

Installation manual

Eccentric chuck
– Adjustable via C-Axis

EN

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»Translation of original installation manual«

1 General

1.1 Information about this manual

This manual enables safe and efficient handling of the clamping device.

The manual is a component of the clamping device and must be kept in the immediate vicinity of the clamping device where it is accessible for personnel at all times. Personnel must have carefully read and understood this manual prior to starting all tasks. The basic prerequisite for safe work is compliance with all the safety instructions and handling instructions in this manual.

Illustrations in this manual are provided for a basic understanding and may deviate from the actual model of the clamping device.

It is assumed that the reader is familiar with standard procedures, such as cleaning the mounting surfaces.

1.2 Explanation of symbols

Safety instructions

Safety instructions are indicated by symbols in this operating manual. The safety instructions are introduced by signal words that express the scope of the hazard.

The safety instructions must be strictly adhered to. You must act prudently to prevent accidents, personal injury, and material damage.



DANGER

... indicates an imminent dangerous situation that can result in death or serious injury if it is not avoided.



WARNING

... indicates a possible dangerous situation that can result in death or serious injury if it is not avoided.



CAUTION

... indicates a possible dangerous situation that can result in minor or light injury if it is not avoided.



NOTE

... indicates a possible dangerous situation that can result in material damage if it is not avoided.

Tips and recommendations



... indicates useful tips and recommendations, as well as information for efficient and trouble-free operation.

1.3 Limitations of liability

All information and instructions in this operating manual have been provided under due consideration of applicable standards and regulations, the current state of technology, as well as our many years of experience.

The manufacturer assumes no liability for damage due to:

- Failure to follow the instructions in the manual
- Non-intended use
- Deployment of untrained personnel
- Unauthorized conversions
- Technical changes
- Use of non-approved spare parts

The actual scope of delivery can vary from the explanations and graphic representations provided in this manual in the case of special versions, if supplemental order options are desired, or on the basis of the latest technical changes.

The agreed obligations in the delivery contract, the general terms and conditions, as well as delivery conditions of the manufacturer, and the statutory regulations valid at the time the contract was concluded, apply.

**CAUTION!**

Our clamping devices are balanced with balance quality $G = 4$, in one level $n = 1$.

The data on the rotation balance refers to rotationally symmetrical work pieces.

The clamping of not rotationally symmetrical work pieces may not be clamped and/or only be clamped after consultation with the manufacturer.

Balancing bolts and balancing weights at the clamping devices may not be removed / disassembled!

1.4 Max. RPM

**CAUTION!**

The maximum permissible speed is marked on the product.

By the combination of a clamping device and an add on clamping element a reduction of the maximum permissible speed may be necessary.

- Of all RPMs of the groups specified, the **lowest given RPM** must always be used.

Note that the clamping force is influenced by the centrifugal force of the clamping elements.

- If necessary, adjust the machining force!

1.5 Copyright

This manual is protected by copyright and is provided exclusively for internal purposes.

Delivery of the operating manual to third parties, duplication in any form – including excerpts – as well as exploitation and/or communication of the content, are not permitted [except for internal use] without written approval from the manufacturer.

Actions to the contrary make damage compensation mandatory. We reserve the right to enforce additional claims.

1.6 Spare parts



WARNING!

Safety risk if the wrong spare parts are used!

Incorrect or defective spare parts can cause damage, malfunction, or total failure; they can also impair safety.

- Only use manufacturer's original spare parts.

Only purchase spare parts from authorized dealers or direct from the manufacturer. Addresses are in the appendix.

1.7 Warranty terms

The warranty terms are included in the manufacturer's terms and conditions.

2 Safety

This section provides an overview of all the important safety aspects for optimal protection of personnel, as well as for safe and trouble-free operation.

2.1 Responsibility of the customer

The device is used in industrial applications. Consequently the owner of the device is subject to legal industrial safety obligations.

In addition to the safety instruction in this manual, generally valid safety and accident protection guidelines, and environmental protection guidelines as well as the machines' manual must be adhered to and complied with for the area of implementation of the device.

Note in particular that the status scans of the machine must be adjusted to the respective clamping device.



DANGER!

Risk of injury due to thrown out parts!

Incorrect machine settings may lead to the throwing out of parts.

- The status scans the machine must be set to the respective clamping device.
- Regularly check the status scans of the machine, see chapter »Maintenance Schedule«. If the end position can not be reached the jaw module may no longer be used.
- Observe the operating instructions of the machine.



WARNING!

Risk of injury!

An incorrect media supply [hydraulic, pneumatic], e.g. by damaged or missing seals or pipes, can cause serious personal injury.

- Hydraulic and / or pneumatic tubes must be secured by the machine by check valves and a permanent pressure monitoring!

**WARNING!****Risk of injury!**

Declining operating force, for example by declining energy supply, may cause serious personal injury.

- The product may be used only on machines where it is ensured, that during use, the operating force does not drop.

2.2 Personnel requirements

**WARNING!****Danger of injury due to insufficient qualification!**

Improper handling of the clamping device can cause serious injury or material damage.

- Only have activities performed by personnel who are qualified to perform these activities.

The following qualifications are cited in the operating manual for the various activity areas.

- **Specialized personnel**

are personnel who due to their specialized training, skills, and experience, as well as knowledge of the applicable regulations, are capable of executing the tasks assigned to them and of recognizing and avoiding possible hazards on their own.

- **Hydraulic specialist**

The hydraulic specialist has been trained for the particular task area in which he is active and is familiar with the relevant standards and regulations. Due to his specialized training and experience the hydraulic specialist can perform tasks on hydraulic equipment and recognize and avoid possible dangers on his own.

- **Electric specialist**

The electric specialist has been trained for the particular task area in which he is active and is familiar with the relevant standards and regulations. Due to his specialized training and experience the electric specialist can perform tasks on electric equipment and recognize and avoid possible dangers on his own.

Only persons from whom it can be expected that they reliably execute their work are considered as personnel. Persons whose capability to react is impaired, for instance through drugs, alcohol, or medication, are not approved.

- Comply with age-specific and job-specific regulations that are applicable at the installation site when selecting personnel.

2.3 Intended use

The clamping device is designed for installation in a machine tool according to CE compliant. Within the machine tool the clamping device is designed exclusively as a through-bore chuck for bar work and / or as an end-stop chuck for chuck work.

The clamping device should only be mounted, operated, maintained, and cleaned by instructed, specialized personnel.

Intended use also includes compliance with all the instructions in this manual.

The clamping device is to be used for the case of application contractually agreed between the producer / deliverer and the user, as well as such cases of application described in the product description which are also in accordance with the technical values.

The safe function of the clamping device is, as far as it can be foreseen, guaranteed when it is used for the intended purpose in accordance with the appropriate safety regulations.

Any use that extends beyond the intended use, or any other use of the clamping device is considered to be misuse and can cause dangerous situations.



WARNING!

Danger due to misuse!

Misuse of the clamping device can cause dangerous situations.

Particularly refrain from the following uses of the clamping device:

- Use in machines other than machine tools.
- Use in machine tools with technical data other than that specified on the clamping device.

Claims of any type due to damage arising from non-intended use are excluded.

Unintended and improper use of the Power Chuck is for example

- If workpieces are not clamped properly
- If safety regulations are disregarded and persons are working at the clamping device without additional protective devices e.g. for machining.
- If the clamping device is used for machines or tools for which it is not intended.

2.4 Personal protective equipment

Wearing of personal protective equipment is required to minimize health hazards when working with the device.

- Always wear the protective equipment necessary for the respective task when working with the device.
- Follow the instructions that have been posted in the work area.

Always wear



For all tasks always wear:

Protective work clothing

is tight-fitting work clothing with low resistance to tearing, with tight sleeves, and without projecting parts. It is primarily used to protect against entanglement by moving machine parts.

Do not wear rings, chains, or other jewelry.



Safety footwear

for protection against heavy falling parts and slipping on slippery substrates.

For special tasks wear

Special protective equipment is required when executing special tasks. Separate reference is made to this equipment in the specific sections of this manual. This special protective equipment is explained below:

**Hard hat**

to protect against falling and flying parts and materials.

**Protective goggles**

to protect eyes from flying parts and liquid splashes.

**Protective gloves**

to protect hands from friction, abrasion, puncture wounds, or deeper injuries, as well as from contact with hot surfaces.

2.5 Special dangers

In the following section residual risks are cited that occur due to installation of the clamping device in a machine tool. In each case the residual risks that have been determined based on a risk analysis of the machine must be specified by the customer.

- Follow the safety instructions listed here and the warnings in the other sections of this manual to reduce health hazards and to avoid dangerous situations.

Horizontal / lying parts

**WARNING!****Danger of injury due to horizontal parts!**

Before transporting the clamping device in horizontal condition:

- Put the clamping device on a non-slip pad
- Screw in the eye bolts

Suspended loads



WARNING!

Life-threatening danger due to suspended loads!

Some clamping devices must be lifted with a crane. When lifting the clamping device there is a life-threatening hazard due to falling parts or parts swinging out of control.

- Never step under suspended loads.
- Comply with the instructions concerning the intended attachment points. Ensure that the sling gear is securely seated!
- Do not attach lifting gear in projecting components.
- Only use approved hoists and sling gear with sufficient bearing capacity.
- Do not use rope and belts that are torn or frayed.

Moving parts



WARNING!

Danger of injury due to moving parts!

Rotating parts of the clamping device can cause serious injuries.

- Do not reach into moving parts or handle moving parts during operation.
- Note the gap dimensions of moving parts.
- Do not open covers when the device is in operation.
- Be aware of afterrun time:
Prior to opening the covers ensure that all parts have come to a standstill.
- Wear tight-fitting protective work clothing in the danger zone.

Wrong clamping of the work piece**WARNING!****Danger of injury due to incorrect clamping of the work piece!**

Incorrect work piece clamping may lead to the ejection of the work piece and result in serious injuries.

Under dimensioned (tolerance) parts can lead to incorrect clamping!

- Check the unmachined work pieces at random on dimensional accuracy.

Too low supply pressure can lead to the reduction of clamping force!

Too high supply pressure can lead to damage of the components of the clamping device!

- Check and adjust, if necessary, the supply pressure regularly.
- Do random checks of the unmachined work pieces on dimensional accuracy.

Missing changing parts**WARNING!****Danger of injury due to missing changing parts!**

When operating the clamping device without changing parts [segmented clamping bushing, clamping heads, work piece end-stops] there is a higher danger of crushing injuries due to the stroke of movable components of the clamping device.

- The clamping process may not be initiated without assembled segmented clamping bushing and/or work piece end-stop.

Parts with sharp edges**WARNING!****Risk of injury!**

When screwing in individual components such as for example work piece end-stops, threaded adapters and similar devices that are equipped with an external thread or wear caused by burrs, there is risk of cutting.

- The operation must be done only by qualified personnel.
- Wearing of gloves / [PSA] is required!



CAUTION!

Risk of injury!

A special use-dependent or job-based design can result in variations in the clamping strokes and thus the clamping force.

- The notes on the associated clamping situations or product drawing must always be observed

2.6 Further warnings



WARNING!

Risk of injury!

Never reach for the clamping device while the spindle is rotating. Before starting to work on the mandrel, make sure the machine spindle cannot be put in motion.



WARNING!

Risk of injury!

Falling down of the clamping device or its parts can cause severe bruises and fractures.

The dead weight of the clamping device or its parts can lead to high physical stress.



WARNING!

Risk of injury!

By repeated reworking or wear and tear of the clamping surfaces sharp edges and burrs may appear and lead to severe cutting damages.

**WARNING!****Risk of injury!****Missing o-rings or seals may cause severe injuries!**

Due to missing / fallen out O-rings and seals compressed air or hydraulic fluids which are under high pressure may expel!

- Make sure that all O-rings / seals for the hydraulic / pneumatic connections are available and undamaged!
- If necessary lubricate them before assembly and/or during service.

**WARNING!****Damage of clamping device!**

The clamping device may be released exclusively in the standing condition!

**Risk of injury!**

Leaking [sprayed out] hydraulic oil can cause serious injury.

- Make sure that all O-rings / seals for the hydraulic and/or pneumatic connections are available and undamaged

2.7 Clamping force

The achieved clamping force can vary due to the maintenance condition of the clamping device [state of lubrication and degree of contamination] [see chapter »Maintenance«].

The clamping force must be checked at regular intervals. This requires the use of static clamping force measuring devices.

**CAUTION!****Damages due to excessive draw and compressive force!**

An excessive draw force and/or compressive force may damage the clamping device.

- The max. draw force and compressive force may not be exceeded.

2.8 Screws

Moving parts



WARNING!

Danger of injury due to screws and stud screws being accelerated out of the device!!

Screws and stud screws radially attached to the product can be accelerated out of the device and cause severe injuries.

- At the product radially mounted screws and stud screws which were loosened for assembly and maintenance must be re-tightened with the correct tightening torque!
The tightening torque is given at the product itself, near the screw or threaded pin, and/or given in chapter »Bolt torque«.
- All screws or stud screws that are not marked with a tightening torque specification are tightened with the prescribed tightening torque and locked [medium-strength bonding] in the factory and should only be unscrewed after consultation with the manufacturer. If in doubt you must contact the manufacturer immediately do determine the subsequent procedure.

2.9 Functionality



NOTICE!

With high contamination of the clamping device the functionality is no longer guaranteed.

- The cleaning and maintenance intervals must be observed.

2.10 Environmental protection



NOTE!

Environmental hazard due to incorrect handling!

Incorrect handling of environmentally hazardous substances, particularly improper disposal, can cause significant environmental damage.

- Always comply with the instructions cited below
- If environmentally harmful substances should inadvertently get into the environment, initiate suitable measures immediately. If in doubt notify the responsible municipal authority about the damage.

The following environmentally harmful substances are used:

Lubricants

Lubricants like greases and oils can contain toxic substances. Ensure that they do not get into the environment.

The device must be disposed of by a specialized disposal company.

To achieve trouble-free operational performance of the clamping device only use HAINBUCH lubricants. See the appendix for reference addresses.

3 Technical data

3.1 General information

The product is available in different sizes and variants.

Information about e.g.

- dimensions
- weight

you will find on the corresponding drawing that you can order at HAINBUCH.

3.2 Overview

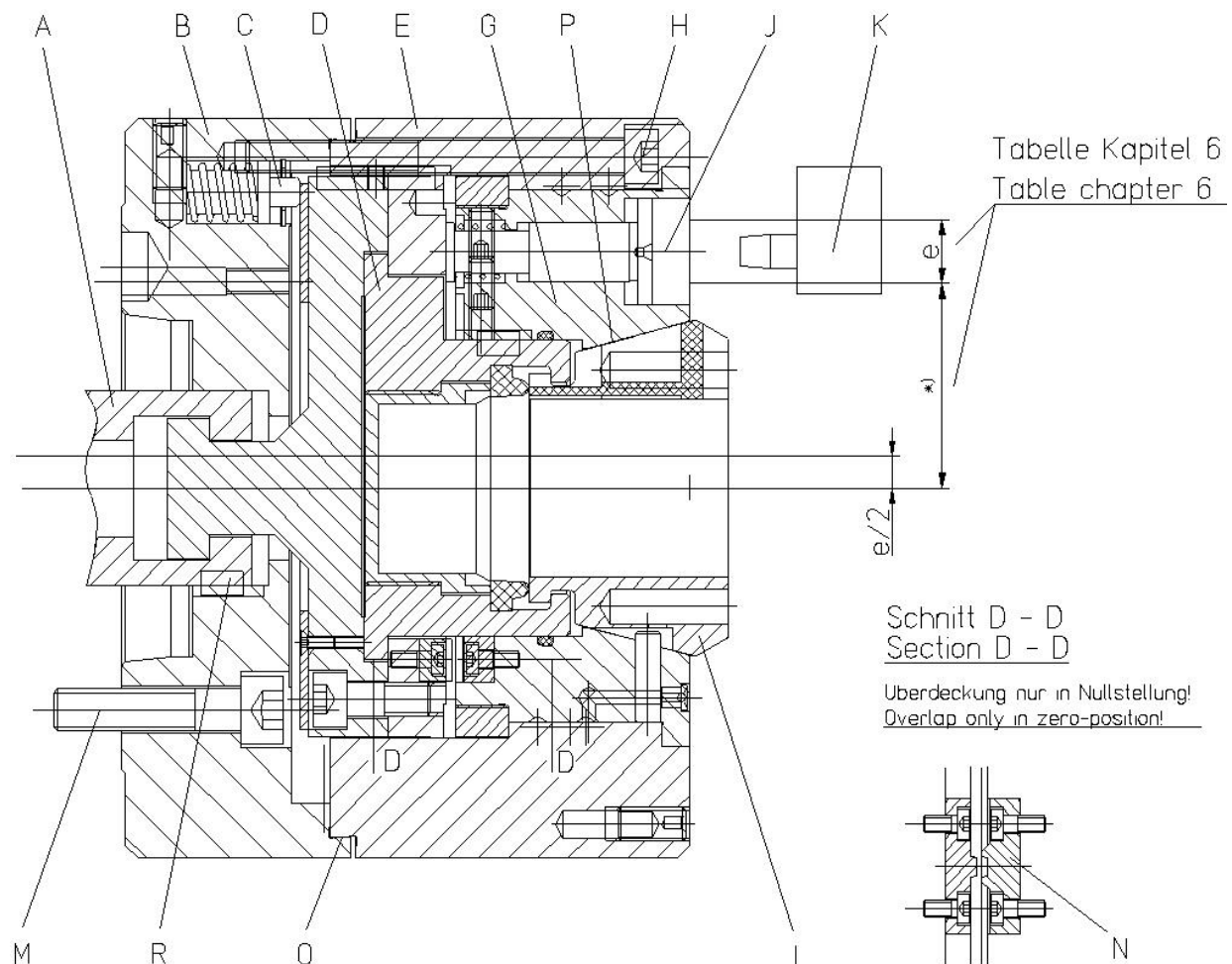


Fig. 1

*) Guiding dimension »A«

e Eccentricity »e«

**WARNING!****Risk of injury!**

Using false technical data can lead to serious personal injury and property damage.

