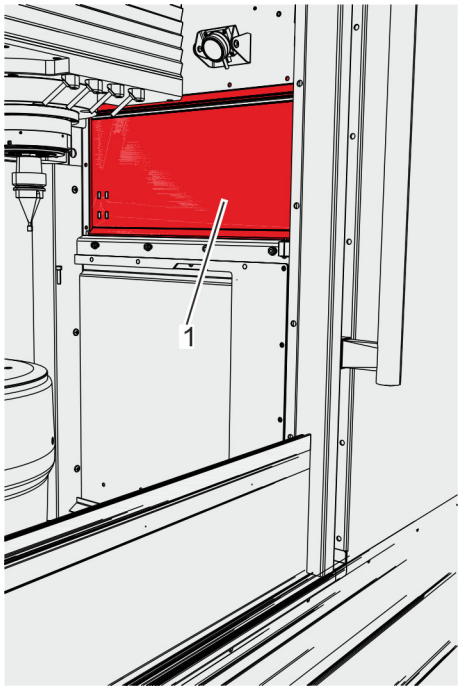


Fig. 8: Tool changer flap

The interface to the internal tool changer is located inside the work area, on the right. It is secured by a monitored flap. When the work area door is open, the flap is locked and cannot be opened.

The interface to the internal workpiece changer is located inside the work area, on the right, below the flap of the tool changer. It is secured by a monitored flap. When the work area door is open, the flap is locked and cannot be opened.

An interface to connect an external workpiece changer is located inside the work area, on the left. It is secured by monitored flaps. When the work area door is open, the flap is locked and cannot be opened.

Protective encasing

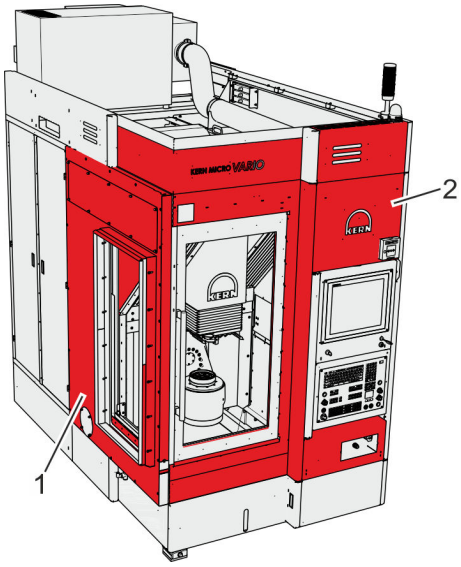


Fig. 9: Protective encasing

The surrounding protective encasing (Fig. 9/1, 2) protects people from chips, tool parts, workpiece parts and cooling lubricant as well as from coming into contact with moving components.

Strip light status display

Chapter 3.5.4 “Strip light status display” on page 72

Signal light

2.5.1 Emulsion mist and oil mist extraction system

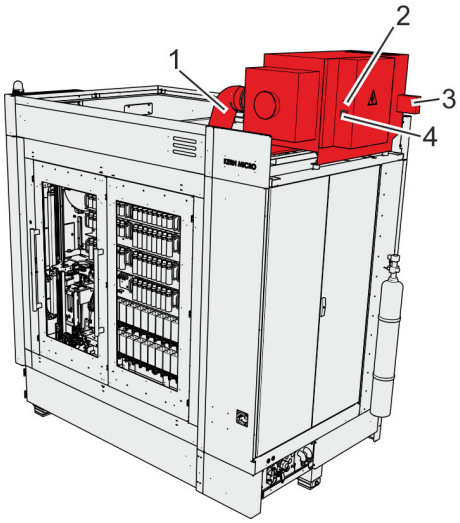


Fig. 10: Emulsion mist and oil mist extraction system

1 Extraction pipe
2 Status display
3 Energy supply connections
4 Main switch

The emulsion mist and oil extraction system with electrostatic separation (Fig. 10) extracts harmful cooling lubricant vapours, oil mist and machining dust that arises during processing. It is located on the switch and supply cabinet.

The exhaust air socket of the extraction system is located at the top, right of the work area and is covered by a mesh screen.

The filter elements of the extraction system must be replaced or cleaned regularly.

In addition, refer to the supplier documentation of the manufacturer provided for the emulsion mist and oil mist extraction system.

2.6 The owner's responsibility

Operating company

The operating company is the party who operates the machine themself for commercial or economic purposes or who leases said machine to a third party for use and is the party who bears the legal product responsibility for the protection of personnel or third parties during operation.

Obligations of the owner

The machine is used in a commercial setting. The owner of the machine is therefore subject to the statutory obligations for occupational health and safety.

The safety, accident prevention and environmental regulations that apply to the area of application of the machine must be adhered to in addition to the safety information in this manual.

The following applies in particular:

- The owner must familiarize themselves with the applicable occupational safety regulations and also conduct a risk assessment to determine any hazards that may arise due to the specific working conditions at the place of use of the machine. The owner must implement them in the form of operating instructions for the operation of the machine.
- During the entire operating time of the machine, the owner must check whether the operating instructions issued by the owner correspond with the currently applicable rules and standards and must adapt them if necessary.

- The owner must clearly regulate and define the responsibilities for installation, operation, troubleshooting, maintenance and cleaning.
- The owner must ensure that all persons who handle the machine have read and understood these instructions. In addition, the owner must train the personnel at regular intervals and inform them about the hazards.
- The owner must provide the personnel with the required protective equipment and must advise that the wearing of the required protective equipment is mandatory.

Furthermore, the owner is responsible for making sure the machine is always in perfect technical condition. Therefore, the following applies:

- The owner must ensure that the maintenance intervals described in this manual are adhered to.
- The owner must have all safety equipment checked regularly for functionality and completeness.
- The owner must ensure that the current safety data sheets are available and that their specifications are adhered to when using dangerous materials or materials that are hazardous to one's health.
- The owner must make sure a fire extinguishing system and a suitable extraction system are installed if flammable cooling lubricants or materials are used.
- The owner must ensure that suitable tools (e.g. hoisting equipment) are available for loading and unloading the machine with heavy workpieces.
- The owner must ensure that the requirements for the installation site of the machine ↬ *"Obligations of the owner" on page 31* are met.

2.7 Personal protective equipment

Personal protective equipment serves to protect people against hazards to their safety and health while working.

The personnel must wear the personal protective equipment while working on and with the machine which is referred specially to in the individual sections of these instructions.

Description of the personal protective equipment

The personal protective equipment is explained below:

Chemical-resistant protective gloves
Chemical-resistant protective gloves protect hands from aggressive chemicals, such as cooling lubricants, oil and grease.

Protective gloves
Protective gloves protect the hands against friction, abrasions, punctures or deep cuts as well as contact with hot surfaces. In addition they protect against skin contact with aggressive materials, such as for example cooling lubricants, oil, and grease.

Protective goggles
The protective goggles protect the wearer's eyes against flying parts and splashing liquids.

Protective work clothing
Protective work clothing is tight-fitting clothing with a low resistance to tearing, with tight sleeves and with no protruding parts.

Safety boots
Safety boots protect feet against crushing, falling parts and slipping on slippery surfaces.

Safety shoes
Safety shoes protect the feet from crushing, from dropping parts, and from slipping on slippery floors.

2.8 Signage

The following symbols and information signs can be found in the work area. They refer to the immediate environment where they have been set up.

WARNING!

Risks due to illegible labels!

Over time, stickers and signs can get dirty or become illegible for other reasons, so that risks can no longer be recognized and necessary operating instructions can no longer be adhered to. This presents a risk of injury.

– Keep any safety, warning and operation related signs in legible condition at all times.
– Replace damaged signs or stickers immediately.

2.8.1 Warning signs

Hand injury

There is a risk of crushing in the areas marked with this sign. Keep hands away from areas that display these warning signs.

There is a danger of hands being crushed, drawn in or otherwise injured.

Laser beam

This information is located on the sliding doors to the work area. Avoid intentional, prolonged looking into the light path of the tool measuring laser.

Voltage

Only qualified electricians may work in the work area labelled with this sign.

Unauthorised persons must not enter the work areas indicated in this way and they may not open the switch and supply cabinet labelled with this sign.

Hot surface

Hot surfaces, such as hot engine housings, containers or materials as well as hot liquids, are not always obviously hot. Do not touch surfaces and liquids without protective gloves.

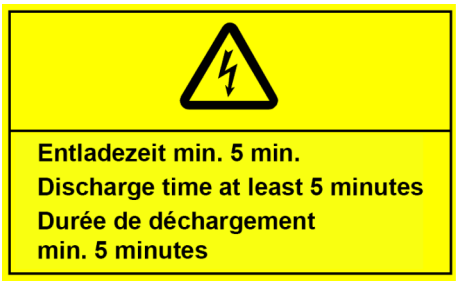
Pull the mains plug

This notice is located on the front of the right door of the switch and supply cabinet.

Pull the mains plug before opening the housing.

If the machine's electrical connection cable does not have a mains plug, have the electrical connection disconnected by a qualified electrician.

Discharge time

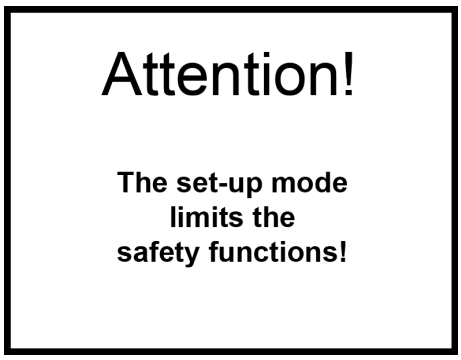


The notice is located on the inside of the switch and supply cabinet.

Discharge time at least 5 minutes

2.8.2 Other signs

Teaching mode

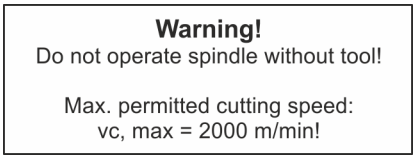


The notice is located on the control panel.

Warning!

The set-up mode limits the safety functions!

Spindle without tool



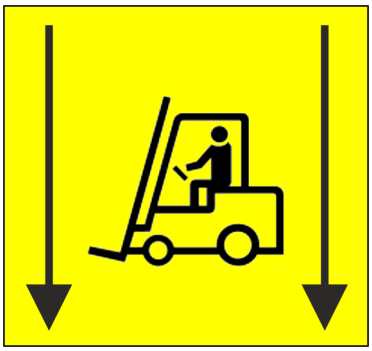
The notice is located on the control panel and on the sliding doors to the work area.

Warning!

Do not operate spindle without tool!

Max. permitted cutting speed: vc, max = 2000 m/min!

Position forklift here



This notice indicates where the forks of the forklift must be inserted under the machine for lifting and transporting.

2.9 Safeguard against restart

WARNING!

Risk of fatal injury due to unauthorized or unintentional restart!

An unauthorized or unintentional restart of the machine can cause serious or fatal injuries.

– Prior to the restart, ensure that all safety equipment has been installed and is fully functional and that no person is in danger.
– Always follow the process to safeguard against a restart as described below.

1. Turn machine off (*Chapter 4.2 “Switching off the machine” on page 88*).
2. Switch off machine.
3. Switch off the energy supply at the main switch (Fig. 11). This done by turning the main switch to the "0" position.
4. Secure the main switch with a lock (Fig. 11).
5. Entrust a responsible employee to keep the key of the lock in a safe place.

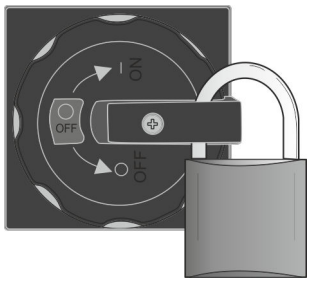


Fig. 11: Main switch

WARNING!

Risk of fatal injury through impermissible restart!

When the main switch has been secured with a lock, persons may be present in the hazard zone. When the energy supply is switched on, these persons risk sustaining fatal injuries.

– Before removing the lock and switching the energy supply back on, ensure that no person is in danger.

2.10 Course of action in an emergency

Preventative measures

- Always be prepared for fires and accidents!
- Keep first aid equipment (first aid kit, blankets etc.) and fire extinguishing systems functional and close at hand.
- Familiarize personnel with accident notification procedures and equipment as well as first aid and rescue equipment.
- Keep access paths clear for rescue vehicles.

Measures in the event of fire and accidents

- Immediately trigger an emergency stop through the emergency-stop system.
- If there is no risk to your own health, rescue any persons in the danger zone.
- Provide first aid if necessary.
- Alert the fire department and/or the emergency medical service.
- In the event of fire: If there is no danger to your own safety, fight the fire with the fire extinguishing equipment until the fire department arrives.
- Notify the responsible person on site.
- Clear access paths for the emergency response vehicles.
- Direct the emergency response vehicles.

2.11 Environmental protection

ENVIRONMENT!

Danger to the environment from improper handling of substances that are harmful to the environment!

Incorrect handling of environmentally hazardous substances, especially incorrect waste disposal, can cause considerable damage to the environment.

– Always observe the instructions below on how to handle and dispose of environmentally hazardous substances.
– If environmentally hazardous substances are accidentally released into the environment, you must immediately apply appropriate countermeasures. If in doubt, notify the responsible municipal authority and inquire about the appropriate measures that need to be taken.
– If environmentally hazardous substances are accidentally released into the environment, you must immediately apply appropriate countermeasures. If in doubt, notify the responsible authority and inquire about the appropriate measures that need to be taken.

The following environmentally hazardous substances are used:

Cooling lubricants

Cooling lubricants may contain toxic and environmentally hazardous substances. They must not be released into the environment. The disposal must be handled by a professional specialized disposal company.

Lubricants

Lubricants such as greases and oils contain toxic substances. They must not be allowed to escape into the environment. Disposal must be carried out by a specialised disposal company.

Coolants

When released, coolants develop decomposition products which are hazardous to the environment. Maximum care and caution are required when handling coolants. Always observe the safety data sheet issued by the manufacturer. Ensure that personnel handling coolants are regularly informed about potential dangers and are instructed in the safe handling of coolants.

Batteries

Batteries may contain reusable substances and/or substances that are harmful to health and the environment.

Do not allow batteries to enter bodies of water, the drains, the soil or domestic waste collection and make sure that they are recycled or disposed of by a specialist company.

Cleaning liquids

Cleaning liquids incorporating solvents contain toxic substances. They must not be allowed to escape into the environment. Disposal must be carried out by a specialist disposal company.

Hydraulic oil

Hydraulic oil must not be released into the environment. Hydraulic oil can result in long-term harmful effects in bodies of water. The disposal must be handled by a professional specialized disposal company.

Observe manufacturer's safety data sheet.

Anti-corrosion agents

Anti-corrosion agents contain environmentally hazardous substances. They must not be released into the environment. The disposal must be handled by a professional specialized disposal company.

Preservation agents

Preservation agents contain poisonous chemical substances. They must not be released into the environment. The disposal must be handled by a professional specialized disposal company.

2.12 Risk of property damage

2.12.1 Damage to property due to incorrect operation of the machine

Collision

NOTICE!

Property damage due to collision during manual movement of axes!

The manual movement of axes presents a risk of collisions with tools or workpieces. This can cause significant property damage and irreparably damage the machine.

- Only allow machine operators to move axes.
- Move axes carefully and with reduced speed.
- Only move axes with a clear view.
- Only allow authorised and instructed personnel to make changes to control settings (options).

Manual flushing gun

NOTICE!

Only point the jet of the manual flushing gun towards workpieces and clamping area. Cleaning the machine with the manual flushing gun can cause machine damage because cooling lubricants can then enter sensitive machine areas.

Short stroke movements

NOTICE!

Repetitive short stroke movements can damage the machines. During repetitive short stroke movements, lubrication strokes must be performed to prevent damage to the machine.

2.12.2 Protection against malicious software

SELinux security software

The Heidenhain control system at the machine enables an access control to be set up to prevent the execution of unauthorized processes or functions, and thereby viruses and other malware.

To prevent this security software restricting the functionality of the machine, it is necessary to allow the execution of programs in VFAT format. This is explained below:

For a more detailed description, refer to the supplied Heidenhain user manual of the CNC control.

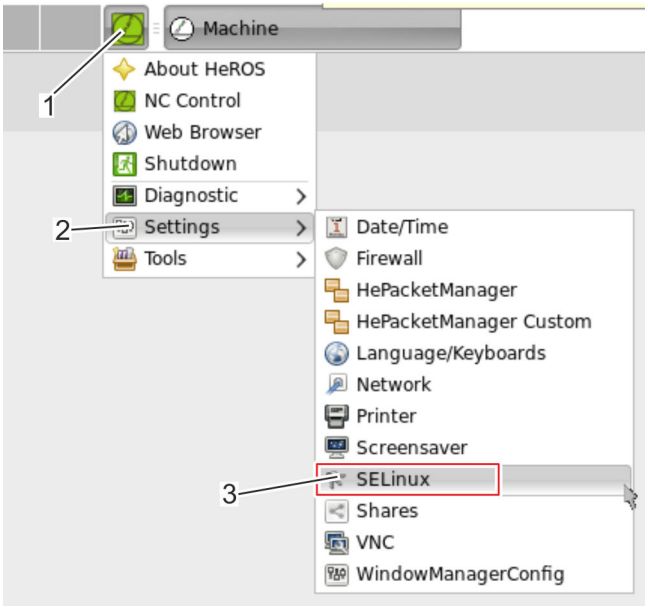


Fig. 12: SELinux security software

1. Launch the SELinux security software: Taskbar “”Diadur icon (Fig. 12/1) “” Settings (Fig. 12/2) “” SELinux (Fig. 12/3).

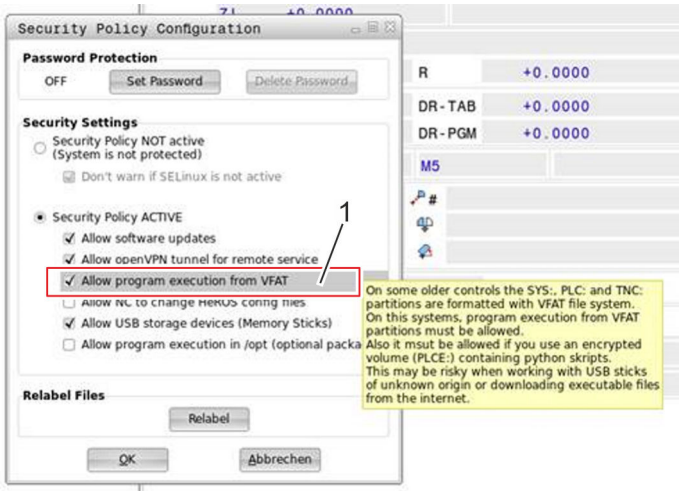


Fig. 13: SELinux security software

2. Select the *“Allow program execution from VFAT”* check box (Fig. 13/1).

⇨ The SELinux security software is set correctly.

3 Description of the machine

3.1 System of coordinates

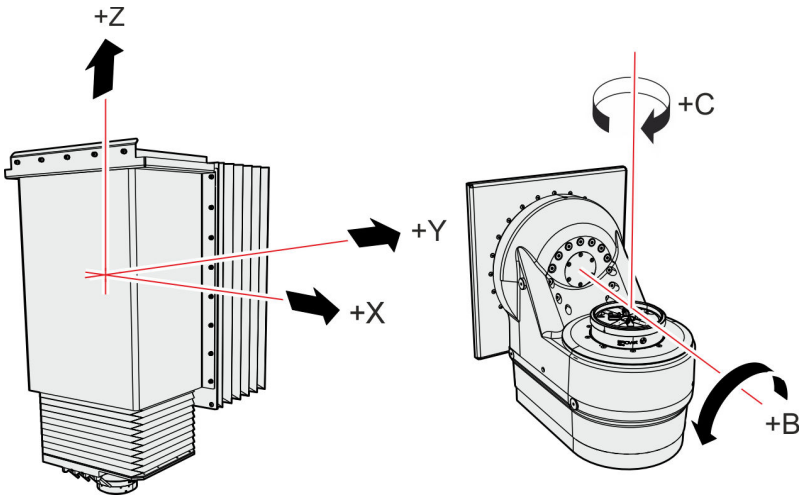


Fig. 14: System of coordinates

X Spindle movement axis
Y Spindle movement axis
Z Milling spindle
B Swivel axis of machine table (only for model with turn/tilt unit)
C Rotary axis of work table (only for model with turn/tilt unit)

The positions on the plane or in the space are specified by a reference system and uniquely described by coordinates. The perpendicular (Cartesian) system specifies three axis directions X, Y and Z. All three axes are positioned perpendicular to each other and meet at the zero point.

With the model with the turn/tilt unit, the machine is also equipped with two additional movement axes. Axial direction B refers to the swivel axis, axial direction C refers to the rotary axis of the turn/tilt unit.

3.2 Module description

3.2.1 Drives, axes, measuring system

Drives and axes

The movements of the individual axes are generated by digital servo-motors. The drives of the Z- and B-axes are equipped with brakes. Undesired axis movements are prevented during a power failure.

Measuring system

The linear measurement for the linear motion and the angle measurements of the rotary axis are executed via linear optoelectronic measurement devices. The linear measurement devices are maintenance-free.

3.2.2 Milling spindle

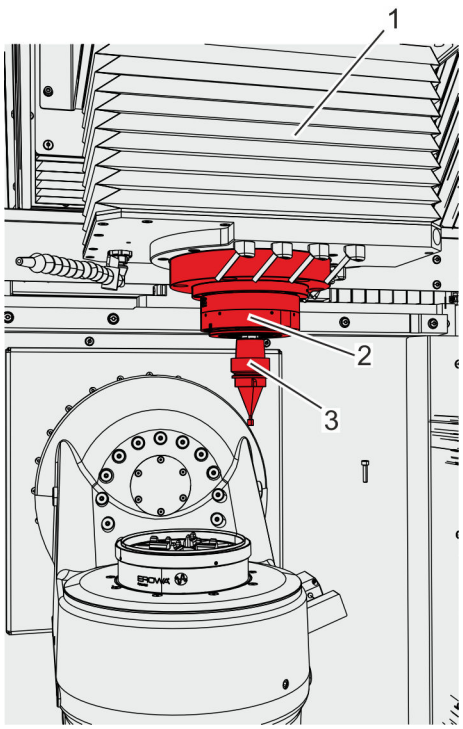


Fig. 15: Milling spindle

1 Bellows
2 Milling spindle
3 Tool (example)

The machine has an HSK-40 milling spindle (Fig. 15/2). The collet chuck used to clamp and release the tools (Fig. 15/3) is operated hydraulically.

The spindle and drive motor are cooled by a cooling unit.

3.2.3 Internal coolant supply

With the internal coolant supply, the coolant is supplied under high pressure through the inside of the machining tool. The coolant supplied flushes the chips out of the cutting edge engagement, especially out of deep bores or deep grooves. This prevents cutting edge chipping, minimises tool wear and, in this way, ensures higher process reliability.

The coolant always reaches the tool cutting edges reliably, even with alternating machining operations, for example milling on surfaces and in deep pockets or grooves. The quantity of coolant supplied can be adapted exactly to the respective type of machining.

3.2.4 Turn and tilt unit

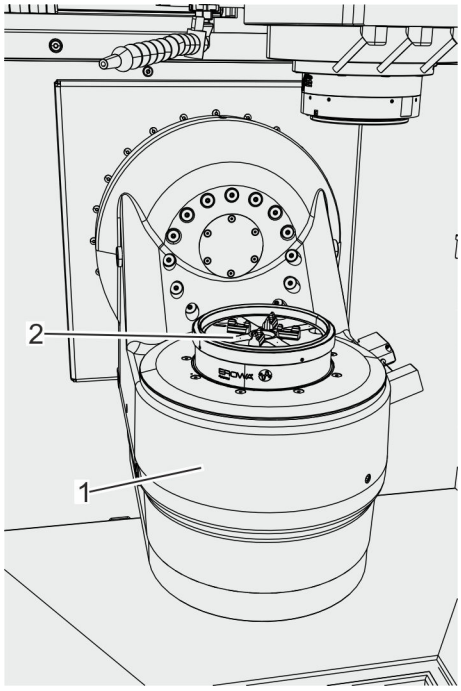


Fig. 16: Machine table (turn and tilt unit)

1 Swivel axis
2 Rotary axis

The machine is equipped for 5-axis machining. By means of the turn and tilt unit, a swivel axis (Fig. 16/1) and a rotary axis (Fig. 16/2) are provided.

3.2.5 Chip collection box

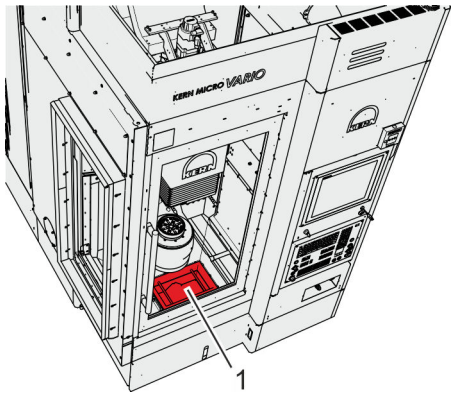


Fig. 17: Chip collection box

1	Coarse screen
Not illustrated	Cooling lubricant tank with chip collection box (fine screen)

The removable chip collection box for coarse chips (coarse screen) (Fig. 17/1) is in the lower part of the machining area. Below the chip collection box (coarse screen) is the pull-out cooling lubricant tank with collection box for small chips (fine screen).

In order to clean/remove the chip collection box, proceed as described in Chapter 11.1 “Emptying the chip collecting box” on page 147.

3.2.6 Work area lighting

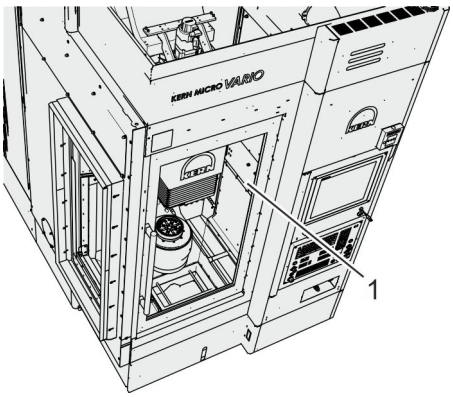


Fig. 18: Work area lighting

1 Work area lighting (not illustrated)

The work area is fitted with splash-proof lighting equipment (Fig. 18/1) on the right-hand side. To protect it against damage, it is placed inside a transparent protective tube.

3.2.7 Tool changer

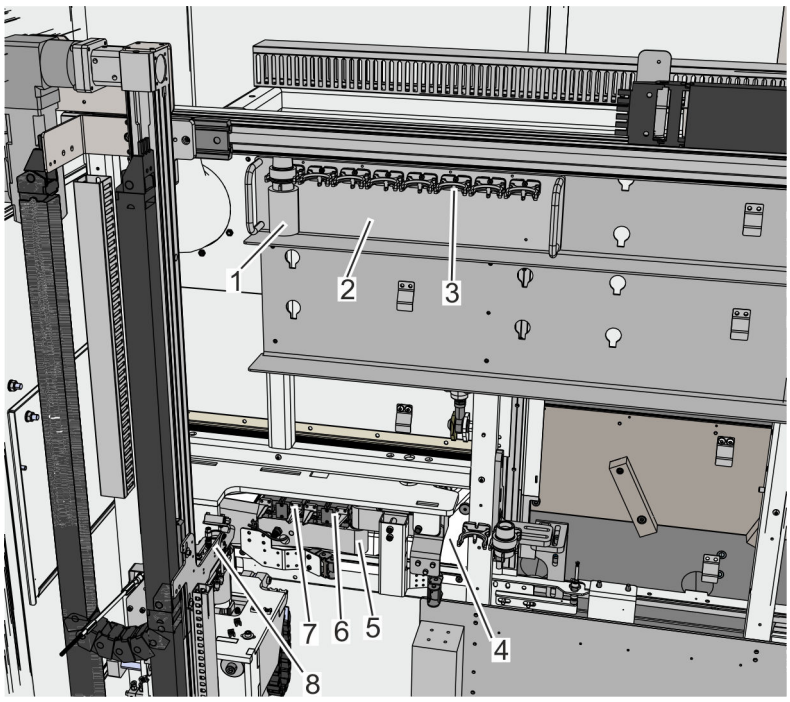


Fig. 19: Tool changer

1 Tool (example)
2 Tool pallet
3 Tool holder
4 Tool changer flap
5 Pivot arm
6 Unloading gripper
7 Loading gripper
8 Magazine gripper

The internal tool changer is located on the side of the machine.

The tools are inserted/removed through the side tool changer door. The tools are inserted in the tool holders (Fig. 19/3) located on the tool pallets (Fig. 19/2). The tools are inserted through the side tool changer door.

The number of tool stations depends on the equipment of the machine (↪ Chapter 15.5 “Other machine data” on page 175).

An automatically controlled tool changer flap (Fig. 19/1) is located between the tool changer and the work area. It is only opened during a tool change and remains closed at all other times.

During a tool change, the magazine gripper positions the requested tool automatically in front of the double gripper (Fig. 19/4, 5). It takes the tool from the magazine gripper and replaces it with the tool that is in the spindle.

3.2.8 Laser tool measuring

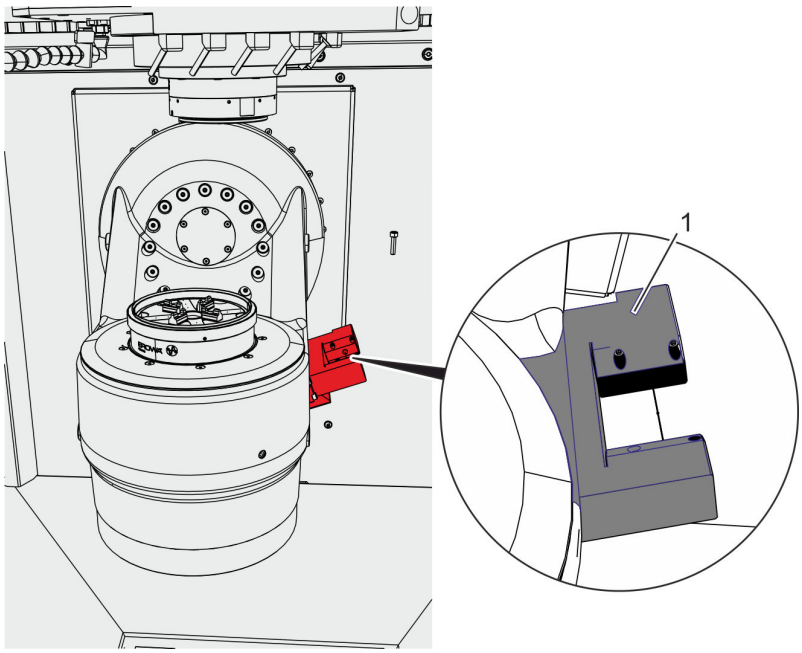


Fig. 20: Laser tool measuring

The laser measuring device (Fig. 20/1) is used for contact-free measuring of tools. The measured tool parameters are automatically entered in the tool table. Available measuring methods include:

- Tool length measurement for the automatic calibration of the tool length on the Z-axis, e.g. after an automatic tool change
- Check for wear and breakage of tools and individual tool blades
- Measuring, inspecting or checking the length and radius of the tool

In addition, refer to the supplier documentation provided for the laser tool measuring system.

3.2.9 Infrared workpiece sensor

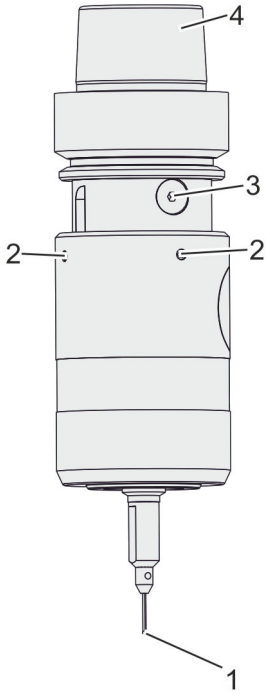


Fig. 21: Infrared workpiece sensor (example)

1	Measuring ball
2	Centring screw (4x)
3	Tensioning screw
4	Holder
Not illustrated	Battery compartment

The machine provides the option of connecting an infrared workpiece sensor (Fig. 21) for measuring workpieces.

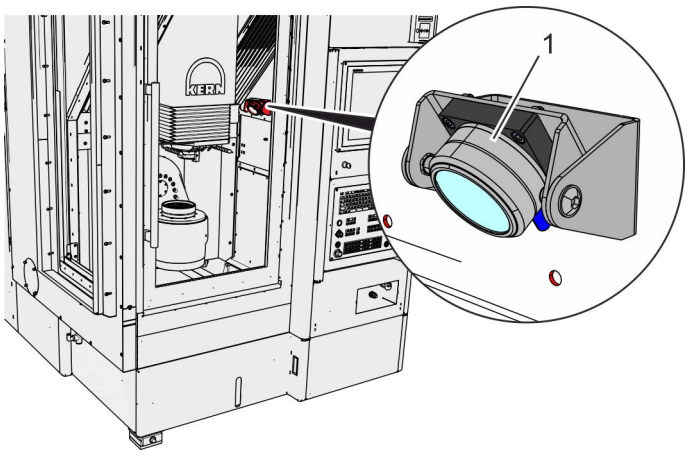


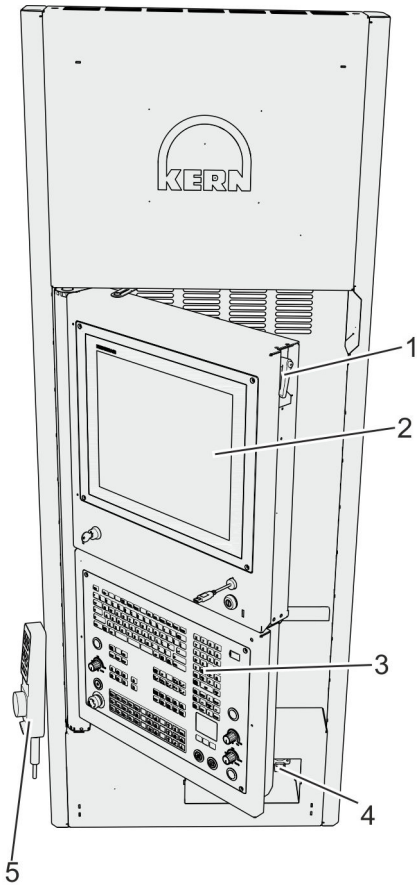
Fig. 22: Receiver for infrared workpiece sensor (option)

The receiver for the infrared workpiece sensor is located at the top, right of the work area (Fig. 22/1).

Refer to the supplier documentation provided for the infrared workpiece sensor.

NOTICE!
Make sure that the set angle of the receiver (Fig. 22/1) is not adjusted (e.g. during cleaning), otherwise communication between the infrared workpiece sensor and the receiver will be interrupted.

3.2.10 Machine control system



1 Locking handle
2 Control monitor
3 Control panel
4 Additional connections
5 Electronic hand wheel

The machine control system has a control panel (Fig. 23/3) with a control monitor (Fig. 23/2). The control system used is an CNC control from Heidenhain. The holder for the electronic hand wheel is directly below the control console.

The locking handle can be used to fixate the unfolded machine control system in place.

For the operation of the control system, refer to the Heidenhain user manual provided for the CNC control.

Fig. 23: Machine control system

3.2.11 Electronic hand wheel

The electronic hand wheel makes it possible to carry out certain machine functions while simultaneously observing the process (teaching mode). It is connected to the control panel with a flexible cable. The electronic hand wheel has a magnetic holder and can be attached to the side of the machine control system *Chapter 3.2.10 “Machine control system” on page 48*.

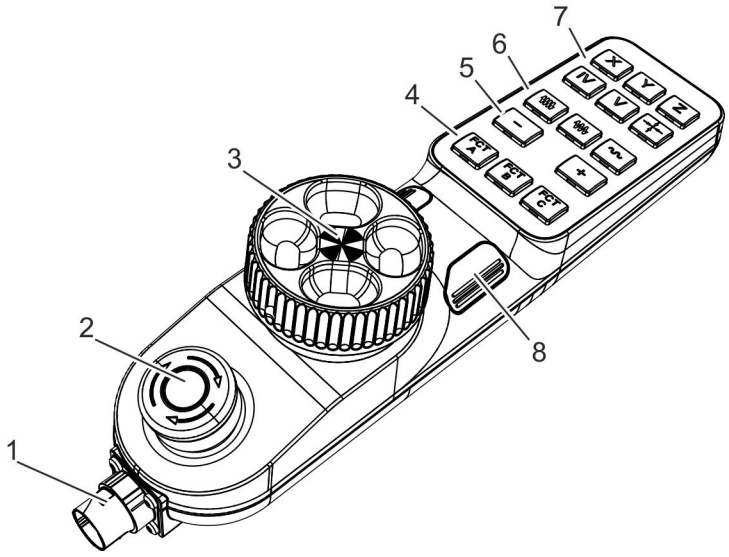


Fig. 24: Electronic hand wheel

1 Cable connection
2 Emergency-stop button
3 Hand wheel (star handle)
4 Function keys (A: spindle start, B: NC start, C: NC stop)
5 Direction of movement of the selected axis
6 Feed rate
7 Axis selection keys
8 Permission keys for two-hand switching (2x)

If the electronic hand wheel is not used, a dummy plug can be inserted in the socket in the storage compartment below the control panel. The hand wheel must then be deregistered in the user parameters.

3.2.12 Switch and supply cabinet

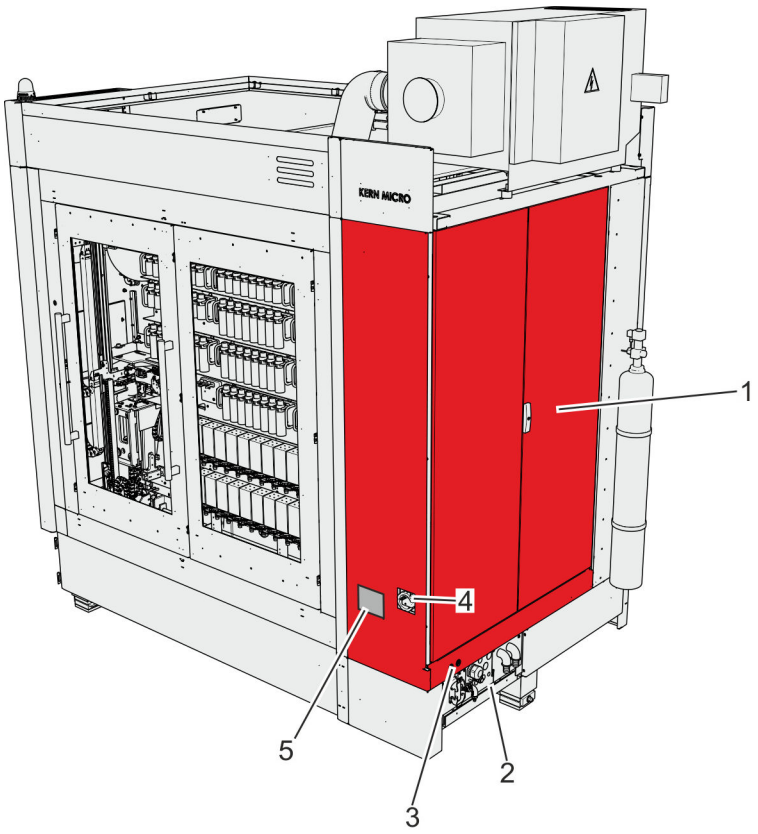


Fig. 25: Switch and supply cabinet

1 Switch and supply cabinet
2 Supply connections
3 Ethernet RJ 45 connections (2x)
4 Main switch
5 Type plate

The switch and supply cabinet (Fig. 25/1) is located on the rear of the machine. The network connections (Fig. 25/3) and the main switch (Fig. 254) are located below it.

3.2.13 Internal liquid cooler

The internal liquid cooler is located in the service area. It is used for the temperature control of the following components:

- Spindle
- Switch and supply cabinet
- Drivers of the turn and tilt unit (option)
- Cooling lubricants
- Hydraulic oil

The internal liquid cooler is supplied with cold water via a domestic water supply provided by the owner.

If there is no cold water circuit in the area of the machine, the machine can optionally be fitted with an external liquid cooler.

3.2.14 Emulsion mist and oil mist extraction system

Chapter 2.5.1 “Emulsion mist and oil mist extraction system” on page 31

3.2.15 Oil-air lubrication for the HSK 40 spindle

The machine model with an HSK 40 milling spindle features oil-air lubrication.

3.2.16 Extended swivel angle (option)

With this option, the swivel range of the B-axis is extended to 170° or 180° (MPVH).

3.2.17 Lift-off function

This option is used to prevent damage to the workpiece and tool in the event of power failure. The tools indicated in the tool table are lifted off the contour by means of residual energy.

3.2.18 Teleservice package

In this option, the machine has an access option for remote diagnosis by Kern Customer Service. Customer Service can access the following components:

- Heidenhain machine control system
- Other component control systems

Access is either via the telephone line (ISDN) or Ethernet.

3.2.19 Air gun

In this option, the machine has an air gun for cleaning the workpieces and tools with compressed air.

3.2.20 Spray gun

The machine has a spray gun to clean the work area with cooling lubricant. The spray gun is located on the right side of the work area.

3.2.21 DCM collision monitoring

With this option, the machine has collision protection by means of DCM (dynamic collision monitoring).

3.2.22 Blow-off connection for dry processing

In this option, the machine is equipped with a nozzle to which compressed air can be applied. This nozzle is attached underneath on the Z-axis. This makes it possible to blow off chips from the processing site during dry processing.

3.2.23 Energy saving package

This package provides energy saving and autostart functions, thereby increasing productivity. This package makes it possible to specify freely selectable standstill times after which the individual units or the entire machine can be switched to standby mode.

It is also possible to set a freely selectable time at which the machine exits standby mode (if active) and is switched to active again.

3.3 Service area

Overview

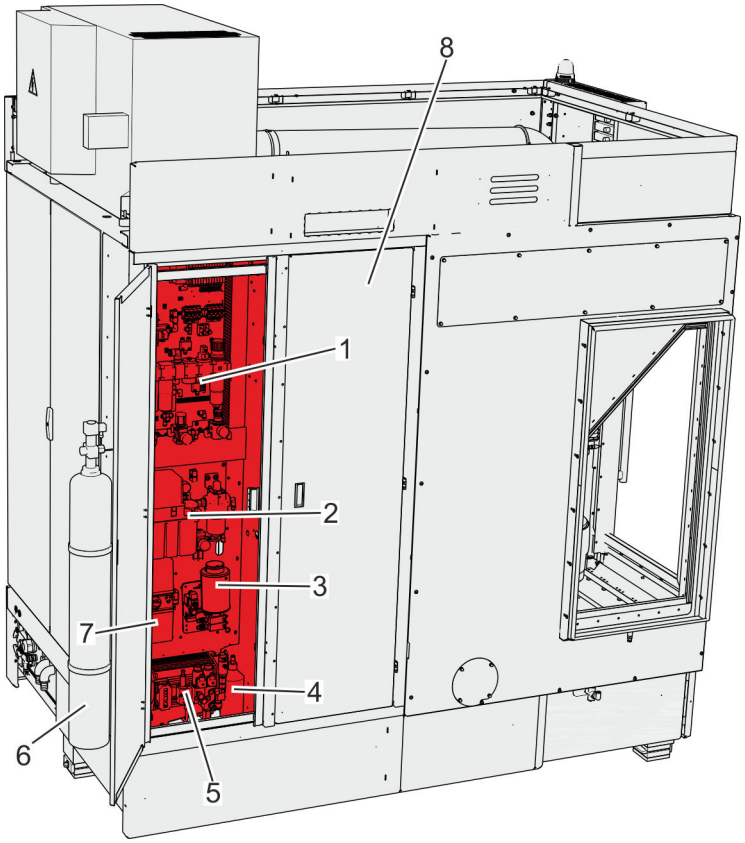


Fig. 26: Overview of the service area

1 Mounting plate with valve manifold and maintenance unit for pneumatics *“Compressed air supply” on page 54*
2 Spindle lubrication unit *“Spindle lubrication unit” on page 55*
3 Minimal quantity lubrication (option)
4 Oil return collecting flask
5 Hydraulic unit spindle (option)
6 Extinguishing agent tank for fire extinguishing system (option)
7 Central lubrication unit *“Central lubrication unit” on page 57*
8 Internal cooling management system (behind door)

The service area is located in the rear area on the left side of the machine.

Maintenance and service manual

See the maintenance and service manual provided for the maintenance intervals, descriptions and checklists of all the maintenance work to be performed.

Compressed air supply

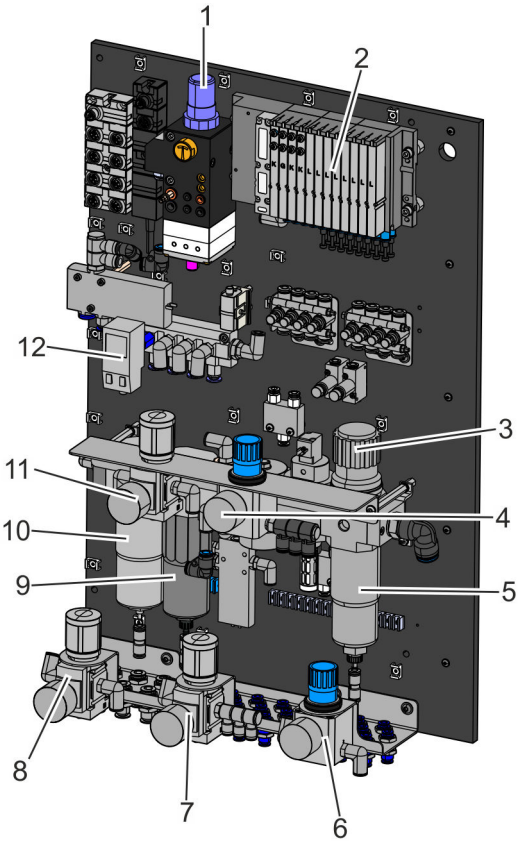


Fig. 27: Compressed air supply

1 Sealing air and valve control for laser tool measuring
2 Valve manifold
3 Pressure controller for main compressed air
4 Bearing sealing air for hydrostatic pockets
5 Fine filter
6 Sealing air, B-axis and C-axis
7 Sealing air, measuring system (X-axis, Y-axis, Z-axis)
8 Sealing air, spindle
9 Maintenance unit, activated carbon filter
10 Micro filter
11 Pressure controller for air mass balancing of Z-axis
12 Digital unit of supplied main air

The compressed air ensures that the machine functions are maintained. The compressed air supply of the machine is monitored. If the pressure falls below the permissible minimum pressure, any further machine movements are interrupted and an error message is issued by the control system.

NOTICE!
Make sure the provided compressed air has the necessary quality *“Pneumatic” on page 173*.

Compressed air is used at the machine for the following functions:

- Purging the spindle cone and the clamping shaft of the tool holder
- Purging the measuring units of the linear measuring system and the C-axis
- Cooling the tools
- Cooling the machine components
- Spindle clamping system
- Providing sealing air
- Tool measuring
- Spindle lubrication
- Pneumatic functions of the tool changer
- Opening and closing the zero clamping system
- Weight compensation
- Sealing air

For information about the supply of compressed air, refer also to the provided pneumatic diagram.

Spindle lubrication unit

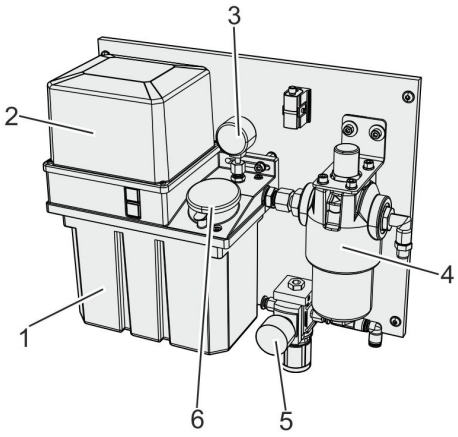


Fig. 28: Spindle lubrication unit

1 Tank
2 Cover
3 Pressure gauge
4 Filter for oil mist supply
5 Pressure gauge, pressure setting for oil mist supply
6 Hinged lid and screen filter

The spindle lubrication unit (Fig. 28/1) continuously supplies the spindle with lubricant.

The quantity of oil in the tank is monitored. If the specified pressure is not reached after switching on the pump of the spindle lubrication unit, any further machine movements are stopped and an error message is issued at the control system.

The lubricant to be used for the spindle lubrication unit can be found in the technical data Chapter 15.9 “Other operating supplies” on page 179.

Minimal quantity lubrication

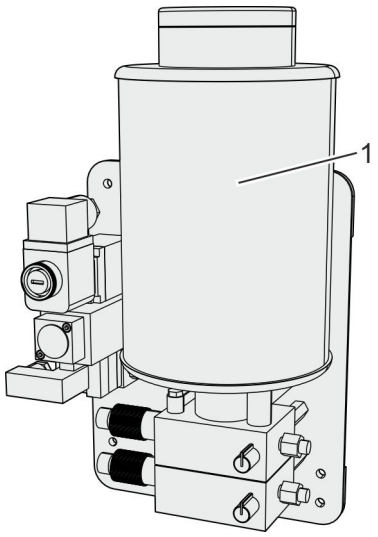


Fig. 29: Minimal quantity lubrication

With minimal quantity lubrication (Fig. 29), a mixture of oil and air is used which prevents friction heat from developing by means of demand-optimised lubrication.

The lubricant to be used for minimal quantity lubrication can be found in the technical data
Chapter 15.8 “Lubricant” on page 177.

Hydraulic unit

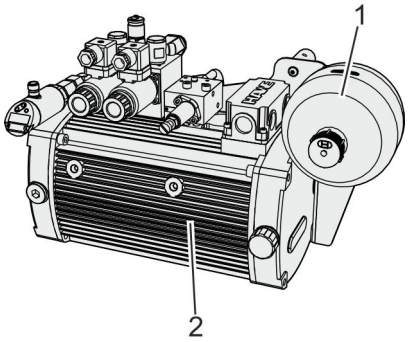


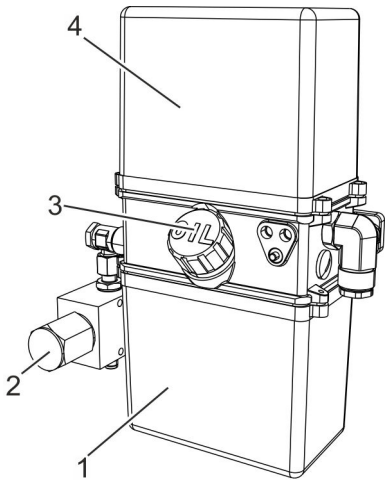
Fig. 30: Hydraulic unit

1 Pressure compensation tank
2 Tank with pump and motor

The hydraulic unit (Fig. 30) is used to clamp and release tools in the tool clamping unit of the spindles (HSK 40).

For all work on the hydraulic unit, refer to the supplier documentation provided.

Central lubrication unit



1 Tank
2 Pressure gauge
3 Filling and venting filter
4 Cover

The central lubrication unit (Fig. 31) continuously supplies the assemblies of the machine with lubricant. The central lubrication unit is located in the service area of the machine (*Chapter 3.3 “Service area” on page 53*).

The oil quantity in the tank (Fig. 31/1) is monitored. If the specified pressure is not reached and maintained for a certain period of time after switching on the pump of the central lubrication unit, any additional machine movements are stopped and an error message is issued at the main control system.

Fig. 31: Central lubrication unit

3.4 Operating modes

3.4.1 Automatic operating modes

Program run full sequence

In the “program run full sequence” operating mode , the control unit continuously carries out a programmed processing sequence in accordance with the programmed process or until an interruption occurs. The access points to the work area are safeguarded during the program sequence. Tools can be set up within the tool magazine.

The automatic mode is the standard operating mode of the machine. In this operating mode the workpieces are processed fully automated in accordance with the program process.

In the Heidenhain user manual for the CNC control system and on the control system monitor, this operating mode is abbreviated to “RUN”.

Program run single block

The “single block program run” operating mode carries out a programmed processing program like the “program run full sequence” operating mode. However, in contrast to that operating mode, only one individual block of the program is carried out. The control unit carries out each block individually when the NC start button is pushed.

In the Heidenhain user manual for the CNC control system and on the control system monitor, this operating mode is abbreviated to “SGL”.

3.4.2 Programming operating modes

Save/edit program

This operating mode is used to create/program processing programs.

Program test

In this operating mode, the CNC control system simulates programs and program sections to identify, for example, geometric incompatibilities, missing or incorrect information in the program and infringements of the work area. The simulation is supported visually by means of different views.

3.4.3 Manual operating modes

Manual operation

In this operating mode, the machine can be controlled directly via the machine function keys without any programming. The machine axes can be positioned manually or gradually; you can set the reference points and pivot the machining plane. Individual machine functions can be switched on and off via the machine function keys. A limitation of the feed rate or rotational speed does not take place in this operating mode.

Automatic machine functions such as a program sequence or an automatic tool change are not possible.

In this operating mode, all the controls for the electronic hand wheel are deactivated, except for those to stop the machine (e.g. NC stop or spindle stop).

In the Heidenhain user manual for the CNC control system and on the control system monitor, this operating mode is abbreviated to “MAN”.

Electronic hand wheel

In this operating mode, the machine axes can be moved directly using the electronic hand wheel. In addition, selected machine functions can also be switched on or off using the buttons on the hand wheel.

A limitation of the feed rate or rotational speed does not take place in this operating mode. Automatic machine functions such as a program sequence or an automatic tool change are not possible. In addition, if used together with the “teaching mode”, it is possible to move the individual axes at low feed speed when the sliding doors to the work area are open.

In this operating mode, all the controls for the control panel are deactivated, except for those to stop the machine (e.g. NC stop or spindle stop).

Teaching mode

The machine can be set up or equipped in this operating mode. Like the operating mode “Manual operation”, the machine can be controlled directly via the machine function keys without programming. In addition, it is possible to move the individual axes at low feed speed and execute machine functions with the permission keys when the sliding doors to the work area are open.

This operating mode is selected using a key switch. For safety reasons, in this operating mode

- The feeds for the X-, Y- and Z-axis are limited to 2 m/min
- The axis movements with the electronic hand wheel can only be operated with at least one permission key pressed
- Rotary movements of the spindle are limited
- No automatic machine functions (e.g. a program sequence or an automatic tool change) are possible

The electronic hand wheel or the control panel can be used in this operating mode.

Positioning with manual input

This operating mode is used for simple processing or for the pre-positioning of the tool. Here, individual program lines can be entered in clear text format or in accordance with DIN/ISO and can be executed directly.

In the Heidenhain user manual for the CNC control system and on the control system monitor, this operating mode is abbreviated to “MDI”.

3.5 Controls and display elements

3.5.1 Main switch

The main switch is located on the side of the switch cabinet on the right machine side *“Main switch” on page 28*.