- The technical data [label on the product, assembly drawing] must be observed and may not be modified by the operator!

3.3 Operating conditions

Environment	Specification	Value	Unit
	Temperature range	15 - 65	°C

Mechanical actuating In each possible operating condition the maximum draw force and compressive force may not be exceeded!

3.4 Power specifications**NOTE!****Material damage if the power specifications do not agree!**

If the power specifications of clamping device, machine adapter and machine do not agree, severe damage extending to total damage can occur.

- Only operate clamping devices and adapters in machines with the same power specifications.

Information on maximum clamping force and draw tube force is provided on the clamping device and the adapter.

3.5 Dimensional sheet

Dimension sheets for the respective product can be requested from HAINBUCH.

3.6 Type designation



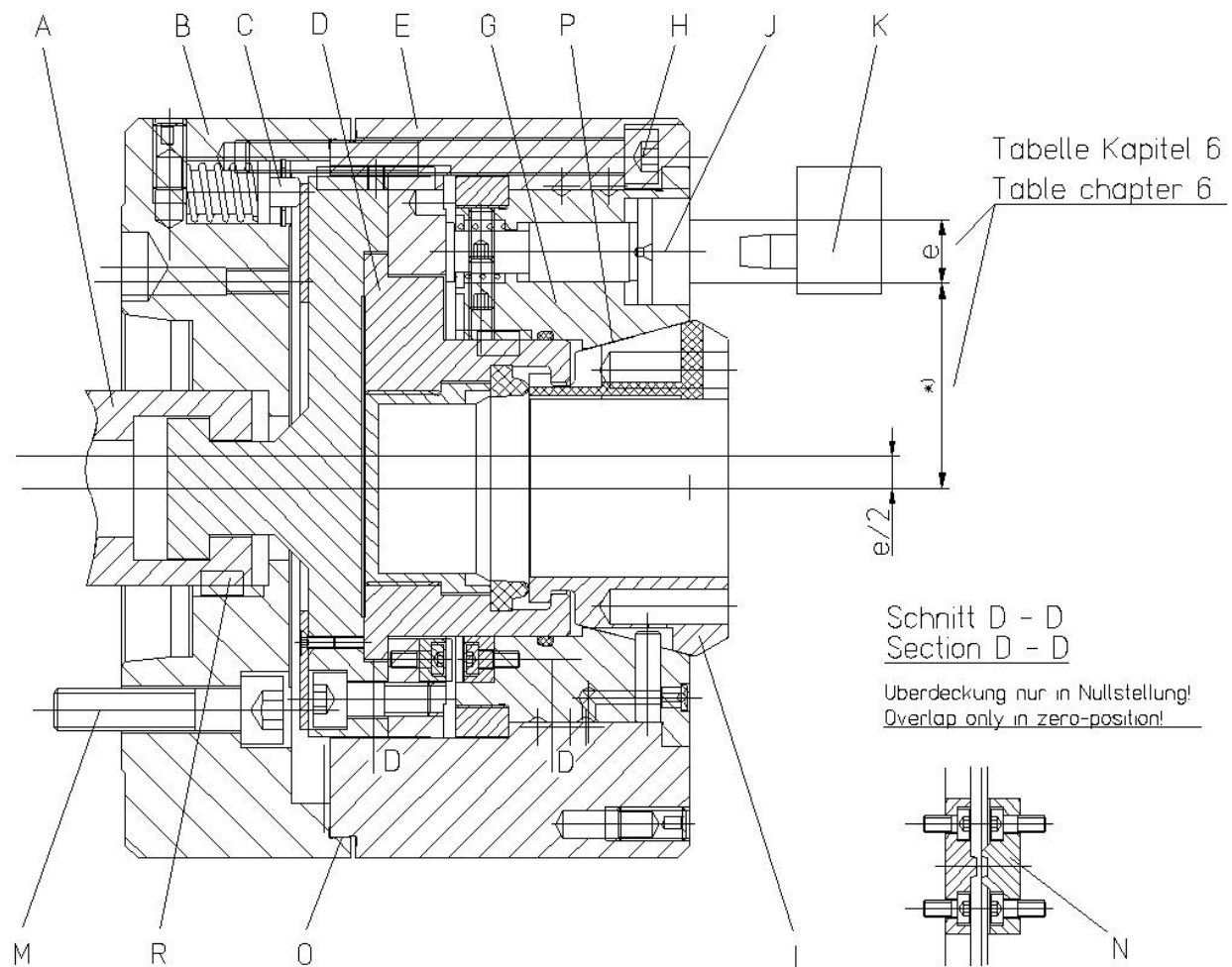
The type designation is on the product and includes the following information:

- 1 ID no. [marked with the # symbol]
- 2 Maximum speed [rpm]
- 3 Maximum clamping force [kN]

Fig. 2

4 Structure and function

4.1 Overview and brief description



* Illustration for example

Fig. 3

A	Threaded adapter	L	Clamping head
B	Spindle flange	M	Cylindrical screws
D	Coupling	N	Adjusting unit
E	Housing	O	Testing edge – concentricity spindle flange
G	Clamping element reception	P	Testing surface – concentricity clamping element reception
H	Cylindrical screws	R	Feather key
J	Clamping bolt		
K	Adjusting tool		

Brief description

Concentric and eccentric complete machining in a single clamping set-up? That's right! With our compact chuck you can now turn an eccentric position on the work piece – in a single set-up without having to re-chuck it!

Thus you save time and money. Change-over from centric to eccentric takes just a few seconds – it is automatic and convenient due to the setting tool in the turret and the C-axis of the machine spindle.

Minimum set-up times and no machine changes whatsoever. And first and foremost: You can use your normal clamping cylinder.

Key advantages:

- Infinite eccentric adjustment via the C-axis
- Concentric and eccentric machining in a single clamping set-up
- Different eccentric dimensions are possible with the same chuck and clamping head
- Minimal inertia loss
- Work piece stabilization through axial draw force applied against the work piece end-stop

4.2 Optional Accessories

The accessories described here are not included in the scope of delivery.

Specially developed segmented clamping bushings match to the respective maximum RPM are available for each clamping device. Trouble-free and precise function of HAINBUCH clamping devices is only ensured when using original HAINBUCH segmented clamping bushings.

Lubricating grease and grease gun are required for cleaning and preservation of the clamping device. The lubricating grease is also specially matched for protection of the vulcanized segments of the segmented clamping bushings and increase their service life and elasticity by a significant factor.

4.2.1 Changing fixture



Fig. 4

Manual changing fixture

The pins of the changing fixture are inserted in the matching holes in the clamping head. The changing fixture is tensioned via hand force. The clamping head is firmly clamped in the changing fixture and can be inserted into the mounted clamping device with the aid of the changing fixture.



Fig. 5

Pneumatic changing fixture

The pins of the changing fixture are inserted in the matching holes in the clamping head. The changing fixture is tensioned via compressed air. The clamping head is firmly clamped in the changing fixture and can be inserted into the mounted clamping device with the aid of the changing fixture.

4.2.2 Clamping head



Fig. 6

The clamping heads are used to accommodate the work piece that will be machined. They consist of hard steel and rubber segments that are connected via a vulcanizing process.

Depending on the requirements of the work piece there are clamping heads in different sizes and with different profiles and bores.

4.2.3 Work piece end-stop

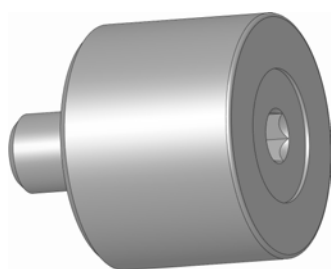


Fig. 7

The work piece end-stop is manufactured with an end-stop dimension according to the customer's request. In combination with the clamping head and the chuck it provides a functional unit.

4.2.4 Grease



Fig. 8

The universal grease for chuck and mandrel lubrication is supplied in a 1000g can. The order number for the universal grease is 2085/0003; it can be ordered from HAINBUCH.

4.2.5 Grease gun



Fig. 9

The grease gun is filled with universal grease, which is pressed into the clamping device. The grease gun has a pointed mouthpiece. The order number for the grease gun is 2086/0004; it can be ordered from HAINBUCH.

5 Transporting, packaging, storing

5.1 Safety instructions for transporting

Unbalanced package



WARNING!

Danger of falling due to an unbalanced package

Packed goods can have an unbalanced package. If attached incorrectly the package can tip and cause life-threatening injuries.

- Note the markings on the packages.
- Attach the crane hook in such a manner that it is located above the center of gravity.
- Carefully lift and see if the load tilts. If necessary change the attachment.



Transport!

- For transport always use a suitable clamping means / crane.
- Make sure that a rolling / falling of the clamping device is not possible.

5.2 Symbols on the packaging



Fragile

Identifies packages with fragile or sensitive contents. Handle the packed goods with care; do not allow them to fall, and do not subject them to impact.



Protect from moisture

Keep packed goods dry and protected against moisture.

5.3 Transport inspection

Check delivery immediately upon receipt to ensure that delivery is complete and to identify any transport damage.

Proceed as follows if there is apparent external damage:

- Do not accept the delivery, or only accept it with reservation.

- Note the extend of transport damage on the transport documents or on the transport company's delivery ticket.
- Submit a complaint.



Report any defect as soon as it is detected. Claims for damage compensation can only be enforced during the applicable periods for giving notice of lack of conformity.

5.4 Unpacking and inner-company transport



Usually the clamping device is packed vertically. Depending on the size it has threaded bores in the circumference of the clamping device for assembling the eye bolts.

In these threaded bores lifting eye bolts can be screwed in.

To safely lift the clamping device out of the package it must be hooked into a crane depending on the weight.

For transporting with transport trolley the clamping device must be positioned in standing condition. Make sure that a non-slip pad has been laid.

All tools and accessories which are not in scope of delivery are marked as optional in the operating instructions.

- Two people are required for this task.
 - Special tools required:
 - Crane and lifting eye bolts from weight 15 kg
1. Screw lifting eye bolts into the thread in the circumference of the clamping device.
 2. Hook the load-handling equipment into the lifting eye bolts.
 3. Use a crane to carefully lift the clamping device out of the transport packaging and put it down on a stable, level substrate.
 4. Prevent the clamping device against rolling away.



Fig. 10

5.5 Packaging

About the packaging

Individual packages are packed according to the expected transport conditions. Environmentally-friendly materials have been used exclusively for the packaging.

Packaging should protect the specific components from transport damage, corrosion, and other damage until installation. Therefore do not destroy the packaging, remove it just before installation.



The packed goods are sealed in foil airtight and packed in cartons. See the »Technical Data« section for the specific weight of the respective sizes.

Handling packaging materials

Dispose of packaging materials in accordance with the respectively valid statutory regulations and local guidelines.



NOTE!

Improper disposal causes environmental damage!

Packaging materials are valuable raw materials and in many cases they can be reused, or they can be effectively treated and recycled.

- Dispose of packaging materials in an environmentally responsible manner.
- Comply with locally applicable disposal guidelines. If necessary commission a specialized company to dispose of packaging.

5.6 Storing



Under certain circumstances instructions for storage and subsequent storage are affixed to the packages that extend beyond the requirements cited here.

Comply with these instructions accordingly.

Storage of packages Only store packages under the following conditions:

- Do not store outdoors.
- Store in a dry and dust-free location
- Do not expose to aggressive media
- Protect from direct sunlight
- Avoid mechanical vibration
- Storage temperature: 15 bis 35 °C
- Relative humidity: max. 60 %
- For storage periods longer than 3 months:
 - Check the general condition of all parts and the packaging at regular intervals.
 - Touch up or re-apply anti-corrosion agents as needed

Subsequent storage of the clamping device Only re-store the clamping device under the following conditions:

- Thoroughly clean the clamping device prior to subsequent storage [see section »Cleaning«]
- Thoroughly oil and grease the clamping device. [see section »Cleaning«]
- Store the clamping device in airtight foil
- The clamping device must be stored securely in position. If this is not guaranteed, use a suitable container for the clamping device or equip the shelf with a circumferential securing edge.

6 Assembly



WARNING!

During the initial installation of the clamping device severe injuries may occur.

- The initial installation must be done only by qualified personnel.
- All screws remaining in the clamping must be tightened firmly.
- All tools and keys must be removed after installation.



WARNING

Risk of injury due to stored energy!

The clamping device can be designed with disc springs. These disc springs are under permanent tension! The release of the stored energy can cause injuries!

- By loosening the corresponding screws they have to be operated continuously alternately to reduce the clamping pressure to a minimum!
- Particularly cautious approach is required!
- For cleaning and maintenance disassemble the clamping device from the machine!
- Always wear personal protective equipment!

6.1 Preparations

The total weight of the clamping device, consisting of spindle flange and clamping unit, depends on the size and can be as much as 40 kg.

The individual weight of the spindle flange can be as much as 20 kg, and the clamping unit can weigh up to 23 kg [see section »Technical data«].

Depending on the weight, to safely lift the clamping device out of the package and position it in the machine it must be hooked into a crane.



WARNING!

Danger of injury due to falling components!

When mounting components can fall and cause severe injury and material damage.

- Two people are always required for this task.
- From size 80 use a crane.

6.2 Installation



WARNING!

Danger of injury due to unintentional startup of the tool spindle!

Unexpected start up of the tool spindle can cause severe injury.

- Prior to switching on automatic mode close all protective doors or hoods that are present on the machine tool.
- Unscrew all eye bolts from the clamping device and remove them from the interior of the machine.
- Only run the machine in set-up mode or jog mode.
- Always remove immediately all the tools and wrenches from the clamping device after use.



WARNING!

Risk of injury!

By operating the clamping device without changing parts [clamping head, segmented clamping bushing, work piece end-stops ...] there is an increased risk of crushing injuries by the stroke of the moving components of the clamping device.

By uncontrolled discharge of the clamping process [e.g. by incorrect installation of the energy supply or faulty programming] there is an increased danger.

**WARNING!****Risk of injury!**

Bending in the working area of the machine can cause severe head injuries!

**CAUTION!****Risk of injury!**

Unexpected start up of the tool spindle can cause severe injury.

- Make sure that the system is pressure-free and that a restart of the machine can be excluded!

**Risk of injury!**

Contamination of the mechanism can influence/reduce the stroke, thus the clamping force is reduced and thus, the work piece is not properly tightened and can be thrown out.

- Clean the product regularly [see chapter »Maintenance and service«].

**Risk of injury!**

If the clamping pressure is too low clamped work piece may be thrown out.

If the clamping pressure is too high severe damages of the components of the clamping device may occur the throwing out of the work piece.

- Before operation set the operation pressure back to operation level.
- The operating pressure should be checked and adjusted regularly!
- The dimension of the work pieces should be checked regularly [clamping- \emptyset]!

**Transport!**

- For transport always use a suitable clamping means / crane.
- Make sure that a rolling / falling of the clamping device is not possible.



WARNING!

Danger of injury due to vertical suspended spindle!

Bending into the machine work area when assembling overhead can cause severe head injuries.

- Secure components prior to overhead assembly.
- For assembly on a vertically suspended spindle always use a suitable mounting aid.



Positioning!

By clever positioning of the clamping device, the subsequent lubricating may be easier.

- Position the clamping device in a way that the lubrication points of the clamping device are always accessible.

6.3 Installation of the clamping device

Two people are required for this task.

Special tools required:

- Allen wrench
- Crane and eye bolts from weight 15 kg



WARNING!

Crushing danger due to machine movement!

Due to the design of the drawtube it may not always be avoided that in the assembly of drawtube adapter and the clamping unit / clamping device there is a gap between machine and clamping device.

Crushing danger, that can cause severe injury.

- Never reach into the gap between machine / spindle flange and clamping device!

1. Put the machine tool in set up mode.
2. Remove all tools from the interior of the machine.
3. Set the clamping pressure of the machine tool on the lowest setting.
4. Move the drawtube of the machine tool into the front stop position.