3.5.2 Control panel

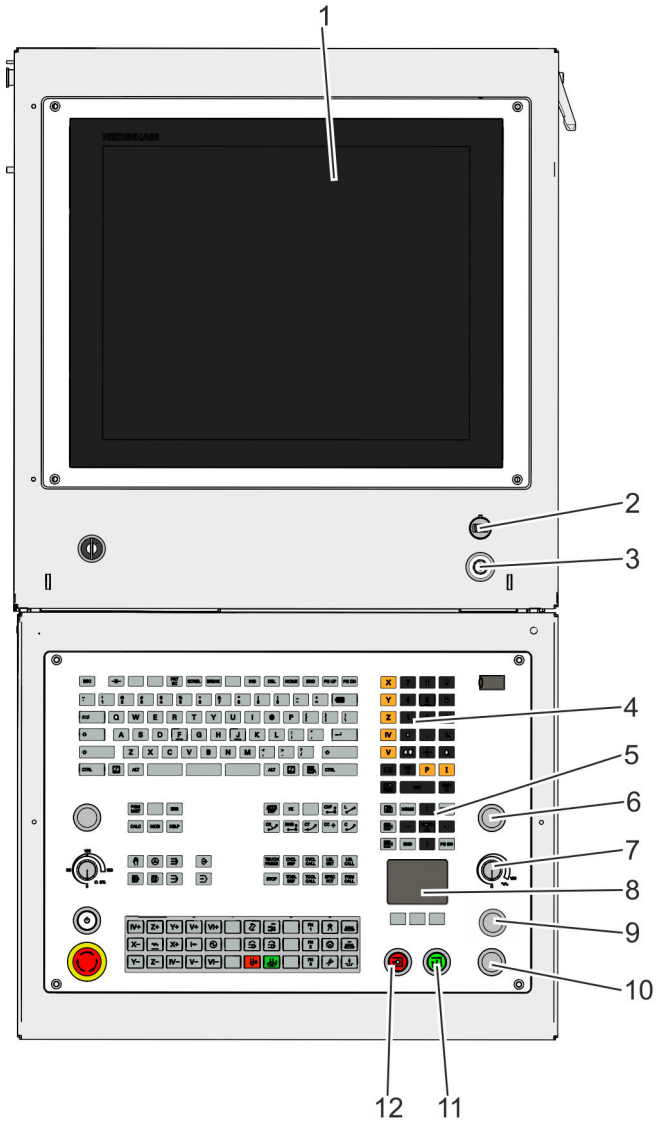


Fig. 32: Overview of the control panel

1 Monitor with touch function
2 USB connection (↯ *Chapter 3.6.2 “Control console connections” on page 74*)
3 Illuminated pushbutton for switching on the machine (↯ *“Main switch control” on page 71*)
4 Keyboard (numeric keypad) (↯ *“Keypad to enter letters and numbers” on page 64*)
5 Cursor control keys, smarT.NC (↯ *“Special functions/ smarT.NC” on page 71*)
6 Not assigned
7 Feed override control dial Fmax (option)
8 Mouse, track pad (↯ *“Mouse and track pad” on page 71*)
9 Not assigned
10 Not assigned
11 NC-START illuminated pushbutton
12 NC-STOP illuminated pushbutton

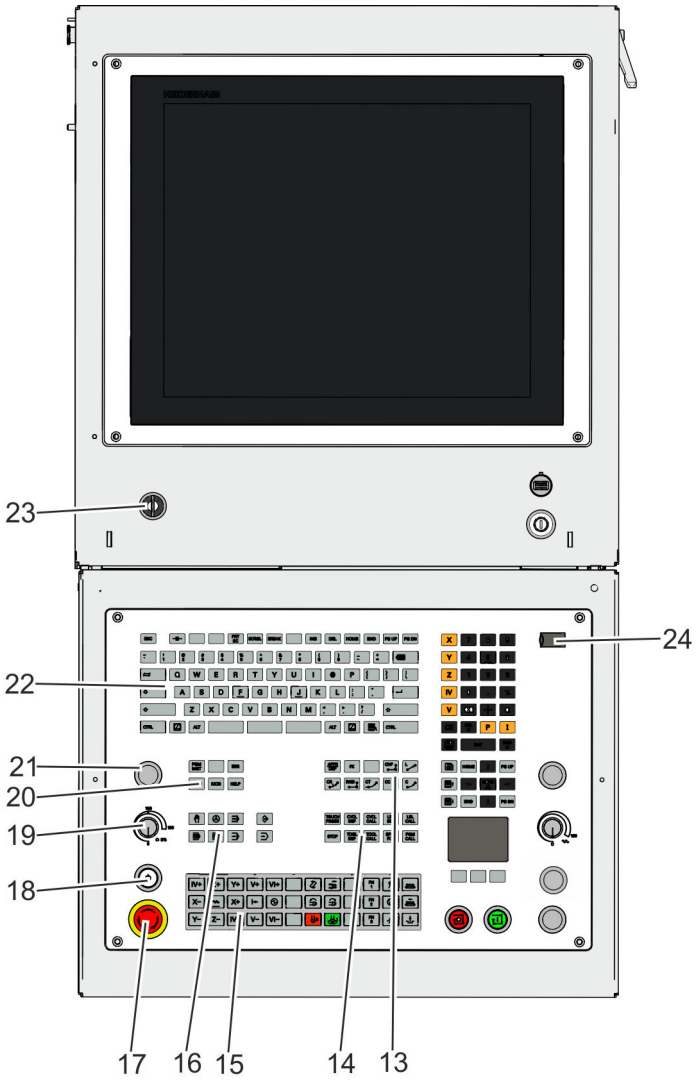


Fig. 33: Overview of the control panel

13 Line movement keys (↳ *"Program line movements" on page 66*)
14 Keys for tools, cycles, programs (↳ *"Tools, cycles, programs" on page 68*)
15 Keys for direct operation, machine function keys (↳ *"Direct operation and machine function keys" on page 69*)
16 Keys for operating modes (↳ *Chapter 3.4 "Operating modes" on page 57*)
17 Emergency-stop button
18 Illuminated pushbutton for control voltage
19 Feed override control dial (↳ *"Override control dial" on page 65*)
20 Program manager keys (↳ *"Manage programs/files, TNC-functions" on page 65*)
21 Speed override control dial (↳ *"Override control dial" on page 65*)
22 Keyboard (↳ *"Keypad to enter letters and numbers" on page 64*)
23 Key switch for teaching mode
24 USB connection (↳ *Chapter 3.6.2 "Control console connections" on page 74*)

Monitor

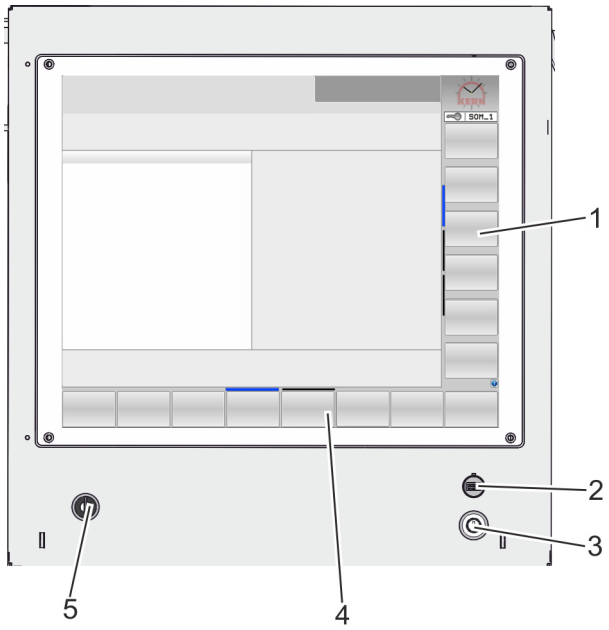


Fig. 34: Monitor with touch function

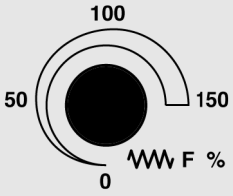
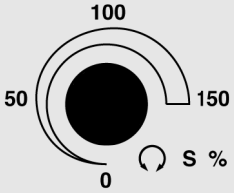
Pos.	Name	Function/assignment
1	Vertical buttons	Buttons (touch function) used to select the individual vertical functions
2	USB connection	
3	Illuminated push-button	Switch on machine
4	Horizontal buttons	Buttons (touch function) used to select the individual horizontal functions
5	Key switch	Switch teaching mode on or off

For the individual software functions, refer to the Heidenhain user manual provided for the CNC control.

Keypad to enter letters and numbers

Illustration	Function/assignment
Q W E	Alphabetic keypad for text input, file names, and DIN/ISO programming
X ... V	Select or enter coordinate axes into the program.
0 ... 9	Numbers
. -/+	Change decimal point or +/- sign.
P I	Enter polar coordinates/incremental values.
Q	Q-parameter programming/Q-parameter status
	Teach-In: Set zero point or accept calculator values.
NO ENT	Skip dialogue questions and delete words.
ENT	Finish entry and continue dialogue.
END	Finish set, end entry.
CE	Reset numeric value entries or delete TNC-error messages.
DEL	Cancel dialog, delete program section.

Override control dial

Illustration	Function/assignment
	**Override control dial for feed F** Potentiometer for continuous adjustment of the axis feed in a range from 0% to 150%. It is not possible to accidentally exceed the maximum permitted axis feed here.
	**Override control dial for spindle rotation speed** Potentiometer for continuous adjustment of the spindle speed in a range from 30% to 150%. It is not possible to accidentally exceed the maximum permitted axis feed or fall below the minimum permitted spindle speed here. NOTE: Optionally, this control dial can also be used for the F-Max feed. The range is limited here to 0% – 100%.

Manage programs/files, TNC-functions

Illustration	Function/assignment
PGM MGT	Select and delete programs/files, external data transfer.
CALC	Show calculator.
MOD	Select MOD function.
HELP	Display help texts for NC-error messages.
ERR	Display all pending error messages.

Program line movements

Illustration	Function/assignment
	Approach/leave contour.
	Free FK outline programming
	Round bevel/corners
	Straight line
	Circular orbit with radius
	Circular orbit with tangential connection
	Centre of circle/pole for polar coordinates
	Circular orbit around centre of circle

Tab. 1: Selection keys of machine operating modes

Illustration	Function/assignment
	**Manual operation** To set up the machine, to position individual axes manually or gradually.
	**Electronic hand wheel** To set up the machine. Individual axes can be positioned manually, gradually or precisely with the hand wheel.
	**smarT.NC** For workshop programming
	**Positioning with manual input (MDI)** To move the axes to specific coordinates or to execute functions that are only possible in the program run
	**Program sequence single block** To confirm each NC line before it is executed
	**Program sequence full sequence** To execute complete NC programs

Tab. 2: Selector keys of programming operating modes

Illustration	Function/assignment
	**Save/edit program** To create and subsequently change the NC programs
	**Program test** To simulate NC programs

Tools, cycles, programs

Illustration	Function/assignment
TOUCH PROBE	Define sensor system cycles.
CYCL DEF CYCL CALL	Define and call up cycles.
LBL SET LBL CALL	Enter and call up sub programs and program component repetitions.
STOP	Enter program stop in a program.
TOOL CALL TOOL DEF	Prepare and switch tools with a defined spindle speed.
SPEC FCT	Display special functions
PGM CALL	Define program call, select zero point and points tables

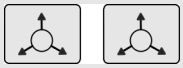
Direct operation and machine function keys

Tab. 3: Axial direction control for direct operation

Illustration	Function/assignment
Z+ Y+ X+ V+ IV+	**Keys for manual movement in the individual axes in the feed (+)** Traversing direction of the individual axes in positive traversing direction
Z- Y- X- V- IV-	**Keys for manual movement in the individual axes in the feed (-)** Traversing direction of the individual axes in negative traversing direction Note: The VI+ and VI keys are not assigned (no function).
	No function
	No function
	Rapid mode
 + Z+	**Manual movement of the axis (e.g. Z-axis) in positive axial direction in rapid operation** Operate both keys at the same time to move the axis into the desired axial direction in rapid mode.

Tab. 4: Machine function keys

Illustration	Function/assignment
	Switch on chip conveyor in forward motion (OPTION).
	Switch on chip conveyor in reverse motion (OPTION).
FN 3 ... FN 5	**Free function keys** The function keys F3, F4 and F5 can be modified by the customer for other machine functions (special functions).
	Commission key machine control panel

Illustration	Function/assignment
	**Clamp/release tool** Releases the tool in the spindle for manual tool change. For safety reasons this key exists twice. To trigger the desired function, push both keys at the same time
	**Cover lighting** Turn cover lighting in the work area on and off
	**Spindle START** Starts the spindle.
	**Spindle STOP (with NC-STOP)** ■ Stops the spindle during manual operation. ■ In the automatic operating modes, the spindle STOP button triggers an *[NC-STOP]*. This stops the program in the current line and the *[INTERNAL STOP]* softkey appears.
	**Free function key (standard), chuck – 3-axis (option)** To open and close the table chuck. If these optional components are not installed, the key can be freely assigned.
	**Free function key (standard), chuck – 5-axis (option)** To open and close the dividing head. If these optional components are not installed, the key can be freely assigned.
	**M8/M9** Exterior cooling/surge cooling ON/OFF
	**M7/M9** Minimal quantity lubrication ON/OFF
	Triggers a request to unlock the machine guard. Once the machine reaches a non-hazardous state, the door can be opened.

Mouse and track pad

Illustration	Function/assignment
	Mouse buttons (from above): ■ Right mouse button ■ Middle mouse button ■ Left mouse button
	Mouse pad (track pad)

Special functions/smarT.NC

Tab. 5: Special functions/smarT.NC

Illustration	Function/assignment
	Select next tab in the form.
	Select first input field in previous/next frame.

Tab. 6: Move cursor

Illustration	Function/assignment
	Cursor up/down
	Cursor right/left
	Directly select sets, cycles and parameter functions.

Main switch control

Illustration	Function/assignment
	**Main switch** Turn machine on and off.

3.5.3 Electronic hand wheel

Chapter 3.2.11 “Electronic hand wheel” on page 49

3.5.4 Strip light status display

Fig. 35: Strip light status display

The strip light status displays (Fig. 35) show the various operating statuses of the machine in colour. There is a strip light status display on both the side and front.

Light signal	Description
Malfunction (red)	Lights up if there is a pending error message.
Operation (clear/white)	Lights up during automatic mode or when the star handle is activated in the control system.
Ready for operation (green)	Lights up when ready for operation.

The signal light may have additional signal colours and/or a different order of the signal colours, depending on the machine version.

Light signal (extra/ option)	Description
Warning (yellow)	Lights up if a warning message is pending or in the start-up menu.
Note (blue)	Lights up if a notice is pending.

3.6 Interfaces

3.6.1 Supply connections

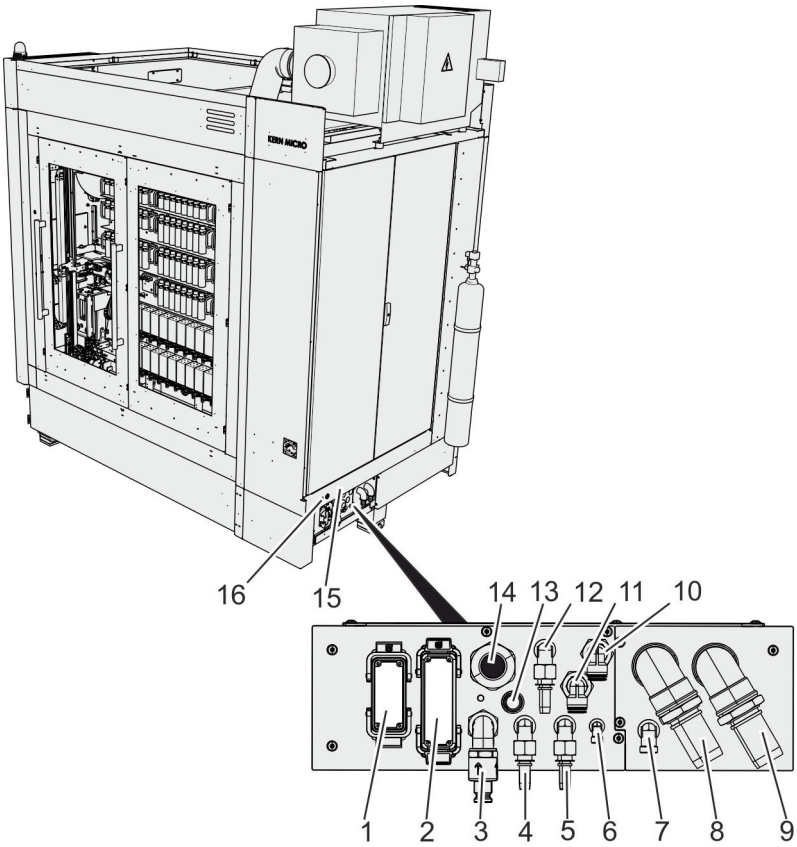


Fig. 36: Supply connections (maximum use)

1 Data interface for cooling water filter system (option)
2 Hybrid aggregate data interface (option)
3 Compressed air supply
4 Cooling water filter system feed (option)
5 Cooling water filter system return (option)
6 Internal cooling lubricant supply for spindle (option)
7 Hydraulic pressure for lowering linear axes (option)
8 Cooling water feed
9 Cooling water return
10 Hydraulic supply for linear axes, return (option)
11 Hydraulic leakage for linear axes, return (option)
12 Hydraulic supply for linear axes, feed (option)
13 Pneumatic connection for cooling water filter system (option)
14 Mains connection
15 Ethernet (2x)
16 Data interface for external liquid cooler

3.6.2 Control console connections

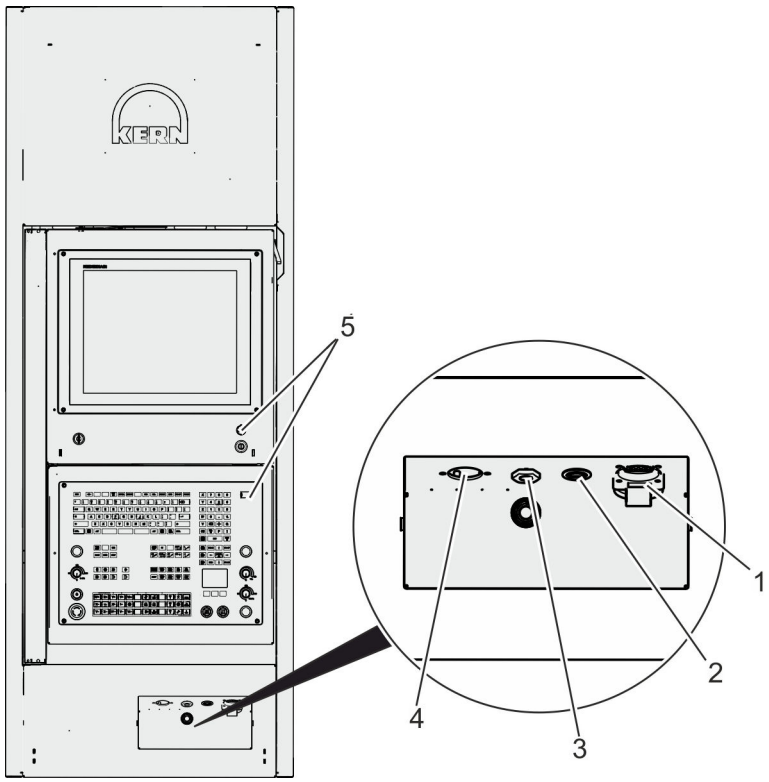


Fig. 37: Control panel connections

1 Grounding-contact socket for additional equipment (max. 16 A)
2 Ethernet RJ 45
3 Compressed air connection for compressed air gun
4 Electronic hand wheel connection
5 USB connection

NOTICE!
Observe the 16 A capacity of the grounding contact socket when connecting devices.

3.6.3 Connections on the switch and supply cabinet (on the side)

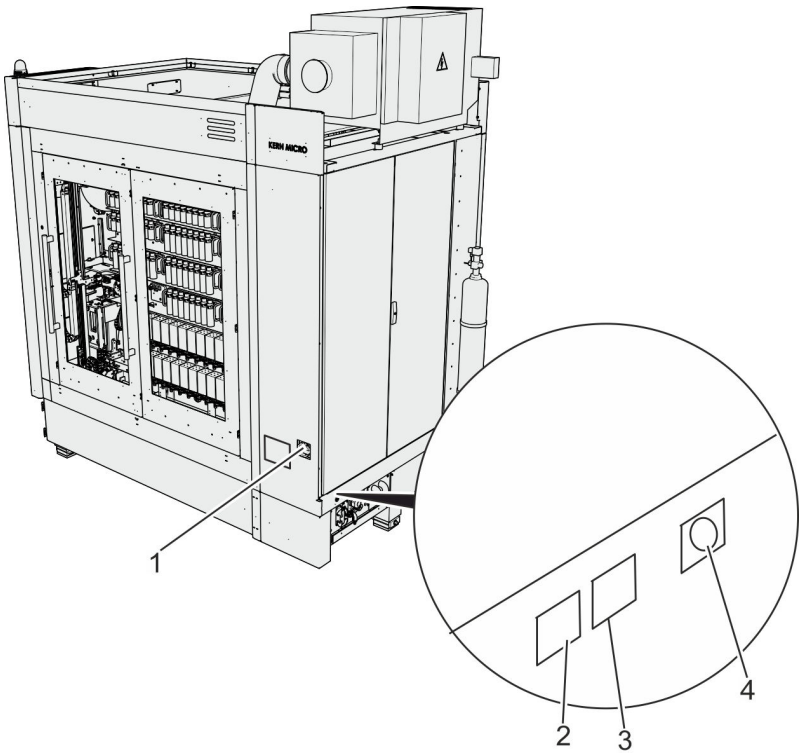


Fig. 38: Switch and supply cabinet

1 Main switch
2 Ethernet RJ 45 connections
3 Ethernet RJ 45 connections
4 External liquid cooler connection (option)

3.6.4 Connection for external workpiece changer

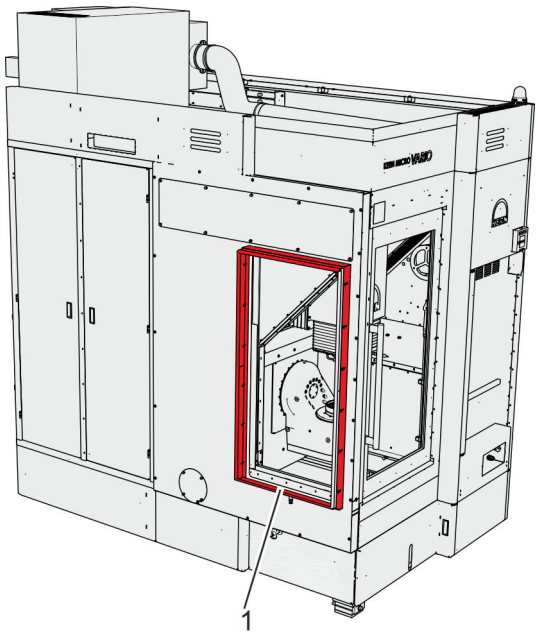


Fig. 39: Connection for external tool changer

Additional components can be connected on the left side of the work area (e.g. an external tool changer). Instead of the fixed side plate with view panel, an automatic (Fig. 39/1) flap is installed, which is opened only when inserting or removing a workpiece.

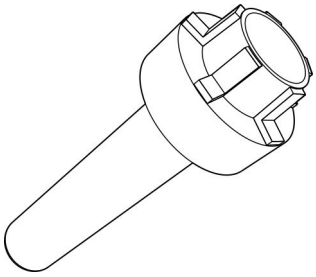
For more information about connecting an external tool changer, please contact Kern's customer service “Customer service” on page 4.

3.7 Accessories

Infrared workpiece sensor for workpiece measuring

Is automatically changed into the spindle and transmits the data via infrared interface for an automatic workpiece position measuring.

Cone head cleaner



Cone head cleaner (Fig. 40) for manual cleaning of the conical head of the spindle.

Fig. 40: Cone head cleaner (example HSK 40)

3.8 Machine-specific M-functions

The M-functions are utilized to control specific machine functions, e.g. interruptions in the program run, turning on coolant. An overview of the machine-specific additional functions is set out below. For a detailed description of the M-functions, see the Heidenhain user manual for the CNC control unit.

M-command	Function
M00	Program STOP / spindle STOP / coolant OFF
M01	Optional program STOP
M02	Program STOP / spindle STOP / coolant OFF; if necessary, delete the status display (independent of the machine parameters) / return to set 1
M03	Switch on the spindle running clockwise
M04	Switch on the spindle running anticlockwise
M05	Stop spindle
M07	Switch on external oil-air supply / minimal quantity lubrication (option)
M08	Switch on coolant
M09	Switch off coolant
M10	Switch on external air supply
M13	Switch on the spindle running clockwise + switch on coolant
M14	Switch on the spindle running anticlockwise + switch on coolant
M15	Switch on the spindle running clockwise + switch on minimal quantity lubrication (M3+M7)
M16	Switch on the spindle running anticlockwise + switch on minimal quantity lubrication (M4+M7)
M18	Align spindle to reference

M-command	Function
M19	Align spindle to 0°
M20	Align spindle with CYCL 13
M24	Chip conveyor interval on (option)
M25	Chip conveyor continuous operation on (option)
M26	Chip conveyor off (option)
M30	Same function as M02
M31	Unlock work area door
M32	Axes to comfort position
M40	Switch on additional air (option)
M41	Switch off additional air (option)
M45	Blow air tool cleaning on (option)
M46	Blow air tool cleaning off (option)
M50	Switch on table flushing (option)
M51	Switch off table flushing (option)
M52	Activate sensor flushing (option)
M52	Deactivate sensor flushing (option)
M62	Turn on compressed-air supply
M63	Turn off compressed-air supply
M67	Switch off machine (e.g. after program end during the night).
M70	Piece counter 1 reset; visible in PLC window
M71	Piece counter 1 plus 1; visible in PLC window
M75	Open the tool change flap
M76	Close the tool change flap
M89	Free additional function or cycle call, modally effective
M90	Constant line speed at corners
M91	In the positioning set: Coordinates refer to the machine zero point
M92	In the positioning set: Coordinates refer to a defined position
M94	Reduce the display of the rotary axis to a value below 360°
M97	Process small contour steps
M98	Completely process open contours

M-command	Function
M99	Cycle call in sets
M101	Automatic tool change with a sister tool when service life expires
M103	Reduce feed when dipping to factor F (percentage value)
M104	Reactivate the last reference point set
M105	Perform processing using second Kv factor
M106	Perform processing using first Kv factor
M107	Reset error message for sister tools with machining allowance
M108	Suppress error message for sister tools with machining allowance
M109	Constant line speed at the tool cutting edge (feed increase and feed reduction)
M110	Constant line speed at the tool cutting edge (feed reduction only)
M111	Reset M109/M110
M112	Insert contour transitions between any contour transitions
M113	Reset M112
M115	Reset M114
M116	Feed at rotary tables in mm/min
M117	Reset M116
M118	Overlap the hand wheel position during the program
M120	Predict radius-corrected contour (LOOK AHEAD)
M124	Contour filter
M126	Move line-optimised rotary axis
M127	Reset M126
M128	Maintain the position of the tool tip when positioning the swivel axes (TCPM)
M129	Reset M128
M130	In the positioning set: Points refer to the non-tilted coordinate system
M135	Reset M134
M136	Feed F in millimetres per spindle revolution
M137	Reset M136

M-command	Function
M138	Selection of swivel axes
M140	Retraction from the contour in tool axis direction
M141	Suppress sensor system monitoring
M143	Delete basic rotation
M144	Takes machine kinematics into account in the ACTUAL/TARGET position at the end of the set
M145	Reset M144
M148	Automatically lift tools off the contour at NC-STOP
M149	Reset M148
M150	Suppress limit switch message
M197	Round corners
M300	Start spindle infeed (option depending on spindle type)
M301	Processing without M3 M4
M302	Automatic tool measuring (option)
M307	Switch on internal oil-air supply (option)
M308	Switch on internal coolant (option)
M310	Switch on internal air supply (option)
M313	Execution of M303 & M308
M314	Execution of M304 & M308
M384	Set spindle override to 100%
M385	Set feed override to 100%
M386	Set rapid mode override to 100%
M387	Reset all overrides to 100%
M391	Freeze theta compensation
M392	Unfreeze theta compensation
M393	Switch off theta compensation
M394	Extend tailstock (option)
M395	Retract tailstock (option)
M398	Activate DCM (collision monitoring) (option)
M399	Deactivate DCM (collision monitoring) (option)
M403	Switch on dressing spindle running clockwise (option)

M-command	Function
M404	Switch off dressing spindle running clockwise (option)
M405	Switch off dressing spindle (option)
M410	Switch on feed block X-axis
M411	Switch off feed block X-axis
M414	Switch on feed block Z-axis
M415	Switch off feed block Z-axis
M416	Switch on feed block B-axis
M417	Switch off feed block B-axis
M418	Switch on feed block C-axis
M419	Switch off feed block C-axis
M420	Activate 4th axis clamping
M421	Release 4th axis clamping
M422	Feed block OFF Z-axis
M424	Feed block OFF C-axis
M480	Free M-function_01 (customer option) is programmed for special customer wishes
M481	Free M-function_02 (customer option) is programmed for special customer wishes
M482	Free M-function_03 (customer option) is programmed for special customer wishes
M483	Free M-function_04 (customer option) is programmed for special customer wishes
M484	Free M-function_05 (customer option) is programmed for special customer wishes
M485	Free M-function_06 (customer option) is programmed for special customer wishes
M486	Free M-function_07 (customer option) is programmed for special customer wishes
M487	Free M-function_08 (customer option) is programmed for special customer wishes
M488	Free M-function_09 (customer option) is programmed for special customer wishes
M489	Free M-function_10 (customer option) is programmed for special customer wishes
M500	Solids extraction ON (option)
M501	Solids extraction OFF (option)

M-command	Function
M505	Oil mist extraction ON (option)
M506	Oil mist extraction OFF (option)
M510	Air workpiece cleaning/cooling ON (option)
M511	Air workpiece cleaning/cooling ON (option)
M700	Activate minimal quantity lubrication “light” (option)
M701	Activate minimal quantity lubrication “medium” (option)
M702	Activate minimal quantity lubrication “heavy” (option)

4 Switching on and off

4.1 Switch on the machine

Switching on and starting up the machine

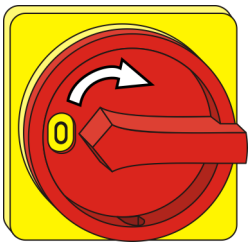
Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

To switch on the processing centre, proceed as follows:

Switching on additional components

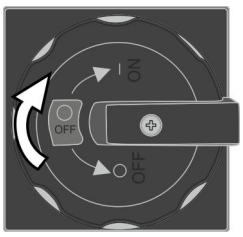
Switching on additional components



2. *Normally, the emulsion mist and oil mist extraction system does not need to be switched on and off separately as it is supplied with power via the main switch of the machine.*

Turn the main switch of the emulsion mist and oil mist extraction system to **1** in accordance with the supplier documentation from the manufacturer.