5. Take the supplied chuck assembly and disassemble the spindle flange [B] and draw-tube adapter [A], by removing the 8 screws [H]. Take the draw-tube adapter [A] and the spindle-flange [B] to the machine.
6. Assemble the draw-tube adapter [A] on to the draw-tube. Turn the draw-tube adapter on to the draw-tube, till the end of the thread. Turn the draw-tube adapter reverse, till the feather-key [R] is in position with the respective key-slot on the spindle-flange [B] and the spindle-flange [B] on itself is in position with the drive-pin of the machine spindle.
7. Install the spindle flange [B] on to the machine spindle. Tighten the screws [H] lightly only, if your machine spindle has an cylindrical register.
8. Use an dial indicator, set on to the flange inner dia. 130 [O], and check the concentricity of the spindle flange. If necessary clock the flange by using an plastic mallet. Tighten the six screws [M] of the flange.
9. Check on the face of the chuck assembly [E], that the eccentric adjustment is in the centre [zero position]. For reference look at the scale on the face of the chuck body.
10. Take the chuck assembly [E]. Connect the bayonet joint with the draw-tube connector in the way, that after rotating the chuck assembly by 60°, the marking on the spindle flange [B] and the marking of the chuck assembly [E], match. [This marking is on the OD of the spindle-flange [B] and the OD of the chuck assembly [E].
11. Screw in the 8 screws [H], to tighten the chuck assembly [E] to the spindle flange [B]. Tighten the screws slightly only.
12. Check the concentricity of the chuck assembly at the inner taper [P], by using an dial indicator. If necessary clock the chuck assembly [E]. [The concentricity error should be smaller than 10 µ]. Tighten all screws [H] firmly, and check the concentricity error again.

13. Actuate the chucking cylinder. Move the draw-tube in chuck closed position and back in chuck open position again. With this actuation, the chuck assembly is mechanically reset in centric [zero] position.

14. Check the concentricity of the chuck assembly [E] at point [P] one more time.

The installation and alignment of the chuck is now completed.

! **NOTE!**

Before the actual machining process is initiated, please adjust the chucking pressure to the required value.

You also need a minimum axial drawtube force of 15 kN to ensure the correct function of the chuck.

The maximum draw force – to be taken from the respective clamping device drawing – must not be exceeded!

6.3.1 Installing the base end-stop



If the eccentric chuck will be used as end-stop chuck the base end-stop must be mounted.

Special tools required:

- Allen wrench
- Mounting bolt or suitable cylindrical screw

1. Take the clamping head out of the taper.
2. Unscrew the clamping screws [see section »Disassembling the base end-stop«].
3. Screw the mounting bolt clockwise into the threaded bore in the center of the base end-stop.



Screw the mounting bolt into the base end-stop so that the polished side of the base end-stop is pointing up.



Fig. 11



Fig. 12



Fig. 13

4. Use the mounting bolt to insert the base end-stop into the clamping device in such a manner that the lateral fixing pin of the base end-stop is aligned flush with the fixing groove in the centering disk.

**NOTE!**

Material damage is possible if the clamping screws are tightened too forcefully!

Tightening the clamping screws too forcefully can damage or destroy them. The base end-stop can no longer be clamped in.

- Tighten the clamping screws by hand.
- Do not screw in beyond the resistance.

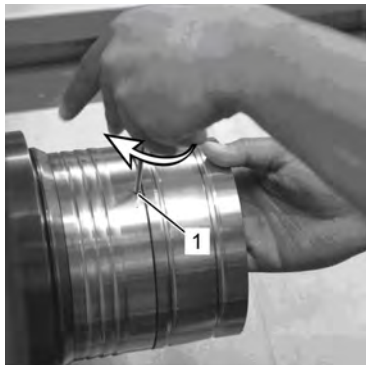


Fig. 14

5. Tighten all clamping screws of the base end-stop in the spindle flange clockwise with an allen wrench. The base end-stop is now secured.

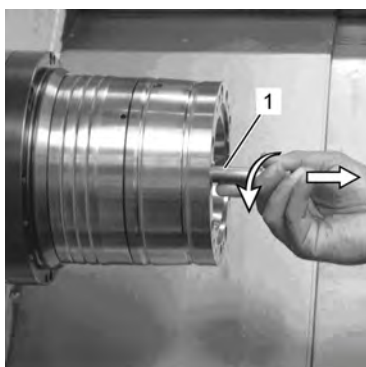


Fig. 15

6. Unscrew the mounting bolt counterclockwise.

6.3.2 Disassembling the base end-stop



If the eccentric chuck will be used as through-bore chuck the base end-stop must be disassembled.

Special tools required:

- Allen wrench
- Mounting bolt or suitable cylindrical screw

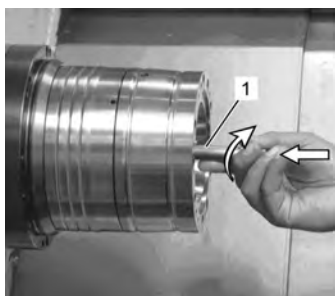


Fig. 16

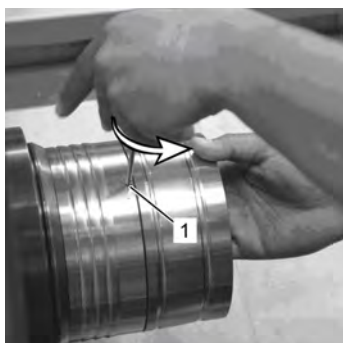


Fig. 17

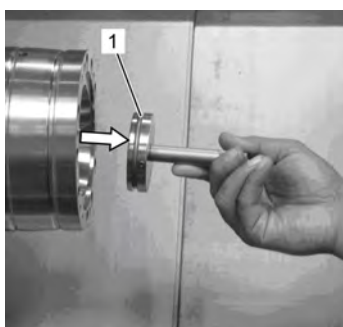


Fig. 18

1. Take the clamping head out of the taper of the clamping element reception.
2. Insert the mounting bolt and screw it clockwise into the threaded bore in the center of the base end-stop.



NOTE!

Material damage if the clamping screws are loosened incorrectly!

Tightening the clamping screws too forcefully can damage or destroy them. The base end-stop can no longer be clamped in.

- Loosen the clamping screws by hand.
- Do not unscrew beyond the resistance.

3. Carefully loosen all clamping screws with an allen wrench counterclockwise until resistance is tangible.
The base end-stop is now loosened.
4. Carefully pull out the base end-stop straight from the front.

**WARNING!****Risk of injury!**

Tools and gages that are thrown out of the machine can cause injury.

- Remove all tools and gages from the working area of the machine before the machine is started up.

**Risk of injury!**

If the clamping pressure is too low clamped work piece may be thrown out.

If the clamping pressure is too high severe damages of the components of the clamping device may occur the throwing out of the work piece.

- Before operation set the operation pressure back to operation level.
- The operating pressure should be checked and adjusted regularly!

**WARNING!****Slipping danger due to escaping hydraulic fluid!**

Escaping (sprayed out) hydraulic oil can cause serious injuries.

- Make sure that all o-rings/seals for the hydraulic / pneumatic interfaces are available and in undamaged condition.
- Make sure that the clamping device is empty and leakage of hydraulic fluid is avoided.

6.3.3 Assemble / disassemble the clamping head



For changing in the clamping head move the coupling of the clamping device to front end position.

Depending on the model of the clamping head the handling of the changing fixture is easier or more difficult.

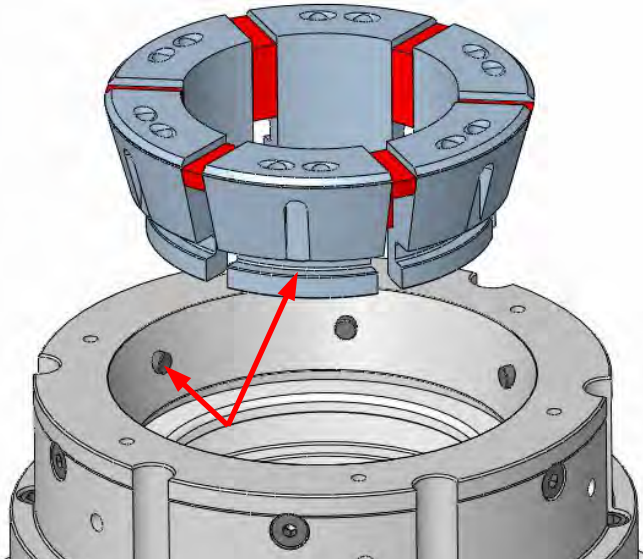


Fig. 19



WARNING!

Danger of violent pressure to hands and fingers!

- During operation never reach into the coupling or slot area of the clamping head nor in the changing fixture.
- Only run the machine in set-up mode or jog mode.
- Before working at the installed clamping device make sure that starting of the machine is impossible.

6.3.4 Assembly of the workpiece end-stop

Special tools required:

- Allen wrench



Fig. 20

1. Put the workpiece end-stop through the assembled clamping head into the clamping device.



NOTE!

Material damage is possible if the mounting screws are tightened too forcefully!

Tightening the mounting screws too forcefully can damage or destroy them.

- Tighten the mounting screws by hand.
- Do not screw in beyond the resistance.

2. Screw in and firmly tighten mounting screws.

6.4 Function

- Manual loading or automatic pick-up of the work piece from the main-spindle. Clamping of the work piece and centric machining.
- Adjust the chuck for the second, eccentric machining process, with the adjustment tool (K), mounted into the machine turret. The pin of the adjustment tool must be moved with the x-axis to dia. see above. The adjustment pin must then engage with the slot (J) on the chuck face. Using the turret force function of the machine CNC-control, the pressure from the adjustment-pin to the SPANNTOP coupling (D) of the chuck assembly (E) should be set to approx. 1.2kN. This pressure will pull the clamping head (L) into the chuck body (G), the work-piece remained in clamped position.
- Actuate the chucking cylinder and push the draw-tube in front end position. There is no pulling force acting now on the chuck, the off-centre adjustment via the C-axis can now be actuated.
- After completing the desired C-axis movement, the chucking cylinder has to be actuated, to move in chuck closed position. The work-piece will be clamped with the set gripping force.
- Disengage the adjustment tool, set in the turret, from the chuck by actuating an Z-axis return.
- The off-centre machining process can now be actuated via the CNC-program.

- Upon completion of the off centre machining, move the adjustment tool (K), using the turret force function, (specified pressure on the adjustment tool to the chuck assembly, approx. 1.2kN) into the slot (J) on the face off the chuck assembly (X-axis position of the adjustment tool pin must be at dia. see above). Move the chucking cylinder in chuck open position. By actuating the C-axis, reverse the off-set position of the chuck body into the centric (zero) position.
- By actuating an Z-axis return of the adjustment tool now, the work piece gripping will be released, and the work piece can be removed from the chuck. (if a robotic loading / unloading is applied, you need to position your unloading gripper in position to pick-up the work-piece, before the actuation of the Z-axis return of the adjustment tool).
- During the opening stroke of the chucking cylinder (draw-tube move in front end position) the chuck body (G) of the chuck assembly (E) will be mechanically aligned to the centric (zero) position.

**NOTE!**

After each eccentric machining it is necessary to unload the work piece and to reset the chuck into centric (zero) position.

6.5 Applicable spindle speed

- The chuck is balanced in centric position only according to balancing accuracy 4
- Spindle speed for centric work-piece machining approx. 3000 to max. 6000 rpm (depending on the work-piece and concentricity requirement)
- Spindle speed for eccentric work-piece machining up to 5 mm max. 4000 rpm
- Spindle speed for eccentric work-piece machining up to 10 mm max. 2800 rpm
- Spindle speed for eccentric work-piece machining up to 15 mm max. 1500 rpm
- concentricity accuracy at centric position = 0.02 mm
- The parallel runout between centric and eccentric machined surfaces can reach to an amount of 0.03mm, concerning to max. clamping diameter.

This are approximate spindle speeds only. The max. spindle speed depends on the work-piece contour, work-

piece eccentricity and imbalance, which influences the spindle speed.

6.6 Work piece



WARNING!

Risk of injury due to thrown out parts!

During clamping of the work piece and the processing parts can be thrown and cause severe injuries and property damage.

- Check the clamping diameter of the work piece.
- Tighten only work pieces that meet the dimensional requirements.
- For clamping very long work pieces use in addition a tailstock / a steady rest for support.
- Do not exceed the maximum permissible clamping force.
- Make sure that the applied clamping force is set correctly [neither too high nor too low].



CAUTION

Risk of injury!

When placing the work piece:

- Make sure that the hands / fingers may not be clamped between the flange and the work piece!

6.7 Inspections

NOTE!

Material damage due to damaged clamping devices!

A damaged, incomplete, or unbalanced clamping device can significantly damage or even destroy the machine tool and the work piece.

- Only install undamaged, complete, and precisely balanced clamping devices.
- If in doubt contact the manufacturer.

Ensure the following points prior to each installation and start-up of the clamping device:

- All cylindrical screws of the clamping device must be present and tightened with the proper tightening torque.
- The balance screws of the clamping device must all be present and undamaged.
- All rubber segments must be intact; this means that they are neither torn, nor are they porous at any point.
- All edges and bearing surfaces are intact; this means that they are neither broken nor do they show any signs of wear.
- The set speed of the machine tool should not exceed the maximum permissible speed of the clamping device.
- The maximum draw tube force specified on the perimeter of the clamping device must not be exceeded.
- The clamping pressure of the machine must be sufficiently high.
- All mounting tools must be removed from the interior of the machine.
- Clamping device and work piece must be compatible –check the clamping diameter regularly.
- The work piece must be clamped into the clamping device with sufficient work piece tension.
- Do a pressure loss test and a measurement of clamping force.

6.8 Control of the stroke position



WARNING!

Crushing danger from moving parts!

Crushing danger from moving parts during controlling the stroke position!

Gaps, caused while controlling the stroke position, can cause severe injury.

- Only do the controlling of the stroke position with assembled changing parts.
- Only run the machine in set-up mode or jog mode.
- Do not reach into moving parts or handle moving parts during operation.
- Note the gap dimensions of moving parts.
- Wearing of gloves / [PSA] is required!

6.9 Activities after production is concluded

1. Move the clamping device into unclamped position.
2. Switch off the machine tool and safeguard it from being switched on again.
3. Open the protective door or hood.
4. Clean the clamping device and a possibly mounted adaptation clamping device and adapter of chips and production residues using a soft, lint-free cloth and oil them lightly.
5. Close the protective door or hood.

7 C-Axis movement for Off-Centre Positioning

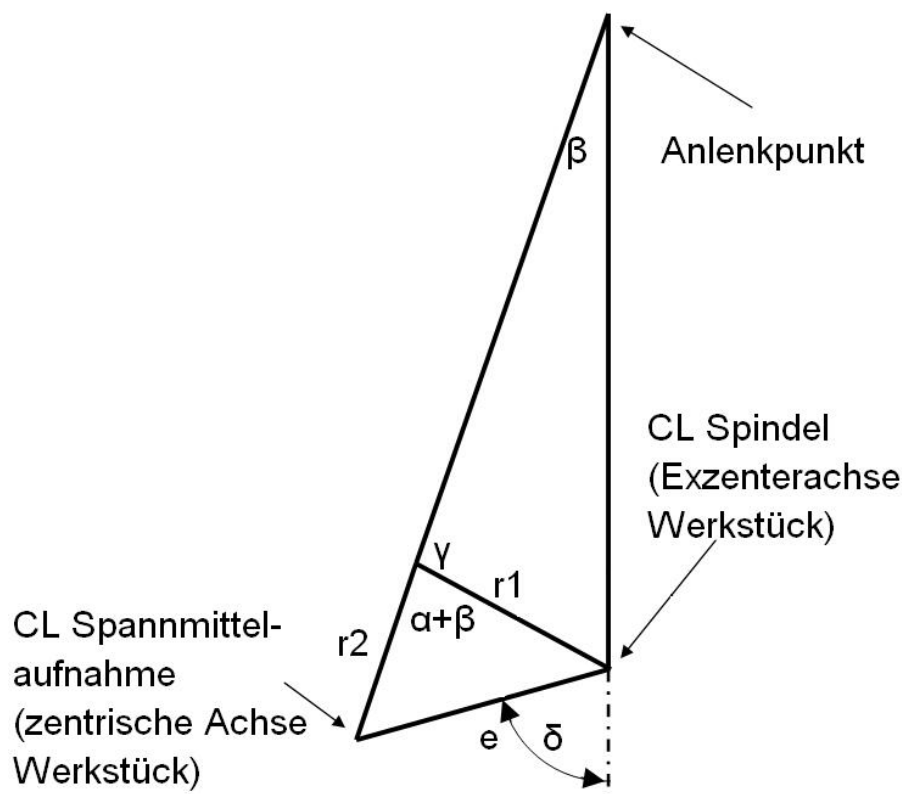
The following table gives the C-axis angle movement »alpha« for the linear off centre position »e«. The stated values for the angular adjustment are approximate values only.

For adjusting the max. attainable accuracy a correction of the angular rotation of the C-axis during the machining of the first work pieces must occur.