Switching the machine on



3. Turn the main machine switch to **I** ON.

4. Press the *[Switch on]* illuminated pushbutton.

⇨ The control unit powers up. This can take several minutes. Afterwards, the *"Power interruption"* message is displayed in the monitor header.

5. Press the *[CE]* button on the numeric keypad to delete the *"Power interruption"* message.

⇨ The control unit software is loaded.

6. Press the *[Control voltage On]* illuminated pushbutton.

7. Press the *[NC-START]* illuminated pushbutton.

⇨ The monitor displays the request to briefly open the door to the work area and close it again.

8. Open the door to the work area briefly and close it ↳ *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

   ⇨ The notice of a reference run appears on the screen.

NOTICE!

Reference run

During the start-up, the machine must carry out a reference run in order to specify a distinct position of the individual axes. For this purpose, there are regularly spaced reference points on the individual axes. During the reference run, each axis moves far enough until the next reference point is captured.

The sequence during the movement toward the reference points on the individual axes is specified as follows:

- The Z-axis moves to the next reference point in + traversing direction.
- The X-axis moves to the next reference point in - traversing direction.
- The B-axis (swivel axis) moves to the next reference point in + traversing direction.
- The C-axis (rotary axis) moves to the next reference point in + traversing direction.
- The Y-axis moves to the next reference point in - traversing direction.

The axis positions of all axes are saved when the control unit is switched off. During the restart of the machine the traversing direction of the axes is inverted when the axis is at a distance of less than 50 mm to a software limit switch.

Workpieces or other components in the area of the axis movements can cause a collision and hence damage the machine.

Moving over reference points

9. Check whether the work area is unobstructed so that the reference run can be carried out.

In respect of reference runs, also observe the notes in the supplier documentation provided for the Heidenhain control unit.

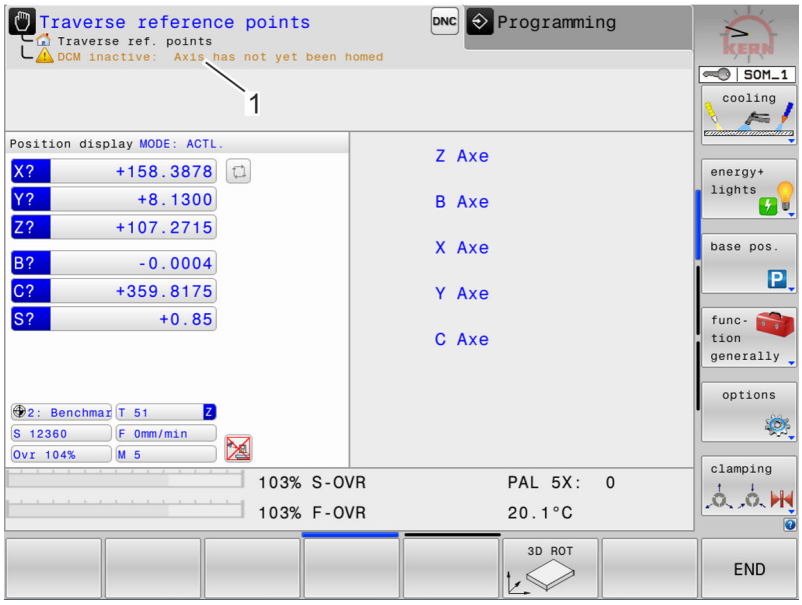


Fig. 41: Warning notice for reference run

10. Confirm the warning notice on the monitor (Fig. 41/1) with the *[NC-Start]* illuminated pushbutton.

⇨ The automatic reference run starts. All axes are checked automatically.

NOTICE!

If the machine axes have been moved when the machine is switched off, the control unit detects a position difference during start-up. In such cases, the axes in question need to be inspected again ↳ *"Check axis position" on page 86*.

11. If the automatic reference run has been carried out successfully, note the following points:

- Do not operate the spindle in the following circumstances:
  - There is no tool clamped in the spindle.
  - The optional components are switched off or are in a defective condition
- After a standstill phase of more than two weeks, only start workpiece processing after the run-in phases ↳ *"Standstill > 2 weeks" on page 92*.
- If oil-air lubrication is used on the machine, ensure prior to any start-up that the bearings in the spindle are supplied sufficiently with oil. In this regard, carry out an oil distribution run after switching on the machine and prior to the start of production ↳ *"Run-in phase for oil-air lubrication" on page 92*.

Check axis position

NOTICE!
If the machine axes have been moved when the machine is switched off, the control unit detects a position difference during start-up. In such cases, the axes in question need to be inspected again.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:

- Machine is switched on and powered up *“Switching on and starting up the machine” on page 83*.

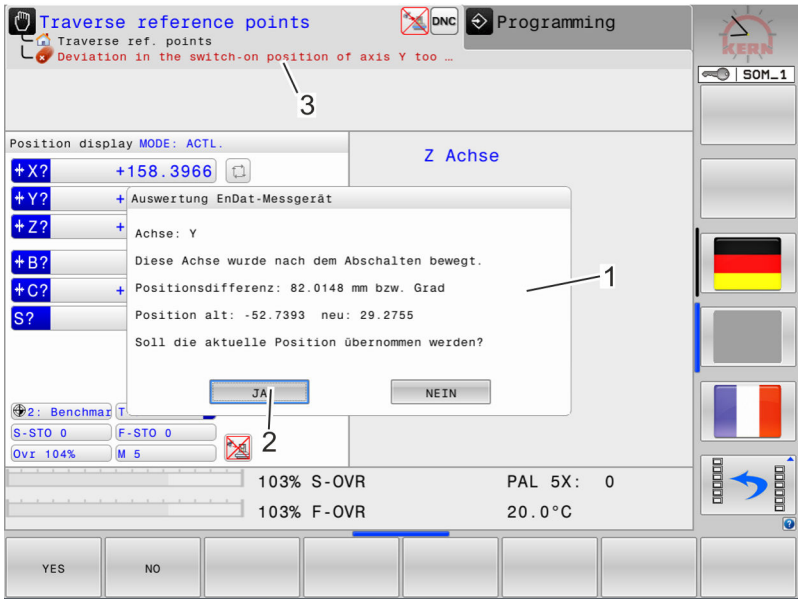


Fig. 42: Deviation in the switch-on position

1. Confirm the deviation following a visual inspection (Fig. 42/1) with the *“YES”* button.

2. Press the *[CE]* button on the numeric keypad to delete the error message (Fig. 42/1).

3. Press the *[Control voltage On]* illuminated pushbutton and hold it for about 2 seconds.

4. Start the reference run with the *[NC-Start]* illuminated push-button.

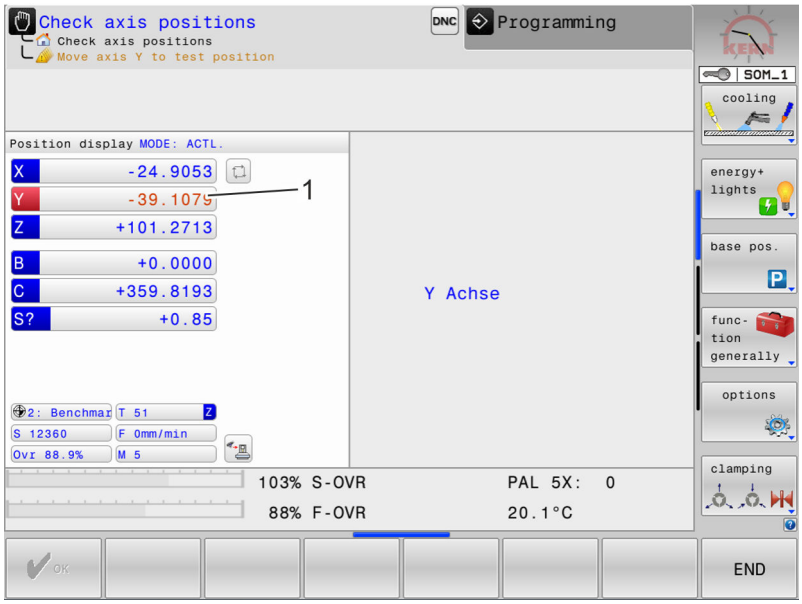
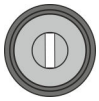


Fig. 43: Reference run, Y-axis (example)

5. Press the *[NC-Start]* illuminated pushbutton to move the first faulty axis (example Y-axis: Fig. 43/1) to the test position.



6. Use the *[teaching mode]* key switch to activate teaching mode ↳ *Chapter 5.2 “Setting teaching mode” on page 95*.

⇨ ■ The screen displays the blinking notice *“SOM2.”*
■ The door to the work area is unlocked.

If the sliding door was open during activation of teaching mode, close it once and open it again so that operating mode can be used.

7. Open the sliding door to the work area ↳ *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

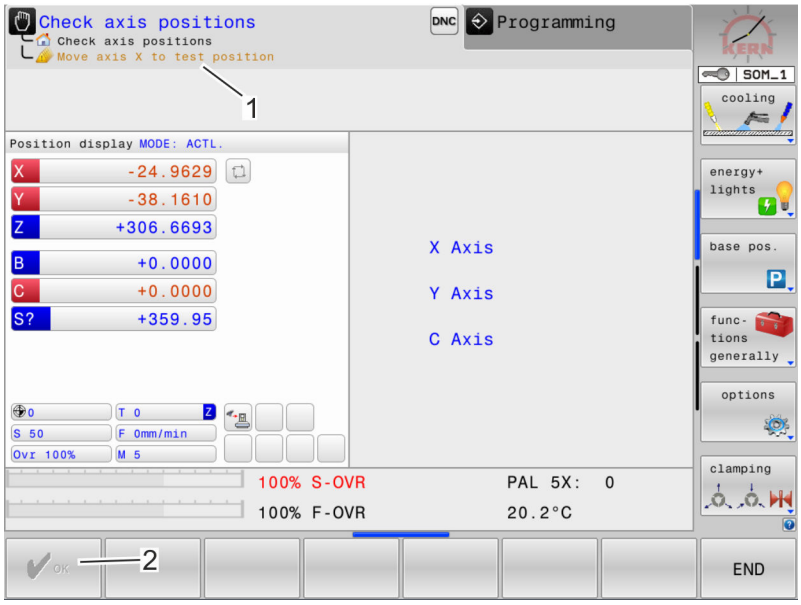


Fig. 44: Is the axis at the test position?

8. Confirm the dialogue on the monitor (Fig. 44/1) with the *"OK"* softkey (Fig. 44/2).

9. Press and hold the permission key.

⇨ The first faulty axis is positioned at its referenced test position (0 mm).

NOTICE!
If there are obvious and conspicuous deviations of the axes from the previously indicated values, contact Kern customer service.

10. Repeat steps 5 – 10 until all faulty axes are referenced.

⇨ The test of the axis positions is complete.

4.2 Switching off the machine

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:
- No processing program is active.

NOTICE!
It is possible to switch off the machine while a processing program is running. However, this should generally be avoided because it may damage the tools and the machine.

1. Remove the processing tool from the spindle *Chapter 6.4 “Changing the tool in the spindle” on page 100*.
2. Set the operating mode to “Manual operation” *Chapter 5.3 “Setting manual operation” on page 96*.
3. Press the arrow keys to switch to the next softkey bar until the softkey bar with the main switch symbol appears.

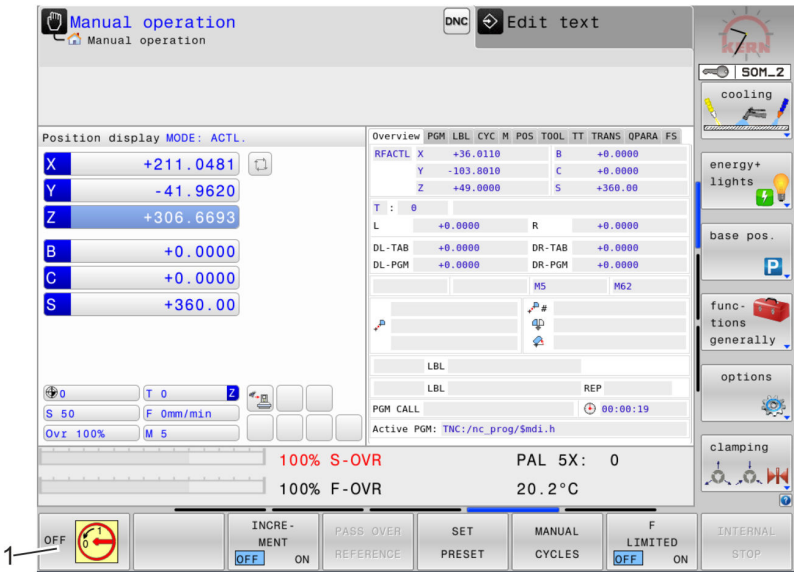


Fig. 45: Switching off

4. Press the *[OFF]* softkey (Fig. 45/1).

5. Press the *[OK]* softkey to confirm switching off.

⇨ All current processing and system data are written to the internal hard drive and the machine turns itself off automatically.

NOTICE!

Do not switch off the machine with the main switch while the data are written to the hard drive, because otherwise the data will not be saved.

ENVIRONMENT!

Save energy!

If the machine is to be shut down for a longer period, it should also be switched off at the main switch.

The emulsion mist and oil mist extraction system does not need to be switched off separately as it is supplied with power via the main switch of the machine.

4.3 Shutdown in emergencies

In hazardous situations, all movements of the components must be stopped as quickly as possible.

Shutdown in emergencies

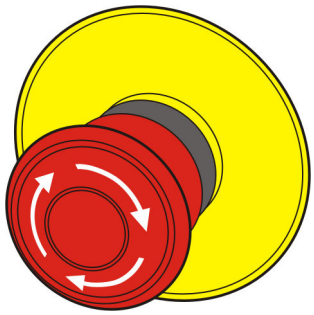


Fig. 46: Emergency-stop button

Proceed as follows in case of an emergency:

1. Press the emergency-stop button (Fig. 46) immediately.
2. If there is no risk to your own health, rescue any persons in the danger zone.
3. Provide first aid if necessary.
4. Notify the responsible person on site.
5. Switch off the machine and secure it against restarting
↳ *Chapter 2.9 “Safeguard against restart” on page 36*.

WARNING!
Risk of fatal injury due to residual voltage!
For 5 minutes after the main switch has been switched off, there is still a dangerous residual charge at the machine. Furthermore, 230 VAC are permanently applied to the fire extinguishing system (option).

– Wait until the residual voltage has dissipated before starting any work on electrical components.

4.4 Restarting after an emergency stop

When an emergency stop button has been pressed, comply with the following procedure to restart.

Personnel: ■ Machine operator

Prerequisite:

■ The cause of the emergency stop has been eliminated

1. Unlock the emergency stop button by turning it.
2. Press the *[CE]* button to acknowledge the fault.
3. Press the *[Control voltage On]* illuminated pushbutton.
   ⇨ The machine is ready for operation again.

4.5 Restarting after longer standstill

Standstill lasting from a few hours to ≤ 2 weeks

If the motor spindle has cooled down to room temperature or below after a longer downtime, do not immediately operate it with the maximum operating speed upon restart because this can damage the spindle bearing.

Personnel:
- Machine operator
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

→ Increase the spindle speed up to the target speed in stages.

NOTICE!

Operating life of spindle

The operating life of the spindle depends heavily on the operation with high speeds, therefore avoid the continuous operation with rotations that exceed 85% of the maximum speed.

NOTICE!

Machine damage due to excessive spindle temperature

If the spindle temperature exceeds 40 °C or if the drive motor exceeds the maximum temperature stored in the control unit, this indicates an error that can damage the machine. In this case, stop the spindle immediately and let it cool down.

Standstill > 2 weeks

NOTICE!

After a standstill time of more than 2 weeks, only put the spindle into operation after the specified run-in periods to prevent damage. Observe and comply with the specifications in the supplier documentation provided.

Run-in phase for oil-air lubrication

When utilizing the oil-air lubrication, the machine automatically starts a spindle run-in program when it has previously been standing still for a longer period of time.

Minimal quantity lubrication

NOTICE!
After a standstill lasting more than 24 hours, operate the minimal quantity lubrication for a few seconds without any consumers. This prevents dry running.

4.6 Shutting down the machine

If the machine is not going to be used for a long period of time, preparatory measures must be taken in this regard.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

1. Take the tool out of the spindle ↳ *Chapter 6.4 “Changing the tool in the spindle” on page 100*.
2. Thoroughly clean the machine ↳ *Chapter 11 “Cleaning the machine” on page 147*.
3. Manually move the X-, Y- and Z-axes to the centre position ↳ *Chapter 8 “Operating the machine in manual mode” on page 118*.
4. Move the B- and C-axes of the turn and tilt unit to 0°.
5. Lightly oil the tool changer with resin-free oil.

During the downtime

6. Recirculate/vent the cooling water filter system and the cooling lubricant every two days to ensure the service life and quality.
7. If recirculation/venting is not possible, completely remove the cooling lubricant from the machine ↳Maintenance and service manual.

NOTICE!
In the event of a downtime of more than 6 months, always remove the cooling lubricant completely.

8. Rotate the spindle on a monthly basis to avoid damage due to idle corrosion and idle marks caused by its own weight.

After a long standstill, carry out the restart as described in ↳ Chapter 4.5 “Restarting after longer standstill” on page 92.

5 Setting the operating modes

5.1 Setting automatic mode

Program run full sequence

Personnel: ■ Machine operator

→ Press the *[program run full sequence]* key.

⇨ The operating mode is set.

Further information on programming in this operating mode can be found in the supplied Heidenhain user manual for the CNC control unit.

Program run single block

Personnel: ■ Machine operator

→ Press the *[program run single block]* key.

⇨ The operating mode is set.

Further information on programming in this operating mode can be found in the supplied Heidenhain user manual for the CNC control unit.

5.2 Setting teaching mode

Teaching mode

WARNING!

Risk of injury in teaching mode!

In teaching mode, the access safety features of the work area are disabled. If any persons are in the vicinity of the moving axes, they may suffer sever injuries, even at low speeds.

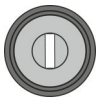
– Limit access to the key for selecting teaching mode to personnel who are authorised for this operating mode.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots
- Protective goggles

Prerequisite:

- The sliding door to the work area is closed *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.



→ Use the key switch to activate teaching mode.

⇨
- The operating mode is set to teaching mode.
- The screen displays the blinking notice *“SOM2.”*
- The door to the work area is unlocked.

If the sliding door was open during activation of teaching mode, close it once and open it again so that operating mode can be used.

In teaching mode, the machine can also be moved – with restricted speed and feed – by means of the electronic hand wheel.

5.3 Setting manual operation

In manual operation, the machine can be moved directly using the machine function keys.

Personnel:
- Machine operator

→ Press the *[Manual operation]* key.

⇨ The operating mode is set.

5.4 Using the electronic hand wheel

In this operating mode, the machine can be moved using the electronic hand wheel.

Personnel:
- Machine operator

→ Press the *[electronic hand wheel]* key.

⇨ The operating mode is set.

5.5 Positioning with manual input

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:

- No processing program is active.

→ Press the *[positioning with manual input]* key.

⇨ The operating mode is set.

Further information on positioning with manual input can be found in the Heidenhain user manual for the CNC control unit.

6 Performing basic tasks

6.1 Opening and closing the sliding door to the work area

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:
- No axis or spindle movement is being carried out.

With unlock key

1. Press the *[Unlock work area door]* key.
   ⇨ The request for the work area door to be unlocked is issued.
2. Wait until the work area door is released.
3. Open the sliding door to the work area completely to the right using the handle (Fig. 47/1).
4. To close the sliding door, use the handle (Fig. 47/1) to push it to the left as far as it will go.
   ⇨ The sliding door is locked automatically.

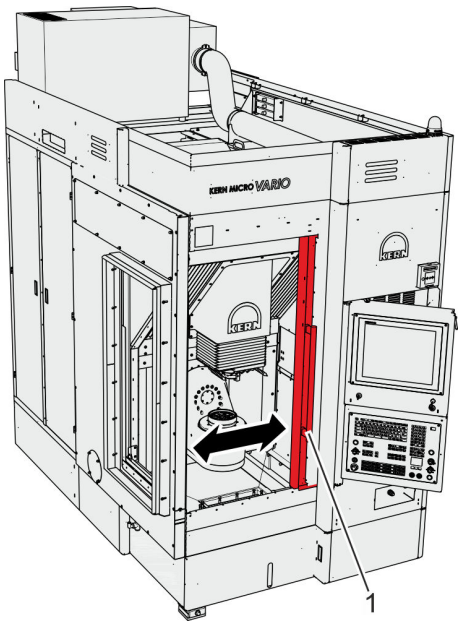


Fig. 47: Opening the sliding door

With the key switch for teaching mode

5. Activate teaching mode (↬ *Chapter 5.2 “Setting teaching mode” on page 95*).
   ⇨ The flashing notice *“SOM2”* appears on the monitor. The door to the work area is unlocked.
6. Open the sliding door to the work area completely using the handle (Fig. 47/1).
7. To close the sliding door, push it as far as it will go.
   ⇨ The sliding door is locked automatically.

6.2 Opening and closing the door to the tool changer

To open the door to the internal tool changer, proceed as follows.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:

- No processing program is active.

Opening the doors

When a processing program is running, the doors are locked automatically.

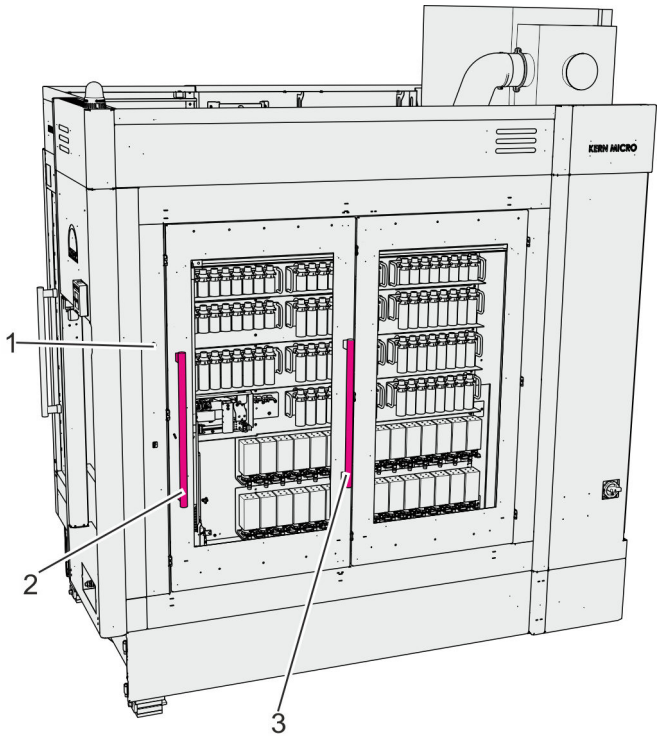


Fig. 48: Tool changer door

1. Press the illuminated pushbutton (Fig. 48/1).

The door to the tool changer is released when no further movement is requested by the tool changer.

2. Wait until the illuminated pushbutton lights up continuously.

3. Pull the door open to the front using the right handle (Fig. 48/3).

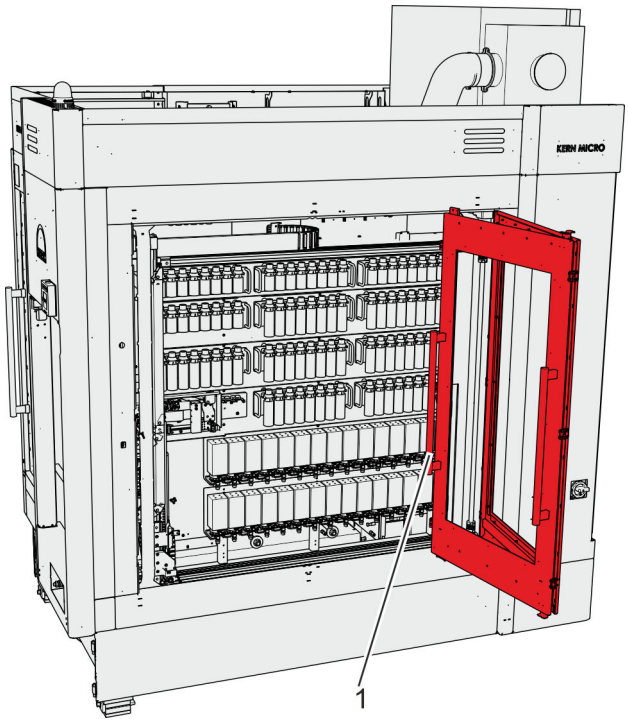


Fig. 49: Tool changer door

4. Use the left handle (Fig. 48/1) to push the door as far as it will go to the right.

Closing the doors

5.

CAUTION!
Danger of crushing in the gap between the door wings!

Use the left handle (Fig. 49/1) to push the door closed to the left until the door contact is closed.

⇨ The door is locked automatically.

6.3 Swinging out the control panel

The control panel has a turn and tilt bearing and can be set individually.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

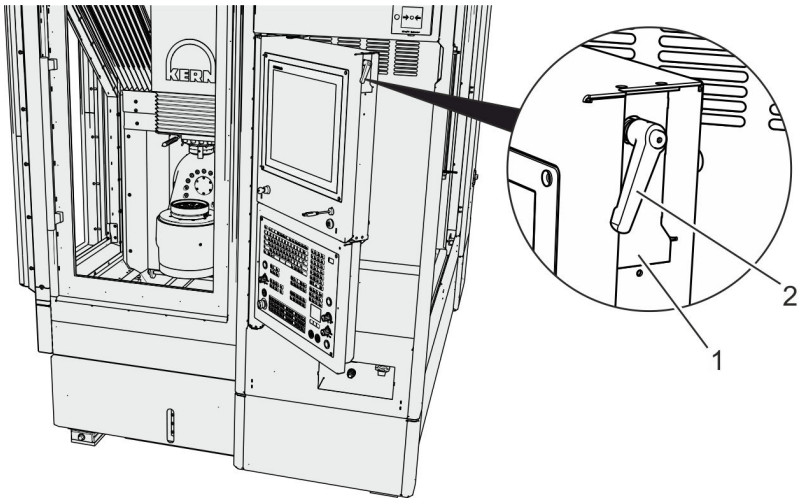


Fig. 50: Positioning the control panel

1 Handle recess
2 Clip

1. Open the clip (Fig. 50/2).
2. Swing the control panel by the handle recess (Fig. 50/1) to the desired position.
3. Tighten the clip (Fig. 50/2).

6.4 Changing the tool in the spindle

A tool change in the spindle can take place in various ways:

Name	Explanation
Automatic *“Automatic tool change” on page 104*	Programmed and fully automated tool change within a program (cycle). The program run is not interrupted thereby. The tool is exchanged from the tool magazine.
Manual *“Manual tool change” on page 101*	Manual tool change with interruption of the program run (cycle). The tool is not in the tool magazine. It is inserted manually in the spindle instead.
By hand *“Manual tool change” on page 103*	The tool change triggered by hand outside a program (cycle). The tool is not in the tool magazine. It is inserted manually in the spindle instead.

Manual tool change

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots
- Protective goggles

Prerequisites:
- The tool to be inserted is available in the tool table.
- The tool to be inserted is available in the position table.

1. Press the *[positioning with manual input]* button.

2. Press the *[TOOL CALL]* button.

3. On the numeric keypad, enter the number of the tool to be inserted as per the tool table.

> *To remove the tool without inserting a new tool, press the number **0**.*

4. Confirm the prompt on the control unit.

5. Insert the cone cleaner (Fig. 51) in the tool holder and turn it 2 – 3 times.

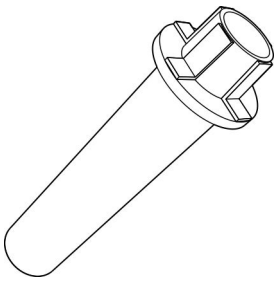
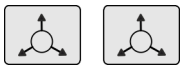


Fig. 51: Cone head cleaner (HSK 25 example)



6. Simultaneously press and hold both release buttons with one hand.

7.

WARNING!
Risk of injury due to sharp tool edges!

Insert the tool with force up to the stop position in the spindle with the other hand and hold it in place.

8. **WARNING!**
Risk of crushing fingers in the tool clamping device!

When clamping the tool, make sure you keep your fingers away from the tool cone.

9. Let go of both release buttons on the control panel.
10. Wait until the tool is clamped in the spindle.
11. Let go of the tool.
12. Check that the tool is properly seated in the spindle. If not, repeat the insertion process.

NOTICE!
Incorrect or incorrectly inserted tools can cause faults.

13. Confirm the prompt on the control unit.
14. Close the sliding door to the work area.

15. When prompted to do so on the screen, confirm the tool change on the control unit with *[NC-START]*.

Manual tool change

WARNING!
Risk of injury due to tool breakage!
The use of non-measured tools can result in collisions and tool breakages. Breaking and flying tool parts can cause serious injuries and damage the machine.

– Always measure all the tools that are to be used properly.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots
- Protective goggles

Prerequisite:

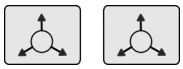
- The tool to be inserted is to hand.

1. Open the sliding door to the work area *Chapter 6.1 "Opening and closing the sliding door to the work area" on page 97*.

If there is no tool in the spindle, the following two work steps can be skipped.

WARNING!
Risk of injury due to sharp tool edges!

2. Hold the tool in the spindle with one hand so that it does not fall down when it is released.



3. Simultaneously push both release buttons on the control panel with the other hand.

   ⇨ Take the tool out of the spindle.

4. **NOTICE!**
   Faults due to tool or spindle cone not being clean.

   Insert the cone cleaner (Fig. 52) in the tool holder and turn it 2 – 3 times.

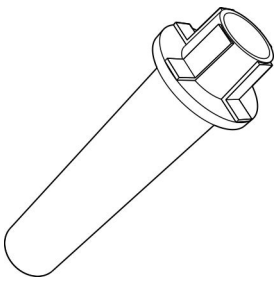


Fig. 52: Cone cleaner (HSK 25 example)

5. **WARNING!**
Risk of injury due to sharp tool edges!

Hold the tool to be inserted with one hand.

6. Simultaneously press and hold both release buttons with the other hand.

7. **NOTICE!**
Faults due to incorrectly inserted tools.

Slowly insert the tool with force up to the stop position in the spindle and hold it in place.

8. **WARNING!**
Risk of crushing fingers in the tool clamping device!

When clamping the tool, make sure you keep your fingers away from the tool cone.

9. Let go of both release buttons on the control panel.
10. Wait until the tool is clamped in the spindle.
11. Let go of the tool.
12. Check that the tool is properly seated in the spindle. If not, repeat the insertion process.

NOTICE!
Incorrect or incorrectly inserted tools can cause faults.

13. Close the sliding door to the work area ↬ *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

14. When prompted to do so on the screen, confirm the tool change on the control unit with *[NC-START]*.

Automatic tool change

Perform an automatic tool change within a program run in accordance with the supplied Heidenhain user manual for the CNC control unit.

6.5 Changing tools in the internal tool changer

6.5.1 Removing or inserting individual tools

To insert tools into the internal tool changer or to remove them, proceed as set out below.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety shoes

Prerequisites:

- The tool has been properly measured *Chapter 6.6 “Measuring tools with a laser” on page 110*.
- The tool has been properly added to the tool table *Chapter 6.5.2 “Opening and editing the tool table” on page 106*.
- No processing program is active.

1. Open the door to the tool changer *Chapter 6.2 “Opening and closing the door to the tool changer” on page 98*.

WARNING!
Risk of injury on sharp tool blades!

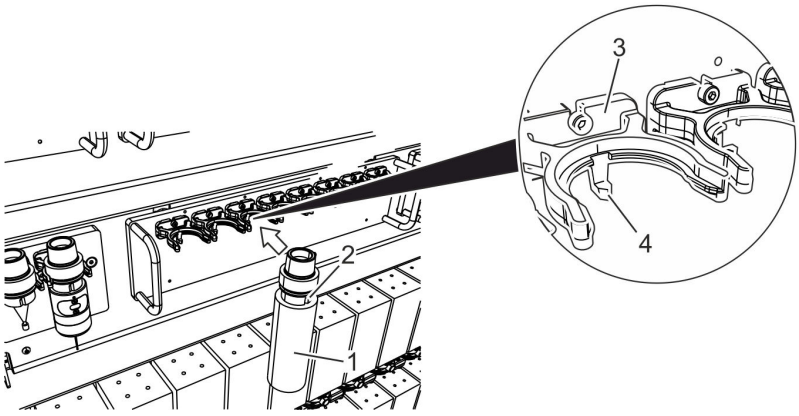


Fig. 53: Removing/inserting a tool

2. Insert the tool (Fig. 53/1) in the corresponding tool position (Fig. 53/3) as specified in the position table.

NOTICE!
When inserting, make sure that the notch of the tool (Fig. 53/2) is positioned so that the pin of the plastic bracket (Fig. 53/4) fits into the notch.

3. Close the door to the tool changer *Chapter 6.2 “Opening and closing the door to the tool changer” on page 98*.

6.5.2 Opening and editing the tool table

What is the tool table?

Information about the tools used is stored on the machine in two different tables. The **tool table** includes specific tool data (length, diameter etc.).

The **tool position table** allocates the tools defined in the tool table to a position in the tool magazine.

Before using new tools, they must be entered with their parameters in the tool table.

> *In respect of the function of the tool table, also refer to the supplier documentation provided for the Heidenhain CNC control unit in the appendix.*

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

1. Press the *[TOOL TABLE]* softkey.

⇨ The tool table opens.

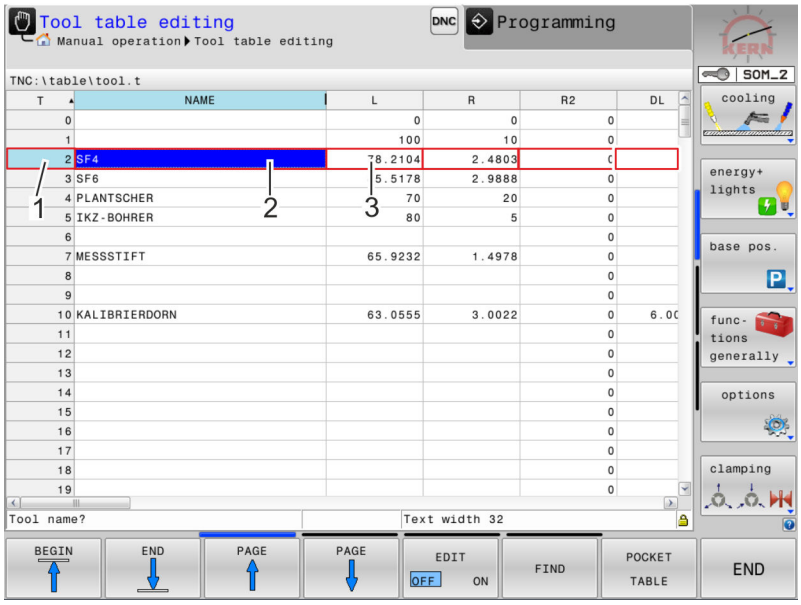


Fig. 54: Tool table

1 Tool number
2 Tool name
3 Columns with tool parameters

2. Use the cursor keys or the *[GOTO]* function in the tool table (Fig. 54) to move into the line of the desired tool.

3. Press the *[EDIT]* softkey.

⇨ Editing the tool table is activated.

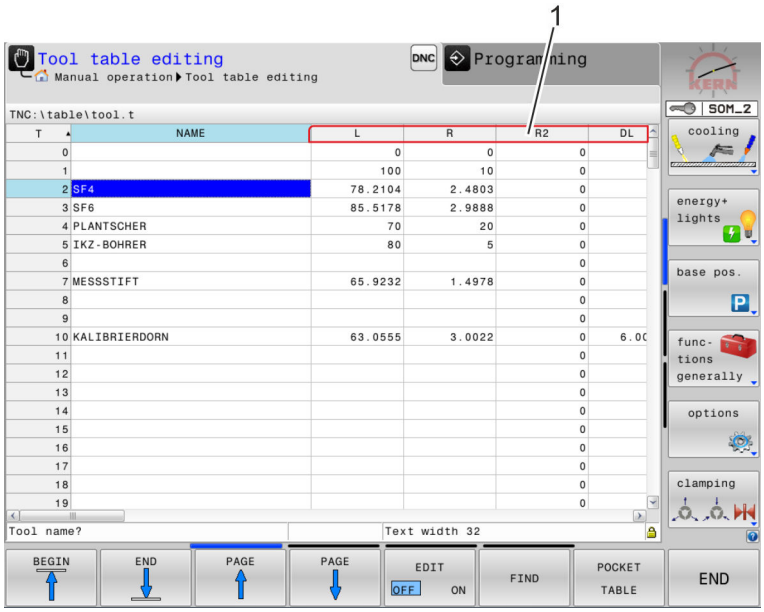


Fig. 55: Editing the tool position table

4. Use the cursor keys to move to the individual columns (Fig. 55/1) of the selected tool and adjust the tool data.

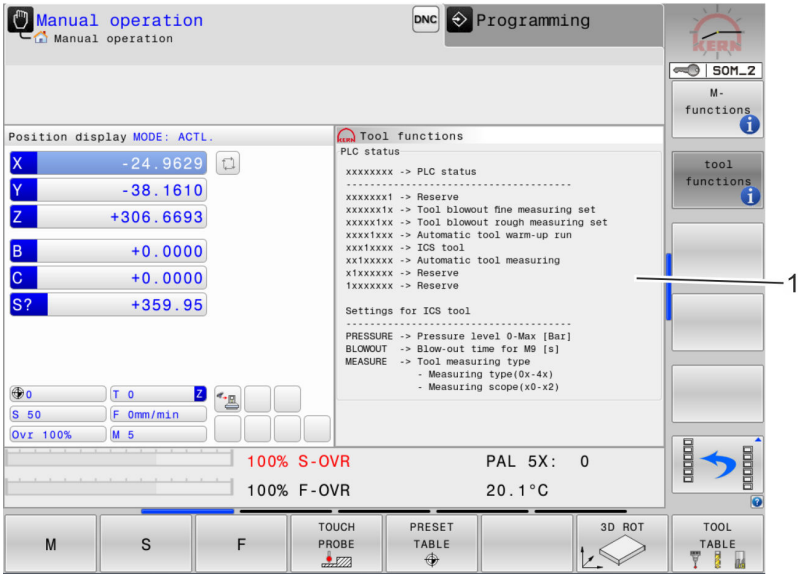


Fig. 56: Help window of the tool functions

5. For details about the described tool functions, press the *[tool functions]* softkeys (Fig. 56/1).

⇨ A pop-up window (Fig. 56/2) opens with descriptions of the tool-specific information.

6. Press the *[EDIT]* softkey again to save the changes and cancel the activation of the tool table.

7. Press the *[END]* softkey to exit the tool table and return to the start screen.

6.5.3 Opening and editing the tool position table

What is the tool position table?

Information about the tools used is stored on the machine in two different tables. The **tool table** includes specific tool data (length, diameter etc.). The **tool position table** allocates the tools defined in the tool table to a specific position in the tool magazine.

Before using new tools, they must be entered with their parameters in the tool table.

In respect of the function of the tool table, also refer to the supplier documentation provided for the Heidenhain CNC control unit in the appendix.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety shoes

For the general handling of the tool table and the position table, refer to the supplier documentation provided for the Heidenhain CNC control unit in the appendix.

1. Switch to “Manual operation” or “Program run full sequence” operating mode ↳ *Chapter 5 “Setting the operating modes” on page 94*.

2. Press the *[TOOL TABLE]* key.

⇨ The tool table opens.

3. Press the *[POCKET TABLE]* key.

⇨ The tool position table opens.

4. Press the *[EDIT]* key.

⇨ The button changes to *“ON”* and the tool position table is activated for editing.

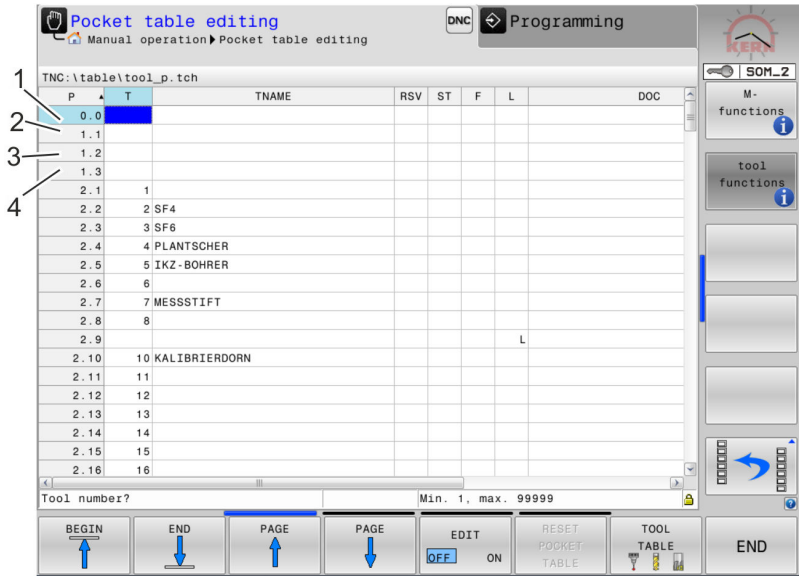


Fig. 57: Tool position table

1 0.0: Tool number in the spindle
2 1.1: Tool number in the unloading gripper
3 1.2: Tool number in the loading gripper
4 1.3: Tool number in the magazine gripper

5. Check whether the positions in the tool position table (Fig. 57) match the actual positions in the tool magazine.

6.6 Measuring tools with a laser

Perform the tool measurement in accordance with the supplier documentation provided by Blum.

6.7 Clamping and releasing workpieces

Heavy workpieces

WARNING!

Risk of injury due to heavy workpieces!

Heavy workpieces can fall down and cause severe injuries to hands and feet due to crushing.

– Insert heavy workpieces into the machine only with the assistance of a second person.

Clamping fixture

WARNING!

Risk of injury due to an unsuitable combination of workpiece and clamping fixture!

Clamped workpieces can come loose if unsuitable clamping fixtures are used. This may cause the workpieces or components to break and broken pieces could be ejected. This may cause serious injuries.

– Only clamp workpieces for which the clamping fixture was designed.
– Ensure that the workpieces are placed securely on the machine table and cannot tip over or slide off (e.g. when processing workpieces that are larger than the clamping area).
– Ensure that the clamped workpieces are always in the centre of the table.
– In the case of workpieces that are not rotationally symmetrical, make sure that the clamping forces are sufficient for the ensuing loads.
– Always clamp workpieces tightly. The heavy weight of a workpiece is no substitute for a clamping fixture.
– Only use undamaged screws, washers, steel ties or similar for clamping.
– Only use suitable and undamaged tools for clamping.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots
- Protective gloves

Prerequisites:

- No processing program is active.
- Suitable clamping devices are available.

1. Open the sliding door to the work area *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

WARNING!
Risk of crushing between the workpiece and clamping fixture when placing the workpiece!

2. Carefully insert the workpiece into the turn and tilt unit.
3. Tightly clamp the workpiece.
4. Remove any clamping devices, tools etc. from the work area.
5. Close the sliding door to the work area *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.
6. Carry out the processing program.
7. Once the processing is complete, fully open the sliding door to the work area *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.
8. Remove any cooling lubricant residue on the workpiece with a rag or cloth.
9. Release the clamping fixtures.
10.

WARNING!
Risk of cuts due to sharp tool edges!

Carefully remove the workpiece from the machine table.

6.8 Using tool cooling

6.8.1 Exterior cooling / surge cooling

WARNING!

Risk of injury due to fire in conjunction with the use of flammable cooling lubricants and cleaning agents!

The utilization of flammable cooling lubricants may cause a fire in the machine. This may cause serious injuries and significant material damage.

– If flammable cooling lubricants are used, ensure that this does not cause a concentrated build-up of aerosol.
– Ensure that the jets are always correctly pointing toward the machining point.
– Make sure that the jet nozzle used is suitable for the cooling lubricant used.
– Make sure that the fire extinguishing system has been installed.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

→ Press the *[exterior cooling]* button to switch the cooling on or off.

6.8.2 Minimal quantity lubrication

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

→ Press the *[minimal quantity lubrication]* button to switch the cooling on or off.

6.8.3 Using internal tool cooling

If a processing tool with drill holes is to be used for internal tool cooling, it must be entered in the tool table together with the corresponding parameters.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

1. Open and activate the tool table ↳ *Chapter 6.5.2 "Opening and editing the tool table" on page 106*.

GOTO

2. Use the cursor keys or the *[GOTO]* function to move to the line of the desired tool with internal cooling.
3. Move the cursor into the column *"PLC"* to specify tool-related information.

⇨

Up to eight functions can be specified in the column. The row of numbers in the "PLC" column consists of a number sequence with eight bits. Each bit or function can be switched on and off by entering 1 (on) or 0 (off). A combination of several functions is possible.

0 = function not active

1 = function active

- *00000001: 3D sensor system*
- *00000010: Tool blow-off fine measuring set*
- *00000100: Tool blow-off rough measuring set*
- *00001000: Automatic tool warm-up*
- *00010000: Tool with internal coolant supply (ICS)*
- *00100000: Reserve*
- *01000000: Reserve*
- *10000000: Reserve*

4. Switch on the function for internal tool cooling by setting the bit (XXX1XXXX).

   ⇨ The internal tool cooling system is activated for the selected tool.
5. Move the cursor into the *"PLC-VAL"* column and specify the pressure in bar for the interior cooling of the selected tool.
6. Move the cursor into the *"P1"* column and specify the blow-out time in s for the selected tool.

NOTICE!
The blow-out function removes the existing coolant in the cooling channels and prevents coolant from leaking during the tool change and soiling the spindle cone.

7. Save and close the tool table *Chapter 6.5.2 “Opening and editing the tool table” on page 106*.

6.8.4 Manual flushing gun

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots
- Protective goggles

1. Open the sliding doors to the work area.

2. Press the *[cooling]* softkey.

3. Switch to the vertical softkey bar with the *[arrow up]* button.

4. Turn on the manual flushing gun with the *[hand shower ON]* softkey.

5. **NOTICE!**
Only point the jet of the manual flushing gun towards workpieces and the clamping area. Cleaning the machine with the manual flushing gun can damage the machine because cooling lubricants may enter sensitive machine areas.

Clean the workpiece and clamping area with the manual flushing gun.

6. After completing the work, press the *[hand shower OFF]* softkey again to turn off the manual flushing gun.

6.9 Changing the cooling lubricant

Personnel:
- Maintenance personnel

Protective equipment:
- Protective work clothing
- Safety boots

1. Completely clean the machine as per the maintenance and service manual provided.
2. Remove all cooling lubricant residue from the work area and all other machine areas.
3. Completely empty the cooling lubricant tank as described in the supplier documentation provided for the cooling water filter system.
4. Clean the cooling lubricant tank and remove all cooling lubricant residue.

NOTICE!
Even the smallest amount of residue of the old cooling lubricant can have a negative impact on the tooling process.

5. Flush the cooling lubricant lines with cleaning agent in order to remove any cooling lubricant residue.
6. Completely remove the cleaning agent.
7. Fill with new cooling lubricant up to the permitted fill level.

When changing the cooling lubricant, also adhere to the separate instructions for the cleaning agent. Contact Kern's customer service if anything is unclear with regard to the procedure.

7 Selecting and starting the processing program

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisites:

- The work area door is closed.
- No processing program is active.

1. Insert the calibration tool into the spindle (*Chapter 6.4 “Changing the tool in the spindle” on page 100*).

2. Switch to the operating mode “automatic mode with program run full sequence” (*Chapter 5.1 “Setting automatic mode” on page 94*).

3. Press the *[save/edit]* key.

4. Press the *[PGM MGT]* key.

5. Open the program directory.

Further information on the program directories can be found in the supplied Heidenhain user manual for the CNC control unit.

6. Call up the desired processing program.

7. Press *[NC-START]* to start the processing program.

8 Operating the machine in manual mode

In manual mode, a variety of functions can be performed on the machine using the machine function keys. As an example, the method for setting a speed and moving the spindle manually is described below.

> *For a description of the individual machine function keys, see the description of the control panel*
> *Chapter 3.5.2 “Control panel” on page 60.*

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:

- The sliding door to the work area is closed.

1. Switch to the operating mode “Manual operation” *Chapter 5.3 “Setting manual operation” on page 96*.

2. Press the *[S]* softkey to adjust the speed.

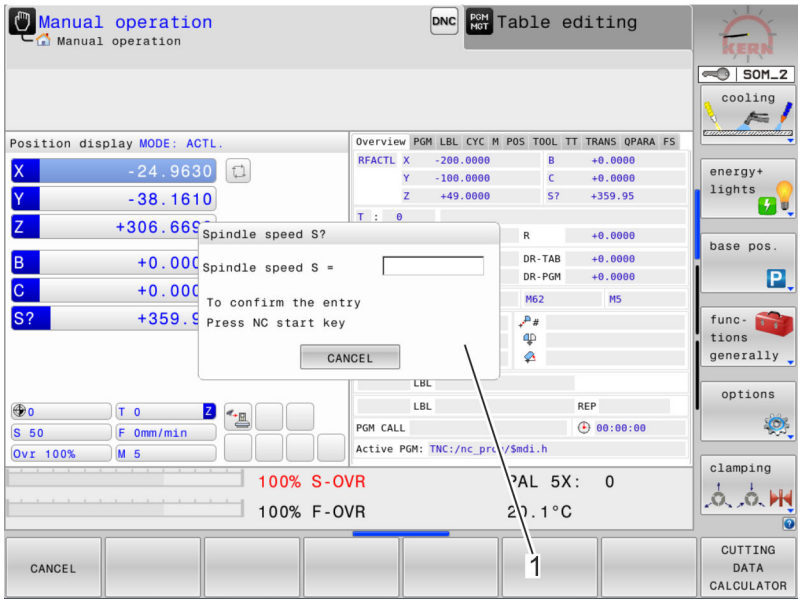


Fig. 58: Speed input

3. Enter the desired value for the speed using the numeric keypad Fig. 58/1.

> *Non-permissible values for the speed are rejected by the control unit.*

4. Press the *[Start/NC-START]* softkey to adopt the speed.

5. Press the *[M]* softkey to adjust the spindle direction of rotation.

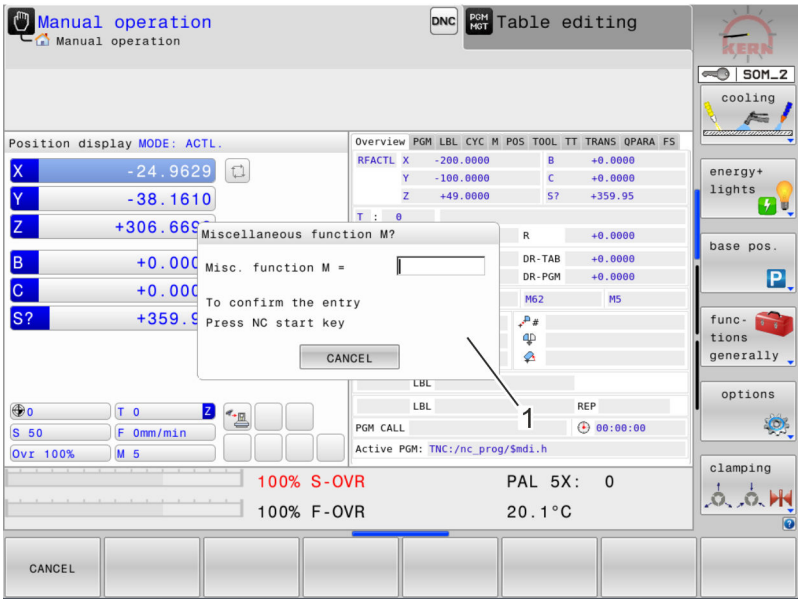


Fig. 59: Direction of rotation

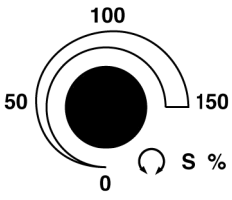
6. Enter the value for the spindle direction of rotation using the numeric keypad.

- M3: Clockwise rotation
- M4: Anticlockwise rotation

7. Press the *[Start/NC-START]* key to adopt the direction of rotation and start the spindle rotation.

8. Carry out the desired axis motion by continuously pressing the axial direction keys on the selector key block.

Machine motion can only be carried out with a continuously pressed key. When the key is released, the machine stops the movement of the axes.



9. If necessary, vary the spindle speed with the *[Spindle override]* control dial.

9 Calibrating and adjusting

9.1 Calibrate laser

Providing a calibration tool

Personnel:	■ Machine operators authorised for teaching mode
Protective equipment:	■ Protective work clothing ■ Safety boots
Special tool:	■ Dial gauge with measuring accuracy of 2 µm
Materials:	■ Lint-free cleaning cloth ■ Non-re-greasing cleaning agent ■ Cone head cleaner ■ Model cleaning product (e.g. Läufer Typutz)

Prerequisites:

- No processing program is active.
- There is no tool in the spindle
- There is a calibration tool available.

1. Open the door to the tool magazine ↬ *Chapter 6.2 “Opening and closing the door to the tool changer” on page 98*.

2. Remove the calibration tool (Fig. 60/1) from the tool magazine Fig. 60.

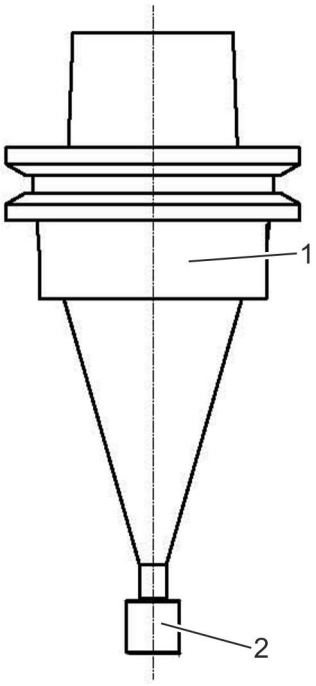


Fig. 60: Calibration tool

> **NOTICE!**
> When removing the calibration tool, take note of the orientation of the tool in the tool magazine, as the necessary accuracy cannot otherwise be guaranteed later.