The eccentricity »e« and the adjusting measure of »A« of your eccentric chuck read off the clamping device and/or from the associated drawing.

The given angle »beta« for orientation is the angle, to which the clamping device might be turned [while the adjustment tool is pulled], to bring the axis of the centers of clamping device and eccentricity to vertical alignment.

Do not confound with the given angle »d« for alignment. The clamping device might be turned by the angle »d« after adjusting the eccentricity with pulled adjustment tool to align the axis of the work piece between centric and eccentric center (front sight) in vertical order.



7.1 Angle movement and adjusting dimension

Depending upon size there are different eccentricities and adjusting measures.

In the following table you can find some examples:

Size Clamping device	Document number	Eccentricity e	Adjusting dimension A
32	SP.0915.0047.00	5	38,25
32	SP.0915.0048.00	5	38,25
32	SP.0915.0050.00	5	38,25
42	SP.0916.0014.00	10	47,5
42	SP.0916.0018.01	10	47,5
42	SP.0916.0016.01	15	48,5
42	SP.0916.0017.00	15	48,5
42	SP.0916.G001.00	15	48,5
52	SW.SP.0917.0001.00	15	51
52	SW.SP.0917.0002.00	15	51
52	SW.SP.0917.0003.00	15	51
52	SW.SP.0917.0004.00	15	51
52	SW.SP.0917.0005.00	15	51
52	SW.SP.0917.0006.00	15	51
65	SP.0918.0012.00	15	58,6
65	SP.0918.0014.01	15	58,6
65	SP.0918.0015.01	15	58,6
65	SP.0918.0016.01	15	58,6
65	SP.0918.0017.01	15	58,6
65	SW.SP.0918.0003.00	15	60
65	SW.SP.0918.0009.00	15	60
65	SW.SP.0918.0010.00	15	60
65	SW.SP.0918.0011.00	15	60
65	SW.SP.0918.0012.00	15	60
65	SW.SP.0918.0013.00	15	60
65	SW.SP.0918.0014.00	15	60
80	SP.0919.0003.00	15	67,1
80	SP.0919.0004.00	15	67,1

7.2 Max. eccentricity of 5 mm

7.2.1 C-axis movement at adjusting measure A=38.25 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000				
0,1	2,142	0,150	89,004	3,1	72,986	3,646	55,330
0,2	4,286	0,299	88,007	3,2	75,898	3,686	53,894
0,3	6,431	0,449	87,009	3,3	78,884	3,716	52,416
0,4	8,580	0,597	86,009	3,4	81,950	3,737	50,893
0,5	10,733	0,745	85,006	3,5	85,107	3,747	49,320
0,6	12,892	0,892	84,000	3,6	88,364	3,745	47,690
0,7	15,057	1,038	82,990	3,7	91,732	3,730	45,999
0,8	17,231	1,183	81,976	3,8	95,226	3,702	44,238
0,9	19,413	1,326	80,956	3,9	98,863	3,658	42,398
1	21,606	1,468	79,931	4	102,663	3,597	40,467
1,1	23,811	1,608	78,899	4,1	106,652	3,517	38,433
1,2	26,028	1,745	77,859	4,2	110,865	3,416	36,275
1,3	28,259	1,881	76,811	4,3	115,345	3,289	33,972
1,4	30,507	2,014	75,753	4,4	120,153	3,132	31,490
1,5	32,771	2,144	74,686	4,5	125,377	2,939	28,781
1,6	35,055	2,271	73,608	4,6	131,151	2,702	25,775
1,7	37,358	2,395	72,519	4,7	137,700	2,403	22,351
1,8	39,684	2,516	71,416	4,8	145,466	2,014	18,274
1,9	42,034	2,633	70,300	4,9	155,583	1,461	12,939
2	44,410	2,747	69,169	5	180,000	0,000	0,000
2,1	46,813	2,856	68,021				
2,2	49,247	2,961	66,857				
2,3	51,714	3,061	65,673				
2,4	54,215	3,155	64,470				
2,5	56,755	3,245	63,245				
2,6	59,336	3,329	61,996				
2,7	61,961	3,406	60,722				
2,8	64,635	3,477	59,421				
2,9	67,360	3,541	58,090				
3	70,142	3,597	56,727				

7.3 Max. eccentricity of 6 mm

7.3.1 C-axis movement at adjusting measure A=38.25 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000				
0,1	1,760	0,150	89,195	3,1	58,239	3,979	62,870
0,2	3,521	0,299	88,389	3,2	60,404	4,058	61,827
0,3	5,283	0,449	87,583	3,3	62,602	4,132	60,765
0,4	7,047	0,598	86,775	3,4	64,836	4,200	59,682
0,5	8,814	0,746	85,966	3,5	67,108	4,262	58,577
0,6	10,584	0,894	85,155	3,6	69,422	4,318	57,448
0,7	12,358	1,041	84,342	3,7	71,779	4,367	56,294
0,8	14,137	1,188	83,525	3,8	74,184	4,409	55,113
0,9	15,921	1,333	82,706	3,9	76,639	4,444	53,902
1	17,711	1,477	81,883	4	79,150	4,470	52,660
1,1	19,508	1,620	81,056	4,1	81,721	4,489	51,384
1,2	21,312	1,761	80,225	4,2	84,357	4,498	50,071
1,3	23,125	1,901	79,388	4,3	87,063	4,497	48,717
1,4	24,947	2,040	78,546	4,4	89,848	4,486	47,319
1,5	26,779	2,176	77,699	4,5	92,718	4,463	45,873
1,6	28,621	2,311	76,845	4,6	95,683	4,428	44,373
1,7	30,476	2,443	75,984	4,7	98,753	4,381	42,814
1,8	32,342	2,573	75,115	4,8	101,942	4,318	41,188
1,9	34,222	2,701	74,239	4,9	105,265	4,240	39,487
2	36,117	2,826	73,354	5	108,742	4,144	37,701
2,1	38,027	2,948	72,461	5,1	112,396	4,028	35,816
2,2	39,953	3,067	71,557	5,2	116,258	3,889	33,815
2,3	41,897	3,184	70,643	5,3	120,370	3,724	31,677
2,4	43,860	3,297	69,719	5,4	124,788	3,528	29,370
2,5	45,842	3,406	68,782	5,5	129,593	3,294	26,851
2,6	47,846	3,512	67,833	5,6	134,908	3,013	24,052
2,7	49,873	3,614	66,870	5,7	140,943	2,667	20,862
2,8	51,924	3,712	65,894	5,8	148,105	2,225	17,060
2,9	54,001	3,806	64,902	5,9	157,442	1,607	12,082
3	56,105	3,895	63,895	6	180,000	0,000	0,000

7.4 Max. eccentricity of 10 mm

7.4.1 C-axis movement at adjusting measure A=47.0 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000								
0,1	1,025	0,121	89,548	4,1	43,894	4,515	70,311	8,1	102,453	5,739	41,643
0,2	2,051	0,241	89,095	4,2	45,067	4,603	69,768	8,2	104,499	5,671	40,586
0,3	3,077	0,362	88,643	4,3	46,247	4,688	69,220	8,3	106,604	5,593	39,494
0,4	4,103	0,482	88,190	4,4	47,436	4,772	68,668	8,4	108,774	5,506	38,366
0,5	5,130	0,602	87,736	4,5	48,634	4,853	68,109	8,5	111,014	5,409	37,197
0,6	6,157	0,722	87,283	4,6	49,841	4,933	67,546	8,6	113,332	5,301	35,985
0,7	7,186	0,842	86,828	4,7	51,058	5,010	66,976	8,7	115,736	5,181	34,723
0,8	8,215	0,962	86,373	4,8	52,285	5,086	66,401	8,8	118,236	5,048	33,406
0,9	9,246	1,081	85,918	4,9	53,522	5,159	65,819	8,9	120,846	4,901	32,028
1	10,278	1,200	85,461	5	54,770	5,230	65,230	9	123,579	4,737	30,579
1,1	11,312	1,319	85,004	5,1	56,029	5,299	64,635	9,1	126,455	4,556	29,050
1,2	12,347	1,437	84,545	5,2	57,299	5,365	64,033	9,2	129,499	4,353	27,427
1,3	13,384	1,555	84,085	5,3	58,582	5,429	63,424	9,3	132,743	4,127	25,692
1,4	14,423	1,672	83,624	5,4	59,877	5,491	62,807	9,4	136,232	3,871	23,820
1,5	15,465	1,789	83,162	5,5	61,185	5,549	62,182	9,5	140,030	3,580	21,775
1,6	16,508	1,905	82,699	5,6	62,506	5,605	61,549	9,6	144,236	3,244	19,504
1,7	17,554	2,021	82,233	5,7	63,842	5,658	60,908	9,7	149,015	2,846	16,915
1,8	18,603	2,136	81,766	5,8	65,192	5,709	60,258	9,8	154,690	2,353	13,831
1,9	19,655	2,251	81,298	5,9	66,558	5,756	59,599	9,9	162,096	1,685	9,794
2	20,710	2,364	80,827	6	67,940	5,800	58,930	10	180,000	0,000	0,000
2,1	21,767	2,477	80,355	6,1	69,338	5,841	58,251				
2,2	22,829	2,590	79,881	6,2	70,754	5,878	57,562				
2,3	23,893	2,701	79,404	6,3	72,188	5,912	56,862				
2,4	24,962	2,811	78,925	6,4	73,641	5,942	56,151				
2,5	26,034	2,921	78,444	6,5	75,114	5,969	55,427				
2,6	27,110	3,030	77,960	6,6	76,608	5,992	54,692				
2,7	28,191	3,137	77,473	6,7	78,124	6,011	53,944				
2,8	29,276	3,244	76,984	6,8	79,662	6,025	53,182				
2,9	30,366	3,350	76,492	6,9	81,225	6,035	52,405				
3	31,461	3,454	75,996	7	82,813	6,041	51,614				
3,1	32,561	3,557	75,498	7,1	84,428	6,042	50,807				
3,2	33,666	3,659	74,997	7,2	86,071	6,038	49,984				
3,3	34,777	3,760	74,491	7,3	87,744	6,029	49,143				
3,4	35,894	3,860	73,983	7,4	89,448	6,015	48,283				
3,5	37,017	3,958	73,471	7,5	91,186	5,995	47,404				
3,6	38,146	4,055	72,954	7,6	92,960	5,969	46,505				
3,7	39,281	4,150	72,434	7,7	94,771	5,937	45,583				
3,8	40,424	4,244	71,910	7,8	96,623	5,898	44,638				
3,9	41,573	4,336	71,381	7,9	98,518	5,853	43,667				
4	42,730	4,427	70,848	8	100,460	5,800	42,670				

7.5 Max. eccentricity of 15 mm

7.5.1 C-axis movement at adjusting measure A=48.5 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000								
0,1	0,646	0,118	89,736	5,1	34,078	5,675	75,798	10,1	75,793	8,857	56,532
0,2	1,292	0,236	89,472	5,2	34,795	5,772	75,488	10,2	76,817	8,870	56,027
0,3	1,938	0,354	89,208	5,3	35,515	5,868	75,176	10,3	77,852	8,881	55,514
0,4	2,584	0,472	88,944	5,4	36,238	5,962	74,862	10,4	78,900	8,889	54,995
0,5	3,230	0,590	88,680	5,5	36,964	6,056	74,546	10,5	79,960	8,894	54,467
0,6	3,877	0,708	88,416	5,6	37,694	6,149	74,228	10,6	81,033	8,896	53,932
0,7	4,523	0,826	88,151	5,7	38,426	6,241	73,907	10,7	82,119	8,894	53,388
0,8	5,171	0,944	87,887	5,8	39,163	6,332	73,585	10,8	83,219	8,890	52,835
0,9	5,818	1,061	87,622	5,9	39,903	6,422	73,260	10,9	84,334	8,882	52,274
1	6,466	1,179	87,356	6	40,646	6,510	72,932	11	85,463	8,870	51,704
1,1	7,115	1,296	87,091	6,1	41,393	6,598	72,602	11,1	86,608	8,855	51,124
1,2	7,764	1,413	86,825	6,2	42,144	6,685	72,270	11,2	87,769	8,836	50,534
1,3	8,414	1,530	86,558	6,3	42,899	6,770	71,935	11,3	88,946	8,814	49,934
1,4	9,064	1,647	86,292	6,4	43,658	6,854	71,598	11,4	90,141	8,787	49,323
1,5	9,715	1,763	86,024	6,5	44,421	6,937	71,258	11,5	91,354	8,757	48,701
1,6	10,367	1,880	85,757	6,6	45,189	7,019	70,915	11,6	92,587	8,722	48,068
1,7	11,019	1,996	85,488	6,7	45,960	7,100	70,570	11,7	93,839	8,683	47,422
1,8	11,673	2,112	85,219	6,8	46,736	7,179	70,221	11,8	95,111	8,639	46,764
1,9	12,327	2,227	84,950	6,9	47,517	7,257	69,870	11,9	96,406	8,591	46,092
2	12,982	2,342	84,680	7	48,302	7,334	69,516	12	97,723	8,537	45,407
2,1	13,639	2,457	84,409	7,1	49,093	7,409	69,158	12,1	99,064	8,479	44,707
2,2	14,296	2,572	84,138	7,2	49,888	7,483	68,798	12,2	100,430	8,415	43,993
2,3	14,954	2,686	83,866	7,3	50,688	7,556	68,434	12,3	101,823	8,346	43,262
2,4	15,614	2,800	83,593	7,4	51,493	7,627	68,067	12,4	103,244	8,271	42,514
2,5	16,275	2,913	83,319	7,5	52,304	7,696	67,696	12,5	104,695	8,191	41,748
2,6	16,937	3,026	83,045	7,6	53,120	7,764	67,322	12,6	106,177	8,103	40,963
2,7	17,600	3,139	82,769	7,7	53,941	7,831	66,945	12,7	107,692	8,010	40,159
2,8	18,265	3,251	82,493	7,8	54,769	7,896	66,563	12,8	109,243	7,909	39,333
2,9	18,932	3,363	82,216	7,9	55,602	7,959	66,179	12,9	110,832	7,801	38,484
3	19,599	3,475	81,938	8	56,441	8,021	65,790	13	112,462	7,685	37,611
3,1	20,269	3,585	81,658	8,1	57,287	8,081	65,397	13,1	114,136	7,561	36,712
3,2	20,940	3,696	81,378	8,2	58,138	8,139	65,000	13,2	115,857	7,427	35,785
3,3	21,612	3,806	81,097	8,3	58,997	8,195	64,599	13,3	117,630	7,285	34,828
3,4	22,287	3,915	80,814	8,4	59,862	8,250	64,194	13,4	119,458	7,132	33,837
3,5	22,963	4,024	80,531	8,5	60,733	8,303	63,785	13,5	121,347	6,969	32,811
3,6	23,641	4,132	80,246	8,6	61,612	8,354	63,371	13,6	123,304	6,794	31,745
3,7	24,321	4,240	79,959	8,7	62,499	8,403	62,952	13,7	125,335	6,605	30,635
3,8	25,003	4,347	79,672	8,8	63,392	8,450	62,529	13,8	127,450	6,403	29,477
3,9	25,687	4,453	79,383	8,9	64,293	8,494	62,101	13,9	129,658	6,184	28,263
4	26,373	4,559	79,093	9	65,202	8,537	61,667	14	131,973	5,948	26,988
4,1	27,061	4,664	78,802	9,1	66,120	8,578	61,229	14,1	134,411	5,692	25,641
4,2	27,752	4,769	78,509	9,2	67,045	8,617	60,786	14,2	136,993	5,413	24,210
4,3	28,444	4,873	78,214	9,3	67,979	8,653	60,337	14,3	139,747	5,107	22,680
4,4	29,140	4,976	77,918	9,4	68,922	8,687	59,882	14,4	142,711	4,769	21,029
4,5	29,837	5,078	77,620	9,5	69,874	8,719	59,422	14,5	145,940	4,390	19,225
4,6	30,537	5,179	77,321	9,6	70,836	8,748	58,956	14,6	149,517	3,960	17,221
4,7	31,240	5,280	77,020	9,7	71,807	8,775	58,484	14,7	153,585	3,458	14,936
4,8	31,946	5,380	76,717	9,8	72,787	8,799	58,006	14,8	158,420	2,847	12,214
4,9	32,654	5,479	76,413	9,9	73,779	8,821	57,521	14,9	164,731	2,030	8,649
5	33,365	5,578	76,107	10	74,780	8,840	57,030	15	180,000	0,000	0,000