3. Clean the cylinder of the calibration tool (Fig. 60/2) with a cleaning cloth and non-re-greasing cleaning agent.

4. Precisely dab the cylinder of the calibration tool (Fig. 60/2) with model cleaning product.

5. Insert the calibration tool in the position defined in the tool table and with the same orientation as when it was removed from the tool magazine.

6. Close the door to the tool magazine ↬ *Chapter 6.2 “Opening and closing the door to the tool changer” on page 98*.

7. Open the work area door ↬ *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

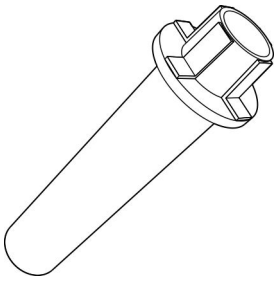


Fig. 61: Cone head cleaner (HSK 25 example)

8. Insert the cone cleaner (Fig. 61) in the tool holder and turn it 2 – 3 times.

WARNING!
Hazard due to flying chips! Never clean the spindle cone with compressed air!

9. Close the work area door ↳ *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

10. Press the *[positioning with manual input]* key.

11. Press the *[TOOL CALL]* button.

12. Enter the number of the calibration tool on the numeric keypad.

13. Press *[NC-START]*.

⇨ The calibration tool is inserted into the spindle.

14. Open the work area door ↳ *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

15. Use the dial gauge to check the true-running accuracy at the cylinder radius (Fig. 62/2).

⇨ The deviation must not be more than 2 – 3 µm.

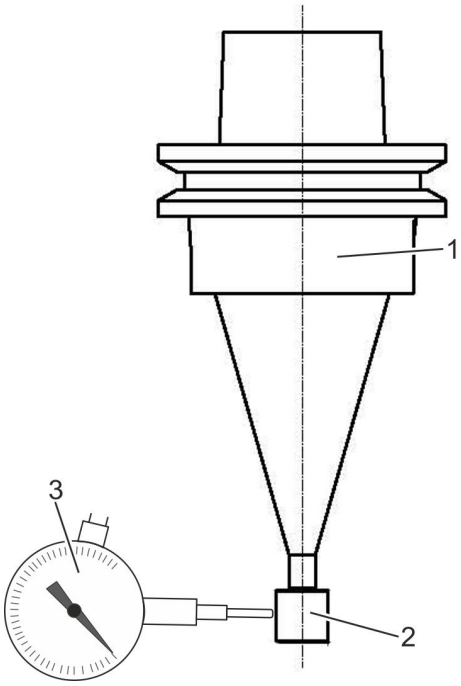


Fig. 62: Calibration tool

1 Calibration tool
2 Measuring cylinder
3 Dial gauge

16. In the event of larger deviations, press the *[TOOL CALL]* key again.

17. Press the number 0.

18. Press *[NC-START]*.

⇨ *TOOL CALL 0* is executed and the calibration tool is placed in the tool magazine.

19. Take the calibration tool out of the tool changer and clean it again.

20. Repeat steps 1 – 17 until the permissible deviation of 2 – 3 µm is reached.

Checking the calibration tool

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:

- The calibration tool has been provided *“Providing a calibration tool” on page 120*.

1. Open and activate the tool table *Chapter 6.5.2 “Opening and editing the tool table” on page 106*.
2. Navigate to the line of the calibration tool.

   Standard positions:

   - T 10 position (HSK 25 spindle)
   - T 10 position (HSK 40 spindle)
3. Compare the following values of the calibration tool (Fig. 63) from the enclosed inspection protocol with the values from the tool table, and adjust them if there are any deviations:

   - Length **L**: Top edge of cylinder to spindle nose
   - Diameter **D** (R = D/2)
   - Cylinder length **DL**
4. Save and close the tool table *Chapter 6.5.2 “Opening and editing the tool table” on page 106*.

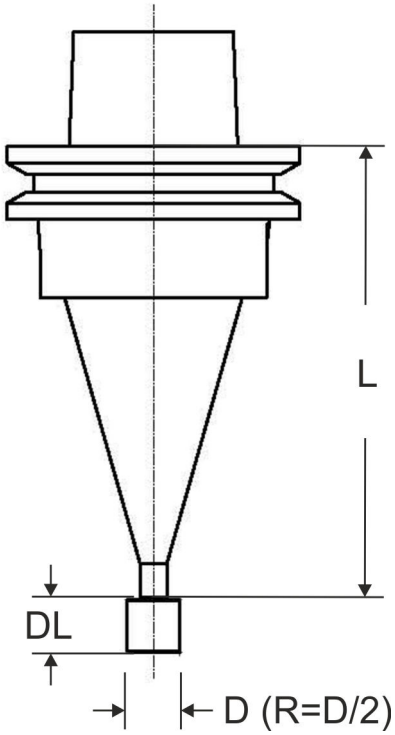


Fig. 63: Calibration pin dimensions

Checking the radial true running of the calibration tool

This diagnostics program determines the radial true running and axial true running of the calibration tool at the spindle speed S10000. The measured deviations are then entered in the tool table.

In addition, it is possible to determine whether the calibration tool is dirty or damaged after the diagnostics.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

1. Insert the calibration tool into the spindle (↳ *Chapter 6.4 “Changing the tool in the spindle” on page 100*).
2. Run the *“S_RUNOUT.H”* file in the *“TNC_TAB”* program directory to determine the axial and radial true running errors ↳ *Chapter 7 “Selecting and starting the processing program” on page 117*.

   ⇨ The program carries out two subsequent calibration cycles and saves the calibration values between:

   - *Calibration cycle 581 with the option “pulling measurement from the beam” to determine the shortest length and the smallest radius*
   - *Calibration cycle 581 with the option “pushing measurement into the beam” to determine the longest length and the largest radius*
   - *The dispersion and the axial true running error are calculated based on the difference between the calibration values L- and L+.*
   - *The dispersion and the true running error are calculated based on the difference between the calibration values R- and R+. The half true running value is entered in the tool table TOOL.T in the column DR.*
   - *The dispersion of the measuring results as well as axial and radial true running errors are monitored for adherence to limit values.*
   - *The measuring result is written to the file TNC:\BLUM\E_RUNOUT.A and is placed at the program end (L, DL, R, DR).*

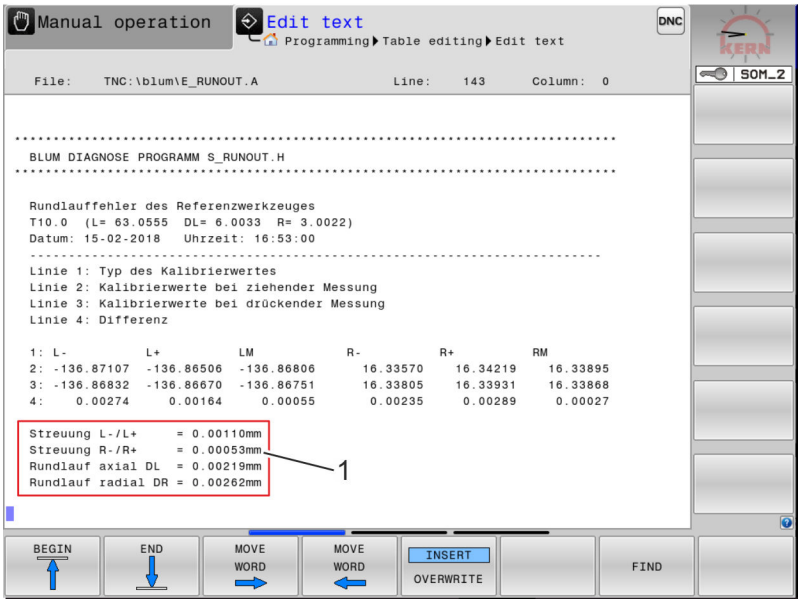


Fig. 64: Radial true running error

3. Check that all the displayed values (Fig. 64/1) are < 0.005 mm.

4. If the values are greater than this value, clean the calibration pin again and then execute the diagnostic program again. Repeat the cleaning and diagnosis until the value is reached.

NOTICE!

If the value is not achieved even after several repetitions, check the calibration pin carefully for dirt or damage.

Calibrating the laser

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:

- The calibration tool has been checked (*“Checking the calibration tool” on page 123*).

1. Make sure that the machine has warmed up.

The warm-up time depends on the speed. At 10,000 rpm, the warm-up time is approximately 120 s.

2. In the program directory *“TNC:\BLUM”*, run the *“BLUM581.H”* file *Chapter 7 “Selecting and starting the processing program” on page 117*.

⇨ The calibration of the laser is finalized.

NOTICE!
During the calibration, ensure that the calibration tool **moves out** of the laser and not into it.

Determining the laser position

It is only necessary to determine the position of the laser if the position has been mechanically altered.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisites:
- The calibration tool has been checked (*“Checking the calibration tool” on page 123*).
- No processing program is active.

1. Insert the calibration tool (*“Manual tool change” on page 101*).
2. Start the *“S_LASPOS.H”* file (*Chapter 7 “Selecting and starting the processing program” on page 117*) in the program directory *“TNC:\BLUM”*.
   ⇨ The laser beam is switched on and the reflection point is visible on the tool.
3. Switch to the operating mode “Manual operation” *Chapter 5.3 “Setting manual operation” on page 96*.

4. Roughly position the calibration tool manually on the tool centre using the *[axis control keys]* or electronic hand wheel on the radial axis.
5. Position the calibration tool exactly in the focal point on the beam axis.
6. Roughly align the longitudinal axis of the calibration tool with the tool centre of the inspection diameter.

7. Press the *[program run full sequence]* key.

8. Press the *[GOTO]* key.
9. Enter the desired start line number as per the displayed comment.

10. Press the *[ENT]* key.

11. Press the *[NC-START]* key to continue the program.
    ⇨ The program carries out a measurement in all measuring directions (R-, R+, L-, L+) and calculates the laser beam centre in the longitudinal axis (LM) and radius axis (RM) based on the switching points.

The following processes start:

- *The calculated positions are automatically transmitted to the control unit.*
- *The calibration tool is positioned on the radial axis exactly at the tool centre.*
- *The calibration tool is positioned on the beam axis exactly in the focal point.*
- *The calibration tool is positioned on the longitudinal axis exactly on the bottom edge of the tool of the inspection diameter.*
- *The measuring result is written to the file TNC:\BLUM\E_LASPOS.A.*

12. Once the S_LASPOS.H program is complete, visually check that the calibration tool is in the correct position.

13. Press the *[NC-START]* key to continue running the program until it has been completed.

9.2 Adjusting IR workpiece sensor

Checking the infrared workpiece sensor

Mechanical adjustment is only necessary for a new infrared workpiece sensor or a new sensor tip.

NOTICE!
After a lengthy machine standstill, check the battery status of the infrared workpiece sensor as per the provided supplier documentation. Replace the batteries if necessary.

Personnel:	■ Machine operators authorised for teaching mode
Protective equipment:	■ Protective work clothing ■ Safety boots
Special tool:	■ Set of Allen keys ■ Dial gauge with measuring accuracy of 2 µm
Materials:	■ Lint-free cleaning cloth ■ Non-re-greasing cleaning agent ■ Cone head cleaner ■ Calibration ring

Prerequisites:

- No processing program is active.
- There is no tool in the spindle
- The (new) infrared workpiece sensor is ready.

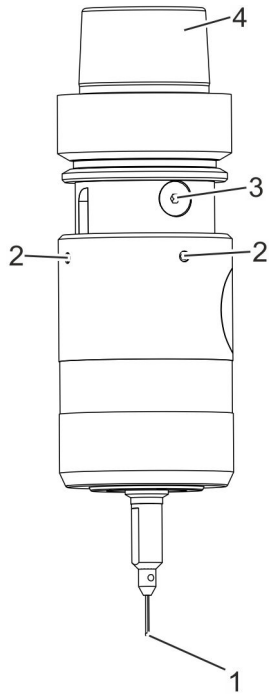


Fig. 65: Infrared workpiece sensor

1 Measuring ball
2 Centring screw (4x)
3 Tensioning screw
4 Holder

1. Clean the holder (Fig. 65/4) and measuring ball (Fig. 65/1) of the infrared workpiece sensor with a cleaning cloth and non-re-greasing cleaning agent.
2. Switch to the operating mode “Manual operation” *Chapter 5.3 “Setting manual operation” on page 96*.
3. Insert the infrared workpiece sensor into the spindle by hand *“Manual tool change” on page 103*.

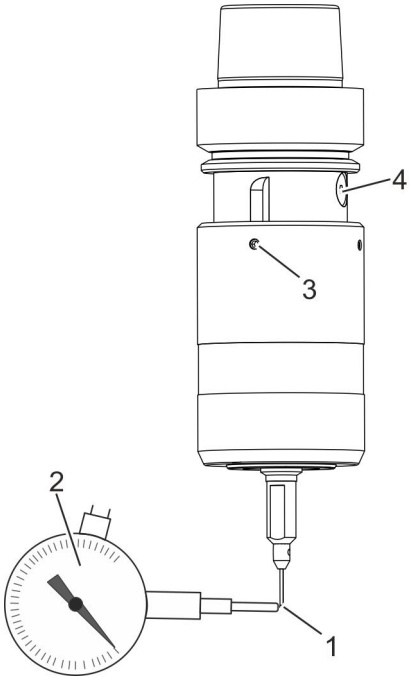


Fig. 66: Infrared workpiece sensor with dial gauge

4. Position the dial gauge so that the measuring ball (Fig. 66/1) can be measured.
5. Rotate the spindle by hand, while identifying the radial true running accuracy with the dial gauge (Fig. 66/2) on the measuring ball (Fig. 66/1).

NOTICE!
The deviation must not exceed 2 – 3 µm.

6. If the deviation is more than this, readjust the four centring screws (Fig. 66/3) using an Allen key.
7. Secure all four centring screws.
8. Remove the infrared workpiece sensor from the spindle by hand.

Carrying out the radius calibration

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

Materials:
- Calibration ring

Prerequisites:

- The infrared workpiece sensor is in the tool magazine.
- The infrared workpiece sensor has been checked *“Checking the infrared workpiece sensor” on page 129*.

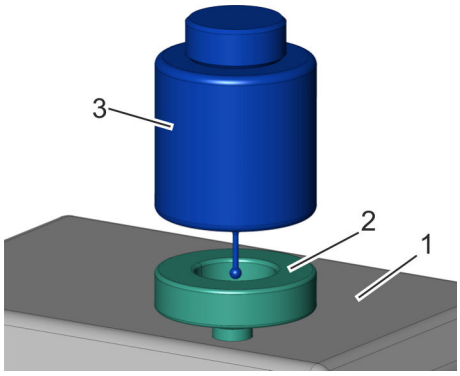


Fig. 67: Placing the calibration ring (example)

1 Magnetic surface
2 Calibration ring
3 Infrared workpiece sensor

1. Check the calibration ring (Fig. 67/2) for damage and dirt.

2. Place the calibration ring (Fig. 67/2) on a magnetic surface (Fig. 67/1) inside the work area.

3. Insert the infrared workpiece sensor into the spindle *“Manual tool change” on page 101*.

4. Switch to “Manual operation” or “Electronic hand wheel” operating mode *Chapter 5.3 “Setting manual operation” on page 96*.

X ... V

5. Position the measuring ball of the infrared workpiece sensor (Fig. 67/3) manually with the axis control keys or the hand wheel in X, Y and Z direction roughly over the centre of the calibration ring (Fig. 67/2).

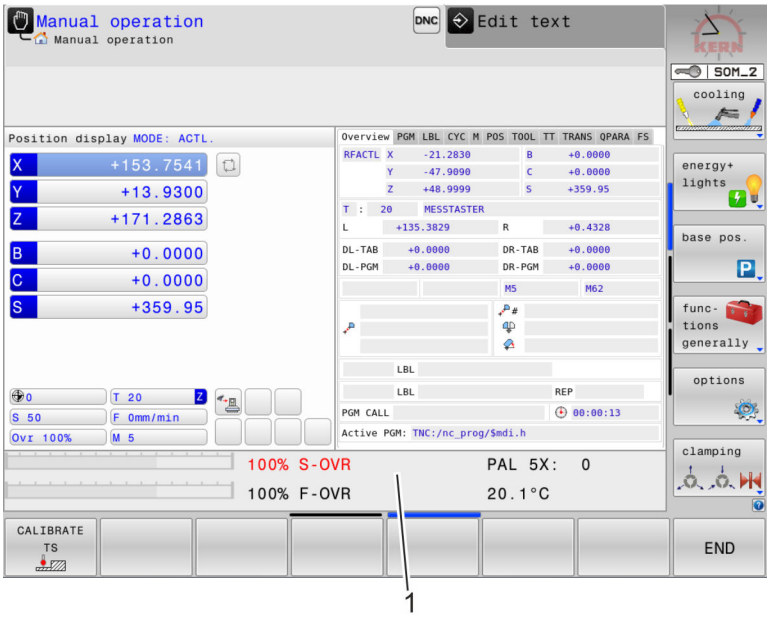
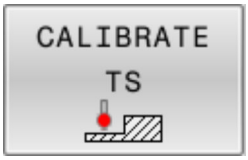


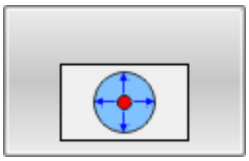
Fig. 68: Connection test

6. Check on the screen whether the connection between the infrared workpiece sensor and interface still exists Fig. 68/1.

An established connection is indicated by a green illuminated “PROBE” (Fig. 68/1).



7. Press the *[CALIBRATE TS]* key.



8. Press the *[CAL. R.]* key.

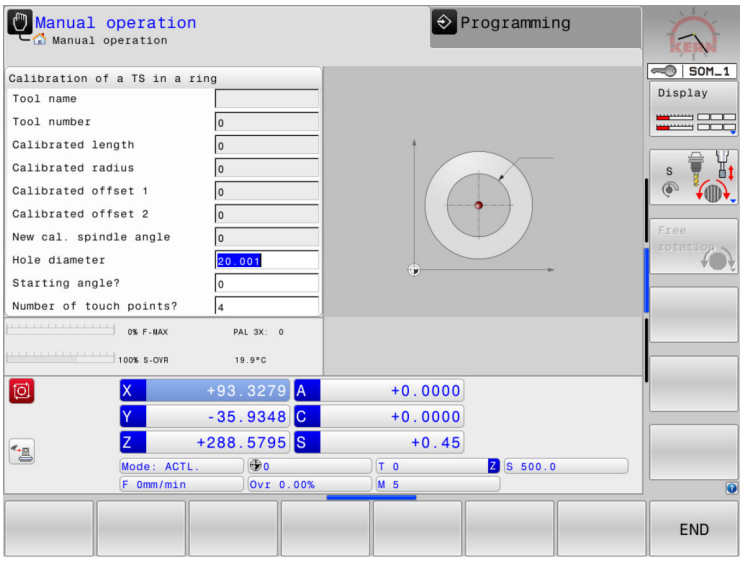


Fig. 69: Setting ring radius

9. Enter the radius of the setting ring Fig. 69/1.

The radius is printed on the calibration ring.

10. Press the *[NC-START]* key.

⇨ The measurement starts. The ball diameter and the tool offset are automatically written to the tool table.

If the infrared workpiece sensor is oriented in such a manner that the tracer pin is always turned in the same direction, a single NC-START command is sufficient. Otherwise, each travelling movement must be started individually

Carrying out length calibration

To execute the length calibration, a workpiece with a smooth surface must be milled to an arbitrary dimension using a measured milling tool.

Personnel:	■ Machine operators authorised for teaching mode
Protective equipment:	■ Protective work clothing ■ Safety boots
Materials:	■ Test workpiece with a smooth surface made of aluminium or brass ■ New end mill D = 6 mm

Prerequisites:

- The infrared workpiece sensor is in the tool magazine.
- Radius calibration has been executed *“Carrying out the radius calibration” on page 131*.

1. Insert a new end mill *“Manual tool change” on page 101*.
2. Measure the new end mill with cycle 584 *Chapter 6.6 “Measuring tools with a laser” on page 110*.
3. Clamp the test workpiece *Chapter 6.7 “Clamping and releasing workpieces” on page 111*.
4. Insert a new end mill *“Manual tool change” on page 101*.
5. Mill a clean reference surface on the clamped workpiece and then leave the milling tool at the set Z height.

6. Press the *[Set Datum]* softkey.

7. Press the *[Z]* softkey.

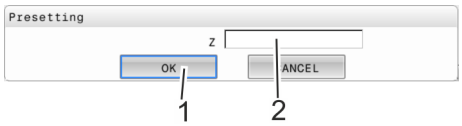
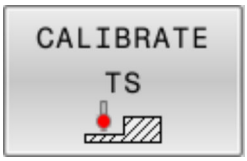
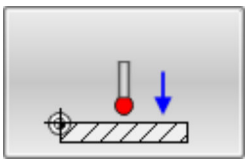


Fig. 70: Reference point (example)

8. Enter “0” in the input field (Fig. 70/2) to place the reference point on the milled surface.
9. Confirm with *[OK]* (Fig. 70/1).
10. Clean the milled reference surface.
11. Insert the infrared workpiece sensor (*“Manual tool change” on page 101*).
12. Manually position the infrared workpiece sensor above the milled surface.

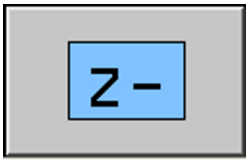


13. Press the *[CALIBRATE TS]* softkey.



14. Press the *[CAL. L]* softkey.

15. Enter the 0 reference point.



16. Press the *[Z–]* softkey.

17. Press *[NC-START]* to touch the milled surface.

⇨ The length of the infrared workpiece sensor is calibrated and the results are written automatically to the tool table.

10 Setting the control functions

10.1 Activating the advanced control functions

To protect vulnerable control functions from improper access, they are secured with a code number.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

1. ■ Set one of the following operating modes:
- Program run full sequence *“Program run full sequence” on page 94*.
- Program run single block *“Program run single block” on page 94*.
- Manual operation *Chapter 5.3 “Setting manual operation” on page 96*.

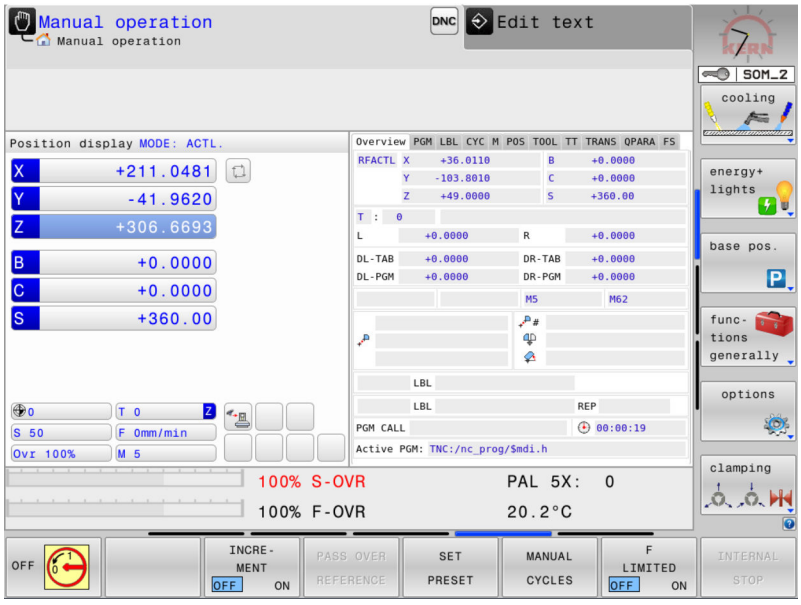


Fig. 71: Start screen

2. Call up the start screen for visualisation Fig. 71.

3. Press the *[save/edit]* key.

⇨ The program window opens.

MOD

4. Press the *[MOD]* key.

⇨ The input window for the code number appears.

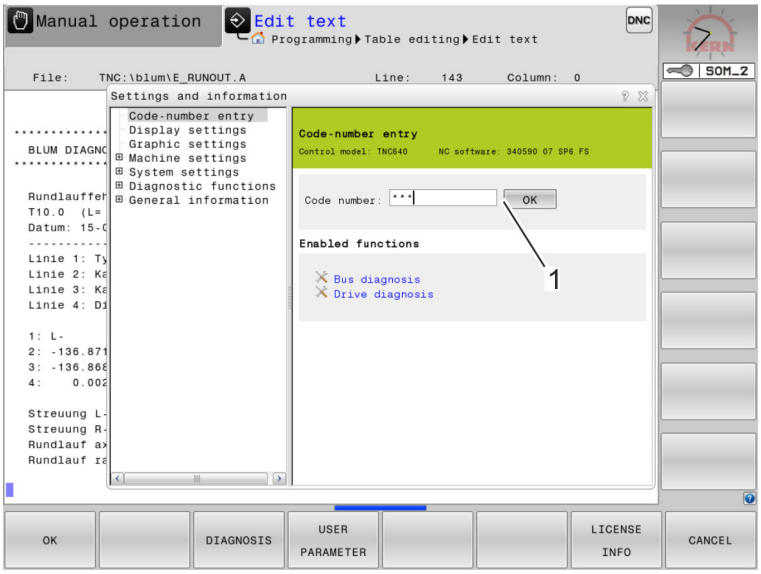


Fig. 72: Code number

5.

You receive the code number from our customer service.

Enter the code number (Fig. 72/1).

ENT

6. Use the *[ENT]* key to confirm.

⇨ The advanced control functions are activated.

Cancelling the activation

MOD

7. Press the *[MOD]* key.

⇨ The input window for the code number appears.

8. Enter *“0”* as the code number.

⇨ The activation of the control functions is cancelled.

10.2 Setting the machine-specific user parameters

User parameters are machine specific settings which permanently impact the behaviour of the machine or of specific components. They can be changed by the user himself to the extent that he is authorized to do so.

NOTICE!
Improper changes to the user parameters can result in serious damage or even a total failure of the machine.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

For user authorizations, see the Heidenhain user manual for the CNC control unit.

1. Press the *[save/edit program]* button.

2. Press the *[MOD]* button.

Fig. 73: User parameters

3. Press *[USER PARAMETER]* softkey.

4. Press *[keys to move the cursor]* and select the desired parameter from the list.

NOTICE!
When axes or spindles are registered and deregistered, this may result in an undefined machine standstill. In this event, the control system prevents further operation of the machine.

5. Use the numeric keypad to enter the desired value for the selected parameter.

6. Press the *[END]* button to confirm the selection.

⇨ The changed parameter is now accepted by the control unit.

An automatic restart of the control unit takes place depending on the changed parameter.