7.5.2 C-axis movement at adjusting measure A=49.0 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000								
0,1	0,647	0,117	89,735	5,1	34,137	5,617	75,740	10,1	75,884	8,766	56,441
0,2	1,294	0,234	89,470	5,2	34,854	5,713	75,429	10,2	76,908	8,779	55,936
0,3	1,941	0,351	89,205	5,3	35,575	5,807	75,116	10,3	77,944	8,790	55,423
0,4	2,589	0,468	88,939	5,4	36,299	5,901	74,801	10,4	78,991	8,798	54,903
0,5	3,236	0,584	88,674	5,5	37,026	5,994	74,484	10,5	80,051	8,803	54,376
0,6	3,884	0,701	88,409	5,6	37,757	6,086	74,165	10,6	81,124	8,804	53,840
0,7	4,532	0,818	88,143	5,7	38,490	6,177	73,843	10,7	82,211	8,803	53,296
0,8	5,180	0,934	87,877	5,8	39,228	6,267	73,520	10,8	83,311	8,798	52,744
0,9	5,829	1,051	87,611	5,9	39,968	6,356	73,194	10,9	84,425	8,790	52,183
1	6,478	1,167	87,344	6	40,713	6,444	72,865	11	85,554	8,779	51,612
1,1	7,128	1,283	87,077	6,1	41,461	6,530	72,535	11,1	86,699	8,764	51,033
1,2	7,778	1,399	86,810	6,2	42,213	6,616	72,202	11,2	87,859	8,745	50,443
1,3	8,429	1,515	86,543	6,3	42,969	6,701	71,866	11,3	89,037	8,723	49,843
1,4	9,081	1,630	86,275	6,4	43,728	6,784	71,528	11,4	90,232	8,697	49,233
1,5	9,733	1,745	86,006	6,5	44,492	6,866	71,187	11,5	91,444	8,667	48,611
1,6	10,386	1,861	85,737	6,6	45,261	6,947	70,843	11,6	92,676	8,632	47,978
1,7	11,040	1,975	85,468	6,7	46,033	7,027	70,497	11,7	93,928	8,593	47,333
1,8	11,694	2,090	85,198	6,8	46,810	7,105	70,148	11,8	95,200	8,550	46,675
1,9	12,350	2,204	84,927	6,9	47,592	7,183	69,796	11,9	96,494	8,502	46,004
2	13,006	2,318	84,656	7	48,378	7,259	69,440	12	97,811	8,450	45,319
2,1	13,664	2,432	84,384	7,1	49,169	7,333	69,082	12,1	99,151	8,392	44,620
2,2	14,322	2,545	84,112	7,2	49,964	7,406	68,721	12,2	100,517	8,329	43,906
2,3	14,982	2,659	83,838	7,3	50,765	7,478	68,356	12,3	101,909	8,261	43,176
2,4	15,643	2,771	83,564	7,4	51,571	7,548	67,988	12,4	103,329	8,186	42,429
2,5	16,305	2,884	83,290	7,5	52,383	7,617	67,617	12,5	104,779	8,106	41,664
2,6	16,968	2,996	83,014	7,6	53,199	7,685	67,243	12,6	106,260	8,020	40,880
2,7	17,632	3,107	82,737	7,7	54,022	7,750	66,864	12,7	107,775	7,927	40,076
2,8	18,298	3,218	82,460	7,8	54,850	7,815	66,482	12,8	109,325	7,828	39,252
2,9	18,966	3,329	82,181	7,9	55,684	7,877	66,097	12,9	110,913	7,721	38,404
3	19,635	3,439	81,902	8	56,524	7,938	65,707	13	112,541	7,606	37,532
3,1	20,305	3,549	81,622	8,1	57,370	7,998	65,314	13,1	114,214	7,483	36,635
3,2	20,977	3,658	81,340	8,2	58,222	8,055	64,917	13,2	115,933	7,351	35,709
3,3	21,651	3,767	81,058	8,3	59,081	8,111	64,515	13,3	117,704	7,210	34,753
3,4	22,327	3,875	80,774	8,4	59,946	8,165	64,109	13,4	119,531	7,059	33,764
3,5	23,004	3,983	80,489	8,5	60,819	8,217	63,699	13,5	121,419	6,897	32,739
3,6	23,683	4,090	80,203	8,6	61,698	8,268	63,285	13,6	123,374	6,724	31,675
3,7	24,364	4,196	79,916	8,7	62,585	8,316	62,866	13,7	125,403	6,537	30,567
3,8	25,047	4,302	79,628	8,8	63,479	8,363	62,442	13,8	127,515	6,337	29,411
3,9	25,732	4,408	79,338	8,9	64,381	8,407	62,013	13,9	129,721	6,121	28,200
4	26,420	4,513	79,046	9	65,290	8,450	61,580	14	132,034	5,887	26,927
4,1	27,109	4,617	78,754	9,1	66,208	8,490	61,141	14,1	134,469	5,634	25,583
4,2	27,800	4,720	78,460	9,2	67,134	8,528	60,697	14,2	137,048	5,358	24,155
4,3	28,494	4,823	78,164	9,3	68,068	8,564	60,248	14,3	139,799	5,055	22,628
4,4	29,191	4,925	77,867	9,4	69,012	8,598	59,793	14,4	142,760	4,720	20,980
4,5	29,889	5,026	77,568	9,5	69,964	8,629	59,333	14,5	145,985	4,345	19,180
4,6	30,590	5,126	77,268	9,6	70,925	8,658	58,866	14,6	149,558	3,919	17,181
4,7	31,294	5,226	76,966	9,7	71,897	8,685	58,394	14,7	153,621	3,423	14,901
4,8	32,001	5,325	76,662	9,8	72,878	8,709	57,915	14,8	158,449	2,818	12,184
4,9	32,710	5,423	76,357	9,9	73,869	8,730	57,431	14,9	164,752	2,009	8,628
5	33,422	5,521	76,049	10	74,871	8,749	56,94	15	180,000	0,000	0,000

7.5.3 C-axis movement at adjusting measure A=51.0 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000								
0,1	0,652	0,112	89,730	5,1	34,358	5,396	75,519	10,1	76,230	8,419	56,095
0,2	1,303	0,225	89,461	5,2	35,079	5,488	75,204	10,2	77,255	8,432	55,589
0,3	1,955	0,337	89,191	5,3	35,804	5,579	74,888	10,3	78,291	8,443	55,076
0,4	2,607	0,449	88,921	5,4	36,531	5,669	74,569	10,4	79,339	8,450	54,556
0,5	3,259	0,561	88,651	5,5	37,262	5,758	74,248	10,5	80,399	8,455	54,028
0,6	3,911	0,674	88,381	5,6	37,996	5,847	73,925	10,6	81,472	8,457	53,492
0,7	4,564	0,786	88,111	5,7	38,733	5,934	73,600	10,7	82,558	8,455	52,948
0,8	5,217	0,898	87,840	5,8	39,474	6,020	73,273	10,8	83,658	8,451	52,396
0,9	5,870	1,009	87,570	5,9	40,219	6,106	72,944	10,9	84,772	8,443	51,835
1	6,524	1,121	87,298	6	40,966	6,190	72,612	11	85,901	8,432	51,266
1,1	7,178	1,233	87,027	6,1	41,718	6,273	72,278	11,1	87,045	8,418	50,686
1,2	7,833	1,344	86,755	6,2	42,473	6,356	71,941	11,2	88,205	8,400	50,098
1,3	8,489	1,455	86,483	6,3	43,232	6,437	71,602	11,3	89,381	8,379	49,499
1,4	9,145	1,566	86,211	6,4	43,996	6,517	71,261	11,4	90,575	8,353	48,889
1,5	9,801	1,677	85,938	6,5	44,763	6,596	70,916	11,5	91,787	8,324	48,269
1,6	10,459	1,788	85,664	6,6	45,534	6,674	70,570	11,6	93,017	8,291	47,637
1,7	11,117	1,898	85,390	6,7	46,310	6,750	70,220	11,7	94,267	8,254	46,993
1,8	11,776	2,008	85,116	6,8	47,090	6,825	69,868	11,8	95,538	8,212	46,337
1,9	12,436	2,118	84,841	6,9	47,875	6,900	69,513	11,9	96,830	8,167	45,668
2	13,097	2,227	84,565	7	48,664	6,972	69,154	12	98,144	8,116	44,986
2,1	13,759	2,337	84,289	7,1	49,458	7,044	68,793	12,1	99,483	8,061	44,289
2,2	14,422	2,446	84,012	7,2	50,256	7,114	68,429	12,2	100,846	8,000	43,577
2,3	15,086	2,554	83,734	7,3	51,060	7,183	68,062	12,3	102,235	7,934	42,850
2,4	15,751	2,662	83,456	7,4	51,869	7,251	67,691	12,4	103,652	7,863	42,106
2,5	16,418	2,770	83,176	7,5	52,683	7,317	67,317	12,5	105,099	7,787	41,344
2,6	17,085	2,878	82,896	7,6	53,503	7,382	66,939	12,6	106,577	7,704	40,564
2,7	17,754	2,985	82,615	7,7	54,328	7,445	66,559	12,7	108,087	7,615	39,764
2,8	18,425	3,092	82,334	7,8	55,158	7,506	66,174	12,8	109,633	7,519	38,943
2,9	19,097	3,198	82,051	7,9	55,994	7,567	65,786	12,9	111,217	7,416	38,100
3	19,770	3,304	81,767	8	56,837	7,625	65,394	13	112,841	7,306	37,232
3,1	20,445	3,410	81,482	8,1	57,685	7,682	64,998	13,1	114,509	7,188	36,340
3,2	21,121	3,514	81,197	8,2	58,540	7,737	64,599	13,2	116,223	7,061	35,419
3,3	21,799	3,619	80,910	8,3	59,401	7,791	64,195	13,3	117,989	6,926	34,469
3,4	22,479	3,723	80,622	8,4	60,269	7,843	63,787	13,4	119,809	6,781	33,486
3,5	23,160	3,826	80,333	8,5	61,143	7,893	63,375	13,5	121,690	6,626	32,468
3,6	23,844	3,929	80,043	8,6	62,025	7,941	62,958	13,6	123,638	6,459	31,410
3,7	24,529	4,032	79,751	8,7	62,913	7,988	62,537	13,7	125,660	6,280	30,310
3,8	25,216	4,133	79,459	8,8	63,809	8,033	62,112	13,8	127,765	6,088	29,161
3,9	25,906	4,235	79,165	8,9	64,713	8,075	61,681	13,9	129,962	5,880	27,959
4	26,597	4,335	78,869	9	65,624	8,116	61,246	14	132,265	5,656	26,695
4,1	27,290	4,435	78,572	9,1	66,543	8,155	60,806	14,1	134,691	5,412	25,361
4,2	27,986	4,534	78,274	9,2	67,471	8,191	60,360	14,2	137,259	5,147	23,944
4,3	28,684	4,633	77,975	9,3	68,406	8,226	59,910	14,3	139,998	4,856	22,429
4,4	29,384	4,731	77,673	9,4	69,351	8,258	59,454	14,4	142,945	4,534	20,795
4,5	30,087	4,828	77,371	9,5	70,305	8,288	58,992	14,5	146,155	4,175	19,010
4,6	30,792	4,925	77,066	9,6	71,267	8,316	58,524	14,6	149,712	3,765	17,027
4,7	31,500	5,021	76,761	9,7	72,240	8,342	58,051	14,7	153,755	3,288	14,767
4,8	32,210	5,116	76,453	9,8	73,222	8,365	57,571	14,8	158,559	2,707	12,074
4,9	32,923	5,210	76,143	9,9	74,214	8,386	57,086	14,9	164,831	1,930	8,550
5	33,639	5,304	75,832	10	75,217	8,404	56,593	15	180,000	0,000	0,000

7.5.4 C-axis movement at adjusting measure A=58.6 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000								
0,1	0,666	0,098	89,716	5,1	35,059	4,695	74,818	10,1	77,329	7,321	54,996
0,2	1,332	0,196	89,432	5,2	35,793	4,775	74,491	10,2	78,355	7,332	54,489
0,3	1,999	0,293	89,147	5,3	36,529	4,854	74,162	10,3	79,392	7,341	53,974
0,4	2,665	0,391	88,863	5,4	37,268	4,932	73,832	10,4	80,441	7,348	53,453
0,5	3,332	0,489	88,578	5,5	38,011	5,009	73,499	10,5	81,502	7,352	52,925
0,6	3,999	0,586	88,294	5,6	38,757	5,086	73,165	10,6	82,575	7,353	52,389
0,7	4,666	0,684	88,009	5,7	39,505	5,162	72,828	10,7	83,661	7,352	51,845
0,8	5,333	0,781	87,724	5,8	40,257	5,237	72,490	10,8	84,761	7,348	51,294
0,9	6,001	0,878	87,439	5,9	41,013	5,311	72,149	10,9	85,874	7,342	50,734
1	6,669	0,976	87,153	6	41,772	5,385	71,806	11	87,001	7,332	50,166
1,1	7,338	1,073	86,867	6,1	42,534	5,457	71,461	11,1	88,143	7,320	49,588
1,2	8,008	1,170	86,581	6,2	43,300	5,529	71,114	11,2	89,301	7,304	49,002
1,3	8,677	1,266	86,295	6,3	44,070	5,599	70,764	11,3	90,474	7,286	48,406
1,4	9,348	1,363	86,008	6,4	44,844	5,669	70,412	11,4	91,665	7,264	47,799
1,5	10,019	1,459	85,720	6,5	45,621	5,737	70,058	11,5	92,873	7,238	47,183
1,6	10,691	1,556	85,432	6,6	46,403	5,805	69,701	11,6	94,099	7,210	46,556
1,7	11,363	1,652	85,144	6,7	47,189	5,871	69,341	11,7	95,344	7,177	45,917
1,8	12,037	1,747	84,855	6,8	47,979	5,937	68,979	11,8	96,609	7,141	45,266
1,9	12,711	1,843	84,566	6,9	48,773	6,001	68,614	11,9	97,895	7,102	44,603
2	13,386	1,938	84,276	7	49,572	6,065	68,246	12	99,203	7,058	43,927
2,1	14,062	2,033	83,986	7,1	50,375	6,127	67,876	12,1	100,534	7,009	43,238
2,2	14,739	2,128	83,694	7,2	51,183	6,188	67,502	12,2	101,889	6,957	42,534
2,3	15,418	2,223	83,403	7,3	51,996	6,248	67,126	12,3	103,270	6,900	41,815
2,4	16,097	2,317	83,110	7,4	52,814	6,306	66,746	12,4	104,677	6,838	41,080
2,5	16,777	2,411	82,817	7,5	53,636	6,364	66,364	12,5	106,114	6,772	40,329
2,6	17,459	2,504	82,523	7,6	54,464	6,420	65,978	12,6	107,581	6,700	39,560
2,7	18,142	2,598	82,228	7,7	55,297	6,475	65,589	12,7	109,080	6,622	38,771
2,8	18,826	2,691	81,932	7,8	56,136	6,528	65,196	12,8	110,613	6,539	37,963
2,9	19,512	2,783	81,636	7,9	56,980	6,581	64,800	12,9	112,183	6,450	37,133
3	20,199	2,875	81,338	8	57,830	6,631	64,400	13	113,793	6,354	36,281
3,1	20,887	2,967	81,040	8,1	58,686	6,681	63,997	13,1	115,445	6,252	35,403
3,2	21,577	3,058	80,740	8,2	59,548	6,729	63,590	13,2	117,143	6,142	34,500
3,3	22,269	3,149	80,440	8,3	60,417	6,775	63,179	13,3	118,890	6,024	33,567
3,4	22,962	3,240	80,139	8,4	61,291	6,821	62,765	13,4	120,692	5,898	32,603
3,5	23,657	3,330	79,836	8,5	62,172	6,864	62,346	13,5	122,553	5,763	31,605
3,6	24,354	3,419	79,532	8,6	63,060	6,906	61,923	13,6	124,479	5,618	30,570
3,7	25,053	3,508	79,228	8,7	63,955	6,946	61,496	13,7	126,477	5,463	29,493
3,8	25,753	3,597	78,922	8,8	64,856	6,985	61,064	13,8	128,557	5,296	28,370
3,9	26,456	3,685	78,615	8,9	65,766	7,022	60,628	13,9	130,727	5,115	27,194
4	27,160	3,772	78,306	9	66,682	7,058	60,188	14	133,001	4,920	25,960
4,1	27,866	3,859	77,996	9,1	67,607	7,091	59,742	14,1	135,394	4,709	24,657
4,2	28,575	3,945	77,685	9,2	68,539	7,123	59,292	14,2	137,928	4,478	23,275
4,3	29,286	4,031	77,373	9,3	69,479	7,153	58,837	14,3	140,629	4,225	21,798
4,4	29,999	4,116	77,059	9,4	70,428	7,181	58,376	14,4	143,534	3,945	20,206
4,5	30,714	4,201	76,743	9,5	71,386	7,207	57,911	14,5	146,697	3,632	18,467
4,6	31,432	4,285	76,426	9,6	72,352	7,231	57,440	14,6	150,201	3,276	16,538
4,7	32,152	4,368	76,108	9,7	73,328	7,254	56,963	14,7	154,182	2,861	14,340
4,8	32,875	4,451	75,788	9,8	74,313	7,274	56,480	14,8	158,911	2,356	11,723
4,9	33,600	4,533	75,466	9,9	75,308	7,292	55,992	14,9	165,081	1,680	8,299
5	34,328	4,614	75,143	10	76,313	7,307	55,497	15	180,000	0,000	0,000