10.3 Changing display settings

You can use the display options to individually adjust the look of parts of the user interface.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

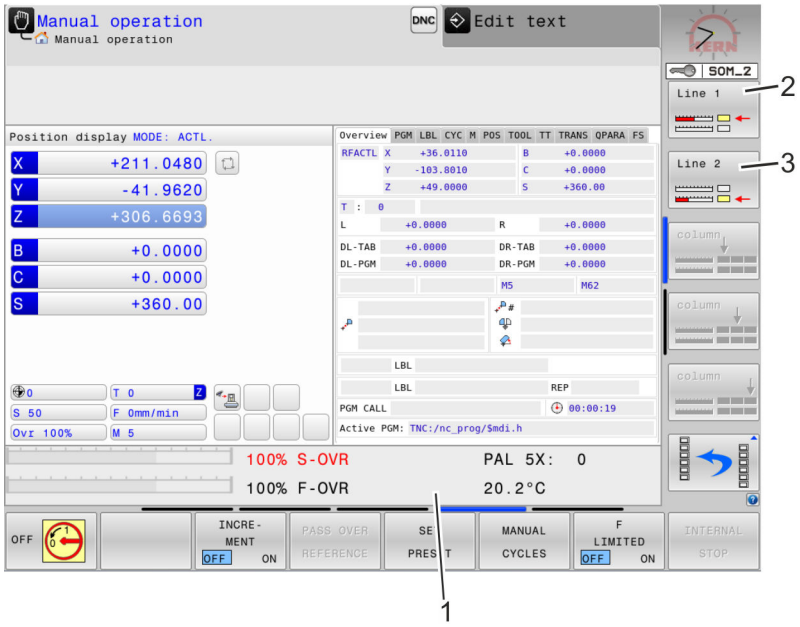


Fig. 74: Start screen (example)

1. Call up the start screen for the control system (Fig. 74).
   ⇨ You can now adjust the six fields in the lower display area (Fig. 74/1) individually.
2. Press the *[Line 1]* (Fig. 74/2) or *[Line 2]* softkey several times (Fig. 74/3) to change the information that is displayed.
3. The following information can be displayed:

Display	Meaning
S-Override	Spindle speed potentiometer
F-Override	Axis feed potentiometer
z-Override	Pendulum feed via S override
C-Override	Feed for free turning via S override
S-Ist	Current spindle speed as a percentage
S [Nm]	Current capacity of the spindle
X [Nm]	Current capacity of the X-axis
Y [Nm]	Current capacity of the Y-axis
Z [Nm]	Current capacity of the Z-axis

Display	Meaning
4 [Nm]	Current capacity of the A/B-axis (swivel axis)
5 [Nm]	Current capacity of the C-axis (rotary axis)
WZ-Name	Name of the tool in the spindle
08:45	Current time (hh:mm)
PROBE	Status of the infrared workpiece sensor (red = inactive / green = active)
Pa:	Current workpiece pallet (5-axis / dividing head chuck)
Pi:	Current workpiece pallet (3-axis / table chuck)
LIMIT 1	Active range of motion limitation
23.3 °C	Current spindle bearing temperature
Z1: 0	Workpiece counter (5-axis / dividing head chuck)
Z2: 0	Workpiece counter (3-axis / table chuck)

10.4 Changing the machine settings

Machine-specific settings can be made in this area.

> **NOTICE!**
> Improperly changing the settings can damage the machine!

Personnel:
- Machine operators authorised for teaching mode

1. Press the *[options]* softkey.

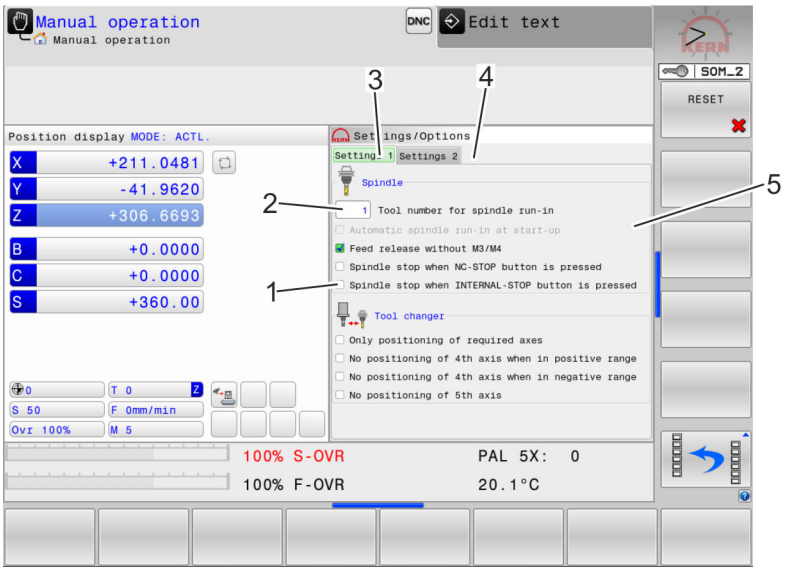


Fig. 75: Settings/Options

⇨ The settings 1 window with the settings for the spindle and tool changer is opened.


2. Use the *[cursor keys]* to navigate between the individual options.

3. Enable or disable the desired options (Fig. 75/1) per mouse click.

4. Select the input fields (Fig. 75/2) per mouse click.

5. Enter the values using the numeric keypad.

6. Confirm your entries with *[ENT]*.

> *Apart from a few exceptions, the settings remain active even after a machine restart.*

7. Switch to the “Settings 2” tab (Fig. 75/4).

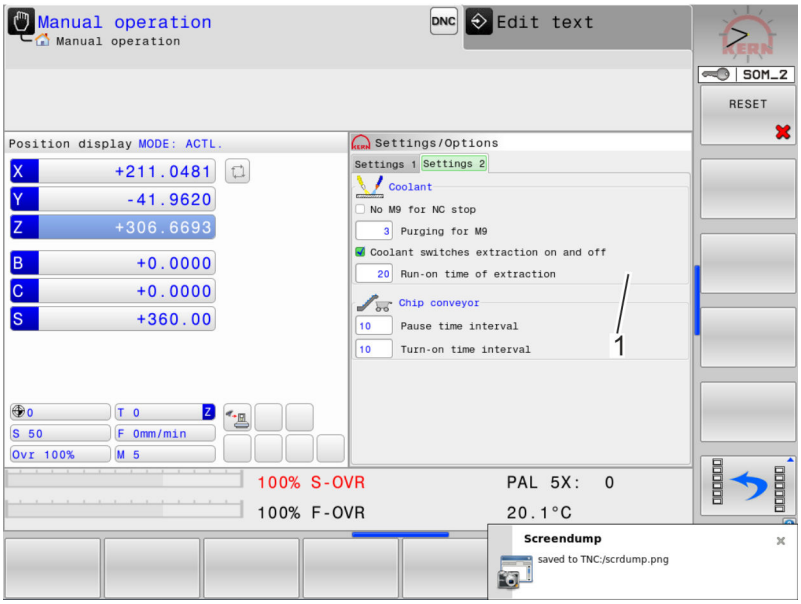


Fig. 76: Options 2

8. The settings for the cooling water can be changed in the settings 2 window (Fig. 76/1).

10.5 Switching to automation

An automation system connected to the machine can be controlled by a higher-level job management system.

Personnel:
- Machine operators authorised for teaching mode

1. Press the *[options]* softkey.

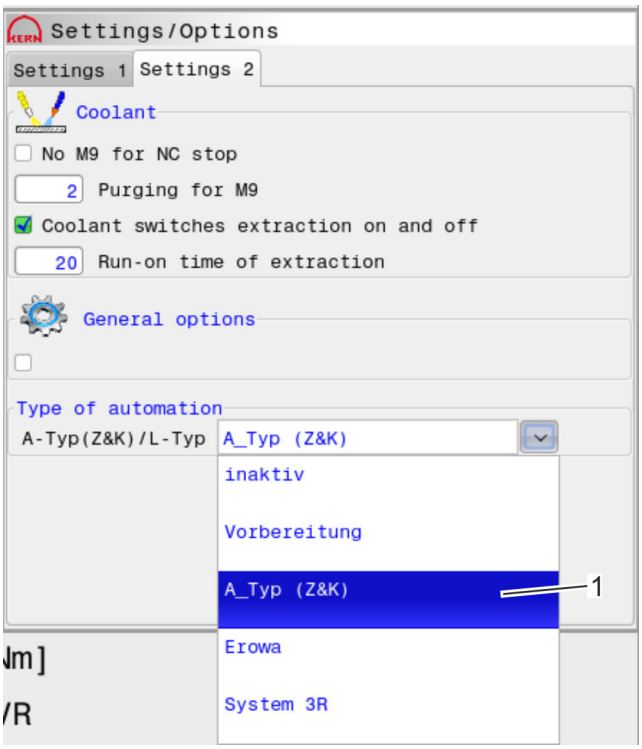


Fig. 77: Automation

2. Select the setting *[A_Typ (Z&K)]* (Fig. 77in the settings 2 window.

⇨ The setting is effective from the next restart.

10.6 Resetting the options

You can reset all the changes made to the options back to the factory settings by activating the RESET function.

Personnel:
- Machine operators authorised for teaching mode

Prerequisite:
- Extras and options have been activated (↬ *Chapter 10.1 “Activating the advanced control functions” on page 136*).

Press the *[options RESET]* button.

⇨ All options are reset to the default settings.

10.7 Setting the service functions

10.7.1 Opening the service menu

The service menu provides the option for the further parameterization of individual machine functions.

NOTICE!
Improperly changing these settings can cause serious damage to the machine!

Personnel: ■ Machine operators authorised for teaching mode

1. Activate the advanced control functions *Chapter 10.1 “Activating the advanced control functions” on page 136*.

2. Switch back to the main menu by pressing the *[manual operation]* key.

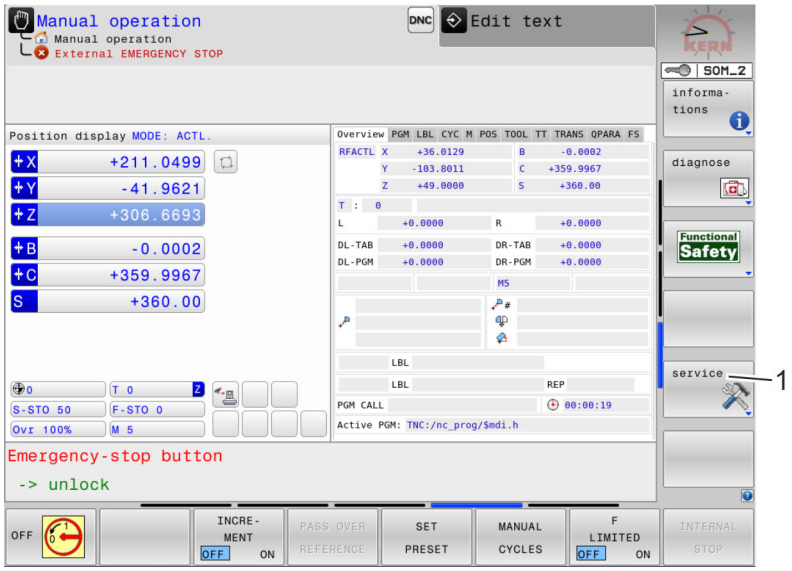


Fig. 78: Service menu

3. Press the *[service]* softkey (Fig. 78/1).
   ⇨ The service menu is opened.

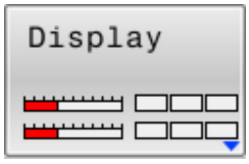
4. Press the *[end service menu]* key to end the activation.

10.7.2 Changing the display language

The display language for the control system can be adjusted as needed.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots



1. Press the *[Display]* softkey.

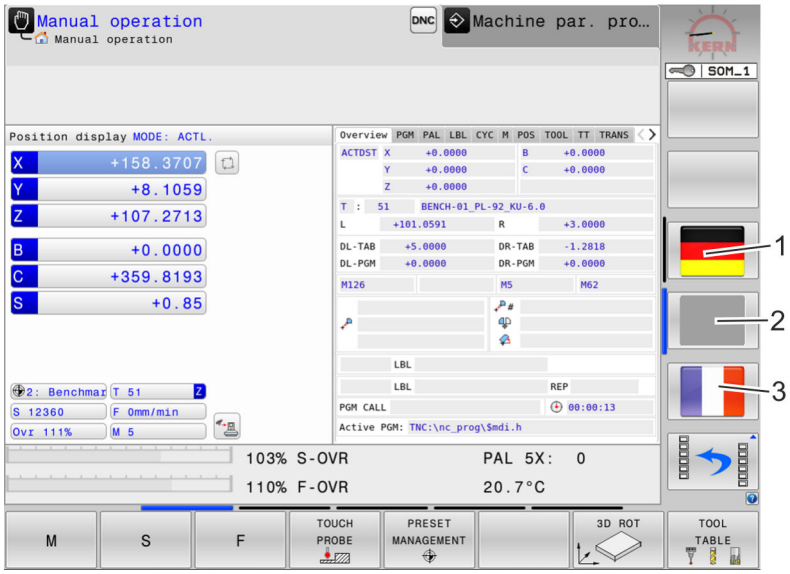


Fig. 79: Language settings

1 Language 1
2 Language 2
3 Language 3

2. Press the softkey for the desired language (Fig. 79/1 – 3).

⇨ The display language changes immediately.

A greyed-out softkey indicates which display language is currently selected.

11 Cleaning the machine

11.1 Emptying the chip collecting box

Interval: daily

The following work only applies to machines without an automatic chip conveyor (option).

If the machine is equipped with such a chip conveyor (scraper conveyor), please adhere to the separate operating instructions for the chip conveyor.

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety shoes
- Chemical-resistant protective gloves
- Protective goggles

Prerequisites:
- No processing program is active.
- The chip collection box is full.

1. Open the sliding door to the work area *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.

Chip collection box, coarse screen

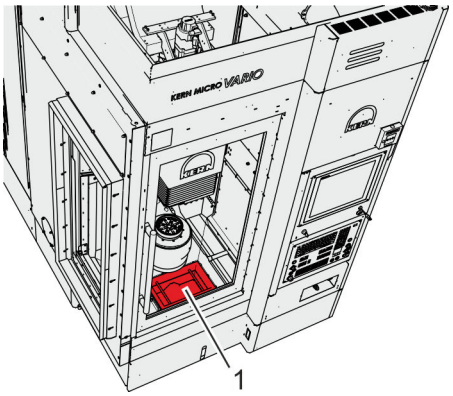


Fig. 80: Chip collection box, coarse screen

2.

The full chip collection box weighs about 10 kg.

Pull out the chip collection box upwards by the handles (Fig. 80/1, 2) and let it drip.

3.

WARNING!
Danger of slipping due to dripping cooling lubricant!

Dispose of the chips properly and safely.

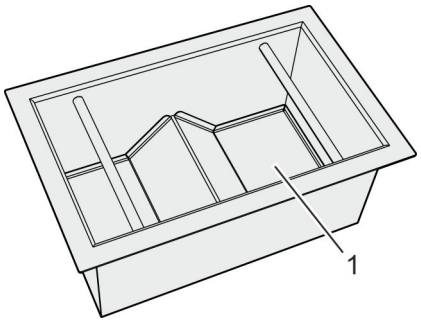


Fig. 81: Chip collection box, coarse screen

4. Clean the chip collection box (Fig. 81/1).
5. Set down the chip collection box outside the machine.

Opening the access flaps

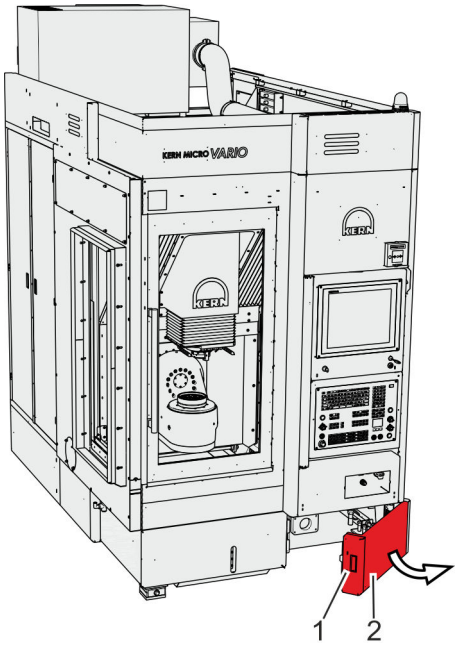


Fig. 82: Opening the flap (right)

6. Pull open the right flap (Fig. 82/2) using the handle (Fig. 82/1).

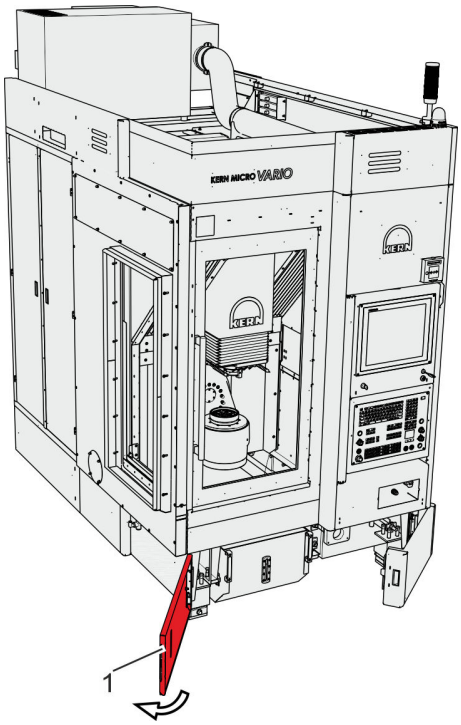


Fig. 83: Opening the flap (left)

7. Pull open the left flap (Fig. 83/1) using the handle.

⇨ The chip box is exposed.

Chip collection box, fine screen

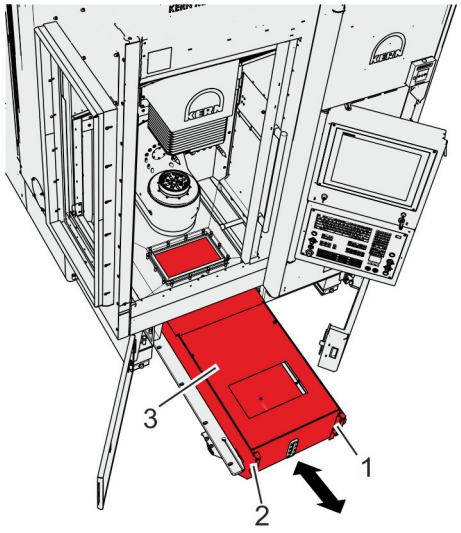


Fig. 84: Cooling lubricant tank

1, 2 Handle
3 Chip collection box cover

8.

CAUTION!
Spilling cooling lubricant!

NOTICE!
The connection cables may become damaged if the cooling lubricant tank is pulled out too far.

Pull the entire cooling lubricant tank slowly by the handles (Fig. 84/1, 2) only so far out that the cover (Fig. 84/3) is completely visible.

9. Remove the cover from the cooling lubricant tank (Fig. 84/3) and place it to the side.

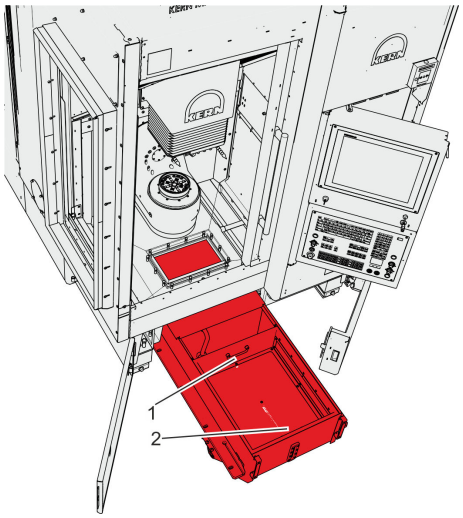


Fig. 85: Chip collection box, fine screen

1, 2 Handle

10. *The full chip collection box weighs about 10 kg.*

To empty the chip collection box, pull it upwards out of the cooling lubricant tank by the handles (Fig. 85/1, 2) and let it drip.

11. **WARNING!**
Danger of slipping due to dripping cooling lubricant!

Dispose of the chips properly and safely.

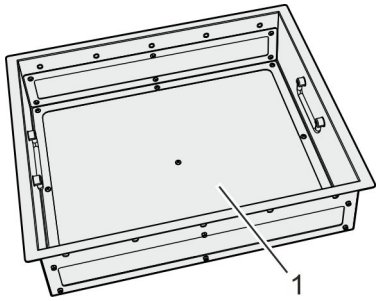


Fig. 86: Chip collection box, fine screen

12. Clean the chip collection box (Fig. 86/1).

13. Re-insert the chip collection box.

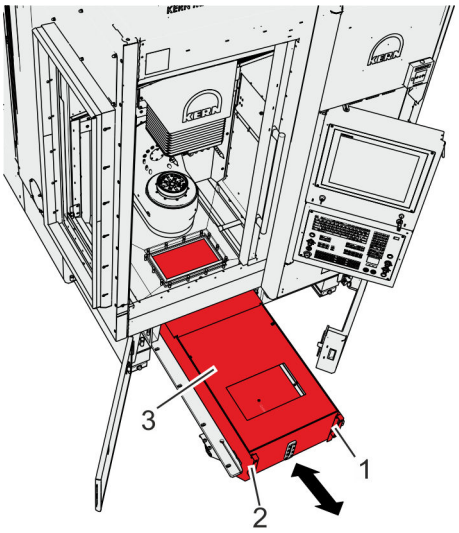


Fig. 87: Cooling lubricant tank

1, 2 Handle
3 Chip collection box cover

14. Place the cover (Fig. 87/3) back on the cooling lubricant tank.

15. **CAUTION!**
Spilling cooling lubricant!

Slowly push in the entire cooling lubricant tank as far as it will go by the handles (Fig. 87/1, 2).

WARNING!
Danger of slipping due to cooling lubricant on the floor!

16. Remove any cooling lubricant residue from the floor.

17. Dispose of any chips, dirty cloths and polluted cooling lubricant in a proper and environmentally sound manner.

11.2 Cleaning the work area

Interval: daily

Automatic locking

CAUTION!
Risk of injury due to self-locking sliding doors!
If the machine is switched on, the sliding doors to the work area are automatically locked when they are closed. If persons are present inside the work area (e.g. while cleaning), they will be locked in because it is impossible to open the sliding doors from the inside.

– Never enter the machine.

Personnel:	■ Machine operator
Protective equipment:	■ Protective work clothing ■ Safety boots ■ Protective gloves ■ Protective goggles
Special tool:	■ Industrial vacuum cleaner ■ Cleaning brush

Prerequisite:

- The machine is switched on.

1. **NOTICE!**
   Damage to the machine due to dirt entering the seals!

   Switch on the sealing air to make sure that no dirt enters sensitive parts of the machine during cleaning.
2. Insert an empty tool holder in the spindle so that no chips or dirt can enter the spindle.
3. Insert a pallet in the workpiece chuck so that no chips or dirt can enter the chuck.
4. **CAUTION!**
   Risk of injury on the sharp steel slats of the guide covers!

   Move the Z-axis down in negative axis direction to allow the bellows to be cleaned.
5. Move the Y-axis forwards in positive axis direction to allow the bellows to be cleaned.
6. **WARNING!**
   Risk of injury due to flying chips when cleaning with compressed air!

   To remove chips, always use the spray gun (option) or, if not present, a broom or brush. Never clean the work area with compressed air. The machine can become damaged if compressed air is used.
7. Flush away coarse chips in the work area with the spray gun (option).

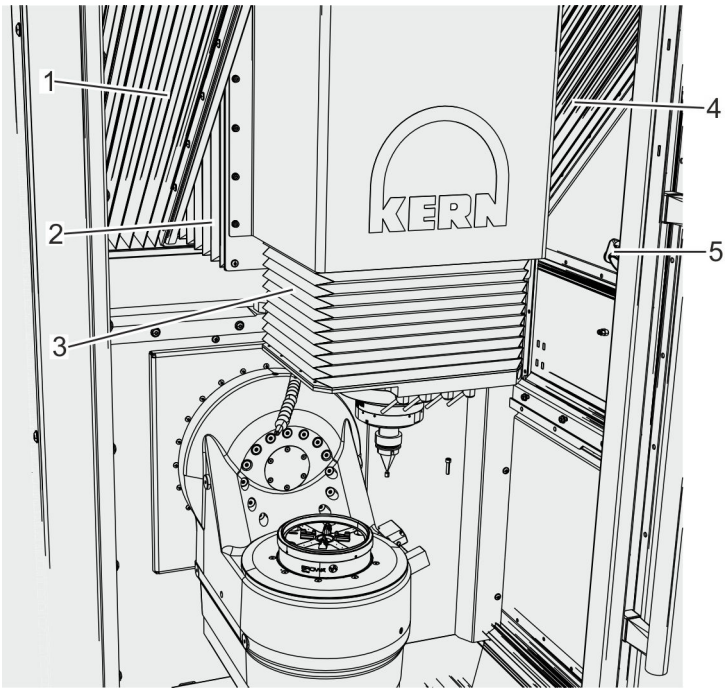


Fig. 88: Slats and bellows

1 X-axis bellows
2 Y-axis bellows
3 Z-axis bellows
4 X-axis bellows
5 Receiver for infrared workpiece sensor

8.

NOTICE!
When cleaning the slats, do not use excessive force when pushing them upwards as this could damage the bellows, allowing foreign particles to enter sensitive areas of the machine.

Use a cleaning brush to clean the slats of the bellows in the Z-axis (Fig. 88/3), Y-axis (Fig. 88/2) and X-axis (Fig. 88/1, 4).

9.

NOTICE!
Make sure that the set angle of the receiver for the infrared workpiece sensor (Fig. 88/5) is not adjusted during cleaning, otherwise communication between the infrared workpiece sensor and the receiver will be interrupted.

Use a cloth to clean the entire work area to remove any chips and dirt.

10. Clean all the surfaces of the machine table or the turn and tilt unit (option). Wipe off any cooling lubricant residue.

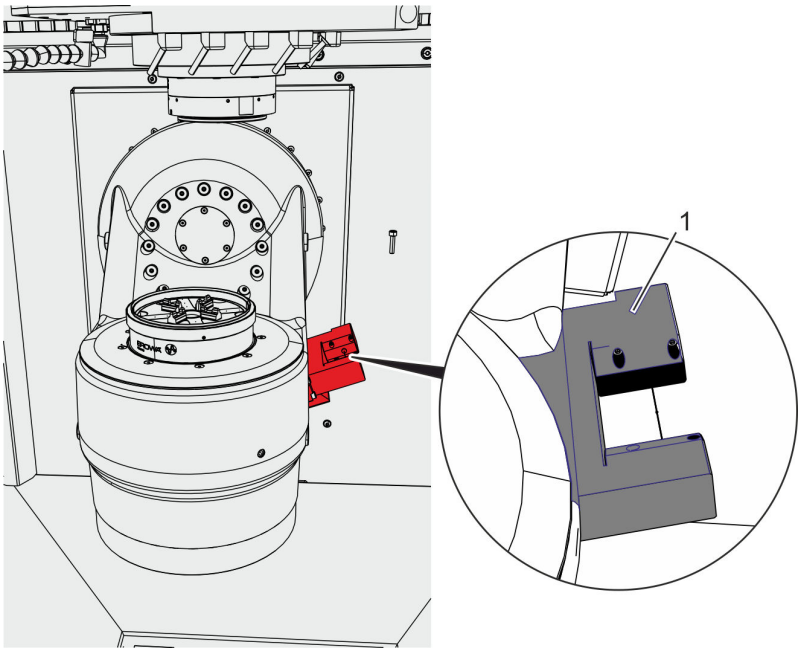


Fig. 89: Laser tool measuring

11. Clean the laser measuring device (Fig. 89/1) with a cloth.

12. Check the entire machine area for leaking oil. Use suitable materials to take up any existing oil residue (e.g. from loss lubrication) and dispose of it properly.

13. Clean the safety panes in the entire work area.

14. Check the safety panes for damage, clouding and remaining service life. When the remaining service life expires, have the safety panes replaced in accordance with the supplied maintenance and service manual.

Each safety pane has a sticker specifying its service life.

15. Check the entire machine area for leaking oil. If necessary, wipe it up using suitable material.

16. Dispose of working materials properly and in an environmentally sound manner.

NOTICE!

Cleaning for longer breaks

For long breaks (e.g. weekends), also take the tool holder out of the spindle. Before the tool holder is re-clamped in the spindle, thoroughly clean the spindle cavity and the holder shaft.

11.3 Checking and cleaning the conical head of the spindle

For information about maintaining the conical head of the spindle, also note and comply with the specifications in the supplier documentation provided.

Personnel:
- Machine operator
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

1. Remove any tool from the spindle.
2. Switch off the machine and secure it against restarting (*Chapter 2.9 “Safeguard against restart” on page 36*).
3. Check the tool holder on the spindle for damage.
4. Insert the cone cleaner (Fig. 90) in the tool holder and turn it 2 – 3 times.