7.5.5 C-axis movement at adjusting measure A=60.0 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000								
0,1	0,668	0,095	89,714	5,1	35,169	4,585	74,708	10,1	77,500	7,149	54,824
0,2	1,337	0,191	89,427	5,2	35,904	4,663	74,379	10,2	78,527	7,160	54,317
0,3	2,006	0,286	89,140	5,3	36,643	4,740	74,049	10,3	79,565	7,169	53,802
0,4	2,674	0,382	88,854	5,4	37,384	4,817	73,716	10,4	80,614	7,175	53,281
0,5	3,343	0,477	88,567	5,5	38,128	4,892	73,382	10,5	81,675	7,179	52,752
0,6	4,012	0,573	88,280	5,6	38,876	4,967	73,046	10,6	82,748	7,181	52,216
0,7	4,682	0,668	87,993	5,7	39,626	5,041	72,708	10,7	83,834	7,180	51,673
0,8	5,352	0,763	87,706	5,8	40,380	5,115	72,367	10,8	84,933	7,176	51,121
0,9	6,022	0,858	87,418	5,9	41,137	5,187	72,025	10,9	86,046	7,169	50,562
1	6,692	0,953	87,130	6	41,898	5,259	71,680	11	87,173	7,160	49,994
1,1	7,363	1,048	86,842	6,1	42,662	5,329	71,334	11,1	88,315	7,148	49,417
1,2	8,035	1,142	86,554	6,2	43,430	5,399	70,985	11,2	89,472	7,133	48,830
1,3	8,707	1,237	86,265	6,3	44,201	5,468	70,633	11,3	90,645	7,115	48,235
1,4	9,380	1,331	85,976	6,4	44,976	5,536	70,280	11,4	91,835	7,093	47,629
1,5	10,053	1,425	85,686	6,5	45,756	5,603	69,924	11,5	93,042	7,069	47,013
1,6	10,727	1,519	85,396	6,6	46,539	5,669	69,565	11,6	94,268	7,041	46,386
1,7	11,402	1,613	85,106	6,7	47,326	5,734	69,204	11,7	95,512	7,009	45,749
1,8	12,078	1,707	84,815	6,8	48,118	5,798	68,840	11,8	96,776	6,974	45,099
1,9	12,754	1,800	84,523	6,9	48,913	5,861	68,474	11,9	98,061	6,935	44,437
2	13,431	1,893	84,231	7	49,714	5,923	68,104	12	99,368	6,892	43,762
2,1	14,110	1,986	83,938	7,1	50,519	5,983	67,732	12,1	100,698	6,845	43,074
2,2	14,789	2,079	83,645	7,2	51,328	6,043	67,357	12,2	102,052	6,794	42,371
2,3	15,469	2,171	83,351	7,3	52,142	6,101	66,980	12,3	103,431	6,738	41,654
2,4	16,151	2,263	83,056	7,4	52,961	6,159	66,599	12,4	104,838	6,678	40,920
2,5	16,834	2,355	82,761	7,5	53,785	6,215	66,215	12,5	106,272	6,613	40,170
2,6	17,517	2,446	82,464	7,6	54,615	6,269	65,827	12,6	107,738	6,543	39,403
2,7	18,202	2,537	82,167	7,7	55,449	6,323	65,437	12,7	109,235	6,467	38,616
2,8	18,889	2,628	81,869	7,8	56,289	6,375	65,043	12,8	110,766	6,386	37,810
2,9	19,577	2,718	81,571	7,9	57,135	6,426	64,646	12,9	112,334	6,299	36,982
3	20,266	2,808	81,271	8	57,986	6,476	64,245	13	113,942	6,205	36,132
3,1	20,957	2,898	80,971	8,1	58,843	6,524	63,841	13,1	115,591	6,105	35,257
3,2	21,649	2,987	80,669	8,2	59,706	6,571	63,433	13,2	117,287	5,998	34,356
3,3	22,343	3,076	80,367	8,3	60,575	6,617	63,021	13,3	119,031	5,883	33,426
3,4	23,038	3,164	80,063	8,4	61,451	6,661	62,605	13,4	120,830	5,760	32,465
3,5	23,735	3,252	79,758	8,5	62,333	6,703	62,185	13,5	122,688	5,628	31,470
3,6	24,434	3,339	79,453	8,6	63,222	6,744	61,761	13,6	124,610	5,487	30,438
3,7	25,135	3,426	79,146	8,7	64,118	6,784	61,333	13,7	126,605	5,335	29,365
3,8	25,837	3,513	78,838	8,8	65,020	6,821	60,901	13,8	128,680	5,172	28,246
3,9	26,542	3,599	78,528	8,9	65,930	6,858	60,464	13,9	130,846	4,996	27,075
4	27,248	3,684	78,218	9	66,848	6,892	60,022	14	133,116	4,805	25,845
4,1	27,957	3,769	77,906	9,1	67,773	6,925	59,576	14,1	135,504	4,599	24,547
4,2	28,667	3,853	77,593	9,2	68,706	6,956	59,125	14,2	138,033	4,373	23,170
4,3	29,380	3,937	77,278	9,3	69,647	6,985	58,669	14,3	140,728	4,126	21,699
4,4	30,095	4,020	76,963	9,4	70,597	7,013	58,208	14,4	143,626	3,853	20,113
4,5	30,812	4,103	76,645	9,5	71,555	7,038	57,742	14,5	146,782	3,547	18,383
4,6	31,532	4,185	76,326	9,6	72,522	7,062	57,270	14,6	150,277	3,200	16,461
4,7	32,254	4,266	76,006	9,7	73,498	7,083	56,793	14,7	154,249	2,795	14,273
4,8	32,979	4,347	75,684	9,8	74,484	7,103	56,310	14,8	158,966	2,301	11,668
4,9	33,706	4,427	75,360	9,9	75,479	7,121	55,821	14,9	165,120	1,640	8,260
5	34,436	4,506	75,035	10	76,485	7,136	55,326	15	180,000	0,000	0,000

7.5.6 C-axis movement at adjusting measure A=67.1 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000	5,1	35,655	4,099	74,222	10,1	78,260	6,389	54,065
0,1	0,679	0,085	89,703	5,2	36,399	4,169	73,885	10,2	79,288	6,399	53,556
0,2	1,357	0,171	89,407	5,3	37,145	4,238	73,546	10,3	80,327	6,407	53,040
0,3	2,036	0,256	89,110	5,4	37,895	4,306	73,206	10,4	81,376	6,413	52,518
0,4	2,715	0,341	88,813	5,5	38,647	4,374	72,863	10,5	82,438	6,416	51,989
0,5	3,394	0,427	88,516	5,6	39,402	4,440	72,519	10,6	83,511	6,418	51,453
0,6	4,073	0,512	88,219	5,7	40,161	4,507	72,173	10,7	84,597	6,417	50,910
0,7	4,752	0,597	87,922	5,8	40,922	4,572	71,825	10,8	85,696	6,413	50,359
0,8	5,432	0,682	87,625	5,9	41,687	4,637	71,475	10,9	86,808	6,407	49,800
0,9	6,112	0,767	87,327	6	42,455	4,701	71,123	11	87,934	6,399	49,233
1	6,793	0,852	87,029	6,1	43,227	4,764	70,768	11,1	89,075	6,388	48,657
1,1	7,474	0,937	86,731	6,2	44,002	4,826	70,412	11,2	90,230	6,375	48,072
1,2	8,156	1,021	86,433	6,3	44,781	4,888	70,053	11,3	91,401	6,359	47,479
1,3	8,838	1,106	86,134	6,4	45,564	4,949	69,692	11,4	92,589	6,339	46,875
1,4	9,520	1,190	85,835	6,5	46,350	5,008	69,329	11,5	93,794	6,317	46,262
1,5	10,204	1,275	85,535	6,6	47,140	5,067	68,964	11,6	95,016	6,292	45,638
1,6	10,888	1,359	85,235	6,7	47,935	5,125	68,595	11,7	96,257	6,264	45,004
1,7	11,573	1,442	84,935	6,8	48,733	5,183	68,225	11,8	97,517	6,233	44,358
1,8	12,258	1,526	84,634	6,9	49,535	5,239	67,852	11,9	98,798	6,198	43,700
1,9	12,944	1,610	84,333	7	50,342	5,294	67,476	12	100,100	6,160	43,030
2	13,632	1,693	84,031	7,1	51,154	5,348	67,097	12,1	101,425	6,118	42,346
2,1	14,320	1,776	83,728	7,2	51,969	5,401	66,716	12,2	102,774	6,072	41,649
2,2	15,009	1,859	83,425	7,3	52,790	5,454	66,332	12,3	104,147	6,023	40,938
2,3	15,699	1,941	83,121	7,4	53,615	5,505	65,945	12,4	105,547	5,969	40,211
2,4	16,390	2,023	82,816	7,5	54,445	5,555	65,555	12,5	106,975	5,911	39,468
2,5	17,083	2,105	82,511	7,6	55,280	5,604	65,162	12,6	108,432	5,848	38,708
2,6	17,776	2,187	82,205	7,7	56,121	5,652	64,766	12,7	109,922	5,780	37,929
2,7	18,471	2,268	81,899	7,8	56,966	5,698	64,366	12,8	111,444	5,708	37,132
2,8	19,167	2,350	81,591	7,9	57,817	5,744	63,963	12,9	113,003	5,630	36,313
2,9	19,864	2,430	81,283	8	58,674	5,788	63,557	13	114,601	5,547	35,473
3	20,563	2,511	80,974	8,1	59,536	5,831	63,148	13,1	116,240	5,457	34,609
3,1	21,263	2,591	80,664	8,2	60,404	5,873	62,735	13,2	117,923	5,361	33,719
3,2	21,965	2,671	80,353	8,3	61,278	5,914	62,318	13,3	119,656	5,259	32,801
3,3	22,668	2,750	80,041	8,4	62,158	5,953	61,897	13,4	121,441	5,149	31,854
3,4	23,373	2,829	79,728	8,5	63,045	5,991	61,473	13,5	123,285	5,031	30,873
3,5	24,079	2,907	79,414	8,6	63,938	6,028	61,045	13,6	125,193	4,905	29,856
3,6	24,788	2,985	79,099	8,7	64,838	6,063	60,612	13,7	127,171	4,769	28,799
3,7	25,497	3,063	78,783	8,8	65,745	6,097	60,176	13,8	129,229	4,623	27,697
3,8	26,209	3,140	78,466	8,9	66,659	6,129	59,735	13,9	131,376	4,466	26,545
3,9	26,923	3,217	78,147	9	67,580	6,160	59,290	14	133,625	4,296	25,335
4	27,638	3,294	77,828	9,1	68,509	6,189	58,840	14,1	135,992	4,111	24,060
4,1	28,356	3,370	77,507	9,2	69,445	6,217	58,386	14,2	138,496	3,910	22,707
4,2	29,075	3,445	77,185	9,3	70,389	6,243	57,927	14,3	141,165	3,689	21,262
4,3	29,797	3,520	76,861	9,4	71,342	6,267	57,463	14,4	144,035	3,445	19,705
4,4	30,521	3,594	76,537	9,5	72,303	6,290	56,994	14,5	147,158	3,172	18,007
4,5	31,247	3,668	76,210	9,6	73,272	6,311	56,520	14,6	150,616	2,861	16,122
4,6	31,976	3,741	75,883	9,7	74,251	6,331	56,040	14,7	154,545	2,499	13,977
4,7	32,706	3,814	75,554	9,8	75,239	6,348	55,555	14,8	159,209	2,057	11,424
4,8	33,440	3,886	75,223	9,9	76,236	6,364	55,064	14,9	165,294	1,467	8,086
4,9	34,176	3,958	74,891	10	77,243	6,378	54,567	15	180,000	0,000	0,000

7.6 Max. eccentricity of 16 mm

7.6.1 C-axis movement at adjusting measure A=60.0 mm

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000												
0,1	0,621	0,095	89,737	4,1	25,908	3,787	78,940	8,1	54,143	6,686	66,271	12,1	90,687	7,582	48,447
0,2	1,241	0,191	89,475	4,2	26,564	3,873	78,655	8,2	54,922	6,739	65,909	12,2	91,811	7,559	47,874
0,3	1,862	0,286	89,212	4,3	27,222	3,958	78,368	8,3	55,705	6,792	65,544	12,3	92,950	7,534	47,292
0,4	2,483	0,382	88,949	4,4	27,881	4,043	78,081	8,4	56,493	6,843	65,175	12,4	94,105	7,505	46,700
0,5	3,104	0,477	88,686	4,5	28,542	4,127	77,792	8,5	57,287	6,893	64,803	12,5	95,278	7,472	46,097
0,6	3,726	0,573	88,423	4,6	29,206	4,211	77,503	8,6	58,085	6,942	64,429	12,6	96,469	7,436	45,484
0,7	4,347	0,668	88,160	4,7	29,871	4,294	77,212	8,7	58,889	6,990	64,050	12,7	97,68	7,397	44,860
0,8	4,969	0,763	87,897	4,8	30,538	4,377	76,919	8,8	59,698	7,036	63,669	12,8	98,906	7,354	44,224
0,9	5,591	0,858	87,634	4,9	31,208	4,459	76,625	8,9	60,513	7,081	63,284	12,9	100,155	7,307	43,576
1	6,214	0,953	87,370	5	31,880	4,540	76,330	9	61,334	7,124	62,895	13	101,426	7,256	42,915
1,1	6,836	1,048	87,106	5,1	32,554	4,621	76,034	9,1	62,160	7,166	62,503	13,1	102,718	7,201	42,241
1,2	7,460	1,143	86,842	5,2	33,230	4,701	75,736	9,2	62,993	7,207	62,107	13,2	104,035	7,142	41,554
1,3	8,083	1,237	86,577	5,3	33,908	4,781	75,436	9,3	63,831	7,246	61,707	13,3	105,376	7,078	40,851
1,4	8,708	1,332	86,312	5,4	34,589	4,860	75,135	9,4	64,676	7,283	61,304	13,4	106,744	7,010	40,133
1,5	9,333	1,426	86,047	5,5	35,273	4,938	74,833	9,5	65,528	7,320	60,896	13,5	108,140	6,936	39,398
1,6	9,958	1,520	85,781	5,6	35,959	5,016	74,528	9,6	66,386	7,354	60,484	13,6	109,566	6,858	38,646
1,7	10,584	1,614	85,515	5,7	36,647	5,093	74,223	9,7	67,251	7,387	60,068	13,7	111,023	6,774	37,876
1,8	11,211	1,708	85,249	5,8	37,339	5,169	73,915	9,8	68,123	7,418	59,648	13,8	112,513	6,684	37,086
1,9	11,838	1,802	84,982	5,9	38,033	5,244	73,606	9,9	69,002	7,448	59,223	13,9	114,039	6,588	36,275
2	12,466	1,895	84,714	6	38,730	5,319	73,295	10	69,889	7,476	58,79	14	115,604	6,486	35,441
2,1	13,095	1,988	84,447	6,1	39,429	5,393	72,982	10,1	70,783	7,502	58,359	14,1	117,210	6,377	34,584
2,2	13,725	2,081	84,178	6,2	40,132	5,466	72,667	10,2	71,685	7,526	57,920	14,2	118,861	6,261	33,700
2,3	14,356	2,174	83,909	6,3	40,837	5,539	72,351	10,3	72,596	7,549	57,476	14,3	120,560	6,137	32,789
2,4	14,987	2,266	83,640	6,4	41,546	5,610	72,032	10,4	73,514	7,569	57,028	14,4	122,311	6,005	31,847
2,5	15,620	2,359	83,369	6,5	42,258	5,681	71,712	10,5	74,441	7,588	56,573	14,5	124,121	5,864	30,872
2,6	16,254	2,451	83,099	6,6	42,973	5,751	71,389	10,6	75,377	7,605	56,114	14,6	125,994	5,713	29,860
2,7	16,888	2,542	82,827	6,7	43,691	5,820	71,064	10,7	76,322	7,619	55,649	14,7	127,937	5,551	28,807
2,8	17,524	2,633	82,555	6,8	44,413	5,888	70,738	10,8	77,276	7,632	55,178	14,8	129,959	5,378	27,710
2,9	18,161	2,724	82,282	6,9	45,138	5,956	70,409	10,9	78,240	7,642	54,701	14,9	132,069	5,192	26,561
3	18,799	2,815	82,008	7	45,867	6,022	70,077	11	79,214	7,651	54,218	15	134,281	4,991	25,355
3,1	19,438	2,905	81,734	7,1	46,599	6,087	69,744	11,1	80,199	7,657	53,729	15,1	136,609	4,773	24,082
3,2	20,079	2,995	81,458	7,2	47,336	6,152	69,408	11,2	81,193	7,661	53,234	15,2	139,073	4,537	22,732
3,3	20,720	3,085	81,182	7,3	48,075	6,215	69,070	11,3	82,199	7,662	52,732	15,3	141,700	4,278	21,289
3,4	21,364	3,174	80,905	7,4	48,819	6,278	68,729	11,4	83,216	7,661	52,223	15,4	144,526	3,993	19,733
3,5	22,008	3,263	80,627	7,5	49,567	6,339	68,386	11,5	84,245	7,658	51,707	15,5	147,603	3,674	18,035
3,6	22,654	3,352	80,349	7,6	50,319	6,400	68,040	11,6	85,286	7,652	51,183	15,6	151,011	3,312	16,151
3,7	23,302	3,440	80,069	7,7	51,075	6,459	67,692	11,7	86,339	7,644	50,652	15,7	154,884	2,891	14,004
3,8	23,951	3,527	79,788	7,8	51,835	6,517	67,341	11,8	87,405	7,632	50,114	15,8	159,484	2,379	11,448
3,9	24,602	3,614	79,506	7,9	52,600	6,575	66,987	11,9	88,485	7,619	49,567	15,9	165,486	1,695	8,104
4	25,254	3,701	79,223	8	53,369	6,631	66,631	12	89,579	7,602	49,011	16	180,000	0,000	0,000