WARNING!
Hazard due to flying chips! Never clean the spindle cone with compressed air!

5. Clean the HSK clamping area of the tool holder.

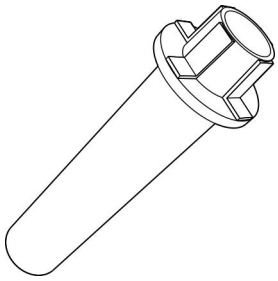


Fig. 90: Cone head cleaner (example HSK 25)

11.4 Cleaning the tool changer

Interval: annually or when necessary

Personnel:
- Machine operator

Protective equipment:
- Protective work clothing
- Safety boots

Special tool:
- Industrial vacuum cleaner
- Cleaning brush
- Cleaning cloths

Prerequisite:

- No process is active.

1. 

   CAUTION!
   Risk of injury on cutting tools!

   Wipe up the residue of any cooling lubricant or oil using a cloth. Remove chips and loose dirt with an industrial vacuum cleaner.
2. Clean the glass of the B821 sensor (tool present) with a cleaning cloth.
3. Check the function of the hydraulic limit stop dampers.
4. Remove any oil from the toothed belt axis with a cleaning cloth.
5. Remove the tools from the tool changer and clean them with a brush or similar.
6. Check the safety panes of the tool changer for dirt and clean them if necessary.
7. Close the door to the tool magazine.
8. Properly dispose of used work material.

12 Maintenance

Maintenance and service manual

See the maintenance and service manual provided for the maintenance intervals, descriptions and checklists of all the maintenance work to be performed.

13 Remedying faults

The following chapters describe the possible causes of faults and the work needed to remedy them.

If faults occur more frequently, shorten the maintenance intervals specified in the maintenance and service manual in accordance with the actual requirement.

If faults arise that cannot be remedied by means of the following instructions, contact our customer service (↳ “Customer service” on page 4).

13.1 Safety instructions for remedying faults

Improper troubleshooting

WARNING!

Risk of injury due to improper troubleshooting!

Troubleshooting performed incorrectly can cause severe injuries and significant property damage.

– If no energy supply is needed for the trouble-shooting, switch off the machine and secure it against restarting.
– Before starting machine movements, make sure that this action does not pose a risk to persons (e.g. when working in the service area). If necessary, cordon off the danger zone.
– Note the personnel qualifications required for each task.
– Observe and comply with the specifications in the relevant supplier documentation.

Dropping spindle stock

WARNING!

Risk of crushing due to the spindle stock sud-denly dropping!

During work on components of the vertical axis (Z-axis), the spindle stock may suddenly drop because the holding force of the motor is not suffi-cient to hold the spindle stock. This can cause serious injuries.

– Secure the spindle stock against dropping or drive it into the lower end position before dis-connecting the axis drive. Place a foam wedge underneath in order to prevent damage.

Tensioned springs

WARNING!

Risk of injuries though pre-tensioned springs!

The tool spindle and the clamping system contain pre-tensioned springs. In the event of improper handling of these components, the springs can come loose and cause injuries.

– Only carry out work on the components in accordance with the specifications of the supplier documentation.

13.2 Procedure in the event of faults

1. In the event of faults that pose an immediate risk to persons or property, immediately press the emergency-stop button.

HELP

2. Press the *[HELP]* key.
   ⇨ The error table is opened.

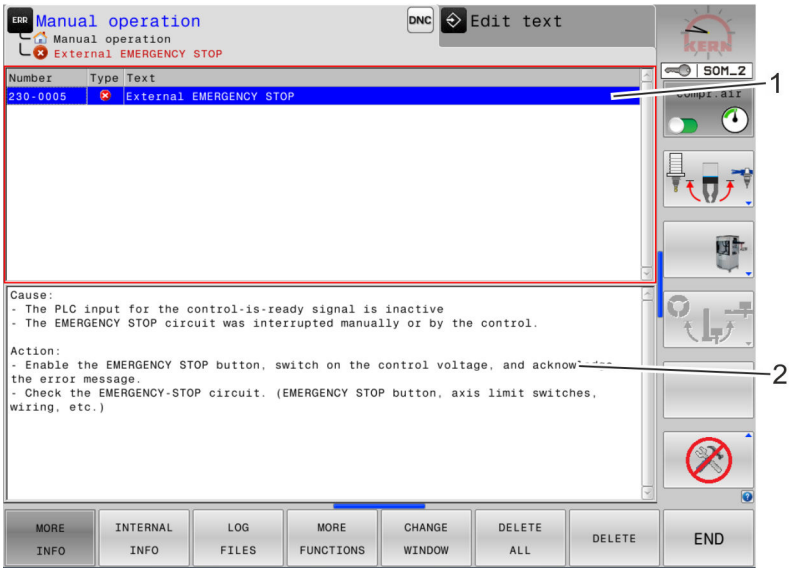


Fig. 91: Fault indicator (example)

3. The name of the fault (Fig. 91/1) as well as the details of the cause of the fault and measures to remedy it can be found in the pop-up window (Fig. 91/2).
4. If remedying the fault does not require the machine to be switched on, switch off the machine and secure it against being switched on again ↳ *Chapter 2.9 “Safeguard against restart” on page 36*.
5. Notify the responsible person on site about the fault.
6. Remedy the fault in accordance with the description of the remedy (Fig. 91/2), taking into consideration the relevant personnel qualifications.

ESC

7. Press the *[ESC]* key to close the pop-up window.

CE

8. Press the *[CE]* key to acknowledge the fault.

13.3 Troubleshooting

13.3.1 Automatically disengaging the tool changer

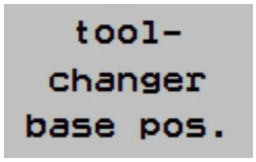
When does the tool changer need to be automatically disengaged?

If there is error on the machine during a tool change, the machine may be able to disengage from error situations on its own under certain circumstances.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

1. Press the *[base pos. generally]* softkey.



2. Press the *[tool-changer base pos.]* softkey.

3. Confirm with *[ENT]*.
   ⇨ The control unit attempts to move the tool changer back to its base position.

If the error cannot be remedied in this manner, disengage the tool changer manually (↯ Chapter 13.3.2 “Manually disengaging the tool changer” on page 161).

13.3.2 Manually disengaging the tool changer

When does the tool changer need to be manually disengaged?

The tool changer is unable to disengage automatically in the event of certain faults. This must then be executed manually. In order to do so, the following tasks must be carried out:

	Steps
1	Correcting the tool position table ↯ *“Correcting the tool position table” on page 162*
2	Resetting the software sequencer ↯ *“Resetting the software sequencer” on page 162*
3	Checking the status of the tool changer components ↯ *“Checking the status of the tool changer components” on page 163*

Correcting the tool position table

In order to manually disengage the tool changer in the event of a fault, you need to ensure that all the tools are in the correct position in the tool magazine.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety shoes

Prerequisites:

- A fault has occurred during a tool change.
- Automatically disengaging the axes is not possible (↳ *Chapter 13.3.1 “Automatically disengaging the tool changer” on page 160*).

1. Open and activate the tool position table ↳ *Chapter 6.5.3 “Opening and editing the tool position table” on page 109*.
2. Check whether the positions in the tool position table match the actual positions of the tools in the machine.
3. If there are deviations, insert the tools in the correct position.

Resetting the software sequencer

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety shoes

Prerequisite:

- The position tables have been corrected (↳ *“Correcting the tool position table” on page 162*).

1. Press the *[emergency-stop]* button.

2. Press the *[Disengage]* button.

3. Press the *[tool-changer RESET]* button.

4. Press the *[OK]* softkey to confirm.
   ⇨ The software sequencer of the tool changer is reset.

Checking the status of the tool changer components

When the tool changer is manually disengaged, the status of the individual tool changer components must be checked.

WARNING!

Risk of crushing by the moving parts of the machine!

In the following test, software functions trigger sudden machine movements (e.g. opening and closing the flaps and grippers). If there are people working on or in the machine during the test, the risk of injury is considerable.

- Ensure that there are no persons in the danger zone before triggering software functions.
- Never work on or in the machine during the test.
- Eliminate faults or blockages only when the machine is switched off and depressurised.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety shoes

Prerequisites:

- The sliding door to the work area is closed *Chapter 6.1 “Opening and closing the sliding door to the work area” on page 97*.
- The door to the internal tool changer is closed *Chapter 6.2 “Opening and closing the door to the tool changer” on page 98*.

1. Activate the advanced control functions *Chapter 10.1 “Activating the advanced control functions” on page 136*.

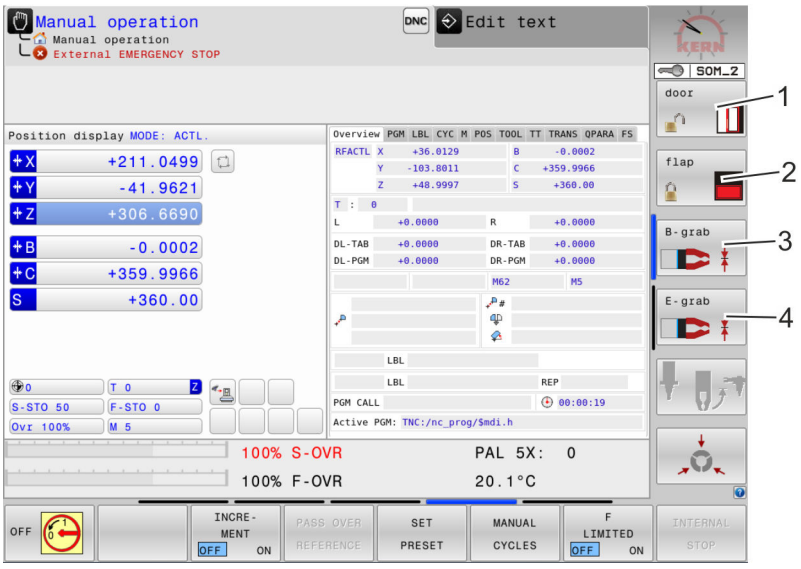


Fig. 92: Service menu

2. Press the *[lock/unlock work area sliding door]* softkey (Fig. 92/1).
3. Press the *[open/close tool changer flap]* (Fig. 92/2) softkey.
   ⇨ Check the movement of the tool changer flap.
4. Press the *[open/close loading gripper]* (Fig. 92/3) softkey.
   ⇨ Check the movement of the loading gripper.
5. Press the *[open/close unloading gripper]* (Fig. 92/4) softkey.
   ⇨ Check the movement of the unloading gripper.

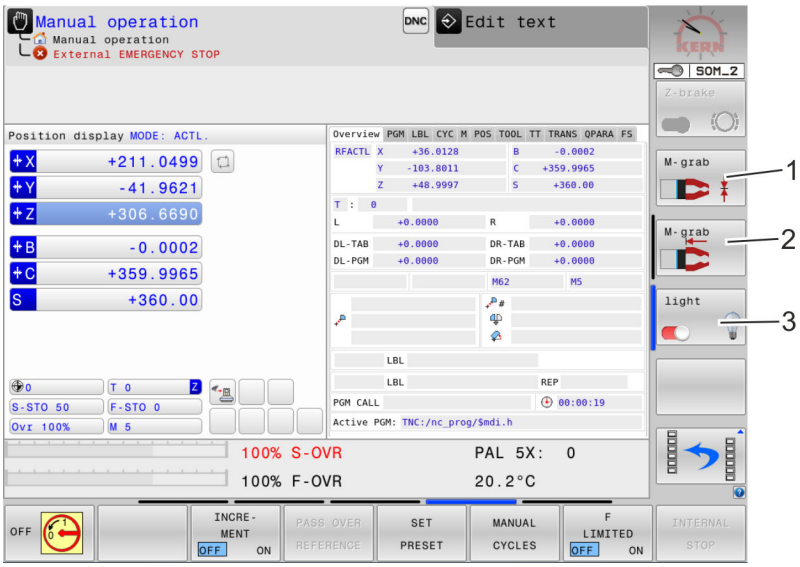


Fig. 93: Service menu

6. Press the *[open/close magazine gripper]* (Fig. 93/1) softkey.
   ⇨ Check the movement of the magazine gripper.
7. Open the magazine gripper

   Press the *[magazine gripper forward/backward]* (Fig. 93/1) softkey.
   ⇨ Check the movement of the magazine gripper.

The lighting in the tool changer can be switched on and off with the [light] softkey.

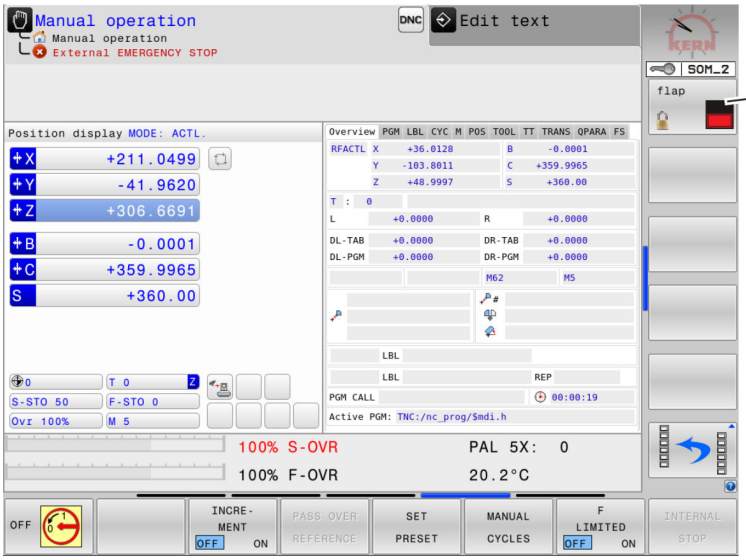


Fig. 94: Service menu

8. Press the *[external workpiece changer flap]* softkey (Fig. 94/1).

⇨ Check the movement of the flap.

9. Press the *[END]* softkey.

⇨ The service menu is closed.

When does the workpiece changer need to be automatically disengaged?

If there is an error on the machine during a workpiece change, the machine is able to disengage from the error automatically.

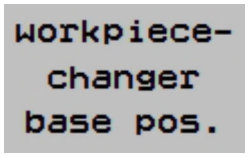
NOTICE!

The processes described below apply exclusively to the internal tool changer of Kern Microtechnik!

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

1. Press the *[Disengage]* softkey.



2. Press the *[Disengage workpiece changer]* softkey.

3. Confirm with *[ENT]*.

⇨ The control unit attempts to move the workpiece changer back into a safe position.

If the error cannot be remedied in this way, proceed as described in .

13.3.4 Referencing the axes manually

In certain situations, such as after changing certain machine parameters or if the machine axes were moved when the machine was switched off, the axes must be referenced again. In this case, a message is displayed on the machine control system.

Personnel:
- Machine operators authorised for teaching mode

Protective equipment:
- Protective work clothing
- Safety boots

Prerequisite:
- During an automatic reference run, some of the axes could not be referenced and remain marked red.

1. Set to teaching mode *Chapter 5.2 “Setting teaching mode” on page 95*.

2. Press the *[NC-START]* key.
   ⇨ The first faulty axis is positioned at its referenced test position (0 mm).

3. Use the *[OK]* softkey to confirm.

4. Press and hold the permission key.
   ⇨ The first faulty axis is positioned at its referenced test position (0 mm).

NOTICE!
If there are obvious and conspicuous deviations of the axes from the previously indicated values, contact Kern customer service.

5. Repeat this procedure until all faulty axes are referenced.

13.4 Start-up following fault rectification

After rectifying the fault, the following steps should be performed to restart the system:

1. Reset the emergency stop devices.
2. Acknowledge the fault at the controller.
3. Ensure that no persons are in the danger zone.
4. Start up in accordance with the instructions in the "Operation" chapter.

14 Decommissioning, dismantling and disposal

14.1 Decommissioning

Once the machine has reached the end of its service life, it must be dismantled and disposed of in an environmentally sound manner.

Personnel:
- Maintenance personnel
- Electrician

Protective equipment:
- Protective work clothing
- Safety boots

Materials:
- Pneumatic diagram
- Fluids diagram
- Electric diagram

1. Shut down the machine *Chapter 4.6 “Shutting down the machine” on page 93*.

Electrician

2. Disconnect the mains cable as per the electrical documentation.
3. Disconnect the energy supply for the included optional components.

WARNING!

Risk of fatal injury due to residual voltage!

For 5 minutes after the main switch has been switched off, there is still a dangerous residual charge at the machine. Furthermore, 230 VAC are permanently applied to the (optional) fire extinguishing system and to sections of the switch and supply cabinet.

– Wait until the residual voltage has dissipated before starting any work on electrical components.

Maintenance personnel

4. Disconnect the water feed and return lines for the machine cooling.
5. Disconnect the compressed air supply.
6. Remove all coolant and lubricant from the machine.
7. Completely clean all the machine components.

14.2 Dismantling, recycling and disposal

Electrical system

DANGER!

Risk of fatal injury due to electric power!

Contact with live components can result in fatal injuries. Live electric components may carry out uncontrolled movements and cause the most serious injuries.

– Prior to dismantling, switch off the electricity supply and permanently disconnect it.

Improper dismantling

WARNING!

Risk of injury due to improper dismantling!

Stored residual energy, sharp-edged components, and points and corners on or in the machine or the necessary tools can cause injuries.

– Ensure there is ample space prior to starting the work.
– Take care with exposed sharp-edged components.
– Keep the work area clean and tidy! Loosely stacked or scattered parts and tools are sources for accidents.
– Dispose of components properly. Note that some components are heavy. If necessary, use hoisting equipment.
– Secure components to prevent them from falling or toppling.
– If anything is unclear, contact customer service.

Tensioned springs

WARNING!

Risk of injuries though pre-tensioned springs!

The tool spindle and the clamping system contain pre-tensioned springs. In the event of improper handling of these components, the springs can come loose and cause injuries.

– Only carry out work on the components in accordance with the specifications of the supplier documentation.

Personnel:
- Maintenance personnel

Protective equipment:
- Protective work clothing
- Safety boots
- Protective gloves

Prerequisite:

- Machine has been removed from service *Chapter 14.1 “Decommissioning” on page 168*.

1. Dismantle the assemblies and components, taking the locally applicable health and safety regulations into account, and sort the assemblies and components into disposal categories.
2. Dispose of the waste, operating materials and auxiliary materials properly and in an environmentally sound manner, taking the locally applicable regulations into account.

The following materials are used:

Material	Examples
Metals and alloys	■ Aluminium (housing, cover panels etc.) ■ Copper (electric wires) ■ Steel (plates, sections, fastening materials such as bolts etc.) ■ Magnetic materials
Glass	■ Glass (safety panes, glass panes in display instruments)
Plastics	■ Plastics (controls, hoses, sheathing, wheels etc.) ■ Rubber seals, silicone hoses
Composite materials	■ Electrical material (cables, motors, components) ■ Electronic material (circuit boards, PC, screen)
Packaging	■ Wood (packing crates) ■ Styrofoam (padding material) ■ Plastic (film) ■ Iron (nails, wire)

ENVIRONMENT!

Environmental hazards due to incorrect disposal!

Incorrect disposal may harm the environment.

» Continued on the next page

- Electrical scrap, electronic components, lubricants, and other auxiliary materials must be disposed of by authorised specialist companies.
- If in doubt, obtain information about environmentally sound disposal with the local municipalities or specialised disposal companies.

15 Technical data

15.1 Dimension sheet

The dimension sheets can be found in the appendix of this manual.

15.2 Dimensions and weight

Data	Value	Unit
Weight	Refer to installation diagram*	
Total length (with control console attached)	approx. 3,200	mm
Total width	approx. 1,600	mm
Total height	2,600	mm

* refer to installation diagram in the appendix of this manual.

15.3 Connection values

Electric

Data	Value	Unit
Voltage	3 x 400 (3P +N+PE)	V
Network quality	EN 50160	
Frequency	50	Hz
Frequency (option)	60	Hz
Control voltage	24	V DC
Three-phase electric plug	64	A
Power consumption, maximum	20	kW
Fuse rating	63	A

In case of an unstable mains supply, it may be necessary to use a transformer. For detailed information in this respect, contact Kern's customer service.

Pneumatic

Data	Value	Unit
Operating pressure (main valve)	6	bar
Permissible pressure fluctuations	± 1	bar
Temperature above ambient air temperature	Max. 5	°C
Quality classes in accordance with ISO 8573-1	Class 5.3.3	
Sealing air, measuring systems (X, Y, Z)	0.8	bar
Sealing air, spindle (MFW1224 Fischer HSK40)	4.5	bar
Sealing air, spindle (Precise HSK25)	0.5	bar
Sealing air, turn and tilt unit (B-axis and C-axis)	0.8	bar
Compressed air, oil-air lubrication (MFW1244 Fischer HSK 40)	5 ± 0.2	bar
Sealing air, valve control for laser tool measuring	2	bar

Cooling water supply (cold water)

Data	Value	Unit
Inlet temperature, max.	15	°C
Flow rate, min.	25	l/min
Flow rate, min.	~1.5	m³/h
Loss of pressure	9.58	kPa
Cooling capacity	12	kW
Total bacterial count	< 1,000	CFU/ml
Chloride content	< 20	mg/l
Alkalinity	< 1	°dH
Total hardness	< 20	°dH
Conductivity	< 2,000	µS/cm
Feed connection	DN 25 hose	mm
Return connection	DN 25 hose	mm

Ethernet connection

Data	Value	Unit
Connection	Twisted pair	
Shielding	CAT5	
Transfer rate	10/100	Mbit
Protocol	TCP/IP	

15.4 Performance data

Spindle HSK 25

Data	Value	Unit
Tool holder	HSK 25	
Speed, setting range	200 – 30,000	rpm
Power (S1)	6.4	kW

For additional performance data of the spindle, refer to the supplier documentation provided in the appendix.

Spindle HSK 40

Data	Value	Unit
Tool holder	HSK 40	
Speed, setting range	200 – 42,000	rpm
Power (S1)	15	kW

For additional performance data of the spindle, refer to the supplier documentation provided in the appendix.

Work process traverse paths

Data	Value	Unit
X-axis	350	mm
Y-axis	220	mm
Z-axis	250	mm
B-axis (option)	-110 – +110	°
C-axis (option)	360	° (limit-less)

Dynamics (feed rates)

Data	Value	Unit
X-, Y- and Z-axis	30	m/min
B-axis (option)	600	°/s
C-axis (option)	1,200	°/s

Axis acceleration

Data	Value	Unit
X-axis, Y-axis and Z-axis	Up to 10	m/s^2

Torque

Data	Value	Unit
Peak torque B-axis	780	Nm
Continuous torque B-axis	447	Nm
Holding torque B-axis (jammed)	300	Nm
Peak torque C-axis	135	Nm
Continuous torque C-axis	75	Nm

15.5 Other machine data

Tool changer

Data	Value	Unit
Tool holder	HSK 40	
Tool length incl. holder, max.	100 – 150	mm*
Tool diameter, max.	45	mm
Chip-to-chip time	< 5	s
Balancing quality at 40,000 rpm	2.5	G

* Depending on tool position

Internal liquid cooler incl. spindle (temperature management)

Data	Value	Unit
Container content	30	l
Operating pressure, max.	10	bar
Power	1	kW
Cooling capacity	12	kW
Coolant type	Water with cool concentrate	
Cool concentrate percentage in the water	11	%

15.6 Operating conditions

Environment during the operation

Data	Value	Unit
Temperature range	20 ± 5	°C
Temperature range for high precision work	20 ± 1	°C
Relative humidity	20 – 55	%
Installation location	max. 3,000	m above sea level

To achieve and sustainably ensure the maximum accuracy of the machine, create a climate-controlled environment of 20 °C ±1 °C.

15.7 Emissions

Data	Value	Unit
Noise emission, max.	75	dB(A)*

* Depending on operating parameters, such as rotational speed, cutting speed, and tool/workpiece combination, certain situations may generate higher noise emissions.

15.8 Lubricant

Cooling lubricants

Lubricant	Manufacturer	Area of application
Zubora 92 F (emulsion)	Zeller + Gmelin	All areas of application
Zubora 20 H extra (emulsion)	Zeller + Gmelin	All areas of application
Multicut HSC 10	Zeller + Gmelin	All areas of application
Castrol Honilo 930	Motorex	Jig grinding
Swisscut Ortho NF-X	Motorex	■ Micro boring and milling ■ Micro thread cutting ■ Chrome-nickel alloys ■ Aluminium alloys ■ Titanium alloys ■ Copper alloys ■ Non-ferrous metals ■ Precious metals
Wicoil 5036	Wilke	■ Micro boring and milling ■ Micro thread cutting ■ Chrome-nickel alloys ■ Aluminium alloys ■ Titanium alloys ■ Copper alloys ■ Non-ferrous metals ■ Precious metals
Wicoil 5045	Wilke	■ Special for brass alloys, if parts must not tarnish ■ Micro boring and milling ■ Chrome-nickel alloys ■ Aluminium alloys ■ Titanium alloys ■ Copper alloys ■ Non-ferrous metals ■ Precious metals

Minimal quantity lubrication (option)

NOTICE!
For all utilized cooling lubricants, always also adhere to the separate information and data sheets of the manufacturers in order to prevent damage to the machine (e.g. due to rust caused by an incorrect mixing ratio)!

Lubricant	Manufacturer	Area of application
Wicoform-S 10/5	Wilke cooling lubricant technology	■ Aluminium ■ Aluminium alloy ■ Magnesium ■ Titanium ■ Titanium alloy
Wicoform-S 22	Wilke cooling lubricant technology	■ Chromium nickel steel ■ Titanium ■ Copper alloy ■ Aluminium alloy
UNILUB 2032	Unilube AG	■ Universal metal processing (e.g. steel and materials that are difficult to machine, reshape)
UNILUB 9107	Unilube AG	■ HSC ■ Aluminium ■ Alloys ■ Synthetic materials (stainless)
Vascomill MMS FA 2	Blaser Swisslube	■ Aluminium ■ Aluminium alloy ■ Ferrous materials ■ Steel ■ Titanium ■ Non-ferrous metals

15.9 Other operating supplies

Spindle cooling

Coolant	Manufacturer	Area of application
Coolant F	Motorex AG	Corrosion protection
Cool X	Motorex AG	Corrosion protection
cool concentrate	Motorex AG	Corrosion protection
Troyshield B7	Troy	Biocide
Troyshield SC-1	Troy	System cleaner

Spindle lubrication

Lubricant	Manufacturer	Area of application
Spindle Lube Hyperclean ISO VG68	Motorex AG	■ Fischer HSK 40 spindle ■ Kessler spindle
Shell Tellus oil 46	Shell Germany oil	Precise SC1060 0A high-speed spindles (160,000 rpm)

Axis lubrication

Lubricant	Manufacturer	Area of application
Centoplex GLP 500	Klüber lubrication	Central lubrication system

See also the data sheets provided for the individual lubricants and additives.

Hydraulic oil (hydraulic unit, spindle)

Hydraulic oil	Manufacturer	Area of application
Mobil DTE 24 VG 32	Mobil Oil	Hydraulic oil

15.10 Type plate

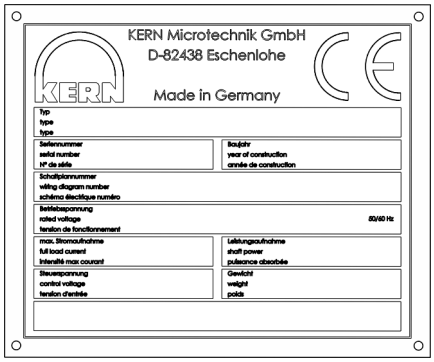


Fig. 95: Type plate

The type plate is located on the side of the switch cabinet below the main switch and contains the following information:

- Manufacturer
- Model
- Serial number
- Circuit diagram number
- Weight
- Year of construction
- Operating voltage
- Control voltage
- Max. current input
- Power consumption

16 Abbreviations and glossary

Name	Description
ICS	Internal coolant supply
PLC	Programmable logic controller Synonymous with programmable logic controller (PLC)
SOM2	Teaching mode
Chuck	Chuck at the turn and tilt unit

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