7.7 Max. eccentricity of 17 mm**7.7.1 C-axis movement at adjusting measure A=90.0 mm**

e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ	e	alpha α	beta β	delta δ
0	0,000	0,000	0,000												
0,1	0,610	0,064	89,727	5,1	31,816	3,099	75,641	10,1	67,720	5,179	58,729	15,1	120,884	4,420	31,768
0,2	1,221	0,127	89,453	5,2	32,469	3,153	75,342	10,2	68,538	5,202	58,332	15,2	122,453	4,338	30,942
0,3	1,831	0,191	89,180	5,3	33,124	3,208	75,042	10,3	69,361	5,224	57,931	15,3	124,067	4,250	30,092
0,4	2,442	0,255	88,906	5,4	33,780	3,261	74,741	10,4	70,190	5,245	57,527	15,4	125,729	4,156	29,214
0,5	3,053	0,318	88,633	5,5	34,438	3,315	74,438	10,5	71,025	5,264	57,120	15,5	127,445	4,056	28,306
0,6	3,664	0,382	88,359	5,6	35,098	3,368	74,135	10,6	71,865	5,283	56,709	15,6	129,219	3,950	27,365
0,7	4,275	0,445	88,085	5,7	35,760	3,421	73,830	10,7	72,713	5,301	56,294	15,7	131,059	3,836	26,389
0,8	4,886	0,509	87,811	5,8	36,424	3,473	73,524	10,8	73,566	5,317	55,876	15,8	132,972	3,715	25,371
0,9	5,497	0,572	87,537	5,9	37,090	3,525	73,217	10,9	74,426	5,333	55,453	15,9	134,967	3,584	24,309
1	6,109	0,636	87,263	6	37,758	3,576	72,909	11	75,293	5,347	55,027	16	137,056	3,444	23,194
1,1	6,721	0,699	86,989	6,1	38,429	3,627	72,599	11,1	76,167	5,360	54,596	16,1	139,253	3,293	22,020
1,2	7,333	0,762	86,714	6,2	39,101	3,678	72,288	11,2	77,049	5,372	54,162	16,2	141,578	3,128	20,775
1,3	7,946	0,825	86,439	6,3	39,776	3,728	71,976	11,3	77,937	5,382	53,723	16,3	144,053	2,948	19,448
1,4	8,559	0,888	86,164	6,4	40,453	3,777	71,662	11,4	78,833	5,392	53,279	16,4	146,714	2,750	18,018
1,5	9,173	0,951	85,889	6,5	41,133	3,826	71,347	11,5	79,737	5,400	52,831	16,5	149,609	2,530	16,460
1,6	9,787	1,014	85,614	6,6	41,814	3,875	71,030	11,6	80,649	5,406	52,379	16,6	152,813	2,280	14,733
1,7	10,401	1,077	85,338	6,7	42,499	3,923	70,712	11,7	81,569	5,412	51,921	16,7	156,451	1,989	12,769
1,8	11,016	1,140	85,062	6,8	43,186	3,971	70,393	11,8	82,498	5,416	51,459	16,8	160,769	1,636	10,433
1,9	11,632	1,202	84,785	6,9	43,875	4,018	70,071	11,9	83,436	5,418	50,991	16,9	166,399	1,165	7,383
2	12,248	1,265	84,508	7	44,567	4,064	69,749	12	84,382	5,419	50,518	17	180,000	0,000	0,000
2,1	12,865	1,327	84,231	7,1	45,262	4,110	69,424	12,1	85,338	5,419	50,040				
2,2	13,482	1,389	83,953	7,2	45,959	4,156	69,098	12,2	86,304	5,417	49,556				
2,3	14,100	1,451	83,675	7,3	46,660	4,201	68,771	12,3	87,280	5,413	49,067				
2,4	14,719	1,513	83,397	7,4	47,363	4,245	68,441	12,4	88,266	5,408	48,571				
2,5	15,339	1,574	83,118	7,5	48,069	4,289	68,110	12,5	89,263	5,401	48,069				
2,6	15,959	1,636	82,839	7,6	48,778	4,332	67,777	12,6	90,271	5,393	47,561				
2,7	16,580	1,697	82,559	7,7	49,491	4,375	67,442	12,7	91,290	5,383	47,046				
2,8	17,202	1,758	82,278	7,8	50,206	4,416	67,105	12,8	92,321	5,370	46,525				
2,9	17,825	1,819	81,997	7,9	50,925	4,458	66,767	12,9	93,365	5,357	45,996				
3	18,448	1,880	81,716	8	51,647	4,498	66,426	13	94,421	5,341	45,460				
3,1	19,073	1,941	81,434	8,1	52,372	4,538	66,083	13,1	95,491	5,323	44,916				
3,2	19,698	2,001	81,151	8,2	53,101	4,578	65,739	13,2	96,574	5,303	44,364				
3,3	20,325	2,061	80,868	8,3	53,833	4,616	65,392	13,3	97,672	5,281	43,805				
3,4	20,953	2,121	80,584	8,4	54,569	4,654	65,043	13,4	98,785	5,257	43,236				
3,5	21,581	2,181	80,300	8,5	55,308	4,692	64,692	13,5	99,913	5,231	42,659				
3,6	22,211	2,240	80,015	8,6	56,052	4,728	64,338	13,6	101,058	5,202	42,072				
3,7	22,842	2,300	79,729	8,7	56,799	4,764	63,982	13,7	102,220	5,171	41,475				
3,8	23,474	2,359	79,442	8,8	57,550	4,799	63,624	13,8	103,400	5,137	40,869				
3,9	24,108	2,417	79,155	8,9	58,305	4,833	63,264	13,9	104,599	5,101	40,251				
4	24,742	2,476	78,867	9	59,065	4,867	62,901	14	105,817	5,063	39,623				
4,1	25,378	2,534	78,578	9,1	59,828	4,899	62,535	14,1	107,056	5,021	38,983				
4,2	26,015	2,592	78,288	9,2	60,596	4,931	62,167	14,2	108,316	4,976	38,330				
4,3	26,654	2,649	77,998	9,3	61,369	4,962	61,797	14,3	109,600	4,929	37,664				
4,4	27,294	2,707	77,706	9,4	62,146	4,992	61,423	14,4	110,908	4,878	36,985				
4,5	27,935	2,764	77,414	9,5	62,927	5,022	61,047	14,5	112,242	4,824	36,291				
4,6	28,578	2,820	77,121	9,6	63,713	5,050	60,668	14,6	113,603	4,767	35,582				
4,7	29,223	2,877	76,827	9,7	64,505	5,078	60,287	14,7	114,993	4,706	34,857				
4,8	29,869	2,933	76,532	9,8	65,301	5,105	59,902	14,8	116,413	4,641	34,114				
4,9	30,516	2,988	76,236	9,9	66,102	5,130	59,514	14,9	117,867	4,572	33,352				
5	31,166	3,044	75,939	10	66,909	5,155	59,123	15	119,357	4,498	32,571				

8 Disassembly, subsequent storage, disposal

If there is break in production that lasts longer than 3 days, the clamping device must be disassembled and properly stored in accordance with the manufacturer's specifications [see section »Transport, packaging, storage«].

Prior to disassembling:

- Put the machine in set-up mode.
- Remove fuels and auxiliary materials, as well as residual processing materials and dispose of these items in an environmentally-responsible manner.

8.1 Safety

Safeguarding against restart



DANGER!

Life-threatening danger if restarted without authorization

When disassembling there is danger of the energy supply being switched on inadvertently. This poses a life-threatening hazard for persons in the danger zone.

- Prior to starting the tasks switch off all energy supplies and safeguard them from being switched on again.



WARNING!

Danger of injury due to falling components!

When mounting components can fall and cause severe injury and material damage.

- Two people are always required for this task.
- Use a crane.
- For assembly on a vertically suspended spindle always use a suitable mounting aid.



DANGER!

Risk of injury by released energy!

Risk of injury during the disassembling of the balance weight due to released energy.

- Pay attention to the safety instruction during the disassembly of the stroke limit screw.



WARNING

Risk of injury due to stored energy!

The clamping device can be designed with disc springs. These disc springs are under permanent tension! The release of the stored energy can cause injuries!

- By loosening the corresponding screws they have to be operated continuously alternately to reduce the clamping pressure to a minimum!
- Particularly cautious approach is required!
- For cleaning and maintenance disassemble the clamping device from the machine!
- Always wear personal protective equipment!



WARNING!

Danger of injury due to vertical suspended spindle!

Bending into the machine work area when assembling overhead can cause severe head injuries.

- Secure components prior to overhead assembly.
- For assembly on a vertically suspended spindle always use a suitable mounting aid.

8.2 Disassembly of the workpiece end-stop

Special tools required:

- Allen wrench



Fig. 21

1. Loosen and remove the mounting screws.
2. Remove the workpiece end-stop out of the clamping device through the assembled clamping head

8.3 Disassembly of the eccentric chuck

Two people are required for this task.

Special tools required:

- Allen wrench
- Crane and eye bolts from weight 15 kg

1. Put the machine tool in set up mode.
2. Remove all tools from the interior of the machine.
3. Set the clamping pressure of the machine tool on the lowest setting.
4. Move the drawtube of the machine tool into the front stop position.
5. Loosen and remove the 8 mounting screws [H] at the spindle flange.
6. Turn the clamping unit in the bayonet by 60°.
7. Remove the clamping unit [E] from the threaded adapter.
8. Loosen and remove the cylindrical screws [M].
9. Remove the spindle flange [B] by the threaded adapter [A] from the machine spindle.
10. Unscrew the threaded adapter [A] from the drawtube of the machine.

8.4 Subsequent storage of the clamping device

The clamping device must be cleaned and treated with corrosion protection for subsequent storage [see section »Cleaning«].



NOTE!

The storage conditions are specified in the section »Transport, packaging and storage«.

8.5 Disposal

If a return or disposal agreement has not been concluded, then recycle disassembled components.



CAUTION!

Risk of injury due to leaking fluids!

Hydraulically or pneumatically operated clamping devices may contain residues of liquids. Uncontrolled leakage of fluids can lead to severe injuries.

- Open the pressure relief screw and drain remaining liquid.
- Discard the liquid.



NOTE!

Improper disposal causes environmental damage!

Lubricants and other auxiliary materials are subject to treatment as special waste, and should only be disposed of by approved specialist companies!



NOTE!

Composite materials!

For disposal clamping devices which include composite materials [mineral cast, CFK] must be returned at HAINBUCH!

Local municipal authorities or specialized disposal companies provide information on environmentally-responsible disposal.

9 Maintenance

Environmental protection

Comply with the following instructions for environmental protection when performing maintenance work:

- At all lubricating points where lubricant is applied by hand, remove escaping, used, or excess grease, and dispose of it in accordance with applicable local regulations.
- Collect used oil in suitable containers and dispose of it in accordance with applicable local regulations.

9.1 General

Cleanliness of the appropriate end-stop as well as the guidance diameters are conditions for reaching the concentricity and perpendicularity tolerances. Clean these surfaces with an appropriate cleaner.



CAUTION

Danger of injury due to improper handling of cleaners!

Improper handling of cleaners can cause health impairments.

- Always comply with the safety data sheets and guidelines provided by the manufacturer of the cleaning agent for handling/using the cleaners.



CAUTION

Danger of injury due to loss of clamping force!

Fouling of the clamping device can cause the clamping device to lose considerable clamping force.

- Always comply with the maintenance and cleaning intervals specified in this manual.
- In conjunction with the maintenance intervals, regularly check the maintenance status of the clamping device through clamping force measurements.



Risk of injury!

Slipping while the lubricating with a grease gun can lead to severe cuts!

**WARNING****Risk of injury due to stored energy!**

The clamping device can be designed with disc springs. These disc springs are under permanent tension! The release of the stored energy can cause injuries!

- By loosening the corresponding screws they have to be operated continuously alternately to reduce the clamping pressure to a minimum!
- Particularly cautious approach is required!
- For cleaning and maintenance disassemble the clamping device from the machine!
- Always wear personal protective equipment!

9.2 Cleaning

**NOTE!****Material damage if cleaned with compressed air!**

Cleaning the clamping device with compressed air can force metal chips into thread and grooves. This can damage or even destroy the clamping device.

- Never clean the clamping device with compressed air!
- Auxiliary material required:
 - Ester-free, non-polar cleaning agent
 - Soft, lint-free cloth
- 1. Disassemble the clamping device [see section »Disassembling the clamping unit«].
- 2. Clean all the components listed below with cleaning agent and a cloth; remove all oil and grease residues:
 - Spindle flange
 - Clamping unit
 - Taper reception and coupling area
 - Drawtube adapter
 - Threaded adapter [optional]
 - Cylindrical screws

9.3 Preservation



Fig. 22

- Special tools required:
 - Universal grease 2085/0003
 - Grease gun
 - Oil stone
 - Soft, lint-free cloth
1. Disassembling the clamping device [see section » Disassembling the clamping unit«].
 2. Hone all the bearing surfaces of the clamping device with an oil stone.
 3. Lightly grease all cylindrical screws. Remove excess grease with a cloth.
 4. Remount the clamping devices.
 5. Screw all cylindrical screws into the clamping device again and tighten them hand tight.

! For subsequent storage tightening the cylindrical screws hand tight suffices. This facilitates re-commissioning and protects the cylindrical screws.



Fig. 23

6. Use the lubricating nipples to grease the clamping unit with a grease gun and universal grease.
7. Lightly grease all interior and outer surfaces of the clamping device. Remove excess grease with a cloth.
8. Pack the clamping device airtight in foil. Place it on a level, impact-free storage location and safeguard it from falling.

9.4 Use of lubricant

With the usage of lubricant you may only use grease that corresponds to the requirements concerning bond, pressure-stability and solubility in lubricating coolant. In addition no dirt particles may be in the grease; they cause run errors if they come in in-between two mating surfaces.

We recommend for this the following lubricant:

HAINBUCH grease

See optional Accessories

Alternatives:

Lubricant	Manufacturer	Product
Universal grease	MicroGleit	GP 355
	Klüber	QNB 50
	Zeller & Gmelin	DIVINOL SD24440
	Bremer & Leguill	RIVOLTA W.A.P.
Special grease	Klüber	MICROLUBE GL 261

9.5 Maintenance schedule

Maintenance tasks are described in the sections above that are required for optimal and trouble-free operation.

If increased wear is detected during regular inspections, then reduce the required maintenance intervals according to the actual indications of wear.

Contact the manufacturer, [see the service address on the back] if you have questions concerning maintenance tasks and intervals.

Interval	Maintenance task
Daily	Visual inspection and complete cleaning in case of heavy contamination [see section »Cleaning«]
Weekly	Clean the clamping unit [see section »Cleaning«]
	Clean the taper reception and coupling area [see section »Cleaning«]
	Grease the clamping unit [see section »Preservation«]
Every 6 months	Completely disassemble and clean the clamping unit [see section »Cleaning«]



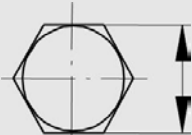
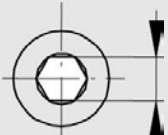
For proper operation of the coolant feed a pre-filtering with duplex filter (mesh size 100 µm, PI 3754) is necessary. The duplex filter is mounted on the coolant cleaning system.

9.6 Bolt torque

Metric ISO thread

The guide values for bolt tightening torque for achieving the highest permissible pre-tension for metric ISO thread are specified in Nm in the table.

- Total friction coefficient $\mu_{\text{tot}} = 0,12$

Diameter	 [mm]	 [mm]	Torque for screw quality 10.9 [Nm]
M 4	7	3	4
M 5	8	4	7
M 6	10	5	12
M 8	13	6	25
M 10	17	8	50
M 12	19	10	100
M 16	24	14	220
M 20	30	17	400
M 24	36	19	600

The table shows the prescribed values.

Knowledge of the applicable guidelines and configuration criteria are the prerequisites.

10 Trouble shooting

Possible fault causes and the tasks to correct these faults are described in the following section.

If faults occur more frequently, the maintenance intervals must be shortened to correspond to the actual system load.

Contact the manufacturer if there are faults that cannot be corrected by following the instructions below; see the service address on the back of this operating instruction.

10.1 Safety

Trouble shooting

The following always applies:

1. For faults that pose a direct danger for personnel and or property immediately execute the emergency-stop function of the machine.
2. Determine the cause of the fault.
3. If correction of the fault requires work in the danger zone, put the machine in set-up mode.
4. Immediately inform the responsible parties at the installation site of the fault.
5. Depending on the type of fault, either have authorized specialized personnel correct the fault, or correct it yourself.



The trouble shooting table provided below lists personnel who are authorized to correct the fault.

6. If there is a fault that was not caused by the clamping device the cause of the fault may be in the machine area. See the operating manual for the machine in this regard.

10.2 Trouble shooting table

Fault	Possible cause	Fault correction	Corrected by
Clamping device does not open or the release stroke is insufficient.	Fouling between the draw mechanism and the clamping unit	Remove the clamping head, move the draw tube back and clean the coupling area [see section »Disassembling the clamping head«].	Specialist
	Dimensional deviation of the draw tube adapter	Check the dimensions of the draw tube adapter and correct them if necessary.	Specialist
Clamping force is too low	Work piece is under-dimensioned	Replace with a suitable clamping head	Specialist
	Insufficient hydraulic pressure on the clamping cylinder	Check the machine-side hydraulic aggregate	Hydraulic specialist
	Defective clamping cylinder or blocked draw tube	Contact the machine manufacturer	Machine manufacturer
	Compression springs fatigued [at permanent tension]	Replace compression springs	Specialist
Eccentric dimensional deviation on the work piece	Contaminated coupling area	Clean the coupling are of the clamping unit [see chapter »Cleaning«].	Specialist
	Contaminated clamping cone	Disassemble and clean the clamping head [see chapter »Cleaning«].	Specialist
Formal defect on the work piece	Elastic deformation of feedstock that is subject to formal defects. After machining, the work piece returns to its original form.	Use feedstock with fewer formal defects. Use a clamping head with several sharp teeth in the clamping surface.	Specialist

10.3 Start-up after corrected fault

After correcting the fault execute the following steps to start up again:

1. Reset the emergency-stop device
2. Acknowledge the fault on the machine tool controller
3. Ensure that no one is in the danger zone
4. Start the machine tool

11 Appendix

11.1 Service Hotline

Order Hotline

Quickly ordered and delivered. A call is all it takes:
+49 7144. 907-333

Schedule Hotline

Current status of your order? Just call:
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24h emergency call

Has there been a crash or other technical emergency?
Our experts are at your service around the clock:
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11.2 Representatives

The sales partners and service employees listed below are available for further consultation or support.

11.2.1 Europe

Austria

HAINBUCH in Austria GmbH SPANNENDE TECHNIK

Pillweinstr. 16
5020 Salzburg
Phone +43 662 825309
E-mail: verkauf@hainbuch.at
Internet: www.hainbuch.com

Belgium

BIS Technics bvba/sprl
Zevenputtenstraat 20
3690 Zutendaal
Phone +32 89518890
Fax +32 89518899
E-mail: info@bistechnics.com
Internet: www.bistechnics.com

Denmark

Jørn B. Herringe A/S
Ramsømagle
Syvvejen 31
4621 Gadstrup
Phone +45 46170000
Fax +45 46170001
E-mail: sales@jbh-tools.dk
Internet: www.jbh-tools.dk

Austria

GGW Gruber & Co. GmbH
Kolingasse 6
1090 Vienna
Phone +43 13107596-0
Fax +43 13107596-31
E-Mail: office@ggwgruber.com
Internet: www.ggwgruber.com

Czech Republic,

TMC CR s.r.o.
Masná 27/9
60200 Brno
Phone +420 533433722
Fax +420 548217219
E-mail: info@tmccr.cz
Internet: www.tmccr.cz

Estonia, Latvia, Lithuania

DV-Tools OÜ
Peterburi tee 34/4
11415 Tallinn
Phone +372 6030508
Fax +372 6030508
E-mail: info@dv-tools.ee
Internet: www.dv-tools.ee

Finland

Oy Maantera Ab
PL 70 Keinumäenkuja 2
01510 Vantaa
Phone +358 29006130
Fax +358 290061130
E-mail: maantera@maantera.fi
Internet: www.maantera.fi

France

Representative for: Haute Savoie

Utilis France Sarl
597, Avenue du Mont Blanc
74460 Marnaz
Phone +33 450963630
Fax +33 450963793
E-mail: contact@utilis.com
Internet: www.utilis.com

Greece

PAPET Papadopoulos GbR
Martinstrasse 68
DE-73061 Ebersbach/Fils
Phone +49 71635858/530668
Fax +49 716352265
E-mail: paris@papet-technologies.de

Ireland

HAINBUCH UK Ltd.
WORKHOLDING TECHNOLOGY
6 Newmarket
Keys Business Village, Keys Park Road
Hednesford, Staffordshire
WS12 2HA
Phone +44 1543 278731
Fax +44 1543 478711
Mobile +44 7980212784
E-mail: nick.peter@hainbuch.co.uk
Internet: www.hainbuch.com

Netherlands

BIS Specials
[Brandenburg Industry Service Dongen BV]
Dreef 7
6996 BA Drempt
Phone +31 313482566
Fax +31 313482569
E-mail: info@bisspecials.com
Internet: www.bisspecials.com

France

HAINBUCH France SNC
Equipements de machines-outils
ZI Lons-Perrigny
1600, Route de la Lième
39570 Lons-le-Saunier
Phone +33 384876666
Fax +33 384876677
E-mail: info@hainbuch.fr
Internet: www.hainbuch.com

Great Britain

HAINBUCH UK Ltd.
WORKHOLDING TECHNOLOGY
6 Newmarket
Keys Business Village, Keys Park Road
Hednesford, Staffordshire
WS12 2HA
Phone +44 1543 278731
Fax +44 1543 478711
Mobile +44 7980212784
E-mail: nick.peter@hainbuch.co.uk
Internet: www.hainbuch.com

Hungary

GIMEX Hydraulik GmbH
Selyem utca 1.
9025 Györ
Phone +36 96525588
Fax +36 96427239
E-mail: info@gimex.hu
Internet: www.gimex.hut

Italy

HAINBUCH Italia srl
Via Caduti di Nassiriya 5
22036 Cantu [Co]
Phone +39 0313355351
Fax +39 031611570
E-mail: info@hainbuchitalia.it
Internet: www.hainbuchitalia.it

Norway

Onstad Maskin A/S
Chr. H. Blomsgt. 13
3717 Skien
Phone +47 35532373/74
Fax +47 35532375
E-mail: postmaster@onstadmaskin.no
Internet: www.onstadmaskin.no

Poland

BIM Sp. z o.o.
Złotniki, ul. Kobaltowa 6
62-002 Suchy Las
Phone +48 616232041
Fax +48 616232040
E-mail: bim@bazafirm.pl

Russia

ROSNA Engineering LLC
Sveaborgskaya street, 12, Letter »A«, office
20N,
196105 Saint-Petersburg
Phone +7 812 4016767
Fax +7 812 4016767
E-mail: rosna@rosna.spb.ru
Internet: www.rosna.spb.ru

Slovenia

Elmetool d.o.o.
Prvomajska ulica 62
5000 Nova Gorica
Phone +386 53303300
Fax +386 53303304
E-mail: info@elmetool.si

Sweden

HAINBUCH Svenska AB
SPÄNNANDE TEKNIK
Kemistvägen 17
18379 Täby
Phone +46 87327550
Fax +46 87327650
E-mail: hainbuch@hainbuch.se
Internet: www.hainbuch.com

Turkey

Hidkom
Organize Sanayi Bölgesi
75. Yil CD. Demirciler Sit. B Blok No.2
16159 Nilüfer / Bursa
Phone +90 2242438292
Fax +90 2242436365
E-mail: hidkom@tr.net
Internet: www.hidkom.com

Romania

Banatech srl. – connecting technologies
Ep. Miron Cristea 26
325400 Caransebes, Caras Severin
Phone +40 255517175
Fax +40 355814125
Mobile +40 749220553
E-mail: office@banatech.ro
Internet: www.banatech.ro

Slovakia

NS s.r.o.
Vácka ulica 4109/10
01841 Dubnica N/V
Phone +421 424450873
Fax +421 424440406
E-mail: tns@tnssro.sk
Internet: www.tnssro.eu

Spain, Portugal

ATM S.L
C/. Gran Bretanya, 16
Pol. Ind. Pla de Llerona
08520 Les Franqueses del Vallès
[Barcelona]
Phone +34 938700885
Fax +34 938606572
E-mail: atm.sl@atmbarcelona.com

Switzerland

Utilis Müllheim AG
Präzisionswerkzeuge
Kreuzlinger Strasse 22
CH-8555 Müllheim
Phone +41 527626262
Fax +41 527626200
E-mail: info@utilis.com
Internet: www.utilis.com

11.2.2 America

Argentina

HAINBUCH America Corp.
WORKHOLDING TECHNOLOGY
 W129N10980 Washington Dr.
 Germantown, WI 53022
 U.S.A
 Phone +1 4143589550
 Fax +1 4143589560
 E-mail: sales@hainbuchamerica.com
 Internet: www.hainbuchamerica.com

Canada

HAINBUCH America Corp.
WORKHOLDING TECHNOLOGY
 W129 N10980 Washington Dr.
 Germantown, WI 53022
 U.S.A
 Phone +1 4143589550
 Fax +1 4143589560
 E-mail: sales@hainbuchamerica.com
 Internet: www.hainbuch.com

Mexico

HAINBUCH America Corp.
WORKHOLDING TECHNOLOGY
 W129 N10980 Washington Dr.
 Germantown, WI 53022
 Phone +1 4143589550
 Fax +1 4143589560
 E-mail: sales@hainbuchamerica.com
 Internet: www.hainbuch.com

Brasil

SSanposs Tecnologia
 Suprimentos e Consultoria Internacional Ltda.
 Rua Cândia n° 65 - Jardim do Mar
 CEP: 09726-220
 São Bernardo do Campo - São Paulo
 Phone +55 11 41266711
 Fax +55 11 41266710
 E-mail: tsci@sanposs.com.br
 Internet: www.sanposs.com.br

Canada

Representative for: Ontario, Québec
 J.Winkel & Associates Inc.
 6516 Warbler Lane
 L5N 6E1 Mississauga, Ontario
 U.S.A
 Phone +1 4143589550
 Fax + 1 4143589560
 E-mail: sales@hainbuchamerica.com
 Internet: www.hainbuch.com

USA

HAINBUCH America Corp.
WORKHOLDING TECHNOLOGY
 W129 N10980 Washington Dr.
 Germantown, WI 53022
 Phone +1 4143589550
 Fax +1 4143589560
Se habla español:
 Tel +1 2143268081
 E-mail: sales@hainbuchamerica.com
 Internet: www.hainbuch.com

11.2.3 Asia

China

HAINBUCH Shanghai Co. Ltd.
WORKHOLDING TECHNOLOGY
 Room 611-612 BaoHong Center
 No. 7755 Zhongchun Road
 Minhang District, Shanghai 201101
 Phone +86 2120916384
 Fax +86 2120916383
 E-mail: sales@hainbuch.cn
 Internet: www.hainbuch.cn

India

A.H. Rao
 Technical Consultant to HAINBUCH
 Ground Floor, # 4157, 14th Main
 HAL 2nd Stage, Indiranagar
 Bangalore 560 008
 Phone +91 8041463972
 Mobile +91 9986997959
 E-Mail: ahr.rao@gmail.com

India

M'la Sales Corporation
 5, Yeshwantnagar
 Telco-Century Enka Road
 Pimpri, Pune 411018
 Phone +91 20 27477405
 Fax +91 20 27464249
 E-mail: info@m-la-sales.com
 Internet: www.m-la-sales.com

Indonesia

PT. STAHL ARBEIT
 WTC Mangga Dua 2nd Floor A-6
 JL. Mangga Dua Raya No. 8
 Level 2 Blok C No. 41-45
 Jakarta 14430
 Phone +62 21 3777 6622
 Fax. +62 21 3001 8070
 E-mail: info@stahl-arbeit.com
 Internet: www.stahl-arbeit.com

Israel

M.T.M. Machine Tools Marketing Ltd.
 26 Hakishor St.
 Holon 58867
 Phone +972 36479560
 Fax +972 36479578
 E-mail: sales@mtm.co.il
 Internet: www.mtm.co.il

Korea

Kimi Co.
 B-101 98 Okgucheondongro Siheung-Si
 429-925 Gyeonggi-Do
 Phone +82 24137911
 Fax +82 24137910
 E-Mail: kimi@kimigroup.co.kr

Taiwan

GSTC Technology Co., Ltd.
 No. 418, Youn-Chun East 1st Rd
 Taichung City 40877, Taiwan'
 Phone +88 6423805678
 Fax +88 6423805511
 E-mail: gstc@seed.net.tw
 Internet: www.gstctech.com.tw

Japan

NK Works Co LTD
 2-17-17 Iwamoto-cho, Chiyoda-ku
 Tokyo, 101-0032
 Phone +81 338645411
 Fax +81 338646752
 E-mail: info@nk-works.co.jp
 Internet: www.nk-works.co.jp

Malaysia, Singapore & Vietnam

Jebesen & Jessen Technology [S] Pte Ltd.
 Process Engineering Division
 18 Enterprise Road
 Singapore 629824
 Phone +65 63053692
 Fax +65 63053699
 E-mail: phillip_lee@jjsea.com
 Internet: www.jjsea.com

Thailand

HAINBUCH [Thailand] Co. Ltd
WORKHOLDING SOLUTIONS
 2/25 Sukhapiban 2 Road Prawet,
 Prawet, Bangkok 10250
 Phone +662329 0622/23
 Fax +662329 0624
 E-Mail: info@hainbuch.co.th
 Internet: www.hainbuch.com

11.2.4 Australia**Australia**

Romheld Automation Pty Ltd
 Unit 30 115 Woodpark Road
 Smithfield . NSW. 2164
 Phone +61 297211799
 Fax +61 297211766
 E-mail: sales@romheld.com.au
 Internet: www.romheld.com.au

11.2.5 Africa**South Africa**

South Africa Retecon [PTY] Ltd.
 P.O. Box 1472
 1620 Kempton Park
 Phone +27 119768600
 Fax +27 113942471
 E-mail: tools@retecon.co.za
 Internet: www.retecon.co.za

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EC Declaration of conformity**EG-Konformitätserklärung im Sinne der EG-Richtlinie 2006/42/EG über Maschinen [Anhang II A] /****EC Declaration of conformity according to EC directive 2006/42/EC on machinery [Annex II A]****Original-Konformitätserklärung / Translation of original declaration of conformity**

Hersteller / HAINBUCH GmbH Spannende Technik
Manufacturer: Erdmannhäuser Straße 57
 71672 Marbach
 Deutschland

Diese Erklärung bezieht sich nur auf die Maschine in dem Zustand, in dem sie in Verkehr gebracht wurde; vom Endnutzer nachträglich angebrachte Teile und/oder nachträglich vorgenommene Eingriffe bleiben unberücksichtigt. Die Erklärung verliert ihre Gültigkeit, wenn das Produkt ohne Zustimmung umgebaut oder verändert wird. /

This declaration relates exclusively to the machinery in the state in which it was placed on the market, and excludes components which are added and/or operations carried out subsequently by the final user. The declaration is no more valid, if the product is modified without agreement.

Hiermit erklären wir, dass die nachstehend beschriebene Maschine /
Herewith we declare, that the machinery described below

Produktbezeichnung / **Eccentric chuck C axis**
Product denomination:

allen einschlägigen Bestimmungen der Maschinenrichtlinie 2006/42/EG entspricht. /
 is complying with all essential requirements of the Machinery Directive 2006/42/EC.

Angewandte harmonisierte Normen / Harmonised Standards used:

- EN ISO 12100:2011-03 Sicherheit von Maschinen – Allgemeine Gestaltungsgrundsätze /
 Safety of Machinery – Basic concepts
- DIN EN 1550:2008-07 Sicherheitsanforderungen für die Gestaltung und Konstruktion von Spannfuttern für die Werkstückaufnahme /
 Safety requirements for the design and construction of work holding chucks

Bevollmächtigter für die Zusammenstellung der technischen Unterlagen /
 The person authorized to compile the relevant technical documentation:
 HAINBUCH GmbH Spannende Technik
 Konstruktionsleitung
 Erdmannhäuser Straße 57
 71672 Marbach
 Deutschland

Marbach, 01.01.2015

Konstruktionsleitung / Head of engineering

Ort, Datum /
Place, Date

Funktion / function of signatory



SPANNENDE TECHNIK

HAINBUCH GMBH
SPANNENDE TECHNIK
PO Box 1262 · DE-71667 Marbach
Erdmannhäuser Straße 57 · DE-71672 Marbach
Phone +49 7144. 907-0
Fax +49 7144. 18826
sales@hainbuch.de
www.hainbuch.com
24h-Emergency call +49 7144. 907-444